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AGRICULTURAL MUSEUM AUDITORIUM

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Cooperating Institutions

Egyptian Ministry of Agriculture
University of California, Davis
University of Arkansas, Fayetteville
The International Rice Research Institute
U.S. Agency for International Development

PREFACE

The Rice Research and Training Project has about reached the midpoint of its duration. It has been two and half years since the contract for the project was signed between The Egyptian Ministry of Agriculture and the University of California, Davis.

The Egyptian strategy for national self sufficiency in foodstuffs is based upon the increase in productivity of all crops and particularly the main cereals, namely rice, wheat and corn. Increased rice production per unit area is the main responsibility of the Rice Research and Training Project.

The project is financed by the United States Agency for International Development (USAID) and the Egyptian Ministry of Agriculture (A.R.E.), and supported scientifically by the Universities of California and Arkansas, U.S.A., and the International Rice Research Institute, Manila, Philippines. Capable scientists from these institutions and from the Ministry of Agriculture are carrying on a fine job towards the target of the project.

The project is organized under six specific programs, each intended to make its contribution to improve rice culture and to work co-operatively among the program areas. The Rice Breeding Program develops high yielding varieties of better qualities. The Agronomy Program contributes to increased rice yields by improving production practices. The Plant Protection Program devises more effective systems to control rice diseases, insects and weeds in the rice fields. The Seed Production Program improves the quality of rice seed and reduces red rice as a production problem in Egypt. The Mechanization Program devises simple machines for planting, transplanting, harvesting, threshing and pumping water. The Extension Program is the ultimate means for the delivery of knowledge to better production practices to farmers.

The Conference, reviewed and discussed the results of the different programs obtained from the research done during the 1982 season, as well as developed new plans for the programs for the 1983 season.

Ali Abdel Aziz
Director General

A.L. Isa
Rice Project Consultant

DEDICATION

These proceedings are dedicated to Dr. M.L. Peterson, a remarkable scientist-adminisrator and the first Principal Investigator associated with Egypt California Rice Research and Training Project. It was largely through his vision, organizational and administrative abilities that the Project was conceived and established. It is a model for development of an effective research and extension program. His scientific and administrative contributions will long be remembered and his friendship cherished by each of us whose life he has touched.

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21 - 24 FEBRUARY, 1983 CAIRO ,EGYPT

WELCOMING REMARKS
ALI ABDEL AZIZ, PROJECT DIRECTOR
RICE RESEARCH AND TRAINING PROJECT

Your Excellency Dr. Youssef Wally	Minister of Agriculture and Food Security
Mr.Michael Stone	General Director, United States Agency for International Development

Distinguished Guests
Ladies and Gentlemen

Welcome to the Third Conference of the Rice Research and Training Project.

Rice is considered one of the important cereal crops in Egypt which plays a significant role in the strategy of food security. We hope that by increasing the productivity per unit area of rice, wheat and maize we will become self sufficient in such vital foodstuffs.

Rice Research and Training Project started in the summer of 1980 aiming to increase the productivity of this crop through six channels:

1. Developing rice varieties which possess high yielding capacity, early maturity, short stature and resistance to diseases and pests and can tolerate saline or alkaline soils.

2. Improving the agricultural practices which include preparation of soil, rates of seed per unit area, proper time of seeding and transplanting fertilizer application in the proper rate and at the proper time and following the best water regime.

3. Controlling rice pests including insects, diseases and weed, and decreasing losses due to these pests to the minimum as well as efficient use of herbicides which have no side effects on rice plants.

4. Producing certified seed to cover between 50 to 70% of the area annually.

5. Mechanizing most operations done in rice fields including land preparation, transplanting, irrigation, harvesting and threshing. Machinery are imported from China and South East Asian countries then they become

modified to suit the local agriculture prior to manufacturing them locally.

6. Extension is very important to the project programs. Through extension, farmers will be able to apply the proper and new technology in rice production. The extension program is carried out in three steps.

   A. Applied research in farmers fields to verify results of research conducted at experimental stations to train the rice extension personnel on the application of agricultural practices in these fields.

   B. Extension fields covering all districts of the rice growing governorates in an area of about 20,000 acres.

   C. Small extension plots are established in most villages of the six governorates to train farmers on the proper practices in rice farming.
   The Rice Research and Training Project covers all items of rice production and provides the assistance to all other sectors in the Ministry dealing with this important crop as well as for extension and seed production.

Once again I welcome you and thanks to all of you for your interest in participating in our conference.

OPENING REMARKS
H.E. YUSSEF WALLY,
MINISTRY OF AGRICULTURE AND FOOD SECURITY, A.R.E.

Distinguished Guests
Ladies and Gentlemen

It gives me great pleasure to participate in the opening of the Third Rice Conference held by the Rice Research and Training Project. Our policy in the Ministry of Agriculture is directed towards self sufficiency in foodstuffs in general and cereals in particular. It is planned that within five to seven years our production of cereal crops will cover all our needs.

Regarding rice, the area cultivated with this crop is around one million feddans yearly. This area produces about 2.4 million tons. A few years ago, this amount was enough to cover the local consumption and some hundred thousands tons for exportation. However, last season we exported only twenty five thousand tons due to the drastic increase in human population and the increase in the rate of consumption per capita.

The Ministry is giving higher priority to this crop through the Rice Research and Training Project and certain other rice projects such as Rice Mechanization programs.

The objectives of these projects include:

1. Increasing the productivity of the rice crop per unit area.

2. Overcoming the problems of labour scarcity in the rural areas by introducing suitable mechanization for agricultural operations for this crop, and by replacing hand weeding by nonpollutant chemical herbicides.

3. Reducing and controlling pests.

4. Producing high quality certified seed.

5. Introducing and adapting machinery suitable to rice farming in Egypt.

6. Expediting the transfer of information from the researchers to the farmers through a stronger extension program.

This last item is considered the backbone of the project. The extension program called "Mabrouk 4" was designed to demonstrate the potential of rice extension in Egypt.

In 1981 extension rice fields consisted of 20 thousand feddans grown in 47 localities and covered the main rice growing governorates. A package of ideal cultural practices was applied in these fields and the result was a yield 3 to 4.75 tons per feddan with an average of 3.55 tons. This yield was 60% over the yield of adjacent fields. These fields drew the attention of many rice growers who have seen and learned the new technology advocated by the Rice Research and Training Project.

Small extension demonstration fields of about 5 feddans each were also made in 1266 villages out of the 1400 villages making up the 6 rice growing governorates. These demonstration fields were considered "Class rooms" as they were used for teaching extension personnel in villages who in turn taught farmers how to apply the new practices in rice production.

I have received a large number of letters and cables from farmers expressing their enthusiasm about "Mabrouk 4" and their appreciation to the Ministry for efforts exerted to increase rice production.

I would like to mention that President Mobarak is giving great attention to agriculture in Egypt and to rice production in particular.

Finally I would like to thank the U.S. Agency for International Development for the financial support and the technical assistance offered by the Universities of California and Arkansas and the International Rice Research Institute in the Philippines.

I hope you have a very successful conference and I extend my thanks to all those who came from abroad to attend the meetings.

God bless you all.

PURPOSE AND OBJECTIVES OF CONFERENCE
RAY E. ELY, TECHNICAL DIRECTOR
RICE RESEARCH AND TRAINING PROJECT

Minister Wally, Mr. Stone, Dr. Aziz, distinguished guests amd participants of the Third National Rice Conference. I am pleased to join with Minister Wally in welcoming each of you to the conference. On behalf of the entire staff of the Rice Research and Training Project we wish to acknowledge the excellent co-operation we have had from the Ministry of Agriculture, Advisory Committee including the representatives of various sections of the rice industry, The Technical Committee and other Related Projects.

I particularly want to recognize the various program units of the project that have co-operated together and co-ordinated their programs to most effectively and efficiently accomplish the project objectives.

The principal objectives of the Third National Rice Institute Conference is to plan for the immediate and long term progam of the Rice Research and Training Project.

This is accomplished through reporting and review of the last years accomplishment and planning the work program for 1983 and the longer term.

The overall objective of the Rice Research and Training Project is to achieve increased production and improved quality of rice in Egypt.

The contract specifies that the project will accomplish "progress toward a potential increase of 25% in rice yield over a period of 10 years". While much has already been accomplished it is essential to continue to (1) establish goals, (2) identify problems needing solution and answers (3) set priorities and (4) develop procedures for problem solving.

Much has already been accomplished in each of the program areas. This years Conference emphasizes New Strategies for Increasing Rice Production.

An important aspect of the early accomplishments toward the project goals is the co-operation between the various program areas. Co-operation between programs is particularly important and beneficial with the Breeding, Plant Protection, Agronomy, Mechanization, Seed Production and Extension areas.

The Extension-Demonstration program and the Seed Production program have developed co-operation and co-ordination that will supply high grade certified seed rice for a large part of the 1983 planting. Continued expansion

of this program will supply a red rice free market rice sufficient for the entire country production. This will supply a significantly greater yield of good quality marketable rice from the increased paddy yields through lower milling losses.

The 1982 accomplishments of each program area are presented in detailed reports and discussed by each of the program co-leaders in the following section of the Conference.

Significant accomplishments to date include:

1) Two varieties : Reiho (short grain japonica) and IR 1626-203 (long grain Indica) have been nominated for release. They both have excellent yields, and resistance to pests, disease, lodging and bird damage.

2) Extensive top crosses were made and grown in the winter nursery. The pedigree nursery have 1000 lines, from which selections are made for testing.

3) Developed a system to eliminate the red rice problems by a well controlled and supervised production of adequate supplies of certified seed.

4) Developed a cultural management package, Mabrouk 4, used by rice farmers that significantly increases yields.

5) Made extensive surveys of incidence of insects, assessment of losses, and effectiveness of chemical control.

6) Developed recommendations for control of weeds under practical farm conditions and at significant savings to the producer.

7) The demonstration fields showed potential of over 50% increase to the national average.

8) Adapted transplanters, reapers, threshers and windrowers for Rice under Egyptian conditions.

9) Conducted seven applied research trials in 20 locations and produced 1500 feddans of demonstration rice in 24 locations.

10) Field days were held demonstrating the research results and the effectiveness of the Mabrouk 4 program.

11) Developed training program for 6 Egyptian Scientists at California, Arkansas and the Philippines (IRRI).

12) Eleven Egyptian scientists are pursuing the Doctorate

and two Master Science degrees at Egyptian Univeristies with specialized training for rice programs.

13) Nine feddans at Sakha have been assigned for the NRI facilities site.

14) A & E contract awarded for development of facilities plan including offices, laboratories, seed cleaning, grain storage, maintenance, greenhouses, screenhouses and equipment storage.

15) A 45 feddan site at the Sakha Station has been levelled and tile drainage installed for research and breeding plot work.

16) Portable irrigation pumps of 6 to 10 inch axial flow design have been shown to be successful. These can be constructed in Egypt by small manufacturers.

Additional attention must be given to the development of an organization for the management of continued technology improvement through research and education.

THE ROLE OF INSTITUTION BUILDING IN AGRICULTURAL DEVELOPMENT

MAURICE L. PETERSON
PROFESSOR EMERITUS
DEPARTMENT OF AGRONOMY AND RANGE SCIENCE
UNIVERSITY OF CALIFORNIA , DAVIS

Several months ago, I received your invitation to address the opening session of the Third National Rice Institute Conference. At some risk on your part, I was given complete freedom to select the subject of my remarks. I have chosen one which has been of much interest to me and, I hope, to you as well -- The Role of Institution Building In Agricultural Development.

Since July, 1980, you have been developing a new institute to improve the quality and production of rice, your most important food crop. You are at mid-point of a 5-year project. Just 2 1/2 years remain during which AID financial support and University and IRRI technical support are available.

The purpose of the Annual Conference is to review progress and make plans for the next year. Your theme for 1983, New Strategies for Increasing Rice Production, indicats your forward thinking. Strategies used in the past have served their purposes well. New ones are needed to solve current and future problems in rice production. The technological progress you have made has been excellent considering some delays and problems in getting expatriate staff appointed and settled in Egypt.

My confidence in success of the rice project remains strong. The initial leadership of Dr. Isa, Dr. McClellan and Dr. Balal got the project off to a good beginning. The loss of Dr. McClellan was a personal as well as a professional loss but, while still in the hospital in Cairo, Dr. McClellan was thinking about who should follow him should he be unable to continue or after the completion of his contract. He told me he thought Dr. Ray Ely would be an excellent candidate. Fortunately for all of us, Ray was willing to accept. Mr. Swagerty was appointed Deputy Director at this time and brought to the project a lifetime of practical and technical experience with rice in Califoria and many other parts of the world. We are also pleased that someone with the experience and knowledge of Dr. Aziz was appointed Director when Dr. Isa retired and that we still have the advantage of Dr. Isa's presence as a consultant on the project.

I don't need to tell you how much Mr. Scott has done for the project. We benefited greatly from his experience in establishing the business office. He has brought together an excellent support staff that has made the work of all of you much easier. Then there are those you only see infrequently but are working very hard to provide you with your needs. Dr. Mikkelsen is your new California based leader and Betsey Marsh is the Administrative Officer who gets things done correctly and efficiently.

We have been successful in providing knowledge and materials from IRRI and the Universities of California and Arkansas for use in Egypt. This enormously expands the knowledge and research base for advancing rice production in Egypt. This has resulted in a research network of four institutions whose combined staff and research base could never be assembled and supported in any single country. The trainees, graduate students, and post-doctoral scholars you have sent abroad have provided another channel for transfer of new technology to Egyptian agriculture.

The technological developments in progress are for the most part those with low risk and high returns. The breeding program is developing early maturing, short statured, high yielding varieties, that soon will be replacing existing ones. The seed program is providing pure seed, free of red rice, for all rice farmers. Direct seeding is replacing transplanting on many farms with savings in labor and production costs. The incorporation of ammonia forms of nitrogen fertilizer in the dry seed bed before planting is proving just as successful in Egypt as it has been for many years in California. Improvements in water management and use of zinc for rice nurseries is producing better seedlings. The availability of inexpensive, low-lift pumps in the near future should make possible the use of ground water to supplement canal water or provide water when canals are dry as well as replace animal power for lifting water. Advances in mechanization, pest and disease control are future developments that will improve yields and decrease production costs.

With these technological improvements well under way, serious attention should be directed to the organization and management of the institution through which future research and extension education is to be conducted. It is a well-known fact that the success of a research-extension program is conditioned by the strengths or weakness of the structure and management of the institution that is responsible for the program. Certain patterns of operation can inhibit progress, rather than help. In some cases, institutions actually create barriers to progress by discouraging cooperative work between scientific groups. I have observed procedures so time consuming and cumbersome that real progress was almost impossible.

About ten years ago, I developed a graduate course on agricultural research planning and management. The purposes were to help graduate students, many from foreign countries, gain experience in goal formulation, problem identification, priority setting, and project development. Also covered were the structure, functions, and operating procedures of research agencies.

In the remaining few minutes available to me, I will present a few of these principles for structuring and operating research and extension organizations. They should be useful to you as the Rice Research and Training Project is phased into a permanent organization in the Ministry for the improvement of rice or other crops. Although these principles apply to all institutions, where appropriate I have made references to the rice project in particular.

The first step in institutional development is to define the goals. This must precede all other steps if confusion is to be avoided. Goals are the end points to be achieved -- not the means. An improved rice variety is a goal -- plant breeding is a means to achieving the goal. Goals are needed for purposes of planning, assessing progress, and informing the public.

Here is what John Kenneth Galbraith, economist and former U.S. ambassador to India, had to say about the importance of goals to development :

> "There will be improvement in economic development, only when we begin to ask what is needed -- when targets are established and attention is focused on what is required to meet them. Then it will be impossible (or anyhow difficult) to avoid thinking about the missing elements, and once targets are established, we shall have measures of success or failure. Then conspicuous failure will have to be explained and the responsibility for wrong decisions assigned."

This is the end of the quotation, but I would add -- "then also will those whose vision and hard work led to success be given proper credit and rewarded for their achievements."

The primary goal of the rice project is stated in the contract with the Ministry of Agriculture. It is to increase rice production in Egypt by 25% in 10 years. This is an average of 2.5% per year, which is in line with average yield increases established in most other crops in other parts of the world when supported by an effective research and extension organization. Goals must be realistic. Unrealistic goals, made for political and propaganda purposes, only lead to discredit of the agency. It is far better to exceed an honest goal than to fail on unrealistic one.

Since the goal of the rice project is to increase rice production, the staff that is assembled should include those skilled in techniques needed to get the job done. This includes plant breeders, agronomists, pathologists, entomologists, weed control specialists, seed production experts, engineers, extension educators and economists. I do not believe you can accomplish your goal in Egypt if specialists are placed in institutes organized according to disciplines. Then their work would be oriented more toward their discipline rather than the goal. You have taken steps toward structuring the project in harmony with goals, not disciplines. This structure should be formalized and preserved for the future.

Institute directors, research scientists and extension educators should be spared the necessity of providing operational services. These can be provided better by specialists for purchasing, accounting, farm management operations, equipment maintenance, statistical and laboratory analyses. An institute director who has a competent management staff has more time for program leadership.

All research-extension agencies need a well organized system for the collection, storage and recall of information. This is accomplished most easily through use of a project system. A project is plan of work of either a single investigator or a small team of investigators working cooperatively. It normally covers work to be done over a period of 3 to 5 years. A project has a specific goal or objective, a statement of why this goal is important, and a review of what has been done in the past. A project does not detail experiments to be performed. These should be left to the discretion of the research worker and his immediate supervisor. The Technical Committee for the Rice Research and Training Project is composed of highly qualified and experienced leaders. This is the group best qualified for long-range planning for the institute. They also should be helpful in budget planning, improving institute management, considering facilities and major equipment needs and for the review and approval of Project Proposals. Their time is too limited and valuable to spend on the review of the individual experiments.

Annual reports filed with the institute according to a coded system provides not only a permanent record, but ready access to past achievements. Project reports should be available to anyone wishing to read them. Projects do not replace annual work plans. They provide an organized framework into which work plans must fit. Time does not permit an adequate discussion of project preparation and reporting, but The following is a suggested brief outline for project preparation.

GUIDELINES FOR PREPARATION OF A RESEARCH PROJECT PROPOSAL

1. Title: A brief description of the subject of the research.

2. Principle Investigator : Full name, title, and address.

3. Organization: Name and address of the performing organization.

4. Objectives: Give the overall objective or long-term goal of the proposed research. The focus can be further sharpened by listing specific subobjectives. These should be clear. concise statements logically arranged.

5. Importance: This is a statement of the current level of technology and pertinent data to substantiate the significance of the research. It should indicate changes that will occur if the research reaches a successful conclusion.

6. Resume of Previous Work: The resume should describe the most advanced level of technology known at the present time. It should not be a statement of current practices which may be below the level of knowledge. The more important research advances should be cited and references listed at the end of the proposal.

7. Plan of Work: This is a description in detail of how the research is to be conducted. Where appropriate, indicate the experimental designs to be used under each sub-objective. The research plan should stretch to the end of the research activity, i.e., until the goals have been achieved or a modification of the project is needed.

8. Cost Estimates: Cost estimates are normally required to cover the entire life of the project, normally two or three years. Categories of costs are personnel (salary and fringe benefits), equipment, supplies, travel, and in some cases consultant costs. These costs are detailed by years.

9. References: Follow the system of citing references used by the Journal in which the research is likely to be published.

It is almost universally accepted that the leader of a research-extension institute should have earned his credentials as a practicing scientist or extension educator. In the U.S. and many other countries, staff members are given an opportunity to indicate their choice and acceptance of a leader. Leadership characteristics include the ability to mold a cohesive group, a willingness to seek and accept advice, able to make decisions, and able to be successful in representing the organization within governmental circles and with the public. Since both research and extension activities are involved, the leader should be able to represent both groups even-handedly and arrange for cooperative work between them.

Scientists, educators, and staff like to be appreciated, recognized, and rewarded for superior performance. Superior performance should be rewarded by salary advances, higher titles within the organization, increases in responsibility, awards, and by kind words or commendations. Although kind words are very important, I have never known them to replace a salary increase. All of these are stimulants to higher performance. A salary reward system must be fair and equitable to have the desired effect. This requires that standards of expected performance be established and known by those being judged. The standards should be in harmony with project goals. They should include evidence of progress toward the goals, the writing of higher quality publications, both technical and popular, and various measures of professional competence. Because it is essential that staff member know the criteria used in evaluation of their performance, these criteria should be written. In our case, the performance standards could be the responsibility of the co-directors and the Technical Committee.

Program leaders and their staff members need to know the amount of money available for their program for the year. Therefore, budget making accordia to program is important and should be the responsibility of program co-leaders. These budget requests should be reviewed by the two directors and the business manager and adjustments made in accordance with the availability of funds. The directors should retain some funds unallocated to meet possible unforeseen emergencies.

Most public institutions have external review systems. Members are selected because of position or special knowledge. Their purpose is to review what you are doing and advise if changes in directions are needed. Most review groups are advisory and they can be very helpful. You have an Advisory Committee of Ministers, industry heads, and farmers for this project. The rice project also is to be reviewed this summer by a group of outside specialists chosen by AID. The review team will want to know if you are making progress, spending money wisely, and complying with the terms

of the contract. Most of you will be asked to explain what you are doing and why you are doing it. You should be preparing for that now. I have participated in many of these reviews for AID as a member of AID's Research Advisory Committee for centrally funded research. I can advise you that some very hard questions will be asked. Reviews are very good for keeping institutes working on the right problems and for preventing them from becoming complacent and unproductive.

Staff moral is improved when there is wide participation and responsibility by staff in day-to-day operations of the institute. Efficiency also is improved by distributing responsibilities among staff members according to their interests and abilities. Good leadership does not require that all decisions be made by the organization head. Some decisions will be made better farther down the line by staff members who are closer to the problem. The delegation of responsibilities is an effective administrative procedure when policies and procedures have already been formalized.

In our department at the University of California, we use faculty committees for recruitment of new faculty, for advice on promotion or merit increases in salary, library acquisitions, farm operations, laboratory equiment needs and many other activities. The department head appoints the committees and assigns their duties in writing. Committee heads are expected to keep the leadership informed of their activities and needs for possible changes in policies or procedures. This system frees the department head from routine matters but not from his overall responsibilities for the department.

Training should be an essential part of the activities of every research-extension organization. Recent graduates from universities need assistance in getting started in a research or extension education career. Older staff members need updating on new research techniques. You are doing this in the Rice Research and Training Project by sending staff abroad for graduate degrees or post-doctoral research. Training is a major part of your extension rice program. This conference has a training function because all of us learn what specialists are doing in their own specialities. Your weekly seminars are further means of keeping up with new developments.

Training should not cease when this project is terminated in just 2 1/2 years. It can be continued without great expense by sharing the talents you already have. At Davis, we recently completed a 2-day training conference of all research and extension rice personnel. In another department in our college, interested staff members are being trained in the use of mini computers for research, by others

in the department who have specialized in their use. Much can be done to continually upgrade program quality using your current staff resources.

Staff freedom in the planning, conduct, and publication of research can be preserved in research organizations whose goals are clear. A well-trained scientist is the one most qualified to decide the best approaches to solving a critical problem. Scientists are inquisitive, creative, and imaginative. Freedom to use that creativity is essential to scientific advancement. Total freedom is not possible in an agricultural research organization dedicated to solving the problems of food production, but the procedures used to solve them should be left to the scientists.

When I wrote the Plan of Work for the Rice Research and Training Project, I had expected it would serve as a model research-extension team effort. If successful, it could then be used or modified if needed, for other agricultural crops. You can and are providing proof that new knowledge and materials can be put to immediate use on farms. The key element of our plan was research/extension cooperation.

The technology part of the project is working. But technology is developed by institutions. We have not made equivalent progress in developing the institutional structures and procedures. I understand that the institutional structure for the rice project has not yet been formalized. When this is done, and it should be done soon, these are good principles to follow:

1. The goals or objectives should precede and determine organizational structure.
2. Services should be provided for non-research and extension education activities so that the time and talent of professionals are reserved for program activities.
3. A system of permanent research records should be devised and made accessable to all who are interested in them.
4. A reward system for superior performance of staff members should be formalized.
5. The delegation of duties to staff according to their interests and talents to improve efficiency, staff morale and to allow more time for leadership on program direction.
6. Budget preparation according to program should be the responsibility of program co-leaders.
7. Use of "outside" advisory committees to evaluate program direction and progress to ensure that the program is meeting vital needs as viewed by the public.
8. Training on a continuous basis to improve staff competence and to keep us with new research and educational techniques.

9. Freedom to conduct research aimed toward established goals according to well-made plans of the investigator and his colleagues.

In conclusion, I want to express my personal thanks to the Ministry, to AID staff, and to all the members of the Rice Research and Training Project for their friendliness, coopertion and hard work in making this project a success. This has been a team effort from the very beginning. The most lasting and personal rewards for me are the warm friendships we have enjoyed. You will be remembered long after this program has finished.

PROMISING RESEARCH RESULTS RELEVANT TO INCREASED PRODUCTION IN IRRIGATED RICE (1)

S.K. DE DATTA (2)

Considerable steady increase in rice yields has generated confidence in many countries that science-based technologies can sustain high yields that can keeep in pace with the current level of increased demand. Such confidence is based on recent experiences in many rice-producing countries. In Asia, a steady increase in grain yields has taken place in almost all countries. For example, since 1953, Asia's rice production has increased at an average rate of 2.7% - slightly faster than the rate of population growth, but somewhat slower than the rate needed to keep up with the growth in demand (Herdt 1981). Sixty to sixty-five percent of the growth was achieved through increases in yield per unit area, the rest from expanding area. Some of these yield increases were due to actual area expansion for rice production but the most important changes are the increased area brought under irrigation to provide rice production capability during dry season. Yield increases have also been brought about by the adoption of modern varieties and associated technology, increased year-round irrigation facilities, and more fertilizer use. As a result of the shift to modern rice technology through concerted efforts at all levels, average rice yields in Indonesia have increased steadily since 1967. Similar spectacular gains have been recorded in Burma since 1978. When IR 8 was introduced in the Philippines in 1966, the national average grain yields were 1.3 t/ha. They increased to 2.3 t/ha in 1981. Production increase and national average yields in East Asia such as Korea, China, and Taiwan are most impressive as have been in Japan.

These spectacular yield increases still do not reflect the potential that researchers believe the technology has at the farm level in tropical Asia. However, in areas where year round irrigation water is available, rice yields with modern rice technology have been most remarkable. In rainfed wetland and dryland, yield changes are modest to negligible (Fig. 1).

In Egypt where rice is entirely grown under irrigation, national average yields in 0.43 million hectares (Balal 1981) increased from 5.0 in 1976 to 5.8 t/ha in 1980 (Fig. 2).

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1. Paper presented at the Third National Rice Institute Conference, Cairo, Egypt, 21 - 24 February 1983.

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Even in Egypt with favorable ripening period environoment, rice average yields are about 2 t/ha less than in a similar environoment in California, which is about 8.0 t/ha. Figure 3 shows the average daily solar radiation values in some temperate rice-growing countries and in Los Banos, Philippines, where IRRI headquarters and experimental farms are located. With the advantage having a high solar radiation, are also some associated disadvantages such as low temperature problems, both cool nights (14 - 19 C minimum) and wide diurnal fluctuations (13-17 C) in summer (Wahby and Tinsley 1981). As a result of low temperature problems, IR36 takes 147 days to mature in Sakha, Egypt, compared with 106 days in Thailand and about 115 days in Los Banos, Philippines.

It is not my intention to suggest research strategies for increased rice production in Egypt. Instead, I would like to share with you recent results from promising research areas that may have some relevance to Egypt's rice production.

CROPPING INTENSIFICATION

The opportunities for the rice crop to meet the challenges of the 1980s are built on 20 years of rice varietal improvement in most rice-producing countries. These opportunities have been aggressively and effectively intensified by the International Rice Research Institute that has generated new breeding strategies and an effective collaborative international testing to speed the identification of superior rices (Freeman et al 1981).

One remarkable success of varietal development in recent years is the shortening of growth duration, which provides opportunity to increase cropping intensities by double and triple croppings. For example, prior to 1966, most Asian farmers grew long-duration (150-170 days) insensitive to photoperiod-sensitive rices.

IR 8, which was introduced in tropical Asia in 1966, matures in almost 125 days. The first group of early-maturing rices developed at IRRI -- IR28, IR30 and recently IR36 and IR50 -- mature in about 115 days. Similar early-maturing rices such as BR7 in Bangladesh and Ratna, Palman 579, Pusa 2-21, Rasi and Akashi, Annapurna and Triveni in India were also developed by many national programs. In the past 3 years, the IRRI Agronomy Department has been testing several early-maturing rices for their yield potential under various fertilizer management practices. Some of these rices matured in about 105 days (Table 1) and still maintained reasonably high yields and high productivity (kg/ha per day). Promising early-maturing rices in IRTP trials in Egypt are

shown in Table 2.

PROTEIN-YIELD RELATIONSHIP IN EARLY-MATURING RICES

It is generally true that the protein content of early-maturing rices is higher than that of later maturing rice; however, very early-maturing rices may yield less than those which take longer to mature in the field. Table 3 shows comparative yield and protein content of seven IR lines and varieties. The early-maturing rices included in this comparison has retained high protein content without losing their yield advantage over longer-maturing rices such as IR 8 and IR 42, and in addition have many other highly favorable characteristics.

MANAGEMENT PRACTICES TO INCREASE RICE PRODUCTIVITY

Several management practices -- ratooning, use of older seedlings -- that increase productivity per hectare per day are used or are being researched on.

RATOONING

Ratooning of rice should be evaluated as a means of making the land productive. Although ratooning of rice has been tried in many countries, such as India, Philippines, Japan, Swaziland, United Stats, and Colombia, it is practiced in limited areas. Under some situations, ratoon culture is attractive because it requires less operation, less irrigation water, and lower production costs than raising other crops. Raising a successful ratoon crop would depend largely on the variety's ratooning ability, pest resistance, cultural practices such as proper cutting height, water management, nitrogen level of the main crop as well as the ratoon crop, control of volunteer rice and weeds in ratoon rice (Bahar and De Datta 1977).

Although absolute yield of a ratoon crop is about 30-50% of the main crop, productivity of rice varied from 37 to 66 kg/ha per day (Bahar and De Datta 1977).

Subsequently, Sompaew (1979) reported that IR 42 rice yielded (1.48 t/ha) significantly higher than IR 36 (1.08 t/ha) and IR 38 (0.96) rices, due largely to a higher number of panicles in IR 42. The grain yield of the ratoon crop was about 28-34% of the yield of the main crop (Fig. 4). Compared with split application, deep placement of nitrogen in the main crop increased grain yield significantly in the ratoon crops of IR 36 and IR 42 but not in IR 38 (Table 4). Seedling ages of the main crops of IR 36, IR 38, and IR 42 did not generally affect the grain yields of the ratoon crops (Table 5).

Studies at IRRI and elswhere would suggest that low yield in ratoon rice may be due to less effective tiller number, which is attributed to a high percentage of missing hills (unsprouting hills) and tillers produced from axillary buds.

Chang's (1978) study on plant growth regulators and rice tillering suggests that rice tillering is controlled mainly by auxins and cytokinins. The leaves produce auxin and exhibit inhibitory effect in tillering, while cytokinin synthesized in the root is required for bud activation. Chang also demonstrated that applied DPX-3778 <3-P-chlorophenyl) -6-methoxy-5-traizine-2,4 (1H, 3H) dione trimethanolamine salt> and chlorflurenol (2-chloro-9-hydroxyfluorene-9-carboxylic acid methyl ester) are two auxin transport inhibitors at concentrations ranging from 0.6-5 mM, which greatly promote tillering. Hanada's (1976) study on branching habits in crop plants showed that tiller bud growth was promoted by kinetin at 10-7 M but was inhibited at a higher concentration; GA3 promoted tiller bud growth when kinetin was present but promoted the apical bud only when IAA was applied

In a recent study, plant growth regulators were evaluated on the main and the ratoon rice crops (Hou 1983). The following are highlights of one experiment.

Sequential application of plant growth regulators and herbicides for controlling volunteer rice in ratoon crop. Volunteer rice is considered a weed in the ratoon crop. It is more difficult to control because it exhibits the same response to herbicides that the rice plants do.

Main rice crop grown in the field was cut 15 cm from the ground level and was transplanted in drums as the ratoon crop. One hundred newly harvested seeds of IR9752-71-3-2 were broadcast in each drum as volunteer rice.

Pretreatment with plant growth regulators such as GA3, kinetin, CCC, and TIBA before herbicide application satisfactorily controlled volunteer rice and improved the performance of the ratoon rice (Table 6).

Application of butachlor alone at 2.0 kg ai/ha soon after emergence of volunteer rice and before weed emergence controlled the volunteer rice, grasses, and other weeds. However, rice crop growth was slightly inhibited as reflected in the reduction in number of tillers per plant. Foliar application of GA3 or Kinetin one day before butachlor application prevented this, and is as good as hand weeding. Similar results were obtained with CCC or TIBA prior to 2,4-D application (Table 6).

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The results suggest that a successful ratoon crop will depend largely on the ratooning ability of a cultivar, its level of resistance to insects and diseases, the stand of the main crop, the moisture supply, and such cultural practices as proper cutting height, nitrogen level, and water management (Bahar and De Datta 1977).

Research should be intensified if growth regulators can help increase ratooning ability and control volunteer rice in a ratoon rice crop.

USE OF SEEDLINGS

In monsoonal Asia, it is difficult to precisely predict the onset of the rainy season; that is why many farmers delay planting. In the meantime, seedlings get older and taller and considerable damage of seedling roots takes place when seedlings are pulled. Often, recovery of older seedlings after transplanted is slow.

Some studies reported that delayed transplanting with older seedlings may result in lower yields, particularly if the crop suffers from moisture stress at a critical growth stage (Herrera and Zandstra 1979).

Nevertheless, one advantage of using older seedlings is the reduced duration of the rice crop in the main field, hence, the chance of increasing productivity per hectare per day.

In China, rice farmers shorten the field duration of the summer rice crop by using old seedlings in a double transplanting system so that a winter wheat crop can be planted on time. To compensate for yield losses due to the use of older seedlings, Chinese farmers use more than 8 to 10 seedlings per hill. This practice shortens the field duration thereby increasing cropping intensity and productivity per hectare per day without a substantial loss in yield.

In an experiment at the IRRI farm during the 1980 dry season, fertilizer nitrogen efficiency was evaluated at two seedling ages (20 and 40 days) of two varieties (early-maturing IR36 and intermediate-growth-duration IR42). The

experiment evaluated two split applications and controlled-release fertilizer sulfur-coated urea (SCU) broadcast and incorporated during land preparation. Results suggest that significant yield reductions were more pronounced in older seedlings of early-maturing IR36 than in those of IR 42 (Table 7). Results further suggest that without sacrificing grain yield slightly longer growth duration may be partially compensated by using older seedlings (De Datta et al 1981).

These and other results suggest that to increase the number of croppings per year and thereby increase the productivity per hectare per day, 40-day-old seedlings may be planted, provided that efficient forms and sources of fertilizer nitrogen are used. Furthermore, the number of seedlings may be increased to compensate for a possible decrease in yield due to the use of old seedlings which have a slow recovery rate after transplanting.

Effect of seedling age and planting date on yield. There is continued interest in decreasing the field duration of rice, primarily to increase production per hectare per day of transpanted rice under intensive cropping. Transplanting older seedlings can decrease field duration, but even with them it is essential to maintain high yields.

We ran tests on four farms in Nueva Ecija Province, Philippines, to determine how the age of seedlings influence rice yield. Seedlings at five ages -- 20 to 60 days with 10-day intervals -- were transplanted simultaneously late in each planting season and on staggered dates starting 1 to 1.5 months earlier. Examination of the average yields from the four farms for both seasons (Fig. 5) emphasized that:

- for simultaneous plantings made late in the season, yields during the dry season declined slightly with increased age of seedlings but remained essentially unchanged in the wet season; and

- early planting of young seedlings in both seasons produced higher yields than later planting of older seedlings.

These results indicated that grain yields of early-maturing IR 36 are affected not solely by the age of seedlings but, more importantly, by the time of transplanting. The environment in the main field has greater influence on the yield performance of rice than the environment in the seedbed.

The performance of seedlings of different ages will depend on the growth duration of a variety, among many other factors. An experiment at IRRI compared the 20 - and 40-day-old seedlings of early-maturing IR 36 and intermediate-maturing IR 42.

The grain yield of the 20-day-old IR 36 seedlings was significantly higher (0.7 t/ha) than that of the 40-day-old. But in IR 42, the difference in grain yields between the two seedling ages was not significant. The data suggest that with optimum water, fertilizer, and pesticide treatment, varieties with longer growth duration suffer less yield loss from older seedlings than varieties that mature early. This means that whenever a farmer plants a longer-duration variety that yields higher, any time lost due to longer field duration can be compensated by planting relatively older seedlings, thereby maintaining about the same level o productivity per hectare per day that is possible with the shorter-duration rice.

BASIC AND APPLIED STUDIES ON NITROGEN USE EFFICIENCY

The energy shortage of the past and increased costs of fertilizer processing have greatly accelerated the price of N fertilizers, which in turn has generated serious interest in the efficiency use of the plant nutrients for rice production in the developing world.

While learning to maximize grain yields at a high level of profitable fertilizer rate, the maximization of yields at a low fertilizer rate should not be ignored if the results are to be useful for the developing countries. Savings in fertilizer use and, hence costs, could help millions of small rice farmers obtain a higher yield with less fertilizer.

The following are results from some recent basic and applied studies relevant to increased fertilizer nitrogen efficiency in wetland rice soils.

BASIC STUDIES ON NITROGEN LOSSES

The magnitude and mechanisms of nitrogen losses need to be clearly identified to facilitate development of suitable management practices for maximizing the use of fertilizer N within given soil, climate, and water regimes.

Ammonia volatilization Ammonia volatilization losses in floodwater occur even when the soil is moderately to slightly acidic. However, losses are usually highest on alkaline soils (De Datta 1978).

The main factors affecting ammonia volatilization losses are temperature, soil texture, soil moisture, soil PH, and method and time of nitrogen application (Mikkelsen and De Datta 1979, De Datta 1981). At IRRI, ammonia volatilization losses range from negligible to as high as 60% (De Datta 1981, Sevant and De Datta 1982). Vlek and Stumpe

(1978) and Vlek and Craswell (1979) pointed out that ammonia losses from broadcast urea are potentially higher because urea hydrolysis produces alkalinity in floodwater. Field and greenhouse studies confirm that contention (Mikkelsen et at. 1978).

Changes in pH, ammonia, and urea nitrogen in floodwater systems. Many studies (Mikkelsen et al. 1978, Vlek and Craswell 1981, Craswell et al. 1981) recognized that soil pH may influence ammonia volatilization and that the higher the soil and the floodwater pH, the higher is the potential nitrogen losses. Up to about pH 9, ammonia concentration increases by a factor of 10 per unit increase of pH.

In a recent study on a clayey Alfisol (Maahas clay), floodwater pH was recorded to be greater in the dry season than in the wet season with a maximum pH of 9.7 occuring after basal application of urea (Cao et al. 1982). This is due to a higher floodwater temperature and photosynthetic activity of the aquatic biota that increase alkalinity.

High concentration of total N in floodwater, mostly urea N (Fig. 6), results where prilled urea is applied in split doses or in a band. In the dry season, the concentration of total N in floodwater remained high up to 7 days. The second topdressing of nitrogen into floodwater 5 to 7 days before panicle initiation increased total N in the floodwater only up to 3 days. At a large stage, rapid absorption by rice plants greatly reduces nitrogen concentration in floodwater.

Uniform placement of prilled urea and point placement with urea supergranules (USG) resulted in negligible concentration of total N (<5ppm) in floodwater in both seasons. These data suggest that very little fertilizer N ends up in the floodwater with these two placement methods. On the other hand, the very high total N in floodwater with band placement of prilled urea confirmed that band placement would result in poor nitrogen efficiency in wetland rice. This is due to the large amount of urea that is dissovlved in the floodwater before the fertilizer band is covered with soil.

Ammonia volatilization is certainly not the only pathway of fertilizer N loss. However, results (Fig. 6) do provide valuable estimation of the potential for NH3 volatilization and denitrification losses. Split application and band placement were both inefficient in minimizing N losses in wetland rice.

With the use of micrometeorological technique, direct measurements of ammonia loss in the field, done both at IRRI and at the Maligaya Rice Research and Training Center

(MRRTC), Munoz, Nueva Ecija, further substantiate the importance of this loss mechanism in flooded soils. For example, up to 47% of the urea-N topdressed into the floodwater 14 DT at MRRTC was found to be volatilized as NH (Fillery et al. 1982). The peak rate of NH3 loss approached 0.84 kg N/ha per h while rates of loss of 0.6 kg N/ha per h were common (Fig. 7).

Floodwater pH in this study (Fig. 8) and all other studies showed a pronounced diurnal patterns, implying biotic organisms, especially algae, were responsible for the floodwater pHs needed for significant NH3 loss (Mikkelsen et al. 1978).

Ammonia volatilization losses were substantially lower when urea was incorporated prior to transplanting or when urea was topdressed 5 to 7 DBPI. However, the total NH3 loss still accounted for a significant portion of the fertilizer-N added (Fillery et al. 1982).

Denitrification. Nitrate is reduced by a series of steps to nitrous oxide (N2O) and nitrogen gas (N2) which are then released into the atmosphere. This process of microbial denitrifiction results in the loss of nitrogen from the soil-water system. The major effect of flooding is impedance of oxygen diffusion, creating an aerobic-anaerobic system in which nitrification-denitrification occurs (Ponnamperuma 1972).

Quantitative evidence of nitrification-dentrification has recently been obtained from measurements of N2O fluxes. The fluxes are reportedly small, less than 3.0 g N/ha per hour (Craswell and De Data 1980).

Ammonium fixation It is known that the 2 : 1 clay minerals such as illite, vermiculite, etc., entrap ammonium ions between the silica sheets, which resist the usual methods of cation exchange (Broadbent 1978).

Recently Keerthisinghe et al. (1982) studies fixation and the release of nonexchangeable ammonium in three wetland rice soils in the Philippines.

Field studies on those three soils suggest that nonexchangeable ammonium is released during the first 30 days after transplanting, after which an equilibrium level is reached. During the fallow period between the 1981 dry season harvest and the 1981 wet season transplanting, an increase in nonexchangeable ammonium was observed in all nitrogen treatments in Maligaya silty clay loam (Fig. 9). The increase in nonexchangeable ammonium in the Maligaya silty clay loam is consistent in both seasons and is attributed to the presence of vermiculite as a major clay

mineral in the soil. Vermiculite has the ability to fix ammonium under both wet and dry conditions (Mengel and Kirkby 1978).

15 N-labeled nitrogen studies on fixation and the release patterns of nonexchangeable ammonium verified its contribution to plant nutrition in wetland rice soils (Keerthisinghe et al. 1983).

15 N balance studies with urea and modified urea products in irrigated rice. Recently, 15N balance was calculated from field experiments using deep placement techniques in wetland rice soil. Only 4% of the applied N was unaccounted for with point, deep placement of urea supergranules (USG) after harvest of the wet season crop (Fig. 10). In contrast, 35% of the applied N was unrecovered at harvest when prilled urea was applied in split doses (two-thirds basal incorporated and one-third topdressed at panicle initiation), indicating substantial loss of fertilizer N. Uniform deep-placement also resulted in high recovery of 15 N (92%), confirming that the high total 15 N recovery obtained with point, deep-placed USG was largely a function of depth of placement (Cao et al. 1982).

MANAGEMENT OF FERTILIZER NITROGEN FOR EFFICIENT USE

The steadily increasing cost of fertilizer has resulted in more emphasis being placed on improved management of N fertilizers for efficient use in wetland rice. Constraints studies in the Philippines showed that farmers were not able to achieve high yields from the fertilizer inputs (Garcia et al. 1983). Fertilizer nitrogen accounts for 30-40% of crop production; production of 50 million tons of nitrogen fertilizer requires natural gas equivalent to 300 million barrels of oil (Wittwer 1978). A 10% worldwide improvement in recovery of plant nutrients would give at the farm level a minimum saving of US$ 3.2 billion per year.

Some examples of recent research to improve nitrogen utilization of the rice crop by better management practices follow.

Timing of nitrogen application. One way to increase fertilizer nitrogen efficiency with the same amount of nutrient absorbed by the plant is to apply the fertilizer at a time which best meets the demand of the rice crop. In recent years, we have observed from our farm level constraints studies in the Philippines that many farmers obtain low yields because they apply fertilizer inefficiently (Fig. 11), a practice that is referred to as technical inefficiency.

Modified urea materials and their application method. Most of the nitrogen produced or imported in tropical Asia is

and will continue to be in the form of urea. The rapid and large expansion in nitrogen fertilizer production and the increased use of nitrogen for rice are important developments in the region (De Datta et al. 1981).

The International Fertilizer Development Center (IFDC) and several commercial companies are constantly developing new modified urea products that are being jointy evaluated by the national programs, IRRI, and IFDC through a collaborative network called the International Network on Soil Fertility and Fertilizer Evaluation for Rice (INSFFER).

Besides applying nitrogen at an appropriate time, two other concepts are evaluated by IRRI, IFDC, and the national programs to increase fertilizer nitrogen efficiency in wetland rice.

They are :

1. Deep placement of nitrogen fertilizer
2. Use of controlled-release fertilizers

Deep placement. Deep placement of nitrogen fertilizer, a concept that has been reported for at least two decades, has not been found practical in large areas in farmers' fields because of lack of suitable placement machines.

We continued testing applicators developed for deep placement of nitrogen fertilizers and compared them with either the farmers' practice of urea application or our improved method and timing. The floodwater nitrogen concentration was measured for six days starting one day after fertilizer application to evaluate the magnitude of nitrogen losses.

Our findings during the dry season confirmed previous results that deep placement of prilled urea or urea supergranules were better than our improved timing of urea application (Table 8). Deep-point placement of urea supergranules by machine performed as well as hand placement. Fertilizers that were deep-placed produced low nitrogen concentration in the floodwater. Low nitrogen concentration in the floodwater indicated relatively lower nitrogen losses.

From several placement machines that were tested in the dry season, two promising modified ones - IRRI transplanter with liquid injector and deep plunger--were used for advanced testing at IRRI and the Maligaya station in Nueva Ecija Province during the wet season. Point placement of nitrogen using the two machines gave significantly higher yields than the farmers' practice of urea application (Table 9). The two placement machines performed equally well but neither increased grain yield significantly over researchers' timing of applying urea in split doses. Our improved timing

produced a grain yield that is 0.5 t/ha higher than the farmers' timing of urea application.

Controlled release fertilizers. Of the coated fertilizers, sulfur-coated urea (SCU) has been most widely tested in rice (Craswell and De Datta 1980, De Datta et al 1981, Craswell and Vlek 1982, De Datta 1982). In the INSFFER trials, SCU appeared to be effective in increasing grain yield in various soils and environments (De Datta and Gomes 11981). Studies in Egypt confirm these results (Balal 1981).

Urease inhibition. Another approach that is being followed to reduce urea-N loss via ammonia volatilization is to inhibit the buildup of ammonia in the floodwater by blocking urease activity. One such inhibitor, phenylphosphoradiamidate (PPD) at a rate of 2% (wt/wt of urea) delayed the appearance of aqueous ammonia in the floodwater after urea application under controlled conditions (Vlek et al. 1980). Recent results with PPD do not show advantage in grain yield or nitrogen uptake. However, PPD does suppress production of NH4 and urea-N in floodwater (Fig. 12).

ZINC NUTRITION

As early as 50 years ago, zinc was recognized as an essential micronutrient. Rice areas deficient in zinc are now considered probably next in extent to areas deficient in nitrogen and phosphorus. Zinc deficiency occurs on Histosols; sodic, calcareous, and sandy soils, and on soils wet for prolonged periods. In highly zinc-deficient soils, no grain yields are obtained. Such was the case in Tiaong in Quezon Provine in the Philippines (Tabe 10).

In Egypt, zinc deficiency is a widespread nutritional problem in rice-growing areas. In a recent report by Ross et al.(1982), there was almost a one ton per hectare grain yeild increase with zinc application (Table 11).

AMELIORATION OF SALINITY AND SODICITY

Salinity and sodicity are two serious soil stresses that affect millions of hectares of rice land. Of about 60 million hectares in South and Southeast Asia, 27 million hectares in the humid tropics are climatically, physiographically, and hydrologically suited to rice but are not cultivated because of severe salinity (Akbar and Ponnameruma 1982).

Rice is grown in Egypt mainly on soil of medium salinity (EC>3<8 mS/cm), the dominant salt being sodium chloride, sodium sulfate, and magnesium chloride (Elgabaly 1978). Mineral stresses other than salinity include deficiencies of nitrogen, phosphorus, and zinc and excess boron in arid saline soils (Ponnamperuma 1981).

Rice is the crop best suited to saline soils because flooding is necessary for reclamation and rice thrives in flooded soils. A number of rices, both traditional and modern, can tolerate excess salts (Ikehashi and Ponnamperuma 1978). In Egypt, the following rices appeared promising for salinity tolerance: CR-S-2, IR 10198-66, and CR 984-2-2-2 (Balal et al. 1981).

In sodic soils, the addition of gypsum before rice cultivation is a prerequisite for a successful rice crop. The practice is usually repeated every 5 years to keep the soil in favorable physicochemical conditions (Elgabaly 1978).

The gypsum requirement and the amount of water needed for leaching can be reduced by using rices tolerant of sodicity (Ikehashi and Ponnamperuma 1978, Ponnamperuma 1981).

Under the International Rice Testing Program (IRTP), the salinity and alkalinity nursery was conducted during 1976 and 1977. In both years, no varietal differences were recorded because of mild stress in 1976 and extremely high stess in 1977. With appropriate breeding strategies, it is however evident that Pokkali and Nona Bokra derivatives may perform well under saline conditions (D.V. Seshu, IRRI, personal communication).

WEED CONTROL

The rice crop-weed competition varies with type of rice culture, methods of planting, variety, and cultural practices. Such variation in competition presents an opportunity to develop combinations of practices to minimize weed problems in rice (De Datta 1981).

WEED CONTROL IN TRANSPLANTED RICE

Weed control has always been one of the major inputs in rice production throughout monsoon Asia because a large portion of the total labor required traditionally has been devoted to weeding.

In irrigated transplanted rice culture, hand weeding is the most common weed control method in South and Southeast Asia but it requires considerable labor. As labor costs rise, chemical methods of weed control combined with other cultural practices and direct methods of weed control provide an excellent alternative to hand weeding alone. Phenoxy acid herbicides such as 2,4-D and MCPA and some selective herbicides such as butachlor and thiobencarb are being used. Recent advances in weed control technology made possible a wide choice of cultural practices. As a result, countries with high cost of labor and greater control of irrigation water such as Japan, Korea, and Taiwan, use herbicides in 75

to 100% of the rice areas.

In South and Southeast Asia, farmers choose the combination of weed control inputs that provide the desired degree of weed control at lowest cost. The chosen combination is largly determined by the input relative prices while the total expenditure on weed control is determined by its effectiveness and cost relative to the total value of the crop.

Generally, weeds such as Echinochloa sp. and Monochoria vaginalis (Burm.f.) Presl, which are the most common in transplanted wetland rice, are more competitive than rice because of their discontinuous germination, rapid growth, and high plasticity. Because early weed competition is more serious in yield reduction, early weed control is important for achieving high rice yields.

In the Asian tropics, a number of selected herbicides such as butachlor, thiobencarb, and others either alone or in combination with 2,4-D as MCPA provides excellent control of annual weeds in transplanted rice.

In Egypt, weeds have been considered as one of the serious production constraints in rice. The most prevalent weeds are Echinochloa crus-galli, E. colona among grasses, and Cyperus difformis among sedges. Several herbicides such as molinate, thiobencarb, pendimethalin, oxadiazon, perfulidone, and bentazon, are recommended (Abdel-Hak 1981).

WEED CONTROL IN BROADCAST-SEEDED FLOODED RICE

In recent years, broadcast seeding of pregerminated seeds on puddled field has become increasingly popular in the Philippines, Thailand, and Malaysia. This practice has been followed by large number of farmers in Sri Lanka and by some farmers in India and Bangladesh.

Relevance of increase in broadcast seeding has increased because of the following reasons:

1. Increased area under irrigation;
2. Increased cost of labor;
3. Availability of early maturity modern rices;
4. Development of appropriate chemical weed control technology.

In the Asian tropics, butachlor, thiobencarb, piperophos/dimethametryn, and butralin effectively control weeds in broadcast-seeded flooded rice. Results from our recent trials are given in Table 12.

In Egypt, the cost of labor is increasing steadily. As a result, there is considerable interest in developing technology for direct-seeded flooded rice.

In many rice-growing countries in developing regions, herbicide use is frequently looked upon as a threat to employment. This situation may be true in some regions in a given country, but the use of herbicides can complement the increased use of labor to raise farm production.

It is, therefore, important to recognize that weeds can be controlled by different methods and the choice will depend on the technology available, the type of rice culture, and the farmers' resources. The cost of weed control must be compared with the value of the yield increase resulting from weeding (De Datta and Barker 1975, De Datta and Herdt 1982).

SUMMARY

Science-based technologies have revolutionized irrigated rice production in the tropics and the temperate regions. As a result, national average rice yields of many countries have steadily increased over the years.

To sustain the 2.7%, or higher, growth rate of rice production in this decade, rice research should be sharply focused on issues relevant to increased production. In such efforts, development of cost-efficient technologies should include increased productivity of irrigated land by introducing early-maturing modern rices and associated improved cultural practices such as stand establishemnt techniques, fertilizer application, and weed control.

Basic studies should complement research on management practices. Considering the limited economic endowment of rice farmers in the region, the introduced technology should be not only highly productive but also profitable.

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Table 1 : Effect of fertilizer nitrogen application on field duration and productivity of 3 rice varieties and 4 early-maturing rices (a). IRRI, 1982 dry and wet seasons.

Entry	Dry season			Wet Season		
	Field duration (days)	Grain yield (t/ha) with deep placement	Productivity (kg/ha per day)	Field duration (days)	Grain yield (t/ha) with deep placement	Productivity (kg/ha per day)
IR 8	112	6.1 bc	55	105	1.5 d	14
IR 36	91	5.7 c	63	90	4.7 bc	52
IR 42	112	6.9 ab	62	117	4.5 bc	39
IR 9719-67-3	87	7.0 a	81	89	6.1 a	68
IR 9752-71-3-2	84	5.6 c	67	83	5.2 b	62
IR 199743-25-2-2	84	5.8 c	70	82	4.0 c	49
IR 25588-32-2	90	6.7 ab	75	86	5.1 b	60

(a) Nitrogen rates were 87 kg N/ha in the dry season and 58 kg N/ha in the wet season. Av of 4 replications. Separation of means in a column at the 5% level.

Table 2 : Promising early maturity rices in the International Rice Testing Program (IRTP) trials. Sakha, Egypt, 1977-81.

Year, nursery (a)	Designation	Yield (t/ha)	Days to flower	Date	
				Seeded	Transplanted
1977 (IRYN-E)	IR 3941-25-1-1 (b)	5.1	103	May 30	June 30
	IR 1561-228-3-3	4.4	108		
	IET 2881	4.3	109		
	Local check (name not given)	4.3	103		
1978 (IRYN-E)	Local check (name not given)	8.8	116	May 18	June 18
	RP 79-5	8.7	101		
	IR 3941-25-1-1 (b)	8.2	106		
1979 (IRYN-E)	Kaohsiung 139	4.8	102	June 17	July 13
	RP 1158-72-1	4.5	102		
	IR 9129-209-2-2-2-1	4.3	113		
	Local check (Giza 172	3.5	95		
1980 (IRYN-E)	Chianung sen yu 13	7.3	112	May 22	June 20
	BR 169-1-1	7.0	106		
	IR 9828-91-2-3	6.4	115		
	Kaohsiung 139	5.7	107		
	Local check (Giza 172)	5.4	108		
1981 (IRYN-E)	Taichung sen yu 285	8.8	112	May 14	June 19
	IR 13429-109-2-2-1	8.3	111		
	IR 13427-60-1-3-2-2	7.5	99		
	Chianung sen yu 13	6.7	114		
	Local check (Giza 172)	5.3	111		
1981 (IRYN-VE)	BG 276-5	7.5	107	May 14	June 19
	Suweon 287	7.3	101		
	IR 9729-67-3	7.1	98		
	Local check (Reiho	6.6	105		

(a) IRYN = International Rice Yield Nursery, E = early, VE = very early.
(b) cold tolerant

Table 3 : Field duration, productivity, and brown rice protein content of 3 varieties and 4 early-maturing IR rices as affected by the rate and method of nitrogen application. IRRI, 1982 dry season.

Variety, line	Field duration (days)	Nitrogen Applied			
		NONE		87 kg N/ha urea supergranule a	
		Grain yield (t/ha)	Brown rice protein (%)	Grain yield (t/ha)	Brown rice protein (%)
IR 8	112	3.4	7.3	6.1	7.7
IR 36	91	3.2	7.8	5.7	8.7
IR 42	112	4.1	7.0	6.9	7.8
IR 9729-67-3	87	4.7	8.1	7.0	8.9
IR 9752-71-3-2	84	3.0	7.9	5.6	9.3
IR21015-80-3-3-1-2	97	5.0	7.3	7.2	8.9
IR 25588-32-2	90	5.3	7.8	6.7	9.7

(a) deep placement

Table 4 : Effect of nitrogen application on the main crop on the grain yield of ratoon crops of IR36, IR 38, and IR 42 (av of 4 seedling ages). a IRRI, July-November 1978. (Adpated from Sompaew and De Datta 1981).

Nitrogen application	Grain yield (t/ha) of ratoon crop		
	IR 36	IR 38	IR 42
Split doses	0.9 b	0.9 a	1.4 b
Deep placement	1.2 a	1.0 a	1.6 a

(a) In a column, means followed by the same letter are not significantly different at the 5% level.

Table 5 : Effect of seedling age of the main crop on the grain yield of ratoon crops of IR36, IR 38, and IR 42 (av of 2 nitrogen applications). a IRRI, July-November 1978. (Adpated from Sompaew and De Datta 1981).

Seedling age (days)	Grain yield (t/ha) of ratoon crop		
	IR 36	IR 38	IR 42
20	1.2 a	0.9 a	1.6 a
30	1.2 a	0.9 a	1.3 b
40	1.1 a	1.1 a	1.4 ab
50	1.0 a	1.0 a	1.5 ab

(a) In the same column, any two means followed by the same letter are not significantly different at the 5% level.

Table 6 : Effect of sequential application of plant growth regulators and herbicides on weed control and grain yield of ratoon IR 9752-71-3-2 rice. IRRI, June - August 1982.

Treatment (a)	Rate (b)		Volunteer rice control (%)	Weed dry weight (g/m2)	Grain yield (g/plant)	Panicles (no./plant)
	Growth regulators	Herbicides (kg a.i./ha)				
Butachlor	-	2.0	98	53	15	19
GA3 fb butachlor	100	2.0	95	39	18	21
Kinetin fb butachlor	50	2.0	95	32	21	25
2.4-D	-	2.0	94	100	13	18
CCC fb 2,4-D	5000	2.0	96	26	17	21
TIBA fb 2,4-D	500	2.0	96	22	20	21
Hand weeding	-	-	64	29	23	21
Unweeded	-	-	0	530	3	6

(a) fb = followed by
(b) plant growth regulators were applied when the coleoptiles of broadcast seeds of volunteer rice and just emerged. Herbicides were applied one day after plant growth regulator application.
a.i. = active

Table 7 : Effect of various fertilizer management practices on grain yield of IR 36 and IR 42 transplanted as 20 - and 40 - day-old seedlings. (a) IRRI, 1980 dry season. (From De Datta et al. 1981)

Treatment (b)	Grain yield (t/ha)		
	20-day-old	40-day-old	Difference
	IR36		
No nitrogen	3.9 b	3.6 c	0.3 ns
87 kg N/ha			
2/3 BI + 1/3 5-7 DBPI	6.4 a	4.9 b	1.5 **
1/2 15 DT + 1/2 40 DT	6.4 a	4.8 b	1.6 **
Ordinary SCU, broadcast and incorportated	6.7 a	5.6 b	1.7 **
150 kg N/ha			
2/3 BI + 1/2 5-7 DBPI	6.7 a	5.6 a	1.1 **
	IR42		
No nitrogen	4.4 c	4.0 b	0.4 *
87 kg N/ha			
2/3 BI + 1/3 5-7 DBPI	6.4 b	6.5 a	-0.1 ns
1/2 15 DT + 1/2 40 DT	6.6 b	6.6 a	0.0 ns
Ordinary SCU, broadcast and incorporated	7.0 a	6.6 a	0.4 *
150 kg N/ha			
2/3 BI + 1/3 5-7 DBPI	7.0 a	6.8 a	0.2 ns

(a) In a column under each variety, means followed by a common letter are not significantly different at 5% level.

(b) BI = basal and incorporate, DBPI = days before panilce initiation, DT = days after transplanting, SCU = sulfur coated urea.

* Significantly different at 5% level,
** Significantly different at 1% level,
ns = not significant.

Table 8 : Effects of sources of urea and application methods on the floodwater nitrogen and grain yield of rice. IRRI, 1982 dry season.

Source of urea	Application method	Nitrogen applied (kg/ha)	Floodwater nitrogen (a) (ppm)	Grain yield (b) (t/ha)
No fertilizer nitrogen	-	0	1	2.6 c
Prilled	Point placement by liquid injector (c)	87	7	5.5 ab
Supergranule	Point placement by furrow plunger Rockwood gun	85	8	6.0 a
Supergranule	Point placement by hand	87	14	6.1 a
Prilled	Researchers' split	87	80	4.7 b

(a) Urea - N plus NH_4^+ - N concentration one day after basal application of fertilizers.

(b) Yields followed by a common letter are not significantly different at the 5% level.

(c) 2/3 injected with transplanter at planting and 1/3 injected by prilled urea solution injector 3 - 4 days before panicle initiation.

Table 9 : Effects of sources of urea and application methods on the labor equipments and grain yield of rice. IRRI and Maligay Rice Research and Training Center in Nueva Ecija, Philippines, 1982 wet season.

Source of urea	Application method	Nitrogen applied (kg/ha)	Floodwater nitrogen (a) (ppm)	Grain yield (b) (t/ha)
No fertilizer nitrogen	-	0	0	3.7 c
Supergranule	Point placement by deep plunger	56	42	5.1 a
Prilled	Point placement by transplanter with liquid injector	54	24	5.3 a
Prilled	Farmers' split	58	9	4.2 b
Prilled	Researchers' split	58	10	4.7 ab

(a) Av of 4 replications and 2 sites (IRRI and Nueva Ecija). Yields followed by a common letter are not significantly different at the 5% level.

Table 10 : Response to zinc in transplanted and direct-seeded flooded rice on a Lipa clay loam at Tiaong, Quezon Province, Philippines. (From IRRI 1978).

Rice crop	Zinc application	Grain yield (t/ha)
Transplanted	None	0
Transplanted	Zinc oxide to roots (2% suspension)	2.7
Transplanted	Zinc sulfate to soil (50 kg/ha)	2.1
Direct-seeded	None	0
Direct-seeded	Zinc oxide as seed coating (2% of seed weight)	2.4
Direct-seeded	Zinc sulfate to soil (50 kg/ha)	3.9

Table 11 : Effect of zinc application in wetland rice soils in applied research trials in Egypt. (Adapted from Ross et al. 1982)

Zinc treatment	Grain Yield (a) (t/ha)
Seedling dip in 1% ZnO suspension in water	9.1 b
Zinc sulfate at 24 kg/ha applied to the main field	9.1 b
Zinc sulfate at 48 kg/ha applied to nursery bed	9.4 a
Untreated control	8.5 c

(a) Means followed by ther same letter are not significantly different at the 5% level.

Table 12: Weed control in broadcast-seeded wetland rice at IRRI and at two Philippines Bureau of Plant Industry research stations, 1979-81 wet seasons.

Treatment (a)	Rate (kg a.i./ha)(b)	Grain yield (c) (t/ha)			Trials resulting in higher yields (d)
		IRRI	Maligaya	Bicol	
Naproanilide/thiobencarb	1.0/0.7	2.2	5.4	4.0	7
Piperophos/2,4-D IPE	0.33/0.17	2.1	5.7	3.7	7
Butachlor + 2,4-D	0.75+0.5	2.5	4.5	4.4	9
Thiobencarb/2,4-D IPE check	1.0/0.5	2.5	5.1	4.5	9
Untreated check	-	0.9	2.6	2.7	

(a) IPE = isopropyl ester (b) a.i. = active ingredient.
(c) Av of 3 years/site
(d) Number of trials that resulted in significantly higher yields over untreated control. Total number of trials was 9.

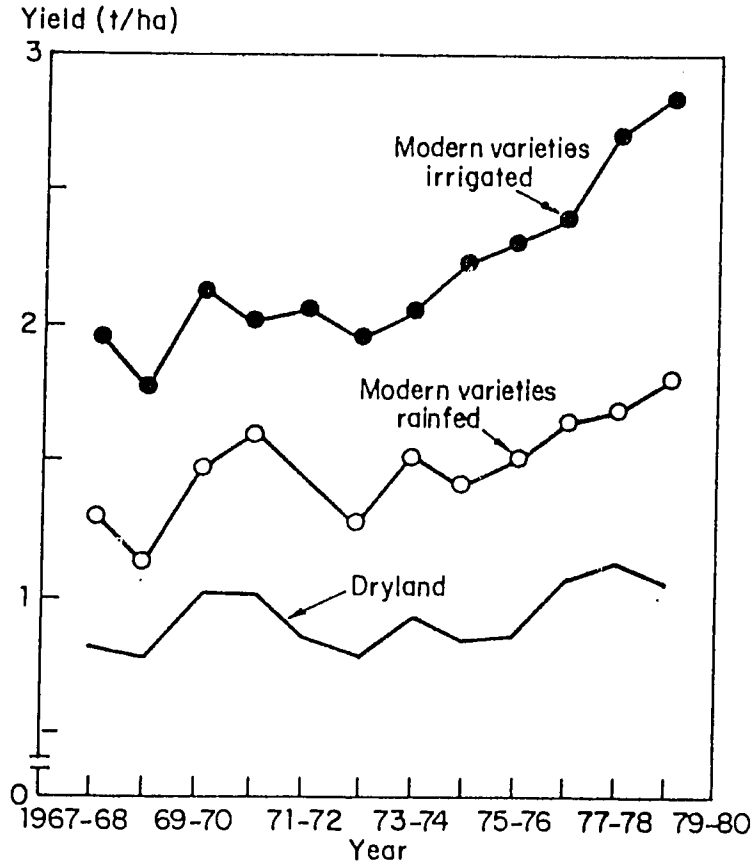

Fig. 1. Average grain yields in the Philippines with modern varieties in irrigated and rainfed wetlands and with traditional varieties in drylands, 1966-77 to 1979-80 (from IRRI 1982).

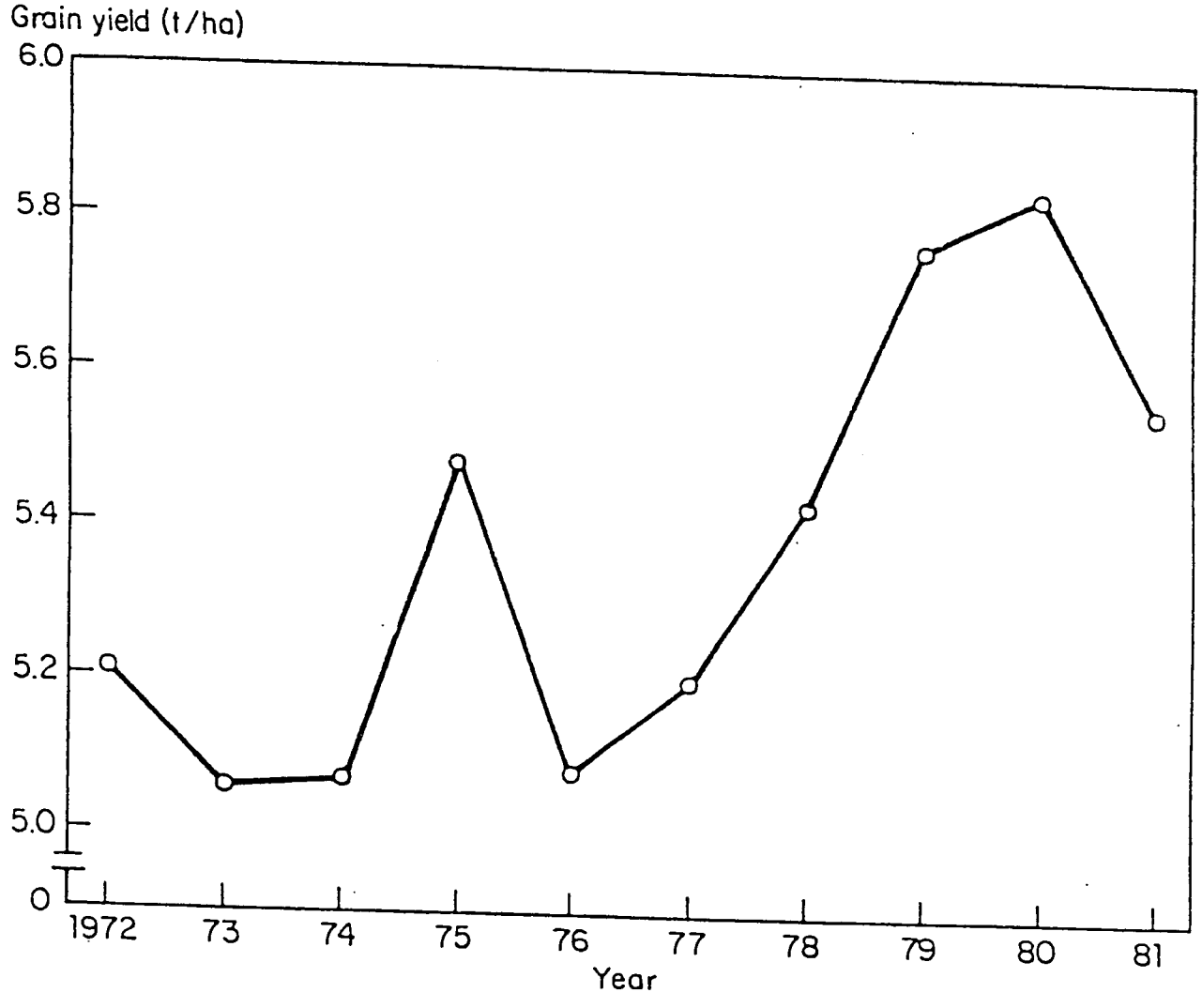

Fig. 2. National average yields in Egypt, 1972-81 (from USDA 1982).

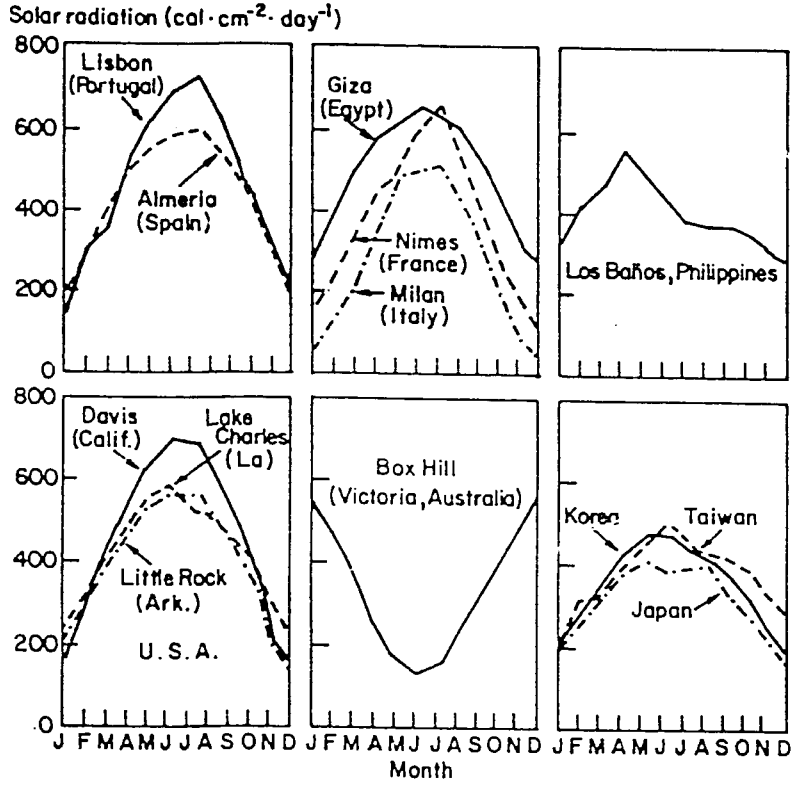

Fig. 3. Average daily solar radiation values by month in some rice-growing areas in temperate countries and in Los Baños, Philippines, in the tropics (adapted from De Datta 1981).

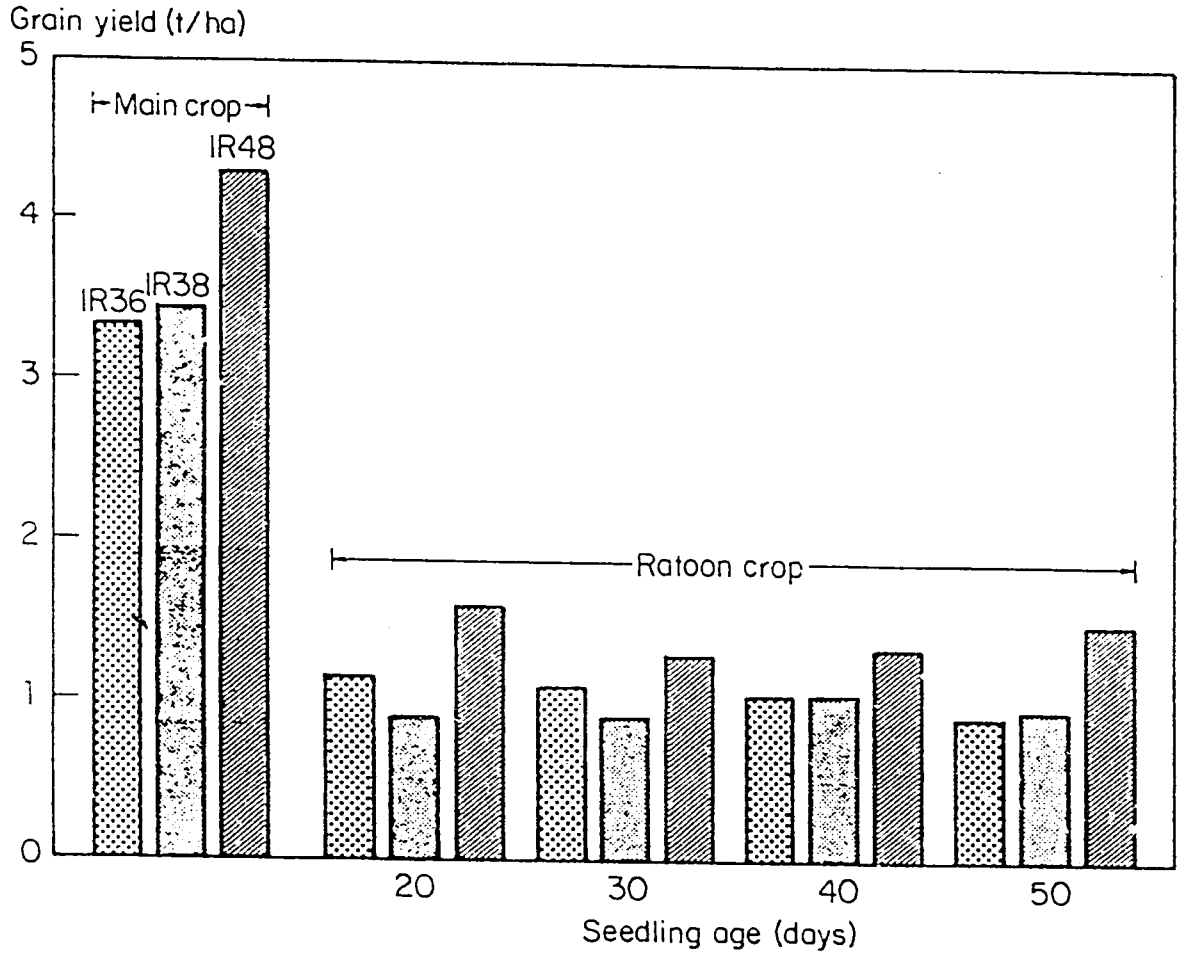

Fig. 4. Effect of seedling age on grain yields of 3 IR rice varieties in the main and the ratoon crops. IRRI, July-November 1978 (from Sompaew 1979).

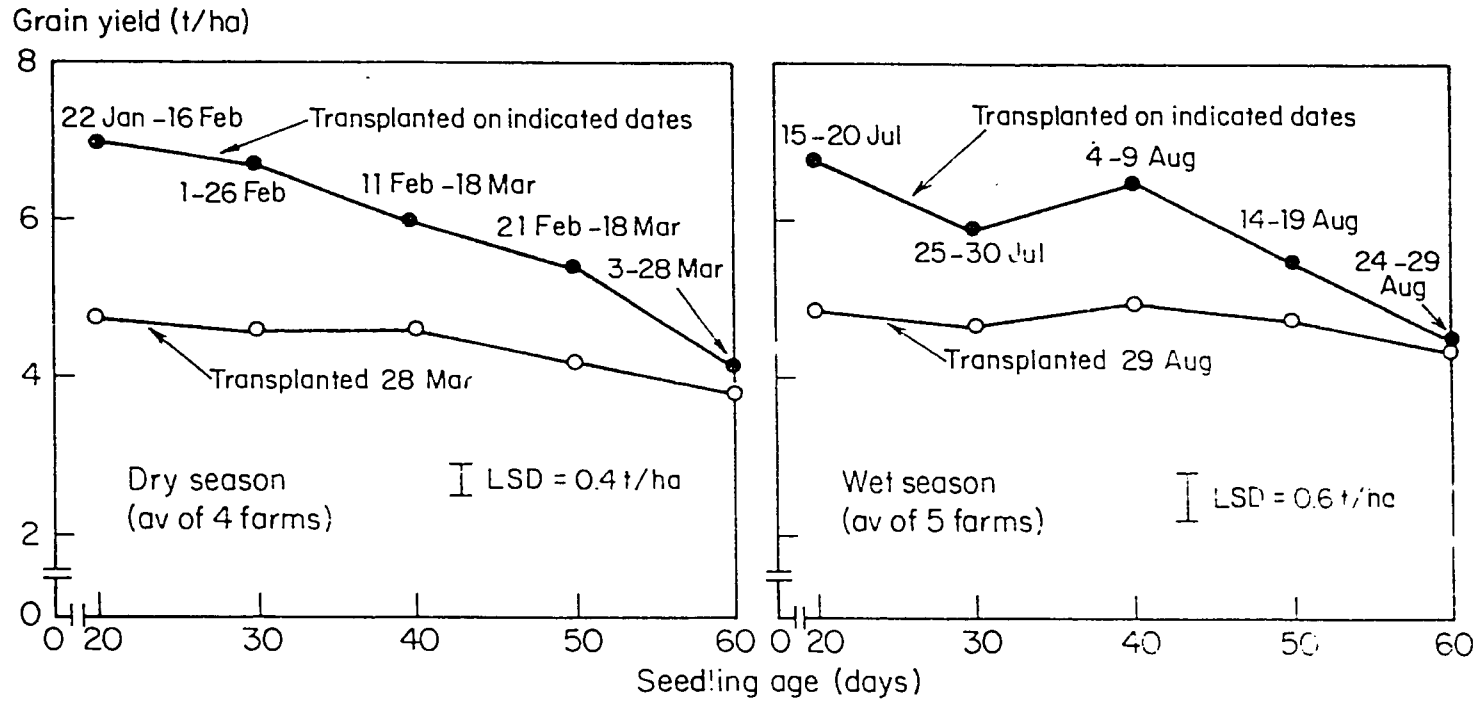

Fig. 5. Effect of seedling age on grain yields of IR36 under staggered (seedlings from seedbed on range of dates shown) and simultaneous (all seedlings at all ages planted same day) transplanting. The lower yield from simultaneous transplanting indicates an environmental effect of the main field.

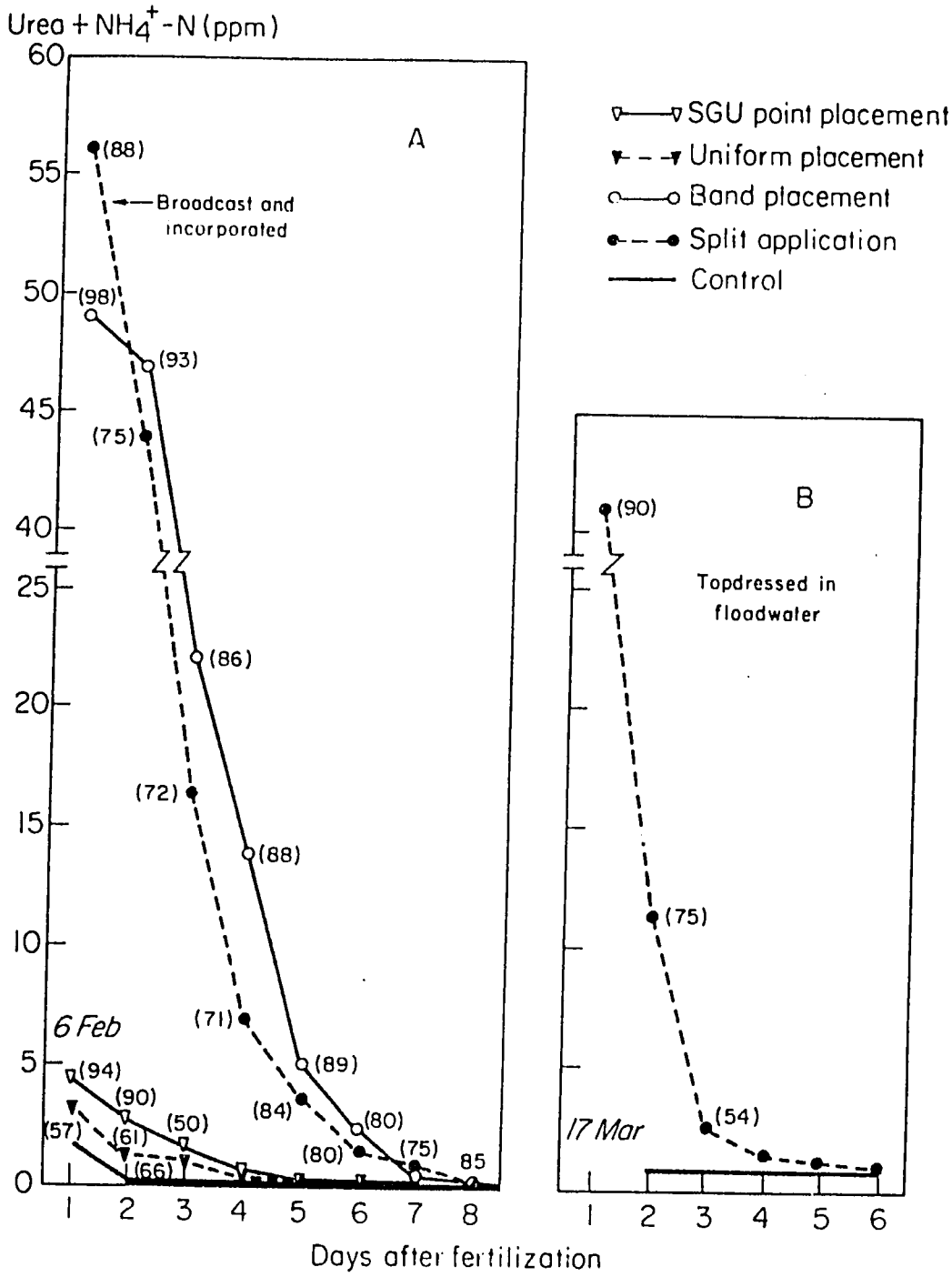

Fig. 6. Effect of placement methods on total nitrogen (urea and NH_4^+) in floodwater at 1330 h. IRRI, 1981 dry season. The number in parentheses is urea-N as a percentage of urea plus NH_4^+-N (from Cao et al. 1982).

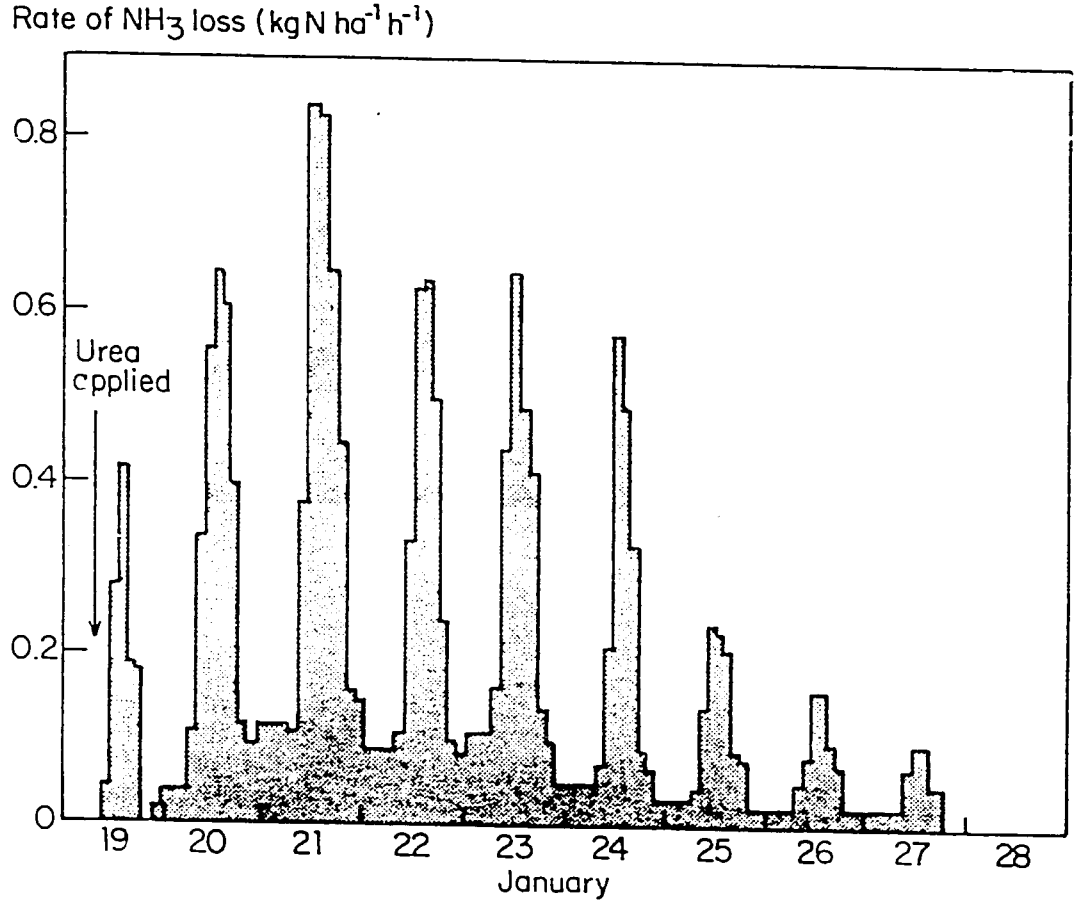

Fig. 7. Ammonia fluxes from urea (80 kg N/ha) topdressed 14 days after transplanting. Maligaya Rice Research Training Center, Nueva Ecija, Philippines, January 1982 (from Fillery et al. 1982).

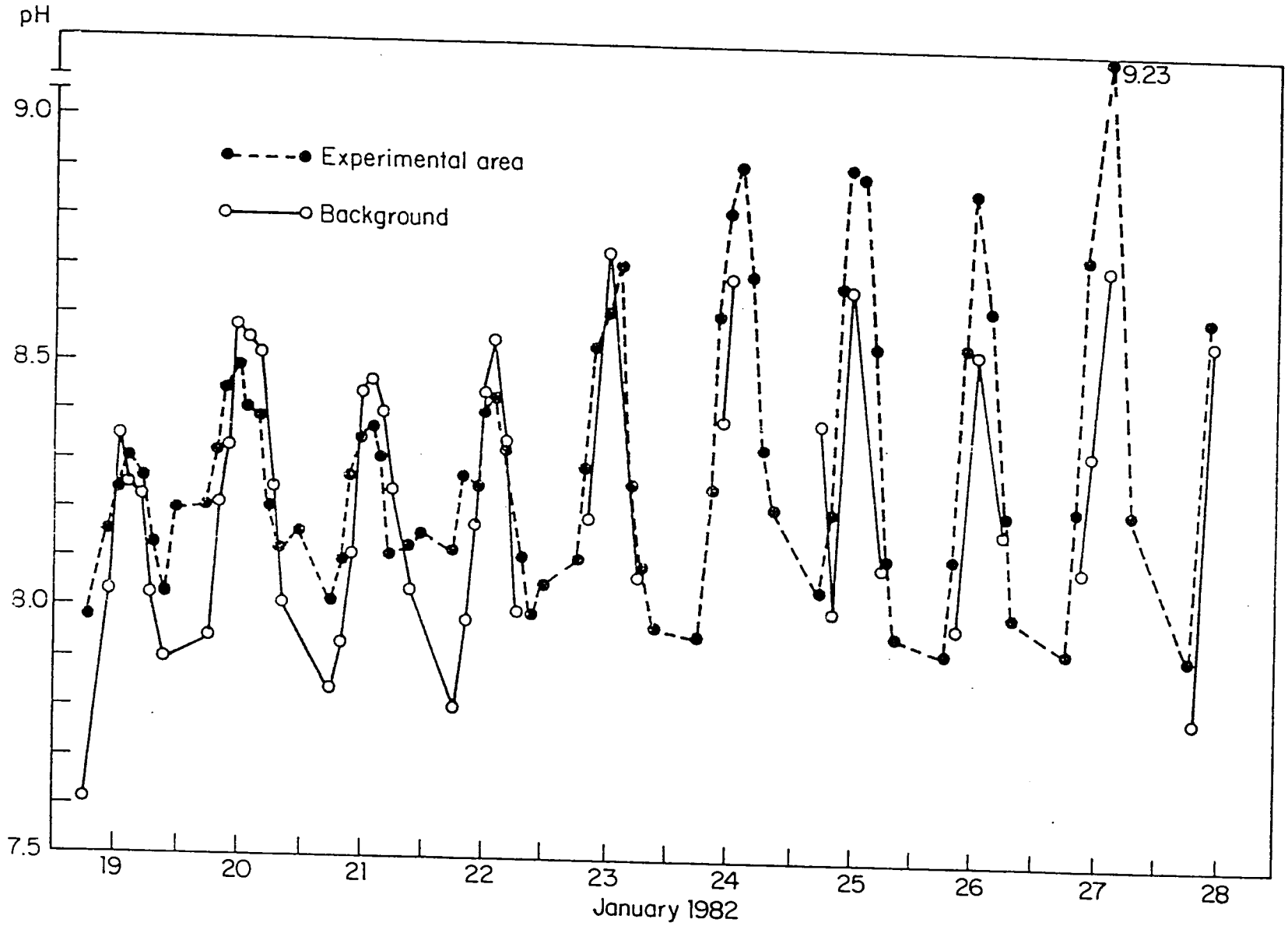

Fig. 8. Floodwater pH over time for the experimental area (urea topdressed 14 days after transplanting) and background areas (not fertilized). Maligaya Rice Research and Training Center, Nueva Ecija, Philippines, January 1982 (adapted from Fillery et al. 1982).

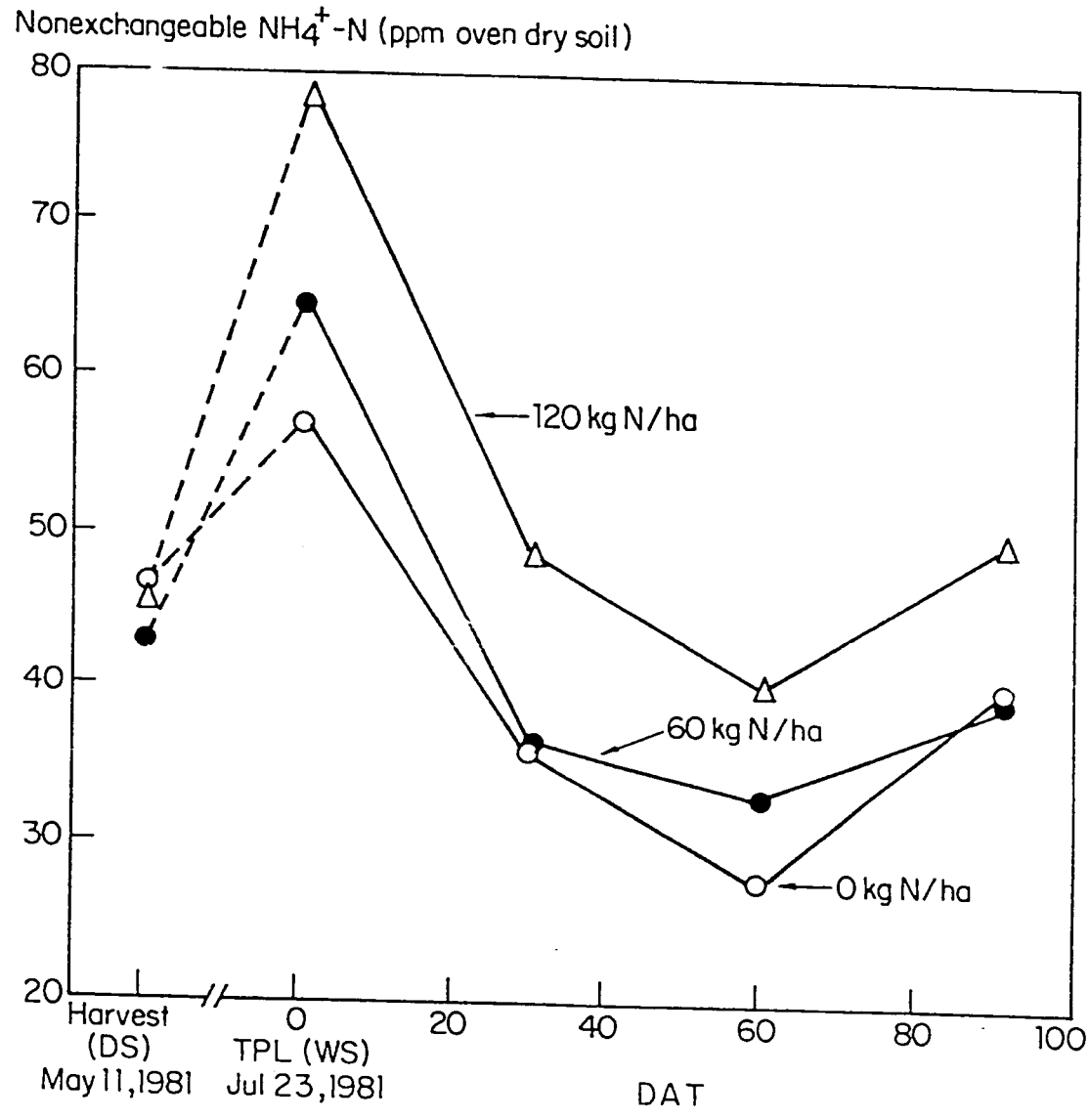

Fig. 9. Content of nonexchangeable ammonium N in Maligaya silty clay loam during the 1981 wet season in N-response experiments at Maligaya station, Philippines (from Keerthisinghe et al. 1982).

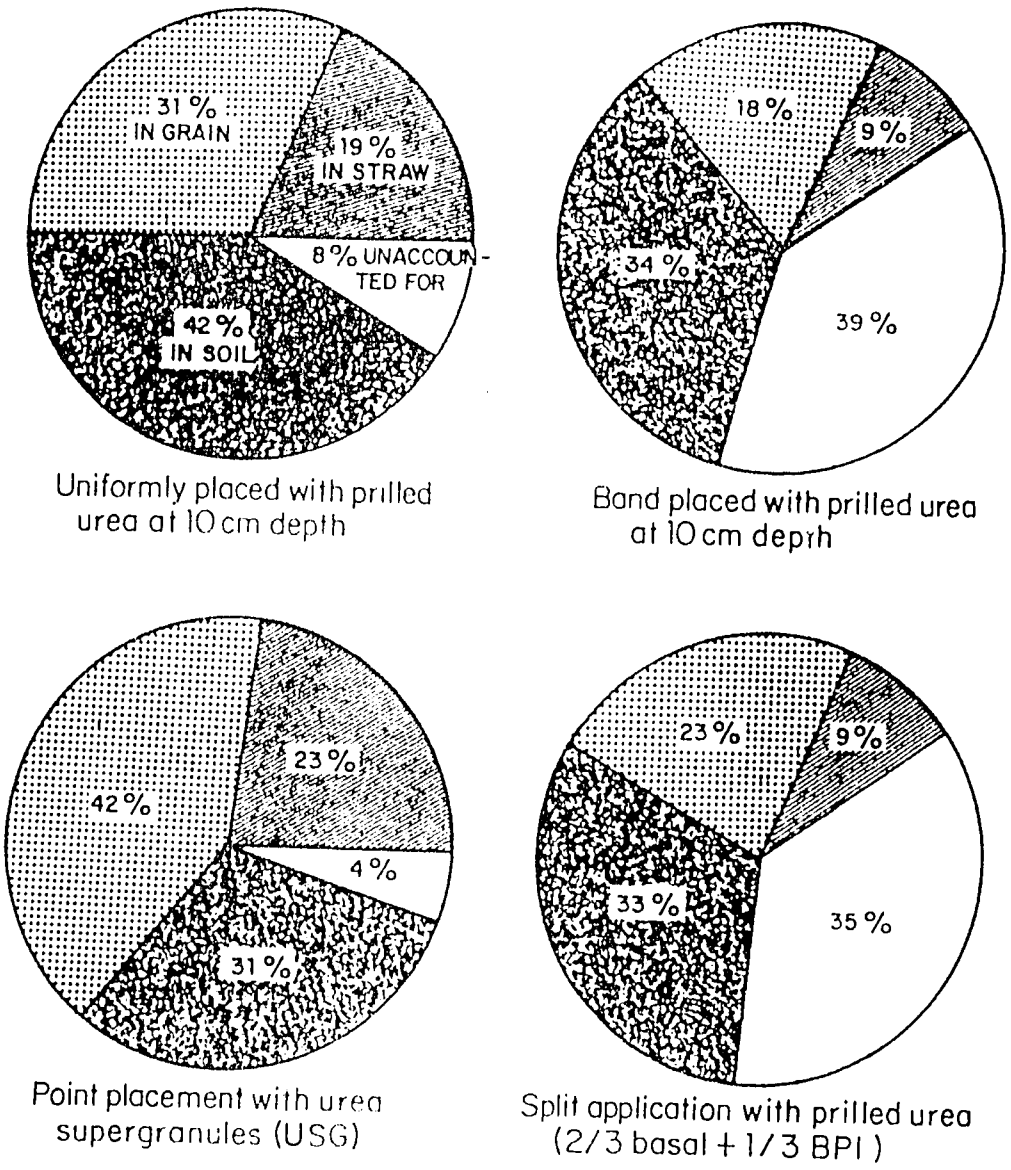

Fig. 10. Balance of ^{15}N-labeled urea at harvest with various placement methods and time of application. IRRI, 1981 wet season (adapted from Cao et al. 1982).

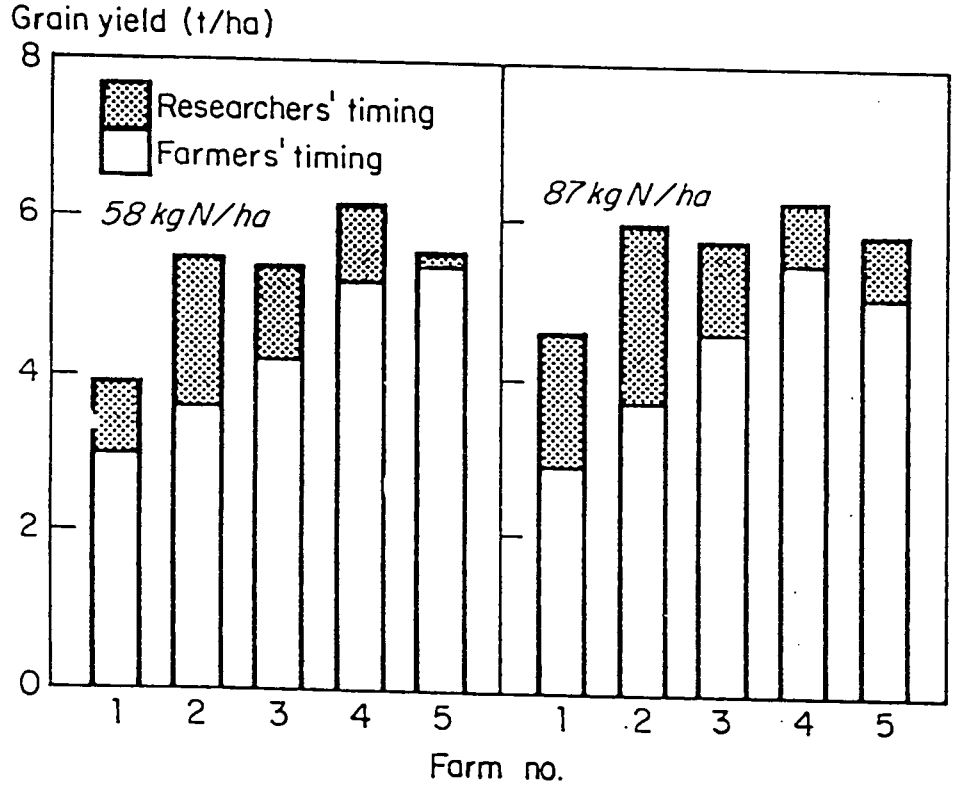

Fig. 11. Increases in grain yield with researchers' timing over farmers' timing (18 days after transplanting and early booting stage) at both 58 and 87 kg N/ha across all farms. Yield-constraints experiments in irrigated farms in Libmanan, Camarines Sur, Philippines, 1982 dry season.

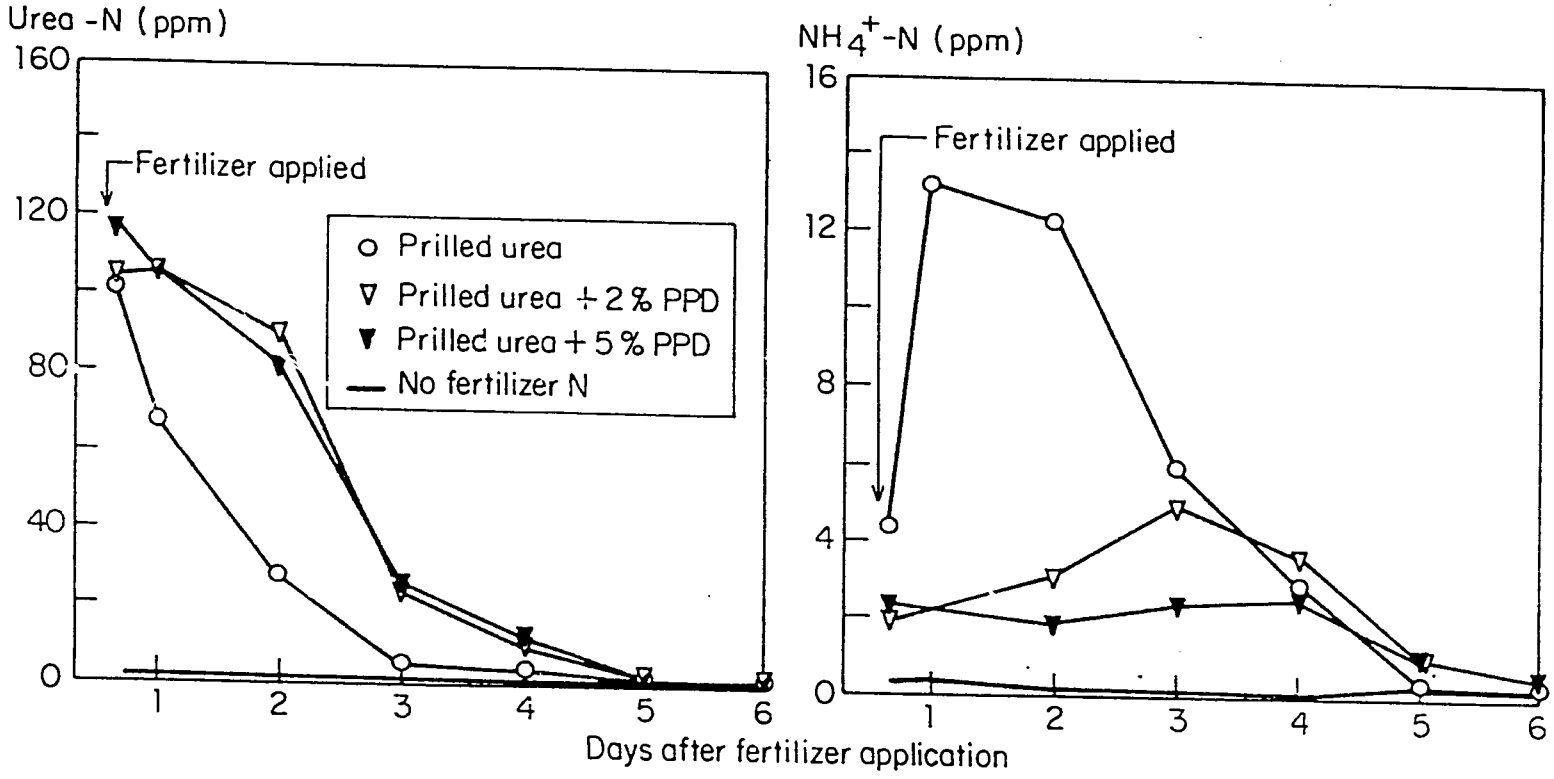

Fig. 12. Floodwater urea-N and NH_4^+-N after application at 20 days after transplanting of 67 kg N/ha prilled urea, and urea with 2% and 5% phenylphosphorodiamidate or PPD (average of two sampling times at 0700 and 1300 hours, except during the 5th and 6th day when samples were taken once at 1300 hours). IRRI, 1982 dry season.

THE ROLE OF SHORT DURATION VARIETIES IN CROPPING INTENSIFICATION IN SOUTH AND SOUTHEAST ASIA

G.S. KHUSH *

Up to the present, increases in food production have been achieved through bringing more lands under cultivation, by increasing productivity per unit area and by cropping intensification. However, in the years to come increases in food production will mainly occur through increased yields per unit area and through increasing the cropping intensity. Only marginal increases will occur in the net cropped area as most of the suitable agricultural lands have already been brought under the plough.

Cropping intensity can be increased through several approaches which are grouped under four categories as follows:

1. Supplemental Irrigation

   Supplemental irrigation in the rainfed areas extends the growing season and more number of crops can be grown on the same piece of land.

2. Mechanization

   Mechanization is helpful in reducing the turn around time, so that more crops can be grown on the same piece of land. In Philippines for example, farmers take 6 - 8 weeks after the first crop is harvested and the second crop can be planted. During this intervening period valuable resources of sunshine, irrigation water and land remain unutilized. However, mechanization of harvesting, threshing, drying of grain and ploughing the land can reduce the interval between harvesting of one crop and planting of the next to only a few days, thus allowing greater number of days for crop growth.

3. Cultural Practices

   Management practices such as, use of older seedlings, dry seeding of first crop without puddling, mulching of the upland crops, use of drought tolerant varieties and sowing of following crop before the previous crop is harvested, are all helpful in increasing the intensity of cropping.

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4. Use of Short Duration Cultivars

Short duration cultivars are of great importance in increasing the intensity of cropping. Often a reduction of as few as 7 - 10 days in the total growth duration of a crop cultivar makes it possible to grow two crops where only one was grown before or three crops where only two were grown earlier.

Use of Short Duration Cultivars in Rice based cropping systems

Major advances have been brought about in the cropping intensity of rice based cropping systems through the development of rice varieties with shorter growth duration during the last two decades. Most of the traditional rice varieties grown in the countries of south and southeast Asia were of long growth duration and vast majority of them were sensitive to photoperiod. They took 150 to 180 days from sowing in the seedbed to maturity and were suited for the single crop rainfed agriculture. However, growth duration of the modern rice cultivars has been progressively reduced and cropping intensity has been increased. Modern rice varieties for tropics and sub tropics developed at the International Rice Research Institute (IRRI) such as IR 8 and IR 5 were released in 1966 and 1967 respectively. They are photoperiod insensitive and mature 30 - 50 days earlier than the traditional photoperiod sensitive varieties. After the introduction of these varieties farmers were able to plant a short duration upland crop after rice under many situations. Under strictly rainfed situations in Burma those farmers who plant photoperiod sensitive varieties in June - July harvest them in December - January and by that time the soil is completely dry and no upland crop can be grown. However, under the crop intensification scheme about 45% of the rice area in Burma has been brought under photoperiod insensitive varieties such as IR 5 and its radiation induced long grain mutant Schive-war-tun and locally developed Seintley. These varieties when planted in June - July are harvested in end of October and early November. Soil at that time is still quite wet and can be planted to upland crops such as peanuts, sesamen, sunflower, soybean or corn. These crops can be raised on residual moisture supplemented by light rain showers in November and December. About twenty five % of the rainfed rice area in Burma is now double cropped.

In Philippines Indonesia and Viatnam, where IR 8, IR 5 and later IR 26 were accepted on large scale, cropping intensity was increased through supplemental irrigation and it became possible to grow two crops of rice on the same land. However, further reduction in growth duration was achieved through the development of IR 28, IR 30 and IR 36 which mature in 105 days. Out of these varieties IR 36

became very popular because of its multiple disease and insect resistance and high and stable yield potential under many growing environoments. It is now the most widely grown variety of rice and is planted to 11 million hectares of rice land in the countries of south and southeast Asia. Farmers using these varieties can often grow two successive rice crops under rainfed conditions. However in some areas with full irrigation facilities 3 crops of rice a year are grown. Most widespread rotation under irrigated agriculture, however, is two crops of rice and an upland crop in one year.

In China where all the rice area is irrigated, major advances have also been made in increasing the intensity of cropping through the development of short duration crop cultivars. In Peking area (40 N latitude) for example where only one crop a year (wheat or rice) was traditionally grown, it is now a widespread practice to grow rice in summer and wheat in winter on the same land. This has been achieved through the development of short duration varieties of wheat and rice. In the Yangtze river valley in central China two crops (rice in summer and wheat or barley in winter) were traditionally grown. Now it is a common practice to grow two crops of rice during summer and a third crop of wheat or barley in winter. Again this has been possible due to the availability of short duration varieties of rice, wheat and barley.

Breeding early maturing rice at IRRI

Major emphasis has been placed on the development of short duration rices in the breeding program at IRRI. These rices which mature in 100 - 110 days are distributed to the cooperating national rice improvement programs either on the basis of requests originating from the scientists working in the national rice improvement programs or through the International Rice Testing Program. These rice are globally evaluated. Some of them are released as varieties whereas others are used in the hybridization programe. To-date 15 early maturing breeding lines developed at IRRI have been released as varieties by the national programs (Table 1) and are widely grown.

Besides the high and stable yield potential, efforts have been made to incorporate resistance to major diseases and insects (Table 2) and tolerance to various problem soil stresses. For example IR 36 is resistant to blast, bacterial blight, tungero, grossy stunt, two biotypes of brown planthopper, green leafhopper, yellow and striped stemborers and gall midge. It is also tolerant to soil salinity, alkalinity, iron toxicity, zinc deficiency, iron deficiency and aluminum toxicity. It is also moderately tolerant to drought.

In recent years IRRI breeding program has attempted to develop breeding lines which mature in 90 to 100 days. Many such lines with multiple disease and insect resistant have been developed. Their yield potential is comparable to IR 36 (Table 3) but their per day productivity is much higher (Table 4). These lines are being evaluated in many coordinated trials worldwide. Some of them will be released as varieties and will help increase the cropping intensity further.

The shift in the proportion of early maturing rices being evaluated at IRRI in the replicated yeild trials is shown in Figure 1. As the figure shows 70% of the rices in the replicated yield trials in 1978 matured in less than 110 days (96 - 109 days), a marked change from 1969 trials when only about 18% of the entries required less than 116 days to mature.

Table 1: Early maturing varieties developed from IRRI bred materials.

Selection	Name	Countries where named
IR 532-176	Chandina	Bangladesh
IR 579-48-2-1	Palman 579	India
	Giza 180	Egypt
IR 747 B2-6-2	GPL 1	Solomon Islands
IR 1561-228-3-3	TN 73-2	Vietnam, Kenya, Mauritania, China
IR 1516-216-6	Prasad	India
IR 2053-87	BR 7	Bangladesh
IR 2061-214-3-8-2	IR 28	Philippines, Indonesia, China, Burma, Bangladesh, India
IR 2061-628-1-6-4-3	Laxmi	Nepal
IR 2153-159-1-4	IR 30	Philippines, Indonesia, Vietnam, India, Nigeria
IR 2071-623-1-252	IR 36	Philippines, Indonesia Malaysia, Vietnam, Laos, Kampuchea, India, Malawi, Mozambique
IR 2307-247-2-2-3	Semeru	Indonesia
	NN6A	Vietnam
IR9129-192-2-3-5	NN7A	Vietnam
IR9224-117-2-3-3-2	IR50	Philippines, Indonesia, India
IR 13429-109-2-2-1	IR 56	Philippines, Indonesia
IR 9752-71-3-2	IR 58	Philippines

Table 2 : Disease and insect ratings of early maturing varieties developed at IRRI

Variety/Selection	Growth duration (days)	Reaction to				BPH Bio.			GLH	Stem borer	Gall midge
		Blast	Blb	Tungro	Grassy stunt	1	2	3			
IR 579-48-1-2	107	R	R	S	S	S	S	S	S	MR	-
IR 747 B2-6-2	100	R	R	S	S	R	S	R	S	MR	-
IR1561-228-3-3	110	R	R	S	S	R	S	R	S	MR	-
IR 28	105	R	R	R	R	R	S	R	R	MS	-
IR 30	107	MS	R	MR	R	R	S	R	R	MS	-
IR 36	107	R	R	MR	R	R	R	S	R	MR	R
IR 50	105	R	R	R	R	R	R	S	R	MS	-
IR 56	105	R	R	R	R	R	R	R	R	MR	-
IR 58	98	R	R	R	R	R	R	S	R	MR	-

Table 3 : Promising early maturing lines evaluated during 1981 at IRRI

Selection	Growth duration (days)	Yield (t/ha)	
		1981 D.S.	1981 W.S.
IR 8455-78-1-3-3	100	6.2	4.6
IR 9729-67-3	100	7.2	5.1
IR 9752-71-3-2	98	7.5	4.7
IR 15429-268-1-2-1	97	6.8	5.1
IR 19729-5-1-1-3-2	97	6.1	4.3
IR 19735-5-2-3-2-1	100	6.5	4.9
IR 19743-25-2-2-3-1	96	6.4	4.6
IR 19743-40-3-3-2-3	97	5.8	4.6
IR 19746-28-2-2-3	97	6.0	4.5
IR 36 (check)	108	6.9	4.7

Table 4 : Yield of early maturity entries in the replicated yield trials grown during 1980 Dry and Wet season at IRRI.

Selection	Cross	Growth duration (days)	Dry Season Yield (t/ha)	Dry Season Yield per field day a/ (kg)	Wet Season Yield (t/ha)	Wet Season Yield per field day a/ (kg)
IR 9752-71-3-2	IR28/Kwang Chang Ai//IR36	99	5.70	75.0	4.32	56.8
IR 9729-67-3	BG34-8/IR28//IR36	101	5.53	70.8	3.64	46.6
IR15429-268-1-2-1	74-5461/IR36//IR747B2-6	99	5.25	69.0	4.51	59.3
IR19728-6-3-2-2-3	IR8608-298///Ir747B2-6/Ai-nan Tsao 1//IR747B2-6	100	5.18	67.2	4.00	51.9
IR19743-25-2-2-3-1	IR9129-192-2///IR747B2-6/29 Lu 1// IR 747B2-6	98	4.74	63.2	4.08	54.4
IR19743-46-2-3	"	99	4.97	65.3	3.81	50.1
IR19746-28-2-2-3	IR9129-192///IR747B2-6/Kwang Chang Ai//IR 747B2-6	99	5.13	67.5	3.94	51.8
IR19774-23-2-2-1-3	IR9698-26-3///IR747B2-6/29 Lu 1//IR747B2-6	95	4.55	63.1	4.23	56.4
IR19819-31-2-3-1-1	IR9715-4///IR747B2-6/29 Lu 1// IR747B2-6	95	4.84	67.2	3.89	54.0
IR 36	IR 1561-228-1-2/IR1737///CR93-14	108	5.43	63.8	4.04	47.5

a/ 23 days in the field.

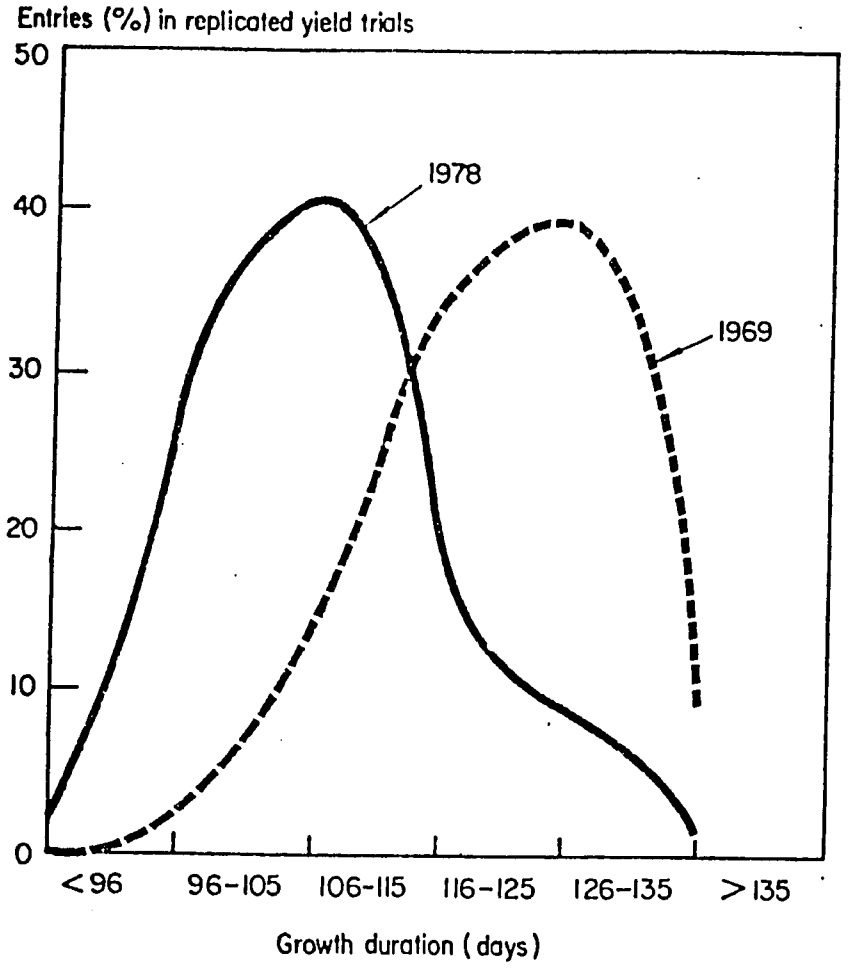

Fig. 1. Proportion of entries (% of total) with different growth duration grown in replicated yield trials in 1969 and 1978 wet seasons at IRRI.

THE ROLE OF SHORT DURATION VARIETIES OF RICE IN CROPPING INTENSIFICATION IN EGYPT

M.S. BALAL*

Field crops represent the most important sector of Egyptian Agriculture with respect to the area occupied and their share in the national economy.

The total cultivated area in Egypt is about 2.46 million hectaress with a cropping intensity of about 1.90 crops per year gives the country an equivalent crop area of about 4.68 million hectares.

Area, production and yield of the major field crops are shown in Table 1. It is clear from the table that clover occupies about 1.19 million hectares (25 percent of the crop area). Cereal crops constitute the most important group of field crops being grown on about 2 million hectares (43 percent of the crop area). The group includess, two winter cereals wheat and barley and three summer crops, maize, rice, and sorghum.

The present productivity of Egyptian crops as measured by their yield per unit area is among the highest in the world (Table 1). The fertile alluvial soils, high sunlight intensity, warm weather and highly skilled farmers are the vital components that result in high levels of crop productivity in the country, however, potential yields (Table 1) indicate the possibility of increasing national average yields by 20-30 percent.

Agricultural intensification is the most important component of Egypt Food Security Program. Inspite of the high standards achieved in using agricultural lands through cultivation twice a year, the agricultural production is still beyond the sufficient food requirement of the increased population.

Therefore agricultural intensification, particularly in field crops production, became a must within the current circumstances. The policy of the Ministry of Agriculture in this issue could be summarized as follows:

1. Expanding production of exportation or high value crops such as cotton, rice and vegetables in order to maximize foreign exchange earnings.

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2. Breeding high yielding short duration varieties in order to increase the present cropping intensity (1.9 crops/year) to reach 2.5 crops per year.

3. Encouraging intercropping practices to increase income of small farmers.

4. Maximizing productivity of the various field crops through optimizing management practices and agricultural inputs

5. Large-scale, utilization of farm machinery as a solution for agricultural labor shortage and their high wages and to carry out the agricultural operations in due time.

Rice area has averaged 0.44 million hectares during the period 1976-1980, which is equivalent to 9.41 percent of the total crop area (Table 1).

The rice belt is restricted to the northern half of the Delta because it is well served with irrigation and drainage facilities especially designed for rice growing. The six northern governorates, namely, Dakahlia (27%), Kafr El-Sheikh (23%), Beheira (17%), Sharkia (16%), Gharbia (9%) and Damiatta (5%), account for 97 percent of the rice area. Rice occupies annually about 30% of the total cultivated area in these six governorates which is about 1.23 million hectares.

The most common crop rotation is a 2-year rotation, in which the areaa is divided into two blocks. The first block is planted in winter, by temporary clover, followed by cotton, as the summer crop. The second block is divided into two parts, one for clover or legumes and the other for wheat or barley, both to be followed by either rice, maize or soybean as summer crops, depending on the locality and soil fertility. This sequence is rotated in the two blocks in the second year and so on.

Transplanting is the common method of planting. Nurseries which are planted in late April and May and seedlings are transplanted to the fields one month later, usually during June, one hectare of nursery usually supplies enough transplants for 6 to 8 hectares of rice.

The key technology to intensify (maximize production per unit area through better utilization of the available resources such as land, weather, irrigation water, and manpower) rice production and rice-based cropping system is to develop high yielding early maturing varieties.

Total growth duration of the present dominant varieties, Giza 171 and Giza 171 is about 150-160 days. Therefore, major emphasis was placed to develop early maturing - short stature varieties through the following breeding procedures :

a. Introduction : mainly through IRRI- International Rice Testing Program or directly from China, California and Japan.

b. Hybridization : the following sources are extensively utilized in the crossing program :

IR 747 B2-63	Ai-nan-tsao
IR 1561-228	Nan-king 11
IR 28	Nan-king 13
IR 30	Shan-ai-4
IR 9129-169	Early mature Nan Zao 33
IR 9209-181	Guang Lieu Ai No. 4
IR 50	Reiho
IR 9752-71	Tarehonami
IR 19743-46	Toyonishiki
IR 19762-2	Nihonbare
RNR 7306	Clorose 76
CNM 6	M 101

c. Mutation Breeding : Giza 171 and Giza 172 were treated with gamma rays and EMS. M4 and M5 populations were grown in 1982 and 99 mutants were selected for early maturity and short stature.

The outcome of this program is 41 promising strains possessing early maturity, short stature and high yield. In 1982 these strains were included in the performance tests to be evaluated for yield and yield stability.

Relative duration of these selections in comparison to the check variety Giza 172 is shown in Figure 1. The figure shows that most of the short duration strains are about 20 days (7-37 days) earlier than Giza 172.

Table 2 shows average duration, plant height and yield for the promising strains which were included in the final, regional and preliminary yield trials. The table shows that the promising strains are 20 days earlier in maturity and 33 cms shorter in plant height than the check variety Giza 172. A significant correlation (r=0.784) coefficient was obtained between culm length and early maturity.

Daily production was investigated to study the relationship between early maturity and high yielding ability. The experiment was conducted during the last three seasons including 25 varieties belonging to five maturity groups.

Results obtained in the 1982 season are shown in Table 3. The table shows that the highest yield and production per day were obtained from the short duration varieties (100-110 field days) while the lowest yield and production per day were obtained from the very long duration varieties (more than 130 field days).

In order to inquire into the possibility of utilizing the short duration varieties in increasing the present cropping intensity from two crops a year to three crops a year an experiment was carried out during the last three years in which four cropping patterns were included as follows:

c.p.	Winter	Early summer	Late summer
	Dec. - March	April - July	Aug. - Nov.
1	clover	sunflower	rice
2	clover	soybean	rice
3	clover	rice	rice
4	clover	rice	

Results obtained (Table 4) showed that rice planted in the late summer season after sunflower or early maturing soybean was higher in yield than rice planted after late maturing soybean or rice. The results also showed that one rice crop grown in the normal season (June - October) gave better yield than two rice crops grown from May to November.

Results of the performance tests as well as the daily production experiment indicated that the future rice varieties will be 20 - 30 days earlier than the present varieties Giza 171 and Giza 172 with the same or even higher yielding ability.

The early maturity rices of about 100 field days will contribute to improving rice production as well as the rice based cropping system in Egypt in the following ways:

1. Possibly increasing cropping intensity from two crops a year to 2.5 crops a year.

2. Saving 20-25% of the irrigation water based on number

of flooding days which may lead to an expanded rice area from one million feddans (0.42 million hectares) to 1.2 million feddans (0.52 million hectares).

3. Stabilizing the yield with the short duration varieties rather than the long duration varieties, since delayed planting to June instead of May will not affect yields of the short duration varieties.

4. Using the short duration varieties which will enable the farmers to get more cuttings from the previous clover crop and to prepare the land for planting the proceeding winter crops in due time.

Table 1 : Area, Production, National average yield and potential yield of the major field crops (1976-1980)

Crop	Area 1000 ha	% Crop area	Production million ton	National aver. yield tons/ha	Potential yield tons/ha
Clover	1.190	25.37	49.22	41.36	60-70
Wheat	0.563	12.00	1.84	3.28	5.0-6.4
Broadbeans	0.117	02.49	0.26	2.22	4.3-5.7
Barley	0.043	00.92	0.12	2.75	4.0-5.7
Cotton	0.529	11.28	1.33	2.51	4.3-5.3
Maize	0.785	16.74	2.99	3.81	6.7-8.6
Rice	0.434	09.25	2.39	5.51	8.3-9.5
Sorghum	0.179	03.82	0.67	3.75	6.0-7.1
Soybean	0.040	00.85	0.09	2.36	2.8-3.3
Sugar cane	0.094	02.00	75.88	80.82	120-140
Others	0.326	06.95	-	-	-
Total (field crops)	4.302	91.73	-	-	-
Vegetables	0.388	8.27	-	-	-
Total (crop area)	4.690	100.00	-	-	-

Table 2 : Average duration, plant height and yield of the short duration strains included in yield trials - Sakha 1982

Trial	Entries	Duration (field days)	Plant height cm	Yield ton/ha
Final	Giza 172	114	123	9.76
	Average S.D.S. (8)	99	95	9.22
	Range S.D.S. (8)	94-107	83-103	7.70-10.93
Regional	Giza 172	116	121	9.88
	Average S.D.S.(14)	92	89	8.76
	Range S.D.S. (14)	78-108	60-105	7.07-10.56
Preliminary	Giza 172	115	129	10.45
	Average S.D.S.(19)	95	88	8.86
	Range S.D.S. (19)	87-103	65-106	7.75-10.00
Average	Giza 172	115	124	9.81
	Average S.D.S. (41)	95	91	8.89
	Range S.D.S. (41)	78-108	60-105	7.07-10.93

r
Duration x plant height = 0.784

Table 3 : Production per day for rice varieties with different maturity periods (field days) Sakha-1982

Maturity Group	# Varieties	Actual duration (field days)	Yield Ton/ha	Production per day kg/ha
1. Very short duration (less than 100 days)	6	93	6.72	72.00
2. Short duration (100 - 110 days)	7	104	8.69	83.67
3. Medium duration (111 - 120 days)	6	116	7.99	68.96
4. Long duration (121 - 130 days)	5	124	7.88	63.36
5. Very long duration (more than 130 days)	1	131	6.02	45.95

Table 4: Yields of Sunflower, soybean and rice in the crop intensification experiment (Sakha - 1982)

C.P. No.	Early Summer (April-July)		Late Summer (August-November)	
	Crop	Yield Ton/ha	Crop	Yield Ton/ha
1	Sunflower (Miak)	-	Rice (IR 28)	6.190
2a	Soybean (S 1346)	-	Rice (IR 28)	4.210
2b	Soybean (Clark)	-	Rice (IR 28)	1.050
3a	Rice (IR 28)	7.550	Rice (IR 28)	0.903
3b	Rice (Nan Zao 33)	5.640	Rice (IR 28)	3.070
4a	Rice	(Giza 172)		12.540
4b	Rice	(IR 28)		9.120

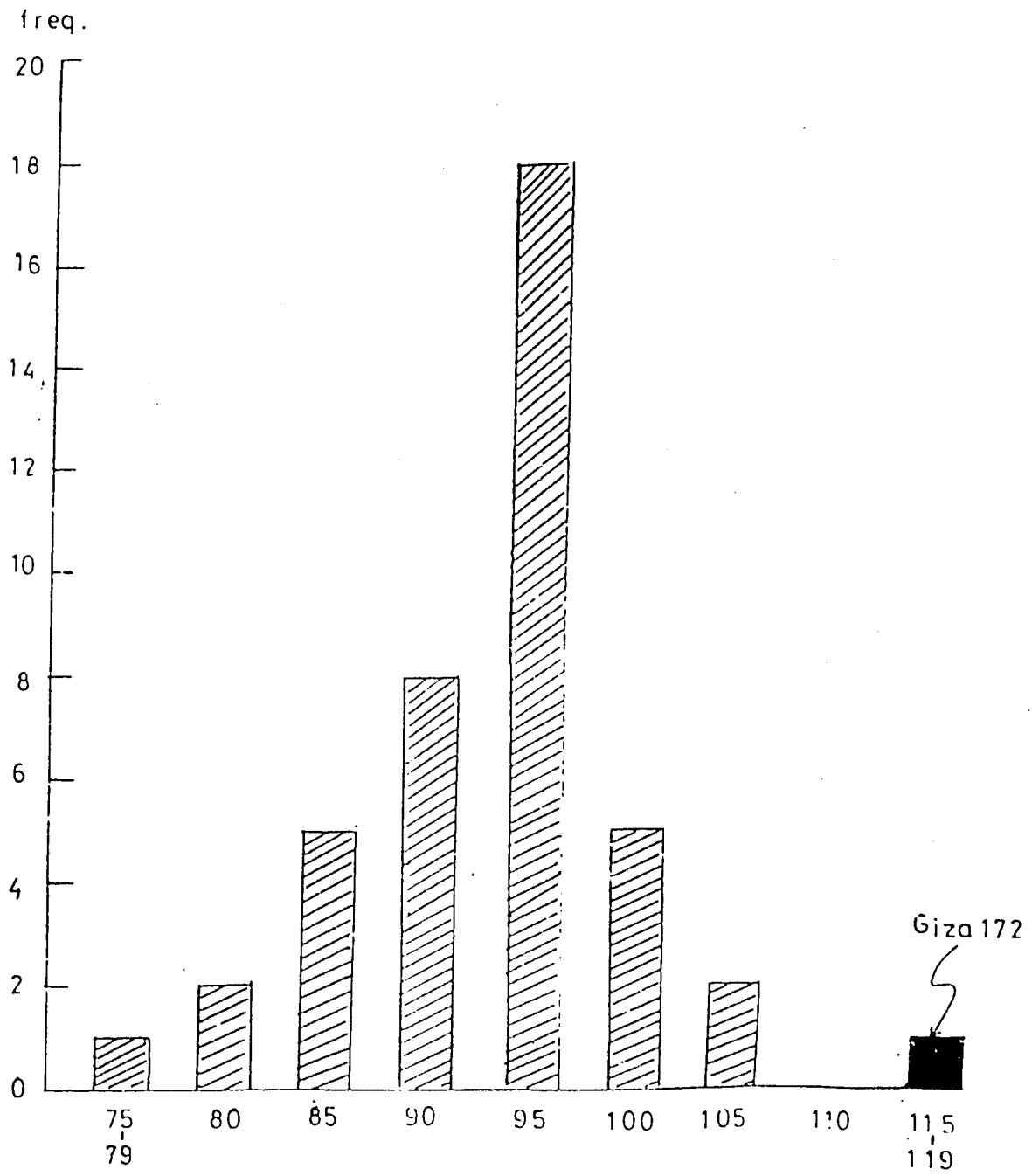

Figure 1 : Relative duration of the short duration strains included in yield trials - Sakha 1982

STATUS OF THE PROJECT AND PLANS

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The Rice Research and Training Project, which meets in this Third Annual Program Review and Planning Conference, is a joint effort financed by the Egyptian Ministry of Agriculture and the U.S. Agency for International Development. Administrative and scientific direction are provided by the Ministry of Agriculture, the University of California as the contractor, and the University of Arkansas, and The International Rice Research Institute, cooperating as sub-contractors.

The primary purpose of the 5-year project started in 1980 is to implement a technical assistance-institutional building relationship within the Ministry of Agriculture to develop a viable rice research and extension program. The organization should be fully staffed and structured to extend rice research beyond conventional plant breeding objectives to function in all aspects rice production technology to serve the nation. The project, patterned after other successes, should also serve as a model for other segments of Egyptian agricultural development. The ultimate objectives of the project, as have been stated before, are to improve the production and quality of rice and to benefit the rice farmers of Egypt. Specific objectives seek to :

1. Strengthen national planning and performance capabilities in rice research and extension education;

2. To devise the most effective administratiive structures, policies and procedures for a national rice research and extension program;

3. To improve the physical facilities and supply equipment for research and extension education;

4. To attract the most capable Egyptians to staff a complete rice and extension program together with expatriate professionals to assist training in rice research and extension;

5. To upgrade Egyptian professionals, by means of graduate and post-graduate training programs within or outside of Egypt, as well as through seminars, short courses, workshops and collaborative projects;

6. To initiate new and enlarged research and extension projects and activities aimed at high priority rice production problems;

7. To initiate more effective programs directed to motivating the adoption of rice production practices that increases yields, quality and net returns from rice production.

The problems and challenges of increasing rice production are complex and many-faceted, some call it a "systems problem." There are many elements to be dealt with, meshed together and combined into a single action program. In this effort, one must be concerned with systems such as organization, administration, well trained and motivated staff, adequate facilities, supplies, credit, markets, incentives, and many other aspects. Unfortunately there is no single, simple key to answering the question of how rice production can be increased. The basic elements are known but every country has to deal with its own particular set of circumstances or systems that affect its agricultural output.

We are primarily concerned with rice production in Egypt, where the average national yields have been among the highest in the world. The period of 1961-65 produced an average paddy rice yield of 5.3 T/ha; 1971-75 produced about the same national average (5.26 T/ha). During the period of 1976-1980, the average yield has increased slightly to 5.47 T/ha. These yields have been produced during a period of time when land planted to rice has increased about 31 percent. Fortunately Egypt is blessed with good rice varieties, few insect and disease pests; it enjoys an excellent climate, good soils and water supplies. All these combined have contributed to relatively high yields. Rice yields and total production, however, have not kept pace with population which grows at an annual rate of 2 1/2 percent. Rice which is one of Egypt's major food crops is no longer in surplus and concerns have been expressed as to how future national needs will be met. Agriculture does hold the key to economic progress. The large rural sector depends directly on agriculture for income, employment and livelihood.

In recent years, Egyptian rice researchers have given priority to various lines of investigations designed to improve on the already high national yields. It is not possible to present details of the various programs, but varietal improvement, proper combinations of good seed and environmental modifications, improved agronomic practices, better plant protection, better harvest and post-harvest handling have all made important contributions. Despite these important advances already made and many more to be reported in this Conference, there is a great need for

further progress. It is a project goal to accelerate the rice program to get national production up near its full potential. A stated goal is to obtain a 2 1/2 percent annual average increase in rice yields over the next ten years. A 25 percent increase in paddy yields by 1990 would raise the national average to 6.6 T/ha. This is a reasonable and attainable goal and will significantly improve the national rice supply. Project personnel will not be completely satisfied however until world record yields of 10-14 T/ha or greater have been attained in Egypt.

Solid successes have been achieved in the recent past as revealed in the research reported at previous Conferences and we will hear more such reports in the next few days. We must, however, examine our successes and failures and continually adjust our focus to changing needs and greater expectations. An atmosphere must exist among all national scientists so that a free exchange of ideas can occur, wherein present constraints are determined and strategies planned to overcome them. Active discussions at this planning conference and analyses should provide such a dialogue to identify new problems and their solutions, create new and exciting challenges and to ultimately help satisfy the national rice demand. We need not be reminded that a proposal for change does not necessarily imply condemnation of the past, but exemplifies a willingness to assess and profit from past experience.

In the work before us, to increase national rice production, we are dependent upon the rice plants ability to convert the energy of the sun into grain and straw. The quantity of rice grain produced is influenced by climatic factors over which man, so far, has been able to exert little control. Crop production is also influenced by a number of factors that we have learned to control to a considerable degree. These later factors include the genetic nature of the plant various agronomic practices, plant protection against diseases, insects and weeds, the conservation and utilization of water and soil management to provide the proper amount and availability of nutrients. We have learned to use power and machinery to lighten the work load and to increase human efficiency.

The extent to which the project can help Egypt meet its rice needs in the next decades will depend in a large measure on our ability to manipulate those factors for which we have some control. Some areas of the world have been highly successful in this regard and have produced more food than is immediately required for needs. They have also been able to convert surplus agricultural commodities into other resources for development. In other parts of the world, for one reason or another, we have not yet learned how to successfully manage factors to the same degree and the populace are

suffering from malnutrition, facing possible hunger and economic problems as a result.

In our project areas, maximum yield research must be accelerated to develop optimum economic yield production systems for Egyptian rice farmers. Such systems must increase crop yields, lower unit production costs and increase farm profits. Maximum yield research should seek to identify and develop the production systems that include the best of all controllable factors needed to produce the highest possible yield for a specific soil and climate. It should evaluate interactions among production inputs and provide a moving yield target to be increased constantly as we improve our rice production capabilities. Packages of technological practices, aimed at increasing rice production, should be developed by interdisciplinary teams in basic and adaptive research directed at solving production problems.

An effective rice production program is not completed however without a strong extension program. Researchers and extension specialists must work in close liaison to identify and overcome constraints to increased production. Extension specialists must not only understand the principles of communication, but must know how to grow a crop of rice, diagnose problems the farmers may encounter, and demonstrate how to produce high yields. They should have frequent contact with research people who provide scientifically proven principles for extension use. Extension specialists conducting on-farm demonstrations and promoting technology transfer will immeasurably help the national effort.

Other components are also needed for an accelerated national rice program including credit, incentives, price stabilization, available production inputs and regional pests such as birds and rats and others. Certainly national planning must take all these matters into account and be responsive to farmer needs.

I would like to report that the Rice Research and Training Project is well organized to study ways of improving rice production in Egypt. The "project" is a team of highly trained and experienced specialists, carefully selected for that purpose. Capable specialists are available in most of the disciplines needed to accomplish the job and others will soon be on the project, these include plant breeders, seed production specialists, pathologists, entomologists, agronomists, economists, soil scientists, agricultural engineers, weed control and an extension rice production specialist. We hope they can be provided with the best available equipment needed for the work. The project leadership is superb and the espirit de corps is high. Each scientist has a great deal of freedom to attack the problems in his field as he professionally chooses. He has

colleagues when they are needed, to help with problems which arise outside his field of competence and he can feel free to call on them for assistance.

As a team we have learned how to produce yields of 6 - 9 tons of rice per hectare. The extension rice production specialists have demonstrated too, that farmers can produce high rice yields and do it economically. Our next job is to find out how to help all Egyptian rice farmers, in all governorates, to obtain these higher yields.

Planning for 1983 gives us an occasion to consider not only successes, but areas where improvements can be made. Some specific goals for the current year include the following:

1. Consumate planning in the Ministry of Agriculture for organization of a permanent unified rice research and extension organization, fully staffed with permanently employed, full-time scientists, with capabilities of conducting a first class national rice research and extension program.

2. Provide a full staff of expatriate scientists to assist in establishing well conceived programs for increasing rice yields in Egypt with both short and long-term work plans. Expatriates should be intimately involved in training, planning, researching, and developing resources to enhance project success.

3. Training needs must be re-evaluated and up-dated to insure that within the available resources every eligible scientist or extension specialist is allowed opportunity for professional development. Training programs, seminars and short courses both in Egypt and outside will be used to the maximum extent possible.

4. Research and extension facilities, where not presently adequate, must be improved to a satisfactory operating level. Needs for high quality fields experimentation, adequate office and laboratory support and technical support staff needs should be met to enable greater scientific inquiry into rice production practices.

5. Operational constraints in conducting effective research and extension programs should be clearly defined. Adjustments should be made to optimize the productivity of each program within the project. Cooperative research should be encouraged and project leaders should have a maximum latitude in the decision making and resources allocation.

6. The Project is exploring the possibility of producing a Monograph on Rice production in Egypt which we would like to start in 1983. A committee will be identified to determine the contents, but it could be a valuable document containing historical background, past and present research developments in each area of rice production technology and deal with the future proposals and strategies for rice production in Egypt.

7. We will have Mr. Ray Coppock, from the public service office at the University of California with us for one month. We expect him to help us produce two publications. One is designed to describe the project, its purpose, goals and organization. A second publication will be a progress report of research and derivation of the Mabrouk 4 rice production recommendations for farmers.

8. Graduate and post-doctoral training programs for rice project personnel are proceeding very well at the International Rice Research Institute and the Universities at Arkansas and California. Your colleagues are doing well and will make a contribution to rice research capability when they return.

9. We anticipate a Project review sometime in the next six months to determine if the Project, as originally conceived, will achieve all the purposes and goals for which it was established. The evaluation will determine if revisions are required to meet project goals and provide recommendations for mid-project changes. Your assistance and support in this evaluation will be appreciated and it should be useful to all concerned.

While the above specific goals relate to our immediate objectives, the longer term objectives of the Project must ultimately be :

a. A National Rice Institute on rice research and extension Program functional and full staffed.

b. The NRI will have an improved process for identifying problems, establishing priorities, programs for their solutions, and the delivery of improved production practices to farmers.

c. A trained research staff will be in place and functioning at Sakha.

d. Improved and enlarged research facilities will be available.

e. Extension specialists and a corps of rice production extension advisors will be selected and trained.

f. Farm demonstrations of improved varieties and cultural practices will be in operation.

g. The progress of the rice breeding program will be nearly doubled with a winter nursery program.

h. Mechanization needs will be identified and new or modified equipment developed and evalauated.

i. Advice and consultation will be provided in the purchases, manufacture or adoptation of new equipment.

j. Rice disease problems will be identified, evaluated for their importance, and programs initiated for their control.

Finally I would like you to know that the Project Directors are pleased with the project as it is developing. Some very significant accomplishments have been made and we anticipate even greater things for the future. Egypt's future in rice production will be greatly improved because of your efforts. As professional scientists and support staff on the project you can be proud of your efforts.

AGRONOMY

A. CULTURAL PRACTICE

M.I. Shaalan	Agronomist
A.T. Badawi	Research worker
F.N. Mahrous	Co-Leader, Cultural Practices
J.P. Craigmiles	Co-Leader, Agronomy

The main target of the Cultural Practices program is to provide a package of recommendations for improving rice production efficiency, especially for the new released varieties.This can be achieved by determining the best method of land preparation, planting dates, seeding rates, planting methods, seed treatments and other agronomic practices for seedling establishment and for maximum grain yield. Four experiments were conducted at Sakha Agricultural Research Station in 1982. These studies and the results obtained are summarized as follows:

I. COMBINED EFFECT OF IMPROVED LAND PREPARATION AND PLANTING METHODS ON RICE YIELD

This experiment was conducted to cover the following objectives:

a) Comparison of three methods of seed bed preparation in the permanent field and no tillage to determine maximum grain yield.

b) Replacement of puddling with dry leveling in order to maintain better physical soil properties and to save costs, labor and time.

A split-plot design with four replicates was used. The main plots were assigned to the four land preparation practices and the planting methods were in sub-plots. The treatments were as follows:

Main plots (four land preparations):

A1 Standard practices (one chisel plowing followed by flooding and puddling.

A2 No tillage practice (Flooding only).

A3 Improved practices (one mold board plowing followed by disk harrowing, dry leveling and flooding).

A4 Improved practices (one chisel plowing followed by dry leveling and flooding.

Sub-plots (five planting methods):

B1 : Broadcasting

B2 : Mechanical drilling in dry soil followed by flooding

B3 : Traditional transplanting

B4 : Recommended transplanting

B5 : Mechanical transplanting by Japanese transplanter.

Sub-plot size was 5 x 10 m = 50 m2

It is evident from Table 1 that highly significant yield differences due to land preparation treatments were obtained. The yield from no tillage was significantly lower than the other treatments. The highest grain yield was produced on land that was dry leveled after moldboard plowing and disk harrowing. Slightly lower yields were obtained when the soil was puddled than when dry leveled (7.53 and 7.28 tons/ha respectively). One chisel plowing followed by dry leveling gave as high a yield, statistically, as did the moldboard plowing, followed by disk harrowing and dry leveling (7.53 and 7.73 tons/ha for A3 and A4 respectively).

The grain yield was highly significantly affected by the planting methods. The highest significant mean values were those of (B2) mechanical drilling, (B4) recommended transplanting and (B5) mechanical transplanting (7.84, 7.80 and 7.72 tons/ha, respectively). However, broadcasting (B1) and traditional transplanting (B3) gave 6.26 and 6.63, tons/ha, respectively, and these values were significantly lower than those obtained from B2, B4 and B5 treatments.

The combination of no-tillage practice with broadcasting (A2 B1) resulted in the lowest grain yield of 5.42 tons/ha as opposed to the maximum yield of 8.96 tons/ha obtained from the A3 B2. The A4B2, A4B4 and A4B5 combinations save time, labor and tillage costs and are recommendd. These data confirm the results obtained in 1982.

II. APPLYING TACHIGARIN TO THE NURSERY FOR THE IMPROVEMENT OF SEEDLING ESTABLISHMENT AND GRAIN YIELD

The objective of this study was to detect the

effect of the growth promoter, Tachigaren, on (1) Seedling growth and grain yield of three rice varieties and (2) Determine the best rate of Tachigarin for two planting dates i.e. early (April 25) and normal (May 25).

Two experiment were conducted at Sakha. One was concerned with the early sowing date of April 25, and the other with a normal sowing date of May 25. A split-plot design, with four replicates, was used in both studies. The main plots were assigned to three rice varieties (Giza 172, Reiho and IR 1626-203) and the sub-plots to four concetrations of the dust formulation (70% active ingredient) of Tachigarin (0, 0.5, 1.0 and 2.0% of seed weight). Nursery plot size 3 x 5m = 15m2. The results obtained are summarized as follows:

Rice Grain Yield :

Statistical analysis show significant varietal differences in both experiments. Local variety Giza 172 gave the highest combined yield of the early and normal sowing dates (Tales 2a and 2b). No marked difference was detected between Reiho and IR 1626-203 varieties when planted early, but Reiho yielded significantly less planted on the normal sowing date (May 25).

No advantage was found in using Tachigaren at a rate greater than 5% of seed weight since the yield increase at higher rates was not significant (Table 2).

III. MANAGEMENT AND EVALUATION OF RICE CULTIVARS FOR RATOONING

This field study was conducted at Sakha, to investigate the effect of harvesting heights, N levels and cultivars on rice ratooning. The experiment included the following variables :

1. Three cultivars : A1 = Reiho, A2 = IR 28
   A3 = Nanzao No. 33

2. Three harvesting heights :
   B1 = 15 cm (6 inches); B2 = 22.5 cm (9 inches)
   B3 = 30 cm (12 inches)

3. Three N levels : C1 = 0 (Control) C2 = 48 kg N/F and C3 = 96 kg N/ha.

A factorial split-split plot design, with four replicates, was used. Main-plots were assigned to three cultivars, sub-plots to three harvesting heights and sub-sub-plot to three N levels. Field sub-sub plot

size was 1.4 x 5 = 7m2. The experimental results are given in Table 3a, 3b, and 3c.

Grain Yield

Data in Table 3a indicates that cultivar Reiho produced the highest first crop grain yield (9.54 tons/ha) followed by IR 28 (9.12 tons/ha). While Nanzao 33 gave the lowest grain yield (7.12 tons/ha).

Table 3b contain the grain yield (tons/ha) for the second crop of Nanzao 33. The second crop of IR 28 and Reiho cultivars was cancelled because of the late harvesting of the first crop. Yield of Nanzao 33 increased significantly as the harvesting heights increased, (grain yield was 2.88, 2.71 and 3.18 tons/ha. for 15 cm, 22.5 cm and 30 cm, respectively). Also, grain yield increased significantly as nitrogen level increased (grain yield was 2.32, 28.6 and 3.60 tons/ha for 0, 48 and 96 kg N/fed respectively).

The interaction effect of harvesting heights and N level on grain yield was inconsistent (Table 3b). For zero N level the grain yield was greatest at the 30 cm harvesting height followed by 15 cm and 22.5 cm. Grain yield for 48 kg N/ha increased as harvesting heights increased. While 96 kg N/ha gave the highest grain yield with 15 cm harvesting heights followed by 30 cm and 22.5 cm.

Moisture percentage as influenced by harvesting heights and nitrogen levels is shown in Table 3c. Moisture percentage decreased as harvesting height increased. Moisture percentage increased as nitrogen level increased.

IV. OPTIMIZING AGRONOMIC PRACTICES FOR RICE CULTIVAR "REIHO"

This study was initiated to determine the best cultural practices, including sowing date, seedling age, and N fertilization, for optimum yields for Reiho. A factorial experiment in a split-plot design, with four replicates was used. Main-plots were assigned to three sowing date (April 20, May 20 and June 20), sub-plots to three seedling ages (25, 35 and 45 days after sowing) and sub-sub-plots to three N levels 40 kg N/F. 96 kg N/F. and 144 kg N/F). Field sub-sub-plot size was 3 x 5m = 15m2. The effect of date of sowing, seedling age and nitrogen levels on grain yield (tons/ha) is presented in Table 4.

Grain Yield

Results in Table 4 indicate that grain yield of Reiho was highly significantly influenced by sowing date, seedling age and nitrogen levels. Sowing on the medium date of May 20 gave a higher grain yield than the early sowing date on April 20 or late sowing on June 20. Grain yield was 8.24, 8.63 and 4.04 tons/ha. for early, medium, and late sowing, respectively. Highest grain yield were obtained at the transplanting age of 25 days after sowing. Grain yield was 7.28, 7.02 and 6.66 tons/ha for 25 days, 35 days and 45 days after sowing, respectively.

Grain yield ton/ha was significantly affected by nitrogen levels. Grain yields increased significantly with nitrogen level increases. (6.25, 7.21 and 7.52 tons/ha for 40 kg N/ha, 96 kg N/ha and 144 kg N/ha., respectively).

Accordingly, it was concluded that the optimum agronomic practices for Reiho cultivar, in view of 1982 results are :

a. Sowing date in nursery : May 20
b. Age of transplants : 25 days after sowing.
c. Fertilization :40 kg N/fed.(96 kg N/ha).

Table 1 : Combined effect of improved land preparation and planting methods on rice grain yield (tons/ha)

Land Preparation Practices		Planting Methods: Broadcasting B1	Mechanical Drilling B2	Traditional Transplanting B3	Recommended Transplanting B4	Mechanical Transplanting B5	Land Prepation Means
A1	One chisel plowing followed by dry leveling & puddling	6.86	7.72	6.50	7.92	7.40	7.28
A2	No tillage practice	5.42	6.36	6.16	7.12	7.06	6.43
A3	One moldboard plowing followed by disc harrowing, dry leveling and flooding	6.70	8.96	6.82	7.92	8.24	7.73
A4	One chisel plowing followed by dry leveling and flooding	6.04	8.26	7.02	8.20	8.12	7.53
Planting methods means		6.26	7.84	6.63	7.80	7.72	7.25

	L.S.D 0.05	L.S.D. 0.01	
Land preparation practices	0.35	0.50	ton/ha
Planting methods	0.46	0.61	ton/ha

Table 2 a : Improvement of seedling establishment and grain yield by applying Tachigarin to the nursery

Early Sowing grain yield (ton/ha)

Rice Varieties	Tachigaren Concentrations %				Variety Means
	Control	0.5	1.0	2.0	
Giza 172	9.18	10.35	10.23	9.80	9.89
Reiho	8.80	9.57	9.17	8.82	9.10
IR 1626-203	8.82	9.22	9.01	8.87	8.98
Tachigaren means	8.94	9.72	9.48	9.17	

	L.S.D. 0.05	L.S.D. 0.01	
Varieties	0.63	-	ton/ha
Tachigaren conc.	0.37	0.50	"

Table 2b Normal Sowing grain yield (ton/ha)

Rice Varieties	Tachigaren Concentrations %				Variety Means
	Control	0.5	1.0	2.0	
Giza 172	8.46	9.08	9.20	8.95	8.92
Reiho	7.86	8.02	7.75	8.22	7.96
IR 1626-203	7.80	8.30	8.83	8.61	8.38
Tachigaren means	8.04	8.47	8.59	8.59	

	L.S.D. 0.05	L.S.D. 0.01	
Varieties	0.40	0.61	ton/ha
Tachigaren conc.	0.43	-	"

Table 3 a : Management and evaluation of rice cultivars for ratooning

Rice Grain yield for the first crop (ton/ha)

Rice Cultivars			L.S.D.	
Reiho	IR 28	Nanzao 33	0.05	0.01
9.54	9.12	7.12	0.35	0.52

Table 3 b : Rice grain yield for the second crop of Nanzao 33 variety in tons/ha

Harvesting Heights cm	Nitrogen levels kg/ha			Harvesting Heights means
	0	48	96	
15.0	2.22	2.50	3.92	2.88
22.5	2.12	2.90	3.10	2.71
30.0	2.62	3.16	3.74	3.18
N levels means	2.32	2.86	3.60	2.93

	L.S.D. .05	L.S.D. .01
Harvest heights	0.25	0.38 ton/ha
Nitrogen levels	0.29	0.39 ton/ha
Harvest ht x N levels	0.50	0.68 ton/ha

Table 3c : Moisture content in percent for rice grain of Nanzao 33 from the second crop

Harvesting Heights cm	Nitrogen levels kg/ha			Harvesting Heights means
	0	48	96	
15.0	17.5	18.0	18.5	18.0
22.5	17.0	17.5	18.0	17.5
30.0	16.5	17.0	17.0	16.8
N levels means	17.0	17.5	17.8	17.4

Table 4 : Optimizing agronomic practices for Reiho (rice grain yield in tons/ha)

Seedling Age Days	Nitrogen levels kg / ha	Sowing Dates April 20	May 20	June 20	Mean
25	48	7.73	8.15	3.50	6.46
	96	9.27	9.13	4.56	7.65
	144	9.25	9.03	4.92	7.73
Mean		8.75	8.77	4.33	7.28
35	48	7.30	8.18	3.54	6.34
	96	8.47	8.77	4.42	7.22
	144	8.70	9.13	4.66	7.50
Mean		8.16	8.69	4.21	7.02
45	48	7.09	7.57	3.17	5.94
	96	7.93	8.83	3.52	6.76
	144	8.48	8.93	4.46	7.29
Mean		7.82	8.44	3.72	6.66
Sowing Dates Means		8.24	8.63	4.09	6.99

Sowing Date	L.S.D. .05	=	0.37 ton/ha
	L.S.D. .01	=	0.56 "
Seedling age	L.S.D. .05	=	0.23 "
	L.S.D. .01	=	0.31 "

Means of rice grain yield as affected by N levels (Sub-Sub-plots) in tons/ha

	Nitrogen levels kg/ha			L.S.D.	
	48	96	144	0.05	0.01
Grain Yield	6.25	7.21	7.52	0.19	0.25

B. SOIL AND WATER RESEARCH COMPONENT

M.R. Hamissa	Co-Leader, Soil and Water
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I. INTRODUCTION: Efficient use of fertilizers and water are among the most effective management resources in producing high crop yields at low unit cost. During the 1982 season, eight soil and water study topics were investigated. The procedures used and the results obtained are discussed in this report.

II. OBJECTIVE: The main purpose of this program is to economically increase production of paddy through the efficient use of fertilizers and water.

III. EXPERIMENTAL WORK: All field trials were conducted at Sakha Experimental Station located in the center of the Rice Belt in the North Delta.

Composite soil samples were taken from the experimental sites to a depth of 20 cm. Soil samples were airdried, ground to pass through a 1 mm sieve for chemical analysis, and soil definition.

Available N which includes the ammonium and nitrate nitrogen was determined according to Koeing method. Available P was determined by Olsen et al method. Available K was determined by the ammonium acetate method. Zn, Fe & Mn were extracted by DTPA method. Other chemical constituents were determined according to official methods.

IV. RESULTS AND DISCUSSION:

A. Description of soil samples used in the studies

Detailed information and chemical analysis of the soil in each experiment are in Table 1. Only a slight range in the soil constituents was found since all studies were located adjacent to each other. The texture of the soil was a heavy clay. The soils were all slightly alkaline with a pH range from 8.25 to 8.4. Calcium carbonate content was adequate, ranging between 3.24 and 3.91. Total soluble salts were not excessive and did not approach the toxic level.

In general, the soils were poor in organic matter and consequently in N content. Avaliable P was sufficient in all soils ranging between 11.8 and 22.3 ppm. determined by sodium bicarbonate method. Values of available K indicate that all the soils were rich in potassium. Values obtained by the concentration of available Mn, Fe and Zn are above the critical limits established by Sultanpour et al.

The soils reflected the general characteristics of most soils in the rice belt of Egypt.

B. Crop Yield Data:

1. Nutritional requirements for the traditinal and improved short statured rice varieties: Reiho and IR 1626-203 are newly developed short statured varieties. Before their release and use by farmers, the fertilizer requirements should be known. Therefore, the main purpose of this trial was to determine the response of these new varieties to N, P and zinc compared with the traditional varieties.

A simple split plot design included 8 fertility treatments in the main plots and three varieties G 172, Reiho and IR 1626-203 in the subplots was used. Each of the 24 treatment were replicated 4 times.

Data in Table 2 indicate that yield of paddy increased gradually as the rate of N increased up to 192 kg N/ha. However, 96 kg N/ha. (40 kg N/fed) is a reasonable rate of N to obtain economical yield. At this particular rate, the average yield of the three varieties was increased by 37% over that obtained from the check. Reiho and IR 1626-203 were found to be more responsive to high rates of N than was G 172. Adding Phosphorus at the rate of 36 kg P205/ha gave an average yield increase of ton .64 of paddy/ha. At the current value of rice and phosphorus, it is profitable for farmers to apply phosphorus.

A yield increase was not obtained by adding zinc probably because of the high concentration of availale Zn in the soil (2.6 ppm determined by DTPA method).

2. Foliar spray and soil application of Macro and Micro Elements for paddy
This experiment was designed to study the fertilizer value of several foliar compounds containing macro and micro elements. Also included were soil applied micro nutrient compounds.

Twelve treatments, replicated four times were arranged in a randomized complete block design using Giza 172.

According to the data (Table 3) no significant effect was detected due to fertilizer treatments. Zincin, a form of zinc sulphate applied to the soil produced the highest yield, followed by sicostreen, a chelated zinc used as a foliar spray.

3. Optimization of paddy yield through variety x spacing x fertilizer interactions
The objective of this trial was to study the interaction between rice variety x spacing x fertilizer treatments to give an effective recommendation for the best N level and spacing for the short and long statured varieties. A factorial split-split-plot design, replicated 4 times was used in the field trial. The main plot was devoted to varieties the subplot to spacing and the sub-plot to N level. Data from all 18 treatments summarized in Table 4 show that yields from G 172 and Reiho were similar with G 172 slightly greater. The closest spacing, 20 x 20 cm, was superior to other spacing when no other variables were considered. The N level of 96 kg N/fed proved to be the best.

Considering the interaction between all factors, it was concluded that Reiho and made the highest, and almost equal, yield at the closest spacing (20 x 20 cm) when fertilized with 96 kg N/ha (40 kg N/fed).

4. N fertilizer Efficiency in Wet Land Rice
The purpose of this study was to determine a) The response of paddy to different rates of N and b) the relative effectiveness of sources and placement of N applied at different times. The experimental treatments superimposed on G 172 are indicated in Table 5. Each treatment was replicated 4

times in a randomized complete block design. Results obtained are presented under the following two headings :

A) Response of paddy to different levels of N application
Big differences in grain yield, as reported in Table 5 indicate that paddy responded significatly to N application. The grain yield increased gradually and consistantly as the rate of N increased up to 174 kg N/ha. However, the differences between rates did not reach the statistical level of significancy.

B) Relative effectiveness of various sources of N applied at different times and methods of placement.
Yield comparisons amoung the sources of N reported in Table 5 indicate that no significant differences were detected amoung the N sources at comparable levels of N. However, yields obtained from super granule urea (SGU) and sulfur coated urea (SCU) were slightly superior to ordinary urea. These findigs are in close agreement with our results from previous years. This yield increase is probably due to the slow release of N from these two sources satisfying the requirements of the plant during its entire growth period. However, it could be due to the deep placement of the SGU and SCU which minimized the loss of N through volitalization and/or denitrification. On the other hand broadcasting urea on the surface of the soil could have led to significant losses of N and in turn reduced the efficiency of the surface applied urea compared to SGU and SCU. Regardless of the reasons for the increase in yield of the SGU and SCU, the price of the N and the value of the crop must be economically considered before a definite conclusion is reached as to the most profitable source of N to use.

5. Phosphorus Sources for Paddy
The main objective of this experiment is to evaluate the relative effectiveness of rock phosphate sources in flooded rice. Single

super phosphate was used as the standard source of P. In addition to the basic coordinated treatments, Triple Super Phosphate (TSP) and Egyptian rock phosphate were incorporated into the experiment as optional treatments to study their fertilizer value.

A randomized complete block design including 16 treatments in 4 replications was employed using G 172. N was added to all plots at the recommended rate.

Results in Table 6 show only a slight and insignificant, response to P irrespective of the rate or the source of material. Such a lack of response might be due to the relatively high concentration of available P from the preceeding crop at the experimental site. Available P amounted to 14.3 ppm which is considered adequate. There were no significant differences amoung sources of P. Egyptian rock phosphate is a good source.

To obtain more conclusive results on the nutritive value of P sources a test-site, deficient in soil P, should be selected. The isotope technique using radio active P would also be an effective tool to provide a direct answer to the question.

6. N Recovery by Paddy using tracer technique
The objectives of this experiment are to study a) the relative effectiveness of the N unit in urea compared with ammonium sulfate and b) the N recovery from both sources as affected by time and method of fertilizer placement. Thirteen fertility treatments were arranged in a randomized complete block design with 4 replications. In addition to the check treatment, two sources of N were used. Each source was tested under different times and methods of application.

Two sources of N; regular urea and N15 depleated ammonium sulphate (provided by Dr.R.N. Mikkelsen) were used. The 15N depleted ammonium sulphate plot consisted of two subplots one of which was fertilized with isotopic fertilizers and the other with regular ammonium sulphate using the same rate, time and method of application. The

rate of N application was 72 kg N/ha or 75% of the recommended rate. Plant material was collected from each plot for total N and 15N: 14N ratio analysis. The College of Agriculture, University of California - Davis is responsible for the tracer analysis of the plant material. Since analysis have not yet been completed, only yield data are presented (Table 7). These data show a definite yield response to the different methods of nitrogen application. Comparison between urea and ammomium sulphate indicates that the nitrogen unit in both sources has about equal value irrespective to time and method of fertilizer applicatin.

Results from the time and method of fertilizer placement show that N applied to G172 following barley either :

a. Broadcated and incorporated in dry soil preplant; or
b. Point placement at planting ; or
c. 2/3 Broadcasted 40 days after transplanting (DAT) + 1/3 at panicle initiation (PI) have almost equal effect and are superior to either:
   1) Surface broadcasting ; or
   2) 2/3 broadcasted 15 DAT+ 1/3 P.I.

However, more precise conclusion will be obtained when the tracer analysis is completed especially the N recovery from the ammonium sulphate.

7. <u>Response of rice varieties to N levels under different water regimes:</u>
The main objective was to study the response of three rice varieties differing in their water requirements to three nitrogen levels. Also, the interaction among water regimes, nitrogen rates and rice cultivars was determined.

A split-split plot design with four replicates was used. The main treatments were assigned to three water regimes i.e. irrigation at every 4, 8 and 12 days after transplanting ; the irrigation depth was 7.5 cm for all treatments. The sub-plots were devoted to three nitrogen levels of 47.5, 95.0 and 142.5 kg N/ha. Giza 172, Giza 180 and IET-1444 rice varieties were distributed on the sub-sub plots.

The results showed highly significant difference among the three water regimes. Prolonging the irrigation interval to 12 days resulted in a significant grain yield reduction compared with 4 and 8 days which did not differ significantly. No significant differences were detected for nitrogen levels or rice varieties. Neither first nor second order interactions showed any significance except between nitrogen levels and rice varieties. The rice cultivar IET-1444 gave the lowest grain yield under 20 kg N/fed. (47.5 kg N/ha) while it increased significantly at 40 kg N/fed. However, no marked differences among the other combinations of nitrogen levels and rice varieties were found (Table 8).

8. Physiological studies on the relationship of salinity, fertility and rice varieties
The purpose of this study was to determine the response of rice varieties to different methods of nitrogen application under four salinity levels.

The clay soil sample used in this pot experiment was transfered to the greenhouse, well mixed and homoginized. The initial electric conductivity of the soil paste (ECE) was found to be 2.04 mmhos/cm at 25 C. Three soil samples were salinized to the desired levels (5, 10 and 15 mmhos/cm) by the addition of Nacl and Cacl2. The amount of salt added to give the required level of salinity was calculated from a standard curve. A factorial experiment in a complete randomized design was used. The three factors under study were two varieties (Giza 172 and Reiho), four levels of salinity i.e. Natural (2.04 mmhos/cm), 5, 10 and 15 mmhos/cm. The three nitrogen application methods used were a) incorporation in dry soil; b) broadcasting 15 days after transplanting (15 DAT) and; c) split application of 1/2 15 DAT and 1/2 at panicle initiation (PI). The twenty four treatments were replicated four times. Plastic pots with capacity of 17 kg of soil were used.

The statistical analysis indicated highly significant differences with treatments of each factor under study. Also, all the first and second order interactions

were highly significant. Means of rice grain yield in g/pot are presented in Tables 9a and 9b. The data show Giza 172 to be more tolerant to salinity than Reiho. No harmful effect was detected due to salinity levels up to 5 mmhos/cm. The rice grains weights were 20.75, 26.86 19.65 and 11.28 g/pot for natural (2.04), 5, 10 and 15 mmhos/cm respectively. Splitting 30 kg N/fed at 15 DAT and PI (m3) was superior to a single application either before or 15 DAT on saline soils. The respective yields were 22.42, 15.56 and 20.93 g/pot. Incorporating the nitrogen fertilizer at 15 mmhos/cm resulted in dessication of the transplanted seedlings, and complete loss of yield. The second order interaction indicated that the combinatin of Giza 172 variety at 5 mmhos/cm using broadcasting method of 15 DAT for nitrogen application gave the highest weight of grain followed by G 172 x 5 mmhos/cm x split application method without significant differences between the two.

Table 1: Chemical anaylsis of soil samples taken from the experimental sites

Experiment	Depth of layer cm	Soil Texture	PH 1,2.5 water	Organic matter %	Total N ppm	Inorganic N (ppm) NH4-	NO3+	Total	Av.P Olsen ppm	Av. K (Am ac.) ppm	CaCo3 %	Total Soluble salt-	Available (DTPA)	Fe	Zn
1. Nutritional requirements for the trad. & improved short statured var.	0-20	Heavy clay	8.43	2.16	850	Traces	21.0	21.0	13.8	520	3.656	.132	6.6	12.4	2.6
2. Foliar spray and soil appl. of major and micro elements	0-20	"	8.25	2.55	900	Traces	19.0	19.0	11.8	550	3.32	.132	8.4	13.8	4.0
3. Variety x Spacing x fertilizer interaction	0-20s	"	8.30	2.24	850	Traces	16.0	16.0	12.5	490	3.91	.148			
4. N fertilizer efficiency in wet land rice	0-20	"	8.25	2.24	1050	2.5	21.5	24.0	15.8	520	3.24	.148			
5. Phosphorus sources for paddy	0-20	"	8.25	1.85	950	2.5	21.0	21.0	14.3	510	3.32	.116			
6. N recovery by paddy using tracer technique	0-20	"	8.26	1.93	875	2.5	24.0	24.0	16.3	540	3.47	.148			
7. Fertilizer requirements for rice under different water regimes	0-20	"	8.25	2.08	950	5.0	14.0	19.0	22.3	500	3.49	.132			

Table 2 : Nutritional requirements for the traditional and improved short statured rice varieties.

Fert. treats. kg/ha			Seed Yield in t/ha			
N	P2O5	ZnSo4	G172	Reiho	IR 1626-203	Mean
-	-	-	7.92	6.41	6.86	7.06
-	36	48	8.13	6.81	7.56	7.50
48	36	48	8.72	7.31	7.39	7.80
96	36	48	9.65	8.75	8.85	9.09
144	36	48	10.20	8.58	8.90	9.23
192	36	48	9.40	9.60	9.86	9.64
96	-	48	8.90	8.32	8.13	8.45
96	36	-	9.57	9.27	8.41	9.08
	Mean		9.06	8.13	8.25	8.48

LSD (5%), Fert .89; Var .42; Fert.x var N.S. - P= 8.45 t/ha; +P=9.09 ton/ha.

Table 3: Foliar spray and soil application of major and some micro elements.

Treatment		Seed Yield t./ha
O		5.78
N		8.26
N + P		7.87
N + P + Iral	)	7.85
N + P + Folifertile	)	7.59
N + P + Fetroline Combe	) Foliar	8.37
N + P + Nitramin 6	) appl.	7.32
N + P + Sicostreen Zn.	)	8.83
N + P + Ner vanid Zn.	)	7.63
N + P + Zn So4	)	9.60
N + P + Fe So4	)soil appl.	8.11
N + P + Mn So4	)	8.66
L.S.D. 5%		2.15

72 kg N/ha and 36 kg P2O5/ha applied

Table 4 : Optimization of paddy yield as affected by variety x spacing x fertilizer interaction.

	Variety	Spacing cm	N level kg / ha	Yield t/ha.	
1		20x20	48	9.45	Varieties:
2		"	96	9.48	G.172 = 8.97 t/ha
3		"	144	9.58	Reiho = 8.43 "
4	G 172	20x30	48	8.35	L.S.D.= N.S.
5		"	96	8.93	Spacing:
6		"	144	8.85	20x20 cm = 9.20 t/ha
7		20x40	48	8.80	20x30 cm = 8.65 "
8		"	96	8.68	20x40 cm = 8.42 "
9		"	144	8.58	L.S.D.5% = .5 "
10		20x20	48	7.18	N.Level
11		"	96	9.93	48 kg/ha = 8.16 t/ha
12		"	144	9.58	96 " = 9.00 "
13		20x30	48	7.90	144 " = 9.10 "
14	Reiho	"	96	8.68	L.S.D. 5%= .27 "
15		"	144	9.18	LSD 5%:
16		20x40	48	7.30	Varxspacing=1.07 "
17		"	96	8.35	VarxNlevel =1.07 "
18		"	144	8.80	SpacingxN level=.74"
					Var x Spacing x N level = 1.07 t/ha

Table 5 : N. Fertilizer efficiency in wet land rice

Treat #	N level kg/ha	Source	Time & method of applic.	Seed t/ha	Av. t/ha
1	0	None	None	7.00	7.00
2	58	Urea	2/3 Broadcasted 15 DAT + 1/3 P.I.	8.32	
3	58	SCU	Inc in dry soil	9.51	9.06
4	58	SGU	Point placement 10 DAT	9.82	
5	29+29	SGU+U	Point pl 10DAT + P.I.	8.57	
6	87	Urea	As treat (2)	9.58	
7	87	SCU	" (3)	9.53	
8	87	SGU	" (4)	10.06	9.81
9	58+29	SGU+U	" (5)	10.06	
10	116	Urea	" (2)	9.49	
11	116	SCU	" (3)	10.98	
12	116	SGU	" (4)	10.05	10.10
13	87+29	SGU+U	" (5)	9.88	
14	174	Urea	" (2)	9.71	
15	174	SCU	" (3)	9.60	
16	174	SGU	" (4)	10.73	10.12
17	145+29	SGU+U	" (5)	10.44	
18	87	Am.S.	" (2)	9.19	
L.S.D.				1.64	

N level kg/ha			
0	=	7.00	t/ha
581	=	9.06	"
87	=	9.81	"
116	=	10.10	"
174	=	10.12	"

Source of N			
Urea	=	9.28	t/ha
SCU	=	9.91	"
SGU	=	10.17	"
SGU+U	=	9.74	"

Table 6 : P sources for paddy in flooded soils

Treat No.	P205 Kg/ha	Source of P	Yield t/ha	Note
1	-	-	7.21	Effect of P
2	20	Single S.P.	7.01	- P = 7.21 t/ha
3	40	"	7.14	+ P = 7.72 "
4	60	"	6.74	
5	20	Phospal R.P.	7.13	Effect of Rate:
6	40	"	7.02	Kg P205 t/ha
7	60	"	7.53	0 = 7.21
8	40	Guano R.P.	7.61	20 = 7.48
9	80	"	7.86	40 = 7.54
10	120	"	8.07	60 = 7.65
11	20	T.S.P.	7.63	Effect of source:
12	40	"	8.30	Single S.P. = 6.94 t/ha
13	60	"	8.47	Phospal R.P.= 7.28 "
14	40	Egyptian R.P.	8.69	Guano R.P. = 7.97 "
15	80	"	7.93	T.S.P. = 8.58 "
16	120	"	8.64	Egyptian R.P= 8.29 "

Table 7 : Fertilizer N recovery by paddy using tracer technique

Source of N	Time and method of fer. appl	Seed yield t./ha	Av.Yield t./ha
None	None	7.08	7.08
Urea	Incorporated in dry soil	9.00	
	2/3 Incorp. in dry soil+1/3 P.I.	9.11	
	Surface broadcasting pre transpl	7.95	
	Point placement	9.64	8.89
	2/3 Broadcasting 15DAT+1/3 P.I.	8.68	
	2/3 Broadcasting 40DAT+1/3 P.I.	8.95	
Amm. Sulphate	Incorporated in dry soil	8.87	
	2/3 Incorp. in dry soil+1/3 P.I.	8.56	
	Surface broadcasting pre transpl.	8.46	
	Point placement	9.07	8.69
	2/3 Broadcasting 15DAT+1/3 P.I.	8.23	
	2/3 Broadcasting 40 DAT+1/3 P.I.	8.95	

Time & method of application	Av. yield (t/ha)
Point placement	9.36
2/3 Broadcasting 40 DAT + 1/3 P.I.	8.95
Incorporated in dry soil	8.94
2/3 Incorporated in dry soil + 1/3 P.I.	8.84
2/3 Broadcasting 15 DAT + 1/3 P.I.	8.46
Surface broadcasting pretransplanting	8.06

Table 8 : Fertilizer requirements for rice varieties under different water regimes - Yields ton/ha

Water Regime	N level	Rice Varieties G.172	G.180	IET 1444	Mean
W1	N1	9.69	10.13	10.02	9.95
	N2	9.78	10.00	10.27	10.02
	N3	9.70	8.97	10.48	9.72
W1 x varieties		9.72	9.70	10.26	9.89
W2	N1	10.60	10.62	8.02	9.75
	N2	9.18	9.67	9.80	9.55
	N3	9.55	9.67	9.74	9.65
W2 x varieties		9.78	9.99	9.19	9.65
W3	N1	8.17	7.74	9.57	8.49
	N2	8.83	9.43	9.41	9.22
	N3	8.91	8.89	9.36	9.05
W3 x varieties		8.64	8.69	9.45	8.92
VARIETIES		9.38	9.46	9.63	9.49

N 1 = 9.40; N2 = 9.60; N3 = 9.47 N.S.

Water regimes L.S.D. .05 0.60 ton/ha
.01 0.91 "

Varieties x N levels L.S.D. .05 0.68 ton/ha

Table 9 a : Rice grain yield (in gram/plot) as influenced by varieties, salinity levels, methods of nitrogen application and their interactions

Variety	Salinity levels mmhos/cm	Methods of Application Inco.in Dry soil	Broadcast 15 DAT	1/2 15 DAT and 1/2 PI	Mean
	Natural(2.04)	21.08	23.65	27.52	24.08
	5	24.33	31.96	28.19	28.16
Giza 172	10	23.82	21.39	19.38	21.53
	15	-	17.36	18.00	11.79
M E A N		17.31	23.59	23.27	21.39
	Natural	18.28	15.28	18.65	17.40
	5	22.50	26.13	28.02	25.55
Reiho	10	14.42	18.31	20.58	17.77
	15	-	13.34	18.99	10.78
M E A N		13.80	18.27	21.56	17.88
Methods of Appli. means		15.56	20.93	22.42	

Methods of Nitrogen appliction	L.S.D. .05	1.08	G/pot
	L.S.D. .01	1.43	"
Methods of applic x varieties	L.S.D. .05	1.52	"
	L.S.D. .01	2.03	"
Salinity levels x varieties	L.S.D .05	1.76	"
	L.S.D. .01	2.34	"
Varieties x salinity levels x methods	L.S.D. .01	3.04	"
	L.S.D. .05	4.05	

Table 9 b : Rice grain yield (gram/pot) as affected by the interaction between salinity levels and nitrogen application methods.

Salinity levels mmhos/cm	Methods of Application Inco.in Dry soil	Broadcast 15 DAT	1/2 15 DAT and 1/2 PI	Mean
Natural(2.04)	19.68	19.47	23.09	20.75
5	23.42	29.05	28.11	26.86
10	19.12	19.85	19.98	19.65
15	-	15.35	18.49	11.28
M E A N	15.56	20.93	22.42	19.64

Salinity levels L.S.D. .05 = 1.24 G/pot
L.S.D. .01 = 1.65 g/pot

Salinity levels x methods of L.S.D. 0.05 = 2.15 G/pot
L.S.D. 0.01 = 2.32 G/pot

G 172 = 21.39 grams
Reiho = 17.89 grams
Varietal yield difference is highly significant

C. ECONOMICS PROGRAM

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INTRODUCTION

The economic program initiated its research activities in August, 1982. The responsibility of this program is to provide analysis of 1) the constraints on and 2) the consequences of increased rice production in Egypt, the primary project objective.

OBJECTIVES

The constraints research has a primary focus on identifying and explaining differences in rice yields at the farmer, extension demonstration, and experiment station levels.

The research on consequences of changes in the production regime for increased output at the farm level focuses on impacts on resource use and returns for the individual producer. At the industry level, consequences on factor and product prices, implications for market structures and organization and government policy will be analyzed.

The 1982 plan of work called for the development and implementation of a research program designed to begin to achieve these objectives. Given the limited time and research resources available, the major objectives established for 1982 were :

1. Design and test a survey questionnaire to identify and explain yield gaps at the farm level especially between farmers participating and not participating in extension demonstration trials.

2. Collect and analyze survey and experimental data to compare resource use and costs between traditional and alternative methods of rice production.

ACHIEVEMENTS

The questionnaire was developed by November and the survey was completed by January. Preliminary tabulations have been completed. However much of the data has not been tabulated nor analyzed to date. Little progress on the second objective has been made due to a lack of available research resources. The following discussion summarizes the progress on the survey and presents some preliminary results.

QUESTIONNAIRE DESIGN

A questionnaire for rice producers was designed to identify socio-economic characteristics which are associated with differences in the level of rice production. The questionnaire elicits information in six general areas:

1. Demographic information about the operator and family.
2. Farm size, field size and number, and tenure relationship.
3. Crop rotation practice.
4. Cost of production by cultural methods
5. Value of product by method of marketing.
6. Descriptive and attitudinal response to issues of participation, methods of production and production policy.

SAMPLE METHODOLOGY

The following issues were taken into consideration in developing a sample frame :

1. Each demonstration district is represented (field trials are located in 46 districts).
2. Each district is represented by 12 farms; unless noted otherwise, 6 farms from the demonstration fields and 6 farms outside the demonstration trial.
3. Farms of each district are classified by size into 3 classes :
   a. One feddan and less
   b. More than one up to five.
   c. More than five feddans.
4. The six farms from the demonstration fields of each district are randomly selected from the three size classes in the same proportion as they exist in the population. The same procedure is followed in selecting the other 6 farms outside the demonstration fields.

SAMPLE FRAME

The sample was drawn using the extension records at Sakha Experimental Station and records of the village agricultural co-operatives. Table 1 reports the sample frame by governorate and farm size which comprised the list of 276 farmers selected in the sample of farms cooperating in the demonstration.

Table 1 : Samples selected from Demonstration Fields

Governorate	No. of Districts	No. of Farmers	Feddan and less	More than feddan to 5 feddans	More than 5 feddans
Sharkia	6	36	14	13	9
Beheira	9	54	23	23	8
Dakahlya	12	72	36	27	9
Kafr El-Sheikh	9	54	19	26	9
Damietta	4	24	7	11	6
Gharbyia	6	36	19	13	4
TOTAL	46	276	118	113	45
%		100.0	42.8	40.9	16.3

Enumerators were instructed to select an equal number of farmers from outside the demonstration field in each district using farmer lists provided by the village agriculture cooperatives.

The actual number of completed questionnaires was only 468. Some 84 forms were not included; namely 41 forms were excluded because of serious shortage or inconsistancy of data collected, 36 forms arrived from the field too late to be included and 7 forms were never returned.

It should be also noted that there was a slight divergence in the number of observations in some classes due to personal choice of some enumerators. Table 2 is a summary of the actual sample forms analyzed :

Table 1 : Number of Analyzed Questionnaire forms by size, method of seeding and location

Governorate	Feddan and less				More than feddan to 5 feddans				More than 5 feddans				No.of farmers
	T		B		T		B		T		B		Total
	W	O	W	O	W	O	W	O	W	O	W	O	
Sharkia	11	10	-	-	10	12	-	-	9	6	-	-	58
Beheira	20	20	-	-	20	22	-	-	8	7	-	-	97
Dakahlyia	23	23	-	2	18	22	-	1	10	4	1		104
K.El-Sheikh	15	22	-	-	28	24	-	-	7	8	-	-	104
Damietta	7	7	-	1	8	9	-	-	9	7	-	-	48
Gharbyia	11	18	-	-	15	7	-	3	2	1	-	-	57
TOTAL	87	100	-	3	99	96	-	4	45	33	1		468

T = Transplanting B = Broadcasting
W = Within demonstration O = Outside demonstration fields.

PRELIMINARY RESULTS OF THE TEST

The survey has not been completely tabulated and the preliminary findings reported here have been generated without significant data editing. The broad range of information gathered by the survey is in the process of being coded into a computerized data base so that statistical tests and analysis may be completed to evaluate the survey methodology.

Keeping in mind that the primary objective of the 1982 survey is only the design and testing of the questionnaire the following results are reported with the reservation that they are a preliminary. A full analysis will be made prior to the initiation of the 1983 cropping season so that the questionnaire will provide accurate and useful information. It will be essential to identify those variables or parameters which distinguish the process of participation and constrain adoption of the project recommendations for increasing rice production.

Data collected through the pretesting of the questionnaire was utilized in calculating some estimates of costs and return of rice production in 1982.

This report considered only the transplanting method of rice production, since only 8 of the 468 farmers selected used the broadcasting method of production.

The main issues in this presentation are concerned with costs of production and value of output.

FIRST : Costs of Production:

Table 3 shows the costs of inputs by major field operation per feddan (without land cost and value of family labor) as a weighted average for farmers cooperating with the extension program. These costs amount to about L.E. 154, of which labor accounts for 51.1%, machinery 28.2%, draft animal 9.0% and material inputs (seeds, chemical fertilizers and pesticides) 11.7%.

The cost of nursery required for one feddan of rice represents about 24.6% of the total variable input costs. Permanent field production cost is L.E. 59.01 representing 38.3% of the costs of production. Costs of harvesting are L.E. 57.13 or 37.1% of total variable costs. This operation is performed primarily by labor.

Table 3 : Costs* of Inputs by Major Operations per feddan of Transplanted Rice within the Demonstration fields. 1982 National Average of Sample.

Operation		Human labor L.E.	Machinery L.E.	Draft Animals L.E.	Material Inputs L.E.	Total L.E.	%
Nursery		21.44	4.45	3.82	8.18	37.89	24.6
Permanent Field		19.66	24.21	5.34	9.80	59.01	38.3
Harvest & other costs		37.58	14.71	4.73	0.11	57.13	37.1
T O T A L	L.E.	78.68	43.37	13.89	18.09	154.03	
	%	51.1	28.2	9.0	11.7		100.0

* Costs reported exclude land costs and and value family labor.

Total variable input costs per feddan outside the demonstration fields are higher, costing L.E. 200.76, as indicated in Table 4. However, the relative importance of the various input costs is almost identical to that of production within the demonstration fields. Labor accounts for 51.2%, mechanical power 25.8%, draft animal 9.1% and material inputs 13.9% of total variable costs. The cost of nursery required for transplanting of one feddan of rice amounts to L.E. 51.92 or about 25.9% of the total reported costs. Permanent field production cost is about L.E. 87.16 or 43.4% of the total cost. Harvest and other costs amount to L.E. 61.68 or 30.7% of the total reported costs.

Table 4 : Variable Costs* of inputs by major operations per feddan transplanted rice not in demonstration fields. 1982 National Sample Average.

Operation		Human labor L.E.	Machinery L.E.	Draft Animals L.E.	Material Inputs L.E.	Total L.E.	%
Nursery		28.40	6.72	5.11	11.69	51.92	25.9
Permanent field		33.71	30.05	7.77	15.63	87.16	43.4
Harvest and other costs		40.73	14.93	5.42	0.60	61.68	30.7
Total	L.E.	102.84	51.70	18.30	27.92	200.76	
	%	51.2	25.8	9.1	13.9		100.0

* Costs reported exclude land costs and value of family labo..

A comparison of the preliminary cost of production information suggests several issues of interest to the project.

1. Demonstration fields and recommended production practics are cost saving. The average total variable cost is 23.3% less than for non-demonstration production.

2. Nearly all of the cost reduction is associated with pre-harvest operations. Nursery cost is 27% less presumably due in part to adoption of recommended seeding rates . The major cost reduction is in the permanent field production. Non-demonstration costs are reduced by 32.3%. The most significant input reduction appears to be human labor, particularly that required for plant protection e.g. weeding, due to the recommended herbicide practice.

3. There appears to be no significant reduction in harvest costs which is consistent with the fact that the project has not fully implemented improved labor saving techniques e.g. mechanical threshers. Given the substantial human labor costs associated with harvest, some mechanization in this operation would appear to be able to generate significant cost reductions.

4. Finally, assuming that relative factor prices are homogenous between demonstration and non-demonstration farmer, the similarity of the factor use ratios (percentage of input expenditure to total cost) suggests that the new technology recommendations are factor neutral, i.e. both labor and capital saving.

SIZE ECONOMICS AND REGIONAL DIFFERENCES

Substantial differences in costs of production per feddan appear to exist among the three size classes of land holdings and across governorates within the demonstration fields, (Table 5). Total variable costs are L.E. 253.83 for the first class, L.E. 150.26 for the second class and L.E. 126.40 for the third class. While the substantial size economies are implied by the group means reported here, no statistical analysis of these differences has been made at present. The same conclusion applies to the case of non-cooperating farmers, (Table 6).

A comparison of size economies and regional differences by participation raises the issue of whether or not the new technology recommendations are neutral to size of farm and region. The preliminary data generate ambiguous results and consideration of this issue must follow further investigation.

Table 5 : Cost of Production per feddan* of transplanted rice within the Demonstration fields by size class in various governorates, 1982

Governorate	1st Class	2nd Class	3rd Class	Average
Sharkia	250.86	111.57	NA	146.18
Beheira	231.39	169.76	116.64	150.03
Dakahlyia	237.19	142.00	101.44	130.55
Kafr El-Sheikh	283.82	138.89	149.60	166.68
Damietta	335.22	337.13	217.65	235.22
Gharbia	248.97	161.07	NA	178.05
National Average	253.83	150.26	126.40	154.03

* Excluding cost of land and value of family labor
N.A. = insufficient observation to report class average

Table 6 : Cost of production (L.E.) per feddan* of transplanted Rice off the demonstration fields by size class in various governorates 1982

Governorate	1st Class	2nd Class	3rd Class	Average
Sharkia	259.46	NA	NA	258.10
Beheira	290.41	144.90	186.08	182.34
Dakahlyia	273.85	155.34	155.36	174.91
Kafr El-Sheikh	260.28	193.66	228.84	215.28
Damietta	471.32	301.30	267.79	297.44
Gharbia	237.68	121.45	NA	170.19
National Average	275.51	166.32	191.71	200.76

* Excluding cost of land and value of family labor
N.A. = insufficient observation to report class average

SECOND : Yield per Feddan

Tables 7 and 8 show the reported grain yield per feddan in the farms of the sample.

The yield data reported here is based upon the farmer's response, not upon objective field testing. The yield data and differences reported here should be treated with reservation.

Yield of cooperating farmers averaged 2.63 tons. Government delivery is 46.4% of output, while 19.8% is sold in the market and 33.8% is kept for home consumption. The highest yield of 2.88 tons is found in Kafr El-Sheikh while the lowest one of 2.16 tons is found in Sharkia.

Yield of noncooperating farmers averages 2.29 tons, of which 55.5% is government delivery, 17.9% sold in the market and 26.6% is kept for home consumption. The highest yield is 2.78 tons in Dakahlyia and the lowest yield is 1.78 tons in Sharkia.

Table 7 : Grain yield per feddan of transplanted rice within the demonstration fields by method of product disposal in the various governorate 1982

Governorate	Yield (tons)	Method of Product Disposal (tons)		
		Government delivery	Sold in the the market	Home consumption
Sharkia	2.16	1.32	0.47	0.37
Beheira	2.65	1.21	0.21	1.23
Dakahlia	2.80	1.25	0.52	1.03
Kafr El-Sheikh	2.88	1.22	0.55	1.11
Damietta	2.68	1.33	0.89	0.46
Gharbia	2.37	0.89	0.92	0.56
Average	2.63	1.22	0.52	0.89

Table 8 : Grain Yield per feddan of transplanted rice outside the demonstration fields by method of product disposal in the various governorates, 1982

Governorate	Yield (tons)	Method of Product Disposal (tons)		
		Government delivery	Sold in the the market	Home consumption
Sharkia	1.78	1.29	0.23	0.26
Beheira	2.18	1.20	0.23	0.75
Dakahlia	2.78	1.40	0.62	0.76
Kafr El-Sheikh	2.07	1.12	0.42	0.53
Damietta	2.39	1.38	0.53	0.48
Gharbia	2.49	1.29	0.40	0.80
Average	2.29	1.27	0.41	0.61

THIRD : Value of Output

The value of grain is calculated for all governorates on the basis of L.E. 95.00/ton for government delivery and L.E. 220.00/ton for market sale and for home consumption (The latter is an assumed value, not based on survey data which was however, collected). The value of straw, is calculated using the market price in each governorate.

Tables 9 & 10 report the value of both grain and straw per feddan of transplanted rice.

Total value of output per feddan in the demonstration fields amounts to L.E. 441.94 on the average. The value of grain accounts for about 96.4% of this total.

Table 9 : Value of Output (L.E.) per feddan of transplanted rice within the demonstration fields in the various governorates 1982

Governorates	Grain	Straw	Total
Sharkia	310.20	1.72	311.92
Beheira	431.75	27.94	459.69
Dakahlyia	459.75	21.60	481.35
Kafr El-Sheikh	481.10	5.55	486.65
Damietta	423.35	12.42	435.77
Gharbia	410.15	27.87	438.02
Average	426.08	15.86	441.94

Table 10 : Value of output (L.E.) per feddan of transplanted rice outside the demonstration fields in the various governorates, 1982.

Governorates	Grain	Straw	Total
Sharkia	230.35	2.32	232.67
Beheira	329.60	16.28	345.88
Dakahlyia	439.60	16.16	452.76
Kafr El-Sheikh	351.40	6.09	321.49
Damietta	353.30	9.30	362.60
Gharbia	386.55	30.39	416.94
Average	345.21	12.62	357.83

For non-cooperating farmers, the total value of output, L.E. 357.83/fed, is lower as expected due to the lower yields reported.

Since the average rent per feddan of rice on the national level is L.E. 33.3 (Department of Statistics, Ministry of Agriculture), the net revenue per feddan roughly averages L.E. 254.61 and L.E. 123.77 for cooperating and noncooperating farmers respectively.

Some Limitations of the Survey for consideration

1. Insufficiency of detailed information. Therefore, the questionnaire must be reviewed, and readjusted for data completeness before the coming season.

2. The size of sample in both the governorate and the district should be in proportion to the area planted to rice at both levels.

3. The questionnaire was completed at a relatively late time. Hence the farmer had difficulty in recalling some data especially those related to the amount and cost of inputs.

4. Enumerators were involved in other assignments and did not have adequate time for data collection. In addition, training of enumerators was not sufficient for accurate data collection.

BREEDING PROGRAM

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INTRODUCTION

Presently the dominant rice varieties "Giza 171" and "Giza 172" which were first released in 1977 are grown over 95 percent of the rice area.

Giza 171, a cross betwen Nahda and Calady 40, is grown in Beheira, Gharbia, and Sharkia governorates.

Giza 172, a cross between Nahda and kinmaze, is grown in Kafr El-Sheikh, Dakahlia, Damietta and Fayoum governorates.

Giza 159, (Agami x Giza 14) was released in 1964 with particular advantage of being salt tolerant to be planted in the poor soils and newly reclaimed areas. It is still grown on a very limited area where soil salinity is a problem.

Giza 180 (IR 579-48-1-2) is a high yielding short stature, long grained selection from material introduced from IRRI. It was released in 1977 and is grown on a very limited area because most of the rice mills in Egypt are not suitable for the long grain milling.

BREEDING OBJECTIVES:

The current breeding program aims to develop improvd high yielding varieties possessing one or more of the following traits :

- Short stature for lodging resistance under heavy application of nitrogen fertilizers.
- Pest resistance, in particular blast, brown spot and stem borers.
- Tolerance to soil salinity and alkalinity, and
- Long grain for export.

ACCOMPLISHMENTS:

The work accomplished in 1982 could be summarized as follows :

I. Breeding Materials:

1. 477 new simple and top crosses were made out of which 392 crosses were sent to IRRI to be grown in 1983 winter nursery.

2. The F2 nursery included 139 populations out of which 712 individual plants were selected to be grown as F3 lines in 1983.

3. The pedigree nursery was conducted as follows :

Generation	# lines planted	# plants selected
F3	2545	510
F4	308	79
F5	71	40
Gizcal		
F4	1139	689
F5	690	34

4. The mutation breeding nursery included 241 mutants mostly derived from Giza 171 and Giza 172 out of which 99 mutants were selected.

5. The observational nursery was grown to purify and increase seed of 197 varieties and promising strains.

6. Initial seed increase was carried out for the 51 promising strains which were included in the regional and final yield trials of 1982.

7. The salinity tolerance nursery was conducted as follows:

Generation	# Planted	# Selected
F2	100 populations	477 plants
F3	45 populations	112 plants
F4	251 lines	74 plants
F5	63 lines	4 plants

8. 112 promissing strains were selected from the F5 populations, mutation nursery and IRTP nurseries. These strains will be evaluated for the important milling and cooking quality characteristics to be included in the 1983 preliminary yield trials.

II. IRRI - International Rice Testing Program

The following nurseries were grown and a number of strains were selected from each nursery :

1. Yield nursery - very early (28 entries)
2. Yield nursery - early (28 entries)
3. Observational nursery (350 entries)
4. Arid regions observational nursery (65 entries)
5. Blast nursery (393 entries)
6. Salinity and Alkalinity tolerance (120 entries).

III. Yield Trials:

Performance tests to evaluate selection for medium maturity, early maturity and salinity tolerance including 19 yield trials were carried out at various locations as follows :

No.	Trial	# Entries	Locations
1	Final medium duration	9	Sakha, Gemmiza, Zarzoura Sirw, Fayoum
2	Final short duration	9	Sakha, Gemmiza, Zarzoura
3	Final salinity tolerance	9	Sakha, Sirw
4	Regional medium duration	16	Sakha, Gemmiza, Zarzoura
5	Regional short duration	15	Sakha, Gemmiza, Zarzoura
6	Preliminary medium duration	25	Sakha
7	Preliminary short duration	20	Sakha
8	Preliminary salinity tolerance	20	Sakha and Sirw

Grain yield and some agronomic characters of strains included in final yield trials are shown in Table 1. The table indicates that the following strains are superior over the check varieties in regard to yield dwarfness, early maturity and blast resistance.

Medium Duration (Table 1a):

1. IR 1626-203 (IR 22/IR 24)
2. CR 882-2-2 (CR 265-72/Reiho)
3. CR 951-7-1 (IR 24/CR 265-65)

Short Duration (Table 1b):
4. Reiho (Hoyoku/Ayanishiki)

Salinity Tolerance (Table 1c):
5. CR 587-S-2 (Reiho/CR 260-65)
6. CR 587-S-6 (Reiho/CR 250-65)
7. IR 10198-66-2 (IR 2071-88/N Bokra//IR 2153-26)

The most promising of these seven strains which are in the seed increase program will replace the present varieties, Giza 172, Giza 180, Giza 171 and Giza 159 in three years.

IV. Breeding - Agronomy Trials:
The following three experiments were conducted at Sakha:

A. Crop Intensification Experiment:
The purpose of this study is to inquire into the possibility of increasing the cropping intensity from two crops a year to three crops a year.

Results obtained (Table 2) showed that rice planted in the late summer season after sunflower or early maturing soybean was higher in yield than rice planted after late maturing soybean or rice. The results also showed that one rice crop grown in the normal season (June - October) gave better yield than two rice crops grown from May to November. These results agreed with the previous results obtained in 1980 and 1981.

B. Production per day Experiment:
This experiment was conducted to study the relationship between early maturity and high yielding ability. The experiment included 25 varieties belong to five maturity groups.

Results obtained are shown in Table 3. The table shows that the highest yield and production per day were obtained from the short duration varieties (100 - 110 field days) while the lowest yield and production per day were obtained from the very long duration varieties. Similar results were obtained in 1980 and 1981 seasons.

C. Ratooning Ability Experiment:
A preliminary experiment was conducted to inquire into the variation in ratooning ability of some early maturing rice variety as an alternative to rice double cropping.

Yields of the first crop were ranging between 5.33 - 10.71 tons/ha but the ratoon crop was damaged by rats.

Ratooning ability was investigated for the rice varieties IR 28 and Early Mature Nan Zao 33 in a part of the crop intensification experiment.

Results obtained (Table 4) showed that Nan Zao 33 gave higher ratoon yield than IR 28. However, total yield of Nan Zao 33 from the two crops (8.47 tons/ha) was less than that of one crop of IR 28 (9.12 tons/ha) grown in the normal season.

Table 1 : Yield and agronomic characteristics of rice strains in the final trials - 1982

A. Medium Duration:

No	Strains	Yield Ton/ha		Culm L. cm	Head days	Blast	Milling %
		Sakha	3 loc.				
1	Giza 171	10.57	9.64	109	121	5	71.73
2	Giza 172	11.07	9.21	103	111	5	70.70
3	Giza 180	9.36	9.63	72	110	2	67.30
4	IR 1626-203	11.92	10.65	65	107	2	65.73
5	CR 576-12-4-1	9.29	8.74	64	108	2	69.17
6	CR 882-2-2-2	10.62	9.22	76	108	2	71.33
7	CR 951-7-1-2	11.14	9.98	76	108	2	72.20
8	CR 1028-4-2-2	11.45	9.26	80	108	5	70.13
9	CR 1077-24-1-2	9.64	9.86	76	112	5	72.43
	Average	10.56	9.58	80	110	3.3	70.08

B : Short Duration:

No	Strains	Yield Ton/ha		Culm L. cm	Head. days	Blast	Milling %
		Sakha	3 loc.				
1	Giza 172	9.76	9.24	101	112	5	70.86
2	IR 28	8.93	8.85	72	99	2	68.60
3	Reiho	10.93	9.32	79	107	2	72.17
4	IR 50	8.53	7.73	77	100	2	67.17
5	IR 9129-169	10.25	8.55	80	98	2	67.07
6	IR 9209-181-2	8.42	8.48	69	96	1	67.57
7	CR 900-9-2-1	10.12	8.96	76	100	4	71.27
8	RNR 7306	8.89	7.99	71	98	1	66.87
9	IR 19746-28-2-2	7.70	7.54	64	94	2	68.73
	Average	9.28	8.51	77	100	2.3	68.92

C : Salinity Tolerance:

No	Strains	Yield Ton/ha		Culm L. cm	Head days	Blast	Milling %
		Sakha	Sirw				
1	Giza 159	7.24	7.61	114	114	8	70.80
2	Giza 172	7.45	7.51	111	115	5	72.40
3	CR 587-S-2	7.31	6.71	96	109	-	73.30
4	CR 587-S-6	7.55	7.03	72	114	-	72.20
5	IR 10198-66	5.67	10.33	109	109	2	67.80
6	CR 948-2-2	7.50	6.48	85	111	2	73.70
7	CR 1079-24-1	7.31	7.62	84	110	2	72.30
8	CR 1287-S-2	8.45	6.41	86	112	2	72.90
9	CR 1153-S-6	6.38	9.88	92	110	1	67.80
	Average	7.21	7.69	94	112	3.1	71.47

Table 2 : Yields of sunflower, soybean and rice in the crop intensification experiment (Sakha - 1982)

C.P. No.	Early Summer (April-July)		Late Summer (August-November)	
	Crop	Yield Ton/ha	Crop	Yield Ton/ha
1	Sunflower (Miak)	-	Rice (IR 28)	6.190
2a	Soybean (S 1346)	-	Rice (IR 28)	4.210
2b	Soybean (Clark)	-	Rice (IR 28)	1.050
3a	Rice (IR 28)	7.550	Rice (IR 28)	0.903
3b	Rice (Nan Zao 33)	5.640	Rice (IR 28)	3.070
4a	Rice (Giza 172)			12.540
4b	Rice (IR 28)			9.120

Table 3 : Production per day for rice varieties with different maturity periods (field days) Sakha-1982

Maturity Group	# Varieties	Actual duration (field days)	Yield Ton/ha	Production per day kg/ha
1. Very short duration (less than 100 days)	6	93	6.72	72.00
2. Short duration (100 - 110 days)	7	104	8.69	83.67
3. Medium duration (111 - 120 days)	6	116	7.99	68.96
4. Long duration (121 - 130 days)	5	124	7.88	63.36
5. Very long duration (more than 130 days)	1	131	6.02	45.95

Table 4 : Yield of the first and ratoon crops of IR 28 and Nan Zao 33 (Sakha - 1982)

Variety	First Crop		Ratoon Crop		Total	
	Yield Ton/ha	Duration*	Yield Ton/ha	Duration*	Yield Ton/ha	Duration*
Nan Zao 33	5.640	100	2.830	77	8.470	177
IR 28	7.550	114	2.170	70	9.720	184
IR 28	Check (Normal season)				9.120	111

* Number of field days

EXTENSION PROGRAM

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The main objective of the extension program "Mabrouk 4" is to increase the national rice production by :

1. Establishing a strong link between research and developing programs to speed up the transfer of research information to rice farmers by effectively organized research and extension on a commodity basis.

2. Identifying rice growers problems and suggesting suitable solutions to eliminate the barriers to goal achievement.

Transfering Research Results to Farmers

During 1981 crop season, the subject matter specialists (S.M.S.) trained 20 extension workers who conducted seven different applied research trials in 20 locations, and produced 1500 feddans of demonstration rice fields in 24 locations.

The results obtained from the trials and demonstration fields clearly indicated the unusual potential Eqypt has for increasing rice production. These demonstrations provided an opportunity for about 30,000 farmers to participate in a large number of field days and learn the new technology. It also illustrates the effectiveness of these 20 workers in mastering their job. In 1982 they became rice production advisors (R.P.A.)

The following is the new package of technology derived from the applied research trials :

1. Plant the nursery during the first half of May, using 40 kg of certified seeds per feddan.
2. Make dry applications of nitrogen to both nursery and main field.
3. Apply zinc sulphate to the nursery, 1 kg/kerate, during talweeting.
4. Use chemical weed control in both nursery and main field.
5. Soak and incubate seeds before sowing.
6. Transplant 4 - 5 plants per hill, of thirty old seedlings at regular spacing (20 x 20 cm)
7. Use good water management.
8. Drain the field two weeks before harvesting.

9. Harvest the rice crop when 85% of the grains of the upper half of the panicle turns yellow (straw color).
10. Place the rice bundles in heaps with panicles upwards until completely dry.
11. Thresh carefully and remove mud balls from the grain.

During 1982 crop season, a national production campaign was orgainzed to disseminate the above information to large numbers of rice farmers. The following activities were accomplished in achieving this objective :

1. Training Sub-Program:
The training sub-program was carried out in the following five steps :
First step: Training of Rice Production Trainers:
Fifty additional extension workers were selected to join the rice extension team. They completed two weeks of intensive training from January 16 - 30, 1982 at Sakha along with the 20 rice advisors. One additional was added to each of the 53 rice producing district. Two to three rice production workers were assigned to each of the rice advisors to form "Buddy system" for each sector.

Second step: Six major orientation meetings were held in the capital of each governorate under the chairmanship of the corresponding undersecretary. The participants of these meetings were the district directors, their associates and the extension inspectors. Plans were developed during those meeting to hold 53 district meetings for cooperative directors.

Third Step: The S.M.S. held several orientation meetings in each governorate immediately after the Second Rice Conference. These meetings were organized to accomodate the pyramid system of the agricultural officers and to inspire and persuade farmers to join "Mabrouk 4". The philosophy of the program and the scientific basis of the improved practices were explained.

Fourth step: The rice extension advisors and trainers, held meetings at the village level, with the help of village extension agents and cooperative directors, to teach the farmers how to adopt the package of new technology.

Fifth Step: Seed Purity Training in order to obtain rice-seed of known varietal purity from the demonstration plots the seed production and extension teams cooperated in training 94 personnel, selected from the seed production board. Six training sessions were held in the capital of each governorate to teach

workers the proper roguing technique so that off-type plants could be removed from seed fields.

1. Extension Aid Materials:

A. Letter to the farmer

A letter signed by the Minister of Agriculture was sent to each of the one half million rice growers persuading him to join the "Mabrouk 4" program. It briefly explained the new low cost package of technology which should increase rice yields by one ton when properly followed.

B. Bulletin:

Fifteen thousand copies of the bulletin explaining details of the production package and the scientific background for each step were distributed to cooperative directors, extension agents and leading farmers.

C. Flip Charts:

Three hundred copies of plastic flip charts were developed to help trainers effectively present result at village meetings. These visual aids explained to the farmer how he could obtain higher net returns by adopting the new package of technology.

2. Implementing the adoption sub-program

Village meetings were held in 1416 Co-operatives to explain new technology to the farmers and to convince him the need for adopting to the entire package. After the village meeting, an influential and knowledgable farmer who understood the package and who possessed desirable leadership was selected from his home village to produce the classroom demonstration field. It was necessary for him to plant early so that other farmers could observe and follow his porcedures. The co-operatives directors and the village extension agent invited other farmers to study the operations in this classroom from seed to seed. The distribution of class rooms in 1416 villages are in Table 1.

Table 1 : Class rooms conducted in the Co-op. of rice producing governorates, (Adoption Sub-Program, 1982 season).

Governorate	Number of		% Class Rooms	Yield t/ha		% Increase in yield	% Efficiency
	District	Co-op		Class Rooms Fields	Common Fields		
Kf. Sheikh	9	222	88	7.7	5.7	34	10
Dakahlia	12	398	92	8.5	5.2	63	22
Damiatta	5	73	93	8.1	5.9	28	14
Sharika	11	313	89	8.3	6.3	32	38
Beheira	10	254	83	7.6	6.2	23	25
Gharbia	5	156	94	9.0	6.2	46	23
	Grand total		Over-all		Means		
TOTAL	53	1416	89	8.2	5.9	39	22

The area of rice in 11% of the villages was not large enough to conduct class-rooms. Therfore, they were conducted in only 1266 villages. The total rice acreage in the rice cooperatives, where the classrooms were conducted, were 300,965 hectares. While the acreage of those farmers who adopted the new package of technology, was 67,354 hectares. Thus based on acreage only 22% of the classrooms could be considered effective the first year. This was due to:

a. Small farmers considering it too risky to adopt the package of technology the first year.
b. Some cooperatives did not receive zinc sulphate and/or saturn at early enough for participating farmers to imitiate the practice.

The 8.2 t/ha mean rice yields of the class rooms was 39% higher than the 5.9 t/ha yield of the average rice farmer. This dramatic increase in yield convinced even the most hesitant farmers to adopt the new package in 1983.

The effort of the Credit Bank in distributing inputs should be integrated with the national compaign activities to accomodate farmers who desire to join the program. Also, the buddy extension system in each governorate should be accelerated to effictively distribute the rice inputs.

3. Demonstration Sub-Program

It has been demonstrated in each rice producing district that contiguous rice fields are ideal for rice seed production. The seed crop in these fields will be used as certified seeds for the 1983 season. Farmers who followed the package of recommendations were not charged for the input

costs of 40 kg. of certified seeds, one liter of saturn, 2.5 kg. of zinc sulphate and 5 LE for plowing each feddan. Distribution and production of the demonstration fields in the six governorate are listed in Table 2.

The total planned acreage for the 53 demonstration fields was 8595 hectars. The total number of farmers who joined the demonstration sub-program was 11661. The total successfully established acreage was 93% of the planned acreage and accepted fields which could be used as seed production fields were 84% of the total established acreage.

4. Adaptive Research Sub-Program

To improve the package of new technology for the 1983 rice extension season and to aquaint the extension team with up-to-date rice technology, three applied research trials were conducted in two locations as follows:

a. Varietal Applied Research Trial (Table 3).
Reiho and Giza 171 show their superiority over the varieties: Giza 172, Giza 180, IR 1626-203 and Cr 882-2-2-2. Reiho has been recommended to replace Giza 172.

b. Weed Control in Direct Seeded Rice (Table 4).
The following chemicals gave the best results to control weeds in direct seeded rice:
Saturn 50 (1 l/fed) after talweeting, or
Saturn 50 + Ronstar 12 (0.5 + 0.5 L/fed.) after talweeting.

c. Weed Control in Transplanted Rice (Table 5)
Saturn 50 or Ronstar 12 (1 L/fed) are effective after talweeting to control weeds in transplanted rice.

Table 2 : Demonstration Field Production of Each Governorate, Demonstration Sub-program, 1982 Season.

Governorate	No.of Demons. fields	Variety	Actual Yield t/ha Max.	Mode	Average	Sampling yield t/ha Dem.	Control	% increase
Kf.Sheikh	1	Reiho*	13.1*	9.9*	10.2*	12.4	6.5*	89
	8	G.172	10.7	8.5	8.0	9.5	5.8	66
Damietta	5	G.172	10.1	8.5	8.1	9.8	5.8	67
	1	Reiho**	9.5**	8.5**	6.5**	7.3**	5.4**	36
Dakahlia	1	Reiho*	10.2*	8.5*	8.7*	9.3*	5.0*	8.1
	10	G.172	11.9	8.5	8.4	9.0	6.5	4.1
Sharkia	11	G.171	9.5	8.5	8.8	9.9	6.3	5.6
Behera	10	G.171	10.7	9.9	8.9	9.9	6.5	52
Gharbia	6	G.171	10.8	9.9	8.9	9.6	6.2	5.3
Over		Reiho	13.1	9.9	8.5	9.6	5.6	71
All		G.171	10.8	8.5	8.8	9.6	6.4	54
Mean		G.172	11.9	8.5	8.1	9.3	6.1	58

* Manually Transplanted

** Mechanically Transplanted

Table 3 : Variety Applied Research Trial (Adoptive Research Sub-program, 1982 Season).
Grain Yield, Ton/ha

Variety	Locality		
	Sharkia	Beheira	Variety
Giza 171	9.6 a	7.4 e	8.5 ab
Giza 172	8.5 bc	7.7 cde	8.1 b
Giza 180	7.4 de	8.3 bc	7.9 b
Reiho	8.9 ab	9.0 ab	9.0 a
IR. 1626-203	7.0 e	8.4 bc	7.7 b
Cr. 882-2-2-2	7.1 e	8.2 bcd	7.7 b
	n.s.	n.s.	
Locality Mean	8.1	8.2	

There is no significant differences between means with the same subscript.

Table 4 : Weed Control in Direct Seeded Rice

Treatment	Total Weeds Ton/ha	% Control	Grain yield ton/ha	% Increase Decrease
Control	21.2 a	0.0	2.5 f	-63
Handweeding Twice	5.5 c	74	6.7 d	00
Handweeding all season	0.6 d	97	7.9 c	18
Sat. 4.8L/ha 7 D.A.S.	1.6 d	92	9.0 ab	34
Sat. 2.4L/ha A.T.	1.5 d	93	9.2 a	37
Sat.1.2L+Ron.1.2L ha/A.T.	1.5 d	93	9.3 a	39
Ron. 3.6 L/ha A.T.	1.5 d	93	9.0 ab	34
Ron. 2.4 L/ha A.T.	1.9 d	91	8.4 bc	25
Drep. 7.7 L/ha D.A.S.	5.6 c	73	6.2 d	-7.5
Drep. 5.4 L/ha A.T.	4.1 c	80	6.8 d	1.5
Drep. 4.2 L/ha A.T.	9.4 b	56	5.3 e	-22

A.T. = After talweeting
D.A.S. = Days after sowing
% increase of decrease in grain yield compared with handweeding twice.

Table 5 : Weed Control in Transplanted Rice

Treatment	Total Weeds Ton/ha	% Control	Grain yield ton/ha	% Increase Decrease
Control	5.50 a	00	6.7 f	-49
Handweeding Twice	0.90 c	84	10.0 de	00
Handweeding all season	0.05 de	99	11.4 ab	12
Sat. 4.8L/ha 7 D.A.T.	0.30 d	95	11.4 ab	12
Sat. 2.4L/ha A.T.	0.14 de	97	11.4 ab	12
Ron. 4.8L/ha D.A.T.	0.00 e	100	11.6 ab	14
Ron. 3.6L/ha A.T.	0.02 e	99	11.7 a	15
Ronstar 2.4 L/ha A.T.	0.14 de	97	11.5 ab	13
Drep. 7.7 L/ha 7 D.A.T.	0.18 de	96	10.9 abc	8
Drep. 6.5 L/ha A.T.	0.18	96	9.8 e	- 2
Drep. 5.4 A.T.	0.70 c	87	10.8 bcd	7
Drep. 4.2 L/ha A.T.	1.31 b	69	10.4 cde	4

D.A.T. = Days after transplanting
A.T. = After talweeting
% increase or decrease in grain yield compared with handweeding twice.

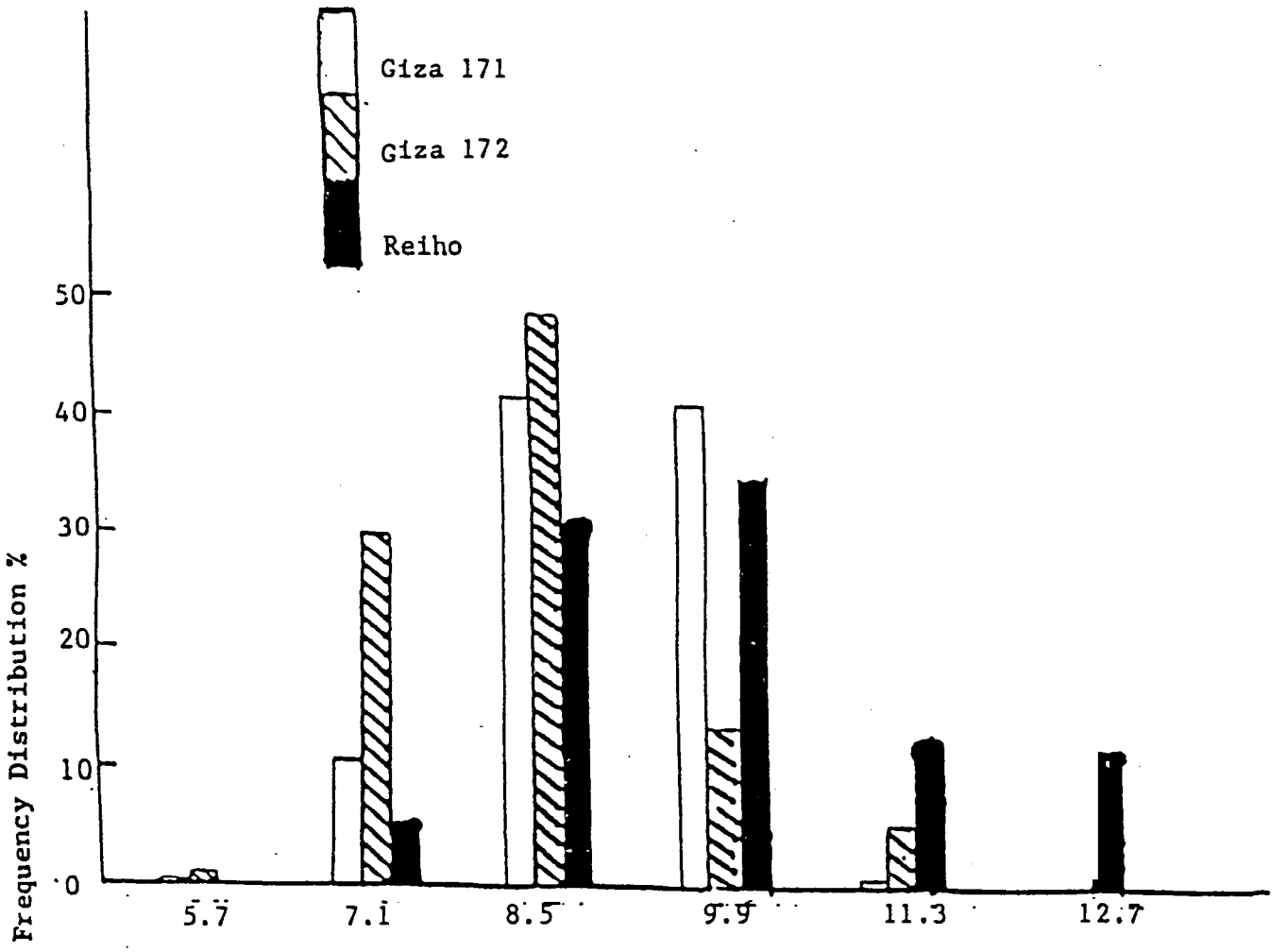


Fig.1 Frequency Distribution of Farmersm Participating in Mabrouk 4 Program according to varieties and yields (1982)

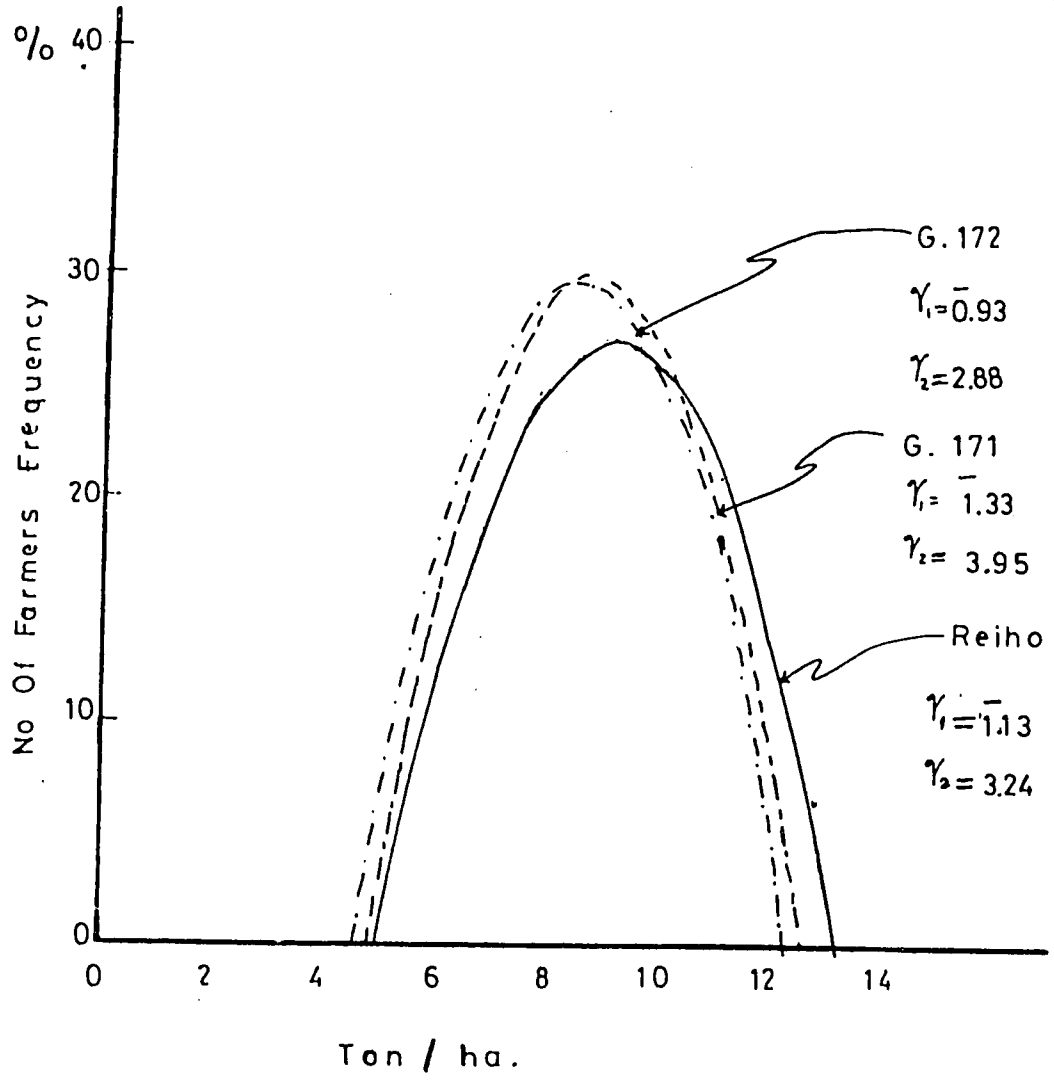
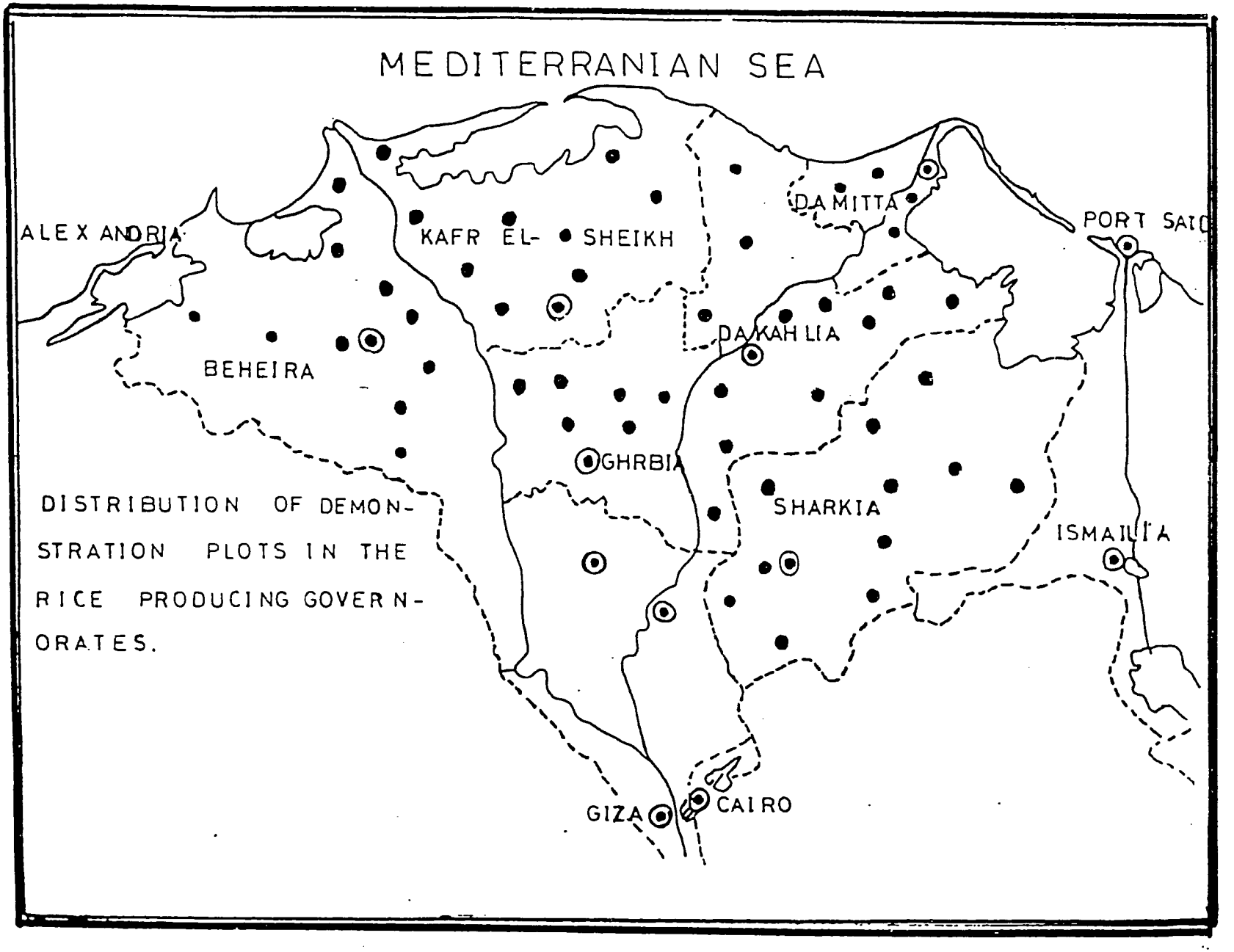


Fig.2 : No. Of Farmers Frequency Distribution And Production Of Rice Varieties In Demonstration Fields.



DISTRIBUTION OF DEMONSTRATION PLOTS IN THE RICE PRODUCING GOVERNORATES.

MECHANIZATION

M. Parker
A. El-Serafi

FOREWORD:

This report describes the work of the Mechanization element of the Rice Project for the period January 1, 1982 to February 21, 1983. Included is a review of the present status of Project-designed equipment in Egypt along with guidelines for preparing adaptive equipment designs. Progress and plans for developing improved items of machinery and for providing mechanization support for cultural practices experiments are noted.

The previous engineer completed his tour of duty during the early part of this period. Never-the-less, a considerable amount of equipment development was accomplished during the months just preceeding the arrival of the present engineer in October 1982. Kinds of machines introduced included transplanters, direct seeders and threshers.

The work was continued by Project personnel and a number of machines were tested in field, problems noted and in some instances improvements were made.

Of special note, during this period, was the completion, by Project personnel, of experiments in cultural practices from which some useful information on land preparation methods was derived.

It is planned to continue the work which appears to offer the best chance for solving the small farmers mechanization problems.

1. INTRODUCTION:

The objective of the Rice Mechanization Project is to improve the incomes and economic welfare of small rice farmers by development and introduction of adaptive, low-cost, labor-saving and thus profit enhancing rice farming machinery and cultural practices.

To reach this objective, the Project will (a) develop designs of improved farm machines and assist manufacturers to fabricate production models for sale to farmers, (b) provide mechanization support to research specialists to develop improved technology and to training specialists to extend the benefits to farmers through demonstrations on the farmers own fields.

Since adaptive mechanization is more readily applied to production of the new short strawed rice

varieties, it should become a strong incentive to farmers to adopt these more productive varieties and the farming practices which go with them.

Mechanization will thus contribute directly to the goal of the Rice Production and Training Project which is to increase production and quality of rice in Egypt.

II. CRITERIA FOR DEVELOPING ADAPTIVE MACHINES:

To assure success, machinery designed for small farmers should satisfy these conditions :

1. Meet the small farmers cultural practices needs, economic resources, risk considerations and preferences.
2. Use the proven farm machinery principles in simple, low-cost, easy to maintain designs which are attractive to manufactures.

The difference in the size of farms in Egypt indicates a number of machinery types and capacities.

The small farmer who uses hand and animal power needs improved tools or attachments for tillage, weed and pest control, fertilizer placement and seeding. Economic resources limit the cost and number of machines which may be considered. Implements and attachments must be effective and low in cost.

Once the farmers are convinced that new technology means more income, effective attachements to the present implements may be enough to encourage them to adopt more productive farming methods.

Farmers and farm service contractors who own tractors need improvements to their large capacity machinery for more economic use of tractor power and to expand the usefulness of their services to farmers.

Except for harvesting and threshing machinery, large investments in completely new and different machines may not be needed or accepted by them.

Because a majority of farmers in Egypt get the use of tractor power by hiring the services of a tractor owner, the Mechanization Project is developing a system of attachments to the basic chisel plow to provide these additional services: Seeding, fertilizer placement at recommended rates and depths, land leveling and seed-bed finishing.

The complete attachment system may be transported on the chisel plow or trailed behind it on a single trip to the work area.

Changes in cultural practices may be needed to assure success of certain machines such as transplanters and seed drills.

Some machines require special attention to the cultural methods which were developed along with them.

The role of mechanization in agricultural development is to support the work of development agencies both public and private and especially the researcher, the extension (farmer trainer) and the farmers themselves to develop, teach and apply more productive farming methods.

Adaptive mechanization is thus an important support element in a complete agricultural development system without which the farmer may not be able to apply the more productive methods developed and introduced by the research and extension agencies. Mechanizatiopn alone, however, may not contribute much to increased production.

III. DEVELOPING ADAPTIVE FARM MACHINERY AND PRACTICES: Adaptive technology in machinery and farm practices implies the careful selection of rice production machinery and the related cultural methods already developed in Egypt and from other rice-producing countires to be tested, modified and further improved if needed, toward the ultimate goal of perfection.

A major resource for design technology is the International Rice Research Institute (IRRI), Los Banos, Philippines.

Completely new inventions are not needed to achieve this. The vast, world knowledge of machinery principles and systems can supply the ideas to be applied either in the original form or modified as needed to solve specific problems. The results can be rapid and economical benefit to the farmers without the large expenditure of time and other resources required by long term research and development of completely new ideas.

Well designed adaptive machines should give a level of performance which is acceptable for research in cultural practices and for the farmer.

Use of farmer and small manufacturer oriented designs is a practical way to encourage the movement of machinery ideas and recommended practices from the research and extension agencies through the manufacturer and on to the farmer. It also increases

the farmers confidence in his ability to get similar results because the implements used in the research can also be available to him.

The construction of the Project-developed seed metering device is an example of this method. This semi-precision seed metering unit uses a very old and dependable principle which was refined by IRRI for direct seeding of pre-germinated rice. The Project-developed adaptation permits multi-crop use in single or multi-row planting of rice and other common crops grown in Egypt.

Applications of this seed metering device provide for different levels of mechanization.

The unit is simple and easy to fabricate. The capacity to plant other crops in the rice farming system should be attractive to farmers, farm service operators and fabricators.

IV. PROGRESS IN MECHANIZATION:

Work during the period October 5 to December 31, 1982 has been directed toward finding solutions to the rice mechanization needs which have been consistantly identified as priorities. These include new machines or improvements to the following : (a) Transplanters; (b) seeders, (c) reapers, (d) threshers, (e) land preparation and leveling, (f) fertilizer applicators and (g) water pumps.

A) Transplanters and Seed Drills:

1. The IRRI 5-row manual transplanter has not given satisfactory service in previous seasons. Factors other than the machine such as operator technique, adjustment or soil conditions may have caused the troubles. The machine has been checked for manufacturing specifications and no important errors were found. Seedling mats are being prepared by the Agronomy section so the machine can be operated under field conditions and the probable cause of the reported troubles noted and corrected. this should be completed by early spring, 1983.

2. Seed Drills: Emphasis is placed on developing a multi-crop seed drill attachment for the 7-tine chisel plow. This is a low-cost attachment to adapt the chisel plow to row planting of rice, wheat and other common crops designed to be attractive to the farm service contractor. Row spacing may be adjusted from about 10 cm to 90 cm. Working width is about 1.5 meters. Rate and depth

of seeding is precisely adjustable.

Other seed drills planned include an attachment for the animal drawn plow and a hand-push one row seeder for use in calibrating the Project seed metering device and for use in research experiments in cultural practices.

B. Threshers: The original IRRI thresher cylinder design does not perform well because the long straw which is common in Egypt, loops around the cylinder teeth and ultimately jams the cylinder.

One portable machine was modified by use of bolt-on rub bars on the cylinder and rubber belt extensions to the straw throwers. Engine power was increased from 5 to 7. In tests, rice having partially dry straw and one meter in length was threshed without diifficulty.

Egypt is believed to be on the threshold of a dramatic change from production of long straw rice varieties to short stature varieties and when this happens, the original IRRI-designed cylinder equipment may be used. The result will be a marked improvement in threshing efficiency and another incentive for farmers to adopt the new varieties.

1. The CRS Thresher: The Catholic Relief Service (CRS) Egypt has developed a multi-crop thresher based largely on the IRRI-TH-8 thresher principle but with the extensive modifications needed to thresh, winnow and chop the residue of the common seed crops grown in Upper Egypt. About 70 threshers are in use by owner-operators who are engaged in a profitable farm service business.

Custom threshing of rice and wheat in the Delta using similar type portable thresher should be equally profitable.

2. The Project Thresher: The Project has acquired a new CRS thresher equipped with a 12 HP Disel engine and work is in progress to adapt it for threshing long straw rice by replacing the drum type cylinder with an open type cylinder equipped with bolt-on rub bars. Straw choppers used for wheat and other crops are easy to remove.

The completed thresher with these simple, low cost adaptations will closely resemble the IRRI-TH-8 thresher and a similar high quality of performance is anticipated. The machine will be ready for extensive field work during the 1983

wheat season.

3. Small-Farmer Threshers: For a safe efficient "hold on" thresher for the small farmer, an engine driven version of the Japanese type "hold on" thresher may be constructed with two or more driven by the same engine.

C. Land Preparation and other Cultural Practices Equipment:

1. Chisel Plow and Attachments: The Project has acquired a good quality locally made 7-tine chisel plow for use in development, training and demonstration of tillage practices and other operations.

Four innovations are currently planned for this implement:
(a) Twisted shares, easily made by the blacksmith may result in better seed bed preparation.

(b) A flexible harrow to be pulled behind the chisel plow as an implement team in a once-over chiseling and harrowing operation.

(c) A grain drill attachment using the Project-designed seed metering device and other components.

(d) A fertilizer applicator attachment for multiple line deep placement of fertilizer at recommended rates and depths of placement.

2. Land Leveling and Smoothing Equipment:
(a) The Project has recently acquired a locally made tractor operated planing scraper which effectively does small scale earth moving and smoothing operations in small fields.

Another valuable use for this machine is to finish and smooth seed beds to a higher degree of precision and with fewer trips over the field when compared with the plank leveler commonly used.

(b) Plans have been made for a small scale precision land leveler which uses the tractor 3-point hitch configuration to extend the effective length of the leveler to about 6 meters. A local fabricator is ready to begin construction.

The design principles of this machine may be applied to the chisel plow as an integral attachment to provide precision leveling, smoothing and seed bed preparation services at a greatly reduced implement cost.

D. Water Pumps:

The IRRI-designed axial-flow pump has given excellent service on the Rice Research Center during the past season.

Two Cairo fabricators are working on prototype models. Units can be made ready for the 1983 season if they are needed.

The pump is considered fully proven and ready for introduction to fabricators and farmers.

E. Reaper:

It is recommeded that reaper development be started by arranging to purchase from the Philippines a one-meter power tiller mounted reaper of the most recent IRRI specifications to be ready for the 1983 harvest season. This smaller machine can be used to develop solutions to operational problems if any should occur.

IV. Cooperating Agencies:

1. The resources of the Ministry of Agriculture shops are available for construction and reproduction of prototype machines.

2. The Engineering and Industrial Design Development Center, (EIDDC) 203 Pyramids Road is working on 3 IRRI axial-flow pumps.

3. Three private sector firms are producing adapted models of IRRI-designed machines.

4. The mechanization specialist is cooperating with the CRS engineer on thresher development, an activity which should result in benefits to both programs.

V. Workshop Facilities at the Rice Research and Training Center:

Facilities for prototype construction, adaptation and repair are being developed at Sakha. Basic shop machines and tool resources are being improved and the smaller prototype equipment is being fabricated there.

Of special note is the assignment of certain persons from the shop staff to work for the project.

VI. Research in Rice Mechanization at Sakha has been hampered by lack of staff members having mechanization experience. This problem is being addressed and substantial mechanization support will be ready for the 1983 growing season.

A. All new machines and adaptations will be evaluated by means of field performance observations.

Evaluation guidelines follow the recommended practices for the operations being studied. Machines are adjusted or modified, if necessary, to get an acceptable level of performance.

This work will be carried out in consultation with appropriate members of the research staff. The purpose of this procedure is to develop farmer and small shop oriented machinery designs which provide for a practical level of performance at an affordable cost.

The practice of designing to use proven farm machine principles greatly shortens the development period and some of the implements and attachments should be ready for introduction to manufacturers and farmers during the 1983 season.

B. Mechanization support for experiments in cultural practices will be provided by the Mechanization Project.

C. Technical Assistance to Manufacturers: Technical assistance in design, development and testing of prototype equipment is being provided to interested private firms and volunteer agencies.

A. PLANT PATHOLOGY

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INTRODUCTION

One of the main objectives of the plant pathology program has been to cooperate with the plant breeders to produce improved rice varieties that are resistant to the important diseases which attack rice in Egypt. This objective requires periodic survey for diseases in the different rice governorates, and also the collection of disease samples for identification and isolation of different strains and races of the pathogens, and propagating these races for use in screening breeding lines and varieties in the blast and brown spot nurseries.

In addition, other studies were conducted concerning additional methods of disease control such as chemical treatments, and also the effect of different fertilizer levels and times of application upon disease development. Moreover studies were made on the epidemiology of blast and brown spot diseases, and also on the effect of disease on crop loss.

Disease survey

Results of the rice disease survey in the different rice growing governorates showed that the amount of brown spot disease was negligible. The level of leaf blast infection was also quite low but the severity of neck infection was variable and was as follows :

Kafr El-Sheikh	: rare - 5%	Behera	: 3 - 15%
Dakahlia	: 5 - 15%	Sharkia	: rare - 25%
Gharbia	: 5 - 10%		

This range in percent infection was due to the distribution of rice varieties with differing resistance in the various governorates with the highest rate of infection on Giza 159. Individual plants showing symptoms of white tip disease were found among the Rice breeding lines and microscopic examination of the seeds revealed nematodes.

Identification of physiological races

Specimens of blast infection collected during 1980 and 1981 were used for race identification in 1982. Identification was made using the 8 international rice blast

differential varieties. In addition, 12 Japanese selections and 4 Egyptian varieties were used as supplementary differentials. Results of these tests revealed the existence of 15 races, 6 of which were present in Egypt in previous years (Table 1). The use of the supplementary differentials in 1980 showed that three of these races were heterogeneous and could be further divided into six sub-races (Table 2) and in 1981 four could be divided into ten sub-races (Table 3).

Screening varieties and breeding lines for resistance to blast and brown spot

Project breeding lines, including the irradiated material, along with two other selected collections, Observation Blast nursery and the International Rice Blast nursery, were screened for blast and brown spot resistance at Sakha, Gemmeiza and Zarzoura stations. Blast infection resulted from artificial inoculation whereas brown spot occured under natural conditions except at Zarzoura. A summary of the results of the tests is presented in table 4. Out of 197 entries tested in the observation nursery 77 were resistant to blast and showed a range of resistance to brown spot (Table 5). The tests of the reaction of commercial varieties to blast races showed that :

Present cultivars

Giza 180 - Resistant to all races tested.
Reiho - Resistant to all races except race IC-14
Giza 171 - Resistant to some races and susceptible to others.
Giza 172 - Resistant to some races and susceptible to others.
Giza 159 - Highly susceptible to all races tested.
IR 1626-203 - Resistant to all races tested.

Other IRRI lines resistant to all races tested

IR 20, 22, 24, 26, 28, 30 and 36

Old Cultivars

Nabatat Asmar - Resistant to all races tested.
Arabi - Resistant to all races tested.
Nahda - Resistant to some races and susceptible to others
Sabieny - Susceptible to all races tested.
Yabani 15 - Susceptible to all races tested.

Apparently there is ample blast and brown spot resistance to current races available at present.

Chemical control

In this study the fungicides Beam, Benlate, Hinosan, Kitazin and Tilt were evaluated for their efficacy in controlling blast on Giza 159 and brown spot on Giza 180. Kitazin was applied to the plots as granules and the others as sprays. In the blast test, plots were inoculated with a composite of races whereas with brown spot inoculation was by natural means. The results showed that all the fungicides except Tilt significantly reduced leaf and neck blast infection with apparent corresponding yield increases (Table 6). However, the yield increases over the control were statistically nonsignificant due to wide replicate variability due to severe rat damage. The results of the brown spot test showed no differences between treatments for either disease control or yield due to an overall low level of infection.

Blast loss assessment

In this experiment the fungicide Beam was applied as separate sprays one, two and three times to the blast susceptible variety Giza 159. All plots were inoculated with a composite of blast races. The amount of leaf and neck blast that developed was measured along with yield. Results of the test showed that two to three applications of Beam reduced blast proportionally but the corresponding yield increases were not statistically significant, again due to in plot rat damage (Table 7).

Epidemiology of blast disease

Three hygrothermographs were stationed in rice plots at Sakha, Gemmeiza and Alexandria for recording daily temperature and relative humidity. Analysis of the Data showed consistantly higher relative humidity at Gemmeiza which may partially explain the greater severity of blast at this location (Table 8). Furthermore, the consistantly lower relative humidity at Alexandria, particularly during the critical month of September, may partially explain the low infection at this location (Table 8).

Effect of nitrogen rate and timing on blast development

This Experiment was a repetition of last year's test except only one variety was used instead of three, the blast susceptible Giza 159. Three levels of nitrogen fertilizer were used; 30, 60, and 90 kg/feddan applied at 6, 12 ad 24 mm Internode Elongation in all combinations.

Increased levels of blast occured with increased levels of nitrogen application. Delay in application resulted in progressively less disease. (Table 9).

Table 1 : Summary of physiologic races of *Pyricularia oryzae* identified in Egypt during 1977 - 1981

1977	1978	1979	1980	1981
IA 5 IA 13	IA 77 IA 87 IA 128	IA 28 IA 87	IA 17 IA 57 IA 64 IA 121	IA 116
IB 6 IB 55	IB 1 IB 4 IB 9 IB 31	IA 28	IB 32 IB 34 IB 57 IB 59 IB 62	
IC 5	IC 19 IC 21 IC 26	IC 19 IC 26	IC 14 IC 27 IC 30	IC 17 IC 20 IC 1
ID-5 ID-6			ID 5	ID 1 ID 9 ID 54
IE 1 IE 2	IE 1 IE 7 IE 8	IE 1 IE 7		IE 1 IE 2 IE 5 IE 6
IF 1	IF 4		IF 1 IF 2 IF 3	IF 1 IF 2
IG 1	IG 1	IG 1	IG 1 IG 2	IG 1
	IH 1	IH 1		IH 1
TOTAL 11	16	9	18	15

Table 2 : Subraces of *Pyricularia Oryzae* identified by using supplementary varieties (1980)

Variety	Races and subraces & reaction					
	IH 1		IE 1		IA 87	
	a	b	a	b	a	b
Nahda	S	S	S	S	S	S
Agami ml	R	R	R	MR	R	R
Arabi	R	R	R	R	R	R
Giza 159	R	R	S	S	S	S
Giza 172	R	R	S	S	R	S
Giza 180	R	R	R	R	R	S
Sabieny	S	S	S	S	S	S
Lacrose	-	R	S	-	S	S
Chokoto	R	S	S	R	S	S
Aichi Asahi	S	S.	S	S	S	S
Te - Tep	R	R	R	R	R	R
Designation	IH-1a	IH-1b	IE-1a	IE-1b	IA-1a	IA-1b

Table 3 : Subraces of *Pyricularia oryzae* identified by using supplementary varieties (1981)

Variety	Races and subraces and Reaction									
	IE - 1			IE - 2			IF - 1		IF - 2	
	a	b	c	a	b	c	a	b	a	b
Aichi Asahi	R	S	R	R	R	S	R	S	S	R
Chin 2	-	-	-	S	R	S	-	-	-	-
K 1	S	R	R	-	-	-	-	-	-	-
Isuyuaka	R	S	S	-	-	-	R	S	-	-
K 59	S	R	S	-	-	-	-	-	-	-
Fujisaka	-	-	-	R	S	R	-	-	S	R
Fukunishiki	-	-	-	S	R	S	-	-	-	-
K 60 (Pik P)	-	-	-	-	-	-	S	R	-	-
Designation	IE - 1a			IE - 2a			IF - 1a		IF - 2a	
	IE - 1b			IE - 2b						
	IE - 1c			IE - 2c			IF - 1b		IF - 2b	

Table 4 : Summary of blast reactions of rice varieties and breeding lines inoculated in nurseries at Sakha, Gemmeiza and Zarzoura in 1982

Nursery & Location	Type of Infection* 1-2	3	4-9	Absent	Total Plants Tested
Observation Nursery					
Sakha	133	11	50	3	197
Gemmeiza	130	11	50	6	197
Zarzoura	136	5	51	5	197
IRRN Nursery					
Sakha	269	22	54	48	393
Pedigree Nursery					
Sakha	1052	82	448	770	2352
Radiation Nursery					
Sakha	1	3	51	1	56

* 1 - 2 = highly resistant
3 = moderately resistant
4 - 9 = susceptible

Table 5 : Brown Spot reactions of Blast resistant varieties and lines grown in disease nurseries at Sakha, Gemmeiza and Zarzoura. Reactions are predominant reactions recorded at all three locations.

Entry	Brown Spot Natural	Brown Spot Artificial**	Blast Artificial*
Kim Rad F 87	3	5	2
YNA 282	3	3	2
YNA 223 (pi No 1)	1	2	2
Arabi	4	4	2
IR 1516-246	1	1	2
Zagazig 1	5	6	2
IR 8	4	4	2
IR 20	3	3	2
IR 22	3	3	2
IR 24	3	3	2
IR 26	3	6	2
IR 36	1	3	2
Fri 346	1	1	1-2
Ratna	3	3	2
IR 2003-P5-3-2x	2	4	2
IR 480-5-1-9-2	1	3	1
BRI 165-6-7	3	6	2
BRI-1-13-B55	5	5	2
IR 2066-P4-5-2	1	4	1-2
IR 2016-P4-4-3-5	3	4	1
UPR 82-1-7-12	1	3	2
BG 34-8	3	4	1
BG 35-2	1	2	1
Bala	1	2	1
IET 1444	1	1	1
Chen-Chai-ai II	1	3	1
Tchin-chu-ai	1	2	2
Tongil	3	5	1-2
IET 1353	3	6	2
IR 841-67-1	4	5	2
IR 5153-26-3-5	3-5	5	2
IR 2153-43-1-5-4	3	4	2
IR 2307-64-2-2	2	4	2
RP 633-200-1-7-4	4	4	2
Taichung Sen 71	6	6	2
Improved Subermati	3-5	5	2
MRC 172	5-6	6	2
China 1039	6-8	8	2
Cross 882-2-2-2	4-5	5	2
Cross 951-7-1-2	3	3	2
IR 101-98-66-2	3-4	4	1-2
Cr 1079-24-1-1-2	5	5	2

Cont'd Table 5

Entry	Brown Spot Natural	Brown Spot Artificial**	Blast Artificial*
Cr 1153-5-6-1	1	3	1
Brown Spot 4	3	4	2
Cr 949-5-2-1	4	4	2
Cr 1108-4-1-3	1	3	2
Cr 1108-6-1-3	2	4	1
Cr 1220--6-2-1	3	4	2
Cr 1255-5-4-4	4	6	2
Cr 8608-298-3-1-1-2	1	3	1
IR 9129-457-2-2-1-2	1	2	1
IR 9209-48-3-2	1	3	2
Wu Kwan Zhau	1	3	1-2
Cr 1321-2-3-4	2	3	2
Cr 1321-2-3-5	1	4	1
Cr 1373-9-2-3	2	5	2
Cr 1506-8-1-4	4	5	2
Cr 1514-9-2-2	1	4	2
Cr 1526-2-1-3	5	7	1
BG-276-5	3	5	1
Kaohsing sen yu 213	2	4	2
Kau 1727	3	3	2
Cr 1362-5-1-3	2	3	2
Cr 1373-9-4-6	4	4	2
IR 9729-67-3	5	6	2
IR 9752-71-3-2	5	5	2
IR 13204-3-3-3	1	3	2
Cr 1319-5-5-2	1	5	1
Cr 13215-10-1	1	2	1
Cr 13215-21-4	1	3	2
Cr 13245-3-3	2	4	2
Cr 13555-4-2	4	6	2
Cr 13685-5-2	6	6	2
Cr 13685-5-4	4	6	2
Cr 1446-5-3-1	2	3	2
IR 52	1	3	2
IR 56	4	5	2

* Disease reaction Types;
0 - 2 = highly resistant
3 = moderately resistant
4 = moderately susceptible
5 - 9 = highly susceptible

** Only at Zarzoura

Table 6 : Evaluation of fungicides for control of rice blast on the susceptible variety Giza 159

Treatment Rate/Fed & Timing		Leaf Infection %	Leaf Infection Severity*	Neck Infection %	Neck Infection Severity	Yield T/Ha
Hinosan	400 ml 3x	33.3	78.8	30.3	12.8	5.7
Beam	125 g 2x	27.1	56.5	28.3	11.6	6.1
Benlate	500 g 3x	37.0	116.3	36.5	20.9	4.7
Kitazin	6 kg 2x	34.1	83.0	31.9	14.9	5.2
Tilt	200 ml 2x	46.9	239.0	46.2	26.5	3.4
No Treatment		54.2	244.2	51.3	28.6	3.9
LSD 5%		5.1	32.6	6.7	3.3	N.S

* Number of type 4 lesions on 100 leaves collected at Random from each plot.

Table 7 : Assessment of rice blast loss in the susceptible variety Giza 159 using one, two and three spray applications of the fungicide Beam.

Treatment Rate/Fed & Timing	Leaf Infection %	Leaf Infection Severity*	Neck Infection %	Neck Infection Severity	Yield T/Ha
Beam 125 g 1x	30.6	110.0	45.4	35.7	6.6
Beam 125 g 2x	25.3	60.0	37.3	22.8	7.4
Beam 125 g 3x	20.2	35.0	35.2	22.2	8.6
No Treatment	36.0	182.5	55.7	41.8	6.7
LSD 5%	6.5	78.5	10.6	11.1	N.S.

* Number of type 4 lesions on 100 leaves collected at Random from each plot.

Table 8 : Hygrothermograph readings of relative humidity in rice plots at Sakha, Alexandria and Gemmeiza

Month	Sakha	Alexandria	Gemmeiza
	No. of days over 80% / No. of days recorded		
August	19/31 *	14/17	31/31
September	17/30 *	26/30	30/30
October	13/31 *	13/15	18/18
	No. of days 100% /No. of days recorded		
August	0/4	0/17	27/31
September	4/20	4/30	30/30
October	-	5/15	18/18
November	14/19	-	-

* Data from station instrument not located in plot

Table 9 : Effect of different levels and timing of application of nitrogen fertilizer on rice blast development in the susceptible variety Giza 159. Application at 6, 12, and 24 mm internode elongation

Treatment Rate/Fed & Timing	Leaf %	Infection Severity*	Neck %	Infection Severity	Yield T/Ha
No Treatment	8.0	2.0	27.1	12.1	9.4
30 kg 6 mm	18.9	25.3	36.7	15.2	9.3
30 kg 12 mm	15.6	15.3	33.1	16.7	10.4
30 kg 24 mm	13.2	12.5	30.6	15.2	8.5
60 kg 6 mm	22.0	43.8	44.1	20.6	9.0
60 kg 12 mm	19.6	33.0	40.0	19.6	8.8
60 kg 24 mm	19.3	28.3	41.9	18.7	8.2
90 kg 6 mm	27.9	80.5	56.1	26.8	8.9
90 kg 12 mm	22.0	47.8	49.6	25.8	9.3
90 kg 24 mm	21.1	44.0	45.6	22.2	10.1
LSD 5%	5.4	31.5	4.6	4.5	N.S.

* Number of type 4 lesions on 100 leaves collected at Random from each plot.

B. ENTOMOLOGY PROGRAM

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The following is a summary of Entomology work achieved during 1982 crop season:

Assessment of losses in rice grain yield due to rice stem borer infestation:

A. In Extension Demonstration fields: At harvest time, 350 samples taken at random from 35 fields out of 53 total demonstration fields in six rice production governorates were examined for borer infestations. Number of dead hearts, white heads, and partially infested tillers were recorded separately. Losses were estimated using a certain formula based on numbers of tillers showing different infestation symptoms in the samples. Data obtained are summarized in Table 1. Estimated yield losses ranged between 4.30% and 7.32% with an average of 5.45% in comparison to 5.96% in farmers fields. Demonstration fields at Sharkia Governorate received the highest borer infestations, while those at Behira Governorate the lowest. It was concluded that adoption of the Mabrouk 4 package of rice technology in the Demonstration fields increased grain yield without increasing the borer damage.

B. In farmers fields: About 1100 samples selected at random were taken from farmers rice fields cultivated either by the broadcast or transplanting method. Losses were estimated and results are shown in Table 2. Estimated losses averaged 5.23% and 6.90% in the 1982 crop season in comparison to 4.32% and 6.75% in 1981; only a slight increase (0.24%). Rice fields at Sharkia and Damietta Governorates received relatively high infestations, while those at Behira Governorate were less infested.

C. Determination of the potential of Furadan (Carbofuran - Nematicide / Insecticide) for controlling stem borer and other rice seedling pests

An experiment was conducted to test the effect of number, time, and method of Furadan application on rice stem borer infestations as well as on other pests attacking seedlings. Seven treatments of three replicates each were applied in a randomized way. Treatments and rates of Furadan application are listed in Table 3. Lindane 5% in the granular form at the rate of 17.5 kg/fed. is currently recommended for the control of the rice stem borer in Egypt and was used

Table 1 : Assessment of losses in rice grain yield due to rice stem borer attack in 35 Demonstration fields in six rice growing Governorates, 1982.

Governorate	No. of localities	No. of samples	No. of hills	No. of tillers	Borer infestation at harvest						% Estimated yield losses in Demonstration fields	% Estimated yield losses in farmers fields
					Dead hearts		White heads		Infested stems			
					No.	%	No.	%	No.	%		
Sharkia	8	80	400	8127	122	1.5	342	4.21	1308	16.1	7.32	6.90
Damietta	3	30	150	3500	37	1.03	105	3.00	595	17.0	5.73	6.19
Kafr El-Sheikh	6	60	300	6201	69	1.11	174	2.81	682	11.0	5.02	5.82
Gharbia	6	60	300	6444	64	1.00	177	2.75	799	12.4	4.99	5.77
Dakahlia	5	50	250	5000	70	1.4	155	3.09	260	5.2	5.01	5.66
Behira	7	70	350	7233	98	1.36	173	2.39	398	5.5	4.30	5.23
TOTAL	35	350	1750	36505	460	1.26	1126	3.08	4042	11.07	5.45	5.96

Table 2 : Estimated losses in rice grain yield in farmers fields due to infestation by the rice stem borer, *Chilo agamemnon* Bles. in six rice growing Governorates, 1982.

Governorate	No. of samples	No. of hills	No. of tillers	Borer infestation at harvest time						% Estimated yield losses (1982)	% Estimated yield losses (1981)
				Dead hearts		White heads		Infested stems			
				No.	%	No.	%	No.	%		
Sharika	200	1000	20552	400	1.95	804	3.91	2150	10.46	6.90	6.19
Damietta	100	500	8490	137	1.61	277	3.26	1112	13.10	6.19	6.27
Kafr El-Sheikh	200	1000	20206	338	1.67	676	3.35	1614	7.99	5.82	6.16
Gharbia	200	1000	20746	302	1.46	600	2.89	2960	14.27	5.77	4.32
Dakahlia	200	1000	17752	274	1.54	542	3.05	1884	10.61	5.66	4.88
Behira	200	1000	17456	218	1.25	558	3.20	1362	7.80	5.23	6.75
TOTAL	1100	5500	105202	1669	1.59	3457	3.29	11082	10.53	5.96	5.72

as the standard insecticide. A randomized sample of 10 hills per plot was taken at the yellowing stage and examined. Data were recorded for :

1. The number of rice tillers in the sample,
2. Number of rice tillers showing dead heart symptoms,
3. Number of rice tillers showing white head symptoms, and
4. Number of rice tillers showing infested stems and sound heads.

Yield losses due to the borer infestations were then calculated. Grain harvested was also weighed. Data obtained are summarized in Table 3. Results and observations made during the course of this experiment indicated the following :

1. Furadan 35% E.C. applied as seed treatment at the rate of 50 cc/kg to rice grains before sowing gave the best control of the insect and animal pests such as Mole crickets, Bloodworms, Rats and Birds, during the early period of plant growth. Furadan applied as seed treatment had no effect on the stem borer incidence in rice nurseries as it was shown that the plants received heavy borer infestations 30 days after Furadan application. No considerable increase in the yield was obtained in the seed treated plots. Furadan 5% in the granular form applied 50 days after transplanting gave considerable control against the borer (54.82% reduction in infestation, and 24.34% increase in the yield). Linadane 5% in granules appeared to be the most effective treatment and resulted in a 70.24% reduction in borer infestation and a 37.04% increase in grain yield.

   It should be mentioned that one application with Furadan is not sufficient and rice plants should receive two applications at two different stages of growth, the first in the nursery with Furadan 35% E.C. as seed treatment to protect rice seedlings and the second in the permanent field using granular Furadan 5% applied 50 days after transplanting. However, the use of Furadan should be studied economically before being recommended.

Chemical control of the rice stem borer, *Chilo agamemnon*, Bles;

An experiment was conducted to test the effect of a number of insecticides applied at different dates on *Chilo agamemnon*, Bles infestations, Chemicals used included Larvin 80%, Sevin 43%, Methavin 90%, and Dimilin 24% (growth regulator). The experiment was conducted with seven

Table 3 Effect of different treatments of Carbofuran on infestations by Chilo agamemnon, Bles. on rice (Sakha 1982)

Treatment & rate of Application	No. tillers examined (30 hills)	Borer Infestation: Dead hearts		White heads		Infested stems		% losses in yield	% Reduction in losses	Yield/fed (Ton)	% Increase in yield
		No.	%	No.	%	No.	%				
Furdan E.C. 35% seed treatment, 50 cc/1 kg of rice seeds	511	15	2.94	21	4.11	64	12.52	8.30	32.68	2.09	10.58
Furdan in granules 5%, nursery treatment 5 days after sowing, 6 grams/sq.m.	437	16	3.66	22	5.03	51	11.67	9.86	20.03	2.00	5.82
Furdan in granules 5%, soil treatment just before transplanting, 8 kg/fed.	499	13	2.61	24	4.81	69	13.83	8.80	28.63	2.10	11.11
Furdan in granules 5%, once 50 days after transplanting, 8 kg/fed.	494	4	0.81	15	3.04	85	17.21	5.57	54.82	2.35	24.34
Furdan in granules 5%, twice 15 & 30 days after transplanting, 8 kg/fed	513	5	0.97	29	5.65	81	15.79	8.20	33.50	2.10	11.11
Lindane in granules 5%, once 50 days after transplanting, 17.5 kg/fed	487	4	0.82	8	1.64	59	12.11	3.67	70.24	2.59	37.04
Untreated (for control)	498	22	4.42	31	6.22	84	16.87	12.33	-	1.89	-

treatments, three replicates each in a split-plot design with Lindane 5% in the granular form (17.5 kg/fed) used as standard. Spraying was conducted at 30 days, 50 days and 30 plus 50 days after transplanting. Rates of application are indicated in Table 4. Examination of the different treatments took place at harvest time. Samples taken consisted of 36 hills for each treatment. Number of tillers showing dead hearts, white heads, and sound heads with infested stems were recorded. Reduction in yield losses due to the borer damage was calculated as a ratio represented by the estimated yield losses due to borer attack for each treatment compared to the control. The results obtained (Table 4) are summarized as follows:

1. Significant increase over the control was detected in plots treated twice, 30 and 50 days after transplanting, whatever the insecticide used. However, in most cases no significant difference in results was found between either two applications or one application applied 50 days after transplanting.

2. Lindane 5% in granules (17.5 kg/fed.) showed its superiority over all tested materials followed by Larvin 80%. The effect of Sevin 43% S.L. and Tamaron 60% E.C. seemed to be intermediate, while Methavin 90% S.P. was less effective.

3. Dimilin 25% w.P. was inferior to other all tested toxicants. Methavin 90% caused a rather severe leaf burn of rice plants.

The last two generations of the rice borer are usually the most substantial, the first of these covering the period from mid-August to the third week of September and the second from the last week of September to harvest time. Consequently, earlier application done 30 days after transplanting was not effective. Accordingly, application of rice fields against the borer should not be started till approximately the middle of August.

Screening rice materials for resistance of the rice stem borer under natural infestation conditions:

About 200 rice strains and varieties in the rice breeding program were exposed to natural borer infestations in the field and examined for borer incidence on two different dates; 40 days before harvest and at harvest time. Percentages of dead hearts and of white heads were recorded separately as different varieties may respond differently to borer infestation at different stages of rice plant growth.

Table 4 : Effect of number and time of insecticide application of different insecticides on *Chilo agamemnon*, Blas infestations in rice (Sakha 1982)

Treatment	Rate of application/fed	One application, 30 days A.T.*					One application, 50 days A.T.					Two applications 30 and 50 days A.T.				
		% Dead heart	% White heads	% Infested stems	% Estimated yield losses	% Reduction in losses	% Dead heart	% White heads	% Infested stems	% Estimated yield losses	% Reduction in losses	% Dead heart	% White heads	% Infested stems	% Estimated yield losses	% Reduction in losses
Lindane 5% in granules	17.5 kg	3.14	5.03	12.37	9.4[illegible]	43.07	1.02	2.24	11.02	4.36	73.62	0.86	1.37	10.81	3.31	79.98
Larvin 80% wettable powder	1.5 kg	3.51	6.85	16.70	12.03	27.20	1.41	3.84	10.1	6.26	62.13	0.95	2.28	12.55	4.48	72.90
Sevin 43% soluble liquid	3.0 l	5.65	3.97	14.02	11.05	33.15	1.34	5.37	9.40	7.65	53.72	1.82	2.35	13.02	5.47	66.91
Tamaron 60% E.C.	2.0 l	1.45	6.15	20.61	9.66	41.56	1.26	4.86	9.37	7.06	57.29	1.34	3.025	15.80	5.95	64.00
Methavin 90% Soluble powder	0.75 kg	4.53	5.25	14.48	11.63	29.64	4.10	4.56	7.06	9.36	43.38	3.89	3.42	16.51	8.96	45.80
Dimilin 25% wettable powder	0.5 kg	3.06	8.60	19.31	13.59	17.79	5.57	6.96	12.52	13.78	16.64	4.09	7.99	8.70	12.95	35.80
Untreated (for control)	-	4.53	9.06	29.35	16.53	-	4.53	9.06	29.35	16.53	-	4.53	9.06	29.35	16.53	-

* A.T. = after transplanting

Considerable variations in the susceptibility to infestations by the borer were found among tested materials. Varieties reacting as resistant had about 20 to 70 times fewer dead hearts and white heads than the susceptible varieties. Generally, Reiho was relatively resistant, and Giza 180 relatively susceptible. Resistance to borer infestations at dead heart and white head stages of rice plant growth was found independant for each variety. Some varieties were resistant during one stage but susceptible during another, while others were resistant or susceptible during both stages.

A preliminary study on the control of the stem borer in rice fields through weed management:

A field was divided into 34 plots, the dimensions of each being 5 x 8 meters (i.e. 1/100 feddan). Four plots were dedicated for each of the eight treatments. The variety used was Giza 180, the most susceptible local variety. Rice plots were artificially infested with certain numbers of hills of Echinochloa crus-galli, Cyperus difformis, C. alopecuroides, and Panicum repens as indicated in Table 5. Transplanted weeds were left as such until rice harvest in one half of each plot, while handweeding was done in the other half for comparison.

Each sample was comprised of 12 rice hills pulled out at random from the two halves of each plot.

It was observed that timing of handweeding had a significant effect on the degree of rice infestations by the rice borer (Table 5). Rice was the most favourable host plant for the borer followed by Panicum repens, Echinochloa crus-galli, and Cyperus alopecuroides. Graminaceous weeds in rice fields may help to carry over infestation from one season to another. Removal of these weeds throughout the winter may help in the reduction of infestations during the following spring and summer. Cyperus alopecuroides was heavily infested with a Pyralid borer that was identified as: Arenipses sabella, Hmp. (Lepidoptera : Pyralidae).

Table 5 : Effect of removal of certain graminaceous weeds from a rice field at different dates on stem borer infestation (Sakha, 1982)

Treatment	Removal of weeds from treatment	Percent Borer Infestation on Rice				
		Infested stems	Dead hearts	White heads	Estimated yield losses %	Percent reduction in infestation
Rice (Giza 180) + 200 hills of *Echinochloa crus-galli*	No	10.0	2.11	6,18	9.29	48.30
	Yes	14.0	3.60	9.18	14.18	21.09
Rice + 100 hills of *Cyperus difformis* + 100 hills of *Cyperus alopecuroides*	No	12.6	2.32	8.88	12.46	30.66
	Yes	12.8	3.82	10.07	15.17	15.58
Rice + 200 hills of *Panicum repens*	No	9.0	1.19	5.34	7.43	58.65
	Yes	12.1	3.01	6.20	10.42	42.01
Rice + 50 hills of *E. crus-galli* + 50 hills *P. repens* + 50 hills *C. difformis* + 50 hills *C. alopecuroides*	No	7.6	1.15	4.00	5.91	67.11
	Yes 20 DAT*	14.7	4.00	10.80	16.27	9.46
" " " " " " " " " " " "	No	8.1	2.12	5.16	8.09	54.98
" " " " " " " " " " " "	Yes 40 DAT	11.0	3.70	8.60	13.40	25.43
" " " " " " " " " " " "	No	7.5	2.14	4.90	7.79	56.65
" " " " " " " " " " " "	Yes 60 DAT	12.9	4.65	9.28	15.22	15.30
" " " " " " " " " " " "	No	10.0	1.60	3.99	8.59	52.20
" " " " " " " " " " " "	Yes 80 DAT	8.5	2.30	4.70	7.85	56.32
Rice (Giza 180) alone		15.8	4.32	12.07	17.97	-

* DAT = days after transplanting

Survey of insect pests attacking rice at different stages of plant growth:

Samples of rice plants were taken at random from certain fields cultivated by either broadcast or transplanting methods in the six rice growing Governorates. Rice plants were carefully inspected and existing insects were recorded. A regular insect net was also used for sweeping insects from rice plants. The under-ground portion of the plants was also examined. Inspections were made on four different dates; in the nursery, 40 days after transplanting, 30 days before ha vest, and at harvest time.

Insects reported attacking rice plants were:

1. Order Diptera:

Chironomus sp. (Chironomidae)

Hydrellia prosternalis D., and Ephydra macellaria, Egger (Ephydridae).

Atylotus agrestis Wied. (Tapanidae).

2. Order Orthoptera:

Anacridium aegyptium L. (Acrididae)

Gryllotalpa gryllotalpa, and G. g. var kophta (Gryllotalpidae)

3. Order Heteroptera:

Eusarçoris inconspicuus, Nezara viridula, and N.v. var. turquata (Pentatomidae)

Nysius ericae (Schill.) (Lygacidae).

4. Order Homoptera:

Nephotettix modulatus, Balclutha hortensis, Exitianus taeniaticeps, Deltacephalus schmidtani, Opsius lethierryi, Empoasca decedens, Macrosteles osssiumilssoni (Cicadellidae; Leaf hoppers).

Sogatella catopatron (Delphacidae)

5. Order Lepidoptera:

Chilo agamemnon, bles (Crambidae)

Spodoptera littoralis, and Phytometra gamma (Noctuidae).

C. WEED CONTROL

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INTRODUCTION

Weeds present a serious problem in Egyptian rice fields and great loss in yield is attributed to weed competition. The major weed problems are barnyard grass (Echinochloa crusgalli), jungle rice (Echinocloa colonum), small-flower (Cyperus difformis), redstem (Ammania aegyptiaca) and tago weed (Eclipta alba). Hand-weeding is the common practice of weed control in rice fields in Egypt, but this method is becoming unavailable due to the scarcity of hand labor.

Transplanting is the common method of planting in order to minimize the weed problem and to save water and land. With rising labor costs and competition for labor with cotton and maize at the time of transplanting, there will be increased mechanical transplanting and at the same time a shift to direct seeded rice. Modern chemical methods of weed control with herbicides and the rotary weeder offer the most practical, effective and economical means of reducing weed competition, crop losses and production costs.

WEED RESEARCH

Field trials were conducted during the 1982 rice season at Sakha Experimental Station utilizing Giza 172 and Giza 180 rice varieties. Thirty day old plants were transplanted between 16th to 20th of June in tests which involved the transplant procedure. Herbicide evaluation tests for drill system were seeded 11th of June.

Herbicide treatments were applied by spray or broadcasted by clay granular carrier. Spraying was carried out with CO2 and CP3 knapsack sprayers. All chemicals used were in rates per hectare active ingredient. Randomized complete block designs were utilized for all tests. Plot size was 21 m2 for the competition and integrated tests and 10.5 m2 for drill and transplanted herbicide trials. Plots of each test were replicated four times. All plots were overseeded with barnyard grass and small-flower at 10 and 3 grams respectively.

Competition Test

The weed competition trial was established for the purpose of determining the period and time from transplanting that rice plants can overcome the adverse effect of weeds to obtain maximum grain production and the length of

time following transplanting that weeds may compete without reducing rice yield. Treatments were classified into two groups as follows: weed-free rice for periods of 20, 30, 40, 50 and 60 days for comparison with plots maintained free of weeds for the entire season. The second group of treatments involved normal development of weed competition for duration of 20, 30, 40, 50 and 60 days after transplanting and for the entire season.

Results of the trial, as demonstrated in (Table 1), indicated that weed effect was quite pronounced on grain yield with a linear decrease from 10.453 to 0.357 ton/hectare. The critical period of weed competition started beyond the 20th day after transplanting. Apparently, 60 days of weed free maintenance is required for appreciable yield. However, percent yield reduction from the optimum grain yield attained was 89, 56, 45 and 27% respectively for weed free periods of 20, 30, 40 and 50 days after transplanting. It is apparent that there is a linear increase in cost of production for grain yield from 0.0 to 959.12 dollars according to weed effect. Cost of yield reduction from the optimum attained was 883, 557, 442 and 273 dollars respectively from weed free periods of 20, 30, 40 and 50 days after transplanting.

Integrated weed control in transplanted rice

Due to increasing shortages of hand labor for weed control and increasing cost (3.00/man/day), an experiment involving hand weeding, chemical control and a hand pushed rotary-hoe; alone and in combinations, were evaluated. Treatments containing thiobencarb at 2.4 kg/ha, were applied June 24. Weed removal times were taken every 10 days according to treatment. Manual rotary-hoe timings were also recorded. Labor cost were calculated on the rate of $ 0.33 per hour. The cost of thiobencarb at the rate of 2.4 kg/ha is $ 42.15. Rice is purchased by the government for $ 112.00 per ton.

All treatments containing the herbicide thiobencarb, reduced manual labor hours (Table 1). Treatments involving the rotary-hoe, without supplemental hand weeding, were inadequate in controlling weeds and resulted in an increased occurance of Ammania (Table 2).

The most successful treatment was thiobencarb plus supplemental all season handweeding. This treatment yielded 10.61 t/ha, and returned a net profit of $ 1018.69/h. There was no significant difference between the handweeded all season, thiobencarb alone, and thiobencarb plus rotary-hoe plus two handweeding treatments with respect to rice yield or net profit return (Table 1). Thiobencarb plus rotary-hoe and rotary hoe alone treatments were not different from the no treatment in respect to occurance of Ammania. The rotary-hoe treatment resulted in the lowest yield, 0.74 t/ha, and a

negative net profit return, $ -23.69 (Tables 2 and 3).

Herbicide Evaluation Trials

Screening tests were conducted in order to (a) evaluate herbicides for weed control efficiency and (b) chemical injury of various herbicides on rice plants according to rate, method and time of application under drill-seeded and transplant establishment systems. All trials included hand weeded, no weeds and weedy check plots. The density of weeds was recorded as percent to reflect treatment efficiency. Visual observations for chemical injury taken at 25 and 7 days after herbicide application in drill-seeded and transplanted rice respectively.

Drill-Seeded

A. Various herbicide treatments together with application rates screened for use in drill-seeded rice are presented in (Table 4). Percent chemical injury and percent weed control are also listed in Table 4 according to treatment and time of application. The most effective treatments for grass control were butachor (treatments 5 & 6) thiobencarb + propanil <(tank-mix)-treatment 4> and propanil alone (treatment 13) with improvements in grain yield without visible crop injury. The lowest yield was obtained from the check plots (treatment 18) which differed significantly from all other treatments.

B. Molinate (treatments 1 & 11) and pendimethalin (treatment 3) provided good control of grassy weeds and high grain yield (Table 5). The injury rating was 8% for pendimethalin (treatment 3) and less with molinate treatments. All treated plots gave higher grain yields than did the untreated.

Transplant

A. Data reported in (Table 6) indicate clearly that the recomended rate (medium) of herbicides, used with the two methods of application (spray or with clay carrier), were generally more effective than the lower rate in controlling weeds and gave better grain yields. Spray application of thiobencarb was more effective in controlling weeds with better grain yield than the same treatment distributed with clay carrier (treatments 2 & 5). Butachor at 2.856 kg/ha at the recommended rate gave very good efficiency in controlling weeds and also better results in grain yield either when applied as spray or by clay carrier (treatments 8 & 11). Rice injury was observed in plots sprayed with thiobencarb, butachlor, perfluidon at the highest rates after a period of 7 days had passed (treatments 3, 9, 15 and 18).

B. The effectiveness of herbicidal treatments, in controlling the most common three weeds in transplanted rice fields, is recorded in (Table 7) and showed that piperophos/dimethametryne, pendimethalin, oxadiazon, molinate and thiobencarb exhibited the greatest reduction in grassy weeds. The grassy weed reduction was over 90% and more than 80% for controlling broadleaves (treatments 1, 2, 3, 4, 5, 6, 11 & 12). Pendimethalin (treatment 4) gave the greatest grain yield (9.317 t/ha), followed by piperphos/dimethametryne (treatment 2), thiobencarb (treatment 12), piperphos/ dimethametryne and oxadiazon (treatments 5 & 6). Handweeding all season increased grain yields by at least 1.35 t/ha more than pendimethalin (treatment 4) and 6.3 t/ha.more than handweeding twice (treatment 14). The lowest value in grain yield was obtained from the check plots (treatment 15). Injury rate was slightly greater in plots when oxidiazon was applied at a high rate (treatment 6).

Table 1 : Critical period of weed competition on rice

Treatments	Duration days after transplanting	Yield t/ha	Yield per hectare lost to weed competition	
			Percent	Dollar value
Weed Control	all season	10.453 a*	0.0	0.0
	20	1.155 e	88.95	883.31
	30	4.595 d	56.04	556.51
	40	5.798 d	44.53	442.23
	50	7.583 c	27.45	272.65
	60	8.953 bc	14.35	142.50
Weed competition	all season	0.357 e	96.58	959.12
	20	10.012 ab	4.21	41.90
	30	7.714 c	26.20	260.21
	40	4.905 d	53.08	527.06
	50	1.583 e	84.85	842.65
	60	0.893 e	91.46	908.20

* Means followed by different letters are significantly different at the 5% level of probability (Duncan's multiple range test).

Table 2 : Effect of several practices on weed control and yield in transplanted rice.

Treatment (1)	Weed Control % (2)			Rice Yield t/ha
	Echinochloa crus-galli	*Cyperus difformis*	*Ammania* spp.	
Thiobencarb 2.4 kg/ha	86	96	73	7.850 b (3)
Thiobencarb 2.4 kg/ha + handweeding all season	95	100	91	10.610 a
Thiobencarb 2.4 kg/ha + Rotary-hoe	81	61	18	3.610 c
Thiobencarb 2.4 kg/ha + Rotary + 2 handweedings	84	85	68	8.410 b
No treatment	0.0	0.0	0.0	1.190 d
Handweeding all season	93	88	86	9.880 ab
Rotary-hoe	56	24	16	0.740 d
Rotary-hoe + 2 handweedings	76	69	66	4.510 c

(1) All herbicides were applied as sprays 4 days after transplanting

(2) Measurements made 97 days after transplanting

(3) Means followed by different letters are significantly different at the 5% level of probability (Duncan's multiple range test).

Table 3 : Costs and returns of several weed control practices

Treatment	Handweeding		Rotary		Herbicide $/ha	Total Cost $/ha	Rice Yield		Net value $/ha
	Hour/ha	$/ha	Hour/ha	$/ha			t/ha	$/ha	
Thiobencarb, 2.4 kg/ha					42.15	42.15	7.85 b	879.20	837.05 b
Thiobencarb, 2.4 kg/ha + handweeded all season	385.41	127.19			42.15	169.34	10.61 a	1188.32	1018.98 a
Thiobencarb, 2.4 kg/ha + Rotary - hoe			197.91	65.31	42.15	107.46	3.61 c	404.32	296.86 c
Thiobencarb, 2.4 kg/ha + Rotary-hoe + 2 handweedings	156.25	51.56	166.67	55.00	42.15	148.71	8.41 b	941.92	793.21 b
No treatment							1.19 d	133.28	133.28 d
Handweeded all season	843.75	278.44				278.44	9.88 ab	1106.56	828.12 b
Rotary - hoe			322.91	106.56		106.56	0.74 d	82.88	-23.68 e
Rotary-hoe + 2 Handweedings	500.00	165.00	260.41	85.94		250.94	4.51 c	505.12	254.18 c

Table 4 : Percent chemical injury, percent weed control and grain yield according to herbicide treatments and time of application in drill-seeded rice.

Treatments			Injury % (25 DAS)	Weed Control% (Grasses) (3)	Yield t/ha
Herbicide	Rate kg/ha	Time of(1) application (DAS)			
Thiobencarb	2.4	PSPI (2)	0.0	80.59 abc	4.512 bc4
Thiobencarb	2.4	4	0.0	65.99 bcd	3.167cdef
Thiobencarb	2.4	8	0.0	70.89 abcd	3.691 cde
Thiobencarb+propanil	2.4+2.6	12	0.0	93.56 a	7.238 a
Butachlor	2.9	PSPI	0.0	97.44 a	6.786 ab
Butachlor	2.9	4	0.0	93.56 a	7.024 a
Butachlor	2.9	8	0.0	60.17 cd	3.024 cdef
Butachlor + propanil	2.9+2.6	12	0.0	84.47 abc	6.810 ab
Bifenox	2.3	PSPI	6.0	47.59 d	2.048 def
Bifenox	2.3	4	0.0	49.53 d	1.381 ef
Bifenox	2.3	8	12.5	51.48 d	1.310 ef
Bifenox + propanil	2.3+2.6	12	20.0	65.06 bcd	3.429 cde
Propanil	5.2	12	0.0	91.85 ab	7.095 a
Bentazon/propanil	3.8	14	78.0	79.58 abc	3.762 cde
Bentazon/propanil	5.7	12	0.0	63.12 cd	3.286 def
Four hand weedings				82.14 abc	6.667 ab
Two handweedings				62.11 cd	3.833 cd
Weedy check				0.00 e	0.905 f

Weed infestation rate t. (grasses)/ha, 122.7

(1) DAS = days after sowing, (2) PSPI = post-sowing pre-irrigation

(3) Measurements made 86 days after seeding

(4) Means followed by different letters are significantly different at the 5% levels of probability (Duncan's multiple range test).

Table 5 : Percent chemical injury, percent weed control and grain yield according to herbicide treatments and time of application in drill-seeded rice

Treatments			Injury % (25 DAS)	Weed Control% (Grasses) (4)	Yield t/ha
Herbicide	Rate kg/ha	Time of(1) application (DAS)			
Pendimethalin	2.0	PSPI (2)	0.0	81.92 a (5)	5.167 abc
Pendimethalin	2.0	4	0.0	66.96 abcd	4.500 abc
Pendimethalin	2.0	8	8	79.18 a	6.286 ab
Pendimethalin fb/bentazon	2.0fb1.1	4fb30	1	78.01 ab	5.548 abc
Oxadiazon	0.6	PSPI	9	73.61 abc	5.000 abc
Oxadiazon	0.6	4	3	58.94 abcd	3.476 abcd
Oxadiazon	0.6	8	6	40.57 cd	2.595 cd
Oxadiazon/propanil	1.9	12	5	74.10 abc	5.262 abc
Oxadiazon/propanil	2.9	12	5	75.76 abc	5.619
Molinate	4.3	PSPI	0	82.40 a	6.167 ab
Molinate	4.3	4	0	80.16 a	6.691 a
Molinate	4.3	8	0	42.33 bcd	2.619 cd
Molinate+propanil	4.3+2.6	12	2	53.57 abcd	4.405 abc
Piperophos/dimethametryne	1.5	PSPI	5	35.19 d	3.000 bcd
Piperophos/dimethametryne	1.5	4	0	74.58 abc	5.595 abc
Piperophos/dimethametryne	1.5	8	10	65.79 abcd	4.381 abc
Four handweedings				68.23 abcd	5.762 abc
No treatment control				0.0 e	0.833 d

Weed infestation rate t/ha 97.4

(1) DAS = days after sowing (2) PSPI = post-sowing pre-irrigation

(3) fb = followed by (4) measurements made 80 days after seeding

(5) Means followed by different letters are significantly different at the 5% level of probability.(Duncan's multiple range test).

Table 6 : Percent chemical injury, percent weed control and grain yield according to herbicide rates and method of application in transplanted rice.

Treatments			Injury % (7days after application)	Weed control % (2)				Grain yield t/ha
Herbicide (1)	Rate kg/ha	Method of application		Cyperus difformis	Ammania spp	Echinochloa crus-galli	Total	
Thiobencarb	1.2	clay	0	69	50	98	72.7	4.072 fg (3)
Thiobencarb	2.4	clay	5	88	83	98	89.7	6.334 bcd
Thiobencarb	3.6	clay	10	91	91	98	93.3	8.405 bcd
Thiobencarb	1.2	spray	.6	75	62	95	77.3	5.857 ef
Thiobencarb	2.4	spray	1	93	90	100	94.3	9.762 abc
Thiobencarb	3.6	spray	6	85	81	97.5	88	8.548 abcd
Butachlor	1.4	clay	0	80	65	97.5	81	6.976 de
Butachlor	2.9	clay	5	97	98	98	98	9.155 abcd
Butachlor	4.3	clay	10	93	95	98	95	9.005 abcd
Butachlor	1.4	spray	0	84	89	95	89	7.155 de
Butachlor	2.9	spray	0	98	99	95	99	10.370 ab
Butachlor	4.3	spray	5	99	100	99	99	10.334 ab
Perfluidon	0.6	clay	0	82	43	97	74	4.510 fg
Perfluidon	1.2	clay	10	95	84	100	93	8.543 abcd
Perfluidon	1.8	clay	11	98	85	96	93	7.417 de
Perfluidon	0.6	spray	0	23	8	96	43	3.538 g
Perfluidon	1.2	spray	8	98	78	99	92	8.000 cd
Perfluidon	1.8	spray	10	93	77	98	89	7.119 de
No control				0	0	0	0	4.052 fg
No weeds				100	100	100	100	10.738 a
Weed infestation rate no./m2 after harvesting				196	156	1.2	353.2	

1) All herbicide treatments were applied 4 days after transplanting
2) Measurements made at 77 days after transplanting.P
3) Means followed by different letters are significantly different at the 5% level of probability (Duncan's multiple range test).

Table 7 : Percent chemical injury, percent weed control and grain yield according to herbicide rates in transplanted rice.

Treatments		Injury % (7 days after application)	Weed Control % (2)				Grain yield t/ha
Herbicide (1)	Rate kg/ha		*Cyperus difformis*	*Ammania spp.*	*Echinochloa crus-galli*	Total	
Piperophos/dimethametryne	1.5	6	78	92	96	90	7.476 bcd (3)
Piperophos/dimethametryne	2.4	14	82	95	99	96	7.967 b
Pendimethalin	2.1	0	79	88	98	76	7.003 bcd
Pendimethalin	3.0	11	81	85	93	89	9.317 ab
Oxadiazon	0.6	14	55	81	91	76	7.422 bcd
Oxadiazon	0.9	20	47	93	93	90	7.291 bcd
Molinate	4.3	0	51	39	95	35	2.622 ef
Molinate	6.4	10	63	19	88	21	3.298 ef
Perfluidon	1.2	3	55	59	89	61	3.600 ef
Perfluidon	1.8	10	69	75	86	70	5.179 cde
Thiobencarb	2.4	3	81	93	93	95	7.148 bcd
Thiobencarb	3.6	10	65	95	90	98	7.698 bc
No weeds			100	100	100	100	11.176 a
Two handweedings			74	79	90	74	4.865 de
Weedy check			0.0	0	0	0	2.136 f
Weedy infestation rate no/m2 after transplanting			236	148	0.8	384.8	

(1) All herbicide treatments were sprayed 4 days after transplanting.
(2) Measurements made 78 days after transplanting
(3) Means followed by different letters are significantly different at the 5% level of probability (Duncan's multiple range test).

Herbicide Used in the Weed Control Program - 1982

Common Name	Product
Bentazon	Basagran (50% E)
Bentazon/propanil	Basagran PL2 50%
Bifenox	Modown 4F - 48 %
Butachlor	Machete 60% EC
Molinate	Ordram 6 E (72% EC)
Oxadiazon	Ronstar 12 L (12% EC)
Oxadiazon	Ronstar 25% EC
Oxadiazon/propanil	Ronstar Pl 40%
Pendimethalin	Stomp 500 E
Perfluidon	Destun 50% W.P.
Piperophos/dimethametryne	Avirosan 50% E.C.
Propanil	Stam F-34
Thiobencarb	Saturn 50% EC

SEED PRODUCTION

A.F. El-Azizi	Program Co-Leader
J.M. Swagerty	Program Co-Leader
Mohmoud A. Shata	Sakha
Abdel A. El-Kholy	Sakha
Isa A. Salem	Sakha

OBJECTIVE

Egypt has a rice production of over one million feddans. The farmers complain of poor quality seed from government sources and the milling industry complains of high incidence of red rice being delivered to their mills.

Egypt has a certified seed program in the Ministry of Agriculture under the Seed Production Board. However, this program for certified rice seed has not kept the seed source from being contaminated by varietal mixtures and infested with red rice. The Minister has been complaining of the high rate of field contamination one can readily observe in the fields when the crop is maturing.

Our objective under the Rice Research and Training Project has been and is presently to maintain and provide varietal pure varieties for the farmers to plant. We produce foundation and registered seed rice under our supervision to maintain that genetic purity. This is done with experienced well trained personnel that rogue the foundation and registered fields for any and all off types that may appear.

The production of foundation seed is planted the following year for registered seed and the registered seed is sold to contractors to produce certified seed. The certified seed is then sold to the farmers for commercial production. We aim to have enough quantity of certified rice seed to plant every feddan in Egypt before the termination of the contract of the Rice Research and Training Project.

WORK PROGRAM

During 1982 the Seed Production Team produced 160 feddans of foundation seed and 2438 feddans of registered seed. We provided registered seed for the extension program to plant approximately 20,000 feddans of demonstration fields in the six rice growing governorates of the delta. The extension team did what I consider an excellent job this past year in teaching the farmers and getting their cooperation to produce close to four tons per acre as an average over the 20,000 feddans. An increase of well over one ton per feddan

above the national average. A job well done and congratulations.

The Seed Production Team obtained the cooperation of the extension team for training the extension village workers and ninty four Seed Production Board personnel to rogue the demonstration fields from off types so that the production may be used as pure variety certified rice seed in 1983. For several different causes, which I will not go into detail here, approximately 16,000 feddans was accepted for certification. The samples are now being tested in the certification laboratories at Giza and Tanta to check for varietal purity before being sent to the seed cleaning plants. Unfortunately too many samples are being rejected at the laboratory due to red rice.

Each plant will clean only one variety, except for the plant at Sakha which will have to clean several varieties grown on the state farms of the foundation and registered seed.

The Seed Production Board contractors do not have a roguing program or field inspection and their rejections at the certification laboratory is very high, especially, the Agrarian Reform areas.

It is expected that with the certified rice seed available from both programs there will be enough pure variety certified seed available to plant about one-half total feddans in Egypt during 1983.

PROBLEMS

There are many problems to initiate and implement such a large seed production program such as this. The gears of bureaucracy are very slow to turn or to change pace, for that matter.

There has been no field inspections or roguing being done in the past or at present in the contractors fields. This is one of the major keys to any certification program and if it is not done then much effort and expense is wasted.

The pricing policy for seed production is not inducive for farmers to produce certified seed. The farmer has been offered ten percent over the government price in the past, this year we were able to obtain twenty percent. However, the free market gives about one hundred percent above the government price.

There is grave concern by the Ministry that good pure seed is not available for the farmer to plant. Yet, the Ministry will only allow one and one-half tons per feddan of

seed to be purchased from the farmer.

Enough variety pure certified seed was produced this year to plant every feddan of rice in Egypt during 1983 if it had been purchased. It is a shame to waste all the effort, expense and technology expended by top rate scientist involved in the Rice Project and still have fifty percent contaminated poor quality seed.

I wish to add here that the extension team from the Rice Research and Training Project did a tremendous job this past year. They worked in over one thousand four hundred (1400) villages with the farmers. Extension had applied research and classrooms throughout all the rice growing areas showing and demonstrating a new package of technology for rice growing. As stated earlier they increased production in farmers fields, with the farmers themselves doing the work under the extension workers supervision. As always many neighbouring farmers watched with scepticism the new practices, but after seeing the production results now wish they had joined the program and are ready to use these practices themselves in 1983. I expect to see a large increase next year of these practices with the corresponding increase in production regardless of any work done by other organizations or institutions that may be working in rice extension this next season. A one ton increase per feddan would be a million tons more rice for Egypt and could put her back into the export business again.

To continue with problems, the State Farms production is a disgrace. This is the area that produces the foundation and registered seed rice. The production during 1981 was only 1.36 tons per feddan and in 1982 is hardly more than one ton.

This is caused by poor management and poor practices as well as inadequate support and funding to do a proper and timely operation of rice production. Rats destroyed large areas in many fields and practically totally destroyed the production in Gemmeiza and Bandara farms. Irrigation and drainage canals are fouled with weeds and debris so that water can not run but the rats make a haven out of it. Also one third of the state farms areas are allowed to go fallow after wheat which again gives the rats a haven with plenty food until the rice and corn fields are ready to be attacked.

All the farm managers that had rice in their fields were called to a meeting in Sakha. The leaders of the extension and seed production teams outlined the 1982 program with them previous to planting. The new technology of practices were explained and it was also explained that the Rice Research and Training Project was supplying all the zinc sulphate and herbicides required for their areas. Less than

twenty percent of the material was used and much of that not on the proper timing requested. This is not a lack of knowledge or availability of materials or funds, but a total lack of interest. The system works here by paying an incentive for doing the work requested. I don't believe in paying for work not being done. A realistic production base should be established and then incentives paid only when that base is exceeded. Some of the farm production only averaged 245 kilograms per feddan.

Under these circumstances it is difficult to obtain enough pure variety certified seed production to stay in business. We hope to improve the situation this coming season.

To mention some of the other problems we are also dependent upon the Ministry of Supply for inputs of fertilizers and chemicals. The Central Credit Bank for distribution of these materials to the cooperatives and the cooperatives and credit bank stores to furnish sacks and supplies and receive the crop production. I will not bore you with details, but many meetings and pleading were done this past season to overcome some of the many roadblocks we ran into trying to do our job. There needs to be much greater cooperation and coordination between agencies and their personnel from top to bottom. It is all for the good and advancement of Egypt and I hope for a more cooperative and better year ahead.

The seed testing and cleaning operations are now in progress and the quantities available for planting can not be reported at this time.

The above problems as mentioned are being worked upon for solutions and we are sure many of them can be resolved. Good progress has been made in the past year. In 1981 the millers reported that 6 to 8 percent of all rice received was red rice. During 1982 they report 3 to 4 percent red rice. That is a reduction of 50 percent and we also have enough certified seed for half the planting area for all of Egypt. Progress is being made.

Table 1 :

State Farm Production and Yields

Variety	Class	Farm	Area fed.	Prod/. tons	Yield /fed.
Giza 171	Breeder	Gemmieza	0.36	0.600	1.660
	Foundation	Gemmieza	42.50	19.280	0.454
	Registered	Bandara	68.0	46.680	0.686
	"	Saft Khaled 1st	143.0	166.560	1.165
	"	Saft Khaled 2nd	138.0	176.800	1.281
	"	Zarzoura	32.60	28.200	0.865
	"	Kafr Soliman	51.67	42.160	0.816
	"	Moshtoher	52.16	38.746	0.743
	"	Mecere 1st	72.0	39.200	0.544
	"	Mecere 2nd	97.13	30.360	0.313
	"	Mecere 3rd	111.0	119.760	1.079
	"	Karada 1st	188.70	83.880	0.445
	"	Karada 2nd	198.20	146.400	0.739
	"	Kafr Defria	92.0	101.800	1.106
Giza 172	Breeder	Nattaf 2nd	0.36	1.550	4.306
	Foundation	Nattaf 2nd	42.0	63.440	1.510
	Registered	Nattaf 2nd	42.20	52.120	1.336
	"	Rewina 1st	100.0	130.800	1.308
	"	Rewina 2nd	165.25	118.080	0.715
	"	Rewina 3rd	138.20	100.200	0.731
	"	Met El-Diba 1st	158.60	63.600	0.401
	"	Met El-Diba 2nd	125.0	30.600	0.245
	"	Met El-Diba 3rd	175.30	82.080	0.468
	"	Tamia	30.0	22.300	0.743
	"	Edfina	163.40	117.680	0.720
Giza 159	Breeder	Sakha	0.14	0.240	1.714
	Foundation	Sakha	8.0	15.360	1.920
	Registered	Sakha	87.67	144.000	1.655
Giza 180	Breeder	Mecere 1st	0.14	0.196	1.400
	Foundation	Mecere 1st	12.0	5.600	0.467
	Registered	Mecere 1st	60.25	48.680	0.808
Reiho	Breeder	Nattaf 1st	0.25	0.686	2.744
	Foundation	Nattaf 1st	33.0	69.600	2.109
	Registered	Nattaf 1st	49.0	81.440	1.662
	"	Mehallet Mousa	121.35	168.960	1.392
	"	Hamrawi	90.13	121.680	1.350

Variety	Class	Farm	Area fed.	Prod/. tons	Yield /fed.
IR 28	Breeder	Hamrawi	0.14	0.29	2.110
	Foundation	Hamrawi	15.0	26.160	1.744
IR 1626-203	Breeder	Nattaf 1st	0.14	0.300	2.140
	Foundation	Nattaf 1st	8.0	10.560	1.320

AGRONOMY PLANNING REPORT FOR 1983

Participants:

S.K. De Data	International Rice Research Institute (Agronomy)
D.S. Mikkelsen	University of California (Agronomy, Administration)
E.J. Wailes	University of Arkansas (Economics)
M.R. Hammissa	Agricultural Research Center (Agronomy)
A.T. Badawi	Sakha (Agronomy)
F.N. Mahrous	Sakha (Agronomy)
M.R. El-Amir	Asuit University (Economics)
M.F. Sharaf	Agricultural Research Center (Economics)
A.H. Saad	Ain Shams University (Economics)
M.M. Parker	Rice Research and Training Project (Mechanization)
A.A. Abdel Rahman	Sakha (Agronomy)
T.S. Ismail	Sakha (Weed Control)
S.M. Hassan	Sakha (Weed Control)
G.W. Hardy	University of Arkansas (Administration)
R.E. Ely	Rice Research and Training Project Technical Director (Administration)
J.P. Craigmiles	Rice Research and Training Project (Agronomy)

Agronomy, including colleagures from Mechanization, Economics, Weed Control and Administration developed a comprehensive program for the 1983 crop season which includes the cooperation of every discipline in the Rice Project. In addition, Agronomy is collaborating with members of Major Cereals studying sequential cropping systems with crops other than rice.

A philosophy has emerged where agronomic research must consider the entire package of technology and be involved in the total production system, rather than concerned with specific fragments of production. Results from all disciplines need to mesh into one central unit and Agronomy appears to be best suited for being this focal point.

RECOMMENDATIONS:

The group made four specific recommendations as follows:

1. Weed science personnel should meet with Agronomy during the work session so that weed control measures can be incorporated into agronomic practices. It was felt this was a more natural alliance than for weed control to be in pest management.

2. Economics should be provided copies of Agronomy's preliminary field plans so that economic inputs can be included before finalization of the experminets is made.

3. Immediate action should be taken to control rats and birds at the Experiment Station. It was suggested that Dr. Balal appoint a rice committee to take measures to reduce the pest population.

4. Dr. Mahrous work with others in making a survey of weather instruments at Sakha and develop a reliable meterological station.

TRAINING

Training during 1983 will include :

1. An Egyptian specialist working in Agronomy at Davis will come to Sakha to help develop the laboratory and train personnel in new techniques and methodologies.

2. Agronomy personnel will go to IRRI for special scientific training.

3. All field and laboratory workers will be trained and instructed locally so as to improve the quality of research and field plot techniques. These workers must understand the importance of their jobs in upgrading the program.

WORK PLAN FOR 1983

Agronomy developed a good mix of experiments that range from (a) Fundemental studies using 15N balance sheet for nitrogen used in rice production. There will be close collaboration with IRRI and Davis and the quality and depth of this research will be comparable to that conducted at those institutions. (b) Applied or adaptive research where soil sample analysis from farmer fields and extension demonstrations will be correlated with on-farm fertilizer trials. (c) Academic studies where information is obtained to help make political or budgetary decisions or to answer questions relating to future direction. Included are feasibility studies on two rice crops a year, ratooning, and sequential growing of three crops a year. Most of the experiments planned for 1983 fall between these three classes and included the following.

SOIL AND WATER

1. Develop a national program using soil and plant test values for estimating fertilizer requirements of rice (cooperating with Extension).

2. Improve Nitrogen efficiency of rice by 15 N tracer and balance sheet (cooperating with U.C. - Davis and IRRI).

3. Determine fertilizer requirements for direct seeded rice (cooperating with Economics).

4. Determine N, P and Zn requirements for new salt tolerant lines under saline and normal soil conditions (Sirw Experimental Station , Cooperating with Breeding).

5. Fertilizer requirements of rice varieties under various water regimes (PhD thesis cooperating with Economics).

6. Optimizing yield of short statured varieties through variety x spacing x fertilizer interaction.

7. Nitrification inhibitors for increasing nitrogen use efficiency.

8. N fertilizer efficiency in wet land rice (cooperating with IRRI).

CULTURAL PRACTICE

1. Determine the most profitable methods of land preparation and seeding for maximum yield. (strip plot: land prep x 5 seeding meth- PhD thesis - cooperating with Mechanization and Economics)

2. Develop cultural practices for optimum yield of Reiho and other new short statured, early duration varieties (cooperation with Weed Science and Mechanization).

3. Effect of Furadan on control of insects, nematodes, birds and rats in direct seeded rice and the use of tachigaren as a fungicide and growth stimulant. (Cooperation with Entomology and Pathology).

4. Multi Crop intensification through sequential soybean-rice-clover-rotation (cooperation with Mechanization, Major Cereals, Economics).

5. Rice - weather relationships study (cooperation with IRRI and Breeding).

6. Feasibility of ratooning 3 var x 4 cutting hieghts x 3 N appl. time (cooperating with Breeding and Pathology).

7. Improvement of direct seeded technology package 3 seeding rates x 3 dates x 3 N rates (cooperating with all disciplines).

8. Weed control in broadcast, drilled and transplanted rice. (Cooperating with Mechanization and Weed Science).

BREEDING

Participants

Dr. Gurdev S. Khush (Chairman)
Dr. Mohamed S. Balah
Dr. Milad A. Maximos
Dr. Maurice L. Peterson
Mr. A.A. El-Hissiwi
Mr. A.E. Draz
Mr. I.R. Aidy

Breeding Objectives

The breeding program aims to develop high yielding varieties possessing one or more of the following traits:

- Short Stature (75 - 85 cm)
- Early Maturity (125 - 135 days)
- Resistance to major diseases and insects (Blast, brown spot, stem borer).
- Salinity tolerance (2500 - 3500 p.p.m. or 4 - 6 mmhos/cm)
- Superior grain quality : (1) high milling out turn, 70-72% for short grain varities and 65-70% for long grain varieties.
  (2) Translucent grains without grooves on lemmas.
  (3) 17-20% amlyose content

WORK PLANS FOR 1983:

1. Make 200-300 single and top crosses at Sakha keeping the breeding objective in mind.

2. Grow the single cross F1S at IRRI or at Davis (California) and make the top crosses at IRRI and make selected top crosses involving Japonica parents at Davis.

3. Establish a large winter nursery (2000-2500 F3 lines) at IRRI. Harvest the F3 rows in bulk taking a single panicle from each plant of the F3 row.

4. Increase the size of the pedigree nursery to include 4000-5000 rows of F3 to F6 materials.

5. Improve the management of yield trials to include proper time of sowing, transplanting, harvesting and irrigation and weed, bird and rat control.

6. Nominate for release:
   Reiho (short statured Japonica) as a replacement for Giza 172

IR 1626-203 (long grain indica) as a replacement for Giza 180
CR 882-2-2-2 or CR 951-7-1-2 as a replacement for Giza 171
CR 587-2 or CR 587-6 as a replacement for Giza 159.

These promising lines are about 15 days earlier in maturity and 30 cm shorter in culm length, have better blast resistance and either have similar or slightly better milling out turn than the check varieties.

7. Increase seed of promising selections from final yield trials.

8. Continue participation in IRRI-IRTP nurseries IRYN-VE, IRYN-E, IRON, IRBN, IRSATON and IRARON

9. Evaluate high yielding early maturing strains to determine their suitablity for the late summer sowing after soybean or sunflower.

10. Intensify selection in Gizcal crosses to identify promising lines with short stature, early maturity and blast resistance.

11. Evaluate promising mutant lines for yield and utilize in the hybridization program.

12. Develop special facilities at Sakha such as salinized field (about 1 feddan) for screening the pedigree materials for salinity tolerance. Send about 200 advanced generation breeding lines for salinity/alkalinity tolerance screening at IRRI.

ECONOMICS PROGRAM

Participants

Dr. Mohamed Sharaf	Program Leader
Dr. Abdel Hamid Saad	Associate Leader
Mr. Shaykhoun E. Mohamed	Researcher
Mr. Mostafa A. Osman	Researcher
Dr. Eric Wailes	Consultant
Dr. Mohamed R. El-Amir	

The 1983 research agenda for the economic program has the following objectives.

1. Compare traditional and alternative methods of rice production for implied resource use, costs and returns on experimental trials.

2. Develop a benchmark description of national rice production with an emphasis on identifying and explaining differences in yields, costs and returns. The yield gap between farm and experimental level will be decomposed by factors which constrain farmers from attaining experimental levels.

To achieve these objectives the following research plans are proposed:

1. Collect and analyze experimental data in cooperation with Agronomy and other project research activities.

2. Conduct a national farm level survey during the 1983 cropping season. Prior to this, complete the evaluation of the 1982 farm level test survey and redesign the questionnaire and survey methodology to improve the objectivity of the 1983 survey.

3. Additional research capacity will be required. We anticipate that a full-time expatriate co-program leader will be appointed to the project.

The first component of the research program will require the placement of an economist at the Sakha research experiment station to work closely with the research staff. Agronomy has indicated the following experimental topics as high priority for economic analysis of cultural practices and fertility and water management.

1. Effect of alternative land preparation and seeding methods.

2. Economic analysis of crop intensification with rice.

3. Evaluation of the package of technology associated with

the Mabrouk 4 program.

4. Analysis of different varieties under different water management regimes.

5. Costs and returns associated with yields by plant spacing and fertilizer treatments.

6. Analysis of optimal methods of production on saline soils by variety and fertilizer treatments.

The second research activity, to identify and explain differences in rice yields, costs and returns at the farm level, will be based on a survey. The proposed design of the study includes:

1. Questionnaire Based upon an evaluation of the 1982 test survey, changes will be made in the questionnaire format. The overall format of information requested will not change. More detailed information on cost of production and cultural practices will be collected. Particular care will be made to identify all labor costs including family labor. Quantity, price and timing of use are the three primary dimensions of each field operation which will be collected. Objective field sampling will be the other major change.

2. Sample A random sample, stratified by governorate area in production, will be drawn from village cooperative rice farmer list. Population distributions of farm size and participation in Mabrouk 4 will be identified. In order to facilitate analysis by farm size and participation/non-participation, additional samples will be added for categories which would otherwise encounter degree of freedom problems. Population weights would then be used to obtain accurate populations inferences. The proposed sample size will be 1000 farmers.

3. Data Collection Enumeration will be executed by a series of six separate interviews throughout the cropping season beginning with nursery planting and ending with harvest. Other visits will coincide with main field land preparation, transplanting and two during the growing season.

4. Enumerators Training of enumerators will be completed by April 1. 40 enumerators, each to be responsible for 25 samples will be trained. The enumerators will be hired from the Statistics branch of the Ministry of Agriculture. The advantages of using this personnel instead of extension demonstration agents include the following:

a. During the cropping season the agents have other responsibilities which would prevent accurate and timely enumeration (we require six interviews during the cropping season for 25 farmers per enumerator which will require 1 man month per enumerator).

b. Greater objectivity is likely by using personnel who are not already committed to the success of the extension-demonstration programs.

c. The statistics personnel are well trained and staffed to take objective yield measures at the farm level and also have been used extensively for similar special surveys for other research projects.

5. Data Management and Analysis The data will be coded and processed after each of the six interviews. This will facilitate timely analysis as well as an opportunity to recollect inconsistant or questionable responses.

The extent of completing this program will depend on the availability of resources.

EXTENSION PROGRAM

Participants

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Dr. K.G. Salem
Dr. M.H. Hegazy
Mr. M.A. El-Shiaty
Mr. A.B. El-Masry

PLANNED ACTIVITIES FOR 1983

1. Adaptive Research Trials:
To develop a limited applied and adaptive research sub-program designed to further improve the package of technology for rice farmers in 1984 season, and to demonstrate the up-to-date research findings of 1982 to the Rice Production trainees, the village Extension workers and educated farmers. Three trials will be conducted in seven locations as follows:

Governorate	District	No. of trials
Dakahlia	Dekernis	3
	El-Sembelaween	3
Kafr El-Sheikh	El Reyade	3
	Bialla	3
El Behera	El-Mahmoudia	3
	Abou Homos	3
El-Gharbia	Bassiun	3

The following are the applied research trials:

a. Weed Control in transplanted rice; to develop low cost of chemical weed control in transplanted rice.
b. Weed Control in direct-seeded rice; to develop low cost of chemical weed control in direct seeded rice.
c. Varietal trial, to evaluate short stature and early maturity promising varieties in farmers fields.

2. Demonstration fields:
To demonstrate the 1983 package of technology in farmers fields to assist in the production of certified

seed. The production of the 500-700 feddans blocks in 36 locations, a total of about 20,000 feddans, provide a good opportunity for the Rice Production Advisors, (RPA) to demonstrate the new technology of rice production to farmers. Each farmer participant will receive a certain amount of incentives paid per feddan and they in turn will deliver 1.5 ton of certified seed per feddan to the local co-operative as required. The RPA personnel will be responsible for growing the crop and the seed production team will supervise the roguing and other certification steps required.

The following is the proposed distribution of the seed over the demonstration fields:

Governorate	District	Variety	Acreage (feddan)	Seed Class
Damiatta	Kafer Saad	Reiho	600	Certified
	Damiatta	Reiho	600	Certified
	Farasckour	Reiho	600	Registered
	El-Zarka	Reiho	600	Registered
Dakahlia	Mansoura	Reiho	500	Certified
	Belkas	Reiho	600	Registered
	Dekernis	Reiho	600	Registered
	Meet Sweed	Reiho	600	Registered
	Menia El-Nasr	Reiho	600	Certified
	El-Senbelaween	Reiho	600	Registered
	Aga	Reiho	1000	Certified
Kf El-Sheikh	Kf El-Sheikh	Reiho	700	Certified
	Kelline	Reiho	700	Certified
	Sedi Sale	Reiho	1000	Certified
	Desouk	Reiho	1000	Registered
	El-Ryad	Reiho	700	Registered
	Bialla	Reiho	1000	Certified
El-Behera	Rahmania	G-171	600	Registered
	Shobrabiet	G-171	600	Registered
	Etay El-Baroud	G-171	600	Registered
	Damanhour	G-171	600	Registered
	El-Mahmoudia	G-171	600	Registered
	El-Delengat	G-171	600	Registered
	Abou Homos	G-171	600	Registered
	Kafr El-Dawar	G-171	600	Registered
El-Sharkia	Zagazig	G-171	600	Registered
	Diarb Negm	G-171	600	Registered
	Fakous	G-171	600	Registered
	El-Hosenia	G-171	600	Registered
	Abu Kabeir	G-171	600	Registered
	Kafr Saker	G-171	600	Registered

Governorate	District	Variety	Acreage (feddan)	Seed Class
El-Gharbia	Basiun	Reiho	600	Registered
	Kotar	Reiho	600	Certified
	Mehala (A)	Reiho	600	Registered
	Mehala (B)	Reiho	600	Certified
	Samanoud	Reiho	600	Registered

3. Adoption of Technology:

The Rice Production Trainers (RPT) will train the local village extension workers and the co-operative directors by having them participate in holding farmer meetings to explain how to perform the operations required of the new technology of "Mabrouk 4". By having a daily itinerary it will insure that the meetings are being conducted and the SMS will supervisor the activities of RPT. The message about "Mabrouk 4" program will be given to the village extension workers by the RPT to teach the farmers how to implement the new technology. The RPT will monitor growing conditions and technology inputs. They will make immediate reports to the SMS if the rice farmers are facing any problems in irrigation or shortage of inputs. The success of these reports in solving the problems is an absolute necessity if we are to achieve the national target.

MECHANIZATION PROGRAM

Marvin M. Parker Mechanization Specialist

Because Mechanization is a support system for the researcher, the farmer trainer and the farmer-producer, it was a logical decision for the Mechanization study group to meet jointly with the Agronomy and Soils groups.

The priorities and work plan which was developed during this meeting represents a clear statement of the consensus of the three groups.

It is significant to note that priorities remain essentially unchanged from the reports of previous study groups and thus represent the best judgement of both past and present specialists. This can be considered an assurance that the selected course of action is designed to meet the cultural practice needs of the farmers.

PLAN OF WORK: Development and introduction of adaptive machinery for rice and other crops in the rice farming system will be accomplished in separate but coordinated activities:

The development process involves the careful selection of rice production machinery and the related cultural practices already developed in Egypt and from other rice-producing countries of the world to be tested, modified or further improved when needed, toward the ultimate goal of perfection.

The resources of the International Rice Research Institute along with vast, world knowledge of machinery principles can supply the ideas to be applied either in the original form or adapted to solve specific problems.

Selected machines will be developed in a short term process, first by construction, then by field testing and refinement as needed to get acceptable performance.

The selection of machines to be developed depends on the cultural practices needs which have been repeatedly identified as priorities. These priorities are:

(a) Transplanting and direct seeding in wet land with pre-germinated seed.
(b) Harvesting mechanically
(c) Threshing and winnowing
(d) Water pumps
(e) Land preparation and leveling
(f) Fertilizer placement

The time required to develop an implement or machine may vary from a few days to less than one year depending on

the type of machine being developed.

Criteria for developing adaptive designes follow these principles:

(a) Meet the small farmers operational needs, economic resources, risk considerations and preferences.

(b) Use basic farm machinery principles in simple, low-cost, easy-to-maintain designs to enhance attractiveness to both farmers and manufacturers.

Adpative Machines will be evaluated by rating the performance in applying specific recommended practices.

Machines will be subjected to repeated field tests and subsequent refinement or modification as required to get an acceptable level of performance.

This work will be conducted in consultation with appropriate members of the research staff.

The goal is to develop farmer and small shop oriented, low cost machinery desiges which give a level of performance which is acceptable for research, training and the farmer.

Developing Manufacturer Resources: Manufacturers will be encouraged and assisted to fabricate, sell and service Project-designed machines by:

(a) Providing technical information including basic drawings and patterns. Full scale working models of critical components may be loaned to cooperating manufacturers to use as patterns for reproduction.

(b) Providing assistance in the shop to solve prototype construction, testing, refinement and marketing problems including preparation of operators manuals and other customer service materials.

Developing New Information on Machinery Use: Research studies to determine the effect of the kind and amount of mechanization on the yield, quality and economics of rice production will be conducted by the Agronomy and other appropriate sections.

The Rice Mechanization Project will provide mechanization support for these studies.

PLANT PROTECTION PROGRAM

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ENTOMOLOGY PROPOSED PLAN OF WORK FOR 1983

1. Develop a plan for modifying and improving the method currently used to estimate rice yield losses due to stem borer attack.

2. Study seasonal fluctuations in population dynamics of the rice stem borer using ultra-violet light traps.

3. Screen new insecticides for rice stem borer control.

4. Determine the potential of carbofuran (Furadan) used as seed and soil treatment for controlling several pests of direct-seeded rice. (In cooperation with Agronomy and Plant Pathology.

5. Study stem borer infestation of rice in relation to various agricultural practices.

6. Assess losses in rice grain yield due to stem borer infestation in farmer and extension demonstration fields in the six rice growing governorates.

7. Study the effect of applying certain chemicals to the nursery to control stem borers on five varieties of rice.

8. Evaluate rice varieties and breeding lines for resistance to stem borer.

PLANT PATHOLOGY PROPOSED PLAN OF WORK FOR 1983

1. Survey for new or threatening rice diseases in the six rice growing governorates in farmer fields and extension demonstration plots. Yield losses will be estimated from extension demonstration plots involved in the survey.

2. Collections of samples of rice blast disease will be made during the survey and races identified.

3. Virulent blast races will be propagated for use in screening of rice varieties and lines in blast nurseries.

4. Screen for resistance to blast and brown spot in cooperation with the plant breeders in several nurseries at several locations. Materials to be tested will consist of breeding lines, International Rice Blast Nursery and irradiated lines. Special nurseries will also be established for certain promising varieties and advanced breeding lines.

5. Evaluate fungicides for control of blast and brown spot diseases.

6. The epidemiology of blast disease will be studied. Hygrothermographs will be placed in rice plots at Sakha, Gemmeiza and Alexandria to measure daily temperature and humidity. Spore traps will also be deployed with the hygrothermographs to study spore dispersal. The rice plots will consist of paired susceptible and resistant varieties.

7. Determine the potential of carbofuran (Furadan) used as seed and soil treatment for controlling rice pathogens, including nematodes. (in cooperation with Agronomy and Entomology).

8. Study agricultural practices in relation to blast infection (in cooperation with Extension and Agronomy). The study will include the effect of fertilizer and management practices on blast development.

WEED CONTROL PROPOSED PLAN OF WORK FOR 1983

1. Study weed control in broadcast-seeded rice using combinations of herbicides and agronomic practices.

2. Study weed control in drill-seeded rice using combinations of herbicides and agronomic practices.

3. Evaluate integrated weed control in rice using combinations of herbicides, hand weeding and rotary weeder.

4. Examine weed control in mechanically transplanted rice using delayed planting in herbicide treated plots.

5. Evaluate several herbicides in demonstration plots of direct-seeded and transplanted rice. (in cooperation with Extension).

6. Determine the sensitivity of three major rice varieties to different concentrations of three herbicides.

7. Evaluate weed control in hand transplanted rice using several herbicide treatments.

SEED PRODUCTION AND EXTENSION

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OBJECTIVE

The Seed Production and Extension met together for the group meeting to formulate the plans for 1983 rice season.

The two groups met together because of using the extension demonstration fields also for certified rice seed production. However, this report will only cover the seed production program and extension will report separately on their plan of work.

Due to the poor production results on the State Farms the past two years the Agricultural Reserch Centre has reorganized their operations. It is now planned that each crop discipline be responsible for their crop production on the State Farms. The State Farms will be used for seed production purposes for each individual crop produced.

WORK PROGRAM

The rice section is responsible for 3,271 feddans on the State Farms. This will be used for breeders, foundation and registered seed. The Seed Production Board is responsible for certified seed.

The 1983 work program is to divide the 3,271 feddans into two responsibilities. One will consist of full responsibility for the total production practices from seed bed preparation through threshing. The other is to be advisory consultants to the farm managers only.

Previous to the planting season a seminar will be held with all the farm managers where the Mabrouk 4 package of cultural practices will be totally explained.

The total production responsibility area shall be the following:

Variety	Feddans	Total
Reiho	420	
Giza 171	677	
Giza 159	18	
Giza 180	49	
IR 28 and IR 1626-203	28	
		1192

ADVISORY CONSULTANT

Variety	Feddans	Total
Giza 172	672	
Giza 171	728	
Giza 159	400	
Reiho	184	
		1984
Research trial plots and breeders seed		95
GRAND TOTAL		3,271

The extension will be having approximately 20,000 feddans of demonstration fields in about 38 block areas. This 20,000 feddans again may be used for certified seed production.

Since the Seed Production Board is responsible for the certified seed they should assume the responsibility for varietial purity in these areas. The seed production team from the Rice Research and Training Project trained 94 people from the Seed Production Board during 1982 to properly do field inspection and see that the farmers roqued their fields for certification.

The seed production team will again help train personnel previous to the time for field inspection and then turn the responsibility over to the trained Seed Production Board personnel for actual field inspection and roquing.

REQUIREMENTS

One Seed Board Production personnel per demonstration area should be assigned by the time of rice heading. He then can organize his area for field inspection and follow through the threshing and delivery of the seed.

A conference of the following agencies should meet together previous to rice planting and agree to a coordinated and cooperative effort through the total season :

Seed Production Board
Credit Bank
Cooperative
Extension
State Farms
Irrigation

TRANSPORTATION

Two cars must be assigned to the seed production team for their operations on the State Farms to have the mobility necessary over the large area being farmed simultaneously.

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