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LINES BY TESTERS ANALYSIS FOR YIELD AND ITS COMPONENTS IN RICE.

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ABSTRACT

This study was carried out at the farm of Rice Research and Training Center (RRTC), Sakha, Kafr El-Sheikh, Egypt. Three CMS lines as female parents and three restorer lines as male parents were used to produce nine F_1 hybrids by lines x testers mating design to determine the heterosis, as well as gene action of yield and its components. Both general and specific combining ability variances were found to be significant for most of traits. IR69025A/G181R hybrid yielded the highest number of grains/panicle, filled grains panicle^{-1} and panicle weight. On the other hand, the number of days to heading, all hybrids exhibited significant negative heterobeltiosis expect the hybrid IR69025A/G181R. These hybrids appeared to be desirable for earliness.

The results also showed that most traits were controlled by the effects of both general combining ability (GCA) and specific combining ability (SCA) for the CMS and restorer lines. The GCA was found to be more effective. In addition, the study revealed the heterosis presence over better parent (BP%), for yield and its components.

INTRODUCTION

Rice is an important food crop all over the world, especially in the developing countries. Increasing grain yield is the main objective of most plant breeding programs. High yielding rice could be obtained through the utilization of the hybrid vigor which could be attained when diverse parental varieties are hybridized. Accordingly, selection of the parental varieties is very important to obtain high hybrids. Thus, much efforts have been devoted to identify varieties with a high combining ability (Kabaki, 1993).

Breeding strategies based on selection of hybrids require expected level of heterosis as a result of high specific combining ability. In developing high yielding varieties of crop plant, the breeders often face the problem of selecting parents and their crosses to produce hybrids. Combining ability analysis is one of the powerful tools available to estimate the combining ability effects and aids in selecting the desirable parents and crosses for the exploitation of heterosis. Line x tester analysis provides information about general combining ability (GCA) and specific combining ability (SCA) effects of parents and is also helpful in estimating various types of gene actions (Singh and Kumar, 2004).

The genetic basis depends on the presence of significant, dominance and epistatic variances (Mao, 1992), or upon the accumulation of positive alleles from both parents in their corresponding F_1 hybrid (Abdelkhalik *et al*, 2005).

Line x tester analysis in rice has been applied by many researchers such as Young and Virmani (1990), Mishra *et al.,* (1991), Anna Dura (2002), El-Keredy *et al.*, (2003), and Rashid *et al.,* (2007). This method provides very useful information for combining ability and various types of gene actions. Therefore, the main objective of this investigation is to estimate the combining ability and heterosi, for yield and yield component triats.

MATERIALS AND METHODS

The present investigation was carried out at Rice Research and Training Center Experimental Farm, Sakha, Kafr El-Sheikh, Egypt during 2006 and 2007 summer seasons. The line x tester mating design was carried out through three lines namely, IR58025 A. IR69025A and IR70368A in addition to three testers namely, Giza 178R, Giza 181R and Giza 182R (Table 1).

In 2007, six parents, three checks and nine F_1 hybrids were grown in a randomized complete block design with three replications. Each plot consisted of seven rows and single seedlings which were transplanted in hills spaced at 20 cm. Cultural practices were performed as recommended for rice cultivation.

Observations were recorded on an individual plants for ten traits viz. plant height (cm), number of tillers plant^{-1}, number of days to heading (days), panicle length (cm), panicle weight (g), number of grains panicle^{-1}, 1000-grain weight (g), spikelets fertility %, filled grains panicle^{-1} and grain yield plant^{-1} (g).

Heterosis relative to the better parent (heterobeltiosis) was calculated according to Mather (1949) and Mather and Jinks (1971).

Line x tester analysis was done as devolved by Kempthorne (1957) to obtain information about general and specific combining ability and to estimate various types of gene effect. Also, heritability estimates were obtained as described by Burton and Devan (1953).

Table 1. Cytoplasmic male sterile lines, restorer and check lines used for the study.

Genotype	Cytoplasm source	Origin
CMS lines (female parents)		
IR58025A	Wild Abortive	IRRI
IR69025A	Wild Abortive	IRRI
IR70368A	Wild Abortive	IRRI
Restorer lines (male parents)		
Giza 178 R	Restorer	Egypt
Giza 181R	Restorer	Egypt
Giza 182 R	Restorer	Egypt
Checks		
Sakha 101	Check	Egypt
Sakha 104	Check	Egypt
GZ 6522	Check	Egypt

RESULTS AND DISCUSSION

The mean performance of six parental lines (three CMS lines as females and three testers as males) and their nine F_1 hybrids for all studied traits are presented in Table 2. The mean performance of the studied traits varied form one genotype to another. With respect to plant height, the most desirable mean values towards short stem (less than 110 cm) were only found in four hybrids. Complete or over dominance were observed in most hybrids towards the taller parents. Similary, the longest panicle, highest productive tillers plant^{-1}, heaviest panicle weight, highest no. grains panicle^{-1} and heaviest 1000- grain weight were affected by the higher parents. However, some of the hybrids showed dominance effects towards the higher parents for filled grains panicle^{-1}, higher rate of spikelets fertility %, and higher grain yield plant^{-1}.

The highest mean values of grain yield plant^{-1} (g) were obtained from the hybrid combinations: IR70368A/Giza181R, IR69025A/Giza181R, IR58025A/Giza178R, IR69025A/Giza178R and IR58025A/Giza182R with mean values of 52.5 g, 52.1 g, 49.9 g, 49.5 g and 49.3g, respectively. The lowest values were obtained from the hybrids: IR69025A/Giza182R and IR70368A/Giza182R with mean values of 41.3 g and 41.3 g, respectively. The parental lines Giza178R, Giza181R, Giza182R and IR70368A manifested the highest mean performance of 41.4 g, 38.9 g, 37.6 g and 36.7 g, respectively.

Analyses of variance

Highly significant differences among all genotypes were obtained for all yield and its component traits, except for no. of grains panicle^{-1} (Table 3). These results indicated the presence of a wide range of genetic variations among the parental groups used in this study. In the same time, the mean squares of parents *vs.* crosses were found to be highly significant for all grain yield and its components except for spikelets fertility %, 1000-grain weight, no. of grains panicle^{-1} and panicle weight. The results also showed that the general combining ability variance of the lines were insignificant for all yield and it component traits except for filled grains panicle^{-1}. The general combining ability variance of testers (male parents) were also insignificant for all studied yield and it component traits except for plant height and filled grains panicle^{-1}.

Estimation of general combining ability effects

The results in Tables (4 and 5) show that the values of general combining ability (GCA) effects exhibited significance for all traits. IR58025A and Giza 178R exhibited significantly negative GCA effects for plant height. These indicated that these two parents were good combiners for dwarfness. Similarly, the two parents: IR68025A and Giza 182R exhibited significantly negative GCA for number of days to heading indicating that the two parents also could be considered as a good combiners for earliness. In the same fashion, the parents IR58025A and Giza 182R were a good combiners for number of tillers plant^{-1}. Moreover, IR58025A and Giza 178R were exhibited significantly negative for 1000-grain weight. Also, IR68025A and Giza178R were excellent combiners for spikelets fertility %.

Table 2: Mean performance of three lines, three testers, three check varieties and nine F_1 hybrids

Genotype	Plant height (cm)	No. of Tillers plant^{-1}	No. of days to heading	Panicle length (cm)	Panicle weight (g)	No. of grains panicle^{-1}	1000-grain weight (g)	Spikelets fertility %	Filled grains panicle^{-1}	Grain yield plant^{-1} (g)
CMS lines (females)										
IR58025A	110.6	23.8	111.7	25.3	3.9	234.9	23.06	89.3	209.7	23.5
IR69025A	105.7	23.7	102.7	23.8	4.0	148.7	26.9	92.7	137.8	32.8
IR70368A	106.7	19.3	105.7	22.8	3.5	157.0	28.63	92.8	145.7	36.7
Rest or (males)										
Giza 178R	101.0	16.0	104.3	25.7	4.7	179.0	24.0	94.4	169.0	41.4
Giza 181R	109.7	17.4	114.7	24.5	5.0	166.6	28.3	89.7	149.5	38.9
Giza 182R	100.3	16.8	98.0	22.9	4.3	146.3	27.3	83.7	122.4	37.6
Hybrid combinations										
IR58025A/G178R	103.7	18.0	113.7	24.0	5.2	214.5	23.3	85.7	187.3	49.9
G181R	109.3	16.2	110.7	25.0	5.2	203.7	26.3	87.4	174.6	47.0
G182R	112.3	22.2	102.3	26.3	5.2	197.2	27.33	79.3	156.3	49.3
IR69025A/G178R	109.7	16.9	103.7	26.8	5.5	170.8	28.0	92.0	156.4	49.5
G181R	113.7	15.7	105.0	25.9	5.6	168.1	27.3	92.7	155.8	52.0
G182R	108.7	15.5	99.3	24.0	5.9	184.9	27.6	93.3	172.5	41.3
IR70368A/G178R	107.3	17.9	102.7	25.0	5.2	183.1	26.6	98.0	179.5	48.0
G181R	108.7	16.1	101.7	25.8	6.0	201.6	28.6	62.5	126.0	52.4
G182R	114.7	18.3	101.7	25.9	5.4	147.7	27.6	88.5	130.7	41.3
Check varieties										
Sakha 101	96.3	15.1	110.3	23.2	4.3	137.4	30.0	91.6	125.5	43.5
Sakha 104	114.7	18.5	104.7	21.7	4.3	146.0	30.0	84.9	124.0	47.7
GZ6522	99.7	18.2	95.7	21.7	3.8	150.0	27.0	82.9	124.4	43.3

Table 3: Mean square estimates of line x tester analysis for agronomic, yield and its component characters

Source of variation	d.F	Plant height (cm)	No. of Tillers plant^{-1}	No. of days to heading	Panicle length (cm)	Panicle weight (g)	No. of grains panicle^{-1}	1000-grain weight (g)	Spikelets fertility %	Filled grains panicle^{-1}	Grain yield plant^{-1} (g)
Replications	2	0.9630^{ns}	37.2339**	0.1296^{ns}	0.2272^{ns}	0.1835^{ns}	402.5^{ns}	0.6169^{ns}	68.6772**	423.3872^{ns}	23.2057^{ns}
Genotypes	17	86.0741**	21.7974*	73.2865**	6.7310**	1.5160**	1566.825^{ns}	12.2942**	100.6651**	1655.7906**	135.2526**
Parents (P)	5	55.3300**	35.1876**	111.0333**	4.3053^{ns}	1.0703**	2289.859^{ns}	16.0289**	40.5206**	2599.5396**	36.3062^{ns}
Checks (C)	2	286.1111**	22.8144**	164.1111**	2.3511^{ns}	0.244^{ns}	302^{ns}	9.0000^{ns}	10.4933^{ns}	3.0044^{ns}	18.2344**
Hybrids	8	34.3333**	12.8225**	38.2500**	2.5987^{ns}	0.3044^{ns}	1221.113^{ns}	7.0833**	135.0384**	1183.4400**	68.2079^{ns}
Parents vs. hybrids	1	182.5333**	46.1280**	40.8333**	14.6068**	12.90363**	717.368^{ns}	4.1813^{ns}	251.9135^{ns}	3.0720**	1527.4846^{ns}
C.v.s (P.H)	1	157.1704**	0.2803**	15.6481**	52.8013**	4.6151**	1215.21^{ns}	50.0090**	155.4963**	5691.1413**	8.1467**
Lines	2	12.4444^{ns}	16.9478^{ns}	19.1111^{ns}	0.5437^{ns}	0.1911^{ns}	809.231^{ns}	12.0000^{ns}	152.0248^{ns}	66.4811**	33.7737^{ns}
Testers	2	60.3333**	16.2133^{ns}	119.1111**	0.3826^{ns}	0.5200^{ns}	1027.374^{ns}	6.7778^{ns}	57.9359^{ns}	2473.4633*	48.1448^{ns}
Line x Tester	4	32.2778**	9.0644^{ns}	7.3889**	4.7343^{ns}	0.2444^{ns}	1523.922^{ns}	4.7778^{ns}	15.0965^{ns}	1096.9078**	95.4565*
# Error	34	1.6296	3.9402	1.2865	2.4492	0.1712	392.5258	2.1643	9.4536	144.6731	26.7603
C.V %		1.19	10.90	1.08	6.41	8.66	10.27	5.41	3.50	7.98	11.77

including checks

*,** Significant at 5% and 1% levels of probability, respectively.

Estimation of specific combining ability effects

The values of specific combining ability effects (SCA) of nine hybrids for all studied traits are presented in Table (6). Three hybrids exhibited significantly negative SCA effects for plant height, and the best hybrid was IR69025A/Giza182R. Moreover, IR69025A/Giza181R showed significantly negative SCA for number of days to heading. This indicat that this hybrid is anexcellent combination for earliness.

On the other hand, IR58025A/Giza182R and IR69025A/ Giza178R showed significantly positive SCA for panicle weight. Also, IR70368A/Giza181R showed highly positive significant for number of grains panicle^{-1}. Moreover, IR58025A/Giza178R and IR70368A/Giza181R showed significantly positive for filled grains panicle^{-1}. The hybrid: IR58025A/Giza 182R could be considered as the best combination for grain yield plant^{-1}.

Heterosis

The negative values of heterosis for plant height were found to be in the favor of plant breeder. The hybrid IR58025A/Giza178R was lower than the BP% and MP% with values of -6.33 and -2.17%, respectively. On the other hand, heterosis over better parent (BP) was found for number of days to heading in all hybrids which exhibited significantly negative values of heterosis expect for the hybrid IR69025A/Giza 178R. These hybrids were desirable for earliness such as the hybrid IR58025A/Giza178R with values of -7.16 and -4.01% for BP% and MP% heterosis. The hybrid IR69025A/Giza182R was over SH% heterosis with a value of -4.97.

The results in Tables (7, 8, and 9) showed that the nine hybrids exhibited desirable heterotic effects for grain yield plant^{-1} such as IR58025A/G182 and IR70368A/G181R with values of 46.94%, 34.82%, 57.77%, 38.75% and 31.12%, 20.99% over the BP, MP and SH%, respectively. Also, for panicle weight, the results showed significantly positive heterosis for all hybrids over the BP, MP and SH%. The two hybrids IR70368A/Giza182R and IR70368A/Giza181R recorded the highest mean values over BP, MP and SH%. Moreover, IR69025A/Giza178R showed significantly positive heterosis for panicle length with values of 4.02, 8.0 and 4.28% over the BP, MP and SH%. Finally, IR69025A/Giza178R showed values of 4.09, 10.02 and 16.67% for BP, MP and SH% for 1000- grain weight, respectively. Similar results were reported by Rashid *et al.* (2007)

Genetic parameters:

Heritability in both broad and narrow sense and genetic parameters for all studied traits are showed in Table (10). High heritability estimates in broad sense were detected for most studied traits. These results are similar to those obtained by El Abd *et al.*, (2007)

For heritability in narrow sense, the results indicated that it was high for number of days to heading, spikelets fertility% and moderate for grain yield plant^{-1}, field grains panicle^{-1} and number of tillers.

Relatively, moderate genetic gains were estimated for number of days to heading, plant height, filled grain/panicle and grain yield/plant. Low genetic grains were detected for the other traits.

Table 4: Estimates of GCA effect of each line for agronomic, yield and its component characters

Line	Plant height (cm)	No. of Tillers plant^{-1}	No. of days to heading	Panicle length (cm)	Panicle weight (g)	No. of grains panicle^{-1}	1000-grain weight (g)	Spikelets fertility %	Filled grains panicle^{-1}	Grain yield plant^{-1} (g)
IR58025A	-1.3333**	1.3667*	1.3333**	-0.2296 ns	-0.1333 ns	10.51111**	-1.3333**	-7.8926**	2.4889 ns	2.2296 ns
IR68025A	0.8889*	-1.3778*	-1.5556**	0.2593 ns	-0.0222 ns	-7.91111 ns	0.6667 ns	5.8185**	0.4111 ns	-0.9593 ns
IR70368A	0.4444 ns	0.0111 ns	0.2222 ns	-0.0296 ns	0.1556 ns	-2.6000 ns	0.6667 ns	2.0741 ns	-2.9000 ns	-1.2704 ns
L.S.D. 0.05	0.86	1.35	0.78	1.06	0.29	13.5	1.02	2.1	32.9	3.5
0.01	1.2	1.82	1.05	1.43	0.39	18.2	1.4	2.8	44.3	4.7

*,** Significant at 5% and 1% levels of probability, respectively.

Table 5: Estimates of GCA effect of each tester for agronomic, yield and its component characters

Tester	Plant height (cm)	No. of Tiliers plant^{-1}	No. of days to heading	Panicle length (cm)	Panicle weight (g)	No. of grains panicle^{-1}	1000- grain weight (g)	Spikelets fertility %	Filled grains panicle^{-1}	Grain yield plant^{-1} (g)
Giza 178R	-2.8889**	0.1778 ns	-0.8889 ns	-0.185 ns	-0.667 ns	11.0667 ns	-1.3333**	2.9296**	14.3556 ns	0.6185 ns
Giza 181R	0.7778 ns	-1.4222**	4.0000**	0.2148 ns	0.2667 ns	-0.8111 ns	0.6667 ns	-1.4481 ns	3.7889 ns	1.9407 ns
Giza 182R	2.1111**	1.2444 ns	-3.1111**	-0.19603 ns	-0.2000 ns	-10.2556 ns	0.6667 ns	-1.4815 ns	-18.1444 ns	-2.5593 ns
L.S.D. 0.05	0.87	1.35	0.78	1.06	0.29	13.5	1.02	2. 1	32.9	3.5
0.01	1.2	1.82	1.05	1.43	0.39	18.2	1.4	2 .8	44.3	4.7

*,** Significant at 5% and 1% levels of probability, respectively.

Table 6: Estimates of SCA effects of the crosses for agronomic, yield and yield component characters

Crosse	Plant height (cm)	No. of tillers plant^{-1}	No. of days to heading	Panicle length (cm)	Panicle weight (g)	No. of grains panicle^{-1}	1000-grain weight (g)	Spikelets fertility %	Filled grains panicle^{-1}	Grain yield plant^{-1} (g)
IR58025A/G178R	-1.88889**	-0.98889 ns	-1.00000 ns	0.05556 ns	-1.04815**	6.51111 ns	-1.33333 ns	2.18148 ns	16.31111*	-1.45185 ns
G181R	0.1111 ns	-1.5556 ns	-1.11111 ns	-0.244444 ns	-0.34815 ns	-23.711111*	0.22222 ns	-0.37407 ns	-18.88889*	-5.64074 ns
G182R	1.777778*	2.144444 ns	-0.11111 ns	0.18889 ns	1.39630**	17.20000 ns	1.11111 ns	-1.80741 ns	2.577778 ns	7.309259*
IR69025A/G178R	1.888889*	0.722222 ns	1.8889*	0.211111 ns	1.19630**	-1.733333 ns	1.33333 ns	-2.69630 ns	-3.77778 ns	1.2703 ns
G181R	2.22222**	1.08889 ns	-1.66667*	0.044444 ns	0.06296 ns	-1.888889 ns	-0.77778 ns	1.18148 ns	-3.477778 ns	2.44815 ns
G182R	-4.11111**	1.811111 ns	-0.22222 ns	-0.25556 ns	-1.259926**	3.62222 ns	-0.55556 ns	1.51481 ns	7.255556 ns	-3.71852 ns
IR70368A/G178R	0.0000 ns	0.26667 ns	-0.888889 ns	-0.26667 ns	-0.14815 ns	-4.7778 ns	0.00000 ns	0.51481 ns	-12.53333 ns	0.184148 ns
G181R	-2.33333**	0.06667 ns	0.55556 ns	0.200000 ns	0.28519 ns	25.600000**	0.55555 ns	-0.80741 ns	22.36667**	3.19259 ns
G182R	2.33333**	-0.33333 ns	0.33333 ns	0.066667 ns	-0.13704 ns	-20.82221 ns	-0.55556 ns	0.29259 ns	-9.833333 ns	-3.37407 ns
L.S.D. 0.05	1.5	2.35	1.34	1.82	0.47	23.4	1.75	3.6	14.2	6.1
0.01	2.04	3.14	1.82	2.45	0.65	31.5	2.4	4.95	18.96	8.2

*,** Significant at 5% and 1% levels of probability, respectively.

Table 7: Estimates of heterosis over the better parent of each cross for all studied characters

Crosse	Plant height (cm)	No. of tillers plant^{-1}	No. of days to heading	Panicle length (cm)	Panicle weight (g)	No. of grains panicle^{-1}	1000-grain weight (g)	Spikelets fertility %	Filled grains panicle^{-1}	Grain yield plant^{-1} (g)
IR58025A/G178R	-6.33**	-24.40**	-7.16**	-6.61 ns	10.64**	0.087 ns	-2.78 ns	-11.29**	-2.16 ns	20.61**
G181R	-1.20ns	-31.84**	-3.49**	-1.06 ns	1.95**	0.133 ns	-7.06**	-13.61**	-25.94*	21.10**
G182R	1.51ns	-6.73**	-8.64**	4.23**	20.93**	-0.160 ns	0.00 ns	-15.28**	-26.18*	46.94**
IR69025A/G178R	3.79**	-28.45**	-0.64ns	4.02**	16.31**	-0.058 ns	4.09**	-3.30 ns	-0.89 ns	19.48**
G181R	3.65**	-33.66**	-8.43**	5.72**	9.74**	0.0090 ns	-3.53**	-3.83 ns	-3.29 ns	33.70**
G182R	2.84*	-34.65**	-3.25**	1.26 ns	13.18**	0.243 ns	1.22 ns	-3.51 ns	-10.24 ns	9.74*
IR70368A/G178R	0.62ns	-6.29**	-2.84**	-2.33 ns	9.93**	0.023 ns	-6.87**	-2.37 ns	-8.09 ns	16.10**
G181R	-0.91ns	-15.73**	-4.94**	5.45**	16.23**	0.21 ns	0.12 ns	-8.15**	7.17 ns	34.82**
G182R	7.50**	-3.85 *	-3.79**	9.02**	24.81**	-0.059 ns	-3.38**	-7.00**	-25.35*	9.83*
L.S.D. 0.05	2.1	3.3	1.9	2. 6	0.68	33.02	2.5	5.1	20.1	8.6
0.01	2.9	4.5	2.5	3 .5	0.94	44.6	3.3	6.9	26.95	11.6

*,** Significant at 5% and 1% levels of probability, respectively.

Table 8: Estimates of heterosis over mid- parent of agronomic yield and yield component characters

Crosse	Plant height (cm)	No. of Tillers plant^{-1}	No. of days to heading	Panicle length (cm)	Panicle weight (g)	No. of grains panicle^{-1}	1000-grain weight (g)	Spikelets fertility %	Filled grains panicle^{-1}	Grain yield plant^{-1} (g)
IR58025A/G178R	-2.17**	-9.94**	-4.01**	-5.69**	20.93**	0.036 ns	-0.85 ns	-8.57*	4.58 ns	35.20**
G181R	-0.83ns	-21.36**	-2.21**	0.47 ns	15.87**	0.069 ns	2.46 ns	-12.71*	-14.29 ns	31.96**
G182R	6.83**	9.29**	-2.38**	9.28**	26.83**	0.26 ns	8.47**	-15.27**	-4.86 ns	57.77**
IR69025A/G178R	6.33**	-14.91**	0.16ns	8.00**	25.67**	0.042 ns	10.02**	-2.55**	1.05 ns	33.27**
G181R	6.00**	-23.60**	-3.37**	7.11**	23.36**	0.066 ns	-1.03 ns	0.86 ns	3.46 ns	44.96**
G182R	5.67**	-23.56**	-1.00ns	3.28**	17.27**	0.25 ns	2.03 ns	0.12 ns	8.21 ns	17.22**
IR70368A/G178R	3.50**	1.52ns	-2.22**	3.50**	26.53**	0.008 ns	1.33 ns	-2.18*	-7.77 ns	23.14**
G181R	0.50ns	-11.96**	-1.06ns	9.09**	38.76**	0.25 ns	0.64 ns	-4.55**	16.37 ns	38.75**
G182R	11.17**	2.23ns	-0.16ns	9.18**	38.20**	-0.026 ns	-1.13 ns	-4.30**	-8.85 ns	11.26**
L.S.D. 0.05	1.8	2.9	1.63	2.24	0.58	28.9	4.4	1.75	17.4	7.5
0.01	2.5	3.9	2.2	3.03	0.80	38.5	6.1	2.36	23.4	10.2

*,** Significant at 5% and 1% levels of probability, respectively.

Table 9: Standard heterosis for agronomic, yield and yield component characters

Crosse	Plant height (cm)	No. of tillers $plant^{-1}$	No. of days to heading	Panicle length (cm)	Panicle weight (g)	No. of grains $panicle^{-1}$	1000-grain weight (g)	Spikelets fertility %	Filled grains $panicle^{-1}$	Grain yield $plant^{-1}$ (g)
IR58025A/G178R	46.24**	1.25^{ns}	-0.575^{ns}	6.615**	10.64**	19.83^{ns}	-2.9^{ns}	-7.42**	10.83^{ns}	20.53**
G181R	8.22**	1.25^{ns}	6.14**	2.72^{ns}	10.64**	13.79^{ns}	8.75**	1.17^{ns}	3.31^{ns}	13.53**
G182R	11.28**	38.75**	-1.95*	2.33^{ns}	10.64**	10.27^{ns}	13.88**	-2.5^{ns}	-8.13^{ns}	31.12**
IR69025A/G178R	8.614**	5.63**	-0.575^{ns}	4.28**	17.02**	-4.58^{ns}	16.67**	1.80^{ns}	-8.06^{ns}	19.57**
G181R	12.57**	-1.875^{ns}	0.67^{ns}	0.78^{ns}	25.53**	-6.09^{ns}	13.75**	1.17^{ns}	7.81^{ns}	2.56^{ns}
G182R	7.62**	-3.13^{ns}	-4.79**	-6.61**	25.53**	2.85^{ns}	15.0**	-1.16^{ns}	2.03^{ns}	1.59^{ns}
IR70368A/G178R	6.24**	11.88**	-1.53^{ns}	2.72^{ns}	10.64**	2.29^{ns}	10.83**	3.67^{ns}	6.21^{ns}	15.94**
G181R	7.62**	0.63^{ns}	-2.49*	0.39^{ns}	27.66**	-12.63^{ns}	9.09**	-12.61**	-1.78^{ns}	20.99**
G182R	13.56**	14.38**	-2.49*	0.79^{ns}	14.89**	-17.56^{ns}	15.0**	-6.25*	22.66*	0.24^{ns}
L.S.D. 0.05	2.1	3.3	1.9	2. 6	0.68	33.02	2.5	5.1	20.1	8.6
0.01	2.9	4.5	2.5	3. 5	0.94	44.6	3.3	6.9	26.95	11.6

*,** Significant at 5% and 1% levels of probability, respectively.

Table 10: Genetic parameters for agronomic, yield and yield components characters

Genetic parameter	Plant height (cm)	No. of tillers $plant^{-1}$	No. of days to heading	Panicle length (cm)	Panicle weight (g)	No. of grains $panicle^{-1}$	1000-grain weight (g)	Spikelets fertility %	Filled grains $panicle^{-1}$	Grain yield $plant^{-1}$ (g)
σ^2A	0.9132	1.6703	23.5	-0.0938	0.024	-24.0	0.838	53.32	261.997	30.714
σ^2D	14.129	1.708	2.034	0.762	0.0244	125.7	0.8712	1.88	317.4	20.29
σ^2E	1.6296	3.9402	1.2865	2.449	0.1712	392.258	2.1643	9.4536	144.6731	26.7603
σ^2G	14.963	3.378	25.831	0.667	0.0484	101.7	1.7092	55.2	579.397	51.004
σ^2P	16.67	5.648	26.8205	3.117	0.2196	493.96	3.874	64.654	724.0701	77.76
(h^2_b) %	89.76	59.808	95.19	0.214	22.04	205.88	44.12	85.38	80.019	65.59
(h^2_n) %	5.4781	29.57	87.62	-3.010	10.93	-4.556	21.63	82.46	36.18	39.49
GCA %	6.10	49.45	24.69	-14063	49.6	-23.298	49.03	96.59	45.22	60.22
SCA %	94.43	50.56	7.97	114.242	50.41	123.598	50.97	3.41	54.78	39.78

σ^2A=Additive variance, σ^2D= Dominant variance, σ^2E = environment variance, σ^2G= Genotypic variance, (h^2_b) %= Broad sence heritability, (h^2_n) %=Narrow sence heritability

These results are agree with those obtained by Johnson *et al.* (1955) who pointed out that the heritability estimates along with genetic gain from selection were more valuable than the former alone in predicting the effect of selection. Moderate estimates of both narrow sense heritability and genetic advance were obtained for spikelets fertility % and grain yield/plant. These results indicated that low gain was associated with low narrow sense heritability values. The ratio of SCA and GCA variances was very high and more than one for all studied traits which revealed the preponderance of non-additive gene action over the additive gene action.

Thus, the results at this study indicated that dominance variance played a major role in the inheritance of these traits. It would be indicated that the results obtained in the study were in general agreement with the results reported by Ramalingam *et al.*, (1997) and El-Mowafi and Abd El-Hadi (2005).

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تحليل السلالة x الكشاف لبعض صفات المحصول ومكوناته فى الأرز

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أجرى هذا البحث بمزرعة مركز البحوث والتدريب فى الأرز- بسخا- مصر بغرض دراسة بعض المقاييس الوراثية لتسعة من الهجن ناتجة من خلال نظام التزواج Line x Tester mating design لستة أصناف من الأرز حيث تم استخدام ثلاثة منها كأمهات Lines وثلاثة كآباء Testers وتم دراسة عشر صفات محصولية وبعض الصفات المرتبطة بها. وتم تقدير قوة الهجين وطبيعة الفعل الجينى وأيضا تم تقدير القدرة العامة والخاصة على الائتلاف للصفات محل الدراسة. كما تم دراسة قوة الهجين مقارنة بالأب الأعلى وكذلك متوسط الآباء ومقارنة بالأصناف التجارية الثلاثة وقد أوضحت الدراسة أن التركيبة الهجينية IR70368A/Giza 181R كانت ممتازة فى عدد الحبوب الممتلئة بزياده قدرها ٢٢,٣٩% وقد أعطت معنوية عالية فى صفات طول النبات ٢,٣٣% وعدد الحبوب الكلية بالسنبلة ٢٥,٦٠%. وأيضا التركيبة الهجينية IR58025A/Giza178R أعطت قيما مرغوبة ومعنوية عالية فى صفات طول النبات ٦,٣٣ والتزهير -٧,١٦% ومحصول النبات الفردى ٢٠,٦١%. وأيضا التركيبة الهجينية IR70368A/Giza182R أظهرت معنوية مرغوبة فى صفات التزهير -٣,٧٩% وأيضا محصول النبات الفردى ٩,٨٣% كما أظهرت التركيبة الهجينية IR69025A/Giza181R معنوية عالية لصفة التزهير -٨,٤٣ وأيضا صفة محصول النبات الفردى ٣٣,٧٠%.