J.Agric.Chem.and Biotechn., Mansoura Univ.Vol. 9(4): 123 - 135 , 2018

Genetical Studies on Yield and its Components of Four Bread Wheat Cultivers

Zaied, K. A.[1]; A. H. Abd El-Hady[1]; R. A. Ramadan[2] and A. S. M. Lasheen[2]
[1] Genetics Department, Faculty of Agriculture, Mansoura University, Egypt
[2] Wheat Res. Department, Field Crops Res. Inst., A.R.C. Egypt

ABSTRACT

The present investigation used four bread wheat cultivars to study some earliness, yield and its components characters. The parental cultivars produced six F_1 hybrids following 4 x 4 half Diallel crossing without reciprocal. F_1 hybrids and their parents were evaluated via combined analysis to study mean squares due to the parents and their hybrids which showed significant values for all studied traits. The parental variety P_1 was the best for earliness. However, P_4 was the best for yield and its components. The crosses P_1 x P_4 and P_2 x P_4 were the best for earliness. However, four crosses were the best for yield components. The mean squares associated with general and specific combining ability appeared significant values for all studied traits in the both seasons. Gemmeiza 9 was the good parent for earliness traits; however, Gemmeiza 10 was the best parent for yield and its components in the two seasons. The graphical analysis Wr/Vr showed significance of over dominance gene effects, as well as, significance of additive and dominance genetic variance in controlling all traits. The additive components (A) were lower than dominance for all traits in both seasons. Heritability in narrow sense was low for all traits in both seasons. The magnitude of dominance (H_1 and H_2) was significant than additive for most traits in both seasons which reflected the presences of over dominance. The environmental variance (E) showed that all traits have been greatly affected by environmental factors.
Keywords: Genetic analysis, bread wheat, analysis of variance, heterosis, GCA, SCA, heritability.

INTRODUCTION

Wheat (*Triticum aestivum*, L.) is one of the most important nutritional cereal crops in Egypt and all over the world. Wheat is the stable food crop of the urban areas, while it is used widely in blending with maize flour in rural areas to make bread, macaroni, biscuit and sweets. The wheat straws are source of fodder for animals. In Egypt, the total cultivated area of wheat reached about 1.419 million hectare in 2013, and the total production exceeded 9.460 million tons with an average of 6.668 t/ha. (FAOSTAT / FAO Statistics Division 2015 / June 2015).

Wheat production is not sufficient for local consumption in Egypt. This calls for greater attention of all the concerned to increase its production to meet the continuous demand and reduce the gap between the production and consumption. In this respect, National Wheat Research Program, breeders and geneticists who are interested in wheat improvement need conclusive information related to the identification of genotypes.

The development of varieties should be supported by the availability of high quality seeds. Genetic purity is one of the quality criteria needed for successful seed production of wheat. The introduction of Plant Breeder's Rights has brought even more exacting requirements for genotype and distinctness testing in seed certification (Cooke, 1999).

The foundation of plant breeding was based on recognition of gene related plant as the unit of heredity on procedure of gene manipulation and rules of genetic behavior that permitted an accurate prediction of the results from gene manipulation. The genes were identified by their effects on the visible expression of plant traits. Hybridization becomes the principle of plant breeding procedure. The goal of plant breeding is to change the plant's heredity in ways that will improve plant performance. Improved plant performance may be manifested through improved yield and quality is which usually the primary breeding goal. Among the biometrical approaches which have developed the half diallel analysis technique is considered the one which has been developed to provide information on specific genotypes. Such information could be helpful for better choice promising genotypes which should be included in breeding program.

Heterosis is considered as the best tool to increase or break the yield barriers. Because, heterosis is a complication 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 (Kumar *et al.* 2011).

A genetic component of variation is considered as an important parameter which can be used in conjunction with heritability. Heritability evaluates a variable breeding parameter for determining the magnitude of genetic gain for selection. It indicates higher significance of genetic effects in controlling the inheritance of economic traits (Adhiena Mesele *et al.* 2016).

Graphical analysis, the graph of (Wr on Vr) supplies a test of the adequacy of the model; (Wr) is related to (Vr) by a straight line of unit. Also, the departure from the origin of the point where the regression line cuts the (Wr) axis provides a measure of the average level of dominance. The regression line shows the distribution of dominance and recessive genes among the parents i.e. the points nearest the origin are for the arrays derived from parents with most dominance genes (Gebrel, 2010).

Therefore, the objectives of the present investigation are to study the performance of wheat varieties and their F_1 hybrids for earliest traits yield components, heterosis and the variance of general and specific combining ability.

MATERIALS AND METHODS

The present study was carried out at the experimental farm of Tag El-Ezz Agricultural Research Center, El-Dakahlia Governorate, Egypt during the three wheat growing seasons of 2012/2013, 2013/2014 and 2014/2015. The experimental materials comprised of four wheat cultivars and their six F_1 hybrids which genetically differed in their earliness, yield and its components.

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

Four parental wheat cultivars were employed to produce six F_1 hybrids following 4 x 4 half diallel crossing without reciprocals during winter wheat growing season of 2012/2013. The seeds of six F_1 hybrids and their parents were planted and evaluated in the two wheat growing seasons of 2013/2014 and 2014/2015. Single row of 1.5 meter length was kept as an experimental unit at both evaluation seasons. Parents and their crosses were assigned at a randomized complete blocks design with three replicates at random to the experimental units in each replication. Inter-plant and inter-row distances were maintained 10 and 20 cm, respectively.

Table 1. Names, pedigree and origin of wheat cultivars used in this study.

Cultivars	Pedigree	Origin
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

The following traits were studied in the parents and their F_1 hybrids; earliness traits (days number to heading, days number to maturity), yield and its components (plant height by cm, number of spikelets/spike, spike length by cm, grains weight/spike by g, spike density, number of grains/spike, number of spikes/plant, 1000-grain weight by g and grain yield/plant by g).

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

Statistical analysis

The date was subjected to statistical analysis as described by Steel and Torrie (1980).

RESULTS AND DISCUSSION

Mean performance

The mean performance of the parental varieties and their F_1 hybrids were summarized in Table 2. The parental variety P_4 was the latest for day's number to heading and spikelets number/spike in the first season, but it was recorded the highest values of spike density and spike number/plant in both seasons. The parental variety P_3 produced the highest values of days number to heading, plant height, spikelets number/spike, grains weight/spike and grains number/spike in second season. Meanwhile, the same parental variety gave the highest values of days to maturity and spike length in both seasons. The parental variety P_2 recorded the tallest plants (undesirable), gave the heaviest grains weight/spike in first season, but it was recorded the highest values for i.e. plant height, 1000-grain weight and grain yield/plant in two seasons.

The cross P_2 x P_4 was the best for number of days to heading in both seasons. The cross P_1 x P_4 in the first season and the cross P_2 x P_4 in the second season was the best for number of days to maturity. The cross P_1 x P_4 in the first season and P_3 x P_4 in the second season was the best for plant height. The cross P_2 x P_3 in the first season and P_1 x P_3 in the second season was the best for spikelets number/spike. The cross P_1 x P_3 in the first season and P_3 x P_4 in the second season was the best for spike length. The cross P_2 x P_3 was the best in the two seasons for spike density. The cross P_2 x P_3 in the first season and the cross P_1 x P_2 in the second season was the best for grains weight/spike. The cross P_1 x P_2 was the best in the two seasons for spikes number/plant and grains number/spike. These results are in harmony with those of Shehab El-Deen (2008); Aboshosha and Hammad (2009); Gebrel (2010); Sulaiman (2011); Abd El-Lateef (2012) and Baloch *et al*., (2016).

Table 2. Mean performances of parental wheat varieties and their F_1 hybrids for earliness, yield and its components.

Traits	Days to heading		Days to maturity		Plant height(cm)		Spikelets number/spike		Spike length (cm)	
Genotypes	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
P1	107.67	98.33	158.67	155.67	112.92	95.77	22.42	20.57	11.94	11.17
P2	109.67	104.67	159.33	160.00	119.70	117.98	24.00	19.93	13.15	12.66
P3	110.33	111.33	162.00	160.33	114.33	118.72	24.38	24.75	13.52	14.59
P4	112.00	110.00	161.33	160.00	98.80	97.74	25.20	23.03	10.52	12.61
P1 X P2	109.00	101.67	155.00	152.33	112.67	106.88	24.62	23.83	14.14	14.11
P1 X P3	103.67	104.33	158.67	150.33	104.83	118.70	27.62	25.49	16.52	12.61
P1 X P4	103.67	101.33	154.33	151.33	92.65	104.19	26.80	22.49	13.41	14.34
P2 X P3	103.67	105.67	156.67	152.00	107.00	111.63	28.17	24.10	15.60	13.32
P2 X P4	103.00	100.33	155.33	149.67	98.57	102.40	28.00	20.26	15.34	14.50
P3 X P4	104.33	100.67	157.00	154.00	96.56	97.86	26.04	22.50	14.37	15.00
LSD 5%	2.47	3.08	2.18	2.29	3.15	3.35	1.55	1.59	1.43	1.22
LSD 1%	3.38	4.22	2.98	3.14	4.31	4.59	2.13	2.18	1.96	1.67

Table 2. Continued.

Traits Genotypes	Spike density		Grains weight/spike (g)		Spike number/plant		Grains number/spike		1000-grain weight(g)		Grains yield/plant(g)	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
P1	1.63	1.86	2.75	1.73	13.22	13.93	60.73	76.57	24.76	38.47	23.41	23.41
P2	1.38	1.73	4.02	2.86	18.93	17.80	75.73	64.86	41.47	43.96	46.28	46.28
P3	1.56	1.91	2.64	2.98	12.42	15.52	65.97	76.90	30.87	40.10	29.10	29.10
P4	2.55	2.68	2.62	2.73	21.00	19.97	71.77	64.07	36.33	27.66	35.52	35.52
P1 x P2	1.73	1.79	3.72	4.61	27.69	28.99	89.82	91.55	45.04	42.12	50.84	50.84
P1 x P3	1.54	1.96	3.75	2.81	25.52	17.86	84.03	61.64	37.78	44.21	45.94	45.94
P1 x P4	1.79	1.73	3.04	3.69	16.87	17.69	78.33	83.95	37.63	44.60	30.81	30.81
P2 x P3	2.83	2.31	5.33	2.68	21.38	21.35	90.00	66.72	51.06	44.79	60.09	60.09
P2 x P4	1.86	1.76	4.64	2.97	27.65	21.56	74.88	67.42	43.71	49.09	50.15	50.15
P3 x P4	1.86	1.65	4.08	3.25	19.31	26.42	86.79	86.00	47.71	40.88	34.79	34.79
LSD 5%	0.27	0.31	0.76	0.64	2.30	2.31	7.48	6.96	1.92	2.47	11.24	10.32
LSD 1%	0.37	0.43	1.05	0.87	3.16	3.17	10.25	9.54	2.63	3.38	15.40	14.14

1st = Frist season. 2nd = Second season.

Analysis of variance

Analysis of variance for earliness, yield and its components of the parents and their crosses in the two seasons 2013/2014 and 2014/2015 are given in Table 3. The mean squares of the tested wheat genotypes were highly significant for all traits. The significant of the mean squares indicated the presence of true differences among these genotypes. The presence of significant differences between genotypes indicated the presence of genotypic variation. Genotypic variations would insure the validity of the comparisons between the means of these genotypes. Mean squares due to parents were highly significant for all traits in the two seasons except day's number to heading and maturity which were significant in the first season (alone). The results indicated that the parental varieties differed in their performance for all traits. These results are in agreement with those obtained by El-Hawary (2006); Aboshosha and Hammad (2009); Gebrel (2010) and Abd El-Lateef (2012).

Mean squares due to crosses were significant and highly significant for the traits in both seasons. Also parents *vs.* crosses showed highly significant differences for all studied traits in both seasons. The differences between each of the partitioning components namely genotypes, parents, crosses and parents *vs.* crosses were also highly significant relative to all traits. These results could be due to genetic constitutions of the parents, as well as, their differences in their Diallel crosses. This is true because the parents represent a wide range of variability. It could be concluded that the test of potential parents for the expression of heterosis would be necessarily conducting over a number of environmental conditions. Similar results were obtained by Moshref (2006); Mekhamer (2009); Kumar *et al.,* (2011) and Sulaiman (2011).

Table 3. Estimates of mean squares from the analysis of variance for some economical traits of parents and their F_1 hybrids.

S.O.V	Df	Days to heading		Days to maturity		Plant height (cm)		Spikelets number/ spike		Spike length (cm)	
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Replica.	2	7.50	2.23	8.03*	1.63	0.93	1.21	0.32	0.73	0.85	0.28
Genotypes	9	34.40**	54.02**	20.61**	52.60**	242.05**	246.78**	11.05**	11.18**	9.45**	4.42**
Parents	3	9.64*	104.97**	7.56*	14.89**	238.62**	468.56**	4.07*	14.91**	5.51**	5.92**
Crosses	5	14.76**	14.00*	7.57*	7.12*	165.42**	162.52**	5.55**	9.62**	3.83*	2.26*
P *vs.* C	1	206.94**	101.25**	125.00**	393.09**	635.52**	2.68	59.44**	7.80*	49.34**	10.75**
Error	18	2.76	4.31	2.14	2.37	4.48	5.10	1.09	1.15	0.93	0.68

Table 3. Continued.

S.O.V	Df	Spike density		Grains weight /spike (g)		Spike number/plant		Grains number/ spike		1000-grain weight (g)		Grains yield /plant (g)	
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Replica.	2	0.07	0.03	0.135	0.20	4.49	5.26	2.55	24.29	1.66	1.97	57.31	0.93
Gen.	9	0.63**	0.30**	2.46**	1.66**	88.09**	65.91**	297.97**	332.42**	187.10**	98.31**	406.55**	583.60**
Parents	3	0.82**	0.55**	1.38**	0.98**	53.54**	20.93**	129.72**	151.04**	154.76**	146.38**	288.60**	307.53**
Crosses	5	0.62**	0.17*	1.91**	1.57**	62.28**	62.45**	115.76**	462.34**	86.24**	23.86**	356.12**	604.18**
P *vs.* C	1	0.17*	0.22*	8.45**	4.18**	320.80**	218.15**	1713.72**	226.98**	788.47**	326.30**	1012.51**	1308.85**
Error	18	0.03	0.04	0.264	0.185	2.41	2.42	25.36	21.96	1.67	2.76	42.91	36.21

Df = Degrees of freedom. 1st = Frist season. 2nd = Second season.
***, ** = Significance at 0.05 and 0.01 probability levels, respectively.**

Combined analysis for the data was presented in Table 4 which revealed that mean squares due to genotypes were highly significant for all traits except spike length which possessed significant effects. Also, parents possessed highly significant for day's number to heading, plant height, spike density, 1000-grain weight and grain yield/plant, while possessed significant mean squares effects for spikelets number/spike. However, the differences between the studied parents did not reach to the significant level for days number to maturity, spike length and grains weight/spike.

Table 4. Mean squares of the analysis of variance for earliness, yield and its components of parents and their F_1 hybrids.

Source	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)
Location	1	123.27**	160.07**	28.72*	137.74**	1.94	0.06	5.95**	1.27	221.03**	57.15**	31.84
Rep. x Location	4	4.87	4.83	1.07	0.53	0.57	0.05	0.169	4.87	13.42	1.82	29.12
Entries	9	17.14**	15.98**	93.24**	3.65**	2.32*	0.20**	0.57*	31.82**	93.65**	49.26**	805.93**
Entries× Location	9	71.28**	57.23**	395.59**	18.57**	11.55**	0.74**	3.56**	122.18**	536.74**	236.15**	184.21**
Parents	3	21.36**	4.75	144.65**	3.51*	2.17	0.34**	0.37	17.14**	3.79	39.71**	593.10**
P x Location	3	93.25**	17.69**	562.54**	15.48**	9.25**	1.03**	2.00**	57.33**	276.97**	261.43**	3.03
Crosses	5	3.09	1.88	63.02**	1.71	0.22	0.16**	0.18	20.29**	86.59**	11.62**	632.44**
Crosses x Location	5	25.66**	12.81**	264.92**	13.45**	5.88**	0.63**	3.30**	104.43**	491.51**	98.48**	327.87**
P *vs.* C	1	74.71**	120.18**	90.09**	13.79**	13.27**	0.00	3.06**	133.50**	398.51**	266.15**	2311.87**
P *vs.* F_1x Location	1	233.48**	397.91**	548.11**	53.45**	46.82**	0.40**	9.56**	405.45**	1542.19**	848.62**	9.50
Error	36	3.53	2.26	4.79	1.12	0.80	0.04	0.225	2.41	23.66	2.21	39.56

***, ** = Significance at 0.05 and 0.01 probability levels, respectively.**

The average of both seasons 2013/2014 and 2014/2015 showed that the mean squares due to crosses possessed highly significant differences for plant height, spike density, spike number/plant, grains number/spike, 1000-grain weight and grain yield/plant. Other crosses did not deviate significant differences for day's number to heading, spikelets number/spike, spike length and grains weight/spike. Parents *vs.* crosses revealed highly significant mean squares for all traits in the combined data among the two seasons. The results could be explained the favorable effect with the wide range of variability. These results are in accordance with those of Kumar *et al.* (2011) and sulaiman (2011). The combined analysis revealed highly significant mean squares due to genotypes, parents and parents *vs.* hybrids for all traits indicating variability between different genotypes.

Heterosis effects

Heterosis is expressed as the percentage deviation of F_1 mean performance versus the mid-parent (M.P), as well as, the better parent (B.P). High positive values of heterosis would be of interest for most traits. Meanwhile, for days to heading and days to maturity the negative values would be useful from the breeder's point of view. Data in Table 5 showed desirable negative and highly significant heretoric effects in relative to the mid-parent for days to heading by five crosses in the first season and two crosses in the second season. Heterosis estimates relative to better parent for days to heading showed desirable negative significant for four crosses in the first season and three crosses in the second season. Negative significant heterotic affects relative to mid-parent was appeared for days to maturity in four crosses in the first season and six crosses in the second season. Heterotic effects relative to better parent for number of days to maturity revealed that P_1 x P_4 and P_3 x P_4 expressed negative and significant (desirable) heterotic effects in the first season. The same trend was obtainded by five crosses in the second season. Heterosis relative to mid-parent was significant for plant height by two crosses P_1 x P_3 and P_1 x P_4 in the second season. All crosses showed negative significant heterotic effects for the same trait in the first season. On the other hand, heterosis of plant height relative to better parent showed that four crosses recorded positive and significant (desirable) heterotic effects in the second season, while all crosses showed negative significant heterotic effects for the same trait in the first season. All crosses expressed positive and significant heterotic effects relative to mid-parent in the first season for spikelets number/spike, as well as, four crosses appeared the same trend in the second season. Two crosses P_2 x P_4 and P_3 x P_4 had negative and significant heterotic effects for the same trait in the second season. Heterosis relative to better parent expressed positive and significant desirable heterotic effects by all crosses in the first season for spikelets number/spike. However, two crosses (P_1 x P_2 and P_1 x P_3) exhibited positive and significant heretoric effect for the same trait in the second season.

Table 4. Mean squares of the analysis of variance for earliness, yield and its components of parents and their F_1 hybrids.

Source	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)
Location	1	123.27**	160.07**	28.72*	137.74**	1.94	0.06	5.95**	1.27	221.03**	57.15**	31.84
Rep. x Location	4	4.87	4.83	1.07	0.53	0.57	0.05	0.169	4.87	13.42	1.82	29.12
Entries	9	17.14**	15.98**	93.24**	3.65**	2.32*	0.20**	0.57*	31.82**	93.65**	49.26**	805.93**
Entries× Location	9	71.28**	57.23**	395.59**	18.57**	11.55**	0.74**	3.56**	122.18**	536.74**	236.15**	184.21**
Parents	3	21.36**	4.75	144.65**	3.51*	2.17	0.34**	0.37	17.14**	3.79	39.71**	593.10**
P x Location	3	93.25**	17.69**	562.54**	15.48**	9.25**	1.03**	2.00**	57.33**	276.97**	261.43**	3.03
Crosses	5	3.09	1.88	63.02**	1.71	0.22	0.16**	0.18	20.29**	86.59**	11.62**	632.44**
Crosses x Location	5	25.66**	12.81**	264.92**	13.45**	5.88**	0.63**	3.30**	104.43**	491.51**	98.48**	327.87**
P *vs.* C	1	74.71**	120.18**	90.09**	13.79**	13.27**	0.00	3.06**	133.50**	398.51**	266.15**	2311.87**
P *vs.* F_1x Location	1	233.48**	397.91**	548.11**	53.45**	46.82**	0.40**	9.56**	405.45**	1542.19**	848.62**	9.50
Error	36	3.53	2.26	4.79	1.12	0.80	0.04	0.225	2.41	23.66	2.21	39.56

***, ** = Significance at 0.05 and 0.01 probability levels, respectively.**

Data in Table 5 showed desirable positive and significant heterotic effects for spike length relative to mid and better parent for all crosses in the first season and four crosses in the second season. Heterosis for the crosses P_1 x P_2 and P_2 x P_3 relative to mid-parent expressed positive and significant heterotic effect for the spike density in the first season. However, the cross P_2 x P_3 exhibited positive significant heterotic effects for the same trait in the second season. Heterosis relative to better parent of the same trait for the cross P_1 x P_2 expressed positive and significant heterotic effects. The other five crosses exhibited negative and significant heterotic effects over the better parent in the first season. At the same time, the cross P_1 x P_3 expressed positive and significant heterotic effect for the same trait in the second season. Also, other five crosses showed negative significant heterotic effects for the same trait in second season. Concerning weight of grains/spike the estimated values showed desirable positive and significant heterotic effect relative to mid-parent for all crosses in the first season and five crosses in the second season. Heterosis relative to better parent for grains weight/spike showed that five crosses possessed positive and significant heterotic effects for the same trait in the first season and four crosses exhibited the same trend in the second season. For spikes number/plant, positive and significant heterotic effects was obtained by five crosses in the first season, but all crosses exhibited the same trend in the second season. Heterosis relative to better parent showed that four crosses appeared positive and significant heterotic effects for spike number/plant in the first season and the five crosses revealed the same in the second season. For grains number/spike, positive significant heterotic effects were found five crosses in the first season and three crosses in the second season. Heterotic effects over better parent revealed that all crosses possessed positive and significant heterotic effects in the first season and three crosses in the second season. Heterosis based on mid-parent for 1000-grain weight, indicated positive significant estimates for all crosses in the first season and five crosses in the second season. Heterosis over the better parent revealed that all crosses possessed positive and significant heterotic effects for1000-grain weight in the first season, as well as, the three crosses in the second season. Heterosis of grain yield/plant based on mid-parent showed positive significant heterotic affects by four crosses in the first season and five crosses in the second season. Concerning heterosis estimates over the better parent, positive significant heterotic effects were shown by crosses P_1 x P_3 and P_2 x P_3 at the first season and three crosses P_1 x P_2, P_2 x P_4 and P_3 x P_4 in the second season. Heterosis effects for most of the studied traits over mid-parent and better parent were reported by Moshref (2006); Shehab El-Deen (2008); Jaiswal *et al.,* (2010); Kumar *et al.,* (2011); Fetahu *et al.,* (2015); Pankaj Garg *et al.,* (2015) and Baloch *et al.,* (2016).

Table 5. Heterosis over the mid and better parent by F_1 hybrids in two growing seasons.

Crosses Traits	Year	Heterosis	P1 x P2	P1 x P3	P1 x P4	P2 x P3	P2 x P4	P3 x P4	LSD	LSD
Days to heading	1st	MP	0.31	-4.89**	-5.61**	-5.76**	-7.07**	-6.15**	2.47	3.38
		BP	1.24	-3.72*	-3.72*	-5.47**	-6.08**	-5.44**	2.85	3.90
	2nd	MP	0.16	-0.48	-2.72	-2.16	-6.52**	-9.04**	3.08	4.22
		BP	3.39	6.10**	3.05	0.96	-4.14*	-8.48**	3.56	4.88
Days to maturity	1st	MP	-2.52*	-1.04	-3.54**	-2.49*	-3.12**	-2.89*	2.18	2.98
		BP	-2.31	0.00	-2.73*	-1.67	-2.51	-2.69*	2.51	3.44
	2nd	MP	-3.48**	-4.85**	-4.12**	-5.10**	-6.46**	-3.85**	2.29	3.14
		BP	-2.14	-3.43*	-2.78*	-5.00**	-6.46**	-3.75**	2.64	3.62
Plant height (cm)	1st	MP	-3.14	-7.74**	-12.48**	-8.56**	-9.78**	-9.39**	3.15	4.31
		BP	-0.23	-7.16**	-6.23**	-6.41**	-0.24	-2.27	3.63	4.98
	2nd	MP	0.00	10.68**	7.68**	-5.68**	-5.06**	-9.58**	3.35	4.59
		BP	11.60**	23.94**	8.79**	-5.38**	4.77*	0.12	3.87	5.31
Spikelets number/spike	1st	MP	6.08**	18.00**	12.55**	16.43**	13.82**	5.05**	1.55	2.13
		BP	2.60**	13.26**	6.35**	15.52**	11.11**	3.35**	1.79	2.46
	2nd	MP	17.65**	12.49**	3.13**	7.90**	-5.67**	-5.82**	1.59	2.18
		BP	15.81**	3.00**	-2.37*	-2.60**	-12.03**	-9.08**	1.84	2.52
Spike length (cm)	1st	MP	12.73**	29.82**	19.46**	17.01**	29.65**	19.58**	1.43	1.96
		BP	7.56**	22.24**	12.34**	15.41**	16.68**	6.31**	1.65	2.27
	2nd	MP	18.42**	-2.08**	20.62**	-2.25**	14.72**	10.29**	1.22	1.67
		BP	11.42**	-13.57**	13.72**	-8.70**	14.48**	2.81**	1.41	1.93
Spike density	1st	MP	14.82**	-3.45**	-14.51**	92.51**	-5.09**	-9.18**	0.27	0.37
		BP	5.92**	-5.71**	-29.84**	81.58**	-26.83**	-26.83**	0.31	0.42
	2nd	MP	-0.28	4.16**	-23.82**	26.92**	-20.18**	-27.85**	0.31	0.43
		BP	-3.59**	2.80**	-35.49**	21.15**	-34.25**	-38.23**	0.36	0.50
Grains weight/spike (g)	1st	MP	9.89**	39.18**	13.03**	59.88**	39.59**	55.01**	0.76	1.05
		BP	-7.46**	36.32**	10.29**	32.39**	15.24**	54.42**	0.88	1.21
	2nd	MP	101.31**	19.35**	65.57**	-8.23**	6.27**	14.09**	0.64	0.87
		BP	61.49**	-5.71**	35.21**	-10.08**	3.85**	9.29**	0.74	1.01
Spikes number/plant	1st	MP	72.22**	99.04**	-1.43	36.37**	38.48**	15.57**	2.30	3.16
		BP	46.25**	92.97**	-19.68**	12.90**	31.67**	-8.05**	2.66	3.65
	2nd	MP	82.73**	21.29**	4.38**	28.12**	14.15**	48.85**	2.31	3.17
		BP	62.85**	15.05**	-11.42**	19.93**	7.95**	32.28**	2.67	3.66
Grains number/spike	1st	MP	31.64**	32.65**	18.24**	27.03**	1.54	26.03**	7.48	10.25
		BP	18.60**	27.39**	9.15*	18.84**	-1.12	20.94**	8.64	11.83
	2nd	MP	29.46**	-19.67**	19.39**	-5.86	4.59	22.01**	6.96	9.54
		BP	19.56**	-19.85**	9.64*	-13.24**	3.95	11.83**	8.04	11.01
1000-grain weight (g)	1st	MP	36.03**	35.84**	23.21**	41.16**	12.36**	41.98**	1.92	2.63
		BP	8.63**	22.38**	3.58**	23.13**	5.40**	31.31**	2.22	3.04
	2nd	MP	2.18	12.54**	34.88**	6.55**	37.09**	20.66**	2.47	3.38
		BP	-4.20**	10.25**	15.92**	1.87	11.67**	1.94	2.85	3.90
Grains yield/ plant (g)	1st	MP	45.89**	74.97**	4.57	59.44**	22.61**	7.68	11.24	15.40
		BP	9.85	57.88**	-13.26*	29.84**	8.36	-2.06	11.24	15.40
	2nd	MP	103.15**	7.62	33.02**	17.60**	28.03**	44.64**	10.32	14.14
		BP	50.66**	-7.05	10.12	-2.14	11.19*	37.53**	10.32	14.14

MP = Mid-parent. BP = Better parent. *, ** = Significance at 0.05 and 0.01 probability levels, respectively.

General and specific combining ability

The analysis of variance revealed that the mean squares associated with general and specific combining ability were highly significant for all traits in the two seasons (Table 6). This indicated the presence of both additive and non-additive gene effects involved in determining the perform of progeny. It is clearly evident that the presence of large amount of additive effect suggests the potentiality for obtaining yield and yield components improvements. Also, the results revealed that both-additive and non-additive gene effects were detected and responsible for the expression of these traits. The ratios of GCA/SCA effects were more than unity. It means that additive genetic effects played the major role in the inheritance of these traits. Also, selection procedures based on the accumulation of additive effect would be successful in improving all traits. Consequently, additive type of gene action appeared to be the largest component of genetic variability in these traits. In addition, the estimate of Baker (1978) of Jones (1956) revealed genetic gain is achievable through selection in early segregating generations for all traits. These results corroborates with the findings of Abd El-Hameed (2006); Koumber *et al.,* (2006); Darwish (2007) and Kumar *et al*., (2011).

Table 6. Mean squares of combining ability for earliness, yield and its components of parents and their F_1 hybrids in two growing seasons.

S.O.V	Df	Days to heading		Days to maturity		Plant height (cm)		Spikelets number/spike		Spike length (cm)	
	Year	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
GCA	3	0.51	24.75**	4.35**	4.43**	157.65**	157.26**	1.84	5.56**	2.80**	1.45**
SCA	6	16.95**	14.64**	8.13**	24.09**	42.20**	44.76**	4.60**	2.81**	3.32**	1.49**
Error	18	0.92	1.44	0.71	0.79	1.49	1.70	0.36	0.38	0.31	0.23
Baker ratio		0.06	0.77	0.52	0.27	0.88	0.88	0.44	0.80	0.63	0.66

Table 6. Continued.

S.O.V	Df	Spike density		Grains weight /spike (g)		Spike number/plant		Grains number/spike		1000-grain weight (g)		Grains yield/plant (g)	
	Year	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
GCA	3	0.15**	0.06	1.04**	0.07	17.96**	8.63**	31.90	35.99	78.41**	32.56**	203.29**	232.90**
SCA	6	0.24**	0.12**	0.71**	0.80**	35.07**	28.64**	133.03**	148.22**	54.35**	32.87**	101.63**	175.35**
Error	18	0.01	0.01	0.088	0.062	0.80	0.81	8.45	7.32	0.56	0.92	14.30	12.07
Baker ratio		0.56	0.50	0.75	0.15	0.51	0.38	0.32	0.33	0.74	0.66	0.80	0.73

***, ** = Significance at 0.05 and 0.01 probability levels, respectively.**

The estimates of general and specific combining ability for some earliness yield, and yield components as combined analysis for seasons in relation to the estimated mean squares of combining ability are presented in Table 7. The results revealed that the mean square of genotypes, as well as, their portions general (GCA) and specific combining ability (SCA) and their interaction were significant and highly significant estimates. Also, the results revealed that both-additive and non-additive gene effects were responsible for the expression of these traits. It means that additive genetic effect played the major role in the inheritance of these traits. Consequently, additive type of gene action appeared to be the largest component of the genetic variability for these traits. Similar conclusion was reported by Shehab El-Deen (2008); Kumar *et al.,* (2011); Abd El-Lateef (2012); Yadav *et al.,* (2014); Poodineh and Red (2015) and Nawaz *et al.,* (2015).

Table 7. Combining ability mean squares for earliness, yield and its components of parents and their F_1 hybrids.

Source	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)
Location	1	123.27**	160.07**	28.72*	137.74**	1.94	0.06	5.95**	1.27	221.03**	57.15**	31.84
Replica./ L	4	4.87	4.83	1.07	0.53	0.57	0.05	0.17	4.87	13.42	1.82	29.12
Entries	9	17.14**	15.98**	93.24**	3.65**	2.32*	0.20**	0.57*	31.82**	93.65**	49.26**	805.93**
GCA	3	3.33	1.86	71.41**	1.09*	0.64	0.05*	0.19	6.02**	0.93	18.47**	418.62**
SCA	6	6.90**	7.06**	10.91**	1.28**	0.84*	0.08**	0.19*	12.90**	46.36**	15.40**	193.66**
Entries × L	9	71.28**	57.23**	395.59**	18.57**	11.55**	0.74**	3.56**	122.18**	536.74**	236.15**	184.21**
GCA × L	3	21.92**	6.92**	243.50**	6.32**	3.61**	0.16**	0.92**	20.57**	66.96**	92.50**	17.57
SCA × L	6	24.68**	25.15**	76.05**	6.13**	3.97**	0.29**	1.32**	50.80**	234.89**	71.82**	83.32**
Error	36	1.18	0.75	1.60	0.37	0.27	0.01	0.075	0.80	7.89	0.74	13.19

***, ** = Significance at 0.05 and 0.01 probability levels, respectively.**

General combining ability effects

Estimates of general combining ability effects for the individual parental variety in each trait are illustrated in Table (8). The parental variety P_1 ranked first and exhibited negative and significant desirable effects for number of days to heading in second season, as well as, expressed desirable negative significant and highly significant effects for number of days to maturity in both seasons, respectively. However the parental variety P_3 showed positive and highly significant effects for day's number to heading in the first season, but had highly significant and significant desirable effects for days number to maturity in the first and second seasons, respectively. However the parental variety P_4 detected positive, significant and highly significant desirable effects for spike density in both seasons, spike number/plant in the second season and 1000-grain weight in the first one. In this respect these parents may possess favorable genes that could be considered as an excel lest parents for breeding programs towards releasing varieties characterized by higher grain yield and its attributes. These results are in harmony with those obtained by Abd El-Hameed (2006); Moussa and Morad (2009); Kumar *et al.,* (2011); Ghazanfar Hammad *et al.,* (2013); Ali Ammar *et al.,* (2014); Babar Ijaz *et al.,* (2015); Ismail (2015) and Abro *et al.,* (2016).

Specific combining ability effects

Specific combining ability (SCA) effects seemed to provide an appropriate way of describing the behavior of these crosses. Estimate of SCA effect for the six crosses in the two seasons are given in Table (9). The best crosses combinations displayed fair amount of SCA effects were obtained by P_2 x P_4 and P_3 x P_4 in the both seasons for days number to heading; P_1 x P_4 in the first season and P_2 x P_4 in the second season for days number to maturity; P_1 x P_3 and P_1 x P_4 in the both seasons for plant height; P_1 x P_3 in the first season and P_1 x P_2 in the second season for spikelets number/spike and spike length; P_2 x P_3 in the both seasons for spike density; P_2 x P_3 in the first season and P_1 x P_2 in the second season for grains weight/spike; P_1 x P_2 in the both seasons for spikes number/plant and grains number/spike; P_2 x P_3 in the first season and P_2 x P_4 in the second season for 1000-grain weight and P_1 x P_2 in the both seasons for grain yield/plant. These results are in a good line with these reported by Abd El-Hameed (2006); Darwish (2007); Shehab El-Deen (2008); Moussa and Morad (2009); Gebrel (2010); Zahid Akram *et al.,* (2011); Ahmad *et al.,* (2013); Ghazanfar Hammad *et al.,* (2013); Ali Ammar *et al.,* (2014) and Babar Ijaz *et al.,* (2015).

The results of GCA and SCA effects indicated 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 showed a preponderance of additive x additive, additive x dominance and dominance x dominance gene effects. It could be concluded that GCA effects were generally unrelated to SCA of their respective courses.

Table 8. General combining ability for earliness, yield and its components of parents and their F_1 hybrids.

Parents	Days to heading		Days to maturity		Plant height (cm)		Spikelets number/spike		Spike length (cm)	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
P1	-0.31	-2.53**	-0.64*	-1.25**	1.16*	-2.44**	-0.79**	-0.09	-0.22	-0.68**
P2	0.25	-0.36	-0.58	0.19	4.77**	3.49**	0.03	-0.90**	0.35	-0.03
P3	-0.19	2.36**	1.19**	0.69*	1.34**	4.95**	0.33	1.35**	0.71**	0.44*
P4	0.25	0.53	0.03	0.36	-7.27**	-6.00**	0.44	-0.36	-0.85**	0.27
LSD gi 5%	0.71	0.89	0.63	0.66	0.91	0.97	0.45	0.46	0.41	0.35
LSD gi 1%	0.98	1.22	0.86	0.91	1.24	1.33	0.61	0.63	0.57	0.48
LSD gi-gj 5%	1.73	2.16	1.52	1.60	2.20	2.34	1.09	1.11	1.00	0.85
LSD gi-gj 1%	2.36	2.95	2.08	2.19	3.01	3.21	1.49	1.53	1.37	1.17

Table 8. Continued.

Parents	Spike density		Grains weight /spike (g)		Spike number/plant		Grains number / spike		1000-grain weight (g)		Grains yield /plant (g)	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
P1	-0.17**	-0.08	-0.38**	-0.10	-0.91*	-1.36**	-2.56*	3.41**	-4.70**	-0.01	-4.84**	-4.41**
P2	-0.03	-0.06	0.57**	0.14	2.10**	1.16**	2.86*	-2.41*	4.09**	2.66**	8.36**	8.94**
P3	0.00	0.01	0.02	-0.08	-1.83**	-0.64	0.62	-0.28	0.02	0.36	-0.74	-4.12**
P4	0.21**	0.13**	-0.22	0.04	0.64	0.84*	-0.92	-0.72	0.59*	-3.01**	-2.78	-0.41
LSD gi 5%	0.08	0.09	0.22	0.18	0.67	0.67	2.16	2.01	0.55	0.71	2.81	2.58
LSD gi 1%	0.11	0.12	0.30	0.25	0.91	0.91	2.96	2.75	0.76	0.98	3.85	3.54
LSD gi-gj 5%	0.19	0.22	0.53	0.45	1.61	1.62	5.23	4.87	1.34	1.72	6.80	6.25
LSD gi-gj 1%	0.26	0.30	0.73	0.61	2.21	2.22	7.17	6.67	1.84	2.36	9.32	8.56

*, ** = Significance at 0.05 and 0.01 probability levels, respectively.

Table 9. General combining ability for earliness, yield and its components of parents and their F_1 hybrids.

Hybrids	Days to heading		Days to maturity		Plant height (cm)		Spikelets number/spike		Spike length (cm)	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
P1 X P2	2.36**	0.72	-1.61**	-1.18	0.93	-1.36	-0.34	2.12**	0.15	1.33**
P1 X P3	-2.53**	0.67	0.28	-3.68**	-3.47**	9.00**	2.35**	1.53**	2.18**	-0.65*
P1 X P4	-2.98**	-0.50	-2.89**	-2.34**	-7.05**	5.44**	1.43**	0.24	0.63	1.26**
P2 X P3	-3.09**	-0.17	-1.78**	-3.46**	-4.91**	-3.99**	2.09**	0.96*	0.68	-0.58
P2 X P4	-4.20**	-3.67**	-1.94**	-5.46**	-4.73**	-2.27*	1.81**	-1.17**	1.99**	0.77*
P3 X P4	-2.42**	-6.06**	-2.06**	-1.62**	-3.31**	-8.28**	-0.45	-1.19**	0.66	0.80*
LSD Sij 5%	1.27	1.59	1.12	1.18	1.62	1.73	0.80	0.82	0.74	0.63
LSD Sij 1%	1.75	2.18	1.54	1.62	2.23	2.37	1.10	1.13	1.01	0.86
LSD sij-sik 5%	2.60	3.25	2.29	2.41	3.32	3.54	1.64	1.68	1.51	1.29
LSD sij-sik 1%	3.56	4.45	3.14	3.31	4.54	4.84	2.24	2.30	2.07	1.76
LSD sij-skl 5%	2.33	2.91	2.05	2.16	2.97	3.16	1.46	1.50	1.35	1.15
LSD sij-skl 1%	3.19	3.98	2.81	2.96	4.06	4.33	2.01	2.06	1.85	1.58

Table 9. Continued.

Hybrids	Spike density		Grains weight/spike (g)		Spike number/ plant		Grains number/spike		1000-grain weight (g)		Grains yield/plant (g)	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
P1 X P2	0.06	0.00	-0.13	1.54**	6.11**	9.08**	11.72**	16.58**	6.02**	-2.12**	6.62*	24.48**
P1 X P3	-0.16*	0.10	0.45*	-0.05	7.86**	-0.24	8.17**	-15.46**	2.83**	2.28**	10.83**	-4.45
P1 X P4	-0.12	-0.26**	-0.03	0.72**	-3.26**	-1.90**	4.00*	7.30**	2.11**	6.03**	-2.26	0.99
P2 X P3	0.99**	0.42**	1.07**	-0.41*	0.71	0.73	8.72**	-4.56*	7.31**	0.18	11.78**	-0.74
P2 X P4	-0.19**	-0.25**	0.62**	-0.24	4.51**	-0.55	-4.86*	-3.42	-0.61	7.85**	3.87	1.84
P3 X P4	-0.21**	-0.43**	0.61**	0.26	0.10	6.11**	9.28**	13.03**	7.47**	1.94**	-2.38	10.24**
LSD Sij 5%	0.14	0.16	0.39	0.33	1.19	1.19	3.86	3.60	0.99	1.27	5.03	4.62
LSD Sij 1%	0.19	0.22	0.54	0.45	1.63	1.64	5.29	4.93	1.36	1.75	6.89	6.32
LSD sij-sik 5%	0.28	0.33	0.81	0.67	2.43	2.44	7.89	7.34	2.02	2.60	10.26	9.42
LSD sij-sik 1%	0.39	0.45	1.10	0.92	3.33	3.34	10.80	10.06	2.77	3.56	14.05	12.91
LSD sij-skl 5%	0.25	0.30	0.72	0.60	2.17	2.18	7.05	6.56	1.81	2.33	9.17	8.43
LSD sij-skl 1%	0.34	0.41	0.99	0.82	2.98	2.99	9.66	8.99	2.48	3.19	12.57	11.55

*, ** = Significance at 0.05 and 0.01 probability levels, respectively.

Genetic components of variance and heritability

Validity of hypothesis

Validity hypothesis through t_2, Regression coefficient (b), t-values for b = o and b = 1 Wr + Vr and Wr – Vr for earliness yield and its components in both seasons are presented in Table (10). Consequently the highly significant wheat genotypes (parents and crosses) indicated that the parents possessed widely diverse traits, this diversity could be transmitted to the offspring; hence it permitted the genetic analysis data. As shown heein, non-significant of t_2 test validated the use of simple additive, dominance model for genetic analysis of all studied traits.

Graphical analysis

Hayman graphical analysis of the parent's offspring covariance Wr and array variance Vr and their related statistics was done to obtain a clear picture about the inheritance of all traits (Table 10 and Figures from 1a to 11b), showing additive type of gene action with partials dominance controlling the genetic mechanism of these traits. It was supported by significant or highly significant differences in the magnitude of the Wr –Vr values over arrays in all traits except plant height in the first season and days number to heading, spikelets number\spike and spike length in the second season.

Table 10. Validity of hypothesis through regression coefficient (b) for earliness yield and its components in two growing seasons.

Traits	Year	t^2	Regression coefficient (b)±SE	b = 0	b = 1	W r + V r	W r - V r
Days to heading	1st	0.10	0.85±0.56	1.52	0.27	624.17**	447.59*
	2nd	1.30	0.04±0.34	0.12	2.82	1868.79	403.85
Days to maturity	1st	0.85	0.71±0.22	3.23	1.32	266.12	68.32**
	2nd	1.85	0.57±0.22	2.59	1.95	1355.49**	657.65**
Plant height (cm)	1st	0.17	1.03±0.10	10.30**	-0.30	46740.79**	392.42
	2nd	0.04	0.76±0.57	1.33	0.42	50392.91**	3811.75*
Spikelets number/spike	1st	0.03	0.87±0.27	3.22	0.48	109.08*	25.93*
	2nd	0.19	0.50±0.43	1.16	1.16	112.11**	17.96
Spike length (cm)	1st	0.016	1.00±0.10	10.00**	0.00	76.10**	11.44*
	2nd	0.0002	0.56±0.59	0.95	0.75	16.50*	7.26
Spike density	1st	0.83	-0.37±0.34	-1.09	4.03	0.22**	0.31**
	2nd	0.82	1.19±0.46	2.59	-0.41	0.18**	0.06*
Grains weight/spike (g)	1st	0.09	0.67±0.40	1.68	0.83	5.43*	1.06*
	2nd	0.55	0.32±0.40	0.80	1.70	4.246**	2.314**
Spikes number/plant	1st	2.49	-0.17±0.26	-0.65	4.50*	3629.61**	2337.42**
	2nd	0.30	0.27±0.46	0.59	1.59	2969.66**	1901.71**
Grains number/spike	1st	0.02	0.94±0.33	2.85	0.18	69071.85*	30979.87
	2nd	4.08	-0.72±2.13	-0.34	0.81	81911.65**	69405.14**
1000-grain weight (g)	1st	0.12	1.03±0.20	5.15*	-0.15	27699.90**	1949.07**
	2nd	0.17	0.86±0.21	4.10	0.67	19708.83**	1160.63**
Grains yield/plant (g)	1st	0.25	0.59±0.37	1.59**	1.11**	152450.26**	28679.18
	2nd	0.60	0.54±0.32	1.69**	1.44**	358776.53*	81293.53*

*, ** = Significance at 0.05 and 0.01 probability levels, respectively.

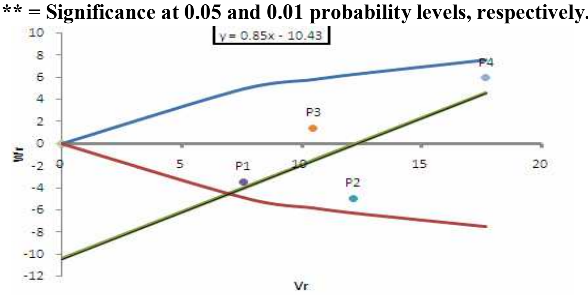

Figure 1a. Days to heading 2013/2014.

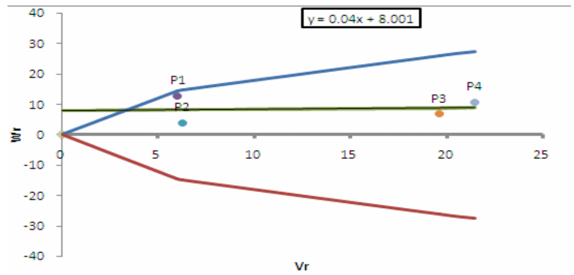

Figure 1b. Days to heading 2014/2015.

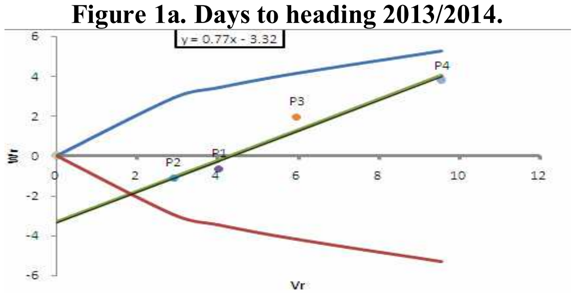

Figure 2a. Days to maturity 2013/2014.

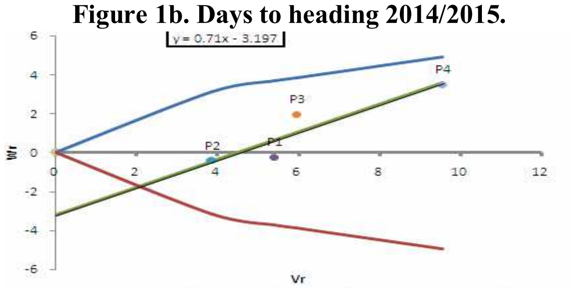

Figure 2b. Days to maturity 2014/2015.

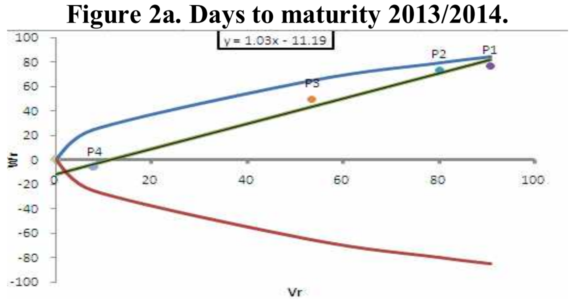

Figure 3a. Plant height 2013/2014.

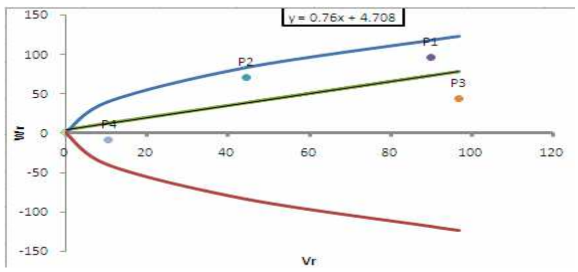

Figure 3b. Plant height 2014/2015.

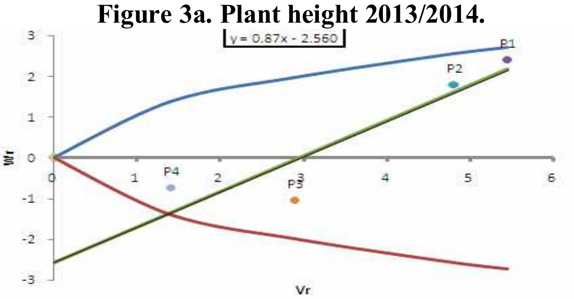

Figure 4a. Spiklets number/spike 2013/2014.

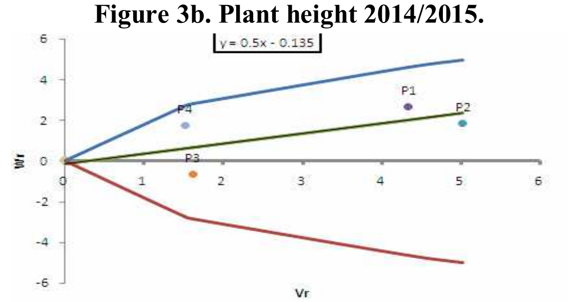

Figure 4b. Spiklets number/spike 2014/2015.

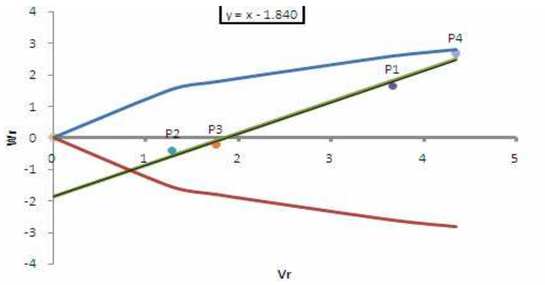

Figure 5a. Spike length 2013/2014.

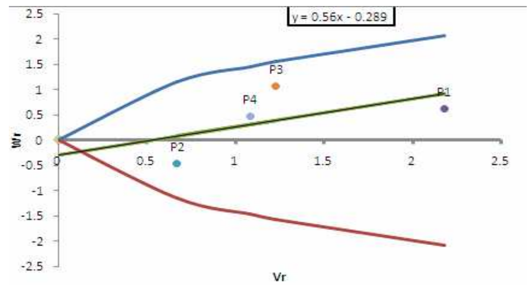

Figure 5b. Spike length 2014/2015.

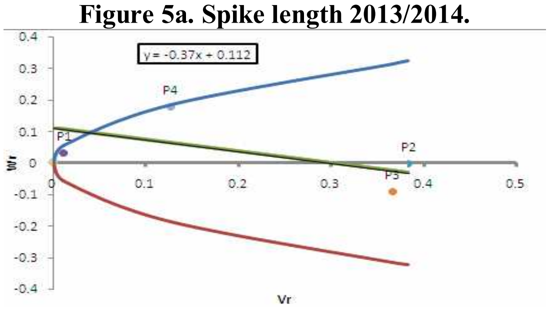

Figure 6a. Spike density 2013/2014.

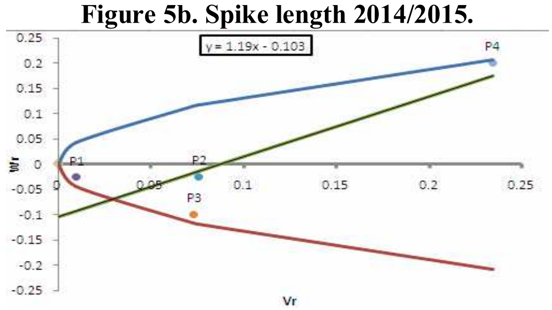

Figure 6b. Spike density 2014/2015.

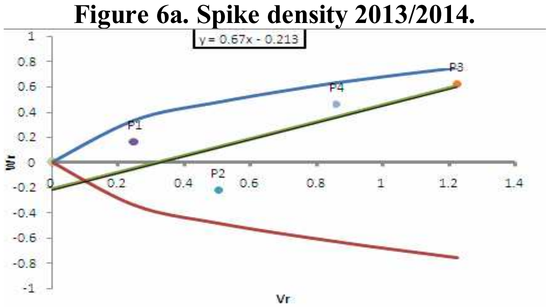

Figure 7a. Grains weight /spike 2013/2014.

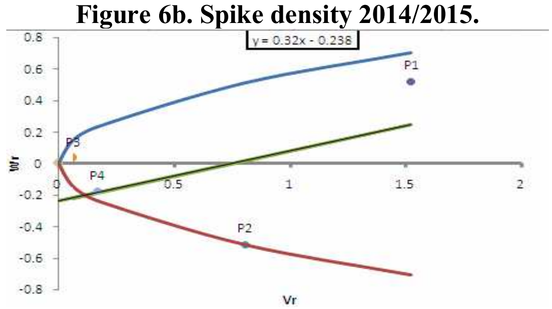

Figure 7b. Grains weight /spike 2014/2015.

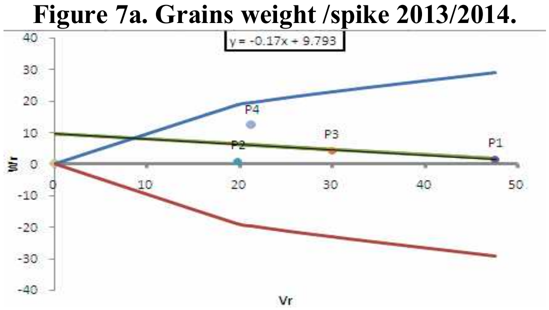

Figure 8a. Spike number 2013/2014.

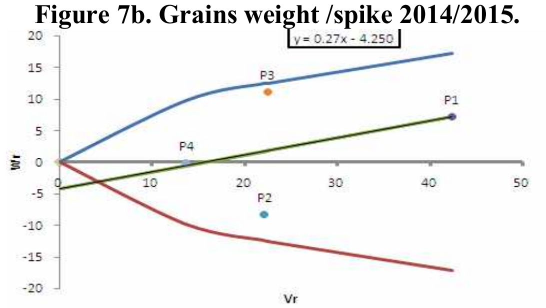

Figure 8b. Spike number 2014/2015.

The distribution of parental wheat varieties along the regression lines showed that the parental varieties, P_1 and P_4 and P_1 and P_3 for days number to heading, P_1 and P_2 for days number to maturity, P_4 and P_4 for plant height, P_4 and P_3 and P_4 for spikelets number\spike, P_2 and P_3 and P_2 for spike length, P_1 and P_4 and P_2 for spike density, P_1 and P_3 and P_4 for grains weight/spike, P_2 and P_4 for spikes number\plant, P_2 and P_4 for grains number\spike, P_2 and P_4 and P_1, P_2 and P_3 for 1000-grain weight and P_2 and P_2 and P_1 for grain yield\plant in the first and second seasons, respectively, seemed to possess the most dominant genes responsible for the expression of these traits, which being closer to the origin of regression graph.

Hayman analysis

Respecting genetic components estimated by the Hayman Diallel Analysis (Table 11) indicated that additive (D) was significantly positive or highly significant for more traits in the two growing seasons. Meanwhile, significant or highly significant values of dominance (H_1 and H_2) detected for all traits in both seasons indicated the important of both additive and non-additive components in the inheritance of these traits. It was supported by the ratio of ($H_2/4H_1$) which showing asymmetrical gene distribution at the loci in the parents showing dominance for all studied traits. The positive was (F) value for most traits indicating that the presence of higher number of dominant than recessive gene's and it was confirmed by high value of (KD\KR) for most traits. Significant environmental variance (E) for all traits indicated that all traits have been greatly affected by environmental factors. The average degree of dominance as indicated by $(H_1/D)^{1/2}$ was higher than unity for all traits in both seasons, Meanwhile, the values of ($H_2\backslash 4H_1$) for all traits were lower than unity, suggested the importance of additive gene effects in the genetic of these traits. The proportion of positive gene effects ($H_2\backslash 4H_1$) nearly or equal 0.25 for all traits indicated the parental varieties in both seasons. Heritability in board sense [h (b-s)] had high value for all traits in both seasons. Whereas, heritability in narrow sense [h (n-s)] were low for all traits in both seasons. Similar results were reported by El-Hawary

(2006); Aboshosha and Hammad (2009); Gebrel (2010); Abd El-Lateef (2012); Usman Ijaz *et al.,* (2013); Adeel Khan *et al.,* (2015); Baloch *et al.,* (2016) and Munaiza Baloch *et al.,* (2016).

Jones analysis

Half diallel analysis of variance for all traits as shown in (Table 12) indicated that additive and dominance gene effects were important in the genetic control of all studied traits. In this respect, the additive component (A) was lower than dominance for all traits in both seasons. These results absorbed in the Griffing (1956) for all the traits, when the dominance component (b) was further their partitioned three comments of (b_1, b_2 and b_3). These results are in a good line with those reported by Hendawy *et al*. (2007).

Table 11. Additive, dominance (H_1 and H_2) and environmental (E) genetic components together with derived parameters for some economical traits in wheat.

Traits Genetic	Year	Days to heading	Days to maturity	Plant height (cm)	Spikelets number/spike	Spike length (cm)
E	1st	1.08±1.22	2.29±0.30**	1.38±1.84	0.34±0.26	0.31±0.07**
	2nd	1.37±3.16	0.77±1.35	1.57±12.13	0.37±0.51	0.21±0.21
D	1st	2.13±2.72	0.63±0.66	78.16±4.12**	1.02±0.58	1.53±0.16**
	2nd	33.62±7.07**	4.19±3.02	154.62±27.12**	4.60±1.13**	1.76±0.47**
F	1st	6.43±6.98	-0.47±1.70	-36.70±10.57	-0.06±1.49	-0.32±0.41
	2nd	34.47±18.17	2.82±7.76	108.44±69.67	3.87±2.92	2.01±1.22
H1	1st	49.44±7.90**	15.64±1.92**	113.91±11.96**	12.65±1.69**	8.42±0.46**
	2nd	50.73±20.56*	61.95±8.78**	191.38±78.84*	10.83±3.30**	4.87±1.38**
H2	1st	45.18±7.29**	15.18±1.77**	110.08±11.04**	12.68±1.56**	8.52±0.42**
	2nd	39.26±18.98*	61.47±8.11**	142.68±72.77*	7.50±3.04*	3.92±1.27**
h^2	1st	63.86±4.95**	31.83±1.20**	197.56±7.49**	18.32±1.06**	15.19±0.29**
	2nd	30.61±12.87*	122.26±5.50**	-0.34±49.36	2.16±2.07	3.20±0.86**
S^2	1st	5.91	0.35	13.55	0.27	0.02
	2nd	40.03	7.30	588.42	1.03	0.18
(H1/D)^0.5	1st	4.82	4.98	1.21	3.52	2.35
	2nd	1.23	3.85	1.11	1.53	1.66
H2/4H1	1st	0.23	0.24	0.24	0.25	0.25
	2nd	0.19	0.25	0.19	0.17	0.20
KD/KR	1st	1.91	0.86	0.67	0.98	0.91
	2nd	2.43	1.19	1.92	1.76	2.04
r	1st	0.94	0.76	0.89	-0.89	-0.96
	2nd	0.61	1.00	0.19	-0.99	-0.11
r^2	1st	0.88	0.58	0.79	0.79	0.92
	2nd	0.37	1.00	0.04	0.98	0.01
h^2/H2	1st	1.41	2.10	1.79	1.44	1.78
	2nd	0.78	1.99	0.00	0.29	0.82
mean of Fr	1st	51.14	18.68	228.22	12.61	10.24
	2nd	151.76	60.74	603.99	23.32	10.18
h^2 (n.s)	1st	0.00	0.11	0.67	0.13	0.26
	2nd	0.32	0.05	0.56	0.47	0.23
H^2 (b.s)	1st	0.91	0.67	0.98	0.92	0.91
	2nd	0.92	0.95	0.98	0.91	0.86

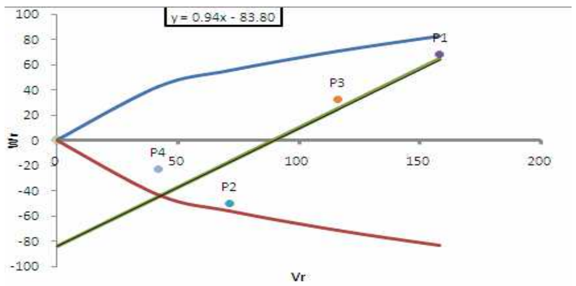

Figure 9a. Grains number 2013/2014.

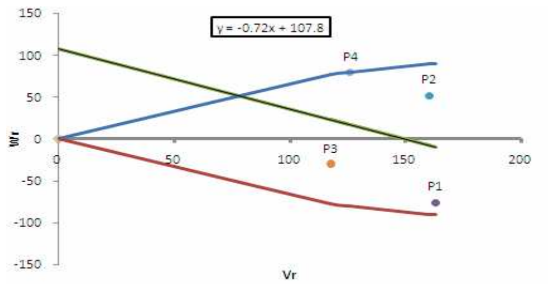

Figure 9b. Grains number 2014/2015.

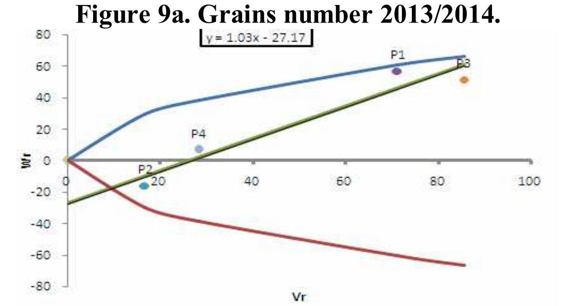

Figure 10a. 1000-grain weight 2013/2014.

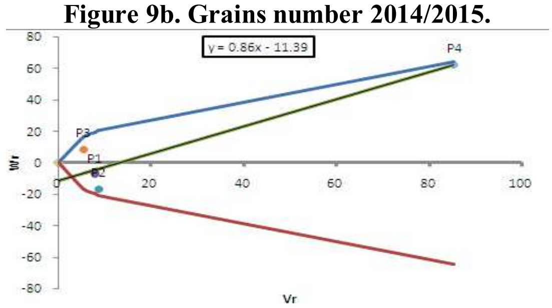

Figure 10b. 1000-grain weight 2014/2015.

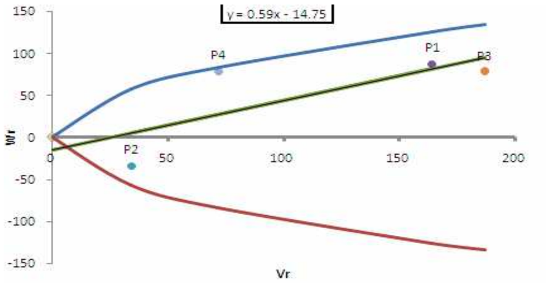

Figure 11a. Grains yield/plant 2013/2014.

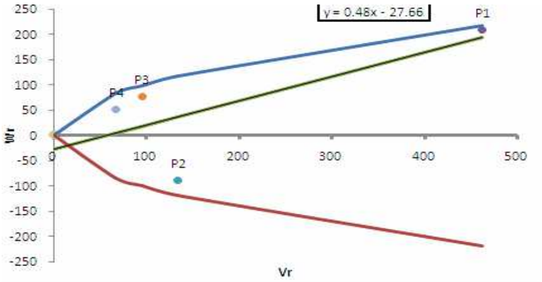

Figure 11b. Grains yield/plant 2014/2015.

Table 11. Continued.

Traits Genetic	Year	Spike density	Grains weight/spike (g)	Spikes number/ plant	Grains number/ spike	1000-grain weight (g)	Grains yield/plant (g)
E	1st	0.01±0.09	0.084±0.10	0.87±5.52	7.69±8.32	0.56±3.31	14.78±17.36
	2nd	0.01±0.02	0.062±0.21	0.90±4.20	7.40±28.46	0.89±4.59	13.56±34.52
D	1st	0.26±0.21	0.38±0.22	16.98±12.34	35.55±18.60	51.03±7.40**	81.42±38.81*
	2nd	0.17±0.05**	0.27±0.47	6.08±9.40	42.95±63.65	47.90±10.26**	84.59±77.20
F	1st	0.41±0.54	-0.21±0.56	15.81±31.69	50.02±47.79	3.53±19.01	-32.95±99.71
	2nd	0.30±0.13*	0.73±1.20	2.91±24.14	69.40±163.51	49.97±26.35	-63.12±198.32
H1	1st	1.01±0.61	2.04±0.64**	115.29±35.86**	382.47±54.08**	152.85±21.51**	305.60±112.82**
	2nd	0.49±0.15**	2.87±1.36*	95.12±27.31**	574.09±185.01**	107.19±29.82**	470.13±224.40*
H2	1st	0.77±0.56	1.75±0.59**	103.92±33.10**	349.18±49.92**	145.45±19.85**	251.76±104.15*
	2nd	0.35±0.14*	2.34±1.25	92.61±25.21**	521.89±170.78**	92.28±27.52**	442.38±207.14*
h^2	1st	0.05±0.38	2.58±0.40**	99.60±22.45**	529.77±33.86**	245.98±13.47**	305.32±70.64**
	2nd	0.06±0.09	1.26±0.85	67.50±17.10**	65.38±115.84	101.30±18.67**	357.26±140.50*
S^2	1st	0.035	0.0385	121.76	276.86	43.80	1205.14
	2nd	0.002	0.1744	70.62	3240.63	84.16	4767.57
(H1/D)^0.5	1st	1.97	2.33	2.61	3.28	1.73	1.94
	2nd	1.70	3.29	3.96	3.66	1.50	2.36
H2/4H1	1st	0.19	0.21	0.23	0.23	0.24	0.21
	2nd	0.18	0.20	0.24	0.23	0.22	0.24
KD/KR	1st	2.35	0.79	1.44	1.55	1.04	0.81
	2nd	3.19	2.43	1.13	1.57	2.07	0.73
r	1st	0.05	-0.66	-0.58	-0.97	-0.91	-0.96
	2nd	0.96	-0.97	-0.94	-1.00	-0.96	-0.87
r^2	1st	0.00	0.44	0.34	0.94	0.83	0.92
	2nd	0.92	0.94	0.88	1.00	0.92	0.76
h^2/H2	1st	0.06	1.47	0.96	1.52	1.69	1.21
	2nd	0.17	0.54	0.73	0.13	1.10	0.81
mean of Fr	1st	1.79	2.39	142.76	437.05	234.45	418.24
	2nd	1.08	3.64	90.30	616.02	240.48	515.42
h^2 (n.s)	1st	0.18	0.46	0.19	0.09	0.43	0.52
	2nd	0.03	0.04	0.11	0.09	0.21	0.41
H^2 (b.s)	1st	0.95	0.91	0.97	0.93	0.99	0.91
	2nd	0.86	0.91	0.97	0.95	0.97	0.94

*, ** = Significance at 0.05 and 0.01 probability levels, respectively.

Table 12. Mean squares of half diallel analysis of variance for earliness, yield and its components of parents and their F_1 hybrids

S.O.V	Df	Days to heading		Days to maturity		Plant height (cm)		Spikelets number/spike		Spike length (cm)	
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
A	3	0.51	24.75**	3.62	4.43**	157.65**	157.26**	1.84*	5.56**	2.80**	1.45**
b1	1	68.98**	33.75**	35.78**	131.03**	211.84**	0.89	19.81**	2.60*	16.45**	3.58**
b2	3	6.40**	16.21**	2.13	1.15	6.03*	65.98**	0.18	4.69**	0.07	1.42**
b3	2	6.74**	2.72	1.24	5.02**	11.64**	34.86**	3.62**	0.09	1.64*	0.54*
B	6	16.95**	14.64**	7.44*	24.09**	42.20**	44.76**	4.60**	2.81**	3.32**	1.49**
TOTAL	9	11.47**	18.01**	6.17*	17.53**	80.68**	82.26**	3.68**	3.73**	3.15**	1.47**
a*b	6	1.16	1.15	3.69	0.70	1.29	0.93	0.73	0.31	0.34	0.05
b1*B	2	0.88	1.51	4.47	0.61	1.30	2.40	0.02	0.32	0.23	0.49
b2*B	6	1.20	1.24	1.06	0.51	1.57	1.27	0.24	0.21	0.44	0.21
b3*B	4	0.16	2.11	0.38	1.44	1.78	3.14	0.19	0.79	0.11	0.37
b*B	12	0.80	1.58	1.40	0.84	1.59	2.08	0.18	0.42	0.30	0.31
TOTAL *B	18	0.92	1.44	2.16	0.79	1.49	1.70	0.36	0.38	0.31	0.23

Table 12. Continued.

S.O.V	df	Spike density		Grains weight/spike (g)		Spike number/plant		Grains number/spike		1000-grain weight (g)		Grains yield/plant (g)	
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
A	3	0.15**	0.06*	4.35**	0.071	17.96**	8.63**	31.90**	35.99*	78.41**	32.56**	203.29**	219.81**
b1	1	0.06*	0.07*	41.67**	1.394**	106.93**	72.72**	571.24**	75.66**	262.82**	108.77**	337.50**	391.92**
b2	3	0.33**	0.19**	1.59	0.739**	15.74**	3.96**	49.51**	74.53**	10.24**	20.46**	81.64**	46.04
b3	2	0.21**	0.04	1.17	0.583**	28.12**	43.63**	39.21**	295.02**	16.27**	13.54**	13.68	177.86**
B	6	0.24**	0.12**	8.13**	0.796**	35.07**	28.64**	133.03**	148.22**	54.35**	32.87**	101.63**	147.63**
TOTAL	9	0.21**	0.10**	6.87**	0.554**	29.36**	21.97**	99.32**	110.81**	62.37**	32.77**	135.52**	171.69**
a*b	6	0.02	0.01	1.46	0.080	1.38	0.38	2.81	12.03	0.63	0.78	7.17	9.59
b1*B	2	0.01	0.02	0.07	0.042	0.63	0.01	25.58	1.84	0.94	1.32	3.67	0.39
b2*B	6	0.01	0.01	0.29	0.053	0.53	1.41	8.01	5.69	0.39	1.15	13.16	16.82
b3*B	4	0.00	0.03	0.56	0.057	0.43	0.95	9.02	5.46	0.50	0.58	32.04	27.12
b*B	12	0.01	0.02	0.34	0.052	0.51	1.02	11.28	4.97	0.52	0.99	17.87	17.51
TOTAL *B	18	0.01	0.01	0.71	0.062	0.80	0.81	8.45	7.32	0.56	0.92	14.30	14.87

***, ** = Significance at 0.05 and 0.01 probability levels, respectively.**

In conclusion, hybridization was the best method to improve yield and its components of bread wheat. The parental variety Sakha 94 was the best for earliness. However, Gemmeiza 10 was the best for yield and its components. The crosses Sakha 94 x Gemmeiza 10 and Misr 2 x Gemmeiza 10 were the best for earliness. However, the other four crosses conducted in this study were the best for yield components. The environmental variance showed that all traits had greatly affected by environmental factors.

REFERENCES

Abd El-Hameed, E.A.M. (2006). Studies on wheat breeding (*Triticum aestivum*, L.). M. Sc. Fac. Agric. Kafr El-Sheikh,Tanta Univ. Egypt.

Abd El-Lateef, M.A.H. (2012). Genetic studies on leaf rust resistance and some agronomic characters in bread wheat under two sow dates. M. Sc., Thesis, Fac. Agric., Mansoura Univ., Egypt.

Aboshosha, A.A.M. and S.M. Hammad (2009). Estimation of genetic parameters for yield and yield components and some agronomic characters in two crosses of bread wheat (*Triticum aestivum*, L.). J. Agric. Sci., Mansoura Univ., 34(5): 4293-4300.

Abro, S.A.; Baloch, A.W.; Munaiza Baloch; Baloch, G.A.; Baloch, T.A.; Soomro, A.A.; Qamaruddin Jogi and Muhammad Ali (2016). Line x tester analysis for estimating combining ability in F_1 hybrids of bread wheat. Pure and Applied Biology, 5(3):647-652.

Adeel Khan; Ihsan Khaliq; M.S. Saddam; H.G.M.D. Ahmed; S. A. Zafar; Waheed Aslam and Dur Muhammad (2015). Estimation of genetic mechanism of stomatal traits influencing grain yield in hexaploid wheat (*Triticum aestivum*, L.). Inter. J. of Biosciences, 6(6): 72-77.

Adhiena Mesele; Wassu Mohammed and Tadesse Dessalegn (2016). Estimation of heritability and genetic advance of yield and yield related traits in bread wheat (*Triticum aestivum*, L.) genotypes at Ofla District, Northern Ethiopia. Inter. J. of Plant Breeding and Genetics, 10(1):31-37.

Ahmed, N.H.; Ghulam Shabbir; Zahid Akram and M.K.N. Shah (2013). Combining ability effects of some phonological traits in bread wheat. Sarhad Journal of Agriculture, 29(1): 15-20.

Ali Ammar; Ahsan Irshad; Shoaib Liaqat; R.I. Ahmad; Abdul Qayyum; Seema Mahmood; Etrat Noor; M.K. Aziz; Arslan Asim; S. A. Manzoor and Waqas Malik (2014). Combining ability studies for yield components in wheat (*Triticum aestivum,* L.). Journal of Food, Agriculture & Environment, 12(2):383-386.

Babar Ijaz; M.I. Arshad; R.H. Shabbir and M. Demir (2015). Estimation of combining ability for selection of (*Triticum aestivum*, L.) genotypes with some yield related traits. Communications in Plant Sciences, 5(3/4):51-57.

Babar Ijaz; Arshad, M.I.; Shabbir, R.H. and Demir, M. (2015). Estimation of combining ability for selection of (*Triticum aestivum*, L.) genotypes with some yield related traits. Communications in Plant Sciences, 5(3/4):51-57.

Baloch, A.W.; Munaiza Baloch; M.J. Baloch; R.A. Kandhro; M. N. Kandhro; Naila Gandahi; G.M. Baloch; I.A. Baloch; M. Ali and A.M. Baloch (2016). Evaluation of exotic bread wheat genotypes for yield and its associated traits. International Journal of Biology and Biotechnology, 13(1):107-110.

Cooke, R.J. (1999). Modern methods for the cultivar identification and the transgenic plant challenge. Seed Sci., Technol 27:669–680.

Darwish, M.A.H. (2007). Genetic studies on some physiological and agronomic characters for some bread wheat crosses. M. Sc. Thesis, Fac. Agric., Kafr El-Sheikh Univ., Egypt.

El-Hawary, M.N.A. (2006). Breeding for drought tolerance in bread wheat. M. Sc. Thesis, Fac. Agric., Mansoura Univ., Egypt.

FAOSTAT / FAO Statistics Division 2015 / June 2015.

Fetahu, S.; S. Aliu; I. Rusinovci; D. Zeka; Q.Shabani; H.P. Kaul and F. Elezi (2015). Determination of heterosis and heterobeltiosis for plant height and spike grain weight of F_1 generation in bread wheat. International J. of Ecosystems and Ecology Sci., 5(3):431-436.

Gebrel, E.M.A.H. (2010). Genetical studies on some economical traits in wheat (*Triticum aestivum*, L.). M. Sc. Thesis, Fac. Agric., Mansoura Univ., Egypt.

Ghazanfar Hammad; Muhammad Kashif; Muneeb Munawar; Usman Ijaz; Raza, M.M.; Muhammad Saleem; Abdullah (2013). Genetic analysis of quantitative yield related traits in spring wheat (*Triticum aestivum*, L.). American-Eurasian J. of Agric. & En. Sci., 13(9):1239-1245.

Griffing, B. (1956). Concept of general and specific combining ability in relation to Diallel crossing System- Aust. J. Biol. Sci., 9:463-493.

Hendawy, F.A.; H.A. Dawwam and Marwa M. El-Nahas (2007). Triple test cross analysis of some quantitative characters in bread wheat (*Triticum aestivum*, L.). Minufiya J. Agric. Res., 34(2):1055-1069.

Ismail, S.K.A. (2015). Heterosis and combining ability analysis for yield and its components in bread wheat (*Triticum aestivum*, L.). International Journal of Current Microbiology and Applied Sciences, 4(8):1-9.

Jaiswal, K.K.; Praveen Pandey; Shailesh Marker and P.J. Anurag (2010). Heterosis studies for improvement in yield potential of wheat (*Triticum aestivum*, L.). AAB Bioflux,2(3):273-278.

Jones, R.M. (1956). Analysis of variance of the half Diallel Table. Heredity, 20:117-121.

Koumber, R.M.; I.E.M. El-Beially and G.A. El-Shaarawy (2006). Study of genetic parameters and bath coefficients for some quantitative characters under two levels of nitrogen fertilizer. Al-Azhar J. Agric. Res., 43:99-122.

Kumar, A.; V.K. Mishra; R.P. Vyas and V. Singh (2011). Heterosis and combining ability analysis in bread wheat (*Triticum aestivum*, L.). J. Plant Breed. and Crop Sci., 3(10):209-217.

Mather, K. and J.L. Jinks (1982). Biometerical Genetics. 3rd Ed. Chapman and Hull, London, 382 P.P.

Mekhamer, K.I.S. (2009). Inheritance of some important agronomic traits in common wheat. Ph. D. Thesis, Fac. Agric. Moshtohor Banha, Univ. Egypt.

Moshref, M.K. (2006). Heterosis and combining ability in some bread wheat crosses. J. Agric. Sci., Mansoura Univ., 31(3):1213-1220.

Moussa, A.M. and A.A. Morad (2009). Estimation of combining ability for yield and its components in bread wheat (*Triticum aestivum*, L.). Minufiya J. Agric. Res., 34(3):1191-1205.

Munaiza Baloch; A.W. Baloch; M.J. Baloch; R.A. Kandhro; M. N. Kandhro; D.K. Mandan; G.M. Baloch; Naila Gandahi; A.M. Baloch and N.A. Baloch (2016). Analysis of genetic divergence in exotic bread wheat genotypes. Pure and Applied Biology, 5(1):26-30.

Nawaz, M.S.; B.A. Ansari; M.B. Kumbhar and M.I. Keerio (2015). Combining ability estimates of parents and F_1 hybrids for economically useful traits of hexaploid wheat (*Triticum aestivum*, L.). International Journal of Biology and Biotechnology, 12(2):291-298.

Pankaj Garg; R.P. Saharan; Mamta Gupta and Renu Munjal (2015). Heterosis studies for grain yield and its components in wheat (*Triticum aestivum*, L. Em. Thell) under normal and drought conditions. The Bioscan, 10(2 Supplement) :721-728.

Poodineh, M. and M.R.N. Rad (2015). Genetic components for physiological parameters estimates in bread wheat (*Triticum aestivum*, L.). Annual Research & Review in Biology, 7(3):163-170.

Shehab El-Deen, M.T.M. (2008). Genetic studies on earliness and drought tolerance in bread wheat. M. Sc. Thesis, Fac.Agric. Cairo. Univ., Egypt.

Steel, R.G.D. and J.H. Torrie (1980). Principles and Procedures of Statistics. Second Edition, New York: Mc. Graw-H-11.

Sulaiman, H.S. (2011). Heterosis and combining ability in wheat. Egypt. M. Sc. in Agron. 101-110 Faculty of Agriculture, Cairo Univ., Egypt.

Usman Ijaz; Smiullah and Muhammad Kashif (2013). Genetic study of quantitative traits in spring wheat through generation means analysis. American-Eurasian J. of Agric. & Environmental Sci., 13(2):191-197.

Yadav, N.K.; P.C. Yadav; Shweta; R.K. Yadav; Lokendra Singh and Yogesh Pandey (2014). Combining ability and heterotic response for yield and its attributing traits in wheat (*Triticum aestivum*, L.). Intern. J. of Plant Sciences (Muzaffarnagar), 9(2):377-380.

Zahid Akram; Ajmal, S.U.; Khan, K.S.; Rahmatullah Qureshi and Muhammad Zubair (2011). Combining ability estimates of some yield and quality related traits in spring wheat (*Triticum aestivum*, L.). Pakistan J. of Botany 43(1):221-231.

دراسات وراثيه علي المحصول ومكوناته لأربع أصناف من قمح الخبز

خليفه عبد المقصود زايد[1]، أشرف حسين عبد الهادى[1]، رمضان عبد السلام رمضان[2] و أحمد صلاح مصطفى لاشين[2]

[1] قسم الوراثة – كلية الزراعة – جامعة المنصورة.

[2] قسم بحوث القمح – معهد بحوث المحاصيل الحقلية - مركز البحوث الزراعية.

إستخدم هذا البحث أربع أصناف من قمح الخبز لدراسة بعض صفات التبكير وصفات المحصول ومكوناته. وقد أستخدم تحليل الداى اليل الجزئى 4 × 4 حيث أجريت كافة التهجينات الممكنة بين الآباء مع إستبعاد الهجن العكسية لإنتاج بذور الـ 6هجن. وقد تم تقييم كافة التراكيب الوراثية للهجن والآباء وكذلك تم عمل تحليل التباين المشترك بين الأصناف المقيمه جميعاً فى الموسمين. وأمكن تلخيص أهم النتائج المتحصل عليها فيما يلى : أشارت نتائج تحليل التباين إلى وجود فروق معنويه بين الآباء والهجن فى جميع الصفات المدروسة حيث كان الأب الأول (P1) الأبكر فيما كان الأب الرابع (P4) الأعلى لبعض صفات المحصول ومكوناتة. كما أظهرت النتائج أن الهجينين (P1 x P4), (P2 x P4) كانا الأفضل فى صفة التبكير وأن الهجن الأربع (P1 x P2), (P1 x P3), (P2 x P3) و (P3 x P4) كانت الأفضل فى صفات المحصول ومكوناتة. أشارت نتائج تحليل التباين المرتبطة بالقدره العامه والخاصة على الإئتلاف ظهور قيماً معنوية لجميع الصفات المدروسة في كلا الموسمين. وأظهرت النتائج أن Gemmeiza 9 كان له قدرة عالية على التألف لصفات التبكير فيما كان Gemmeiza 10 له قدرة عالية على التألف لمعظم صفات المحصول ومكوناتة في الموسمين. أوضحت العلاقة بين Wr/Vr أهمية تأثيرات الفعل السيادى للجين المتحكم فى كل الصفات. وأوضحت النتائج أن كلاً من التباين الراجع للفعل الجينى المضيف والفعل السيادى يتحكمان فى هذه الصفات. وكانت قيمة التباين الراجع للفعل المضيف "a" أقل من قيمة التباين الراجع للفعل السيادي لكل الصفات في كلا الموسمين. فيما وأوضحت النتائج أن معامل التوريث بالمعنى الضيق كان ذا قيمة منخفضة لجميع الصفات فى الموسمين. وقد أوضحت النتائج أن قيمة H2، H1 والتى تشير إلى أن السيادة معنوية عن القيمة المضيفة لأكثر الصفات في الموسمين. أظهر التباين البيئى (E) أن جميع الصفات تتأثر بدرجة كبيرة بالعوامل البيئية.