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ESTIMATION OF SOME GENETIC PARAMETERS FOR YIELD AND ITS COMPONENTS USING DIALLEL CROSSES IN WHEAT (*TRITICUM AESTIVUM* L.).

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ABSTRACT

This investigation was carried out to study heterosis, combining ability and genotypic and phenotypic correlation coefficients in a diallel mating among 6 wheat varieties. The varieties used in this study were Gemmeiza 9 (P_1), Gemmeiza11 (P_2), Gemmeiza12 (P_3), Giza171 (P_4), Sids 12 (P_5), and Shandaweel 1 (P_6). The studied traits in this work were number of spikes / plant, spike length, number of grains/spike, grain weight/spike, 100-grain weight, grain yield/plant, and harvest index %.

The experiment was conducted at the Experimental Farm of Faculty of Agriculture Al-azhar University Cairo Egypt and El-Hamoul, Kafr El- Sheikh Governorate during 2016/2017 and 2017/2018 growing seasons.

The results revealed that the genotypes were highly significant in all studied traits. Positive and highly significant percentages of heterosis were with great interest in the most of traits during this study. The crosses ($p_1\times p_2$) and ($p_2\times p_6$) showed positive and significant heterosis for mid and better parent for most studied characters, while the crosses ($p_4\times p_6$) and ($p_3\times p_6$) were negative and significant for mid and better parent heterosis for most studied traits.

The parents (Gemmeiza 9), (Gemmeiza 11) and (Giza171) were good general combiner for most yield and its component traits. The crosses ($p_2\times p_6$) and ($p_3\times p_4$) were positive and significant for specific combining ability effects for most studied traits while the crosses ($p_3\times p_5$) and ($p_5\times p_6$) recorded negative and significant values for specific combining ability effects for most studied traits.

Grain yield/plant exhibited significant and positive genotypic and phenotypic correlation with number of spikes / plant, 100-grain weight, and harvest index%.

Keywords:combining ability, correlate, diallel analysis, heterosis,wheat.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the most important and strategic crops all over the world. In Egypt, wheat is the main cereal crop used as a stable food for urban and rural societies and the major source of straw for animal feeding. However, total wheat consumption has drastically increased due to over population growth by about 2.5% per year. Egypt imports about 45% of its wheat requirement. This reflects the size of the problem and the efforts needed to increase wheat production. Thus, increasing production per unit area appears to be one of the important factors for narrowing the gap between wheat production and consumption. In 2016, world production of wheat was 749 million tonnes, making it the second most-produced cereal after maize. **(FAO 2016)**.

Wheat breeding programs played the major role in developing new high yielding varieties, early maturing, resistant to pest and diseases as well as tolerant to different environmental stress. In order to achieve such goals, choice of the best parents are very important to obtain the most desired genetic recombinants followed by effective selection in segregating generations until homozygesity is reached and desired genotypes are selected and assessed.

The diallel analysis programs provide detailed genetically information about specific genotypes before including in breeding programs. Many researches indicated the importance of diallel technique to obtain genetically information about yield and yield component characters in wheat, in this respect **Al-Kaddoussi (1996), Esmail (2002), and Sultan *et al* (2005).**

Knowledge of the degree of heterosis plays a decisive role towards the choice of breeding methodology. Exploitation of heterosis is considered to be one of the outstanding achievements of plant breeding. In a self-pollinated crop like wheat, the scope for utilization of heterosis depends mainly upon its direction and magnitude. Estimation of heterosis over the better-parent (heterobeltiosis) is useful in identifying truly heterotic cross combinations **(Sindhu and Singh 1975)**.

Combining ability analysis of **Griffing (1956)** is most widely used as biometrical tool for identifying parental lines in terms of their ability to combine in hybrid combination. With this method, the resulting total genetic variation is partitioned into the variance effects of general combining ability, as a measure of additive gene action and specific combining ability, as measure of non-additive gene action.

Complete knowledge on interrelationship of plant character like grain yield with other characters are of paramount importance to the breeder for making improvement in complex quantitative character like grain yield for which direct selection is not much effective. Hence, association analysis was undertaken to determine the direction of selection and number of characters to be considered in improving grain yield.

The main objectives of this work were to detect the magnitude of both general and specific combining ability (GCA and SCA), heterosis and genotypic and phenotypic correlation coefficients for yield and its component characters in 15 wheat crosses made among six bread wheat genotypes using one way diallel crosses.

MATERIALS AND METHODS

The present investigation was carried out at the Experimental Farm of Agronomy Department، Faculty of Agriculture، Al-Azhar University, Cairo. Egypt and El- Hamoul, Kafr El- Sheikh Governorate Egypt during 2016/2017 and 2017/2018 growing seasons to estimate heterosis, combining ability, of some wheat genotypes (varieties) in respect to some quantitative traits. These traits were number of spikes / plant, spike length (cm), number of grains/spike, grain weight/spike (gm) 100-grain weight (gm), grain yield/plant (gm), and harvest index %. The six varieties in this study were Gemmeiza 9 (P_1), Gemmeiza11 (P_2), Gemmeiza12 (P_3), Giza171 (P_4), Sids 12 (P_5), and Shandaweel 1 (P_6). Pedigree of the six parental genotypes were presented in **(Table 1)**.

Table 1: Parental wheat genotypes and its pedigree.

Genotypes	Pedigree
Gemmeiza 9 (P_1)	ALD "S" /HUAC // CMH 74 A. 630/SX CGM 4583 - 5 GM - 1GM – OGM
Gemmeiza 11 (P_2)	BOW"S"/KVZ"S"//7C/SERI 82/3/GIZA168/SAKHA61 CGM7892-2GM-1GM-2GM-1GM-0GM
Gemmeiza 12 (P_3)	OTUS/3/SARA/THB//VEE CMSS97YOO227 S-5Y-010M-010Y- 010M-2Y – 1M-0Y- OGM
Giza 171 (P_4)	Sakha 93/ Gemmeiza 9 Gz 2003-101-1Gz- 4Gz-1Gz-2Gz-0Gz
Sids 12 (P_5)	BUC//7C/ALD/5/MAYA74/ON//1160.147/3/BB/GLL/4/CHAT"S"/6/MAYA/VUL //CMH74A.63014*SX SD7096-4SD-1SD-1SD-0SD
Shandaweel 1 (P_6)	Site / Mo / 4/ Nac / Th. Ac //3* Pvn /3/ Mirlo / Buc CMSS93 B00S 67S -72Y - 010M - 010Y - 010M – 3Y – 0M – 0THY – 0SH

These varieties represented a wide range of diversity in several of studied characters. In 2016/2017 season, the tested varieties were crossed in all possible combinations excluding reciprocals, to generate 15 hybrids (F_1 crosses) at the Experimental Farm of Agronomy Department، Faculty of Agriculture، Al-Azhar University, Cairo. In 2017/2018 season F_1 crosses and their parents were evaluated at El-Hamoul, Kafr El- Sheikh Governorate, Egypt in a randomized complete block design (RCBD) with three replications. Each entry was grown in one row 3 m. long and the plants were individually spaced 15 cm and 25 cm between rows.

The recommended agronomic practices for wheat were applied. Data were recorded on 10 random guarded plants chosen from each F_1 crosses and parents in each replication. The data were statistically analyzed by using the ordinary analysis of variance to test the significant of differences among the twenty one genotypes under study. **Snedecor and Cochran (1982)**. General and specific combining ability estimates were obtained by **(Griffing, 1956)** model 1 method 2.

Heterosis is expressed as percent (%) deviation from the mid and better parents estimated by **(Turner, 1953).**

Genotypic and phenotypic correlation coefficients among the characters under study were estimated according to the statistical techniques outlined by **Kwon and Torrie (1964)**.

RESULTS AND DISCUSSION

Analyses of variance

Data in **Table (2)** shows that the mean square values among genotypes and the partitioning of genetic variance into general and specific combining ability were highly significant differences among entries for all studied traits indicating the wide diversity between the parental materials used in the present study. Similarly the results indicated that, there were highly significant estimates for general and specific combining ability effects indicating the relative importance of additive and non-additive genetic variances for all studied characters. Similar results obtained by **El-Hossary *et al* (2000), Meana and Sastry (2003) and Awan *et al* (2005)** reported that, the combining ability analysis indicated significant general and specific combining ability variances for all studied traits. The ratios of GCA/SCA were more than unity for spike length, grain weight/spike, grain yield/plant and harvest index indicating that additive gene effects were more important than dominance gene effects. These results are in agreement with those reported by **Koumber *et al* (2006)**.

Table 2: Mean squares of genotypes, general combining ability (GCA) and specific combining ability (SCA) and their ratios for all studies traits in wheat.

S.O.V	d.f	Spike length (cm)	Number of spikes /plant	Number of grains/ spike	Grain weight/ spike (gm)	100-grain weight (gm)	Grain yield/ plant (gm)	Harvest index (%)
Replicates	2	1.69	0.19	198.61	0.33	0.03	18.58	9.30
Genotypes	20	2.13**	9.57**	127.10**	0.72**	0.34**	61.89**	13.74**
Error	40	0.26	0.44	10.41	0.03	0.03	3.47	1.69
GCA	5	0.78**	2.18**	16.97**	0.30**	0.32**	24.31**	5.48**
SCA	15	0.69**	3.53**	50.83**	0.22**	0.04**	19.40**	4.28**
Error	40	0.09	0.15	3.47	0.01	0.01	1.16	0.56
GCA/SCA		1.13	0.62	0.33	1.36	8.00	1.25	1.28

*and ** denote significant and differences at 0.05 and 0.01 of probability levels respectively.

Mean performance :

The mean performance of the six parental genotypes and their F_1 crosses are presented in **Table (3)**.

The parental variety P_5 (Sids 12) gave the highest value for spike length While, P_3 (Gemmeiza12) recorded the lowest value. The parental variety (Shandaweel 1) gave the highest value for number of spikes/plant spike length. However, the parent P_5 (Sids 12) recorded the lowest value. For number of grains/spike the parental variety P_5 (Sids 12) gave the highest value while the P_1 (Gemmeiza 9) gave the lowest value. The parental variety P_5 (Sids 12) gave the highest value for grain weight/spike (gm) while the P_2 (Gemmeiza 11) gave the lowest value. The P_1 (Gemmeiza 9) variety record the highest value for the 100-grain weight, however the (Shandaweel 1) gave the lowest value. For grain yield cultivar d/plant, the parental cultivar (Giza 171) gave the highest value, while the cultivar (Sids 12) gave the lowest value. At last, for the harvest index trait (Giza 171) gave the highest value, while, the (Gemmeiza 12) gave the lowest value. Concerning F_1 crosses, the mean performances for spike length trait ranged from 16.90 cm for the cross ($P_2 \times P_5$) to 13.85 cm for the cross ($P_3 \times P_6$).for the number of spikes/plant trait the cross($P_1 \times P_3$) recorded the highest value 13.59 while, the cross ($P_2 \times P_4$) recorded the lowest value 7.16. For number of grains/spike values ranged from 94.41 for the cross ($P_2 \times P_6$) to 69.35 for the cross($P_1 \times P_3$) .

The cross ($P_1\times P_5$) recorded the highest mean value of 5.46 gm for100-grain weight while, the cross ($P_4\times P_6$) showed the lowest mean value of 4.36 gm. For the grain yield/plant the crosses ($P_3\times P_4$), ($P_2\times P_6$) and ($P_1\times P_2$) gave the highest mean values of 37.79,36.41 and 36.33 gm ,respectively, while the crosses ($P_3 \times P_6$), ($P_5 \times P_6$) and ($P_2 \times P_4$) gave the lowest mean values of 22.28,22.72 and 23.57 gm ,respectively. Regarding harvest index (%) the mean performances of F_1 crosses ranged from 40.18 % for the cross ($P_4\times P_5$) to 33.31 % for the cross ($P_1\times P_3$).

Table (3): Mean performances for all studied traits of the six parents and their 15 F_1 crosses in wheat.

Genotypes	Spike length (cm)	Number of spikes /plant	Number of grains/ spike	Grain weight/ spike (gm)	100-grain weight (gm)	Grain yield/ plant (gm)	Harvest index (%)
(P_1)	14.70	9.19	80.67	4.00	5.19	29.18	34.39
(P_2)	14.55	8.62	81.91	3.53	4.80	27.35	35.62
(P_3)	14.07	8.80	87.29	3.90	4.57	26.27	33.30
(P_4)	15.07	8.91	81.70	4.12	4.98	30.55	37.62
(P_5)	15.13	6.32	90.03	4.64	4.88	22.90	34.24
(P_6)	14.63	9.96	84.96	3.59	4.29	24.71	33.63
$P_1 \times P_2$	16.31	12.36	84.24	4.38	5.13	36.33	37..64
$P_1 \times P_3$	14.41	13.59	69.35	3.31	4.73	29.66	33.21
$P_1 \times P_4$	15.85	10.01	85.67	4.55	5.39	31.55	36.96
$P_1 \times P_5$	14.61	10.43	79.85	4.03	5.46	29.24	35.86
$P_1 \times P_6$	16.01	8.62	94.20	4.55	4.76	26.24	38.07
$P_2 \times P_3$	15.38	11.48	84.80	4.04	4.90	31.86	39.76
$P_2 \times P_4$	16.46	7.16	92.82	4.94	5.19	23.57	38.09
$P_2 \times P_5$	16.90	9.78	87.54	4.35	5.06	30.04	36.53
$P_2 \times P_6$	15.57	12.15	94.41	4.16	4.84	36.41	36.11
$P_3 \times P_4$	15.39	11.78	87.98	4.32	4.92	37.79	39.39
$P_3 \times P_5$	15.64	8.24	93.29	4.25	4.55	27.18	37.94
$P_3 \times P_6$	13.85	9.60	76.92	3.24	4.59	22.28	35.61
$P_4 \times P_5$	14.50	11.47	85.95	4.21	5.37	27.96	40.18
$P_4 \times P_6$	14.65	10.43	80.23	3.45	4.36	24.34	34.60
$P_5 \times P_6$	14.11	8.78	75.04	3.17	4.48	22.72	34.20
L.S.D at 5%	**0.84**	**1.09**	**5.32**	**0.26**	**0.26**	**3.07**	**2.28**
1%	**1.12**	**1.46**	**7.12**	**0.38**	**0.38**	**4.11**	**3.05**

***and ** denote significant and differences at 0.05 and 0.01 of probability levels respectively.**

Heterosis :

Table 4 Useful heterosis, expressed as the percentage deviations of the 15 F_1 crosses mean performance from mid and better–parents for studied traits are presented in **Table 4 and Table (4) cont.** For the spike length percentage of mid and better parents heterosis showed highly significant positive values for four crosses ranged from 14.05 and 11.70 for the cross $P_2 \times P_5$ to 9.15 and 8.91 for the cross $P_1 \times P_6$ respectively while the cross $P_5 \times P_6$ gave the highest significant negative values for the heterosis over mid and better parents. **Qaisar *et al* (2005)** obtained significant heterosis over mid and better parent in most studied crosses for spike length. For number of spikes/plant, six crosses showed highly significant positive heterosis over mid and better parents. The crosses ($P_1 \times P_3$), ($P_4 \times P_5$) and ($P_1 \times P_2$) gave the highest significant positive values while the cross $P_2 \times P_4$ gave the highest significant negative values for the heterosis over mid and better parents. For number of grains/spike the crosses ($P_1 \times P_6$), ($P_2 \times P_4$) and ($P_2 \times P_6$) showed highly significant positive heterosis over mid and better parents. On contrast, three crosses showed highly significant and negative heterosis over mid and better parents. Five crosses exhibited highly significant and positive heterosis and four crosses exhibited highly significant and negative heterosis over mid and better parents for grain weight/spike. The results on the heterotic effects relative to the mid-parents of 100- grain weight indicated that, seven crosses showed significant and highly significant and positive heterotic effects which ranged from 4.52 for the cross $P_2 \times P_3$ to 8.86 for the cross($P_4 \times P_5$). Three crosses displayed positive and highly significant heterobeltiosis for 100- grain weight which gave values ranged from 3.85 for the cross($P_1 \times P_4$) to 7.83 for the cross ($P_4 \times P_5$). **Thomas *et al* (2017)** found that, the estimates of heterosis and heterobeltiosis were positive and significant for 1000-grain weight in some wheat crosses. Heterosis for grain yield and its components is very important consideration in heterosis breeding. Yield is a complex trait and ultimate aim of plant breeding. Highly significant and positive heterosis as a deviation from mid and better parents was observed for grain yield/plant in five crosses under study. The crosses ($P_2 \times P_6$), ($P_3 \times P_4$) and ($P_1 \times P_2$) recorded the highest positive heterosis values over mid and better parents. Consequently, these crosses might be used in breeding programs for producing hybrid wheat. A high percentage of heterosis as percentage from mid and better-parents for grain yield /plant in wheat crosses were reported by **Singh *et al.* (2013) , Garg *et al*. (2015) and Kalhoro *et al*. (2015)**. Consenting, harvest index trait, three crosses showed highly significant positive heterosis over mid and better parent. The cross ($P_2 \times P_4$) recorded the highest positive values over mid and better parents. Al-Ashkar (2007) reported that, most crosses showed positive significant heterosis over mid and better parent in wheat.

Table 4: Heterosis as percentage of mid-parent (M.P) and better parent (B.P) in the F_1 crosses for studied characters in wheat.

Traits / Crosses	Spike length (cm)		Number of spikes /plant		Number of grains /spike		Grain weight/ spike (gm)	
	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P
$P_1 \times P_2$	11.70**	10.95**	38.79**	34.49**	3.63	2.84	16.44**	9.50**
$P_1 \times P_3$	0.16	-1.97	51.11**	47.88**	-17.4**	-20.55**	-16.12**	-17.25**
$P_1 \times P_4$	6.48*	5.18*	10.61*	8.92	5.53	4.86	12.24**	10.44**
$P_1 \times P_5$	-2.03	-3.44	34.55**	13.49*	-6.44*	-11.30**	-6.68**	-13.14**
$P_1 \times P_6$	9.15**	8.91**	-10.01*	-13.45*	13.75**	10.88**	19.81**	13.75**
$P_2 \times P_3$	7.64**	5.70	31.76**	30.45**	0.24	2.85	8.75**	3.59
$P_2 \times P_4$	11.27**	9.22**	-18.30**	-19.64**	13.47**	13.32**	29.26**	19.90**
$P_2 \times P_5$	14.05**	11.70**	30.95**	13.46*	1.83	-2.77	6.61**	-6.25*
$P_2 \times P_6$	6.89**	6.43*	30.76**	21.99**	13.50**	11.12**	16.76**	15.88**
$P_3 \times P_4$	5.59*	2.12	33.02**	32.21**	4.13	0.79	7.81**	4.85
$P_3 \times P_5$	7.10**	3.37	9.02	-6.36	5.23*	3.62	-0.45	-8.41**
$P_3 \times P_6$	-3.52	-5.33	2.33	-3.61	-10.69**	-11.88**	-13.56**	-16.92**
$P_4 \times P_5$	-4.01	2.45	50.65**	28.73**	0.11	-4.53	-3.92*	-9.27**
$P_4 \times P_6$	-1.37	-2.79	10.58*	4.72	-3.72	-5.57	-10.51**	-16.26**
$P_5 \times P_6$	-5.16*	-6.74*	10.28	-11.85*	-14.73**	-16.65**	-23.00*	-31.68**
L.S.D 5%	**0.73**	**0.84**	**0.95**	**1.09**	**4.61**	**5.32**	**0.17**	**0.26**
1%	**0.97**	**1.12**	**1.27**	**1.46**	**6.17**	**7.12**	**0.20**	**0.38**

***and ** denote significant and differences at 0.05 and 0.01 of probability levels respectively.**

Table 4: cont.

Traits / Crosses.	100-grain weight (gm)		Grain yield/plant (gm)		Harvest index (%)	
	M.P	B.P	M.P	B.P	M.P	B.P
$P_1 \times P_2$	2.74	-1.16	28.51**	24.50**	7.52**	5.67
$P_1 \times P_3$	-3.04	-8.86**	6.99	1.64	-1.87	-3.43
$P_1 \times P_4$	5.90**	3.85*	5.65	3.27	2.65	-1.75
$P_1 \times P_5$	8.48**	5.20**	12.27*	0.21	4.52	4.27
$P_1 \times P_6$	0.46	-8.29**	-2.62	-10.08	11.93**	10.70**
$P_2 \times P_3$	4.52**	2.08	18.83**	16.49**	15.37**	11.62**
$P_2 \times P_4$	6.20**	4.22	-18.60**	-22.85**	4.00	1.25
$P_2 \times P_5$	4.69**	3.69	19.56**	9.83**	4.57	2.55
$P_2 \times P_6$	4.64**	0.83	39.89**	33.12**	4.29	1.38
$P_3 \times P_4$	2.96	-1.20	33.00**	23.70**	11.09**	4.70
$P_3 \times P_5$	-3.70*	-6.76*	10.53	3.46	12.34**	10.81**
$P_3 \times P_6$	3.69	0.44	-12.59*	-15.19*	6.41*	5.89
$P_4 \times P_5$	8.86**	7.83**	4.62	-8.48	11.81**	6.80
$P_4 \times P_6$	-6.01**	-12.45**	-11.90*	-20.33**	-2.89	-8.03*
$P_5 \times P_6$	-2.29	-8.20**	-4.57	-8.05	0.79	-0.12
L.S.D 5%	**0.17**	**0.26**	**2.66**	**3.07**	**1.86**	**2.28**
1%	**0.20**	**0.38**	**3.56**	**4.11**	**2.49**	**3.05**

***and** denote significant and differences at 0.05 and 0.01 of probability levels respectively.**

Data in **Table (5)** revealed the estimates of general combining ability effects for all parents under study. The promising general combiners for spike length was Gemmeiza11 which attained highly significant positive general combining ability effects while highly significant and negative general combining ability effects were Shandaweel 1 and Gemmeiza12. Moreover, the parents Gemmeiza 9 and Gemmeiza12 gave the highest positive general combining ability estimates for number of spikes/plant .Concerning number of grains/spike Gemmeiza11 exhibited positive and significant GCA effects towards increasing number of grains/spike while the cultivar Gemmeiza 9 was negative and significant GCA. For100-grain weight results indicated that the cultivar Gemmeiza 9 proved to be a good combiner followed by Giza 171 but the three parents Gemmeiza 11, Gemmeiza 12 and Shandaweel 1 exhibited significant negative GCA for this trait. The cultivars Gemmeiza 9, Gemmeiza 11 and Giza 171 exhibited significant positive general combining ability effects for grain yield/plant and Harvest index (%), in contrast Shandaweel 1 exhibited highly significant negative effects for grain yield/plant and Harvest index (%). The crosses involving these good general combining ability genotypes should produce promising sergeants with higher mean performance of those traits. Consequently, the results of the average performance of the respective traits are in agreement with those reported by **Kumar *et al.* (2011) and Ashraf *et al.* (2015)**.

Table 5: Estimates of general combining ability effects for the studied traits in wheat.

Traits / parents	Spike length (cm)	Number of spikes /plant	Number of grains/ spike	Grain weight/ spike (gm)	100-grain weight (gm)	Grain yield/ plant (gm)	Harvest index (%)
P_1	0.08	0.51**	-2.29**	0.07*	0.21**	1.50**	0.48*
P_2	0.47**	0.11	1.84**	0.08*	-0.07*	1.69**	0.63**
P_3	-0.29**	0.37**	-0.75	-0.16**	-0.16**	0.24	-0.23
P_4	0.13	-0.08	0.39	0.18**	0.13**	0.87*	1.27**
P_5	0.01	-0.97**	1.10	0.13**	0.07*	-2.05**	-0.14
P_6	-0.31**	0.05	-0.28	0.31**	-0.32**	-2.25**	-1.06**
S.E.(gi)	**0.10**	**0.12**	**0.60**	**0.04**	**0.03**	**0.35**	**0.24**
S.E.(gi-gj)	**0.15**	**019**	**0.93**	**0.06**	**0.05**	**0.54**	**0.37**

***and ** denote significant and differences at 0.05 and 0.01 of probability levels respectively.**

The estimates of specific combining ability effects for all F_1 crosses are presented in **Table (6)**. The crosses $P_2 \times P_5$, $P_1 \times P_6$, P3 × P_5 and $P_2 \times P_4$ showed positive highly significant specific combining ability effects for spike length. For the number of spikes/plant, eight crosses showed positive and significant specific combining ability effects whereas four crosses showed significant negatively ones. The crosses $P_1{\times}P_6$, $P_3{\times}P_5$ $P_2{\times}P_6$ and $P_2{\times}P_6$ gave the highest significant positive values for the estimates of specific combining ability effects for number of grains/spike therefore; these crosses could be of great values for varietal improvement programs. Regarding grain weight/spike seven crosses exhibit positive and significant specific combining ability effects whereas; five crosses showed negative significant values. For 100-grain weight, the crosses $P_1 \times P_5$, $P_4 \times P_5$,

$P_2 \times P_6$ and $P_3 \times P_6$ gave the highest significant positive values for the estimates of specific combining ability effects, therefore the choice of the best crosses combinations could be based on specific combining ability effects. The crosses $P_2{\times}P_6$ $P_3{\times}P_4$ and $P_1{\times}P_2$ are considered promising for grain yield improvement as they showed highly significant positive combining ability effects. These crosses could account for the highest average performance of the respective traits. Similar results were obtained by **Akinci (2009), Kumar *et al.* (2011), Aida Rizkalla *et al.* (2012) and Ashraf *et al.* (2015)**. Five crosses exhibited positive and significant specific combining ability effects for harvest index (%), the crosses $P_1{\times}P_6$ and $P_2{\times}P_3$ gave the highest positive values for this trait.

Table 6: Estimates of specific combining ability effects for the studied traits in wheat.

Traits / Crosses	Spike length (cm)	Number of spikes /plant	Number of grains/ spike	Grain weight/ spike (gm)	100-grain weight (gm)	Grain yield/ plant (gm)	Harvest index (%)
$P_1{\times}P_2$	0.63*	1.84**	-0.02	0.19*	-0.03	4.65**	1.15
$P_1{\times}P_3$	-0.42	2.81**	-12.32**	-0.63**	-0.19*	-0.56	-2.42**
$P_1{\times}P_4$	0.50	-0.32	2.87	0.26**	0.17	0.70	-0.16
$P_1{\times}P_5$	-0.62*	0.94**	-3.67*	-0.21*	0.30**	1.31	0.15
$P_1{\times}P_6$	1.10**	-1.84**	12.06**	0.75**	-0.01	-1.50	3.27**
$P_2{\times}P_3$	0.17	1.09**	-0.99	0.08	0.11	1.44	3.02**
$P_2{\times}P_4$	0.73**	-2.77**	5.89**	0.64**	0.11	-7.48**	-0.14
$P_2{\times}P_5$	1.29**	0.74*	-0.10	0.10	0.05	1.92*	-0.29
$P_2{\times}P_6$	0.28	2.09**	8.15**	0.35**	0.21*	8.49**	0.21
$P_3{\times}P_4$	0.51*	1.58**	3.64*	0.26**	0.07	8.20**	2.02**
$P_3{\times}P_5$	0.88**	-1.06**	8.24**	0.25**	-0.23*	0.51	1.97**
$P_3{\times}P_6$	-0.59*	-0.73*	-6.76**	-0.32**	0.20*	-4.20**	0.56
$P_4{\times}P_5$	-0.78**	2.62**	-0.24	-0.14	0.29**	0.67	2.72**
$P_4{\times}P_6$	-0.31	0.56	-4.59**	-0.46**	-0.33**	-2.76**	-0.194**
$P_5{\times}P_6$	-0.72**	0.01	-10.49**	-0.68**	-0.15	-1.46	-0.93
S.E.(sij)	**0.26**	**0.34**	**1.65**	**0.09**	**0.09**	**0.95**	**0.66**
S.E.(sij-sik)	**0.39**	**0.51**	**2.46**	**0.14**	**0.15**	**1.42**	**1.00**

***and ** denote significant and differences at 0.05 and 0.01 of probability levels respectively.**

Estimates of genotypic and phenotypic correlation coefficients

Genotypic and phenotypic correlation coefficients among the seven characters were assessed and presented in **Table (7)**. Spike length exhibited significant and positive genotypic and phenotypic correlation with number of grains/spike, grain weight/spike and harvest index %. Grain yield/plant was significant and positive genotypic and phenotypic correlated with number of spikes/plant, 100-grain weight and harvest index % indicating the importance of these traits as selection criteria in yield enhancement programmes. Significant and positive correlation among number of productive tillers per plant and grain yield/plant was also noticed by **Ali *et al.* (2008)**. Number of grains/spike exhibited significant and positive genotypic and phenotypic correlation with grain weight/spike (gm), similar findings were also reported by **Khan *et al* (2013)**.Also, harvest index % exhibited significant and positive genotypic and phenotypic correlation coefficients with grain weight/spike and 100-grain weight.

Table (7): Estimates of genotypic (rg) and phenotypic (rp) correlation coefficients between the studied traits in wheat.

Traits		Spike length (cm)	Number of spikes /plant	Number of grains/ spike	Grain weight/ spike (gm)	100-grain weight (gm)	Grain yield/ Plant (gm)
Number of spikes/plant	rg	-0.03					
	rp	-0.05					
Number of grains/spike	rg	0.65**	-0.35				
	rp	0.63**	-0.35				
Grain weight/ spike (gm)	rg	0.82**	-0.28	0.79**			
	rp	0.79**	-0.27	0.78**			
100-grain weight (gm)	rg	0.44*	0.12	0.12	0.61**		
	rp	0.39	0.12	0.12	0.60**		
Grain yield/ Plant (gm)	rg	0.46*	0.68**	0.16	0.29	0.43*	
	rp	0.41	0.67**	0.16	0.29	0.42*	
Harvest index (%)	rg	0.60**	0.24	0.42*	0.58**	0.56**	0.53*
	rp	0.45*	0.19	0.37	0.50*	0.51*	0.47*

*and ** denote significant and differences at 0.05 and 0.01 of probability levels respectively.

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تقديربعض المقاييس الورائية للمحصول ومكوناته باستخدام الهجن الدائرية فى القمح

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أجريت هذه الدراسة بالمزرعة البحثية لقسم المحاصيل - بكلية الزراعة - جامعة الأزهر – القاهرة ومنطقة الحامول محافظة كفر الشيخ وذلك خلال موسمى الزراعة 2017/2016 و 2018/2017م لدراسة قوة الهجين والقدرة على التآلف للمحصول ومكوناته بإستخدام الهجن الدائرية (ما عدا الهجن العكسية) لستة أصناف من القمح هى: جميزة 9 – جميزة 11- جميزة 12 – جيزة 171 – سدس 12 – شندويل 1.

وكانت الصفات المدروسة هى طول السنبلة (سم) – عدد السنابل /نبات -عدد الحبوب / السنبلة – وزن حبوب السنبلة (جرام) - وزن 100 حبة (جرام) — وزن محصول الحبوب/نبات (جرام) – دليل الحصاد % .

نتائج التحليل أن الآباء والهجن أظهرت معنوية عالية فى كل الصفات المدروسة .كانت القيم الموجبة والمعنوية لقوة الهجين ذات أهمية كبيرة فى معظم الصفات المدروسة. وأظهرت الهجن جميزة 9 × جميزة 11 و جميزة 11 × شندويل 1 قوة هجين موجبة ومعنوية بالنسبة لمتوسط الأبوين وبالنسبة لأفضل الأبوين بينما سجلت الهجن جيزة 171 × شندويل 1 وجميزة 12 × شندويل 1 قوة هجين سالبة ومعنوية بالنسبة لمتوسط الأبوين وبالنسبة لأفضل الأبوين فى معظم الصفات .

كانت الآباء جميزة 9 جميزة 11 وجيزة 171 أفضل الآباء بالنسبة لتأثيرات القدرة العامة على الإئتلاف فى معظم الصفات المدروسة مما يدل على أهمية إستخدام هذه الآباء فى برامج التربية لتحسين صفات مكونات المحصول فى القمح .

أظهرت الهجن جميزة 11 × شندويل 1 وجميزة 12 × جيزة 171 قيماً موجبة ومعنوية لتأثيرات القدرة الخاصة على الائتلاف فى معظم الصفات المدروسة .

كما اظهرت الهجن جميزة 12× سدس 12 و سدس 12 × شندويل 1 قيما سالبة ومعنوية لتأثيرات القدرة الخاصة على الائتلاف فى معظم الصفات المدروسة.

اظهرت صفة محصول الحبوب /النبات ارتباطاً موجباً ومعنوياً مع عدد السنابل/نبات وزن 100 حبة بالجرام ودليل الحصاد .