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COMBINING ABILITY, HERITABILITY AND CLUSTER ANALYSIS FOR YIELD AND YIELD ASSOCIATED TRAITS IN RICE (*Oryza sativa*, L.).

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ABSTRACT

The main objective of this study was to study the genetic behavior for some Japonica rice varieties in Egypt. An experiment was conducted to evaluate the performance of 15 F_1 hybrids along with their parents i.e Giza177; Sakha101; China2; IR67701B; GZ8479-6-2-3-1 and GZ7955-13-2-1-1 in rice by using a half diallel analysis mating design at Rice Research and Training Center (RRTC) Farm, Sakha, Kafr El-Sheikh, Egypt during 2010 and 2011 growing seasons. Analysis of variance revealed highly significant differences among genotypes; parents and crosses for days to maturity (days); plant height (cm); panicle length (cm); spikelets panicle^{-1}; panicles plant^{-1}; panicle weight (g); 1000-grain weight (g); spikelets fertility% and grain yield plant^{-1} (g). Both general and specific combining ability variances were found to be highly significant for all studied traits. The ratio of σ^2 gca / σ^2 sca values were less than unity for all studied traits indicating the preponderance of non-additive genetic variance in the inheritance of these traits. High broad sense heritability estimates were observed for all studied traits suggests high component of heritable portion of variance, which is the portion exploited by rice breeder and that selection for these traits can be achieved directly based on their phenotypic performance. While, heritability estimates in narrow sense was relatively low for the same traits. According to the mean performance for the studied traits, cluster analysis divided the six rice parental varieties into tow major group based on days to heading (day), plant height (cm), spikelets panicle^{-1} and spikelets fertility%.

Keywords: Rice, combining ability, heritability, cluster analysis, yield traits.

INTRODUCTION

Rice is one of the most important staple food for about one-half of the world population. About one-third of mankind (7.2 billion people) depends on rice more than half of its food (IRRI, 1996). Rice is considered the most popular and important field crop in Egypt for several reason: as a staple food after wheat; as an exporting crop; as a land reclamation crop for improving the productivity of the saline soils widely spread in northern part of the delta and coastal area and finally it is a social crop in which every person in the farmers family could find work in rice fields and earn money during the growing season. Rice crop plays a significant role in Egypt, as strategic crop for sustaining the food self-sufficiency and for increasing the export. In 2012 growing season, the total rice production in Egypt reached 7.1 million tons with a national average of 9.9 tons/ha. This average ranked the first among the rice producing countries in the world (RRTC 2013). Further increase in rice production through increased yield per unit area is needed. Continuously, rice breeders and producers looking for new technology and new lines which increase rice production with acceptable grain quality. Rice production should increase by about 60 % by the year 2025 to feed the additional rice consumers (Duwayri *et al.*, 1999). The main objectives of our study to assess the variation amongst some rice genotypes and available crosses, general and specific combining abilities and their interaction and different genetic parameters as additive, dominance, heritability and cluster analysis between the used parents.

MATERIALS AND METHODS

This study was conducted at Rice Research and Training Center (RRTC), Sakha, Kafr El-Sheikh, Egypt during 2010 and 2011 growing seasons. Combining ability effects and genetic components were studied in six Japonica parents and their 15 F_1 hybrids, using the parental varieties viz. Giza177; Sakha101; China2; IR67701B; GZ8479-6-2-3-1 and GZ7955-13-2-1-1. The six parental varieties were used in this study sown in the summer season of 2010 in three sowing dates, at 15 days intervals to overcome the differences of heading date among the parental varieties. After 30 days from sowing, seedlings of the parents were transplanted to the experimental field in three rows, of 5 meters long and 20 x 20 cm apart between plants and rows. A half diallel cross was affected among the six parents in 2010 growing season to produce 15 crosses. The hybridization technique of Jodon (1938) and modified by Butany (1961), the hot water method of emasculation, was utilized. The six parental varieties and the resulting 15 crosses were evaluated and arranged in a Randomized Complete Block Design (RCBD) experiment with three replications in 2011 growing season. Each replication contained of 25 individual plants. Data were collected for the following agronomic traits; days to heading (day); plant height (cm); panicle length (cm); spikelets panicle^{-1}; panicles plant^{-1}; panicle weight (g); 1000-grain weight (g); spikelets fertility% and grain yield plant^{-1} (g). Data were analyzed according to (Griffing analysis, 1956), method-2, model-1. This is a fixed model and was considered most appropriate as its all requirements were met by the experiment. Variances due to general and specific combining ability were estimated. All rice recommended cultural practices were followed to obtain normal growth of the crop.

RESULTS AND DISCUSSION

Mean performances: The mean performances of the six parents and their 15 F1 hybrids for all studied traits are presented in Table 1. For days to heading (day), among parents Giza177 and GZ7955-13-2-1-1 recorded the lowest and desirable mean values for this trait with mean values of 95.3 and 96.0 (day), respectively. On the contrary, the variety China2 gave the highest undesirable mean value for days to heading (115.3 day). At the same time, the crosses IR67701B x GZ8479-6-2-3-1; IR67701B x GZ7955-13-2-1-1;

Sakha101 x GZ8479-6-2-3-1 and Sakha101 x GZ7955-13-2-1-1 scored the earlier mean values with the mean values of 92.7, 94.3, 94.3 and 94.3 (days), respectively. But Sakha101 x IR67701B was the latest cross for this trait with the mean value of 109.7 days. Concerning plant height (cm), three parents showed the shortest plants (desirable) and ranged from 92.0 cm for GZ8479-6-2-3-1 to 100.3 cm for Giza177. The parental lines; China2 and IR67701B showed the tallest plants (undesirable) with mean values of 127.0 cm and 116.3 cm, respectively. However, the most desirable mean values towards dwarfness were found in the F_1 hybrids, Sakha101 x GZ7955-13-2-1-1 (94.3 cm); Giza177 x Sakha101 (99.3 cm); China2 X IR67701B (100.3 cm) and China2 x GZ8479-6-2-3-1 (101cm) Table 1. Selection of parental lines with appropriate plant height and non-lodging characteristic was important for high yield potential hybrids particularly inter sub specific hybrids. Regarding panicle length (cm), the three parents; GZ7955-13-2-1-1, China2 and Sakha101 recorded the highest mean values for this trait with the mean values of 23.0, 22.5 and 22.2cm, respectively (Table 1). On the contrary, the two parental varieties IR67701B and GZ8479-6-2-3-1 gave the lowest mean values for panicle length (cm) with the same mean values of 20.5cm for both parents. At the same time, the crosses China2 x IR67701B; Sakha101 x GZ8479-6-2-3-1; IR67701B x GZ7955-13-2-1-1; and Giza177 x China2 recorded the highest mean values of 24.8; 24.7; 24.7 and 24.2cm for the same trait, respectively. But the two crosses; China2 x GZ8479-6-2-3-1 (17.7cm) and China2 x GZ7955-13-2-1-1 (18.8cm) gave the lowest mean values for this trait. Concerning spikelets panicle^{-1}, the three parents China2; Sakha101 and IR67701B recorded the highest mean values for the number of spikelets panicle^{-1} which were 251.0; 172.7 and 167.7spikelet, respectively. On the contrary, the parental variety GZ8479-6-2-3-1 gave the lowest mean value (133.0spikelet) for this trait. Among the crosses, data showed that, most of hybrids were desirable for spikelets panicle^{-1}. The crosses; China2 x IR67701B; Sakha101 x GZ8479-6-2-3-1; Sakha101 x China2 and IR67701B x GZ7955-13-2-1-1 gave the highest mean values of 309.3, 274.3, 238.0 and 216.0 spikelets panicle^{-1}, respectively. Hybrids indicated variable expressions for number of panicles plant^{-1}. China2 x IR67701B had minimum panicles plant^{-1} with the mean values of 28.0 while Sakha101 x GZ8479-6-2-3-1 had the maximum mean for panicles plant^{-1} with the mean value of 37.3. At the same time, the parents GZ8479-6-2-3-1; Sakha101 and GZ7955-13-2-1-1 gave high number of panicles plant^{-1}. On the contrary, IR67701B and China2 recorded the lowest values with 16.3 and 19.7 panicles plant^{-1}, respectively. With respect to panicle weight (g), (Table 1) showed that the; GZ7955-13-2-1-1 (5.3g) and China2 (5.0g) and the crosses China2 x IR67701B (6.2g), Giza177 x IR67701B (6.1g), Giza177 x Sakha101 (5.9g) and Sakha101 x IR67701B (5.6g) recorded the highest mean values for panicle weight. On the contrary, the parents Giza177 and IR67701B and the crosses IR67701B x GZ7955-13-2-1-1, Sakha101 x GZ8479-6-2-3-1 and Sakha101 x China2 gave the lowest mean values of 3.7; 3.9; 4.8; 4.9 and 4.9g, respectively for the same trait.

Table 1: Mean performances for all studied traits of parents and their 15 F_1 hybrids resulted from a half-diallel cross in rice.

Genotypes	Days to heading	Plant Height (cm)	Panicle Length (cm)	Spikelets panicle^{-1}	Panicles plant^{-1}	Panicle Weight (g)	1000- Grain Weight (g)	Spikelet Fertility %	Grain yield plant^{-1} (g)
Giza177	95.3	100.3	22.0	159.0	20.3	3.7	28.5	95.8	34.8
Sakha101	113.7	92.7	22.2	172.7	27.0	4.3	27.7	95.6	44.5
China2	115.3	127.0	22.5	251.0	19.7	5.0	26.4	89.5	34.6
IR67701B	98.3	116.3	20.5	167.7	16.3	3.9	28.1	96.2	42.8
GZ8479-6-2-3-1	101.0	92.0	20.5	133.0	30.7	4.0	26.7	97.8	42.8
GZ7955-13-2-1-1	96.0	108.0	23.0	158.0	26.3	5.3	27.8	95.9	36.0
Giza177 x Sakha101	97.7	99.3	21.0	183.0	28.7	5.9	28.7	97.6	55.0
Giza177 x China2	95.7	117.7	24.2	191.0	29.3	5.4	28.4	79.9	56.8
Giza177 x IR67701B	95.3	117.0	22.2	202.3	31.3	6.1	28.5	95.6	45.8
Giza177 x GZ8479-6-2-3-1	98.7	102.7	21.3	198.7	33.7	5.3	30.5	96.0	47.4
Giza177 x GZ7955-13-2-1-1	98.3	104.7	20.6	154.7	30.7	5.4	28.8	97.9	57.3
Sakha101 x China2	107.3	117.0	23.3	238.0	32.3	4.9	28.4	93.0	46.6
Sakha101 x IR67701B	109.7	106.3	22.6	172.3	31.0	5.6	27.6	91.5	61.7
Sakha101 x GZ8479-6-2-3-1	94.3	117.3	24.7	274.3	37.3	4.9	28.8	94.6	54.4
Sakha101 x GZ7955-13-2-1-1	94.3	94.3	20.9	139.3	31.7	5.2	29.4	96.2	46.8
China2 x IR67701 B	96.3	100.3	24.8	309.3	28.0	6.2	28.8	75.7	52.5
China2 x GZ8479-6-2-3-1	98.3	101.0	17.7	166.0	30.3	5.1	30.0	98.2	64.0
China2 x GZ7955-13-2-1-1	100.3	106.3	18.8	186.7	34.0	5.2	29.9	96.8	48.9
IR67701B x GZ8479-6-2-3-1	92.7	121.3	22.5	206.7	30.7	5.2	28.2	81.4	54.2
IR67701B x GZ7955-13-2-1-1	94.3	131.3	24.7	216.0	34.3	4.8	30.2	94.9	55.5
GZ8479-6-2-3-1 x GZ7955-13-2-1-1	98.3	112.7	20.8	198.0	36.3	5.2	30.1	95.8	54.7
L.S.D. at 0.05% **at 0.01%**	0.79 1.07	2.82 3.78	0.66 0.88	11.04 14.77	3.64 4.87	0.22 0.29	0.30 0.40	3.48 4.66	2.70 3.62

Thousand grain weight (g) was varied ranging from 26.4 to 28.5g for the parental lines China2 and Giza177, respectively. The parent China2 recorded the lowest value whereas Giza177 had the best mean value for this trait. The cross of Sakha101 x IR67701B showed less values while Giza177 x GZ8479-6-2-3-1 showed the high values of 1000-grain weight (g) among all 15 F_1 hybrids. Six hybrid combinations namely; Giza177 x GZ8479-6-2-3-1 possessing 1000-grain weight of 30.5g, IR67701B x GZ7955-13-2-1-1 (30.2g); GZ8479-6-2-3-1 x GZ7955-13-2-1-1 (30.1g); China2 x GZ8479-6-2-3-1 (30.0g); China2 x GZ7955-13-2-1-1 (29.9g) and Sakha101 x GZ7955-13-2-1-1 (29.4g) were prominent for this trait (Table 1). Considerable variations were observed in spikelet fertility (%) of the hybrid populations. It varied from 75.7 to 98.2%. Minimum fertility was expressed by the hybrid combination China2 x IR67701B and maximum by China2 x GZ8479-6-2-3-1. Among parents, GZ8479-6-2-3-1 and IR67701B gave the highest fertility % with mean values of 97.8 and 96.2 %, respectively. Whereas the parent China2 recorded the lowest mean value (89.5%) for the same trait. For grain yield plant^{-1} (g), among parents Sakha101; IR67701B and GZ8479-6-2-3-1 recorded the desirable mean values for this trait with 44.5; 42.8 and 42.8 gm, respectively (Table 1). On the contrary, the variety China2 gave the undesirable mean value for grain yield plant^{-1} (34.6g). At the same time, the crosses China2 x GZ8479-6-2-3-1; Sakha101 x IR67701B; Giza177 x GZ7955-13-2-1-1 and Giza177 x China2 scored the highest mean values with mean values of 64.0; 61.7; 57.3 and 56.8g, respectively. But Giza177 x IR67701B was the lowest cross for this trait with mean value of (45.8g).

Analysis of variance and combining ability: Data in Table 2 represent the partitioning of total variance among genotypes into general and specific combining ability for yield and its component traits. The mean square estimates for these traits showed highly significant differences among genotypes (parents and crosses as well as their interactions) for all studied traits. These results clearly showed the amount of variability that does exist among the tested genotypes and hence, the ability for further development through selection in the studied genotypes as well as their segregating generations. These findings are coherent with that of Geetha *et al.,* (1994), Singh *et al.*, (2001) and El-Refaee (2002).

Combining ability estimates revealed that both general and specific combining ability variances were highly significant for all yield and its components traits. This result indicated that the importance of both additive and non additive genetic variance in determining the inheritance of these traits under studied. However, the magnitude of ratio GCA/SCA was lower than unity in all yield and its component studied traits. The results suggested the relative importance of non-additive gene action in controlling all studied traits. These results suggest that selection in late generation would be effective, Hammoud (2004); Sedeek (2006) and Anis (2009)

Table 2: Analysis of variance for all studied traits of six rice parents and 15 F_1 hybrids of rice.

S.O.V.	d.f.	Days to Heading (day)	Plant height (cm)	Panicle length (cm)	Spikelets panicle^{-1}	Panicles plant^{-1}	Panicle Weight (g)	1000-grain weight (g)	Spikelet fertility %	Grain yield plant^{-1} (g)
Rep.	2	1.63	0.30	0.21	2.5	1.33	0.03	0.75	7.91	4.17
Genotypes	20	124.03**	370.02**	10.63**	5858.2**	84.82**	1.35**	3.64**	120.64**	208.72**
Parents	5	239.39**	574.59**	3.28**	4879.0**	88.59**	1.24**	1.91**	24.36**	62.82**
Crosses	14	67.17**	309.42**	13.96**	5861.1**	21.78**	0.57**	2.30**	156.46**	90.70**
P.VsC (H)	1	343.21**	195.56**	0.65*	10713.7**	948.46**	12.87**	31.01**	100.66**	2590.45**
Error	40	0.23	2.93	0.16	44.8	4.87	0.02	0.03	4.47	2.69
GCA	5	81.03**	152.99**	1.61**	2463.02**	36.14**	0.15**	0.64**	50.43**	18.25**
SCA	15	28.11**	113.45**	4.18**	1782.63**	25.64**	0.55**	1.40**	36.80**	86.70**
Error	40	0.07	0.98	0.10	14.93	1.62	0.01	0.01	1.50	0.90
GCA/SCA ratio	---	0.36	0.17	0.04	0.17	0.18	0.03	0.10	0.17	0.03

***, ** Significant and highly significant at 0.05 and 0.01 levels of probability, respectively.**

General combining ability effects: Negative general combining ability effects were desirable for days to heading (day) and plant height (cm) while in other studied traits; positive general combining ability effects were desirable. Among parents, Giza177 and GZ8479-6-2-3-1 were observed to be good general combiners for days to heading (day) and plant height (cm) Table 3. The parent IR67701B was found to be good combiner due to its highly significant and positive general combining ability effects for panicle length (cm) and spikelets panicle^{-1}. While, GZ8479-6-2-3-1 was observed to be the best general combiner due to it's highly significant and positive general combining ability effects for panicles plant^{-1} and grain yield plant^{-1} (g).

Table 3. Values of general and specific combining ability effects of parents and their 15 F_1 hybrids for all studied traits.

Parents and crosses	Days to Heading (day)	Plant height (cm)	Panicle length (cm)	Spikelets panicle^{-1}	Panicles plant^{-1}	Panicle weight (g)	1000- grain weight (g)	Spikelet Fertility %	Grain yield plant^{-1} (g)
<u>GCA</u>									
Giza177	-2.57**	-2.49**	-0.04	-13.94**	-1.54**	-0.02	0.18**	0.83*	-1.73**
Sakha101	4.18**	-5.28**	0.42**	-0.86	1.04*	-0.04	-0.28**	1.52**	0.97**
China2	3.89**	4.31**	0.02	29.22**	-1.67**	0.16**	-0.26**	-3.66**	-0.95**
IR67701B	-1.40**	5.89**	0.53**	10.35**	-2.33**	0.04	-0.14**	-2.56**	1.19**
GZ8479-6-2-3-1	-1.53**	-2.86**	-0.70**	-6.19**	2.88**	-0.23**	0.07	1.18**	1.84**
GZ7955-13-2-1-1	-2.57**	0.43	-0.23**	-18.57**	1.63**	0.10**	0.44**	2.68**	-1.32**
L.S.D. at 0.05% at 0.01%	0.28 0.37	0.64 0.86	0.15 0.20	2.52 3.37	0.83 1.11	0.05 0.06	0.10 0.11	0.80 1.10	0.62 0.82
<u>SCA</u>									
Giza177 x Sakha101	-4.07**	-1.74	-1.32**	3.63	-0.36	0.88**	0.15	2.14	6.33**
Giza177 x China2	-4.45**	7.01**	2.25**	-18.45**	3.02*	0.19**	-0.17	-10.40**	10.10**
Giza177 x IR67701B	-0.82*	4.76**	-0.26	11.76**	5.68**	1.05**	-0.20**	4.15**	-3.10**
Giza177 x GZ8479-6-2-3-1	3.30**	-0.83	0.10	24.63**	2.81*	0.44**	1.66**	0.85	-2.08*
Giza177 x GZ7955-13-2-1-1	4.01**	-2.12*	-1.07**	-6.99*	1.06	0.19**	-0.46**	1.22	10.92**
Sakha101 x China2	-0.53	9.13**	0.96**	15.46**	3.43**	-0.28**	0.29**	2.04	-2.81**
Sakha101 x IR67701B	8.10**	-3.12**	-0.29	-31.33**	2.77*	0.57**	-0.61**	-0.63	10.14**
Sakha101 x GZ8479-6-2-3-1	-8.11**	16.63**	3.04**	87.21**	3.89**	0.07	0.37**	-1.28	2.20*
Sakha101 x GZ7955-13-2-1-1	-7.07**	-9.66**	-1.23**	-35.41**	-0.52	0.10	0.59**	-1.11	-2.22*
China2 x IR67701B	-5.95**	-18.70**	2.35**	75.59**	2.48*	0.96**	0.60**	-11.26**	2.91*
China2 x GZ8479-6-2-3-1	-4.15**	-9.29**	-3.59**	-51.20**	-0.40	0.12	1.55**	7.53**	13.75**
China2 x GZ7955-13-2-1-1	-1.11**	-7.24**	-2.96**	-18.16**	4.52**	-0.17*	1.07**	4.66**	1.79*
IR67701B x GZ8479-6-2-3-1	-3.20**	9.46**	0.76**	8.34*	0.60	0.30**	-0.41**	-10.41**	1.79*
IR67701B x GZ7955-13-2-1-1	-1.49**	16.17**	2.46**	30.05**	5.52**	-0.40**	1.22**	1.69	6.27**
GZ8479-6-2-3-1 x GZ7955-13-2-1-1	2.30**	6.26**	-0.24	28.59**	2.31*	0.28**	0.99**	-1.18	4.82**
L.S.D. at 0.05% at 0.01%	0.77 1.03	1.77 2.37	0.41 0.55	6.92 9.26	2.28 3.05	0.14 0.19	0.19 0.25	2.20 2.92	1.70 2.30

***, ** Significant and highly significant at 0.05 and 0.01 levels of probability, respectively.**

The parent GZ7955-13-2-1-1 was the good combiner due to its highly significant positive general combining ability effects for panicle weight (g), 1000-grain weight (g) and spikelets fertility %. Similar findings have been reported by Chowdhry *et al.,* (1996), Singh *et al.,* (1996), Rogbell *et al*., (1998) Swamy *et al.,* (2003), Petchiammal and Kumar (2007) and Saleem *et al.,* (2010).

Specific combining ability effects: For days to heading (day) and plant height (cm) negative specific combining ability effects were desirable where as in the other studied traits positive specific combining ability effects were desirable. The crosses Sakha101 x GZ7955-13-2-1-1, China2 x IR67701B, China2 x GZ8479-6-2-3-1 and China2 x GZ7955-13-2-1-1 exhibited highly significant negative specific combining ability effects for days to heading and plant height (cm) Table 3. In general, six hybrids for panicle length (cm), seven hybrids for spikelets panicle^{-1}; five hybrids for panicle plant-1, nine hybrids for panicle weight (g), nine hybrids for 1000-grain weight (g), three hybrids for spikelets fertility % and seven hybrids for grain yield plant^{-1} (g) recorded highly significant positive specific combining ability effects. Similar type of positive specific combining ability effects were reported by Ramalingam *et al*., (1997), Rogbell *et al*., (1998), Radhidevi *et al*., (2002) and Saleem *et al.,* (2010).

Genetic components and heritability: This part of investigation aimed to study the magnitude of the genetic variance components i.e. additive genetic variance (σ^2A) and dominance genetic variance (σ^2D) using these components to estimate heritability in broad and narrow sense % for all studied traits (Table 4).

Table 4: Estimation of additive genetic variance (σ^2A), dominance genetic variance (σ^2D), environmental variance (σ^2E) and heritability in broad and narrow senses (Griffing, 1956) for all studied traits.

Characters/ Genetic components	σ^2A	σ^2D	σ^2E	Heritability %	
				$h^2{}_b$ %	$h^2{}_n$ %
Days to heading	12.57	29.67	0.59	99.56	29.63
Plant height (cm)	9.88	112.47	2.93	99.20	10.00
Panicle length (cm)	-0.64	4.13	0.16	98.48	18.18
Spikelets panicle^{-1}	170.10	1767.69	44.81	99.23	10.71
panicles plant^{-1}	2.62	24.02	4.90	94.26	10.28
Panicle weight (g)	-0.10	0.54	0.02	98.65	22.31
1000-grain weight (g)	-0.19	1.40	0.04	99.10	15.74
Spikelet fertility %	3.14	35.32	4.47	96.29	10.46
Grain yield plant^{-1} (g)	-17.11	85.78	2.70	98.71	24.12

The results showed that the non-additive or dominance genetic variance as a portion of the total genetic variance was larger than the additive genetic variance for all studied traits. Both of them were significant and positive for all studied traits except additive genetic variance (σ^2A) for panicle length (cm); panicle weight (g); 1000-grain weight (g) and grain yield plant^{-1} (g). Their respective values were -0.64, -0.10, -0.19 and -17.11. A higher estimate for non-additive or dominance genetic variance was computed for all studied traits in comparison with its corresponding estimates of additive genetic variance (Table 4)**.**

This result indicated that dominance genetic variance played the major role compared to the additive genetic variance in the inheritance of these traits. These results were in general agreement with those reported by El-Refaee (2002), El-Mowafi and Abou Shosha (2003), Ahmed (2004), Hammoud (2004), El-Mowafi *et al.,* (2005), Sedeek (2006), Awad-Allah (2006) and Abd Allah (2008).

Heritability in narrow sense is an indicator of the efficiency of selection procedure in identifying the superior genotypes. The results cleared that heritability estimates in broad sense were high for all the studied traits, while heritability estimates in narrow sense were relatively low for the same traits. This further suggested that a major part of the total phenotypic variance for these traits was due to dominance genetic variance and environmental effects. These findings led to conclusions the selection for such traits must be done in the late generations. These results in general agreement with those reported by El-Mowafi (1994), Hammoud (1996), El-Refaee (2002), Hammoud (2004), Awad Allah (2006), Abd Allah (2008) and Anis (2009).

Cluster analysis: According to the mean performance for the nine agro-morphological studied traits which were namely; days to heading (day); plant height (cm); panicle length (cm); spikelets panicle^{-1}; panicles plant^{-1}; panicle weight (g); 1000-grain weight (g); spikelets fertility% and grain yield plant^{-1} (g). Characters normality was checked for all studied traits, which indicated that most traits had good approximations of normal distributions.

Data in Table (5) showed the diversity matrix for the six Japonica parental varieties. The generated cluster divided them into tow main groups based on most of studied traits. The first group included China2 in one branch which was the later parent in heading, tallest in plant height (cm), high in spikelets panicle^{-1} and lower in spikelets fertility%. The second group included all the rest of varieties. The second group was divided into tow sub groups based on panicles plant^{-1} and spikelets panicle^{-1}. The first sub group included GZ8479-6-2-3-1 which was the higher variety in these tow traits. The second sub group included the rest of varieties. The second sub group was divided into tow sub sub groups, the first one included Sakha101 because high in plant height (cm). The second sub sub group included the three varieties Giza177, GZ7955-13-2-1- and IR67701B. These three varieties were similar in most of traits under study.

Table 5: Diversity matrix for the six parental varieties based on nine agro-morphological studied traits.

Parental varieties	Giza177	Sakha101	China2	IR67701B	GZ8479-6-2-3-1	GZ7955-13-2-1-1
Giza177	0					
Sakha101	8.2928	0				
China2	32.635	28.207	0			
IR67701B	6.0748	8.8441	28.716	0		
GZ8479-6-2-3-1	10.735	14.712	42.072	15.221	0	
GZ7955-13-2-1-1	3.3369	8.651	32.676	6.1721	10.251	0

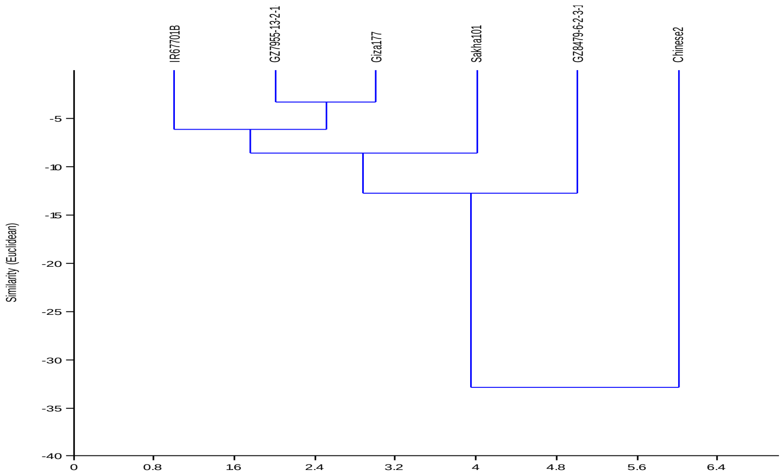

Figure 1: Dendogram of the six Japonica rice parental varieties classified by nine agro-morphological traits.

Conclusion

The overall results indicated that there is adequate genetic variability present in the material studied. The parents IR67701B, GZ8479-6-2-3-1 and Sakha 101 were the best combiners for grain yield trait. Heritability estimates in broad sense were high for all the studied traits, while heritability estimates in narrow sense were relatively low for the same traits. This further suggested that a major part of the total phenotypic variance for these traits was due to dominance genetic variance and environmental effects.

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القدرة علي الإئتلاف والمكافىء الوراثى والتحليل العنقودى لصفات المحصول ومكوناته فى الآرز.

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كان الهدف من هذا البحث هو دراسة السلوك الوراثى لبعض أصناف الآرز اليابانيه تحت الظروف المصريه وذلك من خلال اجراء تهجين بين ست اصناف (تراكيب وراثية) من الارز بنظام التهجين الدورى (دايلل) فى اتجاة واحد حيث اجريت هذه التجربة بالمزرعه البحثيه بمركز البحوث والتدريب فى الارز- بسخا كفر الشيخ خلال موسمين متتاليين هما ٢٠١٠ ، ٢٠١١. أظهرت النتائج أن التباين الوراثي الراجع للتراكيب الوراثيه والآباء والهجن الناتجة منها كان عالي المعنوية لجميع الصفات محل الدراسة وهى عدد الآيام اللازمه للتزهير، طول النبات، طول السنبلة، عدد السنابل للنبات، وزن السنبلة، وزن الالف حبة، النسبه المئويه للخصوبه ومحصول النبات الفردى. وكان التباين الوراثى الراجع إلى القدرتين العامة والخاصة على الائتلاف عالي المعنوية ايضا لجميع الصفات وكانت النسبة بين القدرة العامة على الإئتلاف إلى القدرة الخاصة على الإئتلاف أقل من الواحد الصحيح للصفات محل الدراسة موضحا" أن الفعل الغيرمضيف للجين قد لعب دورا" عظيما" فى وراثة هذه الصفات وعلية فإنة يمكن إجراء التحسين الوراثى لهما بسهولة. وكانت درجه التوريث بمعناها الواسع اكبر من درجه التوريث فى المدى الضيق لجميع الصفات محل الدراسة. وبدراسة العلاقه الوراثيه ودرجة التشابه بين الست اصناف المستخدمه أوضح تحليل الشجرة الوراثية ان هناك تباعد بين الاصناف قسمت هذه الاصناف الى مجموعتين رئيسيتين. وهذا التقسيم راجع الى عدد الايام اللازمه للتزهر، طول النبات، عدد السنابل للنبات وكذلك النسبة المئوية للخصوبة.

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