DIALLELE CROSS ANALYSIS FOR GRAIN YIELD AND ITS COMPONENTS IN SOME BREAD WHEAT CROSSES

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Abstract

A diallel cross among six bread wheat genotypes (parents) namely; Sids 1, Giza 168, Sakha94, Gemmeiza 9, Line 5 and Line 42 was carried out in 2008/2009 season to studay some genetic parameters in F_1 and F_2 generations for grain yield and its components i.e. plant height, noumber of spikes/plant, noumber of kernels/spike, 100- kernal weight and grain yield/plant. Genotypes mean squares were significant for all studied characters. Mean squares for parents vs crosses as an indication for heterosis were significant for all studied characters in the F_1 and F_2. Inbreeding depression was dectected in F_2 for grain yield in 13 crosses and rangead from 22.94 to 59.71 % . Similarly, inbreeding depression, for number of spikes/plant ranged from 13.41 to 39.21 in nine crosses from 21.31 to 59.33 for number of kernels/spike in ten crosses, and from 16.28 to 72.91% for kernel weight in 11 crosses. Both general and specific combining ability (GCA and SCA, respectively,), were significant for all studied characters in $F_{1.}$ These results indicate the importance of both additive and dominance genetic effects in the inheritance of most studied characters. However, the additive gene action (GCA) was of great importance in the performance of most studied characters. Moreover, Results indicated that the cultivar (Giza 168) was good combiner for all studied characters while (line 5) was best combiner for plant height, number of spikes/plant and kernel weight. Moreover, the crosses(P_2 xP_5) , (P_4x P_5) and **(**P_3xP_6) are considered promising for grain yield improvement as they showed high specific combining ability effects.

INTRODUCTION

Wheat, is the leading human food crop in Egypt. The total national consumption is about 14 million tons whereas, the national wheat production was fluctuating from seven to eight million tons during the last five years. Therfore, Egypt imports about six million tons yearly. Reducing the gap between national wheat production and consumption is a national goal. For doing so, breeding for new high yielding cultivars is an ongoing process for the wheat breeders. The assessment of the nature of genetic variation is crucial to any breeding program, since the choice of an appropriate breeding method depends on the relative importance of various genetic parameters. In wheat, plant height and spike characters are important attributes that determine the desirability of progeny of any cross. The appropriate selection of these characters may greatly contribute towards enhancement in the yielding ability. Thus, information on the nature of gene action with respect to these character would be useful in the development of better cultivars. Dominance gene action would tend to favor the production of hybrids, whereas additive gene action signifies that standard selection procedures would be more effective in breeding about advantageous changes in the characters (Edwards *et. al.*, 1976).

Successful breeding programs need continuous information on the genetic variation and systems governing grain yield and its components. Contradictory results were obtained by several authors with respect to genetic systems governing wheat grain yield and its components. For instance, Uddin and Joarder (1987), Hendawy (1990) and Ikram and Tanah (1991) indicated that, additive and non-additive gene effects played equal roles in the inheritance of grain yield, number of spikes/plant, number of kernels/spike and kernel weight. Morover, El-Hennawy (1992) revealed that additive and dominance gene effects were important for grain yield and number of kernels/spike. Furthermore the results obtained by Mohammed (1999) from eight wheat genotypes revealed that, additive and non-additive gene effects were controlling the genetic systems of grain yield and its components. In addition, El-Sayed *et. al.* (2000) and Mostafa (2002) found that both additive and dominance variances were significant for number of spikes/plant, number of kernels/spike, kernel weight and grain yield/plant. Similarly, Hamada and Tawfelis (2001) showed that additive and non- additive gene effects had important roles in controlling the genetic system for plant height, number of spikes/plant, number of kernels/spike, kernel weight and grain yield/plant.

On the other hand, Sharma and Smith (1986) as well as Salem and Hassan (1991) found that non-additive gene effects were more important in the inheritance of grain yield/plant and number of spikes/plant. Similarly, Dawam and Hendawi (1990), and Darwish (1992) found that dominance gene effects were significant for grain yield/plant, number of kernels/spike and kernel weight. Reversely to that, Mekhamer (1995) reported that additive gene effects were significant for number of kernels/spike and kernel weight. On the other side, El-Sayesd *et. al*. (2000), Ashoush *et al* (2001) and Abd El-Hameed (2002), found that GCA and SCA were significant for days to heading, maturity , plant height, number of spikletes/spike and flag leaf area.

The main objectives of this investigation were to study the effect of general and specific combining ability, and inbreeding depression in a six parental diallel cross of bread wheat .

MATERIALS AND METHODS

This study was conducted at Bahteem Agricultural Research Station, Agricultural Research Center (ARC), during the three successive growing seasons 2007/2008, to 2009/2010. Four bread wheat cultivars and two promising lines representing a wide range of genetic variability were selected for this study, however, names and pedigrees of these genotypes presented in Table 1.

Table 1. Names and Pedigrees of Six Parents of Bread Wheat .

No.	Name	Cross and Pedigree	Origin
P_1	Sids 1.	HD 2172/Pavon"s"/1158.571 Maya 74 "s"	Egypt
P_2	Giza 168	MRL/BUC//Seri.	Egypt
P_3	Sakha 94	Sakha 92/ TR810328	Egypt
P_4	Gemmeiza9	ALD "S"/HAVAC "S"//CMH74A.630/SX	Egypt
P_5	Lien 5.	MIANYANG 20-2CHN-0CHN-0ET.	Mexico
P_6	Line 42	2V879. C8.11//V979/3/STAR/4/STAR CMSS92Y01815T-20Y-010M-010Y-9M-0Y0-0ET	Mexico

In 2007/2008 season , all possible crosses (without reciprocals) among the six parents under study were made . In the second season, (2008/2009), the 21 entries (15 F_1's and 6 parents) were planted in the field using the randomized complete block design (RCBD) with three replications according to Steel and Torri (1980). Also, some of F_1plants were selfed to obtain F_2 seeds. In 2009/2010, season parents, $F_{1.}$and F_2 were planted in the field using RCBD with three replications. Each entry was planted in a plot of three rows; for parents and $F_{1.}$ and ten rows for F_2 . Every row was 3.0 m long and 30 cm apart, and contained 15 seeds spaced 20 cm apart . Data were recorded on a random sample of 10 guarded plants from each row. number of spikes/plant SP/Pl, number of kernels/spike (No. kl/s), 100- kernel weight (k.wt), and grain yield/plant (Gy/pl).

The analysis of variance for combining ability effects was calculated according to Griffing (1956). Inbreeding depression, (the converse of heterosis that reflects deteration accompanying inbreeding through the successive generations of selfing) was calculated by the the difference between F_1 and F_2 generation means as percent of F_1 mean.

RESULTS AND DISCUSSION

Analysis of variance for all studied characters (plant height, number of spike/plant, number of kernels/spike, kernel weight and grain yield/plant), for F_1 is presented in Table (2). Analysis indicated that the mean squares of genotypes were significant for all studied characters in the F_1 expet for kernel weight. suggesting the presence of true differences among genotypes. Mean squares due to genotyps were significant for all studied characters. Table (2) shows the results of the analysis for GCA , SCA. and the GCA/SCA ratio. The variance associated with GCA was significant in all studied characters in the F_1 except for no.spikes/plant . The same level of significance was found in most cases for SCA for all studied characters except for plant height and kernal weight, in the F_1. Thus both GCA and SCA revealed the presence of both additive and dominance types of gene effects for most characters. From Table 2, it could be noticed that GCA was relatively larger than SCA for the studied characters except for number of spikes/plant and grain yeld/plant in the F_1 The ratio of GCA/SCA suggested a predominant role for additive type of gene action for these characters and that selection in early generation could be successful.

Table 2. Mean squares from ANOVA and combining ability analysis in the F1 generation of wheat crosses .

Source	d.f	Plant height (cm)	No.of Spikes /plant.	No. of Kerneles /spikes	100-Kernels Weight (gm)	Grain yield/plant (gm)
F_1						
Genotypes	20	121**	57.35**	114.67*	0.545	1728.55*
GCA	5	183.58*	53.99	131.11*	1.2523*	934.37*
SCA	15	101.38	58.47*	109.16*	0.309	1993.27*
Error	40	4.485	2.14	5.96	0.104	41.058
GCA/SCA		1.811	0.923	1.202	4.074	0.469

* Significant at 5% level of probability

Genotypes performancce

The mean performance of six wheat parental genotypes in the F_1 and F_2 generations are presented in Table (3) and Table (4) , respectively. It is obvious that the cultivar Giza 168 (P_2) ranked first for, noumber of spike/ plant and grain yield/plant. Morever, the cultivar, Sakha 94 (P_3) ranked the first for number of kernels/spike while, line 5 (P_5) ranked the first for kernel weight.

The mean performance of tested crosses is presented in Table (3). The four crosses (P_2xP_4), (P_2xP_5) and (P_3xP_6) were the highest number of spikes/plant , while the four crosses (P_1xP_2), ((P_2xP_4), (P_2xP_5) and (P_3xP_6) gave the heighest number of kernels /spike. The heaviest kernel weight was obtained from the crosses (P_2xP_4) and (P_2xP_3). On other hand, the highest grain yield /plant resulted from the crosses(P_4xP_6), (P_2xP_5) , (P_2xP_6) . P_2 and P_4 are considered good combiners and had the best yielder and surpassed all other crosses significantly. It was obvious that genes for higher yield were transmitted from P_2 with a transgressive increase than that parent. In addation, Besides, P_4 seems to be good combiner for grain yield based on kernel weight.

Table 3. Mean performanceof parents and F1 for the studied characters.

Genotyupes	**Pl- H (cm)**	**No.of SP/p**	**No. K /SP**	**100 K.wt (gm)**	**G.Y /Pl. (gm)**
P1 (Sids1)	104.0	20.3	72.0	3.8	63.0
P2 (Giza 168)	118.0	25.0	79.0	4.9	82.6
P3 (Sakha94)	102.3	22.0	81.3	4.5	62.3
P4 (Gem. 9)	107.0	22.3	74.7	4.3	41.6
P5 (Line5)	110.0	22.0	65.3	5.4	45.7
P6 (Line42)	107.7	21.3	64.0	5.1	53.7
P_1 x P_2	116.3	24.6	76.0	4.9	64.0
P_1 x P_3	111.0	24.7	73.3	4.3	67.3
P_1 x P_4	113.0	21.7	76.3	4.3	61.7
P_1 x P_5	115.0	22.0	89.7	4.4	71.3
P_1 x P_6	111.0	28.0	72.7	4.2	76.7
P_2 x P_3	115.0	25.7	75.33	5.1	62.3
P_2 x P_4	114.0	34.6	86.6	5.5	82.0
P_2 x P_5	125.0	32.0	81.0	4.9	119.0
P_2 x P_6	111.	28.0	77.6	4.7	115.7
P_3 x P_4	124.0	20.0	72.7	4.5	79.6
P_3 x P_5	116.6	29.0	72.0	4.4	64.7
P_3 x P_6	99.6	26.3	80.3	4.9	123.0
P_4 x P_5	115.7	30.6	74.6	4.9	115.3
P_4 x P_6	109.3	21.3	72.6	4.6	59.7
P_5 x P_6	116.7	30.7	69.7	4.5	59.3
L.S.D at5%	**3.50**	**2.64**	**4.41**	**0.58**	**9.88**

*, Significant at 5% level of probability.

Table 4. Mean performance of parents and F2 for the studied characters.

No.	Genotypes	Plant Height (cm)	No. SP./Pl.	No. K /SP	100 K.wt (gm)	G.Y /Pl (gm)
1	P1(Sids 1)	108.0	20.6	71.0	4.1	65.3
2	P2(Giza 168)	117.3	24.0	78.3	4.8	84.0
3	P3(Sakha 94)	105.0	21.0	77.3	4.7	64.0
4	P4(Gem. 9)	106.3	18.0	75.3	4.2	40.0
5	P5(Line 5)	107.6	23.3	61.3	3.8	48.3
6	P6(Line 42)	104.3	21.6	64.6	4.3	55.3
7	P_1 x P_2	90.3	21.3	64.0	4.7	54.3
8	P_1 x P_3	98.6	24.3	62.7	4.1	49.0
9	P_1 x P_4	93.3	20.3	56.3	3.6	38.0
10	P_1 x P_5	101.3	18.0	73.0	3.4	62.0
11	P_1 x P_6	105.3	24.4	54.7	3.5	61.0
12	P_2 x P_3	116.7	22.7	50.3	3.6	43.3
13	P_2 x P_4	104.7	25.3	74.7	4.3	57.7
14	P_2 x P_5	111.0	23.0	54.7	4.4	68.3
15	P_2 x P_6	107.7	17.0	51.7	4.0	62.3
16	P_3 x P_4	103.7	23.0	55.3	4.1	53.0
17	P_3 x P_5	102.3	21.7	61.0	3.7	48.3
18	P_3 x P_6	105.3	17.6	58.7	40	48.7
19	P_4 x P_5	102.3	19.0	55.3	4.0	43.0
20	P_4 x P_6	101.0	21.3	51.3	4.2	46.0
21	P_5 x P_6	102.7	19.0	51.0	4.3	45.0
L.S.D 5%		**5.85**	**3.04**	**6.26**	**0.479**	**8.62**

*, Significant at 5% level of probability.

Inbreeding depression

Estimates of inbreeding depression reported in Table (5) were in different directions (positive and negative), in all characters. This may be attributed to the dominance type of gene action controling these characters, especially in number of spikes/plant and number of kernels per spike. Results of Inbreeding depression in F_2 generation for plant height showed that eight progenies gave positive depression ranged from 11.2 -28.79. For yield and its components most of these crosses showed postive inbreeding depression in 10, 11,7 and 7 ranged from (13.41-39.29), (21.31-59.33), (16-28-72.91) and (22.94-59.71)for number of spikes/plant, number of kernels per spike, 100- number of kernel weight and grain yield/plant, respectively. The data were in harmony with those obtained by several workers. Hamada and Tawfeleis (2003)

Table 5. Inbreeding depression% in F_2 for different characters

Genotypes	Plant height	No. SP./Pl.	No. K /SP	100 K.wt	G.Y /Pl.
P_1 x P_2	28.79*	13.41*	15.79*	4.26	15.16
P_1 x P_3	12.57*	1.62	14.53*	4.65	27.19
P_1 x P_4	21.11*	6.45	17.82*	16.28*	38.41*
P_1 x P_5	5.40	18.18*	59.3*	22.72*	13.04
P_1 x P_6	-1.48	12.86*	-0.41	16.67*	23.11
P_2 x P_3	8.77	11.67	27.39*	29.41*	30.49*
P_2 x P_4	11.20*	26.87*	41.92*	72.91*	2963
P_2 x P_5	3.23	28.13*	7.70	10.20	42.61*
P_2 x P_6	16.37*	39.29*	29.51*	14.89	46.15*
P_3 x P_4	-5.41	-15.0	28.19*	8.88	33.42*
P_3 x P_5	-5.72	19.63*	23.19*	15.91	25.35
P_3 x P_6	11.91*	33.08*	31.13*	18.37*	52.71*
P_4 x P_5	7.32	37.91*	21.31*	18.37*	59.71*
P_4 x P_6	0.0	0.0	2.83	8.70	2.94
P_5 x P_6	11.99*	38.11*	26.82*	4.44	24.11

Estimates of general combining ability effects for parents are presented in Table (6). High significant positive values would be of great interest in allstudied characters except for plant height where significant negative values would be more useful for the breeders point of view. Results indicated that the cultivar (Giza 168) P_2 is a good combiner for all studied characters while the (line 5) P_5 is the best combiner for plant height, number of spikes/plant and kernel weight and kernal weight . Moreover (line 42) P_6 showed significant general combining ability effect for grain yield/plant

Specific combining ability was calculated for each cross and presented in Table (7) . The crosses, (P_1x P_2), (P_1x P_3), (P_1x P_4), (P_1x P_5), (P_1x P_6) (P_2x P_5), (3_2x P_4)and (P_5xP_6) should significant specific combining ability effects for plant height. Also, crosses number 9,5 and 6 showed significant specific combining ability effects for number of spikes/plant, number of kernels/spike, kernel weight and grain yield/plant respitively. The crosses(P_2 xP_5) , (P_4x P_5) and **(**P_3xP_6) are considered promising for grain yield improvement as they sowed high specific combining ability effects. In such hybrids, desirable transgressive segregates would be expected in the subsequent generations.

Moreover GCA/SCA ratio was more than unity for plant height, number of kernels/spike and karnel weight, while, it was less than umtiy for number of spikes/plant and grain yield/plant proving that both additive and dominance genes, have considerable roles in the inheritance of these characters.

In concluion , cultivr Giza 168 is a good combiner for all studied characters while, line 5 is the best combiners for plant height, number of spikes/plant and kernel weight. Moreover, line 42 showed high general combining ability effect for grain yield/plant. These results may be useful to wheat breeders in making the proper decision for future crossing plans.

Table 6. Estimates of general combining ability (GCA), effects of wheat parants from F_1 diallel crosses.

S . of .v	**Plant height**	**No. SP./Pl.**	**No. K /SP**	**100-K.wt**	**G.Y /Pl.**
F_1 Hybrid					
P_1	-1.667*	-2.86*	0.375	-0.389*	-7.014
P_2	3.833*	1.806*	3.375*	0.278*	10.611*
P_3	-2.083*	-0.444*	0.917	-0.060	-0.264
P_4	0.292	0.028	0.333	-0.043	-5.264*
P_5	2.667*	1.264*	-1.417	0.153*	-0306
P_6	-3.042*	-0.111	-3.583*	0.061	2.236*
L.S.D 5%					
Gi	1.156	0.074	2.027	0.1 03	1.426
Gi-Gj	1.374	0.179	2.1 97	0.008	3.422

* Significant at 5% level of probability.

Table 7. Estimates of specific combining ability (SC A effects for all the studied characters in the hybids.

Genotypes	Plant height	No. SP./Pl.	No. K /SP	100 K.wt	G.Y /Pl.
P_1 x P_2	1.643*	-0.589	-3.321	0.290*	-14.42*
P_1 x P_3	2.226*	1.661*	-3.530	0.028	-0.214
P_1 x P_4	1.851*	-1.756	0.054	0.011	-0.881
P_1 x P_5	1.476*	-2.714	15.137*	-0.018	3.827
P_1 x P_6	3.185*	4.661*	0.304	0.093	6.619
P_2 x P_3	0.726	-1.631	-4.530	0195	-22.83*
P_2 x P_4	-2.649*	6.619*	7.387*	0.611*	1.82
P_2 x P_5	5. 976*	2.994*	3.470*	-0.801*	34.20*
P_2 x P_6	-1.982*	0.369	2.304	-0.293*	27.99*
P_3 x P_4	13.268*	3.536*	-4.155*	-0.080	10.36*
P_3 x P_5	3.560*	0.577	-3.071	-0.380	9.58*
P_3 x P_6	-7.732*	0.619	7.429*	0.245	46.20*
P_4 x P_5	0.185	3.494*	0.179	0.136	46.07*
P_4 x P_6	-0.440	-4.798*	-0.321	-0.720*	-12.13
P_5 x P_6	4.518*	7.9118	-0.905	-0.435	-17.42
L.S.D 5%					
S ii	0.801	0.383	1.065	0.018	7.332
Sij – Sik	2.616	1.249	3.47	0.060	17.50
Sij –Skl	2.243	1.071	2.98	0.512	15.2

*, Significant at 5% level of probability.

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تحليل بعض هجن قمح الدائرية للمحصول ومكوناته

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قسم بحوث القمح – معهد بحوث المحاصيل الحقلية – مركز البحوث الزراعية

أجرى تقييم الهجن الدائرية فى اتجاه واحد لستة تراكيب وراثية من قمح الخبز (صنف سدس 1) و(الصنف جيزة 168) و(الصنف جميزة 9) و(الصنف سخا 94) و(السلالة 5) و(السلالة 42) بمحطة البحوث الزراعية بهتيم لتقدير القدرة العامة والخاصة على الائتلاف فى الجيل الأول والتعرف على العوامل الوراثية التى تتحكم فى صفة المحصول ومكوناته ويمكن تلخيص النتائج كمايلى:-

وذلك لتقدير القدرة العامة والخاصة على الائتلاف فى الجيل الاول وتاثير التربية الداخلية والتعرف على العوامل الوراثية التى تتحكم فى المحصول ويمكن تلخيص النتائج كالاتى:

- كانت كل من القدرة العامة والخاصة على الائتلاف عالية المعنوية فى جميع الصفات فى الجيل الاول مما يؤكد اهمية الفعل المضيف والسيادى فى وراثة الصفات المدروسة
- اعطى الاب جيزة 168 قوة ائتلاف عالية بالنسبة للصفات المدروسة والسلالة 5 للطول وعدد السنابل ووزن الحبوب والسلالة 42 للمحصول ويمكن استخدام هذه الأباء فى برنامج تربية القمح وبالنسبة للقدرة الخاصة على الائتلاف اعطت الهجن (P1 XP6) (P2XP6) (P2XP3) أفضل النتائج.
- اظهرت النتائج وجود تاثير للتربة الداخلية فى ثلاث تراكيب وراثية ذات معنوية عالية لصفة محصول النبات مما يدل على إمكانية الاستفادة من هذه الهجن فى الحصول على قوة الهجين فى
- قياس القدرة العامة على الائتلاف كانت اكبر من قياس القدرة الخاصة على الائتلاف فى بعض الصفات مما يدل على اهمية الفعل الجينى المضيف فى توارث هذه الصفات.