Wheat Research and Production Programs
North Africa - Tunisia and Algeria

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Report of Activities During the Period:

September 1971 - September 1972

Submitted by:

The International Maize and Wheat Improvement Center
(CIMMYT), Mexico.

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Wheat Research and Production Programs in North Africa - Tunisia and Algeria

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I. INTRODUCTION

The development of the national wheat programs in both Tunisia and Algeria, together with their accomplishments to date, have been documented in previous reports.

This report will deal with the progress of the program from September 1971 for one year.

As in previous years, CIMMYT's activities in Tunisia were financed by the Ford Foundation ($219,328) and the United States Agency for International Development (USAID). In Algeria the Ford Foundation was the sole financing agency for CIMMYT activities ($233,156).

Financial statements of expenditures, based on previously approved budgets, have been submitted to the funding agencies throughout the contract period.

II. CIMMYT TECHNICAL STAFF

Two factors made it necessary for CIMMYT to modify its staff structure in North Africa during 1971-72.

1. The initiation of assistance to the Algerian Cereal Project with finance provided by the Ford Foundation.

   Three CIMMYT scientists were assigned to Algeria in late 1971.

   Dr. Willis McCuistion, a wheat breeder, who had previously been the Team Leader of the CIMMYT staff in Tunisia was transferred to Algiers as Team Leader. He continued to maintain his role as Coordinator of CIMMYT activities for the whole of North Africa. Dr. McCuistion took up his new position in October 1971.

   Dr. Walter Nelson, wheat breeder and research agronomist, was hired from Washington State University. He had previously spent 2 years with CIMMYT in Tunisia as a Research Agronomist. He also arrived in Algiers during October 1971.

. . .

Mr. Herbert Floyd, production agronomist, was hired from the Near East Foundation, Morocco where he had worked for several years as an extension agronomist in collaboration with Moroccan, USAID, and CIMMYT wheat scientists.

Funds were available for a second Production Agronomist. During the year Mr. Francisco Plouin, a Mexican agriculturalist, visited Algeria to assist with plot harvesting and review the project. He was later appointed to this vacant position but did not take up the appointment until September 1972.

The three scientists assigned to the project during the reporting period were all top class men with experience in the region. This provided the basis for a quick and effective start to the assistance program.

The Team Leader position had initially been offered to a Mexico-based wheat scientist who subsequently declined. This forced CIMMYT to recast the structure of its team in Tunisia, resulting in the transfer of Dr. McCuistion.

2. a) The transfer of Dr. McCuistion to Algeria as team leader resulted in staff changes in Tunisia. The transfer of Dr. McCuistion was influenced by two factors. Firstly, as regional coordinator he could operate freely across North Africa and would be available to supervise the trained Tunisians operating the bread wheat program in Tunisia. Secondly, the Tunisian Secretary of State for Agriculture had specifically requested assistance in strengthening the hard wheat (durum) breeding program.

b) For these reasons CIMMYT transferred Dr. George Varughese, one of the world's best durum wheat breeders, from its Mexico headquarters staff to Tunis. He brought with him his best advanced breeding material that was capable of significantly outyielding local hard wheats, but which lacked the rust and Septoria resistance necessary to allow it to be widely grown in the region.

c) The initiation of the winter annual legume pasture/wheat rotation research and production led to the appointment of Mr. J.B. Doolette to coordinate this phase of the program. Mr. Doolette, who had been Head of the Agronomy Division of the South Australian Department of Agriculture, is an authority on pasture/crop rotations in winter rainfall environments. He arrived in Tunis in October 1971.

Because of Mr. Doolette's considerable leadership and administrative experience he was also nominated CIMMYT Team Leader in Tunisia.

Two further staff changes were made during the reporting period.

d) Mr. Paul N. Marko, extension agronomist, left at the end of the season (June 1972) to study for a M.Sc. degree at Reading University, and,

e) Mr. Ken Wilhelmi, who had been in charge of the fertilizer research work for several years, returned to the United States (August 1972) to study for his Ph.D. degree.

Although CIMMYT would have preferred that Mr. Wilhelmi stay for one further year, it was mutually agreed with the Tunisian Team Leader, Mr. Bakhtri, that this section of the Accelerated Cereal Production Program (ACPP) was well staffed and able to continue under Tunisian leadership.

f) Mr. Torrey Lyons, remained as Production Agronomist throughout the year, with his research program emphasizing weed control.

All of the above CIMMYT expatriate staff, in both Algiers and Tunisia, are funded by Ford Foundation. USAID have not had a staff member assigned to the Project since 1970.

III. NATIONAL PROGRAM DEVELOPMENT

A. Tunisia

1. As of the 1st January 1972, the ACPP has been integrated into the Tunisian Cereal Board. This change from the Ministry of Agriculture was made because it was felt that greater administrative flexibility would result, particularly with regard to financial matters.

   Although this was the first year of operation of this new arrangement, there are indications that the expected extra flexibility may be minimal. Close watch will be kept on this point during 1972-73.

   The coordination between the activities of the ACPP and other Tunisian Organizations concerned with cereals rests with the Secretary of State of the Ministry of Agriculture and by the Director of Agricultural Production.

2. On February 8, 1972, the Secretary of State of Agriculture, Mr. Abderrahman Ben Messaoud for the Tunisian Government and Dr. Keith W. Finlay for CIMMYT, signed a simple memorandum of agreement regarding the mutually agreed plan of action for the period 1971-73.

   The signed document stipulated that Mr. Ben Messaoud would set up a Coordinating Committee representing all Tunisian agencies

involved in a national cereals program together with representatives of the ACPP. During the reporting period to September 1972, this Committee did not meet.

3. Discussions, between the Tunisian Project Leader and Drs. Anderson and Finlay of CIMMYT, revealed that:

   a) seed production was a serious bottleneck to progress. Although the West German Government had provided training for some seed technicians, and equipment and funds to build adequate seed cleaning facilities and a seed testing laboratory, Tunisia still lacked an adequate coordinated and efficient seed organization.

   CIMMYT, with Ford Foundation approval, indicated a willingness to appoint a seed specialist to the expatriate staff if requested by the Tunisian Government. Pending an indication of interest from the Government, exploratory talks were held with Dr. Johnson Douglas, a seed production specialist with considerable experience in developing countries. Dr. Johnson is an employee of the Rockefeller Foundation, assigned to India. Talks were also held with the Rockefeller Foundation Directors. They indicated interest in the proposal to assign Dr. Douglas to North Africa. No appointment had been made by the end of the reporting period, although the Tunisian Government was interested;

   b) the National Extension Service was beginning to show real inadequacies in being able to extend the research findings to the farmers. This fact was brought to the attention of Mr. Chetli Boulaaba, Director General of the Office of Cereals in Tunisia, and Mr. Ben Messaoud. The latter was aware of the problem and said he would raise the matter with Mr. Ben Kader;

   c) there appeared to be a lack of adequate statistical and crop reporting services. This made it difficult to adequately measure progress and to plan adequately for future production campaigns.

4. Training of Project staff continued during 1971-72. The following trainees attended the CIMMYT training program during this period:

   Mr. Mohamed Moncef Laamouri, trained in Cereal Chemistry (March - July 1972) funded by USAID.

   Mr. Abdelkrim Ben Rouma - breeding - (February - October 1972) funded by USAID.

   Mr. Amon Yahyaoui - breeding - (February - October 1972) funded by USAID.

Mr. Mohamed Habib Halila, trained for 3 weeks in Maize and Wheat Production - January 1972 - funded by USAID. This trainee was returning home after completing graduate training (M.Sc.) at Utah State University (September 1970 - January 1972).

Mr. Hadj Brahim, returned home without receiving training - USAID funding.

5. Travel and Study Awards. The following Tunisians visited CIMMYT and related programs in Mexico during the reporting period:

   Mr. N. Bakhtri, Director of ACPP visited Mexico for the Inauguration of the new CIMMYT Headquarters at El Batan. He also attended the First International Wheat Workshop held immediately after the inauguration (September 1971).

   During the period April 26 - May 4, 1972, 3 Tunisian agricultural officials visited El Batan, the Puebla Project, the wheat breeding program at Ciudad Obregón, Sonora, as well as farmer organization and production areas in Sonora.

   Mr. Abderrahim Zouari, Attaché, Cabinet of the Ministry of Agriculture, Tunis.

   Mr. Mohamed Hedi Guerbaa, Chief of the Division of Agricultural Extension, Tunis.

   Mr. Mohamed Louardi Lamouchi, Regional Agricultural Development Commissionfor Beja.

   These visits were designed to familiarize government officials with the type of research, extension and infrastructure necessary to facilitate increased cereal production.

6. Details of the national production ACPP research and extension are provided in Annex I, a report prepared by CIMMYT staff, Tunisia.

B. Algeria

1. As of September 1971, the expanded Algerian Cereal Project got officially underway with several organizations assisting the Ministry of Agriculture and Land Reform.

The Algerian Cereal Project is organized as a vertically integrated project with autonomy of operation. The Project Director - Mr. N. Kadra, is responsible directly to a national coordinator commission, chaired by the Secretary General of the Ministyr of Agriculture and Land Reform - Mr. N. Boukli. The Coordinating Commission consists of the Directors of Agronomic Research (INRAA); Cereal Board; Farm Machinery Board; Agricultural Production (Ministry of Agriculture); Agricultural Training (Ministry of Agriculture); Regional Agricultural Services (Ministry of Agriculture); and Director of the Cereal Project.

The organizations cooperating with the Cereal Project are:

a) The Ministry of Agriculture and Land Reform;

b) CIMMYT (from September 1971, with staff assigned to Algeria - earlier assistance was confined to consultation and training). CIMMYT is assisting with the research and experimentation together with the Project staff and staff of INRAA. Three staff assigned - Drs. Willis McCuistion and Walter Nelson in Algiers and Mr. Floyd in Oran.

CIMMYT's role is to help build and train a national wheat research and production staff and assist with planning the technology to increase national wheat production to the level of self sufficiency.

c) FAO/UNDP (From October 1971 - staff assignment began with Mr. Golusic being named FAO team leader. Other staff assigned during the season - not yet fully staffed). This group, together with Project staff are responsible for extension and demonstration of the technology.

d) CCCE (Caisse Centrale Cooperation Economique - from June 1972). This group will cooperate with the project in the areas of Economy, Environment, Machinery, Pilot Regions and Studies.

e) FAO/GOA Fertilizer Program (from October 1971). This program is working with the Project staff, CIMMYT and the FAO/UNDP groups on fertilizer studies.

f) Local Algerian specialists are cooperating on Cereal Seed production and technology (Cereal Board) and Statistical Studies.

g) Algerian and Ford Foundation specialists are cooperating with training and audio-visual preparation.

Three sub-project centers have been created in Algeria, these are at Algiers, Oran and Constantine. Two more will be established at Setif and Tiaret. Members of the various cooperating agencies have, or will assign staff to these regional centers.

A central headquarters building has been occupied in Algiers. However, the Project in its expanded form is only just getting underway. It is too early to indicate the major weak points. The need for a strong base of highly trained people is certainly obvious; this will take time to build !

Graduates from the new Agriculture University at Mostaganem are starting to enter the Project and should provide an increasing flow of trainees for future development.

2. Training of several Algerians from the project was provided in the CIMMYT wheat in-service training program. These were:

Mr. Abderrahman Laarit - Production (Nov. 1971 - June 1972) - funded by Ford Foundation (F.F.)

Mr. Boumediene Moni Moussa - Breeding (Feb. - October 1972) - F.F.

Mr. Lounes Hachemi - Breeding (Feb. - Oct. 1972) - F.F.

Mr. Lakhadar Chaouch Lakhdar - Pathology - (Feb.-Oct. 1972) - F.F.

Mr. Moustafa Djahdou - Pathology - (Feb.-Oct. 1972) - F.F.

Three trainees from the Cereal Board were to have gone to India for training, however, a last minute change by the Algerian Government resulted in them spending time in Mexico and Oregon State University for their training in Cereal Technology. They are:

Mr. Ahmed Lechleche - (March-July 1972) - F.F.
Mr. Tahar Fezzaa - (March-July 1972) - F.F.
Mr. Noureddine Bouchenaki - (March-July 1972) - F.F.

3. Several travel and study awards were made to Algerian officials during 1971-72:

Mr. N. Boukli - Secretary General of the Ministry of Agriculture and Land Reform, and Mr. N. Kadra, Algerian Cereal Project Director attended the CIMMYT inauguration in Mexico and the

First International Wheat Workshop. This provided an opportunity for program discussions between CIMMYT and Project staff.

Mr. Ait Younes, Director General of the Plan, Algeria, visited Mexico April 21-24, 1972, to hold discussions with CIMMYT, Mexican Government Officials, and visit the Puebla Project, and the cereal research and production areas of North West Mexico. This visit was particularly important to orient the Director of the Plan to the philosophy of Agricultural assistance.

Three other officials visited for a similar orientation from April 29 - May 7, 1972. They were:

Mr. Hadj Mokhtar Louhibi, General Director of the Algerial Cereals Board (O.A.I.C.).

Mr. Djaffar Alloun, Director of Vegetable Production, Ministyr of Agriculture and Land Reform.

Mr. Bailiche Kamal Tedjini, Director of Agricultural Education.

4. Details of the national production and Cereal Project breeding and production research are provided in Annex II, a report prepared by CIMMYT staff, Algeria.

ANNEX I

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I. INTRODUCTION

The Climatic Factors of Importance

The season 1971-1972 must be regarded as a favourable one for crop growth within the context of that likely in Tunisia.

Some rains in October allowed soil preparation to advance and rain in November and early December allowed planting to begin. A stress period occurred in December with a 2-3 week period without rain. This had very little effect on wheat, although it slowed the development of newly germinated medicago plants. In general weather conditions were conducive to good soil preparation, weed control and timely planting.

For the rest of the growing season moisture conditions were approaching ideal in much of the wheat land. There was no extreme cold and rainfall was adequate, yet the soils rarely were too wet to permit nitrogen and herbicide application.

In the spring, timely rains were interspersed with sunny weather and hence very little disease was expressed. The country was free from hot drying winds in the later stages of maturation. In some cases there was insufficient moisture for complete grain filling and some grain weights will demonstrate this.

Occasional lodging occurred in older wheat varieties when there was a combination of rain and wind on dense tall crops. Hail caused damage in isolated areas.

The Influence of the Project on Wheat Production in Tunisia

The Project has concentrated its efforts in the better rainfall areas in the North and also with bread wheat production. Some effort has been applied outside these areas and this is increasing; in addition, the effects of the technology applied within these areas spreads out spontaneously.

The area of wheat in the North is approximately 750,000 ha (60% durum, 40% bread). In this last season some part of the new technology was adopted on some 150,000 ha. Improved varieties were planted on 65-70,000 ha and a much greater area received fertiliser (particularly nitrogen) and herbicide.

Approximately 18,400 tons of fertiliser nitrogen was used in the country compared with 13,200 and 9,400 in the two previous years. If 50% is used on wheat this can be interpreted to mean that at least 150,000 ha received some nitrogen fertiliser.

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Herbicide, mainly 2,4-D, was applied to 105,000 ha compared with 70,000 ha in the previous year.

The official estimates of the Government made in June showed an anticipated 5.7 million quintals of durum wheat and 2.4 million quintals of bread wheat. The mean yield per hectare should be 25-28% better for durum wheat than in the previous year and 15% better for bread wheat. This improvement is attributed to a combination of good conditions and new technology.

Financial incentives have been retained. The prices have been maintained at the same level as in the previous year, viz. 5.100 for durum wheat and 4.500 for soft wheat per quintal ($US 10.75, $US 9.50). There have been additional import tax reductions on production items, the most noteworthy of which is that on nitrogen fertiliser (14.4% down to 8%).

Diseases, Pests, Weeds

In general disease was not a problem during this year and could not be regarded as a factor limiting production or affecting experiments except in odd sites.

Septoria was evident in several places such as Mateur, Medjez El Bab, Beja, but the occurrences were minor. Apparently the adequate moisture was sufficiently interspersed with sunshine so as not to allow the disease to develop.

Leaf, stem and stripe rust occurrence was practically nil or so late as to be ineffective.

Powdery mildew was common in some areas but did not appear to be an important factor.

The cereal cyst nematode Heterodera avenae continues to be evident. Some experiments were badly affected, particularly where wheat followed wheat. Steps need to be taken by cultural means to control this pest and acquaint farmers with the hazards it offers.

Insect problems were relatively minor. Frit fly and Hessian fly appeared sporadically and the combination of the two was more significant than leaf beetle. Sawfly was present in half of the sites in the drier areas.

Weeds continue to be a serious contraint and by their competition for water and nutrients are reducing actual yield materially. The position was a definite improvement on the previous season for several reasons. Firstly, timely rains in October allowed farmers to begin seed bed preparation. Rains at planting time were well spaced and allowed some weed control by cultivation. Subsequent crop growth conditions allowed the wheat to advance ahead of weeds in many instances.

A big factor in the improvement was the increased and improved use of

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herbicides. The quantities were referred to above. These treatments are mainly for broad leafed weeds and it should be noted that grassy weeds, particularly wild oats and annual rye grass, are major problems.

II. AGRONOMY

1. Fertilizer Studies

The Project has now completed four seasons of extensive fertilizer experimentation in northern Tunisia. Experimental efforts have been concentrated in the more favorable rainfall areas (300-700 mm annual rainfall) of the country. Geographically, this corresponds to an area between 36°-37.4° north latitude and includes the governorates of Beja, Jendouba, Kef, Bizerte, Tunis and Nabeul. Experiments have been kept relatively simple in design with an emphasis on having them useful for farmer demonstration purposes in addition to applied research and training. All fertilizer trials are under rainfed conditions on farmer fields, with their assistance and cooperation in land preparation, field days and harvesting.

In the fertilizer program for 1971-72 there was a reduction in the types of experiments carried out, but a slight increase in the number of trials. This season 37 experiments as well as several practical fertilizer test strips were carried out. These comprised:

(1) Rate and date of nitrogen application (RDN)
(2) Comparison of three different sources of nitrogen (ammonium nitrate, ammonium sulfate, urea) at different dates (Forms of N)
(3) Nitrogen, phosphorus and potassium at different dates and rates of application (NPK)
(4) Comparison of four bread wheat (blé tendre) and two durum wheat (blé dur) varieties at different nitrogen rates (Varieties x nitrogen)
(5) Simple phosphate demonstration strips comparing two phosphate (P_2O_5) rates adjacent to nitrogen experiments.

A few of the experiments were either not harvested or not acceptable statistically because of high coefficients of variation. This was due mainly to non-uniform damage from hail or wireworms, high level of soluble salts, competition from wild oats and farmer errors. A total of 84% of the trials planted were carried through to completion and met the standards acceptable to statisticians.

More emphasis this season was given to testing the nitrogen responsiveness of the durum wheats. This has been brought about by the recent release of a new variety, INRAT 69, which has more yield potential and better straw strength than the traditional durums. In addition, Jori, a recently introduced short stemmed durum, has been showing promise for the intermediate and

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low rainfall areas. However, it is not recommended for the high rainfall areas because of Septoria and mildew susteptibility.

Yield data from all nitrogen experiments are given in table 1. The average yield for all experiments (31) over all locations (19) was 37.1 qx/ha. The averages for the maximum yield and check treatments were 44.8 and 33.5 qx/ha, respectively. This represents a net increase of 11.3 qx/ha, or a 33.7% increase from nitrogen usage. Moreover, it is approximately the same as the Tunisian national production wheat average, which gives an indication of the potential for increasing wheat yields in Tunisia. The largest single yield increase from nitrogen utilization in all experiments was 26.8 qx/ha. At a nitrogen rate of 133 kg/ha the yield was 54.7 qx/ha compared to the check of 27.9 with the variety Inia.

Most of the fertilizer trials involving nitrogen rates showed definite positive responses again this season. This was especially true for the short stemmed wheats, but less true for the durums because of their lower yield ceiling and weaker straw. However, the new variety, INRAT 69, responded well to approximately 40 qx/ha before lodging became a problem.

It appears that for the short wheats, the optimum nitrogen rate is 90 kg/ha in the high rainfall areas (more than 500 mm) and 67 for the intermediate rainfall zones (400-500 mm). Farmers in areas below the 400 mm annual rainfall limit should not apply more than 45 kg/ha. Nitrogen recommendations for the durum and tall bread wheats are approximately 1/2-2/3 of those for the semi-dwarf wheats. These nitrogen recommendations should be halved when wheat follows sugar beets, green manure, or a good clean winter fallow on soil having a favorable organic matter content. However, the recommendations should be increased slightly (20%) when wheat follows another crop in the rotation such as a cereal, forage (vetch + oats) or weed winter fallow, which leaves the soil residual nitrogen supply very low.

The nitrogen recommendations will vary with soil type, preceding crop, soil moisture reserves, rainfall, varieties, etc. each year. Until more soil testing services are made available, farmers should evaluate the fertility status of their farm based on the cropping history. The recommendations given above are intended only as guidelines for assisting the farmer in predicting their nitrogen requirements for increasing wheat production. It is hoped that more soil testing facilities will be available in the near future to assist farmers in more accurately gauging their nitrogen requirements.

The date of nitrogen application was of much less importance than the rate used. Differences between applying the nitrogen all at seeding, all at tillering or 1/2 at seeding plus 1/2 at tillering were largely non-significant. Moreover, later applications at the jointing stage also gave good results when the level of soil residual nitrogen was favorable. The recommended date for nitrogen application is 1/2 at seeding and 1/2 at tillering. The tillering application should be made only if soil moisture reserves are good and total rainfall has reached approximately 250 mm by January 31.

Experiments with nitrogen, phosphorus and potassium (NPK) have shown no

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Table 1. COMPARISON OF MAXIMUM YIELD TREATMENT WITH CHECK FOR ALL EXPERIMENTS INVOLVING RATES OF NITROGEN

I. Average Annual Rainfall greater than 500 mm.

Type of Experiment	Variety	Experimental Mean (qx/ha)	Maximum Yield Treatment for Each Experiment: Rate of N (kg/ha)	Form of N	Date of Application	Maximum Yield (qx/ha)	Check Yield (qx/ha)	Diff. between Maximum Yield Treatment and Check	Yield Increase %
Forms of N	Penjamo	24.9	90	NH_4NO_3	$\bar{x}$ of 4 dates	35.6	14.5	21.1	145
RDN	Penjamo	17.0	133	NH_4NO_3	Seeding/ Tillering	24.0	18.6	5.4	29
RDN	Inia	37.8	133	NH_4NO_3	Tillering	54.0	27.9	26.8	96
RDN	INRAT 69	41.0	133	NH_4NO_3	Jointing	47.2	33.7	13.5	40
RDN	Utique	22.0	133	NH_4NO_3	Seeding/ Tillering	32.1	11.7	20.4	174
RDN	INRAT 69	18.0	133	NH_4NO_3	Seeding	23.6	15.5	8.1	52
NPK	Inia	39.3	100	NH_4NO_3	Seeding	51.5	23.6	27.9	118
Varieties x Nitrogen	6 varieties	27.1	133	NH_4NO_3	Seeding/ Tillering	42.5	30.1	12.4	41
Varieties x Nitrogen	6 varieties	42.4	100	NH_4NO_3	Seeding/ Tillering	59.2	45.0	14.2	32
Totals		269.5	1088			370.4	220.6	149.8	727
Average for areas with + 500 mm annual rainfall		29.9	120			41.1	24.5	16.6	68

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Table 1 (Cont.)

II. Average Annual Rainfall less than 500 mm.

Type of Experiment	Variety	Experimental Mean (qx/ha)	Maximum Yield Treatment for Each Experiment: Rate of N (kg/ha)	Form of N	Date of Application	Maximum Yield (qx/ha)	Check Yield (qx/ha)	Diff. between Maximum Yield Treatment and Check	Yield Increase %
Forms of N	Inia	28.5	90	$CO(NH_2)_2$	$\bar{x}$ of 4 dates	36.4	21.4	15.0	70
Forms of N	Inia	44.1	90	$CO(NH_2)_2$	$\bar{x}$ of 4 dates	48.1	40.0	8.1	20
RDN	INRAT 69	32.1	67	NH_4NO_3	Seeding	35.8	34.6	1.2	3
RDN	Inia	44.8	90	NH_4NO_3	Seeding/ Tillering	52.6	40.3	12.3	31
RDN	Inia	48.3	67	NH_4NO_3	Seeding	52.2	44.6	7.6	17
RDN	Jori	47.9	22	NH_4NO_3	Jointing	53.8	48.9	4.9	10
RDN	Siete Cerros	45.7	67	NH_4NO_3	Jointing	54.5	36.6	17.9	49
RDN	Inia	35.1	90	NH_4NO_3	Tillering	42.9	34.8	8.1	23
RDN	Inia	43.7	45	NH_4NO_3	Seeding	46.5	42.6	3.9	9
RDN	INRAT 69	32.2	0	--	--	34.9	34.9	--	- *
RDN	Inia	42.4	90	NH_4NO_3	Tillering	50.1	40.3	9.8	24
RDN	Inia	51.8	90	NH_4NO_3	Tillering	59.3	47.2	12.1	26

* No nitrogen response due to high residual soil nitrogen and lodging of durum wheats.

(Cont.)

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Table 1 (Cont.)

II. Average Annual Rainfall less than 500 mm (Cont.)

Type of Experiment	Variety	Experimental Mean (qx/ha)	Maximum Yield Treatment for Each Experiment: Rate of N (kg/ha)	Form of N	Date of Application	Maximum Yield (qx/ha)	Check Yield (qx/ha)	Diff. between Maximum Yield Treatment and Check	Yield Increase %
RDN	INRAT 69	30.3	90	NH_4NO_3	Seeding	36.4	27.0	9.4	35
RDN	Inia	38.9	67	NH_4NO_3	Seeding	43.9	32.7	11.2	34
RDN	Inia	40.5	67	NH_4NO_3	Tillering	51.8	35.0	16.8	48
RDN	Jori	43.4	90	NH_4NO_3	Jointing	48.5	41.4	7.1	17
RDN	INRAT 69	39.7	90	NH_4NO_3	Tillering	43.9	35.4	8.5	24
RDN	INRAT 69	40.1	90	NH_4NO_3	Jointing	48.9	33.2	15.7	47
RDN	INRAT 69	38.6	0	--	--	44.4	44.4	--	- *
RDN	INRAT 69	37.8	90	NH_4NO_3	Seeding/ Tillering	44.6	30.2	14.4	48
NPK	Inia	27.9	100	NH_4NO_3	Seeding	36.5	18.9	17.6	93
NPK	Inia	48.3	0	--	--	52.4	52.4	--	- *
Totals		882.2	1492			1018.4	816.8	201.6	628
Average for areas with - 500 mm annual rainfall		40.1	67			46.2	37.1	9.1	25
Total Over All Experiments		1151.7	2580			1388.8	1037.4	351.4	
Averages Over All Experiments		37.1	83			44.8	33.5	11.3	33.7

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significant responses to either phosphorus or potassium. Also, there were only 3 locations out of 15 that showed phosphate responses in the P_2O_5 demonstrations. Soil tests for phosphorus and potassium have revealed sufficient quantities for cereal production. Although farmers do not apply potassium for cereal production, they have been applying phosphorus for several years. Apparently there has been an accumulation of available phosphate due to the relatively low yields the past few years.

Experiments comparing three forms of nitrogen, viz. ammonium nitrate, ammonium sulfate and urea have shown no significant yield advantage for one form over another. It appears that urea can be used for the seeding application if farmers incorporate it into the soil. Ammonium nitrate is recommended for the tillering application because, theoretically, it is partially readily available and less subject to loss through volatilization than urea. Ammonium sulfate offers no particular advantage since the soils in Tunisia have sufficient sulfur for cereal culture. Also, since most of the nitrogenous fertilizers are imported into Tunisia, it should be more economical to import a form having a higher percentage of nitrogen.

A yield increase and benefit/cost ratio (B/C) of 3:1 is normally necessary for farmers to readily adopt a new fertilizer practice. Considering the cost of ammonium nitrate in Tunisia and the price that farmers receive for their wheat, a B/C ratio for the 31 experiments reported in table 1 has been calculated as follows:

$$\text{Benefit/cost ratio} = \frac{\text{Value of yield increase (dinars/hectare)}^{a}}{\text{Cost of nitrogen fertilizer (dinars/hectare)}^{b}}$$

$$= \frac{11.3 \text{ qx/ha} \times 4^{D}.500 \text{ per quintal}}{0.115/\text{kg} \times 83}$$

$$= \frac{50^{D}.850}{9^{D}.545} + \underline{5.3 : 1}$$

[a] 1 quintal of bread wheat in Tunisia sells for $4^{D}.500$.

[b] A quintal of ammonium nitrate applied on the field costs approximately $3^{D}.800$. This amounts to 115 millimes per kg of nitrogen (US$ 0.25).

Note : 1 Tunisian dinar = US$ 2.12.

Even though the data above are from experiments and do not completely represent large scale production fields, a benefit/cost ratio of 5.3 : 1 is considered exceptional. This is especially encouraging when one considers the wide range of environmental conditions over which these experiments were grown.

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These results along with those of the past three seasons have enlightened farmers and technical personnel about the need for and benefits derived from large increases in nitrogen utilization. The following table shows that nitrogen consumption has more than doubled since the 1968-69 season. In addition, the Tunisian Government is making provisions to have 22,400 tons of nitrogen available for the 1972-73 season, which is nearly three times the quantity consumed in 1968-69. The large increases in nitrogen consumption in recent years have largely been brought about by farmers applying larger quantities to their wheat crop.

	Year	N (tons)	P_2O_5 (tons)
	1961-62	2,382	6,500
	1962-63	3,574	8,600
	1963-64	3,656	11,540
	1964-65	3,944	10,720
	1965-66	5,044	12,280
	1966-67	5,250	11,805
	1967-68	6,153	14,800
	1968-69	8,000	15,135
	1969-70	9,400	18,858
	1970-71	13,200	19,284
	1971-72	18,425	14,925
(Anticipated)	1972-73	22,400	—

Source: Division de la Production Végétale et de la Conjoncture
Ministère de l'Agriculture

2. Weed Control Studies

Better weed control is an important part of the production practices recommended to farmers. The agronomy programs clearly demonstrate the advantages of better tillage practices and the elimination of weeds before seeding. Weed infestation tends to be high as a result of inadequate tillage and the most severe yield reductions occur where weeds survive the pre plant tillage. However, even on well managed cooperatives and private farms, damaging weed infestations sometimes occur which require herbicide application for control.

Although wild oats is generally considered the most damaging weed, this season rye grass, *Lolium rigidum*, appeared equally harmful. This was due to the increased lodging which occurs with rye grass infestation plus a favorable growing season which further increased the tendency to lodge. Canary grass, *Phalaris truncata* and *P. canariensis*, is the third most important grassy weed problem and in some sites it is as damaging as wild oats or rye grass. Present control methods of the grassy weeds are not satisfactory. Most broadleaf species can be controlled with 2,4-D; however, there are problems associated with its use, so that improved practices with 2,4-D are needed as well as alternate herbicides.

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Because of the need to develop improved practices with herbicides a program of 3 types of experiments was carried out: Wild oat control, 6 sites, harvest data from 3 sites; Broad leaf herbicide evaluation, 7 sites, harvest data from 6 sites; and Study of 2,4-D phytotoxicity, 3 sites, harvest data from 3 sites. In the broadleaf weed control trials untreated strips at either side of each treated plot permitted a rating of percent control of each weed species present, see table 2.

In all trials yield increases from herbicide treatment were at a minimum due to near perfect distribution of rainfall. At most sites moisture stress did not occur at any time, with or without control of weeds. With minimum yield increase as a result of herbicide treatment, yield reduction as a result of phytotoxicity was revealed. Yield results of the wild oat control trials are given in table 3 and of the broadleaf control trials in table 4.

The suggested treatment with herbicides tested and evaluation of this treatment are presented by listing advantages and disadvantages.

Wild oat control

Dicuran (80% wettable powder of chlorotoluron) at 2.4 kg of active ingredient per hectare at the 3 leaf stage.

Advantages:

1. Control of both wild oats and rye grass.
2. Control of most important broadleaf species; therefore, only one herbicide is needed.
3. Exact timing not necessary from the 2 to the 4 1/2 leaf stage. This is a 25 to 30 day period.

Disadvantages:

1. Wild oat control not consistent and the influencing factors are not well known.
2. High cost, 10 to 12 dinars per hectare ($21-$25 per hectare)
3. The grower must observe fields and decide early whether or not to treat.
4. Phytotoxic, no margin between adequate control and a dosage free from risk.
5. Accurate application essential; this requires good tank agitation.

Dozanex (80% wettable powder of Metoxuron) at 4 kg of active ingredient per hectare at the 3 leaf stage.

Advantages:

1. Control of both wild oats and rye grass.
2. Control of most important broadleaf species; therefore, only one herbicide application is needed.
3. Less phytotoxic than Dicuran on the variety Inia.

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Disadvantages:

1. Wild oat control not consistent and the influencing factors are not well known.
2. High cost.
3. The grower must observe fields and decide early whether or not to treat.
4. Phytotoxic, similar to Dicuran on the durum variety, Inrat.
5. Accurate application essential.

Suffix (20% emulsifiable concentrate of Benzoyl-Prop. Ethyl) 1.25 kg of active ingredient per hectare at the 6 leaf stage of wheat. This should be completion of tillering but before jointing of the wild oats.

Advantages:

1. Dependable control of wild oats, free of direct influence of soil factors.
2. Relatively free of phytotoxicity problems.
3. The grower has adequate time to assess the wild oat infestation and crop potential before making the decision whether or not to treat.

Disadvantages:

1. Controls only wild oats and therefore a second herbicide application may also be needed.
2. Application of a second herbicide should not be made within 10 days either before or after the Suffix application.
3. Heavy wild oat infestation may reduce yield potential before Suffix can be applied.
4. High cost, especially if a second herbicide is also needed.

Broadleaf weed control

2,4-D (46% emulsifiable concentrate of methoxy butanol low volatile ester) 0.55 kg active ingredient equivalent per hectare at the start of jointing.

Advantages:

1. The practice is established in Tunisia.
2. The cost of material is less than other herbicides.
3. A broad spectrum of broadleaf weeds is controlled.
4. The weed control is reliable, free of direct influence of soil factors.

Disadvantages:

1. May be phytotoxic if applied before the jointing stage.
2. Proper timing for avoidance of phytotoxicity results in

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physical damage to wheat by the ground spray equipment. Air application equipment is very limited in Tunisia.

3. There is only a short period of optimum time of application.
4. Weed competition may become severe before the wheat reaches a safe stage of development for treatment.
5. Grass weeds are not controlled.

MCPA (47.3% equivalent emulsifiable concentrate of low volatile ester) 0.55 kg per hectare at the end of the tillering stage.

Advantages:

1. Less phytotoxic than 2,4-D with an equal range of broad leaf weed control.
2. Can be applied earlier than 2,4-D.

Disadvantages:

1. Does not control grass weeds.
2. Slightly more expensive than 2,4-D.

Buctril (34% emulsifiable concentrate of Bromoxynil) 0.41 kg of active ingredient per hectare at the 4 1/2 leaf stage.

Advantages:

1. Can be used earlier than 2,4-D.

Disadvantages:

1. Often phytotoxic.
2. Spectrum of broadleaf weed control not as wide as 2,4-D.
3. Does not control grassy weeds.

Bronate (21.9% Bromoxynil + 21.9% MCPA emulsifiable concentrate) at 0.41 + 0.41 kg active ingredients per hectare at the 4 1/2 leaf stage.

Advantages:

1. Can be used earlier than 2,4-D.
2. The spectrum of broadleaf weed control is as wide as 2,4-D.

Disadvantages:

1. Slight risk of phytotoxicity.
2. Does not control grassy weeds.

Tribunil (70% wettable powder of Metabenzthiasuron) 1.95 kg active ingredient per hectare at the 3 leaf stage.

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Advantages:

1. High yields as a result of treatment; beneficial growth regulator effects may be involved.
2. Low risk of phytotoxocity.
3. Partial control of rye grass and a few other species not controlled by 2,4-D.

Disadvantages:

1. Poor control of some important broadleaf species.
2. Does not control wild oats.

Phytotoxicity of 2,4-D

In the 1970/71 season there were severe ear distortion symptoms in many of the variety trials treated with 2,4-D. It appeared that Zaafrane, Soltane and Utique were more sensitive than Inia and that the durum wheats were insensitive. Follow up experimentation was conducted in the 1971/72 season at sites representing 3 different climatic zones. Methoxy Butanol low volatile ester of 2,4-D at 0.55 equivalent kg/ha was applied at six different stages of growth on 3 varieties chosen to represent high, medium and low sensitivity to 2,4-D. The varieties were Zaafrane or Soltane, Inia and Jori. The stages of growth were 3 leaf - first tillers appearing; 4 1/2 leaf - maximum tillering; 6 leaf - tillering completed but joints not yet formed above surface; jointing - one or 2 joints above surface; boot stage; and flowering stage. A hand weeded as well as a non weeded check treatment were used.

In the 3 leaf treatment "onion leaf" symptoms appeared in all varieties. Severe ear distortion appeared in Zaafrane or Soltane and Inia, but none in Jori. In the 4 1/2 leaf treatment a small amount of onion leaf appeared in Zaafrane or Soltane, a trace in Inia and none in Jori. Again, severe ear distortion appeared in both Zaafrane or Soltane and Inia but none in Jori. In the 6 leaf treatment medium ear distortion appeared in Zaafrane or Soltane, slight ear distortion in Inia and none in Jori. Normal plant morphology developed in the remaining treatments except for sterility and upright rather than pendant ears.

The highest average yield of all varieties occurred from the jointing stage treatment, the treatment which did not result in ear distortion of the bread wheats, see figure 1. Based on both symptoms and yield reduction, sensitivity of these bread wheats did not differ. However, Zaafrane and Soltane remained in a sensitive condition for a longer period of time which included the recommended time for 2,4-D application. The more abundant and prolonged tillering activity of Zaafrane and Soltane may result in a prolonged period of sensitivity of ear meristem tissue.

The variety Jori was less sensitive to 2,4-D than the bread wheats measured both by symptoms and by yield depression. However, the same trend or maximum yield from the jointing stage treatment indicates negative influence of treatment at other stages which was not expressed by symptoms.

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As a result of these trials 2,4-D will be used with more caution in experiments, extension demonstrations and recommendations in the Tunisian Project.

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Table 2. AVERAGE % CONTROL OF WEED SPECIES IN SEVEN BROADLEAF WEED CONTROL TRIALS - 1971/72

Weed species	Herbicide and stage of wheat when applied, no. of leaves							
	2,4-D	MCPA	Buctril	Buctril	Bronate	Tribunil	Dosanex	Dicuran
	6	6	3	4 1/2	4 1/2	3	3	3
Avena sterilis	14	4	2	8	7	13	69v	67
Lolium rigidum	13	16	24	24	20	46v	87	68
Phalaris truncata	0	0	0	0	0	0	0	5
Fumaria parviflora	77	93	26	25	92	78v	71	43v
Fumaria agraria	51	88	16	27	89	78v	77	23v
Papaver rhoeas	99	95	68	90	96	99	89	92
Raphanus rophanistrum	100	100	93	96	99	100	100	72
Vicia hirsutum	100	95	59	59	97	36v	65v	56
Vicia sativa	100	100	-	11	91	0	35v	20
Medicago hispida	95	95	43	43	73v	53v	90	78
Polygonum aviculaire	100	90	45v	46v	98	67v	100	100
Euphorbia helioscopia	100	98	40	98	100	36	51v	27
Bupleurum lancifolium	100	100	65	87	87	48	100	100
Galium aparine	0	-	-	-	-	-	100	-
Sonchus asper	95	95	30	60v	30v	15v	34v	63v
Chrysanthemum coronarium	91	80	56v	89	99	80	90	91
Calendula arvensis	100	50v	-	-	100	-	-	100
Convolvulvus arvensis	94	93	12	44v	23	0	-	17v
Convolvulvus tricolor	100	100	-	-	-	-	-	-
Lamium amplexicaule	50	0	-	-	100	-	-	-
Veronica hederaefolia	72	89	41v	56	91	90	77	86
Linaria reflexa	80	54	43v	63v	99	97	-	74
Anagallis arvensis	70	97	10	0	54v	100	-	100
Rumex sp.	12	47	87	98	90	100	100	95
Torilis nodosa	95	100	43	80	96	82	-	-
Ridolfia segetum	100	100	80	97	100	99	-	100
Circium arvensis	67v	70	6	0	24	15	-	23

Note: v = variable

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Table 3. YIELDS IN QUINTALS PER HECTARE AT 3 WILD OAT TRIAL SITES, 1971/72

Treatments			Sites and Varieties				
			Beja	Oued Zarga+		Teboursouk	
Herbicide	Wheat development No. of leaves (stage++)	Active ingredient kg/ha	Sonalika	Inrat	Inia	Inrat	Inia
Dicuran	1 leaf (B)	2.4	41.7	16.0	22.2	24.8	33.4
Dicuran	3 leaves (D)	1.6	42.3	15.7	22.6	---	---
Dicuran	3 leaves (D)	2.4	37.6	16.5	24.3	26.2	40.0
Dicuran	4 1/2 leaves (F)	2.4	39.5	16.7	24.6	24.7	38.3
Dosanex	3 leaves (D)	3.2	41.1	17.3	22.6	24.1	27.5
Tribunil	3 leaves (D)	1.95	---	---	---	26.5	39.8
Dicuran + Igran	3 leaves (D)	1.6 + 0.8	31.7	18.5	19.2	---	---
Igran	3 leaves (D)	0.8	39.8	16.4	22.0	---	---
Buctril	3 leaves (D)	0.41	---	---	---	23.1	32.5
Suffix	4 1/2 leaves (F)	1.5	41.5	17.1	25.0	25.3	36.8
Suffix	6 leaves (G)	1.5	40.9	18.0	22.1	28.8	35.5
Suffix + 2,4-D	6 leaves (G)	1.5 + 0.55	---	17.5	22.9	---	---
Dicuran	6 leaves (G)	2.4	37.8	14.5	20.0	27.4	35.6
Check			39.8	16.3	23.7	23.7	33.2
Coefficient of variation, %			10.9	8.5	8.9	11.4	12.1
L.S.D. 10%			5.2	1.7	2.5	NS	7.3
L.S.D. 5%			NS	NS	3.0	NS	9.0
Average of treatments: without 2,4-D			38.6	16.1	22.6	24.3	34.8
overtreated with 2,4-D			39.7	17.3	22.6	26.7	35.7

Differences are not significantly different.

+ At Oued Zarga a hail storm reduced harvested yield of Inia 30 to 45% and of Inrat 50 to 65%.

++ Stage of growth:

B = 1 leaf
D = pre tillering
F = full tillering
G = finished tillering, jointing started

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Table 4. YIELDS IN QUINTALS PER HECTARE OF 6 BROADLEAF WEED CONTROL TRIALS

Treatment Herbicide - kg a.i./ha Stage of growth	Sites St. Cyprien	Srinja	Oued Rmel	Gaafour	Le Krib	Jendouba	Average 6 trials
2,4-D - 0.55 6 leaves	34.5	34.6	40.5	33.9	44.8	34.7	37.1
MCPA - 0.55 4 1/2 leaves	29.9	37.0	40.5	26.8	47.0	35.4	36.1
MCPA - 0.55 6 leaves	32.7	41.0	41.7	32.8	47.3	36.2	38.6
Buctril - 0.41 3 leaves	33.0	36.6	37.9	32.0	45.4	34.1	36.5
Buctril - 0.41 4 1/2 leaves	36.0	40.2	37.8	30.6	49.2	33.2	37.8
Bronate - 0.41 + 0.41 4 1/2 leaves	34.0	37.8	37.6	30.0	47.9	36.2	37.2
Tribunil - 1.95 3 leaves	36.7	39.9	42.4	35.7	49.5	37.9	40.3
Dozanex - 3.2 3 leaves	35.7	39.1	42.6	30.9	47.3	37.5	37.1
Dicuran - 2.4 3 leaves	29.0	42.6	38.2	33.7	49.7	35.4	37.8
CHECK	34.0	37.8	40.9	31.2	45.7	37.9	37.9
Extra treatments*			33.1[a]		46.9[b]		
Extra treatments*			43.1[c]		47.6[d]		
Coefficient of variation	9.0	11.3	6.9	12.4	6.9	5.6	
L.S.D. 10%	3.1	NS	3.3	NS	NS	2.7	
L.S.D. 5%	3.6		3.5			3.0	
L.S.D. 1%	4.9		4.6			NS	

* Extra treatments: a. Dicuran-1.6 + Igran-0.8, 3 leaves
b. Tribunil - 1.95, 2 1/2 leaves
b. Igran - 0.8, 3 leaves
d. Buctril - 0.41, 2 1/2 leaves

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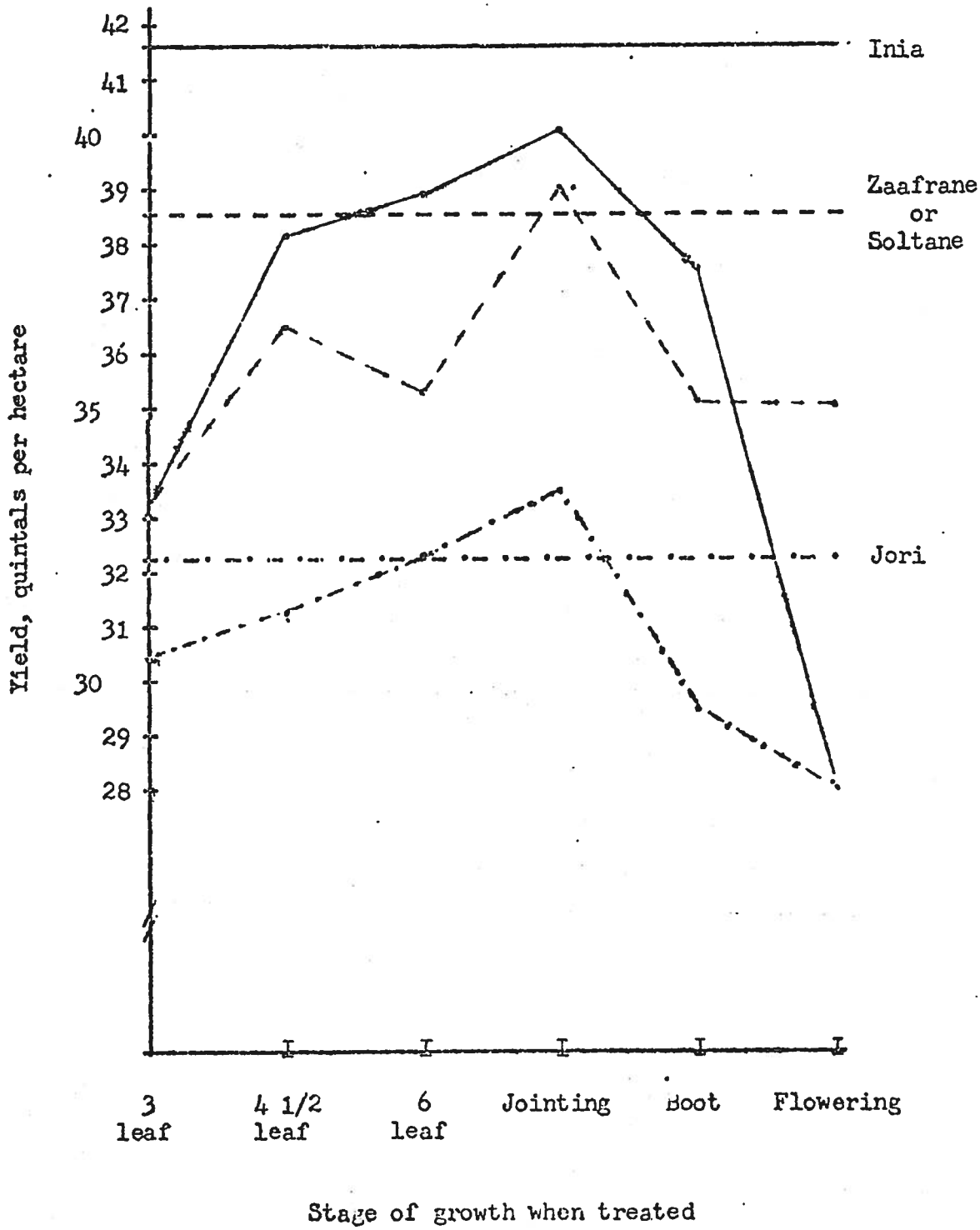
Figure 1. YIELD OF 3 VARIETIES SPRAYED WITH 550 GRAMS OF 2,4-D PER HECTARE AT DIFFERENT STAGES OF GROWTH, AVERAGE OF 3 TRIALS

Horizontal lines are yield levels without 2,4-D including both weeded and non weeded checks.



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3. Rotation Studies

A new dimension was added to the Tunisian program in this crop year. The decision had previously been taken to fit the wheat crop, in appropriate regions in Tunisia, into a rotation with an annual forage legume in a similar manner to that used in southern Australia. The variety of legume, the length of the pasture and crop phases may vary according to environmental and financial considerations, but broadly it is intended that the legume phase should provide soil nitrogen, improve physical fertility, and help control weeds by competition and soil born diseases by breaking the continuum of hosts.

The programme conducted in 1971-72 was aimed at demonstrating the potential of the system and answering simple questions to allow the rotation system to be adopted. It is important to know:

1. Variety and plant growth performance
2. Whether suitable native strains of rhizobia exist
3. The levels of phosphate required to get optimum nitrogen accumulation
4. The time required (number of cycles) to have seed supplies in the soil sufficient to regenerate without replanting and to have sufficient organic nitrogen available to be able to suspend nitrogen fertilizer applications on the wheat crop.

The series of demonstrations and experiments planted in 1971 are required for 2-4 years and many of the results will only arise in the second and subsequent years.

An experiment series was planted at 3 sites that are representative of important environments. These 3 sites each contained the following experiments:

a. A Mini-Rotation Experiment in which medic - wheat rotation begun in each of 3 successive years is compared with fallow - wheat rotation begun in comparable years.

b. A Variety Experiment in which the performance of 5 carefully selected legumes (4 Medicago and 1 Trifolium subterraneum), planted with and without inoculum, was compared.

c. A Fertiliser Experiment with 4 rates of phosphorus and some unreplicated treatments of nitrogen and trace elements.

d. A Management Area for weed and insect control and grazing management studies.

The area of this experiment series is approximately 1 hectare to allow big enough plots for demonstration as well.

No results from the rotation experiment can be expected for several years. The important results for the first year come from the variety x inoculum experiment.

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The demonstration series comprises 1/2 hectare blocks of wheat and medic at 15 sites. These were established on farms on the normal seed bed prepared for wheat although wheat was not always the preceding crop. In the second year, these sites will be further split. The wheat stubble will be planted to medic by two methods. The medic will be split so that half is planted to wheat with various rates of nitrogen and half will be allowed to regenerate for a second year.

In all sites the establishment of medic was very good. Sometimes the planting technique gave patchy establishment, but the season was sufficiently good to allow good dense stands. In fact, the spring weather was very good for medic growth, and better than average stands were produced.

The most important answer obtained during the season was that the cultivars performed in a very similar manner to what would have been expected in Australia. Medicago truncatula C.V. Jemalong and Medicago littoralis C.V. Harbinger proved very adaptable. Medicago paragosa C.V. Paragosa Gama Medic only adapted to the grey brown soils of heavy texture. Trifolium subterraneum C.V. Clare, the only variety of subterranean clover likely to grow in alkaline soil, grew poorly.

The varieties Jemalong and Harbinger can be planted without inoculum in any area where natural medics can be seen in the vicinity. This is an important consideration as the need for inoculation limits the planting time. Inoculated seed has to be planted into a moist seed bed. On the other hand, if inoculation is not necessary, seed can often be planted before the opening rains.

Preliminary yields of pods and seeds have been made, although the detailed counts can only be undertaken in the autumn after animal grazing has taken place. Very high yields of pods and seeds are apparent.

Emphasis has been placed on the importance of maximising seed production in the early years at the expense of other considerations. When this is achieved the system increases in flexibility. Grazing of the medic was restricted in most cases so as not to jeopardise seed production.

Some estimates of total herbage production were made in the spring. Yield of dry matter is in the order to 1-1 1/2 tons.

The major emphasis in the programme is to increase soil nitrogen and this cannot be estimated until the next wheat crop.

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4. Date of Planting Studies

Date of planting experiments were conducted at 6 sites which represented the range of climate of the important wheat producing areas of Tunisia. The trial at Thala was not harvested due to poor stands as a result of horned larks *Alauda calendre* and intermittent drouth during the seeding period. The five trials harvested consisted of 3 dates of seeding of 6 varieties in plots of 5 meters x 50 or 30 meters, depending on whether 2 or 3 replications were used. Dates of planting were:

1. November 11 to 12
2. December 3 to 21
3. January 2 to February 3.

The plan was to seed the third planting of all trials during early January, but rain interferred.

Date of planting x climate effect was often masked by other factors. However this provided the opportunity to observe the influence of date of planting on these factors. In this set of trials these factors were *Septoria*, frit fly, Hessian fly, saw fly, bird damage, drouth, stand, lodging and grass weeds.

Considering only climate, Inia tended to produce maximum yield in the December seeding but was also productive in the November and January seeding dates. Penjamo also exhibited wide adaptability to seeding date, but the January date tended to be lower in yield. The varieties with Tunisian background, Florence Aurore, Ariana, Inrat and Badri were not adapted to the January date, and the November date tended to be better than the December date. Although Badri matures only a few days later than Inia it is not adapted to late planting. *Septoria* infestation may seriously reduce the yield of an early date of seeding of any susceptible variety and the threat diminishes as planting is delayed. Therefore the susceptibility of the variety and the local probability of *Septoria* attack should be considered in making date of seeding recommendations. It is desirable to advance seeding date in the colder plateau areas in the regions surrounding Le Kef. However, this is often not possible due to difficulty in establishing a stand. This is the result of the rainfall pattern plus loss of moisture due to extreme crumb structure of the soil. Experimentation with cultural practices and seeding methods may be needed.

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III. PLANT IMPROVEMENT

1. Plant Breeding

Introduction

The breeding section is the meeting ground for three different institutions of Tunisia, i.e. ACPP of the Office des Céréales, INRAT and ENSAT.

The first phase of the Tunisian program was completed with the successful introduction of high yielding varieties such as Inia, Tobari and Penjamo. Simultaneously, the breeding program was reactivated to cope with the never ending need for new varieties.

Table5 shows the performance of the standard varieties. The yields are averaged over many yield totals and many locations. It is clear that the new Septoria tolerant variety Soltane has a slight edge over Inia even in the absence of the disease.

Wheat yields were excellent this year and Inia was the predominant high yielding variety. As a consequence, the acreage is likely to increase dramatically during the coming years. If the proportion of Inia remains the same in the projected large plantings of the future, there will be a serious problem if something goes wrong with the variety Inia.

Taking this into account, one of the selections of the cross Son.64-Kl. Rendidor, renamed Soltane, and one of the Bluebirds are strongly being considered for official release. Of the two sisters from the Son.64-Kl. Rendidor cross, Soltane and Zaafrane, the performance of Soltane has been consistantly better for the past few years. Moreover, they are very close sibs and their disease reactions do not differ greatly. Therefore, of the two sisters only Soltane will be released.

Table 6 shows the performance of the varieties from the cross 23584 or Bluebird. The data is from 3 different stations. At Béja, the trials were planted late, and under the wet, cool spring conditions all the Bluebirds performed well; Cajeme and Yecora topped the trial. The yield trials in Ariana and Mateur were planted early. Of these two stations, Ariana had practically no diseases and the Bluebirds did very well. However, at Mateur we had a fairly high degree of Septoria infection. As a result, the variety Cajeme, which was 125% of Soltane at Ariana, dropped to 97% and Yecora dropped from 117% to 85%. Thus, Soltane, a low yielder, compared with the Bluebirds, outyielded both under the stress of Septoria. This is a clear indication that these varieties should not be grown in Septoria hot spots.

Diseases

It is true that the year under report was excellent from a crop production point of view. However, diseases like stem rust, Septoria, leaf rust,

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mildew and stripe rust could seriously limit production under conditions favoring their attack. Therefore, in the breeding program the objective is to give sufficient selection pressure against these diseases and in the order of their importance.

Varietal Evaluation

This year we had 12 micro yield trials in addition to the ISWYN, the ESYT 1,2 and the RDYT. In all, 414 lines were tested in these trials. The advance yield trials were planted in 4 different locations, while the preliminary or the first year tests were present only in one location. Outstanding varieties of these yield trials are listed in table7 . The plan is to multiply all these lines simultaneously during the next cycle of yield trials. The best ones will be considered for demonstrations and varietal release.

Except for HD 1799, CC-Inia x Inia "S" - Napo and Potam, all the lines listed have acceptable Septoria tolerance. In the cross Napo-Tob"S"x8156(R) the resistance to Septoria is outstanding.

In addition to the varietal evaluation, we had many screening nurseries for diseases as well as for germplasm evaluation. Of these, the most useful were the ISWSN and RDISN.

Projection for the Future

In the year under report, we have made close to 350 crosses. Yield, Septoria, rusts, and quality to some extent were the deciding factors for these crosses. The F_2's and all the other segregating populations were grown at the Béja station of INRAT. We had excellent Septoria epidemics in the breeding nursery. A large number of lines from the F_4's and F_5's of Tunisian selections are being included in the coming year's yield trials. Of these the selections from the crosses listed in table8, seem to have outstanding potential. We are confident that some of these selections can outyield all the standard varieties we have. In addition, most of these lines have much better Septoria resistance.

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Table 5. PERFORMANCE OF STANDARD VARIETIES AVERAGED OVER 24 TRIALS AND LOCATIONS

	Average yield	% Inia
Soltane	41.65	105
Zaafrane	40.96	103
Tobari	40.79	102
Ariana	37.04	93
Florence Aurore	27.42	69
Inia	39.62	100

Table 6. PERFORMANCE OF THE BLUEBIRDS

a) Béja Station

	Average yield	% Inia
Yecora	57.03	116
Cajeme	56.64	115
Saric	49.91	105
Inia	49.17	100

b)

	Ariana Station			Mateur Station		
	Average yield	% Soltane	Sertoria	Average yield	% Soltane	Loss
Yecora	43.74	117%	7-8	41.80	85%	32%
Cajeme	46.73	125%	7	47.98	97%	28%
Soltane	37.22	100%	4-5	49.23	100%	

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Table 7. OUTSTANDING LINES IN THE YIELD TRIALS

		Average yield	% of check	Septoria 1-9 scale
1	CC-Inia 23528-7m-1t-1m-8y-0m	52.45	121 Tob.	6
2	CC-Inia 23528-7m-1t-1m-7y-0m	47.20	124 Inia	6
3	Cal-Nt-67 27053-7m-2tu-2mb	45.35	120 Tob.	5
4	Kl.Pet.Raf-8156^2 27997-4y-100m-300y	48.48	107 Tob.	4
5	HD 1799	47.88	105 Tob.	6-7
6	Napo-Tob"s"x8156(R) 28071-7m-3y-7m-0y	48.70	107 Tob.	3
7	Cno-No66 25111-6m-7y-3m-0y	41.90	111 Inia	5
8	No 66-Cno"s" 25361-5m-3y-0m	49.31	112 Inia	5
9	Son.64xTzPP-Y54/CC 22346-39m-1v-2m-1t	49.32	112 Inia	5
10	PV18A-Cno 27893-3y-4m-1y-0m	46.65	109 Inia	5
11	S948A1-Cno"s"^{2} H-160-60a-6y-2m-4y-0m	42.02	98 Inia	3-4
12	CC-Iniax Inia"s"-Napo	45.03	119 Inia	6-7
13	Potam	53.93	127 Inia	7
14	Inia (average 21 trials)	39.62	100	7

Table8 . PROMISING CROSSES

	Cross No.
Cno"s"^{2} - Tob 66 x Kl.Pet.Raf - 8156(R)^2	30648
Bb - Nar"s"	30857
Gallo x Cno - Pj	30903
Jar"s" - Cno"s"	30906
CC - Inia"s" x Nar 59 - On	30973
CC - Inia"s" x On - Nar"s"	30976
Cno"s" - On x Cal	31060

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Durums

The two durum varieties INRAT 69 and Bedri released in 1970 have during the past year given 30 to 50% more yield over the old Tunisian varieties. During the 1972-73 cropping cycle it is hoped that these varieties will be grown over about 40,000 hectares. Both these varieties are moderately tall and hence are prone to lodging. Therefore, the variety release committee this year approved the release of two shorter durums Amel 72 and Maghrebi 72. Both these varieties show a moderate amount of Septoria and mildew tolerance. However, both of them are susceptible to stem and leaf rusts.

During the past year 214 lines and varieties were yield tested under various ecological conditions of Tunisia. The best ones are listed in table no. 9 In general the dwarf durums show a tremendous yield potential. However, almost all of them show a high susceptibility to stem rust, leaf rust, Septoria and mildew. Unfortunately these are the most important diseases in Tunisia. In addition to the diseases, quality is another important factor in the durum industry. The high yielders like Cocorit and Brant(BD 1917)are highly susceptible to yellow berry and hence are not being favoured for release in Tunisia.

North Africa in general and Tunisia in particular are in need of some high yielding short durums with acceptable quality and disease resistance. We hope the release of the two short durums Amel and Maghrebi will serve as a short gap adjustment while research continues on the development of strains and varieties suited to our specific needs.

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Table 9 YIELD AND DISEASE REACTION OF DURUM WHEATS 1971 - 1972.

Variety or Lines	Average Yield	% Inrat 69	Diseases PM	Sept.	P.gt.	P.rec
Maghrebi 72= [(TM$_2$-Tc^2) (ZB-w)] / [(Brl80-Lak)(GZx61.130)] -D 26842	48.23	142	9MS	MR	60S	60S
COCORIT 71	47.99	141	9S	S	80S	50S
BD 1917 = BRANT "S"	47.09	139	9S	MS	80S	30S
BD 1941 = COCORIT "S"	45.43	134	9S	MS	60S	50S
AMAL 72 = BRANT "S"	44.87	132	9MS	MS	60S	60S
INRAT 69	34.00	100	9MR	MR	40 MR	30S
DMx69.159.4A.7A=UM6301 By$_E^2$ xTc-II-22252	52.41	139	8S.	MS	20MS	40MS
DMx69.200.1A.33A = II 28953	51.78	137	9S	MS	20MS	30S
DMx69.191.1A.9A =[(TM$_2$-Tc^2) (ZB.W)] B.Ball (By$_E^2$ - Tc) - II 28929	48.09	127	9MS	MR	40MS	50MS
D67.2.12A.7A =[(BB-Mahm981) (Kenya 338-EC)] BD 1419	44.05	117	9MR	MS	50S	60S
DMx.69.200.1A.41A = II 28953	43.97	116	9MS	MS	20MS	30MS
D67.45.12A.11A = BD1419x(Pi-Bell 116xTc^2)	43.67	116	9MR	MS	50S	40S
DMx69.203.1A.3A=[(Tdur-sphxMbgh Karak)] [(TM$_2$-Tc^2) (ZB-w)]^2 - II 28957	43.57	115	9MR	MS	10MR	5MR
D67.51.4A.2A =(Mahm.BD1588)xInrat 69	42.90	113	9MS	MR	10R	10MR
INRAT 69	37.80	100	9MR	MR	40MR	30S

Note :

PM = Powdery mildew
Sept.= Septoria
P.gt.= Stem Rust
P.rec= Leaf Rust
MS = Moderately susceptible
S = Susceptible
MR = Moderately resistant
MR = Highly resistant

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2. Variety testing.

Sixteen variety demonstrations of 15 to 20 varieties were seeded at sites chosen to represent good soil and management of the dryland wheat areas of Tunisia. One was not harvested because of a severe and non-uniform infestation of wild oats. These demonstrations consisted of 2 replications of plots 5 meters by 50 meters. The plots were seeded with Project equipment but harvested with the grower's combine except for parcels utilized for seed increase; these plots were harvested with the Project Wintersteiger combine. Yield results of the variety demonstrations are presented in table10.

The dominant factor in yield performance was lodging. This resulted in the relatively low yield of Florence Aurore, Bedri, INRAT and Roussia. Consistently high yields were produced by the Bluebirds, Saric and Cajeme, with a maximum of 61.5 qx/ha by Cajeme at Mateur. The new Septoria tolerant varieties, Soltane and Zaafeane, performed well in relation to other varieties, even in the absence of Septoria attack. Vigorous tillering gives these varieties an advantage over Inia which often tillers poorly in Tunisia, especially in the colder areas. This is a factor in the relatively poor performance of Inia, which failed to top the yield of any trial. Ponjamo, which produced the highest average yield last season, again performed well. Cocorit was by far the best durum in yield.

Era and Flotcher were planted at the colder sites and appeared unadapted due to lateness of heading. However, this season the grain filled and relative yield was excellent. An abnormal amount of late rainfall and the absence of sirocco winds contributed to their performance. Further evaluation is needed to learn if these varieties can be used in Tunisia.

Martin barley was planted at the 8 sites with lowest average rainfall. Yield was 14% above Inia; however, part of this performance was the result of a severe attack of frit fly plus Hessian fly which reduced the average wheat yield to 1/2 that of the barley at this site.

These trials should be continued because they serve both as demonstrations and a measure of varietal adaptability over a wide range of Tunisian conditions. Barley should be included in the dryer and the colder areas because it extends the range of climatic adaption and pathogen resistance of the plant material tested, as well as its economic importance.

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Table 10. YIELD, GRAIN TEST WEIGHT AND PLANT HIGHT FROM 16 FARM DEMONSTRATIONS THROUGHOUT NORTHERN TUNISIA IN 1970 - 1971.

Variety	N° of locations	Yield Q/ha	Yield % of Inia	Test Wt kgs/hl	Plant Hight cm	Plant hight % of Inia
Ariana 66	15	35.7	100.9	79.5	113.0	119
Florence Aurore	15	27.3	77.0	79.5	130.3	137
Soltane 72	15	38.0	107.3	78.8	94.6	100
Zaafrane	15	36.9	104.2	78.5	94.5	100
Utique	15	34.4	97.1	79.9	90.6	96
Inia 66	15	35.4	100.0	79.6	94.8	100
Tobari 66	15	37.3	105.2	79.4	94.4	99
Penjamo 62	15	37.7	106.6	77.3	97.5	103
Saric 70	15	39.1	110.4	77.6	74.8	79
Cajeme 71 +	15	39.8	112.4	78.1	77.1	81
Era	5	37.1	109.0	79.1	102.4	110
Fletcher	4	30.4	106.0	79.4	97.5	109
Jori 69	13	33.9	96.6	79.4	81.9	86
Cocorit 70	12	38.4	106.5	77.3	68.5	93
Bedri 69	15	30.7	85.8	79.2	96.7	102
Inrat 69	15	31.3	88.5	78.4	110.6	117
Roussia	3	20.9	49.8	77.0	115.3	114
Orge Martin (barley)	8	34.5	114.7	-	103.7	116

+ Released in Tunisia as Vaqa 72

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IV. EXTENSION

A programme of practical demonstrations was conducted throughout the wheat growing regions by a Tunisian engineer and a number of Tunisian adjoints techniques. These were supplemented by field trials referred to above.

There were two types of demonstration, viz. fertiliser demonstrations aimed at showing the benefits of nitrogen fertiliser and variety demonstrations to show the superiority of new varieties and their capacity to respond to fertiliser.

The individual plots in the demonstrations were approximately 2500 square metres in area. Some demonstrations were planted with mobile equipment but the majority were planted with the farmers' own equipment.

The fertiliser demonstrations compared no fertiliser, phosphate only and two levels of nitrogen in the following manner:

	Bread Wheat	Durum Wheat	Barley
Varieties:	Utique and Soltane in Septoria areas Tobari at Beja Inia at all other sites	Bedri and INRAT 69	Ceres and Martin

Units of fertiliser:

More than 500 mm		Less than 500 mm		High rainfall only		Dry areas only	
N	P	N	P	N	P	N	P
0	0	0	0	0	0	0	0
0	45	0	45	0	45	0	45
45	45	45	45	45	45	22	45
90	45	67	45	90	45	45	45

There were 38 demonstrations comprising 25 with bread wheat varieties, 11 with durum wheat varieties and 2 with barley. Of these 38 demonstrations 29 were harvested.

In the high rainfall areas the improved bread wheat varieties yielded 25.9, 31.9, 37.7 quintals/hectare with no nitrogen, 45 units of nitrogen and 90 units of nitrogen respectively.

The improved durum varieties responded to 45 units of nitrogen where the yield increased from 26.0 to 31.4 quintals/hectare. The additional nitrogen treatment of 90 units resulted in only an additional 1 quintal of yield because at this level the varieties lodged.

In the lower rainfall areas the bread wheats yielded 22.1, 25.5 and 28.7 quintals/hectare with 0, 45 and 90 units of nitrogen.

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The variety demonstrations

According to the allocations described above Inia, Utique, Soltane or Tobari was compared with Florence Aurore and INRAT 69 was compared with Mahmoudi. There were 29 demonstrations planted and of these 24 were harvested. In each variety demonstration the two varieties under comparison were grown at two levels of nitrogen and with adequate phosphate. The nitrogen treatments were 0 and 90 units for bread wheat varieties at high rainfall, and 67 units for bread wheat varieties at low rainfalls and for durum wheat varieties.

The level of yield differences obtained are demonstrated in the following data:

Inia 37.0 quintals/hectare, Florence Aurore 29.5 quintals/hectare at 90 units of nitrogen;

INRAT 69 29.6 quintals/hectare, Mahmoudi 21.8 quintals/hectare at 67 units of nitrogen;

Inia 28.5 quintals/hectare, Florence Aurore 21.5 quintals/hectare at 67 units of nitrogen.

Overall, the demonstrations were successful in demonstrating the recommendations arising from work in the Project and were used extensively in farm field days.

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ANNEX II

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CIMMYT REPORT

I. Introduction.

II. Weather Conditions.

III. Diseases and Insects.

IV. Fertilization and Weed Control.

V. Production.

VI. Production Research.

VII. Improvement Section.

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CIMMYT REPORT - ALGERIA 1971-72

I. INTRODUCTION

A Cereal Research and Production Project was established during the summer of 1971 between the Algerian Ministry of Agriculture and CIMMYT. The CIMMYT program in Algeria is supported by the Ford Foundation. Other cooperating agencies are F.A.O. and C.C.C.E. (French Central Economic Agency of Cooperation) directing extension demonstrations, fertilizer distribution and pilot studies respectively. The breeding program is directly connected to I.N.R.A.A. (National Institute of Agricultural Research for Algeria) at 7 Central and branch stations throughout the cereal growing regions of northern Algeria.

CIMMYT production research during 1971 was divided into two large regions of east and west. The country will be divided into three production regions (eastern, central and western) during the 1972-73 season with centers in Constantine, Algiers and Oran.

The Government of Algeria had imported sufficient seed of Mexican varieties during 1969-70 and 1970-71 to plant 5,100 and 148,000 hectares respectively. Based on the success of the introduced varieties, Inia, Siete Cerros and Tobari, Algeria seeded more than 320,000 hectares of high yielding varieties during 1971-72. All but a few percent of this surface consisted of the three Mexican varieties and Strampelli, a promising Italian bread wheat. The projected total surface for 1972-73 season is more than 600,000 hectares. Included in this total are 86,000 hectares of the Mexican durum variety Jori 69 and 3000 hectares of two Italian durum varieties Capeiti and Montanari.

Results of the 1971-72 season were very satisfactory throughout the country owing to favorable climatic conditions, proper placement of varieties by regions, general availability of fertilizer, and good support by the local government.

II. WEATHER CONDITIONS

General and abnormally high total rainfall and very good seasonal distribution contributed to the successful wheat year as shown in the following table.

. . .

Comparison of 1971-72 rainfall with the 50 year average 1971-72 total is for period October 1971 to June 1972.

REGIONS	ALTITUDE METERS	1913-63 AVERAGE MM	TOTAL 1971-72 MM
EASTERN			
Annaba	58	674	
Constantine	660	523	748
El Kroub	640	531	785
Guelma	270	609	714
Sétif	1081	457	611
CENTER			
Algiers (University)	59	753	930
Médéa	912	826	
El Asnam	112	396	
WESTERN			
Oran (Port)	3	381	
Mostaganem	111	425	438
Relizane	80	342	388
Mascara	583	456	616
Tlemcen	810	688	768
Maghnia	399	392	413
Sidi-Bel-Abbés	486	414	485

Although some yield losses were reported from excess rainfall, in general yield of cereals benefited from the high rainfall. Prolonged cool, cloudy days and rainy periods hindered timely application, and the efficacy of chemical weed control. These conditions also affected timely application of nitrogen top-dressing. Losses also occurred from flooding in lowland areas.

Cold weather with snow and late frost caused sterility of early maturing varieties in many areas above 500 meters altitude. The cool spring temperatures, with accompanying above normal rainfall, aided the late maturing varieties. Losses from hot southerly winds (Siroccos) were minimal compared to other years.

III. DISEASES AND INSECTS

Weather conditions were optimum for development of *Septoria tritici*. However, losses were restricted mainly to the higher rainfall, coastal plains. *Puccinia graminus tritici* was generally observed across the coastal plains and the Sétif region on the high plateau. The susceptible local bread and durum wheat varieties, and the Italian introductions were heavily infected. In regions where these varieties matured late, the rust developed early enough to cause considerable losses.

Puccinia recondita and *Puccinia glumarum* were also observed. The duration and intensity of these diseases was not enough to cause appreciable loss in yield.

The high yielding Mexican varieties, Inia, Tobari and to a lesser degree, Siete Cerros, were resistant to the three types of rusts in Algeria. New introductions from Tunisia, Soltane, Zaafrane and Utique also were resistant. Jori 69 developed moderate levels of stem rust. Cocorit 71 also developed some stem rust infection on the summer planting.

Insects were a minor factor in production. Isolated areas had considerable damage from cut worms. Hessian fly damage was limited to isolated areas, and caused very little yield reduction.

In certain regions, early maturing fields of the Mexican varieties suffered from bird damage. This is a universal problem throughout North Africa.

IV. FERTILIZATION AND WEED CONTROL

Based on research and experience in Algeria and other countries of North Africa, fertilizer recommendations were made for the different rainfall regions. These recommendations were as follows.

Rainfall Zone	Nitrogen Recommendation Before Seeding	Tillering	Total	Phosphate Recommendation
< 400 mm	33	22	55	45
400-500 mm	45	22	67	45
500-600 mm	45	33	78	45
> 600 mm	45	45	90	90

The figures are in units of N and P_2O_5 per hectare.

A large percentage of the 320,000 hectares were covered with the recommended rates for nitrogen and phosphorus. Full efficiency from the fertilizer was not realized for several reasons. Some areas did not have the full application due to lack of equipment, and wet weather prohibiting application with farm equipment. Poor weather condition also prevented realizing the 200,000 hectares programmed for aerial application. Late and often uneven hand application also reduced the overall yield benefits from the nitrogen application.

The government recommended and distributed sufficient phosphate fertilizer to apply 45 units/hectare to the more than 2,000,000 hectares of commercial wheat production. Sufficient nitrogen fertilizer was distributed to generally apply 20 units/hectare over the total areas of wheat production.

Weed control with herbicides was used on less than half of the high yielding varieties. Lack of chemicals, equipment and poor weather conditions for treatment all contributed to this problem. Aerial application was hindered by poor weather and only a part of the planned program was completed.

Results from application were spotty. Poor equipment, late application and improper use of some chemicals reduced the overall effectiveness of the application. Good weed control was reported to have doubled yield.

Wild oats, rye grass and Phlarius sp caused considerable losses in many regions. Chemicals used were not effective on these grass type weeds. Oxlais spp. are also a major weed problem throughout the fruit tree and vine areas where cereals occur.

V. PRODUCTION

Although final production figures for the 1971-72 season are not complete,

indications from over half of the production regions show the average yield of the three Mexican varieties to be 15 to 18 quintals/hectare. This compares with a 10 quintals/hectare average of the local bread and durum wheat varieties in the same regions.

On a small area of production, the Italian variety Strampelli also yielded about 17 quintals/hectare.

Several factors reduced the harvested yield for all varieties. The limiting factors of disease, weeds and production have been previously reported. In addition to these factors, high losses occurred at harvest. Harvest was delayed by lack of combines. The high yielding varieties matured early, and were ready to harvest while the harvest of barley and other crops was still in progress. Much of the wheat stood in the field for two to four weeks after it was ready for harvest. High losses from wind shattering and late rain were common. It is difficult to estimate these losses but 10 to 15 percent over all loss is indicated. In general, losses from harvest probably were higher in the early maturing varieties because of the relatively longer period of standing after ripening.

The production of well managed fields indicates the potential of the high yielding varieties. Many fields produced 40 quintals per hectare with a few yields approaching 60 quintals (6 tons per hectare).

VI. PRODUCTION RESEARCH

Variety demonstrations were planted in sixteen locations in 1971-72. Ten demonstrations were planted in the western region and six were planted in central and eastern regions. In general, these demonstrations consisted of 18 varieties with two replications. The demonstrations were fertilized at the recommended rate and were sprayed with chemical herbicides. Farmers equipment was used for seeding and harvesting. Not all varieties were planted at each location, and a total of 24 different varieties were planted. Three demonstrations were not harvested due to flooding, heavy infectation of rye grass and damage from cut worm.

The data are summarized in Table 1.

Siete Cerros had the highest average yield at all locations even though the yield was reduced by Septoria in a few locations. Yield loss at the Annaba location was estimated at 30% when compared to the resistant variety Strampelli.

All demonstrations were seeded after December 20. Although yields of the earlier varieties were not affected by the later seeding, the late varieties may have suffered some yield loss.

TABLE 1. Average Yield Comparative Yield in Percent of INIA and Maximum Disease and Insect Readings for Varieties in 13 Demonstrations Throughout Algeria.

Variety	Location Number	Source	Q/H Yield	Yield % of INIA	Septoria Ratings	Maximum Readings Stem Rust	% Damage Saw Fly	% Lodging	% Shattering
Siete Cerros	12	Mexico	32.3	117	9	R	2%	5	0
Zaafrane	7	Tunisia	26.3	116	7	R	10	10	2
Soltane	13	Tunisia	30.2	113	7	R	5	2	0
Mexico 1601	3	Mexico	46.3	112	5	R	5	-	-
Strampelli	13	Italy	29.7	111	3	S	25	5	0
Utique	11	Tunisia	26.1	108	5	R	5	10	5
Tobari 66	12	Mexico	27.8	106	8	R	5	2	0
Generoso	9	Italy	22.1	106	3	S	10	0	5
Fletcher	3	U.S.A.	29.7	103	2	R	5	0	0
Capeiti (D)	5	Italy	29.9	103	-	S	L	S	-
Inia 66	13	Mexico	26.7	100	9	R	10	5	0
Inrat 69 (D)	13	Tunisia	25.6	96	8	T-R	10	50	0
Moh. Ben Bachir	9	Algeria	23.6	96	-	S	10	S	-
Jori 69 (D)	8	Mexico	23.5	93	9	R	3	0	0
Sparta	12	Italy	25.9	90	3	VHS	5	5	10
Mahon Demais	9	Algeria	21.4	87	-	S	5	S	10
Padre Gemelli	11	Italy	20.8	85	3	VHS	10	0	5
Libellulu (D)	11	Italy	23.0	84	2	VHS	5	0	2
Oued Zenati 368 (D)	11	Algeria	21.6	84	9	S	-	95	0
Montanari (D)	3	Italy	26.0	79	-	S	-	S	-
Splendeur	13	France	14.4	54	2	VHS	5	0	0

NOTE: L = Light attack; R = Resistant; S = Susceptible; VHS = Very Highly Susceptible.
(-) = No comparative reading.

Strampelli was the highest yielding Italian variety and was equal to Siete Cerros in the high plateau region. These two varieties were the best adapted to the high plateau. The other Italian varieties performed fairly well in the high plateau regions but were low producers in general in the other regions. The Italian varieties were all susceptible to stem rust, but Strampelli was attacked later and with less intensity. Strampelli is very susceptible to saw fly damage. Siete Cerros was the most tolerant of the high yielding varieties to saw fly attack. Saw fly was most prevalent in the high plateau where both Siete Cerros and Strampelli are recommended.

The varieties Soltane, Zaafrane, Utique from Tunisia and Calidad sib (Mex. 1601) performed well. Soltane appears to be the best adapted of the varieties, with better performance in the high plateau. It should be recommended for the higher rainfall areas. Utique and Mexico 1601 performed very well in the high rainfall areas where Septoria was a factor, but were too early for the high plateau region.

Fletcher was outstanding in resistance to diseases, but was too late for the later seeding. Both Fletcher and Era need to be tried in earlier seedings to help overcome the late maturity.

Inia 66 and Tobari were not outstanding this year. Neither variety tillered very well this season and they lack adaptation to the high plateau, although Tobari appears to be better in this area. Tobari performed quite well in the high rainfall region and in the one irrigated trial that was late seeded. Until Tobari can be replaced by Soltane, Utique or another new variety, it is the best variety for the high rainfall coastal regions.

Of the durum varieties, Inrat 69, Capeiti and Jori appear to have the most potential of the varieties in the demonstrations. Jori is not adapted to the high plateau and should not be used in the high rainfall area. The best region of adaptation is the 400-500 mm region below 800 meters. Capeiti is better adapted to the higher rainfall areas, but will lodge. Inrat 69 is adapted to both the high and intermediate rainfall areas but it has not performed well on the high plateau. Mohamed Ben Bachir performed very well in the high plateau, but is too weak strawed to be used in the higher rainfall regions. In other tests, Cocorit 71 and other new high yielding durum varieties appear to be much superior to the varieties now grown. Some of these are included in demonstrations for the 1972-73 season.

Three dates of seeding trials were established in eastern Algeria. One of these trials was abandoned due to cut worm damage. Four varieties were planted with two dates of seeding in the high plateau region near Sétif.

There was no significant difference in yield between the two dates of seeding or a significant variety-date interaction as shown in table 1. There was a significant variety difference in yield. The cool spring and good rainfall distribution probably accounted for lack of date of seeding response.

Table 2. Yield of four varieties at two dates of seeding and two locations on the high plateau.

	Yield Q/H					
	Sétif South			Sétif North		
Variety	Nov. 25	Dec. 20	Ave.	Nov. 25	Dec. 19	Ave.
Inia	21.6	24.1	22.9*	24.4	23.6	24.0
Strampelli	23.5	26.1	24.8*	26.9	29.5	28.2*
Siete Cerros	23.9	24.1	24.0*	28.8	28.9	28.9*
Mahon Demais	18.0	16.4	17.2	23.9	21.1	22.5
L.S.D.5%			3.52			5.64

* Significantly higher yielding than Mahon Demais.

Four fertilizer trials were established in eastern Algeria. One trial was destroyed by cut worms. There was a significant response to nitrogen at two locations. The response was related to previous cropping history as has been the case in trials in Tunisia and Morocco. The response was limited to 44 units of N at Guelma following sugar beets with a very high check yield indicating a high carry over of N from the previous crop. At Annaba following vetch harvested for seed, a response was noted at all levels of N to 132 units. These results are shown in Table 3.

At Sétif following summer follow no significant yield response was noted. The data from this trial are not included because faulty second application did not allow analysis of the data.

Table 3. Summary of yield response to nitrogen treatment at two locations.

Location	Preceeding Crop	Units of Nitrogen Yield Q/H				Difference	% Increase
		O	44	88	132		
Guelma	Sugar beet	36.1	44.1	45.0	46.4	10.3	28
Annaba	Vetch (seed)	23.5	37.7	43.5	51.4	27.9	115

L.S.D. Annaba 6.82 Q/H
Guelma 4.79 Q/H

The average yields are determined from 12 plots for each rate of N. There was no difference between dates of application or if the application was split.

VII. IMPROVEMENT SECTION

The good moisture distribution and cool, cloudy days, prolonged plant growth and provided optimum conditions for selection in the breeding nurseries at all research stations across the country. Two distinct zones must be considered in developing wheat varieties across the northern cereal region of Algeria. The extreme northern coastal plain has a mild climate, no freezing termperatures and annual average rainfall varying from 400 to 800 mm. The second region is a high plateau lying inland 60 to 100 kilometers from the coast. This plateau extends over 1000 kilometers east to west across the country and ranges from 600 to 1200 meters in altitude. This large cereals regions is subject to snow. late frost, early siroccos (hot dry dessert winds) and annual average rainfall varies from 250 to 650 mm.

Bread Wheats

The long season with good moisture provided optimum conditions for development of the medium to late maturing varieties. The Mexican variety, Siete Cerros and Italian variety, Strampelli, were the top yielders, as seen in Table 4, for all the National microyield trials and large scale production. Siete Cerros has very good general resistance to the 3 rusts and loose smut but is highly susceptible to Septoria. On the contrary, Strampelli, has good resistance but is susceptible to both stem and leaf rust. Data from the two previous years which had much lower rainfall show these two varieties with the highest yields. Other varieties of interest from the 7th International Spring Wheat Yield Nursery (ISWYN) are showing in Table 5. The yield represent averages from three experimental regions Sidi-Bel-Abbes in the extreme west, Algiers in the center and El-Kroub near Constantine, in the east. The Indian variety, Chhoti Lerma, always yields well in the absence of heavy stripe rust and Septoria attacks. The following three varieties, Toguifen, Victor I and Penjamo have resistance to Septoria tritici, and good general adaptation to North African climate, however, the poor quality of Victor I prohibits its use in commercial production.

Two locations, Algiers in the Center and Annaba in the East, gave good conditions for screening advanced lines and varieties against attack by Septoria tritici. Development of the Septoria occurred in mid-March, which is normally too late for much damage, however, cloudy wet weather with warmer temperatures allowed rapid increases in these two areas. Some of the best Septoria resistant lines and varieties are listed in Table 6. Total rainfall in these two regions was very high, as seen in the earlier precipitation chart, allowing good screening for Septoria.

Table 4. Top Yielding Bread Wheat Varieties From the Different National Yield Trials 1971-72.

Variety or Cross	Yield Q/H	Location	Highest % of Florence Aurore (all trials)
Strampelli	70.2	Guelma	166.8
Siete Cerros	65.2	"	177.6
Un-SkxS. Past/Mara	60.8	Algiers	125.9
Chenab 70	59.8	"	142.1
Un. SkxS. Past/Cno-Inia	59.6	"	123.4
Mexipak 69	58.5	Guelma	184.8
CC-Inia "S" (143)	57.8	Algiers	136.1
Calidad "S" (Mex 1601)	55.4	"	144.8
Wt_E3-Nar 59/Son 64-TzppxY54	53.4	"	150.9
Cno "S" -Inia "S" 2	53.1	"	171.0
Inia "S" - Napo 63 (136)	52.7	"	124.1
B21 x KE 3.2 (French)	52.5	"	130.6
Florence Aurore	52.5	Guelma	100.0
Inia 66	50.3	Algiers	133.2
Tobari 66	44.3	"	142.6

Table 5. Averages of the highest yielding lines and varieties from the 7th International Spring Wheat Yield Nursery for Algiers, El-Kroub and Sisi-Bel-Abbes 1971-72, Algeria.

		Yield (Q/H)
1.	Chhoti Lerma	50.4
2.	Toguifen	49.5
3.	Victor I	48.4
4.	Penjamo 62	48.3
5.	Chenab 70	48.2
6.	UP 301	48.1
7.	Tanovi 71	48.1
8.	Son 64 - Kl Ren	47.9
9.	Pitic 62	47.4
10.	Calidad	46.7

They are not, however, large wheat growing regions. The late development of Septoria rapidly killed all leaf tissue and heavily attacked the stem and leaf sheaths of the susceptible varieties as it moved up from the plant base. Selection was, therefore, based on degree of early (April 15) and late (June 10) attack as shown in the table, appearance of the grain and color of the straw. The Septoria resistant lines had beautiful bright golden straw in contrast to the dull gray colored of the susceptible varieties. The check variety, Super X was dull grey and its grain was badly shriveled. Several lines, as indicated by stars in Table 6, although having small pustules on the upper leaves, maintained good leaf tissue with no further spreading of the Septoria.

Durum Wheats

Rapid improvement is needed in the durum wheat varieties specifically for Algeria, but generally for North Africa. The local varieties, although well adapted are very tall, susceptible to the three rusts and lack yield potential with higher rates of fertilizer. The importance of durum wheat in

Algeria can be seen by comparing the total area with that of bread wheat. Of the roughly 2,250,000 hectares of wheat, there are 1.5 million hectares of durum and 0.75 million hectares of bread wheat.

The major problem with durum wheat introductions is lack of disease resistance. The diseases in order of importance are stem rust, Septoria tritici, leaf rust and stripe rust. The three rusts can develop in any of the cereal areas throughout the country, however, Septoria tritici is restricted to the coastal plain and to areas of higher total rainfall. Varietal recommendations are based on total annual rainfall.

The best yielding varieties and lines from the 3rd International Durum Yield Nursery (IDYN) are given in Table 7. The average yield is based on three locations, Algiers in the Center, Sétif on the eastern high plateau and Guelma on the eastern plain. The Crane Sibs (both A and B) have good yielding ability but are susceptible to rusts and Septoria. The Argentina variety, Parana 66/270, shows good promise with high yield and general resistance for all of the diseases. It is a short-strawed variety with good tillering ability. Another promissing line, T. dic. vernum x G11 "S" gives high yield and good stem rust resistance. Its use commercially remains questionable due to susceptibility for leaf rust and Septoria tritici. The Mexican variety, Cocorit 71, yields well, has good adaptation and some tolerance to Septoria tritici. It has better stem rust resistance than Jori 69 and could be grown commercially for the present time. The Tunisian variety, Inrat 69, has good yielding ability and Septoria resistance. It is gradually losing its resistance to both stem and leaf rust. This variety, however, shows definite resistance to Fusarium culmorum. Jori 69 yields very well in the absence of heavy disease attacks. This variety is, however, susceptible to the 3 rusts, Septoria tritici and Fusarium culmorum. The variety is being grown commercially this year but will have to be replaced as soon as other varieties can be multiplied.

Promising selections and varieties from other yield trials were:

a) T. polonicum x Z-B dwarf, a local selection adapted to the Sétif high plateau region. Due to the wide cross, it has been impossible to fix this line.

b) Anhinga "S", selection from a previous IDYN which has no pedigree, and

c) Mandon, a French variety showing promise in the coastal plain.

Table 6. Best Septoria Resistant Bread Wheat Lines and Varieties from Screening Nurseries and Yield Trials - Algiers 1971-72.

Variety or Cross	ORIGIN	Septoria Observation Early	Late
My54-Nor10/Y50XKLine)xT/Chin166xL-N/M^2-ME)Fr A-3538-12P-5P-5P-1D	PON 30	3	6
H480xAn64A II-MJ-191-1P-1P-1D	" 38	3-5	3-5
Ofn(Com-N/MtxMen) (Kt/Bg-Fn/G4	" 44	4	8 *
Pato (B) 21974-4R-4M-2R-0Y	" 115	1	7
On-Bb/Cno-7CerrosxTob-B Man 34310-6m-1y-Om	" 183	3	7
CC - Tob^2 24027-13t-1m-1y-0m	" 192	3	7
Jar-Napo63/LR64xTzPP-AnE 21823-10y-2m-4y-1m	" 193	4	8
(BYE^2-TC)(YacE-TC^2) x (BYE^2-TC)(Z-BxB) D-31539-3L	" 207	6	7
Super X	" 175	8	9
TobxKlPet-Raf II-23438-5M-1Y-3M-1Y-0M-0Mb	POT 7142	6	7 *
Mex 1601 = Utique (BT 2349)	" 7191	6	6
Napo 63xTzPP-Son64/8156(R) 28071-7m3y-3m-0Y-0Mb	" 7310	4	5
Kt/bg-Fn/ uxB2a VI-1S-22t-1t-1b-1t-1b-0Mb	" 7345	4	5
Fn-K58/Nx(Er-KAD/Gb)^2 II-14239-5t-1b-1t-2b-0Mb	" 7346	6	6
Mexicano 1481	" 7520	4	5
Inia-Cno x Cal. 27220-44M-OY-48M-OY-(1-3Y)	IBWSN 28	3	7
Cno"S"-Gallo 27829-19Y-2M-1Y-OM	" 114	4	6
Tob 66 - CC x Pato 27369-1R-4M-0Y	" 147	2	4
N066-Cno"S"xJar66 27343-2R-3M-3T	" 151	1	3
Era	" 211	4	5
Pj62-Cal 30403-19M-2Y-1M-0Y	" 287	2	4 *
(TzPP-Wt$_E$^{2}x Napo 63)(Inia"S"/S64xTzPP-Y54) 29791-11R-4M-1Y-1M-0Y	" 328	2	5 *
Nar59-101Y/PJ62-GbxTzPP-Knott ## 2)Cal 30409-44R-1M-3Y-1M-0Y	" 330	3	6

* Very samll resistant type pustule not spreading on leaf - Tolerance.

Table 7. Averages of the best yielding varieties and lines from the 3rd International Durum Yield Nurseries for Algiers, Sétif and Guelma, Algeria 1971-72.

Variety	Yield Q/H	SETIF P.glum	ALGIERS P. tec	GUELMA P. gr. tr.	Septoria 15 April	Septoria 10 June	Fusarium culmorum
Crane "S" B	49.3	80S	80S		7	9	S
T. dic.ver. x G 11 "S"	48.1	R	100S		6	8	S
Parana 66/270	47.6	R	R		4	4	MS
Cocorit 71	47.4	20MR	80S	40S	7	7	S
Cisne "S"	45.2	60S	60MS-S	10MR	4	8	S
Jo "S" - Cr "S"	44.2	40S	60MS		5	9	S
Crane "S" A	43.7	80S	80S		8	9	S
Capeiti	43.6	80S	80S		3	8	R?
Inrat 69	43.1	20S	80MS		4	7	R
Quilafen	41.8	80S	100S		5	7	R?
Jori C 69 (check durum)	35.9	60S	80S	Tr	6	9	S
Cajenne 71 (check bread)	50.3	R	R		4	8	-

Table 8. Best leaf rust and Septoria resistant durum wheat lines and varieties from 3rd IDSN Alger 1971-72.

Variety or Cross	ORIGIN	P. Recondita Leaf Rust	Septoria Observation Early	Septoria Observation Late
Flamingo "S"	IDSN 011	20MR-MS	4	8
Flamingo "S"	" 088	40MS 1/	5	7
Jo"S"(LD-357$_E$-Tc^2/G11"S") D-27588-5M-3Y-1M-500Y	" 012	20MR	4-5?	8
D-21563-AA"S" D-27625-5M-2Y-2M-1Y-0M	" 045	10MR	5	7
D-21563-Jo"S" D-31538-14M-3Y-0M	" 068	TrR 1/	4	7
D-21563-Jo"S" D-31538-14M-6Y-0M	" 069	10MR 1/	5	7-8
(LD-357$_E$-Tc^2) Jo"S" D-27534-3M-2Y-1M	" 0137	20MR 1/	5	9
Jo"S"(LD-357$_E$-Tc^2/G11"S") D-27572-20M-3Y-1M	" 0141	10MR 1/	4	7-8
Jo"S"(LD-357$_E$-Tc^2/G11"S") D-27572-20M-3Y-3M	" 0142	20MR 1/	6	8
Jo"S"(LD-357$_E$-Tc^{2}xG11"S") D-27588-5M-3Y-3M	" 0146	20MR	4	8
D-Buck(By$_E$2-Tc)(LD-357$_E$-Tc^2/G11"S") D-27649-0M-38Y-1M	" 0159	20R 1/	7	8
Plc "S" - Jo "S" D-31679-4M-1Y-1M-0Y	" 0188	TrR 1/	4	6-7
Plc "S" - Jo "S" D-31679-9M-1Y-2M-0Y	" 0189	TrR 1/	6	8
Stw63-G11"S"xRD-119-1W-2Y D-31759-1M-2Y-1M-0Y	" 0219	20MR-MS 1/	4	7-8
Cr"S"-Gs"S" D-28980-28Y-13M-5Y-1M-0Y	" 0223	20MR	5	7-8
Masa-177Y-1M-0Y	" 0230	40MS	6	7-8
-Jo"S"/LD-357$_E$-Tc^2-G11"S" D-27588-5M-3Y-3M-1Y-1M-0Y	" 0243	TrR	3	6-7
D-21563-AA"S" D-27625-5M-2Y-2M-1Y-1M-0Y	" 0252	20R	5	6
Gs"S" - Cr "S" D-27676-6M-1Y-1M-2Y-1M-0Y	" 0254	10R 1/	7	9

1/ Also reported to all 3 rusts in Delhi, India.

The best leaf rust and Septoria resistant lines listed in Table 8 were selected from the 3rd IDSN at the central Algiers station. Heavy attacks of both diseases killed the susceptible varieties and caused extensive shriveling of the grain. There was no sufficient stem rust to screen these lines but it is hoped that some will have enough resistance for replacing the present commercial varieties.