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PERFORMANCE AND CLUSTERING OF SOME EGYPTIAN RICE GENOTYPES UNDER DIFFERENT SOWING DATES

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ABSTRACT

A two-year field experiment was carried out at the farm of the Rice Research and Training Center (RRTC), Sakha, Kafr El-Sheikh, Field Crops Research Institute (FCRI), Agricultural Research Center (ARC), Egypt, during 2016 and 2017 seasons. The experiment was conducted to study the effect of different sowing dates on the behavior of twenty four rice genotypes. Three dates of sowing, i.e. April 1st, April 15th and May 1st were used in 2016 and 2017 seasons. The twenty four varieties were laid out in a Randomized Complete Block Design with four replications in each sowing date in both seasons. A combined analysis was performed across sowing dates in each season. The studied characters were flag Leaf area (cm^2) at heading, plant height (cm) at harvest and duration (day), number of panicles per hill, panicle length (cm), number of primary branches per panicle, number of filled grains per panicle, 1000-grain weight (g), grain yield (th^{-1}) and grain quality characteristics (hulling, milling and head rice percentages). Most of the studied traits were affected significantly by sowing date, genotype and their interaction. Sowing date had significant or highly significant effects on all characters except hulling percentage in both the years. The highest values of most traits were obtained by sowing genotypes Giza179 and Sakha102 on April 1st or on April 15th. Clustering of varieties based on their performance under different sowing dates produced two large groups of genotypes; the first group included (Giza178, Sakha101 and GZ10101-5-1-1, GZ10333-9-1, Giza179 and Sakha102), which were the highest varieties in number of filled grains per panicle. On the other hand, the second group included the lowest genotypes in number of filled grains per panicle and divided into two sub group, the promising line (GZ10147-1-21) was in a branch alone. Delaying sowing date depressed grain yield and its attributes for all rice genotypes in the two seasons.

Key words**: *Rice, Sowing date, Planting dates, Rice genotypes, Grain quality, Clustering*.**

INTRODUCTION

Rice (*Oryza sativa*) is the staple food for more than three billion people that is over half of the world's total population contributes over 20% of the total calorie intake of man (FAO, 2016). It is an important cash crop of Egypt. Planting time is a major factor in rice cultivation and indirectly determines soil temperature and weather conditions to which young seedlings and rice plants are exposed during different development stages. It is a major factor for successful enrichment planting. Planting rice in the optimum period of time is critical to achieve high grain yield and good milling quality. However, optimum rice planting dates are regional and vary with location and genotypes. The recommended planting window, normally specific to a particular region, is usually supported by research conducted by the local agricultural experiment station. The trait-influencing attributes of an environment and thus of different planting dates are a complex assortment of factors, including but not limited to temperature, moisture, air temperature, weed, insect, pathogen spectrum, quantity and quality of sunlight, accumulated growing degree days and precipitation.

El-Ramady *et al* (2013) indicated that most effects of climate change on sustainable agriculture in Egypt could be changed through mitigation and adaptation. Metwally *et al* (2015) reported that early sowing on $10^{th}$of April of some Egyptian rice genotypes produced better yield and yield attributes compared with late sowing dates. El-Malky and El-Zun (2014) found that performance of Egyptian rice genotypes varied significantly under different sowing dates. They also reported that early sowing on1^{st} of May gave more grain yield across rice genotypes compared with late sowing.

Metwally *et al* (2016) studied the performance of some Egyptian rice genotypes sown at different dates in yield and quality. They reported that the highest values of number of panicles per hill, number of filled grains per panicle, grain yield, and hulling, milling and broken rice grain were recorded in the early sowing date. The number of days from seeding to maturity and number of unfilled spikelets per panicle were recorded in the decline trend, as sowing was delayed.

Genetic diversity in production fields can reduce vulnerability to stresses and it constitutes the raw material for plant breeders. Relative divergence measures among accessions can be based on quantitative morphological traits. Genetic relationships among individuals and populations can be measured by similarity of number of quantitative characters (Souza and Sorrells, 1991; Zhang *et al* 1995; Dinghuhn and Asch, 1999; Bahrman *et al* 1999 and El-Malky, 2004). A better knowledge of the genetic behavior of some Egyptian cultivars under different sowing dates would help to classify and detect the best cultivars that will be successful under different times of planting.

The objectives of the present investigation wereto study the genetic behavior of twenty four rice genotypesunder three sowing dates and the effect of differentsowing dates on grain yield and grain quality characters.

MATERIALS AND METHODS

In 2016 and 2017, a two-year field experiment was carried out at the farm of the Rice Research and Training Center (RRTC), Sakha, Kafr El-Sheikh,Field Crops Research Institute (FCRI), Agricultural Research Center (ARC), Egypt.The experiment was undertaken to study the effect of different sowing dates on the behavior of twenty four rice genotypes.The studied genotypes are listed in Table 1. Three dates of sowing, i.e. April 1^{st}, April 15^{th} and May 1^{st} were used in 2016 and 2017 seasons.The twenty four varieties were laid out in a Randomized Complete Block Design with four replications in each sowing date in both seasons.

Table 1. The pedigree, origin and type of the studied genotypes.

No.	Genotype	Pedigree	Origin	Type
1	Giza177	Giza171/Yamji No.1//PiNo.4	Egypt	Japonica
2	Giza178	Giza175/Milyange49	Egypt	Indica-Japonica
3	Giza179	Gz1368/IRAT112	Egypt	Indica-Japonica
4	Sakha101	Giza176/Milang79	Egypt	Japonica
5	Sakha102	Gz4096-7-1/Giza177	Egypt	Japonica
6	Sakha103	Giza177/Suwwon349	Egypt	Japonica
7	Sakha105	Gz5581/Gz4316	Egypt	Japonica
8	Sakha104	Gz4096-8-1/Gz4100-9-1	Egypt	Japonica
9	Sakha106	Giza177/Hexi30	Egypt	Japonica
10	Giza182	Giza181/IR39422-163-247-2-2-3	Egypt	Indica
11	GZ9399-4-1-1-3-2-2	Giza178/IR65844	Egypt	Japonica
12	GZ9399-4-1-1-2-1-2	Giza178/IR65844	Egypt	Japonica
13	GZ10101-5-1-1-1	Sakha103/IR385	Egypt	Japonica
14	GZ10147-1-2-1-1	GZ6214/IR385	Egypt	Japonica
15	GZ10154-3-1-1-1	GZ6522/Sakha101	Egypt	Japonica
16	GZ10164-9-2-1-2	Sakha101/SR2247	Egypt	Japonica
17	GZ10305-24-1-2-3	GZ7768/Milang95	Egypt	Japonica
18	GZ10333-9-1-1-3	SKC23822/Munlen4	Egypt	Japonica
19	GZ10364-22-3-1-2	BY-GC30/Milyang30	Egypt	Japonica
20	GZ10365-2-4-1-2	BY-GC30/SKC23822	Egypt	Japonica
21	Egyptian Yasmine	IR262 /DML105	Egypt	Indica
22	GZ7769-10-3-2-1	Gz5385-29-3-2/Akiya Take	Egypt	Japonica
23	GZ7955-1-2	Giza177/Hexi30	Egypt	Japonica
24	GZ6496-1-2-2	GZ 4596/SUWEON 313	Egypt	Japonica

A combined analysis was performed across sowing dates in each season. Maximum and minimum temperature and relative humidity of the experimental site are shown in Table (2) according to records of RRTC Meteorological Station.

Table 2. Monthly temperature and relative humidity at the experimental site in 2016 and 2017 rice growing seasons.

Month	Temperature (°c)				Relative humidity (%)	
	2016		2017			
	Max.	Min.	Max.	Min.	2014	2015
April	**28.28**	**8.46**	**27.54**	**11.23**	**59.37**	**63.76**
May	**29.58**	**10.20**	**29.28**	**12.86**	**57.64**	**59.93**
June	**33.64**	**15.30**	**34.28**	**19.38**	**67.53**	**63.76**
July	**32.64**	**15.96**	**33.66**	**20.60**	**69.16**	**66.61**
August	**34.27**	**16.62**	**35.05**	**19.38**	**70.82**	**67.58**
September	**33.67**	**15.30**	**33.16**	**19.38**	**63.76**	**62.72**
October	**28.56**	**11.22**	**30.91**	**16.52**	**61.21**	**62.99**

The seeds at the rate of 100 kg ha^{-1} of each genotype were sown at the studied sowing dates in both seasons. The unit plot size was 12 m^2 (4m × 3m). Seedlings were transplanted to the experimental fields at 30 days after sowing. Row to row and plant to plant distance was 20cm × 20cm with 2–3 seedlings per hill. Nitrogen fertilizer at the rate of 165 kg N ha^{-1} was added as urea form (46.5% N). Two-third of urea was applied as a basal application, and the other one third was top dressed at 30 days after transplanting (DAT). All plots received identical cultural treatments in terms of ploughing, cultivation, weed control, P, K and Zn fertilizers, and disease control.

The studied characters were flag Leaf area (cm^2) at heading, plant height (cm)at harvest and duration (day), number of panicles per hill, panicle length (cm), number of primary branches per panicle, number of filled grains per panicle, 1000-grain weight (g), grain yield (t h^{-1}) and grain quality characteristics (hulling, milling and head rice percentages).

The genetic relationships among individuals and populations were measured by similarity of number of quantitative characters as reported by Zhang *et al* (1995); Dingkhun *et al* (1999) and El-Malky (2004). Analysis was conducted using the Numerical Taxonomy and Multivariate Analysis system, Version 2.1(Rohlf 2000). The output was analyzed using an agglomerative hierarchical clustering method with complete linkage strategy. Firstly, a matrix of dissimilarity values was produced and the phenotypic distance between each pair of lines was estimated as Euclidean distance. Secondly, cluster analysis was then conducted on the Euclidean distance matrix with un-weighed pair group method based on arithmetic average (UPGMA) to develop a dendogram.

Analysis of variance was carried out as a combined analysis across the four sowing dates in each season according to Gomez and Gomez, (1984). Treatment means were compared by Duncan's Multiple Range Test (Duncan, 1955). All statistical analyses were performed using analysis of variance technique by means of "MSTATC" computer software package.

RESULTS AND DISCUSSION

Table (3) shows flag leaf area, plant height and duration as affected by sowing date, genotype and their interaction in both seasons.Sowing date influenced significantly flag leaf area in thesecond season only. Thus, maximum flag leaf area was produced by plants whichwere sown on April 1st.Rice genotypes exhibited significant differences in leaf area index in both seasons. The rice genotypesGiza179 and Sakha102recorded the highest values of leaf area index without any significant differences between them. The rice genotypeSakha105 produced the lowest values of leaf area index in both seasons. Those differences might be related to the genetic diversity among the tested rice genotypes. The results are in conformity with the findings of Metwally *et al* (2016).

Plant height at headingwas affected significantly by sowing date, genotype and their interaction in both seasons(Table 3).The highest values of plant height were recorded when rice genotypes were sown on April 1st orApril 15th probably due to the interaction of higher solar radiation associated with optimum temperature. Delaying sowing date to May 1stdecreased significantly plant height in the two seasons.Increased plant height in earlier sowing dates may be due to the availability of prolonged period for vegetative growth to rice genotypes in these dates. Data also showed that rice genotypesSakha103 and GZ6496-1-2-2recorded the tallest plantswhileSakha101 and GZ10305-24-1-2-3recorded the shortest plants in both seasons.

Data in Table (3) indicated also that sowing rice plants on April 15th recorded the longest duration followed by the first sowing date whereas sowing on May 1st required fewer days to mature. (Maiti and Sen 2003) reported that the early planting of rice reduced plant growth duration,however too short growth duration may not produce high yields because of limited vegetative growth where the time for tiller production is less. A similar trend was found by El-Malky and El-Zun (2014) and Metwally *et al* (2016). Rice genotypes varied significantly in their number of days to mature. The results showed that genotypes Sakha101 and Sakha102 recorded the longest duration to mature followed by GZ6496-1-2-2.

Table 3. Flag leaf area, plant height and duration of different rice genotypes as affected by sowing date in 2016 and 2017 seasons.

Factor	Flag Leaf area (cm^2)		Plant height (cm)		Duration (day)	
	2016	2017	2016	2017	2016	2017
Sowing date:						
April 1st	30.19	30.15 a	100.0 a	100.30 a	127.3 a	128.2 b
April 15th	29.04	28.95 b	100.10 a	100.40 a	127.5 a	128.9 a
May 1st	28.86	29.03 b	92.47 b	92.82 b	122.3 b	123.7 c
F test	NS	**	**	**	**	**
Genotype:						
Giza177	26.20 fgh	25.67 kl	94.00 ij	94.11 m	123.7 fg	124.9 g
Giza178	31.90 cd	30.76 cd	94.89 hi	94.89 l	132.7 c	134.0 c
Giza179	34.90 b	34.63 b	92.00 l	92.22 o	120.8 j	122.1 l
Sakha101	28.63 efg	29.64 c-g	90.67 m	91.00 p	140.7 a	141.9 a
Sakha102	42.98 a	41.97 a	98.78 e	99.56 g	141.2 a	142.3 a
Sakha103	25.79 gh	25.77 jkl	106.30 a	106.7 b	123.4 fg	124.2 ghi
Sakha105	24.89 h	25.04 l	95.67 gh	96.00 k	118.7 k	119.8 n
Sakha104	27.03 e-h	26.79 h-l	104.70 b	104.90 c	133.3 c	134.7 c
Sakha106	27.90 e-h	28.57 e-h	96.56 fg	96.67 j	122.7 ghi	124.0 hij
Giza182	28.03 efg	28.44 e-h	96.33 fg	96.67 j	123.7 fg	124.8 gh
GZ9399-4-1-1-3-2-2	31.87 cd	31.50 c	92.67 kl	92.89 n	124.3 f	125.7 f
GZ9399-4-1-1-2-1-2	30.09 de	29.87 c-f	97.44 f	98.00 i	123.3 fgh	124.8 gh
GZ10101-5-1-1-1	29.17 def	29.56 c-g	99.89 d	100.20 f	122.7 ghi	123.9 ij
GZ10147-1-2-1-1	27.42 e-h	27.77 f-j	101.70 c	102.00 d	122.3 hi	123.7 ijk
GZ10154-3-1-1-1	29.13 def	29.44 d-g	93.33 jk	93.67 m	122.3 hi	123.3 jk
GZ10164-9-2-1-2	28.61 efg	28.86 d-h	96.00 g	96.56 jk	122.0 i	123.0 k
GZ10305-24-1-2-3	25.87 gh	26.22 i-l	90.56 m	90.78 p	119.3 k	120.3 mn
GZ10333-9-1-1-3	27.71 e-h	28.08 f-i	100.60cd	100.60 f	119.3 k	120.9 m
GZ10364-22-3-1-2	28.02 efg	27.64 g-k	97.22 f	97.56 i	119.3 k	120.6 m
GZ10365-2-4-1-2	28.88 efg	28.59 e-h	93.67 jk	94.00 m	126.0 e	127.3 e
Egyptian Yasmine	26.63 fgh	26.39 i-l	100.80cd	101.30 e	126.3 e	127.6 e
GZ7769-10-3-2-1	33.89 bc	34.17 b	98.67 e	98.89 h	129.3 d	131.0 d
GZ7955-1-2	29.07 def	29.27 d-g	100.90cd	101.30 e	120.3 j	121.8 l
GZ6496-1-2-2	30.08 de	30.36 cde	107.10 a	107.70 a	139.0 b	140.1 b
F test	**	**	**	**	**	**
Interaction	**	**	**	**	**	**

Means in the same column followed by the same latter are not significantly different and *, ** and NS indicate $P < 0.05$, $P < 0.01$ and not significant, respectively. Means of each factor designated by the same latter are not significantly different at 5% level using Duncan's Multiple Range Test.

Table 4 presented number of panicles per hill, panicle length and number of primary branches per panicle of tested rice genotypes as affected by sowing date and interaction in both seasons.

Table 4. Number of panicles hill-1, panicle length and number of primary branches panicle-1 of different rice genotypes as affected by sowing date in 2016 and 2017 seasons.

Factor	Panicles No. hill^{-1}		Panicle length (cm)		Primary branches No. panicle^{-1}	
	2016	2017	2016	2017	2016	2017
Sowing date						
April 1st	21.50 a	21.67 a	22.02 a	22.18 a	10.35 a	10.31 a
April 15th	21.46 a	21.62 a	21.50 b	21.54 b	10.47 a	10.44 a
May 1st	17.60 b	17.57 b	19.95 c	19.96 c	8.76 b	8.76 b
F test	**	**	**	**	**	**
Genotype						
Giza177	18.67 fgh	19.11 g-j	19.82 ij	19.78 i	9.56 fg	9.61 f-i
Giza178	21.78 abc	21.94 bcd	20.71 f-i	20.89 gh	10.44 cde	10.33 cd
Giza179	23.56 a	23.78 a	24.69 a	24.69 a	11.56 a	11.39 a
Sakha101	22.67 ab	22.94 ab	22.36 c	22.48 c	10.78 bc	10.72 bc
Sakha102	22.89 ab	22.78 ab	23.48 b	23.69 b	11.22 ab	11.11 ab
Sakha103	18.33 f-i	18.00 jk	20.42 g-j	20.49 h	9.67 fg	9.78 e-h
Sakha105	17.33 hi	18.61 h-k	18.88 k	19.02 j	9.33 fg	9.39 g-k
Sakha104	21.67 a-d	20.83 def	21.74 cde	21.69 de	10.00 def	10.06 de
Sakha106	19.33 e-h	19.39 f-j	21.31 d-g	21.36 ef	9.33 fg	9.28 ijk
Giza182	18.00 ghi	18.28 ijk	20.63 f-i	20.60 h	9.56 fg	9.61 f-i
GZ9399-4-1-1-3-2-2	19.67 d-g	20.00 e-h	21.49 def	21.59 e	9.67 fg	9.61 f-i
GZ9399-4-1-1-2-1-2	19.67 d-g	19.72 fgh	19.89 ij	19.83 i	9.78 ef	9.83 efg
GZ10101-5-1-1-1	20.00 c-g	19.72 fgh	21.01 e-h	21.06 fg	9.44 fg	9.56 f-j
GZ10147-1-2-1-1	20.33 c-f	20.44 efg	19.92 ij	19.96 i	8.89 g	8.94 k
GZ10154-3-1-1-1	19.33 e-h	19.78 fgh	20.70 f-i	20.75 gh	9.33 fg	9.22 ijk
GZ10164-9-2-1-2	20.33 c-f	20.50 efg	19.59 jk	19.33 j	9.44 fg	9.33 h-k
GZ10305-24-1-2-3	21.33 b-e	21.28 cde	21.18 d-h	21.46 ef	9.44 fg	9.28 ijk
GZ10333-9-1-1-3	21.33 b-e	20.11 efg	22.07 cd	22.02 d	9.33 fg	9.28 ijk
GZ10364-22-3-1-2	16.67 i	17.33 k	22.48 c	22.71 c	9.44 fg	9.39 g-k
GZ10365-2-4-1-2	19.22 fgh	19.39 f-j	20.38 hij	20.52 h	9.22 fg	9.11 jk
Egyptian Yasmine	20.00 c-g	20.50 efg	21.26 d-h	21.46 ef	9.56 fg	9.50 f-j
GZ7769-10-3-2-1	23.00 ab	22.22 bc	21.98 cd	22.07 d	11.22 ab	11.22 a
GZ7955-1-2	19.00 fgh	19.56 f-i	20.51 ghi	20.49 h	9.89 def	9.94 def
GZ6496-1-2-2	20.33 c-f	20.67 def	21.26 d-h	21.49 e	10.56 bcd	10.61 c
F test	**	**	**	**	**	**
Interaction	NS	NS	NS	**	NS	**

Means in the same column followed by the same latter are not significantly different, and *, ** and NS indicate P < 0.05, P < 0.01 and not significant, respectively. Means of each factor designated by the same latter are not significantly different at 5% level using Duncan's Multiple Range Test.

Number of panicles per hill was affected significantly by sowing date in both seasons. Rice plants sown on the first or second dates produced the greater number of panicles in both seasons. Thus, delaying planting reduced significantly number of panicles per hill. Dawadi and Chaudhary (2013) reported that significant higher number of rice panicles per unit area in early planting might be due to favorable environmental conditions which enabled the plant to improve its growth and development as compared to late planting. These results are in harmony with those of El-Malky and El-Zun, (2014) and Metwally *et al* (2015). Rice genotypes Giza179, Sakha101 and Sakha102recorded the greatest number of number of panicles in both seasons. These variations among the genotypes might be due to the genetic potentiality.

Panicle length was significantly high when rice plants were sown at April 1stfollowed by April 15th. Giza179recorded the longest panicles in two seasons,which was significantly higher than all other genotypes.This was due to the fact that rice genotypes planted earlier had a longer period for their vegetative growth compared to those sown later.

Data also showed that April 15thproduced the highest number of primary branches panicle^{-1}. Rice seeded at first of April had similar number of primary pranches to those seeded in med of April but significantly lower than rice planted in the first of May. Giza179, Sakha102 and GZ7769-10-3-2-1) recorded the greatest number ofprimary branches in the two seasons. These findings are in agreement with the observations made by Metwally *et al* (2016).

The data in Table 5 demonstrates the effect of different sowing dates on number of filled grains per panicle, 1000-grain weight and grain yield of tested rice genotypes. Number of filled grains per panicle of tested rice genotypes was significantly affected by sowing date and interaction.

Sowing date substantially influenced number of filled grains per panicle in the two seasons. Rice plants sown on the first or second dates significantly produced the greater number of filled grains per panicle than those sown on the late sowing date in the two seasons. Dawadi and Chaudhary (2013) and Metwally *et al* (2016) found that number of filled grains per panicle increased in the early sowingand declined gradually in the successive later sowing dates.Differences among various genotypes for number of filled grains per panicle were significant when assessed through the yardstick of statistics. The highest values of number of filled grains per panicle were observed by Giza179 and Sakha102 followed by Giza178 and GZ10333-9-1-1-3.

Table 5. Number of filled grains panicle-1, 1000-grain weight and grain yield a of different rice genotypes as affected by sowing date in 2016 and 2017 seasons.

Factor	Filled grains No. panicle^{-1}		1000-grain weight (g)		Grain yield (t h^{-1})	
	2016	2017	2016	2017	2016	2017
Sowing date						
April 1st	137.3 a	136.7 a	25.59 a	25.57 a	8.93 b	8.92 b
April 15th	139.4 a	141.0 a	25.08 b	25.08 b	9.26 a	9.27 a
May 1st	123.7 b	127.3 b	24.24 c	24.19 c	8.28 c	8.40 c
F test	**	**	**	**	**	**
Genotype						
Giza177	127.4 fgh	129.1 g	26.81 d	26.73 d	9.23 ef	9.26 e
Giza178	160.8 ab	161.7 b	20.69 n	20.72 q	10.07 b	10.12 b
Giza179	170.2 a	172.9 a	28.51 a	28.49 a	10.81 a	10.88 a
Sakha101	150.3 bc	158.7 bc	27.13 c	27.07 c	9.89 bc	9.94 c
Sakha102	167.8 a	171.9 a	28.19 b	28.13 b	10.68 a	10.74 a
Sakha103	116.9 hi	117.6 hij	24.92 i	24.92 j	8.65 g	8.65 gh
Sakha105	112.6 i	112.4 j	23.33 lm	23.27 op	7.54 m	7.50 o
Sakha104	136.0 def	135.5 ef	25.99 f	26.02 f	9.71 cd	9.73 d
Sakha106	112.1 i	112.6 j	24.80 i	24.78 j	8.57 gh	8.69 g
Giza182	112.4 i	113.2 j	25.72 fg	25.75 g	8.52 ghi	8.50 hi
GZ9399-4-1-1-3-2-2	115.0 i	116.8 ij	23.23 m	23.19 p	8.28 h-l	8.30 j-m
GZ9399-4-1-1-2-1-2	129.0 e-h	129.3 g	24.50 j	24.53 k	8.33 g-l	8.29 j-m
GZ10101-5-1-1-1	151.0 bc	154.7 c	23.56 l	23.51 n	8.01 l	8.01 n
GZ10147-1-2-1-1	135.8 def	136.1 ef	23.42 lm	23.42 no	8.3 l	8.38 i-l
GZ10154-3-1-1-1	119.2 ghi	120.8 hi	25.67 g	25.67 gh	8.49 g-j	8.41 ij
GZ10164-9-2-1-2	118.0 hi	120.5 hi	25.29 h	25.25 i	8.04 kl	8.23 klm
GZ10305-24-1-2-3	130.7 efg	132.8 fg	24.89 i	24.85 j	8.20 i-l	8.30 j-m
GZ10333-9-1-1-3	161.0 ab	162.2 b	24.22 jk	24.14 m	8.20 i-l	8.18 m
GZ10364-22-3-1-2	114.6 i	115.9 ij	23.32 lm	23.36 nop	8.14 jkl	8.20 m
GZ10365-2-4-1-2	122.6 ghi	123.3 h	24.36 j	24.34 l	8.09 kl	8.21 lm
Egyptian Yasmine	115.0 i	116.5 ij	24.04 k	24.01 m	8.38 g-k	8.40 ijk
GZ7769-10-3-2-1	139.2 c-f	139.6 de	24.81 i	24.87 j	9.52 de	9.60 d
GZ7955-1-2	141.3 cde	141.2 de	26.29 e	26.25 e	8.99 f	9.02 f
GZ6496-1-2-2	144.0 cd	144.5 d	25.58 g	25.53 h	9.11 f	9.20 e
F test	**	**	**	**	**	**
Interaction	**	**	**	**	**	**

Means in the same column followed by the same latter are not significantly different, and *, ** and NS indicate P < 0.05, P < 0.01 and not significant, respectively. Means of each factor designated by the same latter are not significantly different at 5% level using Duncan's Multiple Range Test.

Sowing date substantially influenced 1000-grain weight in the two seasons. Delay sowing date significantly decreased 1000-grain weight in the two seasons. It might be due to the fact that sowing rice on optimum date attains maximum grain weight due to the availability of suitable temperature during grain formation. Giza178 produced the heaviest 1000-grain weight in both seasons followed by Sakha102.

Grain yield of different rice genotypes was affected significantly by sowing dates as well as the interaction. Rice plants sown on April 15thproduced higher grain yield. Delaying sowing date decreased grain yield in both seasons. Under Egyptian condition, Malky and El-Zun, (2014) and Metwally *et al* (2016) found similar tendency and indicated that rice productivity increased in early sowing than late sowing which attributed mainly to the increase in the cumulative mean value of temperature and sunshine hours, more number of panicles per unit area, more number of grains per panicle and higher grain weight. On the other hand, the low grain yield of late planting may be caused by shortened growth period, lower panicle number per unit area and low biomass accumulation at heading. Giza179 and Sakha102 produced the highest values of grain yield followed by Giza178.Higher grain yield of the mentioned genotypes were the resultant of greater flag leaf area, number of panicles per unit area, number of grains per panicle, 1000 grain weight obtained by these genotypes.

The interaction between sowing date and rice genotypes had a significant effect on grain yield in the two seasons (Table 6). The highest grain yield was obtained by sowing genotypesGiza179 and Sakha102on April 1st or on April 15th.Delaying sowing date decreased grain yield of all genotypes in the two seasons. The earlier optimum planting date for the studied genotypes may be attributed to the breeding achievements for not only improving yield potential but also reducing growth duration.

The grain quality characteristics of tested rice genotypes under different sowing dates are presented in Table 7. Hulling percentage did not affect by sowing date in both seasons. There are significant differences among rice genotypes in terms of hulling percentage. GZ9399-4-1-1-2-1-2, GZ10101-5-1-1-1, Egyptian Yasmine, and GZ7955-1-2 produced the highest percentage of hulling without any significant differences among them. Data in Table 7 evidenced that milling percentage was affected significantly by sowing date in the second season only. The highest percentage of milling was recorded with the second sowing date followed by the first sowing date.

Table 6. Grain yield (t h-1) of rice as affected by the interaction between sowing date and genotype in 2016 and 2017 seasons.

Genotypes	2016 season			2017 season		
	Sowing date			Sowing date		
	April 1st	April 15th	May 1st	April 1st	April 15th	May 1st
Giza177	9.21 h-l	9.83 d-g	8.64 l-o	9.23 g-l	9.69 d-i	8.85 j-q
Giza178	10.23 cde	10.71 bc	9.28 g-k	10.23 cd	10.71 bc	9.40 f-k
Giza179	11.02 ab	11.59 a	9.83 d-g	10.99 ab	11.61 a	10.04 c-f
Sakha101	10.3 cd	10.07 def	9.28 g-k	10.16 cde	10.28 cd	9.40 f-k
Sakha102	11.19 ab	11.19 ab	9.69 e-i	11.07 ab	11.31 ab	9.83 d-g
Sakha103	8.57 m-p	9.04 j-n	8.33 o-s	8.57 l-u	9.04 h-n	8.33 n-v
Sakha105	7.62 tu	7.62 tu	7.38 u	7.50 wx	7.74 vwx	7.26 x
Sakha104	9.76 d-h	10.07 def	9.28 g-k	9.64 d-i	10.16 cde	9.40 f-k
Sakha106	8.16 o-t	9.04 j-n	8.50 n-q	8.37 n-v	9.16 g-m	8.52 l-u
Giza182	8.33 o-s	8.97 j-n	8.26 o-s	8.21 o-w	9.00 h-n	8.28 n-v
GZ9399-4-1-1-3-2-2	8.26 o-s	8.81 k-o	7.78 r-u	8.40 m-v	8.69 k-s	7.81 u-x
GZ9399-4-1-1-2-1-2	8.40 n-r	8.97 j-n	7.62 tu	8.38 n-v	8.76 j-r	7.74 vwx
GZ10101-5-1-1-1	8.33 o-s	8.33 o-s	7.38 u	8.21 o-w	8.33 n-v	7.50 wx
GZ10147-1-2-1-1	8.57 m-p	8.97 j-n	7.54 u	8.69 k-s	8.76 j-r	7.69 vwx
GZ10154-3-1-1-1	8.50 n-q	9.12 i-m	7.85 q-u	8.28 n-v	8.97 i-o	7.97 s-x
GZ10164-9-2-1-2	8.50 n-q	8.16 o-t	7.45 u	8.64 k-t	8.38 n-v	7.66 v-x
GZ10305-24-1-2-3	8.26 o-s	8.40 n-r	7.93 p-u	8.16 p-w	8.62 l-t	8.14 q-w
GZ10333-9-1-1-3	8.26 o-s	8.64 l-o	7.69 stu	8.04 r-w	8.62 l-t	7.90 t-x
GZ10364-22-3-1-2	8.16 o-t	8.33 o-s	7.93 p-u	7.90 t-x	8.57 l-u	8.14 q-w
GZ10365-2-4-1-2	8.16 o-t	8.64 l-o	7.45 u	8.38 n-v	8.62 l-t	7.66 vwx
Egyptian Yasmine	8.33 o-s	9.04 j-n	7.78 r-u	8.33 n-v	8.93 i-p	7.93 s-x
GZ7769-10-3-2-1	9.76 d-h	9.76 d-h	9.04 j-n	9.88 d-g	9.76 d-h	9.16 g-m
GZ7955-1-2	9.28 g-k	9.52 f-j	8.16 o-t	9.28 g-l	9.40 f-k	8.38 n-v
GZ6496-1-2-2	9.28 g-k	9.45 g-j	8.57 l-o	9.40 f-k	9.47 e-j	8.71 k-s

Means in the same column followed by the same latter are not significantly different, at (P< 5 or 1 %) and *, ** and NS indicate P < 0.05, P < 0.01 and not significant, respectively. Means of each factor designated by the same latter are not significantly different at 5% level using Duncan's Multiple Range Test.

Table 7. Hulling, milling and head rice percentages of different rice genotypes as affected by sowing date in 2016 and 2017 seasons.

Factor	Hulling (%)		Milling (%)		Head rice (%)	
	2016	2017	2016	2017	2016	2017
Sowing date						
April 1st	80.80	81.60	68.86	69.66 b	62.87 c	63.67 b
April 15th	80.84	81.64	69.01	69.81 a	63.22 b	64.02 b
May 1st	80.66	81.46	68.90	69.70 ab	64.67 a	65.47 a
F test	NS	NS	NS	**	**	**
Genotype						
Giza177	80.30 gh	81.10 gh	70.27 ab	71.07 ab	65.07 de	65.87 d
Giza178	79.20 i	80.00 i	68.43 ef	69.23 ef	65.13 d	65.93 d
Giza179	80.37 gh	81.17 gh	68.83 de	69.63 de	65.80 c	66.60 c
Sakha101	80.53 fgh	81.33 fgh	69.57 c	70.37 c	66.60 b	67.40 b
Sakha102	80.80 d-g	81.60 d-g	70.37 ab	71.17 ab	67.93 a	68.73 a
Sakha103	80.23 h	81.03 h	69.27 cd	70.07 cd	65.93 c	66.73 c
Sakha105	81.17 cde	81.97 cde	69.30 cd	70.10 cd	65.23 d	66.03 d
Sakha104	79.27 i	80.07 i	67.97 fg	68.77 f	64.57 e	65.37 e
Sakha106	81.37 bcd	82.17 bcd	70.77 a	71.57 a	66.14 bc	66.93 c
Giza182	80.67 e-h	81.47 e-h	69.80 bc	70.60 bc	66.12 bc	66.92 c
GZ9399-4-1-1-3-2-2	81.47 bc	82.27 bc	70.50 a	71.30 a	64.93 de	65.73 de
GZ9399-4-1-1-2-1-2	81.80 ab	82.60 ab	70.43 a	71.23 ab	63.37 f	64.17 f
GZ10101-5-1-1-1	82.03 a	82.83 a	69.33 cd	70.13 cd	62.53 gh	63.33 gh
GZ10147-1-2-1-1	81.30 bcd	82.10 bcd	70.20 ab	71.00 ab	62.23 hi	63.03 hi
GZ10154-3-1-1-1	80.83 d-g	81.63 d-g	69.60 c	70.40 c	62.93 fg	63.73 fg
GZ10164-9-2-1-2	81.17 cde	81.97 cde	70.37 ab	71.17 ab	63.07 f	63.87 f
GZ10305-24-1-2-3	81.27 bcd	82.07 bcd	70.53 a	71.33 a	65.87 c	66.67 c
GZ10333-9-1-1-3	81.10 cde	81.90 cde	64.80 h	65.60 g	59.47 k	60.27 k
GZ10364-22-3-1-2	81.20 cde	82.00 cde	70.37 ab	71.17 ab	63.13 f	63.93 f
GZ10365-2-4-1-2	81.07 c-f	81.87 c-f	67.87 g	68.67 f	61.03 j	61.83 j
Egyptian Yasmine	82.00 a	82.80 a	70.30 ab	71.10 ab	61.93 i	62.73 i
GZ7769-10-3-2-1	78.53 j	79.33 j	64.60 h	65.40 g	57.40 l	58.20 l
GZ7955-1-2	82.07 a	82.87 a	61.93 i	62.73 h	57.43 l	58.23 l
GZ6496-1-2-2	78.67 j	79.47 j	68.80 de	69.60 de	62.17 hi	62.97 hi
Giza177	**	**	**	**	**	**
Interaction	**	**	**	**	**	**

Means in the same column followed by the same latter are not significantly different, and *, ** and NS indicate P < 0.05, P < 0.01 and not significant, respectively. Means of each factor designated by the same latter are not significantly different at 5% level using Duncan's Multiple Range Test.

Concerning rice genotypes, highly significant variations were noted among tested rice genotypes for milling percentage.Sakha106, GZ9399-4-1-1-3-2-2 and GZ10305-24-1-2-3 recorded the highest milling percentage. For the head rice percentage, significant differences were noted among the three sowing dates. Delaying sowing date from April 1st up to May 1st increased gradually head rice percentage in both seasons. When comparing the head rice percentage among the tested rice genotypes, highly significant variations were detected among them. Sakha102 produced the highest head rice percentage followed by Sakha101. Clustering of varieties based on their performance under different sowing dates produced two large groups of cultivars; the first group included (Giza178, Sakha101 and GZ10101-5-1-1, GZ10333-9-1, Giza179 and Sakha102) (Fig. 1), which were the highest genotypes in number of filled grain per panicle.

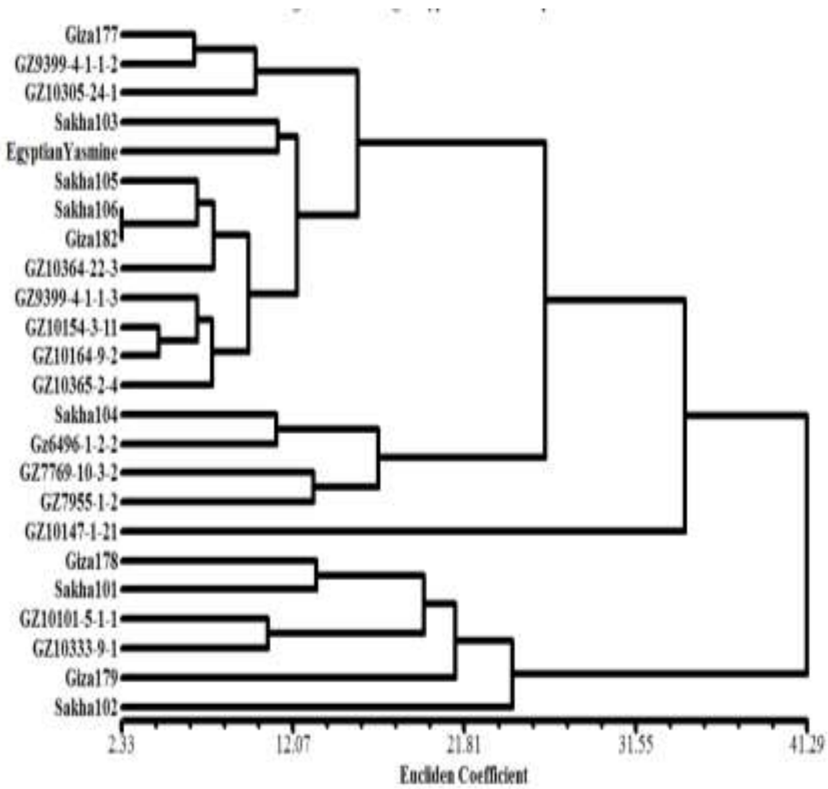

Fig. 1. Dendrogram of 24 rice genotypes based on 12 qualitative characters.

On the other hand, the second group included the lowest genotypes in number filled grain per panicle and divided into two sub group, the promising line (GZ10147-1-21) was in a branch alone. While, the second sub group was divided into two sub-sub groups and the first one included (Sakha104, GZ6496-1-2-2, GZ7769-10-3-2 and 7955-1-2); these genotypes were very closely related in the duration, number of filled grain per panicle and grain yield. On the other hand, the last sub-sub group included (Giza177, GZ9399-4-1-1-2-1-2, GZ10305-24-1-2-3, Sakha103, Egyptian Yasmine, Sakha105, Sakha106, Giza182, GZ10364-22-3-1-2, GZ9399-4-1-1-3-2-2, GZ10154-3-1-1-1, GZ10164-9-2-1-2 and GZ10365-2-4-1-2) (Fig. 1). This distribution is due to the yield and maturing-duration traits (Table 8). These results are in agreement with those of Fahmi *et al* (2005), El-Malky *et al* (2007) and El-Malky *et al* (2013).

Table 8. Similarity matrix for 24 varieties based on 12 morphological characters.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	0.00																							
2	3.53	0.00																						
3	4.49	1.86	0.00																					
4	3.20	1.34	2.69	0.00																				
5	4.87	1.91	2.30	2.21	0.00																			
6	1.67	4.71	5.75	4.45	5.89	0.00																		
7	1.71	5.14	6.08	4.84	6.47	1.28	0.00																	
8	1.68	2.82	4.10	2.48	3.90	2.16	2.95	0.00																
9	1.65	5.03	6.02	4.64	6.23	1.15	6.42	2.73	0.00															
10	1.59	4.98	5.98	4.57	6.17	1.12	6.81	2.66	2.33	0.00														
11	1.43	4.63	5.64	4.23	5.83	1.54	1.05	2.57	6.81	6.97	0.00													
12	6.45	3.40	4.39	3.20	4.67	1.58	1.84	1.49	1.72	1.69	1.45	0.00												
13	2.60	1.52	2.27	2.13	2.95	3.66	4.12	2.14	4.08	4.05	3.78	2.39	0.00											
14	2.96	3.95	4.67	3.85	4.86	3.28	3.66	3.02	3.56	3.54	3.54	3.00	3.43	0.00										
15	9.45	4.31	5.23	3.96	5.57	1.41	1.04	2.27	9.05	8.69	6.28	1.03	3.35	3.44	0.00									
16	1.01	4.38	5.33	4.05	5.62	1.12	9.07	2.23	7.34	7.24	6.95	1.05	3.41	3.17	4.44	0.00								
17	9.40	3.40	4.17	3.24	4.86	2.30	2.12	2.13	2.18	2.17	1.86	1.05	2.39	3.51	1.35	1.57	0.00							
18	3.50	1.60	1.68	2.54	2.88	4.53	4.98	3.00	4.99	4.96	4.71	3.34	1.06	3.93	4.26	4.31	3.22	0.00						
19	1.55	4.87	5.79	4.60	6.15	1.18	7.19	2.68	7.50	7.93	9.30	1.53	3.80	3.80	8.26	8.55	1.85	4.69	0.00					
20	8.03	3.94	5.00	3.56	5.22	1.51	1.41	1.89	1.25	1.18	9.01	8.47	3.08	3.42	5.49	7.85	1.26	3.99	1.16	0.00				
21	1.69	4.75	5.84	4.38	5.95	1.11	1.31	2.31	1.12	1.12	1.25	1.58	3.77	4.05	1.17	1.17	2.05	4.70	9.52	1.17	0.00			
22	1.91	2.45	3.56	2.36	3.59	2.79	3.25	1.35	3.08	3.02	2.70	1.59	1.80	3.71	2.36	2.50	1.86	2.61	2.86	1.97	2.61	0.00		
23	1.79	2.63	3.37	2.80	3.95	2.64	3.08	1.65	3.09	3.03	2.87	1.56	1.42	3.19	2.39	2.44	1.73	2.08	2.80	2.14	2.81	1.32	0.00	
24	2.64	2.26	3.69	2.01	3.03	3.18	4.01	1.11	3.76	3.69	3.53	2.40	2.02	3.48	3.27	3.25	2.95	2.75	3.69	2.86	3.28	1.62	2.13	0.00

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الأداء و الشجرة الوراثية لبعض تراكيب الأرز الوراثية المصرية المنزرعة تحت مواعيد زراعه مختلفه

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أقيمت تجربة حقلية في المزرعة البحثية لمركز بحوث وتدريب الأرز بسخا – كفرالشيخ –مصر خلال موسمي الارز ٢٠١٦ و ٢٠١٧ لدراسة سلوك اربعه و عشرون تركيب وراثيا من الارز منزرعة في ثلاث مواعيد زراعة (اول ابريل – منتصف ابريل – اول مايو). وأعتبر كل ميعاد من مواعيد الزراعة تجربة مستقلة، وزرعت التراكيب الوراثية في كل منها في تصميم القطاعات الكاملة العشوائية في اربعة مكررات. وقد تم إجراء تحليل التباين المشترك بين مواعيد الزراعة الثلاثة في كل موسم زراعة. وتم دراسة الصفات الاتية مساحة ورقة العلم عند التزهير، طول النبات عند الحصاد، عدد الايام حتي النضج، عدد السنابل في الجورة، عدد الافرع الاولية في السنبلة، طول السنبله، عدد الحبوب الممتلئة في السنبلة، وزن ١٠٠٠ حبة، محصول الحبوب للهكتار، وصفات الجوده (النسبة المئوية للتبيض و للتدريج و للتقشير). تاثرت معنويا جميع الصفات المدروسة بمواعيد الزراعه و التراكيب الوراثية وكذلك التفاعل بينهما. اثرت مواعيد الزراعة معنويا على جميع الصفات المدروسة ما عدا صفة تقشير الحبوب فى كلا الموسمين.اظهرت النتائج ان اعلي قيمة لمعظم الصفات المدروسة عند زراعة جيزه ١٧٩ و سخا ١٠٢ في اول ابريل او منتصف ابريل. واظهرت نتائج التحليل العنقودي الي وجود مجموعات من الأصناف على أساس أدائها في تواريخ الزراعة المختلفة الي مجموعتين كبيرتين من الأصناف وشملت المجموعة الأولى(جيزه ١٧٨، سخا ١٠١،GZ10101-5-1-1-1 ، GZ10333-9-1، جيزه ١٧٩ و سخا ١٠٢) والتي كانت أعلى التراكيب الوراثية في عدد الحبوب الممتلئة في السنبله. من ناحية أخرى، تضمنت المجموعة الثانية التراكيب الوراثية التي تحتوي علي أقل عدد من الحبوب الممتلئة في السنبلة، وتنقسم إلى مجموعتين فرعيتين، والتي تضم السلالة المبشرة (GZ10147-1-21) وحيده في هذه المجموعه. أدى تأخير موعد الزراعة إلى انخفاض محصول الحبوب ومكوناته لجميع التراكيب الوراثية للأرز في الموسمين.

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