PD-AAA-173-A1

6080058 (8)

88p.

BEST AVAILABLE DOCUMENT

CEREAL PROJECT REPORT

MOROCCO

1970 - 1971

USAID/Rabat

1/1/71

Table of Contents

		Page
I	Introduction	1
II	Personnel	1
III	Growing Conditions	3
IV	Fertilizer Research	5
V	Production Management Research	20
VI	Varietal Research	43
VII	Farm Demonstrations	52
VIII	Commercial Production	61
IX	Training	63
X	Conclusions	65
XI	Appendix	67

I. INTRODUCTION

This report summarizes the activities of the Cereals Project personnel during the 1970-71 planting season. These personnel work with counterparts or assistants from the Moroccan Ministry of Agriculture and Agrarian Reform, under the terms of the annual project agreement for the "Increase in Cereals Project, No. 608-11-130-058."

Under the terms of the agreement, the services of eight American technicians are provided to the Moroccan Ministry of Agriculture. This includes personnel furnished under contract by the Near East Foundation and CIMMYT (International Center for Wheat & Maize Improvement in Mexico). The CIMMYT technicians are furnished under of the regional project No. 698-11-130-173, entitled "Wheat Improvement in North Africa". This same project also provides personnel for the Accelerated Cereals Project in Tunisia. Project activities in previous years are summarized in the following reports: "Cereals Project Report - Morocco (1968-69)" "Cereals Project Report - Morocco (1969-70)".

II. PERSONNEL

The USAID-supplied personnel are as follows:

Dr. Ralph J. Edwards (Direct Hire)	Project Leader	5 years
Dr. William Hall (CIMMYT)	Research Agronomist	2 years
Dr. Aristeo Acosta (CIMMYT)	Plant Breeder	2 years
Mr. Fran Bidinger (CIMMYT)	Research Agronomist	3 years
Mr. William Davis (Direct Hire)	Extension Agronomist Meknes	3 years
Mr. Herbert Floyd (NEF)	Extension Agronomist Casablanca	3 years
Mr. Arlan McSwain (NEF)	Extension Agronomist Kenitra & Marrakech	3 years
Mr. Clyde Searl (NEF)	Extension Agronomist Fes	1 year

Dr. Edwards is responsible for overall project direction and coordination. He is also responsible for liaison with CIMMYT, NEF, the Rockefeller & Ford Foundations, and the Moroccan Ministry of Agriculture. He is regularly in contact with Mr. Toulali, of the Ministry's Division of Studies and Economic Affairs, Mr. Mohamed Mouline, of the Ministry's Division of Agricultural Development, and Mr. Mouline M'Hamed, of the Ministry's Division of Agricultural Research.

All three research personnel are based in Rabat, where they have the opportunity of maintaining daily contact with their Moroccan Research Organization colleagues primarily Mr. Bouzoubaa, chief of the Cultural Practices Research Section for Mr. Bidinger and Dr. Hall and Mr. Tegyey, chief of the Fall Cereals section for Dr. Acosta.

The four area extension agronomists are assigned to the four important wheat-producing regions of Kenitra, Casablanca, Fes, and Meknes. Mr. McSwain (based in Rabat) also conducts activities with the government-owned, irrigated farms near Marrakech. Mr. Searl, based in Fes also works with Taza province and the irrigated areas of the Basse Moulouya.

III. GROWING CONDITIONS

A. Weather

As in all agricultural endeavors, weather played a major role. Normally, rains begin in late October or early November. These first rains soften the soil surface so that farmers may begin plowing. They also provide moisture for germinating the wheat which is traditionally sown in slightly moist to wet soil.

In 1970, very little rain fell before late December, generally starting about December 22. Modern farmers or those having some modern equipment were able to prepare their fields and sow them before these rains came, even though the ground was hard and dry. Traditional farmers, working with animal-drawn implements, were unable, in many cases, to get the wheat in the ground before the rains. Thus, a large area, perhaps 15% or more of the total acreage, was not sown before January 1, when the frequency and intensity of the rains declined.

However, most of the research trials and demonstrations carried out by the Ministry of Agriculture which involved AID technicians, were sown on time in nearly-ideal conditions. Seedbed preparation was generally good. The rains, which arrived immediately following seeding, in many cases, could not have been better timed.

Rains, once they began, continued throughout January, and early March, at well spaces intervals, alternating with periods of warm, brilliant sunshine. Late March and most of April were dry and warm leading to thoughts of an early harvest and possible yield reductions for late-planted fields because of moisture stress. This quickly changed with rains starting again the last part of April and continuing through May and even into June.

As a result what appeared in March to be a nearly normal or even slightly dry year changed quickly into a season with rainfall nearly 40% above the long-term average in most areas (Table A 1). Although some yields were reduced because of disease losses this was more than balanced by good production from late-maturing fields. As a result national production in wheat was estimated to be the second highest on record, exceeded only by the extremely favorable season of 1968-69.

B. Disease, Insects and Weeds

An early build-up of rust spores -both leaf and stem rust- in the Casablanca area in March combined with the warm, generally sunny weather of March and April led to expectations of probable heavy losses from these diseases, particularly for the late-maturity durums which are highly susceptible. On the other hand the weather had completely suppressed any development of Septoria and all indications were that 1970-71 would be almost completely free of this disease.

The abrupt and unseasonable change which occurred in May and June with cool, overcast days interspersed with rain, completely reversed the situation. The development of the rusts, particularly stem rust, which develops best under warm humid conditions was also completely stopped and few losses were noted. Some losses to leaf rust which develops at lower temperatures were found but these losses were not widespread and were severe in only a few locations.

On the contrary the conditions were perfect for Septoria development which seems to require low light intensity in combination with low temperatures and high humidity. Although losses were nowhere near as widespread as in 1968-69, occasional fields, particularly when planted late suffered reductions of 15-20%. This disease development did, however, permit good selection for resistance in the breeding nurseries.

Insect losses were on the same order as the previous year with reductions of 10-20% due primarily to Hessian Fly and stem sawfly found in some fields. Reduction from insects are probably of greater annual magnitude than losses from diseases but are usually not recognized since the effect is usually less dramatic than disease epidemics. The lack of freezing weather and restricted means of control through cultural practices makes the development of insect resistant varieties of topmost priority.

Weeds were once more a major problem since dry conditions in November and December did not permit weeds to be destroyed prior to planting. Instead weeds and wheat germinated together and weeds were thus very serious early in the season. The greatly increased use of herbicide, mostly with back-pack sprayers enabled some control of weeds during February and March. However the late rains produced a heavy regrowth of weeds late in the season, resulting in harvesting problems and particularly heavy harvesting losses in combine-harvested fields. Wild oats were particularly troublesome, as before, and easily remain the major weed problem in Moroccan wheat production.

IV- FERTILIZER RESEARCH

A. Introduction

Fertilizer experiments were planted at sixteen locations in the major dryland wheat regions of Morocco during the 1970-1971 season. Fourteen locations yielded useful data; the results of thirteen of which, conducted on farmers' fields, are presented here. The data for the fourteenth, a study of varietal-nitrogen interaction conducted on the Merchouch Station, is not yet complete.

Nitrogen rate and method of application trials were planted at all locations. The design of the trials remained largely unchanged from the 1969-1970 season, except that a different series of nitrogen treatments covering a lower response range was used in 450 mm and lower rainfall zones. Table I gives the various rates and methods of application for the two rainfall zones and the basic experimental method for the nitrogen trials.

The trials were planted over a wide range of soil types and rotations representative of the principal dryland wheat areas of the country. As these two variables, soil and rotation, in conjunction with rainfall (considered as a regional variable) are the principal determinants of nitrogen response, the goal of the program has been to build a general picture of the quantitative effect of each on nitrogen response, to use in making recommendations for the specific case.

A number of the nitrogen trials were seeded with two varieties: Tobari and either one of the two new varieties of Italian origin (BT 908 and BT 3597)or the Moroccan variety BT 2306 . Although the Italian varieties appear to have yield potential and fertilizer response similar to that of the Mexican varieties, the contrasting disease resistance and susceptability patterns of the two types may serve as insurance against losses to disease and may permit some measurement of the effects of disease on nitrogen response. The variety BT 2306 was planted with Tobari in three locations in the drier zone to compare the fertilizer response of the dwarf and traditional varieties under limited moisture.

Two trials in the less than 450 mm rainfall zone were seeded under a dryland agricultural system in comparison with the conventional fertilizing and seeding system. The purpose of these trials was to observe the effect of reducing the number of operations and the cost of seeding on nitrogen response and yield. Table I gives the details of the two systems.

Phosphate and potassium trials were continued on a reduced scale at five locations since little response to either element was found the previous year. Table I gives the various rates of each element employed.

Resume of Results - Nitrogen Trials

The results of the nitrogen experiments and data on rainfall, rotation etc.. for each location, are summarized in Tables A2 and A3. The rainfall pattern was generally favorable for both good yields and good nitrogen response at all locations. The magnitude of both was conditioned by a variety of factors, but a profitable response to applied nitrogen was obtained under conditions of good management as well as poor management.

Averages for the entire series of nitrogen trials show a 58% yield increase of 11.7 Qx/ha over a check (non nitrogen fertilized) treatment average of 20.3 Qx/ha (Table A3 a). This means that at the thoretical optimum rate of 67 Kg/Ha (calculated as the average of the optimum rate for each trial), each kg of nitrogen applied produced 17.5 kg of grain. This is a very favorable return which under Moroccan's support price for wheat, is equivalent to a return of 7.5 dirhams per dirham invested on fertilizer nitrogen (at the optimum rate).

The average optimum rate of 67 units/ha (the optimum rate is defined here as the lowest rate giving a yield not statistically different at the 5% level from the maximum yield obtained in the trial) appears to be a reasonable rate. The individual optimum rates however, varied over the entire range from 0 to 120 units of N/ha., due to various factors of management, previous crop, climate etc.. As these factors are basic to developing recommendations as well as interpreting the experimental results, they will be considered individually in the following sections in reference

-Table I-

TYPE OF TRIALS PLANTED

A. Rate and Application of Nitrogen: Rainfall over 450 mm

Treatment	Kg/Ha at Seeding	Kg/N at topdressing
1 (control)	0	0
2	40	0
3	40	20
4	40	40
5	60	0
6	60	20
7	60	40
8	80	0
9	80	20
10	80	40
11	100	0
12	120	0
13	160	0

B. Rate and Application of Nitrogen Rainfall under 450 mm

Treatment	Kg/Ha at seeding	Kg/N at Topdressing
1 (control)	0	0
2	20	0
3	20	20
4	40	0
5	40	20
6	60	0
7	60	20
8	80	0
9	120	0

C. Rate of Potash and Phosphate (all rainfall zones)

Treatment	Kg P_2O_5/Ha	Kg K_2O/Ha
1 (control)	0	40
2	40	40
3	60	40
4	80	40
5	120	40
6	60	0
7	60	80

D. Dryland System Experiment - Nitrogen rates are the same as listed above (Section B)

	Dryland system	Conventional System
- Seeding rate	55 kg/ha	100 kg/ha
- Row spacing	35 cm	17,5 cm
- Phosphate application	20 units banded at seeding	40 units broadcast before seeding
- Nitrogen application	Broadcast before seeding	broadcast before seeding

Table I (cont'd)

E. General Information applies to all trials

Statistical design - Randomized complete block in four replications

Plot sizea - 2,5 X 15 m (seeded)
- 1,5 X 15 m (harvested)

Fertilizer Application: Phosphate and Potash were broadcast 4-6 weeks before seeding at the rate of 60 kg P_2O_5 and 60 kg K_2O/Ha.

applied as 0-23-23 (a mechanical mixture of TSP and Potassium Sulfate)

Nitrogen was broadcast before seeding as ammonium sulfate

Nitrogen topdressing was done with Ammonium Nitrate.

All fertilizer was applied with a specially designed plot spreader.

Seeding: Rate of 100 kg/ha in 20 cm drill rows.

to the results presented. Tables A2, A4 and A5 present information on rotation and management, rainfall and soil analysis, respectively. Table A6 gives the complete yield data and statistical analysis for all treatments of all trials.

B. Discussion of Nitrogen Experiment Results

1. Rainfall

Although the rainfall pattern in general was favorable for excellent yields, the distribution was very abnormal for Morocco. The first effective rains in the northern part of the country did not fall until the final week of December (e.g. Ras Tebouda and Sidi-Kacem, Table A4). The seeding of the experiments in this area was delayed until mid December, however germination and emergence was consequently good. The one exception to this was the trial at Merchouch which was seeded on December 2 into very low soil moisture. Emergence was very irregular and the resulting stand poor, since much of the seed was not placed in sufficient moisture to complete germination and emergence and did not survive the period of drought during December. Soil test results (Table A5) indicate that the soil at this location has a very low field capacity and a low percentage of useful moisture. In contrast, seedings made during the same period on the nearby Merchouch Experiment Station where the soil moisture-holding capacity is higher, emerged irregularly but completely and stands were excellent.

Seedings were also made in early December in the Phosphate Plateau area (Khouribga & Oued Zem) but here a chance thundershower the day following seeding provided sufficient moisture for emergence and growth until the rains began in late December.

The major effect of moisture on yields in several locations was the lack of rain from mid-January until mid-March. Shortage of moisture plus warm February temperatures forced Tobari into early heading at the Sidi Kacem location. Heads formed were markedly small in size and the variety yielded 5 to 10 qx/ha less than BT 908 at the same location. The daylength sensitive character of this latter variety delayed head development until several weeks later, after the rains had recommenced, and it appeared

to suffer no loss in yield. The effect was visible on fertilizer response as well, since BT 908 attained its maximum yield on less applied nitrogen (60 units) than Tobari (80-100 units) see Table A6. Winter moisture was also deficient at the Ben Ahmed and Khouribga locations, but this is a normal occurence for the region, partly due to the very shallow soils. The wheat at both locations made a good recovery on the abundant spring moisture and yields were excellent at Khouribga where Septoria was not a factor.

The rains began again in mid-March and continued almost without interruption until early June, delaying harvest approximately three weeks. Fortunately, the lack of winter moisture in most locations prevented a buildup of Septoria innoculum. Otherwise the disease could have reached epidemic proportions under the cool wet spring conditions. Estimates of damages from Septoria to the crop as a whole were variable but losses appeared to be mainly a local phenomenon in both the experiments and the general crop.

The 1970-71 season was an excellent illustration of the varied nature of the effect of rainfall and rainfall distribution on yield and fertilizer response. The farmer however, is generally unable to effectively use rainfall data when deciding on his fertilization program since the highly variable distribution pattern largely negates the value of the long-term averages.

2. Variety

The results of comparing the nitrogen response of two varieties in trials at several locations were more marked than expected. BT 908 significantly outyielded Tobari at all three locations in which the two were seeded together (Ras Tebouda, Sidi Kadem and Merchouch). Daylength sensitivity appeared to give BT 908 the advantage at Sidi-Kacem as already discussed and probably played a role as well at Merchouch where February rainfall was also subnormal. Septoria was probably a factor at both locations. The disease was not sufficiently severe to affect the filling of the kernels as indicated by the hectoliter weights (Table A6) but was apparently sufficient to reduce the head fertility. This effect appears to be fairly commonly associated with moderate Septoria conditions. Third and fourth florets develop but fail to either pollinate or fill, resulting in reduced, but not always unacceptable yields, as at Sidi Kacem.

The explanation of the yield differences between BT-908 and Tobari at Ras Tebouda is less obvious. Moisture appeared to be adequate the entire season (Ras Tebouda is a hill location with cool winter temperature and deep soils). Some Septoria was present but confined mainly to the lower leaves. Head fertility however, appeared to make the difference; BT 908 regularly set four florets and Tobari did not. Tobari in the same location the previous year under dry spring conditions, made a 50 qx/ha yield. Whatever the reason for the variety yield differences they appear to be associated with the wet, cool spring weather.

Summary data in Table A3b indicate the effect of varietal adaptation on fertilizer response and fertilizer economics. Fourteen ddditional kilograms of nitrogen were required to achieve virtually the same yield increase with Tobari as with the two Italian varieties, and at a lower yield level as well. The kilograms of grain returned per kilogram of nitrogen applied were 30% higher in the case of the Italian varieties than that of Tobari.

Tobari outyielded BT 2306 in both locations in which they were harvested (Khouribga and Oued Zem). The principal factor in Oued Zem was an epidemic of stripe rust to which BT 2306 is susceptible and Tobari resistant. Even in the absence of disease however Tobari would certainly have outyielded BT 2306 since rainfall was sufficient for the superior yield potential of the semi-dwarf variety to express itself.

At Khouribga the difference in yield was less marked at low nitrogen rates but Tobari's yield advantage appeared at higher nitrogen levels where it outyielded BT 2306 by approximately 6 qx/ha (Table A6). In both cases the return on applied nitrogen and the total profitability (Table A 3a) was as much as 100% greater for Tobari than for BT 2306. Varietal adaptation is different for the central zone than for the northern zone due to climate difference, nevertheless the relative responses of adapted and non-adaptated varieties are similar.

3. Previous Crop and Indigenous Nitrogen Fertility

These two factors are considered together since their effect on nitrogen response is often a joint one, one factor compensating for or reinforcing the other. By a proper choice of laboratory chemical and biological tests, it is possible to distinguish between the relatively slow and regular release of nitrogen from the stable organic fraction of the soil and the release or uptake of nitrogen from the easily decomposed residues of the previous crop, or the nitrogen accumulated during a fallow cycle. This is obviously desirable in order to build a general case for the effe of the preceeding crop in the rotation apart from the effect of soil type. The knowledge of the general effect of the cropping sequence in conjunction with a knowledge of the native nitrogen fertility of a given soil then permits the farmer to make a more precise judgement of the fertilizer nitrogen required.

Unfortunately it was not possible to have either nitrate-nitrogen or nitrogen release (incubation) tests performed on the soil samples. The only nitrogen values given in table A5 are those of total nitrogen, available and non-available. In a non-quantitative way, the effect of cropping sequence on wheat yields can be estimated from the check plot (0 nitrogen) yield and the percentage yield increase from applied nitrogen. When taken in conjunction with the soil organic matter level, the degree of nitrogen response indicates the change in nitrogen status of the soil during the previous crop cycle (s).

The two locations following fallow (Ras Tebouda and Oued Zem) both gave excellent check plot yields, 35.0 and 27.5 qx/ha, respectively, but a low response to nitrogen, in the order of a 40% yield increase. Soil organic matter (Table A5) was in excess of 3% at both locations. Undoubtedly the accumulation of nitrogen from the mineralization of the organic matter during the fallow year accounted for the good check plot yields and relatively modest nitrogen response.

The majority of locations following a legume (Moulay Idriss, Souk el Tleta, Merchouch and Sidi Rahal) showed good check plot yields (Table A3a). All four locations also had organic matter contents in excess of 2.2% and the mineralization of the stable organic fraction as well as the preceding crop undoubtedly contributed to the relatively high check plot yields. However, two locations following a legume crop failed to produce good check plot yields. In one case at Settat soil test data indicated an organic matter content of only 1.7%, the lowest of all locations. No soil samples were taken at El Hajeb the other location, but the soils of the Saïs plain are found to be generally low in organic matter. This being the case, it appears that soil organic matter, relative to the effect of the previous legume crop (particularly edible legumes), may play a considerably greater role than was previously suspected.

In the three locations following cereals (El Gara, Ben Ahmed, and Khouribga), check plot yields were very low and yield increases were in excess of 100% at El Gara and Khouribga (Table A3 a). Soil organic matter content at Ben Ahmed and Khouribga was good, 3.89% and 2.89% respectively, but the presence of low nitrogen residues from the previous crop would indicate competition between soil micro-organisms and the wheat crop for the mineralized nitrogen and a resultant lower yield. Organic matter content and total nitrogen were very low at El Gara (1.8% and 0.08% respectively); but at this location the response to applied nitrogen was nearly a three-fold yield increase, although the overall yield level was no higher than at Khouribga. Nitrogen was also more efficient at this location than at any other with each kilogram of nitrogen producing almost 30 kilograms of grain. The extreme nitrogen deficiency was undoubtedly a combined effect of previous crop and low soil organic matter.

At the Sidi Kacem location, check plot yields following sugar beets were excellent and response to applied nitrogen was low despite a soil organic matter content of only 1.8%. Since sugar beets are more heavily fertilized (up to 120 kg/ha of nitrogen) than any of the other previous crops studied, there is undoubtedly a fertilizer residue as well as a plant residue effect. This was apparently sufficient to overcome the effect of low soil organic matter level.

The need for more precise data on the modifying role of both previous crop and soil organic matter is obvious. These are factors which can be quantitatively assessed before the season (unlike the weather) and which can be used effectively by the farmer and the extension agent in achieving maximum yields and fertilizer efficiency.

4. Management

Management is undoubtedly predominant among the factors affecting yield and nitrogen response in commercial wheat production. Unfortunately the importance of this factor was amply illustrated in several of the experiments. Poor stands and subsequent weed problems at Merchouch and Berrechid reduced yields by an estimated 30% in the former and up to 40% at the latter location.

Nitrogen response was satisfactory at Merchouch, with an average return of 19.5 kg of grain per kilogram of nitrogen applied and a yield increase over the check yield of approximately 9.5 qx/ha. (Table A3 a). The predominant effect of poor management in this case was to reduce total yield and hence the profit to the farmer. With adequate stands, yields should have average 40-45 qx/ha at the nitrogen levels which were applied instead of the 30-35 qx actually recorded.

Nitrogen response as well as yield were poor at Berrechid as stands were so decimated by wireworm and Hessian fly that there was literally too few plants per unit area to use the available moisture and fertility. Yet conditions were favorable for good yields (35-40 qx/ha) and an excellent nitrogen response since the crop previous to the fallow year was sudan grass and considerable residue was still visible. Nevertheless the minimal response from nitrogen due to the low overall yield level was inadequate to make nitrogen application economically attractive to the farmer.

5. Splitting the Nitrogen Applications

Splitting the nitrogen rate between preplant and tillering applications generally resulted in a small yield advantage (up to 2-3 qx/ha - Table A6) as compared to a single application of the entire amount at planting. Only very seldom however was this

advantage statistically significant, despite its regular appearance. The only instance in which a split application was statistically superior was at El Gara (Table A6) where the experiment followed a good wheat crop from the previous year. Undoubtedly a significant portion of the preplant nitrogen was diverted to microbial decomposition of the crop residue since the soil was very low in organic matter and total nitrogen (Table A5). In contrast the second application was largely available for the crop since the micro-organism growth should have leveled out by the time of the second application.

Topdressing (increasing the total rate applied through a second application at tillering) was effective in increasing yields generally as related to the total amount applied. That is, applying topdress N following a 40 unit/ha preplant rate tended to be more effective than was topdressing applied after 60 or 80 unit preplant rate since the lower preplant rate was often insufficient for maximum yields. There was generally little difference in the 20 and 40 unit topdress rates however.

A split application is employed mainly as a hedge against loss of preplant nitrogen under excessive moisture conditions early in the season. Where this is a real danger, the practice could appear to be justified, provided the second application is applied at the proper time. Topdressing applied later than the onset of tillering rapidly loses its effectiveness. When early loss of nitrogen is not a problem no evidence of yield reduction has been found with either a 1/2 - 1/2 or 2/3 - 1/3 split of total nitrogen at either high or low nitrogen rates. The small yield gain achieved (which would appear to be real because of its regular occurance) is sufficient to pay the cost of the supplemental application. The major difficulty with the system is the risk of late application and loss of effect due to climatic conditions, other farm work, etc., which often preclude topdressing at the proper time.

C. Other Trials

The phosphate and potassium trials continue to show no response to potassium and little response to phosphate. No responses have been found in excess of the recommended rates of 40-60 kg/ha (P_2O_5) in two years of trials. The experiments have been conducted principally on modern farms where soil phosphate levels have evidently been maintained by years of fertilization.

Two so-called "dryland" experiments were conducted in which a seeding in 35 cm drill rows at a rate of 55 kg/ha was compared to 17.5 cm drill rows seeded at 100 kg/ha under different levels of nitrogen. Results were inconclusive at one location and the dryland system was inferior at the second location. These results were not at all surprising since the heavy spring rains favored the denser plant population and more even distribution of the plants.

D. Recommendations on Nitrogen Use

Table 2 contains recommended nitrogen rates for the principal dryland wheat regions of Morocco. Each region is characterized by a particular rainfall regime and/or a set of soil types and depths which largely determine the nitrogen requirement. The recommended rates are based on data computed by the Station des Améliorations Culturales and recommendations published by them as well as by these experiments conducted on farmers' fields and personal observations.

Two rates of nitrogen are given for each area, depending upon the crop preceding wheat in the rotation. There is undoubtedly some overlapping in the classification, especially in the case of wheat following fallow. The distinction between a clean fallow and a weed or pasture fallow is often difficult to make as many farmers prepare a fallow very late in the year. The limited experience to date also indicates that the beneficial effect of a clean fallow is closely related to the organic matter and/or native fertility of the soil. In general an increase of approximately forty units of nitrogen per hectare or possibly sixty units following safflower or a very good cereal crop is required for maximum yields of wheat following the second category of previous crops (cereal, oilseed and weed fallow). Unfortunately most of the research experience both on and off research stations has been on a wheat-legume rotation and less information is available on which the base recommendations for second-crop wheat or wheat following an oilseed crop.

- TABLE 2 -

RATE OF NITROGEN RECOMMENDED FOR THE MEXICAN AND ITALIAN VARIETIES IN THE RAINFED AREAS OF MOROCCO

	Rainfall mm	Depth of soil cm.	Rate recommended in Kg/Ha		Method and Application
			Rotation I *	Rotation II **	
Gharb Plain	456-600	100 +	60	80	One or two applications
Pré-riffian mountains (Meknes-Fes-Taza-Provinces)	400-800	50-150	60-80	80-120	Two applications
Saïs Plain	500-600	50-100	80-100	100-120	Two applications
Rommani Plateau	450	75-100	60	80-100	Two applications
Chaouia	350-400	50-100	60	80	All at seeding
Upper Chaouia	300-400	50	40	60	All at seeding
Doukkala	300-350	50-100	40	60	All at seeding
Phosphate Plateau	300-400	50	40	60	All at seeding

* Rotation I : Wheat following sugar beets, legume (grain or forage) or clean fallow

** Rotation II: Wheat following oil seed crop, cereal (grain or forage) or weed fallow.

Table A3 b compares the results of the 1970-71 experiments with the recommended rates. For the high rainfall zones the optimum rates in this year's experiments paralled very closely the recommended rates for the various regions (64 and 68 units/ha respectively). Recommendations for this zone are based on adequate available moisture for yields in the 35 to 50 qx range. Moisture limitations on yield appear to be sufficiently infrequent that recommendations can be made for maximum yields based on soil, crop rotation and varietal factors.

In the intermediate rainfall zone the recommended rates were inadequate for maximum yields this year, under a rotation favorable to the wheat crop (wheat following a legume or a clean fallow). Recommendations for this zone in general are based upon a probable shortage of moisture during some period of the growing season, often the spring. As the rainfall, and especially the spring rainfall, in this zone was exceptional during the 70-71 season, the response level was considerably higher than the recommended rates.

In addition the rotation favorable to the wheat crop generally coincides with the better watered and deeper soil areas of this intermediate zone. Particularly in areas of shallower soils, the wheat-legume rotation rapidly becomes marginal and is replaced by a wheat and pastured-fallow rotation or by continuous cereal. Thus the recommended rates for the wheat-legume rotation are more likely to be insufficient in a moist year than are those for the continuous wheat or wheat-pasture rotations which are in less favorable areas of this zone and where yields are also limited by other factors than moisture alone.

The recommendations for these latter two rotations were accurate for this year but by the above argument may be excessive for a year in which spring moisture is limited. Recommendations have been established on the high side in order to assure full use of limited available moisture. These areas however are capable of producing yields of 20 qx/ha with the proper varieties if full use is made of available moisture and can contribute significantly to commercial production.

E. CONCLUSIONS

The fertilizer program is now at the stage where it can function smoothly if general problems relating to wheat committee organization and personnel can be solved. Despite these limitations the program has been able to develop a regular series of off-station trials, prepare a set of nitrogen recommendations for farmers for the new varieties and demonstrate that excellent yields can be obtained with these recommendations on farmers fields.

Further work should continue to expand the geographic area covered by the experiments, to refine the general recommendation for situations in which response has not been consistant, and to begin to study the fertilizer response of the new durum varieties as they become available.

V. PRODUCTION MANAGEMENT RESEARCH

A. Dates of Seeding

1. General

The results of this year's work generally confirm the conclusions drawn from previous experiments. The new, short-strawed, fertilizer-responsive wheat varieties should not be sown before December 1st. Their early maturity requires delay in seeding to allow better adaptation of growth stages to the rainfall pattern and disease cycles of Morocco. With the abundance of late season rainfall, the experiments conducted this year permitted excellent observations on the relationship between diseases and stage of growth. Growth curves for wheat varieties at four stations are shown in Fig. I to IV. These curves were constructed from observations of the stage of growth that the wheat of each seeding date had obtained by the date indicated. A study of the curves indicates the stage of growth at which wheat from a certain date of seeding would be most susceptible to Septoria during the wet period. November seedings were heading in late February and March when rain during this time promoted development of Septoria. Rust spores also began to build up during the same period as temperatures became warmer. Septoria is more damaging when it attacks the plant at heading or post-heading stages of growth. Rusts on the other hand cause greater damage when they attack the plant in early stages of growth and persist until after heading or until maturity.

November seedings of Siete Cerros and Tobari were badly attacked by Septoria. Varieties BT 908 and BT 2306 showed some resistance to Septoria and at the early seeding dates generally escaped severe damage from rust.

December seedings did not head until late March or early April. Above normal rains at this time continued to promote the development of diseases. Siete Cerros and Tobari were less affected by Septoria, because of their earlier stage of growth. The rust susceptible varieties BT 908 and BT 2306 began to show more damage from rust because of their delayed maturity.

Figure I

Growth Curves Wheat Varieties from the date of Seeding Experiment at Ellouizia in 1970-1971

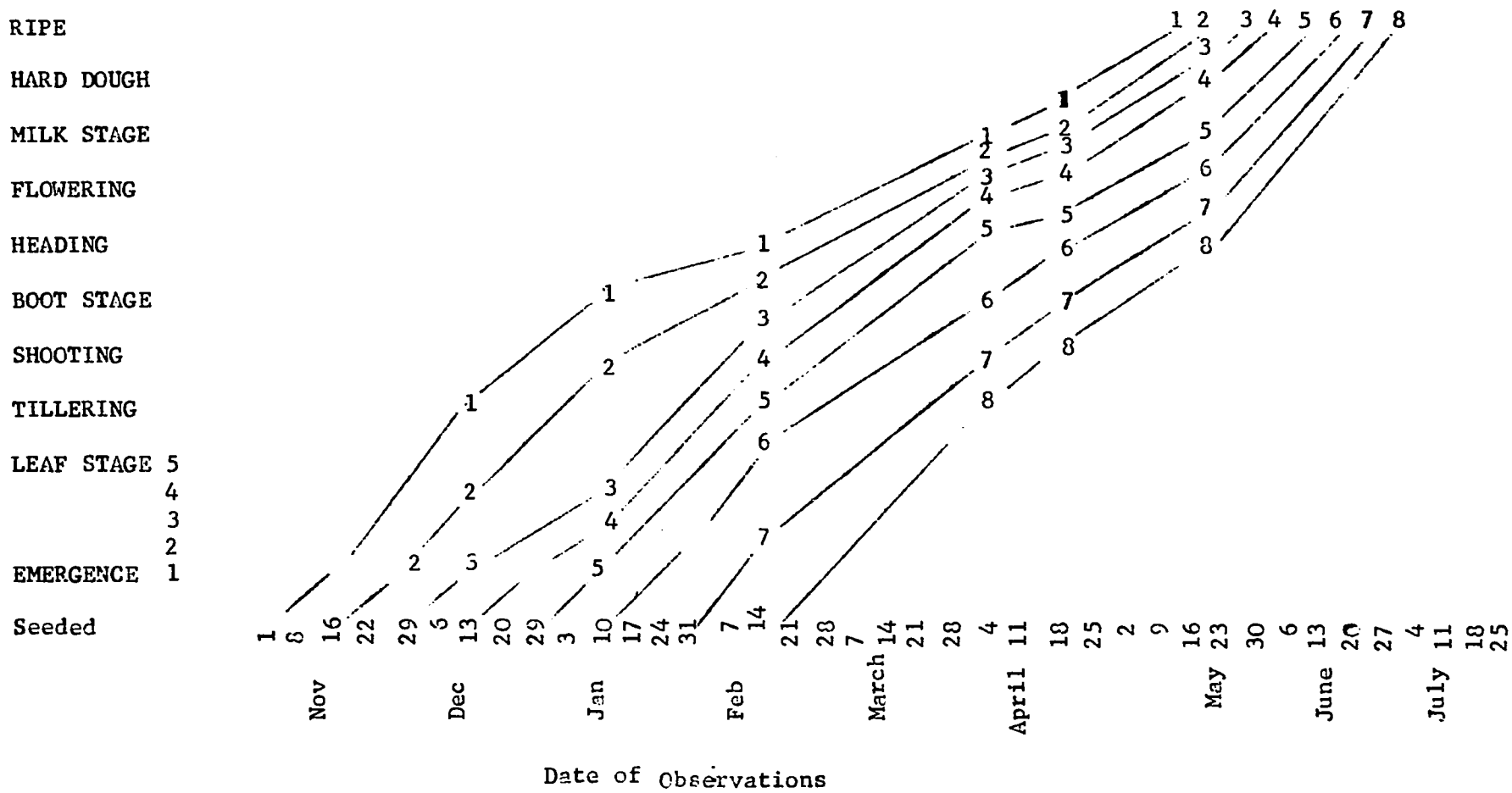
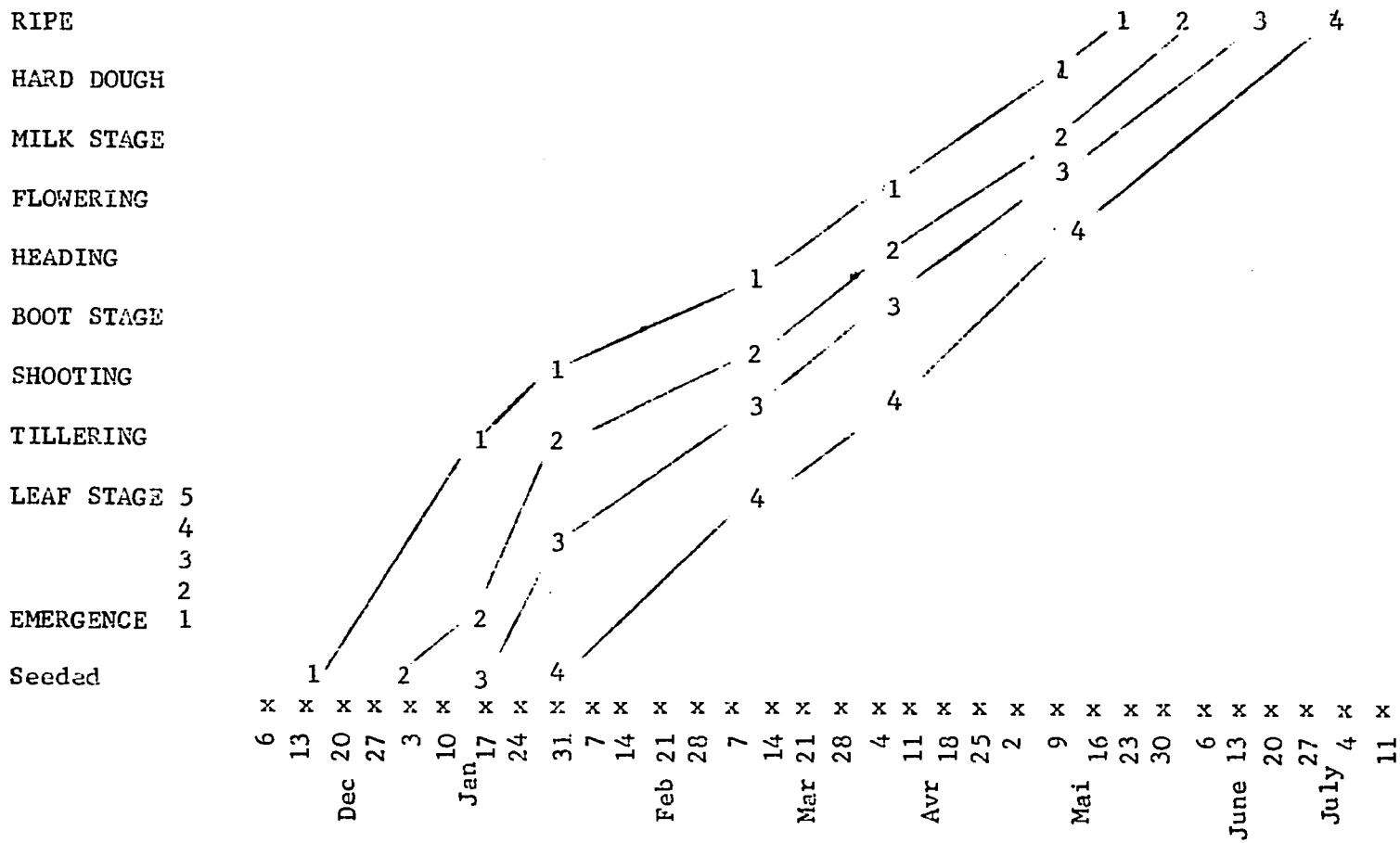


Figure 2 Growth Curves Wheat Varieties from the Date of Seeding Experiment at AIN CHAIB in 1970-1971



Date of Observations

Figure 3 Growth Curves Wheat Varieties from the Date of Seeding Experiment at BERKANE in 1970-71

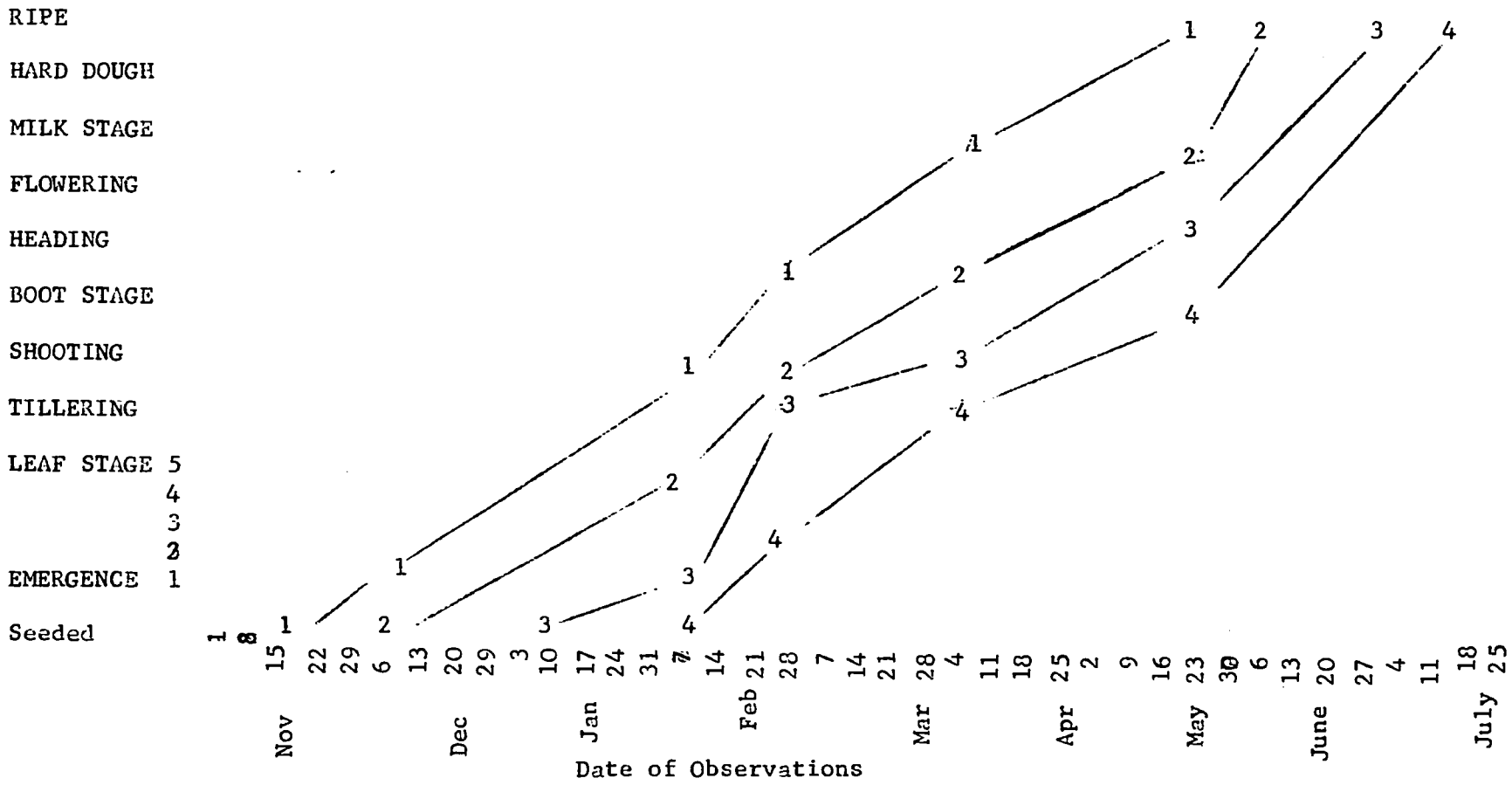
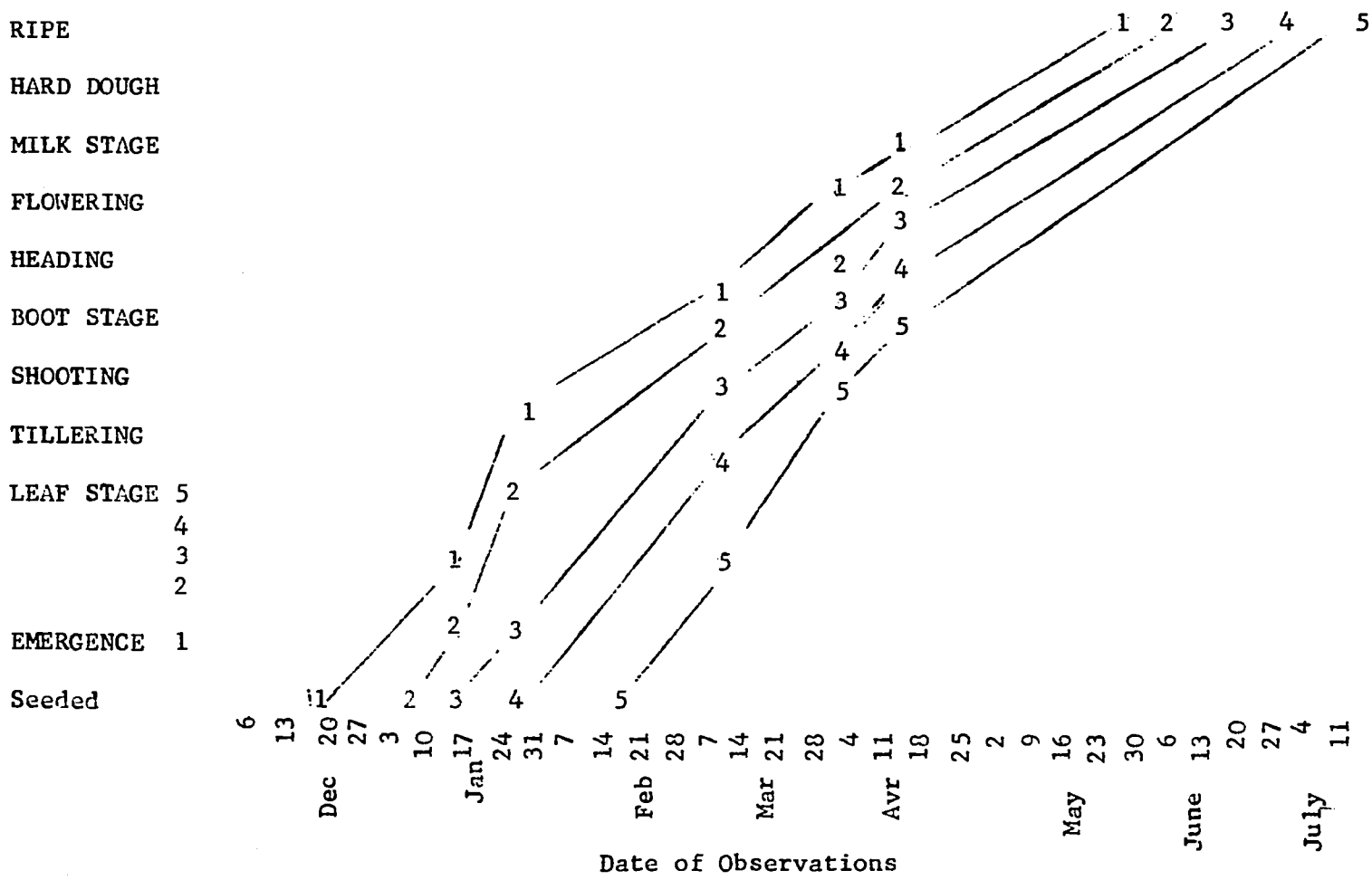


Figure 4 Growth Curves Wheat Varieties from the Date of Seeding Experiment at SOUILHA in 1970-71



January seeding did not head until late April and early May, when rains would normally have ceased. These dates are too late for the slower developing varieties BT 908 and BT 2306. Tobari yielded better than Siete Cerros at the late dates. Normally, early maturity vaireties seeded in January would escape Septoria, but that was not the case this year and Septoria caused some damage at Ellouizia.

2. Ellouizia

Figure V and Table A7 show the average yield of each variety from five replications at seven seeding dates. The variety BT 908 was the highest yielding at all dates except February 1. Septoria was more prevalent than rust in this experiment and was first noted on 16 February on the earliest seedings. The Septoria resistance of BT 908 accounts for the better yields of this variety. Poor seedbed and difficult seeding conditions after 1 January resulted in poor stands and decreased yields for all varieties.

3. Sidi Kacem

The average yields from five replications of each variety seeded at five dates at Sidi Kacem are shown in Fig. VI and Table A8. Dry seeding conditions in November delayed emergence of the early seeding dates until after rains on 20 December. Thus the first three dates all emerged at the same time. The 4th date seeded 15 December emerged slightly later.

Septoria was also present in this experiment and severely affected Siete Cerros and Tobari in seedings prior to 15 December. Their early maturity resulted in heavy infection during the heading period. The 1 January seeding of all varieties escaped serious damage from Septoria.

4. FES

Figure VII and Table A9 show the average yield from five replications of each variety from eight seeding dates at Fes. However, dry seeding conditions here also delayed emergence of the early seeding dates so that the first three seedings emerged at the same time. The rusts were more prevalent than Septoria at this site. Siete Cerros and Tobari were the highest yielding

Figure 5

WHEAT YIELDS OF FOUR VARIETIES FROM SEVEN DATES OF SEEDING
at ELLOUIZIA IN 1970-71

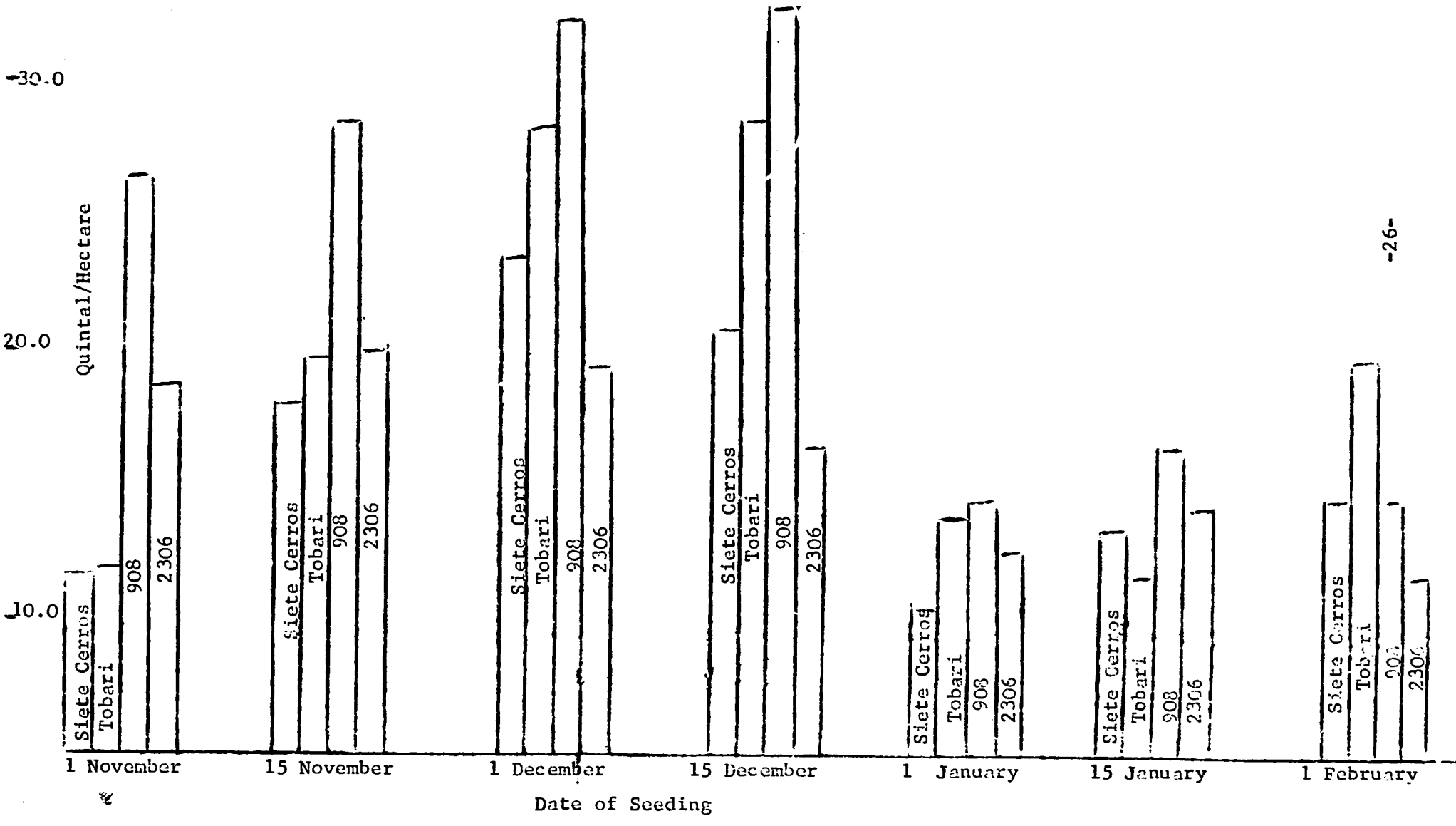


Figure 6

Wheat Yields of Four Varieties from Five Dates of Seeding at Sidi Kacem in 1970-71

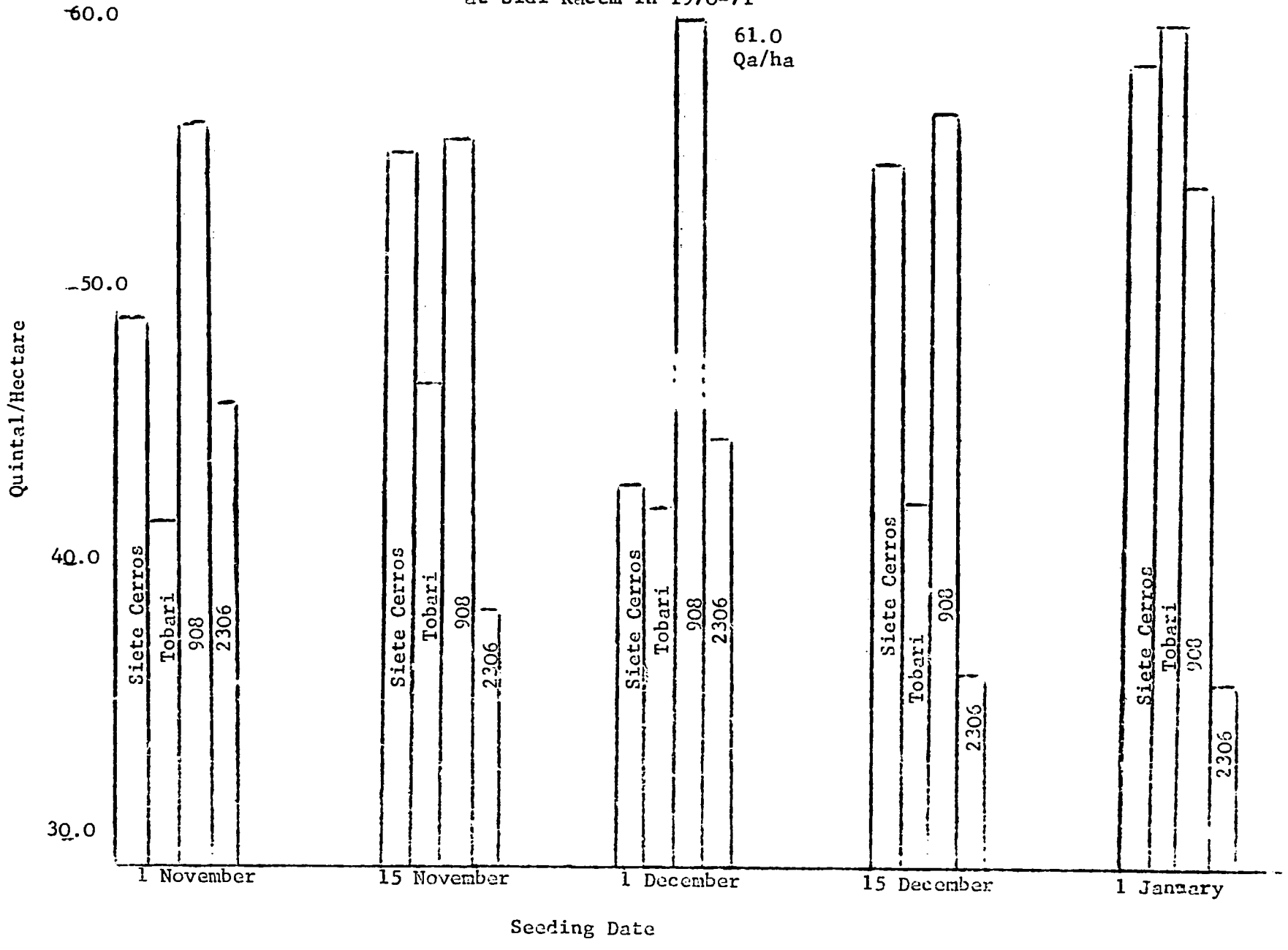
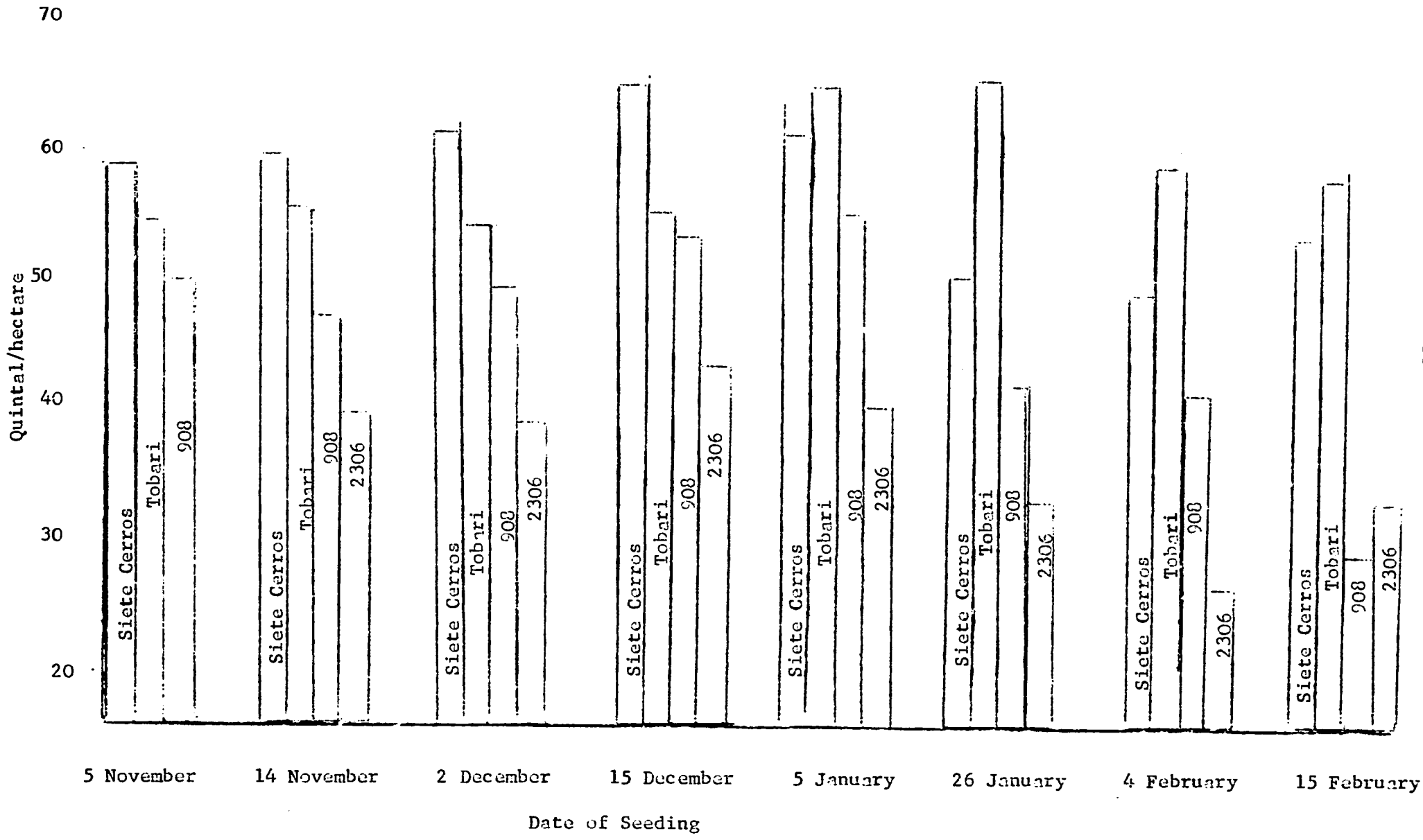


Figure 7 Wheat Yields of Four Varieties from Eight dates of Seeding at FES in 1970-71



varieties at all dates, although Siete Cerros was best from seeding dates prior to 1 January while Tobari was the superior variety at later dates.

5. Berkane

The date of seeding experiment at Berkane was conducted on a private farm with traditional land preparation and irrigation methods. Yields were not exceptional for irrigated wheat, but considering the traditional practices used, they far surpassed other yields of the region. Uneven irrigation following the 10 November seeding resulted in irregular emergence of the first seeding date. Small samples were harvested from the early emerged portion of the plots and yields were used for calculations as more representative of the performance of the early seeding (see Fig. VIII). Highest yields were obtained from the 1 December and 12 January seedings. The yields of each variety at each date from four replications are shown in Table A-10. Stem rust was prevalent in this experiment and had a definite depressing affect on BT 2306.

Irrigation water was unavailable for the period from December 10 to January 10 due to repair on the dam. Thus the long span between the second and the third seeding dates. Again the fast maturity and high yield of Tobari from late seeding is evident, with yields of 33.9 quintals per hectare from seedings made on 27 January.

6. SOUILHA (Marrakech)

Figure IX and Table A-11 show the average yields from five replications of each variety from five seeding dates at the Souilha experiment station. This was an irrigated experiment following cotton so that the first date was delayed until 15 December. Yields of all varieties decreased as the date of seeding became later. Rust was the predominant disease and seriously affected BT 2306 and BT 908.

Figure 8

Wheat Yields of Four Varieties from Four Dates of Seeding at Berkane in 1970-71

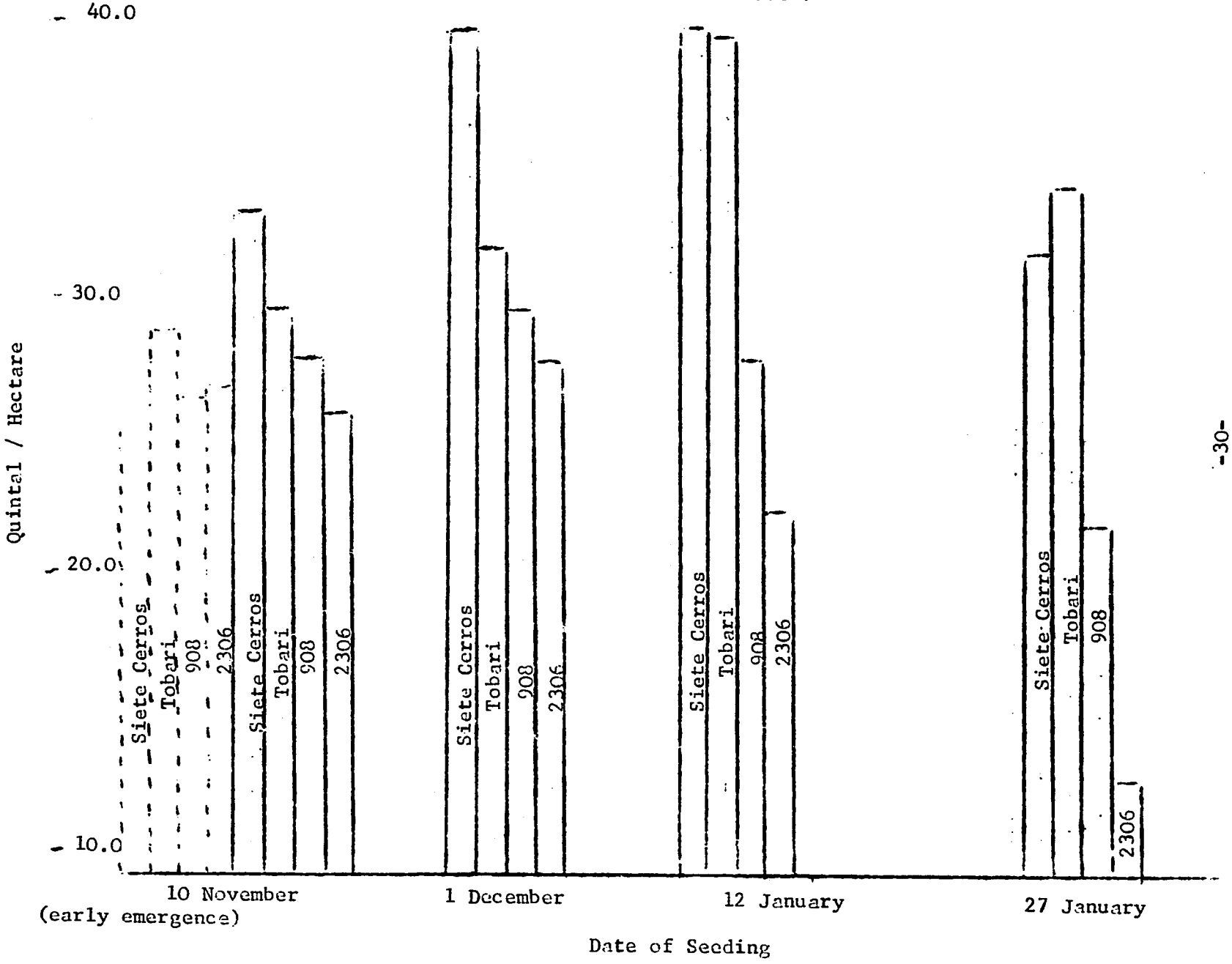
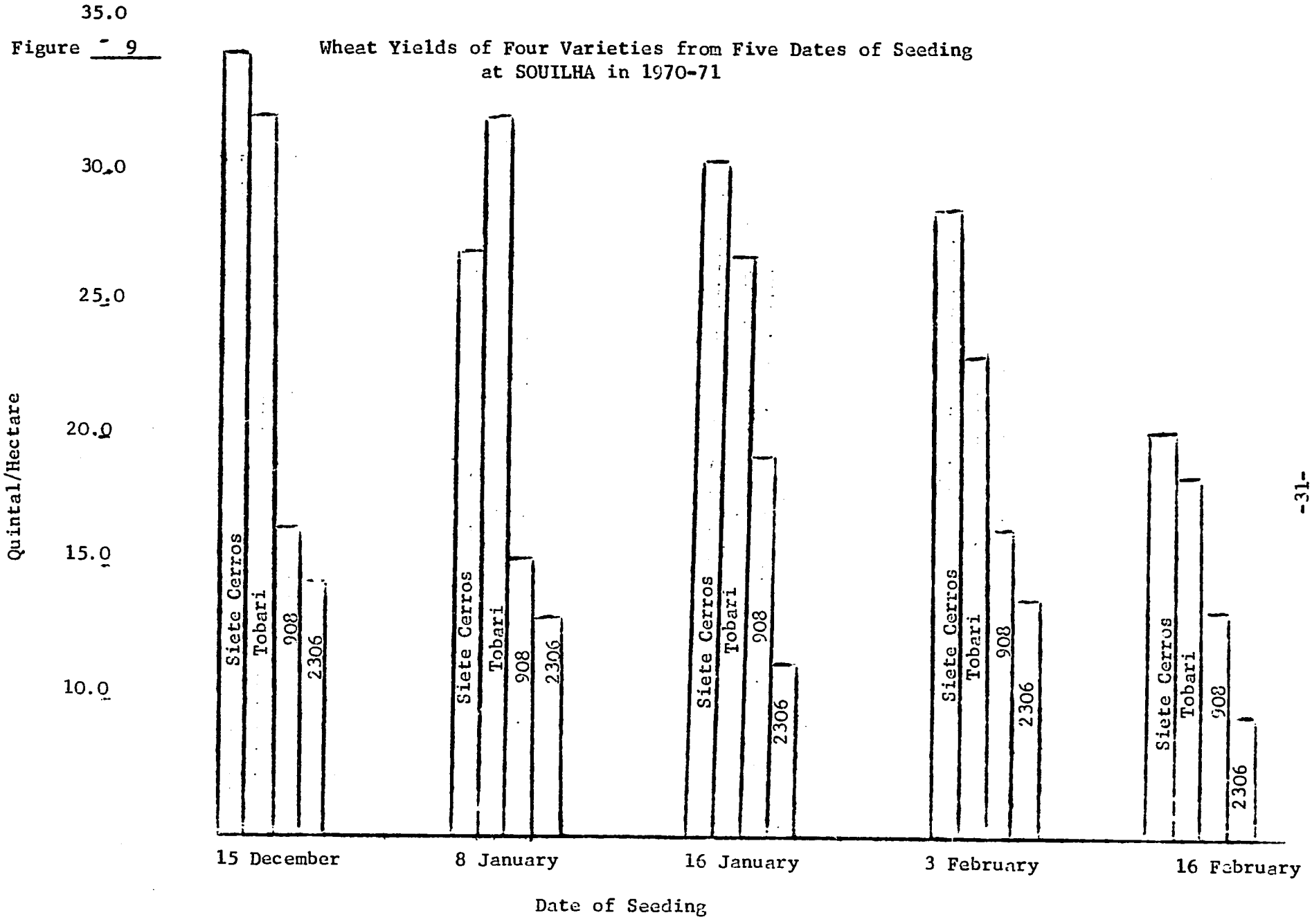


Figure 9

Wheat Yields of Four Varieties from Five Dates of Seeding at SOUILHA in 1970-71



7. AIN CHAIB (Souss)

Figure X and Table A-12 show the average yields from four replications of the three varieties seeded at four dates at the Ain Chaib experiment station. This irrigated experiment produced excellent yields of Siete Cerros. Stem rust was severe and seriously affected BT 2306. Septoria has not been a problem in this region and the new wheat varieties are being sought by the farmers.

B. Date of Plowing and Rate of Seeding

Experiments were conducted at Merchouch and Sidi Kacem to evaluate the benefits of early VS late plowing dates and to compare the disk and chisel plows. The plot size for such an experiment has to be large enough to allow proper operation of the equipment. Because this provides more space than necessary for determining the yield of plowed plots, a rate of seeding experiment was imposed in each experiment.

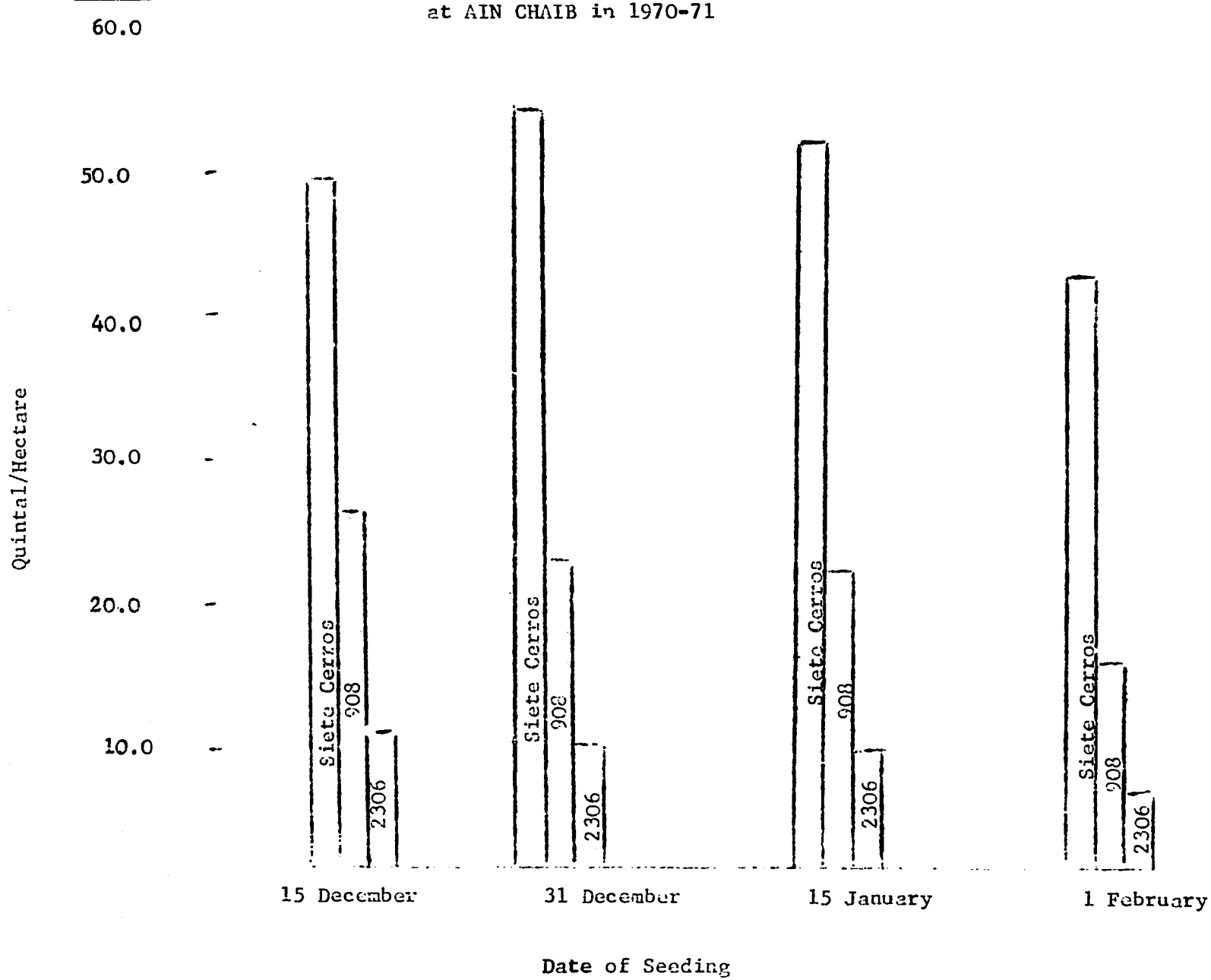
There is little chance to conserve moisture in Moroccan soils following the harvest of a cereal crop. Plots plowed 15 July produced large, dry clods. Bigger clods were turned up by the chisel plow than by the disk plow, but no difference in weed control or in preparing the seed bed could be observed in either treatment. The fall rains had not yet started when the last plowing was made in October, so that, much the same type of clods were developed as from the earlier plowing dates.

Fertilizer was applied uniformly to all plots at the rate of 60 kg of nitrogen, 80 kg of P_2O_5 and 60 kg K_2O per hectare at time of seedbed preparation. An additional 60 kg of nitrogen was applied at the time the wheat was tillering.

Tobari was seeded at both locations the middle of December with seeding rates adjusted to place 21, 28, 35 and 42 seeds per 1000 cm2. This would be approximately seeding rates of 60, 80, 100 and 120 kg per hectare based on a 1000-kernel weight of 33 grams. .

Figure 10

Wheat Yields of Three Varieties from Four Dates of Seeding at AIN CHAIB in 1970-71



Plant counts made when the wheat was in the one-leaf stage showed good differences in plant densities at the lower rates. See Fig.XI. It is not known why the seeding rate of 42 kernels per 1000 cm2 gave a plant density similar to the seeding rate of 35 kernels per 1000 cm2.

There were no differences in yield from any of the plowing dates at either location. Table 3 presents the average yields from four replications at Merchouch. Yields for different dates of plowing ranged from 42.4 to 43.0 qls/ha. The disk and the chisel plow treatments both averaged 42.8 qls/ha over all dates of planting. The rate of seeding treatments ranged from 42.4 to 43.3 qls/ha.

Yields were slightly higher at Sidi Kacem as shown in Table 4, but the yield differences were the same as for Merchouch. Plowing date yields ranged from 49.1 to 55.2 qls/ha. The average yields for the chisel and disk plow were 51.8 and 52.6 respectively. The yields actually declined with increased seeding rates, but this is a non-significant difference with the range being only 50.1 to 53.3 qlx/ha.

Thus it appears plowing can be done anytime during the summer period as convenient to the farmer. If he has equipment for dry plowings he can perform this operation before the fall rains begin. The large, rough clods should aid in water penetration, and lessen the chance of water loss by run-off during intense rainfall.

The rate of seeding experiments allow a study of the influence different factors have on yield. Yield is influenced by plants per unit area, heads per plant; kernels per head and size of kernels. Determination of these factors were made and are summarized in Tables 5 and 6. Increasing the seeding rate increased the plants and heads per 1000 cm2. However, the heads per plant and the weight per head decreased when the seeding rate was increased. The calculated number of kernels per head, by dividing the weight per head by the 1000-kernel weight, decreases as the seeding rate is increased. These compensating factors produced uniform yields in each experiment. The 1000-kernel weight and the weight per hectoliter did not appear to be affected by the seeding rate.

Figure 11 The Number of Wheat Plants Emerged from Different Rates of Seeding at Sidi Kacem, Merchouch and Marrakech in 1970-71

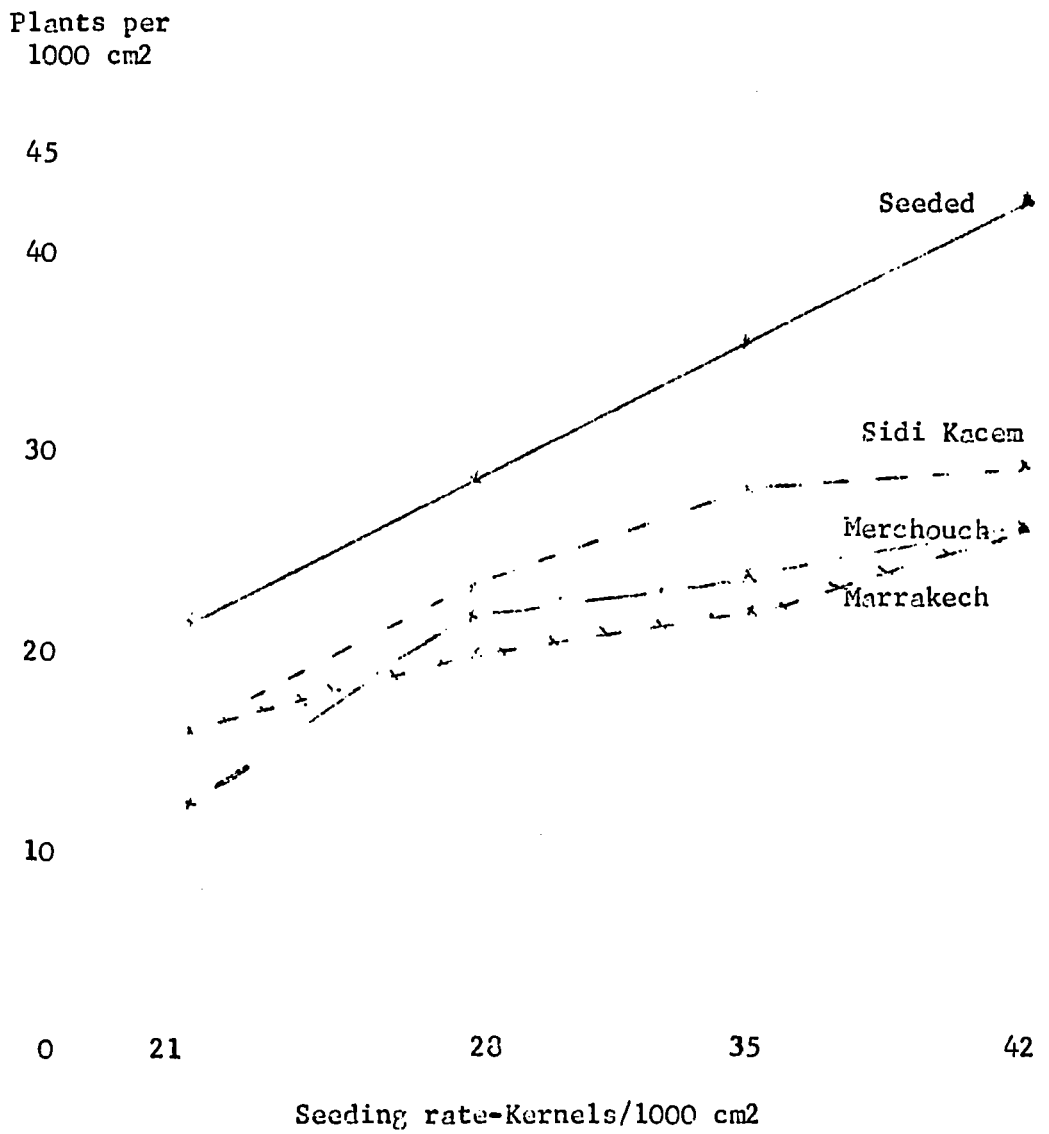


Table 3. Yield in Quintals per Hectare from Date of Plowing and Rate of Seeding Experiment at Merchouch in 1970-71 (Variety Tobari)

Treatment Date of Plow.	Type of Plow	Rate of Seeding (Kg/Ha) 60	80	100	120	Average
July	Chisel	40.1	44.2	38.7	39.3	40.6
	Disk	43.7	44.4	43.9	45.0	44.3
						42.4
August	Chisel	45.4	40.9	44.0	42.3	43.2
	Disk	39.8	43.3	39.9	43.2	41.6
						42.4
September	Chisel	44.9	41.0	45.1	42.5	43.4
	Disk	42.2	44.3	41.2	42.9	42.7
						43.0
October	Chisel	42.9	44.9	44.7	43.8	44.1
	Disk	43.9	43.3	41.5	42.0	42.7
						43.3
Av. for	Chisel	43.3	42.8	43.1	42.0	42.8
	Disk	42.4	43.8	41.6	43.3	42.8
Av. for seeding rate		42.9	43.3	42.4	42.6	42.8

Table 4-.

Yield in Quintals per Hectare from Date of Plowing and Rate of Seeding Experiment at Sidi Kacem in 1970-71 (Variety Tobari)

Treatment		Rate of Seeding (Kg/ha)				
Date of Plow	Type of Plow	60	80	100	120	Average
July	Chisel	54.4	56.5	53.8	53.0	54.4
	Disk	52.3	53.6	51.6	50.2	51.9
						53.2
August	Chisel	56.6	56.2	49.2	53.5	53.9
	Disk	54.8	57.1	59.2	54.6	56.4
						55.2
September	Chisel	52.9	56.4	55.3	49.8	53.6
	Disk	53.8	47.8	50.5	43.1	48.8
						51.2
October	Chisel	49.6	50.0	48.4	45.7	48.4
	Disk	52.0	46.6	49.7	51.1	49.9
						49.1
Av. for	Chisel	53.8	54.8	51.6	50.5	52.6
	Disk	53.2	51.3	52.8	49.8	51.8
Av. for Seeding Rate		53.3	53.0	52.2	50.1	52.2

Table 5- The Effect of Seeding Rate on Factors of Yield in Rate of Seeding Experiment at Merchouch in 1970-71

Yield Factors	Seeding Rate (Kg/Ha) 60	80	100	120
Kernels/1000 cm2	21	28	35	42
Plants/1000 cm2	12.5	21.5	23.5	26.0
Heads/1000 cm2	31.5	33.7	36.5	38.0
Heads/plant	2.52	1.57	1.55	1.46
Weight of head (grms)	2.32	2.10	1.97	2.00
1000 kernel Wt. (grms)	43.3	44.0	43.6	43.0
Kernels per head (1)	53	49	45	46.0
Kg/hectliter	55.4	60.8	61.8	58.3
Quintal per hectare	42.9	43.3	42.4	42.6

(1) Calculated by dividing weight of head by 1000-kernel weight.

Table 6- The effect of Seeding Rate on Factors of Yield in Rate of Seeding Experiment at Sidi Kacem in 1970-71

Yield Factors	Seeding Rate (Kg/Ha) 60	80	100	120
Kernels/1000 cm2	21	28	35	42
Plants/1000 cm2	16.1	23.2	28.2	29.1
Heads/1000 cm2	36.2	38.1	39.0	41.5
Heads per plant	2.24	1.64	1.34	1.44
Weight of Head (grms)	2.30	2.18	2.15	2.09
Quintal per hectare	53.3	53.0	52.2	50.1

C. Rate of Seeding and Row Spacing Experiment

A rate of seeding experiment using different row spacings was made on a Block farm at Marrakech to determine proper seeding techniques with irrigation, using the variety Siete Cerros. Heavy wild oat competition may have reduced the differences that would have occurred between high and low plant-density treatments. The oats were removed by hand, but not until after heading when much competition had already occurred.

Table 7 shows the average yield from four replications of each treatment. There are no statistically significant differences in the yields. At the lower rates of seeding, the 30 cm row spacing produced less yield than the 15 cm spacing. Plant counts revealed that the desired seeding rate was not achieved at the wide row spacing. The 60 kg/ha seeding rate had only 12 plants per 1000 cm2 at the wide spacing less than two-thirds of the desired stand. At the 120 kg/ha seeding rate there were 19 plants per 1000 cm2 less than half the desired level. The increased yield of the higher seeding rate in 30 cm row spacing and the comparable yield between 15 cm and the 30 cm spacing at the highest seeding rate would indicate that 60 kg/ha is apparently the minimum rate to be used without affecting yield. Yields were not as high as they should have been for irrigated wheat probably due to the wild oat problem and considerable bird damage.

Plants counts, weight of heads and 1000-kernel weights were made in this experiment also. Unfortunately, heads were lost. As shown in Table 8, as plant density increased, weight of head declined from 2, 4 to 2,0 grams. The 1000-kernel weight does not appear to be affected by plant density, but when the head weight is divided by the 1000-kernel weight, the number of kernels per head decreases at higher seeding rates.

Table 7- The Average Yield in Quintals per Hectare from four Replications of a Rate of Seeding - Row Spacing Experiment on Block 919 at Marrakech in 1970-71 (Variety Siete Cerros)

Rate of Seeding	Row Spacing 15 cm	Row Spacing 30 cm	Average for Rate
60 Kg/Ha	22.8	17.8	20.3
80 "	24.2	17.3	20.7
100 "	23.6	23.6	23.6
120 "	20.6	23.6	22.7
Average for Row Spacing	22.8	20.6	21.6

Table 8 - The Effect of Seeding Rate on Factors of Yield in Rate of Seeding Experiment on Block 919 at Marrakech in 1970-71

Yield factors	Seeding Rate (Kg/Ha) 60	80	100	120
Kernels/1000 cm2	21	28	35	42
Plants/1000 cm2 (15 cm2) (1)	16	20	22	26
(30 cm2) (1)	12	18	19	19
Weight of head (grms)	2.41	2.48	2.15	2.04
1000 kernel weight (Grms)	37.0	40.1	36.5	35.5
Kernels per head (2)	65	62	59	57
Quintal per hectare	20.3	20.7	23.6	22.1

(1) Row spacings of 15 and 30 cm

(2) Calculated by dividing weight of head by 1000-kernel weight

VI- VARIETAL RESEARCH

A. Introduction

The experimental material which was planted at seven Research Stations included:

Bread Wheat

Homozygous material	4766 lines and varieties
Heterozygous material	4085 lines
Total bread wheat	8851 entries

Durum Wheat

Homozygous material	490 lines & varieties
Heterozygous material	485 lines
Total Durum wheat	975 entries

Triticale

Total entries (Homozygous & Heterozygous) 169 lines

Barley

Total entries (all homozygous) 442 varieties

All of the above experimental material was planted at the Merchouch Station comprising 9 hectares. Most was also planted at the other stations as follows:

Sidi Kacem - 3 hectares - 476 entries = Homozygous & Heterozygous material

Fes -3/4 hectare - 247 entries = Homozygous lines & varieties

Marrakech (3 locations) 3 has -1399 entries = Homozygous & Heterozygous material

Beni Mellal (Cotton Station)-1 hectare - 1241 homozygous lines & Varieties .

Dates of planting were determined by weather conditions, primarily rainfall. However it was possible to plant during the recommended period of December 15 to January 15 at Merchouch (Dec. 1-20), Sidi Kacem (Dec. 21-23), Fes (Jan. 13-14) and the nurseries in the Marrakech region (Jan. 11-15). At the Cotton Station at Beni Mellal the nursery was planted on January 26-27, 1971.

B. Effect of Weather Conditions

The rainfall distribution was near ideal at the Sidi Kacem Station and the nursery never suffered water stress. However temperatures were relatively high during February resulting in some reduction in tillering. Rainfall distribution was not as good at the other stations where the nurseries suffered moisture stresses at various times although never reaching critical levels. The high temperatures in February reduced tillering at all locations, particularly Beni Mellal which was planted last.

From March to June the weather was cloudy, rainy and cool, resulting in excellent soil moisture conditions but producing extremely favorable conditions for *Septoria* development. As mentioned previously the total rainfall for the 1970-71 crop season was well above normal throughout Morocco (Table A 1). Specific rainfall data for the breeding nurseries showing monthly distribution and days with rain are given in Table 9.

C. Problems with Cultural Practices.

Due to the lack of initial soil moisture, germination was not uniform in the first 10 yield trials planted at Merchouch. Germination was very good for all other trials at all stations except for the *durum* yield trials (O I to O VIII) planted at Sidi Kacem and Merchouch where stands were thin and uneven. This phenomenon has been observed for two seasons in seed received from the summer nursery at Toluca, Mexico, leaving a suspicion that it might be caused by too short a period between harvest and planting to break seed dormancy.

TABLE 9

RAINFALL AT BREEDING NURSERIES

Monthly rainfall in mm and Days with rain
Cycle 70-71

Month and Year	STATIONS									
	Merchouch		Sidi Kacem		Fes		Cotton Station		Marrakech (Menara)	
	Amt.	Days	Amt.	Days	Amt.	Days	Amt.	Days	Amt.	Days
September 1970					1.4	1				
October 1970	57.9	5	9.5	3	16.0	-	18.3	-	35.0	-
November 1970	8.0	3	20.0	5	24.8	-	10.2	-	9.5	-
December 1970	104.5	12	116.5	13	99.2	-	55.3	-	61.5	-
January 1971	121.5	8	105.7	9	110.1	8	110.6	-	72.0	-
February 1971	13.5	4	15.0	3	12.0	3	19.6	3	30.0	-
March 1971	112.5	12	87.1	12	151.3	13	122.6	12	87.5	11
April 1971	181.0	14	113.3	18	153.2	16	112.7	16	70.0	11
May 1971	98.5	10	50.5	16	55.5	15	71.8	9	63.0	6
June 1971	3.5	2	15.5	4	22.5	1	7.0	1	0	
TOTAL FOR SEASON	700.0		532.8		646.0		528.1		428.5	
Normal Season	450.0		467.7		503.1		587.1		247.5	

Nitrogen top-dressing was not generally done at the proper stage of growth to encourage maximum tillering except at the Cotton Station at Beni Mellal and the Menara station at Marrakech where tillering was entirely satisfactory. Weeds, particularly wild oats, were a serious problem at Merchouch, the Cotton station and the Souilha station at Marrakech . Since weeds were not removed until they had already taken great quantities of nutrients from the soil, yield reductions were observed at all three locations.

Serious flooding occurred on part of the nursery at Merchouch and several experiments were drowned out. Considerable mechanical damage was done by workers during several passages through the trials for hand weeding operations. Some damage from 2, 4-D was observed at Merchouch, Menara, Souilha and Sidi Kacem due to improper dosages and timing enhanced by the onset of cloudy wet weather shortly after herbicide application.

D. Diseases and Insect Pests

Weather conditions were very favorable for the development of Septoria epiphytoics at the Sidi Kacem and Merchouch stations and to a lesser degree at Marrakech. Consequently it was possible to do good screening for Septoria resistance in the material.

Some damage from wheat stem maggot was observed early in the season followed by later infestations of Hessian Fly, particularly in the January seedings at Merchouch. No appreciable damage by wheat sawfly was detected in any of the nurseries.

Pollen sterility was observed, probably caused by the relatively wide ranges and rapid changes in temperature during February. This phenomenon was most evident in the variety Penjamo which, nevertheless, produced relatively good yields including one of 50 qx/ha in a one hectare increase plot at Fes.

E. RESULTS

1. General

Growing conditions for wheat and for the development of Septoria were very good at Sidi Kacem, consequently results from this station are the best selection indicators for yield and disease (Septoria) reaction. However the results from Fes and Merchouch were also valuable for selection for broader adaptability and yield potential.

The results obtained at all stations clearly indicates the necessity to develop specific varieties for each major region (Tables 10 & A 13). The results obtained at Fes where diseases and insects were not important give an idea of the yield potential of some lines under near-ideal growing conditions.

Many entries produced both good yields and good quality grain in spite of a severe Septoria epiphytotic. This indicates that some materials have adequate tolerance to this disease and could be used on a short-term basis until varieties with more adequate Septoria resistance can be developed. The results from Merchouch, particularly, demonstrate tolerance and/or resistance to Septoria in many entries although yields were sometimes greatly affected by weeds, particularly wild oats, mechanical damage and, to a lesser degree, by leaf rust. Despite these negative factors, several entries, both homozygous and heterozygous, showed good yield and good quality grain.

2. At Sidi Kacem 12 lines and varieties out-yielded the check variety BT-908 from 1 to 17% (Table 10). The varieties Siete Cerros, Nuri, Penjamo and Cajeme 71 yielded practically the same as BT-908 even with a heavy infection of Septoria. In the Crossing Block group of progenitors there were 14 lines that yielded from 3 to 26% more than BT-908, (Table A 13). Among this group there are seven lines showing good tolerance to Septoria.

3. At FES 23 varieties and lines outyielded BT-908 from two up to 79% (Table 10). These results show very clearly the yield potential of some lines, as well as the yield potentiality in this region, with good cultural practices and, obviously, adequate and well distributed rainfall.

TABLE 10

SUMMARY OF YIELDS FOR BEST YIELDING LINES AND VARIETIES
Cycle 1970-71
(Yields based on 4 replications except where noted)

Code No.	Name of Variety or Cross and Pedigree	Sidi Kacem			FES		Marrakech		Merchouch	
		Septoria % 5/10/71	Yield Kg/Ha	Check BT-908 %	Yield Kg/Ha	Check BT-908 %	Yield Kg/Ha	Check BT-908 %	Yield Kg/Ha	Check Bt-908 %
88	Son 64-L1.Rend/Bb "S"(26804-6y-IM-0y)	60	4542	117	3838	105				
142	Son 64-LR64 (HD-1799)	50	4504	116	5525	151				
39 *	Bb"s" - CNO (26572-61Y-3M-0y)	60	4454	114	4529	124				
68	Son 64-Y50ex Gto/INIA"S"(23528-7M-IT-IM-8y-0M)	80	4454	114	4479	122				
66	Son 64-Y50ex GTO/INIA"S"(23528-7M-1T-1y-0M)	80	4446	114	4567	125				
118 *	NO"s"-CNO"s"(24941-13M-3y-1M-2y-1M)	40	4384	112	4250	116				
98	INIA"s"(Son 64 AxTzpp-Y54)(LR624-Son64 x Jus) (23817-4T-1M-1y-1M-0y)	50	4296	110	2792	76				
157	Tacuari-Pj 62 (Mj-119-100M-100y)	40	4284	110	4896	134			2854	88
101 *	Jar 66-CNO"s"(25067-32M-2y-1M-1y-0M)	30	4041	104	3742	102	4171	126		
193	Son 64-Y50ex Gto/CNO-Son 64(30426-2M-0Mch)				4009	109				
191	" " " " " " " (30426-6M-0Mch)				3979	108				
144	LR 64A (Tzpp-Y54) (HD-1622)	40	3967	102	5404	147	5275	160		
- **	POTAM S-70	70	3928	101	4413	120	6075	184	3369	104
150	LR64 "S" x Huar (HD-1675)	20	3917	100	5279	149				
- **	NURI F-70	50	3879	100	4355	119	6162	186	3160	97
- **	BT-908 (check)	30	3894	100	3666	100	3304	100	3245	100
13	Bb "s"-INIA 66 (26591-IT-7M-0y)	90	3870	99	5384	147	5900	178		
- **	Penjamo 62	70	3827	98	4223	118	5117	155	2599	80
- **	CAJEME 71 (Bb ≠ 4)	40	3821	98	4743	129	6442	195	3257	100
7	CNO"s" - INIA"s" (23959-52T-1M-3y-0M)	90	3820	98	6584	179	6542	198		
- **	Siete Cerros	100	3772	97	3950	108	5571	169	2798	86
- **	YECORA F-70	90	3568	92	3986	109	5779	175	3125	96
- **	TOBARI 66	70	3337	86	3954	108	5050	153	2885	89
- **	INIA 66	70	3287	84	4052	110	5846	177	2839	87
163	MID - 7	30	3179	82	3258	88			2300	71
169	MID-324	30	2764	71	3113	85			2667	82
	BT - 2306						2653	80		

** = yield for these standard varieties determined from 12 to 88 replications depending on location.
* = These entries were also among the best yielders in 1969-70.

4. At Menara Station (Marrakech) Eight varieties and two new lines yielded from 52 up to 98% more than BT-908 while BT-2306 (a standard local variety) yielded 20% less than the BT-908 check.

At Fes and Menara stations these same two lines also outyielded BT-908 while at Sidi Kacem they yielded about the same as the check.

5. At Merchouch in spite of all the adverse factors that affected the yields the variety Potam S-70 yielded a little more than BT-908 while Cajeme 71 (Bb ≠ 4), Yecora F-70, and Nuri F-70, yielded practically the same as this check variety (Table 10).

In the crossing Block group of progenitors (Table A13), two crosses with "Calidad" genes outyielded the variety BT-908 by six and 11% and showed also good tolerance to Septoria. In the international nurseries planted at Merchouch, several varieties outyielded the check BT-908 by up to 80% (Tables A 14 & A 15).

In the 4th International Screening Nursery series "B" 32 lines and varieties gave yields above 5000 kgs. per hectare. Most of these lines demonstrated good tolerance to Septoria. Twenty three lines of the 4th International Bread Wheat Screening Nursery series "A" showed yields above 5000 kgs/Ha. Again, most of these lines showed good tolerance to Septoria.

In the Regional Disease and Insect Screening Nursery (RDISN) only 42 lines showed good tolerance in the last observation made on June 9, 1971. In the Regional Coordinated Screening from Lebanon (RCSN-Leb) 63 lines showed good tolerance to Septoria according to the observations made on May 4, 1971. In the FAO nursery 49 lines showed good tolerance to Septoria according to the observations made on May 14, 1971.

In the segretating material, a total of 1658 individual plants (F_3, F_4 and F_5) were selected for further study. Most of these plants have good tolerance to Septoria and only those with good quality grain will be kept for next season.

More than 600 new crosses were made at the stations of Merchouch, Sidi Kacem, Marrakech and the Cotton Station.

6. Conclusions and Final Observations

The program, after its third formal cycle has yielded good and promising results. There are many lines with good yielding ability and good tolerance to Septoria (Table 11). The variety Potam S-70 outyielded Bt-908 in all locations and was also one of the best yielding varieties on an overall basis, during the 1969-70 crop season. Several promising new lines are under consideration for release as varieties, and preliminary increase programs are already underway for them.

TABLE 11

YIELDS AND RANKS OF SOME VARIETIES GROWN
IN MOROCCO
in Experimental Plots
1970-71
(Kg/Ha)

	Average for all 5 locations	STATIONS					
		Marrakech		Sidi Kacem			Cotton Station
		Menara	FES	Yield	Septoria reaction	Merchouch	
CAJEME 71	4303 1	6442 1	4743 1	3821 5	8	3257 2	3254 1
POTAM S-70	4090 2	6075 3	4413 2	3928 1	8	3369 1	2667 4
NURI F-70	3968 3	6162 2	4355 3	3879 3	7	3160 4	2283 7
INIA 66	3848 4	5846 4	4052 5	3287 9	8	2839 7	3215 2
YECORA F-70	3838 5	5779 5	3986 6	3568 7	8	3125 5	2733 3
SIETE CERROS	3717 6	5571 6	3950 8	3772 6	8	2798 8	2495 5
PENJAMO 62	3649 7	5117 7	4323 4	3827 4	7	2599 9	2378 6
TOBARI 66	3444 8	5050 8	3954 7	3337 8	8	2885 6	1995 9
BT-908 (check)	3235 9	3304 9	3666 9	3894 2	6	3245 3	2064 8

VII- FARM DEMONSTRATIONS

The major demonstration program was continued almost exactly as it was conducted during the two previous years. A total of 187 demonstrations were planned for the 15 Provincial agricultural services (SP) and the 7 Regional Irrigation perimeters (OR).

Each province or regional perimeter was assigned one large demonstration of either 5 or 10 hectares plus one (sometimes two) one hectare demonstrations for each work center (CT or CMV). Each demonstration was planted with the same ten varieties as for the previous two years consisting of the major local durum variety BD-2777, two local bread wheats, BT 2306 and BT 2511, two semi-dwarf bread wheats of Italian origin, BT 908 and BT 3597 and the five Mexican bread wheat varieties imported in 1968, Siete Cerros, Inia, Tobari, Penjamo and Norteno.

A uniform application of fertilizer was recommended throughout the country consisting of 200 kg of 14-12-14 applied before planting and a top-dressing of 50 kg of urea (46-0-0) applied during or after tillering. This meant that the plots should have received 51 kg. N, 24 kg P_2O_5 and 28 kg K_2O per hectare. These amounts were generally applied although nitrogen top-dressing was often applied too late for maximum benefit. Weeds were quite often a serious problem and considerably reduced yields on many demonstrations.

Of the 187 demonstrations planned, results were obtained for 154 as summarized in table 12. Results were obtained from all provinces and perimeters except Nador province. Average results summarized by province or perimeter are given in Table A 16.

TABLE 12

SUMMARY OF DEMONSTRATION RESULTS
(154 locations)

Variety	Yield (Qx/Ha)	Rank
Siete Cerros	24.5	1
BT-908	24.1	2
BT-3597	22.6	3
BD-2777	22.4	4
Penjamo	21.7	5
Tobari	20.9	6
BT-2306	20.6	7
BT-2511	19.8	8
Inia	19.4	9
Norteno	18.8	10

The average yield for all varieties and all locations was 21.5 qx/ha, somewhat higher than in previous years. However the range of yields varied greatly from a low of 8.8 for Tobari in five demonstrations in Tetouan (the province with the lowest average yields) to a high of 43.7 for Siete Cerros over seven demonstrations in the Moulouya perimeter.

In addition to advising and assisting with the regular demonstrations in their area each Production-Extension Agronomist organized additional programs in his area to demonstrate various aspects of improved wheat production. In Casablanca Province, Mr. Floyd arranged several on-farm demonstrations. Most of these were in cooperation with the Massey-Ferguson company in relation to their "dry land" farming program. The company loaned several items of equipment, particularly a chisel plow and an experimental dryland drill. The farmer supplied all fertilizer, seed and herbicide while Mr. Floyd and Moroccan extension technicians provided technical guidance, transportation and in some cases, a tractor. These trials were not set up to provide statistically relevant yield data but were intended to demonstrate the effect of using special techniques under a range of seeding rates and row widths under low rainfall conditions.

However, the above-average rainfall received tended to eliminate the expected effect of the dryland method. Nevertheless the results obtained on two farms, one in the Settat area and one at Guisser between Settat and El Borouj are indicative of the effect of improved methods and give some indication of the effect of seeding rate and row spacings.

On the Abes farm near Settat where an average yield of 15 qx/ha is considered very good, yields were obtained ranging from 15.5 to 30.5 qx/hq. (Table 13). Furthermore the results indicate that these type of yields can be obtained with seeding rates in the 40-60 kg/ha range in contrast to the 100-120 kg usually sown by farmers in the area.

TABLE 13-

DRYLAND DEMONSTRATIONS

Abes Farm Settat

69 KG N preplant plus 23 Kg top-dressed
20 Kg P_2O_5 banded in 35 cm rows
Received 580 mm rainfall (normal 400)

Normal seed bed preparation and seeded with drill-
Variety Tobari

	Yield
40 Kg seed/ha	25.1 Qx./Ha.
60 Kg seed/ha	30.5 " "
80 Kg seed/ha	25.4 " "

Same Farm:

42 Kg N preplant plus 23 Kg top-dressed
land preparation by "dry land" method -(chisel plow followed by disk)
seeded with drill in 35 cm row-
Variety Siete Cerros

	Yield
60 Kg seed 45 Kg P_2O_5 in Row	17.9 Qx/ha
60 Kg seed 20 kg P_2O_5 in Row	15.5 " "
80 kg seed 20 kg P_2O_5 in Row	22.8 " "

Zrak Farm - Guisser

525 mm rainfall (250 mm normal)
Land preparation by chisel plow and disk
42 Kg N and 45 kg P_2O_5 preplant plus 23 Kg N top-dressed
Variety Inia seeded with drill

Results	Yield
60 Kg seed/ha 50 cm row	12.48 Qx/Ha
120 kg seed/ha 25 cm row	18.08 Qx/Ha

The Guisser area where the normal rainfall is about 250 mm actually received over 500 mm this year negating to a large extent the expected effect of the dryland methods. In this demonstration row spacings of 25 & 50 cm were compared, with both having same seed spacing in the row-resulting in 60 kg/ha in the wide rows and 120 kg/ha in the narrow rows. Although average yields for this area are on the order of 8-10 qx/ha the plots produced 12.5 and 18.1 qx/ha(Tablo 13). The difference between the two row spacings was due primarily to the weed problem engendered by the wide row spacing under relatively high rainfall conditions. In the narrower rows weeds were much less of a problem resulting in better yields.

In Marrakech Province, Mr. McSwain set up, in cooperation with the Provincial state farm manager, a demonstration of recommended wheat production under irrigation. In addition to four hectares of land on a Bloc farm just west of Marrakech, the Province supplied all fertilizer, labor and irrigation water. Recommended equipment and seed were supplied by the project and careful records were kept on all operations in order to establish production costs and the amount of profit for comparison to return from the normal irrigated crops of citrus and forage. A total of 160 kg/N ha was applied and irrigations were made on a 2-3 week basis. One hectare was sown to each of three varieties, BT 2306, a local breadwheat, and to Siete Cerros and Tobari.

The yields obtained were 63 qx/ha for Siete Cerros, 60 qx/ha for Tobari and 30 qx/ha for BT 2306. Total production costs, including land rent, were equivalent to only 18 qx/ha leaving an extremely good profit for both Siete Cerros and Tobari(Table 14). The net return on Siete Cerros of 1931 dirham/ha compares very favorably with the best results obtained with citrus in the area. The additional costs over present Bloc farm practices of growing wheat under irrigation would be:

1)	57.50 DH.	for extra fertilizer
2)	41.00 "	water costs
3)	21.00 "	labor costs
4)	60.00 "	for land planing
	179.50 DH.	TOTAL

Therefore, the added return would be approximately 40 quintals of Wheat (above average yield of 23) or 1,720.00 DH. for an additional cost of 179.50 DH.

A number of farmers, province inspectors, extension agents and research technicians visited the demonstration one or more times during the season and are expected to apply at least part of the improved practices they saw on other fields in the area next year.

TABLE 14- COSTS & RETURNS PER HECTARE FOR WHEAT PRODUCTION UNDER IRRIGATION & IMPROVED PRACTICES
Marrakech - 1970-1971

		Labor and Machine Requirements & Costs	
		COST	
OPERATION	DESCRIPTION	Labor (DH)	Machine (DH)
Plowing			50.00
Planing	3 times		60.00
Disking	2 times		40.00
Build borders (machine)			10.00
Pre-plant irrigation (1,250 m3)		16.00	25.00
Disking	one time		20.00
Re-run borders			10.00
Dirtribute fertilizer-(Nitrogen)			10.00
Drilling seed-fertilizer			12.00
Chemical weed spraying -	Back-pack sprayer	2.00	
Top dressing - (Nitrogen)			10.00
Irrigation	400 m3 each in February, March April and May	20.00	32.00
Guardian for birds		60.00	
Total pre-harvest		98.00	279.00
Harvest - combine			70.00
TOTAL		98.00	349.00

PRODUCTION, COSTS, & RETURNS PER HECTARE

ITEM	UNIT	Price or Cost per Unit (DH.)	Quantity	Value or Cost (DH.)
1. Production	Quintals	43.00	63	2709.00
2. Cash Expense				
Seed	Quintals	60.00	1	60.00
Fertilizer				
Ammonium Nitrate	Quintals	15.00	5	75.00
45% Super Phosphate	Quintals	20.00	2	40.00
Chemical -2-4D				6.00
Machine costs				349.00
Total non-Labor Cash Costs				530.00
3. Returns to Land, Labor & Management				2179.00
4. Labor Costs				98.00
5. Returns to Land & Management				2081.00
6. Land Rent				150.00
7. Returns to Management				1931.00

For the Meknes area Mr. Davis developed a series of trials to verify the optimum planting date for the semi-dwarf varieties as well as a trial demonstrating the possibility of cutting wheat for forage at an early vegetative stage and still obtaining reasonable grain yields following regrowth. He also planted a series of small demonstration plots of a new short-strawed durum variety, Jori-69, and has planted plots of several old local varieties which show promise for resistance to Septoria. An additional trial was planted to assess the yield reductions caused by wild oat infestations.

Mr. Davis was able to confirm the recommended planting date of mid-December for the semi-dwarf varieties in the Meknes area. He found that yields were somewhat reduced when Tobari was planted in early November but yield levels tended to remain good even up to mid-January planting dates. For Jori, yields tended to decrease for planting dates after mid-December so it would appear that this variety cannot be seeded as late as Tobari in the Meknes area.

We was also able to show that if a farmer desired he could graze his wheat or cut for forage and still obtain a good grain yield. His plots which were cut for forage in early February produced 4.96 metric tons of green forage and then yielded 35 qx/ha of grain. In contrast the plots which were not cut for forage yielded 45.8 qx/ha.

Also of major interest to farmers were the results of the trial showing the effect of wild oats on yield. For the parcels where wild oats were removed, 25 cm rows yielded 31.6 qx/ha and 50 cm rows produced 34.1 qx/ha. In contrast yields from plots with wild oat infestation were only 18.8 qx/ha for 25 cm rows and 21.0 qx/ha for 50 cm rows.

Mr. Davis reported disappointing yields of 25 qx/ha or less for Jori 69 due in part to head sterility with resultant reduction in seed set and to Septoria susceptibility. However the variety will be tried again and may demonstrate more promise next year. Two old local varieties Guery and Ghomri showed good resistance to Septoria and will be used in the breeding program as possible sources of resistance.

Mr. Searl also conducted several small demonstrations of the semi-dwarf durum Jori 69 in the Fez area and some plots of Potam, a bread wheat. He cooperated with Dr. Acosta in planting durum and bread wheat yield trials at an agricultural school at Sahel Ben Tahar north of Fes. This had the double advantage of gaining information from an area of high rainfall (1500 mm) and also served to interest the students in new varieties for Morocco.

Yields for Jori were likewise disappointing in the Fes area ranging from 14 to 24 qx/ha. However the local durum varieties planted adjacent averaged only 8 qx/ha. Single one-tenth hectare parcels of Penjamo and Potam produced 34 and 37 qx/ha respectively.

In the durum nursery at Sahel Bou Tahar the best yielding semi-dwarfs were Capeiti, Anhinga"S", Brant"S" and Crane"S" B, yielding 46.7, 44.7, 45.1 and 46.8 qx/ha respectively compared to 33.8 for BD 2777, the best local durum. In the bread wheat trial at the same location, Potam was the highest yielder at 33.3 qx/ha compared to 15.4 for BT-908, 22.7 for Siete Cerros and 28.9 for Tobari. Several other varieties and lines yielded from 24.9 to 29.5 qx/ha.

VIII- COMMERCIAL PRODUCTION

During the 1970-71 planting season slightly more than 9000 quintals of seed of semi-dwarf varieties of Mexican origin were distributed for planting either through government programs or on direct sale to farmers. It is estimated that an equivalent amount of these varieties was retained by farmers for their own use or sale to others. This would indicate a total area of nearly 20,000 hectares during the 1970-71 season.

The two semi-dwarf varieties of Italian origin were also widely used throughout the country, particularly in the north. 20,400 quintals of certified seed of these varieties were sold through SCAM for the 1970-71 planting season. Of this amount 11,860 qx were distributed through the "Operation Engrais" program. Approximately 1700 quintals of Siete Cerros and Tobari were distributed through "Operation Engrais", primarily in Agadir, Tadla and Rommani.

"Opération Engrais" was planned for 210,000 hectares during the 1970-71 season of which 206,000 hectares were attained. Under Operation Assolement only 52,700 hectares were completed out of the 76,400 hectares originally planned. According to the results of a survey conducted by the Statistical Service of the Ministry of Agriculture the average yield increase obtained under Operation Engrais was 7.1 qx/ha. The overall average yield for fields in the program was 19.5 qx/ha compared to 12.4 for non-Operation Engrais fields. Average yield increases ranged from 22.6 qx in the Agadir area down to an increase of only 2.68 qx in the Doukkala area and 1.53 in the Gharb. Since a two quintal increase is needed to pay for the increased costs the program was profitable in all areas except the Gharb.

Although precise figures are difficult to obtain for production by private farmers growing the semi-dwarf varieties outside of government programs some indication of the yields obtained can be indicated. For example in the Agadir area the Mexican varieties averaged 33.2 qx in the "Operation Engrais"program. The yields commonly reported for other commercial production fields of Mexican wheats in this area also averaged close to 30 qx/ha.

As a consequence the farmers in the Souss Valley are turning primarily to Siete Cerros and the area planted might reach as high as 10,000 hectares in the 1971-72 crop year if seed is available. Bread wheats were almost unknown in the area before the Mexican varieties were introduced in 1968-69.

Around Marrakech the average yield of bread wheats on the Provincial Bloc farms has doubled since the introduction of the semi-dwarf varieties two years ago. For the 1970-71 season the Bloc farms averaged just over 20 qx/ha on 1000 hectares compared to a previous average yield below 10 qx. The area planted to these varieties in the Marrakech area will also be greatly increased next season if sufficient seed is available.

In the Casablanca area one farmer obtained 65.4 qx/ha on a 6.6 hectare field of BT-908 and 59.7 qx/ha for Siete Cerros on a field of the same size. Another farmer in the same area averaged 42.3 qx over 40 hectares with Siete Cerros and 30.6 for Penjamo on 9 hectares. A farmer near Berrechid harvested an average yield of 54.0 qx with BT-908. Several additional yields ranging from 23 to 46 qx/ha were obtained by other farmers in the area with Siete Cerros, BT 908 and Tobari.

In the northern areas of Kenitra, Meknes and Fes the varieties BT-908 and BT-3597 were the best performers. Numerous yields ranging from 30-45 qx/Ha were reported across the area. In the Fes area, for example, one of thelarger Bloc farms averaged 42 qx/ha for BT-908 on 300 hectares while in the same area the highest single commercial yield reported was 47 qx/ha for BT-908 on 30 hectares.

Yield increases for the semi-dwarf varieties under irrigation were confirmed by a Statistical Service survey which showed an average yield of 33.9 qx/ha for the Mexican varieties compared to an average of 16.6 qx for local varieties under similar conditions. These results were obtained primarily in the south in the Agadir, Marrakech and Tadla areas.

Even though the yield increases obtained with the semi-dwarf varieties were obviously profitable the yields obtained were still well below the levels which can be attained when recommended practices are followed fully. It is obvious that much effort must yet be made in organizing and conducting extension programs which will show farmers how to use recommended varieties and production practices for profitable wheat production.

IX- TRAINING

In-country training sessions were held during September, October, January, and February, in widely scattered parts of the country. All courses were for field agents of the Ministry of Agriculture, or managers of state-owned farms (Marrakech). The numbers of agents attending were as follows:

Agadir	23
Berkane	53
Marrakech	40
Ben Ahmed	15
Meknes	18 and 15 (two courses)

The courses at Agadir, Berkane, and Marrakech concerned irrigation and were presented with the help of Mr. Yacoubi, of the Ministry of Agriculture. He presented a classroom session on evapotranpiration and how to measure water needs for crops and water content of soil. He also presented mimeographed information on measurement of water flow through ditches and flumes. Mr. Floyd, USAID, organized a session on recommended cultural practices and another on the economics of irrigated wheat production, land levelling, and land-layout for irrigations. Mr. Floyd also built a land float for levelling land which was demonstrated and used by the trainees at Agadir, Marrakech, and Berkane. Mr. McSwain assisted in the training course at Marrakech with demonstrations of a tractor-drawn land leveller.

At Ben Ahmed and Meknes, both field and classroom sessions were held on operation and adjustment of the principal tillage machines; i.e. moldboard plows, disk plows, disk harrows, spike-tooth harrows, spring-tooth harrows, fertilizer spreaders, grain drills, and weed sprayers. This included actual field operation and adjustment by all the trainees of a disk plow. Few of the trainees had ever operated a tractor, let alone plow a field. The training course gave many their first chance to do so.

At Agadir, Berkane, and Marrakech, agents spent a half-day using the level to prepare a simple topographic map of proposed irrigation plots. None of them had ever used one before. One of the interesting features of the courses at Agadir and Marrakech was the discussion of the profitability of wheat production. To agents accustomed to hear about wheat production as a "national duty" it was a departure into a new world to discuss wheat farming for profit.

The training courses held in January and February involved a minimum coordiantion by USAID personnel. The first one, held at Meknes, concerned weed control, and how to lay out a good demonstration. This was followed by a classroom and then a shop session on how to maintain farm tractors. Subsequent sessions followed this theme with addition of other topics such as the government's programs for aiding farmers.

Unfortunately, a whole series of training courses destined to be held during April, May, and June, were concelled due to administrative difficulties within the Ministry.

In addition to the regular in-service training program for extension agents, a group of five Moroccan technicians received training in Mexico during the year.

Messrs Mohamed Mouloua and Mohamed Abbous of DRA were trained in cereals production at CIMMYT as were Messrs Driss Kinany and Bouchaib Rachidi of DEAEJ. Mr. Brahin Ait El Kadi of DRA attended the wheat breeding course at CIMMYT. No trainees were sent to the TVA fertilizer course during the year.

Among the four nominees for degree training in the U.S. Mr. Mohamed Yacoubi was accepted for the M.S. Degree at the University of Arizona and Mr. Mehdi Adlouni was accepted at Kansas State University, both for the second semester of 1971-72. The other two nominees have yet not completed all requirements for acceptance although Mr. El Mniai lacks only a small improvement in English ability to be approved and might be able to leave soon. Additional nominees will be sought from the Ministry of Agriculture.

X- CONCLUSIONS

The yield results obtained during the 1970-71 season and in previous years now give a basis for recommendations for improvement of wheat production in most areas of Morocco. Experimental evidence to date with short-strawed varieties indicates fertilizer rates of 60-120 units of N per hectare in dryland areas according to area and previous crop and 120-150 units under irrigation will give profitable response. The date of seeding should be later than with the local varieties to better coordinate growth cycles with climate conditions. Seedings of the newly introduced varieties made in December have a better chance of escaping damaging yield reductions from Septoria.

Several new bread wheat varieties with satisfactory resistance to Septoria appear ready for commercial use and final recommendations to the GOM for release will be made on the basis of results obtained during the next crop season. Although a few short-strawed durums with good yield and quality characteristics are available their poor Septoria resistance makes then suitable for use only in southern areas. Additional work remains to be done before durum varieties satisfactory for use in the heavier rainfall areas in the north will be available.

Research and extension technicians are generally convinced of the possibilities of improvement through the use of the improved short-strawed varieties and the fertilizer and cultural practices which should accompany their use. Many farmers have also grown one or more of the semi-dwarf varieties and have realized their yielding potential. Other farmers have seen them also, either in their neighbors fields or in demonstrations and are purchasing seed from any farmer who will sell it.

However even those farmers who have grow these varieties have not generally realized their full potential due to failure to follow all of the recommended practices required for top production. Much additional research still must be done, particularly toward developing semi-dwarf durum varieties capable of high production under North African condition. Additional research is also needed to refine the production management and fertilizer practices required for top yields.

During subsequent crop seasons project activities should continue to emphasize:

A. Selection and multiplication of bread wheat and durum varieties adapted to Moroccan conditions, particularly with resistance to Septoria as well as other prevalent diseases and insects.

B. Determination of varietal response to nitrogen levels for economical production and cultural practices required for the new short-strawed varieties, under Moroccan growing conditions. The different growth pattern of these new varieties require changes in the normal production practices.

C. Assistance to local seed production agencies to provide adequate quantities of high quality seed with which the farmer can take advantage of the high potential yield of these new varieties. Improved cultural practices and increased fertilizer rates are wasted if the seed is of poor quality.

D. Development and conduct of an extension program to demonstrate to farmers through on-farm trials and demonstrations how to increase production through the use of improved varieties and recommended cultural practices.

E. Training of Moroccan specialists and technicians. The program for the development of training Moroccan personnel at this time are inadequate. A dynamic wheat production program cannot be properly serviced without trained scientists for continuing research, extension agents to conduct coordinated demonstrations and recommended production practice and seed producers to provide continuity of production.

The research programs underway in Morocco and other North African countries have provided and are providing solutions to the problems limiting cereals production in Morocco and North Africa. But the translation of these recommendations into actual increased production is or more difficult to obtain. Consequently major attention must be paid to programs designed to show and persuade farmers how to put these recommendations into practice.

XI- APPENDIX

Table A 1 to Table A 16

TABLE A 1

CUMULATIVE RAINFALL MM in 1970-71 v s Normal

LOCATION	Sept - Nov		December		January		February		March		April		M A Y	
	1970	Norm	1970	Norm	1971	Norm	1971	Norm	1971	Norm	1971	Norm	1971	Norm
AGADIR	70	58	233	99	256	146	259	179	295	200	398	214	4[illegible]6	218
BERRECHID	33	97	123	175	208	229	221	280	309	329	411	365	484	379
F E S	43	115	161	200	313	270	320	323	446	393	614	454	682	481
KASBA TADLA	59	92	153	157	266	206	300	255	433	309	590	357	656	379
MARRAKECH	45	60	105	93	170	119	208	149	308	180	403	209	463	224
MEKNES	42	140	165	244	304	329	318	394	436	471	599	531	655	559
BERKANE	35	45	65	134	135	186	135	229	205	268	231	321	275	352
ROMMANI	45	83	146	151	225	215	235	272	325	330	463	378	521	396
S A F I	71	75	198	160	269	214	316	251	417	287	524	315	574	331
SETTAT	62	105	214	177	305	235	327	289	434	335	565	373	635	386
SIDI KACEM	45	104	146	186	249	260	254	320	370	381	590	428	615	448
TAROUDANT	38	54	188	99	203	136	215	168	271	190	339	207	340	211

TABLE A 2-

GENERAL INFORMATION - NITROGEN TRIALS

Location	Geographical Area	Soil Type	Depth of Soil	Rainfall Oct-June	Preceding Crop	Seeding Date	Varieties	Observation
Ras Tebouda	Pré-riffian Hills	Loam	140 mm	638 mm	Cultivated fallow	12/24	BT 908 Tobari	Excellent condition-Septoria on Tobari
El Hajeb	Sais Plain	Loam	70 cm	-	Broad beans	12/22	BT 3597 Tobari	Field infested with wild oats Not enough moisture at the beginning of the crop season
Moulay Idriss	Pré-riffian Hills	Loam	40 cm	-	Peas	12/21	BT 3597 Tobari	Reduced growth due to the inadequate February moisture
Sidi Kacem	Gharb Plain	Light Dess	1 m	533 mm	Sugar beets	12/20	BT 908 Tobari	Jointing stage was forced for Tobari by high temperature and dry weather in February.
Souk El Tleta	Gharb Plain	Silt loam	2 m	641 mm	Chick peas	12/19	BT 908	Excess moisture reduced tillering
Merchouch	Rommani Plateau	Sandy loam	-	700 mm	Broad beans	12/2	BT 908 Tobari	Irregular emergence due to dry soil conditions at seeding
El Gara	Chaouia	Clay	150 cm	484 mm	Wheat	12/17	Tobari	Excellent condition - Low soil nitrogen level
Berrechid	Chaouia	Loam	80 cm	604 mm	Cultivated fallow	12/16	Tobari	Wire worms and Hessian fly attacks

TABLE A 2 - (cont'd)

GENERAL INFORMATION - NITROGEN TRIALS

Location	Geographical Area	Soil Type	Depth of Soil	Rainfall Oct-June	Preceding Crop	Seeding Date	Varieties	Observations
Settat	Chaouia	Clay loam	-	-	Broad beans	12/9 12/16	Tobari	Loss of 50% due to attack of Hessian fly
Sidi Rahel	Upper Chaouia	Sandy clay loam	120 cm	375 mm	Fenugreeck Chick peas	12/8 12/15	Tobari	Excellent conditions - Excellent rainfall distribution
Ben Ahmed	Upper Chaouia	Sandy clay loam	40 cm	637 mm	Barley	12/5	BT 2306 Tobari	Heavy Septoria attack on Tobari
Khouribga	Phosphate Plateau	Loam	50 cm	-	Wheat	12/4	BT 2306 Tobari	Very favorable Spring rainfall
Oued Zem	Phosphate Plateau	Sandy loam	50 cm	-	Cultivated fallow	12/4	BT 2306 Tobari	Leaf rust attack on BT 2306

TABLE A 3a

SUMMARY OF RESULTS OF NITROGEN RATE TRIALS

REGION	Check Yield Qx/Ha	Recommended N rate Kg/Ha	Rate of Maximum response Kg/Ha of N **	Yield Qx/Ha	INCREASED OBTAINED Qx/Ha	in %	Qx/20KgN	Profit in DH/Ha * per 20 Kg/N	Total
Fas Tebouda - Tobari	26.6	60	40 + 0	35.1	8.6	32%	4.30	150	300
Fas Tebouda - 908	35.0	60	40 + 20	50.3	15.3	44%	5.10	182	546
El Hajeb - TOBARI	13.1	80-100	100 + 0	27.0	13.9	106%	2.78	89	445
El Hajeb - BT 3597	11.6	80-100	40 + 20	24.2	12.6	109%	4.20	146	458
Moulay Idriss - Tobari	29.6	60- 80	40 + 20	41.7	12.1	41%	4.03	139	417
Moulay Idriss-BT 3597	27.6	60- 80	40 + 20	40.6	13.0	47%	4.33	151	453
Sidi Kacem - Tobari	31.2	60	60 + 40	45.9	14.7	47%	2.94	96	490
Sidi Kacem - BT 908	40.3	60	40 + 20	50.8	10.5	26%	3.50	118	354
Souk El Tleta - BT 908	37.5	60	-	-	-	-	-	-	-
Merchouch - BT 908	25.9	60	40 + 0	35.8	9.9	38%	4.95	176	352
Merchouch - Tobari	20.1	60	40 + 20	28.8	8.7	43%	2.90	94	282
El Gara - Tobari	9.4	80	60 + 20	27.4	18.0	191%	6.00	218	654
Berrechid - Tobari	14.1	60	20 + 20	20.3	6.2	44%	1.55	40	80
Settat -Sye conventional	12.4	40	80 + 0	28.1	16.3	141%	4.75	168	672
Sys "dry farming"	13.1	40	80 + 0	28.2	15.1	115%	3.78	129	516
Sidi Rahal-Sys convent.	21.3	40	20 + 20	31.5	10.2	48%	2.55	80	160
Sys "dry farming"	18.9	40	120 + 0	32.9	14.7	78%	2.45	76	456
Ber Ahmed - Tobari	12.3	60	20 + 20	16.6	4.3	35%	2.15	64	128
Khouribga - Tobari	13.0	60	60 + 20	29.2	16.2	125%	5.50	158	632
Khouribga - BT 2306	13.0	40	40 + 20	22.5	9.5	73%	3.17	105	315
Oued Zem - Tobari	27.5	40	60 + 20	38.5	11.0	40%	2.75	88	352
Oued Zem - BT 2306	19.8	40	60 + 0	24.8	5.0	25%	1.67	45	135
AVERAGE	20.3 Qx	59 Kg/Ha	67 Kg/Ha	32.0 Qx/ha	11.7 Qx/Ha	58%	3.54 Qx	120 DH	400 DH

* Bread Wheat Price 40 Dh/Qx - Price of 20 kg of Nitrogen=22 DH

** Pre-plant plus topdressing

TABLE A 3b

SUMMARY OF NITROGEN TRIALS RESULTS

	Yield's check Plot Qx/Ha	Nitrogen rate recommended Kg/Ha	Response level Kg/Ha	Yield at the response level Qx/Ha	Yield increase Qx/Ha	Yield Kg/Grain / Kg/Nitrogen
High rainfall zone (450-800 mm)						
Rotation I *	26.1	68	64	38.0	11.9	18.6
Tobari variety	24.1	68	72	35.7	11.6	16.1
Varieties BT 908 & 3597	28.1	68	58	40.3	12.0	21.0
Intermediate rainfall zone (300-450 mm)						
Rotation I *	20.3	48	65	30.7	10.4	16.0
Rotation II *	11.6	63	63	23.3	11.7	18.6
Average of all Trials	20.3	60	67	32.0	11.7	17.5

Rotation I = Wheat following sugar beets, legumes, forage or clean fallow.

Rotation II = Wheat following cereals (grains or forage oil seed crop, or weed fallow.

Table A 4

RAINFALL AT TRIAL LOCATIONS - 1970-1971

Areas	October	November	December	January	February	March	April	May	June	Total
RAS TEBOUDA	-	15,0	89,5	127,5	12,50	154,5	134,5	66,5	38,0	638,0 mm
SOUK EL TLETA	37,6	40,3	124,2	116,5	10,5	80,9	176,6	54,3	6,0	640,9 mm
BERRECHID	32,7	23,5	91,4	114,6	12,6	83,6	184,3	60,5	1,2	604,4 mm
EL GARA	-	-	76,5	118,4	55,5	32,5	120,5	81,0	-	484,4 mm
SIDI RAHAL	14,9	13,5	56,5	46,5	24,5	44,4	123,9	43,2	7,5	374,9 mm
BEN AHMED	59,1	14,1	120,2	125,2	13,5	51,9	180,1	73,0	1,7	636,8 mm
SIDI KACEM	9,5	20,0	116,5	105,7	15,0	87,1	113,3	50,5	15,5	532,8 mm
MERCHOUCH	57,0	8,0	104,5	121,5	13,5	112,5	181,0	98,5	3,5	700,0 mm

TABLE A 5- PHYSICAL AND CHEMICAL ANALYSIS OF SOIL

	Texture of Soil	Mechanical Analysis *			P H		Chemical Analysis (in percentage)					Soil Water Characteristic		
		% Sand	% loam	% clay	H_2O	KCL	organ. matter	Total N	P_2O_5	K_2O	active CaCo3	Water holdg capac	Wil-ting pt.	Capi-llary water
RAS TEBOUDA	loam	26.7	42.7	25.2	7.55	6.55	3.52	0.182	0.045	0.810	13.68	28.37	21.59	6.78
EL HAJEB	loam													
MOULAY IDRISS	Loam	17.9	40.2	25.3	8.40	7.00	3.44	0.195	0.015	0.384	83.14	31.90	26.43	5.47
SIDI KACEM	loam/silt loam	24.9	46.3	9.9	8.20	7.05	1.76	0.096	0.007	0.477	10.21	29.07	22.38	6.69
SOUK EL TLETA	Silt loam	3.4	55.7	23.9	8.25	7.15	2.57	0.187	0.012	0.523	108.81	36.56	18.07	18.48
MERCHOUCH	Sandy loam	61.7	13.8	25.6	6.30	5.60	2.24	0.121	0.067	0.552	3.20	11.94	8.42	3.52
BERRECHID	loam	36.7	41.2	11.5	8.55	7.10	2.45	0.144	0.001	0.542	50.13	38.90	21.96	16.84
EL GARA	clay	17.4	17.3	66.6	7.60	6.35	1.83	0.080	0.069	0.471	19.49	39.66	27.18	12.48
SETTAT	clay loam	40.1	17.0	40.9	8.25	7.00	1.74	0.103	0.005	0.330	21.79	32.14	18.49	13.65
SIDI RAHAL	clay loam	23.4	31.3	41.3	8.40	7.00	2.26	0.128	0.008	0.430	38.40	35.02	24.29	10.73
BEN AHMED	sandy clay loam	14.2	19.3	26.9	8.25	7.45	3.89	0.224	0.096	0.288	149.19	38.79	18.35	12.62
KHOURIBGA	Sandy loam	18.3	32.6	9.5	8.35	7.35	2.89	0.172	0.026	0.260	118.42	29.45	13.31	16.41
OUED ZEM	sandy loam	23.7	25.0	15.6	8.05	7.15	3.84	0.217	0.031	0.482	109.37	28.52	12.47	16.05

* Exclusive of Calcium carbonate content.

TABLE A 6

TRIALS RESULTS

Nitrogen Rate and Time of Appliaction (Yield Qx/Ha.) - Northern Area

Preplant plus Top-dressing Kg/Ha/N	RAS TEBOUDA		EL HAJEB		MOULAY IDRISS		SIDI KACEM		SOUK EL TLETA	MERCHOUCH	
	Tobari	908	Tobari	3597	Tobari	3597	Tobari	908	908	Tobari	908
Check Plot	26.55	34.95	13.05	11.55	29.61	27.55	31.20	40.30	37.45	20.05	25.85
40 + 0	35.05	43.75	18.05	19.75	36.00	35.00	38.90	47.75	39.00	25.65	35.75
40 + 20	36.30	50.25	21.42	24.20	41.70	40.60	41.45	50.80	39.35	28.80	34.70
40 + 40	37.65	50.15	23.73	25.10	42.35	42.80	45.40	51.25	42.85	27.75	36.20
60 + 0	33.45	47.90	24.43	21.90	40.80	38.55	40.25	49.40	37.70	28.50	34.75
60 + 20	37.35	48.80	23.68	24.80	43.25	42.50	44.65	52.65	38.40	29.25	35.75
60 + 40	37.50	50.85	26.75	24.50	44.95	43.30	45.90	49.25	38.40	31.55	38.95
80 + 0	33.60	46.00	22.40	22.85	43.45	41.00	44.80	51.60	43.55	29.40	35.65
80 + 20	38.90	48.85	27.53	28.10	41.90	42.05	46.85	52.00	37.90	31.60	36.65
80 + 40	38.20	51.60	26.50	28.85	45.85	44.40	48.75	50.75	39.45	34.15	36.75
100 + 0	38.55	50.00	27.00	23.55	43.81	42.00	44.70	51.45	39.50	32.20	36.75
120 + 0	36.85	50.90	27.70	28.25	44.45	39.10	45.45	53.20	37.30	32.20	37.00
160 + 0	39.80	52.55	31.35	27.20	46.75	43.80	48.40	51.25	35.95	32.90	32.85
l.s.d. 5%	5.82	5.82	4.71	4.71	5.55	5.55	3.33	3.33	N.S.	3.32	3.32
Test weight	80.5	79.3	79.6	79.5	80.6	78.0			75.2	79.8	75.6

TABLE A 6 (cont'd)

TRIALS RESULTS

Nitrogen Rate and Time of Application
(Yield Qx/Ha) - Central Area

Preplant plus Top-dressing Kg/Ha/N	EL GARA	BERRECHID	SETTAT		SIDI RAHAL		BEN AHMED	KHOURIBGA		OUED ZEM	
	Tobari	Tobari	Tobari(1)	Tobari(2)	Tobari(1)	Tobari(2)	Tobari	Tobari	BT2306	Tobari	BT2306
Check plot	9.40	14.10	12.40	13.05	21.34	18.90	12.34	12.96	13.00	27.47	19.80
20 + 0	15.00	16.85	17.75	17.20	24.85	23.70	10.52	18.50	15.75	32.60	20.67
20 + 20	22.40	20.25	21.50	21.70	31.50	27.40	16.65	20.65	20.25	31.59	20.71
40 + 0	15.90	19.30	20.70	21.05	29.80	26.10	15.15	16.75	18.30	24.60	18.40
40 + 20	24.75	23.44	24.65	26.83	35.00	29.70	15.80	22.90	22.45	33.67	24.00
60 + 0	22.20	21.15	25.00	22.15	31.35	25.45	15.35	21.25	20.25	24.00	24.80
60 + 20	27.40	23.55	28.45	27.65	34.22	29.60	17.55	29.15	23.50	38.53	24.89
80 + 0	24.50	20.85	28.13	28.20	34.15	28.70	19.17	25.00	21.80	36.00	26.33
120 + 0	28.44	21.60	31.95	30.20	36.20	32.90	19.90	32.60	26.30	42.13	22.35
26 + 46 *	23.53	22.75									
l s d 5%	2.60	3.52	2.54	2.22	4.80	3.01	3.90	4.92	4.92	5.00	5.00
Test Weight	81.20	77.40	76.7	78.7	82.90	83.2	70.00	79.70	78.10	81.5	78.1

* Rate and Time of Application used by farmer at Berrechid and El Gara

(1) Seeding conventional system.

(2) Seeding dry farming system.

Table A 7

Yields of Wheat Varieties Grown in Date of Seeding Experiment at Ellouizia in 1970-71

Date of Seeding	Quintal per Hectare				Ave. for Date (1)
	Siete Cerros	Tobari	908	2306	
1 November	11.7	11.8	26.2	18.7	17.1
15 November	19.0	19.9	28.6	20.0	21.9
1 December	23.8	28.4	32.5	19.6	25.8
15 December	20.9	28.5	32.8	17.3	22.3
1 January	11.5	14.0	14.6	12.8	13.3
15 January	13.2	11.5	16.5	14.1	13.7
1 February	14.6	20.0	14.6	11.9	15.3
Average for variety (2)	14.8	19.2	23.7	16.3	19.5

(1) L.S.D. 5% between averages of two dates 1.8 qx/ha

(2) L.S.D. 5% between averages of 2 varieties 3.4 qx/ha

L.S.D. 5% between averages of two dates with same variety and averages of two varieties at the same date 3.5 qx/ha.

Table A 8 Yields of Wheat Varieties grown in date of Seeding Experiment at Sidi Kacem in 1970-71

Date of Seeding	Quintal per hectare				Average for date
	Siete Cerros	Tobari	908	2306	
1 November	48.7	41.6	55.8	44.7	44.7
15 November	54.8	46.3	55.1	38.2	48.6
1 December	42.9	42.0	61.0	44.5	47.6
15 December	54.6	42.3	56.4	36.1	47.5
1 January	58.0	59.3	53.7	35.8	51.7
Average for Variety	51.8	46.3	56.4	39.8	48.6

Table A 9

Yields of Wheat Varieties grown in Date of Seeding Experiment at FES in 1970-71

Date of Seeding	Quintal per hectare				Average for date
	Siete Cerros	Tobari	908	2306	
5 November	59.0	54.3	50.1	50.1 *	54.5
14 November	59.6	55.3	47.3	39.8	50.5
2 December	61.5	54.0	49.5	39.2	51.1
15 December	64.9	54.7	53.7	43.1	54.1
5 January	60.9	64.7	54.7	40.0	55.1
26 January	50.2	65.5	42.2	33.0	47.7
4 February	49.1	58.6	41.4	26.3	43.9
15 February	53.3	57.8	29.2	33.0	43.3
Average for Variety	57.0	58.1	46.0	36.3	48.3

* 908 substituted for 2306 in first seeding date. This figure not included in averages.

Table A 10 Yields of Wheat Varieties grown in date of Seeding Experiment at Berkane in 1970-71

Date of Seeding	Quintal per hectare				Average for date
	Siete Cerros	Tobari	908	2306	
10 November	32.9	29.1	27.2	25.4	28.7
1 December	39.3	31.6	29.1	27.4	31.9
12 January	39.3	39.1	27.4	23.0	32.2
27 January	31.3	33.9	21.6	13.4	25.1
Average for Variety	37.5	33.4	26.4	22.3	29.4

Same footnotes as on Table A 7.

Table A 11 Yields of Wheat Varieties Grown in Date of Seeding Experiment at Souilha in 1970-71

Date of Seeding	VARIETY Siete Cerros	Tobari	908	2306	Average for Date (1)
15 December	34.8	32.3	16.7	14.7	24.6
8 January	27.1	32.2	15.6	13.3	22.0
16 January	30.8	27.1	19.4	11.8	20.7
3 February	28.9	23.1	16.6	14.0	20.7
16 February	20.4	18.8	14.6	9.6	15.8
Average for Variety (2)	28.4	26.7	15.8	12.2	20.8

Same footnote as on Table A7

(1) L.S.C. (5%) between averages of two dates 4.0 qx/ha

(2) L.S.D. (5%) between averages of two varieties 8.1 qx/ha

L.S.D. (5%) between interaction of dates & varieties N.S.

Table A 12

Yields of Wheat Varieties Grown in Date of Seeding Experiment at Ain Chaib in 1970-71

Date of Seeding	Siete Cerros	Quintal per hectare 508	2306	Average for date
15 December	49.8	26.6	11.7	29.4
31 December	54.4	23.4	10.3	29.4
15 January	52.2	22.3	10.1	28.2
1 February	43.4	16.1	7.7	22.4
Average for Variety	50.0	22.1	10.0	27.3

TABLE A 13

BEST YIELDERS IN THE CROSSING BLOCK
at Two Locations
(Unreplicated)

Plot No. CB-70-71	Name of Variety or Cross and Pedigree	SIDI KACEM Septoria ✱ reading 5/20/71	SIDI KACEM Yield Kg/Ha	SIDI KACEM Yield % check	MERCHOUCH (1) Septoria ✱ reading 5/21/71	MERCHOUCH (1) Yield Kg/Ha	MERCHOUCH (1) Yield % check
46	CNO-Pjs CNO-7 cerros (26265-22-y-300M-302y-2M)	9	4911	126	6	2638	81
53	Pj 62 - WRT x calidad (26978-2M-300y-1M)	7	4709	121	4	2496	77
27	INIA-CNO x calidad (27220-302M-301Y-1M)	7	4636	119	3-4		
19	NP 876- Pj62 x Calidad (27110-303M-301Y-1M)	8	4470	115	4	2401	74
45	CNO - Pj x CNO - 7 cerros (26265-22y-301M-301Y-2M)	9	4423	136	8	1722	53
42	CNO-Pj x CNO - 7 cerros (26265-22y-300M-300y-1M)	8	4353	118	8	2560	79
37	CNO-7 cerros/(S64-Y50-EXGTO) Tob (25918-20y-1M-300Y-1M)	7	4345	111	3	2737	84
112	Calidad (22429-10M-6T-0M)	9	4258	109	5-6	3459	106
25	INIA-CNO x CAL (27220-301M-300y-2M)	9	4225	108	6	1973	61
26	INIA - CNO x CAL (27220-302M-302y-2M)	7	4187	107	3		
32	CNO-7 cerros x CNO Pj (25917-7y-11M-300y-2M)	9	4130	106	8	2484	76
97	Jar-NAPO/LR64 x Tzpp-Ane (21823-10y-2M-4y-1M)	8	4093	105	6	1895	58
21	CAL/CNO"S" x LR2 64-S64 (27172-303M-302y-1M)	8	4075	105	5	2165	67
20	NP-876 Pj x CAL (27110-303M-301y-2M)	8	4054	104	4	3591	111
54	KALYAN 227 A x Bb "s" (26992-30M-300y-1M)	9	4007	103	8		
Check	BT-908	5	(2) 3894	100	5	(2)3245	100

(1) Yields were greatly affected by a heavy infestation of wild oats, Septoria leaf rust and mechanical damage.

(2) Average of 28-36 replications in yield trials.

✱ Based on scale 0-9 with 0= no disease, 9= complete leaf and glume infection.

TABLE A 14

BEST YIELDERS IN THE INTERNATIONAL SPRING WHEAT YIELD NURSERIES (ISWYN) 1970-71 (1)

Exp. & Var. No. 70-71	Name of Variety or Cross and Pedigree	MERCHOUCH		
		Septoria ✱ reading 5/4/71	KG/HA	% Check
I SWYN-12	Pato Argentino (21974-4R-4M-2Y-OY-OP-OY)	3	3984	164
" 34	CAJEME 71 (Bb ≠ 4) (23584-26Y-2M-3y-2M-OY)	7	3746	154
" 22	(LR 64 X NIO B) An3E	2	3454	141
" 13	Son 64 x Tzpp-Nai60 (B) (18889-6T-4T-2t-IT-2B)	5	3392	139
" 31	POTAM S-70	5	3359	138
" 14	SIETE CERROS	6	2621	108
" 50	BT-908 (check)	2	2433	100

(1) Yields were greatly affected by a heavy infestation of wild oats and mechanical damage, as well as by Septoria and leaf rust.

✱ Based on scale 0-9 with 0= no disease, 9= complete leaf and glume infection.

TABLE A 15

BEST YIELDERS IN THE REGIONSAL SPRING
WHEAT YIELD NURSERIES
1970-71
(RSWYN)

Exp. & Var. No. 70-71	Name of Variety or Cross and Pedigree	MERCHOUCH		
		* Septoria reading 5/4/71	Kg/Ha	% Check
RSWYN - 11	Calidad"s" (22429-16M-IY-IM-Oy)	3	3883	180
" 10	PATO	3-9 (2)	3875	179
" 13	ARIANA 66	3	3759	174
" 8	POTAM S-70	6	3596	167
" 14	BT-2297 (19975-68Y-1J-4Y-1J-4Y)	5	3592	166
" 18	SIETE CERROS	6	2538	118
" 12	INIA 66	6	2521	117
" 25	FLORENCE AURORE	5	2500	116
" 6	D 5825	2	2383	110
" 20	PENJAMO 62	5	2175	101
" 5	BT-908 (check)	2	2158	100

(2) Second reading was done on June 14, 1971 to verify the previous reading.

* Based on scale 0-9 with 0= no disease, 9= complete leaf and glune infection.

TABLE A 16 RESULTS OF DEMONSTRATIONS SUMMARIZED BY AREA (Qx/HA)

Province or Perimeter	No. Demon.	BT 2777	BT 908	BT 2306	BT 2511	BT 3597	SIETE CERROS	INIA	TOBARI	PEN-JAMO	NORTENO
TETOUAN SP	(5)	11.7	12.4	12.2	10.0	12.7	10.4	9.9	8.8	9.7	9.8
AL HOCEIMA SP	(3)	24.1	24.9	16.4	20.5	20.9	25.3	17.6	21.0	18.9	20.0
MOULOUYA OR	(7)	32.9	23.4	24.9	23.4	36.6	43.7	31.7	30.1	29.8	21.6
OUJDA SP	(2)	8.3	13.1	13.8	14.2	13.0	17.7	16.8	15.7	15.2	13.4
TAZA SP	(7)	18.1	20.2	21.8	22.6	19.7	22.8	16.9	17.1	19.1	15.9
FES SP	(12)	15.3	22.0	19.6	15.4	21.3	21.8	17.2	19.2	19.0	16.2
MEKNES SP	(11)	27.5	31.0	30.2	21.7	22.2	33.6	15.1	28.0	25.6	24.4
KENITRA SP	(11)	19.2	24.2	17.8	18.2	22.4	19.2	18.4	22.3	18.9	19.7
GHARB OR	(16)	31.6	39.0	30.6	26.1	34.5	30.1	30.3	29.6	34.4	28.2
CASABLANCA SP	(19)	16.4	18.0	17.4	13.5	17.3	16.5	11.7	13.4	15.0	11.9
BENI MELLAL SP	(4)	20.2	15.2	15.5	16.6	17.1	11.6	13.6	14.5	15.7	13.7
TADLA OR	(18)	25.4	28.3	25.7	21.8	23.5	29.0	24.6	26.0	26.1	22.2
MARRAKECH SP	(6)	17.2	20.4	13.6	18.5	16.8	17.0	14.7	15.8	14.7	15.7
HAOUZ OR	(3)	29.5	35.8	21.2	26.0	20.8	32.2	20.8	24.8	29.0	18.8
DOUKKALA OR	(8)	17.5	12.2	18.2	14.6	-	15.0	13.5	13.6	13.6	12.9
SAFI SP	(3)	16.0	17.4	17.4	15.9	16.6	16.3	16.8	12.7	17.4	14.5
AGADIR SP	(6)	13.6	14.6	10.7	13.6	12.5	23.1	17.7	16.5	17.8	14.1
OUARZAZATE SP	(3)	31.4	36.4	27.0	27.8	31.7	37.5	27.8	26.6	36.2	21.2
TAFILALET SP	(3)	24.0	21.8	22.5	30.0	16.6	24.5	22.3	17.4	17.1	23.6
OUARZAZATE OR	(3)	19.5	22.8	19.2	22.4	17.2	22.0	19.4	19.4	18.3	18.6
TAFILALET OR	(6)	38.4	26.9	28.7	31.9	32.3	35.7	24.5	21.0	24.3	28.3
TOTAL	(154)	22.4	24.1	20.6	19.8	22.6	24.5	19.4	20.9	21.7	18.8