RESULTS AND DISCUSSION

1. Broadcasting Method :

1.1. Growth measurements :

1.1.1. Effect of season :

Results in Table (4) present averages of the two seasons of the study. It is evident that all studied characters significantly differed from 1996 than 1997. Higher values for number of tillers/m^2 at all growth stages, and heading date (in days) were detected in 1996, but the situation was reversed for plant height and panicle length which were higher in the second season than in the first one. These results might be attributed to difference in temperature between the two considered seasons.

1.1.2. Effect of nitrogen application :

Table (5) shows the combined data for the averages of number of tillers/m^2 at various growth stages, heading date, plant height and panicle length as affected by nitrogen application in 1996 and 1997 rice seasons.

All studied characters, except number of tillers at the third growth stage, were significantly affected by nitrogen application. Nitrogen applied as $^2/_3$ basal and $^1/_3$ at panicle initiation (T_1) gave higher values of tillers/m^2 at the first growth stage (1635.33 tillers) and second growth stage (1711.30 tillers) and fourth stage (926.83) followed by T_4 (all amount of nitrogen as basal) and T_3 ($^1/_2$ basal + $^1/_4$ at panicle initiation (PI) + $^1/_4$ at complete flowering) at the first stage, T_4 and T_2 (3 equal splits) at the second growth stage, and T_2 and T_3 at fourth growth stage. However, the differences among the previous treatments were not significant. On the other hand, the lowest numbers of tillers/m^2 were obtained by T_2 treatment at 1st growth stage, T_3 at 2nd growth stage and T_4 at 4th stage.

Concerning the heading date (Table 5), the highest value (88.95 days) was obtained at T_3, while the lowest one (88.15 days) was recorded with T_2 treatment. The longest rice plants (87.97 cm) were obtained when nitrogen was applied as $^2/_3$ basal + $^1/_3$ at PI (T_1), while the shortest ones (85.50 cm) were obtained in case of T_4 (all nitrogen as basal, Table 5).

As for panicle length, the values could be descendingly ordered as 20.12 cm for T_2, 19.79 cm for T_1, 19.64 cm for T_4, and then 19.63 cm for T_3.

It is clear that the superiority of growth characters by treatment one (T_1) may be due to that early nitrogen application stimulates the plant growth. Similar results were obtained by Lei *et al* (1971), Islam *et al* (1990), Ali *et al* (1992), El-Refaee (1997) and El-Kady and Abd El-Wahab (1999).

1.1.3. Effect of cultivar :

The effects of tested rice cultivars on number of tillers/m^2 at various growth stages, heading date, plant height and panicle length combined over 1996 and 1997 rice seasons are presented in Table (6).

Table (4): Seasonal effects on the average values of growth attributes in broadcasting method

Season	Number of tillers/m^2 (indicated by growth stages)				Heading date	Plant height	Panicle length
	No. 1	No. 2	No. 3	No. 4	(days)	(cm)	(cm)
1996	1799.51 a	1965.49 a	1667.10 a	912.20 a	89.56 a	86.26 b	19.45 b
1997	1310.55 b	1333.13 b	943.95 b	851.74 b	87.29 b	87.84 a	20.13 a

No. 1: 30 days after sowing, No. 2: Panicle initiation, No. 3: Complete flowering, No. 4: Harvest

Table (5): Effect of nitrogen application on growth attributes in broadcasting method (Combined data of 1996 & 1997).

Nitrogen application	Number of tillers/m^2 (indicated by growth stages)				Heading date	Plant height	Panicle length
	No. 1	No. 2	No. 3	No. 4	(days)	(cm)	(cm)
T_1	1635.33 a	1711.30 a	1366.50 a	926.83 a	88.25 b	87.97 a	19.79 ab
T_2	1492.35 b	1643.15 ab	1290.68 a	883.20 ab	88.15 b	87.44 ab	20.12 a
T_3	1515.33 ab	1558.25 b	1273.58 a	870.40 ab	88.95 a	87.30 b	19.63 b
T_4	1577.13 ab	1684.53 a	1291.35 a	847.45 b	88.35 b	85.50 c	19.64 b
F. test T x S	*	*	ns	ns	**	ns	ns

$T_1 = {}^2/_3$ basal + $^1/_3$ at panicle initiation (PI). $T_2 = {}^1/_3$ basal + $^1/_3$ at maximum tillering (MT) + $^1/_3$ at PI.
$T_3 = {}^1/_2$ basal + $^1/_4$ at PI + $^1/_4$ at complete flowering. T_4 = All amount as basal.

No. 1: 30 days after sowing, No. 2: Panicle initiation. No. 3: Complete flowering

Differences among cultivars were significant in all characters except for number of tillers at 3rd growth stage. Giza 178 produced the highest number of tillers at first (1625.03 tillers), second (1779.91), and fourth stages (949.75). However, these values had no significant superiority over Giza 181 and Sakha 101 at the same aforementioned stages, or over Sakha 102 at 1st growth stage. However, Giza 177 significantly tillered less than Giza 178 in 1st, 2nd and 4th growth stages.

The earliest heading was recorded for Sakha 102 (80.50 days), followed by Giza 177 (80.69), Giza 178 (87.31), and then Sakha 101 (96.44 days), while the latest variety in heading was Giza 181 (97.19 days).

As for plant height, Sakha 102 appeared as the longest variety (88.98 cm) and significantly differed from all other varieties, followed by Giza 177 (87.31 cm), Giza 181 (86.86 cm), Sakha 101 (86.58 cm), while Giza 178 appeared as the shortest one (85.52 cm).

The longest panicles were obtained in case of Giza 181 (20.89 cm) which significantly differed from all other varieties. The second rank of panicle length was occupied by Giza 178 (20.12 cm), and then Sakha 101 (19.91 cm), while Sakha 102 came in the fourth rank (19.51 cm). However, the shortest panicles were measured in case of Giza 177 (18.55 cm).

El-Kalla *et al* (1990), El-Kasaby *et al* (1991), Assy *et al* (1992) and El-Kady and Abd El-Wahab (1999) found differences between the rice cultivars.

Table (6): Growth attributes as affected by rice cultivars in broadcasting method (Combined data of 1996 & 1997).

Cultivar	Number of tillers/m^2 (indicated by growth stages)				Heading date (days)	Plant height (cm)	Panicle length (cm)
	No. 1	No. 2	No. 3	No. 4			
Giza 181	1605.00 a	1702.94 ab	1340.09 a	914.63 a	97.19 a	86.86 bc	20.89 a
Giza 177	1427.75 b	1452.53 c	1240.75 a	818.34 b	80.69 c	87.31 b	18.55 d
Giza 178	1625.03 a	1779.91 a	1304.75 a	949.75 a	87.31 b	85.52 d	20.12 b
Sakha 101	1575.91 ab	1739.97 a	1290.66 a	910.34 a	96.44 a	86.58 c	19.91 bc
Sakha 102	1541.47 ab	1571.19 bc	1351.41 a	816.78 b	80.50 c	88.98 a	19.51 c
F. test V x S	ns	**	**	ns	**	**	ns

No. 1: 30 days after sowing, No. 2: Panicle initiation, No. 3: Complete flowering, No. 4: Harvest

1.1.4. Interaction effect between cultivars and seasons :

Results in Table (6) show that the interactions between cultivars and seasons differed significantly for all measurements except for number of tillers/m^2 in both first and fourth growth stages, and panicle length. This interaction could be attributed to changes in climatic conditions from one season to another.

1.1.5. Interaction effect between cultivars and N application :

Table (7) shows the average numbers of tillers/m^2 at different growth stages, heading date, plant height and panicle length as affected by interaction between rice cultivars and N application as combined data for 1996 and 1997 rice seasons. It was found that the interaction were significant for all studied characters. At the 1st growth stage, the highest number of tillers (1761.75 tillers/m^2) was obtained with Giza 178 under T_1 treatment, meanwhile the lowest value (1402.63 tillers/m^2) was recorded for Giza 177 under the same treatment. At the 2nd growth stage, Sakha 101 proved to be superior in tillering (1925.25 tillers/m^2) but Giza 177 was minimum (1356.38 tillers/m^2) at T_3 treatment. At the 3rd growth stage, Sakha 101 produced the highest number of tiller at T_1 (1491.88 tillers/m^2), and the same variety was the most affected by N application, exhibiting the lowest number of tillers (1138.50) in case of T_3 treatment. At the 4th growth stage, Giza 178 gave the highest tillers (1039.75 tillers/m^2) at T_1, while Giza 177 gave the lowest value (722.25 tillers/m^2) at T_4 treatment.

As for heading date, Giza 177 was the earliest cultivar (80.00 days) in T_2 treatment, followed by Sakha 102 (80.13) for the same N application, both values were statistically the same. The latest cultivar for heading was Giza 181 for all of N applications.

Table (7) : Growth attributes as affected by interaction between time of nitrogen application and rice cultivars in broadcasting method (Combined data of 1996 & 1997).

Time of N application	Cultivars	Number of tillers/m^2 (indicated by growth stages) No. 1	No. 2	No. 3	No. 4	Heading date (days)	Plant height (cm)	Panicle length (cm)
T_1	Giza 181	1742.75 a	1779.75 c	1453.13 ab	950.38 b	97.13 b	86.65 f	21.03 b
	Giza 177	1402.63 g	1400.00 Lm	1212.38 h	910.63 cde	80.25 k	87.49 d	17.83 j
	Giza 178	1761.75 a	1914.25 ab	1440.38 ab	1039.75 a	87.50 f	87.75 d	20.36 c
	Sakha 101	1746.00 a	1925.25 a	1491.88 a	963.62 b	95.63 d	89.10 bc	20.43 c
	Sakha 102	1523.50 de	1537.25 jk	1234.75 gh	769.75 g	80.75 g	88.88 c	19.31 g
T_2	Giza 181	1665.00 b	1788.25 c	1304.13 ef	880.25 ef	97.13 b	86.45 fg	21.48 a
	Giza 177	1381.75 def	1540.75 jk	1220.50 h	877.13 ef	80.00 k	87.96 d	18.49 h
	Giza 178	1530.88 cde	1698.13 def	1249.25 fgh	893.00 de	86.38 g	83.96 j	20.46 c
	Sakha 101	1466.50 efg	1618.50 ghi	1217.25 h	915.63 cd	97.13 b	87.14 e	19.69 ef
	Sakha 102	1417.63 fg	1570.13 ijk	1462.25 ab	850.00 f	80.13 k	91.68 a	20.48 c
T_3	Giza 181	1489.50 def	1600.50 hij	1401.50 bc	891.00 de	98.00 a	87.70 d	19.88 de
	Giza 177	1437.50 fg	1356.38 m	1242.50 fgh	763.38 g	81.38 h	89.39 b	19.73 ef
	Giza 178	1604.00 bc	1648.25 fgh	1206.00 h	962.00 b	88.00 e	85.69 h	19.87 de
	Sakha 101	1556.50 cd	1742.50 cd	1138.50 i	855.63 f	97.13 b	84.56 i	19.55 f
	Sakha 102	1489.13 def	1443.63 L	1379.38 cd	880.00 ef	80.25 k	89.14 bc	19.15 g
T_4	Giza 181	1522.75 de	1643.25 fgh	1201.63 h	936.88 bc	96.50 c	86.62 f	21.19 b
	Giza 177	1489.13 def	1513.00 k	1287.63 efg	722.25 h	81.13 hi	84.40 i	18.15 i
	Giza 178	1603.50 bc	1859.00 b	1323.25 de	904.25 cde	87.38 f	84.69 i	19.79 de
	Sakha 101	1534.63 cde	1673.63 efg	1315.00 e	906.53 cde	95.88 d	85.53 h	19.96 d
	Sakha 102	1735.63 a	1733.75 cde	1329.25 de	767.38 g	80.88 ij	86.25 g	19.09 g
F. test T x V x S		ns	ns	ns	ns	ns	**	**

T_1 = $^2/_3$ basal + $^1/_3$ at panicle initiation (PI). T_2 = $^1/_3$ basal + $^1/_3$ at maximum tillering (MT) + $^1/_3$ at PI.
T_3 = $^1/_2$ basal + $^1/_4$ at PI + $^1/_4$ at complete flowering. T_4 = All amount as basal.

No. 1: 30 days after sowing, No. 2: Panicle initiation, No. 3: Complete flowering, No. 4: Harvest

The tallest plants were observed in T_2 treatment with Sakha 102 (91.68 cm), while the shortest ones were recorded in case of Giza 177 at T_4 treatment (84.40 cm).

With regard to panicle length, the highest value was obtained by Giza 181 under T_2 treatment, whereas Giza 177 under T_1 treatment had the shortest panicles (17.83 cm).

Similar results were obtained by El-Kady and Abd El-Wahab (1999).

1.1.6. Interaction effect between nitrogen application and season :

Data in Table (5) reveal the interactions between N applications and seasons. Interactions were significant for number of tillers/m^2 at first and second growth stages as well as for heading date. However, the interactions were insignificant in case of third and fourth growth stages, plant height and panicle length.

1.1.7. Interaction effect among cultivars, N applications and seasons :

Results in Table (7) revealed that the interaction effect among cultivars, N applications and seasons was not significant in number of tillers/m^2 for all growth stages and heading date, whereas significant interaction effects were detected for both plant height and panicle length.

1.2. Yield and its components :

1.2.1. Effect of seasons :

Table (8) prsents the average values of seasonal effect on yield and its components as combined data for 1996 and 1997 seasons. The results show that all studied characters were significantly variable from one season to another. Higher values of number of panicles/m^2, panicle weight and 1000-grain weight were detected in the first season, while values of filled and unfilled grains/panicle, straw and grain yield and harvest index were higher in the second season. It could be concluded that the increase in grain yield in the second season is due to the significant increase in number of filled grains/panicle and panicle length (Tables 4 and 8). Also, the climatic conditions in the second season may have favoured grain production for all the tested rice cultivars, which is explained by a higher harvest index (Table 8).

1.2.2. Effect of nitrogen applications :

Results in Table (9) present the means of yield and yield components as affected by nitrogen fertilizer applications expressed in combined data for 1996 and 1997 seasons.

Results indicated that grain yield and yield components were significantly affected by nitrogen fertilizer applications, while straw yield did not exhibit significance with these applications.

Number of panicles and panicle weight exhibited highest values being 792.2/m^2 and 2.79 g, respectively, when nitrogen dose was applied in two splits as $^1/_2$ basal, $^1/_4$ at panicle initiation and $^1/_4$ at complete flowering (T_3). The lowest number of panicle (698.0/m^2) as well as weight of panicle (2.35 g) were obtained by applying all nitrogen as basal (T_4).

The highest value of number of filled grains/panicle (103.00) was obtained when nitrogen was applied in two equal splits as basal, at maximum tillering and at panicle initiation (T_2), but the difference between this treatment and T_1 ($^2/_3$ basal + $^1/_3$ at PI) was not significant. However, the lowest number of filled grains/panicle (90.10) was followed the application of all nitrogen as basal (T_4).

Adding nitrogen in three split doses; $^1/_2$ basal, $^1/_4$ at panicle initiation and $^1/_4$ at complete flowering (T_3), markedly gave the highest number of unfilled grains/panicle (8.35). The lowest number was recorded by applying nitrogen in two split doses (T_1), being 5.97 unfilled grains/panicle.

The highest average of 1000-grain weight (27.28 g) was obtained when nitrogen was applied in three split doses (T_2), but with no significant superiority over T_1 and T_4. However, the lowest value was recorded by adding nitrogen in three split doses (T_3), being 26.40 g per 1000 grains.

Concerning grain yield (t/ha), results showed that the highest grain yield/ha followed N application in three split doses (T_3) being 8.15 t/ha, while the lowest average was recorded when all nitrogen was applied as basal (T_4), being 7.17 t/ha.

Table (8): Seasonal effects on the average of yield and yield components in broadcasting method.

Season	Number of panicle/m^2	Panicle weight (g)	Filled grains/ panicle	Unfilled grains/ panicle	1000-grain weight	Straw yield (t/ha)	Grain yield (t/ha)	Harvest index
1996	820.9 a	2.62 a	91.61 b	4.30 b	27.60 a	9.69 b	7.36 b	42.93 b
1997	687.7 b	2.51 b	104.95 a	9.46 a	26.15 b	10.06 a	8.13 a	44.60 a

Table (9): Effect of time of nitrogen application on yield and yield components in broadcasting method (Combined data of 1996 & 1997).

Treatments Time of N application	Number of panicle/m^2	Panicle weight (g)	Filled grains/ panicle	Unfilled grains/ panicle	1000-grain weight	Straw yield (t/ha)	Grain yield (t/ha)	Harvest index
T_1	775.5 ab	2.55 b	101.13 ab	5.97 c	26.93 a	9.95 a	7.73 c	43.79 b
T_2	751.6 b	2.57 b	103.00 a	6.95 b	27.28 a	9.94 a	7.94 b	44.54 ab
T_3	792.2 a	2.79 a	98.90 b	8.35 a	26.40 b	9.88 a	8.15 a	45.07 a
T_4	698.0 c	2.35 c	90.10 c	6.25 c	26.90 a	9.74 a	7.17 c	41.66 c
F. test T x S	ns	**	*	**	ns	**	ns	ns

$T_1 = {}^2/_3$ basal + ${}^1/_3$ at panicle initiation (PI).
$T_2 = {}^1/_3$ basal + ${}^1/_3$ at maximum tillering (MT) + ${}^1/_3$ at PI.
$T_3 = {}^1/_2$ basal + ${}^1/_4$ at PI + ${}^1/_4$ at complete flowering.
T_4 = All amount as basal.

Splitting nitrogen as $^1/_2$ basal, $^1/_4$ at panicle initiation and $^1/_4$ at complete flowering (T_3) or as $^1/_3$ basal, $^1/_3$ at maximum tillering and $^1/_3$ at panicle initiation (T_2) gave the highest harvest index, being 45.07 and 44.54, respectively. While the lowest value (41.66) was recorded by adding all nitrogen basally (T_4).

It could be concluded that the highest values of grain yield and yield components (number of panicles/m^2 and panicle weight) were obtained when nitrogen dose was applied in three splits into $^1/_2$ basally, $^1/_4$ at panicle initiation and $^1/_4$ at complete flowering (T_3).

The highest values of grain yield, number of panicles/m^2, and panicle weight in case of T_3 could be explained on the basis that adding $^1/_2$ of nitrogen activated the tillering at tillering stage, $^1/_4$ produced more effective tiller, while the last $^1/_4$ 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 Gorgy (1988), Salam *et al* (1988), Sahu *et al* (1991) and Porwal *et al* (1994).

1.2.3. <u>Effect of cultivars</u> :

Results of the effect of the tested rice cultivars on yield and yield components combined over 1996 and 1997 seasons are presented in Table (10).

Highly significant differences were observed among the five cultivars in all studied characters.

Giza 178 cultivar significantly produced the highest number of panicle/m^2, being 827.5, while the lowest number was detected by Giza 177 being 703.2 .

Sakha 101 cultivar had the highest panicle weight (2.84 g), but the lowest value was recorded for Giza 181 (2.41 g).

Giza 181 and Giza 178 cultivars had the highest number of filled grains/panicle, being 108.47 and 107.94, respectively, while the lowest number of filled grains/panicle (91.13) was obtained by Sakha 102 cultivar.

The results of unfilled grains/panicle as influenced by cultivars were similar to those of the filled grains number, whereas Giza 181 cultivar, gave the highest number of unfilled grains/panicle (11.34). While the lowest number was detected by Sakha 102 cultivar (5.13).

Sakha 102 cultivar markedly produced the highest 1000-grain weight (28.88 g), followed by Sakha 101 cultivar (28.78 g), while the lowest value was recorded by Giza 178 cultivar being (22.84 g).

The highest values of straw yield were 10.17 and 10.02 t/ha were obtained by Giza 181 and Sakha 101, respectively. On the other hand, Giza 177 cultivar gave the lowest value for straw yield, being 9.59 t/ha.

As for the grain yield, Giza 178 cultivar produced the highest value (8.25 t/ha), but without significant superiority over Sakha 101 cultivar (8.05 t/ha), whereas Sakha 102 cultivar had the minimum grain yield, being 7.28 t/ha.

Table (10) : Yield and yield components as affected by rice cultivars in broadcasting method (Combined data of 1996 & 1997).

Cultivars	Number of panicle/m^2	Panicle weight (g)	Filled grains/ panicle	Unfilled grains/ panicle	1000-grain weight	Straw yield (t/ha)	Grain yield (t/ha)	Harvest index
Giza 181	718.8 cd	2.41 c	108.47 a	11.34 a	25.59 c	10.17 a	7.45 bc	42.45 b
Giza 177	703.2 d	2.53 b	91.69 b	5.56 cd	28.28 b	9.59 c	7.70 b	44.39 a
Giza 178	827.5 a	2.53 b	107.94 a	6.44 b	22.84 d	9.91 b	8.25 a	45.11 a
Sakha 101	775.4 b	2.84 a	92.19 b	5.94 bc	28.78 a	10.02 ab	8.05 a	44.34 a
Sakha 102	746.8 bc	2.51 b	91.13 b	5.13 d	28.88 a	9.68 c	7.28 c	42.54 b
F. test V x S	**	**	**	**	**	**	*	**

Giza 178 cultivar had the highest harvest index followed by Giza 177 and Sakha 101 cultivars, which were 45.11, 44.39 and 44.34, respectively. The lowest value was recorded by Giza 181 cultivar, being 42.45.

It is evident that the increase in the grain yield of Giza 178 cultivar 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 may be attributed to differences in constitution of these cultivars.

These results are in accordance with those obtained by Aly *et al* (1984), Mahgoub *et al* (1986), Badawi *et al* (1990) and El-Kalla (1990).

1.2.4. Interaction effect between cultivars and seasons :

Table (10) shows that the effects of interaction between cultivars and seasons were highly significant for all parameters, but only significant for grain yield.

This interaction with seasons resulted mainly from different ranking of cultivars from season to season.

1.2.5. Effect of the interaction between nitrogen application and seasons :

Table (9) shows that the effect of interaction between nitrogen application and seasons was significant for panicle weight, filled grains (panicle, unfilled grains/panicle and straw yield). However, insignificant effect of interaction between nitrogen application and seasons was detected for other yield and yield components.

1.2.6. Effect of the interaction between cultivars and nitrogen application :

Means of yield and yield components as affected by the interaction between rice cultivars and nitrogen application as combined data for 1996 and 1997 seasons are shown in Table (11).

Results showed that the effect of interaction between rice cultivars and nitrogen application significantly influenced yield and yield components.

Adding nitrogen in three split doses (T_3); $^1/_2$ basal and $^1/_4$ at panicle initiation and $^1/_4$ at complete flowering 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. However, Giza 178 had the highest value for filled grains/panicle (118.75) under T_1 treatment while the highest 1000-grain weight (29.25 g) was obtained with Sakha 102 under T_2 treatment .

On the contrary, application of all nitrogen as basal (T_4) gave the lowest values for panicle weight (2.14 g) and harvest index (40.21) with Giza 181 cultivar, filled grains (79.88) and unfilled grains (4.38) per panicle with Sakha 101 cultivar as well as number of panicles/m^2 (628.1) with Giza 177 cultivar. While, the lowest value for 1000-grain weight (22.63 g) and grain yield (6.85 t/ha) were recorded by applying

Table (11) : Grain yield and yield components as affected by interaction between time of nitrogen application and rice cultivars in broadcasting method (Combined data of 1996 & 1997).

Time of N application	Cultivars	Number of panicle/m^2	Panicle weight (g)	Filled grains/ panicle	Unfilled grains/ panicle	1000-grain weight (g)	Straw yield (t/ha)	Grain yield (t/ha)	Harvest index
T_1	Giza 181	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	706.0 i	2.43 hi	91.38 ij	4.98 i	28.50 e	9.81 fg	7.63 g	43.39 gh
	Giza 178	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	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	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	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	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	730.1 h	2.51 fg	106.13 e	6.00 g	23.00 L	10.27 b	8.42 c	45.54 cd
	Sakha 101	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	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	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	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	916.0 a	2.66 c	108.38 d	8.88 d	23.00 L	9.97 cd	8.83 a	45.95 b
	Sakha 101	853.5 b	3.56 a	90.13 j	7.13 e	28.25 f	9.93 de	8.55 b	46.46 a
	Sakha 102	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	675.4 j	2.14 k	99.88 g	9.50 c	25.00 j	9.85 ef	6.88 Lm	40.21 L
	Giza 177	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	819.4 c	2.46 gh	98.50 gh	6.13 g	22.75 m	9.42 i	6.46 hi	43.64 fg
	Sakha 101	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	731.5 ef	2.33 j	87.88 k	5.00 i	29.00 bc	9.75 fg	6.99 L	40.73 k
F. test T x V x S		**	**	**	**	ns	ns	ns	ns

$T_1 = {}^2/_3$ basal + $^1/_3$ at panicle initiation (PI). $T_2 = {}^1/_3$ basal + $^1/_3$ at maximum tillering (MT) + $^1/_3$ at PI.
$T_3 = {}^1/_2$ basal + $^1/_4$ at PI + $^1/_4$ at complete flowering. T_4 = All amount as basal.

nitrogen in two split doses (T_1) with Giza 178 and Sakha 102, respectively. Concerning straw yield, the lowest value was obtained by Giza 177 (9.30 t/ha) under T_3 treatment.

It could be concluded that applying nitrogen as $^1/_2$ basal and $^1/_4$ at panicle initiation and $^1/_4$ at complete flowering (T_3) favourably affected grain yield of Giza 178 cultivar and significantly increased grain yield compared to other treatments. The superiority of Giza 178 cultivar in grain yield under T_3 treatment might be ascribed to some components of yield, especially number of panicle/m^2.

These results are in harmony with those obtained by Om *et al* (1988), Lopez *et al* (1996), Abd El-Wahab (1998) and El-Kady and Abd El-Wahab (1999).

1.2.7. Effect of interaction between cultivars, nitrogen application and seasons :

Results revealed significant effects of cultivars, nitrogen applications and seasons for number of panicles/m^2, panicle weight, filled grains/panicle and unfilled grains/panicle (Table 11). These results indicated into the unstable effect of interaction between cultivars and nitrogen applications.

1.3. Quality attributes :

1.3.1. Effect of seasons :

Table (12) shows the average values of seasonal effect on some quality attributes as combined data for 1996 and 1997 seasons.

The results indicated that only hulling, milling, head rice and protein percentage were significantly affected by seasons. Higher hulling and protein percentages were deteted in the first season, but values of milling and head rice percentages were higher in the second one.

1.3.2. Effect of nitrogen application :

Data in Table (13) present the average values of some grain quality attributes as affected by time of nitrogen application expressed as combined data for 1996 and 1997 rice seasons. Milling, head rice and protein percentages responded significantly to time of nitrogen application, while the other attributes were statistically the same with different nitrogen application times. When nitrogen was applied as two split doses; $^2/_3$ basal and $^1/_3$ at panicle initiation (T_1), the highest significant values of milling (71.47%) and head rice (62.41%) were obtained. The lowest values of milling (69.46%) as well as head rice (59.16%) were detected when nitrogen was applied as T_3 ($^1/_2$ basal + $^1/_4$ at panicle initiation (PI) + $^1/_4$ at complete flowering) and as T_4 (all amount as basal), respectively. The highest protein content was assessed in rice grains (8.68) when N was applied as T_3, followed by T_1 (8.16%), T_2 (7.83%), while the lowest value was assessed in T_4 (6.98%).

Similar results were obtained by Lei *et al* (1971), Islam *et al* (1990) and El-Refaee (1997).

Table (12): Seasonal effects on the average values of some grain quality in broadcasting method.

Season	Grain length (mm)	Grain width (mm)	Grain shape	Hulling %	Milling %	Head rice %	Protein %	Amylose %
1996	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	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 (13): Effect of time of nitrogen application on some grain quality in broadcasting method (Combined data of 1996 & 1997).

Treatments / Time of N appl.	Grain length (mm)	Grain width (mm)	Grain shape	Hulling %	Milling %	Head rice %	Protein %	Amylose %
T_1	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	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	8.03 a	3.15 a	2.59 a	78.32 a	69.46 b	61.58 b	8.68 a	19.31 a
T_4	8.04 a	3.16 a	2.61 a	78.41 a	69.67 b	59.16 c	6.98 d	19.30 a
F. test (T x S)	ns	ns	ns	ns	*	**	**	ns

$T_1 = {}^2/_3$ basal + $^1/_3$ at panicle initiation (PI). $T_2 = {}^1/_3$ basal + $^1/_3$ at maximum tillering (MT) + $^1/_3$ at PI.
$T_3 = {}^1/_2$ basal + $^1/_4$ at PI + $^1/_4$ at complete flowering. T_4 = All amount as basal.

1.3.3. Effect of cultivars :

Data presented in Table (14) show the performance of rice cultivars in terms of combined data of grain quality in 1996 and 1997 seasons.

Results indicated that the five tested cultivars significantly affected all studied quality attributes. Giza 181 cultivar gave the highest values of grain length (9.13 mm), grain shape (3.46) and amylose content (20.31%). The highest hulling, milling, head rice and protein percentages (80.57, 72.62, 65.23 and 8.26, respectively) were recorded for Giza 177 cultivar which had also the lowest grain shape (2.29). The lowest values of grain length (7.42 mm), hulling (76.85%) and milling (67.91%), head rice (57.74%) and amylose (17.91%) were recorded by Giza 178 cultivar. Sakha 101 cultivar had the highest value of grain width (3.42 mm) and the lowest value of protein content (7.69%).

It could be concluded that the five tested cultivars differed with regard to grain quality attributes, that may be mainly due to differences in growth patterns and genetic constitutions.

El-Kalla *et al* (1990) and El-Kady and Abd El-Wahab (1999) found differences between rice cultivars.

1.3.4. Interaction effect between cultivars and seasons :

Data presented in Table (14) clarify the interaction effect between cultivars and seasons. Significant interactions were calculated for milling, head rice, protein and amylose percentages. These significant interactions reveal that performance of such cultivars varied from one season to another concerning these traits.

Table (14): Some grain quality as affected by rice cultivars in broadcasting method (Combined data of 1996 & 1997).

Cultivars	Grain length (mm)	Grain width (mm)	Grain shape	Hulling %	Milling %	Head rice %	Protein %	Amylose %
Giza 181	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	7.82 b	3.41 a	2.29 c	80.57 a	72.62 a	65.23 a	8.26 a	19.91 c
Giza 178	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	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	7.83 b	3.35 a	2.37 c	79.58 b	71.25 b	63.03 b	7.95 b	19.59 b
F. test (V x S)	ns	ns	ns	ns	**	**	**	**

1.3.5. Interaction effect between cultivars and nitrogen application :

Data in Table (15) revealed significant interaction between the tested cultivars and time of nitrogen applications.

Giza 177 cultivars 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), grain shape (3.57) and amylose (20.6%) under T_2, T_4 and T_1 treatments, respectively.

For grain width, the highest mean value was obtained by Sakha 101 with T_2 treatment being 3.50 mm. On the other hand, the lowest values for grain length (7.28 mm), grain width (2.65 mm), milling (66.02%) and amylose content (17.62%) were produced by Giza 178 cultivar with T_4, T_2, T_3 and T_1, respectively. The lowest values for hulling (75.53%) and head rice (55.55%) were obtained by adding all nitrogen dose as basal (T_4) with Giza 181 while the same treatment of N application resulted in the lowest value of protein (6.84%) with Sakha 102. As for grain shape, the lowest value was produced by Giza 177 under T_3 and T_4 treatments.

Similar results were obtained by El-Kady and Abd El-Wahab (1999).

1.3.6. Interaction effect between nitrogen application and season :

The interaction effect between N applications and seasons is shown in Table (13). Significant effects were found for milling, head

Table (15) : Some grain quality as affected by interaction between time of nitrogen application and rice cultivars in broadcasting method (Combined data of 1996 & 1997).

Time of N application	Cultivars	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 i	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 c	64.15 e	8.79 c	19.43 e
	Sakha 102	7.88 f	3.28 e	2.40 g	78.43 e	69.40 i	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 e
F. test T x V x S		ns	ns	ns	**	**	**	**	**

$T_1 = {}^2/_3$ basal + $^1/_3$ at panicle initiation (PI). $T_2 = {}^1/_3$ basal + $^1/_3$ at maximum tillering (MT) + $^1/_3$ at PI.

$T_3 = {}^1/_2$ basal + $^1/_4$ at PI + $^1/_4$ at complete flowering. T_4 = All amount as basal.

rice and protein percentages that mean that the effect of time of nitrogen application on some grain quality attributes was not constant in both years of study.

1.3.7. Interaction effect among cultivars, nitrogen applications and season :

With the exception of grain length, grain width and grain shape, all attributes showed significant differences due to the interaction effect between cultivars, nitrogen application and seasons (Table 15). This result may be due to the fluctuated effect of the interaction of cultivars and nitrogen application from one season to another.

2. Transplanting Method :

2.1. Growth attributes :

2.1.1. Effect of season :

The effect of season on growth attributes presented in Table (16) showed that the seasonal effects were clear on most of growth attributes. Numbers of tillers/m^2 in the first, second and third stages were significantly higher in the first season than in the second one. However, plant height and heading date gave significantly higher values in the second season than in the first one. On the other hand, panicle length didn't differ significantly in 1996 than 1997 rice season.

2.1.2. Effect of nitrogen application :

Data in Table (17) show the effect of N-fertilizer application on number of tillers/m^2 at different growth stages, heading date and plant height as combined data of the two seasons.

Table (16) : Seasonal effect on the average values of growth attributes of transplanted rice.

Season	Number of tillers/m^2 (indicated by growth stages)				Heading date	Plant height	Panicle length
	No. 1	No. 2	No. 3	No. 4	(days)	(cm)	(cm)
1996	526.81 a	637.81 a	662.50 a	630.31 a	93.75 b	87.66 b	19.78 a
1997	424.38 b	475.23 b	572.81 b	640.69 a	102.83 a	97.84 a	19.58 a

No. 1: 30 days after sowing, No. 2: Panicle initiation, No. 3: Complete flowering, No. 4: Harvest

Table (17) : Effect of time of nitrogen application on growth attributes of transplanted rice (Combined data of 1996 & 1997).

Treatments	Number of tillers/m^2 (indicated by growth stages)				Heading date	Plant height	Panicle length
Time of N application	No. 1	No. 2	No. 3	No. 4	(days)	(cm)	(cm)
T_1	469.25 a	561.00 a	635.63 a	652.38 a	98.78 a	93.38 a	19.77 a
T_2	471.88 a	563.30 a	605.63 b	635.00 b	98.55 ab	93.47 a	19.81 a
T_3	473.75 a	555.35 a	615.00 b	634.00 b	98.00 bc	92.37 b	19.71 a
T_4	487.50 a	546.43 a	614.38 b	620.63 b	97.83 c	91.78 b	19.43 a
F. test T x S	**	ns	**	ns	**	**	*

$T_1 = {}^2/_3$ basal + $^1/_3$ at panicle initiation (PI). $T_2 = {}^1/_3$ basal + $^1/_3$ at maximum tillering (MT) + $^1/_3$ at PI.
$T_3 = {}^1/_2$ basal + $^1/_4$ at PI + $^1/_4$ at complete flowering. T_4 = All amount as basal.
No. 1: 30 days after sowing, No. 2: Panicle initiation, No. 3: Complete flowering, No. 4: Harvest

It was observed that N-fertilizer application gave significant effect on number of tillers/m^2 in the third and fourth stages, heading date, plant height and panicle length. The highest values of number of tillers/m^2 in the third and fourth stages, heading date and plant height were obtained by T_1 ($^2/_3$ basal + $^1/_3$ at panicle initiation), followed by T_2 ($^1/_3$ basal + $^1/_3$ at maximum tillering + $^1/_3$ at panicle initiation). The superiority of the split application of nitrogen may be attributed to the availability of nitrogen in the critical rice growth stages as well as to the decrease in nitrogen losses due to volatilization, nitrification and denitrifiation. These results are in agreement with those obtained by Lai *et al.* (1977). Reddy *et al.* (1985), El-Bably (1990), Attia *et al.* (1994), El-Refaee (1997) and El-Kady and Abd El-Wahab (1999).

2.1.3. Effect of cultivars :

Results in Table (18) revealed that tested cultivars performed significantly for all the considered growth attributes.

Giza 178 produced the highest number of tillers in the first and second growth stages (510.94 & 591.78 tillers/m^2, respectively). However, Giza 177 and Sakha 102 at the first growth stage and Sakha 102 at the second stage gave the lowest tillers/m^2. Giza 177 was superior (670.31 tillers/m^2) in the third stage, while Giza 181 gave the highest number of tillers in stage four (663.44 tillers/m^2) followed by Giza 178 (662.50) and then Giza 177 (652.66), however Sakha 101 came last in this stage (603.13 tillers/m^2).

Concerning the heading date, Giza 177 and Sakha 102 were the earliest cultivars (91.03 and 90.78 days, respectively), but Giza 181 was the latest heading cultivar (108.50 days).

Table (18): Growth attributes of transplanted rice as affected by rice cultivars (Combined data of 1996 & 1997).

Cultivars	Number of tillers/m^2 (indicated by growth stages)				Heading date	Plant height	Panicle length
	No. 1	No. 2	No. 3	No. 4	(days)	(cm)	(cm)
Giza 181	485.16 b	549.22 b	623.44 c	663.44 a	108.50 a	89.48 d	20.40 a
Giza 177	450.78 c	563.81 b	670.31 a	652.66 a	91.03 d	93.23 b	17.86 b
Giza 178	510.94 a	591.78 a	647.66 b	662.50 a	101.59 b	91.10 c	19.89 a
Sakha 101	472.66 bc	554.16 b	578.91 d	603.13 c	99.53 c	89.16 d	20.02 a
Sakha 102	458.44 c	523.63 c	567.97 d	625.78 b	90.78 d	100.78 a	20.22 a
F. test V x S	**	*	**	**	**	**	*

No. 1: 30 days after sowing, No. 2: Panicle initiation, No. 3: Complete flowering, No. 4: Harvest

Sakha 102 gave the highest value of plant height (100.78 cm) followed by Giza 177 (93.23 cm), while the shortest cultivars were Sakha 101 and Giza 181; 89.16 and 89.48 cm, respectively.

As for panicle length, Giza 177 had significantly the shortest panicles (17.86 cm), but the other cultivars had almost the same panicle length, with Giza 181 having the longest panicles (20.40 cm).

Differences in number of tillers and other rice growth attribute in various cultivars were recorded by several authors; Zeidan *et al.* (1980), Assey *et al.* (1992) and Gorgy (1995).

2.1.4. **Interaction effect between cultivars and seasons :**

Table (18) shows that the effect of interaction between cultivars and seasons was statistically significant for all growth attributes. This interaction with season were caused mainly by different ranking of cultivars from season to season.

2.1.5. **Interaction effect between cultivars and nitrogen application :**

The cultivars and N-application interaction showed a significant effect on all growth attributes (Table 19). The highest values for number of tillers at the first growth stages were obtained by T_4 with Giza 178 (562.50 tillers/m^2) followed by T_3 (518.75) and T_2 (503.13) with the same cultivar. Meanwhile, the lowest value of tillers (406.25) was recorded by T_1 with Giza 177 in the first stage.

The highest number of tillers in the second stage was obtained by T_2 and T_1 with Giza 178; 607.00 and 603.00 tillers/m^2, respectively,

Table (19): Growth attributes of transplanted rice as affected by interaction between time of nitrogen application and rice cultivars (Combined data of 1996 & 1997).

Time of N application	Cultivars	Number of tillers/m^2 (indicated by growth stages) No. 1	No. 2	No. 3	No. 4	Heading date (days)	Plant height (cm)	Panicle length (cm)
T_1	Giza 181	518.75 b	562.50 fg	628.13 de	658.75 cde	108.25 b	90.30 k	19.58 e
	Giza 177	406.25 n	561.38 fg	650.00 c	653.13 e	92.13 j	95.15 d	17.96 g
	Giza 178	459.38 jk	603.00 a	684.38 b	709.38 a	102.38 c	90.06 kL	20.05 cd
	Sakha 101	475.00 ghi	554.38 gh	618.75 e	578.13 j	99.88 g	90.65 j	20.48 b
	Sakha 102	486.88 def	523.75 j	596.88 g	662.50 cd	91.25 k	100.71 b	20.79 a
T_2	Giza 181	490.63 de	537.50 i	634.38 d	621.88 g	109.13 a	87.64 n	20.25 bc
	Giza 177	465.65 ij	567.00 ef	646.88 c	656.25 de	90.50 L	94.79 e	18.01 g
	Giza 178	503.13 c	607.00 a	625.00 e	637.50 f	101.88 d	92.59 f	19.80 de
	Sakha 101	446.88 Lm	549.38 h	578.13 b	631.25 f	100.13 g	90.66 j	20.79 a
	Sakha 102	453.13 kL	555.63 gh	543.75 j	628.13 fg	91.13 k	101.68 a	20.18 c
T_3	Giza 181	453.13 kL	593.75 b	621.88 e	656.25 de	108.25 b	89.80 L	20.99 a
	Giza 177	484.38 efg	578.13 cd	703.13 a	629.38 fg	90.38 L	91.93 g	18.03 g
	Giza 178	518.75 b	572.13 de	606.25 f	637.50 f	101.50 e	90.18 k	20.14 c
	Sakha 101	471.88 hi	537.50 i	575.00 h	609.38 h	99.38 h	88.33 m	19.13 f
	Sakha 102	440.63 m	495.25 k	568.75 hi	637.50 f	90.50 L	101.64 a	20.26 bc
T_4	Giza 181	478.13 fgh	503.13 k	609.38 f	596.88 L	108.38 b	90.20 k	20.79 a
	Giza 177	446.88 Lm	548.75 h	681.25 b	671.88 b	91.13 k	91.06 i	17.44 h
	Giza 178	562.50 a	585.00 bc	675.00 b	665.63 bc	100.63 f	91.58 h	19.58 e
	Sakha 101	496.88 cd	575.38 de	543.75 i	593.75 i	98.75 i	86.99 o	19.69 e
	Sakha 102	453.13 kL	519.88 j	575.00 j	575.00 j	90.25 L	99.09 c	19.65 e
F. test T x V x S		**	**	**	**	ns	**	**

No. 1: 30 days after sowing, No. 2: Panicle initiation, No. 3: Complete flowering, No. 4: Harvest

while the lowest number of tillers (495.25) was recorded by Sakha 102 with T_3. Markedly, increases in tillering were recorded in the third growth stage, as Giza 177 produced the highest number of tillers with T_3 (703.13), followed by Giza 178 with T_1 (684.38) and again Giza 177 in T_4 (681.25) and T_1 (650.00 tillers). However, the lowest values were detected for Sakha 102 at T_2 (543.75) and Sakha 101 at T_4 (543.75 tillers). At the fourth growth stage, the highest tillers were recorded by Giza 178 at T_1 (709.38), while the lowest ones were those of Sakha 101 with T_1 (578.13) and Sakha 102 with T_4 (575.00 tillers/m^2).

It could be concluded that number of tillers per m^2 differed from one cultivar to another due to their tillering ability, and from one growth stage to another due to tillering patterns of each cultivar.

The earliest heading occurred with Sakha 102 at T_4 (90.25 days), followed by Giza 177 at T_3 (90.38) and Sakha 102 at T3 (90.50) and T_2 (91.13) and the Giza 177 at T_4 (91.13 days).

The longest plants were always recorded by Sakha 102 at all times of nitrogen application, as the heights ranged between 99.09 and 101.68 cm. The shortest cultivar was Sakha 101 exhibiting 86.99 and 88.33 cm at T_4 and T_3 nitrogen applications, respectively. A similar result was obtained by El-Kady and Abd El-Wahab (1991).

2.1.6. <u>Interaction effect between nitrogen application and season</u> :

Table (17) revealed that the interaction between times of nitrogen application and seasons of study was significant for all growth attributes with the exception of interaction effect at the second and fourth growth stages which revealed insignificance.

2.1.7. Interaction effect among seasons, nitrogen application and cultivars :

With the exception of heading date, all growth attributes showed highly significant differences due to the effect of interaction among cultivars, N-applications and seasons (Table 19). This result may be due to fluctuating effect of the interaction of cultivars and N-applications from one season to another.

2.2. Yield and yield components :

2.2.1. Effect of season :

Results in Table (20) present averages of yield and yield components in the two seasons of the study. From the results, it is evident that all yield and yield components except grain yield were significantly different from one season to another. Higher mean values for panicle weight, filled grains/panicle, 1000-grain weight and harvest index were detected in the first season compared to the second one. However, number of panicles/m^2, unfilled grains and straw yield were found to be higher in 1997 rice season than in 1996 one. However, grain yields for both seasons were very close. These results could be attributed to variations in temperature relative humidity and soil between 1996 and 1997.

2.2.2. Effect of nitrogen ferilizer application :

Table (21) shows the combined analysis of the two seasons for yield and yield components as affected by time of nitrogen application. Data revealed that the differences between the

Table (20): Seasonal effects on the average of yield and yield components of transplanted rice.

Season	Number of panicle/m²	Panicle weight (g)	Filled grains/ panicle	Unfilled grains/ panicle	1000-grain weight	Straw yield (t/ha)	Grain yield (t/ha)	Harvest index
1996	430.94 b	2.86 a	93.64 a	3.86 b	27.84 a	9.74 b	8.15 a	45.60 a
1997	596.81 a	2.44 b	88.90 b	6.63 a	26.14 b	10.24 a	8.18 a	44.28 b

Table (21): Effect of time of nitrogen application on yield and yield components of transplanted rice (Combined data of 1996 & 1997)

Treatments Time of N application	Number of panicle/m²	Panicle weight (g)	Filled grains/ panicle	Unfilled grains/ panicle	1000-grain weight	Straw yield (t/ha)	Grain yield (t/ha)	Harvest index
T_1	551.58 a	2.78 a	91.63 b	4.88 b	26.53 b	10.14 a	8.62 a	45.92 a
T_2	511.43 b	2.65 b	91.28 b	5.43 ab	27.05 ab	9.98 ab	7.99 bc	44.46 b
T_3	501.25 b	2.60 b	94.20 a	5.68 a	27.35 a	10.00 ab	8.17 b	45.04 ab
T_4	491.25 b	2.57 b	87.98 c	5.00 b	27.03 ab	9.86 b	7.89 c	44.35 b
F. test T x S	ns	**	**	ns	ns	ns	*	*

$T_1 = {}^2/_3$ basal + ${}^1/_3$ at panicle initiation (PI).
$T_2 = {}^1/_3$ basal + ${}^1/_3$ at maximum tillering (MT) + ${}^1/_3$ at PI.
$T_3 = {}^1/_2$ basal + ${}^1/_4$ at PI + ${}^1/_4$ at complete flowering.
T_4 = All amount as basal.

averages of all characters under study were significantly affected by N-fertilizer application. The results showed that, the highest number of paniles/m^2, panicle weight, straw and grain yields and harvest index were obtained when plants received nitrogen as $^2/_3$ basal and $^1/_3$ at panicle initiation (T_2). The same N-fertilizer treatment resulted in the lowest mean value for unfilled grains/panicle. This result might be attributed to the fact that splitting the nitrogen dose minimized the losses and met the needs of rice plants. The highest nitrogen losses take place during the wetting and drying period before the permanent floodig. In this period, nitrification-denitrification processes is the common reason of losses. Similar results were reported by Salam *et al.* (1988), Badawi *et al.* (1990), Pandey and Tripathi (1994), El-Refaee (1997) and Sorour *et al.* (1998). However, T_4 (all nitrogen amount applied as basal) resulted in the minimum value of all traits except for unfilled grains/panicle and 1000-grain weight which gave the lowest values due to T_1 treatment ($^2/_3$ basal + $^1/_3$ at PI). These findings are in a close agreement with the results of Gorgy (1988), Salam *et al.* (1988), Sahu *et al.* (1991), Pandey and Tripathi (1994) and Porwal *et al.* (1994).

2.2.3. Effect of cultivars :

The differences in yield and yield components as affected by considered rice cultivars were highly significant (Table 22).

Giza 181 gave the highest values for panicle weight and unfilled grains/panicle. While Giza 178 had the highest values for number of panicles/m^2 (564.06), filled grains/panicle (102.63) and straw yield (10.43 t/ha) and came second for grain yield (8.38 t/ha). Sakha 101

Table (22) : Yield and yield components as affected by rice cultivars of transplanted rice (Combined data of 1996 & 1997).

Cultivars	Number of panicle/m^2	Panicle weight (g)	Filled grains/ panicle	Unfilled grains/ panicle	1000-grain weight	Straw yield (t/ha)	Grain yield (t/ha)	Harvest index
Giza 181	519.16 b	2.78 ab	99.81 b	8.16 a	26.13 c	9.82 c	7.82 d	44.21 c
Giza 177	489.28 c	2.54 a	80.81 d	4.25 c	28.50 b	9.89 bc	7.96 cd	44.52 c
Giza 178	564.06 a	2.61 b	102.63 a	5.66 b	22.44 d	10.43 a	8.38 b	44.48 c
Sakha 101	497.66 c	2.76 b	87.47 c	4.00 c	29.06 a	10.02 b	8.63 a	46.26 a
Sakha 102	499.22 c	2.57 ab	85.63 c	4.16 c	28.81 ab	9.81 c	8.04 c	45.24 b
F. test V x S	**	**	**	**	**	**	**	**

produced the highest values for panicle weight, 1000-grain weight, grain yield and harvest index. Sakha 101 had highest grain yield (8.63 t/ha), followed by Giza 178 and Sakha 102, while Giza 177 yielded lowest. The superiority of Sakha 101 in yield could be attributed to the high values of panicle weight, 1000-grain weight and seed index. Ranking Giza 178 as second in grain yield may be due to high number of panicles/m^2 and number of filled grains/panicle. Similar findings were reported by Aly *et al.* (1984) Mahgoub *et al.* (1986), Badawi *et al.* (1990) and El-Kalla *et al.* (1990).

2.2.4. Interaction effect between cultivars and seasons :

Table (22) shows that the effect of interaction between cultivars and seasons was statistically highly significant for all traits under study. This interaction with seasons was caused mainly by different ranking of cultivars from one season to another.

2.2.5. Interaction effect between cultivars and nitrogen application :

The cultivars and N-applications interaction showed a significant effect on all yield and its components (Table 23).

The highest values for number of panicles/m^2 were obtained by T_1 with Giza 178 followed by T_1 with Giza 181 and T_3 with Giza 178. However, the lowest number of panicles was detected by T_4 with Sakha 101.

The highest value of panicle weight was obtained by T_1 with Sakha 101 followed by T_3 with Giza 181. On the other hand, the lowest panicle weight was obtained by T_4 with Giza 177.

Table (23) : Grain yield and yield components as affected by interaction between time of nitrogen application and rice cultivars of transplanted rice (Combined data of 1996 & 1997).

Time of N application	Cultivars	Number of panicle/m^2	Panicle weight (g)	Filled grains/ panicle	Unfilled grains/ panicle	1000-grain weight (g)	Straw yield (t/ha)	Grain yield (t/ha)	Harvest index
T_1	Giza 181	563.25 b	2.81 c	93.13 f	7.25 c	25.63 i	10.18 d	8.48 d	45.30 e
	Giza 177	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	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	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	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	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	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	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	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	490.63 h	2.55 hi	81.50 g	4.50 gh	29.00 c	9.71 k	7.96 h	45.93 c
T_3	Giza 181	518.75 e	2.99 b	105.88 b	9.63 a	27.25 g	9.56 L	7.85 i	45.30 e
	Giza 177	478.13 i	2.59 gh	83.38 hi	4.13 ij	28.50 d	10.05 ef	7.94 h	44.05 ij
	Giza 178	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	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	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	462.50 k	2.59 gh	99.88 d	7.75 b	25.50 i	9.56 L	7.04 m	42.04 L
	Giza 177	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	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	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	490.63 h	2.58 gh	84.25 gh	4.13 j	29.63 a	9.90 hi	8.06 g	44.66 fg
F. test T x V x S		**	ns	**	**	**	**	*	**

The highest value of filled grains/panicle was obtained by T_2 with Giza 178 followed by T_3 with Giza 181. Whereas, the lowest value was obtained by T_1 with Giza 177. T_1 with Sakha 102 and T_3 with Sakha 101 gave the lowest unfilled grains/panicle. However, T_3 with Giza 181 gave the highest one.

The highest values of 1000-grain wight were recorded by each of T_3 with Sakha 101 and T_4 with Sakha 102, followed by T_2 with Sakha 101. However, T_1 with Giza 178 gave the lowest one.

For straw yield, the highest value was recordd by T_3 with Giza 178, whereas T_3 and T_4 with Giza 181 gave the lowest one. Concerning grain yield, the highest value was recorded by T_1 with Sakha 101 followed by T_1 with Giza 178 and then by T_3 with each of Giza 178 and Sakha 101. The high grain yield of T_1 with Sakha 101 could be attributed to the high panicle weight and harvest index, while, the highest grain yield of T_1 and T_3 with Giza 178 may be attributed to high number of panicles/m^2.

It could be concluded that T_1 is the optimal combination for each of Sakha 101 and Giza 178 to produce the highest grain yield. The highest value of harvest index was detected by T_1 with Sakha 101. However, T_4 with Giza 181 had the lowest one.

Generally, T_1 with all cultivars gave the highest mean values for yield and most of yield components. These results are in harmony with those obtained by Om *et al.* (1988), Lopes *et al.* (1996), Abd El-Wahab (1998) and El-Kady and Abd El-Wahab (1999).

2.2.6. Interaction effect of nitrogen application and seasons :

Table (21) shows that the effect of interaction between time of nitrogen fertilizer application and seasons was statistically significant for panicle weight, filled grains/panicle, grain yield and harvest index, revealing that this effect differed from one season to another. However, insignificant effect of interaction between nitrogen fertilizer application and seasons was detected for other characters.

2.2.7. Interaction effect among varieties, N-application and seasons :

Results in Table (23) indicated that the effect of cultivars, N-application and seasons was significant for yield and yield components except for panicle weight. This result indicates that the effect of interaction between cultivars, N-applications changed from one season to another.

2.3. Quality attributes :

2.3.1. Effect of season :

Results in Table (24) present averages of the two seasons for quality attributes. It is evident that hulling, head rice and protein percentages were significantly different from one season to another. Higher mean values for hulling and protein percentages were detected in the first season, but the situation was reversed in the second season. However, seasonal effect was not significant on the other grain quality attributes.

2.3.2. <u>Effect of nitrogen fertilizer application</u> :

With regard to time of N application, results showed that time of nitrogen application significantly affected all grain quality attributes except for hulling percentage in the combined analysis over both seasons (Table 25).

Grain length reached its maximum value (8.33 mm) by T_3 ($^1/_3$ basal + $^1/_3$ at maximum tillering + $^1/_3$ at panicle initiation), followed by T_1 (8.04 mm), but the minimum value (7.90 mm) was obtained by T_3.

The highest grain width (3.27 mm) was recorded by T_4, followed by T_2 treatment (3.25 mm). On the other hand, T_1 gave the highest grain shape (2.63), followed by T_2 and T_3, while the treatments were statistically the same, but T_4 (all basal) gave the lowest value of grain shape.

T_2 treatment (3 equal splits) resulted in the highest values of milling and head rice percentages, while T_4 (all nitrogen amount as basal) resulted in the lowest values of both traits. T_3 gave the highest protein percentage, and T_4 gave the highest amylose percentage.

The superiority of the split application of nitrogen may be attributed to the occurrence of nitrogen in the critical rice growth stages as well as the decrease in lossing nitrogen to ammonia volatilization, nitrification and denitrification. Similar results were obtained by Lei *et al.* (1971), Islam *et al.* (1990), Ali *et al.* (1992), El-Refaee (1997) and El-Kady and Abd El-Wahab (1999).

Table (24) : Seasonal effects on the average values of some grain quality of transplanted rice.

Season	Grain length (mm)	Grain width (mm)	Grain shape	Hulling %	Milling %	Head rice %	Protein %	Amylose %
1996 (S_1)	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 (S_2)	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 (25) : Effect of time of nitrogen application on some grain quality of transplanted rice (Combined data of 1996 & 1997).

Treatments / Time of N appl.	Grain length (mm)	Grain width (mm)	Grain shape	Hulling %	Milling %	Head rice %	Protein %	Amylose %
T_1	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	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	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	8.13 b	3.27 a	2.54 b	79.90 a	69.71 c	62.18 b	6.52 c	18.71 a
F. test (T x S)	**	*	*	ns	**	**	*	*

$T_1 = {}^2/_3$ basal + $^1/_3$ at panicle initiation (PI). $T_2 = {}^1/_3$ basal + $^1/_3$ at maximum tillering (MT) + $^1/_3$ at PI.
$T_3 = {}^1/_2$ basal + $^1/_4$ at PI + $^1/_4$ at complete flowering. T_4 = All amount as basal.

2.3.3. Effect of cultivars :

Table (26) shows the means of quality properties of the rice grains for the five cultivars under study. The grain length of cultivars ranged between 7.58 mm (Giza 178) and 9.14 mm (Giza 181) and grain width from 2.55 mm (Giza 181) to 3.49 mm (Sakha 102). These measurements in turn affected the grain shape (length/width ratio) which varied from 2.25 (Sakha 102) to 3.65 (Giza 181). The highest values of hulling, milling, head rice and protein content were recorded for Giza 177. Sakha 102 gave the highest value of amylose content followed by Giza 181 and then Giza 177. It could be concluded that Giza 177 is considered the best cultivar for grain quality properties followed by Sakha 102 and 101. Similar results were obtained by El-Kalla *et al.* (1990), El-Kassaby *et al.* (1991), Assey *et al.* (1992) and El-Kady and Abd El-Wahab (1999).

2.3.4. Interaction effect between cultivars and seasons :

Table (26) shows that the effect of interaction between cultivars and seasons was statistically significant for all properties except grain width and grain shape. This interaction with seasons resulted mainly by different ranking of cultivars from one season to another.

2.3.5. Interaction effect between cultivars and nitrogen application :

The differences between the averages of all properties were significant due to the interaction effect between N-application and cultivars (Table 27). This interaction is mainly due to the different ranking of cultivars from one application of nitrogen to another. The highest values of grain length were obtained by T_2 with Giza 181

Table (26): Some grain quality as affected by rice cultivars of transplanted rice (Combined data of 1996 & 1997).

Cultivars	Grain length (mm)	Grain width (mm)	Grain shape	Hulling %	Milling %	Head rice %	Protein %	Amylose %
Giza 181	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	7.75 d	3.41 a	2.31 c	81.64 a	71.97 a	64.31 a	7.53 a	18.26 c
Giza 178	7.58 e	3.14 b	2.40 b	78.43 c	70.37 b	62.70 b	6.73 d	17.65 d
Sakha 101	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	8.09 b	3.49 a	2.25 c	81.11 ab	71.75 a	63.98 a	6.86 d	19.23 a
F. test (V x S)	**	ns	ns	**	**	**	**	**

Table (27): Some grain quality as affected by interaction between time of nitrogen application and rice cultivars of transplanted rice (Combined data of 1996 & 1997).

Time of N application	Cultivars	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 i	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 i	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 e	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	3.57 c	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
F. test T x V x S		**	ns	ns	ns	**	**	**	**

(9.53 mm) and T_4 with the same cultivar (9.45 mm). On the other hand, the lowest value was detected by T_3 ($^1/_2$ basal + $^1/_4$ at panicle initiation + $^1/_4$ at complete flowering) with Giza 178.

For grain width, the highest values were recorded by T_2 with Sakha 101 and Sakha 102, T_3 with Sakha 102 and T_4 with Sakha 102. However, the lowest one was recorded by T_1 with Giza 181.

For grain shape the highest value was detected by T_1 with Giza 181 cv., while the lowest values were obtained by T_3 and T_4 with Sakha 102.

The highest values of hulling percentage were recorded by T_1 and T_4 with Giza 177, followed by T_1 and T_4 with Sakha 102, T_2 with Giza 177 and Sakha 101. However, T_4 with Giza 181 gave the lowest hulling percentage.

For milling and head rice percentages, the highest values were recorded for Giza 177 with both T_2 and T_3, while T_1 and T_2 with Giza 181 gave lowest one for milling and head rice percentages, respectively. Both Giza 177 and Giza 181 produced the highest levels of grain protein; 8.09 and 7.94%, respectively, as a result to T_1, while Sakha 102 produced the lowest value (6.09%) due to T_4, preceded by Giza 178 due to T4 (6.28%).

For amylose percentage, the highest value was obtained by T_3 with Sakha 102 followed by T_1 with Sakha 102. Similar results were obtained by El-Kady and Abd El-Wahab (1999).

2.3.6. Interaction effect between nitrogen application and seasons :

Table (25) shows that the interaction between nitrogen fertilizer levels and seasons was statistically significant for all quality attributes except hulling %, revealing that the effect of nitrogen fertilizer application was unconstant from season to another. These results might be attributed to fluctuated of temperature in both seasons.

2.3.7. Interaction effect among cultivars, nitrogen application and seasons :

With the exception of grain width, grain shape and hulling percentage, all quality traits showed significant differences due to the effect of interaction between cultivars, N-applications and seasons (Table 27). This result may be due to the fluctuated effect of the interaction of cultivars and N-application from one season to another.

Comparison between planting methods :

The averages of the studied characters for the two planting methods are presented in Table (28). The statistical analysis (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 gave significantly the same values under the two methods of planting. It was found that broadcasting method gave higher significant values than transplanting for unfilled grains, and protein and amylose percentages; while transplanting gave higher significant values for heading date, plant height, grain yield, and head rice.

Table (28) : Effect of planting methods on :
a) Growth attributes

Planting method	Heading date	Plant height (cm)	Panicle length (cm)
Broadcasting	88.43 b	87.05 b	19.79 a
Transplanting	98.29 a	92.75 a	19.68 a

b) Yield and its components

Planting method	Panicle weight (g)	Filled grains/ panicle	Unfilled grains/ panicle	1000-grain weight	Straw yield t/ha	Grain yield t/ha	Harvest index
Broadcasting	2.57 a	98.28 a	6.88 a	26.88 a	9.88 a	7.75 b	43.77 a
Transplanting	2.65 a	91.27 a	5.25 b	26.99 a	9.99 a	8.17 a	44.94 a

c) Grain quality

Planting method	Grain length (mm)	Grain width (mm)	Grain shape	Hulling %	Milling %	Head rice %	Protein %	Amylose %
Broadcasting	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	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.