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YIELD AND NITROGEN USE EFFICIENCY OF TWO RICE CULTIVARS OF DIFFERENT GROWTH DURATIONS UNDER ALGALIZATION AND SPLITTING OF TWO N FERTILIZATION LEVELS

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ABSTRACT : A short durated (Giza 177) and a medium durated (Sakha 101) rice cultivars were grown in separate experiments at the Experimental Farm of the Faculty of Agriculture at Zagazig for two seasons (1998 and 2000).

Seedlings of one month old were transplanted in algalized and unalgalized main plots where two N levels (30 and 60 kg N/Fad) were tried in four different splitting patterns (three equal splits before transplanting, one and two months later; two splits as 2/3 before transplanting and 1/3 one or two months later; 2/3 one month after transplanting and 1/3 one month later) compared with a check N treatment.

Giza 177 (125 days) out yielded Sakha 101 (140 days) in grain yield due to a more productive tillering and a stronger grain sink. The former had also better grain quality and as well higher N apparent recovery but lower N agrophysiological, physiological, and utilization efficiencies than the latter.

Algalization was without significant influence on grain yield or on N use efficiency attributes. However, the addition of the first N increment was effective on all these aspects where the N apparent recovery efficiency was increased.

The response equations showed that the response of grain yield to the increase of N level was diminishing where the predicted maximum yields (4.882 and 4.626 ton/fad) could be obtained due to the addition of 48.6 and 54.1 kg N/fad for Giza 177 and Sakha 101, in respective order.

The different N splitting treatments were equally effective except on the grain quality of Sakha 101 where the addition of N as 2/3 before transplanting and 1/3 two months later produced the highest head rice percentage yield. This treatment improved the rice grain quality characters of Giza 177 when the N level was increased.

Significant interactions could be detected to affect some grain yield, N use efficiency and grain quality attributes.

Key words: **Cultivars, algalization, nitrogen, splitting, quality, uptake.**

INTRODUCTION

In Egypt, rice plays a great role in affecting the policy of irrigation water use. According to this policy, rice cultivated area should not exceed 1.2 million Faddan. However, the actual cultivated area exceeded 1.5 million Faddans in 2003, as farmers found rice more profitable than the other summer crops, particularly maize. The national average rice yield amounted to 4.12 ton/Fad. due to the use of high yielding rice cultivars and the adoption of the proper agronomic practices. (Anonymous, 2004).

To optimize the use of irrigation water, a number of short durated rice cultivars was released. Of these cultivars, Giza 177 with life duration of 125 days proved its superiorty. Moreover, Sakha 101 with a life duration of 140 days showed a good performance among a number of high yielding rice cultivars. (Anonymous, 2004) However, efforts are still needed to maximise grain productivity of these cultivars through the adoption of the proper agronomic practices.

Lowland rice fields, need the proper and efficient use of added N-fertilizers. These additions suffer from volatilization of ammonia (Smith and Chalk, 1978; Magalhaes and Chalk, 1987) and N oxide gasses (Sahrawat, 1989) which amounted to 60%. These losses could be minimized to less than

20% when N-fertilizers are subsurface added (Wada, 1969). Moreover, splitting of N was found to avoid much of these losses and increase grain yield (Tomio and Padre, 1972).

Early added N at transplanting was reported to enhance tillering and hence increase the number of panicles / unit area (Brady, 1974and Xiao Lizhong *et al.*, 1999). Whereas, late added N at panicle initiation was found effective to increase the number of fertile spiketes/panicle through enhancing photosynthesis and hence the supply of photosynthates to the developing spikelets, (Senanayake *et al.*, 1996). However, excessive addition of N at panicle initiation had an adverse effect on the fertility of spikelets due to an excessive increase in their number (Surekha *et al.*, 1999).

Biofertilization through algalization with blue green algae was found to satisfy from 20 to 30% of N-requirements of rice plants (Hegazy *et al.*, 1995). This practice was suggested to minimize N volatilization and N leaching losses and hence increases the N use efficiency (Yanni and Osman, 1990).

Therefore, the present study aimed to find out the response of two rice cultivars, of different growth durations, to algalization and splitting of two N fertilization levels compared with a check N treatment on grain yield, grain technological characters and N use efficiency.

MATERIALS AND METHODS

Two separate field experiments were conducted in each of the 1998 and 2000 seasons at the Experimental Farm of the Faculty of Agriculture, Zagazig University at Zagazig. The study aimed to find out the effect of algalization, N level and N splitting on yield and N use efficiency of two rice cultivars of different growth durations.

A. Factors Under Study

A.1. Rice cultivars

a. Giza 177: A short durated cultivar (125 days).

b. Sakha 101: A medium durated cultivar (140 days).

A.2. Algalization

a. Without algalization

b. Algalized with blue green algae (*Nostoc sp*). The inoculum at the rate of 500 gm/Fad was mixed with sand and spread over the soil surface of the field just before applying irrigation for transplanting.

A.3. Nitrogen fertilization levels

a. Check (without N fertilization).

b. 30 kg N/fad.

c. 60 kg N/fad.

Nitrogen was given as ammonium sulphate (20.5%N).

A.4. Nitrogen splitting treatments

Nitrogen was given in two or three splits as follows:

a. Three equal splits before transplanting and one and two months later (M_1).

b. Two partial splits as 2/3 before transplanting and 1/3 one month later (M_2).

c. Two partial splits as 2/3 before transplanting and 1/3 two months later (M_3).

d. Two partial splits as 2/3 one month after transplanting and 1/3 one month later (M_4).

Nitrogen was subsurface added when given before transplanting but top dressed thereafter.

B. Experimental Dsign

A separate experiment was devoted for each rice cultivar as they varied in their growth duration. Experiments were laid out in a split plot design of three and four replications in the two seasons, respectively. Algalization treatments were allotted in the main plots. The combination of the two N fertilization levels and the four N splitting treatments in addition to the check N treatment were allocated in the sub plots (4 x 2.5 m).

C. General Cultural Practices

C.1. Nursery practices

Nurseries were fertilized with superphosphate (15.5% P_2O_5) at the rate of 100kg/fad before the first plow. Urea (46.6% N) was added at the rate of 50kg/fad before the second plow. Thereafter, nurseries were compacted and irrigated.

Nurseries were sown after berseem at the rate of 60kg/fad by mid of May in the two seasons. Irrigation was practiced as needed up to the time of transplanting.

C.2. Main field practices

Main fields were preceded by wheat in the two seasons. Seedlings of 30 days old were transplanted at the rate of five seedlings/hill 20cm apart. Superphosphate at the rate of 100kg/Fad was added before the first plow. Algalization was tried before flooding the field for transplanting. Nitrogen as ammonium sulphate was split at the two N levels and was added as described before. Fields were drained one week after transplanting where Saturn 50% herbicide was applied at the rate of 2 liter/fad. Irrigation was scheduled every six days where fields were drained for two days at heading. Irrigation was thereafter given where the water level was gradually increased up to 15 days before harvest.

D. Recorded Data

D.1. Grain yield and its components

At harvest, plants of five guarded hills were taken where the following grain yield components were recorded:

1. Number of panicles/hill
2. Grain weight/ panicle (gm)

A central area of $2m^2$ was harvested were the grain, straw and total yields/Fad, as well as, harvest index were recorded.

D.2. Rough and milled rice quality characters

A sample of 250 gm from each plot was taken for the determination of the rice grain technological characters. The following grain quality characters were determined by the technology lab of ARC at Sakha according to Khush *et al.*, (1979):

1. Hulling recovery percentage (HRP).
2. Rice husk percentage (RHP).
3. Milled rice percentage (MRP).
4. Rice bran percentage (RPP)
5. Head rice percentage (HRP).
6. Broken rice percentage (BRP).

D.3. Nitrogen uptake and use efficiency

In the second season, grain and straw samples were taken for N determination using the Micro kjeldahl method according to AOAC (1980). The following readings and measurements were recorded according to Fageria *et al.*, (1997).

1. Total N uptake/Fad (TNU).
2. Nitrogen apparent recovery efficiency (NARE).
3. Nitrogen physiological efficiency (NPE).
4. Nitrogen agrophysiological efficiency (NAPE).
5. Nitrogen utilization efficiency (NUE).
6. Nitrogen agronomic efficiency (NAE).
7. Nitrogen translocation efficiency (NTE).

E. Statistical Analysis

Data of each rice cultivar were statisticalty analysed. A combined analysis was made for the two seasons. Cultivar differences were compared using a t – test. The response equation of grain yield to the increase of N level, as well as, the predicted maximum yield and maximum N level were calculated using orthogonal polynomial tables as described by Abdul-Galil *et al.*, (2003). Differences were compared using Duncan Multiple range test according to Duncan, (1955). Interaction tables are provided with small and capital letters to compare differences among columns and rows means, respectively. The statistical analysis was performed according to Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

The following results are those obtained from the combined analysis of the two rice growing seasons.

A. Yield and its Components

A.1. Cultivar differences

The two cultivars varied significantly regarding the number of panicles/hill and the grain weight/panicle and as well the grain and straw yields/fad and harvest index (Table 1). It is evident that Giza 177 had larger number of panicles /hill with lighter grain weight/ panicle than Sakha 101 which had fewer number of panicles but with heavier grain weight. However, Giza 177 out yielded Sakha 101 in grain yield/Fad. On the contrary, Sakha 101 produced higher straw yield/fad than Giza 177. However, the two rice cultivars had an almost similar total yields/fad. Therefore, Giza 177 recorded higher harvest index than Sakha 101.

These results clearly indicate that the number of panicles/hill rather than grain weight/panicle governed the grain yield/fad. The data further indicate that Giza 177 had stronger grain sinke whereas Sakha 101 had, on the other hand, had stronger straw sink. This was clearly expressed in the harvest index which was significantly higher in Giza 177 than in Sakha 101.

In rice, differences among cultivars in growth duration, are mainly in the vegetative growth rather than in reproductive one. (El-Aidy *et al.*, 2000). Under the present study, Giza 177 reached heading two weeks earlier than

Table 1: Panicles/hill, grain, straw, total yields/Fad and harvest index and their attributes as affected by algalization, N level and N splitting in the two rice cultivars (combined)

Main effects and interactions	Panicles/hill (No)		Grain wt/ panicle (gm)		Yield (Ton/Fad) Grain		Straw		Total		Harvest index (%)	
	Giza 177	Sakha 101	Giza 177	Sakha 101	Giza 177	Sakha 101	Giza 177	Sakha 101	Giza 177	Sakha 101	Giza 177	Sakha 101
Algalization (A):												
Not algalized	30.80	25.96	2.010	2.472 b	4.220	3.817	4.618	4.841	8.838	8.658	47.75	44.10
Algalized	30.21	27.14	2.054	2.702 a	4.324	4.276	4.727	5.237	9.051	9.513	47.77	44.95
F. test	N.S	N.S	N.S	*	NS	NS	NS	NS	NS	NS	NS	NS
N level (N):												
Check	24.80 b	21.50 b	1.980	2.502	3.358b	3.189b	3.711b	4.028b	7.069b	7.217b	47.50	44.10b
30Kg N/Fad	33.08 a	28.69 a	2.046	2.648	4.653a	4.342a	4.967a	5.241a	9.620a	9.583a	48.37	45.30a
60Kg N/Fad	33.64 a	29.46 a	2.070	2.610	4.805a	4.609a	5.341a	5.848a	10.15a	10.46b	47.34	44.10b
F. test	**	**	N.S	N.S	**	**	**	**	**	**	NS	*
N Splitting (S):												
M_1	33.59 ab	30.35	2.092	2.785 a	4.593	4.254	5.210	5.461	9.804	9.715	46.86	43.80
M_2	31.51 b	27.58	2.027	2.664 ab	4.873	4.615	5.339	5.598	10.21	10.21	47.73	45.20
M_3	32.75 b	28.43	2.024	2.498 c	4.671	4.648	4.930	5.611	9.601	10.26	48.65	45.31
M_4	35.58 a	29.93	2.087	2.572 bc	4.778	4.385	5.135	5.507	9.913	9.892	48.20	44.34
F.test	*	N.S	N.S	**	NS	NS	NS	NS	NS	NS	NS	NS
Interactions :												
A x N	N.S	**	N.S	**	NS	NS	NS	*	*	NS	NS	**
A x S	N.S	N.S	N.S	**	NS	NS	NS	NS	NS	NS	NS	NS
N x S	**	N.S	N.S	N.S	NS	NS	NS	NS	**	NS	NS	NS
Cultivars differences :												
Giza 177	30.50		2.032		4.272	4.047	4.673	5.039	8.945	9.086	47.76	
Sakha 101		26.55		2.587								44.52
T.Test	**		**		**		**		*		**	

Sakha 101 (1st and mid of Agust, respectively). Therefore Sakha 101 had longer vegetative stage than Giza 177 and hence might have accumulated more photosynthates in plant culms. Moreover, Giza 177 might have had experienced lower maintenance respiration losses due to its lighter biomass than Sakha 101. Furthermore, the former has afforded better grain filling conditions through a higher temperature and hence irradiance. This enhances photosynthesis and thus increase the current photosynthates available for grain filling (Yoshida, 1981).

A.2. Algalization effect

Algalization was without significant favourable effect on yield of the two rice cultivars and its components or harvest index except on the grain weight/ panicle of Sakha 101 (Table 1).

The present results add more to the controversy among authors regarding the benefical effect of algalization in rice fields. Surendra *et al.*, (1995), Sharief *et al.*, (1998) and Bassal and Zahran (2002) found algalization a beneficial practice in rice. Whereas Yoshida *et al.*, (1973) did not find such beneficial effect. This controvery could be attributed to differences in cultivars, as well as, differences in the environmental and soil conditions (Amin *et al.*, 2000). Salinity was reported to hinder N fixation by the algae (Abou El-soud *et al.*, 1990). Also, higher N addition of ammonium containing fertilizers than 40 kg N/ha (16.8 kg N/Fad) was found to inhibit N biological fixation (Roger *et al.*, 1980).

Under the present study, 1/3 or 2/3 of N was added before transplanting i.e, just after algalization. This amounts to 15 and 30 kg N/Fad (average N addition is 45 kg/ Fad). These amounts might have inhibited N fixation by the blue green algae. Moreover, Watanabe (1967) found that the benefical effect of algalization might not be gained during the season of its application but could be gained by the succeeding crops to rice.

A.3. Nitrogen Level effect

It is quite evident from Table (1) that in the two rice cultivars, the first N increment was quite enough to increase the number of panicles/hill. The second N increment failed to add a further significant increase in this number. The two N increments were not effective on the grain weight/ panicle. Therefore the grain, straw and total yield/Fad were increased significantly but with different maguitudes in the two rice cultivars. This was expressed in different trends by the harvest index which tended to decrease in Giza 177 but was significantly decreased in Sakha 101 due to the addition of the second N increment.

These results refer to a differential response by the two rice cultivars to the increase of N level as indicated by the following grain yield response equations:

$$\hat{Y}\ \text{Giza 177} = 3.358 + 1.867^{*}x - 0.572^{*}x^2$$

$$\hat{Y}\ \text{Sakha 101} = 3.189 + 1.594^{*}x - 0.442^{*}x^2$$

These equations clearly indicate that the response of grain yield to the increase of N level was diminishing. They further indicate that Giza 177 could produce 1.867 ton per each N increament compared with 1.594 ton only in Sakha 101. Therefore, the predicted maximum grain yield of Giza 177 was 4.882 ton/Fad which could be obtained due to the addition of 48.6 kg N/Fad. This predicted maximum in Sakha 101 was 4.626 ton/fad but could be obtained due to a higher N addition of 54.1 kg N/Fad.

The beneficial effect of N to rice grain yield and its components is extensively reported by Faizy *et al.*, (1997), Khalil (1997), Ebaid and Ghanem (2000), Awad (2001) and Ibrahim (2002).

A.4. Nitrogen splitting effect

The different N splitting treatments were without significant influence except on number of panicles/ hill of Giza 177 and grain weight/panicle of Sakha 101. In the former the highest number of panicles/hill was recorded by M_4. In the latter the heaviest grain weight/panicle was recorded by M_1. However these differences were not reflected in grain, straw or total yield/fad.

These results clearly indicate that rice growth and yield of the two rice cultivars were favoured by the addition of N through any of the N splitting treatments under study. This could be due to similarity of these treatments, except M_4, in addition of the first split before transplanting. This early N addition might have had equally enhanced tillering and hence the number of panicles/hill as reported by Brady (1974) and Xiao lizhong (1999).

A.5. Interaction effect

In the two rice cultivars, few first order interactions were found to affect the number of panicles/ hill and grain weight/panicle.

However, their effect was not observed in grain, yield/fad (Table 1).

B. Rough and Milled Rice Quality Characters

B.1. Cultivar differences

It was evident that Giza 177 had significantly higher hulling recovery percentage than Sakha 101. Therefore, the former had lower husk percentage than the latter. Giza 177 had also higher milled rice and higher bran percentages than Sakha 101. Moreover, Giza 177 had higher head rice and lower broken rice percentages than Sakha 101. These results clearly indicate that in addition of its superiority in grain yield/Fad, Giza 177 had better grain quality characters than Sakha 101.

B.2. Algalization and N level effects

Neither algalization nor the increase of N level had a significant effect on any of the grain rice quality characters under study (Table. 2). Similar results were reported by Yossef *et al.*, (1980). However, Badawi (1982) and Gorgy (1995) found that head rice and milled rice percentages increased by increasing were N level. On the other hand, Heggy (1993) found that milled rice percentage was decreased by increasing N level.

B.3. Nitrogen splitting effect

With the exception of the head rice and broken rice percentages of Sakha 101, non of the other grain quality characters was affected significantly by varying the N splitting treatment. It is evident from Table (2) that the highest head rice percentage and hence the lowest broken rice percentage was obtained when N was given as 2/3 before transplanting and 1/3 two months later (M_3).

B.4. Interaction effects

The alglization x N level interaction affected significantly the grain quality characters of Sakha 101 and Giza 177 cultivars (Table. 2- a).

It was evident that the addition of the first N increment to the unalgalized plots was accompanied by a significant increase in the hulling recovery percentage and hence a significant decrease in the husk percentage of Sakha 101. This was not observed in the algalized plots.

It was obvious also that algalization along with the addition

Table 2: Rough and milled rice quality characters as affected by algalization, N level and N splitting in the two rice cultivars (combined)

Main effects and interaction	Rice hulling recovery (%)		Husk (%)		Rice milling (%)		Bran (%)		Head rice (%)		Broken rice (%)	
	Giza 177	Sakha 101	Giza 177	Sakha 101	Giza 177	Sakha 101	Giza 177	Sakha 101	Giza 177	Sakha 101	Giza 177	Sakha 101
Algalization (A):												
Not algalizaed	82.67	80.83	17.33	19.17	73.14	72.16	9.535	8.665	64.17	61.70	8.969	10.46
Algalized	82.90	80.91	17.11	19.11	73.39	71.86	9.477	9.054	65.28	63.44	8.130	8.402
F. test	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
N. level (N):												
Check	82.66	80.08	17.35	19.93	72.89	71.72	9.767	8.358	64.58	62.52	8.317	9.260
30 kg N/fad	82.75	81.26	17.25	18.73	73.30	72.19	9.448	9.071	64.63	62.45	8.627	9.721
60 Kg/fad	82.95	81.27	17.06	18.76	73.60	72.12	9.302	9.151	64.96	62.75	8.707	9.367
F. test	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	'N.S
Nitrogen solition (S) :												
M1	83.09	80.73	16.92	19.26	73.36	72.44	9.654	8.296	65.37	ab 62.36	7.962	ab 10.08
M2	82.82	81.38	17.18	18.67	73.10	71.87	9.713	9.508	64.56	b 60.78	8.583	a 11.09
M3	82.90	81.81	17.10	18.19	73.55	72.35	9.338	9.458	65.12	a 64.23	8.433	c 8.121
M4	82.59	81.13	17.41	18.86	73.78	71.95	8.896	9.179	64.09	a 63.02	9.687	bc 8.888
F. test	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	**	N.S	**
Interactions:												
AXN	N.S	*	N.S	*	N.S	N.S	N.S	**	*	N.S	**	N.S
AXS	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
NXS	N.S	N.S	N.S	N.S	**	N.S	*	N.S	**	N.S	N.S	N.S
Cultivars differences:												
Giza 177	82.79		17.22		73.27		9.510		64.72		8.550	
Sakha 101		80.87		19.15		72.01		8.860		62.57		9.430
F. test	**		**		**		*		**		*	

Table 2-a: Some rough and grain milled rice characters as affected by algalization x N level interaction (combined)

Algalization	N level (Kg N/Fad) 0	30	60
	Rice hulling recovery (%) of Sakha 101		
Not algalized	B 79.75 a	A 81.83 a	B 80.90 a
Algalized	A 80.40 a	A 80.69 a	A 81.36 a
	Rice husk (%) of Sakha 101		
Not algalized	A 20.25 a	B 18.17 b	AB 19.10 a
Algalized	A 19.60 a	A 19.3 a	A 18.42 a
	Rice bran (%) of Sakha 101		
Not algalized	A 8.18 a	A 9.48 a	A 8.33 b
Algalized	A 8.53 a	A 8.66 a	A 9.97 a
	Head rice (%) of Giza 177		
Not algalized	A 63.58 b	A 63.72 b	A 65.20 a
Algalized	A 65.57 a	A 65.54 a	A 64.73 a
	Broken rice (%) of Giza 177		
Not algalized	A 9.33 a	A 9.58 a	A 7.99 a
Algalized	A 7.30 b	A 7.67 b	A 9.42 a

Table 2-b: Some milled rice characters of Giza 177 as affected by N. level x N splitting interaction (combined)

N. level	N splitting treatments M_1	M_2	M_3	M_4
	Rice bran (%) of Giza 177			
30 Kg N/Fad	A 9.19 a	A 9.73 a	A 10.28 a	A 8.59 a
60 kg N/Fad	A 10.12 a	A 9.70 a	A 8.39 b	A 9.00 a
	Milled rice (%) of Giza 177			
30 Kg N/Fad	A 73.86 a	A 73.2 a	A 72.26 b	A 73.87 a
60 kg N/Fad	A 72.87 a	A 73.0 a	A 74.85 a	A 73.70 a
	Head Rice (%) of Giza 177			
30 Kg N/Fad	A 64.83 a	A 65.76 a	A 63.79 b	A 64.13 a
60 kg N/Fad	AB 65.91 a	B 63.44 b	A 66.45 a	AB 64.06 a

of the highest N level increased the bran percentage of Sakha 101. This was not observed in the check or low N fertilized plots. However, results in the same table showed that algalization in the check N or low N fertilized plots increased the head rice and decreased the broken rice percentages of Giza 177 cultivar. This was not observed due to algalization in the high N fertilized plots.

The N level x N splitting interaction affected significantly the bran, milled rice, and head rice percentage of Giza 177 (Table2-b).

It was evident that the increase of N level from 30 to 60 kg N/Fad when N was given as 2/3 before transplanting and 1/3 two months later (M_3) caused a significant increase in the milled rice percentage and hence a significant decrease in the bran rice percentage of Giza 177. This effect was not observed when N was given by any of the other N splitting treatments. It was evident, also, that the highest head rice percentage (66.45%) was obtained when the level of N was increased and given by the same forementiond N splitting treatment (M_3).

These results clearly indicate that Giza 177 grain quality characters were improved by the increase of N level to 60 kg N/Fad if given as 2/3 before transplanting and 1/3 two months later i.e post heading. Since the four N splitting treatments were equally effective on the grain yield of this cultivar, improvement observed herein to grain quality, ascertain the superiority of M_3 among the four N splitting treatments. This treatment was found also more effective on the grain yield of Sakha 101 (Table 1). Therefore it is recommended for the two rice cultivars under study.

C. Nitrogen Uptake and N Use Efficiency

In the second season, the total N uptake and its use efficiency were determined and are presented in Table (3) for the two rice cultivars as affected by algalization, N level and N splitting.

C.1. Cultivar differences

It is quite evident from Table (3) that Giza 177 had significantly higher total N uptake than Sakha 101. Moreover, the former had higher N translocation efficiency than the latter. This cultivar, had, also, higher N apperent recovery efficiency than Sakha 101. This indicates its greater capacity in recovering N from added nitrogen,

Table 3: Total nitrogen uptake and some N use efficiency parameters as affected by algalization, N level and N splitting in the two rice cultivars in the second season

Main effects and interaction	N Total uptake (kg N/Fad)		N Translaction efficiency (%)		N Apparent recovery ef. (%)		N Agrophsiological ef. (Kg/KgN)		N Physiological ef. (Kg/Kg N)		N Ultization ef. (Kg/Kg N)		N Agronomy ef. (kg/kg N)	
	Giza 177	Sakha 101	Giza 177	Sakha 101	Giza 177	Sakha 101	Giza 177	Sakha 101	Giza 177	Sakha 101	Giza 177	Sakha 101	Giza 177	Sakha 101
Algalization (A)														
Notalgliazed	75.87	64.23	79.87	72.41	93.88	57.95	46.49	85.53	82.25	139.2	77.68	62.37	42.28	37.20
Algalized	81.64	68.74	81.72	75.65	73.57	72.69	48.60	66.36	85.28	152.4	61.00	90.59	36.82	40.63
F. test	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
N. level (N)														
Check	b 55.97	b 48.59	b 77.50	73.54										
30 kg N/Fad	a 87.44	a 73.40	a 83.31	73.49	a 105.56	a 82.66	49.66	88.44	87.39	153.4	a 86.42	a 96.39	a 51.77	a 52.32
60kg N/fad	a 92.86	a 77.45	a 81.57	75.06	b 61.90	b 47.99	45.43	63.44	80.14	138.3	b 52.26	b 56.58	b 27.43	b 25.51
F. test	**	**	*	N.S	**	**	N.S	N.S	N.S	N.S	**	**	**	**
N splittingi (s):														
M1	89.62	b 73.58	a 83.44	74.10	88.64	65.57	48.05	70.67	101.66	171.3	78.67	69.23	42.15	34.68
M2	90.82	b 72.20	ab 81.81	72.68	80.77	58.21	46.41	82.41	78.42	137.4	65.28	78.58	35.35	39.07
M3	94.38	a 85.01	a 84.24	74.03	90.92	84.78	44.94	54.4	75.38	98.31	76.66	80.89	43.83	43.78
M4	85.77	b 70.91	b 80.27	76.29	74.59	52.74	50.75	96.29	79.60	176.3	56.75	77.23	36.89	38.13
F. test	N.S	**	*	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
Interactions :														
AXN	**	N.S	N.S	*	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
AXS	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
NXS	**	**	N.S	**	N.S	N.S	*	N.S	N.S	N.S	*	N.S	N.S	N.S
Cultivar differences														
Giza 177	78.76		80.79		83.73		47.547		83.76		69.34		39.55	38.92
Sakha 101		66.46		74.19		65.32		75.943		145.8		76.48		
T. test	**		**		**		**		**		N.S		N.S	

i.e. it recovered more than four fifth compared with two third only recovered by Sakha 101.

Regarding the N agrophysiological and N physiological efficiences, as well as, the N utilization efficiency, Sakha 101 had higher values than Giza 177. These efficiencies were 75.95, 145.83 and 76.48 Kg/Kg of absorbed N for Sakha 101 compared with 47.55, 83.77 and 69.34 Kg for Giza 177, in respective order.

These results clearly indicate that Sakha 101 made more efficient use of each obsorbed Kg of N in building up grain, as well as, total yield. Therefore, it recorded higher N utilization efficiency as shown in Table (3) than Giza 177. This point could be little bit confusing, but the high total N uptake and the high N apparent recovery by Giza 177 could settle down this confusion. In other words, the high total N uptake along with the high N recovery efficiency of Giza 177 made a dilution effect to the agrophysiological and physiological efficiencers and hence the N utilization efficiency.

Finally, the N agronomic efficiency was slightly higher in Giza 177 than in Sakha 101 (39.56 and 38.92 Kg/Kg N, respectively).

C.2. Algalization effect

Algalization was without significant influence on the total N uptake or any of the N use efficiency parameters in Table (3). This was also observed in grain, straw and total yields of two rice cultivars (Table 1) and could account for the insiginficancy of differences observed herein.

C.3. Nitrogen level effect

It is quite clear from Table (3) that the total N uptake was increased significantly due to the additions of the first N increment. This uptake continued to increase, but insignificantly, due to the addition of the 2_{nd} increment. It is evident also that the N apparent recovery efficiency, the N utilization efficiency and the agronomic efficiency were significantly decreased due to the increase of N level from 30 to 60 Kg N/Fad. Similar, but insignificant, decrease was observed in each of agrophysiological and physiological efficiencies due the same increase of N level.

These results clearly indicate that rice plants were afforded good N uptake conditions. However, their efficiency in making use of added N was higher due to the addition of the first N increment than the second one. In both cultivars, and in particular Giza 177, rice plants could recover high percentages of added N which amounted to 105.56 and 82.66% when the first N increment was added to the two rice cultivars, in respective order. These recoveries were decreased to 61.9 and 47.99 when the second N increment was added, respectively. These apparent recoveries are higher than those reported by Fageria *et al.*, (1997) who found that it ranged from 12.0 to 60.7 with an average of 38.8% for 12 rice genotypes.

The significant decrease of N agronomic and utilization efficiencies due to the addition of the second N increment indicates clearly that their response to the increase of N level was diminishing expressing the response of grain yield/fad to N level increase (Table 1). The results further indicate/ that rice plants made good use of soil N. These plants could take up about 50 Kg N/Fad without N fertilization (55.97 and 48.59 Kg N/Fad by Giza 177 and Sakha 101, respectively). Under Egyptian soil conditions, Faizy *et al.*, (1997) found the rice plants, fertilized with 20 to 80 kg N/Fad, could derive form 20 to 40% of added N. This indicates that they could derive from 60 to 80% of N from soil nitrogen.

The preference of rice plants in making use of soil N, particularly, during their reproduc-etive stage, was reported by Wada (1969). This preference could be attributed to the high oxidative power of rice roots where oxygen and nitrogen enhance N biological fixation through their diffusion from the atmosphere to the aerenchyma in rice root cortex. It seems evident that the addition of N and the increase of its level played a promotive role in this respect.

C.4. Nitrogen splitting effect

With the exception of the total N uptake of Sakha 101 and N translocation efficiency of Giza 177, the other N use efficiencies attributes were not significantly affected by varying the N splitting treatment (Table 3). It was quite evident that the highest total N uptake (85.01 Kg N/Fad) of Sakha 101 was recorded when N was given as 2/3 before transplanting as 1/3 two months later (M_3). Reference to Table (1) shows that this treatment recorded the highest grain yield/Fad of this cultivar, but without significant differences with the other N splitting treatments.

Table 3–a: Total nitrogen uptake of Giza 177 and N translocation efficiency of Sakha 101 as affected by Algalization x N level interaction in the second season

Algalization	N level (Kg N/Fad) 0	30	60
	Total N uptake (kg N/Fad) of Giza 177		
Not algalized	C 49.59 b	B 83.40 a	A 94.64 a
Algalized	B 62.36 a	A 91.48 a	A 91.10 a
	N Translaction efficiency (%) of Sakha 101		
Not algalized	B 67.65 b	A 73.46 a	A 76.31 a
Algalized	A 79.43 a	B 73.71 a	B 73.81 a

Table 3-b: Total nitrogen and some use N efficiency parameters of the two cultivars as affected by N level x N splitting nitrogen interaction in the second season

N. level	N. splitting treatments M_1	M_2	M_3	M_4
	Total N uptake (Kg N/Fad) of Giza 177			
30 Kg N/Fad	A 94.00 a	B 83.19 b	AB 88.28 b	B 84.3 a
60 kg N/Fad	B 85.23 a	A 98.47 a	A 100.48 a	B 87.24 a
	Total N uptake (Kg N/Fad) of Sakha 101			
30 Kg N/Fad	A 77.30 a	AB 71.25 a	A 77.76 b	B 67.26 b
60 kg N/Fad	B 69.86 b	B 73.14 a	A 92.0 a	B 74.56 a
	N Translaction efficiency (%) of Sakha 101			
30 Kg N/Fad	B 74.36 a	C 68.82 b	A 78.59 a	BC 72.18 b
60 kg N/Fad	B 73.84 a	AB 76.54 a	C 69.47 b	A 80.41 a
	N Agrophsiological efficiency (kg/kg N) of Giza 177			
30 Kg N/Fad	A 52.94 a	A 46.92 a	A 55.27 a	A 43.52 a
60 kg N/Fad	A 43.23 a	A 45.91 a	A 34.61 b	A 57.97 a
	N utilization efficiency (kg/km) of Giza 177			
30 Kg N/Fad	A 109.91 a	B 68.26 a	A 103.62 a	B 63.89 a
60 kg N/Fad	A 47.43 b	A 62.31 a	A 49.71 b	A 49.62 a

C.5. Interaction effect

It is evident from Table (3-a) that the total N uptake by Giza 177 was significantly increased due to each increase of N level up to the addition of 60 kg N/Fad in the unalgalized plots. This was also true in the algalized plots but due to the increase of N level to only 30 kg/Fad.

In Sakha 101, the N translocation efficiency was increased due to algalization in the zero N plots. This was not true in the N fertilized ones.

It is quite evident from Table (3-b) that the highest total N uptake by the two rice cultivars was recorded when the highest N level was given as in M_3 i.e, 2/3 before transplanting and 1/3 two months later. This was reflected in the N translocation efficiency of Sakha 101 where the lowest value was recorded indicating that most of this uptake was by the rice straw rather than by rice grain of this cultivar. In Giza 177, this high uptake was expressed in the N agrophsiologlical and N utilization efficiency where the lowest values were observed.

REFERENCES

AOAC.1980. Official methods of analysis. Association official analytical chemists. 13th ed. Washington, U.S.A.

AbduGalil A. A.; H. A. Basha; S. A. E. Mowafy and M. M. Seham. 2003. Effect of phosphorus addition on the response of four wheat cultivars to N fertilization level under sandy soil conditions. Min. J. Agric. Res. 28 (1) : 1-22.

Abou El- soud M.A., A.A. Amer, W.S.A. El-Sabry and M.S.M. Abo – soliman. 1990. Effect of soil salinity and inoculation with Azotobacter and blue – green algae and N- uptake of wheat and rice crops. J. Agric. Res. Tanta. Univ., 16 (3): 548 – 559.

Amin, M,A,A.; M.A. El- Akabawy and Nadia Monged. 2000. Balanced nutirition and algalization for optimum yield of rice. Egypt. J. Appl. Sci; 15 (10): 321- 336.

Anonymous. 2004. Rice research programe report, ARC, Egypt.

Awad, H. A. 2001. Rice production at the North of Delta Region in Egypt as affected by irrigation intervals and nitrogen fertilizer levels. J. Agric. Sci. Mansoura. Univ., 26 (2): 1151 – 1159.

Badawi, A.T. 1982. Effect of some agronomic practices on yield and quality in rice. Ph.D. Thesis, Fac. Agric. Zagzig Univ., Egypt.

Bassal, S.A.A.; and Zahran. 2002. Effect of farmyard manure, bio and mineral nitrogen fertilizer and hill spaces on rice crop productivity. J. Agric. Sci. Mansoura Univ., 27 (4): 1975 - 1988.

Brady, N.C.1974. A summary of research to increase the efficiency of input use with emphasis on chemical fertilizers. Proc. Plan. and Organ. Meet. of Fert. Inputs Proj., East. West Centre, Honolulu.

Duncan, D.B. 1955. Multiple Range and Multiple F. test, Biometrics 11: 1-24.

Ebaid, R.A. and S.R. Ghanem. 2000. Productivity of Giza 177 variety grown after different winter crops and fertilized with different nitrogen levels under salt affected soil. Egypt. J. Agric. Res. 77 (2): 713- 720.

El-Aidy, A.; M. I. El-Emry; A. E. Draz and A.T. Badawi. 2000. Chemical and morphological characters of some local rice genotypes. Egypt. J. Agric, Res. 78 (2): 693 – 714.

Fageria, N. K.; V.C. Baliger and C.A. Jones. 1997. Growth and mineral nutrition of field crops. Rice: 283 – 344, Marcel Dekker, Inc., 270 Madison Avenue, New York, U.S.A.

Faizy, S.E.D. A; S.A. Machali; M.M. Rezk and A.M. Hamissa. 1997. The recovery of nitrogen by rice in relation to level and time of split application at different growth stages. J. Agric. Res. Tanta Univ., 23 (1): 113-121.

Gorgy, R.N. 1995. Effect of some agricultural treatments in rice yield and quality. Ph D. Thesis, Fac. Agric. Kafr El- sheikh, Tanta Univ., Egypt.

Hegazy, M.H.; Faiza. K. Abd – El Fattah and Dawlat Abadi. 1995. Effect of algalization, nitrogen fertilization and plant density on rice yield and its components. An. Agric. Sci., Ain Shams Univ, Cairo, 40 (2): 547- 557.

Heggy S. E. 1993. Effect of different nitrogen levels and time of application on the grain quality characters of different rice varieties. Egypt. J. Agric. Res., 71 (4): 835- 844.

Ibrahim, E. M. 2002. Effect of preceding winter crops and biological fertilization on growth and yield of rice under different levels of nitrogen fertilization. J. Agric. Sci. Mansoura Univ.; 27 (12): 8021 – 8032.

Khalil, H. E.; F. M. Seif El-Nasr; Zahira. M. Atta and A. I. Nawar. 1997. Effect of preceding crop, soil tillage and nitrogen fertilizer level on rice productivity. Menofiya j. Agric. Res. 22 (2): 327 – 336.

Khush, G.S.; M. Paule and N.M. Dela Cruze. 1979. Rice grain quality evaluation and improvement at IRRI. Proc. Workshop on chemical aspects of rice grain quality.

Magalhaes, A.M.T; and P.M chalk. 1987. Ammonia volatilization. Fertil. Res. 11: 173- 184.

Roger, P.A; S. A Kulasooriya, A. C. Tirol and E.T. Craswell. 1980. Deep placement a method of nitrogen fertilizer application compatible with algal nitrogen fixation in wetland rice soils. Plant and soil, 57 : 137 – 142.

Sahrawat, K.L. 1989. Effects of nitrification inhibitors on nitrogen transformations, other than nitrification, in soils. Advances in Agronomy Vol. 42 (11): 279 – 309.

Senanayake N.; R.E.L. Naylor, and S.K.De Datta. 1996. Effect of nitrogen fertilization on rice spikelet differentiation and survival. An. Agric. Sci., Cambridge, 127 : 303 – 309.

Sharief, A.E.; M. H.Hinidi; A.T. El-Kassaby and F.I. Yossef. 1998. Response of rice productivity to biofertilization type and nitrogen fertilizer levels. J. Agric. Sci. Mansoura Univ., 23 (12): 5817- 5825

Smith, c.J; and P.M Chalk. 1978. Plant nutrition. Proc. Int. Collog. Plant Anal. Fertil. Problems, 8 th. Auckland pp: 483 - 490.

Snedecor, G.W and W.G. Cochran. 1967. Statistical methods, 6th Ed. Iowa State Univ. Press, Ames. Iowa, U.S.A.

Surekha K.; M.N. Reddy; R. M. Kumar.1999. Yield attributes and yield of rice (Oryza sativa) hybrids as influenced by nitrogen sources and its splits application. Indian J. Agron. 44 (1): 80- 88.

Surendra, S.; R. Prasad and S.N. Sharma. 1995. Effect of blue green algae, nitrogen levels and modified urea materials on yield attributes and yield of wet land rice (Oryza sativa). Indian. J. Agron. 40 (4): 594- 597.

Tomio, Y. and B. C. Jr. Padre. 1972. The transformation of fertilizer nitrogen in rice soils and crops. IRRI Saturday Seminar, September.

Wada, G. 1969. The effect of nitrogenous nutrition on the yield determining process of rice plant. National Inst. Agric. Sci. Bul. 16: 159 – 167.

Watanabe, A. 1967. The blue – green algae as the nitrogen fixers, Proc. Ix Int. Cong. Microbiol., Moscow, 77- 85.

Xiao lizhong; lizhilin; zhang jianguo; Ding Chunhua. 1999. Effects of nitrogen application during early growth stage in the tillers and the tiller- panicle turnover rate of two – line hybrid rice. Journal of South China Agric Univ. 20 (3) 10-14 {c.f. field Crop Abst 53 (3), 1666, 2000}.

Yanni, Y. G. and Z. H. Osman. 1990. Contributions of algalization to rice growth, yield, N-attributes and incidence of infestation with the Blast furngus Pyricularia oryzae under different fungicidal treatments. J. Agric. Res. Tanta Univ. 16 (1): 19 -27.

Yoshida, S. 1981. fundamentals of rice crop science. Los Banos. Philippines; International Rice Research Institute.

Yoshida, T., R.A. Rongal and E.M. Bautista. 1973. Atmospheric nitrogen fixation by photosynthetic microorgan-isms in a submerged Phillipine Soil. Sci. Pl. Nutr., 19: 117- 123.

Youssef, S.A.; S. M. El-Aish; M.S. El-Keredy and M. Kreem. 1980. Influence of rate and time of nitrogen application on grain quality of three rice cultivars. Agric. Belgium 28 : 435 – 467 {c.f. Field Crop Abst. 34 (11), 8103, 1981}.

المحصول وكفاءة استخدام النيتروجين فى صنفين من الأرز يختلفان فى فترة النمو تحت تأثير الطحلبة وتجزئ مستويين من النتروجين

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أقيمت تجربتان حقليتان خلال كل من موسمى ١٩٩٨ و ٢٠٠٠ حيث خصصت تجربة للصنف جيزة ١٧٧ (١٢٥يوم) وأخرى للصنف سخا ١٠١ (١٤٠يوم) بمزرعة كلية الزراعة بالزقازيق لدراسة تأثير الطحلبة وتجزئ مستويين من النتروجين (٣٠ و ٦٠كجم ن/فدان) حيث أضيف على ٣ دفعات متساوية عند الشتل وبعد شهر وشهرين من الشتل أو على دفعتين (٣/٢ الكمية عند الشتل و٣/١ بعد شهر أو شهرين من الشتل أو ٣/٢ الكمية بعد شهر من الشتل و ٣/١ بعد شهرين من الشتل) مقارنة بعدم الإضافة ويمكن إيجاز أهم النتائج على النحو التالى :

(١) تفوق الصنف جيزة ١٧٧ على الصنف سخا ١٠١ فى محصول الحبوب/فدان بفضل زيادة فى إعداد الداليات/جورة رغم تفوق الأخير فى وزن حبوب الدالية تميز كما تميز الأول على الثانى فى دليل الحصاد وأيضاً فى الكفاءة الظاهرية لاسترجاع النتروجين المضاف وهو ما أدى إلى انخفاض كفاءة وحدة النتروجين الممتصة فى بناء محصول الحبوب والمحصول الكلى ومن ثم انخاص كفاءة استخدام وحدة النتروجين.

(٢) لم يكن للطحلبة تأثيراً معنوياً على محصول الحبوب أو القش/فدان أو أى من مؤشرات كفاءة استخدام النتروجين الممتص أو المضاف أو على صفات جودة الأرز الشعير أو الأرز الأبيض.

(٣) زاد محصول الحبوب والقش ومن ثم المحصول الكلى بفضل زيادة عدد الداليات/الجورة عند إضافة الوحدة الأولى من النتروجين (٣٠كجم ن/فدان) مقارنة بعدم الإضافة ولم يكن للوحدة التالية أى تأثير معنوى على هذه الصفات ومع ذلك فقد أوضحت معادلات استجابة المحصول إمكانية معظمة محصول الحبوب إلى ٤,٨٨٢ و ٤,٦٢٦ طن/فدان عند زيادة مستوى النتروجين إلى ٤٨,٦ و ٥٤,١كجم ن/فدان للصنفين جيزة ١٧٧ وسخا ١٠١ على التوالى.

(٤) زادت كمية النتروجين الممتصة الكلية عند إضافة وحدة النتروجين الأولى وكذلك كفاءة الاسترجاع الظاهرية ومن ثم انخفضت كفاءة وحدة النتروجين فى بناء محصول الحبوب والمحصول الكلى وكذلك كفاءة الاستخدام.

(٥) لم يكن لاختلاف معاملات تجزئ السماد النتروجينى تأثيراً معنوياً على معظم الصفات تحت الدراسة، باستثناء بعض صفات جودة الحبوب حيث تحسنت فى الصنفين عندما أضيف النتروجين على دفعتين بإضافة ٣/٢ الكمية عند الشتل و ٣/١ بعد شهرين من الشتل.

(٦) لوحظت بعض تداخلات الفعل المعنوية بين عوامل الدراسة على بعض الصفات تحت الدراسة ولكن لم يكن لها تأثيراً معنوياً على محصول الحبوب/الفدان عند الحصاد.