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Genetical Studies on some Bread Wheat Crosses under Three Nitrogen Levels

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Cross Mark

ABSTRACT

Heterosis and nature of genetic effects on plant growth and yield characters were studied in a 7x7 half-diallel crosses, without reciprocals, in the F1 generation in wheat to define and select efficient and prospective materials to be used in hybridization programs in order to improve grain yield of wheat in Egypt. Parents, F1 were evaluated using a split-plot trail in randomized complete block design (RCBD) with three replications for quantitative characters in 2019/2020 season. Significant genotypes mean squares of parents and crosses were obtained for all characters. Significant heterosis in F1 generation was obtained for all studied characters. The useful heterosis of grain yield/ plant relative to better parent varied from 1.667 to 23.457% in F1 crosses. Two crosses, viz. P1xP2 and P1XP4 had the best values of heterosis for grain yield. General (GCA) and specific (SCA) combining ability mean squares were significant for all characters. Besides, MSe (GCA)/ MSe (SCA) ratios indicated the relative importance of additive gene action in their inheritance for all the characters except number of spikes per plant. The two parents P1 and P5 gave the highest positive significant iĝ effects for grain yield plant-1in F1 generation. The three crosses P1xP2, P3xP6 and P4xP$_5$ showed significantly desirable heterotic effects for most studied traits. Generally.

***Keywords:** Wheat, (Triticum aestivum* L.), *Diallel analysis, Gene action, combining ability.*

INTRODUCTION

Wheat is the most important cereal crop in Egypt. Increasing wheat production to narrowing the gap between production and consumption is vital in Egypt. Big variation in wheat productivity in different parts of the country should be reduced to achieve a projected high productivity, through diversification of wheat breeding programs and developing new set of wheat cultivars with high yielding.

Heterosis is a complex phenomenon, which depends on the balance of different combinations of gene effects as well as on the distribution of plus and minus alleles in the parents of a mating system. In self-pollinated crops, like wheat, the scope for utilization of heterosis mainly depends upon the direction and magnitude of heterosis. Heterosis over better parent may be useful in identifying the best crosses but these hybrids can be of immense practical value if they involve the best cultivars of the area (Prasad *et al*., 1998). Production of wheat hybrid seed is expensive and the economics of the commercial production of hybrid wheat have not yet been worked out. Further advancement in yield of this important species requires adequate information regarding the nature of the combining ability of the parents available in a wide array of genetic material to be used in the hybridization programme and also the nature of gene action involved in the expression of traits of economic importance. According to Arunachalam (1976), Baker (1978), Esmail (2002), Joshi *et al* (2004), Hasnain *et al* (2006), Farooq *et al* (2010), EL-Hosary and Nour EL Deen (2015), AL Saadoon *et al* (2017), EL-Gammaal and Yahya (2018) and Yahya (2020), the combining ability is a most reliable biometrical tool to circumvent plant breeding programs. The diallel analysis also provides a unique opportunity to test several lines in all possible combinations.

The present study is aimed at estimating heterosis in F$_1$ and comparing combining ability obtained those of F$_1$ resulting from a set of diallel crosses for certain quantitative traits of wheat.to be used in breeding programs to improve wheat productivity.

MATERIALS AND METHODS

Seven parents of bread wheat were selected for this study representing a wide range of variability. The code number, names and pedigree for the genotypes are presented in Table 1.

Table 1. The code number, name, pedigree and selection history of the studied parental bread wheat varieties and lines.

No.	Variety	Pedigree	Origin
1	Giza 171	Sakha 93 /Gemmieza 9. GZ2003 –101-1GZ - 4GZ –1GZ - 2GZ - 0GZ.	Egypt
2	Misr 1	OASIS / SKAUZ //4*BCN/3/2*PASTOR CMSS00Y01881T-050M-030Y-030M-030WGY-33M-0Y-0S	Egypt
3	Misr 2	SUPER-KAUZ/BAVIACORA-92[3589][3686]	Egypt
4	Gemmeiza 12	OTUS /3/SARA/THB/VEE GMSS97YOO227S-5Y-010M-010Y-010M-2Y-1M-0Y-0GM	Egypt
5	Gemmeiza 10	MAYA74"S"/ON//1160-147/3/BB/GLL/4/CHAT"S"/5/CROW"S"	Egypt
6	Gemmeiza 9	ALD “S” / HUAC “S” // CMH 74 A. 630 / SX	Egypt
7	Sids 1	HD2172 / Pavon "S"//1158.57/Maya74 "S" SD46-4SD-2SD-1SD- 0SD	Egypt

These parents were crossed in all possible combinations excluding reciprocals during 2018/2019 growing season, giving seeds of 21 crosses from F$_1$. In 2019/2020 season, the experiment involved parents and F$_1$ crosses, under three nitrogen levels (25, 50 and 75 kg N/fed.). The experiment was conducted in split-plots trail

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in a randomized complete block design (RCBD) with three replications at Etay El-Baroud Agricultural Research Station, El-Bheira Governorate. Egypt. Plots of parents and F_1's consisted of three rows, with 3 meter long and 30 cm apart, plants within row were 20 cm apart. The recommended agricultural practices for wheat production were applied. Data were recorded on individual plant basis: 10 for F_1 and parents were chosen randomly from each plot. The following traits were measured:Heading date , No.spikes plant , Plant height, No. grains spike, 1000-grain weight, Grain yield plant , Flag leaf area, Chlorophyll a, Chlorophyll b and Total protien.

Heterosis relative to better parent was computed according to Bhatt (1971) as a deviation of F_1 mean performance from the better parent mean value. The general and specific combining ability estimates were determined according to Griffing (1956) for method 2 model 1.

RESULTS AND DISCUSSION

Analysis of variance of F_1 generation for all studied characters is shown in (Table 2). genotypes, parents and crosses mean squares were significant for all traits in F_1 generation. The parents *vs* crosses mean squares were significant or highly significant for all studied characters for most characters studied in the F_1 under 25, 50, and 75 kg N/fed. Significant differences among genotypes for total yield and related characters in different sets of material of wheat were reported by Joshi *et al* (2004), Seleem and Koumber (2011), EL-Hosary and Nour EL Deen (2015), AL Saadoon *et al*. (2017), EL-Gammaal and Yahya (2018) and Yahya (2020),.

Mean performance values of the parents and F_1 generation for all traits are presented in (Table 3). For heading date, the F_1 hybrids of P1xP4, P1xP5 and P4xP7 had the lowest values under 50, 75 kg N/fed., levels and in combined analysis, respectively, hybrid P4xP7 was the latest cross in days to heading with value 111 day.

For No.spikes plant, the hybrids P1xP2, P2xP7 and P1xP5 had the highest values under 25, 50, 75 kg N/fed.

For plant height, the two F_1 hybrids: P2x P5 and P2xP6 showed the lowest values. On the other hand, the hybrid P1xP6 had the highest values under 25 and 75 kg N/fed, dwarf plants are more lodging resistant while tall plants are preferred for straw purpose thus preference depends upon the breeding objective .El-Gammal and Morad (2019)

The F_1 hybrids P1xP2, P5xP6 and P5xP7 had the highest number of No. grains spike^{-1}. For 1000-kernel weight, F_1 hybrids of P1xP2, P1xP3, P1XP4, P1xP5, P1XP6, P3XP4 and P4XP5 the highest values for this character. The F_1 hybrid P1xP2, P1xP3, P1XP5, P1xP6, P3XP7, P4XP5, P5XP6 and P5XP7 were the highest hybrids for grain yield/plant. As for flag leaf area, the F_1 hybrids P3xP7, P1xP7 and P1XP6 exhibited the highest value under three nitrogen levels respectively. As for total protein, chlorophyll a, chlorophyll b, the F_1 hybrids P3xP4 and P3XP6, the crosses P1xP5, P2xP7 and P2XP3, the crosses P1xP3, P3xP4 and P4XP5, exhibited the highest value under three nitrogen levels respectively.

Heterosis

As an indication of average of heterosis in F_1 for all crosses were significant for all the studied characters except No. of spikesplant^{-1} and total protein under 25, 75 kg N/fed. (Table2). The heterotic effects relative to better parent are presented in (Table 4). The most significant and desirable heterosis relative to better parent was exhibited by three crosses P2XP6 under 75 kg N/fed, P4XP7under 25,50,75 kg N/fed and P5XP6 under 25 kg N/fed for days to heading, crosses P2XP7 under 25,50,75 kg N/fed levels and P6XP7 under 25,75 kg N/fed levels for No. of spikes plant^{-1}, crosses P2xP3 under 25 kg N/fed, P3xP5 under 25,50,75 kg N/fed levels and P4xP5 under 75 kg N/fed for plant height, tow crosses P2xP4 under 25,50 kg N/fed levels and P5xP6 under 75 kg N/fed for No. of grains spike^{-1}, crosses P2xP3, P3xP4 and P3xP5 for 1000-grain weight under 25,50,75 kg N/fed levels , cross P6xP7 under 25,50,75 kg N/fed levels for flag leaf area, crosses P1xP2 and P3xP7 under 25,50 kg N/fed levels , P1xP7under 75 kg N/fed for total protein, crosses P1xP5 under 25,50 kg N/fed, P2xP7 under 50 kg N/fed and P4xP5 under 75 kg N/fed for chlorophyll a, crosses P1xP3under 25,75 kg N/fed , P2xP7under 50 kg N/fed and P4xP5 under 75 kg N/fed for chlorophyll b.

For Grain yield/plant crosses p1xp2, p1xp4, p1xp7 and p4xp6, under 25 kg N/fed., were highly significantly positive, crosses p2xp6 and p2xp7 under 50 kg N/fed., were highly significantly positive, in addition, crosses p1xp5, p4xp5, p5xp7 and p6xp7were also highly significantly positive under 75 kg N/fed.

These hybrids exhibited heterosis for one or more of the contributing characters. Significant positive heterotic effects relative to higher yielding parent were obtained by Fonseca and Patterson (1968), Prasad *et al* (1998), Abdullah *et al* (2002), EL-Hosary and Nour EL Deen (2015), AL Saadoon *et al*. (2017), EL-Gammaal and Yahya (2018) and Yahya *et al* (2018).

Table 2. Significance of mean squares from ordinary analysis for all characters studied in F_1 generation.

Source of variation		d.f	Heading date (day) N25	N50	N75	Comb	No. spikes plant-1 N25	N50	N75	comb	Plant height (cm) N25	N50	N75	Comb
Enviroment		2				191.96**				456.78**				1840.36**
Rep.xEnv.	2	6	0.01	1	4.96**	1.99**	0.51	0.47	0.81	0.6	3.68	0.23	20.31**	8.07
Genotypes	27	27	54.07**	18.68**	26.47**	60.78**	2.40**	3.20**	7.96**	6.22**	108.45**	77.98**	36.47**	161.30**
Parents	6	6	18.52**	16.33**	40.11**	54.99**	2.52**	1.98**	8.98**	5.95**	133.22**	207.67**	94.17**	402.79**
Crosses	20	20	63.99**	20.15**	21.60**	65.33**	2.46**	3.68**	7.78**	6.54**	101.87**	42.95**	20.95**	94.89**
Pxf1	1	1	69.14**	3.34*	42.10**	4.45**	0.56	1.07	5.47**	1.4	91.32**	0.44	0.64	40.44**
G. xEnv.		54				38.44				7.34				61.6
p.xEnv.		12				19.97				7.53				32.27
crossesxEnv.		40				40.41				7.38				70.88
P1vsF1xEnv.		2				110.13				5.7				51.96
Error	54	162	0.53	0.59	0.4	0.51	0.42	0.46	0.51	0.46	8.41	3.02	3.98	5.14

Table 2. Cont.

Source of variation		d.f	No. grains spike-1 N25	N50	N75	Comb	1000-grain weight(g) N25	N50	N75	Comb	Grain yield plant-1(g) N25	N50	N75	Comb
Enviroment		2				5267.20**				831.62**				2444.67**
Rep.xEnv.	2	6	26.24	7	10.02	14.42	1.68	2.21	2.78	2.23	4.57	10.39	1.64	5.53
Genotypes	27	27	125.19**	87.97**	146.33**	221.01**	151.89**	139.24**	133.42**	386.98**	34.12**	52.09**	101.68**	112.13**
Parents	6	6	88.32*	57.37*	168.09**	196.01**	289.76**	260.71**	204.64**	736.02**	114.22**	147.03**	122.10**	233.45**
Crosses	20	20	123.51**	78.38**	139.71**	192.39**	87.36**	67.92**	48.01**	162.57**	11.19**	22.33**	97.78**	78.57**
Pxf1	1	1	379.87**	463.60**	148.27**	943.36**	615.17**	836.95**	1414.32**	2781.01**	12.17	77.74**	57.31*	55.46**
G. xEnv.		54				138.48				37.57				75.76
p.xEnv.		12				117.77				19.09				149.9
crosxEnv.		40				149.21				40.72				52.73
P1vsF1xEnv		2				48.38				85.43				91.76
Error	54	162	28.04	20.53	14.27	20.94	3.31	2.17	2.23	2.57	4.42	8.13	11.41	7.99

Table 2. Cont.

Source of variation		d.f	flag leaf area(cm^2) N25	N50	N75	Comb	chlorophyll a N25	N50	N75	Comb	chlorophyll b N25	N50	N75	Comb
Enviroment		2				3907.24**				0.17**				0.98**
Rep.xEnv.	2	6	0.05	0.45	0.02	0.17	0.01**	0.01**	0.02**	0.01**	0.00**	0.02**	0.01**	0.01**
Genotypes	27	27	264.57**	468.44**	506.74**	1069.99**	0.17**	0.17**	0.19**	0.21**	0.02**	0.03**	0.03**	0.04**
Parents	6	6	190.30**	287.87**	648.60**	910.73**	0.14**	0.27**	0.21**	0.40**	0.02**	0.04**	0.03**	0.05**
Crosses	20	20	240.09**	458.98**	442.11**	979.90**	0.17**	0.15**	0.19**	0.15**	0.02**	0.03**	0.03**	0.03**
Pxf1	1	1	1199.61**	1741.06**	948.31**	3827.48**	0.21**	0.00**	0.10**	0.17**	0.04**	0.01**	0.01**	0.04**
G. xEnv.		54				169.76				0.32				0.04
p.xEnv.		12				216.04				0.22				0.04
crosxEnv.		40				161.28				0.36				0.05
P1vsF1xEnv.		2				61.5				0.14				0.02
Error	54	162	0.67	0.61	0.57	0.62	0.01	0.01	0.01	0	0.001	0.002	0.001	0.001

Table 2. Cont.

Source of variation		d.f	Total protein N25	N50	N75	Comb
Enviroment		2				1758.85**
Rep.xEnv.	2	6	9.37**	0.87	3.18**	4.47**
Genotypes	27	27	8.15**	7.34**	8.70**	6.36**
Parents	6	6	2.94**	5.33**	16.33**	7.84**
Crosses	20	20	10.12**	7.79**	6.84**	6.04**
Pxf1	1	1	0.03	10.36**	0.12	3.86**
G. xEnv.		54				17.83
p.xEnv.		12				16.76
crosxEnv.		40				18.71
P1vsF1xEnv.		2				6.65
Error	54	162	0.41	0.47	0.58	0.49

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

Table 3. Mean performance of all studied genotypes (parents and F_1 generation) for all studied traits.

Genotypes	Heading date (day) N25	N50	N75	Combined	No. spikes plant-1 N25	N50	N75	Combined
Giza 171 (P_1)	109k	111.33no	113.66mn	111.33p	6.73 a-f	7.53 b-h	12.2 a-c	8.82 b-e
misr 1 (P_2)	112.33h	112.66l	122.33b	115.77g	6.16 c-h	8.7 ab	10.06 g-j	8.31 d-j
misr 2 (P_3)	112h	116def	116.33gh	114.77h	7.38 a-c	7.46 b-i	10.33 e-i	8.39 c-i
Gemmieza 12 (P_4)	112h	114ij	116ghi	114jk	7.16 a-d	6.5 f-i	12.44 ab	8.70 b-f
Gemmieza 10 (P_5)	116d	118c	119.66e	117.88d	5.70 e-i	8 b-e	10.37e-i	8.02 g-l
Gemmieza 9 (P_6)	116d	115.66efg	123.66a	118.44c	5.33 g-i	6.4 g-i	9.66 h-k	7.13 n0
sids 1 (P_7)	112h	112.66l	116.66g	113.77kl	5 hi	7.73 b-g	7.25 m	6.66 o
(P_1 * P_2)	110j	110.33o	112.66n	111p	7.76 a	8 b-e	10.02 g-j	8.59c-g
(P_1 * P_3)	113g	113kl	114.66kl	113.55lm	5.33 g-i	7 d-i	11.9 b-d	8.07 f-l
(P_1 * P_4)	111i	113.66jk	113.33n	112.66n	4.83 i	6.66 e-i	8.5 k-m	6.66 o
(P_1 * P_5)	111i	111.66mn	114.66kl	112.44n	4.73 i	5 j	13.5 a	7.74 i-n
(P_1 * P_6)	113g	113.66jk	116.66g	114.44hi	5.5 f-i	7.75 b-f	8.66 k-m	7.30 mn
(P_1 * P_7)	115e	115.33fgh	116ghi	115.44g	6.16 c-h	6.73 e-i	10.73 d-i	7.87h-m
(P_2 * P_3)	113g	114.66hi	115jkl	114.22ij	7 a-d	7.83 b-f	11.66 b-f	8.83 b-d
(P_2 * P_4)	111i	112.66l	114.33lm	112.66n	7.5 ab	7.6 b-h	9.36 i-l	8.15 e-k
(P_2 * P_5)	131a	114.66hi	115.33ijk	120.33a	6 d-i	6.33 h-j	11.66 b-e	8 g-l
(P_2 * P_6)	113g	113.66jk	114.66kl	113.77kl	6 d-i	8.36 bc	10.98 c-h	8.45 c-h
(P_2 * P_7)	116d	116.66d	119.33e	117.33e	7.31 a-c	9.76 a	11.86 b-d	9.64 a
(P_3 * P_4)	118c	116def	120.66cd	118.22cd	5.58 e-i	7 d-I	10.16 g-j	7.58 k-n
(P_3 * P_5)	119b	116.66d	120de	118.55bc	5.66 e-i	5 j	8.86 j-l	6.51 o
(P_3 * P_6)	119b	115gh	119.66e	117.88d	6.66 a-f	6.63 f-i	9.73 g-k	7.67 j-n
(P_3 * P_7)	114f	116.66d	116.33gh	115.66g	7.66a	8.25 b-d	11.1 b-g	9.00 bc
(P_4 * P_5)	116d	115.66efg	118f	116.55f	6.5 a-g	7.5 b-h	11.73 b-d	8.57 c-g
(P_4 * P_6)	112h	112.33lm	115.66hij	113.33m	6.5 a-g	6.16 ij	12 b-d	8.22 d-k
(P_4 * P_7)	111i	111no	113.66mn	111.88o	7.33 a-c	8.36 bc	13.33 a	9.67 a
(P_5 * P_6)	113g	116.33de	121c	116.77f	6.83 a-e	7.25 c-i	8.23 lm	7.43 l-n
(P_5 * P_7)	115e	120.66a	121c	118.88b	6.33 b-g	6.93 d-i	12 b-d	8.42 c-h
(P_6 * P_7)	118c	119.66b	118f	118.55bc	7.16 a-d	7.36 c-i	13.33 a	9.28 ab

Table 3. Cont.

Genotypes	Plant height (cm)				No. grains spike			
	N25	N50	N75	Combined	N25	N50	N75	Combined
Giza 171 (P_1)	97.56a-d	104.6a	107.31ab	103.16a	64.16a	64.16ab	74.56b-c	64.35ab
misr 1 (P_2)	90.33e-h	99.93b-f	101.2e-h	97.15e-i	54.33a-d	56.36b-e	62.03ghi	56.91d-h
misr 2 (P_3)	83.6jkl	82.86o	96.83jkl	87.78n	50.66b-e	58.46bcd	56.66hij	54.98f-i
Gemmieza 12 (P_4)	87.33g-j	93.83jk	97.33ijk	92.8klm	48.66b-e	58.33bcd	77.33b	63.16abc
Gemmieza 10 (P_5)	80.66kl	88.83mn	93.3l	87.61n	45.33c-g	67.66a	69.66c-f	63.88ab
Gemmieza 9 (P_6)	97.5a-d	103.13ab	107.66a	102.76ab	38.23fg	60.33abc	72.16bcd	65.55a
sids 1 (P_7)	94.33c-f	103ab	104.83a-e	100.72bcd	35.66g	55.5b-e	63.33fgh	55.16f-i
(P_1*P_2)	100.93ab	102.16abc	103.16c-g	102.08abc	58.83ab	55.5b-e	61.33g-j	55.67e-i
(P_1*P_3)	96.33bcd	97.3f-i	104.73a-e	99.45de	55.33abc	52.76cde	64.5efg	57.2c-h
(P_1*P_4)	99abc	100.66b-e	101.5e-h	100.38cd	55abc	54.5cde	75.5bc	61.66a-e
(P_1*P_5)	95.73b-e	96.66f-j	102.5d-g	98.3d-h	54.83a-d	53.16cde	71.5b-e	59b-g
(P_1*P_6)	102a	101bcd	106.5abc	103.16a	54.5a-d	57.5b-e	70c-f	60.94a-f
(P_1*P_7)	96.33bcd	101bcd	101e-i	99.44def	54.33a-d	61.23abc	64.73efg	57.54c-h
(P_2*P_3)	97a-d	99.5c-g	101.86e-h	99.45def	54.33a-d	54cde	63.33fgh	57.38c-h
(P_2*P_4)	96.66a-d	97.76d-h	96.36kl	96.93e-i	53.9bcd	61.23abc	65.43d-g	61.83a-e
(P_2*P_5)	80l	94.83h-k	102.66d-g	92.5lm	53.83bcd	53cde	55.83ij	51.83hij
(P_2*P_6)	84.73i-l	86.56n	101.16e-h	90.82m	52.33b-e	48.63ef	55.66ij	48.87jk
(P_2*P_7)	92d-g	94.16ijk	105.83a-d	97.3e-i	52.33b-e	56.66b-e	65.5d-g	56.94d-h
(P_3*P_4)	93.73c-f	90.6lm	103.66b-f	96hij	50.2b-e	50.9de	63.16fgh	56.18d-i
(P_3*P_5)	89.66f-i	96.5g-j	97j-l	94.38jkl	49.83b-e	41.73f	54.03j	44.37k
(P_3*P_6)	94c-f	100.83b-e	100.23f-j	98.35d-h	49.5b-e	54.83cde	58.56g-j	54.3g-j
(P_3*P_7)	92.5d-g	97.33f-i	101.5e-h	97.11e-i	48.66b-e	54.5cde	63.43fgh	57.27c-h
(P_4*P_5)	84.73i-l	93kl	101.5e-h	93.07klm	46.66c-f	53.5cde	59.83g-j	50.52ijk
(P_4*P_6)	97.23a-d	99c-g	100f-k	98.74d-g	46.66c-f	50def	65.66d-g	50.44ijk
(P_4*P_7)	89.33f-i	95.33h-k	102.33d-g	95.66ij	46.66c-f	54.33cde	69.66c-f	57.55c-h
(P_5*P_6)	85.83h-k	94.73h-k	98.4h-k	92.98klm	44.33d-g	58.23bcd	83.66a	62.07a-d
(P_5*P_7)	89f-j	95.46h-k	98.16h-k	94.21jkl	42.33efg	67.33a	65.83d-g	59.5b-g
(P_6*P_7)	88g-j	97.66e-h	99.66g-k	95.1ijk	37.36fg	55cde	65.66d-g	57.11c-h

Table 3. Cont.

Genotypes	1000-Grain weight (g)				Grain yield plant(g)			
	N25	N50	N75	Combined	N25	N50	N75	Combined
Giza 171 (P_1)	52.8a	55.1a	55.2a	54.36a	19.16c-h	37a	41.33ab	32.5a
misr 1 (P_2)	21.13o	27.8l	29.8m	26.24o	7.66i	17.33g	35cde	20ij
misr 2 (P_3)	28.77n	29.16l	32.41m	30.11n	23.16bc	25cde	34.16c-f	27.44b
Gemmieza 12 (P_4)	33.06m	35.43k	35.78l	34.76m	19c-h	21.33d-g	31.16c-h	23.83d-g
Gemmieza 10 (P_5)	35.78j-m	43.28ef	41.63jk	40.23jk	27.9a	30.5b	32.5c-g	30.3a
Gemmieza 9 (P_6)	40.1hi	41.95fg	40k	40.68ijk	20b-h	21.83d-g	26.95g-l	22.92fgh
sids 1 (P_7)	36.67jkl	38.01j	40.03k	38.24l	17.37fgh	18.75fg	21.16l	19.09j
(P_1*P_2)	52.15ab	53.73ab	55.4a	53.76a	23.66b	25.66bcd	30d-i	26.44bc
(P_1*P_3)	49.4bc	50.9cd	51.56b-e	50.62b	18.73d-h	21.33d-g	37.06bc	25.71bcd
(P_1*P_4)	42.53e-h	44.36ef	54.3ab	47.06de	21.66b-e	23c-g	32.33c-g	25.66bcd
(P_1*P_5)	46.43cd	51.47bc	53.48abc	50.46b	20b-h	27.5bc	46.23a	31.24a
(P_1*P_6)	49.2bc	50.93cd	51.53b-e	50.55b	19.16c-h	26.16bcd	30d-i	25.11b-f
(P_1*P_7)	43.83def	48.83d	51.83b-e	48.16cd	19.83b-h	21.25d-g	31.25c-h	24.11c-g
(P_2*P_3)	35.5j-m	45.16e	44.73hi	41.8hij	19.25c-h	19.33fg	30.5c-i	23.02fgh
(P_2*P_4)	40.36ghi	40.98gh	45.45gh	42.26hi	18.14e-h	18.83fg	25.33h-l	20.76hij
(P_2*P_5)	43.1d-h	48.91d	50.86cde	47.62de	19c-h	20efg	20.83l	19.94ij
(P_2*P_6)	43.23d-h	44.1ef	46.63gh	44.65fg	19.5c-h	22.5c-g	27.5f-l	23.16e-h
(P_2*P_7)	33.9lm	39.53hij	45.06hi	39.5kl	17.16gh	20efg	23jkl	20.05ij
(P_3*P_4)	35.05klm	51.73bc	51.73b-e	46.17ef	21.25b-g	23.66c-f	31.62c-h	25.51b-e
(P_3*P_5)	46.23cd	48.9d	50.38def	48.50cd	16.16h	18.25fg	22kl	18.80j
(P_3*P_6)	40.53f-i	41.65fgh	42.71ij	41.63ij	20b-h	21.33d-g	24.5i-l	21.94ghi
(P_3*P_7)	35.4j-m	37.73jk	41.6jk	38.24l	22.5bcd	23.73c-f	32.66c-g	26.3bc
(P_4*P_5)	45.53de	51.23bcd	52.4bcd	49.72bc	22.5bcd	21.6d-g	36.23bcd	26.8b
(P_4*P_6)	32.9m	38.9ij	49.33ef	40.37jk	20.33b-h	21.16d-g	27.66f-k	23.05e-h
(P_4*P_7)	43.6d-g	43.74ef	45.53gh	44.29g	18.08e-h	19.77efg	27.88f-k	21.91ghi
(P_5*P_6)	38.6ij	45.23e	46.6gh	43.47gh	21.5b-f	26.25bcd	27.5f-l	25.08b-f
(P_5*P_7)	38.23ijk	42.9efg	44.3hi	41.81hij	22.83bcd	26.16bcd	33.33c-g	27.44b
(P_6*P_7)	40.5f-i	44.36ef	48.13fg	44.33g	20b-h	21d-g	29.33e-j	23.44d-g

Table 3. Cont.

Genotypes	flag leaf area(cm^2)				Chl A			Chl B		
	N25	N50	N75	Combined	N25	N50	N75	N25	N50	N75
Giza 171 (P_1)	66.54hi	79.80d	92.91c	79.75e	1.63i	1.51m	1.46k	0.619ghi	0.682gh	0.40i-l
misr 1 (P_2)	49.25v	49.12z	48.88z	49.08z	1.85d	1.61k	2.09ab	0.679cd	0.689gh	0.670a
misr 2 (P_3)	62.61L	62.63o	69.17q	64.80o	1.58j	2.17a	1.70f	0.606hi	0.934a	0.510cde
Gemmieza 12 (P_4)	47.14X	59.91q	76.90n	61.32q	1.96b	2.00c	1.70f	0.758b	0.870b	0.541c
Gemmieza 10 (P_5)	60.73m	58.53s	78.81j	66.02n	1.78f	1.6j	1.83e	0.681cd	0.672hi	0.598b
Gemmieza 9 (P_6)	47.57w	54.10w	60.63v	54.10x	1.70h	1.45o	1.70f	0.673d	0.629j	0.525cd
sids 1 (P_7)	52.38t	55.39u	59.32x	55.69w	1.30s	1.34r	1.25o	0.497n	0.638ij	0.356l
(P_1*P_2)	72.66d	66.85m	77.48l	72.33j	1.86d	1.60kl	1.88d	0.595ij	0.676h	0.606b
(P_1*P_3)	73.52c	79.61e	83.86h	79.00f	1.54kl	1.71i	1.89d	0.826a	0.732e	0.553c
(P_1*P_4)	56.51p	66.53n	75.50o	66.18m	1.75g	1.27s	1.48k	0.691cd	0.559k	0.603b
(P_1*P_5)	72.66d	69.69j	81.35i	74.57i	2.23a	1.85e	1.40l	0.667de	0.780d	0.402i-l
(P_1*P_6)	67.34g	87.69c	97.12a	84.05d	1.52l	1.81g	1.28n	0.555kl	0.702e-h	0.362l
(P_1*P_7)	68.11f	94.9a	95.91b	86.30b	1.22t	1.71i	1.60h	0.486n	0.696e-h	0.45fgh
(P_2*P_3)	52.19t	52.48y	54.64y	53.10y	1.68h	1.83fg	2.12a	0.629fgh	0.777d	0.672a
(P_2*P_4)	54.65q	59.88qr	64.15t	59.56s	1.37r	1.49n	1.54ij	0.510mn	0.623j	0.463fg
(P_2*P_5)	53.54r	59.79r	59.80w	57.71u	1.91c	1.43p	1.67g	0.705c	0.608j	0.477efg
(P_2*P_6)	63.25k	79.20f	85.66g	76.04h	1.53kl	1.87d	1.47k	0.644efg	0.834c	0.443ghi
(P_2*P_7)	70.64e	68.52k	92.63d	77.26g	1.55jk	2.08b	1.20p	0.607hi	0.853bc	0.512cde
(P_3*P_4)	56.31p	62.44p	65.85r	61.53p	1.48mn	2.00c	1.55i	0.570jk	0.908a	0.494def
(P_3*P_5)	51.17u	54.9v	71.66p	59.24t	1.18u	1.49n	1.93c	0.447o	0.685gh	0.621b
(P_3*P_6)	59.75n	58.28t	64.91s	60.98r	1.51lm	1.37q	1.34m	0.571jk	0.561k	0.394jkl
(P_3*P_7)	76.67b	87.65c	88.58f	84.30c	1.48no	1.37q	1.34m	0.508mn	0.570k	0.369kl
(P_4*P_5)	53.18s	53.61x	62.31u	56.36v	1.45op	1.63j	2.07b	0.534lm	0.693fgh	0.674a
(P_4*P_6)	65.77j	67.17l	81.43i	71.45k	1.41q	2.0c	1.38l	0.560k	0.784d	0.415h-k
(P_4*P_7)	66.75h	72.78i	77.58k	72.37j	1.61i	1.77h	1.65g	0.599i	0.717efg	0.481d-g
(P_5*P_6)	58.66o	74.45g	75.41o	69.51l	1.82e	1.84ef	1.51j	0.647ef	0.780d	0.439g-j
(P_5*P_7)	66.45i	73.74h	77.07m	72.42j	1.43pq	1.59l	1.62h	0.561k	0.671hi	0.44ghi
(P_6*P_7)	82.18a	89.07b	89.90e	87.05a	1.42q	1.76h	1.62h	0.527m	0.729ef	0.522cde

Table 3. Cont.

Genotypes	Total protein		
	N25	N50	N75
Giza 171 (P_1)	5.08r	10.16n	12.68r
misr 1 (P_2)	5.93o	12.82fg	17.52b
misr 2 (P_3)	5.05r	9.26p	18.38a
Gemmieza 12 (P_4)	6.08m	11.78i	13.96n
Gemmieza 10 (P_5)	7.79e	11.51j	13.68p
Gemmieza 9 (P_6)	6.17i	11.30k	16.86e
sids 1 (P_7)	7.12i	9.35p	13.15q
($P_1 * P_2$)	7.55f	12.94ef	14.58l
($P_1 * P_3$)	4.77t	10.45m	14.20m
($P_1 * P_4$)	5.27q	10.68l	12.49s
($P_1 * P_5$)	7.93d	10.21n	16.77e
($P_1 * P_6$)	5.89p	13.34d	14.25m
($P_1 * P_7$)	4.84s	9.88o	17.14d
($P_2 * P_3$)	2.45v	13.01e	16.76e
($P_2 * P_4$)	5.24q	11.92i	14.77k
($P_2 * P_5$)	6.27k	11.80i	13.82o
($P_2 * P_6$)	7.08i	11.16k	17.33c
($P_2 * P_7$)	7.50g	13.49cd	16.19f
($P_3 * P_4$)	8.74a	11.75i	12.77r
($P_3 * P_5$)	6.93j	8.97q	15.72g
($P_3 * P_6$)	1.80w	14.22a	17.48b
($P_3 * P_7$)	8.02c	12.27h	14.58l
($P_4 * P_5$)	6.00n	13.72b	15.81g
($P_4 * P_6$)	6.08m	8.88q	14.96j
($P_4 * P_7$)	7.31n	10.78l	13.06q
($P_5 * P_6$)	7.12i	13.53c	15.57h
($P_5 * P_7$)	3.89u	9.97o	16.86e
($P_6 * P_7$)	8.07b	12.65g	15.43i

Table 4. Heterosis percentage relative to better parent for studied traits in the studied F_1wheat crosses.

Crosses	Heading date(days)			No. spikes plant			Plant height (cm)		
	N25	N50	N75	N25	N50	N75	N25	N50	N75
P1xP2	0.917**	-0.898**	-0.88**	15.404**	-8.046**	-17.814**	3.447**	-2.326**	-3.870**
P1xP3	3.670**	1.50**	0.88**	-27.733**	-7.039**	-2.459**	-1.267**	-6.979**	-2.410**
P1xP4	1.835**	2.10**	-0.29**	-32.589**	-11.465**	-31.672**	1.466**	-3.760**	-5.423**
P1xP5	1.835**	0.30**	0.88**	-29.668**	-37.5**	10.656**	-1.882**	-7.584**	-4.491**
P1xP6	3.670**	2.69**	2.64**	-18.276**	2.922**	-28.962**	4.540**	-3.442**	-1.087**
P1xP7	5.505**	3.59**	2.05**	-8.37**	-12.893**	-12.022**	-1.267**	-3.442**	-5.889**
P2xP3	0.893**	1.78**	-1.15**	-5.149**	-9.962**	12.94**	7.384**	-0.43	0.659*
P2xP4	-0.893**	0	-1.44**	4.603**	-12.644**	-24.705**	7.015**	-2.165**	-4.776**
P2xP5	16.617**	1.78**	-3.62**	-2.755**	-27.203**	12.504**	-11.436**	-5.100**	1.449**
P2xP6	0.593**	0.89**	-6.27**	-2.755**	-3.831**	9.07**	-13.094**	-16.061**	-6.040**
P2xP7	3.571**	3.55**	2.29**	18.585**	12.261**	17.776**	-2.470**	-8.576**	0.957**
P3xP4	5.357**	1.75**	4.02**	-24.345**	-6.292**	-18.274**	7.332**	-3.442**	6.510**
P3xP5	6.250**	0.57**	3.15**	-23.216**	-37.5**	-14.497**	7.167**	8.634**	0.176**
P3xP6	6.250**	-0.58**	2.87**	-9.666**	-11.2**	-5.776**	-3.590**	-2.227**	-6.907**
P3xP7	1.786**	3.55**	0	3.884**	6.727**	7.454**	-1.940**	-5.502**	-3.177**
P4xP5	3.571**	1.46**	1.72**	-9.344**	-6.25**	-5.681**	-2.973**	-0.885**	4.284**
P4xP6	0	-1.46**	-0.29**	-9.344**	-5.128**	-3.537**	-0.274	-4.005**	-7.124**
P4xP7	-0.893**	-1.48**	-2.01**	2.278**	8.236**	7.181**	-5.297**	-7.443**	-2.382**
P5xP6	-2.586**	0.58**	1.11**	19.883**	-9.375**	-20.604**	-11.966**	-8.142**	-8.610**
P5xP7	2.679**	7.10**	3.71**	11.111**	-13.333**	15.718**	-5.650**	-7.314**	-6.356**
P6xP7	5.357**	6.21**	1.14**	34.459**	-4.7**	37.883**	-9.744**	-5.298**	-7.433**

Table 4. Cont.

Crosses	No. grains spike			1000-Grain weight(g)			Grain yield plant(g)		
	N25	N50	N75	N25	N50	N75	N25	N50	N75
P1xP2	-7.602**	-13.511**	-17.751**	-1.231**	-2.480**	0.362	23.457**	-30.631**	-27.414**
P1xP3	0.006	-17.771**	-13.504**	-6.439**	-7.623**	-6.582**	-19.148**	-42.342**	-10.315**
P1xP4	1.233	-15.069**	-2.366**	-19.444**	-19.480**	-1.630**	13.024**	-37.838**	-21.768**
P1xP5	-3.675**	-21.432**	-4.117**	-12.058**	-6.588**	-3.110**	-28.315**	-25.676**	11.864**
P1xP6	-13.717**	-10.394**	-6.128**	-6.818**	-7.562**	-6.643**	-4.167**	-29.279**	-27.414**
P1xP7	-14.105**	-4.576**	-13.191**	-16.982**	-11.373**	-6.099**	3.460**	-42.568**	-24.389**
P2xP3	4.784**	-7.645**	2.101**	23.392**	54.839**	37.981**	-16.918**	-22.667**	-12.857**
P2xP4	9.295**	4.977**	-15.384**	22.064**	15.684**	27.026**	-4.526**	-11.705**	-27.619**
P2xP5	-14.105**	-21.679**	-19.860**	20.458**	13.024**	22.188**	-31.900**	-34.426**	-40.476**
P2xP6	-34.029**	-19.388**	-22.867**	7.814**	5.100**	16.583**	-2.500**	3.069**	-21.429**
P2xP7	-7.000**	0.526	3.426**	-7.579**	4.008**	12.582**	-1.227**	6.667**	-34.286**
P3xP4	1.245	-12.947**	-18.315**	5.987**	46.016**	44.587**	-8.287**	-5.333**	-7.453**
P3xP5	-31.223**	-38.328**	-22.444**	29.216**	12.985**	21.027**	-30.226**	-40.164**	-35.616**
P3xP6	-22.861**	-9.111**	-18.849**	1.081**	-0.739*	6.792**	-13.681**	-14.667**	-28.300**
P3xP7	8.168**	-6.790**	0.163	-3.490**	-0.728*	3.922**	-2.892**	-5.067**	-4.400**
P4xP5	-29.628**	-20.940**	-22.626**	27.259**	18.376**	25.871**	-19.355**	-28.962**	11.487**
P4xP6	-44.418**	-17.122**	-15.083**	-17.955**	-7.293**	23.333**	1.667**	-3.039**	-11.239**
P4xP7	-9.592**	-6.852**	-9.910**	18.866**	15.084**	13.748**	-4.825**	-7.282**	-10.544**
P5xP6	-30.913**	-13.945**	15.930**	-3.741**	4.513**	11.939**	-22.939**	-13.934**	-15.385**
P5xP7	-16.559**	-0.498	-5.507**	4.235**	-0.878**	6.414**	-18.160**	-14.208**	2.564**
P6xP7	-21.043**	-8.835**	-9.011**	0.998**	5.736**	20.243**	0	-3.802**	8.844**

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

Table 4. Cont.

Crosses	flag leaf area(cm^2)			chlorophyll a			chlorophyll b		
	N25	N50	N75	N25	N50	N75	N25	N50	N75
P1xP2	9.197**	-16.239**	-16.607**	0.767**	-0.391**	-10.389**	-12.495**	-1.907**	-9.449**
P1xP3	10.500**	-0.242*	-9.737**	-5.509**	-21.035**	10.554**	33.255**	-21.244**	8.439**
P1xP4	-15.064**	-16.631**	-18.735**	-10.524**	-36.311**	-13.434**	-9.037**	-35.724**	11.751**
P1xP5	9.202**	-12.672**	-12.435**	25.657**	13.529**	-23.416**	-1.831**	14.769**	-32.928**
P1xP6	1.207**	9.878**	4.531**	-10.541**	19.621**	-24.410**	-17.160**	3.351**	-31.568**
P1xP7	2.359**	18.907**	3.236**	-24.774**	13.004**	9.754**	-21.507**	2.369**	11.475**
P2xP3	-16.656**	-16.201**	-20.997**	-8.747**	-15.653**	1.015**	-7.491**	-16.381**	0.300**
P2xP4	10.949**	-0.05	-16.591**	-29.797**	-25.295**	-26.635**	-32.870**	-27.734**	-30.893**
P2xP5	-11.834**	2.135**	-24.117**	3.282**	-11.864**	-20.160**	3.773**	-11.770**	-28.663**
P2xP6	28.414**	46.408**	41.265**	-16.869**	16.669**	-29.879**	-5.270**	20.879**	-33.795**
P2xP7	34.835**	23.711**	56.159**	-15.939**	29.328**	-42.567**	-10.616**	25.503**	-23.466**
P3xP4	-10.071**	-0.298**	-14.376**	-24.009**	-7.552**	-9.121**	-24.993**	-2.324**	-8.507**
P3xP5	-18.274**	-12.342**	-9.068**	-33.630**	-30.918**	5.612**	-34.235**	-26.265**	3.648**
P3xP6	-4.573**	-6.935**	-6.154**	-10.709**	-36.632**	-21.118**	-14.774**	-39.619**	-25.609**
P3xP7	22.448**	39.949**	28.071**	-6.082**	-36.690**	-21.068**	-16.584**	-38.631**	-27.489**
P4xP5	-12.432**	-10.516**	-20.936**	-25.548**	-18.219**	13.406**	-29.713**	-20.283**	12.370**
P4xP6	38.266**	12.118**	5.877**	-27.592**	0.004	-18.834**	-26.189**	-9.788**	-23.080**
P4xP7	27.410**	21.482**	0.875**	-17.776**	-11.376**	-3.092**	-21.091**	-17.567**	-10.821**
P5xP6	-3.398**	27.184**	-4.306**	2.314**	12.890**	-16.963**	-4.767**	16.437**	-26.683**
P5xP7	9.424**	25.977**	-2.204**	-19.535**	-2.175**	-11.092**	-17.391**	0.161**	-25.644**
P6xP7	56.868**	60.817**	48.257**	-16.003**	21.862**	-4.433**	-21.321**	13.918**	-1.504**

Table 4. Cont.

Crosses	Total protein		
	N25	N50	N75
P1xP2	25.603**	0.886**	-16.814**
P1xP3	-5.935**	2.753**	-22.729**
P1xP4	-14.021**	-9.329**	-10.576**
P1xP5	2.333**	-11.349**	22.604**
P1xP6	-4.692**	18.029**	-15.48**
P1xP7	-31.977**	-2.851**	30.300**
P2xP3	-58.657**	1.441**	-8.773**
P2xP4	-13.671**	-7.073**	-15.73**
P2xP5	-18.974**	-7.998**	-21.149**
P2xP6	14.676**	-12.996**	-1.098**
P2xP7	5.329**	5.144**	-7.601**
P3xP4	43.75**	-0.286	-30.482**
P3xP5	-10.451**	-22.070**	-14.459**
P3xP6	-70.792**	25.784**	-4.844**
P3xP7	12.622**	31.183**	-20.661**
P4xP5	-22.467**	16.433**	13.224**
P4xP6	-1.618**	-24.660**	-11.254**
P4xP7	2.664**	-8.545**	-6.496**
P5xP6	-8**	17.513**	-7.620**
P5xP7	-45.301**	-13.411**	23.263**
P6xP7	13.323**	11.925**	-8.437**

Combining ability

The analysis of variance for both general (GCA) and specific (SCA) combining ability showes that the mean squares were highly significant for all studied characters in F_1 generation Table (5) which indicates the importance of both additive and non-additive gene effects in the inheritance of such characters.

The relative importance of additive and non-additive gene actions is essential for the development of an efficient hybridization program. The concept of combining ability as a measure of gene action refers to the capacity or ability of genotype to transmit superior performance to its crosses. The value of an inbred line depends on its ability to produce superior hybrids in combination with other inbreeds. If both GCA and SCA mean squares are significant, it is vital to determine the type of gene action which is important in determining the performance of progeny. To overcome such situation, the magnitude of mean squares can be used to assume the relative importance of general and specific combining ability mean squares which were highly significant.Hence, GCA/ SCA ratio was used to reveal the nature of genetic variance involved. The ratio of MSGCA/MSSCA (Table 5) displays the relative importance of additive gene action effects in their inheritance.

Table 5 . Mean square estimate of combining ability analysis effects for all studied traits in F_1 generation.

S.O.V			Heading date (day)				No. spikes plant				Plant height (cm)			
		d.f	N25	N50	N75	Comb	N25	N50	N75	Comb	N25	N50	N75	Comb
Enviroment		2				191.96**				456.78**				1840.36**
Rep.xEnv.	2	6	0.01	1	4.96**	1.99**	0.51	0.47	0.81	0.6	3.68	0.23	20.31**	8.07
Genotypes	27	27	54.07**	18.68**	26.47**	60.78**	2.40**	3.20**	7.96**	6.22**	108.45**	77.98**	36.47**	161.30**
GCA	6	6	23.53**	14.08**	17.96**	49.64**	0.74**	1.91**	0.69**	1.65**	94.07**	53.48**	27.12**	152.42**
SCA	21	21	16.45*	3.98*	6.21**	11.86**	0.82*	0.83*	3.21**	2.19**	19.60*	18.14*	7.88**	25.58**
GCA/SCA			1.43	3.53	2.89	4.18	0.9	2.3	0.21	0.75	4.79	2.94	3.44	5.95
GCAxEnv.		44				2.97**				0.85**				11.12**
SCAxEnv.		12				3.67				1.33**				10.02**
Error	54	42	0.18	0.2	0.13	0.17	0.14	0.15	0.17	0.15	2.8	1.01	1.33	1.71

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

Table 5. Cont.

S.O.V			No. grains spike				1000-Grain weight(g)				Grain yield plant(g)			
		d.f	N25	N50	N75	Comb	N25	N50	N75	Comb	N25	N50	N75	Comb
Enviroment		2				5267.20**				831.62**				2444.67**
Rep.xEnv.	2	6	26.24	7	10.02	14.42	1.68	2.21	2.78	2.23	4.57	10.39	1.64	5.53
Genotypes	27	27	125.19**	87.97**	146.33**	221.01**	151.89**	139.24**	133.42**	386.98**	34.12**	52.09**	101.68**	112.13**
GCA	6	6	27.74*	21.64*	99.27**	67.04**	120.21**	98.07**	87.97**	298.42**	20.92**	45.47**	65.65**	96.68**
SCA	21	21	45.73*	31.52*	34.35**	75.56**	30.75*	31.66*	32.05**	80.59**	8.65*	9.33*	24.82**	20.43**
GCA/SCA			0.6	0.68	2.88	0.88	3.9	3.09	2.74	3.7	2.41	4.87	2.64	4.73
GCAxEnv.		54				40.80**				3.92**				17.68**
SCAxEnv..		12				18.02**				6.93**				11.18**
ERROR	54	42	9.35	6.84	4.76	6.98	1.1	0.72	0.74	0.86	1.47	2.71	3.8	2.66

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

Table 5. Cont.

S.O.V			flag leaf area(cm^2)				chlorophyll a				chlorophyll b			
		d.f	N25	N50	N75	comb	N25	N50	N75	comb	N25	N50	N75	Comb
Enviroment		2				3907.24**				0.17**				0.98**
Rep.xEnv.	2	6	0.05	0.45	0.02	0.17	0.01**	0.01**	0.02**	0.01**	0.00**	0.02**	0.01**	0.01**
Genotypes	27	27	264.57**	468.44**	506.74**	1069.99**	0.17**	0.17**	0.19**	0.21**	0.02**	0.03**	0.03**	0.04**
GCA	6	6	138.65**	318.96**	323.60**	712.10**	0.08**	0.03**	0.10**	0.12**	0.01**	0.01**	0.02**	0.02**
SCA	21	21	73.77*	109.63*	124.72**	255.11**	0.05*	0.07*	0.05**	0.05**	0.01*	0.01*	0.01**	0.01**
GCA/SCA			1.87	2.9	2.59	2.79	1.6	0.4	2	2.4	1	1	2	2
GCAxEnv.		54				34.55**				0.05**				0.01**
SCAxEnv..		12				26.50**				0.06**				0.01**
ERROR	54	42	0.22	0.2	0.19	0.21	0.001	0.002	0.001	0.001	0.001	0.002	0.001	0.002

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

Table 5. Cont.

S.O.V			Total Protein			
		d.f	N25	N50	N75	Comb
Enviroment		2				1758.85**
Rep.xEnv.	2	6	9.37**	0.87	3.18**	4.47**
Genotypes	27	27	8.15**	7.34**	8.70**	6.36**
GCA	6	6	1.78**	2.35**	5.36**	3.69**
SCA	21	21	2.99*	2.47*	2.20**	1.67**
GCA/SCA			0.59	0.95	2.43	2.2
GCAxEnv.		54				2.90**
SCAxEnv..		12				2.99**
ERROR	54	42	0.14	0.16	0.19	0.16

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

Therefore, selection for these traits in early generations would be effective in developing the high yield in varieties in wheat breeding programs. The preponderance of additive genetic variation gene action for yield and its related characters in F_1 generation indicate that the parents involved in these crosses could be selected based on their GCA values. The genetic variance was previously reported to be mostly due to additive for yield traits by El Seidy and Hamada (1997). On the other hand, the non-additive genetic variance was previously reported to be the most prevalent for plant height by Abd El-Aty and Katta (2002); No. of spikes plant^{-1} and No. of kernels spike^{-1} by Abd El-Aty and Katta (2002); for 200-grain weight by Abd El-Aty and Katta (2002); For grain yield plant^{-1} by Siddique *et al* (2004) and AL Saadoon *et al* (2017).

General combining ability effects

General combining ability effects iĝ of individual parent for each trait from F_1 generation are presented in (Table 6).

The estimates of iĝ effects obtained from F_1 in most cases. High positive response would be of interest for all studied characters except for days to maturity and plant height up to flag leaf since short stature is preferred due to non-liability to lodging and progressive response to increased rate of fertilizer. Therefore, negative combining ability effects regarding plant height up to flag leaf are preferred in wheat.

the parent P1 (Giza 171) expressed significant negative ($\hat{g}_i$) effects for heading date at 25, 50, 75 nitrogen rates as well as the combined data. This particular parent (P_1) exhibited significant positive ($\hat{g}_i$) effects for plant height, number of kernels per spike, 1000-kernel weight and flag leaf area, at 25, 50, 75 nitrogen rates and the combined analysis, The parent 2 (Misr 1) gave highly signifinegative ($\hat{g}_i$) effects for heading at 50 nitrogen rate and the combined analysis. Such results indicated that Misr-1 could be a good general combiner for developing early heading genotypes. On the other hand, this parent P_2 (Misr 1) expressed highly significant positive ($\hat{g}_i$) effects for number of spikes/plant and total protein at 50, 75 nitrogen rates as well as the combined data. The parent No. 3 (Misr 2) showed significant positive ($\hat{g}_i$) effects for number of spikes/ plant, at the 25 nitrogen rate. The parent No. 4 (Gemmeiza 12) showed significant positive ($\hat{g}_i$) effects for number of spikes/ plant and spike length at the 25 nitrogen rate. The parent No. 5 (Gemmeiza 10) showed significant positive ($\hat{g}_i$) effects for 1000-kernel weight at nitrogen rates as well as the combined analysis, for grain yield/plant at 25, 50 nitrogen rates as well as the combined analysis. The parent No. 6 (Gemmeiza 9) behaved as the best combiner for plant height, at 25, 50, and 75 nitrogen rates as well as the combined analysis and flag leaf area, total protein, at 50,75 nitrogen rates as well as the combined analysis. The parent No. 7 (Sids 1) seemed to be good general combiner for plant height, spike length at 50, and 75 nitrogen rates as well as the combined analysis, flag leaf area at 25, 50, and 75 nitrogen rates as well as the combined analysis. It is worth noting that earliness of inflorescence is required for developing early maturing season to escape stem rust. The parent which possessed high ($\hat{g}_i$) effects showed the same effect for one or more of the traits contributing to grain yield. However, exhibited either significant undesirable or insignificant ($\hat{g}_i$) effects for the other traits. From the previous result, it could be concluded that the parental genotype P_1 and P_5 seemed to be the best general combiner for grain yield/plant and some of its components in the combined analysis of the three nitrogen rates. Also, P_1 and P_4 gave the best combiner for heading. In most traits, the values of ($\hat{g}_i$) effects mostly differed from nitrogen rate to other. This finding coincided with that reached above where significant GCA by nitrogen rates mean squares were detected (Table 5) These results are in harmony with those obtained by Hasnain *et al.* (2006), Seleem (2006), Gurmani *et al.* (2007), EL-Shaarawy and Koumber (2010), Seleem and Koumber (2011) and EL-Hosary and Nour EL Deen (2015), AL Saadoon *et al*. (2017), EL-Gammaal and Yahya (2018) and Yahya (2020).

Table 6. Estimates of parental general combining ability effects for all studied traits in F_1 generation.

	Heading date (day)				No. spikes plant				Plant height (cm)			
Parents	**N25**	**N50**	**N75**	**comb**	**N25**	**N50**	**N75**	**Comb**	**N25**	**N50**	**N75**	**comb**
Giza 171	-2.63**	-1.825**	-2.39**	-2.28**	-0.34**	-0.225*	0.17	-0.13*	5.49**	3.800**	2.57**	3.95**
misr 1	0.44**	-1.048**	-0.1	-0.23**	0.34**	0.784**	-0.06	0.36**	-0.45	0.119	0.28	-0.02
misr 2	0.59**	0.730**	0.24*	0.52**	0.21*	-0.177	-0.23	-0.07	-0.61	-2.889**	-0.92**	-1.47**
Gemmieza 12	-1.30**	-0.899**	-1.02**	-1.07**	0.20*	-0.216*	0.42	0.13*	-0.08	-1.085**	-1.21**	-0.79**
Gemmieza 10	2.48**	1.582**	1.39**	1.82**	-0.37**	-0.470**	0.06	-0.26**	-5.53**	-2.770**	-2.67**	-3.66**
Gemmieza 9	0.59**	0.582**	1.79**	0.99**	-0.17	-0.212*	-0.44	-0.27**	1.19*	1.363**	1.15**	1.24**
sids 1	-0.19	0.878**	0.09	0.26**	0.13	0.516**	0.07	0.24**	-0.02	1.463**	0.80*	0.75**
L.S.D.(gi) 5%	0.22	0.23	0.19	0.11	0.19	0.2	0.22	0.1	0.87	0.52	0.6	0.34
L.S.D.(gi) 1%	0.33	0.35	0.29	0.14	0.3	0.31	0.33	0.13	1.33	0.8	0.91	0.45
L.S.D (gi-gj) 5 %	0.335	0.35408	0.28959	0.15	0.2978	0.31076	0.3296	0.15	1.3342	0.79925	0.9171	0.49
L.S.D (gi-gj) 1 %	0.5094	0.53845	0.44038	0.2	0.4529	0.47257	0.5012	0.19	2.0289	1.21543	1.3946	0.65

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

Table 6. cont.

	No. grains spike				1000-Grain weight(g)				Grain yield plant(g)			
Parents	**N25**	**N50**	**N75**	**comb**	**N25**	**N50**	**N75**	**Comb**	**N25**	**N50**	**N75**	**comb**
Giza 171	2.54**	1.622*	3.49**	2.55**	7.54**	6.363**	6.39**	6.76**	0.3	3.996**	5.22**	3.17**
misr 1	0.72	-0.737	-3.80**	-1.27**	-3.42**	-2.792**	-2.58**	-2.93**	-2.96**	-2.439**	-1.71**	-2.37**
misr 2	0.49	-2.526**	-5.00**	-2.34**	-2.41**	-2.083**	-2.60**	-2.36**	0.61	-0.589	0.46	0.16
Gemmieza 12	-0.12	-0.807	3.18**	0.75*	-1.69**	-1.260**	-0.07	-1.01**	0.14	-1.353**	0.09	-0.37
Gemmieza 10	-2.97**	1.544*	0.52	-0.3	0.93**	2.450**	1.15**	1.51**	2.12**	1.986**	0.95	1.68**
Gemmieza 9	0.72	-0.393	2.03**	0.79*	0.43	-0.452*	-0.67*	-0.23	0.2	-0.097	-2.47**	-0.79**
sids 1	-1.38	1.296	-0.42	-0.17	-1.39**	-2.226**	-1.61**	-1.74**	-0.4	-1.503**	-2.53**	-1.48**
L.S.D.(gi) 5%	1.59	1.36	1.14	0.69	0.55	0.44	0.45	0.24	0.63	0.86	1.02	0.43
L.S.D.(gi) 1%	2.42	2.07	1.73	0.91	0.83	0.67	0.68	0.32	0.96	1.31	1.55	0.56
L.S.D (gi-gj) 5 %	2.4355	2.08398	1.73741	1	0.8368	0.67699	0.6872	0.35	0.9667	1.31119	1.5538	0.62
L.S.D (gi-gj) 1 %	3.7037	3.16913	2.6421	1.31	1.2725	1.02951	1.045	0.46	1.4701	1.99394	2.3629	0.81

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

Table 6. cont.

	flag leaf area				chlorophyll a				chlorophyll b			
Parents	**N25**	**N50**	**N75**	**comb**	**N25**	**N50**	**N75**	**comb**	**N25**	**N50**	**N75**	**Comb**
Giza 171	5.57**	9.155**	10.48**	8.40**	0.07**	-0.056**	-0.06**	-0.02**	0.02**	-0.025**	-0.02**	-0.01**
misr 1	-3.15**	-6.393**	-7.84**	-5.79**	0.09**	0.004*	0.12**	0.07**	0.02**	0.003	0.06**	0.03**
misr 2	0.12	-2.430**	-3.87**	-2.06**	-0.08**	0.070**	0.07**	0.02**	-0.01**	0.041**	0.01**	0.02**
Gemmieza 12	-5.15**	-4.474**	-2.45**	-4.02**	0.02**	0.075**	0.02**	0.04**	0.02**	0.033**	0.02**	0.02**
Gemmieza 10	-1.85**	-4.360**	-1.94**	-2.72**	0.09**	-0.045**	0.10**	0.05**	0.01**	-0.019**	0.03**	0.01**
Gemmieza 9	-0.19	2.398**	1.44**	1.22**	-0.02**	0.008**	-0.10**	-0.04**	0	-0.009*	-0.04**	-0.02**
sids 1	4.64**	6.105**	4.18**	4.98**	-0.16**	-0.056**	-0.15**	-0.12**	-0.06**	-0.024**	-0.06**	-0.05**
L.S.D.(gi) 5%	0.25	0.23	0.23	0.12	0.01	0	0	0	0	0.01	0.01	0
L.S.D.(gi) 1%	0.37	0.36	0.35	0.16	0.01	0	0.01	0	0.01	0.01	0.01	0
L.S.D (gi-gj) 5 %	0.3756	0.35848	0.34876	0.17	0.0083	0.0041	0.007	0	0.0069	0.0095	0.0117	0
L.S.D (gi-gj) 1 %	0.5711	0.54515	0.53037	0.22	0.0126	0.0062	0.01	0	0.0105	0.0144	0.0178	0.01

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

Table 6. cont.

	Total protein			
Parents	**N25**	**N50**	**N75**	**Comb**
Giza 171	-0.31**	-0.458**	-0.80**	-0.52**
misr 1	-0.13	0.890**	0.73**	0.49**
misr 2	-0.70**	-0.306*	0.70**	-0.1
Gemmieza 12	0.18	-0.072	-1.13**	-0.34**
Gemmieza 10	0.51**	-0.079	0	0.14**
Gemmieza 9	-0.08	0.493**	0.76**	0.39**
sids 1	0.54**	-0.467**	-0.26*	-0.06
L.S.D.(gi) 5%	0.19	0.21	0.23	0.11
L.S.D.(gi) 1%	0.29	0.32	0.35	0.14
L.S.D (gi-gj) 5 %	0.2948	0.31684	0.35033	0.15
L.S.D (gi-gj) 1 %	0.4483	0.48182	0.53275	0.2

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

Specific combining ability effects

Specific combining ability effects ŝij of F_1 for all characters are presented in (Table 7). The data show highly significant desirable ŝij values for some crosses in the F_1 generation. This result is expected the non-additive or increased the additive portion.

As for days to heading the crosses P1xP2, P1xP5, P4xP6 and P4xP7 under 25, 50, 75 kg N/fed., and P2xP3, P2xP4, P2xP6 and P3xP7 under 25, 75 kg N/fed., in F_1 generation gave significant and negative ŝij effects. As for No. of spikes plant^{-1}, the crosses P1xP2, P2xP4, P3xP7, P4xP7, P5xP6 and P6xP7 under 25 kg N/fed., P1xP6, P2xP7, P3xP7, P4xP5, P4xP7 and P5xP6 under 50 kg N/fed., the crosses P1xP3, P1xP5, P2xP3, P2xP5, P2xP6, P2xP7, P4xP6, P4xP7, P5xP7 and P6xP7 under 75 kg N/fed., in F_1 generation gave significant and positive ŝij effects for this trait. With regard to plant height, in the two rates of nitrogen as well as the combined analysis the cross P2 x P3 exhibited significant positive ($\hat{S}_{ij}$) effect for this trait. However, eight, seven, four and six crosses had positive ($\hat{S}_{ij}$) effects at 25, 50, 75 nitrogen rates and the combined analysis, respectively for plant height. Meanwhile, four, five, three and three crosses exhibited significant negative $\hat{S}_{ij}$ effect at 25, 50, and 75 nitrogen rates and the combined analysis respectively.

As for No. of grains/spike, the crosses P2xP4 and P3xP7 under 25 kg N/fed., P2xP4 and P5xP7 under 50 kg N/fed., the crosses P2xP3, P3xP4 and P5xP6 under 75 kg N/fed., in F_1 generation gave significant and positive ŝij effects for this trait.

Table 7. Estimates of specific combining ability effects of the parental combination for all studied traits in F_1 generation.

	Heading date (day)				No. spikes plant				Plant height (cm)			
Crosses	**N25**	**N50**	**N75**	**Comb**	**N25**	**N50**	**N75**	**Comb**	**N25**	**N50**	**N75**	**Comb**
P1xP2	-2.15**	-1.472**	-1.95**	-1.86**	1.41**	0.161	-0.86*	0.23	3.89**	1.523*	-1.05	1.45*
P1xP3	0.70*	-0.583	-0.29	-0.06	-0.89**	0.122	1.19**	0.14	-0.55	-0.336	1.72	0.28
P1xP4	0.59	1.713**	-0.36	0.65**	-1.38**	-0.173	-2.87**	-1.47**	1.58	1.227	-1.22	0.53
P1xP5	-3.19**	-2.769**	-1.44**	-2.46**	-0.91**	-1.586**	2.50**	0	3.76*	-1.088	1.24	1.3
P1xP6	0.70*	0.898*	0.16	0.59**	-0.35	0.907**	-1.84**	-0.43*	3.31*	-0.888	1.42	1.28
P1xP7	3.48**	1.602**	1.19**	2.09**	0.02	-0.838*	-0.28	-0.37	-1.14	-0.988	-3.74**	-1.95**
P2xP3	-2.37**	0.306	-2.25**	-1.44**	0.1	-0.054	1.18**	0.41*	6.05**	5.545**	1.14	4.25**
P2xP4	-2.48**	-0.065	-1.66**	-1.40**	0.61*	-0.249	-1.77**	-0.47*	5.19**	2.008*	-4.07**	1.04
P2xP5	13.74**	-0.546	-3.06**	3.38**	-0.32	-1.262**	0.89*	-0.23	-6.03**	0.76	3.69**	-0.53
P2xP6	-2.37**	-0.546	-4.14**	-2.35**	-0.53	0.514	0.70*	0.23	-8.02**	-11.640**	-1.63	-7.10**
P2xP7	1.41**	2.157**	2.23**	1.93**	0.49	1.187**	1.07**	0.91**	0.47	-4.140**	3.38**	-0.1
P3xP4	4.37**	1.491**	4.34**	3.40**	-1.17**	0.113	-0.80*	-0.62**	2.41	-2.151*	4.43**	1.56*
P3xP5	1.59**	-0.324	1.27**	0.85**	-0.52	-1.634**	-1.74**	-1.30**	3.80*	5.434**	-0.78	2.82**
P3xP6	3.48**	-0.991*	0.53	1.01**	0.27	-0.258	-0.37	-0.12	1.41	5.634**	-1.37	1.89**
P3xP7	-0.74*	0.38	-1.10**	-0.49*	0.98**	0.631*	0.48	0.70**	1.13	2.034*	0.25	1.14
P4xP5	0.48	0.306	0.53	0.44*	0.32	0.905**	0.48	0.57**	-1.67	0.131	4.02**	0.83
P4xP6	-1.63**	-2.028**	-2.21**	-1.96**	0.12	-0.686*	1.24**	0.22	4.11**	1.997*	-1.31	1.60*
P4xP7	-1.85**	-3.657**	-2.51**	-2.67**	0.66*	0.787*	2.06**	1.17**	-2.57*	-1.769*	1.37	-0.99
P5xP6	-4.41**	-0.509	0.71*	-1.40**	1.02**	0.651*	-2.17**	-0.17	-1.84	-0.584	-1.45	-1.29
P5xP7	-1.63**	3.528**	2.42**	1.44**	0.22	-0.393	1.09**	0.31	2.55*	0.049	-1.33	0.42
P6xP7	3.26**	3.528**	-0.99**	1.93**	0.85*	-0.217	2.92**	1.18**	-5.18**	-1.884*	-3.66**	-3.57**
L.S.D.(Sij) 5%	0.64	0.67	0.55	0.42	0.57	0.59	0.63	0.4	2.54	1.52	1.75	1.33
L.S.D.(Sij) 1%	0.97	1.03	0.84	0.55	0.86	0.9	0.95	0.52	3.86	2.31	2.66	1.74
L.S.D.(Sij-Sik) 5%	0.95	1	0.82	0.62	0.84	0.88	0.93	0.59	3.77	2.26	2.59	1.97
L.S.D.(Sij-Sik) 1%	1.44	1.52	1.25	0.81	1.28	1.34	1.42	0.78	5.74	3.44	3.94	2.59
L.S.D.(Sij-Skl) 5%	0.89	0.94	0.77	0.22	0.79	0.82	0.87	0.21	3.53	2.11	2.43	0.7
L.S.D.(Sij-Skl) 1%	1.35	1.42	1.17	0.29	1.2	1.25	1.33	0.27	5.37	3.22	3.69	0.92

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

Table 7. cont.

	No. grains spike				1000-Grain weight(g)				Grain yield plant(g)			
Crosses	**N25**	**N50**	**N75**	**Comb**	**N25**	**N50**	**N75**	**Comb**	**N25**	**N50**	**N75**	**Comb**
P1xP2	-3.02	-1.435	-4.02*	-2.83*	7.87**	6.016**	5.22**	6.37**	6.49**	1.241	-3.83*	1.3
P1xP3	1.34	-2.38	0.34	-0.23	4.10**	2.474**	1.40*	2.66**	-2.02*	-4.942**	1.07	-1.96*
P1xP4	2.62	-2.365	3.17	1.14	-3.48**	-4.883**	1.61*	-2.25**	1.39	-2.512*	-3.30*	-1.47
P1xP5	2.81	-6.050**	1.83	-0.47	-2.20*	-1.490*	-0.43	-1.37**	-2.26*	-1.352	9.74**	2.04*
P1xP6	2.11	0.22	-1.18	0.38	1.07	0.876	-0.56	0.46	-1.17	-0.602	-3.08*	-1.61
P1xP7	-4.45	2.265	-3.99*	-2.06	-2.48**	0.55	0.67	-0.42	0.09	-4.112**	-1.76	-1.93*
P2xP3	3.66	1.213	6.46**	3.78**	1.16	5.896**	3.54**	3.53**	1.76	-0.507	1.43	0.9
P2xP4	8.27**	6.728**	0.38	5.13**	5.31**	0.893	1.73*	2.65**	1.12	-0.243	-3.37*	-0.83
P2xP5	-1.05	-3.857	-6.56**	-3.82**	5.42**	5.113**	5.93**	5.49**	0	-2.416	-8.73**	-3.71**
P2xP6	-9.07**	-6.287**	-8.23**	-7.86**	6.06**	3.199**	3.51**	4.26**	2.43*	2.167	1.36	1.98*
P2xP7	-0.64	0.057	4.05*	1.16	-1.46	0.406	2.88**	0.61	0.69	1.073	-3.08*	-0.44
P3xP4	4.17	-1.817	-0.68	0.56	-1.02	10.930**	8.04**	5.98**	0.66	2.740*	0.75	1.38
P3xP5	-10.11**	-13.335**	-7.16**	-10.20**	7.54**	4.387**	5.47**	5.80**	-6.40**	-6.016**	-9.73**	-7.38**
P3xP6	-1.67	1.702	-4.13*	-1.37	2.35*	0.04	-0.38	0.67	-0.65	-0.85	-3.81*	-1.77*
P3xP7	4.83*	-0.32	3.19	2.57	-0.97	-2.103**	-0.56	-1.21*	2.44*	2.957*	4.42*	3.27**
P4xP5	-8.63**	-3.287	-9.53**	-7.15**	6.12**	5.897**	4.96**	5.66**	0.4	-1.836	4.87**	1.15
P4xP6	-14.89**	-4.850*	-5.20**	-8.32**	-6.00**	-3.534**	3.71**	-1.94**	0.16	-0.253	-0.28	-0.13
P4xP7	0.21	-2.206	1.25	-0.25	6.51**	3.083**	0.84	3.48**	-1.5	-0.236	0	-0.58
P5xP6	-3.38	1.031	15.45**	4.37**	-2.93**	-0.911	-0.25	-1.36**	-0.66	1.491	-1.31	-0.16
P5xP7	-0.27	8.443**	0.07	2.75*	-1.48	-1.470*	-1.61*	-1.52**	1.27	2.814*	4.59**	2.89**
P6xP7	1.37	-1.954	-1.6	-0.73	1.29	2.899**	4.04**	2.74**	0.36	-0.269	4.01*	1.37
L.S.D.(Sij) 5%	4.64	3.97	3.31	2.68	1.59	1.29	1.31	0.94	1.84	2.5	2.96	1.66
L.S.D.(Sij) 1%	7.05	6.03	5.03	3.52	2.42	1.96	1.99	1.23	2.8	3.8	4.5	2.17
L.S.D.(Sij-Sik)5%	6.89	5.89	4.91	3.99	2.37	1.91	1.94	1.4	2.73	3.71	4.39	2.46
L.S.D.(Sij-Sik)1%	10.48	8.96	7.47	5.23	3.6	2.91	2.96	1.83	4.16	5.64	6.68	3.23
L.S.D.(Sij-Skl)5%	6.44	5.51	4.6	1.41	2.21	1.79	1.82	0.49	2.56	3.47	4.11	0.87
L.S.D.(Sij-Skl)1%	9.8	8.38	6.99	1.85	3.37	2.72	2.76	0.65	3.89	5.28	6.25	1.14

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

Table 7. cont.

	flag leaf area(cm^2)				chlorophyll a				chlorophyll b			
Crosses	**N25**	**N50**	**N75**	**Comb**	**N25**	**N50**	**N75**	**Comb**	**N25**	**N50**	**N75**	**Comb**
P1xP2	8.52**	-3.726**	-0.5	1.43**	0.11**	-0.033**	0.19**	0.09**	-0.06**	-0.018*	0.07**	0
P1xP3	6.11**	5.078**	1.91**	4.37**	-0.04**	0.010*	0.25**	0.07**	0.21**	-0.001	0.06**	0.09**
P1xP4	-5.63**	-5.958**	-7.87**	-6.48**	0.06**	-0.435**	-0.10**	-0.16**	0.05**	-0.166**	0.10**	-0.01
P1xP5	7.22**	-2.912**	-2.52**	0.59*	0.48**	0.262**	-0.27**	0.16**	0.03**	0.107**	-0.10**	0.01
P1xP6	0.24	8.326**	9.85**	6.14**	-0.13**	0.177**	-0.18**	-0.04**	-0.08**	0.020*	-0.07**	-0.04**
P1xP7	-3.83**	11.826**	5.91**	4.64**	-0.28**	0.141**	0.19**	0.02**	-0.08**	0.028**	0.04**	-0.01
P2xP3	-6.51**	-6.507**	-8.98**	-7.33**	0.08**	0.067**	0.30**	0.15**	0.01	0.017	0.10**	0.04**
P2xP4	1.22**	2.933**	-0.89*	1.09**	-0.34**	-0.274**	-0.22**	-0.28**	-0.13**	-0.124**	-0.12**	-0.13**
P2xP5	-3.18**	2.729**	-5.75**	-2.07**	0.13**	-0.211**	-0.17**	-0.08**	0.07**	-0.092**	-0.11**	-0.04**
P2xP6	4.87**	15.388**	16.72**	12.33**	-0.14**	0.178**	-0.17**	-0.04**	0.01*	0.124**	-0.07**	0.02**
P2xP7	7.42**	0.998*	20.96**	9.79**	0.03**	0.446**	-0.39**	0.03**	0.04**	0.158**	0.01	0.07**
P3xP4	-0.38	1.534**	-3.16**	-0.67**	-0.05**	0.172**	-0.15**	-0.01**	-0.04**	0.117**	-0.04**	0.01
P3xP5	-8.82**	-6.124**	2.14**	-4.27**	-0.42**	-0.215**	0.14**	-0.17**	-0.16**	-0.053**	0.08**	-0.04**
P3xP6	-1.90**	-9.495**	-8.00**	-6.47**	0.02*	-0.392**	-0.24**	-0.20**	-0.03**	-0.187**	-0.08**	-0.10**
P3xP7	10.19**	16.161**	12.94**	13.10**	0.13**	-0.329**	-0.19**	-0.13**	-0.03**	-0.163**	-0.09**	-0.09**
P4xP5	-1.55**	-5.370**	-8.64**	-5.18**	-0.25**	-0.084**	0.34**	0	-0.10**	-0.037**	0.12**	0
P4xP6	9.38**	1.432**	7.10**	5.97**	-0.19**	0.228**	-0.15**	-0.04**	-0.06**	0.044**	-0.07**	-0.03**
P4xP7	5.53**	3.335**	0.52	3.13**	0.15**	0.065**	0.17**	0.13**	0.04**	-0.008	0.01	0.02*
P5xP6	-1.02*	8.602**	0.57	2.72**	0.15**	0.188**	-0.10**	0.08**	0.03**	0.091**	-0.05**	0.03**
P5xP7	1.94**	4.188**	-0.5	1.87**	-0.09**	0.007	0.06**	-0.01*	0.01	-0.002	-0.03*	-0.01
P6xP7	16.00**	12.760**	8.94**	12.57**	0.01	0.126**	0.26**	0.13**	-0.02*	0.046**	0.12**	0.05**
L.S.D.(Sij) 5%	0.72	0.68	0.66	0.46	0.02	0.01	0.01	0.01	0.01	0.02	0.02	0.01
L.S.D.(Sij) 1%	1.09	1.04	1.01	0.6	0.02	0.01	0.02	0.01	0.02	0.03	0.03	0.02
L.S.D.(Sij-Sik) 5%	1.06	1.01	0.99	0.68	0.02	0.01	0.02	0.01	0.02	0.03	0.03	0.02
L.S.D.(Sij-Sik) 1%	1.62	1.54	1.5	0.9	0.04	0.02	0.03	0.02	0.03	0.04	0.05	0.02
L.S.D.(Sij-Skl) 5%	0.99	0.95	0.92	0.24	0.02	0.01	0.02	0	0.02	0.03	0.03	0.01
L.S.D.(Sij-Skl) 1%	1.51	1.44	1.4	0.32	0.03	0.02	0.03	0.01	0.03	0.04	0.05	0.01

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

Table 7. cont.

	Total protein			
Crosses	**N25**	**N50**	**N75**	**Comb**
P1xP2	1.77**	1.014**	-0.6	0.73**
P1xP3	-0.35	-0.284	-0.95*	-0.53*
P1xP4	-0.78*	-0.278	-0.83*	-0.63**
P1xP5	1.60**	-0.748*	2.33**	1.06**
P1xP6	0.14	1.816**	-0.96*	0.33
P1xP7	-1.51**	-0.693*	2.96**	0.25
P2xP3	-2.85**	0.933**	0.09	-0.61**
P2xP4	-0.94**	-0.394	-0.07	-0.47*
P2xP5	-0.23	-0.505	-2.15**	-0.96**
P2xP6	1.16**	-1.719**	0.61	0.01
P2xP7	0.97**	1.569**	0.48	1.01**
P3xP4	3.11**	0.636*	-2.04**	0.57**
P3xP5	0.99**	-2.135**	-0.22	-0.46*
P3xP6	-3.56**	2.541**	0.78*	-0.08
P3xP7	2.05**	1.554**	-1.11**	0.83**
P4xP5	-0.82*	2.380**	1.70**	1.09**
P4xP6	-0.17	-3.037**	0.09	-1.04**
P4xP7	0.46	-0.177	-0.79*	-0.17
P5xP6	0.56	1.625**	-0.42	0.59**
P5xP7	-3.28**	-0.976**	1.88**	-0.79**
P6xP7	1.48**	1.134**	-0.3	0.77**
L.S.D.(Sij) 5%	0.56	0.6	0.67	0.41
L.S.D.(Sij) 1%	0.85	0.92	1.01	0.54
-L.S.D.(Sij-Sik) 5%	0.83	0.9	0.99	0.61
L.S.D.(Sij-Sik) 1%	1.27	1.36	1.51	0.8
L.S.D.(Sij-Skl) 5%	0.78	0.84	0.93	0.22
L.S.D.(Sij-Skl) 1%	1.19	1.27	1.41	0.28

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

As for 1000-Grain weight, the crosses P1XP2, P1XP3, P2XP5, P2XP6, P3XP5 and P4xP5 under 25, 50, and 75 kg N/fed., the crosses P2xP3, P3xP4 and P6xP7 under 50, and 75 kg N/fed., in F_1 generation gave significant and positive ŝij effects for this trait.

For total protein, crosses P2XP7, P3XP4, P3XP7, P4XP5 and P6XP7 under 25, and 50 kg N/fed., in F_1 generation, had significant positive ŝij effects.

For chlorophyll a and chlorophyll b, crosses P1XP5, P2XP7 and P5x P6 under 25, and 50 kg N/fed., in F_1 generation, had significant positive ŝij effects.

For grain yield plant^{-1}, crosses P1XP2, P2XP6 AND P3XP7 under 25 kg N/fed., crosses P3XP4 P3XP7 AND P5XP7 under 50 kg N/fed., crosses p1xp5, p3xp7, p4xp5 and p5xp7 under 75 kg N/fed., in F_1 generation, had significant positive ŝij effects. The crosses P1xP2, p1xp5 and p3xp7, gave the highest desirable ŝij effects in F_1 generation.

If crosses of high SCA involve both parental lines which also are good combiners, they could be exploited for breeding varieties. Nevertheless, if crosses of high SCA involve only one good combiner, such combinations would throw out desirable transgressive segregates provided that the additive genetic system in the good acts in the same direction to reduce undesirable characteristics and maximize the character under consideration. Therefore, the mean performance of crosses could be a reliable and effective indication for their specific combining ability effects for all studied traits.

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دراسات وراثية على بعض هجن قمح الخبز تحت ثلاث مستويات من التسميد النيتروجينى

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يهدف البحث إلى اختيار الهجن المتميزة لاستخدامها فى تحسين محصول حبوب القمح فى مصر ودراسة قوة الهجين والقدرة على التآلف للمحصول ومكوناته فى الجيل الأول تحت ثلاث مستويات من التسميد النيتروجينى. أجرى التهجين النصف تبادلي بين سبعة تراكيب وراثية من قمح الخبز فى موسم2018-2019 وتم انتاج بذور الجيل الأول، ثم قيمت الآباء والجيل الأول معا تحت ثلاث مستويات من التسميد النيتروجيني (25 ، 50 ، 75 كجم ن/فدان) في تجربة قطع منشقة فى تصميم القطاعات الكاملة العشوائية بثلاث مكرارات للمحصول ومكوناته فى موسم (2019\2020). كان التباين الراجع إلى التراكيب الوراثية (الآباء – الهجن) معنويا فى كل الصفات تحت الدراسة. وأيضا كانت قوه الهجين معنوية فى كل الصفات تحت الدراسة. تراوحت قيمة قوة الهجين الموجبة والمعنوية مقارنة بالأب الافضل من 1,6 الى 23,45 % فى الجيل الأول. وكانت الهجن (p1x p4),(p1 x p2) هما الافضل في محصول الحبوب للنبات. وكان التباين الراجع للقدرة العامة والخاصة على التآلف معنويا لكل الصفات المدروسه والنسبه بينهم تشير إلى أهمية الفعل الجينى المضيف فى توريث جميع الصفات تحت الدراسة. وأظهرت الآباء (P1 وP5) قدرة عامة عالية على التآلف ومرغوبة لمعظم الصفات تحت الدراسة. أعطت الهجن الثلاثة (P1 X P2, P2 X P4 , P4 X P7) تأثيرات قدرة خاصة على التآلف عالية المعنوية لمعظم الصفات المدروسة. ويمكن استخدام تلك الهجن فى برنامج تربية قمح الخبز لتحسين الإنتاجية..