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Genetic Analysis for Yield and its Components in Bread Wheat

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ABSTRACT

Eight bread wheat cultivars were used to study some earliness and yield and its component traits. The parental cultivars were employed to produce 28 F_1 hybrids following 8 x 8 half Diallel crossing without reciprocals. The seeds of 28 F_1 hybrids and their parents were planted to estimate mean squares due to parents and their crosses which were significant for all studied traits. The parental variety P_3 was the best parent for earliness. However, P_8 was the best for remained traits. The crosses (P_1 x P_4) and (P_2 x P_4) were the best combinations for earliness traits, while the six crosses were the best for remained traits. Highly significant negative desirable heterotic effects were detected for earliness, on the contrary for remained traits relative to mid and better parent. The mean squares associated with general and specific combining abilities detected significant and highly significant estimates for all studied traits. Results indicated that P_4 (Sids12) was good combiner for earliness traits and most of yield and its component traits. The best cross combinations displayed fair amount of SCA effect were obtained from (P_2 x P_4) and (P_4 x P_5) for earliness traits, the six crosses for remained traits. The graphical analysis Wr/Vr indicated the importance of over dominance gene effects in controlling all traits. The results indicated the importance of additive and dominance genetic variances in controlling these traits. The "a" item was significant for most studied traits and more than "b" item. Narrow sense heritability was less than (0.50) for all traits except plant height trait (0.80). Positive alleles were not equally distributed among parents ($H_2/4H_1 \neq 0.25$) for all studied traits. The magnitude of dominance (H_1/H_2) was significant or highly significant higher than additive components (D) for all traits, expect plant height trait. All estimates of environmental variance (E) were positive significant and highly significant for all studied traits indicating that all studied traits have greatly affected by environmental factors.

Keywords: Genetic analyses, bread wheat, mean performance, analysis of variance, heterosis, GCA, SCA, heritability, graphic analysis, Hayman analysis and Jones analysis.

INTRODUCTION

Wheat (*Triticum aestivum*, L.) is considered as one of the major cereal crops in Egypt, as well as, in many parts all over the world which used in human food and animal feed. Wheat seed-storage proteins according to their solubility properties are traditionally classified into four classes: albumins, globulins, prolamins and glutelins. Gluten, the most abundant wheat endosperm protein, is a large complex mainly composed of polymeric and monomeric proteins known as glutenins and gliudins, respectively (Mac Ritchie, 1994).

Recently, under Egyptian conditions increasing wheat yield and its production is considered as one important strategy goals to minimize the great gab between production and consumption that reached 55% especially under the increase in population size than production. Solving these problems need to increase total wheat yield by producing highly productive varieties. This could be achieved by exploring maximum genetic potential from available wheat germplasm, through heterosis, heritability in broad and narrow senses, general and specific combining abilities. Development of hybrid wheat can play a great role in this respect because hybrid crops are more uniform in maturity and vigorous in most cases.

Heterosis is a complex genetically phenomenon which depends on the balance of different combinations of gene effects as well as the distribution of plus and minus alleles in the parents of a mating. So, heterosis is considered as the best tool to increase or break the yield barriers (Kumar *et al.,* 2011).

Heritability estimates are variable breeding parameters for determining the magnitude of genetic gain for selection. Then indicate higher importance of genetic effects in controlling the inheritance of economic traits. A genetic component of variation is considered as an important parameter which can be used in conjunction with heritability (El-Marakby *et al.,* 1993 and Adhiena Mesele *et al.,* 2016).

Gene action is important in determining breeding methodology used to develop cultivar type (hybrid, pure line, synthetic, etc.). Diallel cross mating designs are mostly used to provide information on genetic effects for a number of parental variation or estimates of general and specific combining abilities, variance components and heritability for plant population from randomly chosen parental varieties (Sadeghi *et al.* 2013).

Combining ability analysis is the most widely used biometrical tool for giving an indication of the relative magnitude of genetic variance. These also provide a guide line for selection elite parents and desirable cross combinations to be used in formulation of a systematic breeding project for rapid improvement (Dhonkshe and Rao, 1979).

Therefore, the objectives of the present investigation are to study:

1- Mean performance of the eight tested wheat varieties (parents) and their 28 F_1 hybrids for earliest trait and yield and yield components in 2013/2014 season.
2- Heterosis effects over mid-parent and better parent.
3- Estimation of general and specific combining abilities variances according to Griffing (1956).
4- Separating out the type of gene effects using analysis of variance of half Diallel technique of Jones (1956) (first degree statistics).
5- Partitioning the total genetic components of variation to its separate parts of additive and dominance gene effects using Diallel analysis technique of Hayman (1954a and b) (second degree statistics).

MATERIALS AND METHODS

This research was carried out at the experimental farm of Tag El-Ezz Agricultural Research Station, El-Dakahlia Governorate, Egypt during the two wheat growing seasons of 2012/2013 and 2013/2014. The experimental materials comprised of eight wheat cultivars and their 28 F_1 hybrids which genetically differ in their earliness and yield and its components.

Thess eight parental cultivars were employed to produce 28 F_1 hybrids following 8 x 8 half Diallel crossing without reciprocals during winter wheat growing season of 2012/2013. The seeds of the 28 F_1 hybrids and their parents were planted and evaluated in wheat growing season of 2013/2014. Single row of 1.5 meter length was kept as an experimental unit at evaluation season. The parents and their crosses were assigned at random to the experimental units in each replication. Inter-plant and inter-row distances were maintained 10 and 20 cm, respectively.

The names, pedigree and their origins of the eight tested wheat cultivars are presented in Table 1.

Table 1. The names, pedigree and origin of the tested wheat cultivar.

Cultivars	Pedigree	Origin
Giza 168	MRL/BUC//SERI.	Egypt
Misr1	OASIS/SKAUZ//4*BCN/3/2*PASTOR. CMSSO0Y0 1881T-050M-030Y-030M-030WGY-33M-0Y-0S.	Egypt
Sakha93	SAKHA 92/TR 810328.	Egypt
Sids12	BUC//7C/ALD/5/MAYA74/0N//1160-47/3/BB// GLL/4/CHAT.	Egypt
Sakha94	OPOTA/ RAYON // KAUZ. CMBW90Y3180-0TOPM-3Y-010M-010M-010Y"6M-05".	Egypt
Misr2	SKAUZ/BAV92. CMSS96 M036115-1M-010SY-010M-010SY.	Egypt
Gemmeiza9	ALD "S"/HUA"S"//CMH74A.630/SX.	Egypt
Gemmeiza10	MAYA74"S"/ON//1160-147/3/BB/GLL/4/CHAT.	Egypt

Heterosis percentage in F_1 was calculated according to the two following formulas (Mather and Jinks, 1982).

Heterosis (H) as percent deviation from the mid-parent:

$$H(\overline{MP}\,\%) = (\overline{F}_1 - \overline{MP})/\overline{MP} \times 100$$

Heterosis (H) as percent deviation from the better parent:

$$H(\overline{BP}\,\%) = (\overline{F}_1 - \overline{BP})/\overline{BP} \times 100$$

The appropriate L.S.D. values were computed using F formula to test the significance of heterotic effects.

L.S.D for mid-parent heterosis (F-$\overline{MP}$):

$$\text{L.S.D.} = t_{0.05} \times \sqrt{\frac{3\ MSe}{2\ r}}$$

$$t_{0.01} \times$$

L.S.D for better parent heterosis (F-$\overline{BP}$):

$$\text{L.S.D.} = t_{0.05} \times \sqrt{\frac{2\ MSe}{r}}$$

$$t_{0.01} \times$$

The parents were subjected to techniques described by Steel and Torrie (1980). A Randomized Complete Blocks Design was used. The data were obtained and analyzed according to Griffing (1956); Jones (1956) and Hayman (1954a and b) (One set of parents and their F_1 hybrid excluding reciprocals). The following traits were studied:

A) Earliness:

1. Days number to heading (days).
2. Days number to maturity (days).

B) Yield and yield components:

1. Plant height (cm).
2. Number of spikelets /spike.
3. Spike length (cm).
4. Grains weight/spike (g).
5. Spike density.
6. Number of grains/spike.
7. Number of spikes/plant.
8. 10. 1000-grain weight (g).
9. 11. Grain yield / plant (g).

RESULTS AND DISCUSSION

Mean performance

The mean performances of the eight parental varieties and their 28 F_1 hybrids are presented in Table 2. The parental variety P_3 was the earliest in days to heading and days to maturity. However, P_8 recorded the highest mean values for the spikelets number/spike and spike density, as well as, the heaviest in 1000-grain weight. The parental variety P_6 had the tallest plant (undesirable) and the longest spike (desirable) as well as gave the heaviest grain weight/spike. The parental variety P_4 gave more grain yield/plant.

The two crosses P_1 x P_4 and P_2 x P_4 were the best for number of days to heading and maturity, three crosses P_3 x P_8; P_5 x P_8 and P_4 x P_8 for plant height, seven crosses P_1 x P_8; P_6 x P_7; P_3 x P_7; P_6 x P_8; P_1 x P_7; P_5 x P_7 and P_4 x P_7 for spikelets number/spike, three crosses P_1 x P_8; P_5 x P_7 and P_2 x P_7 for spike length, six crosses P_3 x P_8; P_6 x P_7; P_4 x P_8; P_2 x P_3; P_5 x P_8 and P_5 x P_6 for spike density, three crosses P_6 x P_7; P_2 x P_4 and P_4 x P_7 for grains weight/spike, five crosses P_6 x P_8; P_5 x P_7; P_4 x P_8; P_3 x P_6 and P_5 x P_6 for spike number/plant, five crosses P_4 x P_7; P_2 x P_4; P_4 x P_8; P_3 x P_6 and P_1 x P_4 for grains number/spike, two crosses P_6 x P_7 and P_2 x P_7 for 1000-grain weight and the two crosses P_4 x P_7 and P_4 x P_8 for grain yield/plant. Similar results were obtained by Hendway *et al.*, (2009); Sulaiman (2011); Abd El-Lateef (2012); Bhuri Singh and Upadhyay (2013); Hussain *et al.*, (2013); Abd El-Raheem (2014) and Baloch *et al.*, (2016).

Analysis of variance

Mean squares due to parents were highly significant for all studied traits (Table 3). These results indicated that the parental varieties differed in their mean performance in all studied traits. The differences between each of the partitioning components namely genotypes, parents, crosses and parents *vs.* crosses as indication of herterosis over all crosses were also highly significant relative to all earliness, yield and its components. These results could be attributed to the genetic constitutions of the parents, as well as, the differences in diallel crosses. This may be due to a wide range of variability in the parents. Similar results are in accordance with this reported by El-Hawary (2006); Aboshosha and Hammad (2009); Hendawy *et al.*, (2009); Gebrel (2010); Kumar *et al.*, (2011) and Abd El-Lateef (2012).

Table 2. Mean performances of eight parental wheat varieties and their 28 F_1 hybrids for all studied traits in 2013/2014 season.

Traits Genotypes	Days to heading	Days to maturity	Plant height (cm)	Spikelets number/ spike	Spike length (cm)	Spike density	Grains weight/ spike(g)	Spike number /plant	Grains number /spike	1000-grain weight (g)	Grains yield/ plant(g)
P1	101.33	157.00	106.00	24.67	12.29	1.59	2.62	21.07	73.20	28.27	28.42
P2	103.67	154.67	102.30	21.87	11.41	1.71	2.84	17.20	63.00	32.27	28.28
P3	99.33	151.00	91.79	22.53	11.56	1.28	2.19	12.84	61.58	25.82	18.29
P4	102.33	154.33	102.84	24.71	12.99	1.62	3.54	12.09	85.96	34.84	42.35
P5	106.67	155.33	107.92	19.20	11.61	1.66	2.59	12.89	65.40	26.49	23.16
P6	108.67	158.33	114.70	25.00	13.81	1.68	4.09	20.27	75.73	34.80	36.27
P7	109.33	159.00	109.33	25.05	12.52	1.69	2.64	12.42	65.97	33.21	30.10
P8	109.67	157.33	93.47	25.27	9.25	1.85	2.62	20.67	71.77	37.00	32.86
P1 x P2	99.33	154.33	103.50	22.32	13.26	1.92	2.76	23.40	72.80	38.73	48.14
P1 x P3	97.67	154.33	94.72	24.40	13.77	1.77	2.61	22.87	68.67	35.33	40.94
P1 x P4	96.00	151.33	105.11	24.80	14.89	1.74	3.75	16.07	90.00	40.87	49.40
P1 x P5	99.33	154.33	104.72	25.33	13.69	1.77	3.47	23.33	84.67	35.60	52.51
P1 x P6	100.67	153.33	111.18	25.80	13.16	1.57	3.29	21.53	82.80	35.00	45.54
P1 x P7	104.33	156.00	109.95	26.63	14.72	1.86	3.06	19.67	77.35	37.27	47.57
P1 x P8	103.33	155.33	97.85	28.60	17.32	1.85	3.45	19.87	83.33	39.60	50.61
P2 x P3	104.67	156.00	96.00	24.87	13.22	2.03	2.59	21.13	62.13	37.87	41.12
P2 x P4	96.33	152.67	105.89	24.73	14.39	1.73	4.35	15.27	92.93	42.73	52.19
P2 x P5	100.33	153.67	106.92	23.73	13.95	1.78	3.34	19.87	76.00	40.07	47.63
P2 x P6	103.00	154.33	104.97	25.07	13.39	1.84	3.47	21.47	78.93	39.93	53.78
P2 x P7	104.00	156.00	106.11	25.40	15.58	1.74	3.64	20.20	73.07	47.67	51.73
P2 x P8	103.33	156.67	98.33	24.33	12.49	1.90	3.26	18.47	73.27	37.43	41.63
P3 x P4	99.67	153.67	102.33	24.87	14.52	1.72	3.12	16.67	79.00	37.00	48.33
P3 x P5	99.33	155.00	104.27	25.07	14.61	1.72	3.59	16.60	71.67	33.73	45.79
P3 x P6	103.67	155.33	101.89	24.53	13.77	1.77	2.89	24.80	90.60	38.13	53.28
P3 x P7	103.33	154.67	98.89	26.73	15.48	1.85	3.29	20.80	78.93	35.33	41.57
P3 x P8	102.67	154.33	91.81	25.73	13.15	2.24	2.99	15.47	78.40	35.73	32.97
P4 x P5	103.00	151.00	104.56	24.38	13.11	1.85	3.29	18.25	83.89	38.80	51.20
P4 x P6	103.33	157.00	106.11	25.13	14.17	1.87	3.89	20.80	88.53	40.67	58.65
P4 x P7	103.33	155.33	105.36	26.03	15.25	1.79	4.35	19.53	94.62	41.56	70.07
P4 x P8	102.33	155.00	93.42	24.44	13.60	2.09	3.83	24.80	92.60	42.13	63.85
P5 x P6	105.33	156.33	112.67	24.62	13.14	1.95	3.39	24.36	87.49	38.71	54.17
P5 x P7	103.67	156.67	104.83	26.62	16.32	1.73	3.75	25.52	77.37	37.45	49.27
P5 x P8	103.67	154.67	92.65	25.13	13.41	1.99	2.94	16.87	73.67	37.13	47.48
P6 x P7	103.67	156.67	105.67	27.50	14.27	2.16	4.66	19.94	90.00	47.72	53.00
P6 x P8	103.00	155.33	98.57	26.67	15.34	1.86	3.64	26.32	74.88	39.04	50.15
P7 x P8	104.33	157.00	95.89	25.38	13.70	1.95	3.41	16.98	86.79	41.71	39.46
LSD5%	2.55	2.44	2.37	2.03	1.94	0.21	0.64	3.89	9.65	4.16	6.73
LSD1%	3.38	3.24	3.14	2.70	2.58	0.28	0.85	5.17	12.82	5.52	8.94

Table 3. Mean square of the analysis of variance for some earliness yield and yield component traits all genotypes.

S.O.V	Df	Days to heading	Days to maturity	Plant height (cm)	Spikelets number/ spike	Spike length (cm)	Spike density	Grains weight/ spike(g)	Spikes number/ plant	Grains number/ spike	1000-grain weight(g)	Grains yield/ plant(g)
Total	107	11.89	5.36	37.87	4.00	3.44	0.04	0.45	19.23	114.81	27.52	129.71
Genotypes	35	29.64**	10.13**	109.97**	8.01**	6.69**	0.09**	0.97**	42.84**	255.06**	66.57**	361.73**
parents	7	47.61**	20.18**	182.18**	14.02**	5.50**	0.08**	1.14**	49.12**	196.01**	52.98**	166.87**
Crosses	27	19.43**	7.19**	94.24**	4.55**	3.68*	0.06**	0.75**	30.56**	202.92**	34.21**	165.65**
P *vs.* C	1	179.52**	18.89*	29.33**	59.14**	96.42**	0.94**	5.44**	330.39**	2076.36**	1035.47**	7020.04**
Replica.	2	3.34	4.73	3.26	1.31	0.59	0.01	0.015	12.55	38.32	3.30	11.08
Error	70	3.26	2.99	2.81	2.07	1.89	0.02	0.204	7.61	46.87	8.68	17.10

***, ** = Significant at 0.05 and 0.01 levels of probability, respectively.**

Mean squares due to crosses were highly significant for all studies traits except for spike length (cm) which showed clear significant differences. The differences due to parents *vs.* crosses were also highly significant for all studied traits, except for days to maturity which gave clear significant differences. Similar results were reported by Moshref (2006) and Sulaiman (2011).

Heterosis effects

The results of heterosis effects over both mid-parent and better parent are presented in Tables 4 and 5, significant and highly significant negative desirable heterosis for days to heading relative to mid-parent in 16 crosses and six for better parent for the same trait. The maximum negative values of heterosis were -6.47% and -5.86% for the cross P_2 x P_4 over the mid-parent and better parent for days to heading, respectively. Negative and significant heterosis for days to maturity in the two crosses P_1 x P_4 and P_4 x P_6 over mid-parent. Highly significant negative heterosis for plant height is desirable. Eight crosses exhibited highly significant negative heterosis relative to mid-parent, while, two crosses possessed exhibited significant negative heterosis relative to respective better parent. Positive heterosis for spikelets number/spike is desirable. Twenty three crosses expressed highly significant positive heterotic effects relative to mid-parent, while 11 crosses showed highly significant positive heterotic effects relative to better parent. For spike length, 27 crosses expressed highly significant positive heterotic effects relative to mid-parent, while 22 crosses showed highly significant positive heterosis effects relative to better parent. Similarly, positive and highly significant heterotic effects for spike density are desirable. Twenty seven crosses expressed highly significant positive heterotic effects relative to mid-parent and better parent for spike density are desirable. Positive and highly significant heterotic effects for grains weight/spike are desirable. Twenty five crosses expressed highly significant positive heterotic effects relative to mid-parent. However, 17 from the previous crosses showed highly significant positive heterotic effects relative to better parent. For spikes number/plant, 22 crosses expressed significant and highly significant positive heterotic effects relative to mid-parent, while 16 crosses out of them showed highly significant heterotic effects relative to better parent. Positive heterosis for grain number/spike is desirable in this respect, 18 crosses expressed significant and highly significant positive heterotic effects relative to mid-parent, while eight from the tested crosses showed highly significant heterotic effects relative to better parent. All tested crosses expressed significant and highly significant positive heterotic effects for 1000-grain weight relative to mid-parent. However, 22 from the previous crosses showed highly significant positive heterotic effects relative to better parent. Heterosis was highly significant positive for grain yield/plant in all crosses over mid-parent. In the same time, 27 from the previous crosses showed highly significant positive heterotic effects over better parent.

Finally, heterosis estimates indicated that, the best crosses over their mid and better parents were Giza168 x Sids12 (P_1 X P_4), Giza168 x Sakha94 (P_1 X P_5), Giza168 x Gemmeiza10 (P_1 X P_8), Misr1 x Sakha94 (P_2 X P_5), Sakha93 x Misr2 (P_3 X P_6), Sakha94 x Misr2 (P_5 X P_6), Sakha94 x Gemmeiza9 (P_5 X P_7), Misr2 x Gemmeiza9 (P_6 X P_7) and Gemmeiza9 x Gemmeiza10 (P_7 X P_8). Similar results also, found by Moshref (2006); El-Borhamy *et al*., (2008); Mekhamer (2009); Akbar *et al*., (2010); Kumar *et al*., (2011); Sulaiman (2011); Hussain *et al*., (2013); Pankaj Garg *et al*., (2015); Said Salman *et al*., (2015); Baloch *et al*., (2016) and Hei *et al*., (2016).

Table 4. Heterotic effects as percentage over both mid-parent (M.P) and better parent (B.P), for all stutied traits of the 28 F_1 hybrids in 2013/2014 season.

Hybrids	Days to heading		Days to maturity		Plant height (cm)		Spikelets number/spike		Spike length (cm)		Spike density	
	M.P.	B.P.	M.P.	B.P.	M.P.	B.P.	M.P.	B.P.	M.P.	B.P.	M.P.	B.P.
P1 X P2	-3.09*	-1.97	-0.96	-0.22	-0.62	1.17	-4.08**	-9.53**	11.88**	7.86**	16.16**	11.87**
P1 X P3	-2.66*	-1.68	0.22	2.21	-4.22**	3.20*	3.39**	-1.08	15.43**	11.98**	23.86**	11.76**
P1 X P4	-5.73**	-5.26**	-2.78*	-1.94	0.66	2.20	0.45	0.36	17.77**	14.63**	8.41**	7.19**
P1 X P5	-4.49**	-1.97	-1.17	-0.64	-2.09	-1.20	15.51**	2.70*	14.59**	11.39**	8.83**	6.43**
P1 X P6	-4.13**	-0.66	-2.75*	-2.34	0.75	4.89**	3.89**	3.20**	0.79	-4.75**	-3.67**	-6.35**
P1 X P7	-0.95	2.96*	-1.27	-0.64	2.12	3.72**	7.14**	6.32**	18.63**	17.58**	13.53**	10.06**
P1 X P8	-2.05	1.97	-1.17	-1.06	-1.89	4.69**	14.55**	13.19**	60.79**	40.89**	7.96**	0.36**
P2 X P3	3.12*	5.37**	2.07	3.31*	-1.08	4.59**	12.01**	10.36**	15.11**	14.36**	36.01**	18.68**
P2 X P4	-6.47**	-5.86**	-1.19	-1.08	3.24**	3.51*	6.20**	0.09	17.99**	10.83**	3.70**	0.97**
P2 X P5	-4.60**	-3.22*	-0.86	-0.65	1.72	4.51**	15.59**	8.54**	21.19**	20.16**	5.73**	4.09**
P2 X P6	-2.98*	-0.64	-1.38	-0.22	-3.26**	2.61	6.97**	0.27	6.17**	-3.06**	8.45**	7.39**
P2 X P7	-2.35	0.32	-0.53	0.86	0.28	3.72**	8.28**	1.40	30.20**	24.45**	2.25**	1.56**
P2 X P8	-3.13*	-0.32	0.43	1.29	0.46	5.21**	3.25**	-3.69**	20.88**	9.44**	6.74**	2.89**
P3 X P4	-1.16	0.34	0.66	1.77	5.16**	11.49**	5.27**	0.63	18.31**	11.81**	18.62**	5.95**
P3 X P5	-3.56**	0.00	1.20	2.65	4.42**	13.60**	20.14**	11.24**	26.16**	25.90**	16.91**	3.41**
P3 X P6	-0.32	4.36**	0.43	2.87*	-1.32	11.00**	3.23**	-1.87	8.54**	-0.31	19.95**	5.56**
P3 X P7	-0.96	4.03**	-0.22	2.43	-1.66	7.74**	12.36**	6.72**	28.59**	23.68**	24.72**	9.47**
P3 X P8	-1.75	3.36*	0.11	2.21	-0.89	0.02	7.67**	1.85	26.35**	13.73**	43.44**	21.30**
P4 X P5	-1.44	0.65	-2.48*	-2.16	-0.78	1.67	11.04**	-1.35	6.64**	0.98	12.69**	11.45**
P4 X P6	-2.05	0.98	0.43	1.73	-2.45*	3.18*	1.12	0.53	5.77**	2.61*	13.22**	11.31**
P4 X P7	-2.36	0.98	-0.85	0.65	-0.69	2.45	4.64**	3.93**	19.59**	17.43**	8.05**	5.92**
P4 X P8	-3.46**	0.00	-0.53	0.43	-4.83**	-0.05	-2.18*	-3.26**	22.32**	4.72**	20.65**	13.36**
P5 X P6	-2.17	-1.25	-0.32	0.64	1.22	4.40**	11.43**	-1.51	3.38**	-4.87**	16.77**	16.07**
P5 X P7	-4.01**	-2.81	-0.32	0.86	-3.49**	-2.86*	20.31**	6.25**	35.33**	30.41**	3.48**	2.56**
P5 X P8	-4.16**	-2.81	-1.07	-0.43	-7.99**	-0.88	13.05**	-0.53	28.62**	15.57**	13.31**	7.58**
P6 X P7	-4.89**	-4.60**	-1.26	-1.05	-5.67**	-3.35*	9.89**	9.78**	8.37**	3.28**	28.19**	27.81**
P6 X P8	-5.65**	-5.21**	-1.58	-1.27	-5.30**	5.46**	6.10**	5.54**	33.03**	11.05**	5.67**	0.90**
P7 X P8	-4.72**	-4.57**	-0.74	-0.21	-5.43**	2.59	0.87	0.44	25.91**	9.48**	10.27**	5.60**
LSD 5%	2.55	2.94	2.44	2.82	2.37	2.73	2.03	2.35	1.94	2.24	0.21	0.24
LSD 1%	3.38	3.90	3.24	3.74	3.14	3.63	2.70	3.11	2.58	2.97	0.28	0.32

*** and ** Significant and highly significant values at 0.05 and 0.01 levels of probability, respectively.**

General and specific combining abilities

The mean squares associated with general and specific combining abilities detected significant and highly significant values for all studied traits, except for general combining ability for spike length trait and the data are presented in Table 6. Results showed that all other crosses expressed high GCA/SCA ratios indicating that additive and additive by additive types of gene action were of great importance in the inheritance of all studied traits. It is evident that the presence of large amount of additive effects suggest the potentiality for obtaining yield and yield component improvements. So, selection procedures based on the accumulation of additive effect would be successful in improving all studied traits. These results are in a good line with those reported by Moshref (2006); Dagustu (2008); Dhadhal *et al*., (2008) ; Kumar *et al*., (2011); Abd El-Lateef (2012); Ahmed *et al*., (2013); Singh *et al*., (2014 a and b); Yadav *et al*., (2014) ; and Nawaz *et al*., (2015).

Table 5. Continued.

Hybrids	Grains weight/spike (g)		Spikes number/plant		Grains number/spike		1000-grain weight (g)		Grain yield/plant (g)	
	M.P.	B.P.	M.P.	B.P.	M.P.	B.P.	M.P.	B.P.	M.P.	B.P.
P1 X P2	1.16**	-2.82**	22.30**	11.08**	6.90	-0.54	27.97**	20.04**	69.80**	69.37**
P1 X P3	8.74**	-0.13	34.88**	8.54**	1.90	-06.19	30.66*	25.00**	75.27**	44.04**
P1 X P4	21.71**	5.84**	-3.09	-23.73**	13.10**	4.70	29.51**	17.29**	39.59**	16.64**
P1 X P5	33.50**	32.74**	37.43**	10.76**	22.18**	15.67**	30.03**	25.94**	103.59**	84.73**
P1 X P6	-2.04**	-19.71**	4.19*	2.22	11.19	9.33	10.99**	0.57	40.79**	25.57**
P1 X P7	16.42**	15.91**	17.47**	-6.65**	11.16*	5.67	21.24**	12.23**	62.59**	58.07**
P1 X P8	31.64**	31.55**	-4.79*	-5.70*	14.97**	13.85**	21.35**	7.03**	65.19**	54.04**
P2 X P3	2.85**	-8.92**	40.70**	22.87**	0.25	-1.38	30.39**	17.36**	76.58**	45.40**
P2 X P4	36.47**	22.98**	4.24*	-11.24**	24.78**	8.12	27.35**	22.64**	47.79**	23.23**
P2 X P5	23.10**	17.61**	32.05**	15.50**	18.38**	16.21**	36.38**	24.17**	85.21**	68.43**
P2 X P6	0.19	-15.15**	14.59**	5.92*	13.79**	4.23	19.09**	14.75**	66.64**	48.29**
P2 X P7	32.85**	28.17**	36.41**	17.44**	13.31**	10.76	45.61**	43.55**	77.22**	71.87**
P2 X P8	19.41**	14.79**	-2.46	-10.65**	8.73	2.09	8.08**	1.17	36.20**	26.71**
P3 X P4	8.90**	-11.86**	33.71**	29.80**	7.05	-8.09	21.99*	6.19*	59.39**	14.12**
P3 X P5	50.17**	38.66**	29.03**	28.78**	12.88**	9.58	28.98**	27.34**	120.96**	97.75**
P3 X P6	-7.90**	-29.32**	49.82**	22.37**	31.96**	19.63**	25.82**	9.58**	95.31**	46.19**
P3 X P7	36.09**	24.49**	64.71**	61.99**	23.77**	19.66	19.73**	6.40**	71.84**	38.11**
P3 X P8	24.19**	13.99**	-7.68**	-25.16**	17.59**	9.24	13.77**	-3.42	28.93**	0.36
P4 X P5	7.51**	-6.97**	46.12**	41.58**	10.86*	-2.40	26.52**	11.36**	56.31**	20.89**
P4 X P6	1.83**	-5.05**	28.57**	2.63	9.51	3.00	16.79**	16.71**	49.19**	38.47**
P4 X P7	40.67**	22.79**	59.41**	57.32**	24.56**	10.08	22.14**	19.27**	93.43**	65.44**
P4 X P8	24.46**	8.29**	51.42**	20.00**	17.42**	7.73	17.29**	13.87**	69.78**	50.75**
P5 X P6	1.50**	-17.18**	46.92**	20.18**	23.98**	15.52**	26.32**	11.24**	82.32**	49.37**
P5 X P7	43.62**	42.17**	101.66**	97.96**	17.79**	17.28**	35.47**	12.78**	85.04**	63.71**
P5 X P8	12.80**	12.09**	0.53	-18.39**	7.41	2.65	16.97**	0.36	69.53**	44.51**
P6 X P7	38.42**	13.84**	22.04**	-1.60	27.03	18.84**	40.35**	37.14**	59.73**	46.14**
P6 X P8	8.34**	-11.16**	28.58**	27.34**	1.54	-1.12	8.75**	5.51*	45.10**	38.28**
P7 X P8	29.66**	29.17**	2.63	-17.85**	26.03**	20.94**	18.82**	12.73**	23.35**	20.09**
LSD 5%	0.64	0.74	3.89	4.49	6.96	8.04	4.16	4.80	6.73	6.73
LSD 1%	0.85	0.98	5.17	5.96	9.54	11.03	5.52	6.37	8.94	8.94

* and ** Significant and highly significant values at 0.05 and 0.01 levels of probability, respectively.

Table 6. Mean square estimates of combining ability for some earliness yield and yield component traits of the studied eight parents and their 28 F_1 hybrids in 2013/2014 season.

S.O.V	df	Days to heading	Days to maturity	Plant height (cm)	Spikelets number/ spike	Spike length (cm)	Spike density	Grains weight/ spike (g)	Spike number/ plant	Grains number/ spike	1000-grain weight (g)	Grains yield/ Plant (g)
GCA	7	27.85**	8.70**	151.66**	5.88**	1.72	0.04**	0.81**	20.09**	214.68**	40.67**	164.49**
SCA	28	5.39**	2.04**	7.91**	1.87**	2.36**	0.03**	0.20**	12.83**	52.61**	17.57**	109.60**
error	70	1.09	1.00	0.94	0.69	0.63	0.01	0.068	2.54	15.62	2.89	5.70
baker ratio		0.91	0.90	0.97	0.86	0.59	0.73	0.89	0.76	0.89	0.82	0.75

* and ** Significant and highly significant values at 0.05 and 0.01 levels of probability, respectively.

General combining ability effects

Estimates of the general combining ability effects for individual parental variety in each trait are presented in Table 7. The parental varieties P_1, P_3 and P_4 expressed highly significant negative effects for day's number to heading and recorded the earliest parental varieties for days to heading. However, P_7 followed by P_6 recoded the latest ones. The parental variety P_4 expressed desirable highly significant positive effects for grains weight/spike, grains number/spike, 1000-grain weight and grain yield/plant, in the same time, the same parental variety exhibited highly significant desirable negative effects for number of days to heading and days to maturity. The parental variety P_3 expressed desirable highly significant negative effects for day's number to heading, maturity and plant height, but it was undesirable for grains weight/spike, grain number/spike, 1000-grain weight and grain yield/plant. The parental variety P_6 expressed highly significant positive desirable effects for grains weight/spike ; spike number/plant ; grains number/spike ; 1000-grain weight and grain yield/plant. These findings coincided with the results reported by Abd El-Hameed (2006); Koumber *et al*., (2006); Kumar *et al*., (2011); Srivastava *et al*., (2012); Babar Ijaz *et al*., (2015); Ismail (2015) and Abro *et al*., (2016).

Specific combining ability effects

Estimates of the specific combining ability effects for the 28 crosses in 2013/2014 wheat growing season are presented in Table 8. The best cross combinations displayed fair amount of SCA effect were obtained from P_2 x P_4 for number of days to heading; P_4 x P_5 for number of days to maturity; P_5 x P_8 for plant height; P_1 x P_8 for spikelets number/spike and spike length; P_3 x P_8 for spike density; P_6 x P_7 for grains weight/spike; P_3 x P_6 for spikes number/plant and grains number/spike; P_6 x P_7 for 1000-grain weight and P_3 x P_6 for grain yield /plant. These results agreed with those of Abd El-Hameed (2006); Koumber *et al*., (2006); El-Marakby *et al*., (2007); Dhadhal *et al*., (2008); Aglan (2009); Aknc and Yidrm (2011); Yadav and Anil Sirohi (2011); Ghulam Shabbir *et al*., (2012); Ahmed *et al*., (2013) and Babar Ijaz *et al*., (2015).

From the previous results, here concerning GCA and SCA effects could be concluded that the excellent hybrid combinations were obtained from two possible combinations between the parents of normal and low general combining ability effects i.e. normal x normal, normal x low and low x low. These crosses indicated a preponderance of additive x additive, additive x dominance and dominance x dominance gene effects. Thus it could be concluded that general combining ability effects were generally unrelated to specific combining ability of their respective crosses.

Table 7. Estimates of general combining ability (GCA) for all studied traits of eight parents in 2013/2014 season.

Parents	Days to heading	Days to maturity	Plant height (cm)	Spikelets number /spike	Spike length (cm)	Spike density	Grains weight/ spike (g)	Spikes number /plant	Grains number /spike	1000-grain weight (g)	Grains yield/ Plant (g)
P1	-2.11**	-0.28	1.59**	0.29	0.21	-0.06*	-0.22**	1.38**	-0.07	-1.75**	-1.39
P2	-0.61	-0.28	0.32	-1.01**	-0.42	0.01	-0.07	-0.09	-5.16**	1.26*	-1.27
P3	-1.47**	-1.05**	-4.96**	-0.30	-0.16	-0.06*	-0.43**	-1.11*	-5.42**	-3.16**	-6.48**
P4	-1.57**	-1.12**	0.53	-0.05	0.26	-0.02	0.39**	-1.95**	8.67**	1.70**	7.30**
P5	0.36	-0.35	2.33**	-1.10**	-0.18	-0.02	-0.09	-0.45	-2.12	-2.19**	-1.11
P6	1.56**	0.92**	4.73**	0.50*	0.16	0.01	0.36**	2.47**	3.80**	1.24*	3.57**
P7	2.09**	1.45**	2.22**	1.01**	0.71**	0.02	0.16*	-0.76	0.33	1.87**	0.74
P8	1.76**	0.72*	-6.77**	0.65*	-0.58*	0.13**	-0.10	0.50	-0.03	1.04*	-1.36
LSD gi 5%	0.61	0.59	0.57	0.49	0.47	0.05	0.15	0.94	2.33	1.00	1.41
LSD gi 1%	0.82	0.78	0.76	0.65	0.62	0.07	0.20	1.25	3.10	1.33	1.87
LSD gi-gj 5%	1.88	1.81	1.75	1.50	1.44	0.15	0.47	2.88	7.15	3.08	4.32
LSD gi-gj 1%	2.50	2.40	2.33	2.00	1.91	0.20	0.63	3.82	9.49	4.08	5.73

*** and ** Significant and highly significant values at 0.05 and 0.01 levels of probability, respectively.**

Table 8. Estimates of the specific combining ability (SCA) for some earliness yield and yield component traits of 28 F_1 hybrids in 2013/2014 season.

Hybrids	Days to heading	Days to maturity	Plant height (cm)	Spikelets number /spike	Spike length (cm)	Spike density	Grains weight/ Spike (g)	Spikes number /plant	Grains number /spike	1000-grain weight (g)	Grains yield/ Plant (g)
P1 X P2	-0.66	-0.19	-0.98	-1.89**	-0.23	0.16*	-0.26	2.65*	-0.49	1.85	5.74**
P1 X P3	-1.46	0.57	-4.47**	-0.51	0.02	0.09	-0.05	3.14*	-4.37	2.87*	3.76*
P1 X P4	-3.03**	-2.36**	0.42	-0.37	0.71	0.02	0.27	-2.81*	2.87	3.53*	-1.56
P1 X P5	-1.63	-0.13	-1.77*	1.22	-0.03	0.04	0.47*	2.95*	8.33**	2.16	9.95**
P1 X P6	-1.50	-2.39**	2.29**	0.08	-0.91	-0.18**	-0.17	-1.77	0.55	-1.87	-1.69
P1 X P7	1.64*	-0.26	3.56**	0.41	0.10	0.10	-0.20	-0.41	-1.44	-0.24	3.17
P1 X P8	0.97	-0.19	0.46	2.73**	3.99**	-0.02	0.46*	-1.47	4.91	2.93*	8.31**
P2 X P3	4.04**	2.24**	-1.92*	1.26	0.10	0.28**	-0.22	2.87*	-5.81	2.40	3.82*
P2 X P4	-4.20**	-1.03	2.47	0.87	0.85	-0.06	0.73	-2.15	10.89	2.40	1.11
P2 X P5	-2.13*	-0.79	1.69	0.92	0.85	-0.02	0.18	0.95	4.75	3.63	4.96
P2 X P6	-0.66	-1.39	-2.65	0.65	-0.05	0.01	-0.13	-0.37	1.77	0.06	6.43
P2 X P7	-0.20	-0.26	1.00	0.48	1.59	-0.10	0.24	1.59	-0.63	7.16	7.20
P2 X P8	-0.53	1.14	2.21	-0.23	-0.22	-0.05	0.12	-1.40	-0.07	-2.24	-0.79
P3 X P4	0.00	0.74	4.19**	0.30	0.72	0.00	-0.14	0.27	-2.78	1.08	2.47
P3 X P5	-2.26**	1.31	4.33**	1.55*	1.26*	-0.01	0.80**	-1.30	0.68	1.71	8.34**
P3 X P6	0.87	0.37	-0.45	-0.59	0.08	0.02	-0.34	3.99**	13.70**	2.68*	11.15**
P3 X P7	0.00	-0.83	-0.94	1.10	1.24	0.09	0.25	3.21*	5.49	-0.75	2.26
P3 X P8	-0.33	-0.43	0.97	0.46	0.19	0.36**	0.21	-3.38**	5.32	0.48	-4.23*
P4 X P5	1.50	-2.63**	-0.88	0.60	-0.67	0.08	-0.32	1.20	-1.19	1.91	-0.04
P4 X P6	0.64	2.11	-1.73	-0.24	0.05	0.07	-0.17	0.83	-2.46	0.34	2.74
P4 X P7	0.10	-0.09	0.03	0.15	0.58	-0.01	0.49	2.79	7.09	0.60	16.98
P4 X P8	-0.56	0.31	-2.92	-1.08	0.22	0.18	0.24	6.80	5.43	2.01	12.86
P5 X P6	0.70	0.67	3.03**	0.30	-0.53	0.15*	-0.20	2.89*	7.29*	2.29	6.66**
P5 X P7	-1.50	0.47	-2.29**	1.79**	2.10**	-0.08	0.36	7.27**	0.63	0.39	4.59*
P5 X P8	-1.16	-0.79	-5.49**	0.66	0.47	0.07	-0.18	-2.64*	-2.71	0.91	4.90*
P6 X P7	-2.70**	-0.79	-3.86**	1.06	-0.30	0.32**	0.82**	-1.22	7.35*	7.23**	3.64
P6 X P8	-3.03**	-1.39	-1.97*	0.59	2.06**	-0.09	0.07	3.89**	-7.41*	-0.62	2.89
P7 X P8	-2.23**	-0.26	-2.13**	-1.21	-0.12	-0.01	0.04	-2.22	7.96*	1.42	-4.98*
LSD Sij 5%	1.64	1.57	1.52	1.31	1.25	0.13	0.41	2.51	6.22	2.68	3.76
LSD Sij 1%	2.18	2.08	2.02	1.74	1.66	0.18	0.54	3.33	8.26	3.55	4.99
LSD sij-sik 5%	2.79	2.67	2.59	2.22	2.12	0.23	0.70	4.26	10.58	4.55	6.39
LSD sij-sik 1%	3.70	3.55	3.44	2.95	2.82	0.30	0.93	5.66	14.04	6.04	8.48
LSD sij-skl 5%	2.63	2.52	2.44	2.10	2.00	0.21	0.66	4.02	9.97	4.29	6.02
LSD sij-skl 1%	3.49	3.34	3.24	2.78	2.66	0.28	0.87	5.33	13.24	5.70	8.00

*** and ** Significant and highly significant values at 0.05 and 0.01 levels of probability, respectively.**

Genetic components of variance and heritability

Validity of hypothesis

For testing the validity of the major unit or amity of (Wr – Vr) and regression analysis them conducted underlying the genetic model as shown in Table 9. The regression coefficients were significantly different from zero to unity for all studied traits consequently the highly significant differences among 36 genotypes which indicated that the parents possessed widely diverse traits. This diversity could be transmitted to the offspring; hence it permitted the genetic analysis of data. The non-significance of t^2 test validated the use of simple additive dominance model for genetic analysis of all studied traits at 2013/2014 wheat growing season.

Table 9. Validity of hypothesis through L^2, Regression coefficient (b), t- values for (b = 0) and (b = 1) (Wr + Vr) and (Wr - Vr) for earliness, yield and yield component traits in 2013/2014 season.

Traits	t ^ 2	Regression coefficient (b) ± SE	b = 0	b = 1	Wr + Vr	Wr – Vr
Days to heading	0.11	0.62±0.38	1.63	1.00	663.81**	23.22
Days to maturity	0.21	0.09±0.34	0.26	2.68*	117.86**	17.20*
Plant height (cm)	0.02	0.94±0.16	5.88**	0.38	8701.44**	105.90*
Spikelets number/spike	0.69	0.80±0.14	5.71**	1.43	84.42**	9.30*
Spike length (cm)	1.170	0.48±0.22	2.18	2.36	51.32**	27.22**
Spike density	0.42	0.70±0.20	3.50*	1.50	0.01**	0.00**
Grains weight/spike (g)	0.03	0.89±0.21	4.24**	0.52	0.96*	0.18**
Spikes number/plant	2.20	0.40±0.20	2.00	3.00*	1548.65**	521.66**
Grains number/spike	0.07	0.91±0.22	4.14**	0.41	53989.72**	9056.71**
1000-grain weight (g)	2.32	0.32±0.21	1.52	3.24*	2717.66**	660.67**
Grains yield/plant (g)	1.62	0.66±0.16	4.13**	2.13**	53262.60**	15293.96**

*** and ** Significant and highly significant values at 0.05 and 0.01 levels of probability, respectively.**

Graphical analysis

Hayman graphical analysis of the parent-offspring covariance (Wr) and array variance (Vr) and their related statistics was done to obtain a clear picture about the inheritance of all studied traits (Figures 1-11). The graphical analysis Wr/Vr indicated the importance of over dominance gene effects in controlling all traits. The presence of complementary type of non-allelic interaction which inflated the ratios of (H_1/D) ½ and distorted the (Wr, Vr) graphs (Hayman 1954b and Mather and Jinks, 1982). The array points of parental varieties were widely scattered for all studied traits, indicating presence of genetic diversity among the tested parents.

The distribution of eight parental wheat varieties along the regression lines showed that the parental varieties, P_7 for number of days to heading ; P_2, P_7 and P_8 for number of days to maturity ; P_8 for plant height ; P_4 and P_7 for spikelets number/spike ; P_4 for spike length ; P_1, P_2 and P_5 for spike density ; P_5 for grains weight/spike ; P_2 and P_8 for spikes number/plant ; P_4 and P_6 for grains number/spike ; P_4 and P_6 for 1000-grain weight ; P_1 and P_6 for grains yield/plant seemed to possess the most dominance genes responsible for the expression of these traits which being closer to the origin of regression graph.

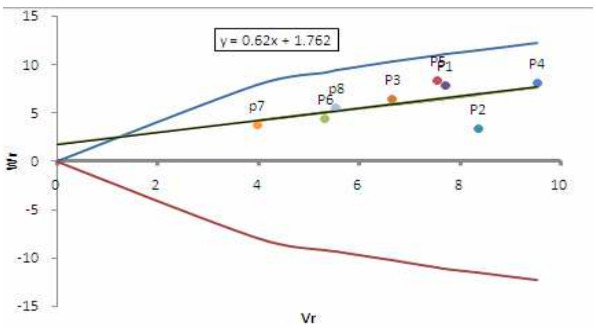

Figure 1. Days to maturity 2013/2014.

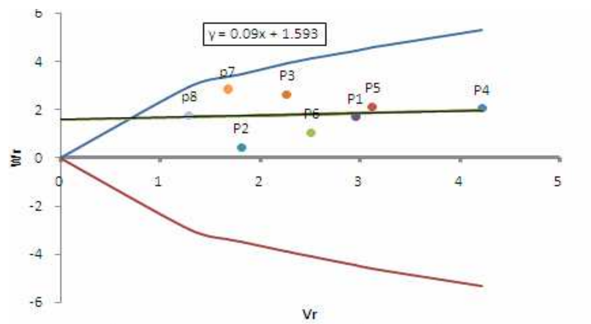

Figure 2. Days to heading 2013/2014.

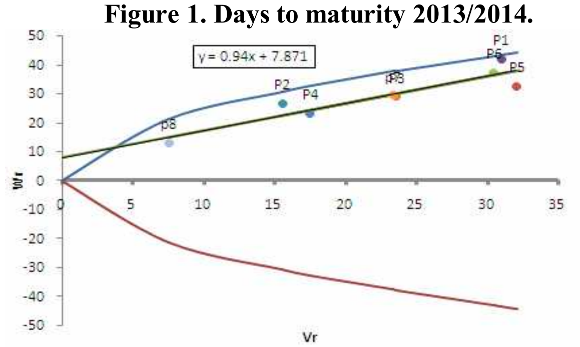

Figure 3. Spiklets number/spike 2013/2014.

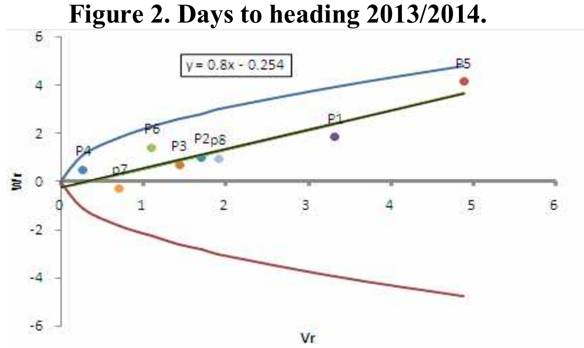

Figure 4. Plant height 2013/2014.

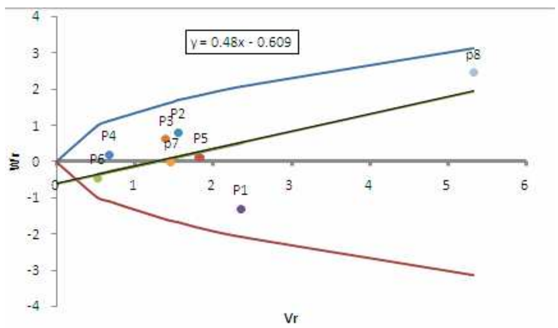

Figure 5. Spike density 2013/2014.

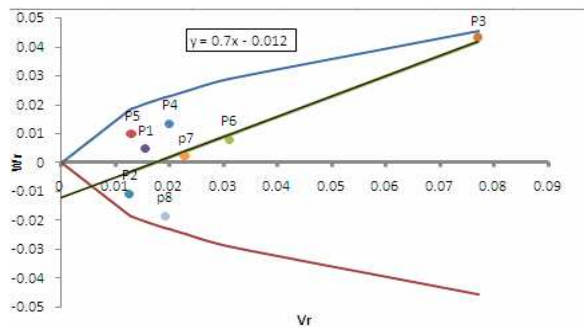

Figure 6. Spike length 2013/2014.

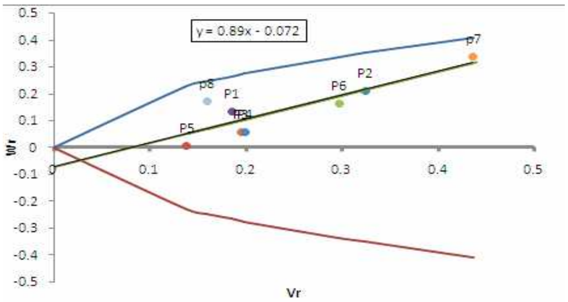

Figure 7. Spike number 2013/2014.

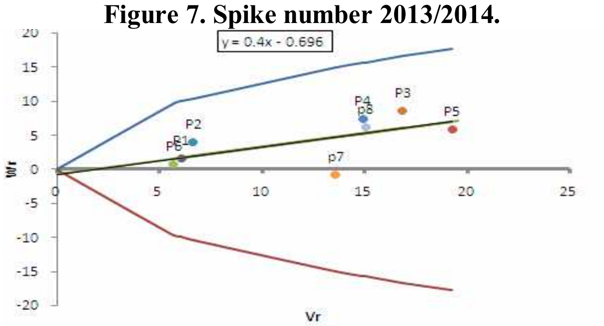

Figure 8. Grains weight/spike 2013/2014.

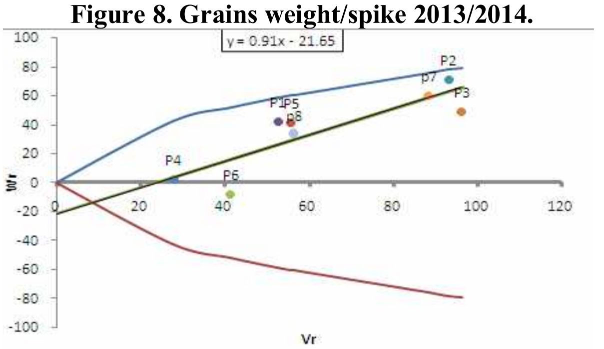

Figure 9. 1000-grains 2013/2014.

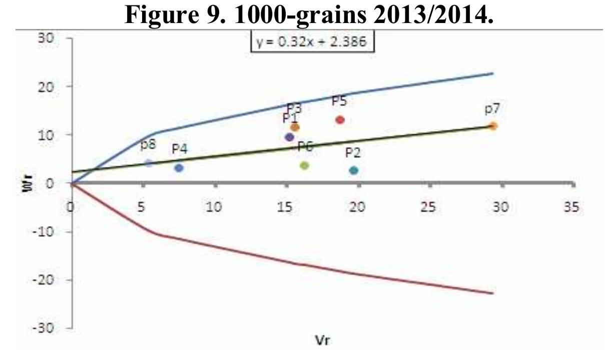

Figure 10. Grains number 2013/2014.

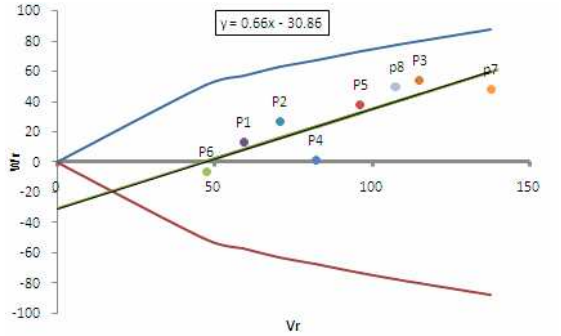

Figure 11. Grains yield 2013/2014.

Hayman analysis

With respect to genetic component estimated by the Hayman's Diallel Analysis (Tables 10 and 11), the magnitude of dominance (H_1/H_2) was significant or highly significant higher than additive components (D) for all traits, expecting plant height trait indicating the presence of over dominance for this trait. The F values and KD/KR were more than one for all traits, except grains number/spike and grain yield/plant indicating that recessive alleles were more frequent than dominant ones in the genetic constitution of parental genotypes for these traits. All estimates of environmental variance (E) were positive significant and highly significant for all studied traits indicating that all studied traits have greatly affected by environmental factors. The average degree of dominance overall loci, as estimated by (H_1/D) 0.5 ratio was found to be more than the unity for all studied traits, except plant height trait indicating the role of over dominance gene effects in the inheritance of these traits for trait which were less than unity (0.73) indication the presence of partial dominance in the control of this trait. Narrow sense heritability was less than (0.50) for all traits, except plant height trait (0.80) indicating that, the importance of additive gene effects in controlling this trait. Positive alleles were not equally distributed among parents ($H_2/4H_1 \neq 0.25$) for all studied traits. Similar results were reported by El-Hawary (2006); Aboshosha and Hammad (2009); Barot *et al*., (2014); Gezahegn Fikre *et al*., (2015); Ljubicic *et al*., (2015); Adhiena Mesele *et al*., (2016); Baloch *et al*., (2016) and Munaiza Baloch *et al*., (2016).

Table 10. Estimates of genetic components (Hayman's Analysis) for earliness, yield and yield component traits in 2013/2014 season.

Traits Genetic components	Days to heading	Days to maturity	Plant height (cm)	Spikelets number/ spike	Spike length (cm)	Spike density
E	1.09±0.45*	1.01±0.29**	0.94±0.85	0.68±0.15**	0.62±0.28*	0.01±0.00*
D	14.78±1.36**	5.72±0.87**	59.79±2.54**	3.99±0.45**	1.21±0.85	0.02±0.01*
F	6.13±3.22	4.67±2.05*	3.53±6.01	3.20±1.06**	1.55±2.00	0.02±0.02
H1	16.20±3.13**	6.60±2.00**	32.08±5.85**	5.36±1.03**	6.50±1.95**	0.09±0.02**
H2	14.71±2.72**	4.70±1.74**	26.70±5.09**	4.21±0.90**	5.66±1.70**	0.08±0.02**
h^2	28.98±1.83**	2.66±1.16*	4.40±3.41	9.41±0.60**	15.55±1.14**	0.15±0.01**
S^2	1.65	0.67	5.75	0.18	0.64	7.69-05
(H1/D)^0.5	1.05	1.07	0.73	1.16	2.32	2.09
H2/4H1	0.23	0.18	0.21	0.20	0.22	0.22
KD/KR	1.49	2.23	1.08	2.06	1.76	1.51
r	-0.63	-0.28	0.66	-0.71	-0.94	-1.00
r^2	0.40	0.08	0.44	0.50	0.88	1.00
h^2/H2	1.97	0.57	0.16	2.24	2.75	1.96
mean of Fr	14.07	7.99	30.29	5.61	3.03	0.04
h^2 (n.s)	0.52	0.40	0.80	0.36	0.11	0.20
H^2 (b.s)	0.89	0.72	0.98	0.75	0.73	0.79

Table 10. continued.

Traits Genetic components	Grains weight/spike (g)	Spike number/plant	Grains number/spike	1000-grain weight (g)	Grains yield /plant (g)
E	0.066±0.01**	2.58±1.04*	15.54±3.52**	2.84±1.58	5.64±3.96
D	0.31±0.04**	13.79±3.12**	49.80±10.55**	14.82±4.74**	49.98±11.87**
F	0.09±0.09	12.06±7.38	-38.60±24.92	1.12±11.20	-9.78±28.05
H1	0.59±0.09**	41.46±7.18**	132.22±24.25**	43.63±10.90**	285.18±27.29**
H2	0.50±0.08**	36.51±6.25**	130.90±21.10**	41.20±9.48**	275.17±23.75**
h^2	0.86±0.05**	53.08±4.19**	333.85±14.15**	168.64±6.36**	1149.26±15.92**
S^2	0.0014	8.67	98.90	19.98	125.30
(H1/D)^0.5	1.37	1.73	1.63	1.72	2.39
H2/4H1	0.21	0.22	0.25	0.24	0.24
KD/KR	1.23	1.67	0.62	1.05	0.92
r	0.12	-0.61	-0.89	-0.55	-0.51
r^2	0.01	0.37	0.79	0.30	0.26
h^2/H2	1.74	1.45	2.55	4.09	4.18
mean of Fr	0.31	23.31	1.94	13.11	46.55
h^2 (n.s)	0.46	0.22	0.48	0.38	0.32
H^2 (b.s)	0.81	0.83	0.83	0.87	0.95

*** and ** Significant and highly significant values at 0.05 and 0.01 levels of probability, respectively.**

Jones analysis

Analysis of variance of half diallel for earliness, yield and yield component traits (Table 11) showed that additive and dominant gene effects were important in the genetic control of these traits. The additive components were more than dominance, these results observed in the Griffing (1956) for all studied traits. When the dominance component (b) was farther partitioned to three components b_1, b_2 and b_3, these results indicated that "b" was highly significant for all studied traits that the mean of $F_1^{'s}$ theirs and parents were significantly different. Similar findings were reported by Abd El-Rahman (2008); Hendawy *et al.*, (2009); Hafiz Ghulam Muhu-Din Ahmed *et al.*, (2015) and Ahmad *et al.*, (2016).

Table 11. Mean squares of the half diallel analysis of variance for earliness, yield and yield component traits of eight parents and their 28 F_1 hybrids in 2013/2014 season.

S.O.V	df	Days to heading	Days to maturity	Plant height (cm)	Spikelets number / spike	Spike length (cm)	Spike density	Grains weight /Spike (g)	Spike number /plant	Grains number /spike	1000-grain weight (g)	Grains yield / plant (g)
a	7	27.85**	8.70**	151.66**	5.88**	1.72*	0.037**	0.809**	20.09**	214.68**	40.67**	164.49**
b1	1	59.84**	6.30*	9.78**	19.71**	32.14**	0.314**	1.814**	110.13**	692.12**	345.16**	2340.01**
b2	7	2.47*	2.84*	6.49**	1.76*	1.39*	0.017*	0.158*	7.35*	13.84	4.86	30.73**
b3	20	3.69**	1.55	8.31**	1.01	1.20*	0.019**	0.134*	9.88**	34.20**	5.64*	25.68**
b	28	5.39**	2.04**	7.91**	1.87**	2.36**	0.029**	0.200**	12.83**	52.61**	17.57**	109.60**
TOTAL	35	9.88**	3.38**	36.66**	2.67**	2.23**	0.031**	0.322**	14.28**	85.02**	22.19**	120.58**
a*b	14	1.71	1.69	1.04	0.86	0.55	0.005	0.045	2.26	14.54	3.59	4.78
b1*B	2	1.00	2.27	1.54	0.10	0.51	0.005	0.033	2.75	127.15	4.58	6.02
b2*B	14	0.87	1.19	0.75	0.80	0.43	0.005	0.126	1.71	11.62	1.86	3.12
b3*B	40	0.94	0.62	0.94	0.63	0.74	0.009	0.057	2.91	11.83	2.93	6.91
b*B	56	0.93	0.82	0.91	0.65	0.65	0.008	0.074	2.61	15.89	2.72	5.93
TOTAL *B	70	1.09	1.00	0.94	0.69	0.63	0.01	0.068	2.54	15.62	2.89	5.70

*** and ** Significant and highly significant values at 0.05 and 0.01 levels of probability, respectively.**

CONCLUSION

From the previous work it could be concluded that, the hybridization was the best methods to improve yield and its components of bread wheat, because its desirable heterotic effects which showed highly significant were detected for all studied traits relative to mid-parent and better parent; the mean squares associated with general and specific combining abilities showed significant and highly significant estimates for all studied traits; the graphical analysis Wr/Vr indicated the importance of over dominance gene effects in controlling all traits and the magnitude of dominance (H_1/H_2) was significant or highly significant higher than additive components (D) for all traits, expect plant height trait.

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التحليل الوراثى لصفات المحصول ومكوناته فى قمح الخبز

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تم إستخدام ثمانية أصناف من قمح الخبز لدراسة بعض صفات التبكير والمحصول ومكوناته. وقد أستخدم تحليل الداى اليل بدون الهجن العكسيه 8 × 8 حيث أجريت كافة التهجينات الممكنة بين الآباء مع أستبعاد الهجن العكسية. تم زراعة بذور الآباء وذلك لإنتاج نباتات الجيل الاول لإنتاج بذور الـ 28 هجين. وأمكن تلخيص أهم النتائج المتحصل عليها فيما يلى : أشارت نتائج تحليل التباين الي وجود فروق معنويه بين الآباء والهجن لكافة الصفات المدروسة حيث كان الأب الثالث P_3 الأبكر فى ميعادى طرد السنابل والنضج بينما كان الأب الثامن P_8 الأعلى لباقي الصفات. كما أظهرت النتائج أن الهجينين (P_1 x P_4); (P_2 x P_4) كانا الأفضل فى صفة التبكير وأن الهجن (P_1 x P_6), (P_1 x P_7), (P_1 x P_8), (P_3 x P_7), (P_4 x P_7) and (P_4 x P_8) كانت الأفضل فى صفات المحصول ومكوناتة. أظهرت النتائج وجود قوة هجين سالبة وعالية المعنوية لصفتى التبكر والنضج بالنسبة لمتوسط الأبوين والأب الأفضل لعديد من الهجن, بينما أشارت النتائج إلى وجود العكس لباقي الصفات بالنسبة لمتوسط الأبوين والأب الأفضل لعديد من الهجن. أشارت نتائج تحليل التباين المرتبطة بالقدره العامه والخاصة على الائتلاف إلي ظهور معنوية ومعنويه عالية لجميع الصفات المدروسة. وأظهرت النتائج أن الأب Sids12 (P_4) كان له قدرة عالية على التآلف لصفتى التبكير ومعظم صفات المحصول ومكوناتة. وكانت أفضل الهجن بالنسبة للقدرة الخاصة على الإئتلاف (P_2 x P_4) و (P_2 x P_5) لصفتى التبكير، (P_1 x P_5), (P_1 x P_8), (P_3 x P_5), (P_3 x P_6), (P_3 x P_8) and (P_6 x P_7) لصفات المحصول ومكوناتة. أوضحت العلاقة بين Wr/Vr أهمية تأثيرات الفعل السيادى للجين والمتحكم فى كل الصفات. وأوضحت النتائج أهمية كلاً من التباين الراجع للفعل الجيني المضيف والفعل السيادى للجين ودورهما فى وراثة هذه الصفات. وكانت قيمة التباين الراجع للفعل المضيف "a" بطريقة Jones أعلى من نظيره "b". فيما أوضحت النتائج أن معامل التوريث بالمعنى الضيق كان أقل من 50% لجميع الصفات فيما عدا صفة إرتفاع النبات والذى كان مرتفعاً 80% وهذا يشير إلى أهمية الفعل الجيني المضيف للجين فى التحكم فى هذه الصفة. وأظهرت النتائج أن الأليلات الموجبة لم تكن موزعة بالتساوى فى الآباء $H_2/4H_1 \neq 0.25$ لكل الصفات المدروسة. مما يشير إلي التوزيع الغير متماثل للجينات الموجبة لهذه الصفة. وكانت قيمة H_1 ،H_2 والتى تشير إلى أن السيادة معنوية وعالية المعنوية للقيمة المضيفة D لكل الصفات المدروسة فيما عدا صفة إرتفاع النبات موضحاً وجود سيادة فائقة لتلك الصفة. كما أظهرت النتائج أن جميع تقديرات التباين البيئى E كانت عالية المعنوية لكل الصفات المدروسة وهذا يبين أن جميع الصفات تتأثر بدرجة كبيرة بالعوامل البيئية.