Rice agronomic research in Egypt

Tantawi Badawi A.

in

Chataigner J. (ed.).
Perspectives agronomiques de la culture du riz en Méditerranée : réduire la consommation de l'eau et des engrais

Montpellier : CIHEAM
Cahiers Options Méditerranéennes; n. 15(1)

1996
pages 71-76

Rice agronomic research in Egypt

A. Tantawi Badawi
Agricultural Research Center (Egypt)

I – Introduction

Rice is one of the most important crops in Egypt and its production plays a significant part in the strategy to overcome food shortage and improve self sufficiency. It is grown on about one million feddans (about 0.42 million ha). Because of the limited land available for cultivation in Egypt, further increase in rice production from increased yield per unit area is needed. This can be achieved through varietal improvement, optimization of cultural practices as well as the control of weeds, diseases and insects.

Rice is grown as a labor-intensive crop requiring much labor. However, shortage in field labor has become evident in recent years. Transplanting being one of the most labor consuming practice, the area of transplanted rice is decreasing year after year. The direct-seeded rice area reaches about 20–25% mostly occupied by pre-germinated seeds sown in shallow water.

To get the package of recommendations needed to improve the production of transplanted and direct seeded rice, a series of experiments were conducted at the Rice Research and Training Center (Sakha, Kafr El-Sheikh, Egypt). From these experiments, the following conclusions can be drawn as a base for the package of recommendations for transplanted and direct seeded rice in Egypt.

II – 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:

1. Developing technology for efficient use of micro- and macro-nutrients for different rice genotypes and soil conditions.
2. Evaluation of new fertilizer compounds and growth regulators.
3. Optimizing cultural practices for transplanted, broadcasted, drilling and dibble seeded rice.
4. Applying appropriate water management practices for each method of planting.
5. Adapting research for mechanization of small holder rice cultivation for crop planting and harvesting.
6. Updating agronomic recommendations to accomodate 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:

1. Nutritional requirements (N, P, K & Zn) for different rice varieties and promising lines.
2. Studies of timing, method of placement and rate of nitrogen as affected by the new shorter statured rice genotypes that are more nitrogen responsive.

3. Studies on the cultural practices associated with the development of early maturing lines, and limited tillering lines under different methods of planting.

4. Studies on water management and the effects of withholding irrigation at different growth stages.

5. Studies on the use of growth regulators, urease and nitrification inhibitors and bio-fertilizers.

6. Evaluation of compound fertilizers containing both macro- and micro-nutrients.

7. Studies on zinc and other micro-nutrients to determine the special need for micro-nutrients and the most efficient means of applying them.

8. Studies on adapting all agronomic practices to salt affected soils.

III – Achievements

1. Need to sow within the first 3 weeks of May and transplant with seedlings of 25–35 days age at 20 x 20 cm spacing *(table 1)*.

2. Modification of N rate between tall and short statured varieties from 96 kg/ha to 144 kg/ha *(figure 1)*.

3. Applying $ZnSO_4$ to the nursery at 48 kg/ha, since nursery is the simplest method of including Zn in the nutrient management package *(figure 2)*.

4. Fertilizer N recovery—using tracer techniques—vary from 10% to 40% depending on time and method of application *(figure 3)*.

5. Greater importance of splitting the application for salt affected soils *(table 2)*.

6. Modified IRRI drum seeder as a means of direct seeding, rice can give yields comparable to broadcast seeding *(table 3 and figure 4)*.

7. 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 *(table 4)*.

8. The most sensitive growth stage for irrigation is the reproductive stage *(table 5)*.

9. Timing of N applications for:
   a) Transplanted rice: 2/3 basal & 1/3 PI
   b) Broadcasted: 1/3 basal, 1/3 maximum tillering and 1/3 PI
   c) Drilling: 1/2 PBF and 1/2 at PI *(figure 5)*

10. Use of unrease inhibitor (NBPT) minimized N losses resulting in increased grain and N uptake *(table 6).*

IV – FAO-RRTC collaborative research

In Egypt, varietal improvement plays an important role in yield increment of rice. The commercial cultivars currently used in Egypt are long, medium and short duration. The characteristics of high-yielding cultivars (GZ 4120, Giza 176, Giza 181 and IR 72) in Egypt were physiologically evaluated when transplanted and fertilized by the recommended dose of N (150 kg/ha) as shown in *table 7*. The data indicated that LAI and flag leaf area as a photosynthetic area were higher in medium duration varieties (Giza 176 and Giza 181), followed by the long and short duration varieties (GZ 4120 and IR 72). It can be also noticed that dry matter content was improved and gave higher value in medium duration varieties than the other tested varieties. It might be due to the increases in the LAI and flag leaf area. The HI of medium duration varieties was higher (0.48 to 0.49) than the long duration (IR 72) and short duration varieties (GZ 4120). It can be also observed that medium duration varieties gave better yield than the long and short duration varieties. It could be attributed to the increase in LAI and biomass production at heading, that translocated direclty to the panicles.

V – The relationship between LAI and the number of spikelets as well as grain yield

In accordance with yield increment of cultlivar, medium duration varieties which had optimum leaf area index (8.01–8.05) accumulate sufficient amount of biomass and gave higher yield (about 10.2–10.3 t/ha) as shown in *table 7* and illustrated in *figure 6 b*.

Increasing yield potential of rice varieties is determined not only by sufficient source of photosynthates, but also by the sink capacity of spikelets for receiving photosynthates from the leaves.

The medium duration varieties which had LAI about 8 produced more that 40,000 spikelets/m^2, while short and long duration varieties which had LAI about 5–6 gave about 30,000 spikelets/m^2 as illustrated in *figure 6a*.

The distribution and accumulation pattern of assimilates of a cultivar is one of the most important characters of high yield. The long duration and tall varieties translocated most of their assimilates into straw. So their harvest index (HI) were low (0.3–0.4). In the semidwarf and medium duration varieties, yields were significantly increased through a change in the distribution pattern, through which more assimilates were translocated to the grain, so that the HI went up to 0.48–0.49 and the grain yield reached more than 10 t/ha *(figure 7)*.

The medium growth duration varieties, as high yieding ones in Egypt, are long enough to allow a cultivar to accumulate sufficient amount of dry matter content for high yield and for the heading and grain filling stages. So, Giza 176 and Giza 181 which accumulate about 12.14 to 12.32 t/ha dry matter yield produced about 10.21 to 10.3 t/ha grain yield as shown in *table 7* and in *figure 8*.

VI – Rice varieties as affected by levels, time and methods of N application after leguminous and non leguminous crops

This investigation was conducted to identify the nitrogen requirements for each traditional and new Egyptian rice varieties when transplanted after leguminous and non-leguminous crops. *Table 8* indicated that Giza 171, as a long stature rice variety, responded to 100 kg N/ha when transplanted after clover while, after barley, its response extended to 150 kg N/ha. Moreover, Giza 175, Giza 176 and Giza 181, as short stature and medium duration varieties, as well as GZ 4120, as a short duration variety, responded to 150 kg/ N/ha when transplanted after clover.

Regarding the effect of methods of N application, data in *table 9* indicated that there was no significant differences when nitrogen fertilizer was applied as single dose (all incorporated in the dry sol before planting) or as double split (2/3 incorporate in dry soil + 1/3 at PI) and triple split (1/3 incorporate in dry soil + 1/3 at mid-tillering + 1/3 at PI).

Table 1. Effect of sowing dates on rice yield

Date of sowing	Grain yield t/ha	Yield decrease kg/ha/day
20 May	9.33	–
1st June	7.92	140
10th June	5.34	260

Table 2. Grain yield of broadcast seeded rice Giza 176 as affected by different levels and method of nitrogen application under saline soil condition

Main effets	Grain yield (t/ha)
Nitrogen levels (kg/ha)	
0	3.18
48	4.65
96	4.51
144	4.28
F test	*****
LSD 5%	**0.69**
Methods of nitrogen application	
All 25 DAS	4.05
2/3 25 DAS + 1/3 PI	4.32
1/3 25 DAS + 1/3 50 DAS + 1/3 75 DAS	4.11
1/4 Inc. + 1/3 25 DAS + 50 DAS + 1/4 PI	4.14
F test	**NS**
LSD %	**–**
Interaction F test	**NS**

EC: 9.2; pH: 7.6

Table 3. Effect of some planting methods on yield of Giza 175 rice variety (normal soils)

Planting methods	* Panicle/m2	Panicle weight (g)	Grain yield (t/ha)
Broadcasting	533	2.40	9.63
Drilling	510	2.43	8.95
Transplanting	500	2.68	8.51
Dibbling	512	2.46	9.03
IRRI drum seeder	525	2.59	9.49
LSD (%)	**22**	**NS**	**0.79**

Table 4. Response of two rice varieties to N, P, K & Zn

N	P_2O_5	K_2O (kg/ha)	$ZnSO_4$	G.176	G. 181 (t/ha)	Mean	Reduction (%)
Control	–	–	–	7.57	7.58	7.57	28.44
144	36	58	48	10.38	10.77	10.58	
144	36	58	–	9.70	9.66	9.68	8.50
144	36	–	48	9.77	10.09	9.93	6.14
144	–	58	48	9.57	9.85	9.71	8.22
Mean				**9.40**	**9.59**	**9.50**	**10.20**

Average of 70 trials.

Table 5. Effect of irrigation intervals along the growth period of rice (Giza 176)

Treatments No.	Irrigation intervals period of growth 1st	2nd	3rd	Grain yield (t/ha)	%	Water requirement (No. of irrigations)	CM	Save (%)
1	6	4	6	9.8 a	102	18	119.5	–
2	6	6	6	9.6ab	100	16	114.3	–
3	6	6	8	9.3	97	14	106,7	–
4	6	8	8	8.9b	93	14	103.2	–
5	8	6	8	9.2ab	96	13	104.0	–
6	8	6	10	9.0b	94	12	100.0	–
7	8	8	8	8.9b	93	12	100.5	–
LSD 5%		**0.6 req. = 34 cm + WT**						
1	Sub	Sub	Sub	10.1	105	31	152.0	–
2	Sub	Sat	Sat	9.7	100	31	111.3	27
3	Sat	Sub	Sat	9.5	99	30	82.5	46
4	Sat	Sat	Sat	9.4	98	30	69.3	54
5	Irrigation every 6 days			9.7	100	16	121.0	20
LSD 5% NS		**Total W. req. = 34 cm + WT**						

Table 6. Yield and N uptake as affected by unrease inhibitor NBPT*

Treatment (g/pot) **Urea**	**Grain Urea w/NBPT**	**Increase yield** (g/pot)	**from NBPT** (%)	**Total N uptake** (g/pot)**	**Increase from NBPT** (%)
–	–	35.8	–	36.8	–
3	–	43.4	–	89.2	–
–	3	67.8	56	119.2	34
6	–	72.4	–	147.3	–
3	3	92.8	28	199.3	35
12	–	123.0	–	258.6	–
9	3	113.8	–	259.0	–
LSD 5%	**33.8**	**44.4**			

***** NBPT = N-(n-butyl thiophosphoric triamide); ****** Includes N from both grain and straw.

Table 7. Physiological evaluation of some rice varieties (1993)

Treatments (kg N/ha)	**Varieties**	**Tillers/m²**	**LAI** (cm)	**Flag LA** (t/ha)	**DWH Yield**		**HI**
	GZ 4120	220	2.73	8.98	8.67	5.42	0.36
Zero	Giza 176	228	3.02	10.51	9.58	6.14	0.40
	Giza 181	238	3.15	13.72	9.71	6.82	0.41
	IR 72	335	2.81	8.12	9.41	6.48	0.40
150 kg	GZ 4120	284	5.94	16.24	11.46		
N/ha	Giza 176	307	8.01	18.18	12.14	10.21	0.48
	Giza 181	312	8.05	18.12	12.32	10.30	0.49
	IR 72	406	6.29	14.07	11.75	9.38	0.44

DWh = dry weight at heading.

Table 8. Rice varieties as affected by levels, time and methods of N application after leguminous and non-leguminous crops
Effect of N fertilizer in the grain yield

Treatments	Varieties	Kg N/ha					
		Control	50	100	150	200	Mean
	Giza 171	8.04	9.62	9.95	9.56	8.59	9.15
After legume	Giza 175	8.48	10.78	11.40	10.65	10.13	10.29
	Giza 176	8.59	11.04	11.10	10.72	9.94	10.28
	Giza 181	8.84	11.01	11.32	11.04	10.92	10.63
	GZ 4120	7.41	9.54	9.98	10.05	9.20	9.04
	Mean	**8.27**	**10.39**	**10.55**	**10.40**	**9.76**	
After non-legume	Giza 171	5.20	6.09	6.50	8.24	–	6.51
	Giza 176	5.48	7.06	8.31	9.39	–	7.56
	Giza 181	5.57	7.11	8.28	9.52	–	7.62
	GZ 4120	5.17	6.58	7.40	8.98	–	7.03
	Mean	**5.36**	**6.71**	**7.62**	**9.03**	**–**	

Table 9. Effect of methods of N application

Treatments	Varieties	M1	M2	M3	Mean
	Giza 171	9.24	9.28	9.77	9.43
	Giza 175	10.82	10.65	10.75	10.74
After legume	Giza 176	11.00	10.50	10.59	10.70
	Giza 181	11.33	10.89	10.99	11.07
	GZ 4120	9.41	9.07	9.86	9.45
	Mean	**10.36**	**10.08**	**10.39**	
After non-legume	Giza 171	6.78	6.81	7.04	6.87
	Giza 176	8.04	8.36	8.35	8.25
	Giza 181	8.29	8.24	8.38	8.30
	GZ 4120	7.57	7.68	7.62	7.62
	Mean	**7.67**	**7.77**	**7.84**	

M_1: all incorporation; M_2: 2/3 incorporation + 1/3 at PI; M_3: 1/3 incorporation + 1/3 at MTS + 1/3 at PI.