Phenotypic Performance of Rice Cultivars under Different Locations and Tow Nitrogen Fertilizer Conditions in Egypt

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Received on: 12/7/2016 *Accepted: 14/8/2016*

ABSTRACT

Field experiments were conducted at different locations, northern part of the Nile Delta, to study the interaction, adaptability and stability of grain yield and its related traits for three rice cultivars (Giza179, Hybrid 1 and Sakha106) and to develop a technology package for the studied rice planting in different locations; namely, Kafr EL-Sheikh, Sharkia, Dakahlia, Damietta, Gharbia and Bihera governorates,Egypt, under two nitrogen fertilizers[69N (urea) and compost (2 t/fed.) + 46N (urea)]. The results of combined analyses of variance indicated significant differences among locations (L), cultivars (C), nitrogen fertilizers (F), L x C, L x F, C x F and L x C x F for all the traits studied, except for 100-grain weight for(L x C interaction; plant height, panicle length, number of tillers/ plant, panicle weight and sterility percentage(for L x F interaction and plant height, panicle length, number of tillers/ plant, number of panicles/plant, panicle weight and grain yield(t/feddan) (for L x C x F interaction). Adaptability and stability were determined, according to Eberhart and Russell's procedures. The environment + (cultivar x environment) were significant for all the characters studied, indicating distinct nature of environments and cultivar x environment interactions in phenotypic expression. The cultivar x environment (linear) interaction component showed significance for all the characters studied.These findings indicated that significant differences among the cultivars, for linear response to environments (bi) behavior of the cultivars, could be predicted over environments more precisely and C x L interaction was outcome of the linear function of environmental components. Among the three rice cultivars evaluated, Hybrid 1 and Sakha106 gave the regression coefficient 1.26 and 1.32 exhibited high stability of yield where the regression coefficient was more than unity with low deviation from regression, approximately,zero value. Therefore, the cultivars, Hybrid 1and Sakha106 were superior and strongly suggested for planting at multiplication trials at regions of Egypt under both treatments of fertilizer.

Key words: Rice cultivars, adaptability, stability, grain yield.

INTRODUCTION

It is widely recognized that rice grain yield, as a function of total global rice production, has a major impact on the supply and price stability of rice. Rice (*Oryza sativa* L.) is the stable food for sixty percentage of the world population and is now planted on about 147 million hectares. It is grown in more than one-hundred countries of the world. In Egypt, rice is planted in more than 0.70 million hectares during summer season. The average of rice grain yield was decreased, to be less than 4.0 t /feddan over the past five years, may be due to non-adaptability and stability of the grain yield of some high yield cultivars under some environmental conditions (Abd Allah, 2015). Evaluation of cultivars for stability, under varying environmental conditions, has become an essential part of any breeding program. Cultivars, in a series of environments havin a stable average yield, are known to have vast adaptability. However, cultivars, which show high yielding genetic potential, only, in desirable conditions, but, poor yielding potential in undesirable conditions, are known as cultivars with finite adaptability (Lin & Bins, 1991). Cultivars, that show low G x E interaction and have high stable yields, are desirable for plant breeders and farmers, because it indicates the lesser effect of environment on the performance of cultivars and their yields are largely due to their genetic composition (Linnemann *et al.,* 1995). Instability is the result of cultivars response in different environments, which usually indicates a high interaction between genetical and environmental factors (Lone *et al.,* 2009). An understanding of the causes of cultivar x environment interaction can help in identifying traits and environments for better cultivar evaluation and those suitable for planting, since there is a direct need for improving suitable cultivars more adaptable to different geographical areas. To meet these goals, estimation of cultivar × environment interaction is extremely imperative. Grain yield depends on cultivar, environment and management practices and their interaction with each other (Messina *et al*., 2009). Under the same management conditions, variation in grain yield is, principally, explained by the effects of cultivar and environment (Dingkuhn *et al.,* 2006). Interaction between these two explanatory variables gives insight for identifying cultivar suitable for specific environments. The environmental effect is, typically, a large contributor to total variation (Blanche *et al.,* 2009).

Nitrogen fertilizer is the main nutrient associated with yield, but, N management responds differently to rice type, cultivar, geographic zone and other crop practices (Hirzel *et al.,* 2011). Increase in fertilizer nutrient input, especially N fertilizer, has significantly contributed to the improvement of crop yields in the world (Cassman *et al.,* 2003). Fertilization management and cultivar × environment interaction generate differences in plant nutrient composition (Mengel and Kirkby, 1987). Utilization of plant and animal residues in source of compost, as plant nutrients and nutrient cycling, is an age long agronomic practices. Diverse studies, across different agro-ecosystems, have shown importance of organic nutrient sources in improving crop yield and improving soil quality.The objectives of this study were to study the effect of the interaction between different locations under different levels of nitrogen fertilizer on the grain yield and its components for the studied cultivars and to determines the stability of grain yield and adaptability of cultivars of rice for ecological conditions in Egypt.

MATERIALS AND METHODS

Multi environmental experiments were conducted by using three rice cultivars; namely, Giza179, Hybrid 1 and Sakha106, during 2014and 2015 rice growing seasons at six locations;i.e., Kafr EL-Sheikh, Sharkia, Dakahlia, Damietta, Gharbia and Bihera governorates,Egypt, under two levels of fertilizers,[69N (urea) and compost 2(t/fed)+ 46N (urea)]. Two fertilizer levels were designed as the first factor and three rice cultivars have been used as a second factor, within each location. The experiment was laid out in a factorial design, with three replications. The full amount of compost and 2/3 of nitrogen fertilizer were applied at planting date, while, the remaining 1/3 of the nitrogen fertilizer was applied at 60 days after planting time. There were three replications at each location and the sub-plot size was 1.5 x 3 m, and hill spacing was 20 x 20 cm, approximately, where four seedlings were transplanted per hill. Planting dates varied among locations from 1to10 May. Soil samples were taken to a depth of 0-20 cm in each field before the time of planting. Measurements were made for pH and EC of soil (Table 1). Total N contents were analyzed and available N as NH_4-N, was determined by indophenol method (Hidaka, 1997). Data were collected at flowering and maturity stages, observations were recorded on plant height (cm), panicle length (cm), number of tillers/ plant, number of panicles/plant, panicle weight (g), 100-grain weight (g), sterility percentage and grain yield /plant(t/fed).

Statistical analysis:

Analysis of variance was conducted for combined data across two seasons and six locations. Test of homogeneity of variance, using Bartlett test, was done. If variances of all environments were found to be homogenous, then, combined analysis of variance was proceeded to look at cultivar x environment interaction and stability of the cultivars across all environments. The adaptability and stability of yield and attributes traits for each cultivar was calculated, according to Eberhart and Russell (1966). All statistics were done, using Gene's software.

RESULTS AND DISCUSSIONS

The combined analysis of variance for the locations, cultivars and fertilizer application are presented in Table 2. The analysis indicates that the effect of locations (L), cultivars (C), fertilizer (F), L x C, L x F, C x F and L x C x F were highly significant, except for 100-grain weight (g) for L x C interaction, plant height (cm), panicle length (cm), number of tillers/ plant, panicle weight (g) and sterility percentage for L x F interaction and plant height (cm), panicle length (cm), number of tillers/ plant, number of panicles/plant, panicle weight (g) and grain yield /plant for L x C x F interaction. A significant effect of locations implied that means of traits varied, considerably, at different environments. Significant effect of location × cultivar interaction indicated that the influence of environment on grain yield and other studied traits of rice cultivars, among environments, were obviously different. Significant effect of environment × fertilizer interaction means that a number of rice cultivars, in all environments, produced higher values of the traits studied in some environments. However, insignificant effect of location × fertilizer interaction implied that various cultivars had reactions within different environment,

Table 1: Average of soil characteristics data obtained in 2014 and 2015

Location	Texture	Sand (%)	Silt (%)	Clay (%)	PH	Ec (ds/m)	Om(%)	$Caco_3$ (%)
Kafr EL-Sheikh	Clayey	21.42	29.42	49.16	7.50	0.92	3.22	45.70
Bihera	Clayey	20.84	32.88	46.13	7.88	7.75	1.81	3.44
Gharbia	Clayey	18.71	33.40	47.89	7.95	2.14	0.90	3.55
Sharkia	Clayey	29.50	24.70	45.80	8.60	0.56	1.50	28.50
Dakahlia	Cayey loam	12.30	34.30	54.10	8.00	3.97	1.30	14.60
Damietta	Clayey	18.51	34.42	45.89	8.25	7.50	1.10	27.50

Table 2: Mean of sum squares for grain yield and related traits.

S. O. V.	df	Plant height (cm)	Panicle length (cm)	Number of tillers / plant	Number of panicles/ plant	Panicle weight (g)	100-grain weight (g)	Sterility percentage	Grain yield (t/fed)
Reps	2	1.39	0.40	0.65	1.52*	0.04	0.01	0.34	0.02
Locations	5	40.78**	11.35**	17.15**	14.78**	0.12**	0.04**	8.88**	0.06**
Rep/Loc.	10	0.76	0.70	0.04	0.28	0.01	0.006	0.21	0.01
Cultivars	2	985.93**	108.42**	330.65**	512.36**	2.84**	0.02	174.28**	16.43**
Fertilizer	1	77.74**	8.01**	26.60**	7.62**	0.23**	0.11**	65.30**	0.39**
L x C	10	18.31**	3.16**	8.22*	10.80**	0.05**	0.01	7.055**	0.06**
L x F	5	3.60	0.18	0.01	2.71**	0.01	0.02*	0.87	0.02**
C x F	2	15.89**	1.16	1.68*	0.11	0.04	0.02*	1.28	0.01
L x C x F	10	0.65	0.68	0.01	0.23	0.01	0.02**	3.27**	0.01
Error	60	2.0471	0.7404	0.6611	0.4343	0.016	0.0078	0.5244	0.008

*and ** are significant and highly significant at 0.05 and 0.01 probability, respectively.

so that, sometimes, cultivar effects in an environment could be declined by such effect at another environment. These results confirmed those of Honarnejad *et al.* (2000) and Azar *et al*.(2008).

The results in Table 3 explained that the environment and cultivar were highly significant for all traits studied, implying a wide range of variability among the tested cultivar and environment. The cultivar × environment interaction was found to be highly significant for all the traits studied, indicating that the major portion of interaction was linear in nature and prediction over the environments was possible (Satit *et al*., 2000 and Sarawgi et *al*., 2000). Therefore, the cultivars responded differently to the variation in environmental conditions of location and year which indicated the necessity of testing rice cultivars at multiple environment. The variation in both linear and nonlinear trends, relative to traits studied, were significant, where, it was corroborated by Kulkarni *et al*., (2000). Eberhart and Russell (1966) confirmed that a need for considering in both of linear and non-linear trends in order to evaluate yield and other parameters of stability of cultivars, as well as, both the linear regression coefficient and deviation from regression for phenotypic stability. This, also, shows the difficulties encountered by breeders in selecting new cultivars for release and suggested to consider both the linear regression coefficient and deviation from regression for phenotypic stability. The adaptability and stability of a cultivar are useful parameters for recommending cultivars for known cropping conditions. Eberhart and Russell (1966) proposed an assessment of cultivar response to environmental changes, using a linear regression coefficient and the variance of the regression deviations. The cultivars are grouped, according to the size of their regression coefficients, as less than, equal to or greater than one and, according to the size of the variance of the regression deviations (equal to or not different from zero).

The cultivars, having regression coefficients greater than one would be more adapted to favorable growth conditions.

Table 3: Analysis of variance for stability of grain yield and related traits

S. O. V.	df	Plant height (cm)	Panicle length (cm)	Number of tillers / plant	Number of panicles / plant	Panicle weight (g)	100-grain weight (g)	Sterility percentage	Grain yield (t/fed.)
Environment	11	27.24**	5.97**	10.22**	8.64**	0.08**	0.04**	10.37**	0.07**
Cultivar	2	985.93**	108.42**	330.65**	512.36**	2.84**	0.021	174.28**	16.43**
C x E Int.	22	10.06**	1.85**	3.89**	5.02**	0.03**	0.01**	4.81**	0.03**
E / V	33	15.79**	3.22**	6.00**	6.23**	0.05**	0.02**	6.66**	0.04**
E. Linear	1	299.70**	65.70**	112.42**	95.13**	0.94**	0.46**	114.07**	0.84**
C x E linear	2	23.26**	4.33**	1.96*	12.96**	0.05*	0.05**	8.45**	0.07**
Deviation	30	5.83**	1.0709	2.72**	2.82**	0.022	0.0096	2.96**	0.02**
Giza179	10	7.60**	1.42*	1.30*	1.41**	0.0125	0.0146	1.68**	0.0123
Hybrid 1	10	8.70**	0.7023	1.54**	1.45**	0.0231	0.0084	2.48**	0.0158
Sakha106	10	1.1835	1.0883	5.32**	5.59**	0.03*	0.0058	4.72**	0.03**
Pooled error	60	1.8639	0.7352	0.5729	0.4134	0.0155	0.0076	0.4802	0.0085

*and ** are significant and highly significant at 0.05 and 0.01 probability, respectively.

While, those with regression coefficients less than one, would be adapted to unfavorable environmental conditions. On the other hand, the cultivars, having regression coefficients equal to one, would have an average adaptation to all environments. Thus, cultivars, with variances in regression deviations equal to zero, would have highly predictable behavior, whereas, with a regression deviation greater than zero, they would have low predictability because of the environmental stimulus.

The duration average, linear regression coefficient (bi), deviation mean square (S^2d_i) and coefficient of linear determination (R^2), of the three studied cultivars, are presented in Table 4.

With respect to plant height, the cultivar, Giza179, gave the lowest mean value and a regression coefficient greater than one, so, this cultivar would be adapted to environments with a high level of technology. The level of variance in the stability regression deviations was more than zero, indicating low predictability. However, should adversely influence decisions regarding the use of this cultivar, because it had determination coefficient (R^2= 63.11%). The highest mean value for plant height was obtained from Hybrid1 (100.12cm). The regression coefficient was 0.46, 1.14, 1.40, with Sakha106, Giza179 and Hybrid1, respectively. Significant value for deviation from regression was found with cultivars, accompanied low determination coefficient value. The highest mean value for panicle length was obtained from Hybrid1 (22.05 cm). The regression coefficient was insignificant and insignificant values for deviation from regression with low determination coefficient values. The cultivars, Giza179, Hybrid1 and Sakha106, recorded 25.42, 29.34 and 23.38 for number of tillers/ plant. The linear regression coefficient was not-significant with cultivars studied. The deviation from regression produced significant values with Giza179 and Sakha106.The determination coefficient ranged between 52.41 to 68.40% with Sakha106 and hybrid1, respectively.

Regarding number of panicles/plant, the mean values of Giza179, Hybrid 1 and Sakha106 cultivars, were 23.59, 28.05 and 20.55, respectively. The linear regression coefficient was not-significant with these cultivars. The deviation from regression produced highly significant values with the three cultivars. The coefficient value had ranged between 43.85 to 63.07%, with Giza179 and Sakha106, respectively. The mean values of panicle weight were 3.36, 3.61and 3.05 g for Giza179, Hybrid 1 and Sakha106, respectively. The linear regression coefficient was more than unity with Giza179 and deviation from regression produced insignificant values with all cultivars, since the deviation from regression was nearest zero in all cultivars. The determination coefficient was 83.90 with Giza179, indicating that it was more stable for this trait.

Giza179, Hybrid 1 and Sakha106 recorded 2.61, 2.63 and 2.65 g for 100-grain weight, respectively. The linear regression coefficient was found to be more than unity with Giza179 (1.20) and Hybrid 1 (1.48) and deviation from regression produced insignificant values with all cultivars.

Table 4: Adaptability and stability parameters for grain yield and related traits

Cultivars	Plant height (cm)				Panicle length (cm)			
	Mean	bi	S^2d	R^2(%)	Mean	bi	S^2d	R^2(%)
Giza179	89.83	1.14	1.91**	63.11	19.44	1.43	0.23	75.98
Hybrid 1	100.12	1.4	2.27**	69.11	22.05	1.02	-0.01	76.55
Sakha106	93.33	0.46*	-0.23	64.36	18.77	0.54	0.12	37.31
Cultivars	**Number of tillers/ plant**				**Number of panicles/plant**			
	Mean	**bi**	**S^2d**	**R^2(%)**	**Mean**	**bi**	**S^2d**	**R^2(%)**
Giza179	25.42	0.8	0.24*	64.86	23.59	0.59	0.33**	43.85
Hybrid 1	29.34	0.95	3.00	68.4	28.05	0.67	0.34**	49.69
Sakha106	23.38	1.25	1.58**	52.41	20.55	1.74	1.72**	63.07
Cultivars	**Panicle weight (g)**				**100-grain weight (g)**			
	Mean	**bi**	**S^2d**	**R^2(%)**	**Mean**	**bi**	**S^2d**	**R^2(%)**
Giza179	3.36	1.43	-0.001	83.9	2.61	1.20	0.001	60.55
Hybrid 1	3.61	0.95	0.002	55.41	2.63	1.48	0.002	80.35
Sakha106	3.05	0.61	0.01	28.08	2.65	0.31	-0.001	20.9
Cultivars	**Sterility percentage**				**Grain yield (t/fed.)**			
	Mean	**bi**	**S^2d**	**R^2(%)**	**Mean**	**bi**	**S^2d**	**R^2(%)**
Giza179	9.23	1.38	0.40**	81.08	4.79	0.41	0.001	27.99
Hybrid 1	12.04	1.15	0.66**	66.99	5.74	1.26	0.001	73.89
Sakha106	7.7	0.47**	1.41**	15.16	4.43	1.32	0.008**	59.01

*and ** are significant and highly significant at 0.05 and 0.01 probability, respectively.

Therefor, it was nearest zero with all the tested cultivars. The determination coefficient was 80.35 with Hybrid1, indicating that such cultivar was more stable for this trait than the others. Scapin *et al.* (2000) recommended that cultivars, having bi >1, S^2d_i different from zero, high yields and high values of the coefficient of determination b_i ,regardless of the significance of S^2d_i, would be used under favorable conditions. In addition, a cultivar with bi=1, S^2d_i= 0, and a high coefficient of determination, have a stable over environment to all environments and would be highly predictable. Concerning sterility percentage, the mean values of Giza179, Hybrid1and Sakha106 cultivars were 9.23%, 12.04% and 7.70%, respectively. The regression coefficient was highly significant for Sakha106 cultivar. The deviation from regression was highly significant for all cultivars. The determination coefficient ranged from 15.16 to 81.08 % for Sakha106 and Giza179, respectively. The regression coefficient was, approximately, one in most cultivars. Thus, it would be adapted and stabled to environments for sterility percentage character.

Regarding grain yield, the mean values, obtained from Giza179, Hybrid 1 and Sakha106,were 4.79, 5.74 and 4.43 t/fed, respectively. Based on observed results, Hybrid1 cultivar, which gave the regression coefficient of 1.26, exhibited high stability of yield, where the regression coefficient was equal unity with a low deviation, from regression, approximately, zero value. Therefore, the cultivar, Hybrid 1 was superior and strongly recommended for planting at multiplication trials at regions of Egypt. Eberhart and Russell (1966) reported that, when the yield of cultivars was more than total average, the regression coefficient was equal to one and there was a minimum deviation from the regression line that means there was a stability in cultivar. The determination coefficient was 27.99%, 73.89% and 59.01% in Giza179, Hybrid 1 and Sakha106% for grain yield. These results are similar to those of Umadevi *et al.* (2009).They reported that the environment + (cultivar x environment) was significant for grain yield and their component characters, indicating distinct nature of environments and cultivar x environment interactions in phenotypic expression. This indicated significant differences among the cultivars for linear response to environments (bi) behavior of the cultivars and could be predicted over environments more precisely and GxE interaction was outcome of the linear function of environmental conditions. It could be concluded that the cultivars, Hybrid 1 and Sakha106, not only exhibited a high grain yield, but also, regression coefficient and deviation from regression was minimum. So those cultivars were stable than the other cultivar.

Results in Table 5 showed that the highly significant difference was found between environments means for the studied traits. Therefore, Kafr EL-Sheikh location gave the best mean values for number of tillers/ plant, number of panicles/plant, 100-grain weight and grain yield /plant.

The desirable mean values were gained from Sharkia, Damietta, Gharbia and Dakahlia, for plant height, panicle length, panicle weight and sterility percentage, respectively. The application of 69 N gave appropriate mean values for all traits studied.

Location x cultivar interaction, in Table 6, was found to be highly significant for all traits. Where, the tallest plant and panicle length resulted from Hybrid 1, with Dakahlia location, and Kafr EL-Sheikh location, with Hybrid 1, gave the highest mean values for number of tillers/ plant and number of panicles/plant.

Table 5: Mean performance of grain yield and related traits as affected by six locations and two fertilizer levels

Location	Plant height (cm)	Panicle length (cm)	Number of tillers/ plant	Number of panicles / plant	Panicle weight (g)	100-grain weight (g)	Sterility percentage (%)	Grain yield (t/fed)
Kafr EL-Sheikh	95.50	20.43	27.58	25.74	3.31	2.68	9.88	5.04
Sharkia	91.62	18.80	24.89	23.59	3.19	2.54	10.75	4.87
Dakahlia	94.65	20.37	26.18	24.43	3.36	2.65	8.63	5.01
Damietta	94.08	21.18	25.43	23.52	3.36	2.67	9.36	5.00
Gharbia	94.90	19.83	25.52	23.77	3.43	2.64	9.45	4.97
Bihaera	95.80	19.90	26.68	23.31	3.40	2.59	9.86	5.03
LSD(0.05)	0.80	0.48	0.45	0.37	0.07	0.05	0.40	0.05
LSD(0.01)	1.14	0.69	0.65	0.53	0.10	0.07	0.58	0.07
Fertilizer								
69N	95.27	20.36	26.54	24.33	3.39	2.66	8.88	5.05
Compost + 46N	93.58	19.81	25.55	23.80	3.30	2.60	10.43	4.93
LSD(0.05)	0.46	0.28	0.26	0.21	0.04	0.03	0.23	0.03
LSD(0.01)	0.66	0.40	0.37	0.30	0.06	0.04	0.33	0.04

Table 6: Interaction between location and cultivar for grain yield and related traits

Location	Cultivar	Plant height (cm)	Panicle length (cm)	Number of tillers / plant	Number of panicles/ plant	Panicle weight (g)	100-grain weight (g)	Sterility percentage (%)	Grain yield (t/fed.)
Kafr EL-Sheikh	Giza179	93.83	19.12	26.70	24.85	3.33	2.71	9.00	4.73
	Hybrid 1	98.73	22.47	30.58	29.28	3.51	2.68	12.70	5.81
	Sakha106	93.93	19.70	25.45	23.08	3.09	2.64	7.94	4.57
Sharkia	Giza179	86.22	17.80	24.00	22.65	3.10	2.51	11.47	4.79
	Hybrid 1	95.96	20.66	27.92	26.92	3.53	2.52	14.08	5.66
	Sakha106	92.67	17.95	22.75	21.22	2.95	2.60	6.71	4.17
Dakahlia	Giza179	88.83	19.81	25.30	23.35	3.38	2.65	8.00	4.78
	Hybrid 1	102.33	23.02	29.18	27.95	3.57	2.67	10.05	5.67
	Sakha106	92.78	18.28	24.05	22.00	3.13	2.64	7.85	4.58
Damietta	Giza179	89.17	21.83	26.20	24.15	3.45	2.60	8.12	4.88
	Hybrid 1	100.17	22.72	30.08	28.58	3.75	2.68	12.39	5.75
	Sakha106	92.92	19.00	20.00	17.83	2.89	2.74	7.58	4.37
Gharbia	Giza179	89.54	18.86	24.52	22.77	3.52	2.61	9.55	4.78
	Hybrid 1	101.67	21.58	28.58	27.38	3.66	2.68	11.26	5.70
	Sakha106	93.50	19.04	23.45	21.17	3.12	2.64	7.54	4.44
Bihaera	Giza179	91.38	19.21	25.80	23.75	3.40	2.57	9.25	4.81
	Hybrid 1	101.86	21.86	29.68	28.18	3.68	2.55	11.75	5.84
	Sakha106	94.17	18.63	24.55	18.00	3.14	2.66	8.57	4.44
LSD(0.05)		1.38	0.83	0.78	0.64	0.12	0.09	0.70	0.09
LSD(0.01)		1.97	1.19	1.12	0.91	0.17	0.12	1.00	0.12

The heaviest panicle weight was obtained from the interaction between Hybrid 1and Damietta location, while, Sakha106, with the same location, gave the heaviest 100-grain weight. Sharkia location, with Sakha106, produced the lowest mean values for sterility percentage. For grain yield (t/fed.) the highest mean values were observed from the interaction between Bihera location and Hybrid 1cultivar.

The results, presented in Table 7, showed the interaction between location and fertilizer for the studied traits.Kafr EL-Sheikh, with 69N, attained the superior mean values for plant height and number of tillers/ plant, while, Damietta location, with 69N, gave the tallest panicle length.The number of panicles/plant, with the highest mean value, was obtained from the interaction between Kafr EL-Sheikh with Compost + 46N. Whereas,Gharbia location and 69N produced the heaviest value of panicle weight. Damietta location, with 69N, had the highest value of 100-grain weight. The lowest value of sterility percentage was obtained from Dakahlia location and 69N. However, the highest mean value of grain yield was attained from a combination of Bihaera location with 69N.

Table 7: Interaction between location and fertilizer for grain yield and related traits

Location	Fertilizer	Plant height (cm)	Panicle length (cm)	Number of tillers/ plant	Number of panicles/ plant	Panicle weight (g)	100-grain weight (g)	Sterility percentage (%)	Grain yield /plant (t/fed.)
Kafr EL-Sheikh	69N	96.97	20.80	28.07	25.22	3.39	2.74	9.16	5.06
	Compost + 46N	94.03	20.05	27.09	26.26	3.22	2.62	10.59	5.01
Sharkia	69N	92.02	19.03	25.37	24.06	3.20	2.59	9.66	4.92
	Compost + 46N	91.21	18.57	24.41	23.13	3.19	2.49	11.84	4.83
Dakahlia	69N	95.34	20.74	26.67	24.81	3.42	2.64	8.21	5.09
	Compost + 46N	93.96	20.00	25.69	24.06	3.30	2.67	9.05	4.93
Damietta	69N	95.22	21.33	25.91	23.84	3.39	2.75	8.64	5.02
	Compost + 46N	92.94	21.03	24.94	23.20	3.33	2.59	10.09	4.98
Gharbia	69N	95.95	20.00	26.07	24.23	3.47	2.66	8.63	5.05
	Compost + 46N	93.85	19.65	24.97	23.31	3.39	2.62	10.27	4.90
Bihaera	69N	96.13	20.23	27.17	23.80	3.45	2.60	8.97	5.14
	Compost + 46N	95.47	19.57	26.19	22.82	3.35	2.59	10.74	4.91
LSD(0.05)		1.13	0.68	0.64	0.52	0.10	0.07	0.57	0.07
LSD(0.01)		1.61	0.97	0.92	0.74	0.14	0.10	0.82	0.10

Table 8: Interaction between variety and fertilizer for grain yield and related traits

Cultivar	Fertilizer	Plant height (cm)	Panicle length (cm)	Number of tillers/ plant	Number of panicles/ plant	Panicle weight (g)	100-grain weight (g)	Sterility (%)	Grain yield /plant (t/fed.)
Giza179	69N	90.19	19.51	25.82	23.79	3.42	2.65	8.32	4.84
	C +46N	89.47	19.36	25.02	23.38	3.31	2.57	10.14	4.75
Hybrid 1	69N	101.73	22.48	30.08	28.35	3.69	2.69	11.47	5.82
	C +46N	98.52	21.63	28.59	27.75	3.54	2.57	12.60	5.65
Sakha106	69N	93.91	19.08	23.72	20.84	3.06	2.66	6.83	4.48
	C +46N	92.75	18.45	23.03	20.26	3.04	2.65	8.56	4.38
LSD(0.05)		0.80	0.48	0.45	0.37	0.07	0.05	0.40	0.05
LSD(0.01)		1.14	0.69	0.65	0.53	0.10	0.07	0.58	0.07

Table 9: Interaction between Location, variety and fertilizer for grain yield and related traits

Location	cultivar	Fertilizer	Plant height (cm)	Panicle length (cm)	No.of tillers/ plant	No.of panicles/ plant	Panicle weight (g)	100-grain weight (g)	Sterility (%)	Grain yield (t/fed.)
Kafr EL-Sheikh	Giza179	69N	94.67	19.73	27.07	24.50	3.40	2.69	8.92	4.78
		C +46N	93.00	18.50	26.33	25.20	3.26	2.74	9.07	4.67
	Hybrid 1	69N	100.83	23.00	31.33	28.83	3.64	2.85	13.02	5.82
		C +46N	96.63	21.93	29.83	29.73	3.37	2.52	12.38	5.80
	Sakha106	69N	95.41	19.67	25.80	22.33	3.14	2.67	5.54	4.59
		C +46N	92.44	19.72	25.10	23.83	3.03	2.61	10.33	4.56
Sharkia	Giza179	69N	86.11	17.83	24.37	23.00	3.13	2.55	9.67	4.82
		C +46N	86.33	17.76	23.63	22.30	3.06	2.47	13.28	4.76
	Hybrid 1	69N	96.63	21.15	28.63	27.53	3.57	2.63	13.24	5.68
		C +46N	95.29	20.17	27.20	26.30	3.49	2.41	14.91	5.64
	Sakha106	69N	93.33	18.11	23.10	21.63	2.89	2.60	6.09	4.25
		C +46N	92.00	17.79	22.40	20.80	3.01	2.60	7.32	4.08
Dakahlia	Giza179	69N	89.00	20.01	25.67	23.70	3.50	2.65	7.62	4.84
		C +46N	88.67	19.61	24.93	23.00	3.27	2.65	8.37	4.72
	Hybrid 1	69N	104.00	23.15	29.93	28.23	3.60	2.63	9.80	5.85
		C +46N	100.67	22.89	28.43	27.67	3.53	2.70	10.29	5.49
	Sakha106	69N	93.03	19.06	24.40	22.50	3.17	2.63	7.19	4.59
		C +46N	92.53	17.50	23.70	21.50	3.09	2.65	8.50	4.57
Damietta	Giza179	69N	89.67	21.33	26.57	24.50	3.50	2.78	7.24	4.89
		C +46N	88.67	22.33	25.83	23.80	3.40	2.42	9.00	4.87
	Hybrid 1	69N	102.33	23.33	30.83	29.03	3.83	2.73	11.33	5.78
		C +46N	98.00	22.10	29.33	28.13	3.66	2.62	13.44	5.71
	Sakha106	69N	93.67	19.33	20.33	18.00	2.84	2.73	7.33	4.39
		C +46N	92.17	18.67	19.67	17.67	2.93	2.75	7.83	4.36
Gharbia	Giza179	69N	90.18	18.65	25.07	22.93	3.57	2.66	8.53	4.82
		C +46N	88.89	19.06	23.97	22.60	3.47	2.55	10.57	4.73
	Hybrid 1	69N	103.67	22.05	29.33	27.83	3.72	2.70	10.46	5.77
		C +46N	99.67	21.11	27.83	26.93	3.61	2.67	12.05	5.63
	Sakha106	69N	94.00	19.30	23.80	21.93	3.14	2.64	6.88	4.54
		C +46N	93.00	18.78	23.10	20.40	3.10	2.65	8.20	4.34
Bihaera	Giza179	69N	91.50	19.50	26.17	24.10	3.39	2.56	7.96	4.88
		C +46N	91.25	18.92	25.43	23.40	3.40	2.57	10.55	4.74
	Hybrid 1	69N	102.89	22.18	30.43	28.63	3.77	2.58	11.00	6.03
		C +46N	100.83	21.55	28.93	27.73	3.58	2.53	12.50	5.66
	Sakha106	69N	94.00	19.02	24.90	18.67	3.20	2.66	7.95	4.52
		C +46N	94.33	18.23	24.20	17.33	3.07	2.66	9.18	4.35
LSD(0.05)			1.95	1.17	1.11	0.90	0.17	0.12	0.99	0.12
LSD(0.01)			2.79	1.68	1.59	1.29	0.25	0.17	1.41	0.17

The data, presented in Table 8, showed the interaction between cultivars and fertilizer. The combination between Hybrid 1, with 69N, produced the desirable mean values for all traits studied, except for the sterility percentage, which was gained from Giza179 with 69N interaction.

Data in Table 9 showed the effect of interaction between location, cultivar and fertilizer. For Gharbia location, Hybrid 1 and 69N produced the tallest mean value of plant height. Panicle length showed the highest mean value from the interaction between Damietta location and Hybrid 1 and 69N source. Kafr EL-Sheikh location, with Hybrid 1and 69N, gave the highest mean value for number of tillers/ plant while, the highest mean value of number of panicles/plant was achieved from the combination between Kafr EL-Sheikh location and Hybrid 1 and Compost +46N. The heaviest value of panicle weight was gained from the interaction between Gharbia and Hybrid and 169N, while, Kafr EL-Sheikh and Hybrid 1and 69N interaction gave the highest mean value of 100-grain weight. Sterility percentage was the lowest with the interaction between Kafr EL-Sheikh location and Sakha106 and 69N source. The interaction between Dakahlia location, Hybrid 1 cultivar and 69N produced the superior mean value for grain yield.

It could be concluded that grain yield of the studied cultivars could be affected by fertilization with different locations. The cultivars, Hybrid 1 and Giza179, out yielded the others in all tested locations and fertilizer treatments, indicating that these cultivars, which had been developed and selected under favorable conditions, were likely to perform well and adapted under different soil fertilizer conditions. It was suggested that such cultivars ought be tested under unfavorable conditions, such as low input of water, as well as nitrogen fertilizer.

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الملخص العربى

أداء بعض اصناف الارز المنزرعة في مواقع مختلفة وتحت مستويين مختلفين من التسميد النيتروجينى فى مصر

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اجريت هذه الدراسة في مواقع مختلفة لزراعة الارز باستخدام ثلاثة اصناف من الارز المنزرعة خلال موسمي زراعة الارز ٢٠١٤ و٢٠١٥ بغرض دراسة تأثير التفاعل بين التراكيب الوراثية والبيئات المختلفة ومدي تأقلم و ثبات هذه التراكيب الوراثية لمحصول الارز في ستة مواقع مختلفة وهي كفرالشيخ، الشرقية، الدقهلية، دمياط، الغربية، البحيرة تحت ظروف التسميد النيتروجينى بمعدل ٦٩ وحدة نتروجين(يوريا) وكذلك ٢طن سماد عضوي(كومبوست) + ٤٦ وحدة نتروجين (يوريا). وكان الهدف من الدراسة ايضا تحديد حزمة من التوصيات الفنية الخاصة بتلك الاصناف وسلوكها في المواقع المختلفة. اظهر تحليل التباين المشترك اختلافات معنوية بين التراكيب الوراثية والبيئات المختلفة، والتسميد النيتروجينى والتفاعل الوراثي البيئي والتفاعل البيئي والتسميد النيتروجينى والاصناف مع التسميد النيتروجينى وكذلك التفاعل بين الظروف البيئية والاصناف والتسميد النيتروجينى لكل الصفات المدروسة باستثناء صفة وزن المائة حبة للتفاعل البيئي الوراثي ولصفة ارتفاع النبات وطول النوره الدالية وعدد الفروع/نبات ووزن النوره ونسبة العقم للتفاعل البيئي مع التسميد النيتروجينى. استخدم نموذج ايبرهارت وراسل لتقدير مكونات الثبات المظهرى للصفات المدروسة تحت الظروف البيئية المختلفة. كان التباين البيئي + (التركيب الوراثيx البيئي) معنويا لكل الصفات مما دل علي تأثير هذا التفاعل علي التعبير المظهري للتراكيب الوراثية. واظهر التفاعل بين التراكيب الوراثي x البيئي(الخطي) معنوية لكل الصفات المدروسة وقد دل ذلك علي وجود اختلافات معنوية بين التراكيب الوراثية للاستجابة الخطية للبيئيات المختلفة حيث تم التنبؤ بمعامل الانحدار بدقة اكثر عبر البيئيات المختلفة وكان التفاعل البيئي الوراثي نتيجة للاتجاه الخطي للمكونات البيئية. وأعطى الصنفان هجين ١ وصنف سخا ١٠٦ معامل انحدار قدره ١.٢٦ و ١.٣٢ مما يعني ثبات وراثي عالي لصفة محصول الحبوب حيث كان معامل الانحدار اعلي من الوحدة في كلا الصنفين وايضا مع انخفاض قيمة الانحراف عن معامل الانحدار تقريبا وكانت صفرا وعلي ذلك يقترح زراعة الصنفين هجين ١ وسخا ١٠٦ في البيئيات المختلفة في مصر.