RICE VARIETAL IMPROVEMENT IN EGYPT DURING THE LAST TWO DECADES: ACHIEVEMENTS AND FUTURE STRATEGIES

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Abstract

Significant progress has been made in rice production in Egypt during the last two decades. Rice varietal improvement program, as the major component of the National Rice Program, has been successful in developing and distributing many of modern rice varieties that have superior yield potential and excellent agronomic and grain quality characteristics to match the needs of rice growers and consumers in both Egypt and foreign countries. Due to the wide spreading and planting of the new varieties, rice productivity and production have remarkably increased year after year according to the percentage replacement of the rice area with the modern varieties to realize a maximum yield average of 9.9 t/ha in the year 2004 against 5.7 t/ha for the base period (1986 – 88). Adopting of the new rice, short duration varieties should save about 30% of the irrigation water consumption every year.

INTRODUCTION

Rice is considered the most popular and important field crop in Egypt for several reasons: as a staple food after wheat for the Egyptian population, as a second exporting crop after cotton, as a land reclamation crop for improving the productivity of the saline soils widely spread in North delta and coastal area (El-Tobgy 1976), and finally, as a social crop in which most of farmers could find a work in rice fields and gain money during the growing season.

During the last two decades, great attention has been given by the Ministry of Agriculture for supporting this crop to improve productivity, profitability, stability, and sustainability of the rice crop in Egypt. A major indicator of this support is the establishment of new rice research facilities at Sakha , Kafr El-Sheikh dedicated in 1987, through the joint efforts of the Egyptian Ministry of Agriculture and the USAID (Rice Farming Systems New Directions 1989). The research facilities was called Rice Research and Training Center (RRTC). As a result of this support, a remarkable progress has been achieved in different aspects of the rice crop, particularly enhanced productivity and grain quality that enabled Egypt to occupy the top world wide rank in grain yield during the last five years.

Rice Varietal Improvement Program (RVIP), as the major program of the RRTC and the National Rice Research Program, has played the principal role of the rice progress in Egypt during the last two decades.

The objectives of the present paper are:

- To define the research activities of the RVIP during the last two decades.
- To review the results and achievements realized in the last twenty years.
- To suggest the future strategies of the RVIP for realizing more progress.

I. Research Activities of the RVIP During the Period of 1985 – 2004

In light of the previous results of the RVIP in the years before the eighties, it was possible to identify the objectives that have been realized during the last two decades. In order to realize the proposed objectives, suitable breeding materials and methods were selected and planned work was started. The following is a general review for the suggested objectives and the proposed materials and methods.

1.1.Objectives Identified:

- Develop and release new varieties, possessing higher yield potential by developing new plant types (NPTs) and exploiting hybrid vigor.
- Develop and release new varieties tolerant to stress conditions such as salinity and drought to improve productivity of the saline soils widely spread in the Northern Delta and the coastal regions.
- Combine the new developed varieties with the following characteristics desirable to rice growers, marketing, and consumers:
  - Short or medium stature to resist lodging and to suite both manual and mechanical harvesting.
  - Genetic resistance to blast and stem borer, as the most serious pests of rice in Egypt.
  - Short growth duration (120 – 135 days) to save irrigation water and increase crop intensification per unit area of cultivable land.
  - Superior grain quality characters, particularly high milling percentage, translucent endosperm, and good cooking and eating qualities.

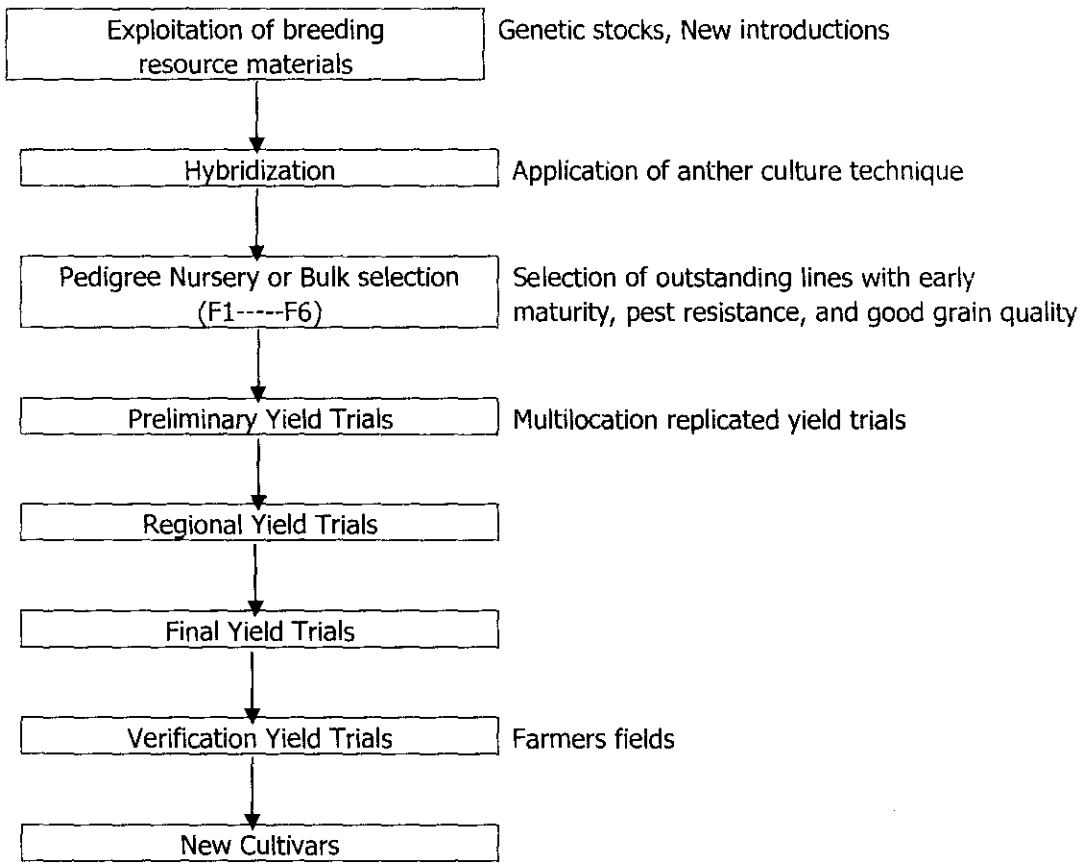
1.2. Proposed Materials and Methods:

As mentioned before, the most important objective is to develop new modern varieties with new plant type to replace the old traditional japonica varieties. The suggested new plant type could be similar to IRRI indica plant type with short and stiff stature, erect leaves, long and broad flag leaf attached with long and dense panicles. The new plant type permits high penetration and absorption of solar energy and an increase in photosynthetic efficiency resulting in greater accumulation of assimilates.

Rice varietal improvement program has been successful in introducing and incorporating this new plant type into the local materials through the fruitful and effective collaboration with IRRI that started in early 1970 (IRRI DG Report 2000 – 2001). A large number of advanced breeding lines, segregating early generation materials, and genetic stocks have been brought to the National VIP through the so-called IRRI Shuttle Breeding Program (SBP) since 1970 till now. Also, in order to increase research interaction with IRRI, Egypt has participated in the International Rice Testing Program (IRTP) starting from 1976. Under this program, more than 1000 varieties and lines are received every year to be evaluated in Egypt. The most suitable and useful lines with remarkable traits were selected to widen the genetic base of the local breeding materials for all major economic traits, especially those related to the new plant type.

As a result of these efforts, our varietal improvement program has been successfully to change the rice varietal map in Egypt during the last two decades. Several modern varieties having new plant type (NPT) were developed, released, and widely spread as commercial varieties (Tantawi and Maximos1998 and Tantawi *et. al.* 2002). These varieties are superior to the old traditional varieties in yielding potential, resistance to the major diseases and insects, earliness and excellent grain quality characters. Some of these varieties have a good tolerance to soil salinity and drought condition. The breeding procedures utilized and applied for developing the new modern varieties are shown in Fig. 1.

Fig 1. Breeding Procedures of the Egyptian Rice Varietal Improvement



2. An Overview on the Results and Achievements of the RVIP During the Last Two Decades (1982 – now).

In the seventies and until the mid eighties, the old traditional varieties, Giza 171 and Giza 172 were predominantly grown in Egypt and occupied more than 90% of the total rice acreage. Both varieties were late maturing (150 – 160 days), highly susceptible to blast which is the most dangerous disease to rice in Egypt, had undesirable plant type with tall weak stems susceptible to lodging, and with medium yield potential. From 1985, RVIP accelerated the breeding research work to overcome the disadvantages of Giza 171 and Giza 172. The efforts of rice breeders succeeded to realize the proposed objectives previously mentioned in this paper. Results could be summarized as follows:

1. Develop and release a group of new modern varieties with excellent new plant type. The new varieties are widely spread after their release replacing the old traditional varieties Giza 171 and Giza 172 because they are more acceptable to both rice growers and consumers. They are also superior to the old varieties concerning yield potentiality and other agronomic and quality characteristics. Table (1) summarizes the yield and ancillary characteristics of the new modern rice varieties.
2. Rice productivity and production were markedly increased during the mentioned period, to the extent that it covered the local consumption with a surplus of milled rice every year for exportation. Data in table (2). demonstrate the increase in productivity (national yield average) and national production year after year according to the percentage increase in the area of the modern varieties over the area of the old varieties. When the area of the MV was 0% in the base period 1986- 88, productivity and production recorded the lowest values (5.7 t/ha and 2.4

million. tons respectively)(Table 2). After the adoption of the modern varieties, productivity and production increased year after year to reach the maximum values in the year 2004 (9.9 t/ha and 6.6 million. tons respectively) when the MV covered about 99% of the total rice area.

3. A big saving in amount of irrigation water each year as a result of developing and growing new modern varieties with short growth duration (120-135 days) replacing the old traditional varieties with long growth duration (150-160 days). According to the results of the water management experiments carried out to identify the water consumption of both modern and old varieties, water consumption of the modern varieties was about 16600 m3/ha against 23600 m3/ha for the old varieties (Giza 171 and Giza 172). This result proves that

Egypt can save 7000 m3/ha of irrigation water if the rice area is cultivated with short duration varieties. Data in Table (3) showed that Egypt saved about 41 milliards of cubic meters of irrigation water during the period 1989-2004 due to increasing the area of the modern varieties and decreasing the area of the old varieties. As shown in Table (3), modern varieties covered almost 99% of the total rice area during the last three years (2002 -2004). This enabled Egypt to save about 4.5 milliard cubic meters of irrigation water each year. Moreover, the modern short duration varieties have enabled farmers to increase crop intensification rate per unit area which leads to an increase in national and income.

4. Minimize or completely stopping the use of chemicals for controlling blast which is considered the most serious rice disease in Egypt. This is because the new varieties are genetically resistant to the blast disease. As a result, the rice area treated with chemicals against blast disease decreased year after year during the period of 1989-2004, Table(3). Decrease or stop using chemicals in the rice fields would also lead to save money and efforts as well as minimize the environmental pollution.
5. Improve rice productivity and production of the saline and poor fertile soils widely spread in the North Delta by planting some of the new modern varieties recently developed such as Giza 178 and Sakha 104. These new varieties have a good tolerance to salinity as well as drought condition.
6. Develop and release aromatic rice variety called "Egyptian Yasmin" mainly for exportation because the aromatic rice is now an important commodity in the international trade (Sing*h et al* 2000).
7. The more recent accomplishment of the rice varietal improvement program in Egypt has been the development of local hybrid varieties which yield 15-20% more than the local commercial varieties (Bastawisi *et al.* 2003).

3.Future Strtegies of the RiceVarietal Iprovement Program in Egypt

The greatest challenge to the rice breeder is how to produce more clean rice with less water. Therefore, breeding efforts are directed towards improving yield potential, resistance to disease and insect pests, tolerance to environmental stresses, and high grain quality. The future strategies of this program could be summarized in the following points:

- Continuation of efforts to develop early maturing duration (110 – 120 days) high yielding varieties. Improve yield potential > 12t/ha, with better resistance to major diseases and insects to reduce or stop the use of chemicals to save money and contribute to a healthy environment.

- More research towards developing varieties with better response to biocultural conditions that produce good yield without resort to chemical fertilizers.
- Continuation of efforts to develop new hybrid varieties for exploiting the potential of this technology for increasing rice yields in Egypt.
- Intensified research on developing varieties with wide adaptation and specific grain quality.
- Expansion of research on allelopathic genes providing genetic control of rice weeds to reduce the use of herbicides.
- Developing early maturing, high yielding aromatic rice varieties more suitable for export.
- Intensified research on combining biotechnological approaches (anther culture and molecular markers) with traditional breeding methods to accelerate rice varietal improvement and increase genetic diversity
- Continue with IRRI shuttle breeding and INGER program to accelerate rice breeding and enrich the local rice germplasm.

Table 1. Parentage, yield, and ancillary characteristics of the modern rice varieties developed and released during the last two decades, 1985 – 2005.

Varieties	Parentage	Yield (t/ha)	Year released	Duration (days)	Height (cm)	*Blast Reac.	Grain type	**Mill. %
a. Modern Vars.								
Giza 177	Giza 171/Yomji No.1//P1 No.4	9.8	1995	125	100	R	Short	73
Giza 178	Giza 175/Milyang 49	11.1	1995	135	98	R	Short	71
Sakha 101	Giza 176/ Milyang 79	12.0	1997	145	95	R	Short	72
Sakha 102	GZ 4096 – 7 – 1/ Giza 177	10.1	1997	125	108	R	Short	72
Sakha 103	Giza 177 / Suweon 349	10.2	1999	120	98	R	Short	73
Sakha 104	GZ 4096 – 8 – 1/ GZ 4100 – 9	10.9	1999	140	104	R	Short	72
Giza 182	Giza 181 / IR39422 – 163 – 1 – 3//Giza 181	11.6	1999	126	95	R	Long	70
Average		10.8		130.9	99.7	R		71.9
b. Old Vars.								
Giza 171	Nahda / Calady 40	8.3	1974	160	145	S	Short	72
Giza 172	Nahda / Kinmaze	7.6	1974	150	135	S	Short	71
Average		8.0		155	140	S	Short	71.5
c. Aroma Vars.								
Egyptian Yasmin	IR 362 – 43 – 8 – 11/ KDML 105	9.4	1997	145	100	R	Long	65

* Blast Reaction.= Leaf and Neck blast reaction
R= Resistant
** Mill. %= Milling %
S= Susceptible

Table 2. Impact of the introduction of modern rice varieties (MV) on rice production and productivity during the period of 1989 – 2004.

Year	Area (1000 ha)		Production (million tons)	Productivity (t / ha)
	Total	MV %		
Base Period 1986 - 1988	400	0	2.4	5.7
1989	413	30	2.7	6.2
1990	435	31	3.2	7.3
1991	454	36	3.4	7.3
1992	511	37	3.9	7.7
1993	538	40	4.2	7.7
1994	570	43	4.2	8.0
1995	588	44	4.8	8.2
1996	592	48	4.9	8.4
1997	651	37	5.5	8.4
1998	517	73	4.4	8.6
1999	655	76	5.8	8.9
2000	659	85	6.0	9.0
2001	563	91	5.2	9.3
2002	647	94	6.1	9.4
2003	633	98	6.2	9.8
2004	671	99	6.6	9.9

MV = Modern Varieties

Table 3. Impact of the introduction of modern rice varieties (MV) on irrigation water consumption and treated area against blast disease during the period of 1989 – 2004.

Year	Area (1000 ha)			WI – Saved (Milliards m3)	Treated area against Blast	
	Total	MV area	%		Total (1000 ha)	%
Base Period 1986 - 1988	400	---	---	0.00	133	33.3
1989	413	123	30	0.86	63	15.3
1990	435	135	31	0.95	45	9.7
1991	454	162	36	1.13	29	6.3
1992	511	189	37	1.32	34	6.6
1993	538	233	40	1.63	77	14.3
1994	570	235	43	1.65	41	7.0
1995	588	261	44	1.83	39	6.4
1996	592	295	48	2.07	41	6.9
1997	651	371	57	2.60	42	6.4
1998	517	377	73	3.64	27	5.2
1999	655	498	76	3.49	39	6.0
2000	659	560	85	3.92	25	3.7
2001	563	512	91	3.58	11	1.7
2002	647	610	94	4.26	10	0.6
2003	633	618	98	4.30	5	0.01
2004	671	664	99	4.60	9	1.00
Total	9097	5843	---	40.88	537	---
Average	568.6	365.2	---	2.6	33.6	---

WI= Water Irrigation.

MV= Modern Varieties. OV= Old Varieties.

Irrigation water consumption for one ha of MV= 16600 m3

Irrigation water consumption for one ha of OV= 23600 m3

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إنجازات برنامج تحسين أصناف الأرزفي مصر خلال العقدين الأخرين (١٩٨٥ – ٢٠٠٤) والاستراتيجية المستقبلية للبرنامج

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جمهورية مصر العربية

يعتبر محصول الأرز من أهم المحاصيل الحقلية في مصر، لكونه غذاء رئيسياً بعد القمح ولأنه المحصول الزراعي التصديري الرئيسي ويتوازي مع القطن في هذه الأهمية كما أنه محصول مهم لإصلاح الأراضي الملحية والضعيفة المنتشرة في شمال الدلتا كما يعتبر الأرز محصولاً اجتماعياً مربحاً لعائلات المزارعين في مناطق زراعته حيث يمكن لجميع أفراد العائلة العمل بحقول الأرز طوال موسم زراعته لكسب الرزق وزيادة الدخل .

ولهذه الأسباب فإن وزارة الزراعة واستصلاح الأراضي المصرية تولي هذا المحصول اهتماماً كبيراً حيث تم إنشاء مركز إقليمي للبحوث والتدريب في الأرز في منطقة سخا بمحافظة كفر الشيخ ، تم افتتاحه في عام ١٩٨٧ وذلك بالتعاون مع الهيئة الدولية للمعونة الأمريكية ، وأيضاً تم تشكيل حملة قومية للنهوض بمحصول الأرز تتولى الإشراف على كل ما يتعلق بالزراعة والإنتاج والتسويق وإرشاد المزارعين بالتوصيات الفنية الخاصة بالعمليات الزراعية وحل المشاكل التي تواجههم .

وكنتيجة لهذا الاهتمام فقد حدث تقدم كبير في إنتاج وجودة هذا المحصول خلال العقدين الآخرين مما جعل مصر تتبوأ المرتبة الأولي على المستوي الدولي في السنوات الخمس الأخيرة .

وقد لعب برنامج تحسين الأصناف كأحد مكونات البرنامج القومي لبحوث االأرز الدور الرئيسي في النهوض بهذا المحصول ورفع إنتاجيته وتحسين جودته .

وفيما يلي ملخص لأهم إنجازات هذا البرنامج خلال العشرين عاماً الماضية:

* استنباط أصناف جديدة ذات طراز نباتى جيد وتحوي عدداً كبيراً من الصفات المرغوبة التي يتطلع اليها كل من المزارع والتاجر والمستهلك المحلي والأجنبي وهي جيزة ١٧٧ ، جيزة ١٧٨، سخا ١٠١، سخا ١٠٢، سخا ١٠٣، سخا ١٠٤ وهذه المجموعة تعرف بما يسمي بمجموعة

الأصناف قصيرة الحبوب بالإضافة إلي مجموعة الأصناف التي تتميز بصفات خاصة ترغبها الأسواق الخارجية كطول الحبة والصفات العطرية وهما الصنفان طويلا الحبوب [جيزة ١٨٢ ، ياسمين المصري] . وتتراوح إنتاجية هذه الأصناف ما بين ٩-١٢ طن للهكتار(٣,٧٨ – ٥,٠٤ طن للفدان)

* تتميز الأصناف الجديدة بالمقاومة الذاتية (الوراثية) لأهم أمراض الأرز وهو مرض اللفحة وأيضاً لأهم الحشرات التي تصيب الأرز في مصر وهي الثاقبات – وقد أدي هذا

إلي تقليل استخدام المبيدات الكيماوية لمكافحة هذه الآفات وبالتالي خفض التكاليف وتقليل التلوث البيئي .

* تتميز الأصناف الجديدة بالتبكير وقصر فترة النمو (١٢٠-١٣٥ يوماً) مقارنة بالأصناف التقليدية القديمة طويلة العمر (١٥٠-١٦٠ يوماً) . وهذا يعتبر إنجازا مهماً لأن زراعة هذه الأصناف توفر حوالي ٣ مليار متر مكعب من مياه الري توجه إلي المشروعات الإنتاجية الكبرى كمشروع توشكي والعوينات - علاوة على أن هذه الأصناف تساهم في زيادة التكثيف المحصولى في مصر .
* تتميز بعض هذه الأصناف بتحمل ملوحة وقلوية التربة كالصنفين جيزة ١٧٨ ، سخا ١٠٤ وهذا يساهم بقدر كبير في تحسين إنتاجية هذه الأراضي وتحسين خواص التربة بها

* ونظراً لأهمية الأصناف ذات الرائحة العطرية في الأسواق الدولية فقد تمكن برنامج تحسن الأصناف من استنباط الصنف العطري " ياسمين المصري " والذي يساهم كثيراً في زيادة التصدير .
* ومن أهم الإنجازات الحديثة لبرنامج تحسين الأصناف استنباط بعض أصناف الأرز الهجين لاستغلال ظاهرة قوة الهجين والتي ستساهم كثيراً في رفع إنتاجية الأرز في مصر من ١٥-٢٠% عن الإنتاجية الحالية (٤,٢ طن / فدان) .

أمافيما يتعلق بالإستراتيجية المستقبلية لبرنامج تحسين أصناف الأرز فهي تتمثل في النقاط التالية :-

- الاستمرار في استنباط أصناف الأرز الهجين وزيادة مساحتها عاما بعد عام .
- استنباط أصناف مقاومة ذاتياً لحشائش الأرز والتي تحمل ما يسمي بجينات أليلوباثية **Allelopathic genes** مما يقلل من استخدام مبيدات الحشائش
- استنباط أصناف تستجيب للزراعة الحيوية تعطي محصولا جيداً سدون استخدام الأسمدة الكيماوية .