RESEARCH | Egyptian Journal of Agricultural Research | Field Crops

Giza 183 Egyptian rice variety: a step to confront climate change challenges

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ABSTRACT

Climate change is one of the biggest threats to plant species around the world. As one of the most important crops worldwide, rice is an awfully climate-sensitive agro-ecosystem. Therefore, Giza 183 will be released in 2023 as a high-yielding variety that has been adapted to mitigate climate change. This new variety is the product of cross-breeding between Giza 178 and SKC 23893 in 2010. The first generation, "F1," of this cross was evaluated in 2011 and planted as the F2 generation in 2012. Sequentially, the next generations from F3 to F6 were evaluated in the pedigree trails from 2013 to 2016, under cross number “GZ 10848." Five promising sister lines of GZ 10848 were selected and evaluated in the preliminary yield trail (GZ 10848-1-2-2-1, GZ 10848-1-2-2-2, GZ 10848-1-2-4-5, GZ 10848-1-2-5-3, and GZ 10848-1-2-5-6). The results revealed that the promising line GZ 10848-1-2-2-1 “Giza 183” surpassed all selected lines. Accordingly, Giza 183 was evaluated from 2017 to 2022 in multi-location yield trails at Sakha, Gemmiza, and Zarzoura as normal conditions and El-Sirw as saline conditions, as well as in regional, final, and verification yield trails. The evaluation resulted in a significant superiority of the yield of Giza 183 over Giza 178, with shorter growth duration and blast resistance. The new variety grain yield recorded 10.88, 10.47, 11.30, 10.60, and 10.70 t/ha during the 2017 to 2022 seasons under normal conditions, respectively, with a total duration of 122 days. while the grain yield for Giza 178 was recoded at 10.50, 10.54, 9.90, 10.00, 9.80, and 10.30 t/ha during the same seasons and conditions, with a total duration of 135 days. Furthermore, Giza 183 exhibited a higher yield than Giza 178 as a salt tolerance check variety at a rate of 0.800–0.160 t/ha under saline conditions at El-Sirw Agricultural Research Station in different years of evaluation. Giza 183 showed a high level of blast resistance in blast nursery and trap varieties in the field and artificial inoculation under greenhouse conditions. Finally, the new rice variety Giza 183 is resistant to stem borer and has high grain quality traits.

Keywords: Rice, variety, high yield, resilient to climate change

INTRODUCTION

Global population growth is expected to reach 8.9 billion people by 2050, according to the United Nations. To feed Global climate changes have an influence on agricultural, forest, and other natural resources, including water from climate-sensitive reservoirs. Given agriculture's inextricable relationship to climatic factors, the impact of climate changes on agriculture and food security have recently risen to the top of the research and policy agenda, and have made it critical to create long-term adaption strategies for the agricultural production (Dabi and Khanna 2018; Saud *et al.*, 2022). One of the most vulnerable agro-ecosystems to climate change is the rice producing system. As well, it is essential to foresee how climate change will affect rice harvest since the fast rising global food demand due to the growing world population (Saud *et al.*, 2022). Rice, being one of the three most important grain crops that serves to meet food demands all over the world, plays an essential part in the world's current and future food security. Moreover, rice is the world's major crop, with half of the world's population eating it every day (GRiSP, 2013). According to (Shetty *et al.*, 2013), several of the main rice-producing countries have seen a long-term plateau in yield and total output despite persistently rising demand from impoverished populations. Additionally, between 1961 and 2019, the production of rice (paddy) increased by more than three times, from 215 million tons to 755 million tons (Bin & Zhang 2022). Unfortunately, the estimate for world rice production in 2022/23 was lowered by 1.35 million tons to 503.7 million tons (milled basis), which is 2% less than expected. Egypt's crop, on the other hand, is forecast to climb the most, by 0.7 million tons to 3.6 million due to a greater harvested area and a higher estimated yield USDA (2022).

Egypt's existing dry environment will experience substantially higher temperatures and decreased rainfall across major agricultural areas as a result of climate change, necessitating further urgent adaptation expenditures. By 2050, it is anticipated that Egypt's crop yields would have decreased by more than 10% as a result of rising temperatures, water stress, and increased salt of irrigation water (Perez *et al*., 2021). The challenge is to close the rapidly high gap between the limits due to various stresses and the increasing demands of rice production. However, its production is influenced by biotic and abiotic stresses Mahmood *et al.* (2019). Drought, severe temperature, salt, harmful radiation, heavy metals, and gaseous pollution are the most damaging abiotic stresses factors that induce morphological, physiological, and biochemical alterations in rice crops, ultimately resulting in a decline in rice production globally (Kumar *et al.*, 2022). Nonetheless, significant progress has been achieved in the production of stress-tolerant rice varieties, and rice breeders in Egypt are making efforts to achieve this goal.

On the other hand, as extreme weather events become more often as a result of climate change, as well as the ongoing pressure from diseases and pests, there is an urgent need to produce new varieties that can resist various biotic stresses Cohen *et al.* (2019). Rice blast, caused by the fungus *Magnaporthe oryzae*, is one of the most serious fungal diseases affecting rice. However, infections may be controlled by utilizing resistant cultivars (Mohiddin *et al.,* 2021). In Egypt, breeding for cultivars with high levels of blast resistance is one of rice breeders' top priorities. The main factor for resistance to rice blast disease to break down is pathogenic diversity, which is why susceptible cultivars result in a significant yield loss. Pathotypes can only be discovered through pathogenicity study utilizing a collection of diverse rice varieties that are generally distinct and carry different resistance genes (Shahriar *et al.*, 2020). The major insect pest of rice, stem borer (*Chilo agamemnon* Bles.), is one of the biotic stresses and a significant constraint on rice production. Since it provides a practical and environmentally friendly strategy, breeding for insect-resistant rice varieties has proven a cost-effective method of integrated pest management (Al-Daej *et al.*, 2022). This study describes the processes utilized to produce the new high yielding variety Giza 183, as well as the best culture practices for maximizing the new variety's production potential.

MATERIALS AND METHODS

Breeding Methodology:

A total of 342 crosses were examined in the experimental field of the Rice Research and Training Center, Egypt, in 2010. The cross between Giza 178 and SKC23893 was one of the crosses used to develop a new breeding population. In order to create a novel F1 recombination, the high-yielding Giza 178 with a medium duration of 135 days and tolerance to salinity was crossed with the japonica type SKC23893 with early ripening and good grain quality. The procedures for releasing the promising line GZ 10848-1-2-2-1 as the new variety "Giza 183" started with crossing to get the fixed line and evaluation in yield trials (preliminary, regional, final, and verification trials) at the distinctness, uniformity, and stability (DUS) and value of cultivation and use (VCU) tests as variety registration requirements (Figure 1). The essential considerations to advance selected plants or lines through the generations were grain yield, duration, plant height, phenotypic acceptability, and tolerance or resistance to abiotic or biotic stresses.Grain quality including hulling%, milling%, head rice%, amylose content and cooking of the new variety Giza 183 and three check cultivars (Sakha101, Sakha102 and Sakha104) were evaluated according to Juliano (1971); standard evaluation system (2013).

Performance of Giza 183 under cyclic irrigation system:

One field experiment was carried out on the farm of the Rice Department in Sakha, Kafer El-Sheikh governorate, Egypt. During the 2019 and 2020 growing seasons, we will understand the performance of eight rice genotypes as cultivated ones as well as some newly promising Indica and Japonica rice varieties under a cyclic irrigation system. In a strip block design with three replications, irrigation cyclic treatment was arranged in the first main block, which expanded from contentious flooding (C.F.), contentious saturation (C.S.), cyclic irrigation every 5 days, cyclic irrigation every 10 days, and cyclic irrigation every 15 days. While rice genotypes Sakha 107, Sakha 108, Giza 177, Giza 179, GZ 10590-1-3-3-2, GZ 9399-4-1-1-3-2-2, Giza 183, and Korea 27 were designated in the second main block, Two weeks after transplanting, until physiological maturity, cyclic irrigation systems were applied.

Performance of Giza 183 under salt stress problem:

The new variety Giza 183 has been evaluated under salt stress at EL-Sriw Agriculture Research Station during 2019 to 2022 rice seasons in regional and final yield experiments and agronomy program to investigated the performance of the new promising line under deferent salinity levels as indicted in the result part.

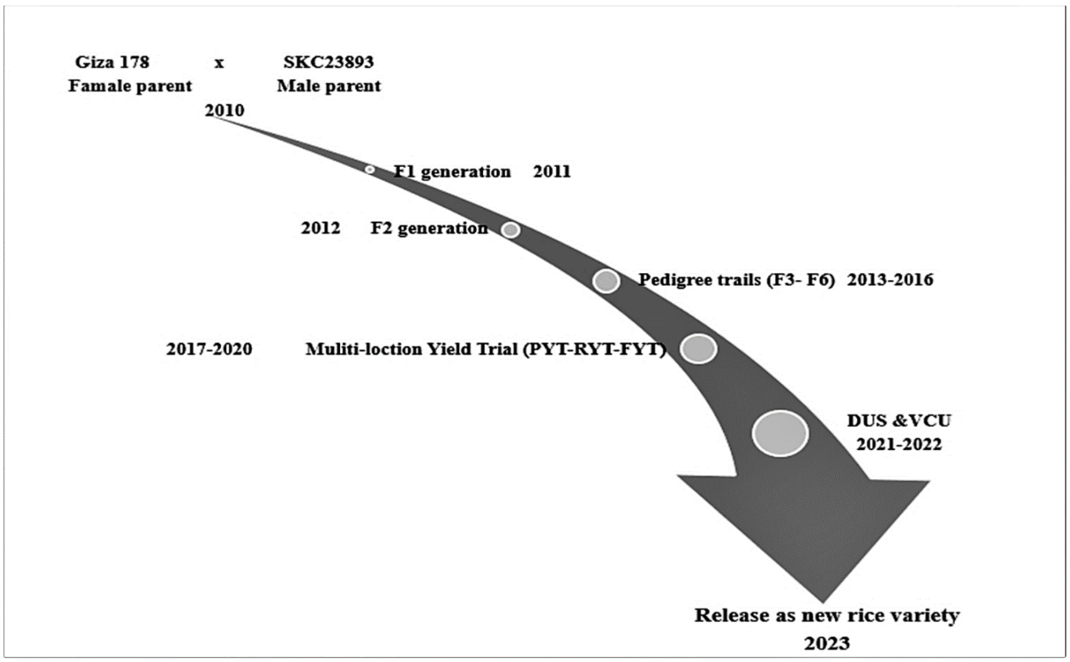


Fig. 1. The procedures of releasing Giza 183

Evaluation of different rice genotypes against blast disease

Field experiments under natural infection:

Blast nursery

Five rice genotypes, i.e., Giza 177, Giza 178 (resistant checks), Sakha 101, Sakha 104 (susceptible checks), and GZ 10848 (new genotype), were evaluated for seedling reaction under blast nursery (natural infection) at three locations, i.e., Sakha (Kafr El-Sheikh), Gemmiza (Gharbia), and Zarzoura (Beheira) governorates, with three replications for each. The seedbed was prepared by adding manure fertilizer during land preparation (20 m3/ha). Each entry was planted in five rows, each 50 cm long and 15 cm apart. Three replicates were performed for each entry. Sakha 101 and Sakha 104 were used as sources of blast inoculum, while Giza 177 and Giza 178 were used as resistant checks. The resistant and susceptible checks were cultivated alternately with five rows of each tested entry. The experiments were conducted. The sowing date was done in the first week of June from the 2020 to 2022 growing seasons. Natural infection was developed, and plants were scored at 40–50 days after sowing for leaf infection using the Stander Evaluation System (SES) of a (0–9) scale designed by IRRI (2013) as follows:: leaf blast score1-2= resistant (R), 3= moderately resistant (MR), 4-6 = susceptible (S), 7-9 = highly susceptible (HS).

Multi-location and variation evaluation

A multi-location test was conducted to evaluate the level of resistance level of the tested genotypes at tillering and mature growth stages to blast infection. At 2020 season, rice genotypes were distributed at 7 locations i.e., Fowa and Qallen (Kafrelshiekh), Meat Azone (Dakahlia), Etayelbarod (Behera), Qtour and Bassion (Gharbia) and Hahea (Sharkia). Rice genotypes were distributed to at 7 locations in 2020 as i.e., Fowa and Qallen (Kafrelshiekh), Meat Azone (Dakahlia), Etayelbarod (Behera), Qtour and Bassion (Gharbia) and Hahea (Sharkia). While, while, 10 location were distributed in at 2021 season as i.e., Sidi salem & Kafrelshiekh (kafrelshiekh), Mansoura and Dekarnes (Dakahlia), Zagazig & Abokber (Sharkia) and Bassion&kotor (Gharbia) governorates. Wwhile, in at 2022 season the tested genotypes were distributed at 13 different locations as i.e., Kafrelshiekh (Desouq, Fowa, Kafrelshiekh), Behera (Eltai elbaroud, Kafr eldawar, Mahmoudia), Dakahlia (Sherbeen, Dekernes, Metfaris, Mansoura), Sharkia (Kafrsaqr, Abokaber) and Gharbia (Elmehala, Bassioun, Kotor).

Rice cultivars genotypes were nursered at breeding experimental field, the nursery was fertilized with 100 Kg/ fed 15 % P_3O_5 and 60Kg 46.5% N/ feddan incorporated into the dry soil. Thirty day-old seedlings were transferred for transplanting at different the aforementioned locations on at demonstration farmers' fields at different rice governorates. The plot size was 1× 3m, and the seedlings were transplanted in rows with 3-4 plants /hill. The nitrogen fertilizer was used applied in the form of urea (46.5%N) at the rate of 60 Kg nitrogen per feddan. Blast reaction was recorded during rice growing season at 20-day intervals according to IRRI (2013).

Evaluation of rice genotypes against different physiological races of *Pyricularia oryzae* under greenhouse conditions during the 2020–2022 seasons:

Typical blast lesions on leaves and panicles were collected from different cultivars and governorates as 37, 56, and 47 during the 2020, 2021, and 2022 seasons, respectively. One hundred and forty isolates were identified using international differential varieties (Atkins et al., 1967) at the rice pathology department in Sakha, Kafrelshiekh. Seeds of each genotype were seeded in plastic trays (30 x 20 x 15 cm). Each tray consisted of 10 rows, representing two rows for each genotype with three replicates for each. The trays were kept in the greenhouse at 25–30 oC and fertilized with urea at 46.5% N (5 g/tray). Seedlings were ready for inoculation at the 3–4 leaf stage, about 3–4 weeks after sowing. Rice genotypes were inoculated with individual physiological *Pyricularia oryzae* races in greenhouse conditions. P. oryzae-identified races were grown and multiplied on banana medium under florescent light for ten days at 28 oC for spore production to prepare the artificial inoculation for rice genotypes. The different physiological races were sprayed using an electrical spray gun with spore suspension adjusted to 5x105 spores/ml. Seedlings were incubated for 24 hours at 100% relative humidity (RH). Plants were moved to the incubation room, which was supplied with an automatic system for temperature adjustment between 25 and 30 °C. RH was maintained at about 95% by fine sprinklers. Seven days after inoculation, typical blast lesions appeared and were scored using the 0–9 scale SES of IRRI (2013).

Insect methodology:

Varietal evaluation for RSB was evaluated at the Experimental Farm of Rice Research and Training Center, Sakha Agricultural Research Station, Kafrelsheikh, Egypt, from the 2019 to 2022 rice seasons. Eight rice Indica/Japonica genotypes, including Giza 183, were evaluated for susceptibility to Chilo agamemnon infestation. The seeds were obtained from the Rice Research Department at the Field Crops Research Institute. The experiment was laid out statistically in a randomized complete block design with three replications. One seedling was transplanted in the permanent field 25 days after sowing with a spacing of 20 x 20 cm between plants in 5 m-long rows. All agronomic practices were done as recommended except insect control with rice crops during the seasons. The pedigree of the studied entries is listed in Table 1.

Evaluation of rice genotypes to Rice Stem Borer (RSB) Infestation:

Forty days after transplanting, dead heart symptom of the rice plants was examined to determine infestation. From each plot, ten random hills were cut at the soil surface. The total number of tillers and those having dead hearts were counted, thus, the dead heart percentage was calculated. Three weeks prior to harvest, white head percentage was estimated. The evaluated entries were categorized as follows: 0 - 3% white heads (WH), resistant, > 3 -6 % WH, moderately resistant, > 6 - 9 % WH, moderately susceptible, > 9 - 12 % WH, susceptible, > 12 % WH, highly susceptible RRTC (2013).

Table 1. Indica/Japonica pedigree of rice genotypes

Genotype	Parentage	Type
GZ10590-1-3-3-2	GZ8126-1-3-1-2/HR17570-21-5-2-5-2	Indica/Japonica
Giza 183	Giza 178/SKC23893	Indica/Japonica
GZ11190-3-13-4-1	Giza 178/GZ6296	Indica/Japonica
GZ11190-3-3-1-1-1	Giza 178/GZ6296	Indica/Japonica
GZ11453-17-7-7-5	Giza 178/Suweon 370	Indica/Japonica
GZ10590-1-1-3-9-1	GZ8126-1-3-1-2/HR17570-21-5-2-5-2	Indica/Japonica
Giza 178	Giza 175/Milyang 49	Indica/Japonica
Giza 179	GZ1368-S-5-4/ GZ6296	Indica/Japonica

Chemical control for accompanied weeds to Giza 183 in broadcast-seeded rice:

A field trail was conducted at the experimental farm of Rice Research & Training Center, Sakha Agricultural Research Station during 2021 and 2022 summer seasons to control accompanied weeds for Giza 183 as promising line under broadcast-seeded rice. Randomized Complete Block Design (RCBD) with three replications was used. Plot size was 16 m^2 (4 x 4 m). Tested Weed control treatments were as follow:

1- Saturn 50% EC (thiobencarb 2.38 kg ai ha^{-1}) at 9 days after seeding (DAS) (W1).

2- Kortika 12% EW as ready mix of cyhalofop-butyl 10.5% + fenoxaprop-ethyl 1.5% at rate of (0.0127 + 0.0893 kg ai ha-1) at 25 DAS (W2)

3- Liquid Gold 29% OD as ready mix of penoxsulam 3% + fluroxyper-meptyl 26% at rate of (0.012 + 0.104 kg ai ha-1) at 15 DAS (W3).

4- Saturn 50% EC (2.38 kg ai ha-1) at 9 DAS followed by Kortika 12% EW at 35 DAS (W4).

5- Saturn 50% EC (2.38 kg ai ha-1) at 9 DAS followed by followed by Liquid gold 29% OD at 25 DAS (W5).

6- Saturn 50% EC (3.571 kg ai ha-1) at 9 DAS (W6).

7- Saturn 50% EC (3.571 kg ai ha-1) at 9 DAS followed by Kortika 12% EW at 35 DAS (W7).

8- Saturn 50% EC (3.571 kg ai ha-1) at 9 DAS followed by Liquid Gold 29% OD at 25 DAS (W8).

9- Hand weeding three times at 20, 40 and 60 DAS (W9).

10- Weedy check (untreated) (W10).

Saturn 50% EC added mixed with sand on flooded land then kept field flooded for three days after application. Kortika 12% and Liquid Gold 29% were sprayed in 300 liter water per hectare on wet land by using Knapsack sprayer then the soil was irrigated after 24 hours from herbicidal application.

Molecular analysis of the Giza183 as compared with other Egyptian genotypes:

Genomic DNA isolation:

Total genomic DNA was extracted from 14 genotypes at seedling stage, after crushing in liquid nitrogen via CTAB method (Murray and Thompson, 1988). The quantity and quality of DNA were adjusted based on the diluted uncut lambda phage DNA as a size standard on 0.8% agarose gel electrophoresis. The concentration of DNA was adjusted to approximately 15ng/µl for PCR reaction.

Table 2. List of SSR primer sequences and chromosome number

Primer name	Chromosome number	Sequence	
		Forward	Reverse
RM5	1	TGCAACTTCTAGCTGCTCGA	GCATCCGATCTTGATGGG
RM148	3	ATACAACATTAGGGATGAGGCTGG	TCCTTAAAGGTGGTGCAATGCGAG
RM164	5	TCTTGCCCGTCACTGCAGATATCC	GCAGCCCTAATGCTACAATTCTTC
RM166	2	GGTCCTGGGTCAATAATTGGGTTACC	TTGCTGCATGATCCTAAACCGG
RM201	9	CTCGTTTATTACCTACAGTACC	CTACCTCCTTTCTAGACCGATA
RM208	2	TCTGCAAGCCTTGTCTGATG	TAAGTCGATCATTGTGTGGACC
RM224	11	ATCGATCGATCTTCACGAGG	TGCTATAAAAGGCATTCGGG
RM246	1	GAGCTCCATCAGCCATTCAG	CTGAGTGCTGCTGCGACT
RM263	2	CCCAGGCTAGCTCATGAACC	GCTACGTTTGAGCTACCACG

Table 2 continued			
RM315	1	GAGGTACTTCCTCCGTTTCAC	AGTCAGCTCACTGTGCAGTG
RM430	5	AAACAACGACGTCCCTGATC	GTGCCTCCGTGGTTATGAAC
RM440	5	CATGCAACAACGTCACCTTC	ATGGTTGGTAGGCACCAAAG
RM510	6	AACCGGATTAGTTTCTCGCC	TGAGGACGACGAGCAGATTC
RM512	12	CTGCCTTTCTTACCCCCTTC	AACCCCTCGCTGGATTCTAG
RM555	2	TTGGATCAGCCAAAGGAGAC	CAGCATTGTGGCATGGATAC
RM585	6	CAGTCTTGCTCCGTTTGTTG	CTGTGACTGACTTGGTCATAGG
RM3586	3	GAAGAGAGAGCCAGAGCCAG	ACACGATCGAGCTAGAAGACG
RM3735	4	GCGACCGATCAGCTAGCTAG	ATAACTCCTCCCTTGCTGCC
RM5687	4	GATCGCTGGCGATTGATC	GACTTGTGGGGTGGTTTTTG
RM7601	7	GCCTCGCTGTCGCTAATAC	CAGCCTCTCCTTGTGTTGTG
RM527	**6**	GGCTCGATCTAGAAAATCCG	TTGCACAGGTTGCGATAGAG

PCR amplification and electrophoresis:

A set of 21 SSR markers were used for the molecular analysis. Primer names, sequences and chromosome number are listed in Table (2). PCR amplification reactions were using 2XGoTaq Green Master Mix (Promega, USA.) as indicated by the manufacturer. The reaction mixture was first denatured for 5 min at 95°C, followed by 35 cycles of denaturation for 1 min at 94°C, annealing at Tm - 2°C for 30 seconds and elongation at 72°C for 1min, and a final extension at 72°C for 10 min. PCR amplification was loaded in 3% agarose gel containing ethidium bromide for electrophoresis in 1XTAE (pH8.0). DNA ladder (100bp) was used for determination of size of amplicons. The gel was run at 60 volts (2.5V/cm) for 3 hrs and analyzed using Biometra gel-documentation system (BioDoc, Biometra, Germany). Scoring of amplified bands was done as present (1) or absent (0) for each genotype and primer pair. Genetic similarity coefficients based molecular data were employed to construct a dendrogram via the unweighed pair group method with arithmetic average (UPGMA) sequential agglomerative hierarchal nested (SHAN) cluster.

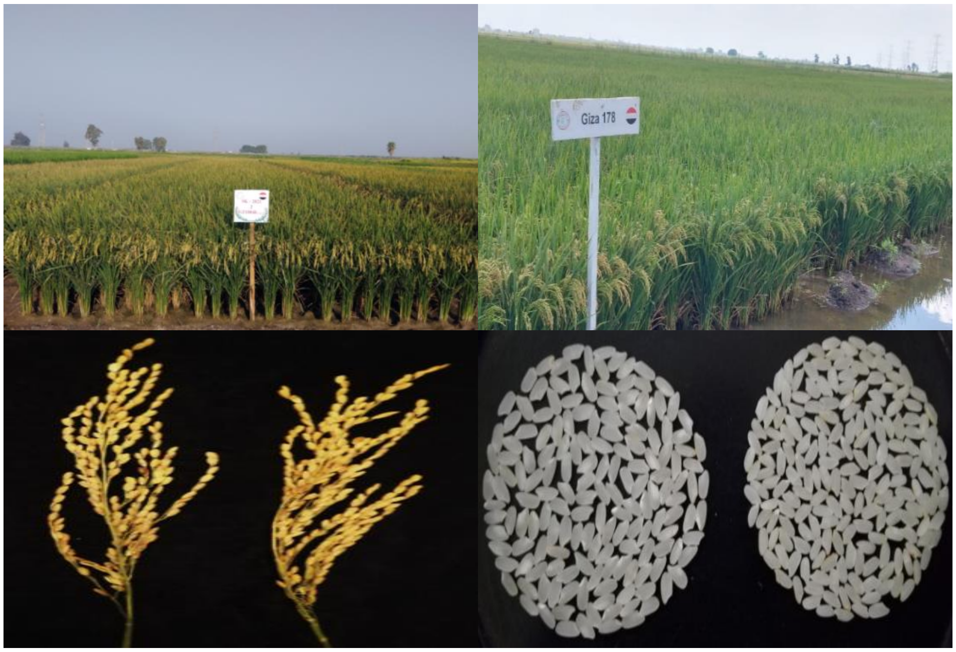
RESULTS

Performance of Giza 183 under normal condition:

The grain yield average of the new variety Giza 183 was significantly higher than the commercial cultivars under normal condition as showed in table 3. Giza 183 is considered an early maturing variety, it recorded 122 days as total duration compared to Giza 178 which recorded 135 days under the same condition. Furthermore, it saved water consumption where it consumed 11904 m3/ha compared to Giza 178 consumed about 13059 m3/ha. Giza 183 is suitable to mechanization harvest due to its short stature compared to Sakha 104 and Sakha 102. Regarding to grain quality traits, Giza 183 recorded 71% milling recovery and low amylose content (18%) without any significant with Giza 178.

Table 3. Grain yield and ancillary traits of selected promising line Giza 183 compared to some commercial cultivars

Character	Giza 183	Giza 178	Sakha 104	Sakha 102
<u>Grain yield (t/ha)</u>				
Preliminary Yield Trial	10.88a	10.54a	10.30b	9.60c
Regional Yield Trial	10.47a	10.16a	9.60c	9.40c
Final Yield Trail	10.70a	10.30a	9.53c	9.30c
Average	10.68	10.33	9.80	9.43
Increase % compared to commercial cultivars (t/ha)		0.350	0.880	1.25
Duration (day)	122c	135a	135a	125b
1000 grain weight (g)	25b	22c	28a	28a
Plant height (cm)	98bc	100b	107a	106a
Water consumption (m3/ha)	11904c	13095a	13810a	12857a
Water use efficiency	0.897	0.789	0.710	0.734
Milling recovery (%)	71b	71b	72a	72a
Amylose content (%)	18a	18a	17a	17a



Giza 183 *Giza 178* *Giza 183* *Giza 178*

Fig. 1. Photo of rice cultivar Giza 178 and Giza 183

The data in Table 4 showed that indica/japonica genotypes; GZ 10590-1-3-3-2, Giza 183, GZ 11190-3-13-4-1, GZ 11190-3-3-1-1-1 and GZ 11453-17-7-7-5 were earlier than Giza 178 by around 10 days, and shorter in plant height except GZ 11190-3-3-1-1-1. The lines GZ 11190-3-3-1-1-1, GZ 10590-1-3-3-2 and GZ 11190-3-13-4-1 recoded the highest values of number of panicles plant^{-1} compared with Giza 178 as indica/japonica type. While, the line GZ 10590-1-3-3-2 gave number of filled grains panicle^{-1} higher than Giza178. For grain yield, the indica/japonica genotypes Giza 183 and GZ 10590-1-3-3-2 gave 11.10 and 11.00 t/ha, while, Giza 178 and Giza 179 gave 10.90 and 10.70 t/ha, respectively. For japonica types genotypes; GZ 10101-5-1-1-1, GZ 10590-1-1-3-9-1, GZ 10686-2-1-3-2, GZ 10804-3-1-2-2-2, GZ 11245-1-3-3-2 and GZ 11245-1-3-3-3 exhibited the highest values for number of panicles plant^{-1} and number of filled grains panicle^{-1} compared to the japonica type Giza 177. In addition, the promising lines were shorter than Giza 177. Furthermore, there was no difference between the japonica promising lines and Giza 177 in duration (Table 4).

Table 4. Duration, plant height, number of panicles, panicle length and number of filled grains for studied rice genotypes

Genotype	**Duration (day)**	**Plant height (cm)**	**No. of panicles/plant**	**No. of filled grains/panicle**	**Grain yield (t/ha)**
GZ 10590-1-3-3-2	123.3	94.7	24.7	165.0	**11.0**
Giza 183	124.3	94.0	24.0	147.7	**11.1**
GZ 11190-3-13-4-1	123.3	99.0	24.7	146.3	**10.5**
GZ 11190-3-3-1-1-1	124.3	100.3	25.0	151.3	**10.5**
GZ 11453-17-7-7-5	124.7	87.0	23.3	133.3	**10.2**
GZ 10101-5-1-1-1	124.3	98.0	22.0	130.0	**9.7**
GZ 10590-1-1-3-9-1	124.7	97.0	22.3	136.7	**9.8**
GZ 10686-2-1-3-2	125.3	97.0	21.3	142.0	**10.7**
GZ 10804-3-1-2-2-2	125.3	98.3	22.3	137.7	**10.7**
GZ 11245-1-3-3-2	124.3	93.3	23.3	137.7	**10.6**
GZ 11245-1-3-3-3	125.0	93.0	23.3	140.7	**10.7**
Giza 178	135.3	100.0	23.3	150.3	**10.9**
Giza 179	121.0	96.0	23.3	142.7	**10.7**
Giza 177	125.0	100.0	18.0	128.0	**9.7**
LSD=0.05	**0.85**	**1.61**	**1.10**	**7.11**	**0.15**
Reprinted data from Anis *et al.* (2022)					

Performance of Giza 183 under cyclic irrigation system:

Data obtained statistically revealed that, a negative relationship was found between cyclic irrigation treatments and rice grain yield of all rice genotypes tested under this study. Among cyclic irrigation system treatments, when cyclic irrigation increased rice grain yield sharply decreased. Both of contentious flooding and contentious saturation statistically recorded the highest and par grain yield values (10.65, 10.81, 10.36 and 10.70 t/ha) in both studied seasons. Data obtained also, revealed that when the cyclic irrigation system increased from 5 days up to 15 days the grain yield reduced by (30.14% and 30.34%) based on the yield produced with contentious and saturation conditions. With regards to rice genotypes used in this study, data obtained stated that, there were a significant superiority of all Indica/Japonica rice including the cultivated Giza 179 variety and the new variety Giza 183 in grain yield compared with the rest tested varieties in both studied seasons. These means that Giza 183 recorded the highest grain yield which, was parallel with Giza 179 (10.09 and 10.09 t/ha) and (10.51 and 10.08 t/ha) in both seasons, respectively. The rest three promising rice Indica/Japonica lines GZ 10590-1-3-3-2, GZ 9399-4-1-1-3-2-2 and Korea 27 came in the following rank and significantly recorded the par grain yield values (Table 5).

Table 5. Grain yield (t/ha) and yield reduction (%) as affected by irrigation cyclic system and rice genotypes during 2019 and 2020 seasons

Treatments	2019		2020	
	Grain yield (t/ha)	**Yield Reduction (%)**	**Grain yield (t/ha)**	**Yield Reduction (%)**
Continuous flooding	10.65 a	-	10.81 a	-
continuous saturation	10.36 a	2.72 d	10.70 a	1.02 d
Every 5 days	9.93 b	6.85 c	10.14 b	6.20 c
Every 10 days	9.09 c	14.65 b	9.11 c	15.73 b
Every 15 days	7.44 d	30.14 a	7.53 d	30.34 a
F. Test	**	**	**	**
Sakha 107	8.76 e		9.00 e	
Sakha 108	9.26 d		9.81 c	
Giza 177	8.37 f		9.11 d	
Giza 179	10.09 a		10.51 a	
GZ 10590-1-3-3-2	9.84 b		9.86 c	
GZ 9399-4-1-1-3-2-2	9.87 b		9.73 c	
Giza 183	10.09 a		10.08 b	
Korea 27	9.67 c		9.72 c	
F. Test	**	**	**	**
Interaction	**	**	**	**

Interaction effect:

With regards to the interaction effect between all cyclic irrigation system and rice genotypes used, data obtained exhibited that a highly significant differences were found between all treatments where the Indica/Japonica cultivated rice variety Giza 179 with both continuous flooding and continuous saturation recorded the first rank (11.43 and 11.53 t/ha) followed by Giza 183 with the same irrigation cyclic system used. While, when the cyclic irrigation starts to be used in case of 5 days, the new variety (Indica/Japonica) Giza 183 showed a marked superiority over than Giza 179 in the first season, and still in the second rank in the second season. Data also demonstrated that, there were a marked stability in rice grain yield under both severe cyclic irrigation system every 10 and 15 days with Giza 183 and recorded the highest grain yield (9.83, 9.50, 8.47 and 8.50 t/ha) in both studied seasons, respectively.

Table 6. Grain yield (t/ha) as affected by the interaction between irrigation cyclic system of water supply and rice genotypes in 2019 and 2020 seasons

	2019							
	Sakha107	**Sakha108**	**Giza177**	**Giza179**	**GZ10590**	**GZ9399**	**Giza 183**	**Korea 27**
C. F	10.37	11.42	10.05	11.43	10.43	10.47	10.72	10.30
C. S	9.73	10.50	9.53	11.53	10.45	10.48	10.72	10.27
5	8.97	9.17	8.87	10.63	10.30	10.40	10.72	10.32
10	8.12	8.41	7.87	9.45	9.90	9.75	9.83	9.35
15	6.62	6.78	5.53	7.70	8.10	8.23	8.47	8.10
	2020							
	Sakha107	**Sakha108**	**Giza177**	**Giza179**	**GZ10590**	**GZ9399**	**Giza 183**	**Korea 27**
C. F	10.15	11.39	10.75	11.48	10.50	10.58	11.03	10.61
C. S	9.85	10.83	10.64	11.47	10.78	10.88	10.61	10.50
5	9.26	10.52	9.24	10.89	10.27	9.85	10.74	10.36
10	8.65	9.07	8.32	9.39	9.45	9.28	9.50	9.23
15	7.11	7.26	6.61	8.27	8.30	8.07	8.50	8.00

Behavior of the new variety Giza 183 under salt stress

The new variety Giza 183 was evaluated under salt stress with varying salinity level. As seen in Table7 Giza 183 significantly surpassed both sensitive and tolerant check varieties under all salinity levels. The salinity score during vegetative growth stage showed the superiority of Giza 183 followed by Giza 178 and Giza 177.

Table 7. Grain yield and some yield attributes of the new variety Giza183 VS the two varieties during 2020~2022 seasons

	2020 season							
	Days to heading (day)	**Plant height (cm)**	**Panicle hill^{-1}**	**Panicle weight (g)**	**Fertility (%)**	**Grain yield (t/ha)**	**Harvest index (%)**	**Salinity score**
Giza177 (salt sensitive check)	96b	80.0c	9.2c	1.8c	70.0c	2.65c	0.34	7
Giza178 (salt tolerant check)	100a	92.6a	15.6b	2.32b	87.0b	5.7b	0.42	2.5
Giza 183	90c	88.6b	17.4a	2.66a	91.0a	6.5a	0.45	1.0
EC dS/m	7.6							
	2021 season							
Giza177 (salt sensitive check)	98.0b	87.0b	9.2c	1.2c	65.0c	1.4c	0.29c	7.5
Giza178 (salt tolerant check)	99.0a	90.0a	16.1a	2.31b	88.0b	5.08b	0.41b	2.0
Giza 183	92.0c	82.0c	15.1ab	2.53a	89.6a	5.24a	0.44a	1.5
EC dS/m	9.0							
	2022 season							
Giza177 (salt sensitive check)	98.0a	96.0ab	8.76b	2.00	60.0c	1.31c	0.27c	
Giza178 (salt tolerant check)	99.0a	97.0a	15.2a	2.80	86.0b	4.19b	0.40b	2
Giza 183	90.0b	90.3c	15.3a	3.05	89.0	4.50a	0.45a	1
EC dS/m	9.5							

Evaluation of Giza183 under high and medium salinity levels

In this experiment, Giza 183 was evaluated under two varying salinity levels whereas they are convenient with the salinity levels over the rice cultivation area in Egypt. The findings listed in Table 8 confirmed that Giza 183 is valid for cultivation under wide spectrum range of saline soil over all Egypt, particularly in rice cultivation area. Data in Table 8 showed that Giza 183 was the best variety under both salinity level without significant differences with those produced by Giza 179.

Table 8. Grain yield (t/ha) of newly salt tolerant rice genotype of Giza 183 under medium and high salinity levels at EL-Sirw agricultural research station during 2022 season

Genotype	Salinity levels dS/m	
	Medium salinity level (6.0)	**High salinity level (9.0)**
GZ 9399-4-1-1-3-2-2	8.35b	4.83g
Giza 183	8.75a	5.35e
Giza 177	5.45e	1.50j
Giza 178	8.40b	4.85g
Giza 179	8.51ab	5.21ef
Sakha 104	7.15c	3.25h
Sakha 105	4.85g	1.66j
Sakha 106	6.15d	2.55i
EC dS/m	2.0	

Response of Giza 183 to nitrogen levels under salt stress:

The response of Giza 183 compared to Sakha super 300 was tested under four nitrogen levels; zero, 55, 110 and 165 Kg N/ha. Generally, Giza 183 showed superiority in grain yield than Sakha super 300 (Table 9). Rice grain yield recoded it highest value when rice plants were fertilized to the highest nitrogen level (165 kg/ha). Regarding the interaction effect, it had significant effect on rice grain yield. Giza 183 responded significantly to nitrogen rate up to 165 kg/ha, while Sakha super 300 got its highest yield at 110 kg/ha of nitrogen level (Table 10).

Table 9. Grain yield of rice as affected by rice varieties and various nitrogen levels under salt stress during 2022 season

Variety	Grain yield (t/ha)
Sakha super 300	6.03b
Giza 183	6.69a
Nitrogen rates (Kg/ha)	
Control	4.90d
55	6.41c
110	6.90b
165	7.23a
EC	7.70

Table 10. Grain yield t/ha of rice affected by the inter action between rice and nitrogen levels in 2022 season

Nitrogen level (Kg/ha)	Rice variety	
	Giza 183	**Sakha Super 300**
control	5.0	4.8
55	6.78	6.04
110	7.20	6.60
165	7.79	6.68
LSD 0.05	0.4	

Response of Giza 183 to foliar spay of some micro and macro nutrients:

Applying foliar spray of zinc, boron and calcium as well as their combination on rice at certain rice growth stage under soil salinity (6.5 dS/m) induced marked improvement in grain yield of Giza 183 over the control treatment. The combination of calcium and boron gave the highest grain yield without any significant differences with the combination of calcium and zinc (Table 11).

Table 11. Rice grain as affected by spraying some micro and macro nutrients under soil salinity condition during 2022

Treatment	Grain yield (t/ha)
Control	6.51c
Zinc	6.97b
Boron	7.01b
Zinc+boron	6.80b
Calcium boron	7.54a
Calcium zinc	7.42a
EC dS/m	6.50

Evaluation of different rice genotypes against blast disease under natural infection:

Blast nursery:

The rice genotypes were evaluated at the seedling stage in blast nurseries at three locations; i.e. Sakha, Gemmiza and Zarzoura from 2020 to 2022 growing seasons under natural infection as shown in Table 12. The results showed that the genotypes Giza 177, Giza 178 and Giza 183 were resistant at all blast nursery locations. The susceptible checks Sakha 101 and Sakha 104 were observed susceptible to highly susceptible to blast. Development of resistant varieties is considered as the most cost-effective and sustainable way to manage rice blast. The New variety Giza 183 proved resistance at different locations from 2020 to 2022 seasons.

Table 12. Reaction of leaf blast disease for five rice genotypes under field conditions during 2020 to 2022 growing seasons

Rice genotypes	2020			2021			2022		
	Sakha	Gemmiza	Zarzoura	Sakha	Gemmiza	Zarzoura	Sakha	Gemmiza	Zarzoura
Giza 183	R	R	R	R	R	R	R	R	R
Giza 177 (R check)	R	R	R	R	R	R	R	R	R
Giza 178 (R check)	R	R	R	R	R	R	MR	R	R
Sakha 101 (S check)	HS	HS	HS	HS	HS	HS	HS	HS	HS
Sakha 104 (S check)	S	HS	HS	HS	S	HS	HS	HS	HS
S= Susceptible, SH= Highly Susceptible, R= Resistance, MR= Moderate Resistance									

Multi-location test:

Rice genotypes were evaluated at the tillering and adult stages in twenty-nine locations covered the rice growing regions during 2020, 2021 and 2022 seasons in Egypt. The results showed that the commercial varieties Giza 177, Giza 178 and the new variety Giza 183 were resistant at twenty-nine locations as mentioned in Table 13. While the susceptible check were varied to blast infection as susceptible to highly susceptible at different locations from 2021 to 2022 seasons in Table 13.

Evaluation of rice genotypes against 140 physiological races of *P. oryzae* under Greenhouse conditions:

140 hundred blast isolates collected from rice growing governorates from 2020 to 2022 were identified according to their reaction on the international differential varieties in the greenhouse under artificial inoculation. 140 *P. oryzae* identified races were belonging to the seven groups IA, IB, IC, ID, IF, IH and II. The five genotypes were scored for typical leaf blast lesions. The results showed that the new variety Giza 183 was revealed resistant with 140 tested blast races while the resistant checks were also resistant (Table 14).

Table 13. Evaluation of five rice genotypes at Multi-locations during2020, 2021 and 2022 seasons

Rice genotypes	Blast Reaction of different genotypes at different locations/ seaseon		
	2020	**2021**	**2022**
Giza 183	R	R	R
Giza 177 (R check)	R	R	R
Giza 178 (R check)	R	R	R
Sakha 101 (S check)	S=5* (Qallen, Etayelbarod, Qtour, Hahea andMeat Azone)	S=5(Kafrelshiekh, Sidi salem, Dekarnes, Abokbeer, Bassion,	S=7 (Desouq, Fowa, Eltaielbaroud, Sherbeen, Metfaris, Abokaber and Bassioun)
Sakha 104(Schech)	S= 4 (Qallen, Etayelbarod, Qtour, Hahea)	S=4(Kafrelshiekh, Sidi salem, Mansoura and Zagazig)	S=5(Kafrelshiekh, Fowa, Mahmoudia, Sherbeen, and Bassioun)
Total No of tested locations	7	9	13
***=Number of infected locations**			

Some blast races are able to infect both cultivars Sakha 101 and Sakha 104. In case of the blast races collected in 2020 season, the known susceptible rice cultivars, Sakha 101 and Sakha 104 were infected with 21 and 13 blast races, respectively, out of the 37 tested races. Three blast race didn't able to infect tested genotypes. Within 2021, Sakha 101 and Sakha 104 were infected with 47 and 13 blast races out of 56 races, respectively. In 2022 season, Sakha 101 and Sakha 104 were infected with 27 and 20 blast races out of 47 race, respectively (Table 14).

Table 14. Evaluation of rice genotypes against Blast races under greenhouse conditions during 2020 to 2022 seasons

Seaseon	Blast reaction with Identified-races		
	2020	**2021**	**2022**
Total No of used blast races groups= 140	37= 3 (IA), 5(IC), 22(ID), 2(IH), 5(II)	56= 8(IB), 14(IC), 17(ID), 8(IH), 2(IE), 7(II)	47=12(IC),19(ID),1(IF),4(IH),11(II)
Giza 183	0	0	0
Giza 177 (R check)	0	0	0
Giza 178 (R check)	0	0	0
Sakha 101 (S check)	21= 1(IC-7), 1(IC-30), 1(ID-13), 14(ID-15), 1(IH-1), 3(II-1),	47= 1(IB-3), 1(IB-39), 1(IB-41), 1(IC-3), 1(IC-9), 1(IC-11),2(IC-13),3(IC-15), 1(IC-16), 2(ID-9),4(ID-11), 2(ID-13), 14(ID-15), 2(ID-16), 2(IE-7),5(IH-1) and 4(II-1)	27=1(IC-6), 1(IC-7), 1(IC-15), 2(IC-21), 1(IC-31), 1(ID-11), 1(ID-13), 13(ID-15), 1(ID-16), 2(IH-1), 3(II)
Sakha 104 (S check)	13= 1(IA-111), 2(IC-3), 1(IC-15), 2(ID-3), 4(ID-11), 1(ID-15), 2(IH-1)	13= 2(IC-3),1(IC-9), 2(IC-11), 1(IC-13), 1(IC-17), 1(IC-32),1(ID-9), 2(ID-11), 1(IE-7) and 1(II-1),	20=1(IC-1), 2(IC-6), 1(IC-7), 1(IC-11), 1(IC-15), 1(IC-21), 1(IC-27), 1(ID-9), 1(ID-13), 7(ID-15), 1(IF-3), 2(II-1)
S=Susceptible R= Resistance			

Susceptibility of rice entries to Rice Stem Borer (RSB):

The evaluation of rice entries (Table 15) revealed that the stem borer infestation ranged in dead hearts between 4.22% (GZ 10590-1-1-3-9-1) and 17.00 % (GZ 10590-1-3-3-2). However, the dependable evaluation is that of white heads, Giza 183 was moderately susceptible while, the commercial cultivars (Giza 178 and Giza 179) performed as susceptible and moderately susceptible, respectively. Only two entries; GZ 10590-1-3-3-2 and GZ 11190-3-3-1-1-1 were estimated as highly susceptible.

Table 15. Susceptibility of rice entries to rice stem borer infestation at Sakha agricultural research station (average of data, 2019-2022 rice season)

Entry	Dead heart %	White head	
		%	Category
GZ 10590-1-3-3-2	17.00	15.30	HS
Giza 183	7.75	6.45	MS
GZ 11190-3-13-4-1	7.86	6.48	MS
GZ 11190-3-3-1-1-1	11.67	19.60	HS
GZ 11453-17-7-7-5	5.82	4.31	MR
GZ 10590-1-1-3-9-1	4.22	3.75	MR
Giza 178	9.19	9.28	S
Giza 179	9.62	8.12	MS
LSD = 0.05 %			

Chemical control for accompanied weeds to Giza 183 in broadcast-seeded rice:

The dominant weeds were *Echinochloa crus-galli* (barnyard grass), *E. colona* (jungle rice) as grasses, *Cyperus difformis* (small flower) from sedges and *Ammannia baccifera* from broad leaf weeds during the study. Data presented in Table 16 showed that all tested chemical weed control treatments exceeded hand weeding three times in broadcast-seeded rice in reducing dry matter of total weeds in 2021 and 2022. Sequential application of early post-emergence herbicide followed by late post-emergence herbicide was better than single application of herbicides (early or post-emergence herbicide). Thiobencarb at rate of (3.571 kg ai ha^{-1}) at 9 day after sowing followed by Kortika 12% at 35 day after sowing by recommended dose recorded the lowest total weeds dry weights and the best weed control efficiency (156.1 g and 93%), respectively with no significant differences between Thiobencarb at rate of (3.571 kg ai ha^{-1}) at 9 day after sowing followed by Liquid Gold 29% at 25 day after sowing by recommended dose which recorded 172.6 g of total weeds dry weight and 92.2% WCE. While hand weeding ranked seven in weed control efficiency and achieved 64.2%.

The highest grain yield recorded by sequential application of thiobencarb (3.571 kg ai ha^{-1}) at 9 day after sowing followed by the recommended doses of Kortika 12% at 35 day after sowing or Liquid Gold 29% at 25 day after sowing as ready mixes herbicides (11.427 and 10.786), respectively. While weedy check (un-treated plots) produced grain yield less than one ton ha^{-1} (0.799 kg ha^{-1}).

Table 16. Effect of weed control on dry weight of total weeds (g m^{-2}), WCE (%), rice number of panicles m^{-2} and grain yield (t ha^{-1}) in 2021 and 2022 seasons

Treatment	Total weeds dry weight (g m^{-2})		Weed control efficiency (WCE%)		Number of panicles (m^{-2})		Grain Yield (t ha^{-1})	
	2021	2022	2021	2022	2021	2022	2021	2022
W1	600.8 (24.5 c)	510.7 (22.6 c)	73.4	76.7	457.6 e	490.7 f	6.792 e	7.150 f
W2	289.7 (17.0 ef)	256.7 (16.0 f)	87.2	88.3	528.0 cd	544.0 cde	9.777 bc	9.902 cd
W3	344.9 (18.6 de)	341.1 (18.5 e)	84.7	84.5	540.8 c	569.3 bcd	9.479 c	9.583 d
W4	232.9 (15.2 f)	159.9 (12.6 gh)	89.7	92.7	589.6 ab	598.ab	10.382 bc	10.493 bc
W5	240.1 (15.5 ef)	195.6 (14.0 g)	89.4	91.1	555.5 bc	584.0 abc	10.090 bc	10.267 bc
W6	452.7 (21.0 d)	426.5 (20.6 d)	80.0	80.6	513.1 cd	532.0 de	8.451 d	8.708 e
W7	196.8 (14.0 f)	115.4 (10.7 i)	91.3	94.7	603.2 a	617.3 a	11.307 a	11.550 a
W8	213.8 (14.6 f)	131.3 (11.5 hi)	90.5	94.0	588.8 ab	605.3 ab	10.653 ab	10.920 ab
W9	877.4 (29.6 b)	719.4 (26.8 b)	61.2	67.2	492.3de	506.7 ef	6.632 e	7.180 f
W10	2259.7 (47.5 a)	2193.6 (46.8 a)	0.0	0.0	72.0 f	76.0 g	0.800 f	0.797 g

Transformed data of weeds followed by the same letter are not significantly different at 5% level, using Duncan's Multiple Range Test. In a column, means followed by the same letter are not significantly different at 5% level, using DMRT

Molecular analysis:

Molecular analysis using 21 SSR markers was conducted to investigate the genetic diversity between the newly released Egyptian variety Giza183 and other Egyptian rice genotypes. Banding pattern of the most informative SSR marker used for this investigation are presented in Figure 3. Among these genotypes, the variety Giza 183, the indica/japonica Egyptian varieties Giza 178 and Giza 179, and the high quality variety Giza 177.

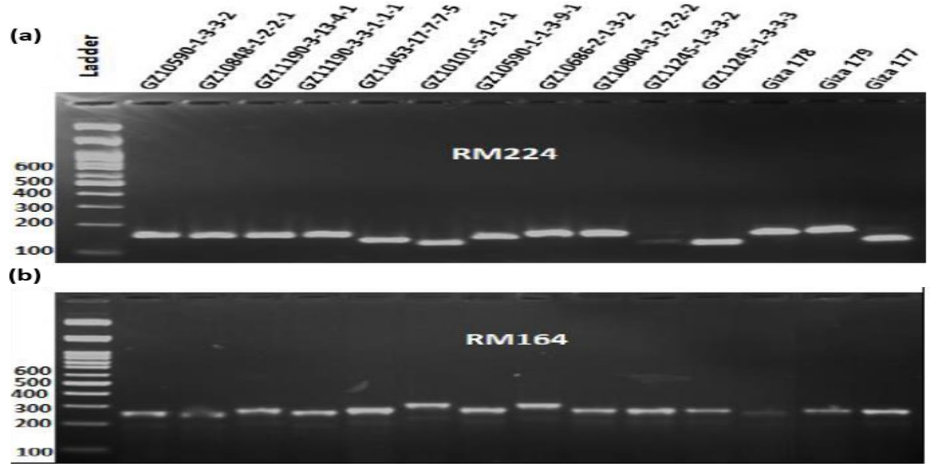


Fig. 3. DNA banding pattern of (a) RM224 and (b) RM164 markers for the 14 rice genotypes

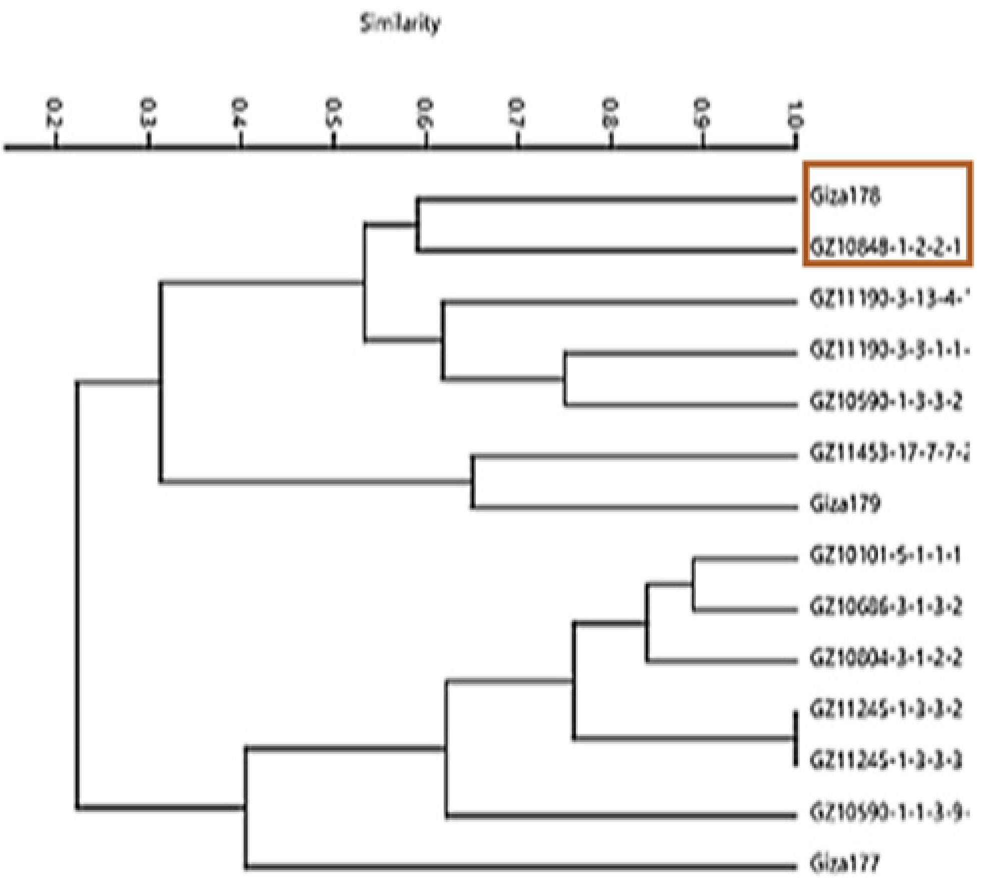


Fig. 4. Dendrogram explaining the genetic relationships among several Egyptian promising and released rice genotypes tested using 21 SSR markers employing UPGMA method (the figure was adopted from, Anis et al., 2022)

The similarity analysis via SSR markers indicated that Giza 183 was clustered in the same main cluster where all genotypes (Giza 178, GZ 10590-1-3-3-2, GZ 11190-3-13-4-1, GZ 11190-3-3-1-1-1, GZ 11453-17-7-7-5 and Giza 179) are Indica/japonica type. Furthermore, Giza 183 was sub-clustered with its parent, the indica/japonica variety Giza178, Figure 4. Generally, the current molecular analysis indicate that the clustering was depending on the heredity and origin fundamentals.

DISCUSSION

Releasing new high yielding variety Giza 183, as well as the best culture practices for maximizing the new variety's "Giza 183" production potential was great challenge in the context of a changing climate. The selected cross was one of 342 crosses were examined in the experimental field of Rice Research &Training Center, Egypt in 2010. In addition, all the procedures were done as the variety registration requirements.

Under normal condition, the grain yield average of the new variety Giza 183 was significantly higher than the commercial cultivars (Table 3). According to FAO (2023) and USDA (2022) Egypt's rice crop has the greater harvested area and the higher estimated yield. Furthermore, Giza 183 was considered an early maturing variety, according to IRRI (2015). In comparison to the result by Gheewala *et al.* (2014), Giza 183 saved water consumption, giving it another comparative advantage. Giza 183 is suitable to mechanization harvest due to its short stature compared to Sakha 104 and Sakha 102. Sedeek *et al.* (2022) reported that the reduction in plant height may be due to reduction in cell turgor which induces reduction in cell enlargement, and turn into decreases shoots enlargement and plant height.

The study of interaction infection resulted that Giza 183 could easily have performed better under continuous flooding, continuous saturation and cyclic irrigation every 5 days and the reduction in grain yield with prolonging irrigation every 10 and 15 days were (9.83, 9.50, 8.47 and 8.50 t/ha) in both seasons of study, respectively (Table 6). The increasing in grain yield as affected by continuous saturation may be due to the increase in dry matter production, plant height and number of Panicles^{-1}. However, the reduction in grain yield as affected by water stress conditions may be due to the reduction in dry matter production, number of panicles^{-1} and number of filled grains panicle^{-1}. A similar trend was found by Gewaily *et al.* (2019) and Sedeek *et al.* (2022).

Rice crop production has significant challenges from salt dangers. Salinity stress affects plant development rates and may be identified by promptly monitoring impacts, which might result in a 50% yield loss. The most affected yield component under salt stress is panicle fertility in which Giza 183 exerted higher panicle fertility and salinity tolerance score combined with high harvest index resulted in higher grain yield (Zayed *et al*., 2018, 2019). The different rice varieties showed varying behavior regarding its nitrogen fertilizer response owing to capability to nitrogen use efficiency and its using of native nitrogen (Yinglong Chen *et al.*, 2022). Generally, Giza 183 showed superiority in grain yield than Sakha super 300 (Table 9).

Under salt affected soil, some nutrients such Zinc and Calcium as well as boron is unavailable in spite of their importance to healthy rice growth. Applying the above-mentioned elements via foliage on rice growing under salt stress might be induced rice productivity improvement. Under salt stress, rice plant is suffering unavailability micronutrient and macronutrient happened under salt stress therefore, foliar spray of them is one option as fast correction. Zinc, boron and calcium element are playing great role in enhancing rice growth, salinity tolerance and yield via improving ion selectivity, increasing, panicle fertility, relieving plant stunt and rising panicle pollination and fertilization and finally, rice grain yield (Zayed *et al.* 2011 and 2019). As in the current investigation, Giza 183 enhanced grain production over the control treatment at specific rice development stages under soil salinity. Furthermore, the combination of calcium and boron gave Giza 183 the highest grain yield.

Rice blast disease caused by a fungus that induces lesions to appear on leaves, stems, peduncles, panicles, seeds, and even roots. This disease has been recognized as one of the most significant plant diseases of all due to the potential hazard it poses for crop loss. According to present research, the findings agreed with those of Awadallah *et al*., (2021); Anis *et al*., (2021) who reported that resistance promising line considered the most effective way to control rice blast disease under field condition. Sehely *et al.* (2008) reported that Sakha 101 and Sakha 104 became completely susceptible or highly susceptible from 2005 to the present season. On the other hand, Giza 177 and Giza 178 were complete resistance until recently.

A multi-location test was conducted to evaluate the level of resistance of the tested materials at tillering and mature growth stages and to isolate any new pathotype on promising lines. Additionally, this test worked also as an early monitoring system for the occurrence of infection at different locations and level of infection at each location for the tested materials. Sehly *et al.* (2008). Conventional breeding is mainly based on the phenotypic selection of varieties or lines in selected locations Ashkani *et al.* (2015) and Sedeek and El-Wahsh (2015), a process highly influenced by environmental interactions and the complexity of resistance inheritance. In this case, the breeder should consider the genotype of the plant, the race or races of the pathogen and whether the resistance is qualitative or quantitative Wang *et al.* (2017).

The causal agent of rice blast has seriously affected rice production in the susceptible cultivars. Despite the efforts of breeding programs, blast resistance breakdown has been recorded shortly after the release of new resistant cultivars developed for the region. Among the causes of resistance breakage is the capacity of the fungus to rapidly develop new pathotypes. Besides, Rice blast fungus, *P. oryzae* is known to be highly variable. For these reasons, 140 blast races were used to evaluate Giza 183. Utilizing host resistance has proven to be the most effective method for managing this disease because it is an environmentally benign method of disease control (Bonman *et al*., 1992). Anis *et al*. (2021) tested some newly created elite rice lines for high yield, blast resistance, efficiency *P. grisea* resistance genes, as well as an evaluation of the genetic diversity in these lines using microsatellite markers. For yield and its component qualities, there were significant differences between the parents and studied new promising lines. In addition to new promising lines were shown resistance for 26 isolates under greenhouse conditions. Furthermore, under artificial and natural inoculation with *P. oryzae*, Giza177, Giza178, Sakha108, GZ10598-9-1-5-5, GZ10101-5-1-1-1 and GZ10848-1-2-2-1 reflected a high level of resistance to rice blast disease (Awadallah *et al*., 2021).

Rice stem borer (*Chilo agamemnon* Bles.) is a serious insect pest that limits rice production. Insect-resistant crop breeding has proven a cost-effective method of integrated pest control since it is both viable and environmentally friendly. Out of the 8 rice genotypes, two entries proved to be moderately resistant to the rice stem borer, and these entries could be candidate for progress evaluations by other disciplines at Rice Research and Training Center (RRTC) for developing new varieties with desirable traits. Anis *et al.* (2022) studied that some rice entries, under Egyptian rice environment, at categorized them as arranged between resistance and susceptible to RSB. Results of Soliman *et al.* (2022) evaluated several rice cultivars; Giza 178 and Egyptian Yasmine decreased significantly at 15-20 % simulated dead hearts. This indicates that rice plants were capable of producing normal yield up to about 14 % dead hearts, which emphasizes that no need to apply insecticides in most cases of dead hearts. Afzal *et al.* (2002) suggested no need to apply insecticides against rice stem borer in most of cases.

The high efficiency of sequential application in controlling weeds in broadcast-seeded rice save optimum atmosphere for rice plants and maximize water use efficiency, more photosensitive, more space and high tillering ability as well as increasing absorption of micro and macro elements which give optimum plant density, dry matter, increase panicles in unit area and increase grain yield of rice. Chauhan *et al*. (2015) reported that it is necessary to use a sequential application of pre and post-emergence herbicides to effective control and improve rice yield and quality in addition to avoid appearance of tolerant-herbicide weeds. Abd El-Naby and El Ghandor, (2022) concluded that sequential application of pendimethalin as pre-emergence herbicide at followed by fenoxaprop-ethyl or ready mix of quinclorac + cyhalofop-butyl as post-emergence herbicides reduced grassy weeds dry matter and recorded 94.4 % of WCE, and produced 10.016 t/ha grain yield. These results mean that in broadcast-seeded rice, it must be a high competitiveness ability rice cultivar to integrate with sequential application of herbicides to keep the field free of weeds during the critical period of weed competition (one third to half of crop life cycle, Mercado, (1979) and increase rice grain yield and quality.

Traditional breeding indirectly selects genotypes via phenotypes, which is often efficient for qualitative qualities but not quantitative traits. This is because quantitative features with continuous fluctuations are influenced by a number of genes and environmental variables. Advances in molecular markers, transgenic technology, and genomics have had far-reaching effects on the idea and methods of traditional rice breeding during the last few decades, enabling for the use of molecular breeding technology in rice. Molecular breeding is the process of creating new rice varieties by incorporating contemporary technologies into traditional breeding procedures (Rao *et al.* 2014). In present investigation, the phenotypic performance of the genotypes under examination was high yielding, early maturing, and low stature plant structure, Anis et al (2022). Confirming that this genotype's genetic characteristic has an indica/japonica background. Furthermore, the classification-based molecular analysis foundation has been previously published in other studies (El-Malky 2007; Mazal, 2014; Ramadan et al., 2017; Mazal 2021).

CONCLUSION

The result indicated significant superiority in the yield of Giza 183 over Giza 178, with shorter growth duration and blast resistance under normal and saline conditions. The new rice variety Giza 183 is resistant to stem borer and has high grain quality traits. Genetic diversity-based molecular analysis using 21 SSR markers revealed that Giza 183 belongs to the indica/japonica type.

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