

The Gap between: Present Farm Yield and the Potential

Major constraints and possible solutions

FIFTH CEREALS WORKSHOP
Algiers, Algeria
May 5-9, 1979

PRESENT

POTENTIAL

Sponsored by

Ministère de l'Agriculture et de la Revolution Agraire

International Center for Agricultural Research in the Dry Areas

CENTRO INTERNACIONAL DE MEJORAMIENTO DE MAIZ Y TRIGO

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(CIMMYT)

Sponsored by

Ministry of Agriculture and Agrarian Revolution, Algeria
International Center for Agricultural Research in Dry Areas—ICARDA, Syria
Centro Internacional de Mejoramiento de Maíz y Trigo—CIMMYT, México

Acknowledgment

The Fifth Regional Cereals Workshop was the result of a combination of interest, dedication and action by many, many persons. The same can be truly said of these two volumes of proceedings of the workshop. Many more persons than can be listed here contributed generously and importantly.

Several played such crucial roles that special acknowledgment must be made: Translations (English to French, French to English) greatly enlarge the reading audiences that can benefit from these papers. Robert Bertram of ICARDA and M.M. Nachit of CIMMYT shared that immense task. The compilation, in Volume 1, of the cereal situations in the several countries was the work of David Saunders, CIMMYT. Jack V. Mertin, then CIMMYT's science writer/editor for wheat, carried the major editing responsibilities.

Special acknowledgment is due to the Ford Foundation, whose grant enabled participation by persons from Sudan and Jordan and provided for both interpreters and equipment for simultaneous translations.

G. Varughese

FIFTH REGIONAL CEREALS WORKSHOP

Preface

The prospects of the green revolution have delayed or averted the Malthusian principle coming into operation. Also it has evoked hope for many of the developing countries.

Crop yields are dependent on interactions of socio-economical, biological, technological and ecological factors. Man has varying degrees of control over these interacting factors. High crop yields from experimental stations are reported almost every year. However, the actual farm yields are still very low. Thus, this workshop, the fifth in a series of regional workshops, which was initiated in 1972 by ALAD, CIMMYT, FAO and other international development agencies in an attempt to provide a forum for the exchange of information, was undertaken with the aim of reviewing the present farm yields and the potential major constraints and possible solutions.

The philosophy behind these workshops has been to bring together active cereal research workers every two years to focus on issues which currently need attention, and to review the most recent research results which could be used by colleagues concerned with cereal improvement in the countries of this region—West Asia and North Africa.

This workshop in Algiers from May 5 to 9, 1979 was jointly organized by the Ministry of Agriculture and Agrarian Revolution of the Government of Algeria, the International Maize and Wheat Improvement Center (CIMMYT) and the International Center for Agricultural Research in the Dry Areas (ICARDA).

Close to 140 scientists representing 25 countries of this region, many international development agencies and well-recognized authorities in cereal production from other parts of the world attended the workshop.

The first day's proceedings were fully devoted to reports from the various participating countries presenting the current status of cereal production, problems and prospects. On the second day, the workshop opened with three major presentations covering agronomic constraints, transfer of technology and economic and policy constraints. These topics were then analyzed in depth in three parallel sessions. During the third day, the participants visited on farm-demonstrations and trials conducted by the IDGC staff in the Willayet of El Asnam. The last two days of the workshop were devoted to an analysis of specific problem areas such as weed control, cropping systems, agronomic practices, fertilizer usage, seed multiplication and related topics.

The last session summarized the various papers presented during the course of the workshop. It is hoped that the published proceedings will remain as a very valuable reference book to suggest solutions to the complex problems of cereal production in this important region of the world.

George Varughese
Chairman Organizing Committee
Wheat Breeder CIMMYT

CINQUIEME CONFERENCE REGIONALE DES CEREALES

Préface

La "Révolution Verte" dans ses perspectives a retardé ou détourné les principes malthusiens d'entrer en opération. Elle a aussi évoqué l'espérance pour plusieurs pays en voie de développement.

Le rendement agricole est dépendant des interactions des facteurs socio-économiques, biologiques, technologiques et écologiques. L'homme peut contrôler ces interagissants facteurs à des degrés différents. Presque chaque année les stations expérimentales rapportent un haut rendement. Pourtant les rendements actuels des agriculteurs sont encore très bas.

Cette conférence, la cinquième dans la série des conférences régionales, initiée en 1972, sous la tutelle d'ALAD, de CIMMYT, de la FAO et d'autres organismes internationaux de développement dans la tentative de pourvoir un forum pour l'information, était entreprise avec le but d'examiner le rendement actuel et le potentiel des fermes agricoles, les majeures contraintes et les possibles solutions.

La philosophie derrière ces conférences était de rassembler les actifs chercheurs sur les céréales tous les deux, pour concentrer sur des questions qui nécessitent actuellement l'attention, et pour examiner les récents résultats de recherches qui pourraient être utilisés par les collègues engagés dans l'amélioration des céréales dans les pays de cette région-l'Asie Occidentale et l'Afrique du Nord.

Cette conférence à Alger des 5-9 Mai 1979 était conjointement organisée par le Ministère de l'Agriculture et de la Révolution Agraire du Gouvernement de l'Algérie, le Centre International de l'Amélioration du Maïs et du Blé (CIMMYT) et le Centre International pour les Recherches Agricoles dans les Régions Sèches (ICARDA).

Presque 140 scientifiques représentant 25 pays de la région, plusieurs organismes internationaux de développement et d'autres autorités bien reconnues dans la production céréalière d'autres parties du monde, ont attendu la conférence.

Les compte-rendus du premier jour étaient totalement consacrés aux rapports des différents pays participants qui présentaient l'état actuel de la production céréalière, les problèmes et les perspectives. Le second jour, la conférence a été ouverte avec trois présentations majeures couvrant les contraintes agronomiques, le transfert de technologie et les contraintes économiques et politiques. Ces sujets ont ensuite été analysés en profondeur en trois sessions parallèles. Le troisième jour, les participants ont visité les champs de démonstration et les essais menés par les membres de l'IDGC dans la wilaya d'El Asnam. Les deux derniers jours de la conférence ont été consacrés à l'analyse des problèmes spécifiques de la région, comme le contrôle des mauvaises herbes, les systèmes de culture, les pratiques agronomiques, l'usage des engrais, la multiplication de semence et d'autres sujets apparentés.

La dernière session résumait les différents travaux présentés au cours de la conférence.

George Varughese
Président du Comité Organisateur
Éleveur du Blé, CIMMYT

THE GAP BETWEEN THE PRESENT FARM YIELD AND POTENTIAL MAJOR CONSTRAINTS AND POSSIBLE SOLUTIONS

**Fifth Regional Cereals Workshop
Algiers, Algeria
May 5-9, 1979**

VOLUME 1

CONTENTS

| | |
|--|-----|
| I. Preface | V |
| II. Inaugural Address | 1 |
| III. Keynote Address | 5 |
| IV. Report on Constraints to Cereal Production | |
| Algeria | 15 |
| Cyprus | 21 |
| Greece | 27 |
| Lebanon | 34 |
| Libya | 38 |
| Morocco | 44 |
| Portugal | 48 |
| Tunisia | 53 |
| Turkey | 59 |
| Spain | 64 |
| Iraq | 69 |
| Jordan | 78 |
| Sudan | 82 |
| Syria | 87 |
| Yemen Arab Republic | 90 |
| Afghanistan | 96 |
| Egypt | 99 |
| Kenya | 109 |
| Pakistan | 116 |
| V. Cereal Situation: Summary Tables | 126 |
| VI. Program | 137 |
| VII. List of Participants | 140 |

ALLOCUTION DE BIENVENUE DE MONSIEUR LE MINISTRE DE L'AGRICULTURE ET DE LA REVOLUTION AGRAIRE A LA OCCASION DE LA 5EME CONFERENCE REGIONALE SUR LES CEREALES D'HIVER.

Selim Saadi*

Excellences, Mesdames, Messieurs

Qu'il me soit permis avant tout, de vous souhaiter à tous une chaleureuse bienvenue dans notre pays qui éprouve une grande satisfaction à accueillir cette cinquième conférence régionale sur la céréaliculture.

Qu'il me soit permis également de féliciter tous ceux qui ont participé à la préparation et l'organisation de vos travaux et remercier de leur présence tous les éminents chercheurs et participants à cette conférence dont l'intérêt et la portée apparaissent clairement à tous ceux qui ont la lourde charge de faire progresser la production céréalière à travers le monde.

En effet, le problème crucial de la production céréalière revêt d'autant plus d'importance, que la situation actuelle de l'alimentation des pays en voie de développement ne cesse de détériorer.

Cette situation, si elle venait à persister, laisserait planer une menace sérieuse sur la stabilité des pays concernés et sur l'équilibre mondial, d'autant plus que les négociations de l'accord international sur le blé visant à aboutir à des arrangements sur les stocks de réserve, les prix et l'aide alimentaire, connaissent à l'heure actuelle des blocages persistants.

L'aide alimentaire en céréales demeure inférieure à l'objectif minimal de 10 millions de tonnes fixé par la FAO et ne paraît pas pouvoir augmenter outre mesure dans les années à venir.

L'apparition sur le marché mondial de nouveaux pays gros importateurs de céréales ne manquera pas de perpétuer sinon d'aggraver la tension actuelle, et de maintenir la majorité des pays importateurs dans une situation précaire quant à la satisfaction de leurs besoins alimentaires.

Ces perspectives pessimistes militent tout naturellement en faveur d'une action dynamique et continue pour la promotion de la production céréalière dans les pays dont la production nationale n'équilibre pas la demande intérieure.

L'action que doit mener chaque pays en fonction de ses spécificités propres reste en cela déterminante.

L'organisation de la recherche, la diffusion du progrès technique l'organisation des producteurs et des structures agraires, la politique des prix, la mécanisation réfléchie et adaptée aux conditions du milieu. l'appui matériel aux producteurs constituent la base essentielle dans le cadre d'une action cohérente et soutenue visant une moindre dépendance en matière de céréales, voire même permettre l'autosuffisance.

L'appui scientifique et matériel que peuvent apporter les organismes internationaux spécialisés tels que le CIMMYT, l'ICARDA, la FAO, l'ACSAD et autres, bien que constituant un apport d'une grande importance ne peut constituer qu'un appoint aux efforts que doivent consentir et avant tout, les pays concernés eux mêmes.

L'Algérie pour sa part, n'échappe pas au grave problème de l'insuffisance de la production céréalière face à des besoins de plus en plus importants. La forte croissance démographique de notre pays ainsi que l'élévation substantielle de niveau de vie des populations et pourtant la consommation des céréales. Cette situation dont l'évolution a été relativement

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rapide a eu pour conséquence un recours de plus en plus massif aux importations avec tout ce que cela implique de négatif sur la balance des paiements du pays.

Pourtant, conscients de l'importance stratégique de la production céréalière, nous avons accordé à ce secteur la première priorité dans le cadre des actions d'appui à la production agricole.

Le projet céréales crée en 1971 et promu l'Institut de Développement des Grandes Cultures en 1974 a reçu pour mission de promouvoir la recherche céréalière, de favoriser une formation conséquente de cadres de haut niveau, de diffuser le progrès technique et d'influencer en somme de façon déterminante la production céréalière vers une croissance correspondante à nos besoins.

Au regard de ces objectifs, de vastes actions ont été engagées en vue d'une intensification de la production. Des efforts particuliers ont été menés dans le domaine de l'équipement mécanique, la fertilisation, le désherbage, la vulgarisation et la formation, l'expansion de l'utilisation des semences sélectionnées.

Parallèlement à cette action au niveau de la production, un travail assez considérable a été fait dans le domaine de la recherche, l'introduction et l'expérimentation de nouvelles variétés de céréales, la sélection de variétés à haut rendement.

Les résultats acquis par nos chercheurs sont intimement liés aux succès réalisés dans d'autres pays et représentent une partie de l'effort général mené à travers le monde pour le progrès de la céréaliculture.

Au cours de la dernière décennie, un progrès spectaculaire a été certes réalisé dans le domaine de l'amélioration génétique des céréales. Les variétés à haut rendement et la "Révolution Verte" ont permis de sensibles améliorations dans certains pays. Les progrès réalisés dans ce domaine constituent sans doute un des grands acquis de notre génération.

Cependant, quelque soient les progrès enregistrés dans le domaine de l'amélioration génétique des espèces, force nous est de constater que le problème de l'augmentation de la production céréalière reste encore posé.

En effet, les variétés à haut rendement ne représentent encore qu'une faible partie des emblavements dans les pays en voie de développement et en dépit d'un accroissement appréciable de la capacité productive de ces pays, ils restent dans leur ensemble encore tributaires des importations pour plus de 50% de leurs besoins, et il en sera ainsi au moins jusque dans les années 1990 selon les prévisions de diverses sources.

La pauvreté des populations rurales et les pénuries alimentaires dans le monde en développement tiennent en grande partie de ce que les petits agriculteurs n'ont pas accès à tous les facteurs de production ni à la technologie moderne.

Il apparaît ainsi, que les progrès obtenus dans le domaine de l'amélioration génétique ne sauraient à eux seuls constituer la solution au problème de la production céréalière. Les faits sont là pour démontrer qu'en la matière il ne peut y avoir de résultats que dans le cadre d'une action cohérente et simultanée au niveau de l'ensemble des facteurs de production parmi lesquels les facteurs organisationnels, économiques, humains jouent sans conteste un rôle aussi fondamental que les facteurs agronomiques.

A notre avis, ces problèmes doivent être l'objet des préoccupations des chercheurs et des responsables du développement de la production au même titre que les recherches liées à l'amélioration du potentiel génétique de la plante et aux techniques culturales.

Plusieurs pays et organisations ont apporté leur contribution à la concrétisation de nos programmes et en particulier dans le domaine de la formation de chercheurs, l'appui scientifique technique et matériel.

Les efforts fournis en particulier par le CIMMYT, la FAO, la Caisse Centrale de Coopération Economique Française, ont été pour nous déterminants. D'autres pays ont également apporté leur contribution et en particulier la Tunisie, la France, l'Italie, la Yougoslavie, le Mexique, l'Inde et d'autres encore.

Je voudrais saisir cette occasion pour exprimer tous nos remerciements aux hommes qui ont participé à cette tâche d'édification et à travers eux, à leurs gouvernements pour leur contribution et leur coopération.

Mais, si nous pouvons nous féliciter de ces progrès dans le domaine de la sélection

variétale, il reste encore beaucoup à faire pour atteindre les objectifs que nous nous sommes fixés en matière de production. Nous sommes, en ce qui nous concerne, déterminés à accentuer l'effort sur l'ensemble des facteurs d'amélioration de la production et notre pays ne ménagera pas à l'avenir ses potentialités et ses ressources en faveur de la production céréalière.

Je suis persuadé que l'ensemble des pays de notre région ont les mêmes préoccupations et les mêmes objectifs.

La concertation permanente qui existe entre nos différents pays, nous permettra d'accélérer le processus de progrès. Nous serons aidés en cela par les différentes organisations de recherche et de développement internationales qui doivent tout en continuant d'approfondir les résultats acquis en matière d'amélioration, se préoccuper des problèmes liés aux techniques culturales appropriées les associations culturales les plus rationnelles en fonction des besoins de consommation des populations, l'organisation des producteurs et des circuits d'appui logistique sans oublier les aspects économiques intimement liés à toute action de production.

Excellences. Mesdames, et Messieurs

Permettez moi, une fois de plus d'exprimer toute ma satisfaction de voir cette conférence tenir ses assises dans notre pays.

Je suis convaincu que cette cinquième conférence des céréales d'hiver apportera une contribution supplémentaire à la connaissance sur les voies et moyens propres à satisfaire les ambitions légitimes de tous nos pays confrontés au grave problème de l'autosuffisance pour ce produit de base qu'est le blé.

Je voudrais saisir également cette occasion pour remercier le Docteur Anderson, ici présent, pour sa contribution inestimable au progrès de la céréaliculture à travers le monde et pour l'appui considérable qu'il a apporté au programme algérien de recherche. Qu'il soit convaincu de la haute estime que lui témoignent tous ceux, responsables et chercheurs, qui ont eu à bénéficier de son concours scientifique au profit de notre céréaliculture.

Je souhaite à vos assises plein succès et déclare ouverts les travaux de la 5^{ème} Conférence régionale des Céréales.

INAUGURAL ADDRESS

Selim Saadi*

Excellencies, Ladies and Gentlemen:

Let me wish all of you a warm welcome to our country. We feel great satisfaction in welcoming the Fifth Regional Cereal Conference.

Let me also congratulate all the people who have participated in the preparation and organization of this workshop. I applaud the participation of the eminent researchers and others. Interest is clearly evident to all those who have had the heavy responsibility of ensuring cereal production throughout the world.

Indeed, the problems of cereal production take on such an importance that the situation of food in the developing countries continues to deteriorate.

This situation, if permitted, constitutes a serious menace to the stability of countries concerned, and world equilibrium—so much so that the international agreement on wheat that is aimed at leading to arrangements for reserve stocks, for food aid prices is still being persistently blocked. The cereal food assistance remains below that of the minimal objective of 10 million ton fixed by the FAO and others, and it does not appear that it will be

* Member, Central Committee, Ministry of Agriculture and Agrarian Revolution.

augmented by further measures in the coming years. The appearance in the world market of large cereal importing countries has served to perpetuate if not aggravate the situation and maintain most importing countries in a precarious situation.

These pessimistic prospects militate in favor of continued activity for increased cereal production in countries where the national production is below demand.

The action that every country must take is specific to each country and is dependent on the organization of research, the diffusion of technical progress, farmer organizations, agrarian structure, the politics of prices and proper mechanization adapted to the environment. The material assistance to the farmers constitutes the essential base in the framework of a coherent action and with continued aim of less dependence in cereal matters and if possible to allow for self-sufficiency.

The scientific and material assistance that can be contributed by specialized international agencies, such as CIMMYT, ICARDA, FAO, ACSAD and others, constitutes a contribution of great importance. They can significantly supplement the efforts of all the concerned countries.

Algeria on its part, has not escaped the grave problem of the insufficient cereal production and is facing even greater requirements. The high population growth of our country, as well as a substantial rise in the standard of living of rural populations, has caused an increase in cereal consumption. This situation which has evolved relatively rapidly has consequently resulted in massive imports with all attendant implications on Algeria's balance of trade.

Nonetheless, because we are conscious of the importance of cereal production, we have given the agricultural sector first priority in the form of financial assistance to agriculture production.

The cereal project initiated in 1971 was established in 1974 as the "Institut de Développement des Grandes Cultures" which received a mandate for promoting cereal research that in turn favored a consequent training of a staff of high level of competence to disseminate technology and ensure production of cereal adequate to our needs. In view of these objectives, a wide action has been taken to intensify production, particular efforts have been made in mechanization, fertilization, weed control, extension and training, and the wider use of improved seed. In a parallel way, considerable work has been done at the production level in the domain of research, introduction and experimentation with new cereal varieties and the selection of varieties for high yield.

The results obtained by our research people are intimately related to the successes in other countries and represent a part of the total general effort provided throughout the world for progress in cereal crops.

During the last decade, spectacular progress has been observed in the genetic improvement of cereals. High yielding varieties of the "Green Revolution" have provided marked improvement in certain countries. Progress in this area has constituted one of the great achievements of our generation. However, despite the progress in varietal improvement, constant production problems are still observed.

Indeed, land planted with high yielding varieties represents only a small part of the land cropped in developing countries and, in spite of the appreciably increased productive capacity of these countries, they are yet wholly dependent upon imports for more than 50 percent of their needs. This situation is foreseen to continue, at least until 1990.

The poverty of rural populations and food penury of the developing world, are, in great part, due to the fact that small farmers have not had the opportunity to take advantage of improved farming methods and technology.

Thus, it seems that progress in varietal improvement cannot alone be the solution to cereal production problems. Clearly, success may be achieved only in the framework of a coherent plan which brings all production factors together, including organizational, economical and human factors, which are fundamentally as important as agronomic factors. In our opinion these problems must be studied and resolved by researchers responsible for development of production with the same concern given to varietal improvements and cultural techniques.

Several countries and organizations have provided both material and technical assist-

ance toward the development of our programs. The assistance provided CIMMYT, FAO and Caisse Centrale of French Economic Corporation has been particularly important to us. In addition, many other countries have also contributed, and I mention particularly Tunisia, France, Italy, Yugoslavia, Mexico and India.

I would like to take the opportunity for expressing all our thanks to the people who have participated in this edifying task and, through them, to their governments for their contributions and cooperation. However, although we can be satisfied with progress in varietal improvement, there is still much to be done to attain all the objectives that have been mentioned as important to production. We are determined to intensify efforts towards the application of total production factors. Our country will direct its resources towards the increase of cereal production.

I am convinced that all of the countries of our region have similar thoughts and objectives.

The common concern among our different countries is to accelerate the process of progress. We will be helped in this by different international research and development organizations that will provide "indepth" results in crop improvement research and agronomic techniques and also be concerned with the needs of the consuming public, the farmer organizations and the supply of inputs, without forgetting the related economic aspects of all production activities.

Excellencies, Ladies and Gentlemen, allow me once again to express my total satisfaction with seeing this workshop held in our country.

I am convinced that this fifth workshop of winter cereals will be a significant contribution to the knowledge on proper ways and means to satisfy the legitimate ambitions of all our countries, which are confronted with grave problems of self-sufficiency in wheat.

I would like also to take this opportunity to thank Dr. Anderson, here present, for his inestimable contribution to the cereal crop progress throughout the world and for the considerable assistance that he has provided to the Algerian research program. We hope he is convinced of the high esteem we bear him; we have profited by his scientific assistance in favor of our cereal crops.

I wish you success and declare open this meeting of the Fifth Regional Cereals Workshop.

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CONSTRAINTS TO CEREAL PRODUCTION KEYNOTE ADDRESS

R. G. Anderson*

Ladies and Gentlemen:

Dr. Borlaug sends his regards to the delegates of the conference. Unfortunately, he became ill in Mexico and has gone to the Mayo Clinic in the United States for a thorough, long overdue checkup. He regrets his inability to be here today.

The subject on which Dr. Borlaug was asked to speak was "The Evolution of Constraints." I will not follow this title exactly since I would like to review constraints in more of a philosophical manner and in the technical sense, since the week will be largely devoted to a consideration of the technical problems concerning the production of winter cereals. The growing of plants and animals, which is collectively referred to as agriculture, is a very complex activity indeed. Production is the end product of a very complex set of events which include climate, soils, biological and economic factors. Climate in general is beyond the control of man except in those cases where available run-off water can be impounded or underground water can be developed so that irrigation may be provided to protect the crop.

* Associate Director, Wheat Program, International Center for Maize and Wheat Improvement—CIMMYT, México.

Modification of climate itself is still in the future and it is likely to be beyond man's control in our time. The other three factors which I mentioned, namely soils, biological and economic factors, may be modified or adjusted by man and it is in these areas that constraints may be minimized or reduced.

If I may speak in allegory one might compare agriculture and the development of research and production as a whole, to the situation that exists in an assembly line where cars are being manufactured. In such a manufacturing process, raw materials which come from a great variety of sources are made into components. *All of these must be produced in concert so that they flow at a regular rate to the production line. Here all the components move to their proper place, vehicles are assembled and come off at a regular rate as finished machines.*

Further, these vehicles must be such as to be in demand by the public and be able to perform their service over a considerable period of time.

Now, let us compare this allegory to the problems of research and production. The breeder working with the plant pathologist has a number of components which he wishes to put into a variety. These are collectively present in his parental varieties, and for specific situations his choice of parents will be dictated by the conditions under which the farmer, namely his customer, must grow the crop. It must also carry disease resistance and insect resistance insofar as possible to provide adequate stability. The varieties must fit into the various rotations which the farmer follows and they must have qualities for industrial purposes which the consumer is prepared to accept. All of these factors or genes are involved in a very dynamic system, so that selected varieties must be fine-tuned to ensure that the interacting physiologic processes are in balance. Insects and diseases are also changing and attempting to adapt to their host plants. Resistance is broken down so that new resistance must be continually sought to offset these changes.

Once the variety is produced it must be reproduced through a seed production process in order that adequate seed is available for distribution to the farmers. At this point we are ready to go to the field with one of the varieties, itself a product of a production line, and this joins the farmer's assembly line. Coming into this line from other sources are the fertilizers which are an adjustment to the soil. The elemental components must be balanced according to the storage which a particular soil exhibits in relation to the particular variety. Should the fertilizer be applied as one dose, or should it be applied as a split dose? Each variety has a proper rate of seeding which on the average will produce the greatest yield for that particular cultivar.

Weeds are a universal problem. How can they best be controlled? Is one seed drill better than another in controlling weeds or ensuring stand; what varieties or crops provide the best competition for weeds; what cultural practices provide best control; should herbicides be used; do herbicides provide the most economic control method, or are the weeds sufficiently limiting that weed control is necessary; does the rotation itself provide adequate control through row cropping or intertillage; what kind of tillage should be used to conserve water best; if irrigation is available, when should it be applied, and what are the most critical stages; does the seed rate have a direct relationship to yield and if so, what should it be; how important is depth of seeding?

These are some of the questions that must be answered by research to produce what is known as a set of agronomic practices which will maximize yield and at the same time be economical for the farmer to put into practice. This is the field of the agronomist. Perhaps the farmer is unable to use part of the agronomist's recommendations. Are fertilizers, herbicides, fungicides and pesticides available and if so are they available at a price that he can afford? If not, what must be done to make them both available and economical. Should there be subsidies, or should the price of the product to the consumer be raised so that the farmer may afford to use them or be persuaded to use them? Is credit necessary; and are economic studies necessary to find why the farmer fails to use these practices?

All of these questions are intimately interrelated and they provide some idea of the complexities of agriculture.

Now, let us assume that the program is going well and production is high. How will it be harvested and threshed? Storage is required for the grain after harvest to protect it from

weather and damage by insects, rodents and birds. Markets must be established in which the farmer can sell his grain. Prices must be stabilized to avoid disenchanting the farmer when he sells into a depressed market at harvest. This means that floor prices are needed and these must be set in the year before he buys the inputs so that he may decide on what levels of inputs he can afford.

Roads or railroads if not already present must be established to make marketing feasible and provide movement of grain to the consumer areas. It is a known fact that production increases normally occur where roads and market facilities are available.

What is the price of his product in relation to what other crops he might grow? This requires a delicate shifting of balances between the alternatives depending on what policy the government wishes to follow in the production of the competing cultivars. It may be seen now, that our assembly line which puts together a long series of very complex and fully interacting systems is not as simple as is summed up in the statement that "anyone can farm." This type of statement is all too widespread I am afraid and has resulted in quite miserly support for agriculture versus other governmental spending activities.

Let me go back a little and look at how all this new production became a reality. First of all, there needed to be a will on the part of the government to achieve increased production. As a first requisite, this needed to be supported at the policy level. But beyond this, there had to be people and these had to be trained people, if the aims were to be accomplished. There are research people, breeders, pathologists, agronomists, chemists, entomologists, physiologists, and so forth; there are experiment station operators; there are extension people with the ability to translate research to production at the farm level. There are economists who deal with the micro or farm level economics and with the macro or policy level economics. There are planners and others who decide as to what degree various inputs are needed at the country level, where they should be distributed and at what price. There are government officials who are responsible for the total success of the program under their different jurisdictions. All of these people that I have mentioned must have training or experience to be functional and all form part of the total effort needed for success.

Interlaced with all of these people are those of the bureaucracy. These are probably the most important of all for the functioning of an operation. If they are dedicated and try to forward their part of the total effort they can be extremely helpful. Unfortunately, it is my experience that most bureaucracies feed on paper and regulations with only the rare use of common sense so that the forward thrust is frustrated rather than assisted. I am sorry to have to say this, but it seems to be the normal situation.

Lest I be labelled as a complete pessimist may I say that for many of the clerical staff, it is the fear of the regulations that have evolved over time that often causes them to be obstructionist. However, there are also the cases where there is a feeling of power which in its exercise allows the bureaucrat to prevent the advance of the various sectors of the system.

In this talk I have kept from using the word constraint but like the vehicle we fictionally produced earlier, the system of food production is only as strong as the weakest link.

Looking over the constraints as I see them, internationally, I should say that varieties with relative stability of yield are generally available in most countries. Seed production is normally poorly developed in most countries. Extension and research are hopelessly separated in most countries and linkages must be reestablished between these two most important arms. The extension man normally has the methods of extension but has little knowledge provided to him of what he should extend. The researcher meanwhile is doing his research and has a restricted contact with the farmer. He often is in no position to see whether his research is entirely relevant or whether it might be better organized or directed to provide the answers needed by the farmer. These two branches must and can be brought together. We feel that it is essential that this linkage be again made as strong as it was back in the far distant past before we became so rigidly attired in discipline orientation. Weeds are major constraints in almost all countries and concerted efforts must be aimed at their control or the fertilizer and other inputs grow healthy weeds at the expense of the crop with a consequent sharp rise in production costs. Conservation practices for water are essential in the existing extremely large, dry land areas.

Concerted and continually modified policy at government level is needed. Often, issues are examined in a vacuum of knowledge about the biological relevance of the stated policies. This is a result of the lack of agricultural education in the early school years in most countries. In fact, a large part of the population grows up and in many cases goes through the university without being exposed to any information about agriculture or how the food reached the table. We need to establish linkages then also between biology and policy, so that the food machine can operate in a functional manner.

Time does not permit me to go into examples of countries suffering from low production because of shortfalls in the areas which I have discussed. I would like to reiterate that production of agricultural products is one of the most complex activities to have engaged the attention of man. The permutations and combinations of the component elements are infinite and it is only through continuous and concerted efforts devoted to the removal of the most limiting factors that progress is made. It requires continuous, fine-tuning to identify and remove the bottlenecks in different countries. Each country may have different constraints and the same one may appear at different times from country to country. It may be a shortage of trained manpower in one, it may be a lack of seed production in another, it may be a shortage of market centers or storage facilities in still another. But at any given time, major constraints can be identified in almost any system which materially prevent an increase in production. As each is removed the efficiency of production increases with a resulting reduction in the price to the consumer.

Now, Mr. Chairman, if I may digress, I would like in a personal way to relate some of the experiences that we have had in our host country, Algeria. Nine years ago this fall, Algeria called a conference on the development of cereal production which was attended by many in this room. At that time the wheat program I believe, consisted of Mr. Kadra and Mr. Golusie both of whom are here today. You have heard the Minister this morning refer to some of the advances that have been made but that there is still a long way to go. May I submit that today there has been a great change in the earlier picture. There is now a large number of trained people; there is now a structured Institute of Grande Cultures and it now boasts a cadre of young trained scientists. There have been large advances made in the agricultural development of the countryside. The picture is optimistic for the future. This year I understand in talking to a number of people from Algeria that the crop promises to be a record. This is a very heartening development. There are still many problems. Weeds are a major problem. They are particularly damaging during the dry years when they take up much of the moisture that has been conserved for the cereal crop. At present, I rate this as the major agronomic constraint of the region.

I am very pleased, Mr. Chairman, to have seen these changes occur in Algeria and I am sure that all of the delegates join me in wishing every success to their cereal program. When I think back over these last nine years in which CIMMYT has been associated with the Government and various other assistance organizations, my mind turns to thoughts of the strong support given by Mr. Boukli, Mr. Bouarfa, Mr. Benzarou, Mr. Kandra, and Dr. Hachemi. I would like to give a special vote of appreciation for the work of Mr. Laddada. He has been responsible for a great deal of the agronomy research accomplished in Algeria over the past several years. His work has been a source of pride to him and a satisfaction to his colleagues.

May I say in closing that I am sure that the deliberations on which we now embark in this workshop will be fruitful and rewarding. It is my sincere hope that change in agricultural production can be expected in many countries of the area, based on the removal of the constraints we are about to consider. We, as delegates, are most thankful to our hosts for the warm reception and the outstanding arrangements made for our comfort. We are most grateful.

CONTRAINTES A LA PRODUCTION CEREALIERE EXPOSE D'ORIENTATION

R. G. Anderson*

Mesdames et messieurs:

Dr. Borlaug envoie ses considérations aux délégués de cette conférence. Malheureusement, il est tombé malade au Mexique, et il est parti à la Clinique Mayo aux Etats Unis pour une complète examination médicale depuis longtemps échue. Il regrette son incapacité d'être ici aujourd'hui.

Le sujet sur lequel Dr. Borlaug a été demandé de parler était "L'Evolution des Contraintes". Je ne vais pas exactement suivre ce titre, puisque je voudrais bien examiner les contraintes dans une manière plus philosophique et dans un sens technique, et puisque la semaine sera largement consacrée aux problèmes techniques concernant la production des céréales de l'hiver. La culture des plantes et des animaux qui se rapporte collectivement comme agriculture, est, en effet, une activité très complexe.

La production est le produit fini de très complexes séries d'événements, qui englobent le climat, les sols et les facteurs biologiques et économiques. Le climat, en général, est hors du contrôle de l'homme, à l'exception des cas où l'écoulement d'eau est disponible pour être endigué ou l'eau souterraine peut être mise en valeur, afin que l'irrigation soit possible pour protéger la culture. La modification du climat, elle-même, est encore dans le futur et il est vraisemblable qu'elle reste hors du contrôle de l'homme dans notre temps. Les autres fois facteurs que j'ai mentionné, c.a.d., les sols et les facteurs biologiques et économiques peuvent être modifiés ou ajustés par l'homme, et c'est dans ces domaines que les contraintes peuvent être minimisées ou réduites. Si j'ose parler en allégorie, on peut comparer l'agriculture et le développement de la recherche et de la production dans son ensemble à la situation qui existe dans une chaîne de montage où les voitures seront manufacturées. Dans un tel déroulement industriel, les matières premières qui viennent des sources de grande diversité, sont formées en composantes. Celles-ci doivent être produites à l'unisson, de manière qu'elles coulent d'un taux régulier à la chaîne de production. Ici toutes les composantes se déplacent à leurs propres places, les véhicules sont montés et s'en sortent d'un taux régulier comme des machines achevées.

En plus, ces véhicules doivent satisfaire la demande du public et être capable de remplir leurs services sur une période considérable de temps.

Maintenant, comparons cette allégorie avec les problèmes de la recherche et de la production. Le sélectionneur travaillant avec le phytopathologue possède plusieurs composantes qu'il espère développer dans une variété. Elles sont collectivement présentes dans ses variétés parentales, et son choix sera dicté pour des cas spécifiques, par des conditions sur lesquelles l'agriculteur, c.a.d. son client, fait pousser sa culture. La variété doit aussi porter la résistance aux maladies et aux insectes la plus possible afin de pourvoir une stabilité adéquate. Les variétés doivent concorder dans les différents systèmes d'assolement, lesquels l'agriculteur suit, et elles doivent avoir les qualités pour les usages industriels que le client est préparé à accepter. Tous ces facteurs ou ces gènes sont enroulés dans un système très dynamique, d'une telle manière que les variétés sélectionnées doivent être en harmonie pour assurer que les déroulements physiologiques interagissants soient en balance. Les insectes et les maladies changent aussi, cherchant à s'adapter aux plantes-hôte. La résistance s'est écroulée d'une façon qu'une nouvelle résistance doit être continuellement cherchée pour compenser ces changements.

Une fois la variété est produite, elle doit être reproduite à l'aide d'un procédé de production de semence, afin que la semence adéquate soit disponible pour la distribution aux agriculteurs. A ce point, nous sommes prêts à aller au champ avec une des variétés, elle-même un produit de la chaîne de production, et celle-ci se joint à la chaîne de montage de l'agriculteur. D'autres composantes venant d'autres sources, comme les engrais vont

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joindre la chaîne, pour ajuster le sol. Les composantes élémentaires doivent être balancées en accord avec la déficience qu'un sol particulier présente en relation avec la particulière variété. Doivent les engrais être appliqués en une seule dose, ou doivent-ils être appliqués d'une manière fractionnée?

Chaque variété a un propre taux de semence qui en moyen produira le plus haut rendement pour ce cultivar particulier.

Les mauvaises herbes sont un problème universel. Comment peuvent-elles être le mieux contrôlées? Est-ce qu'un tel semoir est mieux qu'un autre dans le contrôle des mauvaises herbes ou dans l'assurance du peuplement des plantes; quelles variétés ou cultures fournissent la meilleure compétition contre les mauvaises herbes? Quelles pratiques de cultivation fournissent le meilleur contrôle? Doivent les herbicides être utilisés? Les herbicides fournissent-ils la méthode de contrôle la plus économique? Ou sont les mauvaises herbes suffisamment limitantes que le contrôle des mauvaises herbes soit nécessaire? Est-ce que l'assolement fournit un contrôle adéquat à travers la cultivation des lignes ou interculture? Quelle sorte de culture devrait être utilisée pour mieux conserver l'eau? Si l'irrigation est disponible, quand devrait-elle être appliquée? Et quels sont les stades les plus critiques? Est-ce que le taux de semence a une relation directe avec le rendement? Et si c'est vrai, combien doit-il être? De quelle façon la profondeur de la semence est importante? Ici quelques unes des questions qui doivent être répondues par la recherche, pour produire ce qu'on appelle un ensemble des pratiques agronomiques, qui porteront au maximum le rendement et en même temps seront économiques pour être mise en pratique par l'agriculteur. Ceci est le domaine de l'agronome. Peut-être que l'agriculteur est incapable d'utiliser une partie des recommandations de l'agronome. Est-ce que les engrais, les herbicides, les fongicides et les pesticides sont disponibles et si oui, est-ce qu'ils sont disponibles aux prix qu'il peut assumer? Si non, que doit-être fait pour les avoir disponibles et en même temps économiques? Devrait-il y avoir des subventions, ou devrait le prix du produit augmenter pour le consommateur, de telle manière que l'agriculteur puisse assumer de les utiliser ou être persuadé de les utiliser? Est-ce que le crédit est nécessaire, et est-ce que les études économiques sont nécessaires pour trouver pourquoi l'agriculteur a failli utiliser ces pratiques?

Toutes ces questions sont étroitement liées l'une à l'autre et donnent une certaine idée sur la complexité de l'agriculture.

Maintenant, supposons que le programme marche très bien et que la production est élevée. Comment va-t-on moissonner et battre? L'emmagasiner est exigé pour le grain après la récolte pour le protéger des dégâts dus aux conditions climatiques, aux insectes, aux rongeurs et aux oiseaux. Des marchés doivent être établis dans lesquels lieux pour que l'agriculteur peut vendre son grain. Des prix doivent être stabilisés, pour éviter désenchanter l'agriculteur, quand il vend son grain dans un marché à faible prix, après la récolte. Cela veut dire que les prix de parquette sont nécessaires et qu'ils devaient s'établir dans l'année avant qu'il achète les apports; de cette manière il peut décider sur quels niveaux seront les apports qu'il peut assumer.

Les routes ou les chemins de fer, s'ils n'existent pas encore, doivent être établis pour rendre possible la commercialisation et faire couler le grain aux régions des consommateurs. C'est un fait connu que l'augmentation de la production normalement se présente ou les facilités routières et commerciales sont disponibles.

Quel est le prix de son produit en relation avec celui des autres cultures qu'il pourrait cultiver? Cela nécessite un déplacement délicat des balances entre les alternatives, dépendant de la politique que le gouvernement veut suivre dans la production des cultivars en compétition. On pourrait voir maintenant, que notre chaîne de montage qui assemble une longue gamme des systèmes totalement interagissants et très complexes n'est pas si simple comme dans le jugement que "n'importe qui peut être agriculteur". Je crains que ce genre de point de vue est très répandu, et cela a résulté dans un appui absolument aveugle pour l'agriculture par rapport aux autres activités de dépenses gouvernementales.

Permettez-moi de retourner un peu en arrière et de voir comment cette production nouvelle est devenue une réalité. Avant tout, il devait y exister de la part du gouvernement une volonté pour obtenir une augmentation de la production. En tant que première condition

requis cela nécessite d'être soutenu au niveau politique. Mais hors de cela, il fallait, gens et des gens d'une bonne formation, si les buts pourraient être accomplis. Il y a le personnel scientifique, sélectionneurs, phytopathologues, agronomes, chimistes, entomologues, physiologues, etc', il y a des opérateurs des stations expérimentales, il y a le personnel de vulgarisation avec la capacité de transmettre la recherche à la production au niveau de l'exploitation agricole. Il y a des économes qui s'occupent de la micro-économie ou l'économie au niveau de l'exploitation agricole et de la macro-économie ou l'économie au niveau de la politique. Il y a des planificateurs et d'autres qui décident jusqu'à quel degré les différents apports sont nécessaires au niveau du pays, ou ils seront distribués et à quel prix. Il y a des fonctionnaires d'état qui sont responsables du succès total du programme sous leurs différentes juridictions. Toutes ces personnes que j'ai mentionnées doivent avoir une formation ou une expérience pour être fonctionnels et tous forment une partie de l'effort total nécessaire pour le succès.

Entrelacés avec tous ces gens sont ceux de la bureaucratie. Probablement ils sont les plus importants de tous dans le fonctionnement d'une opération. S'ils sont dédiés et essaient d'avancer leur part de l'effort total, ils peuvent être extrêmement utiles. Malheureusement, c'est mon expérience, la majorité des bureaucraties se nourrissent de papier et de règlements avec l'usage rare du sens commun, de telle façon que la poussée en avant est plutôt frustrée ou assistée. Je suis désolé d'avoir dit cela, mais cela paraît être la situation normale. De crainte que je serais étiqueté comme un complet pessimiste, puis-je dire que pour un grand nombre des employés, c'est la crainte des règlements qui s'est développée avec le temps, qui les fait souvent devenir obstructionnistes. Cependant, il y a aussi des cas où il y a un sentiment de pouvoir, qui dans son exercice permet aux bureaucrates d'empêcher l'avance des différents secteurs du système.

Dans cette conversation je me suis gardé d'utiliser le mot contrainte, mais comme le véhicule que nous avons produit d'imagination au début, le système de la production alimentaire est aussi fort seulement que le point le plus faible.

Examinant des contraintes comme je les vois, dans l'ensemble international, je dois dire que les variétés avec une relative stabilité de rendement sont généralement disponibles dans la majorité des pays.

La vulgarisation et la recherche sont désespérément séparées dans la majorité des pays et la liaison doit être rétablie entre ces deux armes très importantes. L'homme de la vulgarisation a normalement les méthodes de vulgarisation mais il a peu de connaissance prête, sur ce qu'il doit vulgariser. Le scientifique entre-temps, juit au recherche et il a un contact limité avec l'agriculteur. Souvent, il n'est pas dans la position de voir si son travail est entièrement pertinent ou s'il pourrait être mieux organisé et orienté pour donner des réponses dont l'agriculteur a besoin. Ces deux branches doivent et peuvent être mises ensemble. Nous sentons qu'il est essentiel de rendre cette liaison aussi forte qu'elle était dans le passé, avant que nous étions devenus si rigidelement attirés par l'orientation des disciplines. Les mauvaises herbes sont une contrainte majeure dans plusieurs pays et un effort concerté doit être visé à leur contrôle ou les engrais et d'autres apports font pousser les mauvaises herbes vigoureusement aux frais de la culture avec la conséquence d'augmenter nettement les coûts de la production.

Les pratiques pour la conservation de l'eau sont essentielles dans les régions sèches. Une politique concertée et *continuellement adaptée* est nécessaire au niveau gouvernemental. Souvent, les questions sont examinées dans un vide de connaissance de la pertinence biologique de la politique déterminée. Cela est un résultat du manque d'éducation agricole dans les premières années d'école dans la majorité des pays. En effet, une grande proportion de la population devient adulte et dans beaucoup de cas passe l'université sans être exposée à aucune information sur l'agriculture ou comment la nourriture arrivait à la table. Nous avons besoin aussi d'établir des liaisons entre la biologie et la politique, afin que la machine de nourriture puisse opérer d'une manière fonctionnelle.

Le temps ne me permet pas de donner des exemples des pays qui souffrent d'une production basse à cause de déficiences dans les domaines que je viens de discuter. Je voudrais réitérer que la production agricole est une des plus complexes activités, qui a attiré l'attention de l'homme. Les permutations et les combinaisons des éléments composants

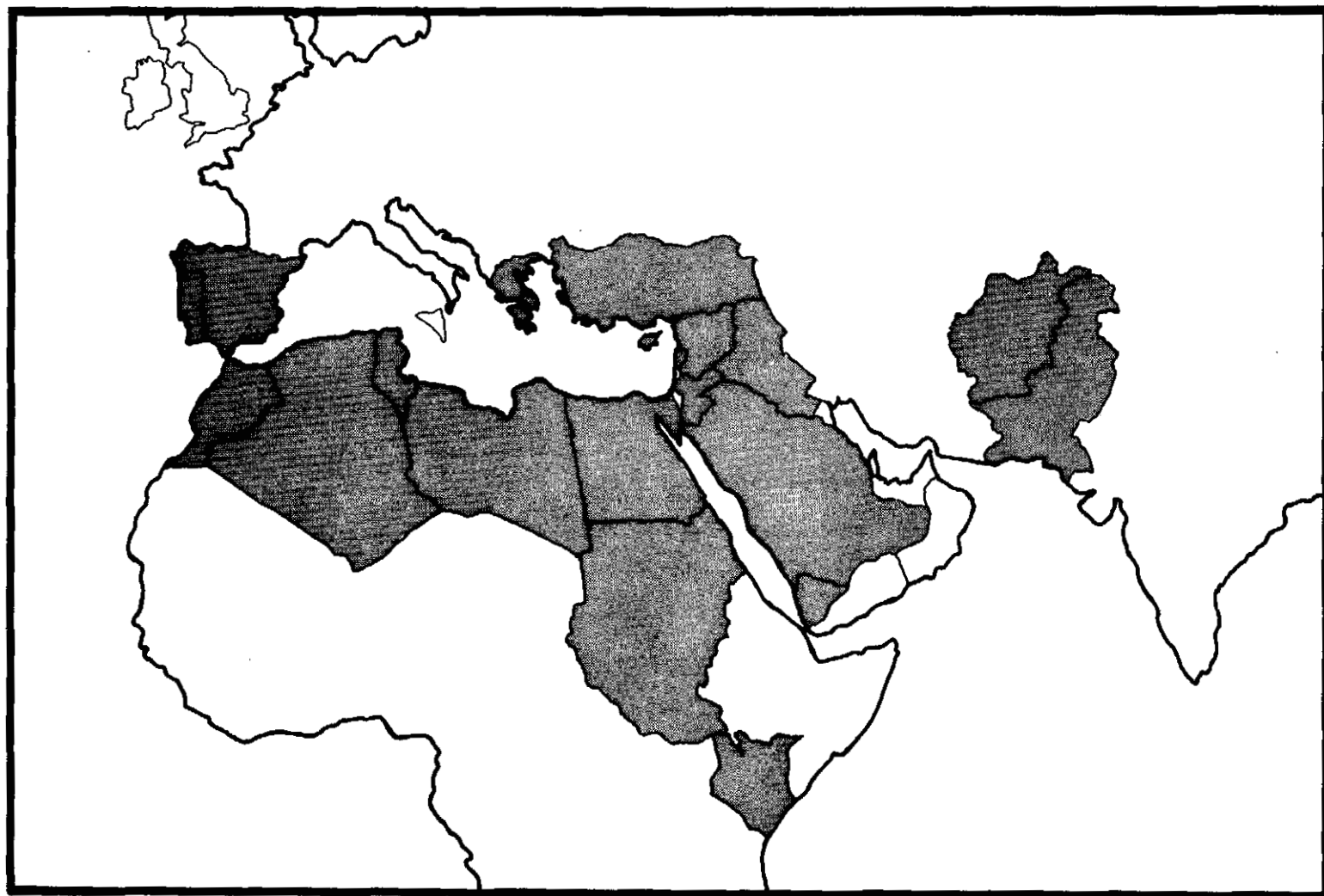
sont infiries et c'est seulement par des efforts concertés et continus consacrés au enlèvement des facteurs limitants que le progres se fait. Il nécessite un réglage continu pour identifier et enlever les goulots dans les différents pays. Chaque pays a des contraintes différentes et la meme contrainte peut apparaitre dans des temps différents d'un pays a l'autre. Il peut être du au manque de personnel qualifié dans un pays, ou au manque de semence dans un autre, et il peut être due au manque des centres de commercialisation ou de l'emmagasinage. Mais à n'importe quel temps donné, les contraintes majeures qui matériellement bloquent l'élévation de la production peuvent être identifiées dans n'importe quel système. Chaque fois qu'une contrainte est enlevée, l'efficacité de la production augmente, avec le résultat d'une réduction dans le prix-consommateur.

Maintenant, Monsieur le Président, si je peux me dévier, je voudrais d'une manière personnelle rapporter quelques expériences que nous avons eues dans notre pays de hôte, l'Algérie. Neuf ans seront écoulés cet automne, quand l'Algérie avait appelé une conférence sur le développement de la production céréalière, qui était assisté par plusieurs personnes dans cette salle. A ce temps là, le programme céréaliier, je crois, était composé de Messieurs Kadra et Golusic, qui sont tous les deux ici aujourd'hui. Ce matin vous avez entendu le Ministre référer a quelques unes des avances qui ont été réalisées, mais qu'il y a toujours un long chemin à marcher. Puis-je faire observer qu'il y a aujourd'hui un grand changement dans l'image d'aparavant. Il-y-a maintenant un grand nombre de personnel qualifié, un institut structuré des Grandes Cultures qui se vante d'un cadre des jeunes scientifiques qualifiés. Une grande avance a été réalisée dans le développement agricole à l'intérieur du pays. L'image est optimiste pour l'avenir. Cette année, comme j'ai compris en parlant à nombreuses personnalités Algeriennes, la récolte promet d'être un record. Cela est un développement encourageant. Il-y-a toujours beaucoup de problèmes. Les mauvaises herbes sont un problème majeur. Elles sont particulièrement endommageants pendant les années sèches, quand elles absorbent une grande quantité de l'humidité qui a été conservée à la culture céréalière. Au présent, je considère cela comme la contrainte agronomique majeure dans la région.

Je suis très heureux, Monsieur le Président, d'avoir vu ces changements se présenter en Algérie et je suis sûr que tous les délégués me joignent dans le souhaite de succès au programme céréaliier Algérien. Quand je réfléchis sur ces neuf ans passés, dans lesquels le CIMMYT a été associé au Gouvernement et a d'autres organisations d'assistance, je pense a l'appui fort donné par M. Boukli, Mr. Bouarfa, M. Benzarou, M. Kadra et Dr. Hachemi. Je voudrais donner mon vote d'appréciation pour le travail de M. Laddada. Il a été responsable d'une grande partie de la recherche agronomique achevée en Algérie pendant plusieurs années passées. Son travail a été une source de fierté pour lui et une satisfaction pour ses collègues. Puis-je dire, en conclusion, que je suis sûr, que les délibérations dans lesquelles nous embarquons maintenant dans cette conférence, seront fructueuses et vont valoir la peine. C'est mon souhait sincère que le changement dans la production agricole peut être attendu d'une manière positive dans beaucoup de pays de la région, basé sur l'enlèvement des contraintes, que nous sommes en train de considérer.

Comme délégués, nous sommes très reconnaissants a nos hôtes de la chaleureuse réception et de l'extrordinaire arrangement faits pour notre confort. Nous sommes très reconnaissants.

CONSTRAINTS TO CEREAL PRODUCTION COUNTRY-BY-COUNTRY



SITUATION DES CEREALES EN ALGERIE

By Benzaghoul, M.M.*

L'Algérie est située au nord de l'Afrique et occupe une superficie totale de 237 806 620 hectares.

L'agriculture classique n'utilise que la partie nord du pays voisine de la Méditerranée. La majeure partie de la surface nationale est désertique ou semi-désertique. La zone semi-désertique est utilisée comme parcours pour le cheptel ovin et comme source d'alfa. Dans la zone désertique se trouvent des oasis où se pratiquent la culture du palmier dattier et les cultures vivrières dont de petites superficies en céréales.

La surface agricole utile (S.A.U.), y compris les cultures pérennes, est de 7 750 000 hectares soit à peine 3,3% de la superficie totale du pays.

La totalité des terres utilisées par l'agriculture est de 39 345 000 hectares dont 30 000 000 d'hectares sont constitués de parcours naturels plus ou moins productifs.

Les céréales d'hiver et les jachères qui font partie de la rotation céréales-jachère, couvrent chaque année plus de 6 000 000 d'hectares soit près de 82% de la totalité de la S.A.U. Les emblavures de céréales d'hiver sont chaque année de l'ordre de 3 000 000 à 3 350 000 hectares. Ces données montrent l'importance des céréales par rapport à l'ensemble des cultures pratiquées.

Si les céréales tiennent, de loin, la première place quant à l'occupation des terres agricoles c'est parce qu'elles servent de base à l'alimentation des habitants et sont consommées sous différentes formes.

Dans les zones rurales les céréales constituent la quasi totalité de la ration alimentaire.

Les céréales sont dispersées pratiquement sur toute la superficie cultivable du pays, souvent au détriment d'autres cultures qui seraient sans doute mieux appropriées à certaines régions, telles que les cultures pérennes, industrielles ou fourragères.

Si les céréales sont cultivées un peu partout, la majeure partie (plus des deux tiers), se trouve dans les hautes plaines caractérisées par une altitude assez élevée (800 à 1 200 m) par des hivers relativement froids, par un régime hydrique capricieux et marqué par une insuffisance assez générale des précipitations et une mauvaise répartition de ces dernières, par des gelées printanières fréquentes et enfin par l'apparition d'un vent chaud et desséchant (sirocco) au stade grain laiteux ou pâteux.

La pluviométrie qui caractérise les zones les plus emblavées en céréales varie de 350, à 550 mm; dans les plaines côtières de l'Est et du centre, la pluviométrie peut atteindre 700 à 900 mm. La répartition des pluies, plus que leur quantité, conditionne grandement le résultat de la culture céréalière. L'absence de pluie printanière engendre toujours une mauvaise récolte; par contre si la répartition est correcte, les rendements peuvent atteindre un niveau satisfaisant.

Les gelées printanières, fréquentes dans les hautes plaines mais aussi dans les plaines intérieures à basse altitude causent des pertes importantes par le gel des épis au stade floraison.

Le sirocco peut réduire de moitié le poids de 1000 graines en ne soufflant que quelques heures.

Le climat peut donc expliquer, en partie, la faiblesse des rendements et surtout leur irrégularité.

Il n'y a pratiquement pas en Algérie de céréales d'hiver cultivées à l'irrigation. Lorsque la céréale alterne avec une culture irriguée (betterave par exemple), la sole céréale n'est pas irriguée.

Les semis se font en novembre et décembre. Les semis les plus précoces assurent, en général une meilleure récolte surtout dans les hautes plaines. La maturité intervient en

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juin sur le littoral et en juillet dans l'intérieur, exceptionnellement début août pour les variétés de blé dur tardives en altitude.

Structures l'exploitation

Il existe actuellement en Algérie trois secteurs agricoles exploitant les terres cultivables.

—Le secteur privé qui occupe de loin la plus grande superficie. Ce secteur est surtout composé de petites exploitations traditionnelles et peu productives, tout au moins en ce qui concerne les céréales. En année moyenne. Ce secteur couvre en peu plus de 2 000 000 hectares en céréales soit environ 60% de la totalité des emblavures.

—Le secteur Révolution Agraire est le moins important quant à la superficie occupée en culture céréalière. Son niveau de productivité est voisin de celui du secteur privé. Ce secteur emblave entre 400 000 et 450 000 hectares de céréales chaque année soit en moyenne 13% des cultures de céréales.

—Le secteur socialiste est le plus moderne et occupe les terres les plus productives regroupées en grandes exploitations. Sa productivité est nettement supérieure à celle des deux précédents secteurs en matière de céréales. Avec une moyenne de 850 000 hectares ensemencés chaque année ce secteur couvre 37% de l'ensemble des céréales d'hiver.

Production et Besoins

La production reste faible et très dépendante des aléas climatiques.

La récolte moyenne annuelle se situe aux environs de 18 000 000 de quintaux pour l'ensemble des espèces, avec des pointes avoisinant 30 000 000 de quintaux les bonnes années et des creux au dessous de 10 000 000 de quintaux lors des mauvaises campagnes.

Le rendement moyen par hectare est de 5 à 7 quintaux pour les secteurs privé et révolution agraire; il est voisin de 9 à 12 quintaux par hectare pour le secteur socialiste.

Cette production ne couvre les besoins estimés à 25 000 000 de quintaux environ, que de très rares années. Un recours important à l'importation a lieu pratiquement tous les ans.

Importance des différentes espèces

Le blé dur est de loin la céréale la plus cultivée. Sa part dans l'ensemble des cultures céréalières varie selon les secteurs; elle est en moyenne de:

- 51% pour le secteur privé
- 44% pour le secteur de la Révolution Agraire
- 38,5% pour le secteur socialiste

Son importance en agriculture privée s'explique par le fait que ce produit est réservé presque exclusivement à l'autoconsommation des exploitants de ce secteur.

Le blé tendre est surtout cultivé en secteur socialiste et entièrement commercialisé. Selon les secteurs il occupe dans l'ensemble des emblavures les proportions suivantes:

- 12% en secteur privé
- 27 à 28% en secteur Révolution Agraire
- 42,5% en secteur socialiste

L'orge cultivée surtout en secteur privé occupe les moins bonnes terres parmi celles réservées aux céréales; La part de chaque secteur est de:

- 35% en secteur privé
- 22 à 23% pour la Révolution Agraire
- 12 à 13% en secteur socialiste

L'avoine est peu cultivée pour la production de grains. Elle couvre respectivement:

- 2% en secteur privé
- 6% en secteur Révolution Agraire et en secteur socialiste.

A l'échelle nationale et en moyenne pondérée, la part de chaque espèce est de:

- Blé dur: 46,6%
- Blé tendre: 22,0%
- Orge: 27,9%
- Avoine: 3,5%

Les Variétés

Les variétés actuellement cultivées sont:

Blé dur: Oued Zenati, Bidi 17, Mohamed Ben Bachir, Hedba 3, Saba et T. polonicum x Zenati Bouteille pour les variétés algériennes; Capeiti, INRAT 69 et Cocorit 71 pour les autres cultivars. Cocorit 71 est réservé à la culture dans les plaines.

Blé tendre: Pour les plaines, Florence Aurore et un peu pumaflor d'origine locale, puis Strampelli et Anza. Pour les hautes plaines intérieures: Mahon Démias cultivar algérien, puis Siété Cerros; cette dernière variété a beaucoup souffert de la rouille jaune (*P. striiformis*) au cours de la campagne 1977-1978.

Orge: Variétés locales Saida (4 rangs) et Tichdrett (6 rangs), puis pour les plaines: Robur et pour les hautes plaines: Ager, toutes les deux à 6 rangs. Il est à remarquer que seules les orges à 6 rangs sont cultivées malgré les excellents résultats obtenus en expérimentation avec des variétés d'orge à 2 rangs brassicoles ou non.

Avoine: En plus des variétés locales: Rouge 31, Noire 912, Cowra et Guelma 4, deux nouvelles variétés sont en culture: Caravelle pour les plaines et Avon pour les zones d'altitude.

Remarque: L'éventail de variétés est assez restreint encore actuellement, surtout si l'on tient compte du besoin de remplacer assez rapidement Siété Cerros trop sensible aux maladies, Septoriose (*Septoria tritici*) et Rouille jaune (*P. striiformis*).

Un certain nombre de lignées a été retenu à la suite d'une longue expérimentation. C'est ainsi que quatre nouvelles variétés de blé tendre ont été mises en multiplication au cours de la campagne en cours; Il en est de même pour 5 variétés de blé dur.

Méthodes de culture

Malgré une campagne de sensibilisation importante auprès des producteurs pour les inciter à réduire les surfaces consacrées à la jachère improductive, la pratique de l'assolement biennal céréales-jachère est encore largement répandue.

Les jachères sont soit incultes, soit travaillées.

—Jachère inculte: elle est laissée sans façon culturales de la récolte de la céréale à la préparation du sol pour la céréale de l'année suivante. Ces terres servent au pâturage des troupeaux ou même à des récoltes de foin;

Cette pratique engendre des sols mal préparés pour le semis de la céréale et favorise la prolifération des mauvaises herbes. Elle est surtout généralisée en secteur privé traditionnel.

—Jachère travaillée: la terre est travaillée soit dès la récolte de la céréale précédente par un déchaumage et labourée en hiver ou au plus tard au printemps. Des passages superficiels d'appareils de pseudo-labour assurent une certaine maîtrise des mauvaises herbes et, dans certains cas, une petite économie d'eau. Si cette pratique est bien menée, elle assure une préparation correcte du lit de semences pour la céréale suivante. Le secteur socialiste pratique généralement ce système.

Indépendamment de la rotation céréales-jachère, on rencontre certaines cultures en alternance avec la céréale toujours dans le cadre d'un assolement biennal; c'est ainsi que la vesce-avoine récoltée comme fourrage est, après la jachère, le plus important précédent à céréale. Pour une partie des surfaces les cultures de légumes secs, lentilles, pois chiches, pois rond ou fèves occupent la sole où les céréales reviennent une année sur deux. Quelques cultures industrielles, carthame, betterave ou tournesol, sont pratiquées également mais à une faible échelle.

La culture des luzernes annuelles en alternance avec la céréale prend une certaine ampleur dans les zones de basse et de moyenne altitude: cette rotation devrait permettre une meilleure intégration de l'élevage ovin à la culture des céréales.

Les assolements plus compliqués, triennal ou quadriennal, ne sont pratiqués qu'à de très rares exceptions.

Contraintes liées à la production

Nous avons souligné que les rendements étaient, le plus souvent assez bas. Si les caprices du climat peuvent expliquer, en partie cet état de fait, ils ne peuvent pas être les

seuls incriminés.

Dans les stations de recherche ou même dans les expérimentations qui sont menées en milieu producteur, les résultats obtenus sont très supérieurs à ceux enregistrés dans l'environnement immédiat. Dans ces cas, le climat est le même pour le producteur ou pour l'expérimentateur, mais une meilleure maîtrise des autres facteurs permet d'obtenir une production nettement plus élevée. Nous allons tenter d'énumérer quelques contraintes qui nous paraissent les plus significatives:

- Le bas niveau de technicité des responsables d'exploitations agricoles et l'insuffisance de cadres de terrain font qu'il est difficile de faire mettre en pratique des résultats obtenus et prouvés par les organismes de recherche et de développement. De cette première constatation découlent pratiquement toutes les imperfections constatées dans la culture des céréales.

- Façons culturales non appropriées ou faites de façon négligée ou encore exécutées à contre temps. Mauvaise préparation assez générale du lit de semence.

- Semis effectués à la volée et non au semoir en lignes et enfouls à des profondeurs variables et non contrôlées.

- Utilisation de variétés peu adaptées à la zone concernée.

- Utilisation de semences de mauvaise qualité.

- Méconnaissance d'une fumure équilibrée et épandue en temps voulu.

- Difficultés rencontrées par les responsables des unités de production pour s'approvisionner régulièrement en semences, engrais, pesticides, fongicides, carburant, lubrifiant, pièces de rechanges . . . etc.

- Très mauvais contrôle assez général des mauvaises herbes.

- Récolte souvent retardées pour diverses causes.

Ennemis naturels de la culture

Parmi les ennemis de la culture céréalière en Algérie, il faut citer en tout premier lieu la végétation adventice. Les dégâts causés par les mauvaises herbes sont énormes (entre 20 à 50%); ils sont d'autant plus importants que la zone de culture est bien arrosée, et devrait donc permettre le rendement maximum. En dehors des dicotylédones, les mauvaises herbes les plus agressives sont par ordre d'importance: la folle avoine, le brôme dans certaines régions, les phalaris et les ray-grass.

La lutte chimique pratiquée depuis plusieurs années, contre les dicotylédones a favorisé la prolifération des graminées adventices.

Les maladies cryptogamiques ont surtout de l'influence dans les zones côtières mais elles entraînent très rarement des pertes de rendement dans les zones des hautes plaines où se pratique la plus grande partie de la culture des céréales, les seules maladies néfastes dans ces zones sont les maladies charbonneuses (charbon et carie), mais ces dernières restent sans importance.

La verse sévit surtout dans les basses plaines, les variétés courtes sont peu sensibles à cet accident.

Parmi les prédateurs animaux, la punaise du blé a causé certaines années des dégâts importants. A l'heure actuelle ce parasite est maîtrisé; les moineaux tendent à devenir un fléau à l'échelle nationale; des vols très importants de ces passereaux causent des dégâts considérables aux céréales au stade grain pâteux. La lutte intégrée ayant pour but de réduire les pullulations de moineaux devient d'une grande nécessité.

Enfin les déprédateurs des grains stockés causent des dégâts très importants si les silos ou autres lieux de stockage ne sont pas désinfectés d'une façon efficace et continue.

ACTIONS ENGAGÉES DANS LE CADRE DE LA PRODUCTION DE LA CEREALICULTURE

La faiblesse de la production découle *en majeure partie des faibles rendements moyens* obtenus. Comme il n'est pas possible d'étendre les superficies consacrées aux céréales

d'hiver en Algérie, il est donc impératif de faire croître les rendements à l'hectare.

Le Ministère de l'Agriculture à travers l'ensemble de ses structures d'interventions s'est attaché depuis plusieurs années à atteindre cet objectif.

Les premiers travaux ont eu pour but de donner à l'agriculture algérienne des variétés plus productives aux celles qu'elles utilisaient auparavant, d'où l'introduction de nouvelles variétés productives et rustiques et la sélection parmi ces cultivars, des mieux adaptés aux conditions locales. Parallèlement à ces introductions de variétés, un travail considérable d'amélioration des plantes a été mis en œuvre afin de créer, sur place, des variétés les mieux acclimatées aux contraintes agro-écologiques rencontrées. Ce travail a surtout porté sur le blé dur et a pris pour base les variétés locales bien adaptées et très rustiques.

On s'est rapidement aperçu que de bonnes variétés mises en terre dans des conditions culturales précaires n'avaient aucune chance d'améliorer le rendement national en céréales. Des travaux concernant les techniques culturales et les fumures ont donc été entrepris, afin de définir des normes optimales applicables à la culture des nouvelles variétés que l'on désirait cultiver.

Le problème des assolements a été étudié parallèlement dans le but de réduire la jachère improductive tout en préservant un bon précédent pour la culture des céréales; les investigations ont poussé à étudier les différentes cultures susceptibles d'entrer dans les soles céréalières et principalement les cultures de légumes secs et de plantes fourragères.

De même il est apparu que le problème des mauvaises herbes constituait un des principaux freins à la production des céréales. C'est ainsi que les recherches menées pour trouver de bons précédents à la culture des céréales s'attachent à avoir une culture propre aussi bien pour les légumes secs ou les fourrages que pour la céréale. Les premiers travaux de recherche sur les herbicides chimiques ont porté sur la culture des céréales puis se sont rapidement étendus aux autres cultures et en particulier aux légumes secs. Les premiers résultats obtenus furent très intéressants et ont amené à tester une gamme très étendue de produits herbicides de façon à avoir un spectre le plus large possible avec comme principale préoccupation la lutte contre les monocotylédones qui constituent à présent un problème sérieux. La recherche de spécialités herbicides efficaces et d'un emploi simple alliée à une maîtrise des techniques culturelles dans toutes les soles de l'assolement céréalière devrait permettre d'améliorer la productivité dans une large mesure.

Une action importante est également engagée en matière de production de semences sélectionnées. En plus de l'extension de notre production de semences, l'Institut des Grandes Cultures s'attache à renforcer ses structures et son organisation de contrôle des semences. Par ailleurs, notre office des céréales s'est engagé dans un programme de réalisation d'infrastructures de traitement et de conditionnement de semences aptes à répondre aux objectifs assignés en la matière.

Des recherches ont lieu également en machinisme agricole de façon à déterminer les équipements les mieux adaptés aux différentes phases de la culture et à en définir les normes d'utilisation.

Des travaux de développement intégré ont lieu sur trois Dairas pilotes, ils doivent permettre de définir les goulots d'étranglement qui nuisent au progrès de la céréaliculture et de mettre au point des remèdes efficaces.

Enfin un gros effort de formation a été entrepris afin de doter l'agriculture de cadres compétents; cette formation se fait tant au niveau supérieur qu'au niveau des cadres de terrain.

Malgré tous les efforts entrepris, les résultats au niveau de la production restent encore insuffisants. Il est clair que les progrès obtenus au niveau de la recherche et de l'expérimentation n'ont pas eu encore l'impact recherché sur l'augmentation des rendements. La vulgarisation devra jouer à l'avenir un rôle encore plus efficace.

Cependant les problèmes techniques liés à la céréaliculture, tels que les problèmes de variétés, de façons culturales, de protection des cultures, de mécanisation autres ne peuvent pas constituer les seuls facteurs de progrès. Les aspects économiques et structurels restent également déterminants dans ce cadre. Compte tenu des acquis non négligeables obtenus par notre pays en matière de technologie de la production, nous axerons à

l'avenir notre réflexion et nos investigations sur l'environnement de la production et sur l'organisation des producteurs sans lesquels au progrès ne peut être obtenu, quelque soit les résultats obtenus par ailleurs.

Résumé

Malgré les trois secteurs exploitant les terres cultivables (Privé, Révolution Agraire et Socialiste), la production reste très faible, de 18.000.000 de quintaux en moyenne. Cette production ne couvre que 72% des besoins nationaux et dépend énormément des aléas climatiques (pluies, gélées printanières et sirocco), mais dépend aussi des techniques culturales et des maladies et prédateurs animaux; on peut citer, par exemple, la mauvaise préparation des lits de semences, les variétés peu adaptées à la région, les semences de mauvaise qualité, la faible utilisation d'engrais et de désherbants (doublée d'un mauvais réapprovisionnement), le très faible contrôle de mauvaise herbes (folle-avoine, phalaris, rye-grass et brome), la récolte trop tardive, les maladies cryptogamiques (en zone cotière), les maladies charbonneuses (en hautes plaines), les punaises des blés, les moineaux (fléau à l'échelle nationale) et les prédateurs de grains stockés.

Les espèces cultivées sont le blé dur (46,6%), le blé tendre (22%), l'orge (27,9%) et l'avoine (3,5%); l'éventail de variétés est assez restreint et durant la campagne en cours 4 nouvelles variétés de blé tendre et 5 de blé dur ont été mises en multiplication.

L'assolement biennal est encore très répandu avec deux types de jachères (incultes et travaillées) mais il existe d'autres précédents à céréales telles que la vesce-avoine, les lentilles, pois chiches ou fèves, le carthame, la betterave ou le tournesol; de plus durant ces dernières années, la culture des luzernes a pris une certaine ampleur (intégration de l'élevage ovin dans la céréaliculture).

Des travaux ont été entrepris pour améliorer les techniques culturales, les fumures, les assolements, les désherbants chimiques, la production des semences sélectionnées, la production de cultivars adaptés aux conditions locales, le machinisme agricole et la formation de cadres compétents. A l'avenir, les réflexions et investigations porteront surtout sur l'environnement de la production et sur l'organisation des producteurs.

CONSTRAINTS TO CEREAL PRODUCTION AND POSSIBLE SOLUTIONS IN ALGERIA

Summary

Cereal production in Algeria occurs in three sectors: —private holdings, agrarian reform lands and socialist communal farms. The principal species of winter cereals are durum wheat (46.6 percent), bread wheat (22 percent), barley (27.9 percent) and oats (3.5 percent). The release of new varieties is a careful process, and at present four new bread wheats and five new durum lines are being multiplied for release. Total crop production however, has remained low —about 1,800,000 tonnes annually, which only meets 72 percent of the country's requirements. In addition to a variable and often unfavorable climate, a variety of factors contribute to overall low yields. In coastal areas, foliar diseases such as rusts, *Septoria* ssp. and *Helminthosporium* ssp. cause considerable damage in some years. In the drier plateau areas, smuts are the most serious disease problem. Other pests include the cereal leaf beetle and sparrows; the latter cause large losses nationwide. Poor land preparation, limited use of fertilizer and a serious lack of weed control are examples of areas needing improvement. The use of herbicides, especially to control grassy species, needs to be increased. Late in the season, delayed harvest and postharvest storage problems also contribute to low returns.

Biennial rotation is very widespread, with two types of fallow being used, either cultivated or non-cultivated. However, other rotations with forage, legume crops and summer crops are also utilized. Most notable in recent years is the large area of cereals being used in rotation with alfalfa, an indication of the importance of livestock production to cereal farmers.

Current areas of study include agronomic practices, use of fallow and green manure crops, and the screening of suitable herbicides. Efforts in the breeding program include trying to develop varieties suited to particular environmental conditions, and to increase the size and efficiency of the seed production and certification system. In the future, additional research will focus on environmental factors and how they affect production. Studies reviewing the organization of the cereal producers in Algeria may also reveal ways to improve efficiency and increase overall production.

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Summary

Cereal production in Algeria occurs in three sectors: —private holdings, agrarian reform lands and socialist communal farms. The principal species of winter cereals are durum wheat (46.6 percent), bread wheat (22 percent), barley (27.9 percent) and oats (3.5 percent). The release of new varieties is a careful process, and at present four new bread wheats and five new durum lines are being multiplied for release. Total crop production however, has remained low —about 1,800,000 tonnes annually, which only meets 72 percent of the country's requirements. In addition to a variable and often unfavorable climate, a variety of factors contribute to overall low yields. In coastal areas, foliar diseases such as rusts, *Septoria* ssp. and *Helminthosporium* ssp. cause considerable damage in some years. In the drier plateau areas, smuts are the most serious disease problem. Other pests include the cereal leaf beetle and sparrows; the latter cause large losses nationwide. Poor land preparation, limited use of fertilizer and a serious lack of weed control are examples of areas needing improvement. The use of herbicides, especially to control grassy species, needs to be increased. Late in the season, delayed harvest and postharvest storage problems also contribute to low returns.

Biennial rotation is very widespread, with two types of fallow being used, either cultivated or non-cultivated. However, other rotations with forage, legume crops and summer crops are also utilized. Most notable in recent years is the large area of cereals being used in rotation with alfalfa, an indication of the importance of livestock production to cereal farmers.

Current areas of study include agronomic practices, use of fallow and green manure crops, and the screening of suitable herbicides. Efforts in the breeding program include trying to develop varieties suited to particular environmental conditions, and to increase the size and efficiency of the seed production and certification system. In the future, additional research will focus on environmental factors and how they affect production. Studies reviewing the organization of the cereal producers in Algeria may also reveal ways to improve efficiency and increase overall production.

CONSTRAINTS TO CEREAL PRODUCTION AND POSSIBLE SOLUTIONS IN CYPRUS

Theodore Samios*

Introduction

The total area of the island of Cyprus is 9,250 Km². Forty-seven percent of this area is cultivated land. Cereals are almost entirely grown on the plains under rainfed conditions and where the annual average precipitation ranges from 250 - 350 mm. This rain falls during the winter and its bulk of incidence occurs in December and January.

As the cultivation of summer irrigated cereals such as maize, sorghum and millet is negligible, information presented herein refers to winter cereals grown in areas receiving less than 350 mm annual rainfall.

Rainfed Grain Cereals

The area of the rainfed arable land is about 120,000 ha. In 1978 bread wheat occupied 10,940 ha, durum wheat 16,350 ha and barley (grain) 33,340 ha. The average production was 9,200, 13,800 and 56,000 tonnes of bread wheat, durum wheat and barley respectively. The average yield of wheat is 0.85 t/ha, while that of barley 1.7 t/ha.

The main commercial varieties grown are listed below, together with the percentage of area occupied by each variety expressed in terms of the total area of the respective species:

| | Variety | Percent |
|--------------|-------------|---------|
| Bread wheat: | Hazera 2152 | 40 |
| | Hazera 18 | 40 |
| | Pitic 62 | 20 |
| Durum wheat: | Capeiti 8 | 20 |
| | Aronas * | 15 |
| | Tripolitico | 30 |
| | Kyperounda | 35 |
| Barley: | Athenais | 100 |

New, promising varieties and lines are either in the process of being released to the farmers or undergoing final tests. The more important ones are: Tobari 66 and Tob-8156 bread wheat, D-Dwarf 2-15xCr''S'' -D-33312-7Y-4M-1Y-OM and Anhinga ''S'' - volunteer ID 31728-3L-OL-LA-OA durum wheat and the barleys Palmella Blue, Composite Cross 89, Roho, Mari-Athenais B4-5A-4A-1A-OA and Arizona 5908xAthenais B8-16A-1A-2A-OA.

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Table 1 shows the production level of both the commercial varieties and of the new promising varieties and lines.

There are no major disease or insect pest problems facing the production of cereals on a permanent basis. Disease epidemics may occur when weather conditions are favorable. Main diseases affecting wheat are stem rust (*Puccinia graminis tritici*), leaf rust (*Puccinia recondita*), stripe rust (*Puccinia striiformis*) and septoria (*Septoria tritici*). Barley is usually attacked by net blotch (*Helminthosporium teres*), powdery mildew (*Erysiphe graminis*), leaf rust (*Puccinia hordei*) and scald (*Rhynchosporium secalis*).

Insect pests such as the leaf miner (*Syringopais temperatella*), Hessian fly (*Mayetiola destructor*), aphids and stored-grain insects, although present, do not constitute a large scale problem.

Diseases are controlled by selecting resistant varieties, and insect pests by insecticides.

Cereals are normally sown in autumn or early winter (November/December). Barley is always sown earlier than wheat, and can also be sown before the rains. Harvesting is carried out in May-June, barley being harvested prior to wheat.

Experimental fields:

All field operations are mechanized. Similar practices regarding land preparation are applied to both wheat and barley, with the exception that wheat should be grown on more fertile land than barley. Barley can also be grown continuously year after year.

Traditional cereal-fallow rotation is still practiced to a considerable extent. Fallow lasts for 17 months and farmers believe that the larger the number of ploughings of the fallow, the better for the succeeding crop, as ploughing controls weeds and conserves moisture. However, work done in some countries suggests that this may not be so under dryland conditions, if the ploughings are not properly timed and related to soil tilth and growth stage of weeds. Moreover, excessive ploughings result in soil pulverization and an increase of production costs.

Trials aimed at finding out the most effective and economic method of seed bed preparation by comparing the number and time of ploughings during the fallow year have been conducted at the Cyprus Agricultural Research Institute from 1964 - 1971. Two ploughings resulted in higher grain yields than one or three ploughings (Table 2). Trials on seedbed preparation in a cereal-fallow rotation are now conducted in an expanded and modified form which includes chisel ploughing, "minimum" tillage techniques and no tillage-chemical weed control practices. These trials have not yet been completed.

As about 30,000 ha are under fallow each year, cereal rotation trials have been going on for a number of years to investigate whether fallow is a necessary practice in the low rainfall cereal growing areas, or whether it could be replaced profitably by a leguminous forage crop, a cereal forage crop or a cereal grain crop with or without increased N fertilizer application.

Results have varied from season to season. Generally, the highest yields are obtained from a cereal that follows a legume. The lowest yields are obtained from continuous cereal growing without increased N fertilization. Other rotation patterns usually result in intermediate cereal grain yields depending on seasonal climatic conditions and soil type. The results of two rotations trials that have been completed, are shown in Tables 3 and 4.

In order to determine the best method of cereal sowing, trials comparing the conventional, the deep-furrow and the press drill have been initiated. The latter has the advantage of direct sowing on stubble, avoiding the necessity of a seed bed preparation, thus reducing production costs and moisture losses. This investigation is still in progress.

Seed and fertilizer rate trials have indicated that the optimum rates suitable for cereals are the following ones:

| | Seed | Fertilizer at sowing | Top dressing |
|-------------|-----------|------------------------------------|------------------------|
| Bread wheat | 120 kg/ha | 35 kg N/ha 45 kg P/ha | 40 kg N/ha |
| Durum wheat | 150 kg/ha | 35 kg N/ha 45 kg P/ha | 40 kg N/ha |
| Barley | 105 kg/ha | 25 kg N/ha 30 kg P/ha (16-20-0) | 20 kg N/ha (26-0-0) |

Additional seed and fertilizer rate trials are conducted involving newly released varieties to establish the optimum rates required in each specified case.

The major weeds infesting cereals are broad-leaved weeds and wild oats. Broad-leaved weeds are easily controlled by post-emergence application of 2, 4-D or MCPA. Recent research work has shown that wild oats can be controlled by post-emergence applications of benzoylprop-ethyl (Suffix) in wheat only, or difenzoquate (Avenge) in both wheat and barley.

Results of research work in the fields described above are conveyed to the farmers through the Extension Service of the Department of Agriculture. Average yields obtained from experimental fields are 3.0 t/ha for both types of wheat and 3.4 t/ha from barley.

Farmers:

The number of traditional farmers is negligible and the progressive ones follow closely the recommendations and advice given to them by officers of the Ministry of Agriculture. New varieties of cereals, new herbicides, improved machinery for dryland farming etc., are easily accepted by the farmers. There is, though, some conservatism as regards quick changes from old to improved farming systems. Thus there are farmers who still continue to plough their cereal fields more than necessary and use higher seed rates than the optimum ones.

Yields obtained in farmers' fields are:

| | Average (t/ha) | Maximum (t/ha) |
|-------------|-----------------------|-----------------------|
| Bread wheat | 0.85 | 2.3 |
| Durum wheat | 0.85 | 3.0 |
| Barley | 1.70 | 3.5 |

Difficulties or problems confronting farmers:

Cereal growers are not confronted by difficult problems. Supply of machinery for land preparation is readily available and most of the farmers own their own tractors and cultivation implements. Costs of contracting work for land cultivation range from C£ 4.500 to C£ 11.000² per ha, depending on the type of land and the implement used. (1² C£=2.8 US\$)

Fertilizers, seed and herbicides as well as insecticides are available. Fertilizer prices are about £ 0.240 per kg N and £ 0.190 per kg P. They usually are available as 16-20-0 mixed fertilizer, 21-0-0 sulphate of ammonia, 0-48-0 phosphorus and 26-0-0 ammonium nitrate.

Seed was supplied in 1978 by the Seed Production Centre, a Government agency, at the following prices per kg: C£ 0.081 for bread wheat, 0.097 for durum and 0.082 for barley.

The prices of the commonly used herbicides are: C£ 0.600/litre for 2, 4-D, 4.500/litre for Avenge and 2.200/litre for Suffix.

There is a scarcity of labor which may create difficulties during peak periods and especially at harvest time. Labor costs vary from C£ 7.000 to 10.000 per day, depending on the nature of the work.

The majority of farmers harvest their crop by combine contracting. Costs are about C£ 15.000/ha including transport of grain to the store.

There are no serious postharvest problems. All grain produced is bought by and transported to the stores of the Grain Commission which undertakes all the marketing of grain cereals.

Production:

Normal yields are 0.85 t/ha bread and durum wheat and 1.7 t/ha barley. Prices paid last year by the Grain Commission were: bread wheat and barley C£ 0.060 and durum wheat C£ 0.075 per kg.

Cereal straw marketed is that of barley at the price of about C£ 17/tonne. The ratio grain: straw is 28:72 and usual yields of straw amount to 4.5 t/ha.

Other Constraints:

The only other constraint that limits cereal production is land scarcity. A recent increase of the irrigated acreage has reduced the area of land available for cereal growing, which is now occupied by cash crops.

Manpower

Research on cereals is carried out by the Agricultural Research Institute where about 12 professionals are involved in breeding, agronomy, pathology and other activities.

Extension work is carried out by 19 professionals while another seven are working at the Seed Production Centre.

Facilities

Credit is available to the farmers for inputs into cereal production such as seed, fertilizers, pesticides and machinery.

By decision of the Council of Ministers, a subsidy is allotted to cereal growers to promote the production of cereals and encourage the livestock industry.

Farmers are supplied with certified seed thus securing a pure variety free of seed contaminants and disease carriers.

Moreover a compensation is paid by the Government to cereal growers in the case of crop failure. Recently the Government has set up an Agricultural Insurance Organization for insuring production against hail, drought, disease, etc. Finally farmers are covered by the Social Insurance Scheme and receive a pension after the age of 65.

Future plans for Increasing Cereal Production

a) Improvement of field crops by introduction and/or breeding, selection, trial and distribution of types or varieties exhibiting high performance under local conditions.

b) Replacement of fallow by leguminous or other crops to encourage the full integration of animal and crop husbandries and diversify farming in general.

c) More effective application of improved cultural practices on a rational and economic basis.

d) Development and application of up-to-date techniques for effective weed and pest control on the crop.

Table 1. Production level of the commercial varieties and the new promising varieties and lines *

| Bread wheat | | Durum wheat | | Barley | |
|-------------|------------------|----------------|------------------|--------------------------|------------------|
| Variety | Production level | Variety | Production level | Variety | Production level |
| Hazera 18 | 100 | Kyperounda | 100 | Athenais | 100 |
| Hazera 2152 | 140 | Tripolitico | 100 | Palmella Blue | 110 |
| Pitic 62 | 140 | Capeiti | 113 | Arizona 5908XAthenais... | 102 |
| Tobari 66 | 137 | Aronas | 131 | Mari - Athenais... | 108 |
| Tob - 8156 | 137 | D-Dwarf... | 144 | Mari - CM67... | 112 |
| | | Anhinga "S"... | 134 | Composite Cross 89 | 112 |
| | | | | Roho | 111 |

* The yield of Hazera 18, Kyperounda and Athenais was taken as 100.

Table 2. Time and number of ploughings in a cereal-fallow rotation. Athenais barley. (Grain yields in kg/ha)

| Treatment | 1963-1965 Athlassa | 1964-66 Prastio | 1966-68 Prastio | 1968-70 Kondemenos Dromolaxio (mean) | 1969-1971 Prastio, Gypsou Dromolaxio (mean) | 1963-71 Mean of 8 trials |
|--|-----------------------|--------------------|--------------------|---|---|--------------------------------|
| A. One ploughing in autumn after the rains | 3683 | 2084 | 777 | 2600 | 4445 | 2719 |
| B. Two ploughings (autumn spring) | 4908 | 2704 | 1591 | 3033 | 4848 | 3414 |
| C. Two ploughings (autumn late spring) | 4587 | 2538 | 844 | 2988 | 4519 | 3093 |
| D. Three ploughings (autumn early spring) late spring) | 4295 | 2532 | 777 | 4631 * | 2988 | |
| Sx | 84.4 | 35.1 | 145.7 | 73.2 | 80.7 | |
| Fallow leg | 220 | 371 | 436 | Kond. Drom. 620 547 | Prast. Gypsou Drom. 240 222 314 | |
| Precipitation Crop leg (mm) | 356 | 233 | 273 | 316 314 | 267 373 388 | |

* At Prastio and Gypsou, it was not possible to carry out the third (late spring) ploughing.

Table 3. Grain yield of Kyperounda durum wheat under various rotations in kg/ha.

| Rotation | Average for 1963-1974 |
|---|--------------------------|
| Kyperounda continuous | 792 |
| Kyperounda following fallow | 1100 |
| Kyperounda following common vetch | 1407 |
| Kyperounda following a two-year (Clare) subclover ley | 1767 |
| Second year Kyperounda following a two-year subclover ley | 1436 |
| Kyperounda following a three-year subclover ley | 2101 |
| Second year Kyperounda following a three-year subclover ley | 1592 |
| Third year Kyperounda following a three-year subclover ley | 1423 |

Table 4. Grain yield of Athenais barley under various rotations in kg/ha

| Rotation | Average for 1974-1978 |
|--|--------------------------|
| Barley continuous | 1785 |
| Barley continuous with increased N fertilization * | 2151 |
| Barley following Lana (Wolffpod vetch) | 2211 |
| Barley following fallow | 2121 |
| Barley following farras (barley forage) | 2009 |

* About 10 kg N/ha in addition to normal dosage, applied as top dressing.

Summary

Wheat and barley occupy about half of the rainfed farm land in Cyprus. In 1978, breadwheat occupied 10,940 ha, durum wheat 16,350 ha and grain barley 33,340 ha. The average yield of wheat is 0.85 t/ha, while that of barley is 1.7 t/ha. Principal breadwheats include Hazera 2152 and Hazera 18, while the leading durum varieties are Kyperounda and Tripolitica. The variety Athenais is the only barley under cultivation. Several new selections are in the final stages of testing or in the process of being released. There are no major disease problems, although epidemics can occur when weather conditions are favorable. Disease control is generally achieved by selecting resistant varieties. Insects do not generally pose a large scale problem in Cyprus.

Important areas for agronomic research have been rotations, tillage timing and methodology, and seed bed preparation. Although results have varied from year to year, rotation trials have indicated that highest grain yields are obtained in cereals following a legume crop. Several seeding methods are being investigated. The use of a press drill has the advantage of allowing direct sowing on stubble, eliminating the need for seed bed preparation. Other agronomic research has identified optimal levels of fertilizer use and suggested application regimes. Weed control work has shown that wild oats are controlled through the use of post-emergence herbicides. Research results are conveyed to farmers through the Department of Agriculture Extension Service.

Most agricultural inputs are readily available to farmers in Cyprus. Fertilizers, herbicides, insecticides and certified seed are used by most farmers. One problem is the scarcity of labour, and another is the lack of additional land available for cultivation. Economic aid includes the use of credits, subsidies and insurance in case of crop failure or losses due to bad weather.

CONTRAINTES LIMITANT LA CEREALICULTURE EN CHYPRES ET LES DIFFERENTES SOLUTIONS POSSIBLES

Résumé

En 1978, le blé tendre occupait 10.940 ha, le blé dur 16.350 ha et l'orge 33.340 ha (environ la 1/2 de la surface agricole non irriguée), avec un rendement moyen de 0,85 t/ha pour le blé et de 1,7 t/ha pour l'orge.

La seule variété d'orge cultivée est l'Athenais alors que pour le blé tendre on peut citer Hazerna 2152 et Hazerna 18 et pour le blé dur Kyperounda et Tripolitica sont les principales variétés cultivées.

A Chypres, on ne rencontre pas de problèmes majeurs dus aux insectes et aux maladies (sauf sous des conditions climatiques favorables). De plus la résistance aux maladies est un critère de sélection important.

De nombreuses études agronomiques ont été entreprises au niveau des assolements, des labourages et de la préparation des lits de semences. Les premiers résultats malgré des variations d'une année à l'autre, indiquent que: les légumineuses sont d'excellents précédents à céréales, l'utilisation d'un "pressdrill" permet le semis sans déchaumage, la folle-avoine est très bien contrôlée par l'utilisation d'herbicides à action post-émergente. Les résultats de ces recherches sont transmis aux agriculteurs grâce aux services de vulgarisation agricole.

Actuellement à Chypre, les fermiers utilisent couramment les engrais (avec les taux recommandés par les scientifiques), les herbicides, les insecticides et les graines contrôlées ainsi que les diverses aides économiques (crédits, subventions, assurances en cas de perte de récoltes). Mais un des problèmes majeurs est celui de la faible quantité de main d'œuvre doublée de l'absence de terres supplémentaires disponibles pour l'agriculture.

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CONSTRAINTS TO CEREAL PRODUCTION AND POSSIBLE SOLUTIONS IN GREECE

Elpis A. Skorda*

Cereal Areas

Most winter cereals are grown mainly in areas with a classic Mediterranean-type climate with a hot dry spring and summer. The growing season varies from 6-8 months depending on the latitude and rainfall, which can average from 380-1200 mm per annum. Rainfall decreases from west to east. Most cereals are grown in lower rainfall areas and with little or no spring and summer rains. Because of the generally arid climate of Greece, relatively small areas are irrigated. Such areas are preferred for crops of greater economic return such as cotton, corn, rice, sugar beets. Wheat on irrigated areas is quite rare, only for rotation purposes. Most winter cereal crops are therefore grown under dryland conditions and are rainfed.

The soils of cereal areas which have developed from limestone or highly calcareous parent material are generally neutral to alkaline in reaction. Most of them are typical red Mediterranean-type soils. Wheat is a favored crop on the heavier soils, while barley predominates on the lighter, particularly on the light sandy loams which stretch along the coast and islands of the Aegean Sea. In the more northerly cereal areas, particularly in West Macedonia, some soils for wheat are heavier.

Climate

Rainfall is erratic and may be inadequate for cereal growth in the spring, or in some years at any time during the growing season. High evapo-transpiration, because of high temperatures from spring onward, can be a major factor in limiting crop yields. The distribution of rainfall, particularly in the spring, and also spring temperatures, are very important factors in crop performance. Crop growth may be restricted by low winter temperatures. In some areas of northern Greece, frost damage can cause reduction in yield. In the southern parts of the country, frost damage at anthesis can cause a yield reduction through damage to the developing heads of some varieties. Later, close to harvest time, shrivelling of grain due to the hot wind "Livas" is also a possibility for late maturing varieties or late sown crops. At harvest, grain loss through shattering due to winds is also a possibility in many areas.

In general, cereal crops in Greece are exposed to all climatic hazards and a variability from year to year that can range from seasons of severe moisture deficit to those of above average rainfall, thereby causing soil nitrogen losses by excessive leaching, or crop damage by lodging.

Edaphic variation between localities, together with seasonal variation at any locality in Greece, poses problems in the stability of crop production and to the plant breeders seeking to increase yield by using the appropriate selection procedures.

Wheat Areas

The area under cultivation is approximately 3,900,000 hectares. Forty six percent of this area is estimated to be sown to cereals. Bread wheat (*Triticum aestivum*) is the most widely cultivated of all cereals. Barley comes next followed by durum wheat. Wheat culture has been a Greek tradition since ancient times. Bread wheat has been and still is Greece's most important crop. The goal is to increase production and to decrease the area grown. It is aimed to increase the area of durum wheat, because its production can be exported easier and the price is higher. In general, spring and winter wheats are the most widely cultivated cereals (see Table 1). Wheat is grown all over the country, from sea-level up to an altitude of 1500 m. About 98 percent of the area is fall sown, even though spring habit types are mainly grown.

The average annual area harvested from 1976-78 was about 720,000 ha bread wheat with a production of 1800 million tonnes and an average yield of 2500 kg/ha. For the same

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period, the average annual area of durum was 220,000 ha with a production of 440 million t and an average yield of 2000 kg/ha. The durum wheat area was higher than bread wheat until 1934, when it started to decrease and since 1965 it has been about 20-25 percent of the total wheat area.

The wheat crop area increased until 1960 and is now stable or slightly declined. Annual production and yield per ha vary greatly with rainfall variations but yield per ha has increased by 10 percent over eight years (Table 1).

Domestic utilization of wheat has increased remarkably. Last year, excessive amounts were used for livestock feed. About 400,000 of flour were exported this year.

Barley Area

The average annual area is about 400,000 ha which produce about 900,000 t at an average yield of 2400 kg/ha. Most of the barley is used for animal feed. Only 10 percent is used by the brewery industry.

Greece has a deficit in barley grain because its feed needs exceed the annual production. However, wheat covers this deficit and the goal is to increase production up to 1,200,000 t, without increasing the grown area of barley. Barley area, production and yield per ha have been increasing since 1945.

Wheat and Barley Varieties

Wheat and barley improvement started in the second decade of this century. A number of improved varieties were developed by the Cereal Institute through pure line selection and hybridization and these were recommended for commercial cultivation. Wheat being superior in grain quality for human consumption, it always received priority over barley in price support from the government. However, since 1962, barley has received special attention from the government and since then the barley area and yield/ha increased 76 percent and 34 percent respectively.

Wheat Varieties

They change continually in Greece because of the development of new or selected varieties from other countries after testing. New varieties currently grown are usually superior to the older ones in such characteristics as yield, disease resistance, strength and height of straw, and milling and baking quality. Most improved varieties produce higher yields than those cultivated prior to 1960, chiefly because of greater resistance to unfavorable weather and to diseases and lodging.

A total of 15 bread wheat varieties were grown in 1978 of which four were sown on 100,000 hectares or more. G-38290 was the most widely grown variety in Greece from 1950 to 1965, but it has now been replaced by new improved varieties, especially because of its yellow rust susceptibility.

The principal bread wheat varieties in 1978 were Generoso, G-84865,, G-84909, S. Cerros, Yecora, Jupateco and G-85458. Others seeded on large areas were Amyntas, G-07783 and Olympia. Promising varieties are G-04472, G-05480, G-05499 and G-05555.

Durum wheat varieties are grown in semi-fertile or infertile soils. Capeiti was sown in about two thirds of the entire durum wheat area in 1978. Limnos and G-0367 are sown in the north part of the country, while Electra is important in the south under dry conditions. Also, for the first time Mexicali was grown this year. Cocorit started to grow but because of its low quality, this year only a small area was sown. Promising varieties are G-04989 and Valgerardo. In general, it is difficult to find good adapted durum wheat varieties for Greece.

Barley Varieties

Beka variety was sown on more than two thirds of the barley area in 1978. Pirolina b, a resistant variety to frost is grown in North Greece, and Attiki in the south and the islands.

Georgia, Carina and Clipper were first sown two years ago, but in limited areas. Elasona, a winter four-row barley, is grown on 50,000 ha. New promising varieties are G-88082-8, G-05935 and G-05945.

More than 40,000 ha are grown for forage with local four-rowed varieties and most areas with variety Elasona.

Wheat Diseases

They are a major limiting factor to the Greek crop. Varieties resistant to two or three rusts help to stabilize production. Yellow rust (*Puccinia striiformis*) is wide spread, and in severe infections can cause crop damage. Yellow rust has limited the varieties which were grown in large areas. Most of the advanced lines were susceptible to race 20A when it suddenly appeared and wheat breeders at the Cereal Institute had to start the breeding programs at the beginning, and very much productive material was lost. Fortunately several sources of resistance have been located in many varieties. Resistant genes are being transferred to Greek varieties and rapid tests for resistance have been carried out to aid selection. Grown varieties are resistant to this rust.

Leaf rust (*P. recondita*) is present almost every year and causes severe losses to susceptible varieties. Most of grown varieties are resistant to this rust. Stem rust (*P. graminis*) is a problem in some years. Losses are significant for susceptible varieties, but grown varieties escape severe infection because of their early maturity.

A research project investigating crop loss assessment, pathogenic variability, race identification, sources of resistance and mechanisms of resistance is being conducted at the Cereal Institute.

Four years ago *Tilletia* spp. became a very severe problem, even though chemically treated seed was sown. After intensive research it was found that new races of the fungus *Tilletia* had developed, which were resistant to many seed dressing chemicals. The use of new chemicals solved the problem, but the studies are being continued, because new races can be developed.

Barley Diseases

The major disease of barley is mildew, to which almost all grown varieties are susceptible. It is very severe in the north and central areas of the country.

The yield loss from an infection level of about 80 percent was more than 50 percent in trials carried out at the Cereal Institute, where plots were sprayed with special chemicals and were compared with untreated plots. Stripe disease (*Helminthosporium gramineum*) was severe but now chemical seed dressings limit the infection. Net blotch (*H. teres*) can be locally severe and has been responsible for some crop failures.

Most barley varieties are susceptible to *Erysiphe graminis*, *H. gramineum* and *H. teres*. They are also susceptible to lodging and frost.

Wheat and Barley Pests

In most seasons insect pests are of little importance, but occasionally aphids can become a problem. Also frit fly is a severe problem in very early maturing barley varieties such as Attiki, which now are grown in very limited areas.

In very cold years, soil borne pests e.g. wireworms, *Zabrus gibus* are a serious problem in some areas and their control is difficult.

Fertilizers

Cereals generally respond to fertilizers because 80 percent of the area is grown continually wheat after wheat, or barley. The cereal crop rarely benefits from the residual effects of fertilizers applied to other crops in the rotation. Usually a starter fertilizer in the grain drill is applied at a rate of 300 kg/ha of 16-20-0. A supplemental application composed chiefly or solely of 20-100 kg/ha of nitrogen generally is used at the end of winter or beginning of spring. A late application after heading, generally increases the vitreousness and protein content of durum grain.

The response of wheat to fertilizers is variable, because moisture has a greater effect on wheat production than does fertilizer. When needed, 120-180, 120 and 70 kg of nitrogen per ha may be applied at planting time or in split applications for bread wheat, durum wheat and barley, respectively. Phosphorus needs are usually met with 40 kg/ha P_2O_5 . Nitrogen fertilizer applied to wheat in Greece shows an increase in yield, protein content, or both. The most economical rate is 120 kg/ha nitrogen for the larger part of the wheat area and 70 kg for barley. All fertilizers for cereals and other crops are produced in Greece.

Generally, Greek farmers use higher quantities of fertilizers than the recommended, because they are subsidized by the government.

Seedbed Preparation

Where lack of moisture is the most important limiting factor in wheat production, methods of seedbed preparation are tied closely to moisture conservation.

When wheat follows wheat, oats or barley, the land usually is plowed just far enough in advance of seeding to provide a well-settled seedbed. The plowed land is usually disked and harrowed immediately before the wheat is sown. Seedbed preparation in humid areas is determined largely by the position of wheat in rotation with other crops. When winter wheat or barley is grown after corn or cotton, the wheat may be drilled in the standing corn or it may be seedbed sown or disced after the corn or cotton crop is removed or shocked.

Although plowing of dry soils may be difficult, the advantages of early tillage are sufficient to make it worthwhile. Early plowing depends on early rainfall.

Seed Rates and Methods

Wheat is sown at 150-200 kg/ha. This rate is higher than the recommended because farmers believe that more seedlings per unit area may control weeds and diseases, but this thick stand may increase lodging.

Heavier seeding than usual is advised where seeding is delayed beyond the normal date, because the plants have less opportunity to tiller especially in very cold areas. The optimum seeding rate of wheat is practically independent of soil type, moisture, locality, date of seeding, cultural treatment and variety. A range in seeding rates for wheat has been found to have only a minor effect on yield. A reduction in the amount of seed tended to be offset by more tillers per plant, larger heads and larger kernels.

Greek farmers realize the importance of good quality seeds and they try to use certified seed by the Seed Centers belonging to the Seed Service of the Ministry of Agriculture which multiply, process, store and distribute the seed at low prices.

Cereals are now almost all sown with a drill. Only small areas of wheat and barley in the hills are broadcast by hand. The common single disc drill is most widely used. This drill spaces the seed in rows 14 cm apart. Wheat generally is sown from 3 - 5 cm deep.

Time of Seeding and Harvest

Mid-season sowing of wheat and barley is generally most favored. Late sown crops usually suffer more winter injury and then drought during the later stages of growth. Also they tiller less. Wheat and barley sown too early in the fall may exhaust the soil mixture, joint very early in the spring, suffer winter injury and sterility, and become infected by root rots. The optimum seeding period ranges from October 20 in North Greece to November or early December in southern regions. Late varieties are sown earlier and early varieties are sown later.

To avoid winter injury in some areas, wheat and barley are sown in humid regions early enough for the plants to become well-rooted before growth ceases in early winter.

Weed Control

Weeds often are a serious problem. The most serious grassy weeds are wild oats in the whole country and *Milium vernale* in the West Macedonia. In recent years, *Lolium* spp. and *Phalaris* spp. have become serious in some areas. Troublesome broadleaf annual weeds include *Papaver* spp. and *Chrysanthemum segetum* in some regions. Weeds in cereal fields are controlled by the use of chemicals.

Chemical control

Since 1950, the use of various formulations of 2,4-D to control weeds has become wide spread. Later, MCPA also became very popular and now one or the other is used in wheat fields.

In some places after the use of 2,4-D or MCPA for many years, weeds resistant to these weedkillers have multiplied. Some new chemicals which control the resistant weeds are used in these cases.

Research Institute and Experimental Stations

The Cereal Institute has a wheat and barley production project, the main objectives of which are to:

- (1) Improve disease and pest-resistant varieties with wide adaptation and high yield potential under moderate fertility conditions in non-irrigated areas in both plains and hills.
- (2) Determine basic information on plant nutrient requirements for each of the principal soil types where wheat and barley are cultivated and with this information then formulate suitable recommendations on fertilizer usage, rate, date of application etc. to achieve increased yield.
- (3) Design agronomic experiments to find suitable dates of sowing, minimum tillage operations, seed rate, planting methods.
- (4) Determine basic information on plant diseases, pests and weed control to guide cereal breeding and production programs.
- (5) Improve economical methods of tillage operations, planting, harvesting etc. to minimize production costs.

The Cereal Institute in Thessaloniki is responsible for all these projects and it cooperates with nine Agricultural Research Stations located in different regions of the country.

There are also about 30 testing fields where new varieties are being tested. The Cereal Institute as well as the nine Research Stations belong to the Ministry of Agriculture.

Achievements

The achievements made under this project are the development of improved varieties for different purposes, the control of diseases and pest problems, and agronomic advancements.

Thus, the Cereal Institute recommends to extension service agronomists and farmers, suitable varieties for each district, the quantity of fertilizers, the date and rate of sowing, diseases and weed control, etc.

The yield in trials is higher than the yield in farmer's fields, for the following reasons:

- (1) Rotations are among the main factors affecting cereal production. Because cereals are grown in non-irrigated, semi-fertile to infertile soils in which no other crop can grow, very few farmers are using rotations. The majority cultivate their land without following any type of rotation, except in high rainfall regions, which are very limited where a two or three year rotation is practiced.
- (2) Small farmers and land fragmentation prevent the use of suitable equipment; about 94 percent of farmers have less than 10 ha and this farm size takes about 75 percent of cultivated land. The mean size of farms is three ha.
- (3) The age of farmers. Farmers with small farms are mainly working in other jobs and send other farmers to the job (contractors) to plow, sow, harvest, etc. and pay them by the hectare. Therefore, most of the farmers are more than 65 years old, 45 percent between 45-65 and in these two categories, about 65 percent of the cultivated land is distributed.
- (4) Although there are varieties suitable for each region and information for proper cultural practices is recommended to farmers for bread wheat, durum wheat and barley, they do not use the proper variety for their farm and the proper cultural practices because of the reasons given in (2) and (3) above. Thus, most of the farmers with small farms harvested 20 to 30 percent less t/ha than from farm demonstrations. Thus, the problem for higher cereal production is more social than technical or economic.

Problems Confronting Farmers

Farmers, except on the small farms, are not confronted with problems such as equipment, fertilizer and seed supply, etc., because the Government subsidizes seed, fertilizer, pesticides, tractors, equipment and provides many cheap credits.

Because of the full mechanization of cereals, there are no labor demand problems, but prices are high.

Greek farmers have purchased many items of field machinery, tractors, cultivators, seed drills, fertilizer drills, combine harvesters and thus wheat and barley production is fully

mechanized. Therefore, farmers do not encounter difficulties during the growing season and at harvest. In some regions, farmers have more items of field machinery than that they need.

Production

The Government fixed wheat and barley grain floor prices and purchases them if the price falls below a fixed price. Since 1976, grain prices have been higher than world prices and farmers sell all their products to government or to market at these high prices (Table 2).

Farmers grow more cereals than the country needs and therefore, new problems have arisen such as inadequate storage facilities and surplus product.

Some straw is used, but most is burned.

Research and Extension Staff

Research in bread wheat, durum and barley is done by the Cereal Institute with nine Agricultural Research Stations. Research in breeding, agronomy, pathology and quality of product is satisfactory with the existing cereal specialists and well trained technicians. But the needs for more research are increasing every day. In order to maintain the successful development of widely adapted fertilizer response and high yielding varieties of wheat and barley and to solve new problems of cereal production, it is imperative that the quality and number of research and development staff be improved. Therefore, efforts should be continued to obtain high quality crop specialists.

The diffusion of new technology is done by extension service staff, cooperating with Cereal Institute scientists, to the more progressive farmers, who are large farm owners. Extension to the farmers with small farms is unsatisfactory. Therefore, a more efficient extension service trained in modern methods of crop production could be of tremendous assistance in spreading the use of new technology.

Facilities

The Cereal Institute and Research Stations are supplied with essential machinery and equipment. All experimental work (seeding, threshing, harvesting, etc.) is almost fully mechanized. Also there are appropriate facilities available for research work (greenhouse, laboratories, etc.). However, the Cereal Institute and Research Stations should be strengthened and provided with some modern equipment and facilities and with more trained staff and adequate financial support.

Table 1. PERFORMANCE OF CEREALS IN GREECE FROM 1961 to 1978

| Seasons | Annual Area (1000 ha) | | | | Annual Yield (kg/ha) | | | | Annual Production (1000 t) | | | |
|-----------|-----------------------|--------|------|------|----------------------|--------|------|------|----------------------------|--------|------|------|
| | Wheat | Barley | Corn | Rice | Wheat | Barley | Corn | Rice | Wheat | Barley | Corn | Rice |
| 1961-1965 | 1085 | 194 | 173 | 21 | 1632 | 1446 | 1700 | 4186 | 1781 | 284 | 288 | 90 |
| Increases | 10 | 76 | -17 | -15 | 14 | 34 | 62 | 22 | 2 | 34 | 31 | 3 |
| 1966-1970 | 980 | 342 | 144 | 18 | 1854 | 1932 | 2750 | 5112 | 1809 | 664 | 377 | 93 |
| Increases | -7 | 18 | 6 | -4 | 17 | 12 | 43 | 1 | 10 | 33 | 55 | -3 |
| 1971-1975 | 913 | 405 | 153 | 17 | 2172 | 2172 | 3946 | 5144 | 1988 | 880 | 585 | 90 |
| Increases | 2 | -5 | -20 | 6 | 10 | 4 | 3 | -6 | 13 | 2 | 14 | 1 |
| 1976-1978 | 933 | 383 | 123 | 18 | 2400 | 2250 | 4066 | 4860 | 2238 | 862 | 501 | 91 |

TABLE 2. Cereal Prices Set by Government (in Drachmas*)

| | 1975 | 1976 | 1977 | 1978 |
|-------------|------|------|------|------|
| Bread wheat | 4.9 | 7.7 | 8.6 | 6.9 |
| Durum wheat | 6.5 | 5.6 | 6.2 | 9.7 |
| Barley | 4.5 | 5.1 | 5.8 | 6.7 |
| Oats | 5.0 | 5.7 | 6.6 | 7.4 |

* drachmas 2.6 dollars

Summary

Winter cereals are the most important crops in Greece, occupying nearly one half of the cultivated land. Bread wheat is the most important cereal. In recent years, the average harvested area has been about 720,000 ha with an average yield of 2500 kg/ha. For durum, the figures are 220,000 ha and an average yield of 2000 kg/ha. Barley is grown on about 400,000 ha, and yields are about 2400 kg/ha. Ninety percent of this production is used for feeding purposes, the remainder going for malt.

Modern cereal varieties grown in Greece are superior to older types in terms of yield, disease resistance, straw strength and grain quality. Some 15 bread wheat varieties are grown, generally on the more fertile soils. Durums often occupy less fertile areas. The main durum variety in 1978 was Capeiti, occupying about two-thirds of the acreage. Similarly the barley variety Beka occupied about two-thirds of the acreage. In the case of both wheat and barley, varieties are available for the specific needs of different areas.

The principal diseases attacking wheat in Greece are the three rusts. Some losses occur in most years, but the widely grown varieties are fairly resistant. Breeding for rust resistance has a high priority in Greece. Major barley diseases are powdery mildew, barley stripe and net blotch. Most barley varieties grown are fairly susceptible, and losses do occur. Insect pests are generally not a serious problem in Greece.

A series of agronomic practices have been recommended to Greek cereal farmers. These deal with such operations as land preparation, seeding, weed control and fertilization. Even so, farm field yields are considerably less than those obtained from farm demonstrations. Principal factors include lack of crop rotations, fragmented land holdings which do not lend themselves to mechanization, and hiring out of important farm operations leaving the owner free to hold a different job. Some problems occur due to lack of storage space for the surplus crop produced. Finally, an improved extension service could play a very important role in increased yields by disseminating research findings to farmers.

CONTRAINTES LIMITANT LA CERÉALICULTURE EN GRECE ET LES DIFFÉRENTES SOLUTIONS POSSIBLES

Résumé

Les céréales d'hiver sont les plus importantes en Grèce, occupant près de la moitié des terres cultivables. Au cours des dernières années, la surface moyenne en blé tendre était de 720.000 ha donnant des rendements moyens de 2500 kg/ha. Pour le blé 220.000 ha sont utilisés avec un rendement de 2000 kg/ha alors que pour l'orge 400.000 ha sont employés avec un rendement de 2400 kg/ha (90% de cette production est utilisée pour l'alimentation du bétail et le reste est utilisé pour le malt).

Les variétés cultivées actuellement en Grèce sont très supérieures aux variétés traditionnelles en termes de rendement, de résistance aux maladies de dureté de la paille et de qualité des grains. Sur les terres les plus fertiles on cultive généralement le blé tendre (environ 15 variétés); sur les sols moins fertiles, on cultive le blé dur (1/3 de la surface) dont la principale variété est Capeiti et l'orge (2/3 de la surface) dont la principale variété est Beka. Il existe des variétés adaptées aux besoins spécifiques de chaque région.

Les maladies affectant le blé sont surtout les trois rouilles, mais les variétés cultivées se montrent assez résistantes et les hybridations pour la résistance aux rouilles ont une forte priorité en Grèce. Pour l'orge les maladies principales sont l'oïdium, l'helminthosporiose et entraînent des dégâts. Les insectes ne sont pas des problèmes sérieux en Grèce.

Une série de pratiques agronomiques ont été recommandées aux céréaliculteurs grecs et celles-ci incluent la préparation des sols, les semis, la fertilisation et le désherbage. De plus, les différences entre rendements des agriculteurs et des stations de recherches sont dues au manque de rotations des cultures, aux exploitations fragmentées non mécanisables et la possibilité de faire les travaux agricoles (laissant les exploitants libres de posséder d'autres sources de revenus) et aux ennuis post moisson lors du stockage. En conclusion, la création d'un important service de vulgarisation pourrait jouer un rôle important dans la dissémination des résultats des recherches aux céréaliculteurs.

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CONSTRAINTS TO CEREAL PRODUCTION AND POSSIBLE SOLUTIONS IN LEBANON

A. Alameddine*

The main commercial wheat varieties cultivated in Lebanon are:

1. Bread wheat: Mexipak 65 covering 80 percent of the area, and Florence Aurore, covering 20 percent of the area
2. Durum wheat: Hourani covering 50 percent of the area, and Jori C 69 covering 40 percent of the area.

Variety Mexicap is the most common bread wheat variety in the Bekaa Valley (350 mm); next is Florence Aurore. In the durum category, Hourani and Jori C 69 should be mentioned. Stork seems to be a promising durum variety after proving to be a top yielder and of the earliest maturity in the 8th Regional Wheat Yield Trial in 1977. It is relatively resistant to yellow rust and stem rust, but susceptible to leaf rust. Local barley (Orge Pays) is still the most widely cultivated barley in Lebanon. In this connection, Beecher, (six-rowed) maturing in about 140-150 days with its relative resistance to yellow rust should not be overlooked as a promising barley variety. Likewise, Giza 121 (six-rowed) maturing earlier than Beecher, should be considered.

Major diseases in all areas of cereal production in Lebanon are (1) Rusts: (*Puccinia* spp.) being more severe in the coastal plain, and (2) Smut (*Ustilago tritici*). With regard to insects, the major insect attacking wheat and barley is *Ceratitis capitata*.

Normal sowing and harvest times in Lebanon are October 15 and June 30 respectively. About 30 percent of the sowing is restricted to areas receiving less than 350 mm whereas 70 percent is practiced in the regions receiving over 350 mm of rainfall.

Data from experimental stations and farmers' fields

1. Package of practices recommended to farmers for bread wheat, durum and barley:
 - (a) Land choice and preparation:
 - (1) land chosen should not have been planted to cereals in the previous year.
 - (2) should be free of slope

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- (3) should be equipped with facilities for irrigation
- (4) should be free of weeds, especially grassy ones and
- (5) should be properly and homogeneously disc-plowed.
- (b) Sowing:
 - (1) a good planter properly calibrated should be used
 - (2) seeds should be placed in the soil 4-5 cm deep
 - (3) planting should be done in November
- (c) Fertilizers:
 - (1) phosphate: Is applied broadcast before planting at the rate of 80 kg P_2O_5 /ha for bread wheat and durum in the regions receiving above 350 mm of rainfall. In the areas under irrigation, this figure should be 100 hg/ha. For barley the rates used are 70 kg/ha and 75 kg/ha of P_2O_5 for areas receiving more than 350 mm of rainfall and areas under irrigation respectively.
 - (2) Nitrogen: Two applications are performed (at sowing and post emergence). Total quantity applied for bread wheat and durum is 80 kg/ha for regions receiving more than 350 mm of rainfall and 120 kg/ha for those under irrigation. For barley, the figures are 70 kg/ha and 80 kg/ha for rainfed areas (350 mm), and irrigated areas respectively.
- (d) Weed control:
 - Printazol, Superhormone or 2,4-D are used at the proper stage and in the proper dose.
- 2. Package developed from research stations results:
 - (a) Germination date
 - (b) Days to heading and to maturity
 - (c) Reaction to yellow, leaf and stem rust
 - (d) Plant height and yield
 - (e) Grain color and size
 - (f) Combining ability and adaptability

Results obtained

Bread wheat

After statistical analysis was performed on yield trials conducted at Tel-Amara using local checks such as Mexipak 65, Haramoun and Sannine, it was concluded that 75 varieties out of 280 equalled or excelled the local checks. The average yield for those varieties ranged between 2.5-3.0 t/ha. Further investigations will be conducted on those varieties for the purpose of selecting a promising few to be included in a seed increase program for subsequent distribution to farmers as certified seed. Examples: Choti Lerma, Inia, Pyramid 73, Emu and Sakha 8.

Durum wheat

The local checks used were Jori 69 and Hourani 27. Eleven varieties outyielded the checks. Worth mentioning are:

1. Stork 'S': early maturing, high yielding variety with relative resistance to yellow rust and stem rust, but susceptible to leaf rust.
2. D-Dwarf 'S' 15-Cr 'S': a top yielder with relative resistance to the three rusts.

Barley

The local checks in barley were local (O.P.25-2100 kg/ha) and Beecher (six-rowed -2216 kg/ha). Varieties which outyielded the checks are:

1. Esp. x Sv. Mari (3204 kg/ha)
2. Zephyr - WI 2197 (2858 kg/ha)
3. Atlas 46 - promesa (2623 kg/ha)

Farmers

(a) Bread wheat

Average yield of bread wheat in regions less than 350 mm of rainfall is about 1000 kg/ha, maximum yield is 1300 kg/ha. For regions above 350 mm, the average yield is 2000 kg/ha with a maximum yield of 2500 kg/ha. For irrigated areas, average yield is 3000 kg/ha whereas maximum yield is 5000 kg/ha.

(b) Durum wheat

| Rainfall | Average Yield | Maximum Yield |
|-----------------|----------------------|----------------------|
| <350 mm | 1000 kg/ha | 1300 kg/ha |
| >350 mm | 1500 kg/ha | 1800 kg/ha |
| Irrig. | 3000 kg/ha | 5000 kg/ha |

(c) Barley

| Rainfall | Average Yield | Maximum Yield |
|-----------------|----------------------|----------------------|
| <350 mm | 1500 kg/ha | 1800 kg/ha |
| >350 mm | 3000 kg/ha | 3400 kg/ha |
| Irrig. | 4000 kg/ha | 4300 kg/ha |

Difficulties confronting farmers:

1. Cost of renting a tractor for plowing.
2. Obtaining credit for fertilizers, especially in case of a poor harvest the previous year.
3. Completing all governmental procedures to obtain certified seed from wheat offices on credit.
4. High price of efficient herbicides, which are all imported.
5. Rising wages of workers for manual operations such as hand weeding, rogueing, etc.
6. Constant guarding of fields after heading starts, particularly with regard to damage inflicted by birds and cattle grazing.
7. Post harvest difficulties, chiefly shortage, and danger of grain loss from field to storage houses.

Production

1. Normal production of wheat is about 140,000 tonnes and the price is about 0.50 LL per kilogram.
2. Normal production of straw is about 70,000 tonnes and the price is about 0.60 LL per kilogram.

Manpower available for research in bread wheat, durum and barley: two staff members with a Ph. D. degree in plant breeding and genetics; two technical assistants and four preparators. The same personnel takes care of the breeding, agronomy and pathology aspects.

Future plans for increasing cereal production

1. Cooperation with FAO in a project of increasing certified seed in farmers' fields in Lebanon.
2. Cooperation with ICARDA to promote our research programs in breeding, agronomy and pathology for bread wheat, durum and barley.

Summary

In Lebanon, the total area occupied by wheat and barley is about 90,000 ha. Of this, approximately 40,000 ha are bread wheat, while durum and barley each occupy about 225,000 ha. Average yields vary greatly, depending on the amount of rainfall. Average figures for areas with more than 350 mm of rainfall are 2200 kg/ha for bread wheat, 2000 kg/ha for durum and 3,150 kg/ha for barley. In drier areas receiving less than 350 mm of rainfall, average farmer yields are 800 kg/ha for bread wheat and durum, and 1,550 kg/ha for barley. Principal bread wheat varieties are Mexipak 65 and Florence Aurore, while for durum Haurani and Jori C 69 are the main cultivars. Most barley grown in Lebanon is local material, although several improved types have been identified for use in the country. The major diseases of the wheat and barley crop are the rusts (*Puccinia* spp.) and covered smut (*Ustilago tritici*).

Recommendations to farmers concerning agronomic practices have been developed in Lebanon. These include information on land selection and preparation, seeding, fertilization and weed control. Farmers do face a variety of difficulties which prevent them from implementing optimal practices. The cost of rental or purchase of machinery and implements are high. Inputs such as fertilizer, and herbicides, which must be imported, can also be expensive, perhaps prohibitively so, in years following a poor crop. The cost of labor for manual operations has also risen sharply. Other difficulties are due to complicated requirements necessary to obtain certified seed from the government. Danger to the crop from grazing or bird damage are examples of further problems.

Future plans for increasing cereal production in Lebanon include the establishment of joint projects with international organizations concerning seed production, plant breeding, agronomy and pathology.

CONTRAINTES LIMITANT LA CEREALICULTURE EN LIBAN ET LES DIFFERENTES SOLUTIONS POSSIBLES

Résumé

Sur 90.000 ha de terres cultivées en céréales, environ 40.000 sont emblavés en blé tendre, l'orge et le blé dur occupant chacun 25.000 ha. Le rendement est très variable suivant les précipitations; ainsi dans les régions à plus de 350 mm le rendement est de 2200 kg/ha pour le blé tendre, de 2000 kg/ha pour le blé dur et de 3150 kg/ha pour l'orge. Dans les régions à moins de 350 mm le rendement moyen du blé est de 800 kg/ha et de 1550 kg/ha pour l'orge.

Les principales variétés cultivées sont Mexipak 65 et Florence Aurore pour le blé tendre et Haurani et Jori C69 pour le blé dur alors que pour l'orge seules des variétés locales sont cultivées (des variétés améliorées ont été identifiées comme étant emblavables dans cette région). Les rouilles (*Puccinia spp.*) et le charbon couvert (*Ustilago tritici*) représentent les maladies importantes des céréales au Liban.

Des recommandations concernant les techniques culturales ont été faites aux fermiers parmi lesquelles on peut citer la sélection et la préparation des terres, le semis, la fertilisation et le désherbage. Les agriculteurs font face à de difficultés surtout au niveau économique (prix prohibitifs des engrais et désherbants, des machines et de la main d'œuvre) ainsi qu'au niveau de l'obtention des graines certifiées, et de la protection des cultures du pacage et des oiseaux.

Les projets futurs d'amélioration de la production céréalière au Liban se feront avec la coopération d'organisations internationales en particulier sur la production de semences, l'amélioration des plantes, l'agronomie et la pathologie.

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CONSTRAINTS TO CEREAL PRODUCTION AND POSSIBLE SOLUTIONS IN LIBYA

Introduction

Libya, a North African country, lies along the southern coast of the Mediterranean approximately between latitudes 18° and 33° North and longitudes 9° and 25° East, with an area of about 1,759,540 square kilometers. More than 90 percent of the total area is desert and barren. Most of the agricultural activities are limited to a long narrow strip along the Mediterranean coast, near low mountains, and at scattered oases in the desert. In recent years the agricultural area was significantly expanded as a result of the programme of land reclamation carried out by the Libyan authorities, which resulted in adding thousands of hectares to the cultivated land.

The prevailing conditions are characterized by *variability and unpredictability*. The rainfall is erratic in quantity, frequency, and distribution. On the basis of climate and soil conditions, four agricultural regions are recognized. These are:

1. **The coastal belt:** a narrow strip with a width varying between 5 and 25 kilometers along the sea. However, south of this, in the West, plains extend to a distance of more than 100 kilometers in the form of an arc to form what is known as the Jefara Plains. The average rainfall there is between 200 mm and 250 mm. Supplementary irrigation, using underground water, is a common practice in this area. Future expansion of irrigation using underground water is curtailed due to the lowering of the water table and intrusion of salty sea water. The soils in the western part of the belt are sandy or sandy loam, very low in nitrogen and organic matter with neutral to slightly alkaline reaction, while soils in the eastern part of the belt are heavier mainly sandy loam to clay loams.

2. **Low mountains (Jebels):** There are two distinct and geographically separate low mountain areas located immediately south of the coastal belt, one in the eastern part of the country known as Jebel El-Akhdar and the other in the western part known as Jebel El-Gharbi. These mountains are generally rocky and stony and intercepted frequently with many wadis. The average rainfall in Jebel El-Akhdar ranges from 250 mm to 600 mm. The soils are terra rosa or heavy clay. In Jebel El-Gharbi the average annual rainfall is much less, between 200 mm and 300 mm. The soils are much lighter and more variable than those of Jebel El-Akhdar.

3. **Semi-desert areas:** These regions come immediately south of and parallel to the Jebel regions. The average rainfall varies from 50 mm to 150 mm and they are used primarily for grazing. However, some primitive agriculture is still practiced by the nomads in the wadi beds.

4. **The desert:** Consisting of sand dunes and gravelly barren, rolling hills or plains. Rainfall is almost non-existent. Agriculture, in the past, was confined to a few scattered oases. In the last decade, due to the discovery of vast quantities of underground water in some part of the desert area, the invasion of the desert has begun by establishing government sponsored agricultural projects aimed at reclaiming the land and settling the nomadic people. This has resulted in bringing about 100 thousand hectares under permanent agriculture.

Important Field Food Crops

Wheat and barley constitute the two staple crops of Libya, being grown under various conditions of climate and soils, under both irrigated and rainfed agricultural systems. The total area seeded to wheat in 1976 was estimated as 261,500 hectares and to barley 294,400 hectares (15). The bulk of which, approximately 90 percent, is grown under rainfed conditions. Wheat and barley under irrigation are grown mainly in the oases of the Fezzan, on the government projects at Kufra and Sarir and, to a less extent, in some parts of the coastal belt.

The average grain yield for wheat and barley under rainfed conditions is estimated as 0.30 t/hectare and 0.37 t/hectare respectively, and 2.0 t/hectare for both crops under irrigated conditions. Fuad (10) summed up the main problem facing wheat production in Libya as being erratic rainfall, absence of soil-water conservation practices, late planting, lack of adequate fertilization, absence of crop rotation and climatological factors such as untimely Ghiblis (hot and extremely dry southerly winds which blow from the desert, especially in spring).

Triticale was introduced recently to Libya. Several promising lines provided by CIMMYT are under various stages of evaluation in several experimental stations. Although triticale is a new crop to Libyan agriculture, and unfamiliar to the Libyan farmer, it is gaining recognition among research workers and it may soon become an important crop alongside wheat and barley.

Summer cereals such as maize, sorghums, and pearl finger millets were in the past among the major components of Libyan agriculture. However, recently, these crops have lost some of their importance in the Libyan diet due to changes in the feeding habits of the people and their shift toward a greater consumption of wheat products. This, among other things, has resulted in a drastic reduction in the area planted to these summer crops. In 1976, for example, only 500 hectares of maize were thought to be grown (15). No reliable figures were available for sorghums and millets.

For the reasons mentioned earlier, the discussion in this manuscript will deal mainly with wheat and barley.

Research Achievements and Work in Progress

The agricultural research in modern Libya effectively started in 1952. A number of FAO experts were assigned, at the request of the Libyan government at that time, to study Libyan agriculture, to recommend appropriate measures toward its further development and to promulgate research programs. In more recent years, as the number of Libyans with adequate research training is steadily increasing, Libyan nationals are gradually taking a greater share in leading, planning, and carrying out work in all the major areas of agricultural research.

In the course of twenty-five years of research, several significant goals toward improving production of wheat and barley have been achieved. These have come about through experiments on dates of seeding (1, 9), rates of seeding (1, 13), methods of seeding (6) and the use of fertilizers (6, 12, 13, 14). Evaluation of introduced varieties under different climatic conditions, as well as hybridization among local and introduced varieties, has resulted in some new high yielding varieties of wheat being distributed (Golden Zorda, Mahmoudi, Florence Aurora, B.D. 3225, B.T. 2306, C. 57944, Chili, Sidi Mesri I, Mokhtar) and also barley (Athenais, California Mariot, Wadi Magenini, Esperance, Libya 4). Even more promising varieties are under various stages of evaluation in several experimental stations. Trials have shown that durum wheats are superior to *T. vulgare* under rainfed conditions in the low mountain areas (Jebels), while bread wheats are superior under irrigation in the coastal plains and in the desert and semi-desert regions (1, 4, 12, 13).

The important task of collecting, identifying and classifying local wheat and barley varieties was carried out by Al-Jabouri in the early 1960's (5). Regrettably, the entire collection is lost because of the lack of appropriate measures to preserve and maintain the collection.

A survey of wheat and barley diseases found that the predominant wheat diseases were leaf and stem rusts, loose and covered smuts, powdery mildew, and *Septoria* leaf disease, while barley diseases were powdery mildew, leaf rust, and loose smut (7). Furthermore, attempts to identify the physiological races of wheat leaf and stem rusts have shown that the most common race of stem rust is race 17, while those of leaf rust are races 20, 38, 93, 107 and 187 (2, 3).

At present, the bulk of the cereal crop research in Libya is carried out by the Agricultural Research Centre (ARC) in addition to significant contributions from the Faculty of Agriculture of Al-Fateh University. The ARC has research facilities in three main stations -one at

Tajoure, near Tripoli (representing the coastal areas), one at El-Marj (representing the Jabel area) and one at Sebha (representing the desert and the semi-desert conditions). Additional research activities occur at a number of sub-stations at various locations where a number of screening nurseries and yield trial nurseries of wheat, barley and triticale are at various stages of evaluation. The nurseries have been provided, in part by CIMMYT, FAO, ACSAD and ICARDA as part of cooperation program with the ARC. Also under test are a few lines of maize, sorghums and various grain legumes originating from ICRISAT, IITA and other sources.

Some additional agronomic trials are being carried out at Kufra and Sarir Projects on seed rate, seed bed preparation, fertilization, etc. to provide the needed agronomic information under desert conditions.

Future Research Imperatives

I. Crop improvement through breeding

Yield. The average grain yield per hectare of wheat and barley under Libyan conditions is still extremely low. Although some progress has been achieved in the last 25 years to raise the productivity of these crops there is obviously an urgent need, and the opportunity now exists, to improve cultural practices and to increase significantly the productivity of crop management systems so as to enable the plant to make better use of the available environmental resources.

Drought Resistance. Most of the wheat and barley is grown under dry farming conditions in Libya, so that both earliness and drought resistance are of particular interest. This is especially the case in the areas of low rainfall and where Ghiblis are a problem. Cultivars are needed which can either escape the damage caused by drought or grow and yield well even under very high rates of evapo-transpiration.

Heat and Shattering Resistance. More effort is needed in selecting for heat and shattering resistance, particularly under the extreme desertic conditions of the Fezzan, Kufra and Sarir where extreme heat and Ghiblis, occurring at some critical stages of plant development, constitute major limiting factors and pose serious problems of management. Such adverse conditions occurring during anthesis, will result in extremely low seed setting and during the milk stage, the result is shrivelled kernels. At the ripening stage, they cause the grain to shatter and, in all cases, the result is a poor harvest.

II. Restoration of a collection of native wheat and barley varieties

The existing native varieties, which are the final products of the action of the forces of natural selection over a lengthy period under the prevailing climatic conditions, are expected to provide very useful material for developing the most suitable varieties for different regions of the country. Hence, there is general agreement toward organizing a task force in the near future for the collection of such material from different ecological zones for identification, classification and testing with this purpose in mind. The cooperation of, and assistance from, all interested parties (countries and international organizations) is needed for the effort to succeed.

III. Wheat-medic farming systems

Medic (annual *Medicago* species) are indigenous and pastures sown from introduced (Australian) cultivars have proved to be very successful in rotation with winter cereals in both the Fezzan Plains (above 180 mm rainfall) and in the Jebel Al-Akhdar (around 300 mm rainfall). Medics are known to perform well in areas with annual rainfall of as low as 200 mm and they are capable of surviving droughts. The growth form of the medics enables them to provide a highly stable cover on the soil. Also, being a leguminous crop, it fixes a significant amount of nitrogen. Another key advantage of the plant is its capability to re-establish naturally after a cereal crop without the need for expensive resowing operations. Furthermore, medic pastures are excellent quality and are grazed well by sheep, both as green herbage and also as the dry (forage) residue during summer. For those reasons, medics appear to be a good choice as pastures to be rotated with winter cereals under rainfed

conditions.

A number of Australian varieties (of Mediterranean origin) were tested in the Jeffara Plains and at El-Marj in the Jebel El-Akhdar. Results of four years work have been most promising and, under a one-to-one rotational system in, for example the Jeffara Plains with areas receiving only between 175-225 mm rainfall per annum, a stocking rate of 1 breeding ewe per hectare of pasture is expected and yields of wheat of up to 6 quintals per hectare (giving a water use efficiency of 3 kg per mm) (8).

In the Spring of 1978, a task force, composed of a number of teams drawn from several national and international organizations and organized under the auspices of ARC, set about collecting the indigenous annual *Medicago* ecotypes from various ecological zones throughout Libya. The effort was a total success. About 1500 ecotypes were collected from approximately 500 locations. The exercise is to be continued and expanded to include other forage legume species this Spring.

Part of the collection is already identified and classified. However, the whole collection is awaiting the proper agronomic evaluation to identify and isolate the most suitable varieties for the various climatic and soil conditions of the country.

IV. Improvements in water-use efficiency

This falls into two parts. For irrigated crops there is still an urgent need to conserve underground water supplied by optimizing irrigation schedules. However in the long-term, Libyan agriculture will inevitably largely depend on its rainfed cropping systems and research on water catchment methods, and soil topographical modifications in conjunction with improved soil surface management practices (minimum tillage) should be greatly expanded. The most promising area for this is in the Jebel El-Akhdar where soils are heavier and considerable run-off can occur during heavy storms.

V. Breeding for salt tolerance

Soil or water salinity is an important factor in making the difference between a successful harvest and a crop failure in many parts of the country. The problem is further aggravated by the intrusion of sea water in the coastal belt region due to the excessive use of the underground water. These alarming facts indicate that the country may soon have to depend to a greater extent than before, on brackish and saline waters for crop irrigation.

This challenge can best be met by developing salt tolerant plants through a viable breeding program coupled with the development of better agricultural systems capable of reducing the effect of salinity stress on plant growth and development.

The relative high tolerance of the barley plant and the striking variation among barley varieties with regard to salinity stress reaction (11) makes barley a prime candidate, among all cereals, for the start of a breeding program for salt tolerance. It is probably premature to spell out the various dimensions for any suggested program at this stage. However, some areas of research which, in my opinion, represent priorities are as follows:

1. Manipulation of crops, or their environments, in ways which obviate or reduce injury from salinity and which increase productivity through the development of crop management systems and cultural practices which reduce exposure of crops to salinity. Modifications of the micro-climate of the crop and, possibly, the use of chemical treatments so as to increase salinity resistance and aid in the recovery of adverse effects produced by salinity damage.
2. Investigation of the basic principles of stress injury and plant tolerance factors which should include the physiological mechanisms of salt stress injury to plants as well as those strategies of avoidance and/or resistance to it.
3. Exploitation of the genetic potential for developing new varieties resistant or tolerant to salinity stress. The first step will be to collect germplasm for screening and evaluation. Also, to develop criteria and methods capable of screening large populations for salinity stress resistance at various stages of plant development. Finally, to use this information to select and/or breed for varieties for increased levels of tolerance to salinity stress.

However, it should be noted that such research programs may materialize only through the joint work of agronomists, soil scientists, plant breeders and plant physiologists. Their success will depend on the cooperation of all the parties concerned, especially in the areas of establishing efficient communication channels, in exchanging the research materials for screening tests, and the provision of data and information regarding salt stress studies as well as in the transfer of technology in general.

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barley. Under irrigated conditions, yields are much higher, being about 2.0 t/ha for both crops.

The principal problems facing winter cereal production in Libya include generally low and erratic rainfall, absence of moisture conservation practices, late planting, lack of adequate fertilization and lack of crop rotations. Many improved varieties of bread wheat, durum wheat and barley are grown in Libya. Experimental evidence suggests that durum is best adapted to the low mountain areas, while bread wheat is better in the coastal plains and irrigated deserts. The major wheat diseases include leaf and stem rusts, loose and covered smuts and *Septoria* spp. The major disease problems encountered with barley are powdery mildew, leaf rust and loose smut.

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CONTRAINTES LIMITANT LA CEREALICULTURE EN LYBIE ET LES DIFFERENTES SOLUTIONS POSSIBLES

Résumé

Le blé et l'orge représentent les deux cultures alimentaires principales en Lybie; elles sont cultivées le long de la côte, dans les zones de faible altitude et dans quelques zones irriguées du désert. En 1976, la surface emblavée en blé était de 261.000 ha et celle emblavée en orge de 29.000 ha dont 90% sont non irriguées. Les rendements moyens sont de 0,3 t/ha pour le blé et de 0,37 t/ha pour l'orge. En condition d'irrigation, les rendements atteignent environ 2 t/ha pour les deux plantes.

Les principaux problèmes rencontrés par les céréaliculteurs lybiens sont surtout la plus ou moins absence de pluies, l'absence de techniques de conservation de l'humidité du sol, des semis tardifs, le manque d'engrais adaptés et l'absence d'assolements des cultures. De nombreuses variétés de blé dur et tendre et d'orge sont cultivées et des essais ont prouvé que le durum est le plus adapté aux zones de faible altitude alors que le blé tendre l'est dans les plaines côtières et les déserts irrigués. Les rouilles brunes et noires, les charbons couvert et nu et les septorioses sont les principales maladies des blés alors que pour l'orge se sont la rouille brune et le charbon nu.

Des recherches sont conduites en stations expérimentales situées dans différentes zones agro-climatiques et du matériel fourni par de nombreuses organisations internationales est criblé pour une utilisation future dans les programmes nationaux. Des essais agronomiques sont entrepris dans diverses régions et se concentrent surtout sur l'étude de la préparation des sols, de la densité de semis et sur la fertilisation surtout pour les zones désertiques.

Les deux travaux futurs sont concentrés surtout sur la production de variétés à bonne résistance à la chaleur et à la sécheresse, ainsi que sur le développement des rotations blé/médic. D'autres domaines seront aussi étudiés tels que la conservation de l'humidité du sol, la production de variétés à forte tolérance saline. Ces efforts seront menés en collaboration avec les scientifiques, le personnel de vulgarisation et les responsables des politiques agricoles.

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LA SITUATION DE LA CEREALICULTURE AU MAROC

Introduction:

Les céréales occupent une place très dominante dans le secteur agricole au Maroc. Ceci est affirmé globalement au niveau des trois paramètres suivants:

- la superficie
- la production
- la population

1) La superficie:

Sur les 7,5 millions d'hectares cultivables au Maroc, les céréales (blé dur, blé tendre et orge) couvrent près de quatre millions d'ha en moyenne, soit 76% des terres ensemencées annuellement (5,3 millions ha); voir tableau en annexe.

Les terres céréalières sont représentées au niveau de toutes les régions économiques du pays, avec toutefois une concentration au niveau des exploitations de moins de 10 ha (2,1 millions d'ha).

2) La production:

La production céréalière connaît de fortes fluctuations au cours des cinq dernières années; la production moyenne a été de 42 millions de quintaux, la plus forte a été enregistrée en 1976 avec 56,5 millions de quintaux et la plus faible en 1977 avec 28 millions de quintaux (voir annexe).

Cependant malgré les fluctuations inter-annuelles très importantes, nous avons assisté entre 1960-64 et 1973-77 à une évolution tendant à une *moyenne continue vers la hausse* de 14%; résultant surtout de l'amélioration du facteur variétal.

Le volume des importations durant les dernières années a connu une hausse continue traduisant le caractère chronique du déficit céréalier (12 millions en 1977).

La part de la production destinée à la consommation humaine serait en 1970/71 d'environ 70% pour le blé tendre, 86% pour le blé dur et de 43% pour l'orge.

3) La population:

Les terres céréalières abritent 72% de la population rurale et les exploitations de moins de 10 ha supportent la plus grande charge humaine, soit environ 88% de la population céréalière.

Variétés et leur ennemis:

Les variétés cultivées par espèce sont:

Blé dur: *Kyperounda*, Zeramek, Cocorit, Hadj Mouline, Oued Zénati, Selbera et Jori.

Blé tendre: Nasma, Siete Cerros, BT 908, Pynite, Potam, Tegye-9, Tegye 32.

Orge: *Rabat-071*; Merzaga, Tripolis 89, Barlis 628, Brasserie Maroc, et Arig 8.

Pour les maladies cryptogamiques les plus importantes:

Blé dur = *Puccinia recondita*

Blé tendre = *Septoria tritici*

Orge = *Helminthosporium Teres* et *Puccinia Mordere*.

La cecidomye importante dans la zone côtière, et les moineaux provoquent parfois des dégâts importants.

Méthodes culturales:

Travail de sol: Si on prenait celui de 1979, le % des superficies labourées était pour:

- | | |
|-------------|-----|
| —cover-crop | 51% |
| —Charrue | 20% |
| —attelage | 29% |

On remarque que le cover-crop, outil non de labour, est pratiquement substitué à la charrue, car il permet de réduire les investissements et d'accélérer la vitesse des pseudo-labours effectués surtout en année tardive.

Cet avantage apparent est obtenu au détriment de la qualité du lit de semences.

Semis: En général, ils se font à la volée suivis du cover-crop ou de l'attelage.

Engrais: (1979) La distribution globale d'engrais de fond destinés aux céréales a été de 70500 tonnes d'unité fertilisant sur 75 000 tonnes prévus.

Désherbage: Le 2-4-D ou le MCPA est utilisé contre les dicotylédones et le suffix (Benzo el Prop Ethyl) contre la folle avoine.

Recommandations à partir des résultats de la recherche:

- Supériorité des semis précoces par rapport aux semis tardifs.
- Supériorité des semis au semoir par rapport au semis à la volée (environ 50% de levée)
- Dose de semis

Blé 120 à 150 kg/ha en irrigué
80 à 100 kg/ha semi-aride (—350 mm)

Orge 80 à 100 kg/ha (- 350 mm)
50 - 80 kg/ha semi-aride (—350 mm)

- Nécessité de fractionner l'apport d'azote en irrigué et plus de 350 mm.
- Traitement des graines à semer avec le Maneb contre les maladies transmissibles par les graines.
- Rendement dans les essais nationaux (4 ans)

| | Irrigué | >350 mm | <350 mm |
|-----------------------|---------|---------|---------|
| Blé tendre Tegye-9 | 59,0 | 43,0 | 31,0 |
| Blé dur: Hadj Mouline | 54,5 | 35,5 | 31,0 |
| Orge: Arig 8 | 45,7 | 34,9 | 26,9 |

Problèmes de la production céréalière:

I. Les structures foncières:

Environ, la moitié des surfaces céréalières est constituée par des exploitations de moins de 10 ha qu'aggrave encore leur morcellement. Cette situation les rend peu perméables à l'introduction des facteurs modernes de production. Cette catégorie d'agriculteurs, n'a pas, en réalité, accès au crédit agricole.

De ce fait, la productivité pour l'ensemble de ce secteur reste faible (entre 4 et 8 qx/ha).

II. Disponibilité et utilisation des facteurs de production

Le taux de mécanisation demeure très faible et ne touche que 15% seulement des exploitations céréalières soit près de 44% de la surface totale réservée aux céréales. Notons en plus de la faiblesse du parc national, une disparité régionale.

| | Zone irriguée | Zone à précipitation >350 mm | Zone à précipitation <350 mm |
|-----------------------------------|---------------|------------------------------------|------------------------------------|
| % superficie céréalière | 20 | 40 | 40 |
| % du total du parc tracteur | 46 | 36 | 18 |

Le taux de fertilisation moyen pour les céréales n'atteint que 17 unités/ha.

Pour les semences sélectionnées, le volume moyen de la production est de 400.000Qtx couvrant à peu près 25% des besoins nationaux.

III. Influence du climat:

Des études menées dans ce sens ont montré que l'effet du climat induit une variabilité de

la production d'environ 20%. En effet, l'influence du climat est fonction du degré de maîtrise des techniques de production.

IV. Faiblesse au niveau de la vulgarisation:

Mesures à prendre pour l'accroissement de la production

Depuis 1965, plusieurs "opérations" ont été lancées pour améliorer les rendements de cette culture, les plus énergiques ont mis l'accent sur le labour, l'emploi d'engrais, l'utilisation des variétés à haut rendement et les assolements.

Pourtant, les rendements nationaux moyens sont encore inférieurs à 100qx/ha; les campagnes n'ont donc pas atteint les résultats attendus mais la culture du blé s'améliore depuis 1971.

Il serait donc nécessaire:

—au niveau des travaux

d'encourager l'acquisition du matériel par les agriculteurs en augmentant la part du crédit pour les individuels et en assurant le financement à 100% pour les groupements (30% de subvention et 70% de crédit).

de créer des entreprises ou l'état serait majoritaire. Ces entreprises travaillent en priorité chez les agriculteurs non mécanisés.

—au niveau de la vulgarisation

Etant donné que la structure existe ainsi que l'effectif en cadres, il faut un désengagement total des centres des travaux de la fonction de prestation des facteurs de production pour s'occuper essentiellement de la vulgarisation des techniques.

Reprendre les essais de démonstration au niveau des agriculteurs.

—Engrais: Renforcer le système mis en place par l'augmentation des points de vente.

—Semences sélectionnées

Augmenter la production et d'une manière proportionnelle à l'importance de chaque espèce.

Faciliter la distribution par l'augmentation des points de vente.

Revoir les prix des céréales et le circuit de commercialisation.

Enfin signalons que plusieurs projets sont en cours d'étude visant à améliorer la production des céréales particulièrement dans les zones bours.

TABLEAU ANNEXE: Superficie, Production et Rendements des trois céréales dans les différentes zones.

| Céréales Zones | Blé dur | | | Blé tendre | | | Orge | | |
|-----------------------|---------------------|-----------------------|----------------|---------------------|-----------------------|----------------|---------------------|-----------------------|----------------|
| | Superfi. 1000 ha | Production 1000 qx | Rend. qx/ha | Superfi. 1000 ha | Production 1000 qx | Rend. qx/ha | Superfi. 1000 ha | Production 1000 qx | Rend. qx/ha |
| Zones «300 mm | 291 | 1670,1 | 5,7 | 247 | 980,6 | 3,9 | 1235 | 10533,7 | 8,5 |
| Zones »300 mm | 989 | 1041,1 | 10,5 | 253 | 2738,6 | 10,8 | 263 | 7481,1 | 13,0 |
| Zones de Montagnes | 154 | 1344,4 | 8,7 | 24 | 233,4 | 9,7 | 175 | 1851,7 | 10,6 |
| Zones irriguées | 55* | | | 55* | | | | | |
| Oasis irriguées | 13 | 300 | 23 | 13 | 350 | 26,7 | 7 | 140 | 20 |
| Total | 1460,0 | 13725,5 | | 524 | 4302,6 | | 1980,0 | 19956,5 | |

*Les superficies des zones irriguées sont incluses dans les zones bours.

Résumé

Très importante au Maroc, tant au niveau de la superficie (4 Millions d'ha) qu'au niveau de la production (28 Millions de qx en 1977), la céréaliculture utilise 72% de la population rurale (dont 88% sont supportés par des exploitations des moins de 10 ha).

Malgré un grand nombre de variétés (parmi lesquelles on peut citer: Kyperounda, Cocorit, Jori pour le blé dur; Siete Cerros, BT 908, Pynite pour le blé tendre; Rabat 071, Barlis 628 pour l'orge), la production céréalière au Maroc affronte de nombreux problèmes: les maladies cryptogamiques (*Puccinia*, *Septoria* et *Helminthosporium*), la cecidomye, les moineaux, les structures foncières, la mauvaise préparation des lits de semences (par une utilisation abusive du cover-crop), un très faible taux de mécanisation (sur 44% de la surface céréalière), un faible taux de fertilisation (17 unités/ha) et une forte influence du climat, fonction du degré de maîtrise des techniques de production (variabilité de la production atteignant 20%).

Malgré de gros efforts au niveau de la recherche et des recommandations en découlant (semis au semoir, traitement des graines au Manebe, amélioration des doses de semis), il subsiste toujours des faiblesses au niveau de la vulgarisation. A l'avenir, il sera nécessaire d'encourager l'acquisition de matériel (par la création de crédits et de subventions), de former le personnel technique, de reprendre les essais de démonstration, d'augmenter les points de vente d'engrais, d'augmenter la production des semences sélectionnées (actuellement seuls 25% des besoins nationaux sont disponibles), d'en faciliter la distribution et de revoir les circuits de commercialisation et les prix des céréales.

CONSTRAINTS TO CEREAL PRODUCTION AND POSSIBLE SOLUTIONS IN MOROCCO

Summary

Cereal cultivation is very important in Morocco both in terms of the area planted (4 million ha) and the number of people involved (72 percent of the rural population). A number of improved high yielding varieties are grown in Morocco. Widely planted durums are Kyprounda, Cocorit and Jori C 69; Siete Cerros, BT 908 and Pynite are the principal bread wheats. The main barley cultivars include Rabat -71 and Barlis 628.

Cereal production in Morocco is faced with a variety of problems. Principal diseases affecting the crop are rusts, *Septoria* ssp. and *Helminthosporium* ssp. Among insects, the Hessian fly causes the most serious damage. Yield losses due to sparrows are considerable and control is difficult. Aside from pests, other production difficulties result from small and often fragmented land holdings. Mechanization remains at a low level (44 percent of the crop) and this lack contributes to other problems such as poor seed bed preparation. Fertilizer is generally applied at low rates; significant gains could come through greater availability and use of fertilizer materials.

Various recommendations have been made to farmers based on the results of research trials and agronomic experiments. These cover such operations as seeding, seed treatment, fertilization and weed control. However, improvement is needed in the extension effort to communicate these findings to the farmer. In the future, there will be an increase in the number of trained personnel; and more use will be made of field demonstrations. Other plans call for subsidies and credits for equipment purchase, increasing the availability of fertilizer and enlarging the seed production and certification system. Finally, a review of the distribution and marketing system in the country could indicate other areas where efficiency could be increased. Postharvest problems are minimal, as most of the crop is sent for milling directly. In addition to production difficulties, economic constraints also pose problems for wheat farmers.

Future production increases will be directed toward increasing the area under cultivation, and improving agronomic practices. These efforts will include application of research findings, timely application of fertilizers and efficient use of agricultural machinery.

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CONSTRAINTS TO CEREAL PRODUCTION AND POSSIBLE SOLUTIONS IN PORTUGAL

Introduction

Portugal is situated in the extreme South West of Europe between Spain and the sea. It is approximately rectangular in shape with a total area of 8,850,000 hectares.

Although it faces the Atlantic Ocean, there is a strong Mediterranean influence (Ribeiro, 1963). These two components exert a decisive effect on the climate, which exhibits a great variety of types.

The geographical relief separates two types of regions with well marked characteristics.

North of the River Tagus, agriculture is greatly limited due to the hilly country. Rainfall is high, reaching 2,800 mm, and the climate along the coast is influenced by the Atlantic. In the interior, a continental climate dominates.

South of the Tagus, the relief is much more reduced and there are many plains. The annual rainfall is low, with a minimum reaching 400 mm, and the climate shows a greater Mediterranean influence.

Fifty-four point four percent of the country's soils are arable, which corresponds to 4,834,000 hectares. Of these, 4,214,000 hectares are dry farmed and 620,000 hectares are irrigated (Cardoso, 1973).

Wheat growing

Wheat is the most important cereal for its food value for the population, and naturally occupies the greatest area and is subject to more intensive care.

The area occupied by wheat is equivalent to that of the other winter cereals together: rye, barley and oats.

Wheat has the greatest economic significance south of the Tagus in the Districts of Beja, Evora and Portalegre. In the uplands of the North East, District of Braganca, wheat is also of great importance to local agriculture.

Although durum wheat is cultivated, its importance is now very reduced. It was widely planted until the beginning of this century in some regions. Now little interest is shown in these varieties, partly because of their low yield and partly due to poor prices paid to the farmer. Under these conditions, durum wheat production is less than 3 percent of the national production.

Portugal's annual requirements for soft wheat are about 800,000 tonnes and 70,000 tonnes of hard wheat per year are necessary for the macaroni industry.

The area sown to wheat and its yields have varied considerably over the years, as can be seen in Table 1.

The normal season for sowing is the middle of November in the South of the country, and October in the North. Harvesting takes place in the months of June, July and sometimes August.

It can be said that all wheat is dry farmed since the irrigated area is not significant and is only occasional.

The varieties most frequently cultivated in the whole country are: Impeto, Mexicano 1481, Anza and Siete Cerros. However, it is difficult to give their percentages since only about 65 percent of the seed is certified.

Of the varieties studied, Anza stands out due to its high yield and great ease of adaptation to the various regions of the country. In the same way Xévora, a Portuguese variety, has proved worthy of wider use for its good adaptability in diverse conditions. On the contrary, varieties such as Siete Cerros, which became extremely susceptible to *P. striiformis* in 1978, and Impeto, should have their areas reduced.

In the cold uplands of the Braganca District, the variety most cultivated is a native one, Barbela, whose hardiness has not been superseded by any other up to now.

Note: With no facility to set type in Portuguese, we could not print the author's references list. CIMMYT will furnish a photocopy upon request.

At the present time, seed from various origins for adaptation continues to be studied all over the country, but the soft wheat types have not yet managed to better the standard ones, especially Anza. As for durum wheats, the most promising in the traditional regions for wheat cultivation are: Corcorit 71, Mexicali 75 and the two new Portuguese genotypes Maioral and Faisca also do well. However, the first two are not yet widely cultivated due to their low quality.

Some diseases assume an appreciable economic importance by limiting production. The extremely irregular climate creates variable conditions for parasite attack. Last year a tremendous attack of *P. striiformis* caused great damage especially to Siete Cerros. In the same way, 1978 was very favorable to root rots, causing great losses.

Other diseases such as *Septoria tritici*, *P. graminis*, *P. recondita* and *Erysiphe graminis* occur with varying intensity.

Also, certain pests sometimes affect the wheat fields. The most serious is, perhaps, *Cephus pygmaeus*, always worse in years when the Spring is dry in the South of the country. Also the Hessian fly (*Mayetiola destructor*) and some aphids cause significant damage.

Barley growing

Like wheat, barley is only grown under dry farming conditions, occupying about 10 percent of the area under Winter cereals.

Barley culture is used mainly for beer and animal feed.

It is also cultivated mainly South of the Tagus, chiefly in the Districts of Beja, Evora, Portalegre and also Santarém.

Barley has been cultivated for animal feed for a long time in Portugal, but for malt only fairly recently.

As with wheat, the area cultivated and the yield are extremely variable. Table 1 shows this variation and the present situation of barley culture.

However, barley for malt is given special attention by both farmers and official bodies, which together with the smaller area under cultivation gives a higher yield per hectare. Thus for an average yield of 880 kg/hectare in the period 1971-75, malt barley registered an average of 1380 kg/hectare, and that grown for animal feed only 680 kg/hectare (Barradas, 1977).

As for consumption, Portugal could easily be self-sufficient in malt barley since the industry needs 60,000 tonnes per year for home use. Animal feed presents a different problem where an enormous cereal deficit obliges us to import. It is possible to consume about 800,000 tonnes per year since the animal feed industry can absorb all the barley produced, which by substituting imported maize could avoid enormous foreign currency losses.

Times for sowing and harvesting are more or less the same as for wheat.

The most frequently cultivated variety of malt barley is Beka; due to industrial pressure on account of its high quality, it occupies 70 percent of the area. Then comes Union with 20 percent and Delisa with 10 percent.

As for barley for animal feed stuffs, the system for seed production is far from perfect. However, the chief varieties recommended which occupy a small area are Arivat, Iris or Clermont and lately also Aramir and Ceres.

The improvement program has revealed new genotypes which are very promising under our agro-ecological conditions, especially the distic barleys Carina (which is already being cultivated) and Ribeka, and hexastic barleys Hop and Robur.

The diseases prevalent in the main cultural regions are *Rhynchosporium secalis*, *Helminthosporium* ssp. and *Erysiphe graminis*. The first of these deserves special attention since it causes serious losses which are worse in wet years.

The worst pest damage is caused by aphids which sometimes reach considerable proportions.

Some of the main factors limiting production

The great majority of Portuguese soils show certain limitations which prevent high

cereal yields. Their fertility does not differ very much from other Mediterranean countries, with low rates of organic material and phosphorus, and reasonable levels of potassium (Alves, 1977). On the other hand, about 80 percent of them have a high degree of acidity with a pH below 5.5, making liming necessary (Santos, 1973; Alves, 1973/74).

Under these conditions, adequate applications of fertilizers and correction of acidity are particularly important to increase yields. But although many experiments have confirmed this, little has been done to solve these problems.

Thus, among the measures of modern technology, just the single factor —correct use of fertilizers, can promote a rapid and substantial increase in our agricultural production, according to Cardoso (1968).

Experiments by Alves, (1978), show that better balanced applications of fertilizer can raise wheat yields by 25-60 percent according to the soils.

Although the problem of soil acidity cannot be considered as the only limiting factor to productivity (Alves, 1973/74), some of our workers consider that liming can promote an immediate increase in yields (Brito and Pereira, 1973). These facts were observed in wheat trials on acid soils where after liming, the yield increased from 140 to 180 kg/hectare. And, for barley, which prefers alkaline soils, liming promoted rises of about 500 kg/hectare.

Other factors, among which we must mention natural vegetation, frequently contribute to a reduction in yields. In fact, infestations of weeds normally cause considerable damage, above all in wet years. In studies carried out some years ago, 224 species of weeds were found in the wheat fields, causing an estimated loss of 10-30 percent (Amaro and Guerreiro, 1971).

In spite of the great predominance of dicotyledons, the wild oat (*Avena sterilis*) has become increasingly important every year. It is normal to find infestations of 100 panicles per square metre and sometimes this reaches 250 panicles/m² (Borges, 1972). Under these conditions, the damage to the wheat crop is even higher, since 100 panicles/m² reduces the yield by about 30 percent.

The application of herbicides is a solution which most farmers use only as a last resort. Not realizing clearly the damage done by the weeds, (herbicide application is dear and so often badly applied), the farmers cut down their expenses, fearing that the yield will not compensate for the treatment. This explains why the area treated can be calculated as only 25 percent of the total (Monjardino, personal comm. 1979).

As in the case of fertilizers, many experiments have been carried out on the use of herbicides, especially by commercial firms. But most of these results do not reach the farmers, who do not usually know the importance of treatments nor how to put them into practice.

With reference to using improved varieties, we also see a discrepancy between research and farmers. In the first place, because the use of certified seed for barley as animal feed is almost nonexistent. Then the value of the varieties is not always realized, serious mistakes being made in choice and sowing times. On the other hand, people insist on using traditional types, which therefore stay on the official certified seed list too long. This catalogue does not tend to become more dynamic, but maintains a certain routine, instead of introducing new varieties which would promote the use of a better technology.

Rotations still need a lot more study and improvement. For the best soils, viz the clay soils of the South, the usual rotation is: ploughed land (oversown with an oil seed crop or chick-pea) - wheat - barley. In the poorer soils, fallow is introduced which is prolonged when the soil is poorer. On the other hand, in most cases fallows are not sown with oil seed crops, but remain bare.

The problem of rotations has raised some controversy among Portuguese specialists. For some, the chief crisis in the country's agriculture arises from excessive and disorderly cropping of cereals which leads to low fertility and degraded soils (Crespo, 1968; 1975). Therefore they recommend temporary pastures substituting the fallow of traditional rotations. According to this author, for most of the country, these pastures should be based on the introduction of subterranean clover, due to the acidity of the soil, as experiments have shown up to the present.

Other problems in production

The Portuguese farmer is facing tremendous difficulties in modernizing and in making his farm pay. The high rate of inflation leads to a constant rise in the cost of production, while the price of agricultural crops rises at a slower rate.

Credit carries a high rate of interest, in spite of benefits granted to some agricultural activities. This naturally does not stimulate enterprises to modernize.

However, there is no technological requirement needed for this credit to be conceded, so it is not accompanied by measures to ensure higher production.

The prices of most agricultural products are not stimulating due to low productivity.

The last few years have seen an increase in cattle raising. Therefore the price of wheat (8\$80 for the next harvest) is often inferior to that of barley and oats on the open market, which does not promote any interest in it, and could lead to a progressive discouragement of wheat growing or even to its use in preparing animal feedstuffs.

On the other hand, straw has reached an unheard value, and farmers in certain regions are going back to long strawed varieties. In the North of the country where there is a higher density of cattle and lower cereal production, straw is in great demand, being acquired at high prices from far away.

For 1977 prices, now naturally out of date, wheat and barley costs of production (Brito, 1977) reveal a slight compensation to the Portuguese farmer for the risks he has to face (Table 2).

The profits as we can see are low (Table 2). However, on better soils, viz the clays of the South, where a better technology is also used, yields have reached 3,500 kg/hectare for wheat and 4,000 kg/hectare for barley. Unfortunately these soils cover a small area —only about 65,000 hectares.

Outlook for the future

In spite of the tremendous crisis in Portuguese agriculture, a crisis which has come from long ago and become worse in the last few years, we believe that it will now be possible to modify this situation considerably.

The fact is that our agriculture, especially that of cereals, is based mostly on traditional and customary farming practices. As Borlaug (1969) points out, there is a set of factors which, if properly manipulated, could revolutionize crop productivity.

Brito (1977) in a curious analysis of the Portuguese agricultural panorama, draws attention (taking our fruit growers of the 1960s as an example) to the efficiency with which our farmers can respond to an attractive dynamic program.

On the other hand, we have sufficient agronomists, both in number and quality, to raise the production level in wheat and barley.

Therefore, remembering the example of what has happened in many countries, it seems fundamental to draw up a well-thought-out plan to motivate agronomists, farmers and politicians. Only in this way, we believe, will it be possible to revolutionize cereal production in Portugal, making better use of soils and counteracting our unfavorable climate.

TABLE 1. Area, production and yield. Values for the last 15 years.

| | Area x 10 ³ ha | | | | Production x 10 ³ t | | | | Yield (kg/ha) | | | |
|------------------|---------------------------|---------------|-------|-------|--------------------------------|---------------|-------|-------|-----------------|---------------|-------|-------|
| | Average Max. | Min. | 64-73 | 74-78 | Average Max. | Min. | 64-73 | 74-78 | Average Max. | Min. | 64-73 | 74-78 |
| Wheat (year) | 685 (1964) | 280 (1977) | 535 | 418 | 794 (1971) | 196 (1977) | 570 | 451 | 1 560 (1971) | 689 (1974) | 1 083 | 1 027 |
| Barley (year) | 126 (1965) | 63 (1978) | 102 | 89 | 94 (1968) | 34 (1977) | 65 | 69 | 917 (1971) | 412 (1974) | 640 | 772 |

Source: INE.

TABLE 2. Production costs of cereals.

| | | Yield levels | Costs of production |
|--------------------|---------------|--------------|---------------------|
| Wheat | Price paid to | 1 210 | 7\$72 |
| | producer in | 1 400 | 6\$78 |
| | 1978: | 1 550 | 6\$22 |
| | 7\$50 | | |
| Barley for feed | Price paid to | 720 | 11\$99 |
| | producer in | 1 000 | 8\$47 |
| | 1978: | 1 440 | 5\$92 |
| | 6\$30 | | |

Source "Ao Servico da Lavoura" No. 147 - 1977

Summary

Wheat is the most important cereal crop in Portugal, occupying about as much land as all other winter cereals combined. Almost all wheat is produced under rainfed conditions. Bread wheat is the principal type grown, with durum accounting for only 3 percent of the production. Principal bread wheat varieties include Impeto, Mexicano 1481, Anza and Siete Cerros. As for durums, Cocorit 71, Mexicali and two new Portuguese selections, Maioral and Faisca, appear promising. Wheat diseases continue to be important. In 1978, *P. striiformis* caused serious damage, and there were widespread root rot problems as well.

Barley occupies about 10 percent of the winter cereal area in Portugal. Cultivated chiefly in the drier southern areas, it is used principally for feed, although significant amounts are grown for malting purposes. Several newer selections look very promising. Principal diseases are *Rynchosporium secalis*, *Helminthosporium* spp. and *Erysiphe graminis*.

One of the most important factors limiting cereal production is soil acidity. Some 80 percent of the soils in Portugal have pH readings below 5.5. Experimental evidence has shown that yields could be greatly increased through liming and correct use of fertilizers. Weeds are also a serious problem, especially in wet years. Because of cost and poor application methods, herbicides are used on only about one quarter of the area planted with wheat and barley. Seed certification remains a problem, especially for feed barleys. Experimental evidence suggests the modification of the traditional rotations; substituting pasture for fallow could improve soil conditions and increase cereal yields. Subterranean clover seems to be an ideal choice for this purpose.

Finally, economic problems continue to limit resources available for farm modernization and expansion. High inflation, low commodity prices and tight credit all play a role in this situation. High prices for meat and straw do not necessarily favor increased grain production. Joint efforts in the areas of production, research and policy are needed to work toward the solution of cereal production problems in Portugal.

CONTRAINTES LIMITANT LA CÉRÉALICULTURE EN PORTUGAL ET LES DIFFÉRENTES SOLUTIONS POSSIBLES

Résumé

Le blé (97% blé tendre et 3% blé dur) est la céréale la plus importante du Portugal et est en majorité cultivée sans irrigation. Les terres emblavées en blé représentent la même surface que celles emblavées en toutes les autres céréales d'hiver. Les principales variétés de blé tendre comprennent Impeto, Mexicano 1481, Anza et Siété Cerros; pour le blé dur, les principales variétés sont Cocorit, Mexicali ainsi que deux sélections prometteuses portugaises Maioral et Faisca. Les maladies affectant le blé continuent d'être importantes en 1978, la rouille jaune (*P. striiformis*) a causé de vastes dégâts et il existe aussi des problèmes dus à la pourriture des racines. L'orge occupe environ 10% des surfaces emblavées en céréales d'hiver. Cultivée principalement dans la partie Sud du pays, il est utilisé en majorité pour l'alimentation du bétail, le reste étant utilisé par les brasseries. De nombreuses sélections semblent être très prometteuses et les principales maladies sont *Rhynchosporium secalis*, *Helminthosporium* spp. et *Erysiphe graminis*.

Un des facteurs principaux limitant la production céréalière est l'acidité du sol. En effet, au Portugal, environ 80% des sols ont un pH inférieur à 5.5. Il a été démontré que les rendements peuvent être fortement accrus par une basification des sols et par un emploi correct d'engrais.

Du fait du coût élevé des herbicides et de leurs mauvaises applications, un quart des surfaces emblavées en blé et orge sont désherbées malgré les sérieux problèmes causés par les mauvaises herbes, surtout durant les années humides.

La certification des graines reste toujours un problème surtout pour l'orge. La modification des assolements peut entraîner une nette amélioration des rendements et des sols (remplacement des jachères par des cultures de trèfles).

L'inflation galopante, les crédits très faibles limitent l'expansion et la modernisation des exploitations. De plus, le prix élevé de la viande et de la paille ne favorisent pas nécessairement l'augmentation de la production grainière. Il est donc important de créer des efforts tant au niveau des surfaces de cultures qu'à celui de la recherche et de la politique agricole en vue de résoudre les problèmes de la production céréalière au Portugal.

CONTRAINTES LIMITANT LA CÉRÉALICULTURE EN PORTUGAL ET LES DIFFÉRENTES SOLUTIONS POSSIBLES

Résumé

Le blé (97% blé tendre et 3% blé dur) est la céréale la plus importante du Portugal et est en majorité cultivée sans irrigation. Les terres emblavées en blé représentent la même surface que celles emblavées en toutes les autres céréales d'hiver. Les principales variétés de blé tendre comprennent Impeto, Mexicano 1481, Anza et Siété Cerros; pour le blé dur, les principales variétés sont Cocorit, Mexicali ainsi que deux sélections prometteuses portugaises Maioral et Faisca. Les maladies affectant le blé continuent d'être importantes en 1978, la rouille jaune (*P. striiformis*) a causé de vastes dégâts et il existe aussi des problèmes dus à la pourriture des racines. L'orge occupe environ 10% des surfaces emblavées en céréales d'hiver. Cultivée principalement dans la partie Sud du pays, il est utilisé en majorité pour l'alimentation du bétail, le reste étant utilisé par les brasseries. De nombreuses sélections semblent être très prometteuses et les principales maladies sont *Rhynchosporium secalis*, *Helminthosporium* spp. et *Erysiphe graminis*.

Un des facteurs principaux limitant la production céréalière est l'acidité du sol. En effet, au Portugal, environ 80% des sols ont un pH inférieur à 5.5. Il a été démontré que les rendements peuvent être fortement accrus par une basification des sols et par un emploi correct d'engrais.

Du fait du coût élevé des herbicides et de leurs mauvaises applications, un quart des surfaces emblavées en blé et orge sont désherbées malgré les sérieux problèmes causés par les mauvaises herbes, surtout durant les années humides.

La certification des graines reste toujours un problème surtout pour l'orge. La modification des assolements peut entraîner une nette amélioration des rendements et des sols (remplacement des jachères par des cultures de trèfles).

L'inflation galopante, les crédits très faibles limitent l'expansion et la modernisation des exploitations. De plus, le prix élevé de la viande et de la paille ne favorisent pas nécessairement l'augmentation de la production grainière. Il est donc important de créer des efforts tant au niveau des surfaces de cultures qu'à celui de la recherche et de la politique agricole en vue de résoudre les problèmes de la production céréalière au Portugal.

LA PRODUCTION CEREALIERE EN TUNISIE

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I. Introduction:

A. Occupation du sol

La Tunisie a une superficie totale de 16.000.000 ha

La superficie agricole utile couvre approximativement 4500.000 ha de terres cultivables

3.300.000 ha de prairies et parcours, et 1.000.000 ha de forêts.

Le régime foncier est diversifié, il existe:

—des terres privatives (sur environ 4.500.000 ha) caractérisées par l'importance des exploitations de petite taille, les fermes inférieures à 50 ha couvrant 3.000.000 ha et celles inférieures à 20 ha couvrant 1.700.000 ha.

—des terres collectives situées notamment dans le centre et le sud du pays et couvrant 2.000.000 ha.

—des terres domaniales, s'étendant sur 816.000 ha dont 220.000 ha sont constitués en coopératives agricoles de production, 110.000 ha en grands domaines étatiques appelés agro-combinats et le reste est en cours d'assainissement;

—des terres servant à l'expérimentation appelées fermes pilotes (76.000 ha) et appartenant à des institutions de recherche et enseignement.

B. Climat:

La Tunisie se caractérise par un climat du type méditerranéen pouvant être subdivisé schématiquement en 4 types de bioclimats:

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—climat subhumide à humide (pluviométrie supérieure à 500. mm, dépassant localement 1.000 mm/an). Ce climat intéresse la région du Nord située entre Tabarka et la vallée de la Medjerda.

—climat semi-aride (300 - 500 mm/an) localise dans le centre-Nord du pays: Cap-bon, région de Tunis, Sahel et le Nord de la dorsale.

—climat aride (200 - 300 mm/an) localisé dans les régions de la Tunisie centrale (plaine de Kairouan, Kasserine) et le Nord de Jeroa.

—climat subdésertique et désertique (pluviométrie inférieure à 200 mm/an) localisé dans le Sud du pays.

II. Production Céréalière

A. Superficie

Sur les 4.500.000 ha de terres cultivables, 1.500.000 ha environ sont réservés à la céréaliculture.

Les emblavures pour la campagne 1978-79, estimées à 1.579.000 ha sont ventilées suivant la nature de la céréale comme indiqué dans le Tableau 1.

TABLEAU 1. Superficies emblavées en céréales, Campagne 78-79.

| Céréale | Région | | |
|------------|---------|---------|-----------|
| | Nord | Centre | Total |
| Blé dur | 622.334 | 181.851 | 804.185 |
| Blé tendre | 123.786 | 107.406 | 231.191 |
| Orge | 199.752 | 343.916 | 543.668 |
| Total | 945.872 | 633.173 | 1.579.045 |

Il est à préciser que les superficies réservées aux céréales dans les zones du Centre-Sud dépendent largement des conditions climatiques et varient donc d'une année à l'autre; en outre, leur contribution dans la production totale du pays reste relativement modeste (1.100.000 q sur 9.648.000 produits durant la campagne 1977-78). Aussi il ne sera question, dans ce qui suit, que du Nord du pays qui constitue la région productrice de céréales en quantités notables et relative-régulières. Des superficies emblavées en céréales dans le Nord (tableau 1) il ressort que le blé occupe 79% et l'orge 21%. Il est à signaler par ailleurs, la place importante réservée au blé dur par rapport aux autres céréales. Rien d'étonnant à cela, puisque le blé dur représente le produit de base de l'alimentation du tunisien, servant principalement à la fabrication du couscous (plat tunisien célèbre) et de diverses pâtes alimentaires.

B. Production et Rendement

La production céréalière totale pour la campagne 1977-78 s'élève à 9.648.000 dont 1.000.000 environ sont produits dans le centre et le sud du pays.

La production et les rendements obtenus dans le Nord pour chaque type de céréale sont montrés dans le Tableau 2.

TABLEAU 2. Production et rendement pour le Nord du pays (campagne 1977-78)

| Type de céréale | Superficie (ha) | Production (1000) | Rendement moyen (/ha) | Rendements moyens extrêmes (/ha) |
|--------------------------|-----------------|-------------------|-----------------------|----------------------------------|
| Blé dur à haut rendement | 292.520 | 3.633.559 | 12.4 | 3.9 - 18 |
| Blé dur ordinaire | 333.404 | 1.956.820 | 5.8 | 1.4 - 15 |
| Blé tendre à haut rend. | 67.818 | 920.660 | 13.5 | 4.0 - 20 |
| Blé tendre ordinaire | 44.339 | 381.701 | 8.6 | 2.4 - 16 |
| Orge | 190.630 | 1.446.034 | 7.5 | 1.7 - 16 |

Les rendements reportés représentent des moyennes générales. En fait les rendements varient, non seulement avec la variété, mais aussi avec la région et l'année. Les faibles rendements enregistrés durant la récolte 1977-78 sont dûs à un déficit hydrique au cours de la saison qui a surtout affecté les régions marginales du Nord.

III. Moyens et techniques de production

A. Variétés:

Un certain nombre de variétés céréalières obtenues par les chercheurs tunisiens sont à la disposition de l'agriculteur.

a - Blé dur:

Les variétés de blé dur les plus préférées sont dans l'ordre (tableau 3): INRAT 69, BADRI, Amal et MAGHREBI.

TABLEAU 3. Adoption des diverses variétés de blé par les agriculteurs utilisant des semences sélectionnées'

| Variétés | Pourcentage d'Adoption |
|----------------------|------------------------|
| Blés durs: | |
| INRAT 69 | 71 |
| BADRI | 15 |
| AMAL | 6 |
| MAGHREBI | 5 |
| CHILI | 2 |
| MAHMOUDI | 1 |
| Blés tendres: | |
| ARIANA 66 | 54 |
| DOUGGA | 21 |
| CARTHAGE | 13 |
| FLORENCE AURORE | 12 |

Un certain nombre de lignées en essais se sont montrées très prometteuses. La lignée BD 2100 notamment (une sélection "Stork") sera multipliée et mise à la disposition de l'agriculteur. Les rendements obtenus avec les meilleures variétés ont dépassé dans de bonnes conditions de culture et de pluviométrie 50 /ha en grande culture et 60 /ha dans les parcelles expérimentales. Les rendements moyens des 4 variétés les plus cultivées obtenus pour les trois dernières années à partir de micro-essais implantés en 3 différentes régions du Nord du pays sont montrés dans le tableau 4.

TABLEAU 4. Rendements (/ha) des 4 variétés de blé dur les plus cultivées en Tunisie. Moyennes de 3 années: 1976, 1977 et 1978

| VARIETE | STATION | | | |
|-----------|---------|-----------|------|---------|
| | Béjà | Bou Salem | Krib | Moyenne |
| INRAT 69 | 45.0 | 40.8 | 38.9 | 41.6 |
| BADRI | 35.8 | 38.5 | 37.3 | 37.2 |
| AMAL | 48.6 | 43.4 | 41.4 | 44.5 |
| MAGHREBI† | 55.2 | 46.1 | 36.6 | 46.0 |

Il est à noter que malgré les rendements plus élevés obtenus avec MAGHREBI et AMAL, les variétés INRAT 69 et BADRI sont plus demandées. L'agriculteur tunisien préfère des variétés plus hautes que MAGHREBI et AMAL. Par contre les agriculteurs, plus particulièrement ceux utilisant les semences sélectionnées, ont tendance à délaisser les variétés traditionnelles. Parmi celles-ci, ne restent cultivées à grande échelle que CHILI et MAHMOUDI.

b. Blé tendre:

Les variétés de blé tendre les plus cultivées sont dans l'ordre: Ariana 66, Florence-aurore, Dougga et Carthage. Cependant, les deux dernières variétés sont plus demandées que Florence-aurore par les agriculteurs utilisant les semences sélectionnées (tableau 3). La préférence du céréaliculteur pour la variété Ariana 66 s'expliquerait par son adaptation relativement large et plus particulièrement par sa résistance aux principales maladies existant en Tunisie.

Les rendements obtenus avec les meilleures variétés sont légèrement supérieurs à ceux des variétés de blé dur tant en grande culture que sur parcelles expérimentales. Cependant, dans certaines zones, les rendements des meilleurs blés durs sont équivalents à ceux des blés tendres.

Les rendements moyens obtenus en essais pour les 4 variétés de blé tendre les plus cultivées sont montrés dans le tableau 5.

TABLEAU 5. Rendements (/ha) des 4 variétés de blé tendre cultivées en Tunisie. Moyennes de 3 années: 1976, 1977 et 1978.

| VARIETE | STATION | | | |
|------------|---------|-----------|------|---------|
| | Béjà | Bou Salem | Krib | Moyenne |
| Ariana 66 | 50.6 | 39.5 | 38.7 | 42.9 |
| Dougga | 60.5 | 43.1 | 39.7 | 47.8 |
| Carthage | 55.4 | 42.8 | 40.3 | 46.2 |
| Fl. Aurore | 40.1 | 32.8 | 40.0 | 37.6 |

Le programme de recherche et amélioration a mis en évidence un certain nombre de lignées très prometteuses. Parmi celles-ci, les lignées BT2506, BT2525, et BT2532 ont donné des rendements supérieurs aux meilleures variétés de grande culture.

c. - Orge:

Les variétés d'orge de grande culture sont Martin, variété à 6 rangs cultivée essentiellement pour l'alimentation du bétail et humaine et Cérés, variété à 2 rangs cultivée principalement pour la brasserie.

L'orge est généralement cultivée dans des conditions de sol et d'humidité défavorables. Dans l'assolement elle suit en général une culture de blé ou de fourrage. Ces conditions de culture et le prix relativement faible (5, 5 D/q contre 7 D pour le blé tendre et 7, 6 D pour le blé dur) font que l'orge occupe une place secondaire dans la céréaliculture tunisienne.

Cependant des efforts de recherche sont déployés pour améliorer le niveau de production et la résistance aux conditions adverses de culture. Des introductions de variétés et de lignées avancées ont été testées sur plusieurs années et ont montré un potentiel de production relativement élevé.

B. Techniques culturales:

La culture de céréales est en général précédée dans l'assolement par une jachère en zones à faible pluviométrie et par une autre culture (légumineuse, betterave, vesce avoine, etc.) dans les zones à climat plus favorable. Un labour, plus ou moins profond selon la région, est généralement pratiqué en été et suivi de recroissements avant le semis. On recommande toujours aux agriculteurs de semer tôt: à partir du début novembre pour les variétés tardives jusqu'à mi-fin décembre pour les variétés, plus précoces. La densité normale de semis est de 100 kg/ha pour le blé et de 70 kg/ha pour l'orge.

C. Parasites des cultures

a. *maladies:*

Les principales maladies du blé en Tunisie sont les rouilles (principalement rouille noire et rouille jaune), la septoriose et l'oïdium. L'orge est surtout affecté par l'oïdium, l'helminthosporiose et la rhynchosporiose.

Cette année une attaque sévère de virus (Barley Yellow Dwarf) a été notée dans différentes régions sur orge, blé et avoine. Différents degrés d'attaque ont été notés sur différentes variétés.

La création de variétés résistantes est le meilleur moyen de lutte contre ces maladies et constitue en fait un des principaux objectifs dans notre programme d'amélioration des céréales.

b. *Mauvaises herbes:*

Les mauvaises herbes sont constituées essentiellement de graminées (folle avoine, rye-grass, phalaris) et de dicotylédones (Chrysanthème, faux fenouil). Ces mauvaises herbes ont toujours constitué une contrainte principale à la production. Des essais de désherbage ont montré une réduction de 3 /ha provoquée par une infestation de mauvaises herbes. L'incidence sur le rendement est d'autant plus nette que les conditions de pluviométrie sont moins favorables. L'utilisation adéquate de désherbants spécifiques ou polyvalents a permis de réduire l'effet des adventices et d'augmenter significativement les rendements.

Les cultures céréalières traitées aux divers herbicides couvrent une superficie de 150 -200.000 ha.

IV. Contraintes à la production:

Les contraintes à la production découlent de 2 types de problèmes; techniques et sociaux.

1. *Problèmes techniques.*

Parmi ces problèmes, il est à signaler le faible taux d'utilisation de semences sélectionnées: 22% pour le blé dur et 29% pour le blé tendre. Ce problème est surtout aggravé par le fait que le céréaliculteur n'utilisant pas les semences sélectionnées est celui qui cultive généralement les variétés traditionnelles à faible rendement.

Malgré les efforts déployés (crédit, subventions, vulgarisation) le taux d'utilisation de désherbants chimiques reste encore faible (30%).

Par contre, des progrès sensibles ont été réalisés dans les domaines d'utilisation d'engrais.

Les travaux de préparation de sol et de semis ne sont pas toujours exécutés à temps. Le retard est quelquefois dû aux conditions climatiques mais le plus souvent à la négligence ou à un faux raisonnement de l'agriculteur. Le niveau intellectuel de l'agriculteur (et plus particulièrement le "petit" et le "moyen" agriculteur) étant faible, un travail de vulgarisation efficace et continu est primordial.

2. *Problèmes sociaux:*

Malgré les encouragements prodigués, une partie des céréaliculteurs garde encore un esprit conservateur, ne voulant accepter d'investissement (en semences, herbicides ou engrais) que très difficilement.

Ce problème est surtout accentué par le fait qu'un grand nombre d'agriculteurs (64,2%) ont des champs ne dépassant pas les 5 ha. Pour ces agriculteurs se posent encore d'une façon plus ardue les problèmes d'assolement et de mécanisation.

V. Encouragement à la production

A. Recherche et Vulgarisation

Des efforts énormes sont déployés par le Ministère de l'Agriculture pour promouvoir les secteurs de recherche et vulgarisation.

Divers services dépendant de la DERV (INRAT, INAT, ESGCK) et de l'Office des céréales; (Division technique) contribuent ensemble à l'amélioration du niveau de production national, l'objectif de la recherche étant d'assurer l'augmentation du rendement et la stabilité de production.

Les acquis de la recherche sont divulgués aux céréaliculteurs par les services de vulgarisation de la DERV et de l'Office des céréales.

Les moyens mis en oeuvre tant du point de vue humain que matériel sont importants.

Outre les documents de vulgarisation qui sont distribués gratuitement, l'information est transmise aux céréaliculteurs par la radio, la télévision et le contact direct. Des journées d'information (tenues 2-3 fois/an) sont organisées en vue de sensibiliser le céréaliculteur et le convaincre à adopter les techniques adéquates de production.

B. Crédits et Subventions

Afin d'améliorer la production, le gouvernement accorde une assistance financière et technique aux céréaliculteurs.

La création récente au sein du Ministère de l'Agriculture de la Direction d'assistance aux petits et moyens agriculteurs témoigne de la volonté des responsables à aider efficacement ces agriculteurs.

L'assistance financière se fait sous forme de crédits et de subventions. La politique d'octroi de crédits améliore de plus en plus afin de toucher toutes les catégories d'agriculteurs. Diverses mesures ont été prises en ce sens telles que la décentralisation d'examen du dossier, l'instauration du crédit supervisé, et l'abaissement de la superficie minimale exigée pour l'octroi d'un crédit bancaire.

Parmi les nombreuses institutions contribuant au développement du crédit agricole il est à citer: la Banque Nationale de Tunisie, les Caisses locales de Crédit Mutuel, les Offices, et diverses agences relevant du Ministère de l'Agriculture.

La structure du crédit agricole a été renforcée par la création des Sociétés de Caution Mutuelle appelées à servir d'intermédiaires entre les organismes prêteurs et les "petits" exploitants qui ne peuvent autrement accéder au crédit bancaire. Il est à signaler, néanmoins, que le pourcentage de crédits remboursés reste très faible, l'agriculteur ayant tendance à confondre entre les deux formes d'assistance: crédit et don.

L'aide apportée aux agriculteurs concerne également la fourniture de semences sélectionnées d'engrais et de désherbants à des prix subventionnés (l'ammonitrate est vendu aux agriculteurs au prix coûtant, et certains désherbants sont subventionnés à concurrence de 50% du prix). Cette aide s'étend également à l'utilisation de machines agricoles (possibilité d'achat à crédit, dégrèvement de carburant).

Résumé

Durant la campagne 1977-78, la production céréalière tunisienne a été de 9.648.000 quintaux pour 1.500.000 hectares emblavés. Les terres céréalières sont réparties sur 2 grandes régions caractérisées par leurs bioclimats: le Nord, à pluviométrie supérieure à 500 mm, où le blé occupe 79% des surfaces emblavées et le Centre, à pluviométrie comprise entre 200 et 500 mm où l'orge occupe 55% des surfaces emblavées.

De nombreuses variétés obtenues par les chercheurs tunisiens sont à la disposition des agriculteurs; on peut citer pour le blé dur INRAT 69, MAGHREBI, BADRI; pour le blé tendre ARIANA 66, DOUGGA, CARTHAGE et pour l'orge MARTIN, CERES. De plus, les programmes de recherches ont mis en évidence un certain nombre de lignées très prometteuses telles que la lignée BD 2100 pour le blé dur et les lignées BT 2506, BT 2525, BT 2532 pour le blé tendre.

Les techniques culturales, le désherbage (pour la folle-avoine, rye-grass et phalaris) et les maladies (rouilles, septariose et oïdium) sont les facteurs limitants la production céréalière. A ceux-ci viennent s'ajouter des facteurs sociaux tels que la faible superficie des exploitations (moins de 5 ha) et l'esprit conservateur des agriculteurs.

Malgré des gros efforts (crédit, subventions, vulgarisation) le taux d'utilisation des désherbants chimiques reste faible (30%) ainsi que celui des semences sélectionnées (22% pour le blé dur et 29% pour le blé tendre). Actuellement, le gouvernement accorde une assistance technique et financière aux agriculteurs sous forme de crédits, de subventions, de dégrèvements, de prix subventionnés et sous forme de documents de vulgarisation et

d'informations par les masses médias.

Par ces moyens, couplés avec l'intensification des recherches sur les céréales, le gouvernement espère encourager le rendement et la stabilité de la production céréalière.

CONSTRAINTS TO CEREAL PRODUCTION AND POSSIBLE SOLUTIONS IN TUNISIA

Summary

During the 1977-78 season, cereal production in Tunisia was 965,000 tonnes harvested from 1.5 million hectares. The cereal growing area is divided into two main regions on the basis of climate. In the north, where rainfall is generally above 500 mm, wheat is the principal cereal, occupying 78 percent of the cereal area. The central region is drier (200-500 mm rainfall) and barley is the chief cereal, planted on 55 percent of the area.

Numerous varieties have been released in Tunisia by the national cereal research scientists. Notable wheat varieties include Inrat 69, Maghrebi, and Badri (durums), and Ariana 66, Dougga and Carthage (bread wheats). The two leading barley varieties are Martin and Ceres. The breeding program continues to develop and test promising new lines, among which the durum BD 2100 and bread wheats BT 2506, BT 2525 and B2523 appear as outstanding.

Cultural practices, weed control (especially wild oats, rye grass and *Phalaris* spp.) and plant disease (rusts, *Septoria* spp, and powdery mildew) are the main factors limiting production. Additionally, the small size of most holdings (less than 5 ha) and a generally conservative attitude on the part of many farmers sometimes do not encourage adoption of new cultural methods. The use of herbicides remains low (30 percent of the cereal area is treated), as does the use of certified seed. (Currently, only 22 percent of the durum and 29 percent of the bread wheat are planted using certified seed.) Subsidies and credits have been applied to seed and herbicides and it is hoped that this will help to increase their use by farmers. Increased extension efforts will rely both on printed materials and on use of the mass media.

By these means, coupled with an enlarged research program, the Tunisian government hopes to increase the overall yield and stability of cereal production.

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CONSTRAINTS TO CEREAL PRODUCTION AND POSSIBLE SOLUTIONS IN TURKEY

Mengü Güler*

Background:

Cereals have always been the most important crop in Turkey, with regard to area as well as production. Approximately 46 percent of the cultivated area of the country is occupied by cereals.

There was a great increase in cereal production area until the mid 1960s. However, the central production area has come to its limit in size. The additional area came from grasslands, pastures and other crop areas, some on higher elevations with steep slopes. The policy during this period was to add area in order to increase the production. However, it quickly became clear to policy makers that increasing the cereal production area was not the solution for the problem. Wheat was still imported every year during this period.

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By the late 1960s, an intensive wheat production program was initiated. This program concentrated on intensive research, extension, supply of inputs to the wheat growing area, marketing, etc.

After successful application of this wheat production project for 10 years, Turkey is now a wheat exporting country even though the population increase is three percent.

Cereal area, production, and yield for the period 1941-1977 are presented in Table 1.

The current five year plan (1979-83) calls for a reduction of 10 percent in the area devoted to cereals.

TABLE 1. Wheat production area, production and yields

| Years | Area (1000 ha) | Production (1000 tonnes) | Yields (kg/ha) |
|---------|-------------------|-----------------------------|-------------------|
| 1941-45 | 3900 | 3200 | 839 |
| 1946-50 | 4200 | 3600 | 861 |
| 1951-55 | 6000 | 6400 | 1071 |
| 1956-60 | 7400 | 7900 | 1063 |
| 1961-65 | 7800 | 8400 | 1079 |
| 1966-70 | 8400 | 9900 | 1197 |
| 1971-75 | 8700 | 10500 | 1200 |
| 1976 | 9500 | 14985 | 1577 |
| 1977 | 9450 | 16370 | 1732 |

Wheat is important as the main food for the whole country but it is also the main source of income for most of the farmers, who have no or very little choice to grow anything but cereals. It is essential that the yield per unit area continues to be increased in order to improve their living conditions.

It is possible to consider the cereal growing areas of Turkey in three categories:

1. *Areas where wheat-fallow rotation is being practiced.* They are the areas located in higher parts of Turkey, in which the amount and the distribution of rain is not sufficient for annual cropping. Each year cereals are sown to 7.8 million hectares in this zone with an average production of 10.74 million tonnes.

2. *Areas where annual cropping is practiced.* Those areas are located in the coastal region and Thrace. 3.4 millions hectares of production area is in that zone with a production of 10.18 million tonnes.

3. *The cereal growing areas under irrigation in dryland areas.* 1.25 million hectares of cereal producing area is in that zone with a production average of 0.85 million tonnes.

Wheat and barley are seeded in early October in the wheat-fallow areas and in November in the annual cropped areas. A very small percentage of the farmers seed up to March under annual cropping conditions.

Cereal research:

The National Cereals Research Project, which is a part of the intensive cereal production program was initiated in 1969 by the Ministry of Agriculture. The main concept of the project was the development of a multi-disciplinary, cooperative and countrywide research system to provide improved, high yielding, disease resistant varieties with good quality plus development of a series of cultural practices leading to a stabilized annual production by the farmers.

The variety improvement activities are being carried out in eleven research institutes located in different parts of Turkey. The varieties of wheat and barley grown in Turkey are listed in Table 2. The main wheat diseases of the country are listed in Table 3. Studies on increasing the quality of the breeding material are being done in two seed technology laboratories in Ankara and Istanbul.

Two-thirds of the cereal production area is in the cereal-fallow zone. The problems of cereal growing in this area are much more complex than in the annual cropped or irrigated zones. For this reason the National Cereals Research Project has initially concentrated the agronomic research activities in cereal-fallow areas.

TABLE 2. Current varieties of wheat and barley grown in Turkey

| Variety | Type | Growth habit | Growing regions |
|------------------|---------|--------------|---|
| Wheat | | | |
| Ankara-093/44 | Bread | Facult | Central Anat., transitional zones |
| Kirac-66 | " | Winter | Central Anatolia |
| Yektay-406 | " | Facult. | Central Anat., transitional zones |
| Bolal-2973 | " | " | Central Anatolia |
| Bezostaya | " | Winter | Central Anat., Kpnace, open winter areas |
| Lanser | " | " | Eastern Anatolia |
| Etoile de Choisy | " | " | Thrace |
| Porsuk-2800 | " | " | Central Anatolia (irrigated) |
| Kunduru-1149 | Durum | Facult. | Central Anat., western transitional zones |
| Berkman-469 | " | " | Central Anatolia |
| Penjamo-62 | Bread | Spring | Coastal areas |
| Libellula | " | " | Marmara region |
| Conte Marzotto | " | " | Coastal areas |
| Orse | " | " | " " |
| Cumhuriyet-75 | " | " | Coastal areas |
| Sakarya-75 | " | " | Coastal areas |
| Dicle-75 | Durum | " | South east Anatolia |
| Gediz-75 | " | " | South coasts and Aegean areas |
| Barley | | | |
| Tokak 157/37 | Two-row | Facult. | Central Anatolia, all winter areas |
| Cumhuriyet-50 | " | " | Western transitional zones |
| Zafer-160 | Six-row | Spring | Marmara region |
| Yercil-147 | Two-row | " | Western transitional zones for spring |
| Gem | Six-row | " | Coastal areas |
| Kaya | Two-row | " | Coastal areas |

There is at least one cereal extension person in each city of the country. In each county there are agricultural engineers and technicians who are responsible for all agricultural activities. In addition to extension activities the extension organization also provides a connection between the farmers and other organizations for the supply of the inputs. The relationship between research and extension organization is not at the desired level so far. The two above mentioned organizations are working on strengthening the dialogue to serve the farmer better.

Cereal farmers

It is possible to say that the farmers of the country are generally receptive. The increased usage of herbicides, tractors, drills, high yielding cultivars, etc., in recent years are examples of this receptiveness.

The farmers in annual cropped or irrigated areas plow their fields in October or November. Most of these farmers apply fertilizer at the proper time and dosage. The use of a seed drill is sometimes (depending on the previous crop) very difficult. In this case, farmers use fertilizer application equipment or broadcast method for seeding. Weed control is extensively practiced in these areas.

The land preparation and crop management practices of the farmers in the cereal-fallow areas show great variability. The offset disc, moldboard plow and sweep are being used as spring tillage implements. Fall tillage and stubble burning are not being practiced by most of the farmers. Depth and time of tillage is still not taken into consideration by some farmers. Drills are used by most of the farmers. Some of the farmers use very high rates of seeding (20-25 sometimes 30 kg/0.1 ha). This is because of the improper seedbed

preparation. Fertilizer usage is extensive in Central Anatolia. However, the average yields from the farmers' fields are much lower than that of experiment stations. The average yields in different zones are shown in Table 4.

TABLE 3. The main wheat diseases of Turkey

| Disease | Region |
|----------------|--------------------------------------|
| Stripe rust | In all the wheat growing areas |
| Stem rust | Transitional zones |
| Leaf rust | Trace, Central Anatolia, the Marmara |
| Common bunt | Central, Southern, Eastern Anatolia |
| Loose smut | In all the wheat growing areas |
| Septoria | Coastal |
| Powdery mildew | The Marmara |
| Root diseases | Trace, transitional |
| Snow mold | Eastern Anatolia |
| Virus diseases | Transitional |

A very extensive agronomy research program is being carried out in the Central and Southeastern Anatolia. The basic research in these regions can be classified in three sections:

(1) Research on land preparation including tillage implements, depth of spring tillage, depth of summer tillage and time of spring tillage. Evaluations are being made on yield, soil moisture content, soil temperature, infiltration rate and weed density.

(2) Crop management research includes nitrogen rate and seeding rate, nitrogen-water relationships, foliar application of nitrogen, application time and rate of 2,4-D studies on the control and bioecology of *Bromus tectorum* L., experiments on composites with eight wheat cultivars etc. The evaluations are being made on yield, yield components and quality characteristics of wheat.

(3) Research aimed to use the fallow lands for annual cropping are being established in transitional areas of the region in which the amount of rainfall varies from 400 - 600 mm in a very short distance.

The Cereal Research Project now has 59 research staff located at 11 research institutes. The number of the research personnel under different disciplines is as follows:

| | |
|-----------|----|
| Breeding | 33 |
| Pathology | 7 |
| Quality | 10 |
| Agronomy | 10 |

TABLE 4. Average Yields (kg/0.1 ha)

| Cereals | Experiment Stations | Fallow-crop Areas | | Zone Average |
|-----------------------------|---------------------|-------------------|-------------------|--------------|
| | | Progressive Farms | Traditional Farms | |
| Bread wheat | 300 | 200 | 110 | 127 |
| Durum | 275 | 175 | 100 | 113 |
| Barley | 325 | 240 | 120 | 184 |
| Annual Cropping Area | | | | |
| Bread wheat | 500 | 300-450 | 200-280 | 284 |
| Durum | 500 | 280-400 | 200-270 | 300 |
| Barley | 450 | 300-450 | 200-300 | 250 |

Since there is still a great difference between the yield averages of experiment stations and farmer fields, it can be concluded that in the coming years the increase in the cereal production of the country will be continued. However, sufficient dialogue among research, extension organizations and the farmers needs to be increased.

Most of the farms in the country are small and traditionally managed. Large progressive farms are mostly in the coastal regions. These large farms occupy a very small percentage of the cereal production areas of the country. On the small farms, the availability of equipment is not a great problem. The majority of these farmers have their own equipment and tractor or they rent these. The fertilizer price is subsidized by the government and usually distributed to the farmers at the proper time. Ten percent of seed is produced by the state farms. The remaining seed requirements are met by contracted farmers under the control of the government.

Herbicide application by airplanes is gradually increasing each year. In the fallow areas, this application had been achieved by having the fallow areas on one side of the village and the crop areas on the other. Herbicides are usually available to the farmers at the proper time.

In order to increase the technology of the farmers, the government has increased its capacity to give more credit to a large number of farmers. Cereal farmers can easily sell their products to the governmental agencies which are distributed throughout the country. Due to the geographical differences of the cereal growing areas, the harvest time varies from May, in coastal areas, to August for the interior of the country. A system has been organized where the same harvesters can be utilized all around the country. The harvesters begin harvesting in the coastal regions in May and they continue harvesting till August by travelling to the higher parts of the country.

As a result of the cooperative work among the General Directorate of Agricultural Research, Agricultural Affairs (extension), State Farms, Soil Products Office and other related organizations, wheat production and export has shown a great increase during the near past.

The amount of wheat targeted for export in 1983 is 3 million tonnes.

The cereal research program also plans to work on the agronomic problems of annual cropping area. As a result of ten years successful breeding, pathology and quality research, many improved cultivars will occupy the cereal production areas in a very near future.

Summary

In Turkey the area of cereal production has reached its full size occupying about 4 percent of the cultivated land. In spite of an annual population increase of 3 percent, Turkey produces surplus wheat which is exported. Within the country, wheat is the principal staple food, as well as the most important source of income for most farmers. Approximately two-thirds of the wheat growing areas is cropped under wheat-fallow rotations, the remainder being made up of annually cropped areas in higher rainfall regions, or irrigated fields in dryland zones.

The National Cereals Research Project was initiated in 1969 as a country-wide coordinated research program aimed at producing improved varieties and developing a series of favorable cultural practices. An important component of the breeding program is working to develop disease resistant varieties. The problems related to cereal production are most complex in the wheat-fallow production zones and therefore, most of the agronomic research has concentrated on these areas. In addition to the research component, there is a large network of extension personnel located throughout the cereal growing areas of Turkey.

In general, cereal farmers in Turkey have proven to be receptive to the introduction of new practices and varieties. Land preparation and crop management practices show a high degree of variability. Seed drills are used by most farmers, but because of poor seedbed preparation, high seeding rates are used. Fertilizer is used by most farmers. However,

there is a large gap between farm yields and experiment station yields. This gap indicates that yield improvements can still be made, and that there is a definite need for improved communication among farmers, researchers and extension personnel.

High quality seed, fertilizers and herbicides are generally available to the farmer at the proper time. Most farmers do own or rent tractors and implements. Because harvest ranges from May until August in different parts of the country, a system of mobilized harvester use, beginning on the coast and working inland, has been initiated.

CONSTRAINTS TO CEREAL PRODUCTION AND POSSIBLE SOLUTIONS IN SPAIN

J. Salazar*

I.

Spain, being a very hilly country, has an arable area of 20.66 million ha; which is about 40 percent of the whole surface. There are hardly any areas with a rainfall under 350 mm and almost no cereals are grown in them. The following facts belong to year 1976:

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Since there is still a great difference between the yield averages of experiment stations and farmer fields, it can be concluded that in the coming years the increase in the cereal production of the country will be continued. However, sufficient dialogue among research, extension organizations and the farmers needs to be increased.

Most of the farms in the country are small and traditionally managed. Large progressive farms are mostly in the coastal regions. These large farms occupy a very small percentage of the cereal production areas of the country. On the small farms, the availability of equipment is not a great problem. The majority of these farmers have their own equipment and tractor or they rent these. The fertilizer price is subsidized by the government and usually distributed to the farmers at the proper time. Ten percent of seed is produced by the state farms. The remaining seed requirements are met by contracted farmers under the control of the government.

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The cereal research program also plans to work on the agronomic problems of annual cropping area. As a result of ten years successful breeding, pathology and quality research, many improved cultivars will occupy the cereal production areas in a very near future.

Summary

In Turkey the area of cereal production has reached its full size occupying about 4 percent of the cultivated land. In spite of an annual population increase of 3 percent, Turkey produces surplus wheat which is exported. Within the country, wheat is the principal staple food, as well as the most important source of income for most farmers. Approximately two-thirds of the wheat growing areas is cropped under wheat-fallow rotations, the remainder being made up of annually cropped areas in higher rainfall regions, or irrigated fields in dryland zones.

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1. **Areas**

| | 350 mm (000 ha) | Irrigated (000 ha) |
|-------------|--------------------|-----------------------|
| Bread wheat | 2.581 | 191 |
| Durum wheat | 97 | 7 |
| Barley | 3.004 | 235 |

2. **Production**

| | 350 mm (000 t) | Irrigated (000 t) |
|-------------|-------------------|----------------------|
| Bread wheat | 4.307 | 491 |
| Durum wheat | 128 | 14 |
| Barley | 4.806 | 647 |

3. **Yield**

| | 350 mm (t/ha) | Irrigated (t/ha) |
|-------------|------------------|---------------------|
| Bread wheat | 1.668 | 2.575 |
| Durum wheat | 1.319 | 2.000 |
| Barley | 1.599 | 2.753 |

Yields have recently risen. In the past crop, yields in the west part of Andalucia have risen to 5800-6000 kg/ha, mainly due to the newer varieties Anza, Yecora, Cajeme 71, without irrigation.

4. **Promising varieties in different regions.**

Ebro Region

Bread wheat: "Anza", "Aragon 03".

Durum wheat: "Abadía".

Barley: "Albacete", "Alpha", "Hop", "Secal 1", "Tina", "Zaphir".

Duero Region

Bread wheat: "Alcazar", "Almirante", "Bastión", "Boulmiche", "Talento".

Durum wheat: "Abadía", "Cocorit".

Barley: "Egea", "Ribera".

Central Region

Bread wheat: "Bastión", "Castan", "Mahisa 13", "Boulmiche", "Partizanka".

Durum wheat: "Abadía", "Cocorit".

Barley: "Abel", "Albacete", "Alpha", "Précoce de peuple".

Andalucía

Bread wheat: "Anza", "Cajeme 71", "Castan", "Yécora".

Durum wheat: "Crane", "Cocorit", "Mexicali".

Barley: "Abacus", "Bolare", "Hassan", "Georgia", "Logra".

Extremadura

The same varieties of Andalucía and also the bread wheat "Marca" and the durum wheat "Esquilache".

5. **The most important diseases are:**

Wheat: *Puccinia striiformis*, *P. recondita*, *P. graminis*, *Erysiphe graminis*, *Septoria tritici* and *S. nodorum*, *Heterodera major*.

Barley: *Erysiphe graminis*, *Rhynchosporium secalis*, *Helminthosporium gramineum*, *H. sativum* and *H. theres*, *Heterodera major*.

6. The most important pests are:
 Wheat: Several Aphids, *Mayethiola* sp., *Aelia* sp., *Eurygaster* sp., *Oulemma* sp., *Cephus* sp., *Tipula* sp.
 Barley: *Cephus pygmaeus*, *Oscinella trit.*
7. Normal sowing and harvest time
 Dates of sowing time: 15 November to 1 February in dry lands.
 1 February in irrigated soils.
 Dates of harvest time: 20 May (S.E.) and 15 August (N.)
8. Percent of area sown in rainfall areas are:
 93 percent of wheat and 97 percent of barley.

II. DATA FROM EXPERIMENTAL STATIONS AND FARMER YIELDS

A. Agricultural practices carried out on experimental fields and research stations.

As a rule, research on agricultural practices is not very developed in our country.

1. A program on minimal tillage by use of direct sowing is starting in the INIA. So far, no reliable experimental data are available to provide information to farmers.

INIA, private firms and Administration services run trials on rates of fertilizing, planting, herbicides and pesticides.

Some trials have been conducted by sowing variety mixtures to achieve highest yields.

2. Some information can be obtained from INIA Annual Reports and from several private agricultural reviews.

3. For 3 years now, SEA (agricultural extension service) and "Dirección General de la Producción Agraria", have been publishing the results of the "Redes Regionales" (Regional Networks) of yield trials with environmental observations and other. The results reach the farmers through the extension service man.

B. Farmers

With the fallow system 3-4 land preparation tillages precede sowing, the last one taking place at planting time. In continuous cultivation one pass less is given (2-3). Fertilizer is applied 2-3 times; first time before sowing and a second and third time with nitrogen during the growing season.

Generally, fertilizer is applied by centrifugal spreaders. The use of liquid fertilizers is less frequent and that of localizing machines is rare.

About 95 percent of the extension is drilled by sowing machine. Broadcasting sowing machines are rare and aerial sowing is still rarer.

Progressive farmers use chemical control of broadleaf weeds and 30 percent of those who are undeveloped, do so. For about three years now, chemical control of grasses is also widespread.

Farm yields maxima and average (Kg/ha).

| | 350 mm rain | | Irrigated | |
|-------------|-------------|-------|-----------|-------|
| Bread wheat | 6,000 | 1,700 | 8,000 | 3,000 |
| Durum wheat | 4,000 | 1,400 | 6,000 | 2,500 |
| Barley | 5,500 | 2,500 | 7,000 | 3,200 |

C. Difficulties confronting farmers

1. Equipment and machinery for land preparation and costs.

Usually the farmer has enough and sometimes an excess of horse power/ha but has not the proper implements. He frequently has no reserve capital available.

Price for length unit of the implements used is:

| Type of implement | Cost of 1 lineal meter | |
|---------------------|------------------------|--------|
| | Pts. | \$ USA |
| Subsole plough | 60.000 | 857 |
| Moldboard plough | 40.000 | 571 |
| Harrow | 18.000 | 257 |
| Rotovator | 40.000 | 571 |
| Fertilizing machine | 6.000 | 85 |
| Sowing machine | 50.000 | 714 |
| Sprayer | 6.000 | 86 |
| Combine | 900.000 | 12,857 |

As we can see, these prices are very high.

Additional data: 1 HP of tractor amounts to Pts. 13000 (\$191) and 1 m² of barn costs Pts. 8.000 (\$117).

2. As regards fertilization in very dry land where fallow is used, the farmer provides 50 percent of the necessary amount of nitrogen and the rest is provided by nitrogen fixation, nitrification and by air N drawn by rain.

Costs are as follows:

1 kg N Pts. 40 (\$0.58); 1 kg P₂O₅ Pts. 33 (\$0.48); 1 kg K₂O Pts. 16 (\$0.23). Compound, complex and liquid fertilizers are cheaper.

3. Seed supplies and prices

Drilling by machine at an average rate of 180 kg/ha is used in dryland with rains, 350mm, and 200 kg/ha under irrigation.

When sowing by hand, the rates reach 220 kg/ha and 240 kg/ha respectively. Seed prices may range between 23-25 pts./kg (\$0.33-0.36) for breadwheat, 25-28 pts./kg (\$0.36-0.41) for durum wheat and 20-24 pts./kg (\$0.29-0.35) for barley.

4. Herbicide supplies and prices

For broadleaf weeds 2,4-D amine is used at a rate of one litre/ha which costs 500 pt. (\$7.35). The treatment of one ha amounting to pts. 700 (\$10.3). Aerial treatments are economically worthwhile from 200 ha on, but it is sometimes difficult to have them applied at the right time.

For grass weeds, Dicloropropano (Dicuran) is used. It costs 1.000 pts./litre (\$14.7) at the rate of 2 litre/ha. Trialates cost 900 pts./kg (\$13.23) and are used at the rate of 1.5 kg/ha.

5. Labor supply and prices

Main tillage is done with 70-80 HP tractors and the cost amounts to 800 pts/per hour (\$11.76).

Secondary tillage is done with 50-70 HP tractors and it costs 700 pts/per hour (\$10.29). Harvesting is performed with a 14 foot (4.20 m) harvester, and it amounts to 1,300 pts/per hour (\$19.11). Pesticide treatments cost 400 pts/per hour (\$5.8).

6. Difficulties

After sowing, formation of crust is very usual and causes difficulty in emergence. It is sometimes necessary to break the crust by means of ploughing or irrigation.

In the Duero and center areas some late frosts are common until the beginning of May.

The dew is a major problem for harvesting since it delays the time to use the combine. The harvest is dried from 10-11 a.m. until 11-12 p.m. There is a shortage of qualified workmen to do this job.

7. Post harvest problems

The government is capable of storing the whole harvest in an average year, and the farmers can store sixty percent, which is going to be used for their own requirements. There are usually storage problems in those years of above average harvest.

D. Production

1. Normal yields and prices for wheat

The usual harvest for the country is: 1.400 kg/ha for durum wheat and 1.700 kg/ha for bread wheat. The average price is 15-17 pts./kg (\$0.22-0.25) for the former and 14-20 pts./kg (\$0.20-0.29) for the latter. The price for the seeds is 23-25 pts. (\$0.33-0.36) for bread wheat and 25-28 pts. (\$0.36-0.41) for durum wheat.

2. Yield and price of straw

Straw means around 1.3 of the total harvested grain in wheat and 1.1 in barley. The packing is made by contract with a cost of nearly 7 to 8 packs for each one.

The sale price of 1 kg straw ranges between 0.5 and 0.6 pts.

E. Other constraints.

Since three years ago, the SEA (National Advisory Service) has kept a complete network of yield trials with commercial varieties of both wheat and barley. In spite of this, usually the farmer has doubts about which varieties to sow.

Another fact which affects the yield is the great change of the climatical conditions from one year to another. It is almost impossible to predict the appearance of rain and it is difficult as well to know the consequence of applying more or less fertilizers.

III. MANPOWER

Manpower available for:

1. Research in bread wheat, durum and barley: 50 BSc, 31 MSc and 16 PhD.
2. Research in breeding, agronomy, pathology and others: 31 BSc, 22 MSc and 15 PhD.
3. Extension personnel: 300 BSc, 300 MSc and 50 PhD.
4. Others: 20 BSc, 10 MSc and 4 PhD.

IV. FACILITIES

The government and other parts of the establishment have a wide law about loans and grants in order to protect agriculture and also they have technical advice. Its spectrum is wide but not complete. Private banks work together with the government in such loans and grants. The SEA (Agricultural Advisory Service) has more than 700 agencies spread all over the country to give technical assistance to farmers.

The concentration of demonstration plots has been done in about 50 percent of the villages of the whole country and it has raised the production between 20 and 30 percent.

V. FUTURE PLANS FOR INCREASING CEREAL PRODUCTION

The aims to achieve are the following:

1. To increase the importance of plant breeding;
2. To promote an improvement of the cultural techniques such as: sowing rate, fertilization, irrigation, pest and disease control;
3. To enlarge the microtrials network within the plant breeding programs prior to the macrotrials;
4. To make possible the elaboration of the recommended varieties list as soon as possible and to increase the spreading of the new varieties among the farmers.

Summary

The principal winter cereals in Spain are bread wheat and barley. More than 90 percent of the crop is rainfed. Yields of non-irrigated bread wheat and barley in 1976 were 1668 kg/ha and 2575 kg/ha respectively. Many varieties are grown in Spain, as there are wide variations in agro-climatic conditions. The principal wheat diseases include rusts, powdery mildew and *Septoria* spp. In barley, powdery mildew, scald and *Helminthosporium* spp. are important. Nematodes cause damage to both crops. In addition several insect pests attack the crop occasionally.

There are several difficulties confronting the Spanish farmer. Although he may have a tractor, he may not own the proper cultivation tools. Seeding is not generally a problem; the crop is 95 percent seed drilled and certified seed is available. Although many farmers use chemical weed control, there are still large numbers who do not. Broadleaf weed control is more general, but grassy species are sometimes also controlled. Other problems encountered include crust formation after seeding, frosts and dew at harvest which delay combining. Postharvest storage problems occur in years when the harvest is exceptionally good; otherwise there are few losses.

Future plans to increase cereal production include the following steps: as improved cultural practices are identified, the extension service will make greater efforts to promote their adoption by farmers. Another important function will be a more concerted effort to provide farmers with information about new varieties, and promote their acceptance.

CONTRAINTES LIMITANT LA CERÉALICULTURE EN ESPAGNE ET LES DIFFÉRENTES SOLUTIONS POSSIBLES

Résumé

Le blé tendre et l'orge sont les deux céréales d'hiver importantes cultivées en Espagne et 90% des cultures sont faites sans irrigation. En 1976, les rendements étaient de 1668 kg/ha pour le blé tendre et de 2575 kg/ha pour l'orge. De nombreuses variétés sont cultivées en Espagne du fait des différentes zones agro-climatiques. Les principales maladies affectant le blé sont les rouilles, l'oïdium et la septariose; pour l'orge ce sont l'oïdium, l'helminthosporiose et la rhynchosporiose. Les nématodes entraînent des dégâts pour les deux plantes et en outre plusieurs insectes attaquent occasionnellement les plantes.

De nombreuses difficultés font face aux céréaliculteurs; ainsi, il existe des tracteurs mais pas toujours des accessoires et tous les agriculteurs n'utilisent pas les hésherbants chimiques. Par contre, la fourniture de semences sélectionnées ne pose aucun problème et la majorité des semis se font au semoir mécanique. La formation d'une croûte après semis, les gélées, et rosées lors de la moisson sont des problèmes que rencontrent de même les agriculteurs. Il existe de même des problèmes de stockage des récoltes qui peuvent entraîner des pertes postmoisson (surtout lors de bonnes récoltes).

Les projets futurs d'amélioration de la production incluent les étapes suivantes: identification des techniques culturales améliorées, puis vulgarisation de ces techniques en niveau des agriculteurs par les services de vulgarisation; de plus, de l'information des fermiers est une visée importante et cela devra permettre une plus facile acception par ces derniers des variétés améliorées.

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CONSTRAINTS TO CEREAL PRODUCTION AND POSSIBLE SOLUTIONS IN IRAQ

Yousif A. Hermis and Sabah A.A. Hussain*

Area and Production

Iraq is situated between 29° - 37° latitude N and 39° - 48° longitude E with a rainfall varying from 50 mm in the south western deserts to about 1000 mm in the northern hills, and is received from November to April. The summer is hot and dry. The climatic conditions range from arid to semi-arid. The absolute minimum and maximum temperatures range

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from 11° C to 50° C. Frost is received in the winter in the plains and there are spells of snowfall in the northern area.

Of the total area of 44 million hectares, 12 million are arable. About 3.5 million hectares are annually cropped. Cereals occupy about 80 percent of the cropped area in which wheat and barley account for about 95 percent of area and production. About 70 percent wheat and 47 percent of barley areas fall in the rainfed zones. Both bread and durum wheat species are grown; durum occupies 10-12 percent of area in the north. In the case of barley, both 6-rowed and 2-rowed varieties are cultivated.

The wheat and barley areas and production for the last 7 years are given in Table 1 below:

TABLE 1. Wheat and barley areas, production and average yields, 1971-72 to 1977-78.

| Year | Area (ha.) | | Production (Ton) | | Average (kg/ha.) | |
|---------|---------------|-------------|---------------------|-------------|---------------------|-------------|
| | Wheat 2 | Barley 3 | Wheat 4 | Barley 5 | Wheat 6 | Barley 7 |
| 1971-72 | 1914600 | 725550 | 2625300 | 979600 | 1372 | 1352 |
| 1972-73 | 1156100 | 464100 | 956788 | 461800 | 828 | 996 |
| 1973-74 | 1655975 | 546225 | 1338900 | 532800 | 808 | 976 |
| 1974-75 | 1447750 | 598225 | 845400 | 437000 | 584 | 732 |
| 1975-76 | 1517600 | 599825 | 1302400 | 579300 | 860 | 964 |
| 1976-77 | 1343775 | 755000 | 695700 | 457700 | 516 | 608 |
| 1977-78 | 1590250 | 775450 | 909800 | 617200 | 572 | 796 |

It is obvious from Table 1 that there is yearly fluctuation in the area planted to the two crops, their total yield as well as the average yields per hectare. This is mainly due to the rains, whether received timely at sowing or otherwise, as well as the total amount of rain and its distribution in the growing season. As most of the wheat area (70 percent) is rainfed, compared to barley (47 percent), so the total production as well as the average yield per ha. of wheat is more variable from year to year. The high yielding varieties of wheat occupy the major area in the irrigated (92 percent) and high rainfall area (75 percent). In case of barley, the high yielding varieties are grown over one third of the total barley area in this country.

The main commercial varieties in cultivation are:

Wheat (bread and durum)

a. Irrigated and high rainfall area: Mexipak, Abu Ghraib 1, Inia 66, Aras, Jori C 69, Cocorit C-71 and some other local varieties.

b. Low rainfall area: Saberbeg, Mexipak, Inia 66 and some other local varieties.

Barley

a. Irrigated and high rainfall: Arrivat, Numar CM67, Clipper, and some other local varieties.

b. Low rainfall area: Arrivat, local black barley and other local varieties.

Promising Variety Lines in the Different Zones.

Irrigated area:

a. Bread wheat: Fath, Mexicali 24 X Ajeeba, C208 X Bajio, We X cno'S' X Gallo'S' and Emu'S'.

b. Durum wheat: Cocorit 'S', G 'S', Gs 'S' and Gs 'S'-D dwarf, S15 X G 'S', Cocorit C71 and Maghrabi.

c. Barley: Giza 121, Minn. 126-CM67, CM67-U.Sask, Clipper (2-rowed), Weah (2-rowed) and Prior (2-rowed).

High rainfall area:

a. Bread wheat: INIA 66, Fath, INIA 'S' X Napo 63, Emu 'S' and C208 X Bajjo.

b. Durum: Cocorit 'S', Mexicali, Maghrabi and Jori.

c. Barley: UPBS - 1233-4 and Composite Cross 89.

Low rainfall area:

a. Bread wheat: INIA 'S' X Napo 63, Mex 24 X Ajeeba, Lerma Rojo X Son 64, Fath and INIA 66.

b. Durum: Ger - V2469, (BYE²-TC) (TACE), Essai-6A and Mexicali.

c. Barley: V. Well, CM67-U-Sask 1800-1-Pro-CM67.

Major Disease Problems in Different Production Zones (Wheat and Barley)

Irrigated:

Rusts (leaf and stem rusts), powdery mildew and *Septoria* are the common wheat diseases. Only the smut (loose smut) is sometimes the problem.

High rainfall:

Smuts, rusts, powdery mildew and *Septoria* are the common diseases. Of these, covered smut and leaf rusts are more common.

Low rainfall:

Diseases are not so serious a problem in the low rainfall areas. Moisture is the most important limiting factor for production of crops.

Major Insects (Wheat and Barley)

Irrigated:

Aphids are among the most serious insects in the irrigated area, both on wheat and barley. Suny bug has been observed.

High rainfall:

Aphids are also becoming serious in high rainfall area. Suny bug is also present, particularly on wheat.

Low Rainfall:

Again there is less problem of insects in the low rainfall area.

Normal Sowing and Harvest Times

Irrigated:

Normal time for wheat sowing is from November 1 to 30.

Wheat:

Harvesting of wheat starts from May 5 and continues to about June 20.

Barley:

Normal sowing of barley starts from the first of October and continues to the end of November. Barley harvesting starts from the middle of April and continues to the first week of June.

High rainfall area:**Wheat:**

Middle of October to end of November. Harvesting of wheat is from the first week of June to the end of July.

Barley:

Sowing is from the middle of October to the end of November. Last week of May to first week of July is the harvesting period.

Low rainfall area:**Wheat:**

Sowing is from middle of October to end of November. Harvesting is third week of May to the end of June.

Barley:

Sowing is from middle of October to the end of November. Harvesting is from first week of May to the second week of June.

Percent of area sown in different rainfall areas or to irrigation (percentages).

| | Less than 350 mm | More than 350 mm | Irrigated |
|--------|------------------|------------------|-----------|
| Wheat | 60 | 10 | 30 |
| Barley | 39 | 8 | 53 |

Agricultural practices carried out on experimental fields and research stations.**Wheat (bread and durum)**

Land preparation: The land should be ploughed 1-2 times and then disked twice and finally levelled. Phosphate fertilizer is applied before sowing and thoroughly mixed in the soil.

Sowing: Should be done in rows with seed drills. Seed rate should be 100 kg/ha. Higher seed rate is used in case of durum and slightly lower in case of bread wheat. Also in dry areas, seed rate is high.

Weed control: Herbicides like 2,4-D should be used for broad leaf weed control. With the new varieties and use of high doses of fertilizer, weeds have become a serious problem.

Irrigation: 4-6 irrigations should be applied in the irrigated area.

Fertilizer application:

Irrigated area, 120 N 40 P205/ha;

High rainfall area, 120 N 80 P205/ha;

Low rainfall area, normally no fertilizer is applied to wheat and barley in low rainfall areas.

Insect control: Aphids should be controlled with insecticide, particularly in irrigated and high rainfall areas.

Harvesting: Should be done at proper maturity. Delays in harvest may cause shattering of the crop.

Drying: The wheat and barley grains should be dried to 14 percent moisture before storing.

Seed storage: The stores should be cleaned and fumigated before storing the seed. During storage, the seeds should be checked for insect attack and fumigated if necessary.

Barley

Land preparation: Land should be prepared as is the case for wheat.

Sowing: Barley also should be sown through seed drills. Seed rate should be used from 100 kg - 120 kg/ha.

Weed control: Weeds must be controlled through herbicides in order to get good yields.

Irrigation: About 4-5 irrigations are sufficient for barley.

Fertilizer application: Normally no fertilizer is applied to barley but if the crop is grown on poor land, a dose of 20 kg N + 10 kg P_2O_5 will give good results. When semi-dwarf varieties become available the recommendations will change.

Insect control: In case of severe attack of aphids, the crop must be protected.

Harvesting: Crops should be harvested at proper maturity. Delayed harvesting may cause shattering and reduction in yield.

Drying: The seed should be dried thoroughly to 14 percent moisture before storing.

Seed storage: The seed should be stored in clean insect free stores. If needed the store should be fumigated before storing the seed in it.

Package Developed from Research Station Results on Farm Trials

Wheat

Seed rate trials: 60, 80, 100 and 120 kg/ha seed rates were tried for three years; 100 kg/ha has been found to give the best yield under irrigation; in the rainfed area in the north 120 kg/ha is found to be the best seed rate.

Sowing-date trials: The month of November (preferably the later half) under irrigation and mid-October to first week of November under rainfed conditions are the best wheat sowing times.

Method of sowing: The common practice of the big farmers in cooperatives and state farms is to sow by drill and irrigate immediately (under irrigation) or wait for the rains (under rainfed conditions). Some small farmers still use broadcast. At the research stations, all trials are planted in rows by manually drawn implements. The line-sown or drilled crop gives better germination and yield.

Irrigation trials: Usually 4-5 irrigations are applied to wheat during the normal season and 5-6 irrigations in a dry season.

Time of application of nitrogen to improved varieties: In irrigated areas a dose of 60 N + 40 P_2O_5 kg/ha was found to be the best. In high rainfall areas, a dose of 120 N + 80 P_2O_5 kg/ha produced the best results. However, the application of potash fertilizer is still under investigation.

Barley

Nitrogen and phosphorus are needed by Arrivat and Giza 121 (6-rowed) barley in irrigated and high rainfall area: in irrigated areas on fallow land, there is no significant difference in yield of the fertilized and unfertilized treatments when barley is planted after maize; then a dose of 80 N + 80 P_2O_5 kg/ha produce the best results. In case of high rainfall areas, the trend is the same with the only difference being when the soils are slightly poor and need more N.

Nitrogen and phosphorus needed by Clipper (semi-dwarf, 2-rowed) in irrigated and rainfed areas: this is the first year of the experiment.

The effect of cutting on yield (grain and forage) and quality of barley variety Arrivat (irrigated and rainfed areas): a total of six different treatments were compared and it was found that treatment with 40 N + 40 P_2O_5 kg/ha produced the best results. However, the economics of the experiment have not yet been calculated.

Yield Results Achieved in Experimental Trials

Wheat varietal trials in irrigated areas (Abu Ghraib, Qadissiya etc.)

Varieties trials (bread) Highest yield was obtained from Fath, 3952 kg/ha.

Varieties trial (bread, durum): Highest yielding variety was Abu Ghraib, 4084 kg/ha.

Varieties trials (durum): Highest yield was given by Cocorit C, 4780 kg/ha.
Varieties Trial (durum): High yield was produced by Cm-18584-1Y-1Y-DY, 3416 kg/ha.
There were several other international and regional yield trials and nurseries grown and selection made.

Wheat varietal trials in high rainfall area (Bakrajo)

Varieties trial (bread, durum): Highest yield was given by Abu Ghraib, 3680 kg/ha.
Varieties trial (durum): Highest yield was produced by variety Mexicali 'S', 4164 kg/ha.
Varieties trial (durum): Highest yield was given by Cocorit C71, 4096 kg/ha.
There were many other regional yield trials and nurseries grown in this area and selection made.

Wheat varietal trial in low rainfall area (Talaifar)

Varieties trial (bread): Highest yielding variety was INIA X Napo, 2504 kg/ha.
Varieties trial (bread, durum): Stork 'S' gave highest yield, 1480 kg/ha.
Varieties trial (durum): Highest yield was obtained from variety Mexicali 'S', 1944 kg/ha.
Varieties trial (durum): Highest yield was given by 21563-AA'S' X Fg'S', 2468 kg/ha.
There were many other national and international yield trials and nurseries grown and selection made.

Barley variety trial in irrigated area (Abu Ghraib, Qadissiya)

Barley varietal trial (6 varieties): Highest yield was produced by variety Numar, 3400 kg/ha.
Varieties/lines trial: Highest yields were produced by variety Beecher, 3520 kg/ha and DPBS, 3248 kg/ha.
Varieties/lines trial (2-rowed): Highest yielding variety was W1-2291, 2376 kg/ha.
Varieties/lines trial (6-rowed): Highest yielding variety was Minn. 126-CM67, 4328 kg/ha.
Varieties regional yield trial: Variety Promesa - Arrivat gave the highest yield of 3348 kg/ha.
Several other nurseries and regional trials were grown and selections made.

Barley varietal trial in high rainfall area (Bakrajo, etc.)

Barley varietal trial (6 varieties): Highest yield was obtained from Arrivat, 4040 kg/ha.
Varieties/lines trial: Variety UPBS-1233-74 gave the highest yield, 5464 kg/ha.
Varieties/lines trial (2-rowed): SV-Mari-CM67 produced the highest yield of 4632 kg/ha.
Several other international yield trials and nurseries were also grown from which selections were made.

Barley varietal trial in low rainfall area (Talaifar, etc.)

Barley varietal trial (6 varieties): Highest yielding, 1808 kg/ha was Giza 121.
Varieties/lines barley trial: Highest yield was obtained from variety CM67-U-Sask, 2620 kg/ha.
Varieties/lines barley trial (2-rowed): Variety Aurore- Esperance gave the highest yield, 2744 kg/ha.
Several other international nurseries and yield trials were also grown from which selections were made.

Farmers:

Land preparation: the farmers normally plough, disc and then sow the crops (wheat and barley). A good farmer will attend to the levelling too.

Sowing: In irrigated and high rainfall areas, nearly 60 percent of farmers sow by drills, whereas, in low rainfed areas, 90 percent of farmers sow by drills.

Weed control: Very limited area of wheat and barley is sprayed by Government for weed control. The Government is increasing the efforts for control of weeds in the major areas in the near future.

Irrigation: Farmers apply 5-6 irrigations to wheat and 4-5 to barley. Sometimes they may over-irrigate and sometimes they may not apply the irrigation at the critical stages.

Fertilizer application: The recommended dose for irrigated area for wheat is 120 N+ 40 P₂O₅ kg/ha. High rainfall area is 120 N+ 80 P₂O₅. In pilot project area, which is covering more and more area, the exact dose is applied. Some 20 percent of area is fertilized.

Insect control: So far there is no serious problem of insects, except aphids in some areas.

Harvesting: 80 percent of the area is harvested with combines, and 20 percent is manually harvested, mainly in the rainfed area.

Drying: The seeds are normally dried.

Seed storage: Most of the wheat is purchased by the Government and stored in Government stores. Similarly most of the barley is purchased and stored by Government.

Farm yields maximum in different zones (kg/ha).

| | Less than 350 mm | More than 350 mm | Irrigated |
|--------|------------------|------------------|------------|
| Wheat | 676 kg/ha | 945 kg/ha | 1279 kg/ha |
| Barley | 600 kg/ha | 823 kg/ha | 1156 kg/ha |

Difficulties or Problems Confronting Farmers

1. Equipment and machinery for land preparation and costs. - Part of the machinery and equipment for land preparation is provided by the government and the cost of it is subsidized up to 50 percent.
2. Fertilizer supply and prices. - The government is supplying both the nitrogenous and phosphatic fertilizer to the farmers at the subsidized rates. The actual prices of urea, ammonium sulphate and triple superphosphate are 22.5, 15.5 and 38 Iraqi Dinars. These are subsidized 50 percent.
3. Seed supplies and prices. - About 15 percent certified seed is supplied by the government, and the price is 69.6 I.D. It is subsidized by the government - up to 20 percent which comes to 55.6 I.D.*
4. Herbicide supplies and prices. - The government is providing a free service of weed control, and the area covered in 1977-1978 was about 50,000 ha.
5. Labor supply and prices. - As sowing and harvesting of wheat and barley is mechanized, so there is less problem with regard to these two operations. For irrigation, and other operations, there is shortage of labor. One laborer will cost 1.5 I.D. per 8 hours work.
6. Difficulties encountered during the growing season and at harvest. - There is still some problem of machinery both for preparation of land and harvesting of the crop at the proper time.
7. Postharvest problems. - The government is purchasing the major part of the produce, but still there is some storage problem which will be solved in the near future after completion of the several silos and stores which are under construction.

Production:

Normal yields and prices for wheat:

Bread wheat = 45 I.D./tonne

Durum = 49 I.D./tonne

Barley = 43 I.D./tonne

Yield and price of straw: Yield of straw varied with the varieties (25 - 50 percent of grain yield). The price per tonne of wheat and barley straw is 17.5 I.D./tonne.

* One I.D. = 3.23 US\$.

Other constraints:

Weed control, particularly in irrigated and rainfall areas, has to be done on the entire area by both herbicides and rotations. Research in drylands needs more concentration, particularly on moisture conservation and rotation.

Manpower available for:

1. Research in bread wheat, durum and barley - Ph.D. 1, M.Sc. 2, B.Sc. 17-20. These staff members are helping in research on other crops too.
2. Research in breeding, agronomy, pathology and others. - In all these disciplines there is need for more trained staff. The available trained staff is about one third of the total actually required.
3. Extension personnel. - There is a need for training of extension personnel as well.
4. Others. - The cooperation between different disciplines is under way and it may prove very useful for the entire research of field crops, including wheat and barley research work.

Facilities

Availability and limitations. - As compared with the research work in hand, the available number of trained personnel is only one third of the total required. Training programme of the staff is going on but it needs acceleration. Similarly, some more facilities are needed in the form of equipment and machinery for planting, weeding, harvesting and cleaning of seed of the experimental plots and also laboratory equipment for seed technology. Availability of laborers for working in the experimental fields is becoming a problem. Small machinery suitable for such work will ease the situation.

Future plan for increasing cereal production.

The future plan for increasing cereal production includes:

1. To re-organize the present research work in such a way that we get:
 - a. Drought resistant varieties for the low rainfed area of the country.
 - b. Salt tolerant wheat and barley varieties for the middle and southern regions of Iraq.
 - c. Long duration wheat and barley varieties for sowing 7-10 days earlier than normal sowing time and thus cover slightly more area and at the same time avoid the danger of shattering, by giving some more time to the combine harvester for timely completion of the harvesting operations.
 - d. Normal duration varieties of wheat and barley for normal sowing in the northern and southern zones.
 - e. Short duration varieties of wheat and barley for late sowing and the double cropping rice area in the country.
2. Training of more research staff in breeding, agronomy, pathology, seed increase and quality testing work.
3. Training of the extension workers so that they can speedily pass on the research findings to the farmers.
4. Organization of the team research work. At present, the various disciplines like breeding, plant pathology and agronomy are working independently. A reorganization scheme is under way in which efforts will be made to inculcate the spirit of teamwork.
5. The seed multiplication, certification, storage and distribution work also requires some streamlining. At present the new varieties are not speedily reaching the farmers.
6. There is a great need to include testing of the new technology (wheat and barley micro- and macro-plot trials, semi-commercial trials, fertilizer trials and so on) in the farmers' fields. At present, the research staff is not conducting any experiments on farmers' fields; thus the flow of information to the farmer is very slow. There is great need to strengthen the research cadre and enable them to help the extension staff in educating and acquainting the farmer with the new technology.

Summary

Of 3.5 million ha annually cropped in Iraq, cereals occupy some 80 percent. Almost all of this is wheat and barley, usually in areas receiving less than 350 mm of rainfall. Ninety percent of the wheat crop is bread wheat, with smaller areas of durum being found in the North. The wheat crop is 70 percent rainfed, while the barley crop is only 47 percent rainfed. Improved high yielding cultivars occupy most of the wheat area, especially in higher rainfall and irrigated areas. With barley only about one-third of the area planted is to newer varieties. Principal wheat varieties include Mexipak 65, Abu Ghraib 1, Inia 66, Jori C69 and Cocorit C71. The leading barley varieties include Arivat, Mumar CM67, Clipper and various local types. Many promising lines are currently being tested in trials around the country. The major diseases of wheat and barley in Iraq are leaf and stem rusts, powdery mildew, *Septoria* sp, and smuts. However, in the low rainfall areas, diseases are less important and do not usually cause large losses. Aphids constitute some problem in high rainfall areas, but insect damage is not usually very serious in drier areas.

The results of field trials have indicated a set of cultural practices which are recommended to the farmer. Operations such as land preparation, seeding, weed control and fertilization are included. These recommendations are modified for various climatic conditions in different parts of the country.

There are various problems confronting cereal farmers in Iraq. Machinery and equipment for land preparation, seeding and harvesting are very costly. There are however, government subsidies for some kinds of land preparation tools. There are also government subsidies for fertilizers, making these more affordable to the farmer. In the case of herbicides, high cost coupled with lack of application equipment result in only a small area being treated. There is some lack of post-harvest storage space, although efforts are underway to provide more silo space.

Future plans call for increasing the number of research and extension personnel. Producing varieties with greater drought resistance and salt tolerance is another important area of work. An improved seed production system, and the use of on-farm trials and demonstrations are two other areas where more effort may lead to increases in cereal production.

CONTRAINTES LIMITANT LA CEREALICULTURE EN IRAQ ET LES DIFFERENTES SOLUTIONS POSSIBLES

Résumé

Les céréales occupent 80% des 3,5 millions d'hectares cultivées chaque année en Iraq.

Le blé et l'orge sont les céréales les plus cultivées surtout dans les zones recevant moins de 350 mm de pluies par an. 90% du blé cultivé est du blé tendre avec une très faible zone emblavée en blé dur dans le Nord du pays. 70% du blé est cultivée sans irrigation supplémentaire alors que seulement 47% de l'orge l'est. Dans les zones irriguées ou à forte pluviométrie, les fermiers utilisent pour le blé des variétés améliorées à très fort rendement alors que l'orge seulement le tiers de la superficie emblavée en cette plante utilise des variétés nouvelles. Les principales variétés de blé cultivées sont Mexipak, Abu Ghraib 1, Inia 66, Jori 69 et Cocorit C71; pour l'orge ce sont Arivat, Numar CM67, Clipper et de nombreuses variétés locales. (Des variétés prometteuses sont testées à travers tout le pays.)

Les maladies principales sont pour ces plantes les rouilles brune et noire, l'oidium la septarioses et les charbons. Toutefois, dans les zones à faibles précipitations, les maladies ne sont pas très importantes et entraînent peu de dégats. Les aphidés constituent un léger problème dans les zones à forte pluviométrie mais dans les zones sèches les dégats dus aux insectes ne sont pas très sérieux.

Suivant les différentes conditions climatique du pays, de techniques culturales sont recommandées aux céréaliculteurs et elles incluent: la préparation des sols, semis, le désherbage et la fertilisation.

De nombreux problèmes s'opposent aux agriculteurs irakiens tels que le coût excessif des machines agricoles (malgré des subventions du gouvernement), des engrais. Pour les herbicides, le manque d'approvisionnement ajouté au manque de moyens d'application résultent dans la faible utilisation de ce contrôle des mauvaises herbes. Bien que des efforts dans la construction de silos soient fait, il existe de nombreux problèmes de stockage des récoltes.

Les futurs plans visent une augmentation du personnel de recherches et de vulgarisation. La production de variétés résistantes à la sécheresse et tolérantes au sel est aussi un domaine très important pour l'accroissement de la production céréalière. De plus, la création d'un système de production de semences et l'utilisation des essais sur les terres des griculteurs sont deux autres moyens d'accroître la production céréalière de l'Iraq.

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Le blé et l'orge sont les céréales les plus cultivées surtout dans les zones recevant moins de 350 mm de pluies par an. 90% du blé cultivé est du blé tendre avec une très faible zone emblavée en blé dur dans le Nord du pays. 70% du blé est cultivée sans irrigation supplémentaire alors que seulement 47% de l'orge l'est. Dans les zones irriguées ou à forte pluviométrie, les fermiers utilisent pour le blé des variétés améliorées à très fort rendement alors que l'orge seulement le tiers de la superficie emblavée en cette plante utilise des variétés nouvelles. Les principales variétés de blé cultivées sont Mexipak, Abu Ghraib 1, Inia 66, Jori 69 et Cocorit C71; pour l'orge ce sont Arivat, Numar CM67, Clipper et de nombreuses variétés locales. (Des variétés prometteuses sont testées à travers tout le pays.)

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CONSTRAINTS TO CEREAL PRODUCTION AND POSSIBLE SOLUTIONS IN JORDAN

Zulfijl Ghosheh*

Geographically, Jordan lies between latitude 29° 33' N and longitude 35° 29' E. The weather in general is mildly cold during winter season, where rains last for about four months (November - early April) and the other eight months are hot and dry.

Jordan has an area of about 93,000 km² where 13 percent is cultivable land (about one million hectares). On the other hand, 93 percent of the total cultivable land is located under rainfed conditions, where the rest is under irrigation mainly in the Jordan Valley.

Agriculture in Jordan is considered as one of the main elements of national income, and about 12 percent of the national income is based on agriculture. According to these conditions, the volume of agricultural production is still short of satisfying domestic needs, except in the case of lentils and vegetables where some of the production is yearly exported.

As mentioned before, the total arable land is about one million hectares where agriculture is practiced in more than 50 percent of this area.

Since Jordan is considered as a dry country, wheat and barley are the main cereal crops occupying most of the cultivated area and this refers to their adaptation to dry conditions. According to scarce and erratic rainfall, the total cultivated area and total production vary from year to year as shown in Table 1.

Durum wheat is the dominant wheat grown and it occupies about 95 percent of the total wheat area. Feed type barley is the only barley cultivated in Jordan.

Cereals are grown in Jordan in five different zones according to the precipitation, as pointed out in Table 2.

The main commercial wheat varieties grown are Horani, Nawawi and Fa8; both are durum and occupy about 75 percent of the total wheat area. On the other hand, Deir Alla 1, 2 and 4 occupy 15 percent, and 10 percent of the area is planted with unknown wheat varieties.

However, in the case of barley, most of the area is still planted with local varieties, and these varieties are occupying more than 85 percent of the barley area, whereas the rest of the area is planted with Arivat, Ogalitsu and Deir Alla 106.

* Agricultural Research Division, Amman

TABLE 1. Area and production of wheat and barley planted in Jordan from 1970 to 1978

| Year | Wheat | | Barley | |
|------|------------|----------------|------------|----------------|
| | Area (ha.) | Prod. (Tonnes) | Area (ha.) | Prod. (Tonnes) |
| 1970 | 222,840 | 54,100 | 35,910 | 8,100 |
| 1971 | 239,404 | 162,755 | 53,860 | 40,000 |
| 1972 | 223,670 | 211,400 | 65,790 | 38,700 |
| 1973 | 244,120 | 50,400 | 40,980 | 5,700 |
| 1974 | 210,000 | 180,000 | 58,540 | 55,700 |
| 1975 | 140,200 | 61,900 | 39,630 | 13,800 |
| 1976 | 147,220 | 120,900 | 51,810 | 35,700 |
| 1977 | 131,200 | 56,000 | 44,070 | 13,600 |
| 1978 | 137,618 | 53,743 | 55,680 | 15,220 |

TABLE 2. Precipitation zones, average area, production and yield for wheat and barley

| Prec. Zones | Wheat | | | Barley | | |
|-------------|-----------|-----------|---------------|-----------|-----------|---------------|
| | Area (ha) | Prod. (T) | Yield (Kg/ha) | Area (ha) | Prod. (T) | Yield (Kg/ha) |
| Less 250 mm | 40,000 | 17,000 | 430 | 25,000 | 12,000 | 480 |
| 250-300 | 70,000 | 44,000 | 630 | 25,000 | 18,000 | 720 |
| 300-400 | 60,000 | 50,000 | 830 | --- | --- | --- |
| above 400 | 18,000 | 20,000 | 1,110 | --- | --- | --- |
| Irrigated | 6,000 | 9,000 | 1,500 | --- | --- | --- |

Promising varieties

Since Jordan is a dry country, most of our field trials are located in areas receiving a rainfall range of between 300-400 mm rain. According to the information obtained from the trials carried out in these areas in the last few years, several promising wheat and barley varieties have shown good characteristics such as yield, early maturity, resistance to lodging, etc. They include:

Wheat: Arvand - D. Dwarf - Stork - Cocorit - Line-Cns-Nox ska/Ron-ch - 348-B (Deir Alla 2 x Hetiya Soda)

Barley: Beecher - Obeez - Composite 259 - Platax SV. Mari - Line 2257/14.

Diseases and insects are considered as a minor problem in Jordan and this refers to low precipitation in wheat and barley zones. However, leaf miner and aphids are noticed in high rainfall zones, where rusts (yellow, leaf and stem rust), powdery mildew and blotch diseases occur, especially in areas receiving late rainfall during April and May.

About 95 percent of the cereals are grown under rainfed conditions and the sowing date varies from one zone to another, and depends on the beginning of precipitation; most of the farmers prefer to sow their seeds after receiving at least 50 mm rain, and this depends on the cereals zones. According to the location, the sowing dates for cereals are between

October - December. A few farmers prefer to sow in the dust during September - October, mainly in the low rainfall zones to gain as much of the rain as possible. Harvesting time lasts for approximately two months from late May - late July, and this is mainly done by combine harvesters, except in sloping lands where manual harvesting is normally used.

A package of recommended practices have been transferred to cereals growers through different aspects to raise the productivity of these crops by using the following techniques:

a. Land preparation

Shallow plowing should be practiced by using chisel or sweep plow between late October - early November.

b. Rate and depth of seeding:

Seventy or 100 kg of seeds are recommended to be sown for zones receiving below 350 mm or above 350 mm of rain, respectively. The seeds must be planted to a depth of about 8 cm, mainly in low rainfall zones.

c. Sowing dates:

The best time for seeding is between November - mid-December.

d. Fertilizers:

Nitrogen and phosphate fertilizers should be added to cereals (mainly wheat) at sowing time to save time and effort.

e. Weed control:

Broad leaf weeds are controlled with 2, 4-D herbicides with 2,4-D low volatile ester being the best. We recommend it to be used during January - early February after the tillering stage in the rainfed zones.

In research work carried out at experimental stations and farmers' fields, we have obtained the following yields, in kg/ha:

| Zones | Less than 350 mm | More than 350 mm | Irrigated |
|--------------|---------------------|---------------------|-----------|
| Bread wheat | 2000 | 3000 | 4000 |
| Durum wheat | 1800 | 2500 | --- |
| Barley grain | 2000 | 2500 | --- |

Farmers' fields

The common cultural practices used in farmers' fields are:

(a) Land preparation: plowing normally starts in September and lasts for two months. It is done by moldboard or disc plow once, followed by broadcasting the seeds and then the disc harrow is used to cover the seeds.

(b) Seeding rate: most of the cereals growers use high amounts of seeds per hectare. The rates on kg/ha are:

| Zones | Less than 350 mm | More than 350 mm | Irrigated |
|--------------|---------------------|---------------------|-----------|
| Bread wheat | --- | 120 | 150 |
| Durum wheat | 80 | 120 | --- |
| Barley grain | 60 | 80 | --- |

(c) Most of the farmers still use traditional methods in cultural practices and this is reflected in the yields obtained, taking into consideration that rain is the main limiting factor in cereal zones.

Therefore, wheat and barley average yields are very low compared with other countries. In kg/ha, they are:

| Zones | Less than 350 mm | More than 350 mm | Irrigated |
|--------------|---------------------|---------------------|-----------|
| Bread wheat | --- | 1000 | 1500 |
| Durum wheat | 700 | 1100 | --- |
| Barley grain | 600 | 700 | --- |

Problems confronting farmers

1. Most of the field equipment used by farmers is not suitable for seed bed preparation for a dry region, because all this machinery was designed for irrigated conditions. The cost of land preparation is very expensive compared with the expected net income from the farm.
2. Fertilizers are available all year in the market, but their prices are very high, because most of them are imported except phosphate. Single super phosphate is produced here in Jordan.
3. Certified seeds are considered as one of the major problems facing growers, because the total amount of seeds produced by both the government and cooperatives is not sufficient to cover cereal areas. We are planning to establish a project to produce certified seeds in cooperation with FAO and other agencies.
4. Herbicides: the main factors encountered in the spread of herbicides are:
 - (a) Unavailability of sprayer equipment
 - (b) High cost of herbicides
5. Labor supply: in spite of the high cost of labor, this problem is not considered a major one at seeding time or during the growing season. The main problem is encountered by the farmers at harvesting time, especially in sloping lands where manual harvesting is practiced. Postharvesting problems are concentrated on the unavailability of storage facilities, and most of the cereal growers store their crops inside houses or in the back-yard.
6. Manpower availability: the research staff working in field crops divisions are very few compared with the achievements gained in the past years.

Future plans:

The Ministry of Agriculture is aiming to increase the total production of cereal by different channels, and an agreement was signed between the Ministry of Agriculture and the Faculty of Agriculture and ICARDA to raise the productivity of wheat and barley in Jordan.

The project's title is "Cooperative Winter Cereal Research and Demonstration/Production Program" and this was commenced in August, 1978.

Summary

Durum wheat occupies about 95 percent of the wheat area in Jordan, while all of the barley is of the feeding type. Principal wheat varieties include Haurani, Nawawi and Fa 8. About 85 percent of the barley area is planted to local varieties, the remainder being planted with Arrivat, Ogalitou and Deir Alla 106. Promising new lines have been identified having good yield, early maturity, and lodging resistance. Because of the dry climate, disease is generally not a problem. However, in some areas receiving late rainfall, rusts and powdery mildew can occur.

A package of recommended agronomic practices has been given to farmers. This includes specific recommendations on land preparation, seeding rates and depths, sowing dates, fertilizers and weed control. Many farmers still use traditional production methods, especially broadcast sowing with very high seeding rates. Research plot yields are 2-3 times those obtained by farmers.

Cereal growers face various problems in Jordan. Purchase and use of machinery and implements is expensive, and this equipment is not always suited to the dry soils of Jordan.

Nitrogen fertilizer is expensive and must be imported. Seed production remains insufficient, although a project is currently being planned to increase the supply of certified seed to growers. Weed control is probably not practiced as extensively as it should be due to the high cost of herbicides and unavailability of spray equipment. Labor supply is a problem in some areas where the crop is hand harvested. Postharvest problems are principally due to the lack of storage facilities.

In the area of research and extension, more manpower is needed for ongoing projects and for future expansion of activities aimed at increasing cereal production in Jordan.

CONTRAINTES LIMITANT LA CERÉALICULTURE EN JORDANIE ET LES DIFFÉRENTES SOLUTIONS POSSIBLES

Résumé

En Jordanie, tout l'orge cultivé est du type alimentaire et le blé dur représente 95% de la culture de blé. Parmi les variétés de blé cultivées on peut citer Haurani, Nawawi et Fa 8; pour l'orge 85% de la surface cultivée utilise des variétés locales, le reliquat utilisant les variétés Arivat, Ogallitou et Deir Alla 106. Des lignées prometteuses ont été identifiées et leurs caractéristiques principales sont un bon rendement, une bonne précocité et une résistance à la verse. Du fait du climat très sec, les maladies ne représentent pas un problème majeur sauf dans les zones recevant des pluies tardives (où les rouilles et le mildiou peuvent apparaître).

Un ensemble de recommandations ont été faites aux fermiers sur la préparation du sol, le taux et la profondeur de semis, la date de semis, le désherbage et l'utilisation d'engrais (les parcelles de recherches obtiennent des rendements 2 à 3 fois supérieurs à ceux des champs de fermiers utilisant des techniques traditionnelles, le semis à la volée à très haute densité par exemple).

Les céréaliculteurs sont confrontés à des problèmes d'achats et d'utilisation de matériel (généralement non adapté aux sols très secs de la région).

De plus, l'engrais azoté doit être importé, donc son prix de revient est très élevé, les désherbants sont, de même très chers et la production de semences reste insuffisante malgré la mise en place d'un projet visant à augmenter l'approvisionnement de graines contrôlées. De plus, la main d'œuvre, dans les régions où la moisson est faite manuellement, est insuffisante et le manque de moyens de stockage posent de très gros problèmes post-moisson.

Au niveau de la recherche et de la vulgarisation des efforts doivent être fournis pour faciliter l'expansion des projets visant l'amélioration de la production céréalière.

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CONSTRAINTS TO CEREAL PRODUCTION AND POSSIBLE SOLUTIONS IN SUDAN

Faisal M. Ali*

Wheat production has been practiced in the Sudan from early times, especially in the northern parts of the country. In an effort to reduce imports much attention has been given to this crop in recent years. Practically all the country production of wheat is raised under irrigation.

* Agricultural Research Corporation, Wad-Medani

Area:

In Table 1, data are presented for areas in the major provinces devoted to wheat. The total area sown with wheat shows a continuous increase to 1975-76 and then it decreased. The decrease was mainly due to the shortage of spare parts, fuel and other agricultural machineries. Also, it was partly due to poor organization of the available resources.

TABLE 1. Wheat areas in Sudan by Provinces (in feddans) for the period 1968 - 1978

| Crop year | Northern and Khartoum Provinces | Blue Nile Province | Kassalla Province | Total |
|-----------|---------------------------------------|-----------------------|----------------------|---------|
| 1967-1968 | 36,906 | 79,774 | 87,475 | 205,155 |
| 1968-1969 | 25,526 | 131,890 | 105,061 | 262,476 |
| 1969-1970 | 22,068 | 147,967 | 120,131 | 290,116 |
| 1970-1971 | 28,719 | 150,400 | 111,280 | 290,399 |
| 1971-1972 | 20,000 | 148,000 | 120,000 | 288,000 |
| 1972-1973 | 21,000 | 155,000 | 72,000 | 248,000 |
| 1973-1974 | 25,000 | 274,000 | 120,000 | 419,000 |
| 1974-1975 | 27,000 | 445,000 | 118,000 | 598,000 |
| 1975-1976 | 30,000 | 600,000 | 120,000 | 750,000 |
| 1976-1977 | 5,115 | N.A. | 78,435 | N.A. |
| 1977-1978 | 4,869 | 465,683 | 71,720 | 542,272 |

1 Feddan = 0.42 hectares

Production and yield

Table 2 shows the total production in metric tons for Sudan as a whole and yield in metric tons per feddan. The improvement in yield per feddan with years, is due to the fact that better and improved crop husbandry was used. The year to year variability was mainly due to environmental conditions.

TABLE 2. Production and yield of wheat in Sudan for the period 1968-78 (in metric tons and metric tons/feddan)

| Crop year | Production | Yield |
|-----------|------------|-------|
| 1967-68 | 87,000 | 0.408 |
| 1968-69 | 122,758 | 0.469 |
| 1969-70 | 115,262 | 0.397 |
| 1970-71 | 162,539 | 0.559 |
| 1971-72 | 140,000 | 0.524 |
| 1972-73 | 149,800 | 0.616 |
| 1973-74 | 281,121 | 0.661 |
| 1974-75 | 246,420 | 0.441 |
| 1975-76 | N.A. | N.A. |
| 1976-77 | N.A. | N.A. |
| 1977-78 | 327,783 | 0.587 |

1 Feddan = 0.42 hectares

Main commercial varieties

At present the two varieties dominating wheat production are Giza 155 and Mexicani, with the former variety predominating in the Kassalla province and the larger proportion of the Northern province. The latter dominates the Gezira (Blue Nile Province).

There are other promising varieties such as Condor and H D 832 which will be released soon.

Disease and Insects

Wheat is relatively little affected by diseases, with the exception of stem rust in the Kassalla province.

Aphids are a problem in all production areas, and aerial spraying of insecticides for their control is practiced.

Sowing and harvesting times

Late October - early November is the recommended period for sowing, whereas harvesting is in the second half of February. Due to practical difficulties resulting from shortage of farm machinery, fertilizer and fuel at the right time for planting, considerable delays occur in the time of planting and consequently in the harvesting date.

Agricultural practices carried out on experimental fields

In early September a pre-watering is given to the land to germinate weed seeds; then ploughing is carried out to control weeds. After ploughing, harrowing and levelling are done until a fine seed bed is obtained. When the seed bed is well levelled, the seeds (treated with Aldrex T) are sown by seed drill at a spacing of 20 cm between rows, at a seed rate of 50 kg/feddan. On the other hand, if levelling is poor, seeds are broadcast and then the land is ridged to 80 cm so as to facilitate watering.

Only nitrogenous fertilizers are used at the rate of 80 kg N/ha at sowing. Watering intervals range between 12 - 14 days.

If aphids reach a sprayable level, they are controlled by the appropriate insecticide. Harvesting is carried out by the combine harvesters.

With this package of practices, yields as high as 1.5 t/feddan are obtained in the Gezira Research Station, whereas in the Northern province Research Stations even higher yields of 2.0 t/feddan are obtained.

The farmers always try to follow the research recommendations, but due to shortage of farm machinery and other practical difficulties seed bed preparation is poor and normally pre-watering to control weeds as well as levelling are not practiced. Hence all agricultural operations are delayed. These delays are reflected in the low yields obtained by the farmers where the highest yield reported was only 0.661 t/feddan.

Difficulties and Problems Confronting Farmers

Equipment and machinery for land preparation

Generally there are not enough tractors and machinery available for land preparation in most of the agricultural areas of the Sudan.

The two major wheat producing areas (the Gezira and Kassalla provinces) have cotton as major cash crop, and cotton receives priority; consequently the preparation for wheat suffers from this bias, especially in land levelling, as there is virtually no proper levelling machinery.

Fertilizers

Most of the problems confronting farmers with regard to fertilizers are due to planning and organization, mainly in transportation and storage facilities. Fertilizers are normally not available at the right quantity at the right time.

Seed supply

In the Gezira province, the Seed Propagation Unit supplies nearly all the seed for their farmers. On the other hand, in Kassalla and the Northern provinces seeds are supposed to

be supplied by the Seed Propagation Section of the Ministry of Agriculture, but due to shortages in cleaning and processing machinery and technical personnel only small amounts of seeds are supplied to farmers. Consequently most of the farmers keep their seeds from previous crops.

Herbicides

At the moment no herbicides are used on a large scale in wheat production areas.

Labor supply

There is no problem in this respect since this crop is fully mechanized. There is great demand for training centres for technicians handling agricultural machinery. The farmers take care of the watering operation.

Difficulties encountered during the growing season and at harvest

One of the major difficulties during the growing season is watering. Sometimes the farmers cannot water their fields at the right time with the right quantity of water. Also due to poor levelling of land, most of the wheat field is either in too wet or in too dry conditions and there is very little which is receiving adequate watering. The adverse effect of improper watering is serious especially at the tillering, flowering and heading phases. This effect will be reflected at harvesting where the wheat field will differ in its maturity and this will result in delayed harvesting in some parts of the field, or harvesting some parts where the crop is not fully matured. Lack of machinery and poor management of those available are also major problems during harvesting time. Added to this is the shortage of trained combine harvester drivers and mechanics.

Postharvest problems

There are little postharvest problems since most of the harvested wheat is sent directly for milling and negligible amounts are stored.

Production

The average yield of wheat is approximately in the range of 0.40 - 0.66 t/feddan and the prices range from 75 - 85 Sudanese pounds/ton.

Since combine harvesters are used, the straw is not collected from the fields. On the other hand, some farmers use it for their animals in the field.

Other Constraints

Marketing problems

Marketing of wheat is inadequately organized, and pricing of the grain is not made at the appropriate time. Also payments to the farmers normally take a long period. These factors lead most of the farmers to mortgage their crops to local merchants at low prices in order to get cash. This system of mortgages has deterrent effects through under-utilization of the milling capacities thereby encouraging the middlemen group which is an un-productive sector of the society, and utilization of the limited capacities of the stores so as to get higher prices at the appropriate time.

Manpower available for:

1. In the various disciplines of wheat research including administration, except agronomy and breeding, there are about 15 researchers.
2. The number of research workers dealing with the breeding and agronomy of wheat is about 12. They are in the Agricultural Research Corporation and the University of Khartoum.
3. Most of the extension services in the Sudan are for all agricultural crops and there is no specific extension service for wheat.
4. As for the extension service, the number of personnel involved in wheat production, marketing, etc., is unknown.

Facilities

The facilities for wheat research and production are less than the minimum. Most of the other limitations are in the agricultural machinery, spare parts, storage capacities, fuel, transport, availability of credit facilities and marketing.

Future plans for increasing production

Most of the future plans are directed towards horizontal expansion by growing new lands. With the yield potential of wheat at the research centers, we think that efforts should be directed towards vertical expansion. This will involve less capital expenditure in agricultural machinery, transport, storage, etc. Vertical expansion will require the better application of the research findings, availability of fertilizers at the right time and the availability and efficient use of agricultural machinery. Also, if varieties with varying harvesting dates are sown, this will help in making better use of the available resources.

Summary

In Sudan nearly all wheat is grown under irrigation. The principal varieties at present are Giza 155 and Mexicani, and the newer lines HD 832 and Condor, will be released soon. Diseases generally pose only a minor problem, although stem rust can be serious in Kassala province. Aphids are a more general problem, and control by use of insecticides is practiced.

On research stations yields as high as 2 t/feddan are obtained. Highest yields reported in farmers' fields are 0.66 t/feddan. The gap here is partly due to delays in field operations due to a shortage of machinery, fuel and fertilizer at planting time.

There is a number of problems confronting wheat farmers in the Sudan. Generally, tractors and land preparation implements are lacking, and since wheat is not as important a cash crop as cotton, it receives a lower priority for these important operations. Storage and transport of fertilizers present a serious problem resulting in the unavailability of these materials at the proper times. In some areas, certified seed is produced and distributed to nearly all farmers. In other provinces however, a shortage of equipment and personnel to produce seed results in most farmers planting their own seed.

Irrigation of the crop is another area where improvements could increase yields. Poor land leveling results in either too wet or too dry areas in the fields. This causes problems during the growth of the crop, as well as later on during the harvest.

CONTRAINTES LIMITANT LA CEREALICULTURE EN SOUDAN ET LES DIFFERENTES SOLUTIONS POSSIBLES

Résumé

Au Soudan, presque toute la culture de blé se fait sous irrigation et les principales variétés utilisées sont le Giza 155 et le Mexicani (HD 832 et Condor seront bientôt livrées aux agriculteurs). En général, les maladies ne représentent pas de problèmes, (sauf la rouille des tiges dans la province de Kassalla) alors que les aphidés sont un problème général contrôlé par l'utilisation d'insecticides.

Alors que les agriculteurs n'obtiennent que des rendements de 0,66 t/feddan en station de recherches en enregistre des rendements pouvant se situer vers les 2 t/feddan; ceci s'explique par un manque de machinerie, de fuel et d'engrais au moment des semis (entraînant un retard dans les opérations agricoles).

Le blé n'étant pas une culture aussi importante que celle du coton, il ne reçoit pas les mêmes priorités que ce dernier et cela entraîne une non disponibilité de machinerie, d'engrais de graines certifiées (sauf dans certaines régions) et de personnel. Par contre, la production étant directement livrée aux minoteries on ne rencontre pas de problèmes de stockage de la récolte.

En général, un mauvais nivellement des terres irriguées entraînent la création dans les champs de zones très sèches menant à une mauvaise croissance des plantes puis à une mauvaise récolte.

Les futurs efforts porteront sur l'augmentation des surfaces céréalières et sur l'amélioration des techniques culturales telles que: utilisation efficace de la machinerie et des engrais ainsi qu'un bon transfert des résultats des recherches conduites au Soudan.

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CONSTRAINTS TO CEREAL PRODUCTION AND POSSIBLE SOLUTIONS IN SYRIAN ARAB REPUBLIC

Y. Swiedan*

The total area of the Syria is 18.5 million hectares of which 8 million hectares is cultivated land. The total area of wheat and barley is about 2.6 million hectares and it is located in three zones as shown in Table 1.

TABLE 1

| | Crop | Less than 350 mm | More than 350 mm | Irrigated | Total | Unit |
|--------|---------|---------------------|---------------------|-----------|-------|---------------------|
| Wheat | Durum | 0.48 | 0.89 | 0.18 | 1.55 | million hectares |
| | Bread | | | | | |
| Barley | Grain | 0.35 | 0.66 | 0.02 | 1.03 | " |
| | Grazing | 0.01 | - | 0.02 | 0.03 | " |
| | Total | 0.84 | 1.55 | 0.22 | 2.61 | " |

It is apparent from this table that 57 percent of the total area is below 350 mm and 9 percent irrigated.

Table 2 shows yields and total production of wheat and barley for the year 1977-1978.

TABLE 2

| | Crop | Less than 350 mm | More than 350 mm | Irrigated | Yield Ton/ha | Production 1000 tonnes |
|--------|---------|---------------------|---------------------|-----------|-----------------|---------------------------|
| Wheat | Durum | 578 | 682 | 391 | 1.1 | 1651 |
| | Bread | | | | | |
| Barley | Grain | 377 | 331 | 21 | 0.7 | 729 |
| Barley | Grazing | 18 | - | 249 | 13 | 267 |

* Directorate of Agricultural Research, Damascus

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The high yielding wheat varieties grown in rainfed and irrigated areas, which are produced in the first zone and irrigated land, are Siete Cerros, Mexipak 65, Jori C 69, and Jazina 17. The total area in irrigated land is about 109,267 hectares and its production 249,787.5 tonnes, with a yield of 2.214.5 t/ha, the area sown in the first zone (rainfed) is about 129,797 hectares and its production is 219,435 tonnes with a yield of 1.654.5 t/ha.

In the second zone, local varieties such as Hourani, Shihany, Senaton Calilaly, Florence Aurore and Hamary are grown.

Barley is grown in rainfed land below 350 mm. Mainly the local varieties are grown, such as Arabic Black (60 percent), Arabic White (30 percent) and others such as Roumy and Arabic Akdar (10 percent), although there are several new promising varieties, which include Arrivat, Tricidrit 3265, Tricidrit and Jeza 117.

The most important diseases of wheat and barley encountered in Syria are leaf rust (black and orange) and powdery mildew. There are especially severe problems in wet seasons.

Wheat and barley are sown between October and November and are harvested between May 15 and June 15. In general, barley is earlier than wheat.

The recommendations to farmers for wheat and barley production include:

1. A good land preparation by tillage, at least two times in the spring and another in the summer.
2. Use agricultural rotations such as wheat-legumes.
3. Time of sowing - before the rains in rainfed land.
4. Fertilizer use according to this table:

| Crop | Fertilizer | Unit | Less than | More than | Irrigated | Note |
|--------|--|-------|-----------|-----------|-----------|---|
| | | | 350 mm | 350 mm | | |
| Wheat | Nitrogen N | kg/ha | 80 | 50 | 130 | Difference according to the varieties and locations |
| | Phosphate P ₂ O ₅ | kg/ha | 60 | 30 | 85 | |
| Barley | Nitrogen | kg/ha | 40 | - | 40 | " |
| | P ₂ O ₅ | kg/ha | 40 | - | 40 | " |

5. Weed control using herbicides such as 2,4-D.
6. Planting high yielding disease resistant varieties.

There are several problems such as seeding equipment, harvesting combines, and labor for sowing and harvesting. The official prices for wheat are 520 L.S./ton (130\$), barley are 400 L.S./ton (100\$).

The manpower available for research in wheat and barley agronomy is limited.

The future plans for increasing cereal production include a national wheat and barley research program prepared and initiated by the Ministry of Agriculture, with the aim of increasing yield and improving the quality of wheat and barley in Syria. Research is carried out in ten location Institutes belonging to the Directorate of Agricultural Research. The Institutes are located in the different regions of the country.

The Agriculture Research plans for the year 1978/79 include: Genetic material of a promising nature is being introduced by the Field Crop Section from the Ford Foundation, CIMMYT, ICARDA, FAO and other organizations. The material is evaluated from the point of view of adaptability and performance under local environment conditions. At present, the wheat research includes 1381 varieties studied as nursery lines in the first year, 360

varieties studied as nursery lines in the second year, 44 strains studied as local pure strains, 326 varieties studied as RDWYT in 14 trials, 295 varieties studied as RBWYT in 12 trials, and segregation populations from F₁, F₂, F₃, F₄, F₅, and F₆.

Barley research includes 483 varieties studied as nursery lines in the first year, 56 varieties studied as nursery lines in the second year, 80 varieties studied as RBYT in 4 trials and segregation population from F₂, F₃, F₄, and F₅.

This research is aimed at increasing the production possibilities for wheat and barley crops in Syria by replacing the established local varieties in the cropping system.

Summary

Wheat and barley together occupy about 2.6 million hectares of land in Syria. This is divided into three categories: high rainfall areas receiving more than 350 mm of rainfall, areas receiving less than 350 mm, and irrigated areas. In the higher rainfall and irrigated plantings the principal wheat varieties are Siete Cerros and Mexipak 65 (bread wheats) and Jori C 69 and Jazeira 17 (durums). Yield levels are generally 1.5 to 2.1 t/ha in these areas. In the drier areas, more local varieties are used. Barley is grown principally in the drier regions, and mostly local varieties are used. Promising improved varieties include Arrivat, Tricidrit and Giza 117. The major diseases encountered in Syria are leaf and stem rusts, and powdery mildew.

Recommendations to farmers concerning various agricultural practices have been developed. These include such subjects as suggested methods and schedule of cultivation, crop rotation plans, sowing dates, fertilizer use, and weed control.

Problems in cereal production include lack of seed drills, combines, and scarce and expensive labor. These factors, combined with low fertilizer use, poor land preparation and sometimes continuous cereal cropping cause yields to be lower than they might otherwise be. In order to increase wheat and barley production, the national breeding program works to identify and select superior germ plasm. Large amounts of germ plasm are evaluated, many of which are sent by international organizations. This work holds the promise that new, high yielding varieties could be produced, thereby further increasing cereal yields in Syria.

CONTRAINTES LIMITANT LA CEREALECULTURE EN REPUBLIQUE ARABE DE LA SYRIE ET LES DIFFERENTES SOLUTIONS POSSIBLES

Résumé

2,6 million d'ha sont emblavées en blé et orge et ces terres sont réparties en trois zones: (1) zones à fortes précipitations (plus de 350 mm), (2) zones à précipitations inférieurs à 350 mm et les zones irriguées (3).

Dans les zones 1 et 3 les principales variétés de blé sont le Siete Cerros et le Mexipak pour le blé tendre, Jori C69 et Jaziera 17 pour le blé dur; dans ces zones les rendements sont généralement de 1,5 à 2,1 t/ha. Dans les zones sèches, les variétés locales sont utilisées et l'orge y est très cultivée avec des variétés prometteuses telles que Arivat, Tricidrit et Giza 117. Les principales maladies rencontrées sont les rouilles brunes et noires et l'oïdium.

Des recommandations sont faites aux céréaliculteurs concernant les méthodes et périodes de cultures, les assolements, les dates de semis, l'utilisation d'engrais et le désherbage.

Les problèmes rencontrés en Syrie sont situés sur le plan de la machinerie et de la main d'œuvre très chère. Ces facteurs associés à une faible utilisation d'engrais, à une mauvaise préparation des sols et une sur-culture céréalière entraînent des chutes de rendement. En vue d'améliorer cette situation, des programmes de travaux sont mis en place pour identifier et sélectionner des germplasmes supérieurs, provenant principalement d'organisations internationales, qui permettront de produire des variétés à haut rendement pouvant assurer un accroissement de la production céréalière Syrienne.

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CONSTRAINTS TO CEREAL PRODUCTION AND POSSIBLE SOLUTIONS IN THE YEMEN ARAB REPUBLIC

M.M. El Ghouri*

Agriculture is the most important sector in the economy of Yemen Arab Republic (YAR), where 90 percent of the population depends upon it. The total area is 20 million hectares, of which only 1.5 million hectares are cultivated; of this, 80 percent is devoted to cereals, while the rest is devoted to other agricultural products, i.e. cotton, vegetables, sesame, pulses, forage crops, coffee, potatoes and fruits, especially grapes.

The major cereal crops in YAR are sorghum, maize, millet, wheat and barley. The total area occupied by wheat and barley is 118,000 hectares. Production of wheat is rather low (annual production about 52,000 tonnes) while consumption is increasing gradually each year (estimated at 250,000 tonnes). As for barley, local need is being fulfilled presently.

Wheat cultivation is concentrated in the central plains, northern highlands and north-eastern semi-arid regions of the country; 90 percent of the wheat is grown under rainfed conditions (which receive about 350 mm of rainfall during the summer), and 10 percent under irrigation during the winter.

Barley is grown in the central plains in the direction to the north, where rainfall decreases to 250-300 mm, or in areas affected by frost, which is caused by fluctuating environmental conditions of YAR.

Main commercial varieties

Commercial varieties are mainly local and are derived through natural selection for a given environmental condition. In the case of wheat, the variety *Bouni Tetraploid* predominates in most wheat production areas (80 percent, especially in areas where there are fluctuations in environmental conditions, i.e. frost, drought and irregular rain distribution during the growth period).

Varieties *Wiemy*, *Tetraploid* and *Canady Hexaploid* are grown under high rainfall areas of Ibb Governates. *Samra*, the only durum, is grown in the eastern and north-eastern parts of the country, forming less than 1 percent. For the variable conditions of Yemen, some other varieties also occur in different micro-environmental conditions, such as *Misri*, *Russi Sorghir*, *Russi Kabir* and *Aalas* (diploid). Generally, the yield of local varieties is low with national average of 1.04 t/ha.

The widely cultivated commercial varieties of barley are *Saklah* and *Aswad*, which are two-row types and grown in more than 99 percent of the barley area. The variety *Habib* (hulless) is grown in a particular environment at *Al Elhagl*, and one commercially unknown six-rowed culture at *Wadi Shaban*.

Promising varieties and lines

Several thousand advanced lines were received from different international Institutes and Centers such as CIMMYT and ICARDA, and were screened in different environments. The screening procedure was accelerated by using the unique environment of Yemen, which permits sowing two successive generations a year. As a result, several promising

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lines were selected, which showed adaptability, high yielding capacity and resistance to diseases and lodging (Tables 1, 2). Most of these selected lines/varieties outyielded the local varieties by at least 2-3 times under farmers' conditions.

TABLE 1. List of bread wheat promising varieties/lines and their economical return compared with local average.

| | Experiment Yield t/ha | % Increase from National Average | Economic Return YR |
|---|-----------------------------|--|--------------------------|
| 1. We - Cno 'S' - No 66/Zn ² | 4.29 | 390 | 5872 |
| 2. Cno 'S' x Inia 'S' | 3.75 | 341 | 4717 |
| 3. Cno - Bb. Cdl (7c/Lib64 - Inia x Inia - Tob)/Tob - 8156) | 3.71 | 337 | 4645 |
| 4. Brochis 'S' | 3.58 | 325 | 4414 |
| 5. D6301 - Nai x Weigni - RM. Cno ² Chr - Dhumran | 3.40 | 309 | 4094 |
| 6. Cno 'S' - 7C - Tng | 3.40 | 309 | 4094 |
| 7. Zmb x Cal. Cno | 3.20 | 291 | 3738 |
| 8. S948 Al x SE ⁵ | 2.89 | 263 | 3186 |
| 9. Sparrow | 2.87 | 261 | 3150 |
| 10. Tob 'S' x Cno 'S' | 2.82 | 253 | 2990 |

TABLE 2. List of promising barley varieties/lines and their economical return compared with the local average.

| | Yield t/ha | Yield increase from national average - % | Yield Difference Gain t/ha | Gain in YR |
|----------------------|---------------|--|----------------------------------|------------------|
| 1. Gem | 2.2 | 100 | 1.1 | 1375.0 |
| 2. Cr 366/1312 | 2.2 | 100 | 1.1 | 1375.0 |
| 3. 2762 x Beecher SL | 2.2 | 100 | 1.1 | 1375.0 |
| 4. Beecher | 2.09 | 95 | 0.99 | 1237.5 |
| 5. Cr 372/4/2 | 1.9 | 86 | 0.80 | 1000.0 |
| 6. Saklah (local) | 1.1 | 0 | 0 | 0 |

Diseases

The main diseases of wheat are stem, leaf and yellow rusts, loose smut, powdery mildew, leaf spot and ear cockle. Among these, the rusts are one of the limiting factors in the main production areas. YAR is considered a good region for rust epidemics because wheat and barley can be grown around the year.

Barley is also affected by the three rusts; moreover, *Helminthosporium* ssp. and powdery mildew are also considered limiting factors.

Insects

A number of insect species are found in wheat and barley cultivation areas, namely fruit fly (more pronounced in barley), saw fly, white grubs, grasshoppers, army worm, Hessian fly and aphids. Among these, aphids are serious but they have been easily controlled by applying insecticides. Moreover, nematodes are affecting the local variety (Bouni).

Sowing and harvest time

There are two major seasons for wheat cultivation. The first one starts during June for HYV and extends to mid-July for local varieties and depends on rainfall conditions (90 percent). Harvest is during October/November. The second season starts during October/November and harvest is during March/April. In this case, the crop is cultivated under irrigation in the north-eastern and southern parts of the country. At highland regions, where frost occurs, the sowing starts mid-January/early February and harvesting is in May/June.

For barley, more than 98 percent of the cultivated area is under rainfed conditions in summer, during the same period as wheat.

Experimental data

Trials were conducted in summer in the high rainfall areas of Ibb station, or in winter at Taiz (Aussifera Station) under irrigation; moreover, cultural practices and observations in wheat and barley production areas are carried out.

Several lines/varieties of wheat were selected, which showed high yielding potentiality combined with desirable characters. The best lines outyielded the local average by 390 percent with a gain in economical returns of about 5678.2 YR/hectares. Tests for stability over environment and persistence in resistance to diseases eliminated some of them.

In the case of barley, the trials revealed that the variety Giza 121 and Arrivat x LD8 outyielded the local variety Salelah by at least double (2-2.5). Moreover, several lines/varieties were selected as shown (Table 2).

Unfortunately, the seed increase and distribution of these promising lines was hindered by the bitter fact of the non-existence of a multiplication system. Consequently, a seed

TABLE 3. Nitrogen rate verification trial at farmers' field on three recommended improved varieties and one local check and their economical return.

| Location DHUMRAN (rainfed) season 1978 | | | | | | | | | |
|--|--------|-------------------|----------------------|---------------------|-------------------|----------------------|---------------------|---------------------------------|-----------------------------------|
| Varieties | N Rate | Grain Yield kg/ha | Grain Increase kg/ha | Gain in YR/ha Grain | Straw Yield kg/ha | Straw Increase kg/ha | Gain in YR/ha Straw | Profit in YR/ha Grain and Straw | Profit YR/ha after deduct. N cost |
| 1 | | | | | | | | | |
| Sonalika | 0 | 1200 | - | - | 2040 | - | - | - | - |
| | 50 | 2200 | 1000 | 2000 | 2840 | 800 | 800 | 2800 | 2528 |
| | 100 | 2480 | 1280 | 2560 | 3200 | 1160 | 1160 | 3720 | 3175 |
| | 150 | 2640 | 1440 | 2880 | 3600 | 1560 | 1560 | 4440 | 3624 |
| 2 | | | | | | | | | |
| Dhumran ^a | 0 | 2560 | - | - | 3600 | - | - | - | - |
| | 50 | 2750 | 190 | 380 | 4800 | 1200 | 1200 | 1580 | 1308 |
| | 100 | 3110 | 550 | 1100 | 5600 | 2000 | 2000 | 3100 | 2556 |
| | 150 | 3000 | 440 | 880 | 4000 | 400 | 400 | 1280 | 464 |
| 3 | | | | | | | | | |
| Inia 66 | 0 | 2200 | - | - | 2000 | - | - | - | - |
| | 50 | 2800 | 600 | 1200 | 2040 | 40 | 40 | 1240 | 968 |
| | 100 | 3040 | 840 | 1680 | 2400 | 400 | 400 | 2080 | 1536 |
| | 150 | 3040 | 840 | 1680 | 2400 | 400 | 400 | 2080 | 1264 |
| 4 | | | | | | | | | |
| Bouni (local) | 0 | 800 | - | - | 1200 | - | - | - | - |
| | 50 | 900 | 100 | 200 | 1300 | 100 | 100 | 300 | 28 |
| | 100 | 1000 | 200 | 400 | 1300 | 100 | 100 | 500 | -44 |
| | 150 | 1000 | 200 | 400 | 1400 | 200 | 200 | 600 | -216 |

^aDhumran = Allondra 'S'

N.B. Price of one sack (50 kg) Ammonium sulphate nitrate 26%N = 68 YR one kg of grain = 2 YR; one kg of straw = 1 YR.

import system was used to satisfy the urgent need of increasing farmers' production. Recently, a seed multiplication system was established by the Ministry of Agriculture.

Verification trials were conducted at farmers' fields in major wheat and barley growing areas. As it shows from Table 3, HYVs have a different response to N rate. Variety Sonalika shows a good response up to 150 kg N as it was recommended by the research station. In the case of variety Dhumran, it gives good grain and straw yields at a rate of 100 kg N. As well, the variety Inia 66 has given maximum yields of grain and straw at 100 kg N/ha.

Previously, farmers were not accustomed to applying fertilizer to local varieties of wheat, because with fertilizer usage, the crops suffer from lodging and the percentage of rust infection was increased. Recently, with the introduction of HYVs, and its high assimilation rate of fertilizer which increase both yield of grain and straw, the usage of fertilizer was greatly expanded.

As a result, HYV wheat growers (500 ha) were very enthusiastic for demanding fertilizer and applied to the Agricultural Credit Fund for opening fertilizer selling agencies in their villages.

Agricultural practices and package deal to farmers

Results obtained from the use of better cultural practices in the experimental fields and research stations could be summarized as follows:

- (a) Seed bed preparation starts by ploughing the soil two times; first, using the mouldboard plough, and the second is at right angles to the first, using the chisel plough (weeds would be eradicated by hand during the interval period); then, pre-sowing using either the rotovator (for heavy soil) or the cultivator for light soil.
- (b) Sowing is done by hand in rows 25 cm apart with seed depth of 5-7 cm.
- (c) Fertilizer: the whole amount of P_2O_5 is added pre-sowing and nitrogen fertilizer is added in split doses —half dose pre-sowing and the second dose as a top dressing during the tillering stage.
- (d) Weed control is practiced by hand. Recently herbicides were applied and primary results indicated that "Bromial-W" gave the best results.

The package deal to farmers is:

- (a) Land preparation - Farmers are advised to plough their fields twice with an interval of at least two weeks to permit volunteer weeds to grow and eradicate weeds before the second ploughing, which should be at right angles to the first. Land levelling is performed by the farmers' system, because of the terrace system, and erosion would be a menace from rainfall.
- (b) Sowing - Distances among rows should be from 20-25 cm and seed depth 5-7 cm for HYVs. The drill machine was put into practice in some villages where wheat and barley are grown extensively. Farmers were encouraged to use the drill machine in the valleys, where the drill could work efficiently and economically, ensuring right distribution of seeds and fertilizer, etc.
- (c) Fertilizer - Addition of the whole amount of P_2O_5 - pre-sowing, and split the dose of nitrogen in accordance to the area at the pre-sowing and tillering stages. To facilitate the system to farmers, they were advised to use the compound 20-20-0, then top dress with ammonium sulphate, nitrate or any other source of nitrogen available in the market. In the case of potash, the farmers were advised to add the recommended amount (40 kg/ha), pre-sowing, if the previous crop were potato.
- (d) Herbicides are under test (as mentioned before) and farmers use hand weeding to feed their animals.
- (e) A combine machine was introduced in the areas where the drill machine was used. Actually, farmers bought the machine through a local cooperation system with a loan from the Rural Agricultural Credit Fund. The usage of the combine will encourage farmers to grow HYVs rather than local varieties, which are susceptible to lodging and give low economic return to cover the expenses of the machine. The problem was the straw which the farmers are used to getting was very fine. They were advised to refine it afterwards by

their own methods (oxen system). In comparison, small threshing machines in different sizes to suit the different systems (valleys and terraces) were introduced and used by farmers.

Farmers' common practices

Traditionally, farmers use local ploughs (oxen pulled) in land preparation, by ploughing soil twice; first after the previous crop, and the second before the rainy season. The local plough takes a long time in preparing soil, which raises the inputs of production. Farmers then start sowing in rows 35-40 cm apart (behind the plough) and seed at a depth from 10-15 cm for local varieties, in the belief that it would help in giving the local varieties support against lodging and for moisture purposes. This practice suits local varieties but this seed depth does not suit HYVs. As far as fertilizer is concerned, farmers are not used to adding any sort of fertilizer to either local wheat or barley varieties.

Difficulties confronting farmers

1. Equipment, e.g. machinery for land preparation are available on the market, especially tractors and mouldboard ploughs, and more recently chisel ploughs and cultivators were introduced. Mechanization is concentrated in the valleys and the sea level lands. There is an intensive program for advancing the design of small equipment adequate for the terraces on the mountains. The main problem is lack of technical centers and maintenance.

2. Fertilizer supplies are available on the market and the price is nearly fixed at 68 YR per sack of 50 kg of any kind of fertilizer, regardless of the container (about \$300 per ton).

3. Seed supplies are available to the farmers, either under contract or by deduction of the amount from the crop after harvest. Price of seeds is 2 YR per kg (\$440 per ton).

4. Herbicides are under experimental tests. Primary results have indicated that herbicides could be more efficient rather than hand weeding. Actually, weeds do not form a serious problem in farmers' fields under rainfed conditions, but could be a problem in high rainfall or irrigated areas.

5. The supply of laborers and their wages is a serious problem which could be one of the limiting factors in production due to the well-organized and continuous emigration of the laborers to neighbouring countries. Consequently, their wages were raised to a high level (50-80 YR/day), and production inputs rose; in contrast, the price of grain is nearly fixed and sufficient amounts of grain are available on the market at any given time. As a result, horizontal expansion of production keeps constant.

6. Difficulties encountered during the growing season are hazards in the environment, such as hail, frost, drought and unexpected heavy showers in the last stage of maturity. Farmers' practices at harvest time lead to a 5-10 percent loss by cutting the crop, tying in bundles, then carrying it by animals to the outskirts of the villages where it is piled until threshing by traditional methods. Leaving the crops for long periods unthreshed may expose it to out of season showers, which leads to sprouting and bad quality of seeds. Consequently, yield of both grain and straw are badly affected. This problem is on the way to being overcome by using the combine and threshing machines, which farmers are enthusiastic to use.

Manpower

Manpower available for research in general is inadequate at all levels.

Future plans

Future plans are to raise production in a short period to arrive at the most economically feasible recommendations needed for the maximization of total production, and to carry such recommendations, in collaboration with the extension service, to farmers' fields. This target could be achieved as planned through the following ways:

1. Establishing sub-stations in different micro-environments for testing, screening lines/varieties and locating the adapted genotype for a given environment.
2. Test for heat tolerance in Tihama region in order to find a genotype which could give

satisfactory economical returns. This step could raise production horizontally. At present neither wheat nor barley is grown in the Tihama region.

3. Organize an efficient seed multiplication system and establish central grain quality laboratory.

4. Encourage application of mechanization as soon as possible to minimize the high cost of inputs which rose due to inflation (50 percent) and emigration.

5. Provide research programs with machines to increase efficiency and precision.

6. Introduction of HYVs in another micro-environment such as Mareb and Goaf (north eastern) and Saada (north of the country). This expansion of the cultivation of HYVs in new areas would assist in raising production vertically and horizontally.

7. Support research team and extension officers with enough personnel in order to increase their activities in both applied research and farmers' fields.

8. Train local staff in all detailed steps, plus training abroad, after they realize the problems of production in the country.

Summary

Wheat and barley are important crops in the Yemen Arab Republic, together occupying about 118,000 hectares. The production level of wheat is low, with the deficit between production and consumption being made up through imports. Barley production is adequate to meet local needs. Nearly all the barley and 90 percent of the wheat is grown under rainfed conditions. Many wheat varieties are grown with an overall yield level of 1.04 t/ha. The two principal barley varieties are Saklah and Aswad. Many promising new varieties are being tested, and several selected lines with wide adaptability, high yield capacity and disease and lodging resistance have been identified. Some diseases are important in the YAR, especially the rusts on wheat, and powdery mildew and *Helminthosporium* ssp. on barley.

In addition to on-site breeding work, verification trials are being conducted in farmers' fields in major wheat and barley growing areas. Agronomic research results have indicated a series of production practices that could greatly increase yields. These include primary and secondary cultivation, hand seeding and weed control. The replacement of local varieties with lodging resistant, high yielding varieties would allow the increased use of fertilizer. Recommendations concerning seeding rate, depth and row spacing have also been developed.

There are several problems confronting wheat and barley farmers in the YAR. Mechanization is advancing in large land holdings, but small terrace holdings do not easily lend themselves to the use of machines. Also, there is a lack of technical and maintenance facilities. Economic pressure results from scarce, expensive labor, compounded by fixed grain prices. Finally, lack of threshing and storage facilities results in postharvest losses.

Steps now being taken to increase wheat and barley production include introduction of new HYVs, breeding for specific micro-climates and the set-up of a seed multiplication system. A larger extension effort is also planned, especially with regard to mechanization.

CONTRAINTES LIMITANT LA CEREALICULTURE EN REPUBLIQUE ARABE DU YEMEN ET LES DIFFERENTES SOLUTIONS POSSIBLES

Résumé

Le blé et l'orge sont d'importantes cultures au Yémén, occupant près de 118.000 ha. Les niveaux de production de blé étant bas, le déficit est comblé par les importations. Par contre, la production d'orge couvre la demande locale.

La grande majorité du blé (90%) ainsi que tout la culture d'orge se font sans irrigation; le rendement moyen de plusieurs variétés principales d'orge cultivées au Yémén sont Saklah et Aswad et elles subissent des dégâts importants à cause du Mildiou et de l'*Helminthosporium* spp. Actuellement de nouvelles variétés et plusieurs lignées obtenues par sélection sont testées pour leur adaptabilité, leur haut rendement, leur résistance aux maladies et à la verse.

En addition aux travaux in situ en station de recherches, des essais de vérification sont entrepris dans les surfaces céréalières importantes du pays. Les résultats des études agronomiques montrent que l'amélioration des techniques culturales et le rendement des variétés traditionnelles par des variétés à haut rendement et résistantes à la verse pourraient améliorer la production (i.e. préparation du sol, désherbage, engrais. . .).

De plus, malgré une forte mécanisation sur les grandes propriétés, il existe un manque de personnel et de matériel sur les petites surfaces de culture. Finalement, le manque de matériel de battage et de lieux de stockage entraînent d'énormes pertes post-moisson.

Actuellement, de gros efforts sont entrepris au Yémén tant au niveau de la mécanisation qu'à celui de la production de semences, de l'adaptation aux microclimats ainsi que par l'introduction de variétés à haut rendement.

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Actuellement, de gros efforts sont entrepris au Yémén tant au niveau de la mécanisation qu'à celui de la production de semences, de l'adaptation aux microclimats ainsi que par l'introduction de variétés à haut rendement.

CONSTRAINTS TO CEREAL PRODUCTION AND POSSIBLE SOLUTIONS IN AFGHANISTAN

Crop production in Afghanistan is dominated by cereals (wheat, barley, maize and rice) which occupy about 90 percent of the total area under arable crops. The remainder is shared by the fruits, vegetables and industrial crops. The agriculture research was initiated in 1963, but gained momentum only in 1966. Most of the agricultural research is carried out by the Research and Soil Science Department of the Ministry of Agriculture and Land Reforms headed by a President. The Department has recently been re-organized and consists of six divisions: viz., *Crop Improvement Agronomy, Soil Science, Plant Pathology and Entomology, Horticulture and Vegetables, and Administration and Statistics*. A brief account of present research status of cereals is presented below:

A. Wheat:

Wheat is grown in all parts of our country both under irrigated and dry land conditions. It accounts for about 63 percent of the total area under cereals and is by far the most important crop so far as cereal production is concerned. Before 1966, wheat was grown with traditional methods and as a result the yield was 1.3 t/ha under irrigated and 0.4 t/ha under dry farming conditions. After 1966, as a result of introduction of high yielding varieties and application of chemical fertilizers coupled with better cultivation practices, both yield and production have shown an upward trend. There was a set-back in 1970-71 because of drought. Now an average yield is about 1.2 t/ha taking into account both irrigated and rainfed crop.

B. Barley:

The area occupied by barley is reported to be about 350,000 hectares in recent years with an average yield of about 1.0 t/ha.

C. Triticales:

It has not so far been grown commercially, but there is a vast potential for triticales production in the country.

Afghanistan is a land-locked mountainous country. The climate is diverse and generally continental, characterized by hot dry summers and cold wet winters with wide fluctuations in temperature. Rainfall varies considerably from year to year and also with altitude and locations. During the last crop year, the average precipitation was below normal (308 mm) with unusual rainfall at wheat crop maturity and harvest, which caused floods and lowered the production.

Afghan soils are highly calcareous and low in organic matter due to continuous cropping and removal of crop-residues. But, there is no evidence of trace element deficiency in winter cereals. The main limiting elements are nitrogen and phosphorus which are supplemented with nitrogen and phosphate commercial fertilizers. The nitrogen source used is not imported. The last item is supplied with a subsidy by the Government. The fertilizer use is mainly restricted to improved varieties, because there is no response by local cultivars. In addition, the farmers may not have cash in hand to buy fertilizers. The Government is now paying attention to the supply of inputs through the Agricultural Bank and Service Cooperatives, and removing the bureaucratic procedure in the selling and distribution of credits and inputs by dealers in provinces and districts. The recommended dosage is 80 kg N/ha and 50 kg P_2O_5 /ha for irrigated wheat. There is sufficient supply of fertilizers in the country at present.

The yields per unit area have not gone up substantially due to the lack of irrigation facilities and inadequate fertilizer use and the lack of adequate seed of improved varieties available to the farmers which in turn is due to the lack of an organized seed industry in the past. The fertilizer and wheat prices are fixed by the Government at the subsidized rates before the sowing time in order to encourage the grower to apply the fertilizers and sow improved seeds. Weeding of winter cereals is not common among farmers, because they consider weed as a source of feed for livestock after harvest. Only few farmers may weed by hand or by applying 2,4-D.

The causes of low yields are primitive methods of planting, more than one wheat and barley variety mixed together, incidence of rusts, lodging, poor quality of seed, inelastic attitude of the farmers, growing cereals on marginal lands without using adequate fertilizers, unscientific cultural methods, lack of trained personnel to train and guide farmers on new innovations, aberrant and uncertain weather conditions especially in the case of dry land farming, lack of adequate irrigation water, lack of credits and other facilities to boost crop productivity. The land is also not being used efficiently because of defective tenancy and share cropping systems. There is only a limited number of research stations at present to cater for the regional needs. The present research capability and infrastructure has been built only within the past two decades and is therefore still in the formative stage.

The economy of Afghanistan, with 85 percent of its population in the rural areas, depends largely upon agriculture. The yield has to be augmented in order to increase the productivity of agriculture.

The yield in research stations is 6-7 t/ha while the national average is only 1.3 t/ha. The increase is attainable by having a problem oriented breeding program. This increase in yield could be achieved by the strong deployment of improved agro-practices and an integrated insect-pests and breeding program to develop new varieties by a strong research infrastructure and extension network.

The package of improved practices for wheat and barley and the timely availability of inputs, viz., seeds, fertilizers, pesticides and credits and improved cultural practices for soil preparation, water use and the perfection of pre- and postharvest technology are essential to enhance yields.

The Government is now giving land free to its actual tillers who did not have land before. They will now work on their own land. This is a strong reason for increasing production potential of cereals. It is expected that in the near future the gap between present farm levels and potential will be reduced and the productivity of the farms will be doubled.

The effectiveness of agricultural research program in Afghanistan appears to be severely constrained by insufficiency of funds, trained manpower, equipment, restrictive administrative management procedures, an inadequate number of research stations,

operation and management. It is not realistic to expect Afghanistan to mount a fully comprehensive research program in the immediate future. It is therefore, suggested that the research program should concentrate on the following three areas of activity in order to make an immediate impact on production:

1. Local level field trials on major field crops
2. Adaptive research
3. Production of foundation and certified seed of principal crops.

There is a substantial quantity of knowledge available internationally on major food crops and the Research and Soils Department should concentrate on adapting this knowledge to local conditions. A large number of field trials should be conducted to determine optimal basic production practices. These should include appropriate varieties, fertilizer application, seeding time and spacing, scheduling of irrigation, weed and pest control, etc. It must be stressed that these field trials are carried out at the local level and not just at regional or national level, to ensure that the recommendations thus obtained, really do apply to local conditions.

These field trials should be carried out in close collaboration with the Extension Department with the objective of determining the appropriate set of production practices to be promoted by the Extension Department through production campaigns.

Summary

Wheat, barley, maize and rice occupy about 90 percent of the total area under arable crops. Most of the agricultural research is conducted by the Ministry of Agriculture and Land Reform. Wheat accounts for 63 percent of the total cereal area. Present day (averaged) yields for irrigated and non-irrigated wheat is 1.2 t/ha. Barley is sown over 350,000 ha and has an average yield of 1.0 t/ha. Triticale is not yet grown commercially but a vast potential exists for its production.

The climate is diverse and is characterized by hot dry summers, cold wet winters, wide temperature fluctuations and considerable rainfall variation. The soils are calcareous, low in organic matter, nitrogen and phosphorus. Fertilizer use is mainly restricted to improved varieties. The recommended dosage for irrigated wheat is 80 kg N/ha and 50 kg P₂O₅/ha.

There has been no significant increase in yield/unit area due to lack of irrigation, inadequate fertilizer use and insufficient seed of improved varieties. Generally crop weeds are not removed as they are regarded as livestock feed after harvest. Seeding methods are primitive, wheat and barley varieties are mixed together, lodging and rusts occur, agronomy is poor, funds are inadequate, technical and extension staff are insufficient, there is a lack of credits and the land tenancy system is defective — all of which contribute to low yields. The wheat yield in research stations is 6-7 t/ha while the national average is only 1.2 t/ha. All the above yield limiting factors need to be corrected to enhance farmer yields.

The research program should concentrate on localized field trials, adaptive research and the production of foundation and certified seeds.

CONTRAINTES LIMITANT LA CERÉALICULTURE EN AFGHANISTAN ET LES SOLUTIONS POSSIBLES

Résumé

Le blé, l'orge, le maïs et le riz occupent environ 90 pour cent de la superficie totale de la terre arable. La plupart de la recherche agricole est conduite par le Ministère de l'Agriculture et la Reforme Agraire. Le blé compte pour 63% de la superficie totale céréalière. Aujourd'hui les rendements (moyennement) pour le blé irrigué et non-irrigué est 1.2 t/ha. L'orge est semée au-dessus de 350.000 ha et a un rendement moyen de 1.0 t/ha. Le triticale n'est pas encore cultivé commercialement mais un vaste potentiel existe pour sa production.

Le climat est variable et est caractérisé par des étés chauds et secs, et des hivers froids humides, des larges fluctuations de température et une variation considérable de précipitation. Les sols sont calcaires, bas en matières organiques, azote et phosphore. L'utilisation des engrais est principalement restreinte aux variétés améliorées. La dose recommandée pour le blé irrigué est de 80 kg N/ha et de 50 P₂O₅ kg N/ha.

Aucune augmentation significative dans le rendement/unité de superficie a été enregistrée, dû au manque d'irrigation, à l'utilisation inadéquate des engrais et à l'insuffisance de semence des variétés améliorées. Généralement les mauvaises herbes ne sont pas éliminées autant, parce qu'elles sont considérées comme fourrage après la récolte. Les méthodes de semis sont primitives, le blé et l'orge sont mélangés, la verse et la rouille existent, l'agronomie est pauvre. Les fonds sont inadéquats, le personnel technique et vulgarisateur sont insuffisants. Il y a un manque de crédits et le système de la location est défectif, tout cela contribue aux rendements bas. Le rendement du blé dans les stations de recherche est de 6-7 t/ha, tandis que le moyen national est seulement de 1.2 t/ha. Tous les facteurs limitants ci-dessus nécessitent d'être corrigés pour élever le rendement de l'agriculteur.

Le programme de la recherche doit concentrer sur les essais de champ la recherche adaptative et la production de semence de fondation ou certifié.

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Le programme de la recherche doit concentrer sur les essais de champ la recherche adaptative et la production de semence de fondation ou certifié.

WINTER CEREAL CROPS IN EGYPT CONSTRAINTS TO CEREAL PRODUCTION AND POSSIBLE SOLUTIONS IN EGYPT

A.S.A. Gomaa*

Wheat

Wheat is the main winter cereal crop in Egypt. It is the staple food of the urban areas and is used widely in blending with maize flour in rural areas. Wheat outranks rice in terms of cash value of the crop. It is also worth mentioning that the wheat straw is a source of fodder for feeding animals.

Wheat areas from about 1950-1978 have ranged from about 500,000 hectares to 700,000 hectares. This represents 23-29 percent of Egypt's total cultivated area of approximately 2.4 million hectares.

Yields have tended to increase in wheat gradually over the 1950-1978 period. The release of improved varieties has figured prominently in this increase. During recent years, however, there appears to be a tendency for wheat yields to plateau around 3.3 t/ha.

The production of wheat has increased over the past years, but not nearly so rapidly as the demand. Quantities of wheat imports continue to rise rapidly. In 1976 wheat production was about 2 million tonnes. Since the population increase is about 2.5 percent a year, and if per capita consumption remains constant, the 1982 apparent annual consumption for wheat will be 6.7 million tonnes.

A wheat yield of 3.3 t/ha appears to be high. It should be remembered that all agriculture in Egypt is "irrigated agriculture", that favorable climatic conditions exist (i.e. sunlight and temperature), and that in general soils are good. In light of this, it should be feasible to increase the wheat yield substantially. An apparent increase of about 20 percent can be expected to come from the use of improved germ plasm alone.

Better varieties are presently being developed in wheat but there is still room for continuous germ plasm improvement. It should also be remembered that additional yield increases can come from improving greatly on-farm soil, water management and drainage efficiency.

Efforts in this area, if massive enough, should produce additional yield increases. Although improved germ plasm will always offer opportunities for continued yield increases, it is believed that a large share of the yield increase will come from improved crop management (better soil and water management, increased plant density, higher levels of fertilizer and better weed control).

With respect to the commercially grown wheat varieties, the majority of the area is sown to the tall Egyptian varieties such as Giza 155 and Giza 156. The remainder of the area is sown to the semi-dwarf variety Chenab which will be replaced by the newly released varieties in the coming 1979-80 wheat season. In Middle and Upper Egypt, a number of local cultivars, many of them durum wheats, are commonly found. A summary of the 1978 estimated production is shown in Table 1.

TABLE 1. - Estimated Yields, Area and Production of Wheat in Egypt, 1978

| VARIETY | YIELD t/ha | AREA ha | PRODUCTION (tonnes) |
|-----------------------------|---------------|------------|------------------------|
| Giza 155, G..156 | 3.21 | 454,535 | 1,456,815 |
| Semi-dwarf varieties | 3.82 | 122,026 | 466,492 |
| Others (local cultivars) | 2.94 | 3,296 | 9,756 |
| Average total | 3.33 | 579,857 | 1,933,063 |

Development of new varieties

Wheat research work has been aimed at the ultimate goal of raising the production vertically. That is, it could be achieved through the use of high yielding varieties and improving the agricultural practices. The activities could be summarized as follows:

Breeding research achieved forward steps in the past ten years by releasing the variety Giza 155 in 1968 and Giza 156 in 1972. These two varieties alone raised the national average from 2.62 t/ha during 1968 to 3.10 t/ha during 1972.

In 1973, the two short statured, high yielding and fertilizer responsive varieties Mexipak and Chenab were recommended for cultivation, besides Giza 155 and Giza 156. As a result the national average reached 3.3 t/ha during 1976.

The variety Mexipak was eliminated from cultivation after 1977, due to shattering and disease problems. The wide-spread cultivation of the variety Chenab during 1976-77 season changed the leaf rust race spectrum due to the rapid build up of the pathogen population on this variety. Therefore, its area declined during 1978 season, and this season it is not among the recommended varieties for cultivation.

In 1976, further progress was achieved by releasing the following new varieties:

Giza 157: G.155 (Pitic 62⁴-L.R. 64²/TZ pp - Knott II).

Giza 158: G.156 x 7c.

(Sakha 8): Indus 66 x Norten "S" - PK. 3418-6s os

Giza 157 and Sakha 8 show good resistance to the three rusts and resist shattering. Thus, both varieties are recommended for commercial cultivation in the Delta region where rust is epidemic.

In addition, G. 157 is also recommended to be grown in Middle Egypt region. The variety G. 158 is highly resistant to stem rust and tolerates stripe and leaf rusts; besides it is highly resistant to shattering. Therefore, it suits the conditions of Upper Egypt. The durum variety

Mexicali (Stork 'S') is also recommended to be grown in Middle and Upper Egypt. These four new varieties were grown in 4,000 hectares during the last season and now they are grown in approximately 30,000 hectares.

Our projection for 1980, is that the newly released varieties will raise the national wheat yield average to approximately 3.8 t/ha as compared with 3.3 t/ha during the 1978 season.

Furthermore, five new lines look very promising in the yield trials during the last three years. These lines are:

Sakha 61 and 69; Inia - R.L. 4220 x 7c/Yr 'S'

CM-15430 - 2s - 5s.

Sakha 62 and 79; We - G to - Kal Bb.

CM-8288-A13M-IY-IOM-IY-IM-os-osw

Sakha 80; Vem Cno 'S' - 7c/Kal - Bb.

CM-8399 - D - 4M-3Y-3M-IY-IM-os.

These new lines outyielded the newly released varieties; G.157, G.158 and Sakha 8 by about 10 percent. Besides, they exhibit stability in performance over all tested sites, which will contribute to stabilizing wheat production in Egypt. In view of that, the policy is to push forward seed multiplication and distribution of these five new lines. In fact, they are each grown this season in 20 acres.

Our durum wheat breeding program was started 6 years ago, and we will be able to distribute quantities of our promising durum material two years from now.

As indicated earlier, approximately 4 million tonnes of wheat are to be imported and this amount of importation will be reduced by encouraging wheat production. As solutions to this, we are now trying to introduce wheat growing to newly reclaimed areas where stresses exist. Thus, our national program includes the following:

1. To select and adapt barley and wheat material to salt affected soils. The alternative is to improve the fertility of the soil and to increase the drainage efficiency. Due to the extensive agriculture we have in Egypt, and accordingly to the application of higher doses of fertilizers and to poor management in irrigation water, the water table is increasing, thus deteriorating the soil and increasing salty conditions.

The data we have are encouraging, because several lines of barley showed tolerance to salt at 25,000 ppm and wheat resists the salt up to 20,000 ppm.

2. A project being initiated for developing barley and wheat material tolerant to drought conditions. This is applicable to the Northern Eastern Coastal regions, the new valley and the Sinai peninsula. The average rainfall during winter fluctuates between 150-200 mm. To ensure the crop, two supplementary irrigations should be given.

3. To develop heat tolerant material of wheat and barley, and adapt them to high temperatures. This is mainly conducted in Upper Egypt, where temperatures are considered high during planting, anthesis, heading and maturity.

4. To breed for very early varieties, with high yield potential, so that we can grow three crops per year on the same land.

Quality

In spite of shortage of wheat production in Egypt, the breeders are trying to improve wheat quality from the nutritional point of view. There has been a material increase in protein content in old wheat varieties from 7.5 percent to 10 percent in the newly released varieties. Still, baking qualities and industry have to be improved. Also, the lysine content has to be increased. Thus, an outstanding breeding program for quality in the segregation populations has to be conducted, but with the main emphasis on high yielding material.

Cultural practices

Parallel to the release of high yielding varieties, intensive studies were conducted on the most important cultural practices on both tall and short varieties. The results obtained could be summarized as follows:

- (a) **Date of sowing:** It was obvious that delayed plantings usually give low yield averages as compared with early ones. In Lower Egypt, the optimum sowing date for the

commercially grown varieties is around the second ten days of November, and ten days later in Middle and Upper Egypt.

(b) **Rate of seeding:** Seed rate varies considerably with the applied varieties and method of seeding. Seeding rates ranging from 120-170 kg/ha are recommended for the present commercially grown varieties in dry and wet plantings, respectively. As hand broadcasting is the dominant sowing method at present (mechanization is very limited), it is difficult to establish accurate plant spacing and seed depth which are very important factors in wheat production under our conditions. Yield average and its stability may be affected considerably, depending upon plant stand and density per unit area.

(c) **Application of fertilizers:** Experimental results indicated that the economic dose of nitrogen for the short varieties is 170 kg N/ha while 100 kg N/ha for tall varieties has proved satisfactory. Apparent interaction of fertilizers was also observed. Thus, 40 kg P₂O₅ is also recommended to be added at land preparation.

In addition, higher yield levels of the same varieties were realized by injecting ammonia in the soil.

(d) **Time of nitrogen application:** The data obtained indicated that application of nitrogen at either three equal amounts—during planting, first irrigation (two weeks after planting) and second irrigation—or at two times, one third during planting and two thirds at the first irrigation—resulted in increasing the yield as compared with other treatments tested.

(e) **Water requirements:** Five and six light irrigations at three weekly intervals proved sufficient under the conditions of Lower and Upper Egypt, respectively.

Present situation in mechanization

Wheat cultivation and production in Egypt so far still depends to a very large extent on both human and animal power. Applying farm machinery in wheat production in experimental farms had raised the yield average by about 25 percent. There is a big gap between experimental results and traditional farming production. Therefore, research work should include the introduction of farm machinery and its adaptation to serve the wheat growers, especially those having small holdings.

Barley:

The area for barley is about 50,000 hectares and this is all under irrigation with an estimated average yield of 2.97 t/ha. There is also a large area where plantings are done on the Northern Eastern Coast, where rainfall occurs. This area fluctuates greatly each year and has been estimated to reach 60-80 thousand hectares but the production is erratic and crop failures often occur. There are no accurate figures regarding the yield of barley in this area but the rainfall varies between 80-200 mm per year and yields probably range between 650-900 kg/ha.

Most of the barley in Egypt is used for animal feed or rarely for human food with approximately 10 percent being used for malting purposes.

A number of diseases occur in the irrigated areas. It is common to find *Helminthosporium teres* (net blotch), and spot blotch is also readily found. Leaf rust can be severe and powdery mildew is common. Aphids are becoming an increasingly important problem. In recent years birds have become a serious problem for barley.

There has been limited breeding work since 1921. Over the years a number of varieties have been selected and released.

The six-rowed barley varieties Giza 119 and Giza 121 now occupy about 90 percent of the area allocated to barley. Bonus is the other principal two-rowed variety being cultivated and used for malting. Some of the new promising lines are:

Cross 366/13/2: (Giza 116 x Bahtim 52);

Cross 366/16/2: (Giza 118 - FAO 86); composite

Cross 89; Strain 205 and Line 207/14

The program is concentrating on the developing of shorter and better strawed varieties. The incorporation of better disease resistance is being continued. Our breeding program is also aimed at incorporating higher nutritional values through the use of higher protein

lines. There is also a project being initiated for developing salt tolerant varieties for some of the coastal areas.

For the commercially grown barley varieties, the optimum seed rate is 100-125 kg/ha depending upon the method of sowing whether dry or wet and also upon the soil type. November is considered the optimum sowing date over all the nation. As for nitrogen fertilizer rates, 75 kg N/ha could be regarded as the recommended rate.

Research staff

The staff in wheat and barley research work is ample; in fact most research stations are over-staffed. Nevertheless, there is evidence of a number of problems which have severely reduced its effectiveness in recent years. Research has been less successful in recent years than in the fifties and sixties in generating a stream of profitable innovations for increasing the productivity of the farming system. Linkages between research and extension, and between research and farmers, are totally inadequate.

The gap between present farm yield and the potential for wheat production

It is of importance to mention that the gap is big between the national yield average as compared with the experimental average of the same variety. The national average yield of the local varieties Giza 155 and Giza 156 is about 1.3 t/feddan (1.038 acre) whereas the experimental average is about 2 tonnes. Also, the national yield average of Chenab is 1.6 t/feddan whereas its average as shown in the yield test is about 2.3. The yield average of the two newly released varieties Giza 157 and Sakha 8 is about 2.5 t/feddan. These two varieties were grown in 1000 feddans last year with an average production of 2.0 t/feddan. However, this year they are grown in 10,000 feddans and the expected average will be about 1.8 t/feddan. Our plans are to grow these two new varieties Giza 157 and Sakha 8 in only 500,000 acres and our expectation is that their yield will average 1.7 t/feddan.

TABLE 2. Mean wheat yields (kg/feddan) from trials conducted by the Wheat Research Section during the 1977-78 season (i.e. "D" trials).

| Entry Name | REGION | | | | | | | |
|----------------|--------|-------|--------------|-------|-------------|-------|--------|-------|
| | 1 | | 2 | | 3 | | 4 | |
| | Delta | % | Middle Egypt | % | Upper Egypt | % | Egypt | % |
| | kg/fed | Local | kg/fed | Local | kg/fed | Local | kg/fed | Local |
| Chenab 70 | 2161 | 107 | 2510 | 126 | 1066 | 106 | 1919 | 115 |
| Giza 157 | 2335 | 116 | 2374 | 120 | 1107 | 110 | 1939 | 116 |
| Giza 158 | 2061 | 102 | 2568 | 129 | 1003 | 99 | 1878 | 112 |
| Sakha 8 | 2336 | 116 | 2490 | 125 | 901 | 89 | 1909 | 114 |
| Line 3590-2653 | 2229 | 111 | 2543 | 128 | 943 | 94 | 1905 | 114 |
| Line 1628-2973 | 2221 | 110 | 2581 | 130 | 1165 | 116 | 1991 | 119 |
| Line 1628-2981 | 2311 | 115 | 2526 | 127 | 922 | 91 | 1920 | 115 |
| L.R. 64-Son. | 2105 | 104 | 2147 | 108 | 919 | 91 | 1721 | 103 |
| Sakha 60 | 2239 | 111 | 2672 | 135 | 928 | 92 | 1946 | 117 |
| Sakha 61 | 2303 | 114 | 2689 | 136 | 1101 | 109 | 2031 | 122 |
| Sakha 62 | 2281 | 113 | 2169 | 109 | 1000 | 99 | 1817 | 109 |
| Giza 155 | 2016 | 100 | | | 1018 | 100 | | |
| Giza 156 | | | 1984 | 100 | | | 1669 | 100 |

1 - Mean of 16 locations

2 - Mean of 7 locations

3 - Mean of 2 locations

4 - Mean of 25 locations

5 - Local variety in the Delta and Upper Egypt is Giza 155 and in Middle Egypt is Giza 156

Constraints facing maximized national production

Constraints to increased cereal yields and production are identified and summarized as follows:

A - Biological and technical constraints

- (1) Soil salinity associated with poor water management, excess irrigation and poor drainage.
- (2) Shortage of nitrogen fertilizer as well as as possible need for other major and minor elements, especially at high N levels. In addition, hand fertilization appears to result in poor distribution.
- (3) Plant densities which are too low or uneven to produce high yields and make efficient use of high nitrogen levels. Poor stand may often be associated with seeding by hand and the consequent poor distribution and seed cover.
- (4) Farmer preference for "Local" varieties instead of improved cultivars.
- (5) Poor weed control, a major problem in wheat and barley fields.
- (6) Poor management practices, such as:
 - a. Poor tillage, especially at primary tillage and planting.
 - b. Late planting. This again relates to tillage as well as to timely removal of the previous crop.
 - c. Late harvesting of cereals, resulting in grain lost to shattering and transport.
- (7) Insect damage to wheat and barley.
- (8) Disease damage due to leaf, stem and stripe rusts in wheat.
- (9) Shortcomings in the improved varieties themselves.
- (10) Lack of modern seed cleaning equipment to produce high quality seed.

B - Institutional and policy constraints

- (1) Segmentation of the various research and production efforts on the same crop into various institutions and sections.
- (2) A complex of an excess number of staff, short working hours, and poor salaries.
- (3) A bureaucratic (routine) system which prevents the efficient and timely execution of tasks.
- (4) The system of staff advancement and promotion based largely on journal publications and on seniority.
- (5) Inadequate program equipment and funds to support an effective research and extension effort.
- (6) Confounding of the experiment station system and the state farm system. The objectives of the two are very different.
- (7) Limited incentives to the farmer caused by low, regulated prices for produce and designated management production control.
- (8) Necessary quantities of quality inputs not readily available to the farmer (largely seed and fertilizer).
- (9) Research information is not being made readily available to the farmer.
- (10) Apparent lack of a dynamic, aggressive and well-funded extension system.
- (11) Lack of cooperation and communication between departments within the Ministry of Agriculture.
- (12) Due to severe shortage in plot machinery it is becoming very difficult to handle all of our testing program, especially on farmers' fields. In fact, we are discarding 30-50 percent of the trials as they lack the precision and accuracy due to less management and control.

Possible Activities for Reducing Cereal Production Constraints

Constraint No. 1:

Soil salinity associated with poor water management, excess irrigation and poor drainage.

Suggested activities:

- (1) Conduct research pertaining to irrigation and water use of cereals.
- (2) Breed for resistance to saline conditions.

- (3) Conduct on-farm water management trials.
- (4) Develop a package program of information on proper irrigation techniques to be disseminated to farmers.

Possible gain in production: 10-15 percent.

Constraint No. 2

Shortage of nitrogen fertilizer as well as a possible need for other major and minor elements, especially at high N levels. In addition, hand fertilization appears to result in poor distribution.

Suggested activities:

- (1) Increase nitrogen fertilizer production.
- (2) Breed cereals which are able to respond to less than optimum amounts of fertilizer.
- (3) Conduct fertility trials to determine the amounts of fertilizer needed for each variety.
- (4) Analyze soils for macro and micro elements and determine critical levels.
- (5) Mechanize the application of fertilizers for better distribution.
- (6) Conduct on-farm trials and demonstrations.
- (7) Extend fertilizer information to the farmer.

Possible gain in production: 5-10 percent.

Constraint No. 3:

Plant densities which are too low or uneven to produce high yields and make efficient use of high nitrogen levels. Poor stands may often be associated with seeding by hand and the consequent poor distribution and seed cover.

Suggested activities:

- (1) Encourage the production of high quality commercial seed.
- (2) Determine proper plant densities through research.
- (3) Develop mechanical planters for uniform seed distribution and uniform planting depth.
- (4) Disseminate research information about seed cultivars, seed quality, and date and rate of seeding to farmers.

Possible gain in production: 5-10 percent.

Constraint No. 4:

Farmer preferences for "local" varieties instead of improved cultivars.

Suggested activities:

- (1) Breed cultivars which are sociologically and economically acceptable to the farmer.
- (2) Educate farmers to the value of new cultivars by on-farm trials and demonstrations.

Possible gain in production: 10-15 percent.

Constraint No. 5:

Poor weed control, a major problem in wheat and barley.

Suggested activities:

- (1) Develop a weed control research program using chemicals, mechanization, cultural practices and/or a combination of different methods. Determine proper herbicide rates and study residue carry over.
- (2) Conduct on-farm trials and demonstrations.
- (3) Disseminate weed control information to the farmers.
- (4) Keep current on the development of new herbicides through journals, contacts with chemical companies and meetings.

Possible gain in production: 5-10 percent.

Constraint No. 6:

Poor management practices, such as:

- (1) Poor tillage practices, especially at primary tillage and planting.
- (2) Late planting. This again relates to tillage as well as to timely removal of the previous crop.
- (3) Late harvesting of cereals, resulting in grain lost to shattering and transport.

Suggested activities:

- (1) Through research, develop a package of cultural practices and test them in farmers' fields.
- (2) Develop machinery, for primary tillage through to harvesting. Timeliness is a major factor and machinery should increase efficiency over the entire production process.
- (3) Cooperate with other commodity groups, such as cotton, for mechanizing their harvest so that there will be no delay in wheat or barley seeding.
- (4) Breed cultivars resistant to shattering.
- (5) Educate the farmer to the benefits of good cultural practices from seed bed preparation to harvest. Use on-farm trials and demonstration tests to show the farmer the benefits that are possible.

Possible gain in production: 10-15 percent.

Constraint No. 7:

Insect damage to wheat and barley.

Suggested activities:

- (1) Breed varieties resistant to aphids.
 - a. Evaluate foreign and native material for insect resistance.
 - b. Develop artificial insect infestation, so germ plasm can be evaluated.
- (2) Evaluate new insecticides by conducting rates and time of application experiments, etc.
- (3) Evaluate cultural practices that help reduce insect populations.
- (4) Evaluate biological control methods.
- (5) Develop an integrated pest management control program using combinations of all factors listed above.
- (6) Develop a program of early detection of insect infestation so control measures can be considered before economic losses occur.
- (7) Through extension, develop a program of education for the farmer to aid him in insect identification and control methods.

Possible gains in production: 15-20 percent.

Constraint No. 8:

Disease damage due to leaf, stripe and stem rusts in wheat and stem rust, powdery mildew and net blotch in barley.

Suggested activities:

- (1) Breed varieties resistant to diseases.
 - a. Evaluate exotic and native genotypes for disease resistance.
 - b. Develop broad germ plasm pools of resistant material.
 - c. Develop disease nurseries such that germ plasm can be evaluated.
- (2) Evaluate new fungicides.
 - a. Conduct rates and time of application, etc.
- (3) Evaluate cultural practices that help reduce fungi population.
- (4) Evaluate biological control methods.
- (5) Develop an integrated disease control management program using combinations of all factors listed above.
- (6) Develop a program of early disease detection such that control measures can be considered before economic losses occur.

(7) Extend information to the farmer on disease identification and the control methods available.

Possible gain in production: 15-20 percent.

Constraint No. 9:

Shortcomings in the improved varieties themselves.

Suggested activities:

(1) Develop a dynamic breeding program for wheat and barley. All cultivars have shortcomings for there is no "perfect" cultivar. Continuous plant improvement program will be vigorously employed to meet the farmers needs.

(2) Testing imported cultivars:

a. A continuous effort should be made to test the best wheat and barley cultivars in the world.

b. Cooperate in planting International and Regional Cultivar Nurseries.

(3) Keep current on the developments of new cultivars, genotypes and breeding procedures through journals, meetings, additional training, etc.

Possible gain in production: 15-20 percent.

Constraint No. 10:

Lack of modern seed cleaning equipment to produce high quality seed.

Suggested activities:

(1) Establish seed production units at each Research Extension Center to produce quality seed.

(2) Provide technical assistance to Seed Department of the Ministry of Agriculture for the production, processing and distribution of quality certified seed.

(3) To extend appropriate assistance in the development of independent seed industry.

(4) Examining the feasibility of a specially funded agri-business project in seed cleaning and processing.

Possible gain in production: 5 percent.

Constraint No. 11:

Segmentation of the various research production efforts on the same crop into various institutes and sections.

Suggested activities:

(1) Establish research teams composed of various appropriate disciplines (e.g. plant breeding, plant pest control, soils, etc.) as required for problem solving.

(2) Provide for linkages between research and extension to disseminate cereals research results to the farmers.

Constraint No. 12:

Inadequate program equipment and funds to support an effective research and extension effort.

Suggested activities:

(1) Provide funds for construction of new, or remodeling of existing facilities.

(2) Acquire needed machinery and laboratory equipment.

(3) Provide vehicles for transportation of staff and materials.

(4) Provide funds for repairs, maintenance and operating costs.

Constraint No. 13:

Due to the apparent lack of emphasis on the extension function and the apparent absence of linkages between extension and research, adequate information regarding cereal production is not reaching the farmers.

Suggested activities:

(1) Administrative and functional linkages between research scientists and extension personnel are needed.

(2) The extensionists should obtain research information immediately after it is generated for use in rural areas.

(3) Research programs will focus more on adaptive rather than basic research. Thus research results will be more readily useful to farmers.

Finally, after the constraints which currently impede maximum production of wheat and barley in Egypt were identified, followed by a tentative list of suggested activities which should alleviate and/or reduce each constraint, it is worth mentioning that if all the proper technology were applied, wheat and barley grain yields could be increased by over 50 percent. However, in nearly all systems a certain amount of slippage occurs. If improved cultivars are developed, pests controlled, a package of cultural practices readied for delivery, sufficient fertilizer and all of this transferred to the farmer, a yield gain of 25 percent should be reached within five years, but only if the farmer has the proper incentive.

Summary

Wheat is the principal winter cereal grown in Egypt. In the period from 1950-1978, the area devoted to wheat has ranged from 500,000-700,000 ha, or some 23-29 percent of the cultivated area of Egypt. Although a production average of 3.3 t/ha has continued to grow more quickly than yield increases, yields are high. But it is important to remember that conditions are very favorable in Egypt, both climatically and agronomically. Using improved varieties and better crop management, it is hoped that yield levels will reach 3.8 t/ha in 1980. New varieties include Giza 157, Giza 158, Sakha 8 for bread wheat and Mexicali for durum. Yield gains are expected also from improved crop management, especially with regard to better soil and water management, increased plant density, higher fertilizer levels and better weed control.

Another source of production increases will come through increasing the area of production to include reclaimed areas where stresses exist. Principally, this will involve breeding varieties that are salt tolerant, drought resistant, heat tolerant or very early. Complementing the breeding program, agronomic studies have identified superior production practices related to sowing date, seeding rate, fertilization and irrigation requirements.

Barley occupies about 50,000 ha in Egypt with an average yield of 2.97 t/ha. In addition, large rainfed areas are planted along the Northeast coast although these are subject to crop failure due to drought in many years. The main goal of the barley breeding program is to develop shorter, stronger-strawed varieties with better disease resistance.

A considerable gap between farm and experiment station yield levels exists in Egypt. Various constraints have been identified, falling into two categories. Biological and technical constraints include such problems as salinity, poor stand establishment, use of unimproved varieties, poor weed control, late planting and later harvest and post harvest losses, all of which are in need of attention. A second category of constraints includes problems in the areas of policy, research, extension and communications.

CONTRAINTES LIMITANT LA CEREAUCULTURE EN REPUBLIC ARABE DE L'EGYPTE ET LES DIFFERENTES SOLUTIONS POSSIBLES

Résumé

Le blé est la principale céréale d'hiver cultivée en Egypte et durant la période 1950 - 1978 la surface emblavée en blé est passée de 500 à 7000.000 ha (23-29% des surfaces cultivées). Malgré une production moyenne de 3,3 tonnes par hectare, les demandes dépassent largement les offres. Les conditions climatiques et agronomiques étant très favorables en Egypte, on espère que sous de meilleures gestions et en utilisant des variétés améliorées, les rendements pourront atteindre en 1980 les 3,8 t/ha. Les nouvelles variétés incluent Giza 158, Sakha 8 pour le blé tendre et Mexicali pour le blé dur. On attend de plus un accroissement des rendements par de meilleures utilisation de l'eau et des sols, une augmentation de la densité des plantes, un taux plus élevé de fertilisation et un meilleur désherbage.

Une autre source possible d'accroissement de la production réside dans l'augmentation des terres emblavables dans le cas de forts besoins. Ceci entraîne le développement de variétés résistantes au sel, à la sécheresse, à la chaleur ou des variétés très précoces. En plus des études d'amélioration, des travaux agronomiques sont entrepris pour étudier les dates de semis, les densités de semis, la fertilisation et les besoins d'irrigation.

L'orge occupe une surface de 50.000 ha et offre un rendement moyen de 2,97 t/ha. De plus, le long de la côte Nord, de grandes surfaces sont emblavées en orge mais montrent des chutes de production dues à la forte sécheresse intervenue en certaines années. Les objectifs majeurs du programme d'amélioration de l'orge sont de développer des variétés plus courtes, à paille plus forte et à meilleur résistance aux maladies. Deux catégories contraintes entraînent des différences de rendements entre les stations expérimentales et les terres des fermiers: les contraintes biologiques et techniques telles que la salinité, de faible désherbage, des semis et des moissons trop tardives et des pertes postmoisson; la seconde catégorie de contraintes fait intervenir des problèmes de politiques agricoles, de vulgarisation et de communications.

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CONSTRAINTS TO CEREAL PRODUCTION AND POSSIBLE SOLUTIONS IN KENYA

Njogu Njeru*

1. General Introduction

Kenya is basically an agricultural country, not endowed with minerals and oil. The Equator cuts the country into two halves, but there is a wide range of ecological conditions due to altitude. Thus there are glacial peaks and semi-deserts. The altitude varies from sea level to nearly 6,000 m. Land utilization is determined by climate, topography and soil. Of these, the most important factor is climate, particularly rainfall.

The total area in the country is 58 million hectares of which 72 percent has a rainfall less than 500 mm/year in 4 years out of 5. Another 12 percent has between 750 and 1250 mm/year. Some of the area in the remaining 16 percent is wet, frosty and forested.

Wheat and barley are grown on land above 1800 m (Acland, 1971). Both are rainfed. While wheat is principally for bread, barley is used for malting and only small quantities fail to meet these requirements and are used for animal feed (although wheat bran and barley malt are useful by-products in the food industry). Durum wheat is produced in very small quantities. This discussion will therefore be restricted to bread wheat and barley, and will be brief.

Wheat and barley areas are shown in Figure 1.

2. Production

Wheat and barley both occupy approximately 140,000 ha (Table 1). Of this area wheat is grown on about 66 percent. The two are normally in areas where cropping intensity is fairly low as they are mainly on mixed, large-scale farms. Thus some of the zones have only 3.8 percent of land under crops and others have about 30 percent. Crop combinations on the

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cultivated areas where wheat and barley are grown include maize, sunflower, grass leys, pyrethrum and wattle (Anon, 1970). Barley generally is grown in areas where rainfall is between 700 and 1200 mm at altitudes above 2,200 m. (Anon, 1971¹). The rainfall should be spread over at least five months in order to have high yields and acceptable malting quality.

Wheat is grown in areas with both lower and higher rainfall than barley. In the marginal areas (with rainfall below 600 mm per annum) the wheat requirement for water was calculated at between 322 and 324 mm depending on season utilized since the area has a bimodal rainfall pattern (van Eijnatten, 1976). Due to high potential evaporation, this requirement was not met. Wheat in this area is a small-scale crop with the majority of farmers having only about 1.5 ha of wheat, for their own home needs. The area under wheat in the marginal lands is decreasing gradually to other food alternatives (Table 2). However, new areas under extensive wheat production are being opened up and this sector may assume significance in the future.

Wheat lands with more than 700 mm of rain are therefore the major sector in the country.

2.1. Varieties

Varietal development in wheat started in 1906 when Mr. G.W. Evans was appointed by an estate owner who had realized that wheat rusts destroyed most of the planted crops. The breeder released a variety Equator which was grown for four years (Pinto and Hurd, 1970). The breeding program subsequently grew in scope so that at present the main objectives are:

1. Shorter strawed varieties
2. Varieties capable of sustaining rust resistance for several years
3. Acceptable quality for baking (or other stated use)
4. High grain yields over fairly wide areas
5. Reduction of the number of varieties for ease of handling a sufficient number for blending purposes.

A total of 132 varieties has been released since 1908, out of which 25 are still being commercially grown (Thairy, *et al* 1978). In 1979, 10 varieties were fully recommended for production in wheat areas and another eight recommended to be grown on restricted acreages due to their higher susceptibility to rust (Anon, 1979).

Four barley varieties, Amani, Research, Tumaini and Proctor are recommended.

Yields of wheat vary with area as shown in Table 1. The low rainfall areas average about 1.0 t/ha while it is approximately 50 percent more in wetter areas.

TABLE 1. - Area, Yields and Production of some Cereals in Kenya 1972 to 1978.

| | Area in 000 ha | | | Yield metric tons/ha | | | Production in 000 metric tons | | |
|----------------|----------------|------|------|----------------------|------|------|-------------------------------|------|------|
| | 1972 - 76 | 1977 | 1978 | 1972 - 76 | 1977 | 1978 | 1972 - 76 | 1977 | 1978 |
| Total | 1651 | 1572 | 1573 | 1.33 | 1.51 | 1.47 | 2199 | 2374 | 2316 |
| Maize | 1190 | 1100 | 1100 | 1.43 | 1.74 | 1.64 | 1702 | 1910 | 1800 |
| *Coarse grains | 1542 | 1450 | 1450 | 1.32 | 1.54 | 1.46 | 2036 | 2230 | 2120 |
| Wheat | 109 | 122 | 123 | 1.49 | 1.18 | 1.59 | 163 | 144 | 196 |
| Barley | 22 | 26 | 32 | 1.0 | 1.2 | 1.2 | 21 | 30 | 38 |
| Millets | 352 | 350 | 350 | 0.95 | 0.91 | 0.91 | 334 | 320 | 320 |

Source: Foreign Agricultural Circular (Cereal) 1979.

* Coarse grains: wheat and maize and millet. Millet includes sorghum.

TABLE 2. - Area, Production and Yields of Breadwheat (1966 to 1978) and Malting Barley (1970 - 1978) in Kenya.

| BREAD WHEAT | | | | | | |
|--------------------|------------------------|-----------------|--------------------------|-----------------------------|-------|------------|
| | Total Area (000 ha) | Yield (t/ha) | Total Prod (000 tons) | Areas with 300 mm 000 ha | Yield | Production |
| 1966 | 136 | 1.32 | 179 | 16 | 1.10 | 18 |
| 1967 | 149 | 1.60 | 239 | 15 | 1.40 | 21 |
| 1968 | 165 | 1.35 | 223 | 15 | 1.13 | 17 |
| 1969 | 163 | 1.32 | 216 | 18 | 0.94 | 17 |
| 1970 | 129 | 1.39 | 179 | 13 | 0.80 | 10 |
| 1971 | 114 | 1.49 | 170 | 10 | 1.13 | 11 |
| 1972 | 104 | 1.44 | 150 | 9 | 0.78 | 7 |
| 1973 | 106 | 1.30 | 138 | 8 | 0.86 | 7 |
| 1974 | 104 | 1.52 | 158 | 7 | 1.2 | 8 |
| 1975 | 116 | 1.51 | 175 | 7 | 1.27 | 8 |
| 1976 | 113 | 1.53 | 173 | 6 | 0.97 | 6 |
| 1976 | 113 | 1.53 | 173 | 6 | 0.97 | 6 |
| 1977 | 122 | 1.18 | 144 | 5 | 1.12 | 6 |
| 1978 | 123 | 1.59 | 196 | 5 | 1.03 | 5 |

Sources: Kenya Wheat Board Annual Reports
Kenya Breweries Limited, Barley Production Offices, Nakuru

2.2. Pests and diseases

The main diseases for wheat and barley are stem rust (*Puccinia graminia tritici*) which occurs in all areas; brown leaf rust (*P. recondita*) in altitudes above 2,100 m; blotch (*Septoria nodorum*, *S. tritici* and *S. avenae*) which inflicts losses on susceptible varieties at all levels and more particularly on poorly drained soils (Pinto and Hurd, 1970). Occasional diseases include loose smut (*Ustilago tritici*); Scab (*Fusarium gramineum*), Take-all (*Ophiobolus graminis*); Root rot (*Rhizoctonia* sp.) and leaf blight (*Helminthosporium trichostoma*) (Robinson, 1960; Guthrie, 1959).

The pests include barley bulbfly (*Hylemya arambourgi*), dusty brown beetle (*Gonocephalus simplex*), black wheat beetle (*Heteronychus consimilis*?) and aphids (*Aphis* spp.). Damages are low.

2.3. Sowing

The sowing date varies with the rainfall pattern. Most of the wheat and barley are sown in the May-July period. In the bimodal rainfall areas, wheat farmers prefer the second (October) peak of rain (van Eijnatten, 1976).

3. Development of package of recommendations by research

Both bread wheat and barley undergo vigorous research so as to derive packages suitable for maximum exploitation of the genetic potential of new varieties (Anon, 1979).

3.1. Land preparation and sowing

Experiments have shown that the first ploughing should be done immediately after harvesting the previous crop. This preserves and facilitates moisture penetration, better controls noxious weeds and ensures efficient decomposition of crop residues. The longer maturing varieties are recommended to be sown first and seeding rates are determined from experiments on tillering ability of varieties. Seed rate varies from 75 to 125 kg/ha.

3.2. Fertilization

The rates of phosphates, nitrogen and copper are determined after replicated trials in all wheat areas. Fertilizer recommendations take into consideration the previous cropping history of the farm.

3.3. Weed control

Similarly chemicals like 2,4-D, 2,4-DP, MCPA, Buctril "M" and others are recommended only after thorough investigations. Many weeds are considered very difficult to eradicate; amongst them are wild oats, rye grass, brome grass, beckeropsis, Chinese lantern, bind weed.

In experimental fields yields of wheat and barley are relatively high, being above 4.5 t/ha.

4. The farm situation

The farm situation is determined by very many factors. Some of them are the farmers knowledge of recommendations, availability of necessary inputs like machinery, fertilizers, the prices of such inputs and availability of credit facilities. The extension efforts for wheat and barley in Kenya are very commendable and generally ensure a fast flow of information from research to farmers. Methods are joint meetings, field staff providing target hectares and conducting surveys throughout the growing period, agricultural shows and field days, bulletins and radio programs. Most of the farmers also avail themselves of credit facilities provided by a para-statal Agricultural Finance Corporation (for wheat) or the private Kenya Breweries Limited (for barley). These farmers are closely followed and given advice as and when deemed necessary. The result is a relatively high managerial standard at field level. However, yields vary depending on differences in inputs and zonal potential productivity.

Average yields in low rainfall areas are approximately 1.0 t/ha. Medium zones average 1.5 t/ha and high potential areas 3.5 t/ha. In the last zone, maximum yields are about 5.0 t/ha, while in drier areas the equivalent yields may be only about 2.5 t/ha.

5. Difficulties confronting farmers

5.1. Imported items

Imported items like machinery, fuel, implements, fertilizers and herbicides have gone up in price in the last four years, some by more than 100 percent. Their distribution and repair services, however, are satisfactorily handled by firms that are well distributed in the main wheat/barley areas. Credit facilities are also available for their purchase.

5.2. Local items

Labor prices have also tended to shift upwards. This is partly due to inflationary trends the world over, and partly to its scarcity in rural areas.

Seed production costs have moved up due to high costs of imported inputs and labor. Availability and distribution of the seed, however, have not been problems. Storage facilities have not posed big problems. There is sufficient storage for both crops. Processors obtain supplies from central stores.

Postharvest problems encountered by farmers are mainly grain moisture content and transportation to central stores. In some seasons, rain continues even when dry conditions suitable for harvesting would be expected. As the two crops are grown on high altitude areas, where temperatures are low, prolonged rainfall may lead to "musty" grains with low or even a totally unacceptable quality.

Many farmers may not have their own trucks or be near railway lines. They depend on commercial transporters who may not be available exactly when required.

Prices of wheat and barley have been retained high enough to encourage self-sufficiency and decrease imports. Growers, however, must achieve reasonable yields so as to make profit on their crops. Credit facilities incorporate a crop-failure risk element in case of natural calamities.

6. Manpower availability and organization

6.1. Research and quality seed control

Research on wheat is done by the Kenya government. The sole marketing agency, the Kenya Wheat Board, is a para-statal body and also has a notable contribution to all aspects of research and production. All research is centrally co-ordinated and has a multi-disciplinary approach. There is maintained sufficient personnel in breeding, agronomy, quality, pathology and entomology.

Seed Quality Control Service within the Research Division ensures that international seed rules for all crop varieties are observed during production. The service certifies seeds which are then distributed and sold by a commercial company.

Research on barley is on similar lines. The agency handling all the commercial barley is a private brewing company.

6.2. Extension services

Wheat extension is in the hands of crops officers of the Kenya government. Barley extension officers are employed by the brewing company. In both cases research information is quickly transmitted to the growers and feedback obtained. It is difficult to determine the exact number of personnel involved. In some areas both Ministry of Agriculture and Ministry of Lands and Settlement staff are extension agents. Besides, they operate for a total farm approach rather than on individual enterprise basis.

7. Future plans

7.1. Wheat

There are definite plans to greatly increase wheat production. Although the country is self-sufficient in many years, there are still occasional imports of about 10 percent (Thairu, *et al* 1978). At present only about one sixth of the wheat potential is being utilized. There are plans to extend cultivation of wheat to Narok district, where nearly 500,000 ha are said to be suitable.

The fight against the rusts is scheduled to be sustained. Various races keep developing and varieties cannot be grown for many years. Incorporation of resistances will continue. Future varieties will also have improved agronomical characters.

Grain quality research for bread and other uses will also continue. There are problem weeds still needing a lot of research into effective herbicides and other cultural methods of control. The work will continue and will help to increase yields.

In areas where soils are of low pH and where soil moisture is limiting, the plant breeders and agronomists will continue to screen triticale varieties for acceptability in the market.

TABLE 3. - Wheat Variety Recommendations, 1979.

| A: Varieties fully recommended for cultivation | | |
|--|-----------------|------------------------------|
| Variety | Altitude range | Important notes |
| Africa Mayo | All altitudes | |
| Bounty | All altitudes | |
| Kenya Leopard | All altitudes | Limited % above 2700 m |
| Kenya Mamba | 1800 - 2300 m | |
| Kenya Bongo | 2200 m and over | |
| Kenya Paka | 1800 - 2400 m | Not above 2400 m |
| Kenya Tembo | All altitudes | Limited % above 2600 m |
| Kenya Fahari | All altitudes | |
| Kenya Nungu | 1800 - 2600 m | Not above 2600 m |
| Kenya Kifaru | All altitudes | Limited acreage above 2600 m |

B: Varieties to be restricted to not more than 10% of farm area

| Variety | Altitude | Variety | Altitude |
|--------------|------------------|-------------|---------------|
| Kenya Kudu | 2100 m and above | Kenya Swara | 1800 - 2300 m |
| Kenya Page | 2400 m and above | Fanfare | All altitudes |
| Kenya Kanga | All altitudes | Kenya Nyati | 1800 - 2400 m |
| Kenya Kiboko | All altitudes | | |
| Kenya Kyoka | All altitudes | | |
| Kenya Kuro | 1800 - 2400 m | | |

7.2. Barley

The requirements for barley are increasing in the country. More areas are likely to be opened up for barley production. Varietal and other requirements are similar to those of wheat as listed above and will continuously be investigated.

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Summary

Wheat and barley are grown on land above 1800 m elevation in Kenya. Together, the two crops occupy 140,000 ha, two-thirds of this area being wheat and the remainder barley. The major areas of wheat and barley generally receive more than 700 mm of rainfall per year. Currently in Kenya, a total of eighteen wheat varieties and four barley varieties are recommended to farmers in various areas. Yields average 1 to 1.5 t/ha in most areas. Important diseases of wheat and barley include stem rust, leaf rust and blotch diseases (*Septoria* spp.). Several insect pests are present, but damages are generally low.

A series of recommended agronomic practices has been developed for wheat and barley growers. These deal with timing and methods of cultivation, fertilization and weed control. In experimental fields optimal practices result in wheat and barley yields of above 4.5 t/ha.

Cereal farmers face a variety of difficulties. Costs of imported items such as machinery, fuel and fertilizers have greatly increased in recent years. Labor scarcity and expense have also contributed to higher costs, both on the farm and in purchases of seed and other supplies. Postharvest problems mainly involve grain moisture and transport to central stores. Unfavorable weather conditions sometimes cause "musty" grains, which are of low or even unacceptable quality. Growers do enjoy a plentiful supply of certified seed, and good prices provide incentive to grow wheat and barley. Credit facilities are available, and these often include managerial advice, crop insurance and other benefits. Extension services, provided by the government in the case of wheat, and by breweries for barley, provide growers with the latest research findings and recommendations.

Future plans of research and extension personnel include the expansion of wheat and barley cultivation to new areas and continued efforts to develop rust-resistant varieties. Another area of interest involves screening triticale varieties for use on low pH soils or in dry areas.

CONTRAINTES LIMITANT LA CEREALICULTURE EN KENYA ET LES DIFFERENTES SOLUTIONS POSSIBLES

Résumé

Cultivées à des altitudes supérieures à 1800 m, le blé et l'orge occupent 140.000 ha de terres, le deux tiers étant emblavée par la première plante le reste par la deuxième. Les terres emblavées reçoivent plus de 700 mm de pluies par an.

Actuellement au Kenya, 18 variétés de blé et 4 d'orge sont recommandées aux agriculteurs de diverses régions et les rendements moyens atteignent 1 à 1,5 tonnes/ha. Les maladies importantes du blé et de l'orge sont les rouilles brunes et noires et les septarioses (*Septoria* spp.). De nombreux insectes sont présents mais leurs dégâts sont généralement de faible importance.

Une série de pratiques culturales ont été développées et sont recommandées aux agriculteurs; elle comprennent les méthodes et les différentes période de culture, la fertilisation et le désherbage. En parcelles de recherches, les pratiques optimales permettent d'atteindre des rendements en blé et en orge de plus de 4,5 t/ha.

Les céréaliculteurs font face à de nombreuses difficultés parmi lesquelles on peut citer le coût d'achat très élevé des machines agricoles, du fuel et des engrais, la rareté de la main d'œuvre et son prix élevé, les problèmes de stockage post moisson des grains (d'humidité et transport) les mauvaises conditions climatiques donnant parfois des grains 'moisis' de qualité très faible ou même inacceptable.

Toutefois, les céréaliculteurs peuvent bénéficier de crédits, d'assurances sur les récoltes, de conseils de gestion et les services de l'orge leur fournissent les dernières recommandations des services de recherches.

Les projets futurs sont d'étendre la céréaliculture à de nouvelles régions et de continuer à développer des variétés résistantes aux rouilles. De plus, des variétés de tritcale sont actuellement criblées pour leur utilisation en zones arides et sur des sols à faible pH.

CONTRAINTES LIMITANT LA CEREALICULTURE EN PAKISTAN ET LES DIFFERENTES SOLUTIONS POSSIBLES

Résumé

Le blé tendre est la principale céréale cultivée au Pakistan sous des environnements divers; mais environ les 3/4 des surfaces à blé sont irriguées le reste étant dans des régions à fortes précipitations hivernales. De nombreuses variétés améliorées sont cultivées bien que les principaux cultivars aient été retirés du fait de leurs sensibilité aux rouilles, des variétés de haute taille, plus anciennes, occupent toujours des surfaces substantielles surtout dans les zones non irriguées. Les rouilles, l'oidium, les charbons et les caries sont les maladies importantes et les insectes ne représentent pas un sérieux problème malgré une forte attaque de vers depuis quelques années. Les méthodes et périodes de culture, les semis, les traitements des graines et la fertilisation sont les sujets importants couverts par les recommandations faites aux fermiers. L'irrigation est aussi un domaine important de recommandations. Les mauvaises herbes causent de gros dégâts (jusqu'à 30%) et sont contrôlées par des labourages et de binages manuels; les espèces les plus nocives sont la folle-avoine et la *Phalaris minor*. Malgré une forte utilisation d'engrais, une meilleure disponibilité hydrique et une mécanisation accrue, les rendements se situent toujours autour de 1200-1400 kg/ha. Toutefois des essais ont montré qu'une amélioration était possible surtout en utilisant des engrais mieux adaptés et plus équilibrés.

Le manque de préparation des sols, de tracteurs (à prix élevé quand ils sont disponibles) entraînent des retards aux semis (de plus les méthodes traditionnelles sont très lentes). La disponibilité en temps des engrais est un autre problème. La production de semences n'est pas aussi efficace qu'elle devrait l'être bien que ce programme ait été renforcé; la rareté des herbicides, le prix élevé de la main d'œuvre, la saturation hydrique et la salinité des sols sont aussi de très gros problèmes. Les efforts futurs porteront surtout sur la pathologie, les engrais et la mécanisation.

L'orge, bien que plus adapté à la sécheresse et aux sols salins, est encore peu cultivé au Pakistan. De nouvelles variétés semblent être très prometteuses et leur rendement devrait dépasser celui des variétés locales.

CONSTRAINTS TO CEREAL PRODUCTION AND POSSIBLE SOLUTIONS IN PAKISTAN

M. Tahir*

Beyond any doubt wheat, *T. aestivum*, is the primary and major food grain of Pakistan and is grown throughout the country under varied soil and climatic conditions. Wheat is planted during the rabi (winter) season on approximately 4.96 million hectares of irrigated land and 1.43 million hectares under rainfed conditions every year. The area and production in the four provinces of the country is given in the following Table:

TABLE 1. Wheat Area and Production in Pakistan

| Province | Area (000 hectares) | Production (000 tons) | Yield Kg/hectares |
|-------------------------|------------------------|--------------------------|----------------------|
| 1976-77 | | | |
| Punjab | | | |
| Irrigated | 3683 | 6178 | 1667.4 |
| Unirrigated | 917 | 522 | 569.2 |
| Total | 4600 | 6700 | 1456.5 |
| Sind | | | |
| Irrigated | 928 | 1455 | 1567.9 |
| N.W.F.P. | | | |
| Irrigated | 284 | 402 | 1415.5 |
| Unirrigated | 433 | 298 | 688.2 |
| Total | 717 | 700 | 976.3 |
| Baluchistan | | | |
| Irrigated | 63 | 102 | 1619.1 |
| Unirrigated | 85 | 41 | 482.4 |
| Total | 148 | 143 | 966.2 |
| Pakistan 1976-77 | | | |
| Irrigated | 49588138 | | 1641.4 |
| Unirrigated | 1434 | 861 | 600.4 |
| Total | 6392 | 8998 | 1407.7 |
| Pakistan 1977-78 | 6396 | 8158 | 1296.0 |
| Pakistan 1978-79 | 6627 | 9500 Estimated | |

* Pakistan Agriculture Research Council, Islamabad

There was a slight increase in acreage during 1977-78 but the production went down by about a million tonnes over 1976-77 mainly due to a rust epidemic on the major commercial varieties.

Commercial Varieties

The wheat varieties have been grouped into: (a) *Old Tall Varieties*: C271, C273, and C591, (b) *Semi Dwarf Varieties*: Mexipak-65, Khushal-69, Tarnab-73, Chenab-70, Pak-70, Blue Silver, SA-42, Lyallpur-73, PARI-73, Sandal, Pothwar, SA-75, LU-26, Yecora, Nuri, Punjab-76, ARZ and Pavon F-76.

Out of these varieties Mexipak-65, Khushal-69, Tarnab-73, SA-42, Pothwar and Punjab-76 were officially withdrawn from commercial cultivation because of their high susceptibility to the brown rust, *Puccinia recondita*. However, due to nonavailability of seeds of other varieties, a considerable area is still under these varieties. Due to heavy infection of stripe (*P. striiformis*) and brown rusts, Pak-70 and Chenab-70 have also been dropped from the seed procurement list this year.

In the irrigated areas, the old tall varieties are occupying 15 percent of the acreage whereas in the unirrigated regions of the country the indigenous old varieties are still cultivated on 73 percent of the area.

Promising Varieties or Lines in the Different Zones

| Line | Institution | Characters |
|--|---------------------------------------|---|
| 1. ZA79 (Nortino x 7C) | ARI Tandojam | Normal duration, resistant to all the rusts, yields about 1.5 tons/acre |
| 2. ZA75 | ARI Tandojam | Short duration, resistant to all the rusts, yields about 1.3 tons/acre |
| 3. 141 (Tobari66 x 8156) | ARI Sariab | Medium duration, susceptible to leaf rust, resistant to stripe rust, suitable for up-lands of Baluchistan, yields 933 Kg/acre |
| 4. 23584/15-13-5 x Son. 64 PARI Faisalabad | | Normal duration, resistant to all the rusts, yields 2.5 tons/acre |
| 5. Inia/Son. 64-P4160 (E) x Son. 64 | PARI Faisalabad | Medium duration, resistant to all the rusts, yields 2.5 tons/acre |
| 6. Bb. x Nayab | ARS Rawalpindi | Long duration, resistant to all the rusts, suitable for rainfed areas, yields about 2.0 tons/acre |
| 7. Ciano's-LR64/Son(Amb) | ARS Bahawalpur | Short duration, resistant to all rusts, yields 1.3 tons/acre |
| 8. LU25 (Blue Silver x Khushal) | University of Agriculture, Faisalabad | Short duration, resistant to leaf rust, susceptible to stripe rust |

| | | |
|----------------------------------|------------|---|
| 9. Nai-60 x 6134-C271/ Pak-70 | ARI Tarnab | Normal duration, still being tested against rusts, yields 2.0 tons/acre |
| 10. Ciano 's'-PJ62 x Gallo | ARI Tarnab | Normal duration, yields 2.2 tons/acre, still being tested for rusts reaction. |

Major Disease Problems in the Different Production Zones

From the disease point of view, the country can be divided into three production zones:

1. Mountainous areas with rainfall above 350 mm. The areas which fall in this zone are: Chitral, Dir, Gilgit, Swat, Mansehra, up-lands of Baluchistan and parts of Azad Kashmir. The major diseases in this zone in order of their severity are powdery mildew (*Erysiphe graminis*), stripe rust (*Puccinia striiformis*) and brown rust (*Puccinia recondita*).

2. Submountainous and rainfed zone. The rainfall in these areas is up to 350 mm. However, in certain areas such as Rawalpindi the rainfall is above 350 mm. This zone covers most of the unirrigated wheat area of the country. The major diseases are stripe rust, brown rust, loose smut (*Ustilago nuda* f. sp. *tritici*) and flag smut (*Urocystis tritici*).

3. Irrigated plains. Seventy percent of the total wheat acreage is cultivated in this zone. The major disease is brown rust which causes great losses to wheat production during the years of heavy infestation. Stem rust (*Puccinia graminis* f. sp. *tritici*) is mainly confined to deep southern areas in Sind Province. For the last six years it did not develop on any variety to cause noticeable damage. Loose smut in certain years appears almost on every variety but the infestation so far has remained on lower side. Partial bunt or Karnal bunt (*Neovossia indica*) occurs in relatively small and specific areas of Sialkot, Gujranwala and Lahore.

Insects

Pakistan is fortunate not to have any major insect problem, except in recent years armyworms have started causing some damage to wheat crop. The other noticeable insect is white ant (termites) in rainfed areas of the country. A survey carried out to determine the extent of damage to wheat this year revealed losses up to 6 percent with an average of 2.4 percent.

Normal Sowing and Harvesting Time

The normal sowing time is from middle of October through the end of November. However, with the availability of seeds of short duration varieties a lot of farmers have adopted the rotation of cotton-wheat, rice-wheat, or corn-wheat and this has extended the sowing time until the end of December. The normal harvesting time is from the beginning of April till the third week of May. However, in the up-lands of Baluchistan and NWFP a small acreage is harvested during June.

Package of Practices Recommended to the Farmers

Seed-bed Preparation

Recent studies have clearly shown that when adequate attention is given to the control of perennial weeds, more than two ploughings are wasteful. If a tractor is available, one ploughing with a soil turning plough, followed by harrowing and levelling if necessary, brings the field in shape for irrigation. After irrigation, a single ploughing by a cultivator is sufficient to create satisfactory seed-bed. If a tractor is not available, similar operations should be done with bullock-drawn improved implements.

Method of Planting

a) **Barani (rainfed) Areas:** All plantings must be done by "Pora" which places the seed at proper moisture and depth which is highly essential to get a good stand of the crop. Fertilizer should be applied by broadcast 2-3 days before planting and mixed in the soil by ploughing and planking.

b) **Irrigated Areas:** The recommended varieties should be planted not deeper than two inches. Drill planting gives higher germination percentage and a uniform stand because the seed is placed at a uniform depth in proper moisture. 'Kera' is next, but in this case care must be taken to plant in high 'vattar' (moisture). Broadcasting does not give a good stand, but if it is unavoidable the seed rate should be increased about 2-3 kg per acre. In late plantings and fields with salinity patches, dry sowing is recommended which involves planting by drill followed by irrigation. In the dry method, shallow planting is a must. Dry planting should be done where there is water shortage. Dry planting should be followed in all cases after December 15.

Seed Treatment

Seed treatment with proper fungicides (Vitavax and Benalate) to protect the seed from seed-borne diseases such as loose smut and flag smut, is useful. Field staff of the extension can supply the chemicals and help in the operation.

Fertilizer Application

In general both nitrogenous and phosphatic fertilizers are of primary importance to obtain good yield of wheat crop. It has been found through experimentation that both N and P must be in a proper balance in the ratio of 1:1 or at least 2:1 to get the best yields.

Potassium sulphate should also be applied when wheat is planted after rice or sugar-cane, at the rate of 30 pounds per acre.

The whole quantity of the phosphatic and half of nitrogenous fertilizer should be applied at seeding time while the remaining half of nitrogenous fertilizer be applied with first irrigation.

In case the phosphatic fertilizer is not applied at seeding time, this can be applied with the first irrigation.

Mixing small quantities of N with the seed has been found deleterious for germination. It is therefore advocated that nitrogenous fertilizers should not be mixed with seed.

Recommended Doses of Fertilizers

1. Barani Area

- a) Rainfall up to 350 mm: 23 kg N and 23 kg P_2O_5
- b) Rainfall 350 to 500 mm: 34 kg N and 23 kg P_2O_5
- c) Rainfall more than 500 mm: 41 kg N and 27 kg P_2O_5

2. Irrigated Areas (Average Fertile Soils)

41 kg N and 27 kg P_2O_5

Irrigation

The wheat plant has two critical stages for its water requirements. The first is at the tillering stage which starts about a week after emergence. The first irrigation should therefore be applied not later than 15-20 days after seeding. In rice growing areas, the sub-soil is usually saturated with moisture as the moisture retention power of the soil is high. The first irrigation should be delayed as long as possible. In many cases it may even be more than a month after emergence.

The second critical stage is between anthesis and grain formation when irrigation is necessary so that the fertilization period is extended. The remaining irrigations, depending on the frequency of rainfall should be well distributed between these stages. In the Punjab, one irrigation may be important by the end of March, if the season becomes warm and dry. In the Sind, this irrigation should be applied in early March. The total number of irrigations should not be more than 4-5.

Depth of pre-sowing irrigation: Very heavy pre-sowing irrigation does not give any added advantage for irrigated wheat crop.

Weed Control

In certain cases the losses are as high as 30 percent in the yield of wheat. Many winter weeds particularly *Phalaris minor* (Dumbi grass) and wild oats (*Javi*) are increasing in intensity and affect the yield. Some weeds are partially controlled by the 'dab' system, except the above mentioned two weeds which even germinate late in the season. Since these weeds consume water and fertilizer, they must be destroyed by the bar-harrow in the beginning and by hand-hoeing later.

Low Average Yields and Availability of Inputs

The average wheat yield in Pakistan has stagnated around 1200-1400 kg/ha during the last few years which is indeed very low when compared to the average national yields of some of the other major wheat producing countries of the world, like Mexico and Egypt which are getting 4175 and 3343 kg/ha respectively. This is in spite of a several fold increase in the use of fertilizer from 193,300 nutrient tons in 1973-74 to 346,800 nutrient tons in 1977-78, and improved N/P ratios from 8:1 in 1973-74 to 3.5:1 in 1977-78. The availability of irrigation water has also increased from 2.1 to 2.4 feet per acre during the past 5 years, through installation of new tubewells and increased water supply in the canals. Efforts at increasing farm mechanization have also resulted in the availability of a larger number of tractors and threshers, which provides a very valuable input into the wheat production system. Similarly the availability of agricultural credit through various institutionalized sources has also increased substantially and it has been ensured that small loans for agricultural inputs are advanced by the banks through simplified procedures. However, it is frustrating to note that wheat production or indeed production of any other crop has not registered any significant increase in yield per acre commensurate with the use of increased inputs.

Instances of Higher Productivity under Farmers' Conditions

This, however, does not mean that it is not possible to get substantially higher yields of wheat under farmers' field conditions in Pakistan. This is clearly shown by two sets of data which prove that with the right package of technology suited to the environment of the particular area and the use of proper cultural practices and requisite inputs like good seed, balanced fertilizers and proper irrigation, even ordinary farmers can get high yields of wheat and other crops. The list of farmers who receive prizes from Daud-Hercules Fertilizer Company for getting highest wheat yields in their districts in 1976-77 is given in Table 2. Admittedly these high yields were obtained under optimum conditions in the farmers' fields, which compared with the national average of 1421 kg/ha points out the very big yield gap, some of which can be bridged if the overall farming system works well.

TABLE 2. - Prize Winning Farmers of Punjab (Daud-Hercules Trials, 1976-77)

| Division/District | Name of the Farmer | Variety | Yield (Kg/ha) |
|----------------------------|--------------------------|-----------|---------------|
| Bahawalpur Division | | | |
| Bahawalnagar | Syed Mairaj Ali Shah | Chenab-70 | 6914 |
| Rahimyar Khan | Khan Majeed Arjmand | PARI | 5900 |
| Bahawalpur | Mian Mohammad Tariq Butt | Chenab-70 | 6360 |
| Multan Division | | | |
| Multan | Ch. Rehmat Ali | PARI | 6360 |
| Muzaffar Garh | Mohammad Bakhsh Bhatti | PARI | 6268 |
| D.G. Khan | Mian Mohammad Ahmad | PARI | 6176 |
| Sahiwal | Mian Bashir Ahmad | Mangla-68 | 6084 |

TABLE 2 Cont'd.

| | | | |
|----------------------------|------------------------|-----------|------|
| Sargodha Division | | | |
| Faisalabad | Ch. Sain Muhammad | Chenab-70 | 6084 |
| Sargodha | Ghulam Muhammad Cheema | Chenab-70 | 5992 |
| Mianwali | Ch. Jan Mohammad | Chenab-70 | 5807 |
| Jhang | Pahalvan s/o Bahaival | Chenab-70 | 5162 |
| Lahore Division | | | |
| Hujranwala | Aftab Ahmad | Chenab-70 | 5900 |
| Lahore | Pir Jamil Hussain Shah | Chenab-70 | 5623 |
| Sheikhupura | Ch. Mohammad Bakhtiar | Chenab-70 | 5162 |
| Sialkot | Ch. Faqir Iqbal | Chenab-70 | 5347 |
| Rawalpindi Division | | | |
| Gujrat | Ch. Allah Ditta | PARI | 6545 |
| Attock | Mian Mohammad Mumtaz | Chenab-70 | 6176 |
| Jhelum | Raja Gulzar Hussain | PARI | 5162 |
| Rawalpindi | Khawaja Raza Ali | PARI | 4978 |

Source: Daud-Hercules Fertilizer Company

Another set of experiments called the Farming For Self-sufficiency (FFS) Programme was carried out in the fields of average farmers with good fertilizer application, both of N and P, and reasonably good care of the crop (Table 3). These conditions can be considered achievable for the large areas in the country since the farmers selected were average or somewhat better than average and did all the operations on their lands themselves under guidance of the experts. These data indicate that even on conservative estimates wheat production can be increased by about 50 percent in most of the wheat growing areas (Table 4).

TABLE 3. - Farming For Self-Sufficiency (FFS) Experiments

Details about demonstration plots on average farmer's field.

Improved semi-dwarf commercial varieties were used. The number of irrigations was from 4-6.

1. Size of plot: 2024 sq. m. (0.50 acre approx.)
2. Size of sub-plot: 1012 sq. m. (0.25 acre approx.)
3. Fertilizer application (kg/ha)

| Site | Irrigated | | Rainfed |
|-------------|--|-----------------|--|
| | At sowing | As top dressing | At sowing only |
| Sub-plot-I | 67.4 N as Urea | 67.4 N as Urea | 55.6 N as Urea |
| Sub-plot-II | 67.4 N 67.4 P ₂ O ₅ | 67.4 N as Urea | 55.6 N 55.6 P ₂ O ₅ |

Source: Dr. Zia-ud-Din, Farming for Self-sufficiency. 1976.

TABLE 4.- Wheat Yield Comparison in Farmers' Fields Under Different Conditions of Fertilizer Application

| District | Average yield for the dist. Kg/ha | Average yield in FFS Demos. | | Percentage Increase of (3) over (2) | Percentage Increase of (3) over (1) |
|---------------------|---|--------------------------------|------|---|---|
| | (1) | N | NP | | |
| A. Irrigated | | (2) | (3) | | |
| Hyderabad (8)* | 1834 | 2110 | 2824 | 33.8 | 72.3 |
| Nawabshah (7) | 1702 | 2391 | 3345 | 39.9 | 96.5 |
| Multan (7) | 1702 | 2391 | 3345 | 39.9 | 96.5 |
| Multan (7) | 1876 | 3896 | 4683 | 20.2 | 149.6 |
| Faisalabad (10) | 1959 | 3888 | 4665 | 20.0 | 138.1 |
| Gujranwala (10) | 1519 | 2940 | 3730 | 26.9 | 145.6 |
| B. Rainfed | | | | | |
| Rawalpindi (8) | 579 | 1488 | 2106 | 41.5 | 263.7 |
| Hazara (5) | 707 | 2016 | 2748 | 30.3 | 288.7 |

Source: Dr. Zia-ud-Din, Farming for Self-sufficiency, 1976.

* Number of sites of fertilizer demonstrations.

Difficulties or Problems Confronting Farmers

1. Though the Government is giving more and more emphasis on mechanization of land preparation through tractors, and due to the high cost and non-availability of tractors in the open market the land preparation operations are mainly done by indigenous un-improved implements drawn by the bullocks which are normally time consuming and a lot of planting is delayed from the normal season.

2. Inadequate and unbalanced use of nitrogenous and phosphatic fertilizers. At present, total fertilizer use is about 350,000 nutrient tons of N and P combined. The requirements of irrigated areas alone amounts to 1.3 million nutrient tons if applied at the recommended rates.

3. Timely availability of right type of fertilizers.

4. The seed production and supply program is not very efficient and effective. After a variety is released by the breeders it takes 4-5 years to get into commercial cultivation and by that time the variety becomes susceptible to one or the other races of rusts. The seed program is now being strengthened and two seed corporations have been created to do the job effectively. The prices of the seed are normally slightly higher than the prevailing grain prices.

5. The weeds have been found to cause major reduction in wheat production. In some instances losses up to 30 percent have been recorded. Unfortunately very little work on weed control and herbicide application has been done inside the country. With the exception of one herbicide 2, 4-D, none is available in commercial quantities in the country.

6. The farm labor supply is becoming expensive and acute these days. Since most of the operations are done manually, therefore the shortage in labor supply causes great problems for the farmers.

7. A study carried out by the University of Agriculture, Faisalabad, has revealed post harvest losses up to 10 percent. There is a need to mechanize harvesting and threshing operations.

8. There is a need to rationalize the prices of wheat. At present, the government support price of Rs. 120.60 for 100 kg seems to be on the low side as the margin of profit is very slim.

9. Many farmers like to plant tall varieties for more straw as the prices of straw have gone considerably high. Straw at present fetches the farmer about one third of the grain income. Tall varieties also compete the weeds in the field. Therefore, the substitution of old varieties with HYV is slow.

10. Widespread water-logging and salinity are retarding yields of crop varieties.

Manpower Available

There are 10 provincial and five federal institutions involved in wheat research. However, there is a great need to strengthen technical manpower, the field and laboratory facilities in those institutions.

Measures for Future

1. The rapid decline in wheat production in 1977-78 has brought into sharp focus the inadequacy of our agricultural research system through which the package of relevant technology for the production of the crop is generated. The failure of several of the popular commercial varieties to withstand the rust attack is primarily due to the lack of sufficient emphasis in our varietal developmental program to breeding for rust resistance. It is planned to strengthen the Cereal Diseases Research Institute to include studies on the new races of the pathogens and elaborate arrangements for screening of the material submitted by the breeders in the country for resistance to various races of rust.

2. The origin of various rust organisms and their movement in different parts of the country have been initiated so that the early establishment of infection can be checked through the judicious distribution of varieties.

3. Research on the development of multilines has been intensified.

4. The possible use of chemical fungicides in case of a rust epidemic will be studied in real earnest.

5. Agronomic and cultural practices for different zones of the country as well as for individual varieties need to be worked out in considerable detail under the conditions prevailing in the farmers fields. It is important that the package of practices finally recommended to the farmers is location specific and is prepared keeping in view the soil type, crop rotation, weather and labor availability in the different regions.

6. Maximum emphasis will be laid on the optimum use of balanced fertilizer, application of organic matter and green manuring, optimum seed rates and irrigation, etc. Coordinated research programs will be developed on some of these aspects and the data obtained from different parts of the country pooled to draw up a national plan to be communicated to the farmers through the extension service.

7. Basic research on photosynthesis ability and development of simple criteria for selection of varieties with ability to withstand environmental stress, e.g. drought.

8. Grain production, in the last analysis, is a result of several activities going on in the plant during its growth period. The most important of these is the photosynthetic ability and translocation of the nutrients to improve the grain/straw ratio. This kind of physiological research has not been done in the country to any appreciable extent and is most essential for achieving higher wheat yield through the use of problem-oriented basic research.

9. Wheat quality, particularly with respect to protein content and chapati-making quality, is being further strengthened.

10. Farm machinery, crop harvesting, threshing, storage and marketing are very important areas having a direct bearing on the total availability of wheat for human consumption in the country. All these areas need further research to generate appropriate technology suitable for Pakistan conditions. In particular, research in the area of Agricultural Engineering is lacking a great deal in Pakistan. This needs strengthening immediately in all aspects so that requisite agricultural machinery is developed for various farm operations particularly because of acute labor shortages which are experienced by the farmers at critical periods. The ARC is planning to have a research institute on Agricultural Engineering to give impetus to this work.

11. The socio-economic research in all its facets also needs strong emphasis. This includes studies on marketing system, prices, farmers cooperatives and credit mecha-

nisms, etc. The PARC plans to have a strong research group on the socio-economic aspects of agriculture, which will also deal with macro and micro-planning of the agricultural resource of the country.

12. The research institutions of the country are being strengthened by providing additional technical manpower, field and laboratory equipment, etc.

13. The government has intensified efforts to achieve self-sufficiency in its nitrogenous fertilizer requirements by 1980-81. By that time 40 percent of the country's requirements of P_2O_5 will also be met locally.

14. Agricultural credit facilities to purchase the inputs have been increased.

15. About 10,000 units of tractors are imported every year to mechanize the agricultural production.

16. With the commissioning of Tarbela Dam, the availability of irrigation water has not only increased but ensured.

17. Better coordination between research, seed production and procurement agencies has been developed.

Barley

Barley is a minor cereal crop in Pakistan and is planted in specific areas such as salinity affected, water deficit and cold regions where wheat cannot be grown economically.

The area and production of barley for 1977-78 in each province is given below:

| Province | Area (000 ha) | Production (000 tons) | Yield/ha (Kg) |
|-------------|------------------|--------------------------|------------------|
| Punjab | 78.1 | 55.4 | 709 |
| Sind | 21.8 | 11.2 | 514 |
| NWFP | 62.4 | 59.0 | 817 |
| Baluchistan | 4.5 | 3.0 | 667 |
| Pakistan | 166.8 | 120.6 | 723 |

In the Punjab and the Sind it is mainly grown for fodder or animal feed purposes where as in Baluchistan and NWFP it is also consumed as human food.

Because of the low acreage, barley is getting low priority in overall research. However, due to its relative tolerance to harsh environmental conditions, screening of barley germ plasm for salinity tolerance, drought tolerance and cold tolerance is being carried out to find out better varieties for barley growing areas of the country. Barley is also attacked by yellow and brown rusts throughout the country and powdery mildew is a problem of the NWFP.

Two better adapted barley varieties, namely Beecher and Arrivat x Local 8D, have been identified out of the international nurseries. Both these varieties have given almost double yield over the existing commercially cultivated varieties.

Summary

Bread wheat is the major food crop in Pakistan, and is grown throughout the country under varying soil and climatic conditions. About three-fourths of the wheat area is irrigated, the remainder being rainfed in areas receiving adequate winter rainfall. Many improved varieties are grown in Pakistan, although in recent years many of the major cultivars have been withdrawn due to susceptibility to rusts. Older, tall varieties still occupy substantial acreage, especially in rainfed areas. Besides the rusts, powdery mildew, smuts and partial bunt cause losses. Insects are generally not a serious problem, although increased losses due to armyworm have been observed in recent years.

A series of recommendations has been developed and passed on to farmers in Pakistan. Methods and times of cultivation, seeding operations, seed treatment and fertilization are

among the topics covered. Irrigation is another important area for which recommended regimens have been devised. Weeds cause serious losses (up to 30 percent) and are usually controlled through cultivation or hand sowing. The worst species include wild oats and *Phalaris minor*.

Wheat yields in Pakistan have stagnated around 1200-1400 kg/ha in recent years. This in spite of more fertilizer use, greater water availability and increased mechanization. Experience has shown, however, that much higher yields are possible, particularly with the use of more and better balanced fertilizers.

There are several difficulties confronting wheat farmers in Pakistan. Lack of land preparation machines and tractors, and their high cost when available, result in late plantings in many areas, as traditional methods are very slow. Timely availability of the correct fertilizers presents another problem. Seed production is not as efficient or effective as it should be, although this program is being strengthened. Other problems include scarcity of herbicides, expensive labor costs and somewhat low prices. Soil waterlogging and salinity pose a serious and long term problem. Future efforts to increase production of wheat will focus especially on diseases, fertilization and mechanization.

Barley is grown on a limited acreage in Pakistan, although its relative adaptation to salinity and drought may increase its importance in the future. New varieties show good promise for increasing yield over currently used cultivars.

CONSTRAINTS TO CEREAL PRODUCTION AND POSSIBLE SOLUTIONS IN PAKISTAN

M. Tahir*

Beyond any doubt wheat, *T. aestivum*, is the primary and major food grain of Pakistan and is grown throughout the country under varied soil and climatic conditions. Wheat is planted during the rabi (winter) season on approximately 4.96 million hectares of irrigated land and 1.43 million hectares under rainfed conditions every year. The area and production in the four provinces of the country is given in the following Table:

TABLE 1. Wheat Area and Production in Pakistan

| Province | Area (000 hectares) | Production (000 tons) | Yield Kg/hectares |
|-------------------------|------------------------|--------------------------|----------------------|
| 1976-77 | | | |
| Punjab | | | |
| Irrigated | 3683 | 6178 | 1667.4 |
| Unirrigated | 917 | 522 | 569.2 |
| Total | 4600 | 6700 | 1456.5 |
| Sind | | | |
| Irrigated | 928 | 1455 | 1567.9 |
| N.W.F.P. | | | |
| Irrigated | 284 | 402 | 1415.5 |
| Unirrigated | 433 | 298 | 688.2 |
| Total | 717 | 700 | 976.3 |
| Baluchistan | | | |
| Irrigated | 63 | 102 | 1619.1 |
| Unirrigated | 85 | 41 | 482.4 |
| Total | 148 | 143 | 966.2 |
| Pakistan 1976-77 | | | |
| Irrigated | 49588138 | | 1641.4 |
| Unirrigated | 1434 | 861 | 600.4 |
| Total | 6392 | 8998 | 1407.7 |
| Pakistan 1977-78 | 6396 | 8158 | 1296.0 |
| Pakistan 1978-79 | 6627 | 9500 Estimated | |

* Pakistan Agriculture Research Council, Islamabad

There was a slight increase in acreage during 1977-78 but the production went down by about a million tonnes over 1976-77 mainly due to a rust epidemic on the major commercial varieties.

Commercial Varieties

The wheat varieties have been grouped into: (a) *Old Tall Varieties*: C271, C273, and C591, (b) *Semi Dwarf Varieties*: Mexipak-65, Khushal-69, Tarnab-73, Chenab-70, Pak-70, Blue Silver, SA-42, Lyallpur-73, PARI-73, Sandal, Pothwar, SA-75, LU-26, Yecora, Nuri, Punjab-76, ARZ and Pavon F-76.

Out of these varieties Mexipak-65, Khushal-69, Tarnab-73, SA-42, Pothwar and Punjab-76 were officially withdrawn from commercial cultivation because of their high susceptibility to the brown rust, *Puccinia recondita*. However, due to nonavailability of seeds of other varieties, a considerable area is still under these varieties. Due to heavy infection of stripe (*P. striiformis*) and brown rusts, Pak-70 and Chenab-70 have also been dropped from the seed procurement list this year.

In the irrigated areas, the old tall varieties are occupying 15 percent of the acreage whereas in the unirrigated regions of the country the indigenous old varieties are still cultivated on 73 percent of the area.

Promising Varieties or Lines in the Different Zones

| Line | Institution | Characters |
|--|---------------------------------------|---|
| 1. ZA79 (Nortino x 7C) | ARI Tandojam | Normal duration, resistant to all the rusts, yields about 1.5 tons/acre |
| 2. ZA75 | ARI Tandojam | Short duration, resistant to all the rusts, yields about 1.3 tons/acre |
| 3. 141 (Tobari66 x 8156) | ARI Sariab | Medium duration, susceptible to leaf rust, resistant to stripe rust, suitable for up-lands of Baluchistan, yields 933 Kg/acre |
| 4. 23584/15-13-5 x Son. 64 PARI Faisalabad | | Normal duration, resistant to all the rusts, yields 2.5 tons/acre |
| 5. Inia/Son. 64-P4160 (E) x Son. 64 | PARI Faisalabad | Medium duration, resistant to all the rusts, yields 2.5 tons/acre |
| 6. Bb. x Nayab | ARS Rawalpindi | Long duration, resistant to all the rusts, suitable for rainfed areas, yields about 2.0 tons/acre |
| 7. Ciano's-LR64/Son(Amb) | ARS Bahawalpur | Short duration, resistant to all rusts, yields 1.3 tons/acre |
| 8. LU25 (Blue Silver x Khushal) | University of Agriculture, Faisalabad | Short duration, resistant to leaf rust, susceptible to stripe rust |

| | | |
|----------------------------------|------------|---|
| 9. Nai-60 x 6134-C271/ Pak-70 | ARI Tarnab | Normal duration, still being tested against rusts, yields 2.0 tons/acre |
| 10. Ciano 's'-PJ62 x Gallo | ARI Tarnab | Normal duration, yields 2.2 tons/acre, still being tested for rusts reaction. |

Major Disease Problems in the Different Production Zones

From the disease point of view, the country can be divided into three production zones:

1. Mountainous areas with rainfall above 350 mm. The areas which fall in this zone are: Chitral, Dir, Gilgit, Swat, Mansehra, up-lands of Baluchistan and parts of Azad Kashmir. The major diseases in this zone in order of their severity are powdery mildew (*Erysiphe graminis*), stripe rust (*Puccinia striiformis*) and brown rust (*Puccinia recondita*).

2. Submountainous and rainfed zone. The rainfall in these areas is up to 350 mm. However, in certain areas such as Rawalpindi the rainfall is above 350 mm. This zone covers most of the unirrigated wheat area of the country. The major diseases are stripe rust, brown rust, loose smut (*Ustilago nuda* f. sp. *tritici*) and flag smut (*Urocystis tritici*).

3. Irrigated plains. Seventy percent of the total wheat acreage is cultivated in this zone. The major disease is brown rust which causes great losses to wheat production during the years of heavy infestation. Stem rust (*Puccinia graminis* f. sp. *tritici*) is mainly confined to deep southern areas in Sind Province. For the last six years it did not develop on any variety to cause noticeable damage. Loose smut in certain years appears almost on every variety but the infestation so far has remained on lower side. Partial bunt or Karnal bunt (*Neovossia indica*) occurs in relatively small and specific areas of Sialkot, Gujranwala and Lahore.

Insects

Pakistan is fortunate not to have any major insect problem, except in recent years armyworms have started causing some damage to wheat crop. The other noticeable insect is white ant (termites) in rainfed areas of the country. A survey carried out to determine the extent of damage to wheat this year revealed losses up to 6 percent with an average of 2.4 percent.

Normal Sowing and Harvesting Time

The normal sowing time is from middle of October through the end of November. However, with the availability of seeds of short duration varieties a lot of farmers have adopted the rotation of cotton-wheat, rice-wheat, or corn-wheat and this has extended the sowing time until the end of December. The normal harvesting time is from the beginning of April till the third week of May. However, in the up-lands of Baluchistan and NWFP a small acreage is harvested during June.

Package of Practices Recommended to the Farmers

Seed-bed Preparation

Recent studies have clearly shown that when adequate attention is given to the control of perennial weeds, more than two ploughings are wasteful. If a tractor is available, one ploughing with a soil turning plough, followed by harrowing and levelling if necessary, brings the field in shape for irrigation. After irrigation, a single ploughing by a cultivator is sufficient to create satisfactory seed-bed. If a tractor is not available, similar operations should be done with bullock-drawn improved implements.

Method of Planting

a) **Barani (rainfed) Areas:** All plantings must be done by "Pora" which places the seed at proper moisture and depth which is highly essential to get a good stand of the crop. Fertilizer should be applied by broadcast 2-3 days before planting and mixed in the soil by ploughing and planking.

b) **Irrigated Areas:** The recommended varieties should be planted not deeper than two inches. Drill planting gives higher germination percentage and a uniform stand because the seed is placed at a uniform depth in proper moisture. 'Kera' is next, but in this case care must be taken to plant in high 'vattar' (moisture). Broadcasting does not give a good stand, but if it is unavoidable the seed rate should be increased about 2-3 kg per acre. In late plantings and fields with salinity patches, dry sowing is recommended which involves planting by drill followed by irrigation. In the dry method, shallow planting is a must. Dry planting should be done where there is water shortage. Dry planting should be followed in all cases after December 15.

Seed Treatment

Seed treatment with proper fungicides (Vitavax and Benalate) to protect the seed from seed-borne diseases such as loose smut and flag smut, is useful. Field staff of the extension can supply the chemicals and help in the operation.

Fertilizer Application

In general both nitrogenous and phosphatic fertilizers are of primary importance to obtain good yield of wheat crop. It has been found through experimentation that both N and P must be in a proper balance in the ratio of 1:1 or at least 2:1 to get the best yields.

Potassium sulphate should also be applied when wheat is planted after rice or sugar-cane, at the rate of 30 pounds per acre.

The whole quantity of the phosphatic and half of nitrogenous fertilizer should be applied at seeding time while the remaining half of nitrogenous fertilizer be applied with first irrigation.

In case the phosphatic fertilizer is not applied at seeding time, this can be applied with the first irrigation.

Mixing small quantities of N with the seed has been found deleterious for germination. It is therefore advocated that nitrogenous fertilizers should not be mixed with seed.

Recommended Doses of Fertilizers

1. Barani Area

- a) Rainfall up to 350 mm: 23 kg N and 23 kg P_2O_5
- b) Rainfall 350 to 500 mm: 34 kg N and 23 kg P_2O_5
- c) Rainfall more than 500 mm: 41 kg N and 27 kg P_2O_5

2. Irrigated Areas (Average Fertile Soils)

41 kg N and 27 kg P_2O_5

Irrigation

The wheat plant has two critical stages for its water requirements. The first is at the tillering stage which starts about a week after emergence. The first irrigation should therefore be applied not later than 15-20 days after seeding. In rice growing areas, the sub-soil is usually saturated with moisture as the moisture retention power of the soil is high. The first irrigation should be delayed as long as possible. In many cases it may even be more than a month after emergence.

The second critical stage is between anthesis and grain formation when irrigation is necessary so that the fertilization period is extended. The remaining irrigations, depending on the frequency of rainfall should be well distributed between these stages. In the Punjab, one irrigation may be important by the end of March, if the season becomes warm and dry. In the Sind, this irrigation should be applied in early March. The total number of irrigations should not be more than 4-5.

Depth of pre-sowing irrigation: Very heavy pre-sowing irrigation does not give any added advantage for irrigated wheat crop.

Weed Control

In certain cases the losses are as high as 30 percent in the yield of wheat. Many winter weeds particularly *Phalaris minor* (Dumbi grass) and wild oats (*Javi*) are increasing in intensity and affect the yield. Some weeds are partially controlled by the 'dab' system, except the above mentioned two weeds which even germinate late in the season. Since these weeds consume water and fertilizer, they must be destroyed by the bar-harrow in the beginning and by hand-hoeing later.

Low Average Yields and Availability of Inputs

The average wheat yield in Pakistan has stagnated around 1200-1400 kg/ha during the last few years which is indeed very low when compared to the average national yields of some of the other major wheat producing countries of the world, like Mexico and Egypt which are getting 4175 and 3343 kg/ha respectively. This is in spite of a several fold increase in the use of fertilizer from 193,300 nutrient tons in 1973-74 to 346,800 nutrient tons in 1977-78, and improved N/P ratios from 8:1 in 1973-74 to 3.5:1 in 1977-78. The availability of irrigation water has also increased from 2.1 to 2.4 feet per acre during the past 5 years, through installation of new tubewells and increased water supply in the canals. Efforts at increasing farm mechanization have also resulted in the availability of a larger number of tractors and threshers, which provides a very valuable input into the wheat production system. Similarly the availability of agricultural credit through various institutionalized sources has also increased substantially and it has been ensured that small loans for agricultural inputs are advanced by the banks through simplified procedures. However, it is frustrating to note that wheat production or indeed production of any other crop has not registered any significant increase in yield per acre commensurate with the use of increased inputs.

Instances of Higher Productivity under Farmers' Conditions

This, however, does not mean that it is not possible to get substantially higher yields of wheat under farmers' field conditions in Pakistan. This is clearly shown by two sets of data which prove that with the right package of technology suited to the environment of the particular area and the use of proper cultural practices and requisite inputs like good seed, balanced fertilizers and proper irrigation, even ordinary farmers can get high yields of wheat and other crops. The list of farmers who receive prizes from Daud-Hercules Fertilizer Company for getting highest wheat yields in their districts in 1976-77 is given in Table 2. Admittedly these high yields were obtained under optimum conditions in the farmers' fields, which compared with the national average of 1421 kg/ha points out the very big yield gap, some of which can be bridged if the overall farming system works well.

TABLE 2. - Prize Winning Farmers of Punjab (Daud-Hercules Trials, 1976-77)

| Division/District | Name of the Farmer | Variety | Yield (Kg/ha) |
|----------------------------|--------------------------|-----------|---------------|
| Bahawalpur Division | | | |
| Bahawalnagar | Syed Mairaj Ali Shah | Chenab-70 | 6914 |
| Rahimyar Khan | Khan Majeed Arjmand | PARI | 5900 |
| Bahawalpur | Mian Mohammad Tariq Butt | Chenab-70 | 6360 |
| Multan Division | | | |
| Multan | Ch. Rehmat Ali | PARI | 6360 |
| Muzaffar Garh | Mohammad Bakhsh Bhatti | PARI | 6268 |
| D.G. Khan | Mian Mohammad Ahmad | PARI | 6176 |
| Sahiwal | Mian Bashir Ahmad | Mangla-68 | 6084 |

TABLE 2 Cont'd.

| | | | |
|----------------------------|------------------------|-----------|------|
| Sargodha Division | | | |
| Faisalabad | Ch. Sain Muhammad | Chenab-70 | 6084 |
| Sargodha | Ghulam Muhammad Cheema | Chenab-70 | 5992 |
| Mianwali | Ch. Jan Mohammad | Chenab-70 | 5807 |
| Jhang | Pahalvan s/o Bahaival | Chenab-70 | 5162 |
| Lahore Division | | | |
| Hujranwala | Aftab Ahmad | Chenab-70 | 5900 |
| Lahore | Pir Jamil Hussain Shah | Chenab-70 | 5623 |
| Sheikhupura | Ch. Mohammad Bakhtiar | Chenab-70 | 5162 |
| Sialkot | Ch. Faqir Iqbal | Chenab-70 | 5347 |
| Rawalpindi Division | | | |
| Gujrat | Ch. Allah Ditta | PARI | 6545 |
| Attock | Mian Mohammad Mumtaz | Chenab-70 | 6176 |
| Jhelum | Raja Gulzar Hussain | PARI | 5162 |
| Rawalpindi | Khawaja Raza Ali | PARI | 4978 |

Source: Daud-Hercules Fertilizer Company

Another set of experiments called the Farming For Self-sufficiency (FFS) Programme was carried out in the fields of average farmers with good fertilizer application, both of N and P, and reasonably good care of the crop (Table 3). These conditions can be considered achievable for the large areas in the country since the farmers selected were average or somewhat better than average and did all the operations on their lands themselves under guidance of the experts. These data indicate that even on conservative estimates wheat production can be increased by about 50 percent in most of the wheat growing areas (Table 4).

TABLE 3. - Farming For Self-Sufficiency (FFS) Experiments

Details about demonstration plots on average farmer's field.

Improved semi-dwarf commercial varieties were used. The number of irrigations was from 4-6.

1. Size of plot: 2024 sq. m. (0.50 acre approx.)
2. Size of sub-plot: 1012 sq. m. (0.25 acre approx.)
3. Fertilizer application (kg/ha)

| Site | Irrigated | | Rainfed |
|-------------|--|-----------------|--|
| | At sowing | As top dressing | At sowing only |
| Sub-plot-I | 67.4 N as Urea | 67.4 N as Urea | 55.6 N as Urea |
| Sub-plot-II | 67.4 N 67.4 P ₂ O ₅ | 67.4 N as Urea | 55.6 N 55.6 P ₂ O ₅ |

Source: Dr. Zia-ud-Din, Farming for Self-sufficiency. 1976.

TABLE 4.- Wheat Yield Comparison in Farmers' Fields Under Different Conditions of Fertilizer Application

| District | Average yield for the dist. Kg/ha | Average yield in FFS Demos. | | Percentage Increase of (3) over (2) | Percentage Increase of (3) over (1) |
|---------------------|---|--------------------------------|------|---|---|
| | (1) | N | NP | | |
| A. Irrigated | | (2) | (3) | | |
| Hyderabad (8)* | 1834 | 2110 | 2824 | 33.8 | 72.3 |
| Nawabshah (7) | 1702 | 2391 | 3345 | 39.9 | 96.5 |
| Multan (7) | 1702 | 2391 | 3345 | 39.9 | 96.5 |
| Multan (7) | 1876 | 3896 | 4683 | 20.2 | 149.6 |
| Faisalabad (10) | 1959 | 3888 | 4665 | 20.0 | 138.1 |
| Gujranwala (10) | 1519 | 2940 | 3730 | 26.9 | 145.6 |
| B. Rainfed | | | | | |
| Rawalpindi (8) | 579 | 1488 | 2106 | 41.5 | 263.7 |
| Hazara (5) | 707 | 2016 | 2748 | 30.3 | 288.7 |

Source: Dr. Zia-ud-Din, Farming for Self-sufficiency, 1976.

* Number of sites of fertilizer demonstrations.

Difficulties or Problems Confronting Farmers

1. Though the Government is giving more and more emphasis on mechanization of land preparation through tractors, and due to the high cost and non-availability of tractors in the open market the land preparation operations are mainly done by indigenous un-improved implements drawn by the bullocks which are normally time consuming and a lot of planting is delayed from the normal season.

2. Inadequate and unbalanced use of nitrogenous and phosphatic fertilizers. At present, total fertilizer use is about 350,000 nutrient tons of N and P combined. The requirements of irrigated areas alone amounts to 1.3 million nutrient tons if applied at the recommended rates.

3. Timely availability of right type of fertilizers.

4. The seed production and supply program is not very efficient and effective. After a variety is released by the breeders it takes 4-5 years to get into commercial cultivation and by that time the variety becomes susceptible to one or the other races of rusts. The seed program is now being strengthened and two seed corporations have been created to do the job effectively. The prices of the seed are normally slightly higher than the prevailing grain prices.

5. The weeds have been found to cause major reduction in wheat production. In some instances losses up to 30 percent have been recorded. Unfortunately very little work on weed control and herbicide application has been done inside the country. With the exception of one herbicide 2, 4-D, none is available in commercial quantities in the country.

6. The farm labor supply is becoming expensive and acute these days. Since most of the operations are done manually, therefore the shortage in labor supply causes great problems for the farmers.

7. A study carried out by the University of Agriculture, Faisalabad, has revealed post harvest losses up to 10 percent. There is a need to mechanize harvesting and threshing operations.

8. There is a need to rationalize the prices of wheat. At present, the government support price of Rs. 120.60 for 100 kg seems to be on the low side as the margin of profit is very slim.

9. Many farmers like to plant tall varieties for more straw as the prices of straw have gone considerably high. Straw at present fetches the farmer about one third of the grain income. Tall varieties also compete the weeds in the field. Therefore, the substitution of old varieties with HYV is slow.

10. Widespread water-logging and salinity are retarding yields of crop varieties.

Manpower Available

There are 10 provincial and five federal institutions involved in wheat research. However, there is a great need to strengthen technical manpower, the field and laboratory facilities in those institutions.

Measures for Future

1. The rapid decline in wheat production in 1977-78 has brought into sharp focus the inadequacy of our agricultural research system through which the package of relevant technology for the production of the crop is generated. The failure of several of the popular commercial varieties to withstand the rust attack is primarily due to the lack of sufficient emphasis in our varietal developmental program to breeding for rust resistance. It is planned to strengthen the Cereal Diseases Research Institute to include studies on the new races of the pathogens and elaborate arrangements for screening of the material submitted by the breeders in the country for resistance to various races of rust.

2. The origin of various rust organisms and their movement in different parts of the country have been initiated so that the early establishment of infection can be checked through the judicious distribution of varieties.

3. Research on the development of multilines has been intensified.

4. The possible use of chemical fungicides in case of a rust epidemic will be studied in real earnest.

5. Agronomic and cultural practices for different zones of the country as well as for individual varieties need to be worked out in considerable detail under the conditions prevailing in the farmers fields. It is important that the package of practices finally recommended to the farmers is location specific and is prepared keeping in view the soil type, crop rotation, weather and labor availability in the different regions.

6. Maximum emphasis will be laid on the optimum use of balanced fertilizer, application of organic matter and green manuring, optimum seed rates and irrigation, etc. Coordinated research programs will be developed on some of these aspects and the data obtained from different parts of the country pooled to draw up a national plan to be communicated to the farmers through the extension service.

7. Basic research on photosynthesis ability and development of simple criteria for selection of varieties with ability to withstand environmental stress, e.g. drought.

8. Grain production, in the last analysis, is a result of several activities going on in the plant during its growth period. The most important of these is the photosynthetic ability and translocation of the nutrients to improve the grain/straw ratio. This kind of physiological research has not been done in the country to any appreciable extent and is most essential for achieving higher wheat yield through the use of problem-oriented basic research.

9. Wheat quality, particularly with respect to protein content and chapati-making quality, is being further strengthened.

10. Farm machinery, crop harvesting, threshing, storage and marketing are very important areas having a direct bearing on the total availability of wheat for human consumption in the country. All these areas need further research to generate appropriate technology suitable for Pakistan conditions. In particular, research in the area of Agricultural Engineering is lacking a great deal in Pakistan. This needs strengthening immediately in all aspects so that requisite agricultural machinery is developed for various farm operations particularly because of acute labor shortages which are experienced by the farmers at critical periods. The ARC is planning to have a research institute on Agricultural Engineering to give impetus to this work.

11. The socio-economic research in all its facets also needs strong emphasis. This includes studies on marketing system, prices, farmers cooperatives and credit mecha-

nisms, etc. The PARC plans to have a strong research group on the socio-economic aspects of agriculture, which will also deal with macro and micro-planning of the agricultural resource of the country.

12. The research institutions of the country are being strengthened by providing additional technical manpower, field and laboratory equipment, etc.

13. The government has intensified efforts to achieve self-sufficiency in its nitrogenous fertilizer requirements by 1980-81. By that time 40 percent of the country's requirements of P_2O_5 will also be met locally.

14. Agricultural credit facilities to purchase the inputs have been increased.

15. About 10,000 units of tractors are imported every year to mechanize the agricultural production.

16. With the commissioning of Tarbela Dam, the availability of irrigation water has not only increased but ensured.

17. Better coordination between research, seed production and procurement agencies has been developed.

Barley

Barley is a minor cereal crop in Pakistan and is planted in specific areas such as salinity affected, water deficit and cold regions where wheat cannot be grown economically.

The area and production of barley for 1977-78 in each province is given below:

| Province | Area (000 ha) | Production (000 tons) | Yield/ha (Kg) |
|-------------|------------------|--------------------------|------------------|
| Punjab | 78.1 | 55.4 | 709 |
| Sind | 21.8 | 11.2 | 514 |
| NWFP | 62.4 | 59.0 | 817 |
| Baluchistan | 4.5 | 3.0 | 667 |
| Pakistan | 166.8 | 120.6 | 723 |

In the Punjab and the Sind it is mainly grown for fodder or animal feed purposes where as in Baluchistan and NWFP it is also consumed as human food.

Because of the low acreage, barley is getting low priority in overall research. However, due to its relative tolerance to harsh environmental conditions, screening of barley germ plasm for salinity tolerance, drought tolerance and cold tolerance is being carried out to find out better varieties for barley growing areas of the country. Barley is also attacked by yellow and brown rusts throughout the country and powdery mildew is a problem of the NWFP.

Two better adapted barley varieties, namely Beecher and Arrivat x Local 8D, have been identified out of the international nurseries. Both these varieties have given almost double yield over the existing commercially cultivated varieties.

Summary

Bread wheat is the major food crop in Pakistan, and is grown throughout the country under varying soil and climatic conditions. About three-fourths of the wheat area is irrigated, the remainder being rainfed in areas receiving adequate winter rainfall. Many improved varieties are grown in Pakistan, although in recent years many of the major cultivars have been withdrawn due to susceptibility to rusts. Older, tall varieties still occupy substantial acreage, especially in rainfed areas. Besides the rusts, powdery mildew, smuts and partial bunt cause losses. Insects are generally not a serious problem, although increased losses due to armyworm have been observed in recent years.

A series of recommendations has been developed and passed on to farmers in Pakistan. Methods and times of cultivation, seeding operations, seed treatment and fertilization are

among the topics covered. Irrigation is another important area for which recommended regimens have been devised. Weeds cause serious losses (up to 30 percent) and are usually controlled through cultivation or hand sowing. The worst species include wild oats and *Phalaris minor*.

Wheat yields in Pakistan have stagnated around 1200-1400 kg/ha in recent years. This in spite of more fertilizer use, greater water availability and increased mechanization. Experience has shown, however, that much higher yields are possible, particularly with the use of more and better balanced fertilizers.

There are several difficulties confronting wheat farmers in Pakistan. Lack of land preparation machines and tractors, and their high cost when available, result in late plantings in many areas, as traditional methods are very slow. Timely availability of the correct fertilizers presents another problem. Seed production is not as efficient or effective as it should be, although this program is being strengthened. Other problems include scarcity of herbicides, expensive labor costs and somewhat low prices. Soil waterlogging and salinity pose a serious and long term problem. Future efforts to increase production of wheat will focus especially on diseases, fertilization and mechanization.

Barley is grown on a limited acreage in Pakistan, although its relative adaptation to salinity and drought may increase its importance in the future. New varieties show good promise for increasing yield over currently used cultivars.

CONTRAINTES LIMITANT LA CEREALICULTURE EN KENYA ET LES DIFFERENTES SOLUTIONS POSSIBLES

Résumé

Cultivées à des altitudes supérieures à 1800 m, le blé et l'orge occupent 140.000 ha de terres, le deux tiers étant emblavée par la première plante le reste par la deuxième. Les terres emblavées reçoivent plus de 700 mm de pluies par an.

Actuellement au Kenya, 18 variétés de blé et 4 d'orge sont recommandées aux agriculteurs de diverses régions et les rendements moyens atteignent 1 à 1,5 tonnes/ha. Les maladies importantes du blé et de l'orge sont les rouilles brunes et noires et les septarioses (*Septoria* spp.). De nombreux insectes sont présents mais leurs dégâts sont généralement de faible importance.

Une série de pratiques culturales ont été développées et sont recommandées aux agriculteurs; elle comprennent les méthodes et les différentes période de culture, la fertilisation et le désherbage. En parcelles de recherches, les pratiques optimales permettent d'atteindre des rendements en blé et en orge de plus de 4,5 t/ha.

Les céréaliculteurs font face à de nombreuses difficultés parmi lesquelles on peut citer le coût d'achat très élevé des machines agricoles, du fuel et des engrais, la rareté de la main d'œuvre et son prix élevé, les problèmes de stockage post moisson des grains (d'humidité et transport) les mauvaises conditions climatiques donnant parfois des grains 'moisis' de qualité très faible ou même inacceptable.

Toutefois, les céréaliculteurs peuvent bénéficier de crédits, d'assurances sur les récoltes, de conseils de gestion et les services de l'orge leur fournissent les dernières recommandations des services de recherches.

Les projets futurs sont d'étendre la céréaliculture à de nouvelles régions et de continuer à développer des variétés résistantes aux rouilles. De plus, des variétés de tritcale sont actuellement criblées pour leur utilisation en zones arides et sur des sols à faible pH.

DATA SUMMARY: WORKSHOP QUESTIONNAIRE

The organizing committee sent out a long and exhaustive questionnaire. Answers were received from 17 countries.

Considering the complexity of the questionnaire, the response was very good. Mr. David Saunders, a member of the organizing committee, summarized the information. Where data were incomplete, they were not included.

The summaries appear under the following five headings:

- 1) Cereal situation and the yield gap: country by country summary - Table I.
- 2) Manpower development and transfer of technology - Table II.
- 3) Economics and policy - Table III.
- 4) Herbicide usage - Table IV.
- 5) Use of improved varieties; importance of diseases and insects - Table V.

QUESTIONNAIRE DE LA CONFERENCE SOMMAIRE DES DONNEES:

Le comité organisateur a envoyé un long et complet questionnaire. Les réponses ont été recues de 17 pays.

Ou la complexité du questionnaire, la réponse était satisfaisante. M. David Saunders, membre du comité d'organisation a résumé cette information, en faisant exception aux données incomplètes. Les sommaires apparaîtront, sous les cinq chapitres suivants:

- | | |
|--|-------------|
| 1) La situation céréale et l'écart de rendement: pays par pays, | Tableau I |
| 2) Le développement du potentiel humain et le transfert de la technologie, | Tableau II |
| 3) L'économie et la politique, | Tableau III |
| 4) L'usage des herbicides, | Tableau IV |
| 5) L'usage des variétés améliorées; l'importance des maladies et des insectes, | Tableau V |

TABLE 1 Farm yield as a percentage of experimental yield
Average of 15 countries

| | Low rainfall | High rainfall | Irrigated | Average |
|-------------|-----------------|------------------|-----------|---------|
| Bread wheat | 31 | 40 | 44 | 40 |
| Durum wheat | 38 | 42 | 59 | 44 |
| Barley | 36 | 49 | 53 | 47 |
| Average | 35 | 44 | 50 | 43 |

The above table is self-explanatory. It would seem that only 43 per cent of the potential is exploited at present.

CEREAL SITUATION AND THE YIELD GAP: COUNTRY BY COUNTRY SUMMARY

Area under bread wheat, durum and barley, their average production, farm yields as a percentage of experimental yields, production requirements, fertilizer use, rotations, and tillage and seeding practices of the various countries of this region are reported in Table 1 sub-tables 1-17.

LA SITUATION CEREALE ET L'ECART DE RENDEMENT: PAYS PAR PAYS

Tableau I avec les sous-tableaux 1-17 rendent compte sur la superficie sous la culture du blé tendre, du blé dur et de l'orge, leur production moyenne, le pourcentage du rendement de l'exploitation agricole par rapport au rendement dans les stations expérimentales, les besoins de la production, l'usage des engrais, les assolements, le labourage et les pratiques de semence dans les différentes pays de la région.

Le tableau sidessus s'explique de lui-même. Il paraît que seulement 43 pourcent du potentiel est exploité jusqu'à maintenant. Les sous-tableaux 1 jusqu'au 17 donnent des détails sur chaque pays. Puisque les tableaux s'expliquent d'eux-même, nous les avons pas commentés.

TABLE I-1 ALGERIA

| | Area (ha) | | | Average Production (kg/ha) | | | % Farm Yields to Experiment Yields | | | Total Requirements (Tonnes) | Production Shortfall (Tonnes) | Projected Increased Requirements 1979-1985 (%) |
|-------------|-----------|------------------|--------|-------------------------------|------------------|--------|---------------------------------------|------------------|--------|-----------------------------------|-------------------------------------|--|
| | Low | Rainfall High | Irrig. | Low | Rainfall High | Irrig. | Low | Rainfall High | Irrig. | | | |
| Bread wheat | | 800,000 | | | 750 | | | 30 | | 1.4m | 800,000 | |
| Durum wheat | | 1,400,000 | | | 570 | | | 34 | | 1.0m | 200,000 | |
| Barley | | 700,000 * | | | 880 | | | 43 | | 0.8m | 200,000 | |

* 50,000 ha for hay in addition.

| | Low Rain | High Rain | Irrigation | |
|--------------|----------|-----------|------------|--|
| Fertilizers: | | | | |
| Nitrogen | 30 | 30 | 30 | Applied at seeding (50%) and in Spring (50%).* |
| Phosphorus | 45 | 45 | 45 | |

Main Rotations: 80% fallow-cereal. The fallow has grazing value. 15% cereal-hay crops. 5% cereal-grain legumes.

Tillage: For fallow, first cultivation is between February and September (disc plough at 15 cm). For annual cropping, first cultivation is in October (mouldboard plough/disc at 15-18 cm). Two subsequent cultivations with disc or tined implement (8-10 cm). 90% mechanized.

Seeding: November (first rains in October). 80% sown with drill, 100 kg/ha at 15 cm spacing. 20% broadcast at 80-100 kg/ha, covered with harrows or disc.

TABLE I-2

CYPRUS

| | Area (ha) | | | Average Production (kg/ha) | | | % Farm Yields to Experiment Yields | | | Total Requirements (Tonnes) | Production Shortfall (Tonnes) | Projected Increased Requirements 1979-1985 (%) |
|-------------|-----------|---------------|--------|----------------------------|---------------|--------|------------------------------------|---------------|--------|-----------------------------|-------------------------------|--|
| | Low | Rainfall High | Irrig. | Low | Rainfall High | Irrig. | Low | Rainfall High | Irrig. | | | |
| Bread wheat | 10,940 | | | 841 | | | 38 | | | 36,850 | 27,650 | 3 |
| Durum wheat | 16,350 | | | 844 | | | 28 | | | 13,800 | 0 | 80 |
| Barley* | 33,340* | | | 1,680 | | | 50 | | | 166,350 | 110,350 | 50 |

* An additional 6,150 ha used for grazing.

Fertilizers: 45 kg/ha phosphate used on all crops. For nitrogen, 45 kg/ha used on barley, 60 kg/ha for durums and 55 kg/ha for breadwheats, applied as split applications.

Main Rotations: 20% fallow, 60% continuous cereal, 20% cereal - hay crops. Negligible grain - legumes. Fallow has grazing value.

Tillage: In fallow system, first cultivation uses mouldboard plough in early winter to 15 - 20 cm. Two subsequent cultivation (Spring and Autumn) using a disc or tined harrow to 15 cm. In annual cropping, initially cultivated with MB plough or tyne cultivator in Autumn to 15 - 20 cm. One additional cultivation with disc or spring cultivator (15 cm). 100% mechanized.

Seeding: First rains late November - early December. Seeding date 15 Nov. - 31 December. 98% sown with drill or 165 kg/ha and 20 cm row spacing. For broadcast sowing seed rate is 180 kg/ha; covered using tined cultivator or iron bar drag.

TABLE I-3

EGYPT

| | Area (ha) | | | Average Production (kg/ha) | | | % Farm Yields to Experiment Yields | | | Total Requirements (Tonnes) | Production Shortfall (Tonnes) | Projected Increased Requirements 1979-1985 (%) |
|-------------|-----------|---------------|---------|----------------------------|---------------|--------|------------------------------------|---------------|--------|-----------------------------|-------------------------------|--|
| | Low | Rainfall High | Irrig. | Low | Rainfall High | Irrig. | Low | Rainfall High | Irrig. | | | |
| Bread wheat | | | 579,857 | | | 3,330 | | | 53 | 6,000,000 | 4,069,000 | 18 |
| Durum wheat | | | | | | | | | 45 | | | |
| Barley | 150,000 | | 50,000 | 775 | | 2,970 | | | 56 | 200,000 | Surplus 064,750 | 0 |

Fertilizers: Under irrigation, short bread wheats 170 kg/ha N, 40 P₂O₅. Tall varieties 120 N, 50 P₂O₅. For durums, short varieties 170 N, 40 P₂O₅; tall varieties 75 N, no P₂O₅. For barley, 75 kg/ha N, 30 kg/ha P₂O₅. Half of the nitrogen is applied before the first irrigation, half before second irrigation, by hand.

Main Rotations: Usually 3 year rotation including cotton, maize, rice.

Tillage: First cultivation October - November using a local plough to 10 - 15 cm. Two or three subsequent before seeding. 10% prepared using tractor.

Seeding: November - December. 89% broadcast, with 150 - 180 kg/ha. Covered using plank.

TABLE I-4

GREECE

| | Area (ha) | | | Average Production (kg/ha) | | | % Farm Yields to Experiment Yields | | | Total Requirements (Tonnes) | Production Shortfall (Tonnes) | Projected Increased Requirements 1979-85 (%) |
|-------------|-----------|---------------|--------|----------------------------|---------------|--------|------------------------------------|---------------|--------|-----------------------------|-------------------------------|--|
| | Low | Rainfall High | Irrig. | Low | Rainfall High | Irrig. | Low | Rainfall High | Irrig. | | | |
| Bread wheat | | 720,000 | | | 2,360 | | | 63 | | 1,300,000 | Surplus 400,000 | 0 |
| Durum wheat | | 180,000 | | | 2,000 | | | 69 | | 300,000 | Surplus 60,000 | 0 |
| Barley | | 360,000* | | | 2,500 | | | 69 | | 900,000 | 0 | 39 |

* An additional 40,000 ha are grazed.

Fertilizers: 40 kg/ha phosphate is applied to all cereals. 40-60 kg/ha N is applied to barley; 80-120 kg/ha to durum and 120-180 kg/ha to bread wheat. 100% mechanized.

Main Rotations: 70% cereal - cereal; 10% cereal - hay crops. 2% cereal - grain legumes, 18% with other alternatives (cotton, sugar beet, tobacco).

Tillage: First tillage July - August with mouldboard or disc to 20 - 30 cm. One further cultivation with disc (10 - 20 cm) in October - November. 100% mechanized.

Seeding: Seeding (in October - November), 95% with disc drill at 14 cm spacing, 150-200 kg/ha. Broadcast seeding at 200 - 250 kg/ha, covered with disc.

TABLE I-5

IRAQ

| | Area (ha) | | | Average Production (kg/ha) | | | % Farm Yields to Experiment Yields | | | Total Requirements (Tonnes) | Production Shortfall (Tonnes) | Projected Increased Requirements 1979-85 (%) |
|-------------|-----------|---------------|---------|----------------------------|---------------|--------|------------------------------------|---------------|--------|-----------------------------|-------------------------------|--|
| | Low | Rainfall High | Irrig. | Low | Rainfall High | Irrig. | Low | Rainfall High | Irrig. | | | |
| Bread wheat | 810,981 | 145,354 | 409,862 | 536 | 1,073 | 1,279 | 34 | 45 | 40 | 1,934,000 | 695,000 | |
| Durum wheat | 45,540 | 106,261 | - | 816 | 816 | - | 51 | 34 | - | | | |
| Barley | 251,213 | 51,089 | 335,465 | 600 | 823 | 1,156 | - | - | 46 | 1,288,000 | 707,000 | |

Fertilizers: Wheats are applied with 120 kg/ha nitrogen in split applications. 80 kg/ha phosphate is applied in high rainfall and 40 kg/ha in irrigated.

Main Rotations: Fallow (grazing value) is 50% low rainfall, 30% high rainfall. Continuous cereal is 50 - 60% depending on region. Grain legumes, hay crops are other major alternatives.

Tillage: In fallow system, initial tillage in March - April with disc or mouldboard plough to 15 - 20 cm. One subsequent tillage (same implements). In annual cropping, two cultivations with disc and springtooth harrow, 10 - 15 cm in September - October. Tillage is 100% mechanized.

Seeding: October (low rainfall), October - November (high), November (irrigated). 80% of low rainfall is sown with drill at 15 cm. 40% of other regions sown with drill. Seed rate is 120 kg/ha. For broadcasting, seed rate is 140 kg/ha in rainfed, 120 kg/ha in irrigated. Seed is covered with disc or toothed harrow.

TABLE I-6

JORDAN

| | Area (ha) | | | Average Production (kg/ha) | | | % Farm Yields to Experiment Yields | | | Total Requirements (Tonnes) | Production Shortfall (Tonnes) | Projected Increased Requirements 1979-1985 (%) |
|-------------|-----------|---------------|--------|----------------------------|---------------|--------|------------------------------------|---------------|--------|-----------------------------|-------------------------------|--|
| | Low | Rainfall High | Irrig. | Low | Rainfall High | Irrig. | Low | Rainfall High | Irrig. | | | |
| Bread wheat | | | 5,000 | | | 1,600 | | | 30 | 330,000 | 191,000 | 21 |
| Durum wheat | 130,000 | 80,000 | 1,000 | 500 | 875 | 1,000 | 47 | 55 | - | | | |
| Barley | 50,000 | trace | trace | 600 | - | - | 25 | - | - | 40,000 | 10,000 | 50 |

Fertilizers: Bread wheat receives 80 - 100 kg/ha and both phosphate and nitrogen. Durums are grown with 40 kg/ha of N and P. All is applied by hand at seeding.

Main Rotations: Fallow (no grazing value) exists only in low rainfall. The majority of the area is cereal - grain legumes or cereal - vegetables.

Tillage: In fallow system, first ploughing is in September using mouldboard plough to 25 - 30 cm. Subsequent tillage is using disc harrow (10 - 15 cm). In annual cropping system, initial tillage is in October. Tillage is nearly 100% mechanized.

Seeding: In low rainfall there is some dry-sowing (first rains October, seeding September - November). In high rainfall, November - January; irrigated is sown in December. 5-10% sown with shallow drill with 25 - 30 cm spacing at 100-120 kg/ha. For broadcast sowing, 60-80 kg/ha low rainfall; 100-150 high rainfall, 120 kg/ha irrigated. Covered with disc harrow.

TABLE I-7

KENYA

| | Area (ha) | | | Average Production (kg/ha) | | | % Farm Yields to Experiment Yields | | | Total Requirement (Tonnes) | Production Shortfall (Tonnes) | Projected Increased Requirements 1979-1985 (%) |
|-------------|-----------|---------------|--------|----------------------------|---------------|--------|------------------------------------|---------------|--------|----------------------------|-------------------------------|--|
| | Low | Rainfall High | Irrig. | Low | Rainfall High | Irrig. | Low | Rainfall High | Irrig. | | | |
| Bread wheat | 6,520 | 109,356 | - | 1,104 | 1,500 | - | - | 56 | - | 190,000 | 16,800 | 16 |
| Durum wheat | - | - | - | - | - | - | - | - | - | 4,000 | 4,000 | 75 |
| Barley | - | 32,000 | - | - | 2,188 | - | - | 86 | - | 65,000 | Surplus 5,000 | 15 |

Fertilizers: Bread wheat receives 10-17 kg/ha N and 40-50 kg/ha phosphate (lower rates in low rainfall zone). 2 kg/ha copper oxychloride applied in high rainfall.

Barley receives 14 kg/ha and 70 kg/ha phosphate plus 2 kg/ha copper oxychloride. All fertilizer is applied at seeding, by hand in low rainfall and by hand or mechanized in high rainfall.

Main Rotations: In low rainfall 40% is continuous cereal, 60% continuous cropping with cereals, legumes, potatoes. In high rainfall 40% is continuous cereal, 60% fallow. Some fallow has grazing value.

Tillage: Fallow system: September - October with disc plough to 20 cm. Second operation in October with disc harrow to 10 cm.

Annual cropping: First cultivation November - December with disc or mouldboard plough to 20 cm. Two subsequent operations with disc harrow, 6 weeks and 1 week before seeding (10 cm). Tillage is 100% mechanized.

Seeding: In low rainfall zone, there are two seeding times: September - October and March - April. 85% is sown with a drill at 18 cm row spacing, using 75-125 kg/ha. Broadcast seeding uses 120 kg/ha and covered using tree branches. In high rainfall, 100% of area sown with drills at 75-125 kg/ha.

TABLE I-8

LEBANON

| | Area (ha) | | | Average Production (kg/ha) | | | % Farm Yields to Experiment Yields | | | Total Requirement (Tonnes) | Production Shortfall (Tonnes) | Projected Increased Requirements 1979-1985 (%) |
|-------------|-----------|--------|--------|----------------------------|-------|--------|------------------------------------|------|--------|----------------------------|-------------------------------|--|
| | Rainfall | | | Rainfall | | | Rainfall | | | | | |
| | Low | High | Irrig. | Low | High | Irrig. | Low | High | Irrig. | | | |
| Bread wheat | 10,000 | 20,000 | 10,000 | 800 | 2,200 | 3,000 | 66 | 102 | 100 | 250,000 | 168,000 | 40 |
| Durum wheat | 5,000 | 15,000 | 10,000 | 800 | 2,000 | 3,000 | 80 | 111 | 100 | 100,000 | 36,000 | 50 |
| Barley | 5,000 | 10,000 | 5,000 | 1,500 | 3,150 | 4,000 | 100 | 79 | 100 | 200,000 | 141,000 | 50 |

Fertilizers:

| | Low Rain | High Rain | Irrigation | |
|------------|----------|-----------|------------|--|
| Nitrogen | 50 | 70-80 | 80-120 | Applied at Seeding (40-80) and in Spring (40-50) |
| Phosphorus | 40-50 | 70-80 | 75-120 | Rates of N and P to barley in all regions lower. |

Main Rotations: Little remaining fallow. Where it exists, it has grazing value except in low rainfall zone. Rotations are Wheat - Barley - Wheat-Alfalfa, Wheat-Lentils.

Tillage: First tillage at about opening rains (October 15) with plough or disc (20 - 25 cm).

Two subsequent tillages (disc, 20 cm) before seeding (November 15). 80% mechanized.

Seeding: 50-60% sown with drill. Seed rates 120-150 kg/ha. Row spacing 14 cm or 30 cms.

Seed rates for broadcast sowing not appreciably increased.

TABLE I-9

LIBYA

| | *Area (Ha) | * Total production (Tonnes) |
|-------------|------------|-----------------------------|
| Bread wheat | 143,164 | 75,134 |
| Durum wheat | | |
| Barley | 368,422 | 191,775 |

* 1975

Tillage: In both the fallow and annual cropping systems, tillage is commenced after the first rains. Fallow has grazing value.

Tillage is carried out using discs at 27 cm. There is some use of rotovators. 95% of tillage is mechanized.

Seeding: 75% sown with seed drill at 20 cm row spacings, 65 kg/ha in rainfed and 100 kg/ha under irrigated conditions.

About 25 % broadcast sown at 120 kg/ha and covered using disc or rotovator.

TABLE I-10

MOROCCO

| | Area (ha) | | | Average Production (kg/ha) | | | % Farm Yields to Experiment Yields | | | Total Requirement (Tonnes) | Production Shortfall (Tonnes) | Projected Increased Requirements 1979-1985 (%) |
|-------------|-----------|---------|--------|----------------------------|-------|--------|------------------------------------|------|--------|----------------------------|-------------------------------|--|
| | Rainfall | | | Rainfall | | | Rainfall | | | | | |
| | Low | High | Irrig. | Low | High | Irrig. | Low | High | Irrig. | | | |
| Bread wheat | 223,000 | 229,000 | 48,000 | 440 | 1,196 | N.A. | 13 | 13 | N.A. | 5.3 m | 1.53 m | 11 |
| Durum wheat | 267,000 | 955,000 | 68,000 | 650 | 1,053 | | 26 | 20 | | | | |
| Barley | 1,231,000 | 560,000 | 7,000 | 853 | 1320 | | 33 | 24 | | | | |

Fertilizers:

| | Low rainfall | High rainfall | Irrigated | |
|-----------|--------------|---------------|-----------|---|
| Nitrogen | 0 | 0-60 | 0-120 | No fertilizer applied to barley. Nitrogen applied as split dressings. Nearly 100% manual application. |
| Phosphate | 0 | 0-40 | 0-80 | |
| Potash | 0 | 0-40 | 0-80 | |

Main Rotations: Low rainfall - 25% fallow (has grazing value), 75% continuous cereal.
High rainfall - 15% continuous cereal, 70% grain legumes, 15% fallow (grazed).
Irrigated - 25% hay crops, 75% sugar beet, cotton, etc.

Tillage: Fallow system - initial tillage at opening rains (October) with disc plough followed by 2 passes of disc harrow (5-10 cm).

Annual cropping - 2 passes of disc harrow (5 cm) during October, November.

Tillage is 10% mechanized in low rainfall, 50% high rainfall, 100% in irrigated.

Seeding: November - December. In low rainfall, all broadcast at 80-100 kg/ha and covered with wooden plough. In high rainfall, 10% seeded with drill at 120 kg/ha, 90% broadcast at 120 kg/ha. In irrigated, 10% seeded with drill at 150 kg/ha, same seed rate for broadcast.

TABLE I-11

PAKISTAN

| | Area (ha) | | | Average Production (kg/ha) | | | % Farm Yields to Experiment Yields | | | Total Requirements (Tonnes) | Production Shortfall (Tonnes) | Projected Increased Requirements 1979-85 (%) |
|-------------|-----------|---------------|--------|----------------------------|---------------|--------|------------------------------------|---------------|--------|-----------------------------|-------------------------------|--|
| | Low | Rainfall High | Irrig. | Low | Rainfall High | Irrig. | Low | Rainfall High | Irrig. | | | |
| Bread wheat | | 1.62 m | 4.86 m | | 494 | 1,399 | | 31 | 23 | 10 m | 2.4 m | 25 |
| Durum wheat | | | | | | | | | | | | |
| Barley | | 0.16 m | | | 723 | | | | | | | |

Fertilizers: 42 units of nitrogen and 12 units of phosphate are applied (National average). Nitrogen applied as split dressings. Most applied by hand.

Main Rotations: In rainfed, the only rotation given is cereal - cereal, apart from fallow - cereal. Rotations are highly diverse under irrigated conditions.

Tillage: In fallow system, tillage commences in July using cultivator to 12 - 15 cm. Approximately 5 subsequent tillages using the same implement at 12 - 15 cm. In annual cropping, first cultivation in mid-October and 3-4 subsequent cultivations, 5-10% of tillage is mechanized.

Seeding: In rainfed, seeding is in mid-October. 40% is sown using a drill (usually single row) at 75 kg/ha and 25 cm row spacing. There is no increase in seed rate for broadcast seeding. Seed coverage is with a cultivator. In irrigated, seeding is later. 30% sown with drill at 95 kg/ha, 25 cm row spacing. No increase in seeding rate for broadcast sowing.

TABLE I-12

PORTUGAL

| | Area (ha) | | | Average Production (kg/ha) | | | % Farm Yields to Experiment Yields | | | Total Requirements (Tonnes) | Production Shortfall (Tonnes) | Projected Increased Requirements 1979-1985 (%) |
|-------------|-----------|---------------|--------|----------------------------|---------------|--------|------------------------------------|---------------|--------|-----------------------------|-------------------------------|--|
| | Low | Rainfall High | Irrig. | Low | Rainfall High | Irrig. | Low | Rainfall High | Irrig. | | | |
| Bread wheat | | 418,000 | | | 1,079 | | | 40 | | 800,000 | 349,000 | 12.5 |
| Durum wheat | | 15,000 | | | 866 | | | 36 | | 70,000 | 57,000 | 14.3 |
| Barley | | 89,000 | | | 775 | | | 45 | | 800,000 | 730,000 | 25.0 |

Fertilizers: 45 kg/ha phosphate applied to wheats; 26 kg/ha to barley, as one-third at seeding, two-thirds in Spring. 70% mechanized.

Main Rotations: Cereal - fallow; fallow has grazing value. A substantial area of fallow - fallow - cereal. Fallow - cereal - subterranean clover increasing in area. Annual cropping: Cereal - cereal, cereal - hay crop, cereal - sunflower. Grain legumes are being abandoned due to Orobanche.

Tillage: For fallow, first cultivation in January (plough, 20 - 30 cm); 2-3 subsequent operations with disc or cultivator/harrow (20-25 cm). 98% mechanized.

Seeding: November (following initial rains in September). 10% sown with drill (180 kg/ha at 25 cm spacing). 90% broadcast (180 kg/ha) and covered using cultivator.

TABLE I-13

SPAIN

| | Area (ha) | | | Average Production (kg/ha) | | | % Farm Yields to Experiment Yields | | | Total Requirement (Tonnes) | Production Shortfall (Tonnes) | Projected Increased Requirements 1979-1985 (%) |
|-------------|-----------|---------------|---------|----------------------------|---------------|--------|------------------------------------|---------------|--------|----------------------------|-------------------------------|--|
| | Low | Rainfall High | Irrig. | Low | Rainfall High | Irrig. | Low | Rainfall High | Irrig. | | | |
| Bread wheat | | 2,581,000 | 191,000 | | 1,669 | 1,576 | | 49 | 43 | 3.8 m | 500,000 (surplus) | |
| Durum wheat | | 97,000 | 7,000 | | 1,320 | 2,000 | | 44 | 50 | 0.15 m | 22,000 | |
| Barley | | 3,004,000 | 235,000 | | 1,600 | 2,868 | | 56 | 58 | 7.0 m | 2,194,000 (surplus) | |

Fertilizers:

High Rain Irrigation

Nitrogen 40-80 100 In rainfed, barley receives more fertilizer than bread wheat, and durum. Nitrogen is applied as split dressings. Fertilization is 85-90% mechanized.

Phosphate 30-50 70

Potash 30-50 70

Main Rotations: 40% fallow - wheat in rainfed, 25% annual cereal, 10% cereal - hay, 5% cereal - grain legumes (others mainly grazed forage). In irrigated, 30% cereal - hay, 30% grain legumes, 26% sugar beet. Fallow has grazing value.

Tillage: In fallow system, first ploughing in February (disc plough, 20-25 cm). Three subsequent tillages February - October at depths 15-8-4 cm. In annual cropping, first tillage is November at 25 - 30 cm, two subsequent tillages, December and January at 15-5 cm. Tillage is 90-95% mechanized. Opening rains are around October 20.

Seeding: 90-95% sown with drill at 18 cm. In rainfed, 180 kg/ha from 15 November to end January. In irrigated, 200 kg/ha at end January. Broadcast seeding is at 220-240 kg/ha and covered with plank or disc harrow.

TABLE I-14

SUDAN

| | Area (ha) | | | Average Production (kg/ha) | | | % Farm Yields to Experiment Yields | | | Total Requirement (Tonnes) | Production Shortfall (Tonnes) | Projected Increased Requirements 1978-1985 (%) |
|-------------|-----------|------|---------|----------------------------|------|--------|------------------------------------|------|--------|----------------------------|-------------------------------|--|
| | Rainfall | | | Rainfall | | | Rainfall | | | | | |
| | Low | High | Irrig. | Low | High | Irrig. | Low | High | Irrig. | | | |
| Bread wheat | | | 129,000 | | | 2,466 | | | 31 | 1,151,000 | 832,900 | 17 |
| Durum wheat | | | | | | | | | | | | |
| Barley | | | | | | | | | | | | |

Fertilizers: 80 kg/ha N applied at seeding. Broadcast on small farms.
Main Rotations: (1) Cotton - wheat - groundnut - sorghum - vegetables.
 (2) Cotton - wheat/groundnut - sorghum - vegetables.
Tillage: Initial tillage September (disc and harrows, 10-12 cm). Second operation in late September with shallow harrowing.
 Initial tillage is preceded by a prewatering. More than 99% of tillage is mechanized.
Seeding: Carried out in late October - mid November. Less than 1% seed with drill, 210 kg/ha at 20 cm row spacing. More than 99% broadcast seeded (210 kg/ha) and covered with chains.

TABLE I-15

TUNISIA

| | | Area (ha) | | | Average Production (kg/ha) | | | % Farm Yields to Experiment Yields | | | Total Requirement (Tonnes) | Production Shortfall (Tonnes) | Projected Increased Requirements 1979-1985 (%) |
|-------------|---|--------------|---------------|--------|----------------------------|---------------|--------|------------------------------------|---------------|--------|----------------------------|-------------------------------|--|
| | | Rainfall Low | Rainfall High | Irrig. | Rainfall Low | Rainfall High | Irrig. | Rainfall Low | Rainfall High | Irrig. | | (*Estimated) | |
| Bread wheat | * | 107,000 | | | 1,308 | | | 33 | | | 1,250,000 | 225,000 | |
| Durum wheat | | 600,000 | | | 1,058 | | | | | | | | |
| Barley | | 141,000 | | | 1,085 | | | 20 | | | 300,000 | 147,000 | |

* Total area sown to cereals in low rainfall zone varies from 300,000 - 700,000 ha depending on climate.

Fertilizers: The national average application to wheats - 15 units/ha of nitrogen and phosphorus (1978). Barley is grown without nitrogen fertilizer.
Main Rotations: (In 1976) - 16% fallow - fallow - cereal, 42% fallow - cereal, 17% cereal - cereal, 14% cereal - hay crops, 11% cereal - grain legumes. Fallow has grazing value, particularly in dry years.
Tillage: For the fallow system, first tillage by mouldboard plough in October (25 - 30 cm). For annual cropping systems, first cultivation with mouldboard immediately following harvest (25 - 30 cm). 2 - 3 subsequent tillages using offset disc or tined cultivator to 10 - 20 cm. Tillage is 80% mechanized.
Seeding: Opening rains at end of September. Drills sow at 15 cm spacing with 100-110 kg/ha. Broadcast seeding is at 100 kg/ha and covered with harrows.

TABLE I-16

TURKEY

| | Area (ha) | | | Average Production (kg/ha) | | | % Farm Yields to Experiment Yields | | | Total Requirement (Tonnes) | Production Shortfall (Tonnes) | Projected Increased Requirements 1979-1985 % |
|-------------|-----------|------|--------|----------------------------|------|--------|------------------------------------|------|--------|----------------------------|-------------------------------|--|
| | Rainfall | | | Rainfall | | | Rainfall | | | | | |
| | Low | High | Irrig. | Low | High | Irrig. | Low | High | Irrig. | | | |
| Bread wheat | 4.15m | 2.8m | 0.2m | 1269 | 2475 | 3500 | 37 | 48 | 100 | 8.63m | Surplus 4.26m | 11 |
| Durum wheat | 1.75m | 0.5m | | 1129 | 3000 | | 38 | 48 | 90 | 1.90m | Surplus 1.58m | 11 |
| Barley | 1.9m | 0.7m | 0.05m | 1842 | 2500 | 3000 | 36 | 56 | | 4.50m | Surplus 0.91m | 29 |

Fertilizers: Low Rain High Rain Irrig.
 Nitrogen 40 80-120 80-140 Nitrogen rate for bread wheat > durum > barley, applied in split applications. Mechanization 70% low; 90% high, 100% in irrigation.
 Phosphate 60 80 80

Main Rotations: In low rainfall, 95% fallow-cereal, 5% grain legume. In high rainfall, 50% continuous cereal, 10% hay crops, 10% grain legumes, 30% others. In irrigated, 30% grain legumes, 70% others (sugarbeet, cotton, tobacco, sunflower). Fallow has grazing value.
Tillage: Fallow system - mouldboard plow, March-April to 20 cm, 2-3 subsequent with sweep and harrow at 10-12 cm. In annual cropping systems, preparation is by disc harrow at 10-15 cm. 80-100% mechanized.
Seeding: October in low rainfall and irrigated, November in high rainfall. 80% drilled in low rainfall, 30-50% in high rainfall, 90% in irrigated. Seed rates 180-250 kg/ha at 17.5 cm row spacing. For broadcast seeding seed rate 300-350 kg/ha, covered with disc harrow or wood drag.

TABLE I-17

YEMEN ARAB REPUBLIC

| | Area (ha) | | | Average Production (kg/ha) | | | % Farm Yields to Experiment Yields | | | Total Requirements (Tonnes) | Production Shortfall (Tonnes) | Projected Increased Requirements 1979-1985 % |
|-------------|-----------|---------------|--------|----------------------------|---------------|--------|------------------------------------|---------------|--------|-----------------------------|-------------------------------|--|
| | Low | Rainfall High | Irrig. | Low | Rainfall High | Irrig. | Low | Rainfall High | Irrig. | | | |
| Bread wheat | | 45,000 | 5,000 | | 1.04 | | | 33 | 34 | 300,000 | 248,000 | 17 |
| Durum wheat | | | | | | | | 44 | 50 | | | |
| Barley | 51,000 | 17,000 | | 1.03 | | | | 43 | 52 | 72,000 | 2,000 | 25 |

Fertilizers: For barley, 40 kg/ha phosphate and 50 kg/ha N as split dressings, in both rainfed and irrigated. For wheats, 60 kg/ha phosphate and 35-35 kg/ha nitrogen in rainfed. In irrigated, 80 kg/ha phosphate and 50-50 kg/ha nitrogen. Potash applied (40-60 kg/ha) when cereal follows potatoes. All hand applications.

Main Rotations: In rainfed, 90% fallow (has grazing value), 8% cereal-cereal, 1% grain legumes, 1% potatoes. In irrigated, 90% annual cropping (cereal-cereal, cereal-grain legume, cereal-potatoes).

Tillage: In fallow system, first ploughing (oxen or mouldboard) in December-January to 20-40 cm. Two subsequent operations with oxen plough to 15-20 cm in April-May. Mechanization: 5% in low rainfall, 20% high rainfall, 40% irrigated.

Seeding: In rainfed, June-July. In irrigated (1) October-November (2) January-February. Most common sowing method uses oxen and thus row spacing is about 30-40 cm. Seed rate is usually 100-150 kg/ha.

A small area is broadcast (100-120 kg/ha) and covered using a wooden roller.

MANPOWER DEVELOPMENT AND TRANSFER OF TECHNOLOGY

TABLE II

Data concerning number of people in cereal improvement programs and local training and extension methods are summarized in Table II.

The Table is self explanatory. However, it is quite possible that the number of people listed for different specialities may overlap. But, in all cases except one, this was not indicated. Cyprus stated that the four people involved in breeding are the same four who carry out the variety trials. Two of them are also responsible for the quality program.

Almost all countries make use of field days and radio and television as tools of extension. Except in five countries, all others have training programs for extension methods.

LE DEVELOPPEMENT DU POTENTIAL HUMAIN ET LE TRANSFERT DE LA TECHNOLOGIE

Tableau II

Tableau II résume les données sur le nombre de chercheurs travaillant dans les programmes amélioration des céréales et entraînement local ainsi que sur les méthodes de vulgarisation.

Ce tableau s'explique de soi-même. Pourtant, il est bien possible que le nombre des chercheurs classifiés pour différentes spécialités peut chevaucher. Mais, à l'exception d'un cas, Chypre affirmait que les 4 chercheurs qui travaillent sur l'amélioration (des plantes) sont les mêmes qui sont engagés dans les essais sur les variétés, et deux d'eux sont aussi responsables du programme de la qualité.

Presque tous les pays utilisent des jours de campagne ainsi que la radio et la télévision comme instruments de vulgarisation. A l'exception de cinq pays, tous les autres ont des programmes d'entraînement des méthodes de vulgarisation.

TABLE II MANPOWER DEVELOPMENT AND TRANSFER OF TECHNOLOGY

| | No. Personnel in Cereal Improvement Programs..... | | | | | | | | B.Sc. M.Sc. Ph.D. | | Local Training | | | | Extension Methods | | | In-country Training in Extension Methods |
|--------------------|---|---------------------|-----------------------|-----------------------|------------------------|--------------------|----------------------|--------------------------------|---------------------------------------|---------------------------|----------------|-------|-------|---------------|-----------------------|-----|--|---|
| | Varietal Testing | Breeding Program | Agronomy Research | Pathology Research | Entomology Research | Quality Program | Extension Program | Agric/ Economics Program | Farm Demonstra- tion Program | Technicians (No./Year) | B.Sc. | M.Sc. | Ph.D. | Field Days | T.V. or Radio Used | | | |
| | | | | | | | | | | | | | | | | | | |
| Algeria | 3 | 13 | 7 | 2 | 0 | 2 | 6 | 0 | 8 | 480 | 620 | 10 | - | Yes | Yes | Yes | | |
| Cyprus | 4 | 4 | 2 | 1 | 1 | 2 | 19 | 3 | 26 | Yes | 2 | 1 | 1 | Yes | Yes | Yes | | |
| Egypt | 22 | 16 | 20 | 14 | 9 | 15 | 7 | 7 | 25 | 2 | 2 | 1 | 1 | Yes | Yes | Yes | | |
| Greece | 7 | 6 | 1 | 1 | 1 | 4 | 7 | 7 | 4 | 5 | 100 | 10 | No | Yes | Yes | Yes | | |
| Iraq | 9 | 6 | 4 | No | No | 1 | 7 | 7 | 7 | No | Yes | Yes | No | Yes | Yes | Yes | | |
| Jordan | 6 | 2 | 5 | No | No | 1 | 10 | No | 2 | 2 | 3 | 2 | No | Yes | Yes | Yes | | |
| Kenya | 4 | 4 | 4 | 2 | 1 | 1 | 36 | 5 | No | Yes | Yes | 70 | 3-8 | Yes | Yes | Yes | | |
| Lebanon | 6 | 6 | 6 | No | No | 1 | No | No | 1 | 8 | 2 | No | No | No | No | No | | |
| Libya | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | No | No | Yes | Yes | Yes | | |
| Morocco | - | 3 | 30 | 8 | 2 | 2 | 3 | 6 | 2 | 724 | 103 | 65 | No | Yes | Yes | No | | |
| Pakistan | 8 | 26 | 8 | 19 | No | 4 | 7 | No | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes | | |
| Portugal | 4 | 2 | Figures not Available | | | | | No | No | 12 | 2.4 | No | No | No | Yes | No | | |
| Spain | 51 | 46 | 23 | 15 | 27 | 10 | 850 | 4 | 30 | 2400 | 1200 | 60 | 30 | Yes | Yes | No | | |
| Sudan | 1 | 3 | 3 | 2 | 2 | 4 | 7 | 7 | 7 | 60 | 120 | Yes | Yes | No | Yes | Yes | | |
| Tunisia | 2 | 9 | 6 | 1 | - | 1 | 3 | - | 5 | 25 | 15 | No | No | Yes | Yes | No | | |
| Turkey | 2 | 33 | 10 | 7 | No | 10 | 1 | No | 7 | Yes | Yes | Yes | Yes | Yes | Yes | Yes | | |
| Yemen Arab Rep. | 2 | 7 | 7 | 3 | 2 | No | 4 | 7 | 1 | 2 | 1 | 1 | No | Yes | Yes | Yes | | |

ECONOMICS AND POLICY

TABLE III

There were many questions covering these two aspects. Answers to these questions are summarized in Table III. Since all the answers are self explanatory, no comments are given.

L'ECONOMIE ET LA POLITIQUE

Tableau III

Il y'avait plusieurs questions qui couvrent ces deux aspects.

Au tableau III les réponses sur ces questions ont été resumées. Puisque toutes les réponses s'expliquent d'elles-mêmes, les commentaires ne sont pas donnés.

TABLE III ECONOMICS AND POLICY

| | Cereal Prices Fixed Each Year | When Are Prices Fixed | % Increase Price Bread Wheat 1975-76 | % Increase Bread Price, 1975-76 | Grain Sold to: | | | Credit Available | | | | Subsidies | | | |
|------------|----------------------------------|--------------------------|--|---------------------------------------|----------------|---------------------|------|------------------|------------|----------|--------------------|-------------|-------|------------|-----------|
| | | | | | Govt | Village Consumption | Seed | Fertilizer | Herbicides | Tractors | Other Machinery | Fertilizers | Seeds | Herbicides | Machinery |
| Algeria | Yes | Harvest | - | 50 | 100 | - | - | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Cyprus | Yes | Harvest | 17.5 | 7.7 | 100 | - | - | Yes | Yes | Yes | Yes | Yes | No | No | No |
| Egypt | Yes | Not Regular | 0 | 0 | 20 | 30 | 50 | Yes | Yes | Yes | Yes | - | Yes | Yes | Yes |
| Greece | Yes | Mid- Season | 98 | 44 | 50 | 35 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes |
| Iraq | Yes | Mid- Season | 7 | 0 | 7 | 1 | 7 | Yes | Yes | Yes | Yes* | Yes* | Yes | Yes | Yes |
| Jordan | No | After Harvest | 7 | 0 | 5 | 80 | 15 | Yes | Yes | Yes | Yes | No | No | No | No |
| Kenya | Yes | Sowing | 50.0 | 21.4 | 93 | - | 7 | Yes | Yes | Yes | Yes | No | No | No | No |
| Lebanon | Yes | Mid- Season | 25 | 14.3 | 100 | - | - | Yes | Yes | Yes | Yes* | - | No | Yes | No |
| Libya | Yes | - | - | - | - | - | - | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Morocco | No | - | 41.7 | 0 | 25 | 75 | - | Yes* | Yes* | No | Yes* | Yes* | Yes | Yes | No |
| Pakistan | Yes | Mid- Season | 40.6 | 25 | 20 | 60 | 20 | Yes | Yes | Yes* | Yes* | Yes* | Yes | Yes | Yes |
| Portugal | Yes | Sowing | 67 | 140 | 90 | - | 10 | Yes | Yes | No | No | Yes | Yes | No | No |
| Spain | Yes | Mid- Season | 30.4 | 75 | 80 | 12 | 8 | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes |
| Sudan | Yes | Mid- Season | 14.3 | 7 | 65 | 25 | 10 | Yes* | Yes* | No | Yes* | Yes* | Yes | Yes | No |
| Tunisia | Yes | Harvest | 16.7 | 0 | 50 | 25 | 25 | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes |
| Turkey | Yes | Mid- Season | - | - | - | - | - | Yes | Yes | Yes | Yes | Yes | Yes | No | No |
| Yemen A.R. | Yes | 7 | 0 | 100 | - | 50 | 50 | Yes | Yes | - | Yes | Yes | No | No | No |

*No for small farms

HERBICIDE USAGE

TABLE IV

Usage of herbicides in the various reporting countries is summarized under three different headings in Table IV.

Herbicides for broadleaf weed control are used more widely than those for grassy weeds. Most of the countries report that grassy weeds are increasingly a problem for cereal production. The 1975 cereal workshop reported that weeds cause 20 percent loss to crop production in this region.

Ten of the 17 reporting countries list availability of chemicals on time as the main constraint, 12 of 17 list availability of proper chemicals as a constraint, while only 8 of 17 indicate availability of appropriate equipment as the major problem. Only seven countries provide subsidies for chemicals.

L'USAGE DES HERBICIDES

Tableau IV

L'usage des herbicides dans les différents pays contribuant à ce rapport est résumé sous trois titres différents au tableau IV.

Les herbicides pour les mauvaises herbes à feuille-large sont utilisés plus que ceux pour les graminées. La plupart de ces pays rapportent que les graminées sont devenues un problème toujours plus grand pour la production céréalière. La conférence céréalière de 1975 avait rapporté que les mauvaises herbes causent une déperdition de 20 pourcent à la production agricole dans cette région.

Dix des 17 pays rapportants ont classifié la disponibilité des herbicides à temps comme la contrainte majeure, 12 des 17 pays ont classifié la disponibilité de herbicides convenables comme une contrainte, pendant que seulement 8 des 17 pays ont indiqué que la disponibilité d'équipement approprié est un problème majeur. La subvention des herbicides existe seulement dans 7 pays.

TABLE IV HERBICIDE USAGE

| | Broadleaf Weeds | | | Grass Weeds | | | Constraints | | | |
|------------|-----------------|---------------|-------------------------|-----------------|-------------|-------------------------|----------------------|----------------------------------|---------------------------|------------------|
| | % Total Treated | Crop Stage | Main Application Method | % Total Treated | Crop Stage | Main Application Method | Availability at Time | Availability of proper Chemicals | Availability of Equipment | Chemical Subsidy |
| Algeria | 17 | Jointing | Air/Sprayer | 1.5 | 3 leaf | Sprayer | Yes | Yes | Yes | Yes |
| Cyprus | 90 | 4-6 leaf | Sprayer | 5 | Varies | Sprayer | Yes | Yes | Yes | No |
| Egypt | 0.6 | 5 leaf | Back-Pack | 0.4 | 5 leaf | Back-Pack | Yes | Yes | Yes | Yes |
| Greece | 70 | Tillering | Sprayer | 15 | 3 leaf | Sprayer | Yes | Yes | Yes | No |
| Iraq | 0.1 | Tillering | Air | 0.1 | First Node | Air | Yes | Yes | Yes | Yes |
| Jordan | 10 | Tillering | Sprayer | 0 | - | - | No | Yes | No | No |
| Kenya | 100 | 4-6 leaf | Sprayer | 30 | 4-6 leaf | Sprayer | No | No | No | No |
| Lebanon | NA | Tillering | Sprayer | 0 | - | - | No | Yes | No | No |
| Libya | NA | - | - | NA | - | - | NA | NA | NA | Yes |
| Morocco | NA | Jointing | Back-Pack | NA | Jointing | Back-Pack | Yes | Yes | Yes | No |
| Pakistan | Trace | Tillering | Broadcast | 0 | - | - | Yes | Yes | Yes | Yes |
| Portugal | 18 | Jointing | Air/Sprayer | 6 | Jointing | Air/spraying | Yes | Yes | Yes | No |
| Spain | 50 | 4 leaf | Sprayer | 10 | - | Sprayer | No | Yes | No | Yes |
| Sudan | 0 | - | - | 0 | - | - | - | - | - | - |
| Tunisia | 13 | End Tillering | Air/Sprayer | 1 | 2-3 leaf | Sprayer | Yes | No | No | Yes |
| Turkey | 60 | Tillering | Air/Sprayer | 5 | Post-Emerge | Sprayer | Yes | Yes | No | No |
| Yemen A.R. | 0 | - | - | 0 | - | - | - | - | - | - |

USE OF IMPROVED VARIETIES; IMPORTANCE OF DISEASES AND INSECTS

TABLE V

Data on percentage area, availability of improved varieties, the constraints of diseases, a list of main diseases, losses due to field insects and storage insects and a list of important insects are summarized in Table V.

It is evident that improved bread wheat varieties are very well distributed in virtually all of the countries. The percentage of improved varieties in durum wheat and barley is low and greater adoption efforts are required.

Most countries report variety availability as a limiting factor for crop production. This is greater in the areas above 350 mm rainfall and under irrigated conditions. Only 50 percent of the countries report the diseases as a constraint. Losses due to field insects vary from very low to 20 percent, while losses due to storage insects are reported to be in the range of very low to about ten percent.

L'USAGE DES VARIETES AMELIOREES ET L'IMPORTANCE DES MALADIES ET DES INSECTES

Tableau V

Tableau V donne un résumé sur le pourcentage de la superficie cultivée, disponibilité des variétés améliorées, les contraintes dues aux maladies, une liste des maladies principales, les déperditions dues aux insectes de champ et aux insectes d'emmagasinement et une liste des importants insectes dans la région.

Il est évident, que les variétés améliorées de blé tendre sont très bien distribués presque dans tous ces pays. Le pourcentage des variétés améliorées de blé dur et d'orge est bas et des efforts plus grands pour son adoption sont nécessaires.

La plupart des pays rapportent que la disponibilité des variétés est un facteur limitant pour la production céréalière. Cela est plus répandu dans les régions qui dépassent les 350 mm de précipitation et qui sont sous les conditions d'irrigation. Seulement 50 pour cent des pays rapportent que les maladies sont une contrainte. Les déperditions dues aux insectes de champ varient de très bas jusqu'à 20 pour cent, tandis que les déperditions dues aux insectes de l'emmagasinement varient entre très bas jusqu'à 10 pour cent.

TABLE V USE OF IMPROVED VARIETIES; IMPORTANCE OF DISEASES AND INSECTS

| | Area with Improved Varieties | | | Constraints | | | | | |
|------------|------------------------------|-------------|--------|--------------|---------|---------------------------------------|-------------------|---------------------|------------------------|
| | Bread Wheat | Durum Wheat | Barley | Variety | Disease | Main Disease | Insect Field Loss | Insect Storage Loss | Main Insect |
| Algeria | 60 | 5 | 20 | Yes | Yes | Stripe Rust | 10% | 10% | Stink Bug |
| Cyprus | 100 | 35 | 0 | In 350 mm | No | - | 0 | 1-2% | - |
| Egypt | 40 | - | 25 | In Irrigated | Yes | Rusts | 5% | 5-10% | Aphids |
| Greece | 98 | 98 | 90 | No | No | - | 0 | 1% | - |
| Iraq | 92 | - | 33 | In 350 mm | Yes | Smut | - | 0 | - |
| Jordan | 3 | 20 | 10 | In Rainfed | No | - | 1-2% | 2-3% | Leaf Beetle |
| Kenya | 100 | - | 100 | In Irrigated | Yes | Rusts | Very low | Very low | - |
| Lebanon | 80 | 100 | 70 | In 350 mm | No | - | 5-10% | 5% | - |
| Libya | - | - | - | No | No | - | - | - | - |
| Morocco | 29 | 7 | 0 | Yes | Yes | Leaf Rust, Septoria, Helminthosporium | - | 4% | Hessian Fly, Stink Bug |
| Pakistan | 65 | - | 0 | Yes | Yes | Stripe Rust, Leaf Rust | 2-3% | 2% | Ants, Sawfly |
| Portugal | 80 | 70 | 40 | Yes | No | - | Low | 5% | Hessian Fly |
| Spain | 97 | 95 | 80 | No | No | - | 15-20% | 5% | Aphids |
| Sudan | 99 | - | - | No | Yes | Stem Rust | Very low | Very low | Aphids |
| Tunisia | 58 | 63 | 0 | No | No | - | Very low | - | - |
| Turkey | 85 | 65 | 90 | In Irrigated | Yes | Rusts | Low | Low | - |
| Yemen A.R. | 5 | 0 | 0 | In 350 mm | Yes | Rusts | Very low | - | Aphids |

PROGRAM

| Date | Time | Topic | Person/Speaker |
|-------------|-------------|---|----------------|
| May 5 | | | |
| Saturday | 08:00-08:30 | Final Registration | |
| Session I | 08:30-08:45 | Introductory and Welcoming Address | Benzaghou |
| | 08:45-09:05 | Inauguration of the Workshop | The Minister |
| | 09:05-09:45 | Keynote Address | Anderson |
| | 09:45-10:00 | Vote of Thanks | Hachemi |
| Session II | 10:30-12:30 | National Reports - Mediterranean Basin | |
| | | Chairman | Hachemi |
| | | Algeria | |
| | | Cyprus | |
| | | Greece | |
| | | Lebanon | |
| | | Libya | |
| | | Morocco | |
| | | Portugal | |
| | | Tunisia | |
| | | Turkey | |
| | | Spain | |
| Session III | 14:00-15:30 | National Reports - Middle East | |
| | | Chairman | Boumaza |
| | | Iraq | |
| | | Jordan | |
| | | Sudan | |
| | | Syria | |
| | | North Yemen | |
| Session IV | 16:00-17:00 | National Reports-Other Countries | |
| | | Chairman | Arched |
| | | Afghanistan | |
| | | Egypt | |
| | | Kenya | |
| | | Pakistan | |
| | | Synthesis of Country Data | Saunders |
| | 20:00 | Dinner and reception given by His Excellency the Minister of Agriculture | |
| May 6 | | | |
| Sunday | 08:00-08:45 | Chairman | Anderson |
| Session V | 08:45-09:30 | Agronomic Constraints | Bolton |
| | 09:30-10:15 | Transfer of Technology | Mann |
| | 10:15-10:30 | Economic Constraints | Bronzi |
| | | Setting up of 3 working groups on the above topics to draw up conclusions | |

| | | | |
|--------------------------------|-------------|--|--|
| Session VI | 11:00-12:30 | Meeting of Working Groups Agronomic Constraints Transfer of Technology Economic Constraints | Animators Bolton Mann Bronzi |
| Session VII | 14:00-14:30 | Chairman A Review of Weed Control Practices in Cereal Rotations in Southern Australia | Qasem Baldwin |
| | 14:30-14:50 | Role of Chemicals in Weed Control | Basler |
| | 14:50-15:10 | Role of Cultural Practices on Weed Control in Central Anatolia | Durutan |
| | 15:10-15:30 | Role of Crop Rotations on Weed Control | Saunders |
| | 15:30-15:50 | Economic Aspects of Weed Control | Logié |
| | 15:50-16:10 | Role of Weeds in Cereal Production and Different Methods of Control in Algeria | Laddada |
| Session VIII | 16:30-17:30 | Chairman Panel Discussions: On the Acceptability of the Various Methods and Measures of Weed Control Drawing up of Conclusions and Recommendations | Qasem Baldwin Basler Durantan Saunders, Logié, Laddada |
| May 7 Monday | | Visits of on-farm demonstration and trials | |
| May 8 Tuesday Session IX | 08:00-08:40 | Chairman Effective Tillage and Cereal Production | Nour Hepworth |
| | 08:40-09:20 | Fallow system in Cereal Production | Güler |
| | 09:20-10:00 | Cropping Systems in Relation to Cereal Production | Hachemi |
| Session X | 10:30-12:30 | Chairman Panel Discussions: Cropping Systems and Constraints in: Case Examples Cyprus Jordan Tunisia Lebanon Pakistan | Hadjichristodoulou Samios Duwayri Maamouri Alameddine Tahir |
| Session XI | 14:00-14:20 | Chairman Reporters Fertilizer Effectiveness Under Low Rainfall Conditions | Benfréha McCuistion & Ketata Bray |
| | 14:20-14:40 | Fertilizer Effectiveness Under High Rainfall Conditions | Skorda |

| | | | |
|--------------|-------------|--|---|
| | 14:40-15:10 | Fertilizer Effectiveness Under Irrigated Conditions | Tahir, Hepworth |
| | 15:10-15:30 | Price Policy and Cost Benefits of Fertilizer Utilization | Gouéli, Fitch |
| Session XII | 16:00-17:00 | Chairman Reporters Varietal Adequacy for Different Agro-Climatic Conditions of the Region Significance of Diseases and Insects in Cereal Production Exploitation of Spring Wheat Potential Discussion | Kadra Burleigh, Fontan Srivastava Varughese Prescott, Kamel Saari Sage |
| | 20:00 | Dinner and reception given by the CIAC | |
| May 9 | | Chairman | McCuistion |
| Wednesday | | Reporters | Ait Amar, Gomma |
| Session XIII | 08:00-08:30 | Procedures of Seed Production in Turkey | Devecioglu |
| | 08:30-09:00 | Procedures of Seed Production in Tunisia | Maamouri |
| | 09:00-09:40 | Panel Discussions: Seed Production in the Cases of: Syria Algeria Lebanon Morocco | Swiedan Kadra Alameddine Ouassou |
| | 09:40-10:00 | Panel Discussions: Seed Production | |
| Session XIV | 10:30-12:30 | Chairman Reports of the Various Working Groups Agronomic Constraints Transfer of Technology Economic Constraints Weed Control Cropping Systems Fertilizer Responses Varietal Development and Disease and Pest Management Seed Production General Summary of the Workshop | Darling Bolton Mann Bronzi Qasem Hadjichristodoulou Benfréha Kadra McCuistion Anderson |
| Session XV | 12:45-13:30 | Concluding Session Chairman Appreciation Closing Address | Louhibi Varughese Bouarfa |

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