RESEARCH | Egyptian Journal of Agricultural Research | Field Crops

Giza 179 Egyptian rice variety: as a new, early, high-yielding, tolerant to saline, and climate change challenge

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Received: 02-03-2023; **Accepted**: 10-60-2023; **Published:** 10-60-2023 **DOI**: 10.21608/ejar.2023.196433.1374

ABSTRACT

Saline and drought conditions are the biggest threats to plant species around the world. The rice crop is one of the most important crops worldwide. Therefore, the Giza 179 rice variety was released in the 2013 season as an early-maturing, high-yielding variety that is adapted and mitigated to drought and saline soils. This new variety was produced by crossbreeding between GZ6296-12-1-2-1-1 and GZ 1368-5-S-4 in the 2001 season. The first generation, "F1," of this cross was evaluated in the 2002 season and planted as the F2 generation in the 2003 season. Sequentially, the next generations from F3 to F6 were evaluated in the pedigree trails during the 2004–2007 seasons under code number GZ 9057. Two promising sister lines, GZ 9057-6-1-3-1 and GZ 9057-6-1-3-2, were selected and evaluated in a preliminary yield trail at the Experimental Farm of Rice Research and Training Center, Sakha, Kafr El-Sheikh Governorate, Egypt. The results revealed that the promising line GZ 9057-6-1-3-2 (Giza 179) surpassed all selected lines. Accordingly, the line GZ 9057-6-1-3-2 was evaluated from 2009 to 2011 and used as a check variety up to the 2022 seasons in multi-location yield trails at Sakha, Gemmiza, and Zarzoura as normal conditions and El-Sirw as saline conditions in regional, final, and verification yield trails. The GZ 9057-6-1-3-2 (Giza 179) recorded 10.47 t/ha for grain yield with a total duration of 122-125 days under normal conditions and 7.000–7.200 t/ha under saline conditions at El-Sirw Agricultural Research Station, while Giza 178 recorded 9.75 t/ha during the same seasons under normal conditions with a total duration of 135 days. Furthermore, the Giza 179 variety showed a high level of blast resistance in blast nursery and trap varieties in the field and artificial inoculation under greenhouse conditions. The results from PCR analysis for the Giza 179 with their parents showed that the proximity matrix was 89.8% between Giza 179 and GZ6296 and 71.1% between Giza 179 and GZ1368. Finally, it is an excellent new cultivar to be released and recommended for cultivation in the different rice-growing governorates, particularly in areas suffering from water shortages and saline soils in Egypt.

Keywords: Rice, Variety, high yield, resistance to blast and salinity

INTRODUCTION

Rice is one of the most important food crops in the world and a primary source of food for more than half of the world's population. In Egypt, rice is considered the second-most important cereal crop after wheat and also one of the main agricultural products for the farmers' income. The total cultivated area of rice in Egypt is about 1.149 million hectares, producing 4.32 million tons of paddy rice with a national average yield of 3.741 t/fed (EAS 2022).

Genetic variation due to the morphological variations of quantitative traits has some disadvantages regarding to time, space and labour cost, in adding to the method cannot be gave the precise level of genetic variability among the varieties based on the effect of additive gene action on the expression of these characters Schulman (2007). Selection based on morphological traits is seductive due to the phenotypic expression affected by environments factors Astarini *et al.* (2004)

Rice yield is controlled by several agronomic factors, from which is planting date. Adjustment to the planting date becomes very important under climate change issue. Metwally *et al.* (2015) reported that early sowing on 10th of April of some Egyptian rice genotypes produced better yield and yield attributes in early sowing compared with late sowing dates. They also reported that early sowing on 1st of May gave more grain yield across rice genotypes compared with late sowing. Salinity affects approximately 900 million hectares of soil, including both sodic and saline soils OECD/FAO, (2012). An integrated strategy incorporating reclamation and management tactics, as well as improved genetic tolerance, may be used to address the declining rice yield in salt-affected regions (Munnas and Tester, 2008). Salinity is a major issue that has had a severe impact on agricultural production in many parts of the world, including Egypt. In general, Egypt's salinity problem is worsening due to rising salt concentrations in irrigation water, water scarcity, climate change, and low precipitation, as well as the use of recycled water in rice farming in the Delta north. Salinization has a negative impact on the productivity of cereal crops, net return for the farmers, the economy for agricultural activities, and ecosystem balance, including different natural resources FAO, (2019).

Pyricularia grisea is the causative agent of rice blast disease, a widespread and devastating ailment that affects rice harvests worldwide. Host resistance is the most efficient and cost-effective method of managing plant diseases, and hybridization has been recognized as an effective method in rice breeding for improving the genetic background and introducing genes associated with high yield potential, disease resistance, and improved traits (Chuanxu et al., 2020).

An important pest of stored grains, *Rhyzopertha dominica* (F.), is responsible for causing economic harm to rough rice because of physical damage to the kernel, which in turn leads to a drop in grain quality (Chanbang *et al*. 2008). Plant breeders have been selecting pest-resistant varieties to improve crop productivity for many years. Host plant resistance is a cornerstone of many successful integrated pest management (IPM) programs. Plants have many natural characteristics for keeping pests at bay: repellent or toxic chemicals, thorns, hairs and hard to penetrate tissues. Insect-resistant plants are bred to resist or repel pests by physical or biochemical means. An insect-resistant plant can physically deter insects from extracting plant juices, for example, by its leaf hairs. The development of molecular markers that are closely linked to target traits is important in allowing reliable selection of different genes in rice breeding. This makes the breeding program and selection process faster and cost efficient. Polymorphic banding pattern, which can be identified by PCR utilizing locus-specific flanking region primers where they are known (Farooq and Azam, 2002). With recent advances in molecular marker research, it is now possible to study both simple inherited traits and quantitative characteristics and subsequently identify the specific genes influencing salinity tolerance, potentially facilitating rice selection for this low heritable trait. The objectives of the present study showed the procedures conducted to develop the promising yielder line (GZ 9057) as a new rice variety, Giza 179, with a package of recommendations to increase the national rice production.

MATERIALS AND METHODS

Methodology: Earliness and high yield line was crossed GZ6296-12-1-2-1-1 with GZ 1368-5-S-4 high tolerant to salinity in 2001 season to develop new breeding population. Table 1, shows the procedures to advance F_1, F_2, F_3, F_4, F_5 and F_6 and yield trials (primary, regional, final and verification trials), during 2008 to 2012 seasons up to 2022 season as check variety under normal and saline conditions, as well as, evaluation the promising line (GZ9057-6-1-3-2) under value of cultivated and used (VCU) and the distinction, uniformity and stability (DUS) tests. Requirements for variety registration are presented in Fig. 1. The key factors used to advance chosen plants/lines through the many generations were grain yield, total duration, plant height, phenotypic acceptability, and resistance to biotic stressors (blast resistant in particular). Grain quality, including milling percentage, head rice percentage, amylose content, and cooking, were assessed using the Juliano (1971) and the standard evaluation system (SES) (IRRI, 2008) methods for the promising variety Giza 179 and two control cultivars (Giza 178 and Giza 182).

As for agronomic evaluation**:** to identify the optimum, location, date of sowing, and nitrogen levels for GZ9057-6-1-3-2 (Giza 179) in addition some promising lines, field experiments were conducted at the farm of Sakha Research Station, Kafrelsheikh, Egypt from 2011 to 2022 rice growing seasons.

Rice genotypes including the promising line GZ9057-6-1-3-2 (Giza 179) and three location, Sakha, Gemmiza and Zarzoura were used, as well as, three sowing dates i.e. S_1:15th April, S_2: 1st May and S_3: 15th May and three nitrogen levels i.e. T_1: control (without N-application), T_2: 110 and T_3: 165 Kg N/ha^{-1} were used

The all experiments were laid out in split plot design. Location, sowing date and nitrogen were arranged in the main plots while sub plots were allocated for rice genotypes. All agricultural practices were made according to rice recommendations of (RRTC 2012) season. The grain yield and agronomic traits were estimated according to IRRI standard evaluation system (SES) (IRRI, 2008).

Diseases and Insect methodology:

A- Blast nursery test:

Five rice genotype as Giza 177 & Giza 178 (resistance checks), Sakha 101 &Sakha 104 (susceptible checks) and GZ 9057-6-1-3-2 a new genotype were evaluated at three locations including Sakha (Kafrelshiekh), Gemmiza (Gharbia) and Zarzoura (Behera) governorates with three replicates foreach. Farmyard manure was added (20m^3 / ha) during land preparation. Seedbeds were prepared, the resistant and susceptible checks as well as new genotype (GZ 9057-6-1-3-2) were cultivated at alternative with five rows for each as 50cm long and 15cm apart. The sowing dates were done in the first week of June in each season. Natural infection was developed, and plants were scored 40-50 days after sowing according to Sehely *et al.* (2008). Blast reaction was recorded according to the standard evaluation system using 0-9 scale (IRRI 2008).

B-Pathogenicity and disease reactions in greenhouse:

Genotypes were evaluated to blast disease under greenhouse conditions by using 45 blast isolates collected from the previous seasons and identified to its races on the International Differential Varieties in the greenhouse seeds of each genotypes were seeded in plastic trays (30 x 20 x15 cm.). Each tray comprised 10 rows representing two rows for each genotype with three replicates for each. The trays were kept in the greenhouse at 25-30ºC, and fertilized with Urea 46.5%N (5 g/tray). Seedlings were ready for inoculation at 3-4-leaf stage, about 3-4 weeks after sowing according to Sehely *et al.*, (2008).

Spore production for 45 blast races was found as 20 and 25 races in the seasons of 2010 and 2011, respectively. Individual blast races were cultivated for 10 days at 28 °C under fluorescent lighting on banana dextrose agar medium (200g banana, 15g glucose, and 15g agar/1000 ml water). The spores were collected at a minimum density of 25 spores per microscopic field and were seen under a 10x objective. By spraying rice seedlings in the trays that were about 20 days old with spore suspension (100 ml) set to 5 x 104 spores/ml, they were infected. To improve the adhesion of spores on leaf surfaces, gelatin was added to the spore suspension at a concentration of 2.5 g/L (Bastiaans, 1993). An electrical spray gun was used to coat each race. According to Sehely et al., (2008) the inoculated seedlings were kept in a wet chamber with at least 90 percent R.H. and 25 to 28 °C for 24 hours before being transferred to the greenhouse. Blast reaction was measured using a 0–9 scale in accordance with the usual evaluation system seven days following inoculation (IRRI, 2008).

Insect methodology: Parents, and advanced promising lines including GZ9057-6-1-3-2 were evaluated for stem borer infestation as the main insect pest for rice in Egypt. The reaction of evaluated genotypes was classified into five categories according to SES (IRRI, 2008).

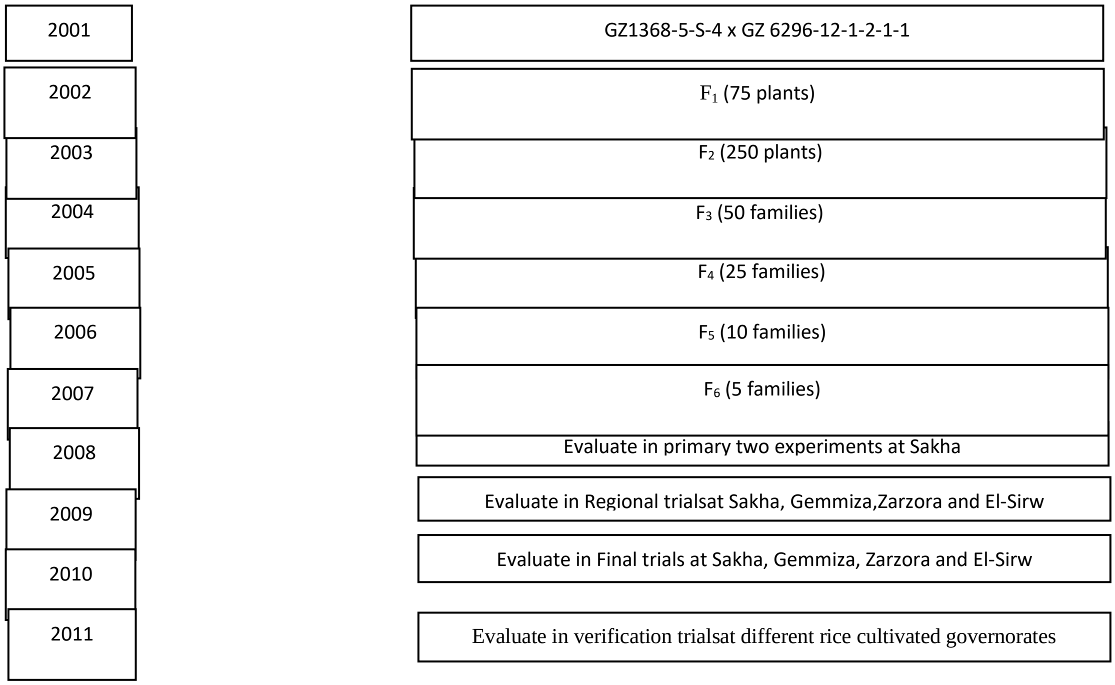


Fig. 1. The diagram depicts the process of developing, registering, and releasing the high-yielding G179 variety.

A- Anatomical studies:

1- Rice cultivars; Giza 179, Giza 178, GZ 1368 and GZ 6296 were sown under normal condition.

2- Root samples were taken after 21 days (primary root stage) to study the anatomical structure by 4, 20 and 40 x magnifying.

3- The sections were computerized morphometrical analysis, the morphometric analysis was done by Research Microscope type Axiostar plus made by Zeiss transmitted light bright field examinations apgrad able to professional digital image analysis system (Carl Zeiss Axiovision Product Suite DVD 30). The best rice varieties were chosen using Sx, and ten root samples were taken from each plot. Each sample's primary root tip measured 0.5 cm in length. In the FAA, every sample was killed and fixed for 48 hours (10 ml. formalin, 5ml. glacial acetic acid, 50 ml. ethyl alcohol and 35 ml. water). The dehydrated samples were infused with paraffin (52–54°Cm.p.) and then embedded in it. On a rotary microtome, sections of the embedded samples were cut at a thickness of 5-7 m. Sections were deparaffinized and placed on slides. Safranine and light green were used for staining, followed by xylem for clearing and Canada balsam for mounting (Gerlach, 1977). According to El-Emery et al., (2016) slides were microscopically examined, measurements, counts, and averages of 9 readings of 3 slides were computed.

Molecular marker analysis:

Assessment and evaluation of genetic diversity for rice promising line GZ9057-6-1-3-2developed from GZ 6296 and GZ 1368 by using PCR technique for ten Random Polymorphic DNA primers are OPA-12, OPB-14, OPH-15, OPG-13,OPG-05, OPE-01, OPM-13, OPC-12, OPZ-03 and OPA-02, were conducted at Agricultural Genetic Engineering Research Institute (AGRI) during 2012.

RESULTS

Grain yield with economic characters for GZ9057-6-1-3-2 line and commercial varieties under different yield trails:

Progeny of the hybridization of GZ6296-12-1-2-1-1 with GZ 1368-5-S-4 were sealed to produce the F2 up to Fn generation. Fig. (1), illustrated the procedures to select and advance early segregated populations and advanced breeding lines. Out of 250 plant of F_2, 100 single plants, were selected based on phenotypic and agronomic performance and disease resistance. About 50 lines were selected out of the 25 lines F_3, and advanced to F_4.

By using yield performance and other selection criteria, ten promising lines were selected and advanced to F_5. Finally, five selected lines (5) has been selected as high yielding potential candidates and promoted to yield trials for further evaluation.

Mean performance: plant height, total duration, 1000-grain weight, blast reaction, milling% and stem borer of five promising lines; GZ 9057-6-1-3-1, GZ 9057-6-1-3-2 (Giza 179); GZ 9057-6-1-3-3; GZ 9057-6-1-3-4 and GZ 9057-6-1-3-5, and their parents GZ6296-12-1-2-1-1 and GZ 1368-5-S-4 in 2009 and 2010 growing seasons, as well as, their combined data are presented in Table (1).

The results showed a wide range of variability for all studied characters. Rice variety GZ 9057-6-1-3-2, was the shortest plant height in 2009 and 2010 with average 92.00 cm, the new variety had shortest duration in 2009 and 2010 seasons with average 122 days and grain yield with average 9.105 t ha^{-1} are shown in Table (1). The new variety GZ 9057-6-1-3-2 showed the highest values of 1000-grain weight in both seasons.

Table 1. Grain yield with economic characters for GZ9057-6-1-3-2 line and commercial varieties under different yield trails from 2008 to 2011 seasons .

No.	Year	Yield/ t/ha				Plant height (cm)	Duration (day)	Blast reaction	Stem borer %	Milling %	1000-grain weight	Type
		SK	GM	ZA	EL Sirw							
1	2008 Primary	9.12	--	--	-	100	120	2R	MR	73	28	Sh
2	2009 Regional	10.19	10.25	10.50	6.71	100	122	2R	MR	72	27.5	Sh
3	2010 Final	10.40	9.57	9.91	6.82	96	123	2R	MR	72	28	Sh
4	2011 Final	10.47	10.10	8.92	6.93	96	122	2R	MR	73	28	Sh
5	Giza 178	9.75	9.70	9.33	6.23	107	135	2R	12	69	21	Sh
6	GZ 6296	9.10	9.20	9.00	4.81	92	130	2R	18	69	25	Sh
7	GZ 1368	6.5	7.00	7.10	5.92	115	150	2R	7	65	26	Sh

Results of grain yield and total duration of the new promising line compared with Giza 178 as medium duration checks for five constitutive seasons 2009-2012. The results of this study are shown in Table (2). The obtained results indicated that the new variety Giza 179(GZ9057-6-1-3-2) exhibited the highest values of grain yield t/ha under normal conditions compared with check varieties Giza 178 and Giza 182. The new variety also exhibited early total duration compared with studied check varieties. Giza 179 (GZ9057-6-1-3-2) was earlier than Giza 178by about 10 days without any significant difference for the yield .

Table 2. Grain yield with economic characters for GZ9057-6-1-3-2 and commercial varieties.

Items	GZ9067-6-1-3-2	Giza 178	Giza 182
Grain yield/ t/ha			
Primary yield trails in two experiments	9.12	9.06	8.6
Final yield trails in nine experiments	10.47	9.75	8.96
The grain yield increased	--	0.720	1.510
The grain yield increased %	--	6.870	14.41
Total duration days	122	135	125
Plant height cm	96	99	97
Blast Reaction	1-2 R	1-2 R	1-2 R
Insect Reaction			
Leaf minor	Resistant	Moderate	MR
Stem borer	Resistant	MR	Resistant
Grian quality			
Milling%	72	70	69
Amylose content%	19	18	22
Eating quality	Excellent	Excellent	Excellent

According to Table, Giza 179 performed better than the two check varieties (Giza 178 and Giza 182) in all three normal locations and the saline location (2). In comparison to the two check types, Giza 179 had the largest grain production in the three typical locales (Sakha, Gemmiza, and Zarzora). Additionally, the time span was 122 to 125 days, with no appreciable variations from the earliest check variety, Giza 182. Also. Under the salty stress circumstances at El-Sirw site, Giza 179 had the highest grain production and shortest overall duration.

Table provides the results on grain quality for the investigated genotypes (2). In the preliminary yield study over two growing seasons, GZ9057-6-1-3-2 (Giza 179) provided the greatest values for the milling percentage, head rice percentage, and eating quality of five promising lines and their parents. In comparison to their parental genotypes, GZ 6296 and GZ 1368, the majority of the five promising lines displayed favorable milling percent and head rice percent values during the course of the two growth seasons.

Mean performance of some rice varieties under VCU experiment:

The results in Table (3) showed that the total duration for GZ 9057 and Giza 178 were 122 and 123 days compared to Giza 178 variety135 days. Moreover, GZ9057-6-1-3-2gave the highest value (10.40 and 11.71 t/ha.), and highest value of grain yield (85.25 and 87.07g/day) compared to the Giza 178 (69.85 and 83.05 g/day) . From these results, it could be concluded that GZ 9057 rice entry variety had superior characteristics such as, highest grain yield and early maturity.

Table 3. Mean performance of some rice varieties for some growth and yield traits under VCU experiment in 2010 and 2011 seasons.

Variety	Grain yield t/ ha		Total Duration (day)		Plant height(cm)		1000- grain weight(g)		Daily production (g)	
GZ 9057	10.40	11.71	122	123	96.00	96.00	27.39	21.60	85.25	87.07
Giza 178	9.43	11.31	135	135	109.00	105.00	21.16	28.21	69.85	83.05
GZ 7112	10.33	9.45	126	122	98.00	95.00	28.00	27.95	81.98	81.50
Significant at										
0-05 %	0.426	0.153	2.00	2.38	2.56	2.11	0.86	0.78		
0-01 %	0.612	0.306	2.87	3.38	3.53	3.14	1.02	1.56		

Performance of GZ9057-6-1-3-2Giza 179under distinction, uniformity and stability (DUS) test:

Performance of promising line GZ9057-6-1-3-2(Giza 179) with two cultivated varieties as the checks in DUS trials are **shown** in Table (4). These results showed that, the promising line GZ 9057 (Giza 179) it's high in uniform and stability as similar to the check varieties Giza 182and Sakha 104. From, these results it could be concluded that, the line GZ 9057 is accepted to be a new rice released variety under Egyptian condition.

Table 4. Scaling test for PQ: Pseudo-Qualitative and QL: Qualitative for some characters of some rice varieties under DUS experiment during 2010 and 2011 seasons.

No.	Traits	GZ9057		Sakha 104		Giza 182	
		2012	2013	2012	2013	2012	2013
11	**Leaf: shape of ligules' P.Q.**	2	2	2	2	3	3
19	**Heading Time: (50% flowering)**	3	3	5	5	3	3
24	**Spikelet: color of stigmaPQ**	1	1	3	3	1	1
46	**Lemma: colorPQ**	1	1	2	2	1	1
60	**Decorticated grain: shape (in lateral view)PQ**	4	4	5	5	3	3

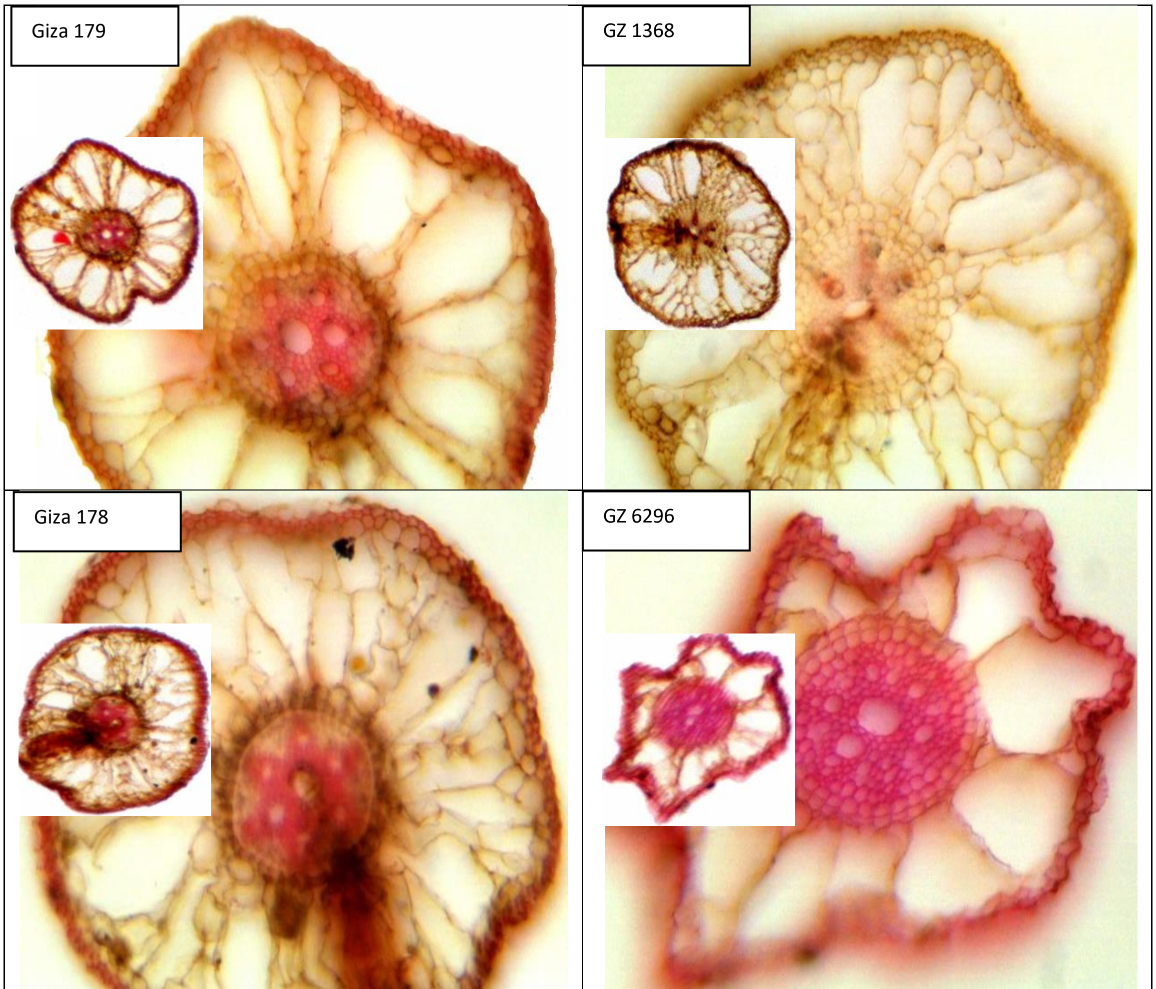
Anatomical:

The micrographs in Fig. (2 and 3) and in Table (5) illustrate that there are differences in epidermis cells thickness for all cultivars especially GZ6296, Giza 178 and Giza 179. The highest value (26.18 µm) was recorded by GZ6296 compared with the lowest value (21.45 µm) which was reported for GZ 1368.

Parenchyma cells were recorded in cortex tissues of nine primary root for all cultivars in this study. Data in Table. (5) and Fig. (2 and 3) representative transverse root sections from nine roots showing different arrangements of bundles' number and diameter of vessels in xylem arch. Results indicated that larger of vascular cylinder with GZ6296 , GZ1368, Giza 179 and Giza 178 respectively, were cleared. Relationship between the larger vascular cylinder and increase of diameter and number of xylem vessels were recorded in Table. (5).

Table 5. Anatomical structure in roots of some rice genotypes.

Rice genotypes	Anatomical Traits (µ)				
	Epidermal thickness (µ)	Cortex thicknessµ	Vascular cylinder r=Ø µ	M.Xylem vessels Ø	Number ofxylem vessels
Giza 179	25.19	173.39	66.72	34.09	7.00
Giza 178	25.28	169.31	68.51	36.25	7.00
GZ 1368	24.77	190.99	70.62	35.35	7.00
GZ 6296	26.18	144.39	78.11	37.05	9.00



Ep, Epidermal cells
Co, Cortex
V.C., Vascular cylinder
XYV, Xylem vessels
No. XYV, Number ofxylem vessels
X=4 and **X=20**

Fig. 2. Transfer sections in roots of some rice cultivars; Giza 179, Giza 178, GZ 1368 and GZ 6296.

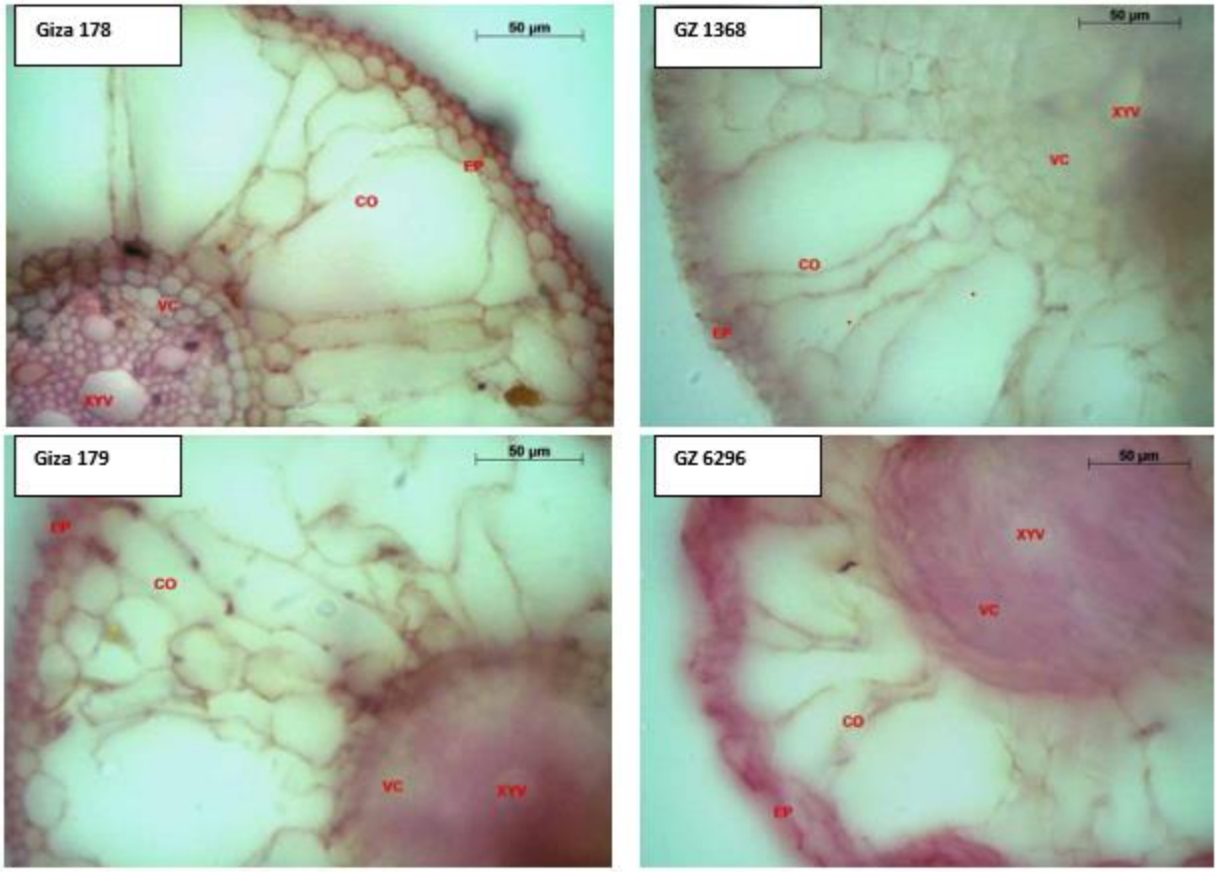


Fig. 3. Transfer sections in roots of some rice cultivars; Giza 179, Giza 178,GZ 1368, GZ 6296

Ep, Epidermal cells
Co, Cortex
V.C. Vascular cylinder
XYV, Xylem vessels
No. XYV, Number of xylem vessels
X=40 – Par= 50µm

The pattern formed in root characteristics, especially at the diameter of vessels and vascular cylinder, was observed with GZ6296 and on the opposite side with GZ1368a in these studies. These results may help in understanding the salt tolerance of some rice cultivars. For example, Giza 178 had a higher tolerance to salinity compared with the other semi-cultivars GZ 6296 and GZ 1368. Also, these results indicate that the anatomical structure characteristics, i.e., epidermis, cortex thickness, number, diameter of vessels in the xylem arch, and diameter of the vascular cylinder, could be used as indicators of salinity tolerance in the early germination stage.

Molecular Marker Analysis:

Genetic relationships among the rice genotypes (parents GZ 6296 and GZ 1368) and the cross GZ 9057 under study were highly different. The results in Figs. 4 and 5 showed that the primers OPA-12, OPB-14, OP H-15, OPG-13, and OPG-05 showed the existence of two alleles. While the primers OPE-01, OPM-13, OPC-12, OP Z-03, and OPA-02 gave three and four alleles, respectively, In this study, the level of polymorphism among genotypes was evaluated by ten SSR markers (Tables 6, 7, and 8). The 10 primers yielded a total of 228 alleles, most of which were polymorphic markers. The Primer OPG-05 was found to have a high polymorphism, and total bands were 27 with molecular weights ranging from 15 bp to 2000 bp. While the primer OPC-12 recorded 12 bands and molecular weights ranging from 350 bp to 1300 bp, Moreover, the primers NO. OPA-12, OPB-14, and OPG-13 gave the same bands for the new variety Giza 179 with female parent GZ 6296, indicating that these primers could be used to detect material effects in rice crops. Finally, highly similarity (Fig. 6) was found between GZ 9057 and GZ 6296; the value was 79.1%, while the similarity between GZ 9057 and GZ 1368 was 71.11%. Also, the results from the dendrogram showed two groups, the first one for GZ 9057 with GZ 6296 and the second one for GZ 1368; moreover, these results were confirmed results for yield and its components; these results were similar toAyaad *et al* (2021)

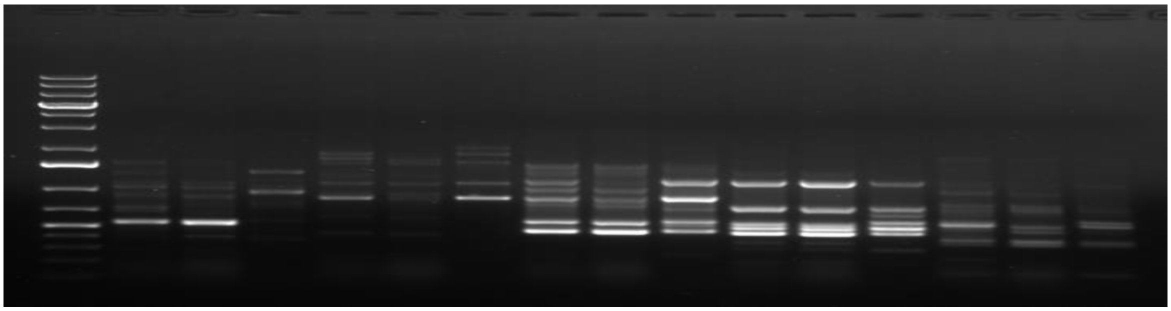


Fig. 4. Random Polymorphic DNA primers profile (**OPA-12OPB-14OPH-15OPG-13OPG-05)**

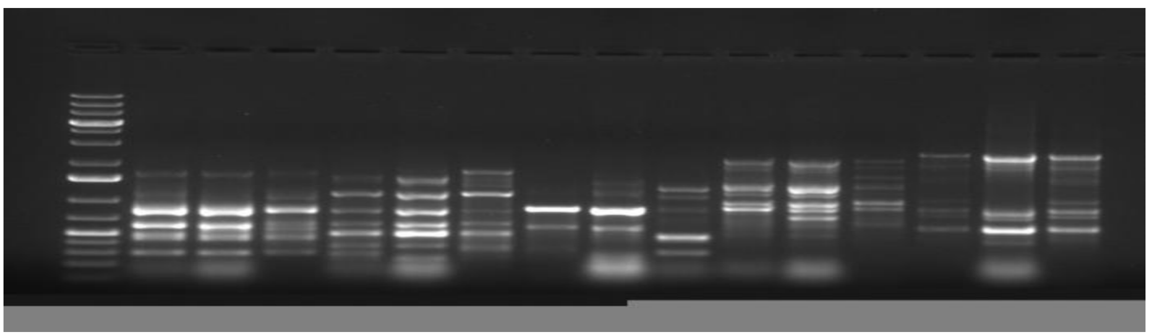


Fig. 5. Random Polymorphic DNA primers profile (**OPE-0 1OPM-13OPC-12OPC-12OPA-02)**

Table 6. The presence or absent of the specific bands for ten primers of studied genotypes during 2012 season.

M A12	**1**	**2**	**3**	**M B14**	**1**	**2**	**3**	**M H15**	**1**	**2**	**3**	**M G13**	**1**	**2**	**3**
400	0	1	0	**400**	1	1	0	**420**	1	1	1	**200**	1	1	0
480	1	1	0	**600**	1	1	0	**550**	1	1	1	**350**	1	1	1
520	1	1	1	**700**	1	1	0	**570**	0	0	1	**400**	1	1	0
680	1	0	0	**900**	1	1	1	**700**	0	0	1	**500**	1	1	1
700	1	1	1	**1000**	1	1	0	**750**	1	1	1	**550**	1	1	1
720	0	1	1	**1200**	1	1	1	**850**	1	1	1	**600**	1	1	1
900	1	1	0	**1300**	1	1	0	**1000**	1	1	0	**700**	0	0	1
1000	0	0	1	**1600**	1	1	1	**1100**	1	0	1	**850**	1	1	1
1050	1	1	1	**1700**	1	1	0	**1300**	1	1	0	**1200**	1	1	1
1200	1	1	1	**1800**	1	1	1	**1500**	1	1	0	**1300**	1	1	0
1400	1	0	1	**2000**	0	0	1	**-**	-	-	-	**-**	-	-	-
1500	1	1	1	**-**	-	-	-	**-**	-	-	-	**-**	-	-	-
Total	9	9	8	**Total**	10	10	5	**Total**	8	7	7	**Total**	9	9	7

1-(GZ9057) Giza 179**2-** GZ 6296**3-** GZ 1368

Table 7. The presence or absent of the specific bands for ten primers of studied genotypes during 2012 season.

M G05	1	2	3	M E 01	1	2	3	M M13	1	2	3	M C12	1	2	3
150	1	1	1	**300**	1	1	1	**250**	1	1	0	**350**	1	0	1
300	1	0	0	**450**	1	1	1	**350**	1	1	1	**480**	0	0	1
400	1	1	0	**500**	1	1	1	**500**	1	1	1	**600**	1	1	0
450	1	1	1	**600**	1	1	1	**600**	1	1	1	**800**	1	1	1
500	1	1	0	**700**	0	0	1	**800**	1	1	1	**1200**	0	1	1
550	1	1	1	**850**	1	1	1	**1100**	1	1	1	**1300**	0	1	1
600	0	0	1	**1100**	1	0	1	**1300**	0	0	1	-	-	-	-
750	1	1	1	**1500**	1	1	1	**1400**	0	1	1	-	-	-	-
800	1	1	0	-	-	-	-	**1500**	1	1	1	-	-	-	-
1500	1	1	0	-	-	-	-	**2000**	0	1	1	-	-	-	-
1200	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-
2000	1	1	0	-	-	-	-	-	-	-	-	-	-	-	-
Total	11	10	6	**Total**	7	6	8	**Total**	7	9	9	**Total**	3	4	5

Table 8. Presence or absent of the specific bands for ten primers, as well as, proximity Matrix of studied genotypes during 2012 season.

M Z03	1	2	3	M A02	1	2	3	Varieties	G.179	GZ6296	GZ1368
400	1	1	0	**450**	1	1	0	G.179	100		
550	1	1	1	**600**	0	1	1	GZ6296	89.8	100	
700	1	1	1	**700**	0	1	1	GZ1368	71.1	72.4	100
800	1	1	1	**850**	1	1	1	**Proximity Matrix**			
1000	1	0	1	**950**	1	1	1				
1400	1	0	1	**1200**	1	1	0				
1700	1	1	1	**1300**	1	1	1				
2000	1	1	1	**1500**	0	0	1				
-	-	-	-	**1700**	1	1	1				
-	-	-	-	**2000**	1	1	1				
-	-	-	-	-	-	-	-				
-	-	-	-	-	-	-	-				
Total	8	6	7	**Total**	7	9	8				

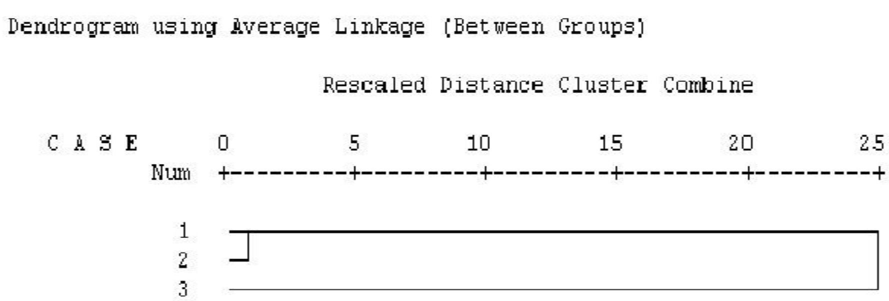


Fig. 6. Dendrogram using average linkage (Between Groups)

Releasing Rice Variety:

Improving Giza 179 rice variety:

During the 2018 season, the Ministry of Agriculture and Land Reclamation and the Ministry of Water Resources and Irrigation reduced the total area of rice from 1.074 million ft2 to 0.724 million ft2 due to a shortage of water. During the 2019 season, the Ministry of Agriculture and Land Reclamation and the Ministry of Water Resources and Irrigation reclassified the total area of rice from 1.074 million Feddan to 0.724 million Feddan, with irrigation from the river Nile, while the area of 0.150 million Feddan was irrigated by mixed drainage water.

Moreover, an area of 0.200 million ft2 was grown under long-interval irrigation to reduce water consumption. The strategy of the rice program in Egypt is to develop more rice varieties that are high-yielding and tolerant to stress, mainly in saline soil areas. Giza 179, a newly released variety, is high grain yielding and tolerant to adverse conditions.

The following Tables showed the results from the promising lines GZ11190-3-13-1-1 and GZ11180-6-6-1-2 which revealed the highest grain yield, in the same time the check variety Giza 179 gave the highest grain yield of (10.32, 10.20and 10.39t/ha, respectively),the Giza 179 variety was superior compared with the promising lines in all yield and yield components traits from the period 2019 up to 2022 seasons.

The performance of Giza 179 as a check variety with some promising lines was superior under the normal location (preliminary yield trials), as shown in Table 9. Giza 179 exhibited the highest grain yield (10.39 t/ha) under normal conditions (Sakha station) compared with the promising lines GZ11190-3-13-1-1 and GZ11180-6-6-1-2, which recorded 10.25 and 10.20 t/ha, respectively. Also, the duration ranged from 120 to 125 days without any significant difference from the earliest promising Results on grain quality for tested genotypes are presented in Table 9. GZ9057-6-1-3-2 (Giza 179) gave an acceptable value for blast reaction, grain shape, and milling percentage among five promising lines in the preliminary yield trial in two growing seasons. In general, Giza 179 is considered the best-cultivated rice variety.

Table 9. Promising entries from the preliminary yield trials- during 2019 season.

Entry	Grain yield (t/ha)	Duration (day)	Plant height (cm)	Blast reaction		Grain type	Mill. (%)
				L	N		
GZ11180-6-6-1-2	10.20	125	94	1	R	Sh	72
GZ11190-3-13-1-1	10.32	120	100	1	R	Sh	72
GZ11190-3-13-4-1	10.25	119	100	1	R	Sh	73
GZ11176-2-6-3-3	9.92	126	90	1	R	Sh	72
GZ11261-1-1-3-3	9.73	124	105	1	R	Sh	71
Giza 179	**10.39**	**120**	**94**	**1**	**R**	**Sh**	**70**
LSD 0.05	0.84	1.43	0.36	-	-	-	0.73

Performance of Giza 179, as well as Giza 177 and Sakha 105, as cultivated and check varieties with some promising lines under two locations (normal and saline) (regional yield trails) as shown in Table (10) during the 2020 season Giza 179 exhibited the highest grain yield under two normal and saline locations (Sakha and El Sirw) compared with the two check varieties. Also, the duration ranged from 120 to 125 days without any significant difference from the earliest check varieties, Giza 177 and Sakha 105. Also, Giza 179 showed the highest grain yield under normal (10.42 t/ha) and saline stress (5.97 t/ha) conditions at the El-Sirw location. In addition, Giza 179 recorded desirable values for plant height, blast reaction, grain shape, and milling%.

Table 10. Yield (t/ha) and ancillary traits of the promising entries in the regional yield trails under normal and saline conditions during 2020season.

Entry	Sakha	EL-Sriw	Ancillary traits				Grain test	
			Duration days	Height cm	Blast R.		type	Mill%
					L	N		
GZ10154-3-1-1-1	9.41	5.10	122	91.7	1	R	SH	71
AC2882	9.38	3.75	119	96.5	1	R	SH	71
GZ9399-4-1-1-3-2-2	10.21	5.85	110	94.7	1	R	SH	70
GZ 10101-5-1-1-1	9.50	6.00	121	99.0	1	R	SH	71
GZ 10598-9-1-5-5	9.36	6.00	120	99.5	1	R	SH	71
GZ 10590-1-1-3-9-1	9.59	4.56	121	95.7	1	R	SH	71
Giza177	9.49	3.21	125	99.3	1	R	SH	73
Giza 179	**10.42**	**5.97**	**120**	**96.3**	**1**	**R**	**SH**	**65**
Sakha105	9.18	3.45	125	95.5	1	R	SH	70
LSD 0.05	0.64	1.23	1.05	3.08	-	-	-	1.16

Performance of Giza 179 as a cultivated variety with some promising lines under final yield trails, as shown in Table 11, in the 2021 season Giza 179 exhibited the highest grain yield in the final yield trails. Also, the duration ranged from 122 to 135 days without any significant difference from the earliest promising lines, GZ10590-1-3-3-2 and GZ10101-5-1-1-1. Also. Giza 179 showed the highest grain yield in final yield trails (10.42 t/ha) and saline stress

(5.21 t/ha) conditions at the El-Sirw location. In addition, Giza 179 recorded desirable values for height plant, blast reaction, grain shape, and milling%.

Table 11. Performance of the promising lines in the final yield trails under normal and saline conditions during - 2021 season.

Genotype	Yield (t/h)		Ancillary traits			Milling %
	Normal	Saline	Days to maturitydays	Plant height (cm)	Blast	
GZ10590-1-3-3-2	10.25	4.05	123	97	R	70
GZ11180-6-7-3	9.50	3.57	126	103	R	70
GZ11190-3-3-1-1	9.70	4.23	134	106	R	73
GZ11190-3-13-4-2	10.30	3.97	123	103	R	70
GZ10101-5-1-1-1	9.40	3.59	124	98	R	73
Giza179	**10.40**	**5.21**	**122**	**97**	**R**	**68**
LSD 0.05	0.73	1.33	1.13	5.60	-	0.34

Results on growth and yield for tested genotypes in verification experiment are presented in Table (12).Giza 179 gave the desirable values for the total duration, plant height and yield and its components compared with three promising lines and two check varieties Giza 177 and Giza178 during 2022 season, that meaning the Giza 179 variety was highly genetic purify and adaptable under different conditions.

Table 12. Duration, plant height, no. of panicles/ plant, no. of filled grains/ panicle and grain yield ofsome rice genotypes under verification yield trials during 2022 season.

Entries	Total duration	Plant height	No. of panicles/ plant	No. of filled grains/ panicle	Grain yield (t/ha)
GZ10101-5-1-1-1	124.3	98.0	22.0	130	9.7
GZ10590-1-1-3-9-1	124.7	97.0	22.3	136.7	9.8
GZ11245-1-1-3-2	124.3	93.3	23.3	137.7	10.6
Giza 178	135.0	100.0	23.3	150.3	10.9
Giza 179	121.0	96.0	23.3	142.7	10.7
Giza 177	125.0	100	18.0	128.0	9.7
LSD 0.05	0.85	1.61	1.10	7.11	0.15

Agronomy evaluation:

Table 9 displays the impacts of various sites on the overall duration, number of panicles per m2, grain yield t/ha, and milled of the studied rice genotypes. The findings in Table (9) regarding total duration demonstrated that planting rice in various sites had no impact on total length in the 2013 and 2014 growing seasons. The findings also provided an explanation for the variation in rice genotypes' days to maturity. It was evident that the rice variety Giza179 matured earlier than Sakha 101, which took roughly 143 days to do so (late genotype).

Also, according to Table (9)'s findings, rice genotypes planted in the Zarzoura and Gemmiza locations, respectively, generated the maximum numbers of panicles per m2. This is mostly because the soil at the Gemmiza area has high soil organic matter, is native to the elements, has low Ec, and is ideal for the growth of rice plants. (Table 9). The abundance of readily accessible fertile minerals, particularly N and P, boosted the flow of metabolites from source to sink, increasing the number of panicles per unit of surface area. The results also revealed that the examined genotypes had considerably different numbers of panicles per square meter (Table 13). In both seasons, the genotype Giza 179 generated the most panicles per square meter, followed by Sakha 101.

Table 13. Effect the different planted locations of rice genotypes and their interaction on total duration, number of paniclesm^{-2}, grain yield t ha^{-1}and milling % during two 2013 and 2014 seasons.

Factor	Duration (days)		No. of panicles m-2		Grain yield (t ha^{-1})		Milling (%)	
	2013	2014	2013	2014	2013	2014	2013	2014
Location:								
Sakha	126.11	125.44	503.05	526.18	8.98	9.32	70.34	69.87
Gemmiza	126.47	125.78	522.78	546.60	9.48	9.95	69.13	69.15
Zarzoura	125.53	126.78	504.58	540.35	9.03	9.43	69.74	70.13
LSD at 0.05	N.S	N.S	13.72	12.56	0.35	0.25	NS	NS
Rice genotype:								
Giza177	124.89	124.89	421.95	497.23	8.96	9.23	69.31	70.18
Giza178	131.22	131.89	556.10	598.05	10.25	10.38	67.01	66.69
Sakha101	143.22	143.00	567.50	580.55	10.75	10.87	69.80	68.86
Giza179	119.44	120.44	552.78	580.55	10.49	10.69	72.11	72.47
GZ9461-4-2-3-1	124.89	122.44	506.95	558.60	8.00	8.34	69.75	69.28
LSD at 0.05	3.61	3.71	19.80	18.70	0.475	0.262	1.04	0.702
Interaction	**	**	**	*	**	*	NS	NS

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

Concerning rice genotypes, they differed significantly in their grain yield in the two seasons of this study, Table (10). The rice variety Giza 179 produced more than 10 t ha^{-1} in both seasons. Giza 179produced the highest grain yield. On the other hand, the line GZ9461-4-2-3-1 recorded the lowest value grain yield. The superiority of rice genotypes Giza 179 and Sakha 101 in grain yield might be due to their high values of each of number of panicles m- 2, number of filled grains panicle^{-1} and 1000-grain weight.

Grain quality characteristics, i.e., milling %, were presented in Table 9. Results explained that the differences in milling character among the three locations were not significant in both seasons; however, the differences among rice genotypes were significant. The highest milling percentage was noticed for Giza179, which produceda statistically identical milling percentage. On the other hand, Giza 178 produced the lowest values of milling% character in two seasons.

The effect of the interaction between rice genotypes and different locations on total duration was significant in both seasons of this study, as shown in Table 10. Giza179 recorded the earliness genotype under Gemmiza conditions in the 2013 and 2014 seasons, respectively, while the rice variety Sakha 101 at Sakha took longer to mature than the other rice genotypes in the two seasons, according to El gohary *et al*. (2016).

Table 14. Duration (days) as affected by the interaction between rice genotypes and location in 2013 and 2014 seasons

Rice 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
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
LSD at 0.05	4.17			4.35		

Results in Table 11 revealed the effect of the interaction between rice genotypes and different locations on the number of panicles per m2, which was significant in both seasons of the study. The rice genotype GZ9057 (Giza 179) recorded the highest number of panicles per m2 at the Zarzoura location in the two seasons, while the rice variety Giza 177 gave the lowest number of panicles per m2 at the Zarzoura and Sakha locations in the two seasons, respectively.

Table 15. Number of panicles per m^{-2} as affected by the interaction between rice genotype and location in 2013 and 2014 seasons

	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
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
LSD at 0.05	21.11			20.94		

It is important to note that the tested genotypes varied in their interaction with the environmental factor and exhibited different responses to the different locations (Table 12). Giza 179 and Sakha 101 produced the highest grain yields under Gemmiza and Zarzoura conditions. The superiority of Sakha101 genotypes at Gemmiza was due to their relative advantages in their yield components.

Table 16. Grain yield t ha^{-1} as affected by the interaction between rice genotypes and locationsin 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
GZ9057 (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
LSD at 0.05	0.66			0.47		

These findings emphasize the significance of testing genotypes in various habitats to determine the appropriate genetic make-up for a given environment. The genotypes of rice under study responded differently to various environmental situations. Table 13 shows that sowing dates and their interactions have a substantial impact on the grain yield of several rice genotypes. The highest grain yields were obtained by the rice variety Giza179, followed by Giza178. The grain yield significantly dropped with the delay in sowing. Rice genotypes sown on April 15th, which statistically were on par with those sown on May 1st, generated the highest values of grain yield. The interaction yielded the maximum yield when the rice varieties Giza 178 and Sakha 101 were seeded on April 15. On the other hand, during late sowing, Giza 179 provided the highest grain production.

Table 17. Grain yield t ha^{-1} of different rice genotypes under variable sowing dates in 2013 and 2014 seasons.

Genotype	2014				2015			
	April 15th	**May 1st**	**May 15th**	**Mean**	**April 15th**	**May 1st**	**May 15th**	**Mean**
Giza 177	8.10	7.99	6.32	7.47	7.96	7.88	5.72	7.19
Giza 178	10.88	9.89	7.41	9.39	10.74	9.77	6.52	9.01
Sakha 101	10.73	9.58	7.26	9.19	10.40	9.47	6.66	8.84
Giza 179	9.91	9.48	9.05	9.48	9.77	9.37	9.06	9.40
GZ 9461-4-2-3-1	8.27	7.06	6.40	7.24	8.13	6.95	6.48	7.19
LSD0.05	1.74			1.20	1.76			1.40
Sowing mean	8.98	8.23	6.86		8.80	8.10	6.54	
LSD0.05	1.43				1.41			

The requirements for nitrogen varied from variation to variety. It is crucial to look into how differing nitrogen levels affect the productivity of recently introduced cultivars. Fig. 7 illustrates how the relationship between the tested rice genotypes and nitrogen levels affected grain production. As a result, Sakha108 and GZ9057 (Giza179), two rice varieties, had the maximum grain yields at 165 kg N/ha, while GZ 9461 acquired statistically the same grain yield at 110 or 165 kg N/ha.

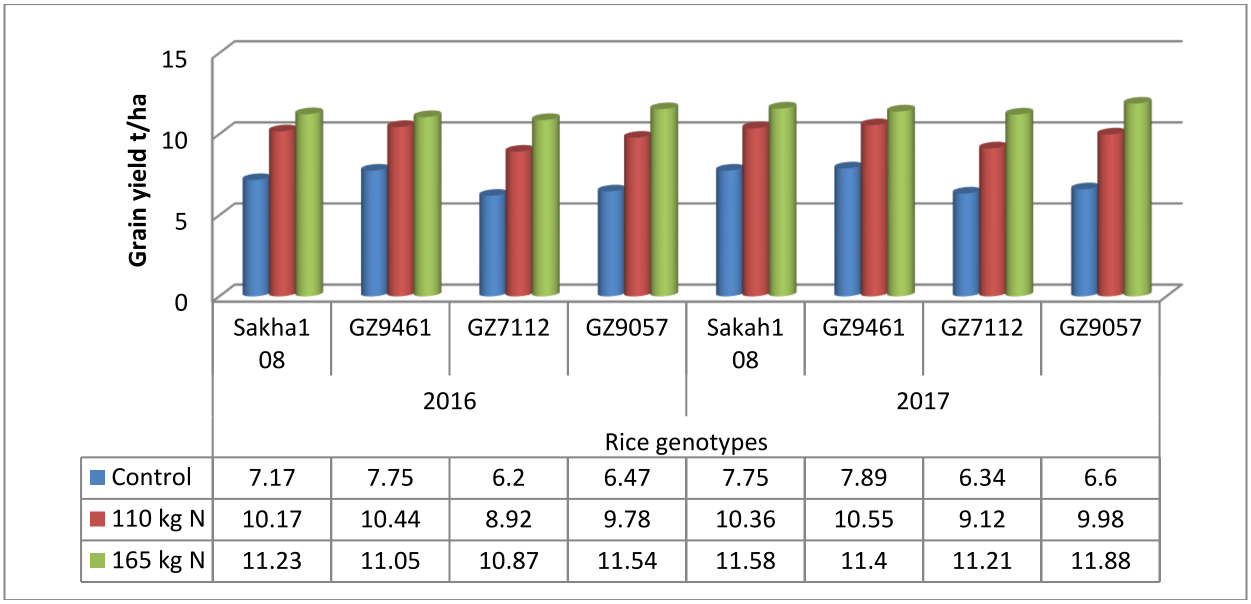


Fig 7. Illustrated the effect of nitrogen levels on some rice varieties for grain yield (t ha^{-1}) in 2016 and 2017 seasons.

Table 18. Grain yield (t ha^{-1}) as affected by the inter action between irrigation cyclic system of water supply and rice genotypes in 2019 and 2020 seasons.

	2019			
	Sakha 107	**Sakha 108**	**Giza 179**	**GZ10590**
C.F	10.37	11.42	**11.43**	10.43
C.S	9.73	11.50	**11.53**	10.45
5	8.97	9.17	**10.63**	10.30
10	8.12	8.41	**9.45**	9.9
15	6.62	6.78	**7.70**	8.10
	2020			
C.F	10.15	11.39	**11.48**	10.50
C.S	9.85	10.83	**11.47**	10.78
5	9.26	10.52	**10.89**	10.27
10	8.65	9.07	**9.39**	9.45
15	7.11	7.026	**8.27**	8.30

Table 19. Grain yield t ha^{-1} for some rice varieties under different planting methods during 2021 season .

Rice varieties	**Grain yield (t/ha.)**		**Increasing yield**	
	Drill	**Transplanting**	**Ton**	**%**
Sakha 108	10.686	10.329	0.357	3.34
Giza 179	**10.591**	**10.096**	**0.495**	**4.67**
Sakha 104	9.889	9.532	0.357	3.61

Table 20. Water requirement for some rice varieties under different planting methods during 2021 season.

Rice varieties	**Water use amount (m^3/ha)**		**Saving water (m^3)**	
	Drill	**Transplanting**	**m^3**	**%**
Sakha 108	11069	13894	2825	25.52
Giza 179	**10460**	**12390**	**1930**	**18.45**
Sakha 104	11069	13894	2825	25.52

Table 21. Grain yield (t/ha) of newly salt tolerant rice genotypes of Giza 179 under medium and highly salinity levels at El sirw agriculture station during 2022 season.

Rice genotypes	**Salinity levels ds/m**	
	6	**9**
Giza 179	**8.51**	**5.21**
Giza 177	5.45	1.50
Giza 178	8.40	4.85
GZ9399	8.35	4.83
E.C	2.0	

Diseases resistance evaluation:

Five genotypes of leaves were infected with leaf blasts using (45) different races, which were then spread during the 2010–2011 growing seasons with 20 and 25 races, respectively (Tables 15 and 16). All these races were administered to five different rice genotypes: the new genotype GZ 9057-6-1-3-2, Giza 177 and 178 as resistant checks, Sakha 101 and Sakha 104 as susceptible checks. Under artificial inoculation in greenhouses in 2010–2011, the resistant checks were resilient in all tested races (Tables 16 and 17). The results showed that Sakha 101 was infected with 14 and 13 distinct races in 2010 and 2011, respectively, with regard to the susceptible checks, Sakha 101 and Sakha 104. While Sakha 104, the other vulnerable checker, contracted the disease in 2010 and 2011 from 11 and 16 different races, respectively.

The brand-new, promising line GZ 9057-6-1-3-2 was impervious to all blast races that were tried (Tables 14 and 15). The rice genotypes were assessed in the blast nursery throughout the growth seasons of 2010 and 2011. According to Sehly et alfindings .'s in Table (16), all genotypes were assessed at the seedling stage in blast nurseries at three different sites: the governorates of Sakha (Kafreilshiekh), Gemmiza (Gharbia), and Zarzoura (Behira) (2008). At every site that was tested, Giza 177, Giza 178, and the newest genotype GZ 9057-6-1-3-2 were resistant. The vulnerable tests Sakha 101 and Sakha 104 were shown to be blast susceptible (Table 17).

Table 22. Numbers of infected blast races out of (45) races were used as 20 and 25 tested in 2010 - 2011 seasons in the greenhouse.

Genotype	**2010**	**2011**
GZ 9057	R	R
Giza177	R	R
Giza178	R	R
Sakha101	14	13
Sakha104	11	16

Table 23. Blast races infected rice entries out of (45 were used as 20 and 25 tested in 2010 – 2011 seasons in the greenhouse.

Genotype	**2010**	**2011**
GZ 9057 (Giza 179)	0	0
Giza177	0	0
Giza 178	0	0
Sakha101	3(IC-3,11,13), 3(ID-1,7,13), 4(IH-1) 2(IG-1) and 2(II)	2(IC-3, 13), 2(ID-1,7), 4(IH-1) 2(IG-1) and 3(II)
Sakha104	1(IC-3), 2(ID-1,7), 4(IH-1) 3(IG-1) and 1(II)	1(IC-13), 3(ID-1,3,7), 5(IH-1) 3(IG-1) and 4(II)

Table 24. Evaluation of rice blast disease for five tested entries under field conditions at blast nurseries during 2010- 2011 growing seasons.

Genotype	Blast nursery reactions for different genotypes					
	Sakha		Gemmiza		Zarzora	
	2010	2011	2010	2011	2010	2011
GZ 9057 (Giza 179)	R	R	R	R	R	R
Giza177	R	R	R	R	R	R
Giza 178	R	R	R	R	R	R
Sakha101	HS	S	HS	HS	S	S
Sakha104	HS	HS	HS	HS	S	HS

R= Resistance. S=Susceptible. HS= highly Susceptible.

Forty promising rice lines and five commercial cultivars were evaluated under greenhouse conditions with 37 *P. oryzae* isolates. Eleven promising lines showed complete resistance to the tested isolates (Table 25). Thirteen rice lines were only infected with one or two of the 37 isolates. GZ10590-1-1-3-9-1, GZ10590-1-3-3-2, and GZ11332-2-2-2 were the highly infected lines with 9 isolates and showed 75.7% resistance. While the rest of the entries represented resistance ranging from 78.9 to 91.9%, the Giza 179, as the check variety, recorded 100% resistance.

Table 25. Reaction of promising lines to 37 tested isolates of *P. oryzae* under greenhouse conditions, 2020.

No	Promising Line	R %	No	Promising Line	R %
1	**Giza 178**	100.0	24	GZ11190-3-13-1-1	97.4
2	**Giza 179**	100.0	25	GZ11190-3-13-4-1	100.0
3	**Sakha 106**	97.3	26	GZ11190-3-13-4-2	100.0
4	**Sakha 108**	91.9	27	GZ11236-2-4-3-2	100.0
5	**GZ10333-9-1-1-3**	97.3	28	GZ11236-2-5-2-1	100.0
6	**GZ1010-5-1-1-1**	97.3	29	GZ11236-2-5-2-3	94.6
7	**GZ10598-9-1-5-5**	100.0	30	GZ11236-2-6-5-2	100.0
8	**GZ10590-1-1-3-9-1**	75.7	31	GZ11245-1-2-3-1	100.0
9	**GZ10590-1-3-3-2**	75.7	32	GZ11245-1-3-3-2	97.4
10	**GZ10848-1-2-2-1**	97.3	33	GZ11245-1-3-3-3	89.5
11	**GZ10991-5-18-5-1**	100.0	34	GZ11261-1-1-3-3	81.6
12	**GZ11180-6-7-3**	92.1	35	GZ11291-6-2-3-2	97.4
13	**GZ11332-2-2-2**	76.3	36	GZ11312-3-3-1-3	78.9
14	**GZ11236-2-1-2**	94.7	37	GZ11316-2-12-1-1	94.7
15	**Korea 27**	81.6	38	GZ11316-2-12-2-1	86.8
16	**G Head Rose-32-17-179**	92.1	39	GZ10365-2-4-1-3	92.1
17	**GZ11176-2-6-3-3**	97.4	40	GZ10598-9-1-5-1	86.8
18	**GZ11180-6-6-1-2**	89.5	41	GZ10749-8-1-8-4	97.4
19	**GZ11180-6-6-1-3**	100.0	42	GZ10804-3-1-2-2	97.4
20	**GZ11180-6-6-5-1**	92.1	43	GZ11022-1-3-19-3	100.0
21	**GZ11190-3-1-1-1**	100.0	44	G RYT-26-17-178	97.4
22	**GZ11190-3-1-2-1**	100.0	45	GZ L x T-2015-65	100.0
23	**GZ11190-3-8-2-3**	100.0			

Insect resistance evaluation:

To estimate the susceptibility of rice varieties to insect infestation in storage, R. dominica adults were released on the tested varieties. The insect infested all rice varieties at variable levels. Results in Table (26) showed that the lowest infested varieties were Giza 178, Sakha 102, Sakha 104, Sakha 105, Giza 182, Giza 179, GZ 9057-6-1-3-3, GZ 9577-4-1-1, GZ 9523-2-1-1-1, and GZ 9514-3-1-3-1. They produced a low number of F1 progeny (ranging from 2.3 to 5.0 insects per jar), the longest insect life cycle (34–40 days), and low values of susceptibility index (SI) (1.12–2.00). The moderately infested varieties were Sakha 103, Sakha 106, GZ 9328-1-2-1-3, GZ 9362-34-2-1-3, GZ 9461-4-2-3-1, and Egyptian Hybrid1, as the F1 progeny ranged from 5.3 to 9.4 insects per jar, the life cycle ranged from 32.3 to 34 days, and SI values were from 2.18 to 2.98. Data revealed that the most infested varieties were Giza 177, Sakha 101, GZ 9057-6-1-3-4, and Egyptian Yasmin. They produced the highest number of F1 progeny (10.3–14.2 insects per jar), the life cycle ranged from 29 to 32.3 days, and SI values were from 3.33 to 3.80.

Table 26. Insect reaction for some rice genotypes during 2009 and 2010 seasons.

Rice varieties	Reaction
Giza 178	Suitable
Giza 177	Moderate resistance
Sakha 105	Resistance
Sakha 106	Resistance
GZ 9057-6-1-3-2	Moderate resistance

The results in Table 27 showed the economic evaluation for GZ9057 (Giza 179) compared to Giza 182 in 2011 and 2012 seasons, whereas the rice variety GZ9057 (Giza 179) recorded the desirable values for days to heading and average production (t/fed.), as well as, the differences were 3 days earliness, 0.729 t/fed. Over in yield production and 1457 E.L and net return, moreover, the GZ 9057 (Giza 179) was resistance for disease, Insect and lodage.

Table 27. Economic Evaluation for GZ 9057-6-1-3-2 compared with Giza 182 during 2011 and 2012 seasons.

Items	GZ9057-6-1-3-2	Giza 182	Difference
Total duration days	122-123 day	125-126 day	3
Total water requirement	6000 m3	6000 m3	--
Average production(t/fed.)	4.437	3.708	0.729
Total costs	The same	The same	-
Total price for ton	2000	2000	-
Net return	--	--	1458
Disease	Resistant	Resistant	-
Insect	Resistant	Resistant	-
Lodge	Resistant	Resistant	-

DISCUSSION

From the previous results of the preliminary, regional, and final yield trails for maturity, plant height, yield, milling, and blast reaction, which indicated a wide range of means, the rice variety Giza 179 showed the minimum number of days to maturity compared with their parents and check variety, which recorded 130, 150, and 135 days, respectively. These results agreed with Weiya et al. (2008), who also observed variations in heading days among several genotypes and identified a regulatory gene responsible for this variation.

Rice genotypes indicated variable expressions of plant height (cm), selection of rice genotypes with appropriate plant height and non-lodging characteristic is important for high yield potential hybrids (Ikehashi *et al.,* 1994). The plant height varied from 94-100 cm. Plant height in rice is generally considered to be controlled by both qualitative and quantitative genes Huang *et al.* (1996). Ashrafuzzaman *et al*. (2009) also considered that,plant height is mostly governed by genetic makeup of the genotypes, but the environmental factors also influence it.

Results for grain yield of the Giza 179 compared with Giza 178 and promising lines as medium duration checks in preliminary, regional and finial yield trails. The obtained results indicated that, the new variety Giza 179exhibited the highest values for grain yield (t/ha)under normal and saline soils conditions compared with check varieties Giza 178 and promising lines.. Also, Giza 179 showed the highest grain yield under normal (10.42 t/ha) and saline stress (5.97 t/ha) conditions at El-Sirw location, in addition, the Giza 179 recorded the desirable values for plant height, blast reaction, grain shape and milling %, due to higher spikelet fertility and thousand grain weight.

These results are in agreement with those obtained by Robin and Saha (2015) who found grain yield of 8.59 g per plant in Kalijira genotype which was much lower than that in the present findings. Minimum grain yield per plant was recorded in Begun bichi and maximum was recorded in Chinikanai-1. Begun bichi showed the least grain yield per plant due to higher spikelet sterility (23.54%) and lower thousand grain weight (9.6 g).

The pooled data over locations (environments) and years showed that the rice variety 179 produced the highest grain yield (10.39 – 10.70 t/ha). The interactive effects of the genotype × environment illustrated that genotypes responded differently to environmental variations at locations suggesting that, the necessity of testing rice varieties at multiple locations, Akter *et al*. (2015). The factors explained (%) demonstrated that genotype (6.58%), environment (37.74%), and interaction (12.72%) influenced the grain yield of rice. This result revealed that, there was a differential yield performance among genotypes across test environments due to the presence of G x E interaction. The relative contributions of G x E interaction effects for grain yield in this study were similar to the findings in other previous studies (Saied 2010; Tariku *et al.,* 2013).

The relationship between the larger vascular cylinder and the increase in diameter and number of xylem vessels was highly different. These results indicated that the anatomical structure characteristics, i.e., epidermis, cortex thickness, number, diameter of vessels in the xylem arch, and diameter of the vascular cylinder, could be used as indicators of salinity tolerance in saline. These results agreed with those obtained by Kawate *et al* (1979) and El-Emery *et al.,* (2016). He proved that the diminution of vascular system in the root is an quite important factor regarding their function. Also, the results are ina harmony with those obtained by Denise (2003), He recorded that, cortex tissues of parenchyma added parenchyma a specialized tissue with abundant interconnected gas spaces is common in the roots and shoots of many emergent wetland plant like rice (semi- aquatic plant). There are integrated correlation between number of vascular elements and root diameter, the style diameter and the pericycle cell number, respectively. Moreover, there are connections between vascular system of the parental roots, nodal roots and lateral roots in the same rice root , these results were similar to (Shigenori and Kelsuke, 1995 D'Abundo (2003); Luquet *et al.* (2006) and El-Emery *et al* (2013)

The genetic variety across all the genotypes examined in this study may be to blame for these variations amongst rice genotypes. Both Sedeek *et al.* (2009) and Faruq *et al.* (2011) noted variances in rice genotypes' heading dates. Results in Table 1 showed that location had a substantial impact on grain yield. The rice genotypes in the Gemmiza location greatly outperformed those at the other two in terms of grain yield, recording the highest values. This variation has been influenced by soil fertility, texture, and soil structure. Even in a single place, unpredictable environmental elements like temperature and humidity can influence how a person's genotype interacts with their environment over the course of the year. According to Tariku *et al.* (2013), the significant genotype environment interaction effects on grain yield showed that different genotypes responded differently to location-specific environmental variations, demonstrating the need for evaluating rice genotypes at various sites. Similar trends were documented by Anputhas *et al.* (2011), Mosavi *et al.* (2012), and El gohary *et al.* (2016). According to Jeng *et al.* (2006), the percentage of filled grains, the number of panicles per unit ground area, the weight of a thousand grains, and the number of grains per panicle all positively linked with the grain production for rice. These findings are consistent with those of Sedeek *et al.* (2009).

According to Jeng *et al.* (2006), the 1000-grain weight and more even grain development within a panicle were substantially correlated with higher grain quality of rice cultivars. The milling percent character was not significantly impacted by the genotype and location interaction in rice. Metwally *et al.* (2016) reported on comparable patterns. Additionally, Dawadi and Chaudhary (2013) and El-Malky and El-Zun (2014) reported that early planting boosted the cumulative mean value of temperature and sunshine hour, as well as the number of productive tillers, the number of grains per panicle, and the seed weight.

Genotype, environment, and their interactions all affect grain yield. Variation in grain production under the same management settings is primarily explained by the impacts of genotype and environment (Dingkuhn *et al.,* 2006). Identification of genotypes appropriate for various contexts is made possible by the interaction between these two explanatory variables. In various conditions, the high-yielding rice genotypes Giza 178, Sakha 101, and Giza 179 exhibit a wide range of phenological and physiological features. These outcomes matched those mentioned by AbdAlla and El Gohary et al. (2016).

These results showed that rice yield increased with applied N to a certain level and after that it decreased with the increased N rates. Tayefe *et al.* (2014) and Moro et al. (2015) reported a quadratic response of grain yield to nitrogen fertilization, which supports our result. The optimum N rates for maximum yield also differed with rice varieties and growing seasons, indicating that N fertilization should be based on considering rice cultivars and climatic conditions. Nitrogen fertilization improved rice vegetative growth in terms of plant height and tiller number, leading to an increased straw yield of the rice varieties.

This increase could be attributed to the increase in nitrogen uptake, which ensures a continuous supply of nitrogen to rice plants. Also, one of the most important roles of nitrogen is the significant increase in both enzymatic activities and chlorophyll content. This increases the viability of flag leaf and delays flag leaf senescence, which leads to more efficient photosynthetic processes and an enhanced metabolite stream that is immediately translocated to the panicles and fills most of the spikelets, leading to a higher grain yield.These results obtained were in accordance with those reported by Koutroubas and Ntanos (2003); Sorour, *et al.,* (2016) and Elhabet *et al*., (2018).

Gabr (2004), El-Wash and Hammoud (2007) found that commercial cultivars such as Sakha101 and Sakha104 noticed susceptible reaction to 20 blast pathogen isolates in a greenhouse test. Also, Sedeek and El-Wahsh (2015) reported that Sakha108 was resistant to rice blast under natural infection in blast nurseries at Sakha, Gemmiza and Zarzoura and under artificial inoculation in the greenhouse compared with Sakha101 was susceptible to blast under the same conditions.

For the reaction to insect the Giza 179 as IndicaL/Japonica rice variety was moderately tolerant under late of sowing. So, the optimum sowing date is very important to avoid the infection from leave minor and stem borer then increase the grain yield, these results were confirmed by El-Aidy *et al.* (2000); El-Adl *et al.* (2011) and Antunes *et al.,* (2016).

The economic evaluation for GZ9057 (Giza 179) compared to Giza 182, whereas the rice variety GZ9057 (Giza 179) recorded the desirable values for days to heading and average production (t/fed.), the value was 0.729 t/fed., over in yield production and net return; moreover, the GZ 9057 (Giza 179) was resistant to disease and insects, and these results are in agreement with El-Saady and Abo Youssef (2010).

CONCLUSION

Generally, the rice cultivar Giza 179 exhibited significant advantages over the wide-spread Giza 178 variety for earliness and yield potential. Furthermore, the new variety is blast-resistant, and hence, it could be an ideal candidate to gradually replace Giza 178. This will significantly help to improve and maintain varietal policy with new high-yielding biotic and abiotic stresses. Giza 179 cultivars have good agronomical traits (earliness duration of 123 days, short stature, strong tillering ability, erect leaves, high leaf area index, high grain, milling%, and short grain shape characteristics), in addition to resistance to lodging and to the major diseases such as blast, brown spot, false smut, and bakanae, as well as high yielding productivity. The results from PCR analysis for Giza 179 and their parents showed that the proximity matrix was 89.8% between Giza 179 and their parents, GZ6296, and 71.1% between Giza 179 and GZ1368. Thus, it is an excellent new cultivar to be released and recommended for cultivation in the different rice-growing governorates, particularly in areas suffering from water shortages and saline soils in Egypt.

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