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EFFECT OF TIME AND METHOD OF NITROGEN APPLICATION WITH TRANSPLANTED AND BROADCASTED RICE ON YIELD AND QUALITY CHARACTERRISTICS

A.A. El-Hosary[1], M.R. Gomaa[1], A.T. Badawi[2], and I.H. Abou El-Darag[2]
[1]Agron. Dept., Fac. Agriculture, Moshtohor, Zagazeeg Univ.
[2]Agricultural Research Center, Giza

ABSTRACT:

Two field experiments for transplanted and broadcasted rice were conducted at the Rice Research and Training Center (RRTC), Sakha, Kafr El-Sheikh, Egypt during the1996 and 1997 seasons to study the response of five rice cultivars, namely, Giza 181, Giza 177, Giza 178, Sakha 101, and Sakha 102 to four spliting times of nitrogen application i.e. (T_1) two splits, 2/3 as basal and incorborated into dry soil + 1/3 as top dressing at panicle initiation time, (T_2) three equal splits (1/3 as basal and incorporated into dry soil + 1/3 as top-dressing at maximum tillering stage +1/3 as top-dressing at panicle initiation time, (T_3) three splits, 1/2 as basal and incorporated into dry soil +1/4 as top-dressing at panicle initiation time + 1/4 as top-dressing after complete flowering, and (T_4) all the nitrogen amount was incorporated into dry soil and their interactions on grain yield, yield components and some grain quality characters. The split plot design was used, and the main plots were devoted to five rice cultivars and the subplots were allocated to the time of nitrogen applications. The results revealed that by using the broadcast method, Giza 178 gave the highest values for number of tillers/m^2, number of panicles/m^2, number of filled grains/panicle, grain yield and harvest index. Whereas Sakha 101 produced the highest values for 100-grain weight, grain yield and harvest index in transplanting method. Split nitrogen (1/2 basal+1/4 at panicle initiation+1/4 at complete flowering) for broadcasted seeded rice gave the highest values for number of panicles/m^2, panicle weight, grain yield and harvest index. While splitting nitrogen (2/3 basal and 1/3 at panicle initiation) gave the highest values of number of tillers/m^2, number of panicles/m^2, panicle weight, straw yield, grain yield and harvest index in transplanting method. Transplanting gave significant higher grain yield and head rice compared with broadcasting method. To obtain high yield and quality, it could be recommended to grow both Giza 178 and Sakha 101 with splitting nitrogen in three splits (1/2 as basal+1/4 at panicle initiation+1/4 at complete flowering) for broadcasting and transplanting methods under conditions similar to that of this experiment.

INTRODUCTION

Rice is considered as one of the most important food crop after wheat in the world and also as the second export crop after cotton in Egypt. It occupies about 1.225 million feddans with approximate production of 4.45 million metric tons. In 1998, the national average rice yield was 3.63 tons/feddan which equals 8.6 tons/ha (Final Report of Rice National Campaign). This was mainly due to replacing the old rice cultivars with newly improved ones such as Giza 177, Giza 178 as well as Sakha 101 and Sakha 102 cultivars and improving field techniques. In this regard, many researchers have shown that rice cultivars differ in their growth, grain yield and its components (El-Kassaby et al., 1991; El-Kalla et al., 1994; Gorgy, 1995; and Said et al., 1998).

The yield of newly recommended rice cultivars is not only influenced by nitrogen fertilizer but also by splitting time of nitrogen application. In this respect, El-Kassaby et al. (1991), Abdo (1994) and Abd Alla (1996) stated that adding nitrogen fertilizer in two equal doses (1/2 on dry soil before transplanting and the rest 20 days later) significantly increased grain yield and most of its components. El-Refaee (1997), Said et al. (1998) and El-Kady and Abd El-Wahab (1999) found that the highest values of yield and its attributes were significantly recorded when two thirds of the applied nitrogen was incorporated with the dry soil and the rest topdressed at panicle initiation. Porwal et al. (1994), Ghanem et al. (1995), and El-Refaee (1997) reported that grain yield was increased by adding N in three equal splits (basal+tillering+panicle initiation) as compared with basal or in two equal doses. Sorour et al. (1998) found that splitting nitrogen dose into two or three splits was superior to single dose application.

Therefore, the present study was performed to study the effect of time and method of nitrogen application on growth, yield, yield components and grain quality of transplanting and broadcasting methods on five newly- recommended rice cultivars.

MATERIALS AND METHODS

Field experiments on transplanted and broadcast-seeded rice methods were conducted at the Rice Research and Training Center (RRTC), Sakha, Kafr El-Sheikh, Egypt during the 1996 and 1997 seasons. This experiment aimed at investigating the performance of five rice cultivars, namely, Giza 181, Giza 177, Giza 178, Sakha 101, and Sakha 102 under four splitting times of nitrogen application i.e. (T_1) two splits, 2/3 as basal and incorborated into dry soil + 1/3 as top dressing at panicle initiation, (T_2) three equal splits (1/3 as basal and incorporated into dry soil + 1/3 as top-dressing at maximum tillering stage +1/3 as top-dressing at panicle initiation, (T_3) three splits, 1/2 as basal and incorporated into dry soil +1/4 as top-dressing at panicle initiation + 1/4 as top-dressing after complete flowering, and (T_4) all the nitrogen amount was incorporated into dry soil and. The dose of 96 kg N/ha as 46% N urea was applied.

A split-plot design with four replicates was used and the main plots were devoted to five rice cultivars and the subplots were allocated to splitting time of nitrogen application. The plot size measured 18 m^2 (3x6 m). In both growing seasons rice was preceded by barley. The soil of the experiment was clay with PH(7.8-8.4) and had organic matter content of (2.20-1.83% for 1996 and 1997 seasons, respectively). Monthly average temperature and relative humidity are shown in Table (1) according to Sakha Meteorological Station. .

Table (1): monthly temperature (°C) and relative humidity (%) at Sakha during 1996 and 1997 rice seasons

Month	Temperature (°C)				Relative humidity % (Mean)	
	1996		1997			
	Max.	Min.	Max.	Min.	1996	1997
May	29.5	13.6	29.0	15.4	53.2	61.0
June	31.5	17.0	32.0	17.8	55.3	48.0
July	29.4	18.0	30.0	19.1	57.3	51.5
August	31.4	20.0	33.5	17.8	63.3	66.5
September	32.3	18.8	35.0	19.2	66.7	70.2
October	30.0	15.0	34.0	17.0	57.7	55.5

All rice cultivars were planted at the rate of 144 kg seeds/ha on 25 May in both seasons. All other cultural practices for both transplanting and broadcasting rice were under taken as recommended.

At harvest, ten plants of guarded hills were taken for estimating the following characters: plant height (cm), panicle length (cm), number of tillers/m^2, heading date (days), number of panicles/m^2, panicle weight (g), 1000-grain weight (g), number of filled and unfilled grains/panicle, and harvest index.

Plants in the inner 10 m^2 were harvested by hand, and left for five days for air and sun drying and then threshed by an experimental threshing machine. Grain weight was recorded and adjusted at 14% moisture content. Grain and straw yields were recorded and expressed in t/ha.

At the grain quality Lab of RRTC, random samples of 500 grains of rough rice per plot were taken to determine the following grain quality characters as described by Khush et al, (1979): hulling recovery (%), milling (%), head rice (%), grain length (mm), grain width (mm) and grain shape (length: width ratio).

Nitrogen content was determined by microkjeldahl and then multiplied by 5.95 to estimate protein content in paddy rice is described by Black, 1965. The simplified procedure of Juliano (1971) to determine amylose content in milled rice was followed.

Data of the two experiments were subjected to proper statistical analysis of variance according to Snedecor and Cochran (1971). The combined analysis was conducted for the data of the two experiments (broadcasting or transplanting in both seasons) according to Cochran and Cox (1968). Duncan's multiplerange test (Duncan, 1955) was used for mean comparison. In the tables, means followed by the same letters are not significantly different at the 0.05% significance level.

RESULTS AND DISCUSSION

1. Broadcasting Method

1.1. *Seasonal effects*

Broadcasted rice grain yield, its contributing components and some grain quality traits were influenced by season (Table 2). The results show that all studied characters except length, width and shape of grain and amylose percent were significantly varied from one season to the other. Higher values of number of tillers/m^2, heading date (days), number of panicles/m^2, panicle weight (g), 1000-grain weight, hulling percent and protein percent were detected in the first season, while values of plant height, panicle length, filled grains/panicle, unfilled grains/panicle, straw and grain yield, harvest index, milling percent and head rice percent were higher in the second season. It could be concluded that the increase in grain yield in the second season was due to the significant increase in number of grains/panicle and panicle length (Table 2). Also climatic conditions in the second season might have favoured grain production for broadcasted cultivars, which was explained by a higher harvest index (Table 2).

1.2. *Effect of nitrogen application*

Table 3 shows the combined data for the averages of broadcasted rice grain yield, yield components, and some grain quality were affected by splitting time of nitrogen application in 1996 and 1997 seasons. Most of the studied characters were significantly affected by times of splitting nitrogen application (Table 3). Adding nitrogen in three splitting doses (T_3) markedly gave highest values of number of panicles/m^2 (792.2), panicle weight (2.79g), grain yield (8.15 t/ha) and harvest index (45.07), while the highest average of panicle length (20.12 cm), number of filled grains/panicle (103), and 1000-grain weight (27.28 g) were obtained when nitrogen was applied in three split doses (T_2). Splitting nitrogen as 2/3 basal and 1/3 at P_1 (T_1) gave the highest values of number of tillers/m^2 (926.63) and plant height (87.97cm).

The highest values of grain yield and yield components (number of panicles/m^2 and panicle weight) in case of T_3 could be explained on the basis that adding ½ of nitrogen activated the tillering at tillering stage, ¼ produced more effective tiller, while the last ¼ increased the panicle weight. Thus, this method of application encouraged the building of metabolites and this in turn resulted in a high yield. These findings are in a close agreement with the results of Porwal et al. (1994), Ghanem et al. (1995) and El-Refaee (1997).

Concerning grain quality attributes (Table 3), results showed that the highest protein content was found in rice grains (8.68 %) when N was applied as T_3, while T_1 treatment resulted in the highest values of milling (71.47%) and head rice (62.41%).

1.3. *Effect of cultivar*

Data presented in Table 4 show the performance of rice cultivars on broadcasted rice grain yield, yield components, and some grain quality combined over both seasons. Highly significant differences were observed among the five cultivars in all studied characters. Giza 178 cultivar significantly produced the highest number of tillers/m^2 (949.75), number of panicles/m^2 (827.5), number of filled grains/panicle (107.94), grain yield (8.25 t/ha), and harvest index (45.11). Sakha 101, however, produced the highest panicle weight (2.84 g), and 1000-grain weight (28.88 g). Giza 181 showed its superiority in panicle length (20.89 cm) and straw yield (10.17 t/ha), while Sakha 102 appeared as the earliest cultivar in heading (80.50 days) and the tallest variety (88.98 cm). It is clear that the increase in the grain yield of Giza 178 cultivar was primarily due to the increase in number of panicles/m^2 and filled grains/panicle, whereas the increase in yield of Sakha 101 cultivar could be attributed to the increase in weight of panicle and 1000-grain weight. It could be concluded that differential performance of the tested cultivars might be attributed to differences in constitution of these cultivars. Regarding grain quality attributes (Table 4), Giza 181 gave the highest values of grain length (9.13 mm). Grain shape (3.46), and amylose content (20.31). The highest percentages of hulling (80.57), milling (72.62), head rice (65.23), and protein (8.26) were recorded for Giza 177. Sakha 101 had the highest value of grain width (3.42 mm). The differences in grain quality among the five tested cultivars might be due to differences in their growth patterns and genetic variability and their interactions with the climatic factors.

1.4. *Interaction effects*

Means of broadcasted rice grain yield, yield components, and some grain quality characters were affected by the nitrogen splitting time x cultivar interaction combined over seasons (Tables 5, 6). The interaction significantly influenced all studied characters. Adding nitrogen in three-split dose (T_3) with Giza 178 cultivar gave the highest values for number of panicles/m^2 (916.0) and grain yield (8.83 t/ha). The same N application resulted in the highest panicle weight (3.56 g) and harvest index (46.46) with Sakha 101 cultivar, as well as unfilled grains/panicle (14.5) and straw yield (10.46 t/ha) with Giza 181 cultivar. Splitting N in three doses (T_2) with Giza 177 resulted in the earliest heading (80 days), and with Giza 181 gave the longest panicles (21.48 cm). However, Giza 178 had the highest filled grains/panicle (118.75) and also the highest number of tillers/m^2 (1039.7) under T_1 treatment, while the tallest plants (91.68 cm) and the highest 1000-grain weight (29.25 g) were obtained with Sakha 102 under T_2 treatment.

Applying N in three-split dose (T_3) favorably affected grain yield of Giza 178 and significantly increased grain yield compared with the other treatments. The superiority of Giza 178 cultivar in grain yield under T_3 might be ascribed to some components of yield, especially the number of panicles/m^2. These results are in harmony with those obtained by Abd El-Wahab (1998) and El-Kady and Abd El-Wahab (1999). For grain quality attributes (Table 6), Giza 177 had the highest values for hulling (80.95%) and head rice (66.57%) under T_2 treatment, protein (9.34%) under T_1 treatment as well as milling (73.60%) under T_3. While Giza 181 cultivar had the highest values for grain length (9.42 mm), grain shape (3.57) and amylose (20.6%) under T_2, T_4, and T_1 treatments, respectively. The highest value for grain width (3.50 mm) was obtained by Sakha 101 with T_2 treatment.

2. Transplanting method

2.1. *Seasonal effects*

Seasonal effects on the averages of yield and its components, and some grain quality of transplanted rice are presented in Table 7. From the results, it is evident that most of the studied characters were significantly differed from one season to another. Panicle weight, filled grains/panicle, 1000-grain weight, harvest index, hulling percent and protein percent were significantly higher in the first season than in the second one. While heading date, plant height, number of panicles/m^2, unfilled grains/panicle, straw yield and head rice percent gave significant higher values in the second season. However, grain yields for both seasons were very close. These results could be attributed to variations in temperature, relative humidity, and soil in the two seasons.

2.2. *Effect of nitrogen application*

Table 8 shows the combined analysis of the two seasons for transplanted rice grain yield, yield components, and some grain quality as affected by time of N application. The results show that all studied characters except panicle length and hulling percent were significantly affected by N application. The highest numbers of tillers/m^2 (652.38), panicles/m^2 (551.58), in addition to, panicle weight (2.78 g), straw yield (10.14 t/ha), grain yield (8.62 t/ha), and harvest index (45.92) were obtained when plants received nitrogen in two-split dose (T_1). Adding N in three-split dose (T_3) gave the highest filled grains/panicle (94.20) and 1000-grain weight (27.35 g), but T_2 resulted ithe highest plants (93.47). The superiority of the split application of nitrogen might be attributed to the availability of N in the critical rice growth stages as well as to the decrease in N losses due to volatilization, nitrification, and denitrification. Similar results were reported by Badawi et al. (1990), El-Refaee (1997), Sorour et al. (1998), and El-Kady and Abd El-Wahab (1999).

Regarding grain quality (Table 8), T_2 (three equal splits) resulted in the highest grain length (8.33 mm), milling percent (71.03%) and head rice (64.69%). Treatment T_1 gave the highest grain shape (2.63) and Treatment T_3 resulted in the highest protein percent (7.56%), while T_4 (all N amount as basal) had the greatest grain width (3.27 mm) and highest amylose percent (18.71).

2.3. *Effect of cultivar*

Results in Table 9 revealed that cultivars significantly varied for all studied characters. Giza 181 gave the highest number of tillers/m^2 (663.44), panicle length (20.40 cm), panicle weight (2.78 g), and unfilled grains/panicle (8.16). Giza 178, in addition, had the highest number of panicles/m^2 (564.06), filled grains/panicle (102.63), and straw yield (10.43 t/ha); but ranked second for grain yield (8.38 t/ha). Sakha 101 produced the highest values for 1000-grain weight (29.06 g), grain yield (8.63 t/ha), and for harvest index (46.26). Sakha 102 and Giza 177 were the earliest cultivars (90.78 and 91.03 days, respectively). The superiority of Sakha 101 in yield could be attributed to the high values of panicle weight, 1000-grain weight, and to seed index. Giza 178 ranked second for grain yield and this might be due to its high numbers of panicles/m^2 and filled grains/panicle. Similar findings were also reported by Badawi et al. (1990) and El-Kalla et al. (1990). For grain quality traits (Table 9), Giza 181 gave the highest values of grain length (9.14 mm), and grain shape (3.65), while Sakha 101 had the highest grain width (3.48 mm). The highest values of hulling, milling, head rice, and protein content were recorded for Giza 177, being 81.64%, 71.97%, 64.31%, and 7.53%, respectively. Sakha 102 gave the highest amylose content (19.23%). It could be concluded that Giza 177 is considered the best for grain quality properties followed by both Sakha 102 and Sakha 101.

2.4. *Interaction effect*

Tables 10,11 show that the interaction between time of N splitting and cultivars was statistically highly significant for all characters under study. Applying T_1 resulted in the highest number of tillers/m^2 (709.4), and number of panicles/m^2 (593.75) for cv. Giza 178, as well as panicle weight (3.09 g), grain yield (9.08 t/ha) and harvest index (47.88) with Sakha 101 cultivar. However, applying N as in T_2 to Giza 178 gave the highest value of filled grains/panicle (107.00), and to Sakha 102 gave the tallest plants (101.68 cm). However, applying N as in T_3 resulted in the longest panicles (20.99 cm) with Giza 181, the highest 1000-grain weight (29.63 g) with Sakha 101 and the highest straw yield (10.78 t/ha) with Giza 178. The earliest heading occurred with Sakha 102 under T_4. The present results showed that T_1 is the optimal combination for each of Sakha 101 and Giza 178 to produce the highest grain yield. In general, T_1 with all cultivars gave the highest mean values for yield and most of the yield components. Similar results were also reported by Abd El-Wahab (1998) and El-Kady and Abd El-Wahab (1999).

Results also revealed that Giza 177 gave the highest values of hulling (82.12%) and protein (80.09%) under T_1 treatment as well as milling (74.42%) and head rice (68.92%) under T_2 treatment. Giza 181 had the highest values for grain shape (3.78) with T_1 and grain length (9.53 mm) with T_2. Sakha 102 and T3 (Table 10) gave the highest values for grain width (3.55 mm), and amylose (19.60%).

COMPARISON BETWEEN PLANTING METHODS

The studied characters means for the two planting methods are presented in Table 12. The t-test revealed that the differences were significant for heading date, plant height, unfilled grains/panicle, grain yield and percentages of head rice, protein and amylose. However, the remaining traits significantly gave the same values under the two planting methods. It was found that broadcasting method gave significant higher values than transplanting for unfilled grains, protein and amylose percent; while transplanting gave significant higher values for heading date, plant height, grain yield and head rice.

REFERENCES

Abd Alla, A.B.A. 1996. Effect of some cultural treatments on rice. M. Sc. Thesis, Fac. Agric., Moshtohor, Zagazig Univ.

Abd El-Wahab, A.E. 1998. Physiological behavior of some Egyptian rice cultivars under different nitrogen levels. Egypt. J. Appl. Sci. 13(4):119-129.

Abdo, M.A.D. 1994. Effect of some agricultural practices on growth and yield of rice. M.Sc. Thesis, Fac. Agric., Mansoura Univ.

Badawi, A.T.; S.A. Ghanem and A.M. El-Serafy. 1990b. Effect of nitrogen levels and methods of application on nitrogen status of broadcast-seeded rice. Proc. 4th Conf. Agron., Cairo, 15-16 Sept. 1:331-342.

Black, A.; D.D. Evan; L.E. Ensminger; J.L. White and F.E. Clark. 1965. Methods of soil analysis (chemical and microbiology properties, Part 2). Am. Soc. Agron.

Cochran, W.G. and G.M. Cox. 1968. Experimental design. 2nd ed., John Wiley and Sons Inc., New York.

Duncan, D.B. 1955. Multiple range and multiple F tests. Biometrics 11:1-42.

El-Kady, A.A. and A.E. Abd El-Wahab. 1999. Nitrogen fertilizer management and its effect on growth, yield and grain quality of some Egyptian rice cultivars. Egypt. J. Appl. Sci. 14(7):24-35.

El-Kalla,S.E; A.T. El-Kasaby; A.A. Leilah; E.M. Saied and E.M. Ibrahim. 1994. Effect of dates and methods of sowing on growth and yield of some rice cultivars. Proc. 6th Agron. Conf., Al-Azhar Univ., Cairo, 1:215-221.

El-Kassaby, A.T.; M.H. El Hindy; A.A. Leilah and A.Z. El-Bab. 1991. Effect of nitrogen levels and time of its application on the productivity of some rice varieties. J. Agric. Sci., Mansoura Univ. 16(2):251-257.

El-Refaee, I.S. 1997. Effect of some irrrigation treatments on growth and yield of rice. M.Sc. Thesis, Fac. of Agric., Kafr El-Sheikh, Tanta Univ., Egypt, 127 pp.

Ghanem, S.A.; A.E. Abd El-Wahab; A.T. Badawi; A.M. El-Serafy; M.A. Nour and S.K. De Datta. 1995. Nitrogen fertilizer management in broadcast seeded flooded rice using N^{15} labeled urea. Menufia J. Agric. Res. 20(1)51-66.

Gorgy, R.N. 1995. Effect of some agricultural treatments on rice yield and quality. Ph.D. Thesis, Fac. Agric., Kafr El-Sheikh, Tanta Univ., Egypt, 194 pp.

Juliano, B.O. 1971. A simplified assay for rice amylose. Cereal Sci. Today 16:334-360.

Khush, G.S.; C.M. Paule and N.M. Dela Cruze. 1979. Rice grain quality evaluation and improvement at IRRI Proc. Workshop on Chemical Aspects of Rice Quality. IRRI, Manila. Philippines.

Porwal, M.K.; G.S. Bhatnagar and P.C. Chaplot. 1994. Effect of nimim-coated urea and other sources at graded level of nitrogen in lowland rice (*Oryza sativa*). Indian J. Agron 39(4):635-637.

Said, El-A.M.; M.A. Badawi; A.A.Abd El-Rahman and F.A. Kalboch. 1998. Performance of some rice cultivars to splitting N fertilization levels. J. Agric. Sci., Mansoura Univ., 23(8):3633-3639.

Sorour, F.A.; M.E. Mosalem; F.N. Mahrous and I.S. El-Refaee. 1998. Effect of irrigation interval and splitting of nitrogen on growth, yield and quality of rice. J. Agric. Res., Tanta Univ., 24(1):60-75.

Table 2. Seasonal effects on the average values of growth attributes, yield, yield components and grain quality in broadcasting method.

Season	Tillers/m^2	Heading date	Plant height (cm)	Panicle length (cm)	Panicles/m^2	Panicle weight (g)	Fill.grains/ panicle	Unfill.grains /panicle	1000-grain weight (g)	Straw yield (t/ha)
1996	912.20 a	89.56 a	86.26 b	19.45 b	820.9 a	2.62 a	91.61 b	4.30 b	27.60 a	9.69 b
1997	851.74 b	87.29 b	87.84 a	20.13 a	687.7 b	2.51 b	104.95 a	9.46 a	26.15 b	10.06 a

Season	Grain yield (t/ha)	Harvest index	Grain length (mm)	Grain width (mm)	Grain shape	Hulling %	Milling %	Head rice %	Protein %	Amylose %
1996	7.36 b	42.93 b	8.10 a	3.16 a	2.62 a	78.98 a	69.23 b	59.99 b	8.41 a	19.04 a
1997	8.13 a	44.60 a	7.96 a	3.14 a	2.62 a	77.94 b	71.11 a	62.23 a	7.42 b	19.59 a

Table 3. Effect of time of nitrogen application on growth attributes, yield, yield components, and grain quality in broadcasting method combined over the 1996 and 1997 seasons.

Time of N application	Tillers/m^2	Heading date	Plant height (cm)	Panicle length (cm)	Panicles/m^2	Panicle weight (g)	Fill. grains/ Panicle	Unfill.grain /panicle	1000-grain weight (g)	Straw yield (t/ha)
T_1	926.83 a	88.25 b	87.97 a	19.79 ab	775.5 ab	2.55 b	101.13 ab	5.97 c	26.93 a	9.95 a
T_2	883.20 ab	88.15 b	87.44 ab	20.12 a	751.6 b	2.57 b	103.00 a	6.95 b	27.28 a	9.94 a
T_3	870.40 ab	88.95 a	87.30 b	19.63 b	792.2 a	2.79 a	98.90 b	8.35 a	26.40 b	9.88 a
T_4	847.45 b	88.35 b	85.50 c	19.64 b	698.0 c	2.35 c	90.10 c	6.25 c	26.90 a	9.74 a

Time of N application	Grain yield (t/ha)	Harvest index	Grain length (mm)	Grain width (mm)	Grain shape	Hulling %	Milling %	Head rice %	Protein %	Amylose %
T_1	7.73 c	43.79 b	7.94 a	3.13 a	2.63 a	78.77 a	71.47 a	62.41 a	8.16 b	19.37 a
T_2	7.94 b	44.54 ab	8.09 a	3.15 a	2.65 a	78.32 a	70.07 b	61.29 b	7.83 c	19.28 a
T_3	8.15 a	45.07 a	8.03 a	3.15 a	2.59 a	78.32 a	69.46 b	61.58 b	8.68 a	19.31 a
T_4	7.17 c	41.66 c	8.04 a	3.16 a	2.61 a	78.41 a	69.67 b	59.16 c	6.98 d	19.30 a

T_1= 2/3 basal+1/3 at panicle initiation, T_2=1/3 basal+1/3 at maximum tillering+1/3 at panicle initiation, T_3=1/2 basal+1/4 at panicle initiation+1/4 at complete flowering, T_4=All amount as basal.

Table 4. Growth attributes, yield, yield components, and grain quality as affected by rice cultivars in broadcasting method combined over the 1996 and 1997 seasons.

Cultivar	Tillers/m²	Heading date	Plant height (cm)	Panicle length (cm)	Panicles/m²	Panicle weight (g)	Fill. grains/ Panicle	Unfill.grain/ panicle	1000-grain weight (g)	Straw yield (t/ha)
Giza 181	914.63 a	97.19 a	86.86 bc	20.89 a	718.8 cd	2.41 c	108.47 a	11.34 a	25.59 c	10.17 a
Giza 177	818.34 b	80.69 c	87.31 b	18.55 d	703.2 d	2.53 b	91.69 b	5.56 cd	28.28 b	9.59 c
Giza 178	949.75 a	87.31 b	85.52 d	20.12 b	827.5 a	2.53 b	107.94 a	6.44 b	22.84 d	9.91 b
Sakha 101	910.34 a	96.44 a	86.58 c	19.91 bc	775.4 b	2.84 a	92.19 b	5.94 bc	28.88 a	10.02 ab
Sakha 102	816.78 b	80.50 c	88.98 a	19.51 c	746.8 bc	2.51 b	91.13 b	5.13 d	28.78 a	9.68c
	Grain yield (t/ha)	Harvest index	Grain length(mm)	Grain width (mm)	Grain shape	Hulling %	Milling %	Head rice %	Protein %	Amylose %
Giza 181	7.45 bc	42.45 b	9.13 a	2.70 c	3.46 a	75.67 d	67.96 c	57.71 d	7.74 c	20.31 a
Giza 177	7.70 b	44.39 a	7.82 b	3.41 a	2.29 c	80.57 a	72.62 a	65.23 a	8.26 a	19.91 c
Giza 178	8.25 a	45.11 a	7.42 c	2.85 b	2.64 b	76.85 c	67.91 c	57.74 d	7.91 b	17.91 d
Sakha 101	8.05 a	44.34 a	7.93 b	3.42 a	2.33 c	79.62 b	71.11 b	61.85 c	7.69 c	19.74 b
Sakha 102	7.28 c	42.54 b	7.83 b	3.35 a	2.37 c	79.58 b	71.25 b	63.03 b	7.95 b	19.59 b

Table 5. Growth, yield, and yield components as affected by N application time x cultivar interaction in broadcasting method combined over the 1996 and 1997 seasons.

Time of N application	Cultivar	Tillers/ m²	Heading date	Plant height (cm)	Panicle length (cm)	Panicles/ m²	Panicle weight (g)	Fill. grains/ Panicle	Unfill. grain/ panicle	1000-grain weight (g)	Straw yield (t/ha)	Grain yield (t/ha)	Harvest index
T_1	Giza 181	950.4 b	97.13 b	86.65 f	21.03 b	758.8 fg	2.42 I	107.38 de	9.38 c	26.00 i	10.37 a	7.30 j	42.27 i
	Giza 177	910.6 cde	80.25 k	87.49 j	17.83 j	706.0 i	2.43 ij	91.38 ij	4.98 i	28.50 e	9.81 fg	7.63 g	43.39 gh
	Giza 178	1039.7 a	87.50 f	87.75 d	20.36 c	844.5 b	2.51 f	118.75 a	4.75 i	22.63 m	9.99 cd	8.29 d	45.30 cd
	Sakha 101	963.6 b	95.63 d	89.10 bc	20.43 c	816.3 c	2.79 b	97.13 h	5.75 h	28.75 d	9.92 de	8.55 b	46.40 a
	Sakha 102	769.8 g	80.75 g	88.88 c	19.31 g	752.1 g	2.61 e	91.00 ij	5.00 i	28.79 cd	9.64 h	6.85 m	41.61 j
T_2	Giza 181	880.3 ef	97.13 b	86.45 fg	21.48 a	721.8 hi	2.59 e	115.50 b	12.00 b	26.63 h	10.00 cd	7.54 gh	42.65 I
	Giza 177	877.1 ef	80.00 k	87.96 d	18.49 h	727.3 h	2.57 e	92.00 i	5.50 h	28.38 ef	9.62 h	7.77 f	45.50 cd
	Giza 178	893.0 de	86.38 g	83.96 j	20.46 c	730.1 h	2.51 fg	106.13 e	6.00 g	23.00 I	10.27 b	8.42 c	45.54 cd
	Sakha 101	915.6 cd	97.13 b	87.14 e	19.69 ef	796.0 d	2.68 c	101.63 f	6.50 f	29.13 ab	10.19 b	7.96 e	43.81 f
	Sakha 102	850.0 f	80.13 k	91.68 a	20.48 c	782.6 de	2.48 fg	99.75 g	4.75 i	29.25 a	9.61 h	7.99 e	45.20 d
T_3	Giza 181	891.0 de	98.00 a	87.70 d	19.88 de	719.3 hi	2.49 fg	111.13 c	14.50 a	24.75 k	10.46 a	8.07 e	44.68 e
	Giza 177	763.4 g	81.38 h	89.39 b	19.73 ef	751.3 g	2.65 cd	99.00 g	5.50 h	27.50 g	9.30 j	7.99 e	45.63 bc
	Giza 178	962.0 b	88.00 e	85.69 h	19.87 de	916.0 a	2.66 c	108.38 d	8.88 d	23.00 I	9.97 cd	8.83 a	45.95 b
	Sakha 101	855.6 f	97.13 b	84.56 I	19.55 f	853.5 b	3.56 a	90.13 j	7.13 e	28.50 f	9.93 de	8.55 b	46.46 a
	Sakha 102	880.0 ef	80.25 k	89.14 bc	19.15 g	720.8 hi	2.61 de	85.88 l	5.75 h	28.50 e	9.71 gh	7.28 j	42.63 I
T_4	Giza 181	936.9 bc	96.50 c	86.62 f	21.19 b	675.4 j	2.14 k	99.88 g	9.50 e	25.00 j	9.85 ef	6.88 lm	40.21 L
	Giza 177	722.3 h	81.13 hi	84.40 I	18.15 I	628.1 k	2.48 fg	84.38 l	6.25 g	28.75 d	9.63 h	7.39 ij	43.04 h
	Giza 178	904.3 cde	87.38 f	84.69 I	19.79 de	819.4 e	2.46 gh	98.50 gh	6.13 g	22.75 m	9.42 i	6.46 hi	43.64 fg
	Sakha 101	906.5 cde	95.88 d	85.53 h	19.96 d	635.8 k	2.35 j	79.88 m	4.38 j	29.00 bc	10.05 c	7.14 k	40.70 k
	Sakha 102	767.4 g	80.88 ij	86.25 g	19.09 g	731.5 ef	2.33 j	87.88 k	5.00 i	29.00 bc	9.75 fg	6.99 l	40.73 k

T_1= 2/3 basal+1/3 at panicle initiation, T_2=1/3 basal+1/3 at maximum tillering+1/3 at panicle initiation, T_3=1/2 basal+1/4 at panicle initiation+1/4 at complete flowering, T_4=All amount as basal.

Table 6. Broadcasted rice grain quality characters as affected by N application time x cultivar interaction combined over the 1996 and 1997 seasons.

Time of N application	Cultivar	Grain length (mm)	Grain width (mm)	Grain shape	Hulling %	Milling %	Head rice %	Protein %	Amylose %
T_1	Giza 181	8.33 d	2.65 i	3.50 b	76.02 h	69.50 l	60.43 h	8.13 e	20.60 a
	Giza 177	7.90 f	3.38 cd	2.35 h	80.47 b	72.13 c	66.38 a	9.34 a	18.63 h
	Giza 178	7.53 g	2.93 f	2.57 f	77.02 g	70.70 g	58.23 j	7.72 h	17.62 l
	Sakha 101	8.08 e	3.40 bc	2.36 gh	80.40 b	71.77 d	62.15 g	7.63 i	20.42 b
	Sakha 102	7.83 f	3.30 e	2.37 gh	79.95 c	73.27 b	64.87 c	8.00 f	19.57 d
T_2	Giza 181	9.42 a	2.73 h	3.43 c	75.53 i	67.40 l	57.40 k	7.79 g	20.20 c
	Giza 177	7.83 f	3.43 bc	2.28 j	80.95 a	73.57 a	66.57 a	7.97 f	19.32 e
	Giza 178	7.52 g	2.65 i	2.85 e	77.13 g	67.95 k	59.83 i	7.97 f	17.80 k
	Sakha 101	7.88 f	3.50 a	2.30 ij	78.05 f	69.88 h	60.52 h	7.44 j	19.70 d
	Sakha 102	7.82 f	3.42 bc	2.37 gh	79.93 c	71.53 e	62.13 g	7.95 f	19.37 e
T_3	Giza 181	9.27 c	2.77 h	3.35 d	75.58 i	66.07 n	57.47 k	8.10 e	20.27 c
	Giza 177	7.77 f	3.45 b	2.27 j	80.92 a	73.60 a	65.00 bc	8.54 d	19.00 g
	Giza 178	7.33 h	2.88 g	2.58 f	77.23 g	66.02 n	56.70 l	8.95 b	18.22 i
	Sakha 101	7.91 f	3.35 d	2.33 hi	79.43 d	72.22 e	64.15 e	8.79 c	19.43 e
	Sakha 102	7.88 f	3.28 e	2.40 g	78.43c	69.40 l	64.60 d	9.01 b	19.63 d
T_4	Giza 181	9.52 b	2.67 i	3.57 a	75.53 i	68.87 j	55.55 m	6.94 m	20.17 c
	Giza 177	7.78 f	3.38 cd	2.27 j	79.95 c	71.18 f	62.95 f	7.19 k	19.15 f
	Giza 178	7.28 h	2.92 fg	2.55 f	76.00 h	66.95 m	56.20 b	7.01 l	18.00 j
	Sakha 101	7.85 f	3.41 bc	2.33 hi	80.58 b	70.58 g	60.67 h	6.91 mn	19.42 e
	Sakha 102	7.78 f	3.42 bc	2.35 h	79.98 c	70.78 g	60.53 h	6.84 n	19.78 c

T_1= 2/3 basal+1/3 at panicle initiation, T_2=1/3 basal+1/3 at maximum tillering+1/3 at panicle initiation, T_3=1/2 basal+1/4 at panicle initiation+1/4 at complete flowering, T_4=All amount as basal.

Table 7. Seasonal effects on the average values of growth attributes, yield, yield components and grain quality of transplanted rice.

Season	Tillers/m²	Heading date	Plant height (cm)	Panicle length (cm)	Panicles/m²	Panicle weight (g)	Fill.grains/ panicle	Unfill.grains /panicle	1000-grain weight (g)	Straw yield (t/ha)
1996	630.31 a	93.75 b	87.66 b	19.78 a	430.94 b	2.86 a	93.64 a	3.86 b	27.84 a	9.74 b
1997	640.69 a	102.83 a	97.84 a	19.58 a	596.81 a	2.44 b	88.90 b	6.63 a	26.14 b	10.24 a

Season	Grain yield (t/ha)	Harvest index	Grain length (mm)	Grain width (mm)	Grain shape	Hulling %	Milling %	Head rice %	Protein %	Amylose %
1996	8.15 a	45.60 a	8.18 a	3.25 a	2.57 a	80.63 a	70.25 a	62.11 b	7.43 a	18.33 a
1997	8.18 a	44.28 b	8.02 a	3.18 a	2.60 a	79.21 b	70.40 a	64.50 a	6.77 b	18.53 a

Table 8. Effect of time of nitrogen application on growth attributes, yield, yield components, and grain quality of transplanted rice combined over the 1996 and 1997 seasons.

Time of N application	Tillers/m^2	Heading date	Plant height (cm)	Panicle length (cm)	Panicles/m^2	Panicle weight (g)	Fill. grains/ Panicle	Unfill.grain /panicle	1000-grain weight (g)	Straw yield (t/ha)
T_1	652.38 a	98.78 a	93.38 a	19.77 a	551.58 a	2.78 a	91.63 b	4.88 b	26.53 b	10.14 a
T_2	635.00 b	98.55 ab	93.47 a	19.81 a	511.43 b	2.65 b	91.28 b	5.43 ab	27.05 ab	9.98 ab
T_3	634.00 b	98.00 bc	92.37 b	19.71 a	501.25 b	2.60 b	94.20 a	5.68 a	27.35 a	10.00 ab
T_4	620.63 b	97.83 c	91.78 b	19.43 a	491.25 b	2.57 b	87.98 c	5.00 b	27.03 ab	9.86 b

	Grain yield (t/ha)	Harvest index	Grain length (mm)	Grain width (mm)	Grain shape	Hulling %	Milling %	Head rice %	Protein %	Amylose %
T_1	8.62 a	45.92 a	8.04 b	3.16 b	2.63 a	80.29 a	70.14 b	62.78 b	7.19 b	18.44 a
T_2	7.99 bc	44.46 b	8.33 a	3.25 a	2.58 ab	79.75 a	71.03 a	64.69 a	7.14 b	18.09 b
T_3	8.17 b	45.04 ab	7.90 c	3.18 b	2.59 ab	79.73 a	70.41 b	62.66 b	7.56 a	18.48 a
T_4	7.89 c	44.35 b	8.13 b	3.27 a	2.54 b	79.90 a	69.71 c	62.18 b	6.52 c	18.71 a

T_1= 2/3 basal+1/3 at panicle initiation, T_2=1/3 basal+1/3 at maximum tillering+1/3 at panicle initiation, T_3=1/2 basal+1/4 at panicle initiation+1/4 at complete flowering, T_4=All amount as basal.

Table 9. Growth attributes, yield, yield components, and grain quality as affected by rice cultivars of transplanted rice combined over the 1996 and 1997 seasons.

Cultivar	Tillers/m^2	Heading date	Plant height (cm)	Panicle length (cm)	Panicles/m^2	Panicle weight (g)	Fill. grains/ Panicle	Unfill.grain/ panicle	1000-grain weight (g)	Straw yield (t/ha)
Giza 181	663.44 a	108.50 a	89.48 d	20.40 a	519.16 b	2.78 a	99.81 b	8.16 a	26.13 c	9.82 c
Giza 177	652.66 a	91.03 d	93.23 b	17.86 b	489.28 c	2.54 b	80.81 d	4.25 c	28.50 b	9.89 bc
Giza 178	662.50 a	101.59 b	91.10 c	19.89 a	564.06 a	2.61 b	102.63 a	5.66 b	22.44 d	10.43 a
Sakha 101	603.13 c	99.53 c	89.16 d	20.02 a	497.66 a	2.76 a	87.47 c	4.00 c	29.06 a	10.02 b
Sakha 102	625.78 b	90.78 d	100.78 a	20.22 a	499.22 c	2.57 b	85.63 c	4.16 c	28.81 ab	9.81 c

	Grain yield (t/ha)	Harvest index	Grain length(mm)	Grain width (mm)	Grain shape	Hulling %	Milling %	Head rice %	Protein %	Amylose %
Giza 181	7.82 d	44.21 c	9.14 a	2.55 c	3.65 a	77.95 c	66.96 c	60.95 c	7.32 b	18.91 b
Giza 177	7.96 cd	44.52 c	7.75 d	3.41 a	2.31 c	81.64 a	71.97 a	64.31 a	7.53 a	18.26 c
Giza 178	8.38 b	44.48 c	7.58 c	3.14 b	2.40 b	78.43 c	70.37 b	62.70 b	6.73 d	17.65 d
Sakha 101	8.63 a	46.26 a	7.94 c	3.48 a	2.30 c	80.47 b	70.58 b	63.46 ab	7.07 c	18.11 c
Sakha 102	8.04 c	45.24 b	8.09 b	3.46 a	2.25 c	81.11 ab	71.75 a	63.98 a	6.86 d	19.23 a

Table 10. Growth, yield, and yield components as affected by N application time x cultivar interaction of transplanted rice combined over the 1996 and 1997 seasons.

Time of N application	Cultivar	Tillers/ m^2	Heading date	Plant height (cm)	Panicle length (cm)	Panicles/ m^2	Panicle weight (g)	Fill. grains/ Panicle	Unfill. grain/ panicle	1000-grain weight	Straw yield (t/ha)	Grain yield (t/ha)	Harvest index
T_1	Giza 181	658.8 cde	108.25 b	90.30 k	19.58 e	563.25 b	2.81 c	93.13 f	7.25 e	25.63 i	10.18 d	8.48 d	45.30 e
	Giza 177	653.1 e	92.13 j	95.15 d	17.96 g	500.80 g	2.55 hi	76.38 k	4.00 jk	28.63 d	9.88 i	8.08 g	44.88 f
	Giza 178	709.4 a	102.38 c	90.06 kl	20.05 cd	593.75 a	2.77 cd	104.38 c	5.00 f	21.75 l	10.67 b	8.99 b	45.80 cd
	Sakha 101	578.1 j	99.88 g	90.65 j	20.48 b	553.13 c	3.09 a	100.13 d	4.88 f	28.63 d	9.89 hi	9.08 a	47.88 a
	Sakha 102	662.5 cd	91.25 k	100.71 b	20.79 a	546.88 c	2.66 ef	84.13 gh	3.25 l	28.00 f	10.08 e	8.48 d	45.74 cd
T_2	Giza 181	621.9 g	109.13 a	87.64 n	20.25 bc	532.13 d	2.72 de	100.38 d	8.00 b	26.13 h	9.96 gh	7.91 hi	44.19 hi
	Giza 177	656.3 de	90.50 l	94.79 e	18.01 g	462.50 k	2.60 fgh	82.50 i	4.50 gh	28.25 e	9.60 l	7.47 l	43.58 k
	Giza 178	637.5 f	101.88 d	92.59 f	19.80 de	562.50 b	2.61 fgh	107.00 a	6.13 e	22.50 k	10.30 c	8.08 g	43.74 jk
	Sakha 101	631.3 f	100.13 g	90.66 j	20.79 a	509.38 f	2.77 cd	85.00 g	4.00 jk	29.38 b	10.33 c	8.51 d	44.86 f
	Sakha 102	628.1 fg	91.13 k	101.68 a	20.18 c	490.63 h	2.55 hi	81.50 g	4.50 gh	29.00 c	9.71 k	7.96 h	45.93 e
T_3	Giza 181	656.3 de	108.25 b	89.80 l	20.99 a	518.75 e	2.99 b	105.88 b	9.63 a	27.50 g	9.56 l	7.85 l	45.30 e
	Giza 177	629.4 fg	90.38 l	91.93 g	18.03 g	478.13 l	2.59 gh	83.38 hi	4.13 ij	28.50 d	10.05 ef	7.94 h	44.05 ij
	Giza 178	637.5 f	101.50 e	90.18 k	20.14 c	565.63 b	2.50 ij	104.88 c	6.50 d	22.75 j	10.78 a	8.68 c	44.44 gh
	Sakha 101	609.4 h	99.38 h	88.33 m	19.13 f	475.00 ij	2.46 jk	84.25 gh	3.38 l	29.63 a	10.08 e	8.73 c	46.79 b
	Sakha 102	637.5 f	90.50 l	101.64 a	20.26 bc	468.75 jk	2.47 jk	92.63 f	4.75 fg	28.63 d	9.54 l	7.66 k	44.64 fg
T_4	Giza 181	596.9 l	108.38 b	90.20 k	20.79 a	462.50 k	2.59 gh	99.88 d	7.75 b	25.50 l	9.56 l	7.04 m	42.04 l
	Giza 177	671.9 b	91.13 k	91.06 l	17.44 h	515.63 e	2.42 k	81.00 j	4.38 hi	28.63 d	10.03 efg	8.36 e	45.56 de
	Giza 178	665.6 bc	100.63 f	91.58 h	19.58 e	534.38 d	2.56 hi	94.25 e	5.00 f	22.75 j	9.99 fg	7.76 j	43.96 ij
	Sakha 101	593.8 i	98.75 i	86.99 o	19.69 e	453.13 l	2.73 fg	80.50 j	3.75 k	28.63 d	9.80 j	8.23 f	45.53 de
	Sakha 102	575.0 j	90.25 l	99.09 c	19.65 e	490.63 h	2.58 gh	84.25 gh	4.13 j	29.63 a	9.90 hi	8.06 g	44.66 fg

T_1= 2/3 basal+1/3 at panicle initiation, T_2=1/3 basal+1/3 at maximum tillering+1/3 at panicle initiation, T_3=1/2 basal+1/4 at panicle initiation+1/4 at complete flowering, T_4=All amount as basal.

Table 11. Transplanted rice grain quality characters as affected by N application time x cultivar interaction of combined over the 1996 and 1997 seasons.

Time of N application	Cultivar	Grain length (mm)	Grain width (mm)	Grain shape	Hulling %	Milling %	Head rice %	Protein %	Amylose %
T_1	Giza 181	9.20 b	2.42 n	3.78 a	79.20 g	67.22 m	58.53 m	7.94 b	18.58 f
	Giza 177	7.80 h	3.38 g	2.35 gh	82.12 a	71.38 f	63.05 h	8.09 a	18.23 gh
	Giza 178	7.55 k	3.10 j	2.43 f	77.68 j	70.48 h	64.60 de	6.47 k	17.60 k
	Sakha 101	7.93 f	3.50 bc	2.28 i	81.05 c	70.83 g	63.47 fg	6.96 h	18.30 g
	Sakha 102	7.70 l	3.40 fg	2.28 i	81.47 b	70.78 g	64.23 e	6.50 k	19.48 b
T_2	Giza 181	9.53 a	2.55 m	3.73 b	77.32 k	66.15 n	61.28 j	7.41 e	18.80 e
	Giza 177	7.68 l	3.45 de	2.25 ij	81.37 b	74.42 a	68.92 a	7.23 f	17.92 i
	Giza 178	7.67 ij	3.18 i	2.33 h	78.15 i	70.42 h	62.87 h	6.79 i	17.37 l
	Sakha 101	7.85 g	3.53 ab	2.28 i	81.35 b	71.98 e	65.40 c	7.23 f	17.78 j
	Sakha 102	8.92 c	3.52 ab	2.28 i	80.58 d	72.20 d	64.97 d	7.05 g	18.57 f
T_3	Giza 181	8.38 d	2.60 l	3.53 d	78.70 h	65.58 o	61.12 j	7.46 e	19.10 d
	Giza 177	7.67 ij	3.40 fg	2.32 h	80.92 c	73.62 b	66.33 b	7.69 d	18.18 h
	Giza 178	7.47 l	2.95 k	2.52 e	78.12 i	69.68 i	59.67 k	7.39 e	17.65 k
	Sakha 101	8.15 c	3.42 ef	2.38 g	79.97 e	70.37 h	62.97 h	7.45 e	17.88 ij
	Sakha 102	7.85 g	3.55 a	2.22 j	80.93 c	72.80 c	63.23 gh	7.79 c	19.60 a
T_4	Giza 181	9.45 a	2.63 l	3.57c	76.57 l	68.90 k	62.87 h	6.47 k	19.15 d
	Giza 177	7.85 g	3.40 fg	2.32 h	82.17 a	68.45 l	58.93 l	7.12 g	18.70 e
	Giza 178	7.63 j	3.32 h	2.32 h	79.75 ef	70.88 g	63.65 f	6.28 l	17.97 i
	Sakha 101	7.82 gh	3.47 cd	2.25 ij	79.52 f	69.12 j	62.00 i	6.64 j	18.47 f
	Sakha 102	7.90 f	3.52 ab	2.23 j	81.50 b	71.22 f	63.47 fg	6.09 m	19.28 c

T_1= 2/3 basal+1/3 at panicle initiation, T_2=1/3 basal+1/3 at maximum tillering+1/3 at panicle initiation, T_3=1/2 basal+1/4 at panicle initiation+1/4 at complete flowering, T_4=All amount as basal.

Table 12. Effect of planting method on growth, yield, yield components, and grain quality of rice.

Planting method	Heading date	Plant height (cm)	Panicle length (cm)	Panicle weight (g)	Fill. grains/ Panicle	Unfill. grain/ panicle	1000-grain weight (g)	Straw yield (t/ha)	Grain yield (t/ha)
Broadcasting	88.43 b	87.05 b	19.79 a	2.57 a	98.28 a	6.88 a	26.88 a	9.88 a	7.75 b
Transplantin	98.29 a	92.75 a	19.68 a	2.65 a	91.27 a	5.25 b	26.99 a	9.99 a	8.17 a

	Harvest index	Grain length (mm)	Grain width (mm)	Grain shape	Hulling %	Milling %	Head rice %	Protein %	Amylose %
Broadcasting	43.77 a	8.03 a	3.15 a	2.62 a	78.46 a	70.17 a	61.11 b	7.92 a	19.32 a
Transplanting	44.94 a	8.10 a	3.22 a	2.59 a	78.92 a	70.33 a	63.31 a	7.10 b	18.43 b

Means followed by the same letter are not significantly different according to t-test.

تأثير ميعاد الإضافة للسماد الآزوتي علي المحصول وصفات الجودة في الأرز الشتل و البدار

علي عبد المقصود الحصري[1] - محمد السيد رياض جمعة[1]
عبد العظيم الطنطاوي بدوي[2]- إبراهيم حمدي أبو الدرج[2]
[1]قسم المحاصيل-كلية زراعة مشتهر - جامعة الزقازيق (فرع بنها)
[2]مركز البحوث الزراعية

الملخص العربي

أجريت تجربتان حقليتان في مزرعة مركز البحوث و التدريب في الأرز، سخا-كفر الشيخ-جمهورية مصر العربية، خلال موسمي ١٩٩٦، ١٩٩٧ وذلك لدراسة سلوك و استجابة خمسة أصناف من الأرز هي:جيزة ١٨١، جيزة ١٧٧، جيزة ١٧٨، سخا ١٠١، و سخا ١٠٢ لأربعة مواعيد إضافة لمعدل (٩٦ وحدة أزوت/هكتار) و كانت مواعيد الإضافة هي:

أولا: دفعتين (ثلثين خلط بالتربة الجافة قبل اشتل أو البدار +ثلث عند بداية تكوين الداليات).

ثانيا: ثلاث دفعات (ثلث خلط بالتربة الجافة+ثلث عند أقصي تفريع+ ثلث عند بداية تكوين الداليات).

ثالثا: ثلاث دفعات (نصف خلط بالتربة الجافة+ربع عند بداية تكوين الداليات+ربع عند تمام طرد الداليات).

رابعا: دفعة واحدة خلط بالتربة الجافة.

أهم النتائج المتحصل عليها:

١- أعطي الصنف جيزة ١٧٨ في حالة البدار أعلي القيم في عدد الأفرع/متر مربع و عدد الداليات/متر مربع و عدد الحبوب الممتلئة/الدالية و محصول الحبوب و دليل الحصاد، بينما تفوق الصنف سخا ١٠١ في وزن ١٠٠٠ حبة ومحصول الحبوب و دليل الحصاد عند الزراعة شتلا.

٢- حقق إضافة السماد الآزوتي علي ثلاث دفعات للأرز بدار (نصف خلط بالتربة الجافة+ربع عند بداية تكوين الداليات+ربع عند تمام طرد الداليات) أعلي القيم في عدد الداليات/متر مربع ووزن الدالية ومحصول الحبوب ودليل المحصول، بينما تفوق السماد الآزوتي المضاف علي دفعتين للأرز الشتل (ثلثين خلط بالتربة الجافة قبل الشتل +ثلث عند بداية تكوين الداليات) في عدد الأفرع/متر مربع و عدد الداليات/متر مربع ووزن الدالية ومحصول القش و محصول الحبوب ودليل المحصول.

٣- تفوقت طريقة الشتل علي البدار في كمية المحصول و النسبة المئوية للحبوب السليمة.

٤- من النتائج المتحصل عليها يمكن التوصية -- تحت الظروف المماثلة لظروف التجربة -- بزراعة الصنفان جيزة ١٧٨ و سخا ١٠١ و إضافة السماد الآزوتي علي ثلاث دفعات (نصف خلط بالتربة الجافة+ربع عند بداية تكوين الداليات+ربع عند تمام طرد الداليات)للحصول علي أعلي إنتاجية و صفات جودة سواء في حالة الشتل أو البدار.