Wheat Research and Production Programs
North Africa - Tunisia and Algeria

(Ford Foundation Grant No. 680-0848, 680-0848A)
(USAID Contract afr/573)

Report of Activities During the Period:

September 1969 - September 1971

Submitted by:

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

CIMMYT acknowledges with gratitude the financial assistance of the Ford Foundation (Tunisia and Algeria) and the United States Agency for International Development (USAID in Tunisia). CIMMYT sincerely thanks the Ford Foundation Representative, Mr. Guillaume de Spoelberch, the USAID Regional Director Mr. Gaylord Walker, and their staffs, for continued invaluable support of the CIMMYT staff assigned to North Africa.

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January 15, 1973.

Wheat Research and Production Program
North Africa

I. Introduction

During the period August-September 1968, the International Maize and Wheat Improvement Center signed contracts with:

A. The Ford Foundation for a wheat research and production program in North Africa, and a maize improvement project in the United Arab Republic. The original grant (680/0848) was of $293,000, of which $218,500 was allocated over 2 years for assisting the Tunisian Government accelerate wheat research and production.

B. The United States Agency for International Development (USAID), also for a Regional Cereals Agreement initially to involve assistance to the Government of Tunisia and Morocco to initiate Accelerated Cereals Production Projects. The original grant (Contract No.AID/afr-573) was of $423,000 for a period of 3 years for the programs in Tunisia and Morocco.

II. Objectives

The objectives of the programs are:

A. to develop high yielding, disease resistant varieties of both bread and durum wheats adapted to ecological conditions prevailing in North Africa;

B. to elaborate and disseminate an appropriate package of cultural practices through field research and demonstration carried out in cooperation with farmers;

C. to train nationals in the breeding and production of wheat; and

D. to help organize and implement effective, well coordinated national wheat research and production programs.

These programs have special significance to the countries concerned, and to CIMMYT, because they represented the first attempt to adapt the Mexican varieties and experience to non-irrigated lands with low

. . .

natural rainfall (300-700 mm).

III. Individual Country Programs (September 1969-September 1971)

A. Tunisia

Introduction: During the first year (September 1968-September 1969) the program had been initiated. The Tunisian Ministry of Agriculture set up a self-contained wheat development center.

The staff assigned to the accelerated Cereals Production Project consisted of 14 Tunisian Technicians with Mr. Slaheddine Ben Said as Coordinator and Ing. Naceur Bakhtri as Technical Director.

USAID provided Dr. Samuel C. Litzenberger as the expatriate Director, and three regional production supervisors. These 4 men were all direct-hire USAID staff.

CIMMYT provided Dr. Willis L. McCuistion as wheat breeder, Mr. Walter L. Nelson as a production agronomist, and Mr. Kenneth Wilhelmi as a soil fertility and fertilizer expert. These three scientists were supported by Ford Foundation funds.

These staff were grouped into five sections; genetic improvement, production and management research, fertility, extension, and irrigation.

The training program was also initiated according to a staffing pattern developed within the project. USAID was to fund the "In-Service" trainees at CIMMYT and other training centers, and also the degree training program. The Ford Foundation was to finance the technical visits of government politicians, directors of research and production, etc. to CIMMYT and other centers to familiarize them with the concepts involved in accelerating national cereal production.

During this first year 4 in-service trainees spent 6 months at CIMMYT; 3 trainees went to three United States Universities for 6 months specialized training; graduate training in the U.S. was started for 2 Tunisians; and 8 government officials spent a few days in Mexico.

Mexican wheat was grown on 12,000 hectares and produced considerably better yields than local varieties despite unfavourable weather conditions and the unsettling effects of the Government's attempt to widen the cooperative system to include the whole agricultural sector.

This initial year launched the program to a satisfactory beginning. This report deals in more detail with the subsequent 2 years through September 1971.

1. Wheat Research

a) Crop Improvement; 1969-70

i) Bread Wheats.

The varietal improvement section of the Wheat Project (ACPP) was established with INRAT (National Institute of Agricultural Research for Tunisia) and is still operated as part of this organization.

The major emphasis in the first year of the project, when the program consisted largely of variety testing, was to identify varieties of immediate value to the various regions of Tunisia while a long term breeding program was reactivated. Results showed that the Mexican varieties INIA and TOBARI to be the best suited for commercial production from the standpoint of yield and general adaptability. Siete Cerros yielded well in certain northern regions, but in general it had to be restricted to the drier irrigated regions of the South because of its high susceptibility to Septoria.

During 1969-70, throughout the higher rainfall zones, Penjamo and Tobari were distributed for cultivation to provide added protection against the threat of Septoria. However, INIA continued to produce the highest average yields even though it showed susceptibility to mildew, Septoria and leaf rust. INIA was adopted as the new control variety against which further improvement would be measured. In general INIA yields 20-40% more than Florence Aurore, the most widely grown bread wheat before the advent of the Mexican dwarf varieties.

Further genetic material was introduced during the year from India, Lebanon, Mexico, Netherlands, Pakistan, Portugal and the USA. Approxiamtely 5000 lines, mainly segregating material from the Indian, Pakistan and Mexican Programs were tested for disease resistance and general adaptation. The best of these lines in micro yield tests produced yields up to 135% above INIA as 100%. These results indicated that considerable potential increased yield could be exploited by a National Breeding Program.

ii) Durum Wheats.

The need to develop high yielding, short strawed, disease resistant durum wheats was recognized from the beginning of the project. The bread wheats were so superior in yield under good management conditions when compared to the durum wheats,

that there was a real possibility that much of the country would be converted to bread wheats.

The local program was testing a Tunisian cross D5825 with good yielding ability. This cross was multiplied ready for release the following year.

A wide range of segregating F_3 populations from Mexico were tested but most proved to be highly susceptible to stem rust. A few individual resistant plants were selected for further test.

iii) Diseases and pests as they relate to breeding.

Tunisia has a wide array of diseases that pose a potential threat to wheat production. The diseases in decreasing order of importance include stem rust, Septoria, leaf rust, stripe rust, mildew, Fusarium, loose smut and take-all.

Although it has been believed that stem rust is not a serious problem in wheat production in Tunisia, several thousand hectares of local durums were completely killed during the season. Had this epidemic, which occurred late in the season, occurred a week or two earlier, it could have been disastrous.

With thicker, more luxuriant stands expected in the future from improved fertilizer and cultural practices, it is almost certain that the hazards from rusts and other diseases will increase.

Septoria develops well in the Beja region where a large number of F_2 populations were grown during the season. Because of the ideal conditions for the development of Septoria, this region has been used since for identifying tolerant lines in the breeding program.

Severe artificial epidemics of the three rusts were developed in the field to aid selection of resistant lines.

The insect pests which are troublesome in Tunisia in decreasing order of importance are, Hessian fly, sawfly, cereal leaf beetle, wireworm, stem maggot, and ants. During the season Hessian fly and cereal leaf beetles were general throughout the wheat regions and there were light infestations of sawfly and stem maggots in all fields.

Birds are a serious pest throughout the wheat regions, particularly heavy damage being observed on all early maturing plots and crops.

b) Crop Improvement; 1970-71.

i) Bread Wheats.

This, the third year of the Tunisian ACPP, saw a considerable increase in the size and complexity of the wheat improvement program carried out in collaboration with INRAT.

During the season 1,015 varieties were sown in the crossing block for observation and hybridization. Also, 210 F_1's, 3371 F_2 populations, 5,465 F_3 lines, 1,702 F_4 lines and 228 F_5-F_9 lines were sown for selection. In addition 11,185 varieties and advanced lines were tested in observation plots and 153 yield tests and 93 preliminary multiplication plots were grown.

Seed introductions were received from 18 countries and Tunisian materials were sent to 14 countries.

Resistance, or at least higher tolerance to Septoria continued to be a major thrust of the program. Adequate resistance to the rusts was fairly readily available in the material received from Mexico and elsewhere. As a result of selection for Septoria tolerance three lines were identified, and multiplication commenced. These were named:

1. Zaafrane = BT 2292 = Sonora 64-Klein Rendidor 19975-68Y-1J-1Y-1J-5Y-1T.

2. Soltane = BT 2296 = Sonora 64 - Klein Rendidor 19975-68Y-1J-6Y-1J-3Y.

3. Utique = BT 2348 = Calidad "S" 22429-16M-1Y-4M-0Y (Mex 1603).

Zaafrane and Soltane had consistently yielded higher than INIA 66 during the previous four years in microtrials and during two years of farmer demonstrations at widely scattered locations. They show good tolerance under heavy attacks of Septoria and have produced well where powdery mildew was also heavy. They possess good resistance to the three rusts.

Utique also has good tolerance to Septoria. Under Septoria-free conditions yields are equal to INIA 66. Under conditions of heavy infection, Utique gives yields one ton per hectare greater than INIA 66. Utique has resistance to stem rust, moderate resistance to leaf rust, but is susceptible to stripe rust.

These three varieties represent the first major advances from the improvement program. The fact that they came after only three years provides a dramatic demonstration of the advantages of being part of an international breeding program. If this work had been completely carried out within one national program (even of a highly developed country) it would have taken 10-15 years to reach this stage.

ii) Durum Wheats.

Durum research continued during the year with the naming of a new variety - INRAT 69 - which had been under development and test in Tunisia for a number of years. This variety was formerly known as D5825. It is reasonably tall and is moderately susceptible to the rusts. It is quite tolerant to Septoria and has yielded well in widescale tests. It is much superior to the old durum wheats it will replace. However, it falls far short of the potential yield that could be achieved by shorter, earlier and more disease resistant durums that should be bred in the next few years. During the season 230 hectares of INRAT 69 were grown for seed production.

The Mexican durum variety Jori 69 and lines of the new Mexican durum Cocorit were tested. Although their yields were high, they are very susceptible to Septoria. For this reason they cannot be grown in high rainfall areas where they would otherwise have greatest potential.

iii) Barley and Triticale.

Tests of a wide range of barley and Triticale lines were tested to select lines and varieties of value to the agriculture of the region. More emphasis has gradually been put on these two crops.

iv) Diseases and Pests.

Septoria tritici was a problem during the season, building up to epidemic proportion in the Mateur area. However, losses were low because Tobari and Penjamo, which are tolerant to the disease, were grown in the area.

Although rusts were present, they posed no problem. For the first time infestations of the oat cyst nematode (Heterodera avenae) was noted in scattered fields.

Hessian fly was only present in small numbers, and although the North African sawfly was common, it did little damage. The new durum variety INRAT 69 appeared to be a little more susceptible to insect pests than other improved durums.

v) Summary of progress.

The initiation of a national bread wheat breeding program within INRAT was progressing very well. CIMMYT has provided the leadership of this program but a group of competent young Tunisians was also building as the training program progressed (see section g page 12). The naming of the varieties Zaafrane, Soltane and Utique was a major step forward. Individual selections within the breeding program indicated considerable potential improvement would be made in yield, disease and pest resistance in the next few years.

The long recognized need for a more dynamic and progressive program of durum breeding had not eventuated. This program, under direct INRAT leadership had made some progress with the release of INRAT 69, but lacked any imaginative on going program likely to markedly increase the production potential of durum wheats in the near future. It was agreed that a way must be found to accelerate this sector of the breeding program.

c) Production and Management Research; 1969-70

i) Fertilizer studies.

See Annex 1 "Summary of Soil Fertility Studies on Wheat in Tunisia" October 1968-August 1972, by Dr. Kenneth Wilhelmi, which sets out a summary of the fertilizer research for the period 1968-72.

This program has been very effective in establishing the levels of fertilizers to be used in different areas, and under different soils and moisture conditions. The research has been practically oriented to provide relevant training and to also serve as farmer demonstration. The increased yields, and amount of fertilizer used on the wheat crop are testimony to the success of this program.

ii) Moisture management.

During the year yields of 4,800 Kg/Ha were obtained in demonstrations at Pont Du Fahs with only 64 mm of rain between January to April, compared to 400-500 Kg/Ha the previous year

with 165 mm of rain for the same period at the same site. The Tunis, Mornag and Crombalia areas had similar results with yields up to 4500 Kg/Ha with 100 to 127 mm of rainfall for the January to April period.

iii) Weed Control.

Most of the weeds, which are a serious production problem, are unpalatable and provide little forage. These weeds which grow during the winter months, either use up moisture that should be stored during the fallow period or compete with the crop for both moisture and nutrients.

Plowing in December or early January and successive shallow cultivations to kill germinating weeds is recommended to preserve the deep subsoil moisture (below 25 cm) for the wheat crop. This cultural practice also reduces weed germination at seeding time resulting in less competition to the wheat early in the season.

Wild oats are a major problem, with over half the potentially highly productive wheat area heavily infested with this weed. Yields are reduced in direct proportion to the percentage of infestation. Until wild oats are effectively controlled only a portion of the yield potential of the high yielding varieties will be realized.

During the past season less than 25% of the areas sown to improved varieties were sprayed to control other types of weeds, particularly flat-leafed species. This resulted in additional monetary loss because the applied fertilizer was relatively ineffective in raising wheat yields because of weed competition.

Although valuable results were obtained and useful farmer demonstrations made with weed control, much more research and extension needs to be carried out to combat this major limiting factor to increased production.

iv) Cultural practice studies.

Studies of date and rate of seeding, and their effect on different varieties was continued during the past season. The tests indicated that varieties with the maturity of INIA 66 can be seeded too early. Later maturing varieties like Siete Cerros and Ariana 66 yield better when seeded early.

These trials illustrated the advantage of having a group of varieties with a range of maturity dates for North African production.

With a variable season, from year to year, this would allow maximum production from the particular early or late season experienced.

In the tests INIA 66 was the best overall variety, when all dates of seeding and rainfall areas were considered. Siete Cerros, Tobari 66 and Penjamo 62 all have particular environmental situations where they fit well.

This second season of the project highlighted some areas of research which need to be strengthened.

As most of the production and management research was carried out in farming districts it was used as farmer demonstrations. They generated à great deal of interest during the growing season, and particularly at organized field days.

v) Two staff changes were made in this program at the end of the season. Mr. Walter L. Nelson, agronomist, completed his contract and returned to the U.S.A. He was replaced by Dr. Torrey Lyons. Mr. Paul Marko, CIMMYT, who had been funded by USAID as a regional production supervisor in the Beja regio' transferred to CIMMYT staff financed by Ford Foundation. He continued his role as production supervisor.

d) Production and Management Research; 1970-71

i) Fertilizer Studies.

See Annex 1.

ii) Weed Control.

An estimate made during the previous season was that weed competition reduced wheat yields by an average of 3 quintals per hectare on 700,000 hectares. This represents a total loss of over 2 million quintals per year in Tunisia. For this reason a weed control program was initiated.

Control of wild oats is most economical if carried out by cultural practice, however, several chemical control methods were tested. Amongst the chemicals tried were Dicuron, WL-17731, Avidex and Carbine. Some promising results were obtained, particularly with Dicuron and more trials will be needed to be sure of recommendations to farmers.

There was shown to be a need for early broadleaf weed control without risking damage of the wheat. 2,4-D is still considered

the best chemical for this purpose because the cost is low and the general proceedures are well known. However, because some varieties are susceptible to 2,4-D at particular stages of growth, more research will be needed to study this aspect with the new varieties of both bread and durum wheat being developed in the breeding program.

Nine promising herbicides not commonly used in Tunisia were tested. More trials will be necessary, but Ingran was promising because a broad spectrum of weeds was controlled. Also Buctri and Bronate were promising for control of broad leafed species of weeds with no apparent phytotoxicity problems.

iii) Cultural practice studies.

Trials with rate and date of seeding of INIA 66 at different nitrogen levels were continued as well as trials with INIA 66, Saltane, Florence Aurore, Siete Cerros and INRAT 69 at three dates of seeding. At Mateur under severe Septoria attack there were differences in yields with date of planting - the middle date of planting being superior in yield to either the early or late dates of planting.

These trials again highlighted the urgent need for more Septoria resistant varieties for Tunisia.

Because of the generally poor internal drainage of Tunisian soils, saturated soils may occur over most of the wheat area in growing seasons of high rainfall, such as 1970-71. Therefore, practices to minimize losses from saturated soils need to be developed. Possible approaches are soil corrugations to provide ridges of aerated soil with seed and fertilizer placement in these ridges, resistant varieties such as Pato, or change of variety maturity and/or seeding date to minimize or avoid the problem.

Production and fertilizer research on irrigated land was never vigorously pursued as the irrigated section of the arable land is less than 2%. This small program operated by USAID was disbanded in 1971 with the departure of the USAID expert.

iv) Rotation Studies.

During 1970, the Government of Tunisia, Ford Foundation and CIMMYT discussed the possibility of introducing wheat into a rotation with an annaul forage legume in a similar manner to that used in southern Australia. To obtain expert advise on the feasability of this proposal, Mr. John B. Doolette, Head of the Agronomy Division of the South Australian Department of

Agriculture was brought to North Africa in November 1970 and again in April 1971 as a Special Consultant.

Mr. Doolette's report "Examination of North African and Middle East Wheat Improvement Programmes" was distributed in February 1971.

Mr. Doolette was favourably impressed with the potential for transferring this technology from Southern Australia to appropriate regions of North Africa. He recommended that if the rotation studies are undertaken, they should be directed towards the wheat production goal and be conducted directly within the wheat project. The animal or forage benefits should be regarded as secondary in the beginning.

e) Tunisian Commercial Production 1969-70.

During the 1969-70 season, approximately 53,500 hectares of Mexican wheat were sown. They produced an average yield of about 2 tons per hectare.

The local varieties were grown on a total of 930,000 hectares, with bread wheat accounting for 180,000 ha of this area. Total production was about 500,000 tons, and bread wheat 200,000 tons of this total. This provides an average yield of 0.54 tons/ha for all wheat, and 1.11 tons/ha for local bread wheats.

5.8 per cent of the total Tunisian wheat area was planted to Mexican wheats, and they produced 20 per cent of the total harvest. For bread wheat area only, Mexican wheats accounted for 29.7 per cent of the area and 50 per cent of the production.

These figures highlight the promising results achieved even in the second year of the official project and in spite of late seeding due to the disbanding of the cooperatives; incomplete application of the package of recommended agronomic practices; and, an abnormal pattern of rainfall.

f) Tunisian Commercial Production 1970-1971

The original target set for commercial production of Mexican wheat for this season at the beginning of the project was 100,000 hectares with an expected yield of 190,000 tons. This estimate was based on the premise that, on average, the Mexican wheats would produce 1.4 tons/ha more than local varieties with proper cultural practices and average rainfall.

The actual area sown was 103,000 hectares which produced 164,800 tons. The respective yields/ha for Mexican and local varieties were 1.6 tons and 0.6-0.7 tons.

Although the official statistics shown 103,000 hectares of Mexican wheat sown they do not take into account approximately another 40,000 hectares sown with old seed with poor germination (5-10%). About 20,000 quintals of seed was distributed to farmers that had been stored too long. This episode further highlighted the weakness of the Tunisian seed industry. It also provided a retarding influence to the program, as many of the farmers provided with the poor seed said that "Mexican wheat is no good, it won't even germinate! "

g) Training

i) The following Tunisians attended the CIMMYT wheat in-service training course in Mexico during 1969-1970.

Four Adjoint Techniques from the Extension program of ACPP completed 8 months of Production Training (February-October 1970). They were sponsored through the USAID/CIMMYT contract. The trainees were:

Mr. Tounekti Slimane
Mr. Serghine Ahmed
Mr. Chtourou Ftouh
Mr. Bousselmi Lassaad

Another Adjoint Technique, from the breeding program in INRAT, also completed 8 months (February-October 1970) wheat breeding training.

ii) During 1970-1971 only two in-service trainees from Tunisia were trained. Both completed 5 months (February-July) of production training in Mexico.

Mr. Mohamed Hachemi Dakhaloui is an adjoint technique working in fertilizer experiments in the ACPP, and

Mr. Barek Chihab a technical assistant from the extension program ACPP.

Both trainees were funded through the USAID/CIMMYT North Africa Contract.

Mr. Mohamed Salah Mekni who completed a M.S. degree at North Dakota State University, with direct financing from USAID, spent 4 weeks during April and May 1971 becoming familiar with the wheat and maize programs at CIMMYT in Mexico.

All of these in-service trainees from Tunisia trained at CIMMYT, have been at the Adjoint Technique level of training. Although

several of them have shown good leadership qualities, the government system of promotion in Tunisia would preclude them from taking major responsibilities within the ACPP without an Engineer's degree. They have helped to build a strong structure at the technical assistant level. With outstanding young men such as Mekni and Daaloul coming back to the program from post graduate training, the program will be well staffed.

h) Travel and Study Awards.

There were a number of travel and study awards made to Tunisians during 1970-71:

i) Mr. Mohamed Salah Mekni on completion of his M.S. degree at North Dakota State University, where he had been studying Plant Breeding and Genetics, was provided with a study grant by USAID to visit CIMMYT, Mexico for one month (April-May 1971) before returning to Tunisia. Mr. Mekni became acquainted with CIMMYT's wheat and maize programs, including work in the milling and baking laboratory.

ii) Because the Accelerated Cereals Production Program had reached a critical stage in its development, and there were signs that a major thrust was needed at the farmer, and farmer organization level, it was decided to provide the Director of the ACPP, a number of key ACPP staff and several farmer organization leaders with travel awards to visit Mexico and the USA to see how an accelerated wheat program was organized and operated. The trip was organized to commence in Mexico on February 28, 1971, and to be of 2 weeks duration.

USAID, Tunisia provided travel awards to:

Mr. Mohamed Naceur Bakhtri, Director of Accelerated Cereals Project, Tunis.

Mr. Ali Kilani Dahmane, Engineer, Fertilization Section, Cereals Project, Tunis.

Mr. Ahmed Sellami, Chief of Section, Cereals Project, Tunis.

Mr. Laroussi Mohamed Sandassi, Engineer, Fertilization Section, Cereals Project, Ministry of Agriculture, Tunis.

Mr. Abdelhamid Touati, Chief of Section, Cereals Project, Tunis.

Mr. Brahim Ben Hassine, Regional Director, Office des Terres Domaniales.

Mr. Mohamed Salah Ben Hamouda, President of "Cooperative de Grandes Cultures" Tunis.

Mr. Lassaad Ben Becher, President, Cooperative Centrale de Semences, Tunis.

The Ford Foundation/CIMMYT grant provided travel awards to:

Mr. Sadok Hassine Djellouli, Principal Engineer State Domaines.

Mr. Mohamed Lassaad Mouaffak, Assistant Director, Extension Service, Tunis.

Mr. Mongi Mohamed Zitouna, Regional Agriculture Commissioner, Tunisia.

Mr. Noureddine Kadra, Head of Cereals Project, Algiers, Algeria.

Mr. Kadra was included in the group because of the request by the Algerian Government for Ford Foundation and CIMMYT assistance to accelerate wheat production in Algeria.

iii) To familiarize some of the Senior Government officials with the philosophy and infrastructure necessary to accelerate wheat production 5 officials were invited to visit Mexico and the United States of America.

Unfortunately two new Secretaries of State were unable to undertake the trip, but the following 3 officials were provided a travel award from the FF/CIMMYT grant. They travelled during the period April 19, 1971, to May 5, 1971:

Mr. Hassine Zayati, Director of the Agricultural Research, Education and Training Division of the Ministry of Agriculture, Tunis.

Mr. Chedli Boulaaba, President and Director of the National Cereals Board.

Mr. Aberahman Ben Messaoud, Commisaire General of the Government Owned Lands Board, and Director of the Farm Management Control Office sponsored by the World Bank.

iv) Following the recommendations made by Mr. John Doolette during his advisory assignments to North Africa, the Ford Foundation and CIMMYT agreed to provide an additional staff member to the CIMMYT team in late 1971. This man would carry out research and initiate a winter annual forage legume rotation program in the ACPP.

Mr. John B. Doolette agreed to accept this position. It was decided that before he left Australia a group of Tunisian scientists should spend from August 17, 1971 to September 5, 1971, studying the system as developed in Southern Australia. The group was led by Mr. Bakhtri, Project Leader and accompanied by Mr. Paul Marko of CIMMYT, Tunisia.

Travel awards were provided from the FF/CIMMYT grant to:

Mr. Mohamed Naceur Bakhtri, Director of ACPP

Mr. Mohamed Skouri, Chief of the Research Division of the National Institute of Agronomic Research (INRAT).

Mr. Abderrahmane Sifaouri, Chief of the Agronomic Laboratory, INRAT.

Mr. Hedi Guerbaa, Chief of the Agricultural Extension Service, Ministry of Agriculture.

Mr. Mohamed Kilani Dahmane, Agronomic Engineer, Head of new Rotation Section of ACPP.

Mr. Paul Marko, CIMMYT Extension Agronomist.

Considerable benefit accrued from all of these study and travel awards. Government policy makers, scientists, farm leaders and project staff were able to form a much clearer picture of their goals and the steps necessary to achieve them.

The visit to Australia was of particular value because it provided an opportunity for relevant Tunisians to see a completely new technology in operation. Further, it provided an excellent opportunity for the Tunisians who would be working with Mr. Doolette, to see him as an expert in his home environment and technology.

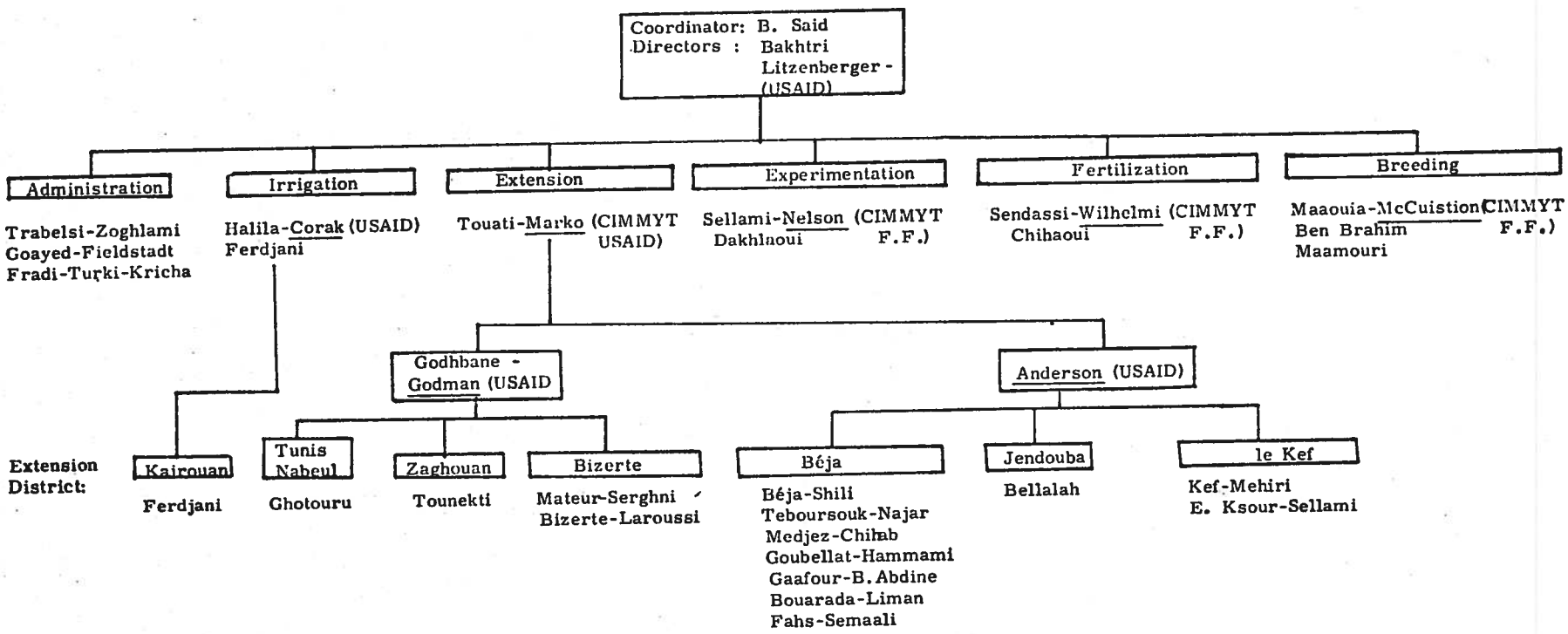
j) Organization and Implementation of Coordinated Production Program

i) Progress 1969-70.

The vertically integrated wheat project within the Ministry of Agriculture had a structure as shown in Figure 1, by the early part of 1970.

The Coordinator was responsible directly to the Minister of Agriculture. There was also a coordinating committee made up of directors of the Sections involved in cereal production. Five

FIGURE 1. Accelerated Cereals Production Program (ACPP).



technical sections were in existence, CIMMYT staff provided joint leadership with Tunisian Scientists for four of these sections; breeding, experimentation, fertilization, and extension. A USAID man provided joint leadership for the irrigation section.

The main advantage of this type of organization consists of the provision of an organizational structure geared to cooperation, under one leadership, of at least all the technical sections necessary to provide information and extend it ti the farmer. Lack of cooperation between different sections of government is one of the main reasons for stagnant production in agriculture.

The project was theoretically freed of much of the bureaucratic control that plagued the Ministry of Agriculture, and it was to have more financial flexibility because of its independent budget.

Although the project had got underway to a reasonable start. Some of the problem areas were beginning to appear.

There was an acute shortage of technical personnel of sufficient quality and training. It was not until January 1970 that the Government appointed the last of the Tunisian counterparts to complete even the most basic staff. Training of these key staff alongside their foreign counterparts was obviously going to take some time; both because of the generally poor basic training of the Tunisians, and because of language problems experienced by the foreign experts.

One of the prime objectives of the project was not only to assist Tunisia to self sufficiency in wheat production, but to also assist the Government ot achieve self-sufficiency in trained manpower, and to help set up a National Cereals program that would be able to cope with future problems of research and production. This organization would need to recognize and have adequate links with other essential components of national cereal production such as fertilizer supplies, credit, storage facilities, seed supply, etc.

By the end of 1969-70 season training was well underway. The second group of in-service trainees sent to Mexico were far superior to the first group who had been poorly chosen.

A number of INRAT and agricultural University staff had gone to the U.S. for graduate training.

Training is, of necessity, a long term undertaking, All that could be said at this stage was that a start had been made. The biggest problem was still a real lack of understanding at the field level of what it takes to accelerate cereal production on a national scale.

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An estimate made at the end of 1969-70 season was that if the Project was to expand its activities in the near future, 9 new agricultural Engineers and 21 Adjoint Techniques (technicians who do not hold a University degree) would be needed. It was very doubtful that these numbers could be made available.

The Project was designed to encourage cooperation. The breeding section of the project was able to establish working links with the local agricultural Research Institute (INRAT). This was not true however for the agronomic and fertilizer sections. No cooperative links were established. As this was the National Research Institute it was important to continue to try and influence the thinking of its staff to take an active role in production oriented research. Up to this time this had not been possible except for genetic improvement.

It was only at this time that some of the recommended practices were becoming available for extension to the farmers. There were real problems in this area of the program. Inadequate numbers and training of staff; a poorly defined and administered extension service; lack of confidence on the part of the farmers, coupled with open suspicion of government personnel after the unfortunate experience with cooperativization.

Plans were made to increase the number of extension technicians trained and expand the demonstration program on to private farms.

The Tunisian leadership of the program was in general dynamic and forceful. Mr. Bakhtri was hardworking and had excellent relationship with Mr. Ben Said the Coordinator which was helpful in maintaining good lines of communication with other government agencies.

Dr. Samuel Litzenberger, USAID, was the co-director of the Project. He was recalled to Washington about the middle of 1970 and was replaced by Mr. Gaylord Walker from Morocco as the Food and Agriculture Officer. Mr. Walker did not, however, take over the co-directorship of the Project. Eventually this was filled by Dr. Willis McCuistion, the CIMMYT wheat breeder in the Project.

The Ford Foundation granted CIMMYT a grant extension for one year. During this time a major review would take place to consider the support necessary for satisfactory continuation of the Project.

ii) Progress 1970-71

During the year it became increasingly clear that ACPP was still unable to take full administrative responsibility for the technical

program that was itself progressing satisfactorily. One of the main problems was that local operating funds were not being made available when needed, due to Tunisian treasury regulations. USAID spent approximately $110,000 to keep the day-to-day operations of ACPP functioning during 1970-71. However, USAID have indicated to the Tunisian Government their intention to eliminate or reduce this support in future.

Discussions between ACPP Directors and Tunisian Government officials continued throughout the year to try and resolve the question of budgetary autonomy for ACPP. Two alternatives were considered:

a) incorporate ACPP into the Tunisian Cereals Board, or

b) transform ACPP into a Cereals Institute, because Institutes in Tunisia are entitled to budgetary autonomy.

The Minister of Agriculture has decided to transfer the ACPP to the National Cereals Board where it will be a self contained technical unit. This decision is to come into effect January 1, 1972.

Further changes occurred in the expatriate staffing pattern during 1970-71. Mr. Paul Marko transferred from USAID to Ford Foundation financing within CIMMYT. All other direct-hire USAID project staff were transferred from Tunisia and were not replaced during the year although it was expected that an agronomist would be added to the program. This left the Project completely operated by CIMMYT staff as far as technical assistance was concerned.

The national staff development program continued with in-service and study and travel awards being provided as already indicated. Approximately 96 Tunisian staff were assigned to the program by the end of the 1970-71 period. These consist of 19 agronomic engineers of which 6 joined the program in July 1971, and 29 Adjoint Techniques.

During 1971, a detailed study was made of the total program by Ford Foundation staff, and also CIMMYT Mexico based directors. The latter, Drs. Borlaug and Finlay spent a total of about 6 weeks in the North African region. Discussions were held with Ford Foundation, USAID, CIMMYT, INRAT, ACPP and Government Staff including the Secretary of State for Agriculture and the Minister of Agriculture.

From these discussions a grant request was formulated for "Wheat Research, Training and Production, North Africa".

A copy of this document, the final version of which was prepared by the Ford Foundation office in Tunis, is attached as Annex 2 . This document, together with one entitled "Suggested Orientation of the Research, Production, Training and Extension Programs of the Tunisian Wheat Project" by Dr. Norman E. Borlaug (Annex 3), provide the basis of the recommended program for 1971-72 and 1972-73.

Apart from continuing the present program, it was decided to emphasize, or initiate other aspects of the cereals program. These were:

1. Place greater emphasis on the development of high yielding, disease resistant, fertilizer responsive varieties of durum wheat.

2. Increased Tunisian emphasis on cereal technology and plant pathology.

3. Development and extension of an integrated land use system for wheat production in Northern Tunisian based on incorporation of annual forage legumes into the cropping rotation.

4. Improvement of the extension program.

5. Establish within the ACPP an active, in-service, production oriented training program.

6. Reinforce the seed production and technology services.

7. Undertake economic studies of cereal production, particularly durum production (not to be conducted as part of the CIMMYT grant).

8. Continue the modest barley breeding program.

B. Algerian National Wheat Program 1969-70 to 1970-71

1. Introduction

Algeria, in 1969, with a large wheat deficit of 300,000-500,000 tons, and the example of a Mexican wheat program next door in Tunisia, indicated to Ford Foundation its interest to initiate such a program.

Mr. Golusic an FAO wheat agronomist working with the National Agronomic Research Institute (INRAA) had demonstrated that Mexican wheats produce high yields in Algeria if given proper agronomic inputs.

The Ford Foundation sent the Secretary General of Agriculture to visit CIMMYT in Mexico in August 1969. At the request of the Algerian Government, a team consisting of Dr. Norman E. Borlaug, Dr. Willis McCuistion and Dr. Arthur Klatt of CIMMYT and Dr. Piero Bronzi of Ford Foundation, Tunis, visited Algeria between June 16 and 19, 1970 to study Algerian Wheat production. They were accompanied by Mr. Kadra, Head of the National Wheat Program.

The report submitted by this team is attached as Annex 4.

Mr. Guillaume de Spoelberch, Ford Foundation Deputy Representative for North Africa, in late July 1970 discussed with Mr. N. Boukli, Secretary General of the Ministry of Agriculture and Land Reform, possible limited assistance could consist of:

a) establishing an effective, coordinated regional program and informing the Algerians of results and experience obtained elsewhere (by means of a Seminar);

b) developing a nucleus of trained Algerian technicians and "sensitized" high-ranking officials (through long - and short - term fellowships at CIMMYT or in the United States, as well as brief indoctrination visits to Mexico);

c) providing practical, on-the-job experience for Algerian wheat technicians and field workers (through a series of brief visits) to participate in key agricultural operations being conducted in Tunisia - or possibly Morocco - under the supervision of CIMMYT experts; and

d) supplying needed guidance at critical moments (by means of occasional consultant visits from Tunis or other resource base).

This approach was designed to lay the ground work for future more concrete assistance, but at this time neither the Ford Foundation would assume any responsibility for the ambitious production program planned by the Algerians.

The International Wheat Seminar was held in Algiers from 14-18th September 1970. It was attended by 150 technicians and Government Officials from North African countries. A number of scientists from various international programs participated. The Seminar was really the turning point with respect to Algeria. Many officials who had been unimpressed with the idea of an accelerated wheat program were willing to give their support after the Seminar. There were still pockets of resistance to the idea.

In September 1970, the Minister of Agriculture signed a decree establishing within the Ministry a project aimed at increasing wheat production through the use of high yielding varieties and improved techniques.

During the middle of 1970, the Ministry of Agriculture started negotiations with FAO. In December 1970 an official request for UNDP assistance for a "Cereal Elimination of the Fallow System" Project. The project aimed a self sufficiency in cereals and the introduction of forage crops to eliminate fallow.

Cereals represent 41.5% of Algeria's GNAP, and cover 91.6% of the total area cultivated with annual crops.

The total cereal area is 3,000,000 hectares with another 2,900,000 ha. in fallow. Of this area, 2,100,000 are sown annually to wheat (1,500,000 ha. durum, 700,000 ha. bread wheat).

Total average wheat production amounts to 1,326,000 tons (857,300 tons of durum, 468,900 tons of bread wheat). The average yields in 1969 were 0.57 tons/ha for durum and 0.67 tons/ha for bread wheat.

The total requirement for 1970 was 1,800,000 tons leaving a deficit of 374,000 tons, almost entirely bread wheat.

About 75% of the durum wheat is produced by private farmers, with much of it consumed on the farm as couscous. Bread wheat production is fairly evenly divided between state and private farms.

From 7-12th May, 1971, a team of CIMMYT scientists including Dr. K.W. Finlay, Dr. W. McCuistion, Mr. K. Wilhelmi, Mr. P. Marco accompanied by Mr. G.de Spoelberch and Dr. Piero Bronzi of the Ford Foundation, Mr. J. B. Doolette special CIMMYT Consultant, Mr. H. Floyd, Near East Foundation, and Mr. N. Kadra

of the Ministry of Agriculture, toured the wheat growing areas of Algeria.

In Algiers this group of visitors met with several Government officials including, Mr. Noureddine Boukli, Secretary General of Agriculture and Land Reform; Mr. N. Bouchetata, Director of INRAA; Dr. D. Alloum, Director of Vegetable Production, Ministry of Agriculture and Land Reform; and Mr. H.M. Louhibi, General Director of Algerian Cereals Board (O.A.I.C.).

Mr. Boukli requested assistance from the Ford Foundation and CIMMYT, to strengthen the research component of the Algerian wheat program by assigning CIMMYT staff to work alongside Algerian scientists. He also asked for training fellowships at CIMMYT, Mexico. Mr. Boukli indicated that a request for assistance with the extension program had been forwarded to UNDP through FAO.

Subject to the approval of Dr. N.E. Borlaug, CIMMYT Board of Trustees and the Ford Foundation it was agreed that CIMMYT would assign 3, and possible 4, wheat scientists to assist the Algerian wheat research effort in September 1971 for a period of two years. Fellowships and study awards would also be included.

A subsequent visit by Dr. Borlaug in June confirmed these arrangements which were then finalized and approved by the Ford Foundation and CIMMYT Board of Trustees. See Annex 2.

2. Training

During 1971, at the request of the Algerian Ministry of Agriculture and Land Reform, and with funds provided by the Ford Foundation the following Algerian scientists were provided in-service training at CIMMYT in Mexico:

Mr. Noureddine Bouattoura - Breeding - (January-July)
Mrs. Fatima Bouattoura - Breeding and Chemistry (January-July)
Mr. Belahouel Belhakem - Production - (January-October)
Mr. Mohamed Laddada - Production - (January-October)

To assist the Office of Cereals (O.A.I.C.) to build a team of adequately trained men to handle the wheat seed production program, three trainees were sent to India to the Tarrai Seed Company for a seed production and certification course. These men were:

Mr. Said Ferhat, Chief of the Seed Section of O.A.I.C. (May-June 1971).
Mr. Moncef Chengual, graduate technician, Seed Section O.A.I.C. (May-October).

Mr. Abdelyakine B. Lehocine, graduate technician, Seed Section O.A.I.C. (May - June).

3. Program Initiation

Staff selection, program details and provision for logistic support were worked out during the latter part of 1970-71 period. However, the details will appear in the 1971-72 report which covers the first full year of operations involving CIMMYT staff stationed in Algeria.

ANNEX 1

SUMMARY OF SOIL FERTILITY STUDIES ON WHEAT IN TUNISIA

Tunis, Tunisia

October 10, 1968 - August 31, 1972

END OF TOUR REPORT

Prepared by

KENNETH D. WILHELMI

With the cooperation and assistance of:

Sendassi, L.	Engineer and Chief of Section
Elloumi, T.	Engineer
Belkhiria, M.	Engineer
Dahmane, A.	Engineer

For

THE INTERNATIONAL MAIZE AND WHEAT IMPROVEMENT CENTER

Prepared in cooperation with the Government of Tunisia

and CIMMYT, Tunis, Tunisia

August 1972

SOIL FERTILITY STUDIES ON WHEAT IN TUNISIA

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- A. Climate
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SOIL FERTILITY STUDIES ON WHEAT IN TUNISIA

I. INTRODUCTION

The soil fertility section of the Accelerated Cereals Production Project (ACPP) was started in 1968. It was designed to study the fertilizer needs of newly introduced, semi-dwarf wheat varieties originating from Mexico along with the traditionally grown Tunisian varieties.

Four years of extensive experimentation have now been completed in the northern, more favorable rainfall area of the country. Experimental efforts have been concentrated in the gouvernorates of Beja, Jendouba, Kef, Bizerte, Nabeul and Tunis, which lie approximately between 36° and 37.4° north latitude. Most of the wheat grown in this area is not irrigated and received an average annual rainfall ranging from 300-700 mm.

II. CLIMATE AND SOILS

A. Climate

Tunisia has a typical Mediterranean climate with dry, hot summers and moderate winters. Most of the rainfall occurs between September and May and decreases rather uniformly from north to south, except parallel to the Algerian border. Generally, only the area north of a line corresponding to approximately 400 mm of annual rainfall is suitable for extensive cereal culture.

The Mediterreanen-type climate is generally quite conducive to wheat production. The wheat is planted in the fall and is favored by the cool temperatures and low evapo-transpiration rates. This results in more favorable moisture-yield relationships than can be obtained in many other parts of the world. However, there are some problems associated with this type of climate that can affect wheat yields and research results even in the normally more favorable rainfall zones. They include:

1) Distribution and frequency of rains
2) Frost damage during early spike formation and anthesis to early maturing varieties
3) Hail damage during advanced growth stages
4) The occurrence of hot, dry winds (sirocco) which arise from the Sahara
5) Long cloudy, wet periods may lead to disease loss, especially from Septoria under cool conditions. This also leads to nitrogen loss through leaching and denitrification.

B. Soils

The soils of Tunisia have been heavily cropped for several centuries. Organic matter values from soil samples taken in the wheat area normally range between 1-2 percent. Values approaching 2.5 percent have been obtained from a few exceptionally good farms where green manure crops are included in the rotation. It is now widely recognized that a large percentage of the farm land no longer supplies enough nitrogen to sustain high crop yields without supplemental nitrogen.

Most Tunisian soils have been formed from calcereous sedimentary parent material and are high in calcium. The Medjerda River drains several of the productive wheat areas including Jendouba, Bou Salem, Testour, Medjez, Teboursouk and Sidi Tibet. Here the soils are formed from recent alluvial deposits and have had little development. Their texture is usually fine. The lower areas including Pont du Fahs, Gafour, Le Kef, etc. are occupied by slightly developed alluvial soils.

Most of the productive soils are 50 cm to more than two meters deep and are fine textures. Soils are expected to be low in available phosphorus and generally have pH values between 7.5 - 8.

III. FERTILIZER PROGRAM

A. General

The fertilizer research program has been designed to work towards three goals:

(1) Research - of an applied adaptive nature to answer practical farm type production questions concerning fertilizer needs.

(2) Training - of engineer counterparts and lesser qualified technicians in the principles of experimentation from the planning of experiments to the analysis and interpretation of results.

(3) Demonstration - research trials are specially designed so they can be used for farmer demonstration purposes on field days. Extra treatments are sometimes added that have no research value, but are very demonstrative for farmers, such as applying nitrogen at a later than recommended date.

Several types of fertilizer experiments and simple demonstrations have been implemented since the inception of the program. Most of the trials have involved nitrogen rates either singly or in combination with other elements. Examples of the experiments and demonstrations conducted include:

(1) Rate and date of nitrogen application (RDN)
(2) Comparison of three different sources of nitrogen at different rates (Forms of N)
(3) Nitrogen, phosphorus and potassium at different rates (NPK)
(4) Comparison of bread and durum wheat varieties at different nitrogen rates
(5) Phosphate rate and method of placement
(6) Simple phosphate demonstrations
(7) Simple micro-element demonstrations

B. Experimental Results

The results of the fertilizer trials have been greatly influenced

by the tremendous fluctuations in the weather pattern from season to season. Given below are the experimental mean yields obtained over the past four seasons with the total average rainfall data over nine stations:

Crop Year	Number of experiments	Experimental mean yields in qx/ha	Total average rainfall over 9 stations
1968-69	5	24.7	293.0
1969-70	21	32.9	638.2
1970-71	25	30.7	501.8
1971-72	31	37.1	505.4

The 1968-69 season was extremely dry with rainfall figures 50-70% of normal. Total rainfall figures for 1969-72 were near the average except that in 1969-70 there were extremely heavy rains in the fall with normal rainfall thereafter. The 1970-71 season was characterized by high rainfall in January and February with a rather dry spring. This season received nearly average rainfall each month throughout the growing season, which explains the high experimental mean yield of 37.1 qx/ha for 1971-72.

Nitrogen responses have been very pronounced in most of the trials conducted heretofore. For example, during the 1969-70 crop season, yield increases from nitrogenranged from zero to 23.4 qx/ha (0-308%) depending on the level of base fertility, soil depth, preceding crop and rainfall. A 7.1 qx/ha average yield increase (26%) was obtained from the use of nitrogen on 21 experiments at the recommended rate as compared to the check.

For the 1970-71 season, a yield increase of 10.3 qx/ha was obtained when comparing the highest yield treatment with the check over 28 experiments. This represents an average yield increase of 37%. Yield increases from nitrogen usage ranged from a minimum of 2.2 qx/ha to a maximum of 24.2

The 1971-72 season was the most favorable for wheat production since the inception of the ACPP. This season the average yield for 31 experiments 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.

Experimental data for the three major elements (nitrogen, phos-

phorus, potassium) have been collected from the three rainfall areas (+500 mm, 400-500 mm, -400 mm), various soil types and depths, different crops in the rotation, various varieties of wheat (durum and bread) and numerous micro-climates. Discussed below are some of the experiences gained in the past four years that are considered to be the highlights of the research program. It is from these and other experiments that the farmer fertilizer recommendations that follow in this report have been refined and substantiated.

1. Effect of rotation practiced on wheat yields including wheat, forage, weed fallow

The rotation followed by the farmer is a very important factor in wheat production. Some preceding crops such as a cereal, forage crop (oats and vetch) or weed fallow leave the soil with a very low base nitrogen level. The data below indicate the importance of applying nitrogen at seeding time, or in equal proportion between seeding and tillering, if good yields are to be obtained. Nitrogen applications made at the jointing stage result in little yield advantage when the base fertility level is low. This is mainly because nitrogen supplies are insufficient to promote good plant tillering and development. (See tables on next pages)

2. Effect of rotation practiced on wheat yields including clean fallow, leguminous crops

Wheat following other crops (green manure, sugar beets) or weed free winter fallow in the rotation, that in Tunisia usually leave the soil nitrogen level high, will give excellent yields without the addition of large quantities of nitrogen. The data from the experiments reported in tables 2.a and 2.b indicate that with wheat following a rotation as mentioned above the nitrogen rate may be reduced by nearly one-half. Moreover, the date of nitrogen application has little influence on wheat yields since there already was enough soil nitrogen available to carry the plants through to the jointing stage.

3. Effect of high rainfall and saturated soil conditions on wheat yields

Nitrogen efficiency and corresponding wheat yields under dryland farming conditions are a direct function of the timing and amount of rainfall. Normal plant growth and development may be restricted by either deficient or excessive soil moisture at any growth stage. The data in table 3 exemplify how nitrogen loss from excess moisture (leaching and/or denitrification) may seriously reduce wheat yields.

1.a. Wheat following wheat

This table illustrates also the point that the rate of nitrogen application is of primary importance in obtaining high wheat yields. The form of nitrogen employed is of little significance as are the differences between application dates when the total dose is applied by tillering time (2-3 tillers/plant).

Treatments			Mean yields
Form of N	Rate of N (kg/ha)	Time applied	qx/ha
$(NH_4)_2SO_4$	120	S	38.0[a]
NH_4NO_3	120	S	35.8[ab]
$CO(NH_2)_2+NH_4NO_3$	120	S/T	35.4[ab]
$CO(NH_2)_2$	120	S/T	35.0[ab]
$CO(NH_2)_2$	120	S	33.7[abc]
$(NH_4)_2SO_4$	120	S/T	33.1[abc]
$(NH_4)_2SO_4+NH_4NO_3$	120	S/T	31.8[abcd]
NH_4NO_3	120	S/T	31.2[bcde]
$CO(NH_2)_2+NH_4NO_3$	80	S/T	29.6[bcdef]
$CO(NH_2)_2$	80	S/T	27.8[cdef]
$(NH_4)_2SO_4+NH_4NO_3$	80	S/T	27.7[cdef]
$(NH_4)_2SO_4$	80	S	27.1[def]
$CO(NH_2)_2$	80	S	26.3[ef]
NH_4NO_3	80	S/T	26.0[ef]
$(NH_4)_2SO_4$	80	S/T	24.3[fg]
NH_4NO_3	80	S	24.0[fg]
$CO(NH_2)_2+NH_4NO_3$	40	S/T	19.1[gh]
$(NH_4)_2SO_4+NH_4NO_3$	40	S/T	18.8[gh]
NH_4NO_3	40	S/T	18.5[gh]
$CO(NH_2)_2$	40	S/T	18.2[gh]
$(NH_4)_2SO_4$	40	S/T	16.4[h]
$(NH_4)_2SO_4$	40	S	16.3[h]
NH_4NO_3	40	S	16.1[h]
$CO(NH_2)_2$	40	S	15.5[h]
Nitrogen - 0 - check	-	-	7.6[i]

Source: Essouman, Beja - 1969-70 Variety: Inia 66

Experiment: Forms of nitrogen

1.b. Wheat following a forage crop (vetch and oats)

Mean Yields in Quintals per Hedare

Dates of Application	Rates of nitrogen (kg/ha) 0	33	67	90	133	Means of Dates
Seeding	18.3[d]	24.9[c]	26.5[bc]	29.9[ab]	30.4[a]	26.0[AB]
Tillering	19.8[c]	22.0[bc]	24.7[ab]	26.6[a]	28.3[a]	24.3[BC]
Seeding/tillering	21.4[c]	24.3[bc]	26.9[b]	30.6[a]	33.9[a]	27.4[A]
Jointing	18.4[b]	23.2[a]	25.3[a]	24.9[a]	24.3[a]	23.2[C]
Means of Rates	19.4	23.6	25.8	28.0	29.2	25.2

Source: Gasset El Bey, Mateur - 1969-70 Variety - Inia 66

1.c. Wheat following weed-free fallow

Mean Yields in Quintals per Hectare

Dates of Application	Rates of nitrogen (kg/ha) 0	22	45	67	90	Means of Dates
Seeding	18.1	22.1	25.2	26.7	27.4	23.9
Tillering	16.1	20.1	23.7	25.6	28.3	22.8
Seeding/tillering	13.5	18.2	22.1	25.5	26.4	21.1
Jointing	13.6	18.2	19.3	20.9	21.6	18.7
Means of Rates	15.3	19.7	22.6	24.7	25.9	21.6

Source: Jehfa, Goubellat - 1969-70 Variety - Inia 66

2.a. Wheat following a good, clean winter fallow

Mean Yields in Qunitals per Hectare

Dates of Application	Rates of nitrogen (kg/ha)					Means of Dates
	0	22	45	67	90	
Seeding	43.1^{b}	50.4^{a}	52.4^{a}	52.4^{a}	56.1^{a}	50.8
Tillering	47.2^{c}	49.7^{bc}	56.8^{a}	55.0^{ab}	59.3^{a}	53.6
Seeding/tillering	45.6^{c}	49.5^{bc}	51.1^{abc}	52.7^{ab}	56.8^{a}	51.1
Jointing	46.5^{c}	49.5^{bc}	53.3^{ab}	53.4^{ab}	55.9^{a}	51.7
Means of Rates	45.6^{D}	49.7^{C}	53.4^{B}	53.3^{B}	57.0^{A}	51.8

Source: El Marja, Pont du Fahs - 1971-72 Variety: Inia 66

Preceding crop: Winterfallow, weeds well controlled

2.b. Wheat following chick peas

Mean Yields in Quintals per Hectare

Dates of Application	Rates of nitrogen (kg/ha)					Means of Dates
	0	22	45	67	90	
Seeding	39.4^{c}	43.7^{bc}	42.5^{bc}	46.3^{ab}	50.1^{a}	44.3
Tillering	37.1^{c}	43.7^{b}	45.1^{b}	52.2^{a}	53.7^{a}	46.3
Seeding/tillering	35.7^{d}	45.3^{bc}	41.9^{c}	48.7^{ab}	53.1^{a}	44.9
Jointing	36.6^{d}	42.8^{c}	47.5^{b}	54.5^{a}	53.8^{a}	47.0
Means of Rates	37.2^{D}	43.9^{C}	44.3^{C}	50.4^{B}	52.7^{A}	45.7

Source: Zaafrana, Le Kef - 1971-72 Variety: Siete Cerros

Preceding crop: chick peas

Apparently, the nitrogen applied at seeding was lost, as there was no significant yield advantage. However, applications made at the tillering, jointing or 1/2 seeding, 1/2 tillering stages resulted in significant yield increases. These data explain why the nitrogen applied in the high rainfall areas (+ 500 mm) should be done 1/2 at seeding and 1/2 at tillering.

Table 3. Mean Yields in Quintals per Hectare

Dates of Application	Rates of nitrogen (kg/ha)					Means of Dates
	0	33	67	90	133	
Seeding	29.7	33.5	34.9	34.4	32.5	33.0
Tillering	29.0[b]	37.3[a]	40.3[a]	38.9[a]	40.8[a]	40.8
Seeding/tillering	31.1[b]	34.4[ab]	39.1[a]	41.5[a]	40.8[a]	37.4
Jointing	26.4[b]	35.2[a]	33.0[ab]	33.0[ab]	32.5[ab]	32.0
Means of Rates	29.0	35.1	36.9	36.9	36.7	34.9

Source: Zaouch, Mateur 1970-71 Variety: Inia 66

4. Effect of Septoria on wheat yields

Sometimes cool temperatures accompany the high moisture conditions which result in nitrogen loss. This set of conditions is also favorable for certain plant pathogens, such as Septoria (Septoria tritici). The data below indicate the magnitude of loss that can be expected when Septoria attacks susceptible varieties such as Florence Aurore and Inia 66.

Table 4. Mean Yields in Quintals per Hectare

Varieties	Rates of nitrogen (kg/ha)					Means of Varieties
	0	33	67	90	133	
Florence Aurore	9.8	12.8	11.4	14.4	16.3	12.9
Inia 66	16.7	17.0	17.7	18.4	19.7	17.9[AB]
Soltane	22.7[b]	26.6[ab]	28.5[ab]	30.9[a]	32.5[a]	28.2[A]
Utique	25.8[b]	27.8[ab]	32.5[a]	31.6[ab]	33.2[a]	30.1[A]

Source: Neffat, Mateur 1970-71

Moreover, the data indicate the importance of built-in disease resistance. The susceptible varieties responded only slightly to the addition of nitrogen, whereas the more resistant varieties responded more favorably and produced yields nearly double those of the susceptible types. Improving the nitrogen fertility level of the soil offered little benefit to the susceptible plant types in combatting the disease.

5. Importance of variety grown in obtaining maximum yields

Several experiments have demonstrated the high yield potentiel of the short stemmed wheats under good growing conditions. In the data below the local variety, Florence Aurore, gave good yields of approximately 40 qx/ha, averaged over the five nitrogen rates. However, under the same excellent growing conditions the yields of the short stemmed wheats tended to be higher at the zero nitrogen level and also at the other nitrogen rates. Yields of the short stemmed wheats were 3.7 to 10.5 qx/ha more than Florence Aurore.

Table 5. Mean Yields in Quintals per Hectare

Varieties	Rates of nitrogen (kg/ha)					Means of Varieties
	0	22	45	67	90	
Florence Aurore	39.0	39.7	40.1	42.8	40.8	40.5 C
Inia 66	47.7	51.0	50.7	53.1	52.1	51.0 A
Soltane	41.4	42.8	44.7	44.9	47.0	44.2 B
Utique	45.6	48.6	48.3	49.9	47.8	48.0 AB

Source: El Amel, Pont du Fahs - 1970-71

6. Effect of lodging on wheat yields

The data below demonstrate the importance of straw strength in overcoming lodging losses when wheat yields are being increased through improved fertilizer practices. The varieties Zaafrane and Utique have good straw strength and yielded well even at the high nitrogen rates. Florence Aurore, Mahmoudi and INRAT 69 all suffered yield loss as a result of lodging at the higher nitrogen rates. This effect was marked because of the high residual nitrogen in the soil. The new Tunisian durum, INRAT 69, has fainly good straw strength with yield potential in the realm of 50% more than the traditionally grown variety Mahmoudi.

Table 6. Mean Yields in Quintals per Hectare

Varieties	Rates of nitrogen (kg/ha)					Means of Varieties
	0	33	67	100	133	
Zaafrane-BW	45.0^{b}	51.4^{ab}	57.7^{b}	59.2^{a}	58.3^{a}	54.3^{A}
Utique-BW	44.0^{b}	50.2^{ab}	56.6^{a}	55.8^{a}	52.2^{ab}	51.8^{A}
Inia 66-BW	44.3	46.6	50.0	48.0	47.1	47.2^{B}
Fl. Aurore-BW	33.4^{a}	30.0^{ab}	21.7^{b}	24.3^{ab}	22.7^{b}	26.4^{D}
INRAT 69-DW	49.8^{ab}	52.0^{a}	41.9^{bc}	40.3^{c}	34.3^{c}	43.6^{B}
Mahmoudi-DW	38.1^{a}	37.0^{a}	29.7^{ab}	25.8^{b}	25.4^{b}	31.2^{C}
Means of Rates	42.4^{AB}	44.5^{A}	42.9^{AB}	42.0^{AB}	40.0^{B}	42.4

BW - bread wheat DW - durum wheat

Source: Ben Frija, Beja - 1971-72

7. Results of form of nitrogen experiments

Experiments comparing three sources of nitrogen, viz. ammonium nitrate, ammonium sulfate and urea have not shown any significant yield advantage for one form over the other. The higher nitrogen content per unit of weight gives urea an advantage over the other two forms if farmers incorporate it into the soil. Ammonium nitrate is recommended for the tillering application because the nitrate portion has maximum availability and ammonium nitrate is less subject to loss through volatilization than urea. Amonium sulfate offers no particular advantage since the soils in Tunisia have sufficient sulfur for cereal culture.

8. Results of nitrogen, phosphorus, potassium (NPK) experiments and phosphate rate and method of placement trials

Nitrogen, phosphorus, potassium experiments and phosphate rate and method of application trials have shown no significant yield response to phosphorus. Soil tests for available phosphorus and potassium show sufficient quantities for the wheat crop. Apparently there has been an accumulation of available phosphorus due to low grain yields and annual applications of phosphate. The recommendation is to apply phosphate at a rate which will maintain the present favorable level as this element could become a limiting factor in the production of the high yielding wheats. Higher yields will tend to reduce the supply of phosphate by removing more from the soil each crop year than has previously been needed.

9. Micro-element experimental results

The addition of micro-elements has not resulted in yield increase in either experiments or farm demonstrations. The micro-element (boron, copper, zinc, manganese, molybdenum) fertilizer used was part of ammonium ortho-phosphate. The Check fertilizer was also ammonium ortho-phosphate, but without micro-elements added.

IV. FERTILIZER CONSUMPTION IN TUNISIA

The table below shows nitrogen and phosphorus consumption in Tunisia since 1961. The figures are for pure nitrogen (N) and (P_2O_5) phosphorus.

	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	3,940	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 Conjuncture
Ministère de l'Agriculture

Since the inception of the ACPP in 1968, the Tunisian farmers have rapidly become aware of the needs for and benefits derived from nitrogen utilization. The Tunisian Government is making provisions to have 22,400 tons of nitrogen available for the 1972-73 campaign, which is nearly three times the amount consumed in 1968-69. The large increases in nitrogen consumption have largely been brought about by farmers applying more fertilizer to their wheat crop. It is estimated that 50-60% of the total nitrogen consumed is applied to cereals, but mostly for wheat.

V. FARMER FERTILIZER RECOMMENDATIONS FOR 1972-73

A. Recommended Rates and Dates of Nitrogen and Phosphorus Application for Semi-Dwarf Wheats in kilograms/hectare

Rainfall	Rotation	Nitrogen			P_2O_5 (45%)
		Seeding	Tillering	Total	
More than 500 mm	1st soil[a]	45	33-45	78-90	45
	2nd soil[b]	67	33-45	100-112	45
400-500 mm	1st soil	33-45	22	55-67	30
	2nd soil	45	33	78	30
Less than 400 mm	1st soil	22-33	22	44-55	30
Irrigated	—	67	45	112	67

[a] Wheat following winter fallow that is well cultivated, or a leguminous crop that is harvested

[b] Wheat following wheat, forage or winter fallow that has been used for pasture

B. Recommended Rates and Dates of Nitrogen and Phosphorus Application for Durum and Traditional Tunisian Bread Wheat in kilograms/hectare

Rainfall	Rotation	Nitrogen			P_2O_5 (45%)
		Seeding	Tillering	Total	
More than 500 mm	1st soil	33	22	55	45
	2nd soil	33	33	66	45
400-500 mm	1st soil	22	22	44	30
	2nd soil	33	22	55	30
Less than 400 mm	1st soil	22	22	44	30

NITROGEN

1. High rainfall areas (+ 500 mm)

Nitrogen applications should be made according to the table with 45 kg/ha being the minimum rate to apply at seeding. The tillering application should be made only if soil moisture conditions are favorable. If moisture is limiting, the tillering rate should be reduced accordingly. In the high rainfall areas there is a risk of nitrogen loss if large quantities are applied at seeding.

2. Intermediate rainfall areas (400-500 mm)

There is usually a yield advantage in splitting the nitrogen application between seeding and tillering. Furthermore, this procedure reduces the economic risk because the farmer is advised to reduce or omit his investment in the second application if at that time his potential yield is threatened by drouth, poor stand or some other limiting production factor. The same principle applies to the regions with less than 400 mm of rainfall.

3. Low rainfall areas (- 400 mm)

For the rainfall areas where moisture is limiting, it is also better to split the rate of nitrogen between seeding and tillering. The tillering application should be made according to the rainfall. If the rains are light and soil moisture reserves low, it is advisable not to apply the topdressing.

Note: A general "rule of thumb" is to apply the nitrogen topdressing at tillering only if the total rainfall between September 1 and January 31 is in excess of 250 mm and soil moisture reserves are favorable.

PHOSPHORUS

The recommendation is 30 kg/ha of P_2O_5 in the regions receiving less than 500 mm of rainfall each year. The phosphate must be applied before seeding and worked into the soil to a depth of 10 to 15 cm because it is normally broadcasted. For the areas receiving more than 500 mm, the rate of P_2O_5 recommended is 45 kg/ha.

ANNEX 2

GRANT REQUEST
WHEAT RESEARCH, TRAINING AND PRODUCTION
NORTH AFRICA

Background and Justification

On August 29th, 1968, a two-year grant of $293,000 to the International Maize and Wheat Improvement Center in Mexico (CIMMYT) was approved for a wheat research and production program in North Africa and a maize improvement program in the United Arab Republic[1] (680-0848). These projects were conceived as integral parts of the Foundation's regional effort to increase food production in the dryland and irrigated areas of the Middle East and North Africa through the Arid Lands Agricultural Development Program (ALAD) headquartered in Beirut.

Under the initial grant, CIMMYT was awarded $218,500 to provide expertise, technical backstopping, and a small amount of equipment and supplies to support the first stage of a phased five-year program for the introduction, adaptation and dissemination in Tunisia of improved, high-yielding wheat varieties (the so-called "Mexican" wheats), in collaboration with the Tunisian Government and USAID. On November 19th, 1970, a first supplemental grant of $233,700 was approved for one-year to consolidate and continue the existing program in Tunisia and to enable CIMMYT to extend limited training and technical advisory services to Algeria in preparation for the possible launching of a full-scale cooperative program in that country.

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(1) Since the maize production program is being funded under a separate action.

The pioneering nature of the attempt to apply the Green Revolution for the first time on a large-scale to dryland agriculture; its potential relevance to other developing countries where wheat can be grown economically under minimum rainfall conditions (300 - 700 mm); the promising results achieved to date in both Tunisia and Algeria; the central role of the cereal sector in their agricultural economies, employment and consumption patterns; the strong interest displayed at the highest level by both Governments and their demonstrated willingness to collaborate together in this sphere; the existence of a scientific "breakthrough", in the form of the new wheat varieties and the associated technology, and of an experienced organization like CIMMYT to assist in their adaptation to local conditions; the clear indication that further development and more widespread utilization of these varieties, together with the appropriate technology, can result not only in national self-sufficiency in wheat, thus eliminating chronic deficits and a heavy annual import burden, but possibly even in the production of hard wheat for export - all of these factors have induced the Tunis Office to make the North African Wheat Program the strategic cornerstone of its agricultural work in the Maghreb.

The second supplemental grant proposed in this request would provide $1,015,450 for an additional two years to permit CIMMYT

(a) to further develop and expand the successful program in Tunisia, in particular through (i) the reinforcement of durum breeding, (ii) the initiation of a research program to identify and extend a more complete rotation system for the wheat zones of Northern Tunisia, and (iii) the establishment of an in-service, production-oriented training program for wheat technicians from Tunisia and possibly from other nearby countries;

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(b) to start to build up in Algeria the necessary national scientific base and cadre of trained personnel to carry out safely and effectively the ambitious production program launched by the Government in the 1970-1971 crop season.

In addition to the new supplement being requested for CIMMYT, the Tunis Office intends to buttress the North African wheat program through a series of small, related program actions worked out in close consultation with CIMMYT and described on the following pages.

Continuing underlying program objectives are to develop high-yielding, disease-resistant varieties of both bread and durum wheats adapted to local ecological conditions; to elaborate and disseminate the optimum package of production practices, including rotation, through field research and demonstration on farmers' fields; to train nationals in the breeding and production of wheat, including seed technology; and to help organize and implement effective coordinated production programs with a view to achieving national self-sufficiency in wheat as soon as possible.

TUNISIA

The Government of Tunisia saw in the high-yielding wheats a possible solution to the country's persistent cereal deficit, which in 1967-68 amounted to 333,000 tons of bread wheat and 81,000 tons of hard wheat. It initially favoured the immediate sowing of as much imported seed of high-yielding varieties to as large an acreage as possible. Foundation and CIMMYT advice focussed attention on the basic importance of adaptive research and testing resources, adequate

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Governmental structure and trained indigenous personnel capable of organizing a national production program and of meeting the vast range of problems that can accompany the massive introduction of new germoplasm into a different ecological environment.

The modified plans drawn up in 1968 envisaged a five-year period in which, as adaptive research permitted, progressively larger areas would be planted with the improved varieties, while Tunisian technicians were being trained to assume the professional and managerial responsibilities of the program. It was hoped that yields from an anticipated total of 740,000 acres sown to the new varieties in 1973 or 1974 would make the country self-sufficient in wheat, thereby meeting one of the program's major targets.

To plan and implement the program, the Tunisian Ministry of Agriculture established a vertically integrated wheat project which now comprises four sections(1) : genetics, production management (which will include the new rotation work), fertility and extension. It has not yet been decided whether a new section will be created to handle the expanded in-service production training program or whether this responsibility will be assigned to the extension section. Although the project's structure is widely credited with facilitating effective operations, experience has shown that still greater administrative flexibility and budgetary autonomy are desirable. The Minister of Agriculture has, therefore, taken the decision - effective in January 1972 - to transfer the wheat project to the National Cereals Board, where it will constitute a self-contained technical unit. The Board is a public body vested by the State with a monopoly in the purchasing, storing,

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(1) The irrigation section, which never played more than a minor role in a country where less than 2% of the arable land is irrigated, was disbanded in 1971 with the departure of the USAID expert.

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importing and marketing of cereals. Its autonomous status and financial resources are expected to give the project the necessary flexibility and funds to cope with expanding activities and to replace the generous USAID contribution to operating costs, which is being gradually phased out.

The Tunisian staff assigned to the project has grown to approximately 96, of which half are agronomic engineers and technicians(1). The Government is also providing research and experimentation facilities, including those of the National Institute for Agronomic Research (INRAT) as well as office costs and operating expenses for equipment and vehicles. Excluding the services and facilities furnished by INRAT and the seed cooperatives, Government appropriations for the project through calendar 1971 are estimated at the equivalent of $486,000.

The Foundation's assistance during the first two years of the project was aimed primarily at supporting the development of the research component. It provided for the services of three CIMMYT scientists in the fields of genetics, production management and fertility; in November 1970, an extension specialist, formerly with the USAID group assigned to the project, joined the CIMMYT team. The Foundation has also borne the costs of consultants, short-term travel awards, essential administrative services and a limited quantity of equipment for the CIMMYT team in Tunisia. During the first two years only, provision was also made for the assignment of a training specialist at CIMMYT to supervise training programs for North Africans.

AID support has focussed on the provision of funds for the purchase of seeds, fertilizers, insecticides, equipment and vehicles. During the

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(1) 19 agronomic engineers, of which six joined the project in July 1971, and 29 adjoints techniques.

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first two years of the program, it also supplied a staff man to supervise these inputs, two specialists in extension and one in irrigation. Turn-over, recruitment difficulties and the transfer of the remaining extension specialist to the CIMMYT team have resulted in a marked reduction of AID technicians assigned to the Project during the third year. The arrival of an AID agronomist/ agricultural economist is expected. AID is funding a substantial fellowship program to train local staff.

The total dollar amount allocated by AID for the first three years of program operations is $1,182,000. In addition, the equivalent of $548,000 in local funds have been made available under U.S. Public Law 480 for the construction of a new Headquarters building, a warehouse and a greenhouse, and to support local currency expenditures.

Coordination of program inputs is ensured through an informal committee which groups the Tunisian Director of the Wheat Project, the Chief of the Agricultural Division of AID, the CIMMYT team leader, and a representative of the Foundation. The committee has direct access to the Secretary of State for Agriculture.

The introduction and development of the high-yielding, disease-resistant varieties has proceded at a very satisfactory pace. A vast program of genetic research on soft wheat has been carried out in collaboration with INRAT, while improvement work has begun on durum wheats and feed grains. As a result, Tunisia has developed three new varieties of soft wheat with yields equivalent to, or greater than, the best introduced varieties and incorporating greater resistance to Septoria and mildew; these new lines have been given Tunisian names and are being multiplied for release as new varieties. INRAT has released a durum wheat variety, INRAT 69,

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which is equal in performance to the best durum introduction from Mexico.

The activities of the genetic section have increased geometrically. The table below summarizes its work during the 1970-1971 crop season :

	Soft Wheats	Durum Wheats	Triticales	Barley
Crossing Blocks and Observation Nurseries	10,899	894	47	508
Yield Trials	798	478	16	96
Multiplication	55	10	-	-
Total Introductions from Abroad	8,134	687	47	275

Notwithstanding poor weather conditions in 1968-1969, extensive floods in September 1969, the unsettling effects of the reversal of the Government's agricultural cooperative program in 1969-1970, and late arrival of the rains in the 1970-1971 season, the production program has developed on schedule. Results are shown in the following table :

Year	Area Sown To Improved Varieties		Production Improved Var.		Av. Yield Improved Var.	Increase Over. Av. Yields Local Var.
	Acres	% of Total Tunisian Wheat Area	Tons	% of Total Tunisian Wheat Prod.	Tons/ Acre	%
68-69	25,325	1.37	14,435	4.81	0.569	349.1
69-70	132,293	5.19	100,000	22.22	0.756	429.5
70-71	247,035	10.00 (1)	Not Yet Available		Not Yet Available	

(1) Estimate

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Although production figures for the 1970-1971 crop season have not yet been compiled owing to abnormally late harvesting, the improved varieties are expected to continue to show a substantial production differential with local varieties. For the reason explained on page 9, however, it is likely that average yields of the improved varieties will show a slight decrease.

The field research and demonstration programs have yielded valuable data for defining the optimum package of cultivation practices to accompany the new varieties. Nitrogen consumption in Tunisia has doubled in each of the last two years, principally as a result of the wheat program.

Overseas training activities have been an important program feature. To date, ten AID-supported Tunisian technicians have completed eight-month CIMMYT courses in wheat breeding and production, and two more are currently undergoing training. Twelve Tunisians have undertaken or are still pursuing M.Sc. studies at U.S. universities under AID auspices, twenty-two Government officials, several at the policy-making level, have visited Mexico and the United States for short orientation programs; seven were financed by the Foundation and the remainder by AID. Tunisian specialists also participated in conferences and exchange visit to Lebanon, Morocco, Algeria, Italy and Turkey.

The wheat program has been described by the Prime Minister Hedi Nouira as a "model project". Farmer acceptance is generally good, and it is possible to discern a "spread" effect as fertilizers are beginning to be applied to local varieties.

Continued Foundation assistance is required, however, to ensure that the early promise is realized, and to tackle some of the new problems now arising. To meet its progressively larger production targets, the

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the project is obliged to extend its activities from the richer, valley-bottom lands generally under more progressive management into hilly, sometimes marginal zones where traditional methods of agriculture prevail[1]. This fact underlies the emergence of many of the so-called "second-generation" problems. Among the matters to which particular attention must now be given, while continuing to foster on-going work on soft-wheat, fertilizer and production management research (especially weed control) are :

1. Development of high-yielding, disease-resistant, fertilizer-responsive varieties of durum wheats

In view of the present importance of durums to North Africa for consumption and their potential for export to Europe in the future, CIMMYT is proposing to shift its entire durum breeding program, as well as the responsible scientist, from Mexico to Tunisia. Improved durum varieties are needed to minimize the risk that farmers will gradually abandon their use in favour of the more productive soft wheats.

2. Cereal technology and plant pathology

The resident expertise in these two fields needed to support the breeding program will be sought through the early identification of suitable young Tunisian scientists for training at CIMMYT under AID sponsorship.

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(1) Plans calls for planting 495,000 acres to the improved varieties in 1971-1972 and 740,000 acres in 1972-1973. If average yields are to be maintained at current levels, some scaling down of these targets may be necessary, as recently recommended by Dr. Norman Borlaug.

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3. Development and extension of an integrated land use system for wheat production in Northern Tunisia based on the incorporation of annual forage legumes into the cropping rotation

Such a system has been evolved and functions effectively in the similar climatic conditions of Southern Australia, using legumes and grasses initially imported from the North African region. It has largely eliminated fallow practices - which, in the Maghreb, cause approximately 50 per cent of the wheat lands to lie unused every year - and has substantially increased both cereal and animal production. In its initial phase, the rotation research effort in Tunisia will be limited to (a) adaptation trials of a number of varieties of legumes and grasses; (b) study of the cultural practices necessary to establish effective stands of legumes; and (c) demonstrations of the best adapted legumes sown with the proper cultural practices.[1] With the full agreement of the Government of Tunisia, CIMMYT will add to its team in Tunisia in October Dr. John Doolette, an Australian scientist with considerable experience in wheat/legume rotations and a former CIMMYT consultant in this field. Foundation headquarters has authorized funds for advanced purchase of the equipment which Dr. Doolette will need to implement his rotation program, in close collaboration with INRAT. A group of five Tunisian scientists and technicians are scheduled to visit Southern Australia in August/September 1971 to become familiar with the rotation system practised there. Three four-months fellowships to Australia for more detailed study are envisaged in 1972.

4. Improvement of the extension program

This is recognized as an essentially Tunisian responsibility; it is strongly recommended, however, that the quality of the demonstration

(1) While this work will be primarily directed towards increasing cereal production, it will have obvious repercussions for the development of animal husbandry in Tunisia. The latter is the subject of a new, large-scale USAID project, with which close contacts will b[illegible]

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plots be increased, if necessary, by reducing their number[1].

As a separate, closely related, program action, the Tunis Office is prepared to send two groups of four Tunisians each to a one-month course in extension methodology given at the Agricultural Study Center financed by SHELL at Borgo a Mozzano in Italy. The trainees selected would be extension workers assigned to the areas where the main rotation experiments are being carried out and could come either from the project staff or from the National Extension Service. This proposed action follows a joint visit to Borgo a Mozzano in May 1971 by the Head of the Tunisian Wheat Project, the Deputy Director of the National Extension Service, Dr. Keith Finlay of CIMMYT, the Representative and his Program Adviser for Agriculture.

5. Establishment within the Wheat Project of an active, in-service, production-oriented training program

The Government of Tunisia has agreed that trainees sent to CIMMYT in the future will be primarily agronomic engineers concerned with wheat breeding, plant pathology and cereal technology; USAID expects to continue financing such training costs for the next two years. At the request of the Government of Tunisia, the Wheat Project will organize and implement a practical production-oriented training program for technicians based on trainee participation, with project staff, in all the operations needed to produce a good crop of wheat - from seed bed preparation to harvesting. A Tunisian agronomic engineer will be assigned to the project to supervise this

(1) In the 1970-1971 season, 260 simple demonstration plots were planted on privately owned farms by two mobile teams of project extension workers. This was too large a number for adequate supervision, and only approximately one-half were considered suitable for demonstration purposes.

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program and will be sent to Mexico by AID to observe CIMMYT training methods in action. The first group of in-service trainees is likely to include many of the extension workers already attached to the project; wheat technicians from neighbouring countries - and, in particular, from Algeria - may also participate.

To provide relevant and utilizable backstopping materials for this and other training programs in the Maghreb, the grant request includes funds for the revision, adaptation to local conditions, translation and publication in both French and Arabic of the wheat production manual currently used by CIMMYT. Paul Marko, the CIMMYT extension specialist in Tunisia, will assist in designing the in-service training program and in adapting CIMMYT's training materials.

As another distinct but supporting program action conceived in consultation with CIMMYT, the Tunis Office has engaged the services for one year of an audio-visual specialist with a background in the natural sciences. Miss Tarlier's regional assignment, to be carried out in close cooperation with CIMMYT and the interested Government services, is to prepare visual materials, especially slides, to illustrate CIMMYT's manual and for use in the various wheat training programs being developed across the Maghreb.

6. Reinforcement of seed production and technology services

Priority attention must be given to the creation of an adequate organizational structure with the trained personnel and equipment to deal with seed multiplication, certification, treatment, storage and distribution problems. At the beginning of the 1970-1971 crop season, 20,000 quintals of seeds of the improved varieties with

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unsatisfactory germinating potential were distributed to farmers; repetition of such incidents must be avoided. Furthermore, five varieties - INRAT 69 (BD5825), ARIANA (BT2123), UTIQUE (BT2359), SOLTANE (BT2296) and ZAAFRANE (BT2292) - are now in various stages of multiplication in Tunisia. Rapid multiplication is urgent, since all have a higher yield potential and/or a greater resistance to Septoria than the best introduced varieties, thus reducing the risk of serious losses from diseases.

With the approval of the Tunisian and Algerian Governments, the Director of the Tarai Development Corporation of the University of Uttar Pradesh in Pantnagar, India, undertook a two-week consultant mission to Tunisia and Algeria in July to study and make concrete recommendations on their respective seed multiplication, certification, processing and storage problems. At Dr. Paliwal's suggestion, provision has been made in the new supplementary grant request to enable four Tunisian and two additional Algerian technicians to gain a thorough grasp of these problems by spending eight months in Pantnagar.

7. Economic studies

These are required to determine whether Tunisia can produce durum wheats of acceptable quality and at economically competitive costs to secure export markets in Europe. Macro- and micro-economic studies of the cereal sector are also needed for the guidance of Government policy makers and farmers. These studies will be conducted outside the CIMMYT grant, although it is not yet known by whom.

8. Barley

A modest barley breeding program will be continued with both native

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types and foreign introductions in order to identify the varieties best suited to serve as a subsequent basis for an enlarged barley breeding program, once Tunisia achieves self-sufficiency in wheat. Under conditions of lower rainfall (200 - 300 mm), barley becomes a more reliable crop than wheat and can be used for food, feed and brewing.

To support the above-mentioned program, AID will continue to cover the costs of trainees sent to CIMMYT and of university training in the United States. It will also provide, but at a declining rate, commodities and equipment, travel expenses in the Mediterranean region, and dinars for local expenses and operating costs. AID's contribution of $125,000 and T.D.70,000 during U.S. FY 1972 is likely to be reduced to a phase-out level of approximately $95,000 and T.D. 10,000 in U.S. FY 1973. Tunisian support for the project reflects appreciation of the fact that its adaptive research, production technology, extension techniques and particularly its in-service training experience for local specialists will serve as a pattern and a stimulus for the improvement of other field crops. The Government's contribution to the operating budget, estimated at the equivalent of $220,000 in calendar 1971, is expected to rise the following year.

The proposed grant supplement, covering the final two years of the initial five-year program, would provide for the continuation of the four CIMMYT posts in Tunisia in genetics, production management, fertility and extension and for the addition of a fifth post in wheat/legume rotation. Funds would be made available for consulting services; fellowships and travel awards to Australia, Mexico and India; preparation of training materials; and a limited amount of

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equipment and supplies, in addition to CIMMYT field operating expenses and overhead.

The necessity to continue on-going research while simultaneously adding new components precludes any scaling down of Foundation inputs to the Tunisian Wheat Project at this juncture. The long-term nature of the new rotation component makes it probable that the Representative - after reviewing the situation - will recommend further support in 1973, although at a reduced overall level.

ALGERIA

The area planted to wheat in Algeria each year fluctuates around 5.4 million acres, of which two-thirds are sown to durums and one-third to soft wheats. Yields of traditional varieties are low (an average of 0.23 tons/acre for durums and of 0.27 tons/acre for soft wheats). Approximately 320,000 tons - or 40% of the country's bread wheat requirements - have to be imported annually. The chronic and worsening cereal deficit, which could lead to an estimated $180 million of imports by 1980, and the fact that the cereal/fallow system covers 90 per cent of Algeria's total land surface cultivated with annual crops, explain the Government's interest in the high-yielding wheat varieties.

The first trials with Mexican wheats in Algeria were carried out by the National Institute for Agronomic Research (INRAA) during the 1967-1968 crop season, under the aegis of an FAO wheat expert. In 1969-1970, field experiments were conducted on 12,400 acres, using seeds purchased primarily from Tunisia. The results and the example

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of the successful Tunisian program led the Government of Algeria, under its current Four-Year Plan (1970-1973), to launch an aggressive program to increase and intensify cereal production by introducing improved varieties and techniques. Its objective was to achieve national self-sufficiency while reducing the overall cereal area and eliminating, where feasible, the extensive use of fallow practices. While the Government was determined to press ahead vigorously with the production program, if necessary, on its own, preliminary discussions to explore the possibilities of CIMMYT support were begun as early as August 1969 with the Foundation's Representative. In June 1970, a CIMMYT/Foundation fact-finding mission, led by Norman Borlaug, visited Algeria and was impressed with the country's potential for wheat growing. It noted the severe shortage of trained scientists and technical supervisory personnel as well as the organizational and administrative problems likely to arise in implementing the ambitious plans for sowing 495,000 acres with the Mexican varieties in the 1970-1971 season. The mission, therefore, recommended a period of initial assistance limited to a modest fellowship program and occasional advisory services.

In September 1970, the Ministry of Agriculture and Land Reform (MARA), in cooperation with the Foundation's Tunis Office, convened a four-day international conference in Algiers to consider the implications of the new wheat programs for all of the Maghreb. At the request of MARA's Secretary-General, the CIMMYT participants prepared a series of technical recommendations for the utilization of the Mexican varieties in Algeria based on relevant Tunisian experience. The Secretary-General credits this well-attended conference with playing a decisive role in overcoming the reticence to the new varieties which existed in certain quarters and in providing a psychological impetus to the nascent Algerian program.

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To plan and implement the national production program, the Government officially established a Wheat Project, named a director (who was simultaneously Chief of the Major Field Crops Section of the Vegetal Production Division of MARA), and created a Wheat Committee to provide policy guidance and supervision. Membership of the Committee includes : the Secretary-General, MARA, as Chairman; the Director of Regional Agricultural Services, MARA; the Director of Vegetal Production, MARA; the Director-General of the National Cereals Board (OAIC); the Director General of INRAA; and the Director of the Project who was, in theory, directly responsible to the Committee. Day-to-day responsibility for field operations rested with the Major Field Crops Section, which has a staff of 15 technicians, including one in each of the 13 wilayas.

Late arrival of a portion of the approximately 17,000 tons of seeds imported from abroad last year obliged the Algerians to cut back to 350,000 acres the area sown to the improved varieties; 97 percent of the acreage planted was in the so-called "socialist" sector. The principal varieties grown were INIA, SIETE CERROS and TOBARI, although Italian varieties were used on 3,300 acres. To facilitate this massive introduction of new varieties, the Ministry of Agriculture and Land Reform - in cooperation with FAO - prepared a booklet incorporating the CIMMYT recommendations and organized special "sandwich" type courses for 1,000 chefs de culture at five agricultural vocational training centres located in the main cereal growing areas.

The preliminary Foundation-funded efforts to help develop the technical competence of the project's expanding staff began in February 1971 with the departure of an Algerian engineer and three technicians to undergo CIMMYT training in wheat breeding, technology, production and pathology(1).

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(1) CIMMYT did not use the funds allocated under the first grant supplement to recruit and train in Mexico a French-speaking candidate for the post of team leader in Algeria.

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In March, the Project Director paid an orientation visit to Mexico, while three technicians from the National Cereals Board left for India in May to start 4-6 months training programs in seed technology at Pantnagar[1].

Although final harvest results are not available, yields in most areas are very good. The Project Director estimates that average yields will be between 0.61 and 0.81 tons per acre. Farmer acceptance and Governmental enthusiasm are widespread. Plans are being made to quadruple the area to be planted with the high-yielding varieties this autumn, from 350,000 acres to over 1.2 million acres. The Project is tooling up for this task. Arrangements have been made to import 85,000 tons of nitrogen and 60,000 tons of super phosphate to supplement local supplies. Staff directly associated with the project is expected to number 120 in FY 1972, and to rise to 170 in FY 1973[2].

The dynamic, aggressive and imaginative manner in which the Algerians successfully organized their first large-scale production season, in line with CIMMYT recommendations, has greatly impressed Norm Borlaug and the four CIMMYT/Foundation missions which have travelled widely throughout Algeria since May. Extensive discussions at all levels, including with President Boumediène, have revealed vigorous Government support for the project. CIMMYT help is requested in putting the national wheat production program on a firm footing by building up a strong indigenous research capacity, developing a cadre of trained

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(1) One had to be repatriated almost immediately because of illness.

(2) The FY 1972 staff will include 10 agricultural engineers, including trainees at CIMMYT/Mexico, 45 adjoints techniques and 50 agents techniques. The FY 1973 figures includes 41 agricultural engineers, including 25 final year students from the Technological Institute for Agriculture in Mostaganem, 65 adjoints techniques and 59 agents techniques.

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Algerian wheat scientists and technicians, and acting as the principal adviser to the Government on cereal policy. The Representative is confident that the Foundation, through CIMMYT, can make a significant contribution in this field.

The cooperative research effort will be focussed on the development of new wheat varieties with better disease and insect resistance as well as modified technology better adapted to the very diverse climatic and soil conditions of Algeria, thus permitting higher potential yields and providing added protection against losses. This effort will be channeled through a reinforced INRAA Cereal Section which, until now, has lacked the trained national scientific personnel to do more than conduct yield variety tests in the main INRAA station near Algiers and in 7 experimental stations scattered throughout the country.

Varietal improvement will be sought through a substantial expansion of INRAA's breeding program in both spring and winter bread wheats and durums. Large numbers of new lines and segregating populations will be introduced from Mexico as well as from CIMMYT Cooperative Programs in other countries such as Tunisia, Morocco, Turkey, India, Pakistan, Argentina and Brazil. The quantities of crosses and selections made in Algeria will be increased, as will the number of locations and environments where the selections are made. In important ecological areas where no INRAA station exists, appropriate lands and facilities will be supplied by state farms or agricultural schools. A profusion of potentially suitable genetic materials is available for testing and selection in the coastal plains. The real research challenge will be the development of hardy winter wheat varieties adapted to the difficult conditions (late frosts and early droughts) of the High Plateaux. This vast inland wheat-

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growing area with a potential of between 7 and 10 million acres stretches across Algeria from the Tunisian to the Moroccan border at an elevation of 800-1200 meters.

CIMMYT experts will also help to design and carry out an extensive program of production management research. This program, which is the vital link between the varietal improvement work and the national production effort, will be implemented at a large number of representative locations in both "socialist" and private farms where wheat is grown commercially. It will include experimentation on varietal adaptation; methods of seed bed preparation, including fallow systems and conservation of moisture; rates, dates and methods of sowing; optimum fertilizer practices for each of the major soil types and varieties; weed control practices; and combinations of the above to determine the best "packages" of production techniques for specific wheat growing areas.

The training of Algerian scientists and technicians, both on-the-job and through participation in carefully selected training programs in Mexico, India and Tunisia, is an integral part of the project. Relevant new research findings will be fed back and incorporated without delay in the cereal training programs organized by Algerian agricultural schools and institutions. The work in adapting and translating CIMMYT's training manual and the visual materials to be prepared by Miss Tarlier will also be useful in this connection. Particular attention will be paid to strengthening existing cooperative relationships with the new Technological Institute for Agriculture (ITA) at Mostaganem; starting in mid-1972, ITA will begin to feed into the project - as counterparts and for further practical training - a steady stream of young agronomic engineers.

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Although CIMMYT staff will be engaged primarily in genetic and agronomic research, they will also have an opportunity to participate actively in organizing the national production program. Both the Government of Algeria and CIMMYT are convinced that the success of the research effort can only be assessed by its impact in triggering significant increases in wheat yields and production. At the Government's request, Dr. Borlaug or his Deputy, Dr. R.G. Anderson, will make themselves available to advise on overall program policy.

The Government has agreed to reactivate the Wheat Committee in order to provide the simple, flexible and functional structure and procedures needed to plan and implement the program. The Project Director will report directly to the Committee, which will meet at least four times a year and on which the CIMMYT team leader will sit as an ex officio, non-voting member.

To support the project, the Government is providing scientific and technical staff and field workers; the research stations, laboratories, facilities and equipment of INRAA; access, where required, to suitable land and facilities of "socialist" farms and agricultural training schools; large quantities of seeds and fertilizers; buildings and office space for project headquarters; heavy capital investment for the construction of seed and grain processing and storage facilities; internal air-travel for the CIMMYT experts; and a two-year operating budget estimated at the equivalent of $.[1] In addition, the National Cereals Board has informally offered to make diners available up to the equivalent of $100,000 to purchase imported equipment needed by the project if either the Foundation or CIMMYT could provide the initial hard currency input. CIMMYT has agreed to advance $20,000 as

(1) Details of this very substantial contribution are contained in a 14-page letter from Mr. Boukli, mailed on August 12th, but not yet received in Tunis. They will be forwarded to New York in the near future.

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part of such an exchange operation to permit the importation of equipment for INRAA's cereal technology laboratory.

Support for the project is coming, or likely to be forthcoming, from other assistance agencies. French bilateral aid has mobilized three young wheat breeders who, until the return of the first Algerian wheat breeder from CIMMYT in July, constituted the scientific core of INRAA's Cereal Section. FAO has furnished two fertilizer experts and the World Food Program has given 5,000 tons of nitrogen fertilizer. As a result of the recently concluded country programming exercise with the Algerian authorities, UNDP has set aside $600,000 to support the Wheat Project over the next two years. Although a detailed work program has not yet been finalized, discussions have centred on a broad complementary program of in-farm demonstrations and extension of the improved varieties and techniques. The Tunis Office is maintaining close contact with both FAO and the UNDP Resident Representative in Algiers to ensure full coordination of the proposed UNDP and CIMMYT inputs.

Foundation financing proposed under the present two-year supplement would cover the assignment to Algeria of an experienced four-man CIMMYT team consisting of (i) a wheat breeder, who would act as team leader, (ii) a production research agronomist capable simultaneously of conducting breeding work for the High Plateaux, and (iii) two production research/extension agronomists. Funds would also be provided for consulting services; fellowships, travel awards and the preparation of training materials; vehicles, essential field and laboratory equipment not available in Algeria and required for the professional use of the CIMMYT staff; and for CIMMYT field operating expenses and overheads.

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Coordination With Other Wheat Programs

The Tunisian and Algerian projects are integral links in a developing network of Wheat Programs in North Africa and the Middle East being supported by USAID and CIMMYT in Morocco, the Rockefeller Foundation and CIMMYT in Turkey, as well as FAO and ALAD in UAR, Iran and other participating countries. FAO, with ALAD cooperation, has played a useful role in distributing a whole range of regional and international wheat nurseries and in administering a Rockefeller-financed training program for wheat specialists from the region. The North African countries will also take part in the network of International Trap Nurseries set up by Dr. Eugene Saari of the Foundation's New Delhi office.

At a seminar in Beirut in April 1971 sponsored by ALAD and attended by representatives of FAO, CIMMYT, Rockefeller and Ford Foundations, it was recommended that CIMMYT assume responsibility for coordinating the wheat programs in the Mediterranean basin being assisted by these agencies. The first of the suggested annual regional wheat workshops will be held in Beirut in February 1972, with ALAD backstopping. CIMMYT is currently exploring possibilities of financing a small core of outstanding wheat experts who, from their base in national programs, would be able to lend support in their specialities throughout the Middle East and North African region.

CIMMYT inputs to the three North African Wheat Programs are harmonized by a sub-regional coordinator. Extensive travel is carried out by both national and international specialists with a view to the sharing of experience and results; for example, some fifty Algerian wheat technicians, officials, farmers and chefs de culture visited Tunisia

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in April and May, and a return visit by officials of the Tunisian Wheat Program was organized shortly thereafter.

Close contacts will be maintained between the Algerian and Turkish Programs as well as with Oregon and Washington State Universities, in view of analogous problems posed by the development of hardy winter wheats for high plateaux areas.

Estimated Budget

See next page.

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ANNEX 3

July 14, 1971.

Suggested Orientation of the Research, Production, Training and Extension Programs of the Tunisian Wheat Project September 1971 - September 1973

Dr. N. E. Borlaug.

Following extensive discussions between representatives of the Tunisian Government, USAID, the Ford Foundation and CIMMYT, it is suggested that the Tunisian Wheat Project be oriented as follows during the next two years:

1. Varietal Improvement

The varietal breeding program a cooperative effort being developed jointly by INRAT, the Wheat Project and CIMMYT, will be aggressively pursued and expanded. It is already apparent that lines have been developed which are far superior to the commercial varieties now available, whether locals or Mexican introductions; they are higher yielding as well as more resistant to Septoria, mildew and stripe rust, which sometimes become factors limiting wheat production in the Mediterranean region. The feasibility of incorporating more resistance to the major insect pests, such as Hessian fly and sawfly, will be explored.

While the breeding program will continue to work on producing better adapted, higher-yielding, disease-resistant varieties of bread wheat, major emphasis will be given to developing high-yielding, disease-resistant, fertilizer-responsive varieties of hard wheat (T. durum) to meet rising domestic consumption and suitable as well for export to Europe. Given the importance of durums to North Africa, CIMMYT is willing to shift its durum breeding program, as well as the scientist responsible for that program, from Mexico to Tunisia.

New improved varieties of both hard and soft wheats with a wide scope of maturity classes ranging from very early to late will be developed, so as to provide maximum flexibility in optimum dates of planting.

2. Fertilizer Research

The rapidly expanding use of chemical fertilizer, especially nitrogen, clearly indicates the large benefits that have already been derived from the research conducted on plant nutrition. Although it is evident from the experimentation conducted to date that virtually all Tunisian soils are deficient in nitrogen, more research is needed to clarify both the most economical dosages and the dates of application of this element. Fertilizer research studies, must,

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therefore, be continued employing a range of varieties, including the best local varieties, so as to determine the most efficient recommendation for each of the different wheat types.

3. Production Research

All experimental lines showing outstanding promise in the breeding plots must be evaluated under a range of conditions on farms in competition with the best commercial varieties. Such evaluation will include experimentation on : (a) dates of sowing; (b) rates of sowing; (c) levels of fertilization; and (d) methods of weed control.

The importance of this type of research has already been demonstrated: it has shown, for example, that late sowing of varieties susceptible to Septoria, such as INIA and Siete Cerros, tends to minimize risk from this disease.

More extensive research must be done on the use of chemical weed killers, so as to minimize losses.

4. Cereal Technology

Major emphasis must now be placed on effective use of the Cereal Technology Laboratory at INRAT in order to help the breeding program identify those lines with outstanding quality characteristics. Excellent laboratory equipment has been provided by USAID. If wheats of suitable quality are to be developed, top priority must now be given to selecting and assigning to the Wheat Project a young Tunisian scientist with competence in biochemistry and mathematics and some understanding of genetic variation. This scientist should be sent to Mexico as soon as possible for training as a cereal technologist.

5. Plant Pathology

The development and use of disease-resistant varieties constitute the best methods of protection against the threat of losses from diseases which continues to face the wheat farmer in Tunisia. Although part-time consultant assistance in cereal pathology is available from CIMMYT or Ford Foundation specialists based elsewhere, a well-trained plant pathologist is now urgently needed in Tunisia to help the wheat breeders evaluate all promising lines in advanced stages of testing for resistance to all of the important pathogens attacking wheat under local conditions. It is recommended that a young Tunisian engineer with good scientific potential be selected soon and trained in Mexico for this important work.

6. Rotation Research

The amount of good land available in North Africa for cereal production in

areas of more or less adequate rainfall is limited. The system of rotation traditionally practiced in the intermediate rainfall areas, wheat followed by fallow, results in approximately 50 per cent of the wheat lands lying unused each year.

For this reason, it has been decided to add a new objective to the Wheat Project: the development of an irrigated land use system for wheat production in Northern Tunisia, based on the incorporation of annual forage legumes into the cropping rotation.

This system has been developed and functions effectively in the similar climatic conditions of Southern Australia, where it has substantially increased both cereal and animal husbandry production. Since the legumes and grasses used in Australia originally came from the Mediterranean region, it should be possible to develop fairly promptly an analogous rotation system suitable for NorthernTunisia and other cereal growing regions around the Mediterrarean basin.

In its initial phases, the rotation research effort will be confined to:

a) Evaluation of a number of varieties of legumes and grasses;

b) Study of cultural practices necessary to establish effective stands of legumes, i.e., rates, dates and depth of sowing; kind, dosage and method of application of fertilizer, especially phosphates; etc.;

c) Demonstration of the best adapted legumes sown with proper cultural practices.

With the full support and approval of the Government of Tunisia, CIMMYT has added to its staff in Tunisia an Australian scientist with considerable experience in wheat/legume rotations. He will begin work on this problem in October 1971 in close collaboration with INRAT. Arrangements have been made for Tunisian scientists and technicians to visit Southern Australia to study the rotation system as practiced there.

7. Extension Program

To be effective in convincing the farmers to adopt the new varieties and production management technology, demonstration plots must be properly made and show large yield advantages over the old practices. Poor demonstration plots, which fail to show significant yield advantages, produce a negative effect and may actually delay farmer acceptance. The attempt to establish too many demonstration plots during the past two years has sometimes been at the expense of quality; this shortcoming must be corrected, if necessary, by a reduction in the number of plots. The extension program is recognized as being essentially a Tunisian responsibility.

8. Training of Tunisian Scientists and Adjoints Techniques

It has been agreed that the Wheat Project, in the future, will send as trainees to CIMMYT primarily agronomic engineers who will concentrate on wheat breeding, plant pathology and cereal technology. USAID will continue to provide the necessary financing for such training in the immediate future.

At the request of the Government of Tunisia, an active, in-service, production-oriented training program will be established within the Wheat Project. Training will be practical in nature and based on the direct participation of trainees, in close association with staff members of the Wheat Project, in the various operations needed to produce a good crop of wheat from seed bed preparation to harvesting. A Tunisian agronomic engineer will be named to the Project to supervise this in-service training program, and will have an opportunity to study CIMMYT training methods in Mexico. Included in the first group of trainees will be many of the adjoints techniques already assigned to the Project as extension workers. It is envisaged that technicians from other Cooperative Wheat Programs in the region may also wish to participate in the training program.

To facilitate this in-service training program, the wheat production manual currently used by CIMMYT in Mexico will be revised, adapted to local conditions, and translated into both French and Arabic. Mr. Paul Marko of the CIMMYT staff in Tunisia is available to assist in the development of the in-service training effort, including the local adaptation of existing CIMMYT training materials.

As a separate contribution, the Ford Foundation has engaged the services for one year (starting in September 1971) of an audio-visual specialist with a background in the natural sciences. The task of this specialist - which will be carried out across the North African region in close cooperation with CIMMYT and the interested Governments - is to prepare visual materials, especially slides, for the various training programs being developed throughout the Maghreb to support the Cooperative Wheat Programs. Close contact will be maintained with the Agricultural Training Departments and Extension Services of the respective Ministries of Agriculture to ensure maximum utilization of the new visual materials as well as of CIMMYT's production and training manual once it has been adapted and translated.

Again as a separate action designed to buttress the Tunisian Wheat Project, the Ford Foundation is prepared to send two groups of four Tunisians to the one-month extension methodology courses given at the Agricultural Study Center financed by SHELL at Borgo a Mozzano in Italy. It is expected that the fellows would be selected from the extension agents assigned to the areas where the main rotation experiments are being carried out and would come both from Project staff and from the National Extension Service.

9. Seed Production and Technology

A varietal breeding program is ineffective in improving national agricultural production unless the means exist to multiply and distribute to the farmers high quality seed of the new varieties with high varietal purity and a high percentage of germination. An adequate organizational structure with the trained personnel and equipment to cope with the seed multiplication and distribution problems is not yet available to the Tunisian Wheat Project.

Five new varieties are now in various stages of multiplication in Tunisia: INRAT 69 (BD5825), ARIANA (BT2123), UTIQUE (BT2349), SOLTANE (BT2296), and ZAAFRANE (BT2292). The rapid multiplication of these new varieties is urgent, since all have higher yield potential and/or exhibit a greater resistance to Septoria than INIA 66 and Siete Cerros thus reducing the risk of serios loss from diseases.

With the approval of the Government of Tunisia, CIMMYT arranged that Dr. Paliwal, Director of the Tarai Development Corporation of the University of Uttar Pradesh in Pantnagar, India, visit Tunisia in July 1971 to study the seed production problem and to make a series of concrete recommendations. In addition, provision has been made in the grant to send four qualified young Tunisian scientists to India to study and work with Dr. Paliwal on all aspects of seed multiplication and quality control. This aspect of the Wheat Project must have high priority in order to ensure its continued successful development in the future.

10. Economic Studies

It is hoped that Tunisia can come close to achieving self-sufficiency in wheat production after the 1972-1973 harvest. This being the case, it must plan ahead to determine whether it can produce durum wheats of acceptable quality and at economically competitive costs to find export markets in Europe. Since major emphasis is increasingly being given in the breeding program to developing high yielding durum wheats of high quality, it is now opportune to initiate a preliminary economic study to determine the feasibility of Tunisian exports, once self sufficiency is achieved. Macro- and micro-economic studies of the cereal sector are also needed for the guidance of Government policy makers and farmers.

11. Barley

Wheat yields drop as one moves southward in Tunisia into areas of lower precipitation. Under conditions of lower rainfall (200 mm to 275 mm), barley becomes a more reliable crop that wheat, and is used both as food and feed. Since the stage is being set to allow Tunisia to achieve self sufficiency in wheat production in the foreseeable future, it is now necessary to explore the possibilities presented by other crops - such as barley - that are either in short supply or can be utilized in greater quantities, and the production of which can be expanded economically.

It is suggested that Tunisia initiate a modest barley breeding effort during 1971-72, in collaboration with CIMMYT. During the past year, a modest program of varietal testing was begun; this program must be continued with both native types and foreign introduction in order to identify those varieties best suited to serve as a basis for the development of an enlarged breeding program.

12. Structure and Coordination

It is understood that the Government of Tunisia has decided to transfer the Wheat Project from the Ministry of Agriculture to the National Cereals Board, where it will constitute a self-contained technical unit. To the extent that this shift will increase the operational and administrative flexibility of the Wheat Project and provide it with an autonomous budget which will permit, *inter alia*, better salaries to be paid to Project staff, the transfer is welcome.

Mr. Mustapha Zaanouni, Secretary of State for Agriculture, has wisely stressed the necessity of convening more frequent meetings of the coordinating committee foreseen in the original agreement.

ANNEX 4

June 1970.

ALGERIAN WHEAT PROBLEMS

Dr. N. E. Borlaug

Upon the request of the Algerian Government to the Ford Foundation in Tunis, a committee made up of Piero Bronzi, Willis L. McCuistion, Arthur Klatt (CIMMYT, Mexico) and Norman E. Borlaug, visited Algeria between June 16 and 19 to study Algerian wheat production problems.

The committee, accompanied by Mr. N. Kadra who is in charged of the so-called "Mexican wheat program" made a two day trip by auto from Algiers to Oran and return to study Algerian wheat production problems; subsequently discussions concerning our observations were held with Algerian officials. This brief report is a summary of our findings.

Algerian wheat production potential is very great but the average yields of wheat at the present time are very low. It is almost certain that yields have dropped since independance; this in part has been due to lack of technical leadership, since there are very few trained scientists in Algeria at the present time.

Moreover, the limited number of trained agronomists that have been available, up to very recently have had to assume many different responsibilities.

Last year, the government of Algeria became interested in the Tunisian-Ford Foundation-AID-CIMMYT wheat production program. They visited Tunisia to observe it first hand and in the fall of 1969 launched their so-called "Mexican Wheat Program". Seed was imported from Tunisia to sow about 4,000 hectares, under Mr. Kadra's leadership. We saw some of these plantings. The tremendous success of the 1969-70 Tunisian Wheat Program now has resulted in some officials in the government of Algeria insisting on expanding their Mexican Wheat Program to 200,000 hectares in 1970-71. The danger now is that it all looks too simple to government officials, at least at some levels, and certain precautions must be taken if a realistic program is to be implemented successfully. The program must be expanded more slowly, because of limitations in the agronomic, economic, administrative and personnel problems if it is to be successful.

Some of the observations made during our trip which bear on these considerations are outlined below.

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1. Agronomic Considerations

Much of the information that has been developed in Tunisia during the past two years will have direct application here in Algeria, once the validity of the Tunisian results has been checked in Algeria in a number of different locations. For example, it was apparent that the varietal adaptation is very similar. Varieties such as Tobari 66 and Penjamo 62 which have been found most suitable in the heavier rainfall areas in Tunisia, where Septoria is a problem, are also probaly the most reliable for similar areas here in Algeria, whereas a variety such as INIA 66 which is very high yielding and broadly adapted, will find use largely in areas of more moderate rainfall where Septoria is less of a problem. The rust diseases in Algeria pose no particular problem since the Tunisian varieties of Mexican origin adequately covered the disease spectrum.

The cultural practices that are needed to successfully grow Mexican wheat varieties with the expectations of harvesting high levels of yields will be similar to those that are now being used successfully in Tunisia. Fertilizer applications will problably be needed at about the same levels, and made up of the same proportions of plant nutrients as those that have been found effective in Tunisia. Nitrogen is needed everywhere. Phosphate is also in insufficient supply and will need to be applied everywhere where wheats are growing. In high rainfall areas, that is 500 mm and above 100 kilos of nitrogen per hectare and perhaps 80 of available phosphate P_2O_5 will probably be needed. There is no evidence to warrant the use of potash. During the course of our tour we only had one opportunity to see a well laid out fertilizer varietal trial - that was at the FAO farm near Debré. If a production program is launched and the Ford Foundation and CIMMYT are to be involved, then we should draw heavily on the Tunisian experience, in all of the technological aspects. The situation on wheat production in Algeria, is very similar to that in Tunisia. If this is done, it should be able to move this program forward rapidly. From an economic stand point, however, Algeria is a very different situation from Tunisia. Budget, per se, is not a serious problem to agricultural improvement. It is estimated at the present time that approximately 60 million dollars per year is being put into agriculture by the Algerian government. Much of this is invested in the state farm system. At the present time, very little support, if any, is going into the private farm section. It so happens that since the nationalization of the colon farms, at the present time all of the good agricultural lands are in the state farm sector and mostly the mountainous rolling land of poor productivity remains in the small farmers sector. The most serious social problem is now in that part of the economy which is held by the private small farmer.

There are some officials (i.e. Mr. Boukli) in the government of Algeria, who feels that a large dynamic program should be launched to produce

Mexican wheat during 1970 and 1971. He and several others believe that attempts should be made to grow 200,000 hectares during the forthcoming season. This is an unrealistic approach, for there are several reasons why this can not be realized:

1. shortage of technical supervisory personnel;
2. shortage of transport for moving the required amounts of fertilizer in the short period of time that is now available;
3. availability of fertilizer would also be a third problem.

But more than any other the success or failure of a large program will depend largely on the availability of people adequately trained to execute it. These are not in sight at the present time for coping with a 200,000 hectare project. Today, while meeting in the planning office we recommended that Algeria not extend themselves beyond an attempt to grow 40,000 hectares of Mexican wheat during the next year.

Although most of the agricultural production at the present time is in the state farms sector, it is still important to consider certain basic economic problems; for example: the ratio of price of grain to price of fertilizer, even though an order can be imposed on a state farm to fertilize. Unless there is an economic incentive for the farm director to apply fertilizer, with the expectation of increasing greatly the income, and consequently the bonus that will be paid to the farm workers, he will be reluctant to fertilize as recommended, and no imposition from above is likely to be very successful. Should the project fail because of diseases, or frost, or some factor that is beyond the control of an individual, somebody will have to suffer the consequences, therefore, it is wise to train people so that the area sown can be adequately handled. If it is successful it can be expanded subsequently, at a reasonable rate, for example for 1970-1971 to 40,000 hectares, for 1971-72 to 100,000 hectares, etc., if this is done, a training program for supervisors can probably keep pace and provide suitable leadership.

There is one great advantage here, from the stand point of fertilizer production. Algeria now has a large program of fertilizer plant construction underway, both for Ammonium Nitrate, and for Super Phosphate. Most of this production will become available during 1973. It is the aim of the government to stimulate and encourage the use of fertilizer and this could be done with a well organized extension program. If properly implemented it will greatly expand agricultural output, not only in wheat but also in other crops. It should point out here that if a highly successful production program can be launched with the so-called "Mexican Wheat Production Campaign" this will have many indirect benefits that will pay off on other crops. The success and the fever for change that will be generated will spread in many cases under its own initiative to other crops. Once a farmer either the collective or private farmer learns how to successfully fertilize one crop, he will begin to look for ways to improve the productivity

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of his other crops by using fertilizer and other improved cultural practices on them as well.

June 15 - Today our group had an opportunity to speak to a number of people in the planning office. With them we discussed the feasibility of launching a Mexican wheat program to handle a maximum of 40,000 hectares during the next year. We pointed out the dangers of trying to move too fast, for example in trying to handle 200,000 hectares, because of shortage of trained personnel, shortage of transport for mobilizing fertilizer and mobility of technicians and many other problems that undoubtedly would arise.

It was pointed out also, that if a production program was to be successful and to serve as a pilot model, it would have to have a straight forward and simplified administrative set up which would permit the implementation of recommendations from the technical director (Mr. Kadra) directly to the various levels of different organizations that intervene with the state farms. If the technical director is cut off from the state farm commissar or state farm manager, then this project will fail. He must not be forced to transmit his knowledge and to have his employees report to the director of the state farm organizations or there will be a tangle of bureaucratic procedures that is almost certainly sure to sabotage the whole operation.

The same sort of simplicity of operation must be devised for the utilization of research and extension budgets. It has been pointed out that although there were allocations made for the purchase of 4 vehicles during the past year for Mr. Kadra's program, because of complications in procurement, ret tape and bureaucracy, none of these vehicles have arrived at the project level at the present time, more than 9 months after the approval was given.

Similarly a complicated bureaucratic procedure of red tape is involved in moving technical personnel from one base of operation to the other. It requires at the present time a letter, authorizing such a mission signed by at least two administrative officials at different levels. Regardless of the system of government, if a country is to have a functional research, extension or production organization it cannot be achieved by cumbersome bureaucratic and administrative organization. If a scientist is not trustworthy, then he should be replaced. We all know that one cannot develop a functional organization by preventative administrative paper control measures. I believe that we got this point across to the officials in the planning office who seemed to be very realistic about our whole philosophy of the program orientation.

We were all tremendously impressed with the caliber of the people who were present at the meeting in the Planning Office. Included were Mr. A. Houhat, Agricultural Counsellor to the President of the Republic; Mr. Ourabah, Assistant Director of Plan; Mr. H. Ait Younes, Director of Agricultural Plan; Mr. Adeziane, Assistant of Agricultural Plan; Mr. A. Golusic, FAO

Expert, and Mr. N. Kadra, Director of Mexican Wheat Campaign.

The greatest restraint on all development throughout Algeria, Tunisia and Morocco, is the shortage of trained people. There is an acute shortage of Ingenieros Agronomos or BS degree equivalents in all disciplines. There are no people with advanced degrees. Even at the adjoint technics level or the sub-professional who will by necessity be required to assume much responsibility for the agricultural programs for the next five to ten years, there is an extreme shortage of man power.

At the present time the so-called "Mexican Wheat Project" is under the directorship of Mr. Kadra, a very confident young man and twelve young adjoint technics. One of these is located in each of the different administrative areas (provinces). There is, however, no transport for these men, and all operations are done by telephone, or by borrowing a vehicle from some other government office, which is both time consuming and requires no end of paper work. It is amazing that as much progress has been accomplished on wheat as has been achieved under these very adverse conditions during the past year.

At the present time if Algeria is to launch an Agricultural production program, it cannot wait for the Agriculture schools to start turning out a large number of technical people, which is being programmed for at present. We must take the adjoint technics that are available now, and give them rapid training in Tunisia and in CIMMYT in Mexico, to improve their capabilities. The same procedure should be used for training one or two Ingenieros Agronomos.

We pointed out both to the people in the Planning Office and in the Ministry of Agriculture, that CIMMYT philosophy on training is simple and straightforward. We want well motivated people; we want young people who have good intellectual and academic ability, because once they have finished the practical training with us, we hope that after several years of experience some of them will become candidates for advanced degrees. We want people who have good health so that they can stand the strenuous physical work which is a part of becoming a functional agronomist; and we demand that the government of any country for which we train people, assure these young trainees that once they have finished the training program, they will be reinstated and supported in the project for which they were trained.

It was pointed out that CIMMYT gives practical training designed to improve the skills of both adjoint technics and Ingenieros Agronomos. The CIMMYT training is largely "learning by doing". We have found it highly effective in transforming the wheat production programs in other countries. Exhibit "A" of such a success was the Ford Foundation Accelerated Wheat Production Program in Pakistan. The training program also has had impact in many other countries of the Near and Middle East as well.

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We have indicated to government officials at many levels the importance of developing a successful wheat program - since this is their first major agricultural program effort. If the wheat program is successful, the spirit of a "winning wheat team" can be used to initiate other programs in research and production on other crops. If on the other hand the Government of Algeria begins to transfer some of these trained people who have begun to show progress in the wheat program, too soon to other crops, they will destroy the wheat program, and they also will fail on the other projects to which they are assigned.

If Mr. Kadra is to be successful in his 40,000 hectare program for next year, he will need another twelve adjoint technics, since currently the Adjoint technics in each province, in addition to being responsible for the wheat program are responsible for all the other crops as well. Currently an adjoint technic can spend only a small amount of his time on the wheat project. Next year, the wheat project must have at least 10 to 12 vehicles for transport. Mr. Kadra must also have one Ingeniero Agronomo to assist him, if the program is to be organized as it should be.

RESEARCH AT INRA

Agricultural Research in Algeria is in its infancy. Today. however, we went to INRA and were pleased to find three young French scientists working with a group of young Algerians. The Algerian technicians were young, capable, and apparently very interested. The French scientists have only been in Algiers for six months, but they have made good progress in getting research underway on wheat.

Among the Algerians assigned to INRA there are some young enthusiastic people, there is also one or two ultra conservatives that one finds always in all countries. These ultra conservatives are always the greatest obstacle to progress. It appears that these built in obstacles to change can be circomvented if a program is launched in which Ford Foundation and CIMMYT is involved. These obstacles to progress are not new to our experiences.

If the research work is to be strengthened it must include agronomic research, (meaning soil fertility, cultural practices) it must include plant breeding, plant pathology and entomology. Subsequently other disciplines can be added as needed.

INRA at present does not have adequate facilities for experimental plots. However, within the next year, approximately 400 hectares, about 5 kilometers from the INRA headquarters will become available. At the present time, a large portion of the area that was formerly given to experimental plots has been taken over for the building of the new agricultural school; but from the physical facilities of the INRA, a separation of 5 kilometers is not serious, and at this location adequate land is available.

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While we were at INRA we pointed out and explained to their staff the international aspects of the CIMMYT wheat program (that CIMMYT and the Ford Foundation-Rockefeller Foundation, the Mexican Government) has been involved in, for many years. We gave them an idea of how it is handled and how it is coordinated with national programs in many parts of the world.

I think that before we left we had changed many ideas about the possible value of collaboration with the Tunisian, Moroccan and Mexican programs, from what they were at the beginning of the meeting. I am not sure, however, that the Director of Research of INRA was convinced, but with this possible exception, virtually all of the other people, I am sure, had changed their ideas diametrically from what they were when the discussion began.

What are the challenges or opportunities for the Ford Foundation and CIMMYT in Algerian Agriculture?

We believe that the Ford Foundation and CIMMYT jointly have a unique opportunity to assist the government of Algeria in the training of young scientists and assisting in developing research in the fore mentioned disciplines. We believe that our know-how in research and training is unique and we could help them move forward aggressively. We have a lot of genetic wheat materials available, not only at the CIMMYT base but also in the Tunisian program, the Pakistan, the Indian, the Lebanon, the Turkish, the Agertinian program, all of which can be brought to Algeria when needed, or when they are in a position to exploit its potential value.

Although the Algerian Accelerated Production Program of Mexican Wheat is very important - (prime importance to Algeria) we feel that CIMMYT and Ford Foundation should not become directly involved in this project at the present time. It might be desirable to serve in a minor role as a consultant to their overall Mexican Wheat Production Program effort.

If we were to participate directly in this production program, it would be absolutely necessary to assign here at least one of our most experienced agronomists to supervise with the coordinator Mr. Kadra, the production effort. In the first place, CIMMYT has only a few experienced scientists who can bring together all of the disciplines which are involved in wheat production, namely agronomy, soils, breeding, pathology and entomology as well as a good sense of farming. This breath of capabilities is something that comes from wide experience. At the present time we have only three, or at the most four people, with this experience, and they are already committed to programs in other countries.

Therefore, if we began to use inexperienced people in the production program at the present time, and at the same time assume the responsibility

for the success or failure of this aspect of the program we are likely to fail. We suggest that anything that Ford-CIMMYT has to do with the production program be confined to, perhaps one or two visits each year by the experienced people as friendly consultants, but nothing more.

This in general summarizes the situation in Algerian wheat production. If the forementioned programs are implemented, it should be feasible to produce the wheat that Algeria needs within five years. At the present time the production runs about 1,800,000 tons and consumption runs about 2,600,000. The deficit or difference being between 600,000 and 700,000 tons annually, depending on the season. Consumption is growing rapidly, and the production must be increased, not only to keep pace with the population growth, but also to correct the deficit.

This can be done, and done within five years at the maximum if the program is attacked vigorously. This is the challenge.