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Combining Ability in F_1 Generation for Diallel Crosses for Yield and Yield Components in Wheat (*Triticm aestivum,* L.)

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ABSTRACT

The combining ability and heterosis have been analyzed in a 6-parents F_1diallel cross for yield and its components. The experiment was conducted at the Experimental Fam., Faculty of Agricultural, Al-Azhar University)Assiut Branch .(The analysis of variance indicated highly significant differences in among 21 enter for plant height, number of spikes/plant, spike length (cm), grain weight/spike,(gm), 100-grain weight(gm) and grain yield/plant(gm). Variance due to general combining ability as well as specific combining ability were highly the above mentioned traits. However, the ratio of genetic components ∑gi∑/ ^{2}sij ^{2}was less than unity of the non-additive genetic variance in the inheritance of all the above traits .Heterosis effects over mid and better parents were shown in F_1hybrid for all studied characters .

INTRODUCTION

Wheat is one of major cereal crop in Egypt, wheat breeding programs played the major role in developing new high yielding varieties, resistant stress, pest and diseases as well as tolerant to different environmental stress. The breeders are screen the breeding materials and then selecting donor parents for breeding programs. The genetic improvement of various traits, which depends on the nature and magnitude of genetic variability, and hybridization, which play a critical role for obtaining the new recombination's and releasing new materials, will help the breeders to identify the best combinations to be crossed and exploit heterosis. Heterosis is considered good criteria for synthetics and ultimately hybrids and could lead to improve the yield and its components in bread wheat. Superiority of hybrids over the mid and better parents for grain yield was found to be associated with manifestations of heterotic effects in main yield components i,e., number of spikes/plant, spike length (cm), grain weight/spike,(gm), 100-grain weight(gm) and grain yield/plant(gm). The concept of combining ability is useful in connection with testing procedures, in which it is desired to study and compare the performance of line in hybrid combination (Griffing, 1956). Combining ability analysis helps the breeders to identify the best combiners which may be hybridized either to exploit heterosis . Therefore ,GCA and SCA variance will be accurate calculation for evaluating yield and components. The objective of this study was to evaluate the nature of gene action and general and specific combining abilities of six bread wheat genotypes and their F_1hybrids .

MATERIALS AND METHODS

The present investigation was carried out at Experimental Farm Faculty of Agriculture, Al- Azhar University (Assiut Branch) during the period of 2014 / 2015and 2015/ 2016 growing seasons. The breeding material used in this study were Sids 1(p_1) ,Sids 4 (p_2) , Sids 12(p_3) ,Giza164(p_4) ,Giza 168(p_5) and Sakha 93(p_6).The characters used in this study were plant height, number of spikes/plant, spike length) cm), grain weight /spike,(gm)) -100,grain weight (gm) and grain yield/plant(gm.)

Experimental layout:

In 2014/2015 season the tested variety were crossed in all possible combinations excluding reciprocals, to generate15 hybrids (F_1) crosses.

In the 2015/2016 grown season F_1hybrids and their parents were grown in a randomized complete block design of three replications. Each entry was grown in 1 row 3m long with 50cm between rows. Planting was done in hills spaced 15 cm apart. The recommended agronomic practices of wheat production were applied at the proper time. The data were recorded on 15 randomly selected plants from each cross and parent. the data were statistically analyzed by using the ordinary analysis of variance to test the significance of differences among genotypes according to Snedecor and Cochran (1982 .(was made on plot mean basis. The variation among parents and F_1crosses was partitioned into general and specific combining abilities as illustrated by Griffing (1956 (Method 2, Model 1The heterotic effects of F_1crosses were estimated as percentage from mid and better parents according to Fonseca and Patterson (1968) as follows :

Mid parents heterosis (%) =(F_1 – mid parent/mid parent) x100.

Better parents heterosis(%) = (F_1 – better parent/better parent) x 100.

RESULTS AND DISCUSSION

Analysis of variance and mean performance :

The analysis of variance (Table 1) cleared the highly significant difference that were found among genotype for all traits, indicating a wide genetic variability in these materials and the genetic analysis could be performed. Mean of parents and their F_1hybrids are presented in (Table 2). Mean of the six parents and their fifteen F_1crosses are presented in Table 2. The results reveled that mean of parents was wide extended with a range of 75.56-118.05 (P – $_4$P) 10.29-8.50 ;($_1$P- $_6$P$_2$) -3.48 ; 10.63 (P– $_6$P) 2.38-1.71 ;($_2$P– $_4$P)5.01-3.98 ;($_3$P $_1$ –P ($_5$and 7.77) 26.33-P- $_6$P ($_2$for plant height, number of spikes/plant, spike length (cm), grain weight/spike,(gm), 100-grain weight(gm) and grain yield/plant)gm), respectively. Meanwhile, means of F_1hybrids were extended with a range70.29 -127.27 (P $_4$Xp)-($_6$P $_1$Xp$_5$) ; 12.36- 9.00(P $_1$Xp)-($_6$P $_4$Xp) 9.96- 4.14 ;($_5$P $_5$Xp)-($_6$P $_2$ Xp) 3.68 – 1.75 ;($_3$P $_1$Xp)-($_2$P $_1$Xp) 5.03-3.21 ;($_5$P $_1$Xp)-($_3$P $_1$ Xp ($_6$and12.65 -33.38) P $_5$Xp)-($_6$P $_2$Xp ($_3$for the above-mentioned traits, respectively. The F_1mean increased over the parental mean for all studied traits. Apparently, the different means among the six parents and their F_1seemed to be valuable in improving the studied traits in bread what breeding programs. These results are in agreement with those reported by Lamkey *et al* ,(1999) .Alam *et al*,(2004) . Saad *et al* (2010) .and Beche *et al* .(2013).

Table 1. Mean squares of genotypes, general combining ability (GCA) and specific combining ability (SCA) and their ratios for yield and its components in wheat.

S.O.V	d.f	Plant height	Spike length(cm)	Number of spikes/plant	Grain weight Spike	-100grain weight	Grain yield/plant
Replicates	2	10.25	2.89	1.26	0.68	1.16	3.44
Genotypes	20	718.96**	4.24**	12.23**	1.38**	1.29**	241.23**
Error	40	8.69	1.19	1.06	0.32	1.11	1.38
GCA	5	630.13**	2.15**	7.17**	0.49**	0.690**	140.78**
SCA	15	109.47**	1.17**	3.05**	0.45**	0.345**	60.18**
Error	40	2.90	0.40	0.35	0.11	0.29	0.47
$\sum gij^2/\sum sij^2$		0.74	0.28	0.32	0.14	0.42	0.31

Table 2. Mean performances for all studied characters of parents and F 1 crosses.

Traits Geno.	Plant height	Spike length (cm)	Number of spikes /plant	Grain weight Spike	-100grain weight	Grain yield /plant
P_1	118.05	8.13	9.40	2.13	3.98	22.01
P_2	93.54	10.29	10.63	2.38	4.52	26.33
P_3	92.10	9.92	8.62	2.38	4.58	22.52
P_4	75.56	9.66	5.74	1.71	3.91	10.84
P_5	99.05	9.37	4.69	2.40	5.01	12.48
P_6	88.24	8.50	3.48	1.08	4.28	7.77
P_1XP_2	123.95	9.19	6.27	1.75	3.43	12.97
P_1XP_3	121.40	9.26	6.01	3.68	3.21	23.11
P_1XP_4	89.45	10.14	8.05	2.98	3.85	25.03
P_1XP_5	127.27	10.92	9.45	3.68	3.88	34.78
P_1XP_6	118.53	9.00	8.37	2.50	5.03	21.91
P_2XP_3	94.93	12.19	9.96	3.35	3.88	33.38
P_2XP_4	82.37	11.39	4.04	3.13	3.78	15.65
P_2XP_5	97.84	10.42	7.87	3.68	4.77	28.97
P_2XP_6	94.52	11.93	6.03	3.01	4.24	20.14
P_3XP_4	94.59	10.10	7.42	2.22	4.75	17.47
P_3XP_5	102.49	11.38	7.06	2.53	5.00	19.87
P_3XP_6	91.58	9.953	5.42	2.35	4.21	15.73
P_4XP_5	92.13	12.36	7.04	2.57	4.10	19.08
P_4XP_6	70.29	10.13	6.65	2.24	4.77	15.87
P_5XP_6	103.64	11.50	4.14	2.57	4.11	12.65
LSD0.05	4.86	1.56	1.47	0.80	1.05	1.68
LSD0.01	6.50	2.08	1.97	1.07	1.33	2.24

Heterosis :

Data in Table 3 showed that there were significant values for the heterosis over mid and better parent for all studied traits, indicating that heterosis played an important role in the inheritance of these traits .for plant height eight crosses out fifteen had desirable highly positive significant values for the heterosis over mid parent and one of them (p_1x p_3) Giza 155 xGiza 168 also, showed highly positive significant value for the heterosis over better parent ,for Spike length (cm) 6 crosses out fifteen had desirable highly positive significant values for the heterosis over mid parent and two of them (p_1x p_5) Sids 1x Giza 168 and (p_1x p_2) Sids1 x Sids 4 also, showed highly positive significant value for the heterosis over better parent .for Number of spikes/plant three crosses had desirable highly positive significant values for the heterosis over mid parent and one of them p_1x p) $_5$Sids 1 xGiza 168) also, showed positive significant value for the heterosis over better parent) .p_1x p) ,($_3$p $_1$x p_5) and (p_2x p_5) had desirable highly positive significant values for the heterosis over mid and better parent for grain weight spike .For -100grain weight (p_1x p_6) and (p_4x p_6) had desirable highly positive significant values for the heterosis over mid and better parent .Grain yield/plant four crosses (p_1x p) ,($_5$p $_2$x p) ,($_3$p $_4$x p_6) and (p_5x p_6) out fifteen had desirable highly positive significant values for the heterosis over mid and better parent .these results are supported with the findings of Kobiljski *et al* ,(2002) , Faiz *et al* ,(2006),Al-Ashkar (2007 ,(Anwer *et al* (2011) . and Khodadadi *et al*.(2012).

Combining ability :

The analysis of variance Table 1 emphasized that mean squares due to general combining ability and specific combing ability were highly significant for all studied traits, indicating that additive and non-additive effects were involved in the control of studied traits. Suggesting the predominate effect of the additive gene involved. The ratio of ∑ gi2 /∑sij2 was less than unity of the inheritance of studied traits. Similar results were reported by Gorjanovic and Balalic (2005 ,(Inamullah ,*et al* ,(2006) .Hassan *et al* . (2007) , Saad *et al* ,(2010) , Zaazaa, E. I. (2010) ,Cifici ,(2012).Yilbirim *et al* (2014) and Ashraf *et al* (2015) . .

A-General combining ability :

Data in table 4 revield that p_5Giza 168 has a desirable significant GCA effects for all studied traits, except ,number of spikes/plant .As well as, the P_2Sids 4 had desirable significant GCA effects for all studied traits, except plant height thus these two parents can be good general combiners for grain yield /plant along with most of the yield contributing traits and can be recommended as a donor in wheat breeding programs .

B-Specific combining ability :

Data in table 4 cleared that most desirable negative significant SCA effects were found in plant height and

100-grain weight. On the other hand most desirable positive significant SCA effects were found in the in the other traits. The cross p $_1$x p $_6$Sids 1 x Shakha 93 had desirable positive significant SCA effects for all traits, so it can be a good specific combination for grain yield /plant along with most of the yield contributing traits.

Table 4. Heterosis as percentage of mid-parents(M.P) and better parent(B.P) in the F $_1$ crosses for studied characters .

Traits	Plant height(cm)		Spike length(cm)		Number of spikes/plant	
Geno.	M.P	B.P	M.P	B.P	M.P	B.P
P_1XP_2	17.16**	4.99*	-0.22	-10.69	-37.41**	-41.03**
P_1XP_3	15.54**	2.84	2.66	-6.62	-33.25**	-36.01**
P_1XP_4	-7.60**	-24.23**	14.03	4.97	6.39	-14.30
P_1XP_5	17.24**	7.80**	24.82**	16.54	34.20**	0.57
P_1XP_6	14.91**	0.41	8.24	5.89	30.05*	-10.89
P_2XP_3	2.27	1.49	20.69**	18.54**	3.53	-6.24
P_2XP_4	-2.58	-11.94**	14.22	10.76	-50.64**	-61.98**
P_2XP_5	1.61	-1.22	5.99	1.26	2.83	-25.91**
P_2XP_6	3.99	1.05	26.99**	15.94	-14.56	-43.29**
P_3XP_4	12.84**	2.71	3.18	1.85	3.32	-13.92
P_3XP_5	7.23**	3.47	17.99*	14.72	6.16	-18.06*
P_3XP_6	1.56	-0.57	8.09	0.34	-10.36	-37.08**
P_4XP_5	5.53**	-6.98**	29.91**	27.94**	34.93**	22.52*
P_4XP_6	-14.18**	-20.34**	11.56	4.83	44.20**	15.79
P_5XP_6	**10.67	4.63	**28.69	*22.70	1.31	11.74-
L.S.D5%	4.21	4.86	1.56	1.80	1.47	1.70
L.S.D1%	5.63	6.50	2.08	2.41	1.97	2.27
Traits	Grain weight Spike		-100grain weight(gm)		Grain yield/plant(gm)	
P_1XP_2	-22.45	-26.57	-19.37**	-24.13**	-46.35**	-50.75**
P_1XP_3	63.05**	54.48**	-23.70**	-27.63**	3.79	2.64
P_1XP_4	55.25**	40.06	-2.49	-3.35	52.34**	11.15
P_1XP_5	62.48**	53.33**	-13.62	-22.4	103.00**	183.93**
P_1XP_6	55.40**	17.22	21.71**	26.19**	57.68**	-0.50
P_2XP_3	40.66*	40.56*	-13.29*	-12.54	36.67**	48.24**
P_2XP_4	52.81**	31.33	-10.24	-16.24*	-15.81**	-40.57**
P_2XP_5	53.87**	54.41**	0.18	-4.67	50.22**	10.05
P_2XP_6	73.65**	26.30	-3.64	-6.20	25.50**	-23.50**
P_3XP_4	8.47	-6.73	13.81*	7.06	4.76	-22.40*
P_3XP_5	5.86	5.42	6.00	0.07	14.32**	-11.75
P_3XP_6	35.52	-1.40	-3.33	-5.11	11.20	-30.16**
P_4XP_5	24.96	7.08	14.51*	2.07	65.32**	55.82**
P_4XP_6	59.95**	30.55	16.48**	21.89**	91.13**	46.43**
P_5XP_6	*47.75	7.22	11.46-	17.87-	**40.36	3.24
LSD0.05	0.80	0.93	0.55	1.05	1.68	1.94
LSD0.01	1.07	1.24	0.94	1.33	2.24	2.59

Table 4. Estimates of general and specific combining ability effects for the studied characters in s ix wheat varieties.

Traits Geno.	Plant height	Spike length (cm)	Number of spikes/plant	Grain weight Spike	-100grain weight	Grain yield/plant
P_1	15.77**	-0.89**	1.02**	0.09	-0.19	-8.33**
P_2	-1.23*	0.47*	0.83**	0.20*	-0.43*	1.90**
P_3	-1.91**	0.10	0.54**	0.10	0.09	3.31**
P_4	-12.07**	0.19	-0.51*	-0.19	0.26	-0.13
P_5	3.64**	0.43*	-0.48*	0.22*	0.36*	1.38**
P_6	**4.43-	0.30-	**1.40-	**0.41-	-0.09	1.87**
LSD0.05	1.11	0.41	0.39	0.21	0.35	0.44
LSD0.01	1.48	0.55	0.52	0.28	0.47	0.59
P_1XP_2	-12.14**	-0.36	0.39	-0.64**	-0.21	-12.86**
P_1XP_3	10.76**	-0.67	-2.55**	-1.13**	-0.15	-12.31**
P_1XP_4	8.89**	-0.22	-2.52**	0.90**	0.72	-4.29**
P_1XP_5	-12.90**	0.57	0.58	0.50*	-0.53	-7.59**
P_1XP_6	9.21**	1.13*	1.94**	0.79**	0.95*	6.00**
P_2XP_3	8.54**	-0.08	1.78**	0.23	0.43	6.50**
P_2XP_4	-2.65	-0.93	2.00**	-0.60*	-0.50	1.32*
P_2XP_5	-0.58	1.35**	1.62**	0.47	-1.31**	3.65**
P_2XP_6	-2.98	0.46	-3.25**	0.54*	-0.13	1.57**
P_3XP_4	-3.22	-0.75	0.56	0.68**	0.45	0.12
P_3XP_5	1.54	1.49**	-0.37	0.64**	0.19	6.11**
P_3XP_6	-2.73	-0.56	0.57	-0.40	-0.03	3.23**
P_4XP_5	9.93**	-0.47	0.42	-0.27	-0.54	4.84**
P_4XP_6	2.11	0.58	0.03	-0.37	0.60	3.44**
P_5XP_6	-0.73	-0.12	-0.69	0.07	0.94*	0.10
LSD0.05	3.05	1.13	1.07	0.48	0.79	1.00
LSD0.01	4.07	1.51	1.43	0.64	1.06	1.34

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القدرة على الائتلاف في الجيل الاول للهجن الدائرية في المحصول ومكوناته للقمح

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تم تقدير القدرة علي الائتلاف وقوة الهجين وذلك من خلال تحليل الهجن الدائرية لستة اباء من القمح لصفة المحصول ومكوناته اجريت التجربة في مزرعة كلية الزارعة جامعة الازهر فرع اسيوط اوضح التحليل للتباين ان هناك معنوية علية لكل من 21 هجين في صفة طول النبات (سم) وعدد السنابل للنبات وطول السنبلة و وزن حبوب السنبلة و وزن 100 حبة وكذلك وزن حبوب النبات ايضا كانت القدرة العامة والخاصة عالية في معظم المعاملات بينما كانت نسبة التباين للقدرة العامة علي نسبة التباين للقدرة الخاصة اقل من الوحدة في كل الصفات هذا يؤكد ان التباين الغير اضافي لعب دورا كبير في توريث تلك الصفات ايضا كان هناك قوة هجين منسوبة لمتوسط الابوين والاب الافضل فى كل الصفات تحت الدراسة.