Current Science International
ISSN 2077-4435

Volume : 04 | Issue : 04| Oct.-Dec.|2015
Pages: 628-632

Response of Some Egyptian Rice Cultivars for Different Levels of Nitrogenous Fertilization

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ABSTRACT

Two field experiments were conducted at the Rosseta region, El-Behira Governorate, Egypt, during 2013 and 2014 summer growing seasons to study the response of some Egyptian rice cultivars of nitrogen fertilization. The applied experimental design was split plot design with three replications. The main plots included the three rice cultivars (Giza 177, Giza 178 and Sakha 102), while four N- fertilization levels (30, 60, 90 and 120 kg N/fed.) as urea for 46 % n were arranged in the subplots. The main results could be summarized as follows; Giza 178 cultivar in all yield and its components i.e. panicle weight (g), number of filled grains/panicle, number of panicle/m^2, 1000- grain weight, grain, straw, and biological yield (tons/fed.) as well as harvest index in both growing seasons. Application of 90 N/fed., gave the highest yield characters and significantly, the highest protein content, hulling, milling and head rice percentages in both seasons. Giza 178 cultivar with application of 90 kg N/fed., was the best combination to obtain the highest values of all yield and its components and all grain quality characters under El-Behira conditions.

Key words: N- fertilization; rice; cultivar; yield; grain quality

Introduction

Rice (*Oryza sativa* L.) is the most important food crop in the diet of the world population (FAO, 2004). Hall of the world's population eats rice daily and depends on it as their staple food. Rice occupies conspicuous position in the predominately agricultural economy of Egypt this attention as required in improve its yield, quality characters and quality of elements nutrition (Chemma, 2004).

Nitrogen plays a vital role in determining the growth and yield potential of crops. According to Ananthi *et al*. (2010), the best rate of mineral fertilizer is that which produces maximum economic return at minimum cost. Nitrogen is one of the most essential macronutrients for rice production and usually, it is one of the most yield limiting in irrigated regions of rice production all over the world (Samonte *et al*. 2006).

Inorganic nitrogen is essential plant nutrient in most cropping systems if maximum yields are to be realized, however, in long term field experiments where only inorganic nitrogen fertilizers have been used and structure has been determined EC of the soil increased and crop yield steadily decreased. Therefore, to maintaining soil fertility, productivity level and lower EC could be achieved through period's addition of proper organic matter (El-Feky, 2006 and Salem, 2006).

Yousef *et al.* (2012) showed that 1000- grain weight, filled grain and grain yield increased significantly with nitrogen fertilizer. Effect of different split application N-fertilizer were significantly on this parameter, 1000- grain weight, filled grain and grain yield with increase split application. Study interaction effect of treatment's revealed that all the parameter's increased significantly with an application of 300 kg/ha N-fertilizer at different stage. Also, yield and almost all yield-contributing attributes were significantly influenced by various transplanting dates and nitrogen levels. Plant height, tillering ability, kernels per panicle, 1000-kernel weight, grain yield, straw yield and biological yield were considerably affected by various transplanting dates and nitrogen application rates. The highest grain yield (10.09 tons ha^{-1}) was obtained with 205 kg ha^{-1} nitrogen application. Greater than 10 tons ha^{-1} paddy yield can be attained by optimum transplanting date along with better management of nitrogenous fertilizer (Abid *et al.*, 2015).

Modern rice cultivars are always responsive to balanced application of fertilizer. Proper management of nitrogen is necessary to improve crop growth and grain yield (Alam *et al*., 2011). Compared with other mineral nutrients, the optimal rate of nitrogenous fertilizer application is vital to decrease the environmental impact of excessive nitrogen and to increase profitability in crop production (Bilbao *et al*. 2004). In most cases, farmers use imbalanced dose of nitrogenous fertilizer which results in higher incidence of attacks by insects or pests, thereby lowering the yield of rice (Alam *et al*. 2011).

Therefore, the objective of the present investigation was carried out in order to study the response of some rice cultivars to nitrogenous fertilization on the productivity and quality characters.

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Material and Methods

Two filed experiments were effectuated for two consecutive seasons, 2013 and 2014 on rice crop (*Oryza sativa*, L.) at a private farm of Rosseta region, El-Behira Governorate, Egypt. The experiments were conducted to investigate the response of some rice cultivars of nitrogenous fertilization on productivity and quality characters.

Soil samples of the experimental sites were taken at the depth of (0 and 30 cm) and its physical and chemical analysis were analyzed and presented in Table (1) were done according to Chapman and Pratt (1978).

Table 1: Physical and chemical properties of the experimental soil sites during both cropping seasons (2012/2013 and 2013/2014).

Soil characteristics		
Physical and chemical properties	Seasons	
	2013	2014
Soil texture (%)	Sandy clay loam	
Sand %	56.99	58.22
Silt %	9.63	8.92
Clay %	33.38	32.86
pH (1: 2.5 water suspension)	8.30	8.00
EC (dSm^{-1})	0.958	0.988
Cations (meq/L.)		
Ca^{++}	1.87	1.77
Mg^{++}	3.27	2.98
Na^{+}	55.00	53.10
K^{+}	5.10	4.98
Anions (meq/L.)		
HCO_3^{-}	2.00	1.95
Cl^{-}	3.85	3.77
$SO4^{--}$	10.50	12.20
O.M. (%)	1.85	1.90
$CaCO_3$ (%)	0.198	0.192
Available Mineral N(mg/kg)	89.40	90.60
Available P (mg/kg)	20.12	28.50

The nursery seed bed was well ploughed and dry leveled- phosphorus fertilizer in the form of single calcium superphosphate (15.5 % P_2O_5) was added at the rate of 100 kg/fed., before tillage. Nitrogen in the farm of urea (46%N) was added at the rate of (30, 60, 90 and 120 kg/fed.) was added in two portions, 2/3 Basel in dry soil before the first irrigation and 1/3 at panicle initiation. Zn sulphate (22% Zn) at the rate of 20 kg /fed., was added after pudding and before planting.

The preceding crop was wheat in the first season and Egyptian clover (*Trifolium alexandrinum,* L.) for the second growing season. The applied experimental design was split plot design with three replications. The main plots included the three rice cultivars (Giza 177, Giza 178 and Sakha 102), while four N- fertilization levels (30, 60, 90 and 120 kg N/fed.) as urea for 46 % n were arranged in the subplots. The plot area was 10.5 m^2 (3.5 m length x 3 m width). Rice seeds at the rate of 42 kg/fed., were soaked in fresh water for 24 hours then drained and inoculated. For 48 hours to hasten early germination. The pre–germination seeds were, uniformly, broadcasted in the nursery in 8th May in 2013 and 2014 seasons.

Data recorded

1- Yield and its components: (panicle length (cm), number of filled grains/panicle, number of panicle/m^2, 1000-grain weight (g), grain yield (tonns/fed.), straw yield (tonns/fed.), biological yield ((tons/fed.) and harvest index (%) were estimate at the every both experiments during both seasons.

2- Grain quality characters:

A- Protein content (%): protein content in while grains was multiplied by grain yield.

B- Milling characters i.e. hulling percentage, milling percentage and broken rice percentage were estimated according to the methods reported by Adain (1952).

B.1. Hulling percentage (about 150 g cleaned rough rice samples at moisture content 12-14 %) was estimated using experimental huller machine at rice technology and training center, Alexandria.

Hulling %= brown rice weight/rough rice weight x 100.

B.2. Milling percentage brown rice was consequently milled using milling machine model. TMOS at rice Technology and training center, Alexandria. The milled rice sample was than collected and weighted taken and percentage of total milled rice calculated by the following equation.

Milling %= Milled rice weight/rough rice weight x 100

B.3. Head rice percentage

All milled grains were separated from the total milled rice by using sieving device. Then, the percentage of broken rice was obtained and calculated as follows:

Head rice (%) = whole grain weight/ rough rice weight x 100.

Statistical analysis

All data collected were subjected to analysis of variance analysis according to Gomez and Gomez (1984). Treatment means were compared by LSD test. All statistical analysis was performed using analysis of variance technique by means of CoStat computer software package.

Results and Discussion

A. Yield and Yield components:

The Data in Tables (2 and 3) revealed that the differences among the studied rice cultivars in yield components i.e. number of filled grains/panicle, number of panicle/m^2, 1000- grain weight (g), grain yield, straw yield, biological yield ((tons/fed.) and harvest index (%) were significant in both seasons.

Table 2: Number of panicles /m^2, number of filled grains/panicle, number of unfilled grains/panicle and 1000- kernel weight (g) of three rice cultivars as affected by N- fertilization level and their interaction during 2013 and 2014 seasons.

Treatments	Number of panicles /m^2		Number of filled grains/panicle		Number of unfilled grains/panicle		1000- kernel weight (g)	
	Seasons							
	2013	2014	2013	2014	2013	2014	2013	2014
Rice cultivar								
Giza177	458.08c	436.78b	92.39b	92.54b	7.60a	7.46a	22.29b	23.08b
Giza178	497.42a	480.77a	93.16b	92.98b	6.84a	7.02a	25.23a	24.53a
Sakha102	480.29b	476.27a	94.83a	94.63a	5.17b	5.37b	23.13b	23.42b
N- fertilization level								
30	433.17c	431.46b	87.89d	90.41d	12.11a	9.59a	21.34c	21.89c
60	494.22ab	475.54a	93.29c	92.83c	6.71b	7.17b	23.22b	22.57c
90	504.89a	478.32a	97.28a	95.81a	2.72d	4.19d	25.67a	24.96a
120	482.11b	473.09a	95.39b	94.49b	4.61c	5.51c	23.97b	23.96b
Interaction								
Rice cultivar x N- fertilization level	**	**	**	*	**	*	*	**

- Mean values in the same column marked with the same letters are not significantly different at 0.05 level of probability.
*- *, **: significant at 0.05 level of probability.*

Table 3: Straw yield tons/fed., Grain yield tons/fed., Biological yield tons/fed., and harvest index % of three rice cultivars as affected by N- fertilization level and their interaction during 2013 and 2014 seasons.

Treatments	Straw yield tons/fed.		Grain yield tons/fed.		Biological yield tons/fed.		Harvest index %	
	Seasons							
	2013	2014	2013	2014	2013	2014	2013	2014
Rice cultivar								
Giza177	6.90b	6.94b	5.14c	5.55b	12.04c	12.39b	42.58b	44.62b
Giza178	8.38a	8.15a	7.30a	6.96a	15.68a	15.11a	46.58a	45.97a
Sakha102	8.35a	7.99a	6.59b	6.74a	14.93b	14.73a	43.89b	45.68a
N- fertilization level								
30	6.61d	6.34d	5.05c	5.01c	11.66d	11.36d	43.30b	44.02b
60	7.48c	7.42c	6.47b	6.54b	13.95c	13.97c	46.30a	46.78a
90	8.81a	8.67a	7.28a	7.24a	16.09a	15.91a	45.10a	45.48ab
120	8.60b	8.21b	6.57b	6.86ab	15.17b	15.06b	42.69b	45.42ab
Interaction								
Rice cultivar x N- fertilization level	**	**	**	*	**	*	**	*

- Mean values in the same column marked with the same letters are not significantly different at 0.05 level of probability.
*- * and **: significant at 0.05 level of probability.*

Giza 178 cultivar significantly surpassed and followed Sakha 102 cultivar in all yield and its components characters under study. These differences may be due to the genetic differences and the differences in 1000-

grain weight might be attributed to the variation in translocation rate of photosynthetic from leaves to the staring organs i.e. the grains. The trends of the obtained results are in good accordance with that reported by many investigators such as El- Refaee (2002); Badawi (2002); El-Khoby (2004); El-Feky (2006); Alam *et al*., 2011.

Data in tables (2 and 3) clear that increasing nitrogen fertilizer levels significantly increased grain, straw, biological yield (tons/fed.) and harvest index (%) in both seasons. This increase in grain yield could be attributed to the significant increase in number of panicle/m^2, number of filled grains/panicle and 1000- grain weight in both seasons. Application of N- fertilizer at level of 90 kg N/fed., gave the highest yield and its components compared to the other levels of application. The effect of N- fertilizer may be attributed to the role of N – in promoting the vegetative growth and moristemic activity during growth. Such finding is in agreement with those of Ebaid and Ghanem (2000); Abou- Khalifa (2001); Mohamed (2001); Badawi (2002); Yousef *et al.* (2012).

It is clear from Tables (2 and 3) that the highest number of panicles/m^2, number of filled grains/panicle, 1000- grain weight, grain, straw, biological yield (tons/fed.) and harvest index (%) were recorded under the treatment including the combination of Giza 178 cultivar with applying 90 kg/fed., in 2013 and 2014 seasons.

B. Grain quality characters:

It is clear that protein content (%), hulling, milling and head rice percentages of the three tested cultivars varied significantly, in both seasons, Table (4).

The highest protein content (8.68 and 9.88 %) hulling percentage content (80.98 and 82.17 %). Milling percentage (71.20 and 72.33 %) and head rice percentage (80.79 and 79.19 %) in both seasons, respectively, belonged to Giza 178 cultivar and without significant differences Skha 102 cultivar in hulling and milling percentages in both seasons. These differences may be due to the differences in the genetic structure and its interaction with environmental conditions. Similar differences among rice cultivar in grain quality reported by El-Ekhtyar (2004); El- Feky (2006).

Table 4: Protein %, Hulling %, milling %, and broken rice % of three rice cultivars as affected by N- fertilization level and their interaction during 2013 and 2014 seasons.

Treatments	Protein %		Hulling %		Milling %		Head rice %	
	Seasons							
	2013	2014	2013	2014	2013	2014	2013	2014
Rice cultivar								
Giza177	7.52c	8.48b	78.00c	79.33b	70.45a	70.38b	73.08c	73.85c
Giza178	8.68a	9.88a	80.98b	82.17a	71.20a	72.33a	80.79a	79.19a
Sakha102	7.99b	8.77b	82.71a	82.39a	70.83a	72.16a	76.35b	77.02b
N- fertilization level								
30	5.60d	6.63d	76.38c	78.11c	68.91d	69.99c	73.56d	71.99d
60	7.85c	9.15c	79.86b	80.62b	70.72c	71.66b	76.44c	74.80c
90	9.95a	10.73a	83.46a	83.22a	72.24a	72.86a	79.00a	80.62a
120	8.85b	9.67b	82.57a	83.22a	71.44b	72.00ab	77.97b	79.33b
Interaction								
Rice cultivar x N- fertilization level	*	**	**	**	*	*	*	*

- *Mean values in the same column marked with the same letters are not significantly different at 0.05 level of probability.*
- **, **: significant at 0.05 level of probability.*

Obtained results recorded in Table (4) revealed that grain protein content, hulling, milling and head rice percentage in grains were significantly affected by adding N- fertilizer levels. The highest values of all grain quality characters were obtained by 90 kg N/fed., compared with applying 30 kg N/fed., on hulling percentage in both seasons. Increase in protein content, hulling, milling and head rice percentages as results of increasing of N levels to up 90 kg N/fed., may be due to increasing nutrient availability. Similar results were reported by Seedek (2001), Mohamed (2001), El-Feky (2006).

Data documented in Table (4) show that the interaction between Giza 178 cultivar and applying 90 kg N/fed., produced the highest values of all grain quality charcters in both seasons.

Conclusion:

From the obtained results of both growing seasons field's study, it was concluded that yield, its components, grain composition and quality of rice crop increased with sowing Giza 178 under application of nitrogen at rate of 90 kg/fed., under study conditions at Rasheed, El-Behira governorate, Egypt.

References

Abid, M., I. Khan, F. Mahmood, U. Ashraf, M. Imran and S. A. Anjum, 2015. Response of Hybrid Rice to Various Transplanting Dates and Nitrogen Application Rates. Philipp Agric. Scientist, 98(1): 98–104.

Adain, C. R., 1952.The Mc. Gill miller method 20 for determining the milled quality of small samples of rice. J. of Appl., Sci., Res. SS.,(2):20-21.

Alam, M., M. Islam and M. Islam, 2011. Farmers' efficiency enhancement through input management: the issue of USG application in modern rice. Bangladesh J Agric Res 36: 129–141.

Ananthi, T., M. Amanullah and K. Subramanian, 2010. Influence of mycorrhizal and synthetic fertilizers on soil nutrient status and uptake in hybrid maize. Madras Agric. J., 97: 374–378.

Badawi, S.A.T., 2002. Physiological studies on rice crop. MSC. Thesis, Fac. Of Agric. Kafr El-Sheikh, Tanta Univ., Egypt.

Bilbao, M., J. Martinez and A. Delgado, 2004. Evaluation of soil nitrate as a predictor of nitrogen requirement for sugar beet grown in a Mediterranean climate. Agron. J., 96: 18–25.

Chapman, H.D. and P.F. Partt, 1978. Methods of analysis for soils and plant and water. Division Agric. Sci. Univ. Calif. pp.162-172.

Chemma, M.A.A., 2004. Effect of nitrogen fertilizers on Basmati rice productivity. Pak., J. of Bontany, 19(5):312-318.

CoStat Ver. 6.311, 2005. Cohort software798 light house Ave. PMB320, Monterey, CA93940, and USA. email: info@cohort.com and Website: http://www.cohort.com/DownloadCoStatPart2.html.

Ebaid, R.A. and S.A. Ghanem, 2000. Productivity of Giza 177 rice variety growth after different winter crops and fertilized with different nitrogen levels. Egypt J. Agric. Res., 78(2):717-731.

El-Ekhtyar, A.M.M., 2004. Behavior of some rice cultivar as affected by drought treatments and direct seedling method (drilling).Ph.D. Thesis, Agron. Dep. Fac. Of Agric. Mansoura Univ., Egypt.

El-Feky, K.A.M., 2006. Agricultural studies of rice crop. Msc. Thesis Fac. of Agric. Kafr El-Sheikh, Tanta Univ.

El-Khoby, W.M.H., 2004. Study the effect of some cultural practices on rice crop.Ph.D. Thesis Fac. Of Agric. Kafr El-Sheikh, Tanta Univ., Egypt.

El-Refaee, I. S.H., 2002. Studies on irrigation system for some rice cultivars.Ph.D. Thesis, Fac. Agric. Kafr El-Sheikh, Tanta Univ., Egypt.

FAO., 2004. FOA STAT.FAO statistical Databases.

Gomez, K.A. and A.A. Gomez, 1984. Statistical Produces for Agriculture Research. 2nd Ed. John Wiley and Sons Inc. New York.

Mohamed, A.A.A., 2001.Response of rice to bio-orgain and mineral fertilizaters and its combination under two irrigation intervals.M.SC. Thesis, Fac. Agric. Kafr El-Sheikh, Tanta Univ., Egypt.

Salem, A.K.M., 2006. Effect of nitrogen levels plant spacing and time of farmyard manure application on the productivity rice. J. of Appl., Sci. Res., 2(11):980-987.

Samonte, S., L. Wilson, J. Medley, S. Pinson, A. Mcclung and J. Lales, 2006. Nitrogen utilization efficiency, relationships with grain yield, grain protein and yield related traits in rice. Agron. J., 98: 168–176.

Sedeek, S.F.M., 2001.Studies of morphological and agronomical characteristics of some early varieties and lines of rice.MSc. Thesis, Fac Agric. Kafr El-Sheikh, Tanta Univ., Egypt.

Yousef, T., Sahar, F. Allahyar and D. Jahanfar, 2012. Effect of split application of nitrogen fertilizer on growth and yield of hybrid rice (GRH1). Australian J. of Basic & Applied Sci., 6(2):1-10.