IMPROVED RICE CULTURAL PRACTICES IN EGYPT

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Abstract

Optimizing package of recommendation of rice cultural practices is required continuously to maintain and sustain productivity as well as maintaining soil fertility .New technologies of cultural practices and fertilizer management such as optimum sowing date, plant spacing, number of seedling per hill, seedling age and seeding rate are introduced to increase the productivity of traditional and newly released rice varieties and lines. Because the rice plant is a short day plant, planting rice later than 15 May causes a reduction in its duration and reaches flowering stage earlier. The short duration varieties are less sensitive to days length than medium or long duration ones. Under Egyptian condition, the optimum date of sowing is the first two weeks of May. Early sowing (at April 1^{st}) exposes the seedling to low temperature specially during night and causes a damage in seedling consequently weak seedling vigor. Transplanting spacing is always identified according to the tillering capacity of the variety. The optimum spacings are 20 x 20 for high tillering varieties and 15 x 20 for the medium tillering varieties, while for low tillering varieties 10 x 20 was the optimum. Four transplants per hill were the optimum for most of the Egyptian rice cultivars under all transplanting spacings. Seeding rate in broadcast seeded rice was identified according to seed indx. The varieties having heavy seed index (ranging from 26-30 g) need 120 to 144 Kg seeds/ha, while those having light index of (25g) need from 96 to 120 seeds/ha. The optimum seedling age for transplanting Egyptian rice varieties is 25 to 30 days, because under this age the rice plant gave the highest number of effective tillers. Also, to rationalize the use of nitrogen fertilizer and increase its efficiency, 165 Kg N/ha in form of urea or ammonium sulfate is recommended as two splits after transplanting rice (2/3 of the amount incorporated into dry soil before transplanting + 1/3 just few days before panicle initiation).For broadcasted seeded rice, three split doses are needed (1/3 incorporated in dry soil before planting + 1/3 30 days from sowing + 1/3 60 days from sowing). Super phosphate 15% P_2O_5 is always applied before blowing at the rate of 36 P_2O_5/ha. Potassium is not recommended to rice soil in Egypt because the Egyptian soil is very rich in potassium except in saline soils, or these have poor drainage systems. Zinc deficiency is common in most of Egyptian soils, so, application of zinc sulphate at the rate of 57 Kg $ZnSO_4$/ha in nursery is recommended.

Utilizing organic fertilizer such as rice straw or rice husk at the rate of 5 tons/ha + 110 Kg N/ha gave the highest grain yield.

Also, application of Farmyard manure (FYM) at the rate of 7ton /ha+ 110 kg N/ha produced higher grain yield and saved about 55 Kg N/ha. Water management for rice in term of increase water use efficiency and saving some of irrigation water without reduction in yield is also considered. Using irrigation intervals (every 4 days) or saturation treatment with short duration varieties saved 30-33% of irrigation water and increased water use efficiency by about 68%.

Under saline soil condition, the optimum date of sowing should be earlier to avoid the negative effect of high temperature. April 20 to May 10 is the optimum date of sowing with 20 days seedling age. Narrow transplanting spacing (15 x 20 cm) with 4 to 6 seedlings per hill were the optimum density and gave higher grain yield. Splitting nitrogen fertilizer to three or four doses is recommended. The optimum dose of nitrogen is 144 /ha if the previous crop was legume and 165 kg/ha when rice came after non leguminous crops. Potassium should be applied at the rate of 57 kg K_2O /ha and zinc at the rate of 24 kg zinc sulphate/ha under salinity condition. Farmyard manure at the rate of 10 tons/ha along with 120 kg N/ha as urea gave highest grain yield and saved about 45 kg N/ha. Continuous flooding irrigation is necessary under salinity condition, while water deficit causes yield reduction for rice. Using salt-tolerant varieties such as Sakha 104 and Giza 178 with the previous recommendation inhances rice yield under saline condition.

INTRODUCTION

Optimizing package of recommendation of rice cultural practices is required continuously to maintain and sustain productivity as well as maintaining soil fertility .New technologies of cultural practices and fertilizer management such as optimum sowing date, plant spacing, number of seedling per hill, seedling age and seeding rate are introduced to increase the productivity of traditional and newly released rice varieties and lines.

Also, rationalizing the use of chemical fertilizers and increase the efficiency and the utilization of the organic and bio-fertilizes as well as micronutrient elements and water management are elements of package of recommendations for the traditional and promising new rice varieties.

1.Cultural practices and rice physiology in normal soil :

1.1.Sowing date :

Sowing date is a major factor for rice growing as it directly influences the physiological processes that affect the rice plant growth, development through day length and temperature (Yoshida 1972).

Number of days from sowing to panicle initiation or to flowering always change under different dates of sowing due to the changes in the day length and temperature (Penning de Vries *et al.* 1989).

Table 1. Identification of number of days to maximum tillering (MT), panicle initiation (PI) and heading date (HD) under different data of sowing for some Egyptian rice varieties.

variety	Growth stages	Date of sowing						
		15/4	1/5	15/5	1/6	15/6	BVP	PSP
Giza 177	Mt	67	65	61	55	46	-	-
	PI	71	69	65	60	53	-	-
	HD	97	95	92	87	84	49	13
Sakha 102	Mt	65	63	61	57	48	-	-
	PI	71	69	66	62	55	-	-
	HD	97	95	90	88	83	48	14
Sakha 103	Mt	65	61	56	52	45	-	-
	PI	70	65	62	58	52	-	-
	HD	97	95	93	88	83	48	14
Sakha 101	Mt	78	66	64	58	54	-	-
	PI	84	70	69	63	61	-	-
	HD	109	105	103	95	88	53	21
Sakha 104	Mt	76	69	66	62	58	-	-
	PI	80	73	70	68	62	-	-
	HD	111	106	104	96	89	54	22

BVP = Basic vegetative phase = highest heading date-35

PSP = Photoperiod sensitive phase = highest heading date– lowest heading date

Data in Table (1) revealed that number of days from sowing to MT, PI and HD decreased under late sowing. It is also easily to notice that short duration varieties (Giza 177, Sakha 102 and 103) are less sensitive to day length and gave lower PSP compared to medium duration varieties (Sakha 101 and Sakah 104).

Grain yield gradually decreased by delaying sowing date. Medium duration cultivars (Sakha 101 and Sakha 104) gave higher yield than short duration cultivars (Giza 177, Skah 102 and Sakha 103) (Table 2) .

Table 2. Grain yield (t/ha)of some Egyptian rice cultivars as affected by sowing date.

Cultivar	Date of sowing					Mean
	15/4	1/5	15/5	1/6	15/6	
Giza 177	8.01 b	8.22 b	8.97 c	7.41 c	5.36 c	7.54
Sakha 102	8.78 a	8.24 b	9.48 bc	7.55 c	5.70 b	7.95
Sakha 103	7.97 c	8.12 b	9.12 b	7.85 b	5.22 c	7.66
Sakah 101	8.88 a	9.16 a	10.10 a	8.29 a	6.50 a	8.58
Sakah 104	8.23 ab	9.05 a	9.89 a	7.83 b	5.57 b	8.11
Mean	8.38	8.56	9.51	7.78	5.67	

Planting rice early at April, 15th reduced grain yield by about 7.2 to 16.7%, while the reduction in yield under late sowing (June ,1st) ranged between 13.9 to 20.8 % and the reduction in the grain yield reached to 43.7% when rice was planted on June, 15th (Table 3).

Table 3. Effect of sowing date on reduction % in grain yield compared to optimum date of sowing.

Cultivars	Early sowing date (15/4)	Late sowing date (1/6)	Very late sowing date (15/6)
Giza 177	10.7	17.4	40.0
Sakha 102	7.2	20.4	39.8
Sakha 103	12.5	13.9	42.7
Sakah 101	12.1	17.9	35.6
Sakah 104	16.7	20.8	43.7

1.2.Planting density and controlling canopy :

Optimum plant density in terms of plant spacing and number of seedlings/hill for transplanted rice or seeding rate in direct seeding are very important for controlling plant canopy.

Efficient interception of radiant energy incident to the crop surface requires adequate leaf area, uniformly distributed to give complete ground cover. This is achievable by manipulating stand density and its distribution over the land surface (**Prine and Schroder 1964**).

1.2.1.Rice plant spacing :

The high tillering varieties such as Giza 178 and Sakha 101 performed better and gave the highest grain yield under wider spacing 20 x 20 cm , while the medium and low tillering capacity reached to the highest grain yield under medium spacing of 15 x 20 cm and narrow spacing of 10 x 20 cm respectively (Table 4).

Table 4. Effect of plant spacing on grain yield (t/ha) in different rice varieties.

Variety	Plant spacing (cm)		
	10 x 20	15 x 20	20 x 20
Sakha 101	9.74 b	11.46 a	11.78 a
Giza 178	9.68 c	10.89 b	11.08 b
Jasmine	9.91 b	10.02 c	10.20 c
Giza 182	9.35 ab	9.98 c	10.60 c
Giza 177	10.56 ab	10.47 ab	9.59 c
Sakha 102	10.32 ab	10.72 b	8.89 d
Sakha 103	10.82 a	9.62 d	9.54 c
Sakha 104	10.36 ab	10.79 b	9.64 c

Table 5. Grain yield of (t/ha) of rice varieties as affected by the interaction between plant spacing and N-levels.

Variety	Spacing cm	Nitrogen level(kg/ha)				Average
		0	110	165	220	
Sakha 101	10 x 20	9.59 e	11.14 c	12.19 b	12.43 a	11.33
	15 x 20	9.38 fe	11.50 b	12.41 a	12.53 a	11.45
	20 x 20	9.59 e	11.16 c	12.53 a	12.61 a	11.47
Sakha 104	10 x 20	9.06 f	10.05 de	10.73 cd	10.78 cd	10.15
	15 x 20	9.44 e	10.24 d	10.95 cd	10.70 cd	10.33
	20 x 20	9.08 f	9.98 e	10.60 d	10.17 d	9.95
Sakha 103	10 x 20	6.88 i	8.64 g	10.70 cd	10.91 cd	9.28
	15 x 20	6.80 i	8.73 g	10.02 de	10.41 d	8.91
	20 x 20	5.87 j	7.85 h	8.61 g	9.18 f	7.87

Grain yield of Sakha 101 as high tillering ability variety, Cv. Sakha 104 as medium tillering capacity and Sakha 103 as low tillering capacity cv. as affected by interaction between spacing and nitrogen levels are presented in Table 5. Data show that higher grain yield was obtained when Sakha 101 variety received 165 kg N/ha under 20 x 20 cm spacing followed by Sakha 104 when fertilized by 165 kg N/ha under 15 x 20 cm spacing. On the other hand, Sakha 103 responded positively to 165 kg N/ha under the space of 10 x 20 cm.

1.2.2.Number of seedling /hill :

Four seedlings/hill are optimum for most of the Egyptian rice varieties. Data in Table (6) show that 4 seedlings/hill of Sakha 101 variety gave the highest grain yield. On the other hand, 12 seedlings/hill gave the lowest yield. While the highest grain yield of Sakha 102 variety was obtained when 8 seedlings/hill was used although there was any significant difference between 4 and 8 seedlings/hill.

Table 6. Grain yield of Sakha 101 and Sakha 102 rice varieties as influenced by number of seedling/hill.

No. of seedlings / hill	Grain yield of Sakha 101(t/ha)	Grain yield of Sakha 102(t/ha)
4	9.60	9.12
8	9.54	9.22
12	9.03	8.91
L.S.D. 50%	0.43	0.78

1.3.Seedling age :

Young seedlings of 25 and 30 days produced higher grain yield than old seedlings (35 and 40 days), for all Egyptian rice varieties (Table 7). This could be attributed to the ability of young seedlings to produce more tillers in the permanent field than the old ones.

Table 7. Interaction effects between varieties and seedling age on grain yield (t/ha)

Variety	Seedling age (day)				Average
	25	30	35	40	
Sakha 101	11.51 a	11.46 a	10.30 b	9.44 d	10.67
Sakha 102	9.77 cd	9.08 e	8.56 f	7.70 g	8.77
Sakha 103	9.5 d8 d	9.41 d	8.58 f	7.68 g	8.81
Sakha 104	11.30 ab	11.29 ab	10.33 b	9.88 cd	10.70
Giza 177	10.24 c	10.33 b	9.93 d	9.13 de	9.90
Giza 178	10.84 b	10.44 b	10.24 c	9.63 cd	10.28
Giza 182	10.05 d	10.13 d	9.75 d	9.46 d	9.84
Average	10.47	10.37	9.67	8.98	

Yong seedling (25-35 days) perform better and gave higher LAI and number of effective tillers as shown in Fig. (1 & 2)

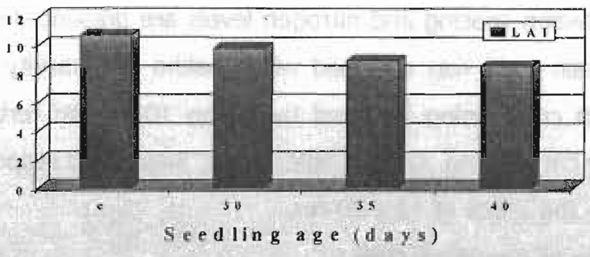

Fig. 1. LAI as affected by seedling age

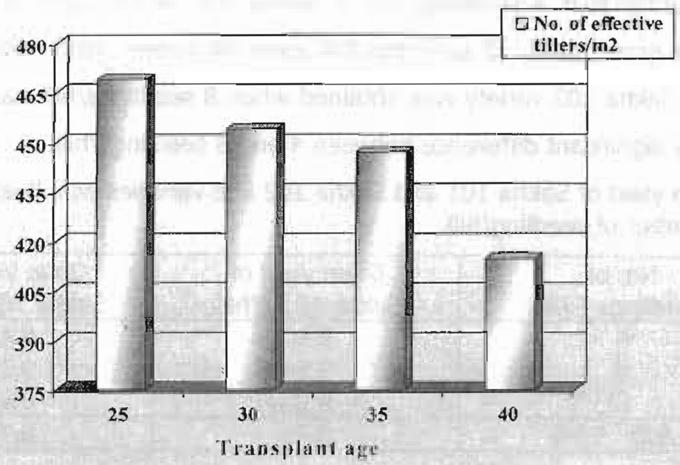

Fig. 2. Effect of seedlings age on number of effective tillers.

1.2.3.Seeding rate:

Seeding rate in direct seeded rice was identified according to the weight of grains of such variety. The varieties which have heavy seed index of 26-30 g/ 1000 seeds need from 120 to 144 kg seeds/ha, while the varieties which have 1000-grain weight ranging between 22-25 g need from 96 to 120 kg seeds/ha. (Table 8).

Table 8. Grain yield of some rice varieties as influenced by seeding rate in broadcast seeded rice.

Seed rate	Grain yield (kg/ha)		
Kg/ha	Giza 178	Sakha 103	Sakha 101
72	8.32 c	8.29 cd	8.40 e
96	9.22 c	8.57 c	9.28 d
120	10.42 a	9.07 b	9.91 c
144	10.51 a	9.87 a	10.17 b
168	10.02 b	9.11 ab	10.87 a
	9.69	8.98	9.72

1000-grain weight of Giza 178 = 22 g, Sakha 103 = 26 g and Sakha 101 = 29 g

1.4.Fertilizer Management

1.4.1.Mineral Nutrition:

Nutrients must be present in amounts and in forms usable by the plant. Under Egyptian conditions, N, P, K and zinc are the essential elements to be added to rice fields to optimize production (Hamissa *et al.* 1996).

Experiments indicated that flooded rice responds better to N application than to P or K. Response to N application, however, depends mainly on soil fertility status and soil condition.

1.4.1.1.*Nitrogen sources* : Rice can absorb and use ammonium – N, nitrate-N, urea –N and amino acid nitrogen. Ammonium is the major and stable form of N in submerged soils, nitrate is the major form in upland soils (Yosida 1981). Results of several research work on N- sources for rice under both normal and saline soil conditions showed that ammonium-N produced higher yield compared to nitrates.

Hamissa *et al.* (1996) in Egypt reported that urea and ammonium sulfate have the same effect on yield as N-sources for rice (Table 9).

Table 9. Effect of different N sources on grain yield of rice

N-Sources	Grain yield (t/ha)
Control	7.1 c
Sulfur-coated urea	10.0 a
Urea super granules	9.4 b
Urea	9.1 bc
Ammonium sulfate	9.0 be

1.4.1.2.Improved nitrogen fertilizer efficiency:

In most studies in transplanted flooded rice, only 20 to 40% of the applied nitrogen is recovered by crop (De Datta 1986) because of the extensive nitrogen losses that accompany poor fertilizer management.

In united states, where rice production was highly mechanized , the nitrogen use efficiency was maximized when applied 5-10 cm deep in the soil (Branden and Wells, 1986).

In Egypt, considerable scope still exists for improving the agronomic efficiency of nitrogen fertilizer. Two field experiments were conducted using urea labeled (N^{15}) in transplanted and broadcasted seeded rice., to : (1) estimate the total nitrogen loss and nitrogen use efficiency using various fertilizer management practices, (2) to give the potential NH3 volatilization from nitrogen applied at different times and methods of application, (3) determine N-balance sheet and grain yield (Abd El-Wahab 1993).

Under transplanted rice conditions, data in Table (10) indicate that deep placement, basal and incorporated nitrogen in dry soil and split into 2/3 basal + 1/3 seven days before panicle initiation (PI) gave the highest grain yield.

Table 10. Grain yield of Giza 175 variety as affected by various time and method of nitrogen application in transplanted method

Treatment	N-levels	N- sources	Grain yield (t/ha)
Control	-	-	7.10
2/3 basal + 1/3 at PI	75 kg N/ha	Urea	9.20
1/3 basal + 1/3 MT + 1/3 PI)	75 kg N/ha	Urea	9.20
2/3 15 DAT + 1/3 PI	75 kg N/ha	Urea	9.00
Point placement	75 kg N/ha	Urea super granules	9.60
All basal	75 kg N/ha	Urea	9.20
2/3 basal + 1/3 PI	75 kg N/ha	Ammonium sulfate	8.50
1/3 basal + 1/3 MT + 1/3 PI	75 kg N/ha	Ammonium sulfate	8.80
2/3 Basal + 1/3 PI	125 Kg N/ha	Urea	10.40
L.S.D. 5%			0.8

Basal = Basal and incorporated in dry soil before flooding and transplanting , PI= panicle initiation, MT= Maximum Tillering

1.4.1.3. Nitrogen balance sheet :

Nitrogen recovery was estimated from grain, straw and soil samples. Data are presented in Table (11). The data showed that incorporating either all the nitrogen amount or 2/3 into dry soil before flooding, minimized nitrogen losses (unaccounted) via volatilization, run off, locking immobilization and might be other ways of loss, i.e when nitrogen was applied late after transplanting in a wet soil or in the presence of floodwater.

Table 11. Nitrogen balance sheet in transplanted rice as affected by labeled urea applied at different dates and methods

Treatments (75 Kg N/ha)	N- recovery % from N-added				
	Grain	Straw	Soil	Total	Unaccounted
2/3 Basal + 1/3 PI	31.04	10.65	10.72	52.41	47.59
1/3 Basal + 1/3 MT + 1/3 PI	19.05	8.97	7.08	35.10	64.90
2/3 15 DAT + 1/3 PI	15.54	8.68	3.34	27.56	72.44
Point placement	33.94	16.76	17.09	67.34	32.66
All Basal	27.38	9.19	14.77	51.79	48.21
(125 Kg N/ha) 2/3 Basal + 1/3 PI	34.16	10.58	14.15	58.89	41.11
L.S.D. 5%	2.18	1.41	1.33	4.25	5.16

In direct seeded rice , the three-split method (1/3 basal + 1/3 at tillering stage + 1/3 seven days before panicle initiation was the optimum hence it decreased N- losses.

Data in Table (12) revealed that most of rice cvs responded for nitrogen up to the rate of 165 kg N/ha except Sakha 102 variety which gave the highest grain yield under 110 kg N/ha. It can also noticed that medium duration varieties (Giza 178 and Sakha 101) produced higher yield than the short duration varieties (Giza 177, Sakha 102 and Sakha 103).

Table 12. Yield response of newly and traditional rice varieties to nitrogen levels

N-levels Kg/ha	Giza 178	Giza 177	Sakha 101	Sakha 102	Sakha 103	Mean
0	6.67 c	6.14 d	6.85 d	6.88 c	6.67 d	6.66 d
55	9.73 b	8.98 c	9.72 c	9.05 b	8.09 c	9.11 c
110	10.00 b	9.09 b	10.06 b	9.87 a	8.92 b	9.75 b
165	10.52 a	9.75 a	10.97 a	9.80 a	9.37 a	10.08 a
220	10.46 a	10.06 a	10.69 a	9.01 b	9.92 a	9.93 a
275	10.35 a	10.25 a	10.32 b	8.89 b	8.84 b	9.83 a
	9.64 a	9.05 b	9.77 a	8.92 b	8.64 c	

1.4.1.4.Phosphorous :

Soil phosphorus increased remarkably with flooding time up to 12th week and the plant uptake increased as P availability increased (Ghanem *et al.*, 1995).

In Egypt, early studies on P fertilizer indicated that 36 Kg P2O5 /ha is the optimum rate of P application (Table 13), also, showed that yields of rice grown in flooded soils fertilized with P from different sources did not differ significantly (Table 14).

Table 13. Grain yield of some rice varieties as affected by phosphorous levels.

Main effect	Grain yield (t/ha)
Varieties :	
Sakha 101	11.57
Sakha 103	10.48
Giza 182	11.53
L.S.D. 5%	0.22
Phosphorous Kg P_2O_5/ha	
0	10.93
18	11.27
36	11.59
54	11.19
72	11.00
L.S.D. 5%	0.24

Table 14. Effect of different P sources on yield of rice grown under flooded condition

P source	Grain yield (t/ha)
Control	9.50 b
Single superphosphate	10.10 ab
Phospal (rock phosphate)	9.30 b
Guans (rock phosphate)	10.20 ab
Triple super phosphate	11.00 a

1.4.1.5.Potassium :

Under Egyptian condition potassium (K) deficiency occurs to limited extent in flooded rice especially in poorly drained soil and under saline condition, while under in saline soil, potassium deficiency is not common practice as most of Egyptian soils is rich in potassium content (Table 15).

Table 15. Effect of potassium levels on yield of rice (average of different varieties)

Main effect	Grain yield (t/ha)
Potassium (K_2O/ha)	
0	10.05 a
57	10.31 a
86	10.29 a
114	10.19 a

1.4.1.6.Zinc fertilizer and rice production :

Zinc is one of the most limiting factors affecting rice production in Egypt. The use of zinc fertilizer is strongly recommended by RRTC .

There are different levels and forms of applying zinc. Data in Table (16) indicate that 24 Kg of $ZnSo_4$/ feddan (about 57 kg/ha) applied to the nursery is enough to produce strong rice transplants and high grain yield.

Table 16. Effect of Zinc rates and sources on productivity of rice

Treatment		Grain yield (t/ha)
Control		8.62
6 Kg ZnO	(14 kg/ha)	8.80
12 Kg ZnO	(28 kg/ha)	10.67
24 Kg ZnSo4	(57 kg/ha)	11.08
48 Kg ZnSo4	(114 kg/ha)	10.21
Urea prorated with zinc		10.77
L.S.D. 5%		0.56

If Zn is not available during raising of nurseries, 10 kg $ZnSo_4$/fed. (24 kg/ha) has to be applied to permanent field. Also, spraying rice by 2% $ZnSo_4$ 50 days from sowing gave comparable yield.

1.4.1.7.Iron and Manganese :

Soil requirements to zinc, iron and manganese were investigated under the Egyptian saline conditions. Application of these micronutrients revealed that these element are effective in raising yield of rice and necessary before raising the nurseries or in the permanent field.

1.4.2. Organic nutrition:

The price of fertilizers are steadily increasing year after year. Thus there is a growing need, on global scale, to reduce the dependence of agricultural production on the commercial chemical sources of nitrogen. Howover, to maintain high productivity of crops and to conserve the environment from pollution as a result of excessive use of N fertilizer, utilizing organic and bio-fertilizers is necessary (Hamissa *et al.*, 1996).

1.4.2.1.Utilizing of rice husk and rice straw :

The application of rice straw or rice husk as compost with 2/3 of the recommended dose of N- fertilizer (as form of urea) improved grain yield of rice (Table 17). Data also showed that there was a big difference between rice straw or rice husk as compost plus 2/3 of the recommended dose of N and the complete dose of N fertilizer (165 Kg N/ha urea).

Table 17. Grain yield (t/ha) of Giza 178 rice variety as affected by urea plus rice straw and rice husk.

Treatment	Grain yield (t/ha)
Control	5.7 c
165 Kg N/ha as form of urea (Recommended)	8.82 a
Compost husk 6 ton/ha + 2/3 N recommended	8.39 ab
Compost straw 6 ton/ha + 2/3 N recommended	8.05 b

1.4.2.2.Utilizing Farmyard Manure (FYM) :

The value of organic manure (FYM) is not only supplying the crop with nutrients, but also improving the physical, chemical and biological properties of the soil (Hamissa *et al*, 1996). Applying 7 tons FYM plus 110 kg N/ha in form of urea gave higher grain yield than the recommended dose of N alone (165 kg N/ha) as shown in Table 18.

Table 18. Grain yield of Sakha 101 rice variety as influenced by different levels of N-fertilizer and farmyard manure (FYM)

Treatment	Grain yield (t/ha)
Control	4.05 dc
7 ton FYM /ha	4.48 d
55 kg N/ha	5.95 d
55 kg N/ha + 7 ton/ha FYM	7.40 c
110 kg N/ha	8.53 b
110 kg N/ha + 7 ton/ha FYM	9.47 a
165 kg N/ha	8.71 b
165 kg N/ha + 7 ton/ha FYM	8.50 b

The application of bio-fertilizer (Rizobacterine and biogene) with 110 kg N/ha increased grain yield by about 47.22 % from control (Table 19). The data also revealed that there was no significant difference between Rizobacterine or biogen and 110 Kg N/ha.

Table 19. Rice grain yield (t/ha) as affected by biofertilizer

Treatments	Grain yield (t/ha)	Increase from control
Control	5.40 e	-
110 Kg N/ha	8.00 a	48.15
Rizobacterine	5.85 d	8.33
Rizobacterine + 55 kg N/ha	6.85 b	26.85
Rizobacterine + 110 kg N/ha	7.95 a	47.22
Biogene	6.08 c	12.59
Biogene + 55 Kg N/ha	6.70 b	24.07
Biogene + 110 Kg N/ha	7.95 a	47.22

1.5.Water management:

Rice is commonly grown under continuous flooding irrigation with about 5cm depth of standing water throughout the growing season. Rices sown produce under this condition higher yield than those exposed to water deficit at certain growth stages.

Most of the Egyptian rice varieties had higher grain yield when soil water content was kept near saturation point throughout the seasons, which was comparable to that of continuous flooding (RRTC 1996).

To save irrigation water with minimum (or without) reduction in yield several studies have been carried out at RRTC, Egypt.

1.5.1. Varietal substitution :

One of the most important ways of saving irrigation water without reducing rice areas is to substitute long duration varieties with short-duration varieties. For example, substituting Giza 171 (155 days) with Giza 177 (120 days) or with Sakha 102 (125 days) saved about 20% of irrigation water. This amount could still be increased to about 30-40% under soil saturation conditions.

1.5.2 Withholding Irrigation Water:

Withholding irrigation water at certain times of the growth stages of rice can save considerable amount of irrigation water. However, sensitive stages have to be determined first before withholding irrigation water. (Table 20) shows the effect of withholding irrigation water for 12 days (2 weeks after transplanting up to maturity) on yield of Sakha 102. The study showed that rice plants can tolerate water deficit for 12 days at 4 weeks after transplanting and either 8, 9 or 10 weeks after transplanting or after full grain filling. Rice was also found to be very sensitive to water deficit soon after transplanting (seedling stage) at 6 and 7 weeks after transplanting (panicle initiation stage), and during the milky stage of grain filling. Exposing rice plants to any water deficit during these critical periods will significantly reduce yields.

Table 20. Effect of withholding irrigation at different dates on productivity of Sakha 102 rice variety

Treatment	Yield (t/ha)
12 days withholding, 15 DAT	6.4 d
12 days withholding, 21 DAT	6.8 cd
12 days withholding, 28 DAT	8.0 ab
12 days withholding, 35 DAT	7.4 bc
12 days withholding, 42 DAT	5.6 e
12 days withholding 49 DAT	6.8 cd
12 days withholding, 56 DAT	8.1 ab
12 days withholding, 63 DAT	8.1 ab
12 days withholding, 70 DAT	8.1 ab
12 days withholding, 77 DAT	6.7 cd
12 days withholding, 84 DAT	7.8 b
12 days withholding, 91 DAT	8.7 a

1.5.3.Irrigation intervals :

Another way of saving irrigation water is to use alternate irrigations during rice growing seasons. Continuous saturation methods save about 20.09 % of water with yield reduction of 3.98 % when medium duration variety Sakha 101 was used, while the water saved was 31.43 with yield reduction of 3.57 % when short duration variety (Giza 177) was cultivated. Irrigation every 6 or 9 days increased water saving, but the reduction in yield was very high (Table 21).

Table 21. Yield reduction and water saving as a result of using different irrigation schedules

Treatment	Sakha 101		Giza 177	
	Yield red. %	Water saved %	Yield red. %	Water saved %
Continous	-	-	-	-
Continous saturation	3.98	20.09	3.57	31.43
Irrigation every 6 days	9.61	32.22	15.39	34.68
Irrigation every 9 days	24.50	50.29	26.48	51.14
Average	12.70		15.15	

Water used by short duration variety (Giza 177) was less than that used by medium duration varieties under different irrigation intervals (Table 22) Also, water use efficiency (WUE) was higher under irrigation every 4 days than under other intervals.

Table 22. Effect of water regime on water used, water saved and water use efficiency of rice

Treatment	Water relations		
	Water use (m^3/ha)	Water saved (%)	Water use efficiency (Kg rice /m^3 water)
Irrigation every 4 days			
Giza 176	11.550	-	0.72
Giza 177	9.240	-	0.83
Giza 178	10626	-	0.95
IET 1444	10.164	-	0.95
Mean	10.395	-	0.86
Irrigation every 6 days			
Giza 176	9.321	19.3	0.62
Giza 177	7.170	22.4	0.61
Giza 178	8.604	19.3	0.89
IET 1444	7.887	22.4	0.99
Mean	8.246	20.8	0.78
Irrigation every 8 days			
Giza 176	7.200	37.7	0.62
Giza 177	5.600	39.4	0.57
Giza 178	6.400	37.9	0.84
IET 1444	6.400	37.0	0.85
Mean	6.400	38.0	0.72

2.Cultural practices and rice physiology in saline Soil :

In Egypt, rice is grown in the northarn belt extending from about the seventh contour (7 m) above sea level down to the Mediterranean Coast.

Rice soils in the northern Nile Delta region are generally poorly drained. In the coastal area of Egypt, salinity occurs because of direct invasion by salt water or by the upward or lateral movement of saline ground water.

Salinity problems in Egypt affect one-third of the irrigated lands and consequently, productivity is affected (Antar 1981).

High productivity of rice under saline conditions could be achieved through soil reclamation, use of salt tolerant cultivars and optimum cutivar practices.

2.1.Sowing date, plant spacing and nitrogen levels :

Rice grain yield of Sakha 104 cultivar under different dates of sowing, plant spacing and nitrogen levels are presented in (Table 23). Data reveled that under saline soil, high yield could be obtained when rice was sown on May 5th with plant spaces of 10 x 20 and nitrogen rate of 110 kg N/ha.

Table 23 . Grain yield of Sakha 104 rice cultivar as affected by sowing date, plant spacing or nitrogen levels under saline soil

Hain effects	Grain yield t/ha
Sowing sates :	
April 25th	5.92 a
May 5th	6.02 a
May 15th	5.36 b
Palnt sapcing (cm)	
10 x 20	6.04 a
15 x 20	5.76 b
20 x 20	5.50 c
Nitrogen levles Kh N/ha :	
0	4.74 c
55	5.94 b
110	6.22 a
165	6.18 a

2.2. Seedling age :

Grain yields of some rice varieties as affected by different transplanting ages are presented in Table 24. Data indicated that Sakha 104 rice cultivar, as tolerant to salinity, gave the highest grain yield compared to other tested cultivars. Data also revealed that the optimum seedling age was 20 days under salinity condition.

Table 24 . Grain yield t/ha of three newly released rice cultivars as affected by different transplanting ages under saline condition

Main Effects	Grain yield t/ha
Varieties:	
Giza 177	4.23 c
Sakha 104	5.50 a
Giza 182	5.15 bc
Transplanting age (Days):	
20	6.06 a
25	5.14 b
30	4.48 c
35	4.23 d

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تحسين المعاملات الزراعية للأرز فى مصر

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أقيم عدد من التجارب فى مزرعة مركز البحوث والتدريب فى الأرز بسخا – كفر الشيخ – بغرض دراسة تحسين المعاملات الزراعية المختلفة والتسميد والرى لأصناف الأرز المصرية المختلفة خصوصا الأصناف الجديدة وقد تم التوصل إلى :

- **ميعاد الزراعة** : إن أنسب ميعاد لزراعة الأرز فى مصر هو الأسبوعين الأولين من مايو والتأخير عن ذلك يؤدى إلى نقص المحصول لأن الأرز خصوصا الأصناف اليابانية حساسة لطول أو قصر الفترة الضوئية حيث أن قصر طول النهار فى مصر فى فترة تزهير الأرز يؤدى لقصر عمر النبات وبالتالى نقص المحصول.
- **مسافات الزراعة** : فى الأرز الشتل حيث تعتمد على قدرة الصنف على التفريع ففى الأصناف غزيرة التفريع تكون المسافات ٢٠ ×٢٠ سم بين الجور والسطور وإذا كان الصنف متوسط التفريع تكون المسافات ١٥ × ٢٠ سم أما الأصناف قليلة التفريع فإن مسافات الشتل تكون ١٠ × ٢٠ سم.
- **وفى الأرز البدار** فإن معدل التقاوى يتوقف على وزن حبوب الصنف ففى الأصناف ذات وزن الحبوب العالى (عدد حبوب أقل) فإن المعدل يكون حوالى ٦٠ كجم تقاوى للفدان أما الأصناف ذات وزن الحبوب القليلة يكون المعدل حوالى ٥٠ كجم للفدان. كما وجد أن العدد الأمثل للنباتات فى الجورة هو أربعة نباتات ويجب آلا يزيد العدد عن ذلك.
- **أما عمر الشتلة** : فقد وجد أن عمر البادرات فى المشتل يجب ألا يزيد عن ٢٥– ٣٠ يوما على الأكثر ولو زاد عن ذلك فإن المحصول يقل بسبب عدم قدرة البادرات على التفريع فى الأرض المستديمة.
- **التسميد الآزوتى** : أثبتت التجارب العديدة أن أنسب وأحسن المصادر فى السماد الآزوتى فى مصر هى اليوريا وسلفات الأمونيوم فى تسميد الأرز إذا تم إضافتها بالطريقة المثلى وفى الميعاد المناسب. ففى الشتل يجب إضافة ثلثى الكمية خلطا بالتربة على الجاف قبل الزراعة ثم ثلث قبل بدء تكون السنبلة بأسبوع أى بعد ٦٠–٦٥ يوما من تاريخ الزراعة (النقع) أما فى البدار يضاف الثلث على الجاف خلطا بالتربة قبل الزراعة ثم ثلث بعد ٣٠ يوما ثم ثلث بعد ٣٠ يوما من الثلث الثانى. والمعدل المناسب حسب النتائج من التجارب العديدة هو ١٦٥ كجم آزوت للكهتار لجميع الأصناف ماعدا الصنف سخا ١٠٢ الذى يستجيب لـ ١١٠ إلى ١٤٤ كجم آزوت للهكتار نظرا لقابليته للرقاد.

- **الفوسفور والبوتاسيوم** : أظهرت نتائج التجارب أن أنسب صور السماد الفوسفاتى هى السوبر فوسفات الثلاثى أو الأحادى وأن المعدل المناسب هو ٣٦ كجم فو٢أ٥ للهكتار مضافة على الجاف خلطا بالتربة قبل الزراعة. أما البوتاسيوم فلم يظهر له أى إستجابة تحت ظروف التجارب ماعدا فى بعض الأراضى الغدقة أو الملحية فيجب إضافته.
- **الزنك** : أظهرت نتائج التجارب أهمية الزنك للأرز تحت ظروف الغمر وقد ثبت أن أفضل المصادر للزنك هى كبريتات الزنك وبمعدل ٤٨ كجم للمشتل أو ٢٤ كجم للفدان للمشتل ، يضاف بعد التلويط أو ١٠ كجم كبريتات زنك للفدان فى الأراضى المستديمة أماباقى العناصر الدقيقة فلم يستجب لها الأرز فى الظروف المصرية.
- **السماد العضوى والحيوى** : أظهرت النتائج أن إضافة السماد العضوى بمعدل ٧ طن للهكتار مع ١١٠ كجم آزوت للهكتار كذلك إضافة الكومبوست من قش الأرز أو قشر حبوب الأرز مع ثلثى المعدل الموصى به من الآزوت (١٦٥ كجم / هكتار) أعطت نتائج جيدة وكذلك بعض أنواع الأسمدة الحيوية مثل الـ Rizobacterine أو Biogene مع ١١٠ كجم آزوت للهكتار أعطت نتائج جيدة وعموما فإن استخدام السماد العضوى أو الحيوى قد سبب وفرا فى السماد الآزوتى مقداره نحو ٥٥ كجم آزوت للهكتار.
- **أما بالنسبة للرى** فى الأرز فقد أظهرت النتائج أنه يمكن توفير جزء من مياه الرى عن طريق وضع الرى فى مراحل فسيولوجية معينة ماعدا مراحل التفريع وبدء خروج السنبلة وكذلك أثناء عملية امتلاء الحبوب أو عن طريق الرى على مراحل معينة وقد ثبت أن الرى كل ٤ أيام أفضل من الرى المستديم وقد أعطى أعلى كفاءة لاستخدام مياه الرى ووفرة مياه الرى وقلة المياه المستخدمة فى الرى.
- **أما بالنسبة للأراضى الملحية** : فقد أظهرت النتائج من التجارب العديدة أن أنسب ميعاد للزراعة هو من ٢٥ إبريل حتى ٥ مايو وأن أنسب مسافات للزراعة الشتل هى ١٠ × ٢٠ سم بين الجورة والسطور وأنسب معدل للسماد هو من ١١٠ - ١٦٥ كجم آزوت للهكتار كما أثبتت التجارب أن عمر الشتلة المناسب هو ٢٠ يوما .