PERFORMANCE OF SOME PROMISING EGYPTIAN RICE GENOTYPES UNDER DIFFRENET LOCATIONS

Elgohary A.A., I.M. Hashem, T.F. Metwally and S.E.M. Sedeek

Rice Research Dpartment, Field Crops Research Institute, Agricultural Research Center, 33717 Sakha - Kafr El-Sheikh, Egypt.

ABSTRACT

Multilocation and on stations trials were conducted during 2013 and 2014 to evaluate the performance of twelve rice genotypes under three locations; Sakha (Kafer El-Sheikh Governorate), Gemmiza (El-Gharbia Governorate) and Zarzoura (El-Behira Governorate). The experiments were conducted using Randomized Complete Block Design with four replications. Combined analysis of variance among the different locations was done.

The results obtained showed highly significant differences among rice genotypes, locations, and genotypes by locations interaction. The rice genotypes recorded the highest values of grain yield at Gemmiza location, surpassing significantly the other two locations. These results indicate that the studied genotypes responded differently to the different environmental conditions suggesting the importance of evaluation of genotypes under different environments in order to identify the best genetic make up for a particular environment. The rice genotypes GZ9523-2-1-1-1, Giza 179 and Sakha 101 recorded the highest values of grain yield under the three locations, of Sakha, Gemmiza and Zarzoura during 2013 and 2014 seasons compared with the other genotypes, indicating that those genotypes have a good adaptation under different environments conditions.

Concerning the grain quality characters among the three locations, all characters were not affected significantly in both seasons, but the differences among genotypes were significant. Stem borer infestation was affect by location and genotype while, rice blast infection differed significantly among rice genotypes. The highest values of infection of rice genotypes to stem borer were observed at Gemmiza location compared with the other two locations. Sakha101 was resistance to stem borer while, Giza177, Sakha105, Giza179, GZ9461-4-2-3-1, GZ9577-4-1-1, GZ9626-2-1-1 and GZ9807-6-3-2-1 were moderate resistance. On the other hand, Sakha106, GZ7576-10-3-2-1 and GZ9523-2-1-1-1 were moderate susceptible. However, Giza178 was susceptible to stem borer. Most of rice genotypes under study were resistant to rice blast, except Sakha 101 cultivar, which was highly susceptible under different locations in the two seasons.

Key words: Rice, adaptability, Rice genotypes x locations, years interaction

INTRODUCTION

Identification of rice genotypes with wider adaptability is the important aspects in varietal improvement and regeistrables to achieve better economic values and return to the farmers.

Information on genotype × environment interaction leads to successful evaluation of stable genotype, which could be used for general cultivation. Yield is a complex quantitative character and is greatly influenced by environmental fluctuations; hence, the selection for superior genotypes based on yield at a single location in a year may not be very effective (Shrestha et al., 2012). Thus, evaluation of genotypes for adaptability of performance under varying environmental conditions for yield has become an essential part of any breeding program. Tariku et al. (2013) evaluated sixteen rainfed lowland rice genotypes at three locations of eight environments. They found that the largest proportion of the total variation in grain yields was attributed to environments in this trial. As a result, almost all of the evaluated genotypes were affected by the genotype × environment interaction effects, so that no genotype had superior performance in all environments. Most of the genotypes showed environment specificity. So that it would be possible to cluster the testing locations into homogenous groups to be used for breeding for specific adaptation and/or for broad adaptation. Anputhas et al. (2011) reported that identification of rice varieties with wider adaptability and stability are the important aspects in varietal recommendation to achieve better economic benefits for farmers. Metwally et al. (2014) studied the genetic variability and performance of some Egyptian promising rice genotypes as affected by nitrogen fertilizer under two locations. They found that the studied genotypes differed significantly under different environments conditions.

This research aims to provide a reference towards understanding the adaptability of some rice genotypes at different locations. It also intends to provide information on the behavior of these genotypes under different environments.

MATERIALS AND METHODS

Twelve rice genotypes (Table 1) were evaluated during 2013 and 2014 growing seasons at three locations; Sakha, Gemmiza and Zarzoura. Randomized Complete Block Design (RCBD) with four replications was used. Each plot had ten rows of 5 m length and spaced 0.2 m apart. A combined analysis was used among the three locations in each season.

The seed rate of 96 kg seed ha^{-1} was used. Clean seeds with at least 90% germination were soaked in water for 24 hours and incubated for 48 hours. Pre-germinated seeds were sown on 6^{th} and 13^{th} May in the first and second season respectively. Seedling at 30 days old (2-3 seedling $hill^{-1}$) were transplanted at 20 X 20 cm distance between hills and rows. The plot size measured 4 X 3 m. The preceding crop was barley in the both seasons. The cultural practices were done as per need of the crop. Nitrogen in the form of urea (46.5%N) was added to plots according to the recommendation (165 kg N ha^{-1}) in two splits application, i.e. two third as basal and incorporated into the soil immediately before flooding, followed by the second dose after 30 days after transplanting.

Representative soil samples were taken at the depth of 0-30 cm from the soil surface. The procedure of soil analysis followed the methods of Black et al. (1965). Results of chemical analysis in both seasons are shown in (Table 2).

Table (1): Parentage and origin for rice genotypes under study

No.	Entry	Parentage	Type	Origin
1	Giza177	Giza 171/Yu mji No.1//PiNo.4	Japonica	Egypt
2	Giza178	Giza 175/ Milyang 49	Indica Japonica	Egypt
4	Sakha101	Giza 176/Milyang 79	Japonica	Egypt
3	Sakha105	GZ5581 /GZ4316	Japonica	Egypt
5	Sakha106	Giza 177/ Hexi 30	Japonica	Egypt
6	GZ7576-10-3-2-1	GZ5418/Milyang 79	Japonica	Egypt
7	Giza179	GZ1368/GZ6296	Indica Japonica	Egypt
8	GZ9461-4-2-3-1	Daey2 Beyo X GZ6396	Japonica	Egypt
9	GZ9523-2-1-1-1	GZ6522 X Zhang Jia129	Japonica	Egypt
10	GZ9577-4-1-1	GZ6910 X Yun Lang14	Japonica	Egypt
11	GZ9626-2-1-1	GZ7185/Non Jing70272	Japonica	Egypt
12	GZ9807-6-3-2-1	GZ7185 X Yum Ling19	Japonica	Egypt

Table (2): Some physical and chemicals analysis of the soil at the experimental sites during 2013 and 2014.

Soil Properties	Sakha		Gemmiza		Zarzoura	
	2013	2014	2013	2014	2013	2014
Clay %	57.0	54.5	40.2	39.9	55.8	52.3
Silt %	32.0	35.0	45.8	46.1	30.6	33.6
Sand %	11.0	11.5	13.0	14.0	13.6	14.1
Texture	Clayey	Clayey	Silty clay	Silty clay	Clayey	Clayey
Organic matter%	1.65	1.55	1.82	1.67	1.62	1.59
Available P, mg kg^{-1}	13.00	12.00	18.00	17.20	16.02	14.00
Available NH_4, mg kg^{-1}	12.5	12.6	17.0	18.0	15.6	16.00
Available NO_3, mg kg^{-1}	10.0	11.8	12.0	11.0	11.5	12.1
Available K, mg kg^{-1}	321	366	456	421	349	375
pH (1:2.5 soil	8.45	8.20	7.95	8.00	8.10	7.92

suspension)	3.0	2.1	2.1	2.0	2.3	2.8
EC dS m^{-1} (soil paste)						
Soluble cations, meq. L^{-1}						
Ca^{++}	7.2	7.0	5.0	4.8	6.0	5.5
Mg^{++}	1.6	1.5	2.2	2.4	1.2	1.4
K^{+}	0.5	0.5	0.8	1.0	0.8	1.1
Na^{+}	13.0	12.0	12.0	11.8	11.8	12.0
Soluble anions, meq. L^{-1}						
CO_3^{--}	0.00	0.00	0.00	0.00	0.00	0.00
$H\,CO_3^{--}$	5.3	5.0	3.8	3.5	4.8	5.0
CL^{-}	15.0	14.0	14.7	14.6	13.9	14.2
SO_4^{--}	2.0	2.0	1.5	1.9	1.1	0.9

The studied characters include flag leaf area (cm^2) at heading, plant height (cm), duration, panicle weight (g), number of panicles per plant, panicle length (cm), filled grains $panicle^{-1}$, panicle weight (g), 1000-grain weight (g) and grain yield (t/ha).

Hulling percentage, milling percentage and head rice percentage, were the ratio of, respectively, brown rice to rough rice, milled rice to rough rice and head rice to milled rice on a weight basis. For each plot, the 250 g of rough rice was de-hulled with a standard de-husker. Brown rice was weighed and hulling percentage was determined. The 150 g of brown rice was milled with a milling machine. After milling, rice bran was removed with 1.7 mm sieve. A cleaned sample of milled rice was weighed and milling percentage was determined. From 100 g of cleaned milled rice, all head rice were taken and weighed, and head rice percentage was then calculated.

Stem borer damage which caused by (*Chuler agamemeson Bles*) was recorded as white head percentage at the maturity stage by counting the number of white head per 100 plants according to the standard evaluation system of Rice Research and Training Center (RRTC), Sakha, Egypt. Resistance (R) = 0 -3%, moderately resistance (MR) = 3-6%, moderately susceptible (MS) = 6-9%, susceptible (S) = 9-12% and highly susceptible (HS) = 12% **(**Anonymous 2009**).**

The tested genotypes were evaluated for their reaction to rice blast disease which caused by *pyricularia grisea* (cooke) under field conditions. . The typical blast lesions were scored, according to the Standard Evaluation System using 0-9 scale (SES of IRRI 1996) as follow: 1-2 = resistant (R), 3 = moderately resistant (MR), 4-6 = susceptible (S), 7-9= highly susceptible (HS).

Analysis of variance was done for each location (environment). Bartlett's test was used to assess homogeneity of error variances prior to combine analysis over environments. The grain yield data for twelve genotypes in three environments were subjected to combine analysis of variance according to Gomez and Gomez (1984) (using Genstat5 version 3.2, statistical software). Significant different means were separated at P < 0.05 by the least significant difference (LSD) test.

RESULTS AND DISCUSSION

The effect of different locations on plant height, duration, flag leaf area and number of panicles per m^2 of tested rice genotypes are shown in Table 3. Data showed that plant height affected significantly by location in the two seasons of the study thus; genotypes which planted at Zarzoura recorded the tallest plants followed by those planted at Gemmiza. These variations could be attributed to the characteristics (Table 1). Plant height at harvest showed significant differences among the twelve genotypes (Table, 3). Sakha106 recorded the highest values of plant height at harvest followed by Sakha106 while, GZ9626-2-1-1 recorded the shortest plants. These differences among the rice genotypes mainly due to their differences in genetic background. Sedeek et al. (2009) and Faruq et al. (2011) found a significant genetic variation among genotypes in plant height. The interaction between location and genotype had no significant effect on plant height in the two seasons.

Regarding to plant duration, data in Table (3) showed that planting rice at different location didn't affect the duration in 2013 and 2014 seasons. Data also revealed that rice genotypes are varied in their number of days to maturity. It was clear that GZ7576-10-3-2-1 and Giza179 genotypes were earlier in maturity while, Sakha 101 matured about 143 days (late genotype). These differences among rice genotypes might be attributed to the genetic diversity among all genotypes under this study. Sedeek et al. (2009) and Faruq et al. (2011) observed the variations in heading days of several genotypes. The effect of the interaction between rice genotypes and different locations on duration was significant in both seasons of study as shown in Table (4). Giza179 and GZ7576-10-3-2-1 seemed to be the earliest genotypes under Gemmiza condition in the 2013 and 2014 respectively while Sakha 101 at Sakha took more days to maturity than the other genotypes in the two seasons.

Table 3: Plant height, duration, flag leaf area and number of panicles per m^2 at harvest of tested rice genotypes at different locations in 2013 and 2014 seasons

Factor	Plant height (cm)		Duration (days)		Flag leaf area (cm^2)		No. of panicles m^{-2}	
	2013	2014	2013	2014	2013	2014	2013	2014
Location:								
Sakha	96.98	98.97	126.11	125.44	27.87	29.11	503.05	526.18
Gemmiza	97.48	100.07	126.47	125.78	29.78	32.01	522.78	546.60
Zarzoura	98.11	101.37	125.53	126.78	28.39	30.87	504.58	540.35
LSD at 0.05	0.96	1.05	N.S	N.S	1.65	1.37	13.72	12.56
Genotype:								
Giza177	100.37	100.96	124.89	124.89	26.86	27.64	421.95	497.23
Giza178	104.77	102.85	131.22	131.89	32.41	36.82	556.10	598.05
Sakha101	92.27	95.54	143.22	143.00	32.79	34.51	567.50	580.55
Sakha105	102.82	105.93	125.33	124.89	28.45	28.35	459.18	508.33
Sakha106	105.72	106.45	121.44	123.78	28.60	29.59	445.55	458.33
GZ7576-10-3-2-1	98.23	98.13	119.78	120.78	22.31	24.84	452.23	445.83
Giza179	94.75	95.81	119.44	120.44	30.45	34.94	552.78	580.55
GZ9461-4-2-3-1	93.30	99.53	124.89	122.44	25.57	28.39	506.95	558.60
GZ9523-2-1-1-1	95.92	102.58	126.22	124.22	36.23	37.80	588.60	621.10
GZ9577-4-1-1	94.47	101.20	126.56	124.44	27.56	28.64	538.60	546.40
GZ9626-2-1-1	91.68	92.80	123.44	126.89	27.58	28.95	516.68	538.90
GZ9807-6-3-2-1	95.95	99.85	126.00	124.33	25.33	27.53	515.55	518.60
LSD at 0.05	0.82	1.03	3.61	3.71	1.47	1.90	19.80	18.70
Interaction	NS	NS	**	**	**	*	*	**

**, ** and NS indicate $P < 0.05$, $P < 0.01$ and not significant, respectively.*

Concerning flag leaf area, data in Table (3) indicated that rice genotypes differ significantly in their flag leaf area at different locations. All the rice genotypes produced the highest values of flag leaf area under Gemmiza followed by Zarzoura location. This mainly due to the high soil native content of organic matter, available NH_4 and available NO_3 of Gemmiza (Table 1). Sahrawat (2005) indicated that microbial activity in a soil drives organic matter decomposition and mineralization processes, leading to release of organically bound plant nutrients in forms available to grow plants. GZ9523-2-1-1-1 gave the highest values of flag leaf area, while, GZ7576-10-3-2-1 recorded the lowest one. The differences among the rice genotypes in their flag leaf area mainly attributed to nature of growth of genotype and plant type.

The effect of the interaction between rice genotypes and different locations on flag leaf area were significant in the two seasons of the study as shown in Table (5). The highest values of flag leaf area were obtained by GZ9523-2-1-1-1 in the first season and Giza178 in the second season at Gemmiza. While, the rice genotype of GZ7576-10-3-2-1 recorded the lowest flag leaf area at the three locations, Sakha, Gemmiza and Zarzoura in 2013 and 2014 seasons.

Table 4: Duration (days) as affected by the interaction between rice genotype and location in 2013 and 2014 seasons

Genotype	2013			2014		
	Sakha	Gemmiza	Zarzoura	Sakha	Gemmiza	Zarzoura
Giza177	125.00	125.67	124.00	124.33	125.33	125.00
Giza178	134.33	130.00	129.33	131.00	131.33	133.33
Sakha101	144.67	143.67	141.33	143.67	142.33	143.00
Sakha105	123.67	126.67	125.67	126.67	124.00	124.00
Sakha106	121.67	122.67	120.00	121.33	124.67	125.33
GZ7576-10-3-2-1	119.00	121.67	118.67	121.67	119.00	121.67
Giza179	118.67	118.33	121.33	119.67	121.00	120.67
GZ9461-4-2-3-1	124.67	125.33	124.67	122.00	121.00	124.33
GZ9523-2-1-1-1	125.33	126.00	127.33	122.00	124.00	126.67
GZ9577-4-1-1	126.00	127.00	126.67	123.33	124.67	125.33
GZ9626-2-1-1	124.67	123.00	122.67	125.33	129.00	126.33
GZ9807-6-3-2-1	125.67	127.67	124.67	124.33	123.00	125.67
LSD at 0.05	4.17			4.35		

Table 5: Flag leaf area (cm^2) as affected by the interaction between rice genotype and location in 2013 and 2014 seasons

Genotype	2013			2014		
	Sakha	Gemmiza	Zarzoura	Sakha	Gemmiza	Zarzoura
Giza177	26.54	26.71	27.33	27.53	28.34	27.04
Giza178	31.60	32.66	32.98	34.47	39.24	36.75
Sakha101	31.19	35.53	31.65	32.48	35.93	35.12
Sakha105	27.88	28.84	28.65	27.15	30.16	27.73
Sakha106	27.08	28.92	29.79	27.07	30.87	30.83
GZ7576-10-3-2-1	20.51	24.66	21.75	22.87	26.51	25.13
Giza179	30.13	31.87	29.36	32.29	38.84	33.70
GZ9461-4-2-3-1	25.53	26.93	24.26	26.73	28.50	29.93
GZ9523-2-1-1-1	34.83	37.22	36.64	36.52	38.76	38.13
GZ9577-4-1-1	28.07	28.86	25.74	28.06	28.87	28.99
GZ9626-2-1-1	26.20	29.15	27.40	27.62	30.28	28.95
GZ9807-6-3-2-1	24.88	25.96	25.16	26.65	27.82	28.11
LSD at 0.05	1.92			2.52		

Data in Table (3) reveled that rice plants which planted at Gemmiza location produced the highest values of number of panicles per m^2 followed by those planted at Zarzoura location. This mainly due to high soil organic matter as well as soil native in available elements and low Ec at Gemmiza location which is suitable for the growth of rice plants. (Table 1). The high content of available contents of minerals fertile specially N and P resulted in increasing the metabolite stream translocated from source to sink which increase the number of panicles per unit area. Data showed also that number of panicles per m^2 varied significantly among the tested genotypes (Table 3.). The genotype GZ9523-2-1-1-1 produced the highest number of panicles m^2 followed by Sakha101 in both seasons. The effect of the interaction between rice genotypes and different locations on number of panicles per m^2 at harvest, which significant in both seasons of study is shown in Table (6). The rice genotype GZ9523-2-1-1-1 recorded the highest number of panicles per m^2 at Zarzoura location in the two seasons, while, Sakha 106 produced the lowest number of panicles per m^2 at Gemmiza and Zarzoura locations in the two seasons, respectively. The prevailing condition of Gemmiza recorded significantly the longest panicle (Table 7).

Table 6: Number of panicles per m^2 as affected by the interaction between rice genotype and location in 2013 and 2014 seasons

location / Genotype	2013			2014		
	Sakha	Gemmiza	Zarzoura	Sakha	Gemmiza	Zarzoura
Giza177	433.33	441.68	400.00	475.00	500.00	516.68
Giza178	575.00	541.68	558.33	583.33	616.68	608.33
Sakha101	550.00	491.68	558.33	566.68	591.68	583.33
Sakha105	458.33	466.68	416.68	491.68	508.33	525.00
Sakha106	391.68	358.33	433.33	483.33	466.68	458.33
GZ7576-10-3-2-1	516.68	483.33	516.68	508.33	450.00	533.33
Giza179	566.68	558.33	533.33	558.33	608.33	575.00
GZ9461-4-2-3-1	516.68	475.00	591.68	558.33	566.68	575.00
GZ9523-2-1-1-1	566.68	583.33	600.00	575.00	641.68	658.33
GZ9577-4-1-1	541.68	541.68	558.33	591.68	533.33	608.33
GZ9626-2-1-1	508.33	516.68	525.00	566.68	533.33	516.68
GZ9807-6-3-2-1	516.68	533.33	583.33	550.00	525.00	566.68
LSD at 0.05	21.11			20.94		

Table 7: Panicle length, number of filled grains per panicle, panicle weight and 1000-grain weight of tested rice genotypes at different locations in 2013 and 2014 seasons

Factor	Panicle length (cm)		Filled grains $panicle^{-1}$		Panicle weight (g)		1000-grain weight (g)	
	2013	2014	2013	2014	2013	2014	2013	2014
Location:								
Sakha	20.618	20.834	154.11	159.69	3.153	3.363	26.568	26.928
Gemmiza	21.155	22.453	162.17	170.61	3.306	3.545	27.023	27.489
Zarzoura	20.520	21.286	157.11	161.42	3.249	3.337	26.781	27.139
LSD at 0.05	0.370	0.250	2.28	2.27	0.106	0.027	0.112	0.104
Genotype:								
Giza177	17.136	18.148	145.33	147.11	3.121	3.390	27.088	27.924
Giza178	24.949	25.428	175.78	177.89	2.930	3.111	21.889	22.229
Sakha101	19.983	20.369	176.33	176.67	3.879	4.171	28.708	29.023
Sakha105	19.083	17.687	153.11	163.00	3.434	3.458	27.796	27.967
Sakha106	20.532	22.298	153.44	163.22	3.382	3.362	28.513	28.591
GZ7576-10-3-2-1	16.837	17.289	156.56	159.11	2.190	2.470	24.362	24.738
Giza179	23.424	24.610	159.89	162.78	3.673	3.821	27.752	28.229
GZ9461-4-2-3-1	18.982	19.812	146.78	160.00	3.121	3.259	26.777	27.142
GZ9523-2-1-1-1	25.071	26.539	173.22	177.11	4.202	4.353	26.966	27.342
GZ9577-4-1-1	24.464	24.977	163.00	171.67	3.341	3.612	27.007	27.121
GZ9626-2-1-1	19.223	21.030	148.33	155.89	2.494	2.740	27.093	27.592
GZ9807-6-3-2-1	19.486	20.106	141.78	152.44	3.062	3.233	27.537	28.322
LSD at 0.05	0.466	0.321	12.76	13.23	0.121	0.082	0.200	0.216
Interaction	**	**	**	**	NS	*	**	*

**, ** and NS indicate P < 0.05, P < 0.01 and not significant, respectively.*

The high soil fertility at Gemmiza location plots might suggest cause that higher soil fertility caused the longest panicle (Table 7). Regarding to rice genotypes, the twelve genotypes differ significantly in this trait. The genotype GZ9523-2-1-1-1 gave the longest panicle, while the genotype GZ7576 recorded the shortest one. These differences among rice genotypes mainly due to genetic background.

Data in Table (8) showed that the interaction between location and rice genotype was significant for panicle length. The genotype GZ9523-2-1-1-1 produced the longest panicle at Gemmiza during 2013 and 2014.

Table 8: Panicle length (cm) as affected by the interaction between rice genotype and location in 2013 and 2014 seasons

Genotype	2013			2014		
	Sakha	Gemmiza	Zarzoura	Sakha	Gemmiza	Zarzoura
Giza177	16.987	17.933	16.487	17.773	19.857	16.813
Giza178	24.040	25.657	25.150	24.400	26.180	25.703
Sakha101	19.897	20.283	19.770	19.780	21.317	20.010
Sakha105	18.993	18.933	19.323	18.683	18.143	16.233
Sakha106	20.053	20.970	20.573	20.013	24.900	21.980
GZ7576-10-3-2-1	16.680	17.010	16.820	16.910	17.057	17.900
Giza179	23.010	23.677	23.587	22.847	26.060	24.923
GZ9461-4-2-3-1	19.023	19.470	18.453	19.020	20.497	19.920
GZ9523-2-1-1-1	24.947	25.797	24.470	25.067	27.997	26.553
GZ9577-4-1-1	24.300	24.790	24.303	25.600	25.053	24.277
GZ9626-2-1-1	19.480	19.507	18.683	20.033	21.680	21.377
GZ9807-6-3-2-1	20.007	19.833	18.617	19.883	20.693	19.740
LSD at 0.05	0.81			0.56		

Data in Table (7) showed that locations and genotypes were found to affect number of filled grains per panicle. Gemmiza location recorded the highest values of number of filled grains per panicle comparing with the other two locations. Data in Table (7) indicted also that there was significant differences among the twelve rice genotypes for this trait in two seasons. Giza178, Sakha101 and GZ9523-2-1-1-1 recorded the highest number of filled grains per panicle in the two successive seasons. While, GZ9807-6-3-2-1 (in the first season) and Giza177 (in the second season) recorded the lowest number. The differences in number of filled grains panicle^{-1} could be attributed to genotypes and environment. Similar trend was found by Sedeek et al. (2009).

Data reported in Table (9) indicated that the rice genotypes under study responded differently under different environments for this trait. The highest number of filled grains per panicle was obtained by GZ9523-2-1-1-1 genotype followed by Sakha101 and Giza178 genotype at Gemmiza location.

Table 9: Number of filled grains per panicle as affected by the interaction between rice genotype and location in 2013 and 2014 seasons

Genotype	2013			2014		
	Sakha	Gemmiza	Zarzoura	Sakha	Gemmiza	Zarzoura
Giza177	144.00	145.67	146.33	144.33	153.33	143.67
Giza178	174.67	178.33	174.33	176.33	178.67	178.67
Sakha101	176.00	179.00	174.00	174.33	181.00	174.67
Sakha105	149.00	156.33	154.00	154.67	166.00	168.33
Sakha106	149.67	154.67	156.00	161.00	167.33	161.33
GZ7576-10-3-2-1	141.67	165.00	163.00	144.33	167.33	165.67
Giza179	157.67	160.67	161.33	163.33	171.67	153.33
GZ9461-4-2-3-1	144.67	149.33	146.33	155.33	166.33	158.33
GZ9523-2-1-1-1	163.00	191.33	165.33	163.33	197.33	170.67
GZ9577-4-1-1	163.67	164.00	161.33	171.00	173.33	170.67
GZ9626-2-1-1	145.67	158.00	141.33	159.33	163.33	145.00
GZ9807-6-3-2-1	139.67	143.67	142.00	149.00	161.67	146.67
LSD at 0.05	14.86			15.06		

Panicle weight was significantly affected by location and genotypes in the two seasons (Table 7). Panicle weight values for the two seasons at Gemmiza location was heavier than other locations. The genotype GZ9523-2-1-1-1 produced the heaviest panicle followed by Sakha101. While, the lightest panicle produced by GZ7576-10-3-2-1 genotype. Concerning locations x genotypes interaction, the interaction was significant in 2014 only (Tables 7 and 10). The highest values were obtained from genotype GZ9523-2-1-1-1 which grown at Gemmiza region. But the lowest panicle weight values were reported at Zarzoura region by GZ7576-10-3-2-1 rice genotype.

Table 10: Panicle weight (g) as affected by the interaction between rice genotype and location in 2013 and 2014 seasons

Location / Genotype	Sakha	Gemmiza	Zarzoura
Giza177	3.267	3.547	3.357
Giza178	3.047	3.173	3.113
Sakha101	4.107	4.233	4.173
Sakha105	3.433	3.550	3.390
Sakha106	3.147	3.550	3.390
GZ7576-10-3-2-1	2.360	2.927	2.123
Giza179	3.883	3.790	3.790
GZ9461-4-2-3-1	3.140	3.580	3.057
GZ9523-2-1-1-1	4.373	4.483	4.203
GZ9577-4-1-1	3.617	3.680	3.540
GZ9626-2-1-1	2.497	2.893	2.830
GZ9807-6-3-2-1	3.483	3.137	3.080
LSD at 0.05	0.140		

Data in Table (7) indicated that 1000-grain weight of rice genotypes was affected significantly by different locations. Rice genotypes at Gemmiza location produced the heaviest 1000-grain weight. The increase in grain yield under Gemmiza condition may be due to high soil native in organic matter, available N, P and K (Table 1). Data revealed also that, differences among the rice genotypes in their 1000-grain weight were significant in the two seasons. Sakha101 gave the highest value of 1000-grain followed by Sakha106 While, Giza 178 recorded the lowest one. These differences may be due to the differences in their genetic structures. These results are in agreement with those obtained by Sedeek et al. (2009) and Faruq et al. (2011). Data in Table (11) showed the effect of interaction between rice genotypes and location on 1000-grain weight. Sakha101 produced the highest values of 1000-grain weight followed by Sakha106 whatever the location.

Table 11: 1000-grain weight (g) as affected by the interaction between rice genotype and location in 2013 and 2014 seasons

Location	2013			2014		
Genotype	Sakha	Gemmiza	Zarzoura	Sakha	Gemmiza	Zarzoura
Giza177	27.033	27.163	27.067	27.930	28.207	27.637
Giza178	21.603	22.877	21.187	22.010	22.993	21.683
Sakha101	28.607	28.607	28.910	28.393	29.727	28.950
Sakha105	27.453	28.007	27.927	27.713	28.127	28.060
Sakha106	28.403	28.697	28.440	28.240	28.857	28.677
GZ7576-10-3-2-1	24.047	24.263	24.777	24.440	24.993	24.780
Giza179	27.470	28.150	27.637	28.083	28.457	28.147
GZ9461-4-2-3-1	27.300	26.110	26.920	27.643	26.660	27.123
GZ9523-2-1-1-1	26.717	27.110	27.070	27.143	27.420	27.463
GZ9577-4-1-1	26.057	27.707	27.257	26.093	28.023	27.247
GZ9626-2-1-1	27.080	27.147	27.053	27.057	28.040	27.680
GZ9807-6-3-2-1	27.047	28.433	27.130	28.383	28.363	28.220
LSD at 0.05	0.34			0.36		

Data in Table (12) indicated that grain yield was affected significantly by location. The rice genotypes recorded the highest values of grain yield at Gemmiza region, surpassing significantly with other two locations. Soil structure, texture and fertility have contributed towards this variation. Unpredictable environmental factors such as temperature and humidity, even at a single location may contribute to genotype by environmental interaction over year. Anputhas et al. (2011) and Mosavi et al. (2012) reported similar trend.

Regarding rice genotypes, they differed significantly in their grain yield in the two seasons of the study, Table (12). Five and six genotypes produced more than 10 t ha^{-1} in 2013 and 2014 respectively. GZ9523-2-1-1-1 produced the highest grain yield followed by Sakha101 and Giza179. On the other hand, GZ9626-2-1-1 and GZ9807-6-3-2-1 produced the lowest grain yield. The superiority of GZ9523-2-1-1-1 and Sakha 101 rice genotypes in grain yield might be due to their high values of each of flag leaf area, number of panicles m^{-2}, number of filled grains $panicle^{-1}$ and panicle weight. Jeng et al.

(2006) revealed that the grain yield for rice was positive correlated significantly with the percentage of filled grains, the number of panicle per unit ground area, 1000-grains weight, and the number of grains per panicle. These results are in agreement with those obtained by Sedeek et al. (2009).

Table 12: Grain yield, hulling, milling and head rice of tested rice genotypes at different locations in 2013 and 2014 seasons

Factor	Grain yield (t ha^{-1})		Hulling (%)		Milling (%)		Head rice (%)	
	2013	2014	2013	2014	2013	2014	2013	2014
Location:								
Sakha	8.974	9.318	80.186	80.646	70.34	69.867	56.39	58.03
Gemmiza	9.479	9.958	80.076	80.369	69.13	69.152	56.95	56.86
Zarzoura	9.037	9.433	80.523	80.930	69.74	70.127	56.46	57.05
LSD at 0.05	0.345	0.253	NS	NS	NS	NS	NS	NS
Genotype:								
Giza177	8.959	9.230	78.897	80.972	69.31	70.179	56.21	54.62
Giza178	10.252	10.383	78.270	78.558	67.01	66.682	47.58	48.37
Sakha101	10.750	10.876	79.498	79.752	69.80	68.860	56.45	58.60
Sakha105	9.537	10.088	80.370	80.268	69.68	69.373	58.38	59.82
Sakha106	9.138	9.461	79.628	81.016	68.71	69.243	56.74	57.83
GZ7576-10-3-2-1	7.716	8.311	79.218	79.560	69.82	66.203	56.87	59.37
Giza179	10.492	10.694	82.488	82.859	72.11	72.473	60.22	61.16
GZ9461-4-2-3-1	8.004	8.338	80.560	80.394	69.75	69.284	57.27	57.33
GZ9523-2-1-1-1	11.010	11.316	81.720	82.627	70.39	71.752	57.86	59.60
GZ9577-4-1-1	10.326	10.336	80.062	79.700	69.28	69.290	55.75	53.35
GZ9626-2-1-1	6.550	7.850	83.000	83.226	72.22	73.130	57.79	59.07
GZ9807-6-3-2-1	7.224	7.956	79.429	78.847	68.74	70.114	58.09	58.59
LSD at 0.05	0.475	0.262	0.6308	0.456	1.04	0.702	1.224	1.104
Interaction	**	*	NS	NS	NS	NS	NS	NS

**, ** and NS indicate $P < 0.05$, $P < 0.01$ and not significant, respectively.*

It is important to note that the tested genotypes were varied in their interaction with the environmental factor and exhibited different responses to the different locations (Table 13.). GZ9523-2-1-1-1 and Sakha101 produced the highest grain yield under Gemmiza condition. Superiority of the GZ9523-2-1-1-1 and Sakha101 genotypes at Gemmiza was due to their relative advantages in their yield components. Grain yield depends on genotype, environment and their interaction with each other. Under the same management conditions, variation in grain yield is principally explained by the effects of genotype and environment (Dingkuhn et al., 2006). Interaction between these two explanatory variables gives insight for identifying genotype suitable for different environments. The high yielding genotypes Giza178, Sakha101, Giza179, GZ9523-2-1-1-1 and GZ9577-4-1-1 cover a broad range of phenological and physiological traits across different environments.

These results indicate that genotypes under study responded differently to different environmental conditions suggesting the importance of the evaluation genotypes under different environments in order to identify the best genetic make up for a particular environment. Tariku et al. (2013) reported that the significant genotype × environment interaction effects on grain yield demonstrated that genotypes responded differently to the variation in environmental conditions of location which indicated the necessity of testing rice genotypes at multiple locations.

Table 13: Grain yield t ha^{-1} as affected by the interaction between rice genotype and location in 2013 and 2014 seasons

Genotype	2013			2014		
	Sakha	Gemmiza	Zarzoura	Sakha	Gemmiza	Zarzoura
Giza177	8.860	9.167	8.850	8.810	9.873	9.007
Giza178	10.040	10.633	10.083	10.180	10.777	10.193
Sakha101	10.613	10.883	10.753	11.020	11.330	10.277
Sakha105	9.477	9.600	9.533	9.603	10.477	10.183
Sakha106	9.103	9.100	9.210	9.287	9.800	9.297
GZ7576-10-3-2-1	7.287	8.537	7.323	8.143	8.720	8.070
Giza179	10.300	10.350	10.827	10.787	10.783	10.513
GZ9461-4-2-3-1	7.640	8.287	8.087	7.823	8.897	8.293
GZ9523-2-1-1-1	10.950	11.513	10.567	11.053	11.737	11.157
GZ9577-4-1-1	10.550	10.657	9.770	10.020	10.557	10.430
GZ9626-2-1-1	6.093	7.503	6.053	7.397	8.283	7.870
GZ9807-6-3-2-1	6.773	7.517	7.383	7.693	8.263	7.910
LSD at 0.05	0.66			0.47		

Grain quality characters i.e. hulling, milling and head rice percentages were presented in Table (12). Data showed that the differences in all grain quality characters among the three locations were not significant in both the seasons, however the differences among genotypes were significant. The highest hulling percentage and milling percentage were obtained from GZ9626-2-1-1. Giza179 produced statistically identical hulling percentage and milling percentage compared with GZ9626-2-1-1. The highest value of head rice percentage was obtained from Giza179. On the other hand, Giza178 produced the lowest values of grain quality characters in the two successive seasons. Jeng et al. (2006) indicated that superior grain quality of rice cultivars related significantly to 1000-grain weight and more uniform grain development within a panicle. The interaction between rice genotype and location had no significant effect on all studied grain quality characters.

Concerning to stem borer infection, data in Table (14) shows that the genotypes, locations and interaction were significant for stem borer infestation (white head percentage). It could be observed that the highest percentage of white head was obtained from rice genotypes at Gemmiza region. Sakha101 was resistance while, Giza177, Sakha105, Giza179, GZ9461-4-2-3-1, GZ9577-4-1-1, GZ9626-2-1-1 and GZ9807-6-3-2-1 were moderate resistant. On the other hand, Sakha106, GZ7576-10-3-2-1 and GZ9523-2-1-1-1 were moderate susceptible and Giza178 was susceptible to stem borer.

Concerning the blast reaction, the differences among the locations were not significant in both seasons. For blast reaction of rice genotypes, most of rice genotypes were resistant to rice blast over all different locations in the two seasons except Sakha 101, which was highly susceptible to rice blast in both seasons (Table 14). Also, the results signifies that no interaction between genotypes and locations was found for this trait.

Table 14: Stem borer and blast reaction of tested rice genotypes at different locations in 2013 and 2014 seasons

Factor	Stem borer %			Blast reaction		
	2013	2014	Reaction	2013	2014	Reaction
Location:						
Sakha	5.884	5.197	-	2.389	2.111	-
Gemmiza	6.359	5.529	-	2.403	2.111	-
Zarzoura	6.147	5.270	-	2.694	2.750	-
LSD at 0.05	0.1482	0.2150	-	NS	NS	-
Genotype:						
Giza177	5.778	4.744	MR	2.000	1.444	R
Giza178	13.602	11.944	S	1.722	1.444	R
Sakha101	2.248	2.027	R	7.444	6.444	S
Sakha105	5.400	4.667	MR	1.889	2.111	R
Sakha106	6.299	5.333	MS	1.556	1.889	R
GZ7576-10-3-2-1	7.444	6.711	MS	3.444	3.333	MR
Giza179	5.667	5.611	MR	1.111	1.000	R
GZ9461-4-2-3-1	4.667	3.600	MR	1.889	1.222	R
GZ9523-2-1-1-1	7.730	7.644	MS	3.111	3.556	MR
GZ9577-4-1-1	6.263	2.622	MR	2.556	2.000	MR
GZ9626-2-1-1	2.597	3.656	MR	1.444	1.556	R
GZ9807-6-3-2-1	5.867	5.422	MR	1.778	1.889	R
LSD at 0.05	0.406	0.3869	-	0.3879	0.3612	-
Interaction	NS	NS	-	NS	NS	-

*(R) Resistance, (MR) Moderately resistance, (MS) Moderately susceptible, (S) Susceptible, (HS) highly susceptible. *, ** and NS indicate P < 0.05, P < 0.01 and not significant, respectively.*

CONCLUSION

The twelve genotypes under study responded differently to the different environmental conditions suggesting the importance of the intensive evaluation of genotypes under different environments in order to identify the best genetic makeup specify for a particular environment. The rice genotypes Giza178, Sakha101, Giza179, GZ9523-2-1-1-1 and GZ9577-4-1-1 have a good adaptation under different environmental conditions.

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الملخص العربي

دراسة سلوك بعض التراكيب الوراثية المبشرة للأرز تحت مواقع مختلفة

على احمد الجوهري وإبراهيم محمد هاشم وتامر فاروق متولي وصابر السيد محمد صديق
قسم بحوث الأرز، معهد بحوث المحاصيل الحقلية، مركز البحوث الزراعية.

أجريت تجربة متعددة المواقع خلال موسمي 2013 و 2014 لتقييم سلوك أثنى عشر من تراكيب الأرز الوراثية المصرية المبشرة في ثلاثة مواقع مختلفة هي سخا (محافظة كفرالشيخ) والجميزة (محافظة الغربية) وزرزورة (محافظة البحيرة). وقد أجريت التجربة باستخدام تصميم قطاعات كاملة العشوائية في أربعة مكررات. وقد تم تحليل التباين المشترك بين المواقع المختلفة.

وأظهرت النتائج التي تم الحصول عليها وجود فروق ذات دلالة إحصائية معنوية بين كلا من تراكيب الأرز الوراثية المختلفة والمواقع وكذلك التباين المشترك. سجلت تراكيب الأرز الوراثية أعلى قيم محصول الحبوب في الجميزة ، متفوقا بشكل كبير على غيرها من الموقعين. وتشير هذه النتائج إلى أن تراكيب الأرز الوراثية المدروسة استجابت بشكل مختلف للظروف البيئية المختلفة مما يشير إلى أهمية تقييم تراكيب الأرز الوراثية تحت بيئات مختلفة من أجل تحديد أفضل التركيب الوراثية المناسبة لبيئة معينة. وقد سجلت تراكيب الأرز الوراثية GZ 9523 و GZ 9057 (جيزة 179) وسخا 101 أعلى قيم المحصول الحبوب تحت المواقع الثلاثة (سخا والجميزة وزرزورة) في موسمي الزراعة 2013 و 2014 مقارنة مع تراكيب الأرز الوراثية الأخرى. أيضا أوضحت النتائج أن تلك التراكيب الوراثية لديها قدرة تأقلم أكبر في ظل ظروف بيئات مختلفة.

وفيما يتعلق بصفات جودة الحبوب، لم يكن هناك أي اختلافات معنوية بين المواقع الثلاثة في كلا الموسمين، ولكن كانت الاختلافات معنوية بين تراكيب الأرز الوراثية. تأثرت معدل الإصابة بالثاقبات بالمواقع والتراكيب الوراثية في حين اختلفت الإصابة باللفحة معنوية بين التراكيب الوراثية فقط. قد لوحظت أعلى قيم للإصابة بالثاقبات في الجميزة مقارنة مع سخا وزرزورة. سخا 101 سجل كتركيب مقاوم للثاقبات في حين كانت التراكيب جيزة177، سخا105، جيزة179، GZ9461، GZ9577، GZ9626 وGZ9807 متوسط المقاومة. من ناحية أخرى كانت سخا106، GZ7576، GZ9523 متوسطة الإصابة. كان جيزة178 قابل للإصابة بالثاقبات. وكان معظم التراكيب الوراثية تحت الدراسة مقاومة للفحة الأرز إلا التركيب سخا 101 كان عرضة للإصابة تحت المواقع المختلفة في العامين.