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Evaluation of some rice varieties under different nitrogen levels

Ali Abdalla Basyouni Abou-Khalifa

Rice Research and Training Center, Filed Crops, Research Institute, ARC, Egypt

ABSTRACT

Two field experiment was conducted at Rice research and training center (RRTC) – Sakha, kafr- El sheikh, governorate, Egypt in (2010) and (2011) seasons to study Evaluation of some rice varieties (Sakha 106, Sakha 105, GZ 7565, GZ 9075 and GZ 9362) under different nitrogen levels [Zero, 55, 111, 165 and 220 (Kg/ha]. Seedling age at transplanting was 26 days from sowing and by 20X20 cm planting spacing. All agricultural practices were applied as recommended for each cultivar. A split plot design with four replication was used. five Nitrogen levels allocated in the main plots. Five nitrogen levels were allocated in sub-plots. Main results induced that maximum tillering, panicle initiation, Roots length, heading dates, grains filling rates (G F R) at five stages, Leaf area index, chlorophyll content, number of tillers/M^2 1000- grains weight, number of grains /panicle, panicle length (cm) and grain yield (Ton/ha) were the highest value at 220 (KgN/ha. Except Light penetration was lowest value with five rice varieties under study. So Sakha 106 gave the highest value to all studied characters. While zero nitrogen with GZ.9362 gave the lowest value with all traits under study. The Sakha 106 and 55kg.N/ha. gave the highest value Agronomic efficiency.

Keywords: Nitrogen levels, rice growth characters and yield.

INTRODUCTION

Rice is a major cereal cultivated in Egypt and the world. It is the main food crop for a majority of the world's population. In the year 2000, the area under rice cultivation in Egypt was about 0.66 million hectare (1.57 million feddans), and total rice production reached about 6 million tons with national average yield of 9.10 tones/ha. This average yield ranked the highest among all rice cultivating countries in the world (Badawi, 2000)[3].

Nitrogen taken up during early growth stages accumulates in the vegetative parts of the plant and is utilized for grain formation. A large portion of the nitrogen is absorbed during differentiation. The leaves and stems contain a large portion of the nitrogen taken up by the plant (Milkkelson, 1982)[15]. Nitrogen fertilization has a vital role in determining the percentage nitrogen in the rice grains and nitrogen uptake by the rice plants (Ebaid and Ghanem, 2000)[5]. Kumer *et al*. (1995)[18] and Maske *et al*. (1997)[10] reported that increasing nitrogen levels up to 120 Kg N/ha significantly increased leaf area, yield component and grain yield. Rice growth characteristics namely, tillers /m^2, leaf area index, dry matter content, grain yield and its components (i.e., number of panicles/m^2, number of grains/panicle, percentage filled grain and 1,000 grain weight) were significantly increased when rice was fertilized with 144kg N/ha (60 kg/N fed.) as double-split application (2/3 or ½ of the dose was incorporated in dry soil: immediately before planting and the rest at panicle initiation (Mahrous *et al*, 1986[12], Hamissa *et al*., 1986[9] and Abd EL-Wahab 1998)[2].Abou-khalifa *et al*,(2007)[1] found that maximum tillering, panicle initiation, heading date, crop growth rates, Leaf area index, and grain yield were increase by increased nitrogen levels of up to 165 kg N/ha.

In Egypt, varietal improvement plays an important role in increasing rice yields. Increases in rice production depend on the availability of high yielding varieties (Abd El-Wahab, 1998)[2]. Varieties differ in their ability to impact productivity. Harbir et al; (1998)[7] reported that in India, medium duration rice cultivars gave maximum value on grain yield and its components, compared with short duration cultivars. Rice hybrids have a mean yield advantage of

10-15 % over inbred varieties. Increased growth rate during vegetative growth gave more efficient sink formation and greater sink size (Kabaki, 1993[17]; Yamauchi, 1994)[11], greater carbohydrate translocation from vegetative plant parts to the spikelets (Song et al., 1990)[20], and larger leaf area index (LAI) during the grain-filling period, but the physiological basis for heterosis remains unknown Peng (1998)[19]. Specific characteristics of the uptake and physiology of N in hybrid rice appear to a key role in characteristics of N uptake and N use by hybrid rice.

Rice grain filling and ripening are affected by many environmental factors, including water, temperature, radiation, and soil nutritional conditions (Yoshida, 1981)[26]. Grain dry matter increase is supported by available assimilates, as defined by C assimilation during the grain filling period plus assimilate reserve stored in the straw (Cock and Yoshida, 1972)[4]. Shortage of assimilate supply due to inhibition of photosynthetic processes is one of the major factors determining grain filling (Matsushima and Wada, 1958[14]; Yoshida, 1981[26]; Evans, 1996[7]; Egli, 1998). Inhibition of photosynthesis during the grain filling period due to environmental stresses such as shading or water deficit can result in a major reduction in grain dry matter in rice (Kobata and Takami, 1986; Kobata and Moriwaki, 1990; Takami et al., 1990). These studies showed clearly that potential grain growth was not realized when available assimilate failed to meet the assimilate requirement. Other work suggests that potential grain growth rate (i.e. ability of the grain to fill, or sink strength) is influenced by change in environmental conditions (e.g. radiation, temperature, and fertilizer application) during the early phase of grain filling (Tanaka and Matsushima, 1963[23]; Yoshida, 1981[26]; Tashiro and Wardlaw, 1990[24]; Sumi *et al*., 1996[21]; Egli, 1998[6]).

Assimilate supply during the first 10 days after heading, coupled with varied planting dates or fertilizer conditions, also affects the final percentage of grain filled.(Tsukaguchi *et al*., 1996[25]; Horie *et al*., 1997[10]).

(Tohru Kobata, *et al*. 1997[24]) found that Filling percentages in the early grain filling period (open symbols, 10 d after full heading date) and at grain maturity (closed symbols, 40 d after full heading date),

(Singh and Jenner, 1984[22]; Nakamura *et al*., 1992[16]; Horie *et al*., 1997). In the first 10 d after flowering, cell division and expansion in the endosperm of most grains ends and starch deposition begins (Egli, 1998[6]). From previous studies, however, it is doubtful that assimilate supply to the grain during the early grain filling period alone defines potential grain growth and determines final grain weight. If assimilate supply to rice is restricted by shading or unfavorable cultivated conditions in the first 10 d of the grain filling period, the grain may be profoundly affected, as grain growth rate is generally highest within the 2 wk after heading.

MATERIALS AND METHODS

Two field experiments were conducted at the Rice Research and Training Center (Sakha- Kafr -El Sheikh – Egypt), in 2010 and 2011 summer seasons to study Evolution some rice varieties (Sakha 106, Sakha 105, GZ 7565, GZ 9075 and GZ 9362) under different nitrogen levels (Zero, 55, 111, 165 and 220 (Kg/ha).

Soil samples from the experimental site were collected randomly from 0-30 cm depth for chemical analysis according to Black *et al* (1965). The results of analysis are presented in Table 1.

Table 1: **Soil chemical analysis of the experimental site**

Soil character	**2010**	**2011**	Mean
Ph	7.3	7.2	7.25
EC dsm-1	1.4	1.3	1.35
Organic matter (%)	2.1	2.0	2.05
Total N(%)	0.32	0.39	0.36
Available P (ppm)	17.55	10.20	18.38
Available K (ppm)	685.0	675.0	680
Available Zn (ppm)	1.4	1.3	1.35
Total soluble salts (mg/L)	10	14.0	12

Seedling age at transplanting was 26 days from sowing and by 20X20 cm planting spacing. and plot sizes of 3x5m. Recommended agricultural practices were applied with all variety under study. The experimental design was a split-plot design with four replications. Nitrogen levels was allocated to the main-plot, rice varieties to the sub-plot. Nitrogen fertilizer for every level was applied in the urea form (46.5%N) in two splits (2/3 the total dose was applied and mixed in the dry soil before flooding irrigation water. The remaining 1/3 was added at panicle initiation stage).

The number of days from sowing to maximum tillering, panicle initiation and 50% heading was recorded for each variety. After 100% heading, leaf area index and total leaf chlorophyll content was recorded using chlorophyll meter 5 SPAD-502 Minolta Camera Co. Ltd., Japan (Futuhara *et al.*, 1979). Before harvest, Number of tillers/hill was counted. Average number of tillers for five hills was recorded X 25. it was recorded by number of tillers by M^2 . The hills were carefully pulled to keep the whole root system and then transferred to the laboratory to determine plant attributes. Grain yield was measured from $12m^2$ (3x4 m) in the center of sub-plot. Grain yield was adjusted to 14% moisture content determined according to Yoshida (1981). spikelets/unit leaf area Ten panicles were randomly collected from each sub-plot to determine 1,000-grain weight and number of grains/per panicle. Grains filling rate (G.F.R.) was determined as the increase of grains weight in ten panicles every 5 days as the following equation:- G.F.R.= (W2-W1)/T2-T1. Where W1 and W2 refer to sample weight at time (5 days) T1 and T2 respectively according to (Bernard Mayor and Donald Andrson 1966. Light penetration by lux/meter pu 150 (K-Pu). Agronomic Efficiency was determined according to the methods obtained by De-Datta (1981) as follow: A.E = (Grain yield treat - Grain yield content)/ Kg N applied x 100. Number of panicles/ m^2 was determined at harvest time by counting the number of panicles / m^2 randomly in each plot. Data collected were subjected to statistical analysis of variance according to Gomez and Gomez (1984)[8] using IRRISTAT computer program.

RESULTS AND DISCUSSION

Number of days up to panicle initiation (P.I), Number of days up to maximum tillering (M.T), Roots length (cm), Leaf area index, Light penetration, Chlorophyll Content, Heading dates, Number of tillers/M^2, grains filling rates (G/D) at different stages , 1000-grain weight , number of grains/panicle, panicle length, grain yield (T/ha) and agronomic efficiency as affected by nitrogen levels and some rice varieties. Its will showed followed

Table (2): Effect of Nitrogen levels, Number of days up to maximum tillering, Roots length and Leaf area index as affected by nitrogen levels and some rice varieties

Characters / Treatments	Number of days up to panicle initiation (P.I)		Number of days up to maximum tillering (M.T)		Roots length (cm)		Leaf area index	
	2010	2011	2010	2011	2010	2011	2010	2011
Nitrogen levels kg/ha								
Zero	66	64	67	66	19.92	20.68	3.91	4.03
N55	65	63	68	67	22.41	21.81	4.72	4.62
N111	64	62	69	68	22.85	22.52	4.83	4.88
N165	64	62	69	68	24.53	23.99	5.13	5.03
N220	62	61	71	69	25.85	25.45	5.39	5.32
LSD at 5%	*1.51*	*0.65*	*1.2*	*1.00*	*0.59*	*0.86*	*0.18*	*0.17*
CV%	*1.5*	*1.0*	*1.25*	*2.9*	*1.7*	*2.4*	*2.2*	*2.2*
Rice varieties								
Sakha 106	63	61	67	66	24.45	24.27	5.43	5.48
Sakha 105	64	62	68	67	23.73	23.81	5.15	5.13
GZ. 7565	65	63	69	68	23.61	23.38	4.86	4.80
GZ. 9075	65	63	69	68	22.20	21.87	4.36	4.30
GZ. 9362	66	64	70	69	21.58	21.11	4.18	4.16
LSD at 5%	*0.72*	*0.65*	*0.82*	*0.65*	*0.46*	*0.45*	*018*	*0.14*
CV%	*1.8*	*1.6*	*1.9*	*1.0*	*1.5*	*2.8*	*2.2*	*2.2*

Table (3): Effect of nitrogen levels and some rice varieties on light penetration, chlorophyll content, heading dates and number of tillers /M2

Characters / Treatments	Light penetration		Chlorophyll content		Heading dates		No. of tillers/M^2	
	2010	2011	2010	2011	2010	2011	2010	2011
Nitrogen levels kg/ha								
Zero	2855	2855	35.74	34.94	101	101	560	574
N55	2016	2445	42.96	43.01	102	101	594	609
N111	1948	2255	43.83	42.23	104	102	623	643
N165	1875	1802	44.43	41.39	104	102	639	677
N220	1628	1665	44.60	40.79	105	103	654	704
LSD at 5%	*142*	*178*	*1.46*	*0.82*	*0.76*	*0.54*	*23.27*	*17.71*
CV%	*23.42*	*5.1*	*2.2*	*1.3*	*0.5*	*0.9*	*2.5*	*1.8*
Rice varieties								
Sakha 106	1532	1539	45.12	43.46	102	101	656	685
Sakha 105	1929	1838	43.13	41.39	103	102	625	656
GZ. 7565	2141	2342	42.28	40.62	104	102	614	645
GZ. 9075	2205	2538	41.44	39.75	104	102	609	631
GZ. 9362	2515	2766	39.60	37.16	104	103	564	589
LSD at 5%	*96*	*140*	*0.95*	*0.85*	*0.76*	*0.30*	*17.89*	*17.96*
CV%	*7.9*	*6.2*	*6.1*	*2.2*	*0.7*	*0.98*	*4.6*	*4.4*

Data in table (2): Showed that nitrogen level at 92.5 kg/N gave the highest value of Number of days up to panicle initiation , Number of days up to maximum tillering (M.T), Roots length (cm) and leaf area index . G.Z. 9362 gave the highest value of number of days up to panicle initiation(P.I) and number of days up to maximum tillering(M.T). It was the lowest value Roots length and leaf area index Compared with other varieties under study. Sakha 106 was early maturity stage therefore it was the lowest value of Number of days up to panicle initiation (P.I) and Number of days up to maximum tillering. And it was the highest value of roots length and leaf area index in both seasons. data are in agreement with those reported by(Milkkelson, 1982), (Song et al., 1990), Kumer *et al*. (1995) and Maske *et al*. (1997). (Mahrous *et al*, 1986, Hamissa *et al*., 1986 and Abd EL-Wahab 1998), (Ebaid and Ghanem, 2000).

Data in table (3): reported that increasing nitrogen levels up to 220(Kg N/ha) significantly increased chlorophyll content, heading dates and number of tillers/M^2 while zero nitrogen gave the highest value of light penetration in both seasons. Sakha 106 gave the highest value of chlorophyll contact, heading dates and number of tillers/M2 while G.Z. 9362 gave the highest value of light penetration. But sakha 106 was the lowest value of light penetration. data are in agreement with those reported by (Li, 1981; Yang and Sun, 1989). (Kabaki, 1993; Yamauchi, 1994). Abou-khalifa *et al*, (2007).

Table (4): grains filling rate (G/D) at different stage as affected by nitrogen levels and some rice varieties

Characters / Treatments	Grains filling rate (G/D) S1 2010	S1 2011	S2 2010	S2 2011	S3 2010	S3 2011	S4 2010	S4 2011	S5 2010	S5 2011
Nitrogen levels kg/ha										
Zero	0.17	0.14	0.25	0.23	0.83	1.10	0.54	0.54	0.45	0.47
N55	0.18	0.21	0.28	0.27	0.93	1.14	0.61	0.60	0.54	0.56
N111	0.22	0.25	0.36	0.38	0.98	1.19	0.62	0.61	0.57	0.57
N165	0.37	0.28	0.50	0.52	1.02	1.36	0.61	0.59	0.66	0.62
N220	0.33	0.30	0.73	0.71	1.07	1.39	0.61	0.59	0.67	0.71
LSD at 5%	*0.10*	*0.09*	*0.06*	*0.05*	*0.08*	*0.09*	*0.08*	*0.05*	*0.07*	*0.07*
CV%	*10.3*	*7.45*	*8.4*	*7.7*	*5.5*	*4.6*	*8.4*	*8.9*	*7.7*	*8.0*
Rice varieties										
Sakha 106	0.33	0.29	0.54	0.54	1.05	1.36	0.58	0.58	0.65	0.64
Sakha 105	0.28	0.26	0.46	0.46	1.01	1.29	0.61	0.60	0.62	0.62
GZ. 7565	0.26	0.22	0.41	0.40	0.95	1.23	0.61	0.60	0.58	0.57
GZ. 9075	0.22	0.21	0.38	0.39	0.93	1.17	0.60	0.58	0.55	0.55
GZ. 9362	0.19	0.19	0.33	0.33	0.90	1.14	0.59	0.57	0.52	0.53
LSD at 5%	*0.05*	*0.05*	*0.057*	*0.06*	*0.05*	*0.08*	*0.04*	*0.08*	*0.07*	*0.07*
CV%	*9.5*	*8.37*	*9.21*	*7.9*	*6.7*	*5.9*	*9.3*	*9.0*	*8.2*	*10.3*

Table (5): 1000-grain weight, number of grains/panicle, panicle length(cm) and grain yield (T/ha) as affected by nitrogen levels and some rice varieties

Characters / Treatments	1000-grain weight 2010	1000-grain weight 2011	No. of grains/panicle 2010	No. of grains/panicle 2011	Panicle length (cm) 2010	Panicle length (cm) 2011	Grains yield (T/ha) 2010	Grains yield (T/ha) 2011
Nitrogen levels kg/ha								
Zero	22.31	21.63	105	105	18.36	18.23	6.8	7.11
N55	23.25	22.55	108	109	18.86	18.74	8.33	8.08
N111	23.77	23.14	111	112	19.50	19.36	9.16	9.15
N165	24.10	23.75	113	114	20.53	20.26	9.86	9.62
N220	25.45	24.95	115	117	21.00	20.81	10.63	10.64
LSD at 5%	*0.69*	*0.53*	*0.86*	*1.47*	*0.36*	*0.13*	*0.28*	*0.24*
CV%	*1.9*	*1.5*	*0.5*	*0.9*	*1.3*	*1.3*	*2.0*	*2.00*
Rice varieties								
Sakha 106	26.08	25.10	115	116	20.59	20.33	9.80	9.80
Sakha 105	24.78	24.23	113	113	20.11	19.96	9.24	9.28
GZ. 7565	23.66	23.22	110	111	19.67	19.53	8.93	8.86
GZ. 9075	22.51	22.12	109	110	18.38	19.22	8.61	8.61
GZ. 9362	21.84	21.35	106	107	18.50	18.37	8.20	8.06
LSD at 5%	*0.65*	*0.65*	*1.23*	*0.97*	*0.38*	*0.10*	*0.24*	*0.24*
CV%	*2.12*	*2.6*	*1.80*	*1.4*	*1.4*	*1.9*	*3.1*	*2.4*

Data in table (4) Showed that grains filling rate at different stages were gradually increased by increase number of days up to S3 third sample or after 15 days from complete heading at different nitrogen levels and rice varieties. Therefore S3 the pest of period to transferred of sugar and starch from leaf and rice stem up to panicle. So irrigation water for rice crop more important after 15 days from completed heading. 220 kgN/ha gave the highest value of grains filling rate at different stages. While zero nitrogen gave the lowest value of grains filling rate at different stage. Sakha 106 gave the highest value of grains filling rate at different stage compared with other varieties under study in both seasons. These data are in agreement with those reported by (Cock and Yoshida, 1972 ;) (Yoshida, 1981). (Matsushima and Wada, 1958; Yoshida, 1981; Evans, 1996; Egli, 1998). (Kobata and Takami, 1986; Kobata and Moriwaki, 1990; Takami et al., 1990. (Tohru Kobata, *et al*. 1997) (Singh and Jenner, 1984; Nakamura *et al*., 1992; Horie *et al*., 1997).

Data in table (5): regarded that 220 kgN/ha gave the highest value of 1000-grain weight , number of grains/panicle, panicle length (cm) and grain yield (T/ha). While zero nitrogen gave the lowest value to all previous characters under study. Sakha 106 surpassed other varieties under study to all previous character study. But GZ 9362 gave the lowest value of all character under study in both seasons. These data are in agreement with those reported by(Ebaid and Ghanem, 2000). Kumer *et al*. (1995) , Abou- khalifa *et al*, (2007)

Fig.(1): found that agronomic efficiency was gradually increase by increase nitrogen levels up to N 220 kg/ha in both seasons. N(kg/ha) gave the lowest value of Agronomic Efficiency.

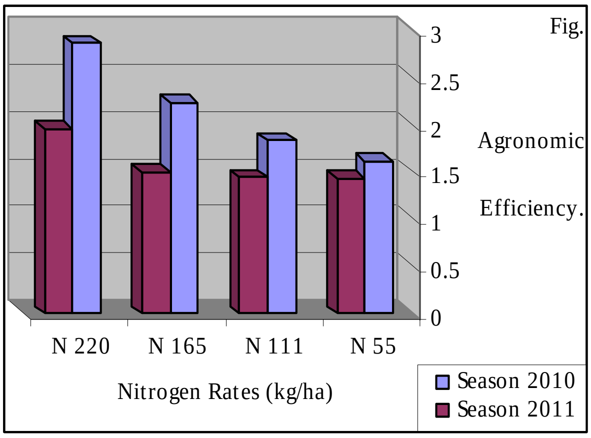

Figure (1):Effect of nitrogen levels on agronomic Efficiency

Fig. (2): Recorded that Sakha 106 surpassed other varieties on agronomic efficiency. While GZ. 9362 gave the lowest value of agronomic efficiency.

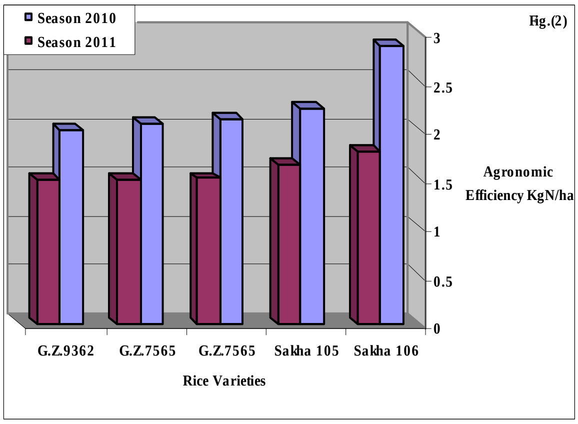

Figure (2):Effect of some rice varieties on agronomic Efficiency

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