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Résumé. *Le riz est en Egypte l'une des principales cultures de plein champ. Environ 600 000 ha (1,4 million de feddans) sont consacrés à la riziculture, ce qui représente près de 16% de la superficie totale cultivée en Egypte pendant la campagne d'été. La production de paddy s'établit à près de 4,8 millions de tonnes et le rendement national moyen est d'environ 8,2 t/ha. N'ayant pas la possibilité de mettre de nouvelles terres en culture et disposant de ressources en eau limitées, l'Egypte doit accroître sa productivité à travers un programme de recherche-développement sur le riz bien conçu. Un Programme de recherche sur le riz a été mis en place au début des années 1980. Ces dix dernières années, des efforts intensifs ont été déployés pour améliorer la production rizicole. Le rendement national moyen en riz a ainsi progressé de 70%, passant des 5,71 t/ha (2,4 t/fed.) enregistrés pendant la période 1984-86, à 8,2 t/ha (3,44 t/fed.) en 1995, et ce grâce à une meilleure gestion de la fumure à travers un emploi efficace des engrais azotés et l'application de sulfate de zinc en pépinière; à l'expansion de la lutte chimique contre les adventices, d'environ 12% de la superficie sous riz en 1981 à quelque 80% en 1995; à la distribution et l'utilisation de variétés à courte paille hâtives et à haut rendement (Giza 181, Giza 175, Giza 176, Giza 177 et Giza 178); à l'augmentation du taux de renouvellement des semences, de 50 pour cent en 1981 à environ 80 pour cent en 1995; à l'adoption d'une stratégie intégrée contre la pyriculariose associant résistance génétique, pratiques culturales appropriées et lutte chimique; au resserrement des liens entre la recherche, la vulgarisation et les riziculteurs, à travers une campagne nationale efficace en faveur de la production rizicole; à l'application, pour chaque système de semis, de pratiques de maîtrise de l'eau appropriées; à l'optimisation des pratiques culturales pour le repiquage, le semis à la volée, le semis direct et le semis en poquets des grains; à la réduction de l'écart entre le rendement potentiel et le rendement national pour un meilleur rendement moyen. Avec une croissance démographique de 2,7% par an et des exportations représentant environ 600 000 tonnes, il est nécessaire que la production rizicole augmente, pour passer du niveau actuel de 4,8 millions de tonnes à 5,5 millions de tonnes d'ici l'an 2000. Cela représente une progression totale de 30% ou un taux annuel de 5%. Pour ce faire, une stratégie diversifiée a été adoptée dans le cadre du troisième Plan quinquennal de développement pour la période 1992-1997. Son principal objectif est d'accroître la productivité par unité de terre, d'eau et de main-d'oeuvre, et d'augmenter les revenus que les cultivateurs tirent des systèmes de culture basés sur le riz. Elle prévoit les interventions suivantes : appui au Programme multi-disciplinaire de recherche sur le riz; soutien du système de production rizicole; amélioration de la productivité à travers l'expansion des semis de variétés améliorées à haut rendement et à cycle court ; et adoption de nouvelles technologies pour une meilleure conduite des cultures.*

Abstract. Rice is one of the major field crops in Egypt. The rice cultivation area in Egypt is approximately 600 000 ha (1.4 million feddans) which is about 16% of Egypt's total cultivated area during the summer season. Paddy production is about 4.8 million tons and the national average yield is about 8.2 t/ha. With no land available for further expansion and limited water resources, Egypt must increase productivity through a well-organized Rice Research and Development Programme. A Rice Research Programme was established in the early eighties. In the last decade, intensive efforts have been devoted to improve rice production. Consequently, the National Average yield of rice increased by 70%, i.e. from 5.71 t/ha (2.4 t/fed.) during the lowest period 1984-1986 to 8.2 t/ha (3.44 t/fed.) in 1995 as a result of the following achievements: better nutrition management through efficient use of the nitrogen fertilizers and applying zinc sulphate to the rice nursery; spread of chemical weed control from about 12% of the rice area in 1981 to about 8% in 1995; release and spread of the short-stature, earlymaturing, high yielding varieties (Giza 181, Giza 175, Giza 176, Giza 177 and Giza 178); increase in the seed renewal rate from 50% in 1981 to about 80% in 1995; use of integrated blast management including genetic resistance, cultural practices and chemical control; strengthened relationship among research, extension and rice growers through an efficient National Rice Production Campaign; applying appropriate water management practices for each method of planting; optimizing cultural practices for transplanting, broadcasting, drilling and dibbling seeded rice; decreasing the gap between the yield potential and national average due to increasing the national average. To keep pace with the 2.7% annual population growth rate and exports of about 600 000 tons, rice production has to be increased from the present 4.8 million tons to 5.5 million tons by the year 2000. This represents a total increase of 30% or an annual rate of 5%. To achieve this goal, a multiprograrnme strategy has been developed as a part of the third Five-Year Development Plan covering 1992-1997. The strategy basically aims at increasing productivity per unit of land, water and labour as well as increasing farmers' income from the ricebased cropping systems. The strategy includes five major tasks, namely: support the multidisciplinary Rice Research Programme; sustain the rice production system; improve the productivity through the expansion of the area planted to the improved high yielding, short duration varieties and adoption of the new technologies for better crop management.

I – General information

* Total land area: 7.7 million feddans (1 fed. = 4200 m^2), distributed as follows:
  5,400,000 fed.: Old lands in the Nile basin and delta
  1,900,000 fed.: Newly reclaimed lands
  400,000 fed.: Rainfed areas and the oases
* Cultivable area: 13 million feddans (5.5 million ha)
* Rice area: 1.4 million feddan (600,000 ha)

II – Constraints of rice production

❑ Climate: Temperature: daily maximum = 30-35°, and minimum = 18-22°; Humidity (55%-65%); Wind speed (1-2 m).
❑ Soils: Texture (clay) – Depth (0.4 m) – Water table (2-3 m) – pH (6.5-7.5).
❑ Water and irrigation: Thus, Egypt's agriculture is almost totally dependent upon surface irrigation. The only effective rainfall is found along the northem coastal area and amounts to only about 135 mm annually.
❑ Diseases: Blast and brown spot.
❑ Insects: Rice stem borer, blood worm and rice leaf minor.
❑ Weeds: *Echinochloa crus-galli, Echinochloa colona* and *Ammania* species.

Table 1. Rice production and consumption in Egypt

	1990	199l	1992	1993	1994	1995
Area	1363.5	1099.7	1214.5	1281.8	1377.7	1400.0
Production tons/fed.	3.055	3.134	3.245	3.265	3.320	3.44
Total production (1000 tons)	3166.1	3446.6	3908.3	4159.1	4581.9	4830.0
White rice (1000 tons)	2185.5	2378.7	2697.7	2869.8	3161.5	3332.7
Local consumption (1000 tons)	1623.0	1665.0	1708.0	1753.0	1799.0	1845.0
Exportations (1000 tons)	41.8	80.1	214.7	132.1	248.2	313.4
Seeds (1000 tons)	50.7	56.1	62.2	65.4	82.7	90.4
Farm price (pound/ton)	367.0	435.8	451.4	504.2	605.4	681.1
Production costs (pound/fed.)	449.9	603.2	747.0	839	898.8	988.7

Table 2. Rice areas, productivity and production in Egypt (1980-1995)

	Area (ha)	Productivity (ton/ha)	Total production (ton/ha)
1980	407,603	5.84	2,381,752
1981	400,900	5.57	2,234,046
1982	430,233	5.67	2,438,769
1983	424,901	5.74	2,439,975
1984	413,217	5.40	2,235,110
1985	388,223	5.95	2,310,304
1986	423,442	5.77	2,443,780
1987	412,210	5.83	2,404,300
1988	351,701	6.05	2,130,070
1989	412,813	6.48	2,676,131
1990	435,439	7.27	3,166,126
1991	462,041	7.43	3,446,570
1992	552,322	7.72	3,908,334
1993	580,584	7.77	4,159,135
1994	578,869	7.90	4,581,901
1995	588,235	8.20	4,821,600

Table 3. Importing countries of Egyptian rice (1994)

Country	Amount (1000 tons)	Price (L.E)	Price ($)
Syria	94.60	27,933,309	9,845,317
Turkey	64.80	53,119,269	15,644,388
Lebanon	13.10	2,647,428	8,989,132
Lybia	7.30	8,112,344	2,389,301
Spain	6.90	5,137,195	1,512,977
Israel	4.45	654,563	2,191,909
Jordan	3.26	3,062,406	901,396
Tunisia	3.25	3,226,725	950,316
Italy	3.20	3,215,556	947,027
Mexico	2.00	1,634,821	481,197
Cyprus	1.59	1,755,794	517,106
USA	1.00	958,800	282,215
Chekoslovakia	1.30	1,223,685	360,392
France	0.52	533,953	157,256
Romania	0.49	33,934	98,585
Macedonia	0.30	319,338	93,994
Germany	0.63	637,799	187,840

III – Potential of rice production

Increase in rice yields and rice area

Table 4. Annual average of rice area, production and yield with respective indices during 1984-1995

	Area		Production		Yield	
	1000 ha	Index	1000 tons	Index	Tons/ha	Index
1984-86*	420	100.00	2.40	100.00	5.71	100.00
1987	414	98.57	2.41	100.04	5.83	102.10
1988	360	85.71	2.18	90.83	6.06	106.13
1989	413	98.33	2.67	111.25	6.47	113.31
Average	***39C***	***94.29***	***2.42***	***100.83***	***6.12***	***107.18***
1990	435	103.57	3.17	132.08	7.28	127.50
1991	454	108.10	3.41	142.08	7.51	132.52
1992	511	121.67	3.91	162.92	7.66	134.15
Average	***467***	***111.19***	***3.50***	***145.71***	***7.48***	***131.00***
1993	538	128.10	4.15	172.92	7.71	135.03
1994	570	135.71	4.55	189.58	7.98	139.75
1995	588	140.00	4.82	200.83	8.20	143.61
Average	***565***	***134.52***	***4.51***	***187.78***	***7.96***	***139.46***

* Base period

IV – Accomplishment of rice research in Egypt

Rice is one of the major field crops in Egypt. The area planted to rice is about 600,000 ha (1.4 million feddans) which is about 16% of Egypt's total cultivated area during the summer season. Paddy production is about 4.8 million tons and the national average yield is about 8.2 T/ha.

Having no land available for further expansion and limited water resources, in order to increase its rice productivity, Egypt must resort to a well-organized rice research and development program. The Rice Research Program was established in the early eighties with the inclusion of the following disciplines:

- ❏ varietal improvement to develop new high yielding varieties with short stature, early maturity and resistance to blast and other diseases;
- ❏ agronomy, including plant nutrition, water management and cultural practices, to maximize yields of newly released varieties;
- ❏ plant protection against weeds, diseases, insects and other pests;
- ❏ seed production to put pure high-quality seed of the new high yielding varieties into farmers' hands;
- ❏ extension (to verify and transfer new technologies to farmers).

In our efforts to strengthen rice research in Egypt, we have established the Rice Research and Training Center (RRTC) at Sakha, Kafr El-Sheikh Govenorates, with strong support from the:

- ❏ Egyptian Ministry of Agriculture & Land Reclamation (MOA);
- ❏ International Rice Research Institute (IRRI);
- ❏ United States Agency for International Development (USAID).

The RRTC at Sakha was dedicated in January 1987. It has a full range of well-equipped research facilities such as: laboratories, glasshouses, screenhouses, library, seed testing and processing facilities, mechanical workshops. The RRTC houses about 100 research workers, 28 senior staff members, 30 research assistants, and some 60 research technicians.

In the last decade, intensive efforts have been made to improve rice production in Egypt. Consequently, the national average yield of rice increased by 70%, i.e. from 5.71 t/ha (2.4 t/fed.) during the based period 1984-1986 to 8.2 t/ha (3.44 t/fed.) in 1995 as a result of the following achievements:

(a) Release and spread of the short-stature, early-maturing, high vielding varieties, Giza 181, Giza 175, Giza 176, Giza 177 and Giza 178.

b) Better nutrient management through efficient use of the nitrogen fertilizers and applying zinc sulfate to the rice nursery.

(c) Spread of chemical weed control from about 12% of the rice area in 1981 to about 80% in 1995.

(d) Increase the seed renewal rate from 50% in 1981 to about 80% in 1995.

(e) Use of integrated blast management including genetic resistance, cultural practices and chemical control.

(f) Strengthened relationship among research, extension and rice growers through an efficient National Rice Production Campaign.

(g) Applying appropriate water management practices for each method of planting.

(h) Optimizing cultural practices for transplanting broadcasting, drilling and dibbling seeded rice.

1. Varietal improvement

In the early eighties, the two japonica short grain varieties, Giza 171 and Giza 172, were occupying more than 90% of the rice area of Egypt. But Giza 171 (Nahda/Calady 40) and Giza 172 (Nahda/Kinmaze) quite impressive yielding was associated with:

- ❏ late maturity;
- ❏ susceptibility to lodging even at moderate N levels; and
- ❏ susceptibility to blast.

Considering these drawbacks of the prevailing varieties, the breeding program has been accelerated and reoriented to develop high yielding varieties with one or more of the following traits:

- ❏ early maturity (125-140 days) for more cropping intensification,
- ❏ short stature (100 cm) to resist lodging under high N rates,
- ❏ durable resistance to blast,
- ❏ tolerance to soil salinity and alkalinity, and
- ❏ acceptable grain quality for local consumption and export.

To reach these goals, four breeding procedures are used:

Hybridization. About 300 single and multiple crosses are effected every year and the F_1's are grown at IRRI, Philippines, as a winter nursery.

Introductions. Egypt has actively participated in the IRRI-INGER (IRTP) since its establishment in 1976. This network supports our national rice breeding program by providing us, every year, with a large volume of potential breeding material for evaluation under local conditions.

Induced mutations. This is being done with very specific objectives to improve the local traditional varieties, Giza 177 and Giza 172, through selection of useful mutations with early maturity and short stature.

Tissue culture. To accelerate the breeding program, some selected cross (10-20 F_1's) are sent to IRRI every year for anther culture, until our own laboratory can be completed.

2. Significant results and achievements

New Crosses. About 450 simple and multiple crosses are effected annually and the F_1's are raised at IRRI as a winter nursery. Most of the donor parents are selected from the INGER nurseries with special focus on blast resistance, short stature, early maturity and salinity tolerance. Most of the new varieties were multiple crosses involving indica and japonica parents. During the last 5 years, 1987-1995, breeders evaluated about 300 F_2 populations annually.

Pedigree nursery. Volume of the pedigree nursery evaluated under normal and saline soils during the period from 1987-1995. During the 5 years, about 23,000 pedigree (F_3-F_5) lines were evaluated at Sakha (normal soil) and Sirw (saline soils) research stations. Pedigree lines with high phenotypic acceptability, blast resistance, salinity tolerance, early maturity and acceptable grain quality were promoted from the F_3 to F_3-F_6 to be evaluated in the replicated multilocation yield trials.

Multi-Location yield trials. Extensive testing of promising lines in various locations and for several years is the most important component of the varietal improvement program. Selected lines from the pedigree nursery, INGER nurseries and new exotic introductions were grouped as medium and early maturing, and evaluated in three stages, preliminary, regional and final, replicated yield trials at different locations for several years in normal and saline soils. During the period from 1987-1995, average numbers of lines evaluated in the preliminary, regional and final yield trials annually were 97, 22 and 12, respectively.

On overall yield potential, consistency of resistance to blast, short stature and early maturity, four strains were promising namely:

- GZ 1368-5-4 (IR 1615-31/BG 94-2);
- GZ 4120-205 (Giza 171/Yomji 1/Pi 4);
- GZ 4255-6-3 (Giza 175/Milyang 49);
- IR 25571-31-1 (IR 1929-192/IR 10176-79).

In general, these promising strains are combining high yielding ability with short stature, early maturity and resistance to blast. Therefore, they have been recently subjected to intensive testing in the farmers' fields prior to being released for general cultivation in the near future.

Recently six improved varieties have been released for general cultivation as follows:

IR 28, an introduction from IRRI. It was released in 1985 because of its early maturity, short stature and blast resistance.

Giza 181 (IR 1626-203) released in 1986 due to its high yielding ability, blast resistance and excellent long grain quality.

Giza 175 (GZ 1394-10-1) combines the improved indice plant type (IRRI) and japonica grain shape with early maturity and blast resistance.

Giza 176 (GZ 2175-5-6), a typical japonica variety released in 1989. Because of its high yield, resistant to blast and acceptable grain quality, it captured about 30% of the rice area in 1991.

Giza 177, a typical japonica variety released in 1994 because of its high vield, resistance to blast and acceptable grain quality. It captured about 15% of the rice area in 1995.

Giza 178, combines the improved indica plant type and japonica grain shape with early maturity and blast resistance. It captured about 10% of the rice area in 1995.

In the 1990 and 1991 seasons, the Department of Agricultural Economics investigated the relative productivity of the improved varieties through categorizing about 2500 crop cuts into three groups as follows:

Group A, including the traditional japonica varieties: Giza 171 and Giza 172.
Group B, including IRRI-type varieties: Giza 175, Giza 181 and IR 28.
Group C, including Giza 176 (GZ 2175) as an improved japonica type.

Results show that the new improved varieties are 20-25% higher in yield than the traditional japonica varieties.

Presently, these improved varieties, Giza 175, Giza 176, Giza 181 and IR 28, are grown on about 40% of the rice area in Egypt, and it is expected that the area planted to the improved varieties will be gradually expanded to reach more than 80% by 1994.

3. Seed production

The target of the Ministry of Agriculture is to produce enough good quality seed to plant 50% of the rice area every year. That amounts to renewing seed for about 220,000 hectares. Therefore, the Rice Research Program planned the seed production component with these specific objectives:

❑ to maintain genetic purity of all the recommended varieties, and
❑ to multiply recommended seed for distribution to the farmers.

To fulfill these objectives, the research staff produces breeder and foundation seed, while the state farms grow the registered seed and contact with growers to produce certified seed through the MOA's Central Administration for Seed (CAS).

Certified seed. The CAS, in collaboration with the RRTC, successfully renews growers' seed for about 75% of the rice area each year. During the period 1987-1995, the CAS produced annually about 61,000 tons of seed, out of which 46,000 tons were distributed to the rice growers. The distribution percentage was higher for the short-grain varieties (80%) than for the long grain varieties (55%) and was, in general, about 75%. The quantity of seed distributed every year was enough to plant about 307,000 ha at the rate of 150 kg/ha. Accordingly, the annual seed renewal rate was about 75% and was a main factor in the big increase (70%) in the national average yield during the last years.

4. Agronomy

A. Objectives

The primary objective of the Agronomy Component is to increase rice production and improve its quality through the efficient use of fertilizers, water management and other cultural practices. The specific objectives are:

❑ developing technology for efficient use of micro- and macro-nutrients for different rice genotypes and soil conditions;

❑ evaluating new fertilizer compounds and growth regulators;

❑ optimizing cultural practices for transplanted, broadcasted, drilling and dibble seeded rice;

❑ applying appropriate water management practices for each method of planting;

❑ adapting research for mechanization of small holder rice cultivation for crop planting and harvesting;

❑ updating agronomic recommendations to accommodate new technology and trends in rice production.

To achieve these objectives, the Agronomy Component conducts several series of field and pot trials on the following:

- ❑ nutritional requirements (N, P, K & Zn) for different rice varieties and promising lines;
- ❑ studies on timing, method of placement and rate of nitrogen as affected by the new shorter statured rice genotype that are more nitrogen responsive;
- ❑ studies on the cultural practices associated with the development of early maturing lines, and limited tillering lines under different methods of planting;
- ❑ studies on water management and the effects of withholding irrigation at different growth stages;
- ❑ studies on the use of growth regulators, urease and nitrification inhibitors and biofertilizers;
- ❑ evaluation of compound fertilizers containing both macro- and micro-nutrients;
- ❑ studies on zinc and other micro-nutrients to determine the special need for micro-nutrients and the most efficient means of applying them.

B. Achievements

- ❑ Need to sow within the first 3 weeks of May and transplanted with seedlings of 25-35 days age at 20x20 cm spacing;
- ❑ Modification of N rate between tall and short statured varieties from 96 kg/ha to 144 kg/ha;
- ❑ Applying $ZnSO_4$ to the nursery at 48 kg/ha, since nursery is the simplest method of including Zn in the nutrient management package;
- ❑ Fertilizer N recovery, using tracer techniques, vary from 10% to 40% depending on time and method of application;
- ❑ Greater importance of splitting the application for salt affected soils;
- ❑ Modified IRRI arum seeder as a means of dried seeding (rice can give yields comparable to broadcast seeding);
- ❑ Fertilizer requirements of rice as affected by the previous crop. In general, N is the most important nutrient. Responses to P, K and Zn have been observed in some, but not all, areas;
- ❑ The most sensitive growth stage for irrigation is the reproductive stage;
- ❑ Timing of N applications for:
  - • Transplanted rice: 2/3 basal & 1/3 PI
  - • Broadcasted: 1/3 basal, 1/3 maximum tillering & 1/3 PI
  - • Drilling: 1/2 PBF + 1/2 at PI
- ❑ Use of urease inhibitor (BPI) minimized N losses resulting in increased grain and N uptake.

5. Weed management

The weed menace is the most serious constraint to rice production. Weeds can reduce rice yields from 15 to 100%, depending on cultural and input management. The most serious weeds of rice in Egypt are: *Echinochloa crus-galli, Echinochloa colona, Echinochloa oryzides, Cyperus difformis, Cyperus rotundus, Eleocharis acicularis* and *Ammania* species.

A. Objectives

The major objective of the Weed Management Component is to develop technically effective and economically viable alternate weed management technologies for different types of rice culture.

B. Experiments

To achieve this major objective, the weed Management Component conducts each year:

- ❑ two or three experiments on managing weeds in each of the different types of rice culture such as transplanted rice, broadcast seeded rice, dibble seeded rice and drill seeded rice;

❑ one of two greenhouse studies on basic aspects of weed species and their management.

C. Achievements

a] Transplanted rice

❑ Integrated weed management strategy was developed which involves combination of close spacing (10x10 cm); 6 seedlings per hill with continuous flooding or normal (20 x 20 cm) spacing, 3 seedings per hill and thiobencarb at 2.4 kg a.i/ha under alternate flooding regime.

❑ Identified suitable herbicides for managing weeds in transplanted rice such as pre-emergence application of:
- Butachlor, 2.1 kg a.i/ha,
- Oxadiazon, 0.45 kg a.i/ha, plus one hand weeding.

b] Broadcasting seeded rice

❑ Effective herbicides were identified such as post-emergence application of:
- Bensulfuron methyl + molinate, 0.05+4.5 kg a.i/ha,
- Thiobencarb + propanil, 2.4+1.8 kg a.i/ha, and
- Thiobencarb, 3.6 kg a.i/ha.

❑ Developed technology for managing weeds before seeding. It involves pre-plant application (pp) of the following herbicides 4 days before seeding:
- Oxadiazon 0.3 kg a.i/ha PP f.b. 0.3 kg a.i/ha EPOE,
- Thiobencarb 1.8 kg a.i/ha PP f.b. 1.8 kg a.i/ha EPOE,
- Butachlor, 1.45 kg a.i/ha PP.

c] Drill seeded rice

❑ Identified effective herbicides and their rates for pre-emergence (PE) and early post-emergence (EPOE) application. They include:
- Pendimethalin, 2.0 kg a.i/ha PE or EPOE,
- Oxadiazon + butachlor, 0.3+2.1 kg a.i/ha PE,
- Thiobencarb, 3.6 kg a.i/ha PE, and
- Pendimethalin + propanil, 0.9+1.8 kg a.i/ha POE.

6. Plant pathology

A. Objectives

The main objective of the Plant Pathology Component is to develop effective management practices for rice disease control by the utilization of different methods of control to decrease disease severity and to minimize crop losses. Rice blast (*Pyricularia oryzae*) is the most important disease in Egypt. However, brown spot is also important under certain conditions. The research agenda includes:

❑ enhancing host plant resistance against major disease;
❑ evaluating cultural practices that minimize blast infection;
❑ identify effective fungicides and their treatment methods;
❑ surveying blast virulence in rice growing governorates;
❑ quantifying losses caused by blast and other diseases.

B. Experiments

To achieve the above objectives, the following studies have been conducted every year:

❑ Blast nursery: Different groups of breeding material have been evaluated for leaf blast infection at the vegetative stage and panicle infection at reproductive stage.

❑ Evaluation of the most promising lines against 25 isolates of *P. oryzae*, prevalent in six rice growing governorates.

❑ Multiplication tests for evaluating blast resistance: 20 selected entries are planted at 20 representative locations.

- ❏ Identification of *P. oryzae* races by testing isolates collected from the different governorates and evaluate resistance genes to *P. oryzae* by testing different genotypes against available races, under greenhouse conditions.
- ❏ Evaluate cultural practices to identify those minimizing blast infection.
- ❏ Screening fungicides to identify the most effective ones in decreasing disease (blast and brown spot) severity through spraying, soil application or seed treatment.

C. Achievements

- ❏ 2655 entries belonging to different breeding material groups were evaluated for blast resistance during five years. Of them, 1774 lines were resistant, 171 moderately resistant, 500 moderately susceptible and 210 susceptible to highly susceptible.
- ❏ Evaluation of the most promising strains (154 lines) in the greenhouse and blast nursery, showed that 75 were resistant, 20 moderately resistant, 30 moderately susceptible and 29 susceptible to highly susceptible. Among these lines, IR 28, Giza 181, IR 25571-31-1, Milyang 95, GZ 1368-S-5-4, and ECIA 31-104 were highly resistant; and GZ 4120-205-2 and Giza 175 were resistant.
- ❏ Among cultural practices tested, early planting tended to decrease blast infection and prevalence. Optimum amounts of fertilizers increased rice resistance to blast.
- ❏ Among fungicides tested, Beam 75% in 100 g or Hinosan 50% at 400 ml/F and Fuji-one Granules at 12 kg/feddan or Fuji-one EC 40% at 400 ml/feddan were most effective in decreasing the severity of blast and brown spot and increasing rice yields.

7. Entomology

A. Objectives

The major objective of the Entomology Component is to develop effective and ecologically sound integrated insect pest management systems for suppressing insect pest population and to minimize rice yield losses due to insect pests.

The key insect pests of rice in Egypt are Rice Stem Borer (*Chilo agamemnon Bles.*), bloodworm (*Chironomus sp.*) and Rice Leaf Minor (*Hydrellia prosternalis* deeming). The research agenda includes:

- ❏ enhancing host plant resistance against major insect pests;
- ❏ identifying cultural practices and insecticides for effectively managing insect pests;
- ❏ exploring feasibility of biological pest control;
- ❏ understanding host-pest relationship and quantifying yield losses due to insect pests in the six rice growing governorates;
- ❏ surveving and monitoring major insect pests and their dynamics.

B. Experiments

To achieve these objectives the entomology component conducts three to five experiments each year on the following aspects:

Varietal screening: to evaluate promising lines for resistance against Rice Stem Borer (RSB) and Rice Leaf Minor (RLM);

Insecticide evaluation: to identify effective, economical and safe insecticides to manage RSB and RLM.

On-farm survey and monitoring: to assess yield losses due to insect pests, quantify insect pest population dynamics using light trap to identify biological control agents.

C. Achievements

- ❏ Identified rice varieties resistant to RSB with early planting (GZ 4071-16-2-1; GZ 4294-10-2, Todorokiwase; Zhong Hoa 3; GZ 4127-2-1-3; GZ 4294-10-5; Giza 159 and Toride 1) and late sowing (Kagahikari; Todorokiwase; IR 40; GZ 4565-S-10; GZ 1368-S-5-4; GZ 4294-9-4 and GZ 3766-38-1-2). In farmers' fields, Giza 171 and Giza 176 recorded lowest RSB infestation.

- Insecticides such as Dursban, Furadan and Diazinox and their doses that were effective against RSB and RLM were identified.
- Large number ot natural enemies were found to be associated with the immature stages of the RSB. True spiders, *Heteropterous* bugs and *Seymnus* sp. are the most etfective predators on RSB.
- RSB moth dynamics were quantified using light trap. A decreasing trend in RSB moth population was observed across years in rice growing governorates.
- On-farm survey indicated that the average percent infestation of RSB was 4.66%. The highest infestation was in Skarkia and Dakahlia governorates while the lowest was in Damietta.

8. Technology transfer

A. Objectives

The major objectives of the Technology Transfer Component are:

- increasing the national rice production through transfer of new technologies to rice farmers;
- facilitating the rapid interchange of field problems and answers between researchers and farmers;
- evaluating new varieties and production technologies in farmers' fields and update the package of production practices for rice;
- training the extension staff and selected farmers in the rice growing governorates about the improved rice production technology.

B. Activities

To achieve the major objectives, the following activities are being undertaken each year in the rice growing governorates:

Demonstration fields. About 70 demonstrations were established each season, from 1988-1995, using the newly released varieties and the improved package of practices. Five varieties were grown: Giza 175, Giza 176, Giza 181, Giza 177 and Giza 178. Each site was about 2 ha.

Verification trials. To verify the technical efficacy and practicability of the on-station research findings in farmers' fields, non replicated on-farm verification trials were carried out each year in about 20 locations.

They include:

- variety verification: involving six varieties under two levels of N (98 and 144 kg/ha);
- fertilizer requirements verification: with two varieties (Giza 181 and Giza 176) for studying the effect of N, P, K and Zn on rice grain yield and some other agronomic characteristics;
- weed management treatments verification in which three weed control treatments each were tested under transplanted and broadcasted seeded rice (Giza 176).

C. Achievements

- The national average rice yield has increased from 5.6 t/ha in 1986 to 8.2 t/ha in 1995.
- In the demonstration fields, the recorded maximum yield potentially of improved varieties was 13.3 t/ha and the average yield was 10.4 t/ha under optimal cultural practices.
- The vast potentiality for further increasing national average rice productivity and total rice production was identified.
- The improved rice production technology was disseminated by training each year about 100 rice advisors from different rice growing governorates prior to the season.
- Trained rice growers to adopt the improved production technologies by holding 2-3 field days/year at each demonstration site.
- On-farm verification trials confirmed:
  - the need for higher N level (144 kg/ha) for improved varieties (IR 25571, Giza 175, Giza 176, Giza 181, GZ 4120 and GZ 4255) compared to 96 kg N/ha needed for Giza 171 and Giza 172,

- the superiority of N, P, K and Z fertilization over N, P, K alone for realizing optimal yields of Giza 176 and Giza 181,
- efficacy of Londax + Ordram and Saturn + hand weeding in managing weeds in broadcast seeded and transplanted rice.

9. International collaboration

The Rice Research Program has for many years worked in close collaboration with other international organizations.

IRRI. The longest and most active collaboration has been with the International Rice Research Institute. Collaboration with IRRI has continued for more than 20 years. It has included:
❏ exchange visits between IRRI and RRTC scientists;
❏ genetic material exchange through the INGER (formerly IRTP) network;
❏ training (both degree and non degree);
❏ program development through participation in IRRI's board of trustees and INGER's advisory committee;
❏ much of the exotic genetic material that has gone into recently released, early maturing, short stature, and blast resistant varieties has come from collaboration with IRRI.

USAID. Along with the IRRI, collaboration has been made with USAID as the principal donor funding the work with IRRI, including the current contract in which 3 IRRI staff members are assigned to the RRTC.

JICA. Other collaborative efforts include the Japanese International Cooperative Agency (JICA). For the past nine years, the RRTC has conducted a JICA-funded 5 month training course for African participants. JICA has also been involved in testing and introducing various rice machinery, of which the most notable is the small combine, milling and processing equipment.

FAO. More recently, the Egyptian Rice Program has been collaborating with the FAO Interregional Network for Rice Research in Mediterranean Climates. Egypt participates in 3 of 5 working groups and is in the process of initiating a Japonica x Indica hybridization service and testing for blast resistance for the network. This is because Egypt is the only network member with a sub-tropical climate that will allow both rice sub-species to flower simultaneously, and a sufficiently specialized staff to complete the work.

10. The future: the year 2000

During the second Five-Year Development Plan (1987-1992), rice production has increased by 42%, from 2.4 million tons to 3.4 million tons. Most of this was due to increase in productivity which reached 8.2 tons/ha in 1995.

To keep pace with the 2.7% annual population growth rate and exports of about 600,000 tons, rice production has to be increased from the present 4.5 million tons to 5.5 million tons by the year 2000. This represents a total increase of 30% or an annual rate of 5%. To achieve this goal a multi-prong strategy has been developed as a part of the Third Five-Year Development Plan covering 1992-1997. The strategy basically aims at increasing productivity per unit of land, water, and labor as well as increasing farmers' income from the rice based cropping systems. The strategy includes five major tasks which are:

1. Support the multi-disciplinary Rice Research Program to continue generation of improved technology with emphasis on:

❏ acceleration of the varietal improvement program to develop new japonica varieties with durable resistance to blast and early maturity;

❏ intensify research on crop management to maximize productivity of the improved varieties and increase fertilizers and water use efficiency;

❏ intensify research on integrated pest management to control weeds, diseases and insects with minimum use of pesticides;

❏ strengthen the collaboration with international organization such as IRRI, JICA and FAO.

2. Sustain the rice production system through supporting the technology adaptation program at all phases: technology verification, technology demonstration and mass-guidance; to motivate the rice farming community for active participation in the rice production program.

3. Improve productivity through expanding the area planted to the improved high yielding, short duration varieties and adoption of the new technologies for better crop management.

4. Problem soils. Identify the reported 20% of the rice soils affected by salinity that can reduce their productivity by as much as 40%.

5. Expansion of area. To the extent irrigation water can be available, expand the area under rice in the Delta by 20% to 0.5 million ha by the year 2000.

V – Rice production policy

As has been mentioned earlier, political stability and commitment for all leaders, starting from the president and minister down to village leaders, play an important role in sustaining agricultural production through establishment of various facilities, allocation of budget and follow-up of the implementation step by step. Also there should be national strategy with clear production goals and objectives for each commodity.