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ESTIMATION OF HETEROSIS, GENETIC COMPONENTS AND CORRELATION COEFFICIENT FOR IMPROVEMENT OF GRAIN YIELD IN RICE (*Oryza sativa* L.).

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ABSTRACT

Line x tester experiment was conducted to evaluate the performance of 25 F_1 hybrids along with ten parents in rice at Rice Research and Training Center (RRTC), Sakha, Kafr El-Sheikh, Egypt during 2007 and 2008 growing seasons to estimate the percentage of heterosis and heterobeltiosis among F_1 hybrids developed from five lines and five testers of rice. Genotypic mean squares for all studied traits were highly significant and had genetic variability for these traits. Heterosis and heterobeltiosis were estimated for number of days to maturing, plant height (cm), number of panicles per plant, panicle weight (g), 1000-grain weight (g), and grain yield per plant in cross combinations of five lines of rice (Giza 177, Sakha 101, Sakha 103, Sakha 104 and one promising line GZ6903-1-2-2-1) and five testers (IRBLI-F5, IRBLzFU, IRBLz5-CA, IRBLTACT2 and IRBLSH-B). The resultes exhibited significant differences among genotypes and their crosses for all studied traits. The crosses Sakha 101 x IRBLzFU and Giza 177 x IRBLzFU depicted significant heterosis and heterobeltiosis for grain yield and most of the other studied traits followed by Giza 177 x IRBLI-F5. Heritability estimates in broad sense were high for all studied traits. While, heritability estimates in narrow sense were relatively low for all traits.

INTRODUCTION

Rice is one of the most important cereal crop all over the world. It is not only a stable food, but also contributes the major economic activity and a key source of income and employment for the rural population. Also, rice is considered the main food for all human ages because rice grains are rich in proteins, minerals, vitamins and fiber (Alam *et al*, 1998). The total rice production in Egypt reached 6.6 million tons with a national average of 10.00 ton/ha. This average ranked the first among the rice production countries in the world. Rice production should increase by about 60% by the year of 2025 to feed the additional rice consumers. The rapidly increasing population of the world necessitates studying heterotic effects on rice for increasing grain yield potential. One of the aspects of heterosis study is development of rice, which might play a big role in this respect because hybrid crops are more uniform in maturity and vigorous in most of the cases. Breeders always try to improve yield potential of rice. Maximum yield potential can be exploited through hybrid vigor. The present study was conducted to estimate the percentage of heterosis and heterobelitosis among F_1 hybrids produced by ten rice varieties. Broad and narrow sense heritability were estimated the phenotypic correlation coefficients was recorded among all possible pairs of the studied traits. This study would be helpful for selecting suitable parents for hybrids development in rice breeding program.

MATERIALS AND METHODS

This study was conducted at Rice Research and Training Center (RRTC), Sakha, Kafr El-Sheikh, Egypt during 2007 and 2008 growing seasons. Heterotic effect was studied in cross combinations using five lines viz. Giza 177, Sakha 101, Sakha 103, Sakha 104 and one promising line GZ6903-1-2-2-1 and five monogenic lines, Viz., IRBLI-F5, IRBLzFU, IRBLz5-CA, IRBLTACT2 and IRBLSH-B were used as "Testers". The ten parental varieties in this study were sown in the summer season of 2007 in three sowing date, at 15 days intervals to overcome the difference 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 line x tester cross was conducted among the ten parents in 2007 growing season to produce 25 crosses. The hybridization technique of Jodon (1938) and modified by Butany (1961), the hot water method of emasculation, was utilized. The ten parental varieties and the resulting 25 crosses were evaluated and arranged in a Randomized Complete Block Design (RCBD) experiment with three replications in 2008 growing season. Each replication contained 25 individual plants. Observations were recorded for duration or days to maturing (days), plant height (cm), number of panicles per plant, panicle weight (g), 1000-grain weight (g), and grain yield per plant. Heterosis in F_1 for all these traits were calculated in percentage over mid parents and better parent values according to Mather (1949) and Mather and Jinks (1982).

Statistical analysis:

The estimation of heterosis:

Heterosis of an individual cross for each trait was determined as the increase of the F_1 hybrid mean over either mid parents and better parent, these proposed by Mather (1949) and Mather and Jinks (1982). But there are two formulas usually used for estimation of heterosis as follows:

1-Mid-parents heterosis or heterosis over the mid- parents (MP%).

2-Heterobeltiosis or heterosis over the better parent (BP%).

Heterosis over the mid- parents (MP%).

The amount of heterosis as proposed by Mather (1949) and Mather and Jinks (1982) was determined as the increase of F_1 hybrid mean over the average of its two parents as follows:

$$\text{Heterosis over the mid- parents \% (MP\%)} = \frac{F_1 - \overline{MP}}{MP} \times 100$$

To test the heterosis significance for the above case, L.S.D. values were estimated according to the following formula suggested by Wynne *et al.* (1970):

$$\text{L.S.D. for MP} = t_{\substack{0.05\\0.01}} \sqrt{\frac{3MSE}{2r}}$$

Heterosis over the better parent (BP%) or (Heterobeltiosis) :

Heterosis of an individual cross was determined as the increase of the F_1 hybrid mean over its better parent, (heterobeltiosis), as follows:

$$\text{Heterosis over the better parent \% (BP\%)} = \frac{\overline{F_1} - \overline{BP}}{\overline{BP}} \times 100$$

The better parent for any trait is that having the highest mean value, except for the traits, days to maturing and plant height, where the better parent has the lowest mean value.

The estimates of correlation coefficients

Correlation coefficients (r) among all studied traits were computed using SPSS statistical package according to the following formula:

$$r = \frac{SS\,xy}{\sqrt{SS\,x \; - \; SS\,y}}$$

Where:

SS xy = Covariance of xy.

SS x = Sum squares of x.

SS y = Sum squares of y.

The significance of correlation coefficients was tested using the following formula according to **Gomes and Gomes (1983):**

$$t = r \frac{N - 2}{\sqrt{1 - r^2}}$$

RESULTS AND DISCCUSION

Mean performance:

Mean performance of the ten parents and their F_1 of the line x tester for the six studied traits are presented in Table 1. The mean performance for the a forenamed traits, varied from cross to another cross combination. For duration (no. of days to maturity, the IRBLI-F5 and IRBLSH–B were the earliest parental lines 117 and 118 days. Moreover, crosses of Sakha 103 x IRBLI-F5 and Sakha 103 x IRBLZ5-CA were the earliest combinations 116 and 117 days, respectively. This in turn suggested that earliness was dominant over lateness for these crosses. Rice crosses, Sakha 101 X IRBLSH-B and GZ6903-1-2-2-1 x IRBLTA CT2 rice combinations were the latest 150 and 147 days, respectively. Complete to over dominance was observed in most of the crosses towards taller parents for plant height. Sakha 101 was shorter than the other parents (92 cm). Generally, most of F_1 hybrids were late and tall in plant height compared with their respective parents. Indicating that the strong effect of the hybrid vigor for this traits. Tallness may be dominated over dwrfness as was stated by El-Hity 1993 and Hammoud *et al*., (2008).

Table (1): Mean performance of parental varieties and their F_1 crosses for studied traits.

Genotypes	Duration (days)	Plant height (cm)	No. of panicles per plant	Panicle weight (g)	1000-grain weight (g)	Grain yield per plant (g)
Giza 177	124	97	17	3.5	28.2	46.6
Sakha 101	140	92	23	4.2	29.4	56.5
Sakha 103	122	98	19	3.1	24.3	43.3
Sakha 104	132	105	21	4.3	28.4	56.3
Gz 6903-1-2-2-1	136	99	24	4	27.2	56.7
IRBLI-F5	117	98	20	1.9	24.2	32.3
IRBLZFU	126	123	17	1.6	26.3	25.2
IRBLZ5-CA	121	140	18	2.7	22.3	39.7
IRBLTACT2	132	115	16	0.84	18.3	13.5
IRBLSH-B	118	100	21	2.1	25.3	37
Giza 177 x IRBL I-F5	127	102	47	4.1	26.4	96.03
Giza 177 x IRBLzFU	120	120	45	5	28.5	64.6
Giza 177 x IRBLz5-CA	118	153	54	4.5	29.6	82.1
Giza 177 x IRBLTACT2	128	133	49	4	26	41
Giza 177 x IRBLSH-B	117	122	47	3.7	29.2	69.3
Sakha 101 x IRBL I-F5	134	121	37	4.2	26.1	67.7
Sakha 101 x IRBLzFU	133	145	55	3.8	22.6	91.5
Sakha 101 x IRBLz5-CA	144	160	55	4.7	25.7	51.3
Sakha 101 x IRBL TACT2	146	122	34	3.06	23	50.02
Sakha 101 x IRBLSH-B	150	140	36	3.4	26.5	58.3
Sakha 103 x IRBL I-F5	116	105	46	4.2	24.2	43.4
Sakha 103 x IRBLzFU	130	128	29	4.1	26.4	32.4
Sakha 103 x IRBLz5-CA	117	150	52	3.6	24.1	38.7
Sakha 103 x IRBL TACT2	138	122	30	3.6	27.6	38.5
Sakha 103 x IRBLSH-B	118	109	21	4.4	26.7	37.7
Sakha 104 x IRBL I-F5	130	115	25	3.3	28	37.8
Sakha 104 x IRBLzFU	131	118	36	6.3	27	31.3
Sakha 104 x IRBLz5-CA	133	143	29	3.7	24.5	37.5
Sakha 104 x IRBL TACT2	145	144	34	3.3	22	33.5
Sakha 104 x IRBLSH-B	135	136	38	5.8	28.1	47.9
GZ6903-1-2-2-1 x IRBL I-F5	132	113	36	4.1	27	33.7
GZ6903-1-2-2-1 x IRBLzFU	135	134	30	5.02	25.3	40.7
GZ6903-1-2-2-1 x IRBLz5-CA	140	165	28	5.2	23.5	52.1
GZ6903-1-2-2-1 x IRBL TACT2	147	159	30	2	24.2	30.4
GZ6903-1-2-2-1 x IRBLSH-B	144	142	30	4.04	26.4	38.05
L.S.D. 0.0 5	1.594	1.623	1.782	0.146	0.186	2.980
0.01	2.120	2.159	2.371	0.194	0.247	3.963

For number of panicles per plant, GZ6903-1-2-2-1 and Sakha 101 rice varieties recorded the highest values of 24 and 23 panicles. While, IRBLTACT2, IRBLZFU and Gize 177 gave the lowest values for number of panicles per plant 16, 17 and 17 panicles, respectively. Regarding to panicle weight, the tow parents Sakha 104 and Sakha 101 rice varieties gave the highest mean values (more than 4g). The crosses, Sakha 104 x IRBLz FU, GZ 6903-1-2-2-1 x IRBLz 5-CA and GZ6903-1-2-2-1 x IRBLzFU gave the highest mean values more than (5.00g). Concerning the 1000-grain weight, the parental varieties Sakha 101, Sakha 104, and Giza 177 showed the highest mean values of 29.4 , 28.4 and 28.2g, respectively. While the crosses, Giza 177 X IRBLZ5-CA, Giza 177 x IRBLSH-B and Giza 177 x IRBLZ FU were the highest crosses with mean values ranged from 28.50 to 29.60g for the same trait and were superior in this respect. For grain yield per plant, GZ 6903-1-2-2-1, Sakha 101 and Sakha 104 exhibited the highest mean values compared with tester genotypes. The rice crosses, Giza 177 x IRBLI-F5, Sakha 101 x IRBLZFU and Giza 177 x IRBLZ5-CA gave the highest grain yield per plant compared with other crosses with mean values of 96.03, 91.5 and 82.1g, respectively. On the other hand the parental line IRBLTACT2 was the lowest one 13.5 g for the same trait.

Estimates of heterosis for agronomic traits:

The heterosis is the measure of superiority of the hybrid over its parents. It is expressed as the percentage deviation of F_1 mean performance from mid-parents and better parent. Heterosis values were calculated for days to maturing, plant height, number of panicles per plant, panicle weight, 1000-grain weight and grain yield per plant. Data of heterosis estimates of mid-parents and better parent for these traits are presented in Tables 2, 3 and 4. For days to maturing, Table 2 reveals that six out of the 25 hybrid combinations showed negative heterosis effects relative to mid –parents for total duration and ranged from – 1.66% for the cross Sakha 103 x IRBLSH-B to – 4.0% for Giza 177 X IRBLZFU it is of interest to note that some of the rice varieties which were involved in these crosses were found to be the best combiners and the others were among the poorest combiners for earliness. In general these results are in agreement with those reported by El-Mowafi and Abou-Shousha (2003), Ahmed (2004), Hammoud (2004) and Awd Allah (2006).

For plant height trait, data in table 2 indicated that all crosses exhibited undesirable positive and highly significant heterotic values, indicating that all F_1 plants were taller than their respective mid-parents and better parent, suggest that dominance or epstasis play a major role in the inheritance of this trait. Regarding number of panicles per plant, 24 out of 25 crosses showed highly significant and positive heterosis effects relative to both mid-parents and better parent. The best three hybrid combinations were sakha 101 x IRBLZFU, Sakha 103 x IRBLZ5-CA and Sakha 101 x IRBLZ5-CA for better and mid parents together. For panicle weight. Data in Table 3 showed that eight hybrid combinations showed highly significant and positive estimates of heterosis relative mid and better parent. The highest estimates were recorded for the crosses Sakha 104 x IRBLZFU, Sakha 104 x IRBLSH-B and Giza 177 x IRBLZFU. These results suggest that these particular crosses can be used for high panicle weight in rice breeding program.

Table (2): Estimation of heterosis in different cross combinations for duration and plant height of rice genotypes.

Crosses	Duration (days)		Plant height (cm)	
	MP%	BP%	MP%	BP%
Giza 177 x IRBL I-F5	5.3**	8.55**	4.61**	10.86**
Giza 177 x IRBLzFU	-4.00**	2.56**	9.09**	30.43**
Giza 177 x IRBLz5-CA	-3.6.00**	0.854	29.11**	66.30**
Giza 177 x IRBLTACT2	0.00	9.40**	25.47**	44.56**
Giza 177 x IRBLSH-B	-3.30**	0.00	23.85**	32.60**
Sakha 101 x IRBL I-F5	4.20**	14.52**	27.36**	31.52**
Sakha 101 x IRBLzFU	0.00	13.67**	34.88**	57.60**
Sakha 101 x IRBLz5-CA	10.00**	33.07**	37.93**	73.91**
Sakha 101 x IRBL TACT2	7.53**	24.78**	17.87**	32.60**
Sakha 101 x IRBLSH-B	16.27**	28.20**	45.83**	52.17**
Sakha 103 x IRBL I-F5	-2.90**	- 0.85	7.14**	14.13**
Sakha 103 x IRBLzFU	4.80**	11.11**	15.83**	39.013**
Sakha 103 x IRBLz5-CA	-3.70**	0.00	26.50**	63.04**
Sakha 103 x IRBL TACT2	8.66**	17.94**	14.55**	32.60**
Sakha 103 x IRBLSH-B	-1.66*	0.854	10.10**	18.47**
Sakha 104 x IRBL I-F5	4.41**	11.11**	13.30**	25.00**
Sakha 104 x IRBLzFU	1.50*	11.96**	3.50**	28.26**
Sakha 104 x IRBLz5-CA	5.13**	13.67**	16.73**	55.43**
Sakha 104 x IRBL TACT2	9.84**	23.93**	30.90**	56.52**
Sakha 104 x IRBLSH-B	8.00**	15.83**	32.68**	47.82**
GZ6903-1-2-2-1 x IRBL I-F5	5.20**	12.82**	14.72**	44.56**
GZ6903-1-2-2-1 x IRBLzFU	3.05**	15.38**	20.72**	45.65**
GZ6903-1-2-2-1 x IRBLz5-CA	8.94**	19.65**	38.07**	79.34**
GZ6903-1-2-2-1 x IRBL TACT2	9.70**	25.64**	48.59**	72.82**
GZ6903-1-2-2-1 x IRBLSH-B	13.38**	23.07**	42.71**	54.34**
L.S.D 0.05	1.38	1.594	1.40	1.623
0.01	1.83	2.120	1.86	2.159

***, ** Significant at 0.05 and 0.01 levels, respectively.**

For 1000-grain weight, fifteen crosses were highly significant and positive heterosis over the mid-parents and the best cross was Sakha103 x IRBL TACT2 with heterotic value of 26.75 %. At the same time, highly significant and positive heterosis values over the better parent were recorded for tow hybrid combinations for the same trait. The highest value was 10.10% for the cross Giza 177 x IRBLI-F5 and the lowest value was 0.79% for Giza 177 x IRBLz5-CA. With respect to grain yield per plant, the estimates of heterosis revealed highly significant and positive heterotic effects were determined for 13 crosses as a deviation from mid-parents values, while, eight crosses showed highly significant and positive estimates as deviation from better parent values, the best crosses were Sakha 101 x IRBLZFU, Giza 177 x IRBLzFU, Giza 177 x IRBLI-F5 and Giza 177 x IRBLSH-B. These results suggest that the parents which were involved in these crosses could be utilized to exploit hybrid vigor for grain yield per plant. significant heterosis effects for grain yield have been reported by El-Mowafi (2001), El-Mowafi and Abou Shousha (2003) and El-Mowafi and Abd El-Hadi (2005).

Table (3): Estimation of heterosis in different cross combinations for number of panicles and panicle weight of rice genotypes.

Crosses	Number of panicles per plant		Panicle weight (g)	
	MP%	BP%	MP%	BP%
Giza 177 x IRBL I-F5	159.45**	105.7**	49.35**	-5.41**
Giza 177 x IRBLzFU	164.70**	92.85**	95.45**	17.04**
Giza 177 x IRBLz5-CA	208.7-**	131.43**	45.16**	4.65**
Giza 177 x IRBLTACT2	196.96**	101.003**	86.03**	-6.11**
Giza 177 x IRBLSH-B	147.36**	101.43**	24.84**	-17.03**
Sakha 101 x IRBL I-F5	71.29**	58.57**	36.67**	-2.32**
Sakha 101 x IRBLzFU	172.9**	153.71**	29.91**	-11.62**
Sakha 101 x IRBLz5-CA	166.9**	135.71**	36.23**	9.30**
Sakha 101 x IRBL TACT2	73.46**	45.71**	21.42**	-28.83**
Sakha 101 x IRBLSH-B	62.89**	54.28**	6.91**	-20.93**
Sakha 103 x IRBL I-F5	135.89**	97.14**	66.46**	-2.32**
Sakha 103 x IRBLzFU	61.11**	24.28**	72.63	-4.65**
Sakha 103 x IRBLz5-CA	181.08**	122.86**	24.13**	-16.27**
Sakha 103 x IRBL TACT2	65.71**	27.14**	82.74**	-16.27**
Sakha 103 x IRBLSH-B	5.00**	-9.99**	67.30**	2.32**
Sakha 104 x IRBL I-F5	21.95**	7.14**	5.66**	-23.25**
Sakha 104 x IRBLzFU	28.26**	54.28**	111.76**	46.51**
Sakha 104 x IRBLz5-CA	38.46**	17.14**	5.71**	-13.95**
Sakha 104 x IRBL TACT2	83.78**	45.71**	28.40**	-23.25**
Sakha 104 x IRBLSH-B	80.95**	62.85**	79.56**	34.88**
GZ6903-1-2-2-1 x IRBL I-F5	65.13**	54.28**	37.12**	-4.65**
GZ6903-1-2-2-1 x IRBLzFU	47.78**	28.57**	76.59**	16.67**
GZ6903-1-2-2-1 x IRBLz5-CA	34.61**	20.00**	54.76**	20.93**
GZ6903-1-2-2-1 x IRBL TACT2	51.51**	28.57**	-22.00**	-55.81**
GZ6903-1-2-2-1 x IRBLSH-B	34.52**	28.57**	30.74**	-6.04**
L.S.D 0.05%	1.54	1.782	0.126	0.146
0.01%	2.05	2.371	0.167	0.194

***, ** Significant at 0.05 and 0.01 levels, respectively.**

Genetic components of variance for agronomic traits:

Genetic parameters, additive and dominance genetic variance as well as heritability values were estimated for the six agronomic traits i.e. duration (days), plant height (cm), number of panicles per plant, panicle weight (g), 1000-grain weight (g) and grain yield per plant (g) and the results are presented in Table 5.

The results indicate that the non-additive genetic variance (σ^2 D) and the relative importance of SCA% of duration, plant height, number of panicles per plant, panicle weight, 1000-grain weight and grain yield per plant traits were higher than those additive variance (σ^2 A) and relative importance of GCA%. These results indicated that these traits, were largely governed by dominance gene action. In the same time, the predominance SCA variance also indicated the importance of non-additive gene action which reported earlier for grain yield and its components traits. Similar results were obtained by Hammoud (1996); Attia (2001); El-Mowafi (2001); El-Refaee (2002), Ahmed (2004) and Hammoud (2004) .

Table (4): Estimation of heterosis in different cross combinations for 1000-grain weight and grain yield per plant of rice genotypes.

Crosses	1000-grain weight (g)		Grain yield per plant (g)	
	MP%	BP%	MP%	BP%
Giza 177 x IRBL I-F5	0.760**	10.10**	14.85**	66.62**
Giza 177 x IRBLzFU	4.95**	-2.61**	81.43**	11.55**
Giza 177 x IRBLz5-CA	17.22**	0.793**	90.81**	42.14**
Giza 177 x IRBLTACT2	11.96**	-11.35**	40.56**	-28.55**
Giza 177 x IRBLSH-B	9.28**	-0.456**	65.13**	20.01**
Sakha 101 x IRBL I-F5	-2.28**	-16.89**	53.75**	16.84**
Sakha 101 x IRBLzFU	18.70**	-22.93**	126.18**	58.25**
Sakha 101 x IRBLz5-CA	-0.50**	-12.48**	6.97**	-11.31**
Sakha 101 x IRBL TACT2	-3.20**	-21.45**	46.27**	-12.94**
Sakha 101 x IRBLSH-B	-2.91**	-9.65**	23.92**	0.59**
Sakha 103 x IRBL I-F5	-2.08**	-17.48**	14.61**	-24.81**
Sakha 103 x IRBLzFU	2.41**	-9.99**	-5.71**	-43.82**
Sakha 103 x IRBLz5-CA	1.26**	-17.93**	-7.67**	-33.06**
Sakha 103 x IRBL TACT2	26.75**	-5.90**	34.62**	-34.12**
Sakha 103 x IRBLSH-B	5.53**	-9.08**	-7.24**	-34.35**
Sakha 104 x IRBL I-F5	6.54**	-4.54**	-14.08**	-35.02**
Sakha 104 x IRBLzFU	-1.27**	-7.95**	-22.17**	-45.82**
Sakha 104 x IRBLz5-CA	-3.66**	-16.81**	-21.04**	-34.83**
Sakha 104 x IRBL TACT2	-5.68**	-24.97**	-0.945	-41.57**
Sakha 104 x IRBLSH-B	4.61**	-4.31**	-0.882	18.45**
GZ6903-1-2-2-1 x IRBL I-F5	5.05**	-7.95**	-25.33	-41.72**
GZ6903-1-2-2-1 x IRBLzFU	-5.45**	-13.84**	-2.52	-29.78**
GZ6903-1-2-2-1 x IRBLz5-CA	-5.32**	-20.20**	6.07**	-9.78**
GZ6903-1-2-2-1 x IRBL TACT2	6.37**	-17.59**	-14.04**	-47.16**
GZ6903-1-2-2-1 x IRBLSH-B	0.57**	-10.10**	-19.67**	-33.13**
L.S.D 0.05	0.16	0.186	2.58	2.98
0.01	0.21	0.247	3.43	3.96

***, ** Significant at 0.05 and 0.01 levels, respectively.**

Heritability estimates in both broad and narrow senses for all studied traits are presented in Table 5. The results showed that heritability estimates in broad sense (h^2_b%) were high for all studied traits. while, heritability estimates in narrow sense (h^2_n%) were relatively low for duration, plant height, number of panicles per plant, panicle weight, 1000-grain weight and grain yield per palnt with values 26.83, 26.61, 32.31, 2.84, 5.07 and 15.75, respectively. This further suggested that a major part of the total phenotypic variance for these traits was due to dominance genetic variance and environmental effects. Thus these results led to conclusions the selection for these traits must be done in the late generations. These results were in full agreement with the previous results obtained by El-Refaee (2002), Hammoud (2004), Awd-Allah (2006), Sedeek (2006) and Anis (2009).

Table (5): Estimates of genetic parameters for yield and its component traits.

Genetic Parameters	Duration (days)	Plant height (cm)	No. of panicles per plant	Panicle weight (g)	1000-grain weight (g)	Grain yield per plant (g)
Additive variance (σ^2 A)	11.66	33.54	32.79	0.02	0.16	29.8
Dominant variance (σ^2 D)	30.86	91.51	67.45	0.67	3.05	155.9
Relative importance of gca %[1]	80.93	80.59	56.62	45.18	48.93	70.57
Relative importance of sca %[2]	19.08	19.41	43.38	54.82	51.07	29.44
Broad sense heritability (h^2_b) %	97.80	99.19	98.82	98.86	99.5	98.23
Narrow sense heritability (h^2_n)	26.83	26.61	32.31	2.84	5.07	15.75

1- Relative importance gca = σ^2 A / σ^2 G x 100
2- Relative importance sca = σ^2 D / σ^2 G x 100, respectively.

Correlation coefficient:

The study of relationships among morphological grain yield and its component traits is of great importance. The estimates of correlation coefficient among all studied traits are presented in Table 6. Concerning duration, data showed that highly significant positive correlation with plant height with value of 0.391. Regarding to correlations between plant height and other studied traits, were highly significant and positive correlation only with number of panicles per plant with values 0.457. As for number of panicles per plant gave highly significant positive correlation coefficient with panicle weight and grain yield per plant with values of 0.457 and 0.589, respectively. With regard to panicle weight, positive and highly significant correlation coefficient were recorded between this trait and each of 1000-grain weight (0.508) and grain yield per plant (0.466). On the other hand, only grain yield per plant showed positive significant correlation coefficient with 1000-grain weight and the value was 0.379.

Table (6): Estimates of phenotypic correlation coefficients among all pairs of studied traits:

Traits	Duration (days)	Plant height (cm)	No. of panicles per plant	Panicle Weight (g)	1000-grain Weight (g)	Grain yield per plant (g)
Duration (days)	1.00	0.391**	-0.019	0.085	-0.137	-0.054
Plant height (cm)		1.00	0.457**	0.162	-0.249	0.022
No. of panicles per plant			1.00	0.457**	0.148	0.589**
Panicle weight (g)				1.00	0.508**	0.466**
1000-grain weight (g)					1.00	0.379*
Grain yield per plan (g)						1.00

***, ** Significant at 0.05 and 0.01 levels, respectively.**

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تقدير قوة الهجين والمكونات الوراثية ومعامل الارتباط لتحسين محصول الحبوب في الأرز

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أجريت هذه الدراسة في مركز البحوث والتدريب في الأرز – سخا – كفر الشيخ – مصر خلال الموسمين 2007-2008 وذلك لتقدير مستوى قوه الهجين لمتوسط الآباء وأفضل الآباء بين نباتات الجيل الأول وذلك باستخدام خمس سلالات كأمهات وهى (جيزة 177-سخا 101-سخا 103 – سخا 104 – GZ6903) وخمس كشافات كآباء وهى (IRBL1-F5, IRBLZFU, IRBLZ5-CA, IRBLTACT2, IRBLSH-B). وأعطى التباين الوراثي للصفات المدروسة اختلافات عاليه المعنوية للصفات التالية (فترة النضج – طول النبات – عدد السنابل – وزن السنبلة – وزن الألف حبه – محصول النبات الفردي). وكانت الهجن سخا 101 IRBLZFU X و جيزة 177 IRBLZFU X كانت معنوية بالنسبة لقوة الهجين لمتوسط وأفضل الآباء وذلك بالنسبة لمحصول الحبوب ومعظم الصفات المدروسة ويلي ذلك الهجين جيزة 177 IRBL1-F5 x. وتم تقدير درجه التوريث في المدى الواسع وكانت عاليه في معظم الصفات المدروسة بينما درجه التوريث في المدى الضيق كانت منخفضة لمعظم الصفات.

قام بتحكيم البحث

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