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GENETICAL STUDY ON SOME BREAD WHEAT CROSSES UNDER TWO NITROGEN LEVELS

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ABSTRACT

Heterosis and nature of genetic effects on plant growth and yield characters were studied in a 6x6 diallel crosses, without reciprocals, in the F_1 and their F_2 generations 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, F_1 and F_2 were evaluated using a randomized complete block design (RCBD) with three replications for quantitative characters in 2018/2019 season. Significant genotype mean squares of parents and crosses were obtained for all characters. Significant heterosis in F_1 generation was obtained for all studied characters. The useful heterosis of grain yield/ plant relative to better parent varied from 6.22 to 38.91% in F_1 crosses. Two crosses, viz. P1xP2 and P3xP6 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. The two parents P1, P4 and P5 gave the highest positive significant $\hat{g}_i$ effects for grain yield plant^{-1}in both generations. The three crosses P1xP5, P3xP6 and P4xP5 showed significantly desirable heterotic effects for most studied traits. Generally.

Key words: ***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. The economic feasibility would be considerably improved if sufficient heterosis was retained in the F2 generation to render its production value. The segregation that occurs in F2 generation could, however, cause problems. 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) and EL-Gammaal and Yahya (2018)**,** the combining ability is a most reliable biometrical tool to circumvent plant breeding programs. The diallel analysis also provides a unique opportunity to test a number of lines in all possible combinations.

The present study is aimed at estimating heterosis in F_1 and comparing combining ability obtained from F_2 crosses with those of F_1 resulting from a set of diallel crosses for certain quantitative traits of wheat.to be used in breeding programs in order to improve wheat productivity.

MATERIALS AND METHODS

Six 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).

Table1. The code number, name, pedigree and selection history of the studied parental bread wheat varieties and lines.

Code No.	Name	Pedigree and selection history
P1	Giza 171	Sakha 93 /Gemmieza 9. GZ2003 –101-1GZ - 4GZ –1GZ - 2GZ - 0GZ.
P2	Shandweel 1	Site / MO/4 /Nac/th.Ac.//3*pvn/3/Mir L0/Buc. Cmss93Boos 67s-72Y-010M-010Y-010M-3Y-0M-0THY-0SH.
P3	Sakha 8	Indus66 x Norteno"S"/PK 3418-65-ISW-0S
P4	Line 6	MILAN/S87230//BABAX
P5	Line 7	SSER11/MLAN CMSS98Y04821S-0100M-04Y-04M-030Y-28M-3Y-0M
P6	Line 8	PG0/SER1//BAV92 CMSS96M031935-10M-010SY-010M-010SY-4M-0Y

These parents were crossed in all possible combinations excluding reciprocals during 2016/2017 growing season, giving seeds of 15 crosses from F_1 In 2017/ 2018 season, hybrid seeds were sown to obtain F_2 seeds and parents were re-crossed for obtaining adequate hybrid seeds. In 2018/2019 season, the experiment involved parents, F_1 hybrids and F_2 crosses, under tow nitrogen levels (35 and 75 kg N/fed.).The experiment was conducted in a randomized complete block design 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 and F_2 consisted of six rows, all 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 and 50 guarded plants for F_2 were chosen randomly from each plot. The following traits were measured: Days to maturity, plant height, No. of spikes plant^{-1}, No. of grains spike^{-1}, 200-grain weight and grain yield plant^{-1}.

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 both F_1 and F_2 generations for all studied characters is shown in Table 2. genotypes, parents, crosses and parent *vs*. crosses mean squares were significant for all traits in both F_1 and F_2 generations, except days to maturity under 75 kg N/fed., for genotypes and parents and No. of spikes/plant under 35 kg N/fed., for parents in the F_2 generation, indicating the presence of diversity in the studied materials and sufficient amount of genetic variability adequate for further biometrical assessment. The parents *vs* crosses mean squares were highly significant for all studied characters in the F_1 and was significant or highly significant for most characters studied in the F_2 under both 35 kg N/fed., and 75 kg N/fed. These findings are reasonable and might be due to existing the F_2 which would reduce the heterosis effects. Significant differences among genotypes for grain 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) and EL-Gammaal and Yahya (2018).

Table 2. Significance of mean squares from ordinary and combining ability analysis for all characters studied in F_1 and F_2 generations.

F_1	df		Days to maturity (days)			Plant height (cm)			No. of spikes/plant		
SOV	S	C	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.
Env.		1			346.67 **			1178.5 **			606.28 **
Rep x Env.	2	4	3.92 **	0.30	2.11 *	0.39	0.11	0.25	0.92	0.91	0.92
Genotypes (G)	20	20	5.28 **	12.90 **	10.20 **	59.43 **	40.51 **	90.15 **	5.08 **	9.35**	8.43 **
Parents (P)	5	5	9.56 **	22.89 **	18.38 **	61.73 **	28.80**	64.51 **	3.26 **	7.98**	4.60 **
Crosses (F_1)	14	14	3.75 **	4.36 **	3.38 **	28.56 **	24.31**	48.70 **	4.82 **	10.45**	9.47 **
P *vs* F_1	1	1	5.34 **	82.51 **	64.92 **	480.14 **	325.92 **	798.61 **	17.88 **	0.78	13.05 **
GxEnv.		20			7.97 **			9.79 *			6.00 **
PxEnv.		5			14.07 **			26.01 **			6.64 **
F_1xEnv.		14			4.73 **			4.17			5.80 **
p *vs* F_1 x Env.		1			22.94 **			7.45			5.60 **
Error	40	80	0.52	0.68	0.60	8.04	2.80	5.42	0.70	0.70	0.70
GCA	5	5	1.78 **	5.25 **	4.75 **	8.42 *	12.25 **	16.39 **	2.56 **	3.18 **	3.81 **
SCA	15	15	1.76 **	3.98 **	2.95 **	23.60 **	13.92 **	34.60 **	1.41 **	3.09 **	2.48 **
Error	40.	80	0.17	0.23	0.20	2.68	0.93	1.81	0.23	0.23	0.23
GCA/SCA			1.01	1.32	1.61	0.36	0.88	0.47	1.82	1.03	1.54

Table 2. Cont.

F_1	df		No. of grains/spike			200-kernel weight			Grain yield/plant		
SOV	S	C	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.
Env.		1			3543.89 **			18.43 **			2581.55 **
Rep x Env.	2	4	21.095	22.369	21.732 *	0.395 **	0.016	0.20 **	4.085	10.96 **	7.524 *
Genotypes (G)	20	20	96.161 **	95.32 **	162.40 **	2.210 **	1.964**	3.89 **	46.86 **	87.22 **	77.76 **
Parents (P)	5	5	141.45 **	163.64 **	267.578 **	2.537 **	3.389 **	5.56 **	68.62 **	152.69 **	45.91 **
Crosses (F_1)	14	14	76.32 **	67.01 **	115.19 **	1.824 **	1.169 **	2.73 **	35.69 **	68.75 **	93.63 **
P *vs* F_1	1	1	147.45 **	150.02 **	297.47 **	5.982 **	5.970 **	11.953 **	94.54 **	18.45 **	14.73 *
GxEnv.		20			29.08 **			0.27 **			56.32 **
PxEnv.		5			37.52 **			0.36 **			175.404 **
F_1xEnv.		14			28.14 **			0.26 **			10.80 **
p *vs* F_1 x Env.		1			0.006			0.000			98.26 **
Error	40	80	8.136	7.832	7.984	0.074	0.037	0.055	4.306	1.629	2.968
GCA	5	5	34.10 **	39.65 **	61.42 **	2.15 **	1.63 **	3.64 **	30.87 **	15.22 **	9.87 **
SCA	15	15	31.37 **	29.15 **	51.71 **	0.27 **	0.33 **	0.52 **	10.54 **	33.69 **	31.27 **
Error	40.	80	2.71	2.61	2.66	0.02	0.01	0.02	1.44	0.54	0.99
GCA/SCA			1.09	1.36	1.19	8.04	4.96	6.99	2.93	0.45	0.32

Table 2. Cont.

F_2	df		Days to maturity (days)			Plant height (cm)			No. of spikes /plant		
SOV	S	C	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.
Env.		1			190.67 **			1790.00 **			365.98 **
Rep x Env.	2	4	9.33 **	7.87	8.60	11.14 *	6.47	8.80 *	0.12	0.22	0.17
Genotypes (G)	20	20	11.37 **	41.52	31.99 **	120.27 **	32.73 **	109.56 **	1.79 *	4.11 **	4.84 **
Parents (P)	5	5	11.39 **	32.89	23.16	227.30 **	29.44 **	174.87 **	1.51	4.55 **	4.61 **
Crosses (F_1)	14	14	12.03 **	34.91	29.71 *	83.70 **	32.87 **	84.08 **	2.01 **	4.05 **	5.20 **
P *vs* F_1	1	1	1.94	177.07 *	108.06 **	97.00 **	47.12 **	139.67 **	0.09	2.67	0.90
GxEnv.		20			20.89			43.44 **			1.06
PxEnv.		5			21.12			81.88 **			1.45
F_1xEnv.		14			17.23			32.50 **			0.86
p *vs* F_1 x Env.		1			70.95 *			4.45			1.85
Error	40	80	0.70	25.67	13.19	2.52	2.73	2.63	0.78	1.03	0.91
GCA	5	5	2.24 **	10.57	7.79	41.16 **	11.54 **	42.99 **	0.60	1.59 **	1.99 **
SCA	15	15	4.31 **	14.93	11.62 **	39.73 **	10.70 **	34.36 **	0.60 *	1.30 **	1.49 **
Error	40.	80	0.23	8.56	4.40	0.84	0.91	0.88	0.26	0.34	0.30
GCA/SCA			0.52	0.71	0.67	1.04	1.08	1.25	1.00	1.23	1.34

Table 2. Cont.

F_2	df		No. of grains/spike			200-kernel weight			grain yield/plant		
SOV	S	C	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.
Env.		1			3420.57 **			11.21 **			3546.34 **
Rep x Env.	2	4	23.87	8.15	16.01	0.43 **	0.01	0.22 *	1.83	1.99	1.91
Genotypes (G)	20	20	144.53 **	108.06 **	224.02 **	2.06 **	1.55 **	3.47 **	47.25 **	95.13 **	85.99 **
Parents (P)	5	5	182.55 **	195.68 **	348.91 **	3.85 **	4.22 **	7.91 **	62.10 **	159.72 **	54.96 **
Crosses (F_1)	14	14	109.07 **	61.14 **	140.23 **	1.49 **	0.70 **	2.07 **	45.22 **	70.31 **	99.85 **
P *vs* F_1	1	1	450.90 **	326.78 **	772.70 **	1.04 **	0.09	0.8 **	1.48	119.64 **	47.25 **
GxEnv.		20			28.57 **			0.1*			56.39 **
PxEnv.		5			29.32 *			0.16 *			166.86 **
F_1xEnv.		14			29.98 **			0.12			15.68 **
p *vs* F_1 x Env.		1			4.98			0.26			73.86 **
Error	40	80	13.37	5.73	9.55	0.07	0.06	0.07	3.98	2.82	3.40
GCA	5	5	86.52 **	64.17 **	133.64 **	2.00 **	1.47 **	3.39 **	22.57 **	17.68 **	17.09 **
SCA	15	15	35.40 **	26.63 **	55.02 **	0.25 **	0.20 **	0.41 **	13.48 **	36.38 **	32.52 **
Error	40.	80	4.46	1.91	3.18	0.02	0.02	0.02	1.33	0.94	1.13
GCA/SCA			2.44	2.41	2.43	8.08	7.39	8.25	1.67	0.49	0.53

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

Mean performance values of the parents, F_1 and F_2 generations for all traits are presented in Table 3. For maturity date, the F_1 hybrids of P4xP5, P2xP3 and P2xP5 had the lowest values under 35, 75 kg N/fed., levels and in combined analysis, respectively. On the other hand, for F_2 hybrids: P1xP4 was the latest cross in days to maturity with value 148.33 day.

Table 3. Mean performance of all studied genotypes (parents, F_1 and F_2 generations) for all studied traits.

F_1	Days to maturity (days)			Plant height (cm)			No. of spikes /plant		
	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.
P1	144.67	152.67	148.67	96.74	106.79	101.77	6.42	14.37	10.40
P2	144.33	153.00	148.67	100.37	106.25	103.31	8.22	14.89	11.56
P3	144.67	147.00	145.83	95.28	98.29	96.78	8.27	13.65	10.96
P4	144.67	146.67	145.67	98.02	104.26	101.14	7.78	10.81	9.29
P5	143.67	148.67	146.17	88.99	102.41	95.70	9.22	14.07	11.64
P6	148.67	150.67	149.67	101.83	104.53	103.18	9.22	11.65	10.44
1x2	146.67	148.00	147.33	98.60	106.39	102.50	9.38	13.82	11.60
1x3	144.67	145.33	145.00	101.51	105.72	103.62	8.15	9.98	9.07
1x4	144.00	148.33	146.17	103.08	110.70	106.89	8.22	12.07	10.15
1x5	145.33	147.00	146.17	106.91	112.29	109.60	7.40	17.65	12.52
1x6	144.33	147.33	145.83	106.55	111.34	108.94	8.76	10.74	9.75
2x3	145.33	145.00	145.17	99.40	106.64	103.02	10.03	13.36	11.70
2x4	145.33	148.33	146.83	102.67	112.14	107.41	9.85	14.55	12.20
2x5	143.67	146.00	144.83	103.86	108.26	106.06	11.41	14.18	12.80
2x6	143.00	147.67	145.33	103.81	110.88	107.35	9.23	13.59	11.41
3x4	143.67	147.33	145.50	106.56	111.68	109.12	9.09	12.06	10.58
3x5	145.00	146.33	145.67	100.66	105.86	103.26	8.78	13.09	10.94
3x6	144.33	146.33	145.33	103.98	108.49	106.24	12.28	15.80	14.04
4x5	142.00	148.67	145.33	107.99	111.38	109.69	10.26	13.81	12.03
4x6	144.67	148.67	146.67	100.51	106.39	103.45	8.47	13.71	11.09
5x6	145.00	148.33	146.67	98.63	103.69	101.16	9.16	13.88	11.52
Mean	144.65	147.97	146.31	101.24	107.35	104.29	9.03	13.42	11.22
L.S.D.5 %	1.19	1.39	1.26	4.68	2.80	3.78	1.38	1.40	1.36

F_1	No. of grains/spike			200-kernel weight			Grain yield/plant		
	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.
P1	55.99	72.41	64.20	9.84	10.19	10.02	19.62	52.11	35.86
P2	70.86	75.54	73.20	8.25	9.80	9.02	24.79	34.50	29.65
P3	61.26	69.37	65.31	8.52	9.30	8.91	29.69	35.13	32.41
P4	73.45	90.56	82.00	8.62	9.73	9.17	33.71	39.14	36.42
P5	70.62	78.84	74.73	7.43	7.68	7.55	27.15	41.41	34.28
P6	70.46	79.69	75.08	7.33	7.87	7.60	28.80	32.54	30.67
1x2	67.50	74.60	71.05	9.99	10.60	10.29	29.08	39.65	34.36
1x3	63.90	73.55	68.72	10.09	10.86	10.47	29.54	35.31	32.43
1x4	64.05	74.59	69.32	9.97	10.50	10.23	27.78	33.47	30.62
1x5	65.66	72.42	69.04	9.56	10.09	9.82	24.61	37.31	30.96
1x6	59.01	70.73	64.87	10.02	10.27	10.15	27.96	34.22	31.09
2x3	72.87	80.23	76.55	8.14	9.03	8.59	29.54	36.36	32.95
2x4	62.23	69.72	65.97	8.90	9.97	9.44	32.55	39.55	36.05
2x5	70.37	82.40	76.39	8.04	8.96	8.50	31.04	41.94	36.49
2x6	64.60	75.97	70.29	8.76	9.93	9.35	32.71	42.66	37.68
3x4	67.50	80.18	73.84	9.43	9.52	9.48	31.58	37.53	34.55
3x5	52.62	67.51	60.06	8.29	10.00	9.15	33.15	40.03	36.59
3x6	60.49	70.41	65.45	9.11	9.48	9.29	34.88	47.00	40.94
4x5	57.88	81.20	69.54	8.05	9.27	8.66	33.97	42.78	38.38
4x6	62.40	69.99	66.19	8.40	9.18	8.79	29.43	33.59	31.51
5x6	64.74	71.28	68.01	8.41	8.98	8.69	22.26	27.72	24.99
Mean	64.69	75.29	69.99	8.82	9.58	9.20	29.23	38.28	33.76
L.S.D. 5%	4.70	4.68	4.59	0.44	0.32	0.38	3.42	2.13	2.79

Table 3. Cont.

F_2	Days to maturity (days)			Plant height (cm)			No. of spikes/plant		
	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.
1x2	147.33	148.67	148.00	100.50	105.88	103.19	8.77	12.63	10.70
1x3	145.00	135.00	140.00	103.29	104.57	103.93	7.27	9.52	8.40
1x4	148.33	149.33	148.83	94.98	106.85	100.92	9.72	12.20	10.96
1x5	142.33	144.33	143.33	109.26	111.47	110.37	8.81	10.52	9.67
1x6	142.33	144.67	143.50	102.78	104.21	103.50	8.40	11.41	9.91
2x3	146.00	146.67	146.33	94.65	102.51	98.58	9.48	12.95	11.22
2x4	142.67	147.67	145.17	93.44	109.20	101.32	9.96	13.99	11.98
2x5	144.67	147.33	146.00	94.13	98.87	96.50	8.70	12.18	10.44
2x6	145.00	148.33	146.67	94.13	106.96	100.55	8.23	12.32	10.28
3x4	144.67	148.00	146.33	101.26	107.38	104.32	8.45	12.13	10.29
3x5	142.67	145.33	144.00	100.67	105.14	102.91	9.51	12.01	10.76
3x6	145.67	147.00	146.33	95.99	103.76	99.88	10.43	14.26	12.34
4x5	146.67	147.67	147.17	100.93	106.53	103.73	9.57	12.27	10.92
4x6	143.00	145.67	144.33	89.48	104.56	97.02	8.33	12.30	10.31
5x6	142.00	145.33	143.67	92.25	99.36	95.81	8.52	12.30	10.41
Mean	144.67	147.13	145.90	97.07	104.60	100.84	8.92	12.33	10.63
L.S.D. 5%	1.38	8.49	5.90	2.62	2.77	2.63	1.46	1.70	1.55
F_2	No. of grains/spike			200-kernel weight			Grain yield/plant		
	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.
1x2	66.38	68.48	67.43	9.82	9.98	9.90	24.67	31.01	27.84
1x3	48.67	70.65	59.66	9.34	9.46	9.40	21.92	28.69	25.31
1x4	69.61	80.01	74.81	9.18	9.47	9.32	29.49	40.33	34.91
1x5	64.24	74.74	69.49	9.17	9.70	9.44	28.16	35.58	31.87
1x6	62.60	74.85	68.73	9.62	9.91	9.76	23.07	33.23	28.15
2x3	56.88	72.09	64.48	7.91	8.68	8.30	27.41	40.47	33.94
2x4	61.67	68.43	65.05	8.36	8.97	8.66	23.98	36.37	30.18
2x5	61.20	69.51	65.36	8.14	8.98	8.56	22.61	38.29	30.45
2x6	65.29	72.81	69.05	7.40	8.42	7.91	26.62	36.94	31.78
3x4	66.60	79.66	73.13	8.33	9.27	8.80	23.99	37.88	30.94
3x5	53.77	65.01	59.39	8.21	8.90	8.56	30.92	40.21	35.57
3x6	58.20	68.99	63.60	9.05	9.24	9.15	33.66	44.62	39.14
4x5	59.44	72.78	66.11	8.18	8.83	8.51	32.86	38.65	35.76
4x6	64.81	73.26	69.03	7.97	8.47	8.22	26.21	32.69	29.45
5x6	71.66	79.81	75.74	8.41	8.91	8.66	21.65	26.86	24.26
Mean	63.76	74.18	68.97	8.53	9.12	8.82	26.38	36.99	31.69
L.S.D. 5%	6.03	4.01	5.02	0.45	0.42	0.43	3.29	2.81	3.00

For plant height, the two F1 hybrids: (P1x P2 and P5xP6) showed the lowest values. On the other hand, for F2 hybrids: P1xP5 had the highest values under 35, 75 kg N/fed., levels as well as for overall the two levels of nitrogen.

F_1 hybrids (P3xP6, P1xP5and P3xP6) had the highest number of spikes splant^{-1}. For No. of grains spike^{-1}, F_1 hybrids of P2xP3, P2xP5 and P2xP3 as well as the F2 hybrid P5xP6 expressed the highest values for this character. The F_1 hybrid P1xP3 and F_2 hybrid P1xP2 were the highest hybrids for 200-grain weight. As for grain yield, the F_1 hybrid P3xP6 exhibited the highest weight.

Heterosis

Mean squares for parents *vs*. crosses in F_1 generation, as an indication of average of heterosis in F_1 for all crosses were significant for all the studied characters except No. of spikes/plant under 75 kg N/fed. (Table 2). 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 two crosses (P2xP6 and P2xP3) for days to maturity, cross (P3xP6) for No. of spikes plant^{-1}, cross (P2xP3) for No. of grains spike-1,tow crosses (P1xP6 and P3xP5) for 200-grain weight under 35, 75 kg N/fed., levels as well as the combined data.

As for plant height six, eleven and nine crosses were highly significantly positive under 35, 75 kg N/fed., and combined analysis, respectively.

For grain yield/plant crosses (p1xp2, p1xp3, p2xp5, p2xp6, p3xp5 and p3xp6), under 35 kg N/fed., were highly significantly positive, crosses (p2xp5, p2xp6 and p3xp6) under 75 kg N/fed., were highly significantly positive, in addition, crosses (p2xp5, p2xp6 and p3xp6) were also highly significantly positive in the combined analysis.

Concerning grain yield plant^{-1}, the four crosses (P1xP2, P1xP3, P2xP6 and P3xP6) showed significant positive heterotic effects under tow nitrogen levels. 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) and EL-Gammaal and Yahya (2018).

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

	days to maturity (days)			Plant height (cm)			No. of spikes /plant		
	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.
F_1									
1x2	1.50**	-3.16**	-0.90*	0.05	-0.12	-0.04	28.17**	-5.56	5.69
1x3	0.00	-3.00**	-1.53**	5.73*	3.10*	4.37*	11.03	-28.79**	-15.10*
1x4	-0.46	-0.89	-0.68	5.85*	4.90**	5.36**	15.83	-4.13	3.06
1x5	0.81	-2.43**	-0.85	15.13**	7.35**	11.01**	-5.37	24.12**	13.66*
1x6	-1.59**	-2.86**	-2.23**	7.32**	5.37**	6.31**	12.07	-17.44**	-6.37
2x3	0.58	-3.33**	-1.41**	1.61	4.28**	2.97	21.65*	-6.35	3.90
2x4	0.58	-1.00*	-0.23	3.50	6.54**	5.07**	23.19**	13.20*	17.04*
2x5	-0.23	-3.20**	-1.75**	9.70**	3.77**	6.59**	30.91**	-2.09	10.31
2x6	-2.39**	-2.74**	-2.57**	2.68	5.21**	3.97*	5.91	2.36	3.77
3x4	-0.69	0.34	-0.17	10.25**	10.27*	10.26**	13.25	-1.34	4.44
3x5	0.58	-1.01*	-0.23	9.25**	5.49**	7.29**	0.46	-5.51	-3.20
3x6	-1.59**	-1.68**	-1.64**	5.50*	6.98**	6.25**	40.49**	24.90**	31.27**
4x5	-1.50**	0.68	-0.40	15.49**	7.79**	11.45**	20.75*	11.02	14.97*
4x6	-1.36**	0.00	-0.68	0.58	1.91	1.26	-0.35	22.08**	12.42
5x6	-0.80	-0.89	-0.85	3.38	0.21	1.73	-0.61	7.93	4.36
	No. of grains/spike			200-kernel weight			grain yield/plant		
	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.
F_1									
1x2	6.42	0.84	3.42	10.50**	6.02**	8.15**	30.96**	-8.44**	4.91
1x3	8.99*	3.75	6.13	9.91**	11.44*	10.70**	19.82**	-19.04**	-5.01
1x4	-1.03	-8.46**	-5.17	8.03**	5.38**	6.66**	4.19	-26.64**	-15.26**
1x5	3.73	-4.24	-0.61	10.73**	12.84*	11.80**	5.25	-20.22**	-11.73**
1x6	-6.66	-6.99*	-6.84*	16.77**	13.76*	15.23**	15.49*	-19.14**	-6.54
2x3	10.30**	10.73**	10.53**	-2.86	-5.41**	-4.22	8.44	4.43	6.19
2x4	-13.76**	-16.05**	-14.99**	5.59*	2.13	3.74	11.28	7.40*	9.12*
2x5	-0.52	6.75*	3.27	2.64	2.55	2.59	19.52**	10.48**	14.16**
2x6	-8.58*	-2.12	-5.20	12.54**	12.47*	12.50**	22.04**	27.25**	24.94**
3x4	0.21	0.28	0.25	10.05**	0.09	4.81*	-0.39	1.07	0.40
3x5	-20.20**	-8.90**	-14.22**	3.97	17.82*	11.11**	16.63**	4.59	9.72*
3x6	-8.15*	-5.52	-6.76*	14.97**	10.46*	12.63**	19.24**	38.91**	29.79**
4x5	-19.65**	-4.13	-11.27**	0.31	6.41**	3.49	11.66*	6.22*	8.56*
4x6	-13.28**	-17.78**	-15.72**	5.37	4.32*	4.82*	-5.83	-6.27*	-6.07
5x6	-8.23*	-10.08**	-9.21**	13.96**	15.45*	14.72**	-20.44**	-25.04**	-23.06**

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

Combining ability

The analysis of variance for both general (GCA) and specific (SCA) combining abilities shows that the mean squares were highly significant for all studied characters in both generations except days to maturity and No. of spikes/plant in F_2 (Table 2) 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 inbreds. 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 2) displays the relative importance of additive gene action effects in their inheritance. 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 and F_2 generations 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 spike 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 both F_1 and F_2 generations are presented in Table 5.

The estimates of iĝ effects obtained from F_2 generation were similar to those of F_1 generation in most cases. High positive response would be of interest for all studied characters except for days to maturity and plant height 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 are preferred in wheat.

The parent P1 (cv. Giza. 171) exhibited significant desirable iĝ effect among all the tested parents in plant height and 200-grain weight in F_1, plant height and 200-grain weight in F_2 generation.

The parental variety P2 (Shandaweel 1) gave significant positive iĝ effects for the No. of spikes plant^{-1} and No. of grains spike^{-1},under 35 N. level, maturity date, plant height, No. of spikes plant^{-1} and 200-grain weight under 75 kg N/fed., level. 200-kernel weight only in the F_2 generation. But, it gave significant undesirable or insignificant iĝ effects for other traits. The variety P3 (Sakha 8) gave significant positive iĝ effects for the grain yield in F_1, plant height and grain yield in F_2 under 35 kg N/fed., level. The parental variety P4 (line 6) expressed significant positive iĝ effects for plant height and 200-grain weight under 75 kg N/fed., levels and grain yieldplant^{-1} under 35 kg N/fed., level . The parental line P5 expressed significant desirable iĝ effects for No. of spikes plant^{-1} and grain yieldplant^{-1} in F_1 generation under 75 kg N/fed., level. The parental line P6 expressed significant positive iĝ effects for days to maturity and No. of spikes plant^{-1} in the F_1. It gave significant positive iĝ effects for Maturity date and No. of grains spike^{-1} in F_2 generations. Such obtained results suggested that a great opportunity for selection would be possible for yield and its components having a semi-dwarf plant height hence can response to more N fertilizers without least of lodging. Therefore, the mean performance of the genotypes could be a reliable and effective indication for their general combining ability effects for most characters. Therefore, selection among the tested parental population for initiating any proposed breeding program could be practiced either on mean performance or iĝ effects basis with similar efficiency. 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) and EL-Gammaal and Yahya (2018).

Table 5. Estimates of parental general combining ability effects for all studied traits in F_1 and F_2 generations.

	Days to maturity (days)			Plant height (cm)			No. of spikes/plant		
	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.
F_1									
P1	0.22	0.69**	0.46**	0.18	1.07**	0.63**	-1.06**	-0.11	-0.58**
P2	0.01	0.65**	0.33**	0.06	0.67*	0.36	0.39*	0.67**	0.53**
P3	-0.03	-1.43**	-0.73**	-0.75	-2.06**	-1.40**	0.21	-0.29	-0.04
P4	-0.44**	-0.14	-0.29**	1.03	1.17**	1.10**	-0.22	-0.76**	-0.49**
P5	-0.53**	-0.26	-0.40**	-1.58**	-0.64*	-1.11**	0.28	0.85**	0.57**
P6	0.76**	0.49**	0.62**	1.06	-0.20	0.43*	0.39*	-0.36*	0.02
LSD gi 5%	0.27	0.31	0.14	1.07	0.63	0.41	0.32	0.31	0.15
LSD gi 1%	0.36	0.42	0.18	1.43	0.84	0.55	0.42	0.42	0.20
LSD gi-gj	0.42	0.48	0.22	1.65	0.98	0.67	0.49	0.49	0.24
LSD gi-gj	0.56	0.65	0.30	2.21	1.31	0.89	0.65	0.65	0.32
P1	0.08	0.10	0.09	3.53**	2.00**	2.77**	-0.42*	-0.62**	-0.52**
P2	0.29	1.68	0.99**	0.15	0.51	0.33*	0.35*	0.67**	0.51**
P3	0.00	-1.90	-0.95**	1.11**	-0.78*	0.16	0.17	0.33	0.25**
P4	0.33*	0.06	0.19	-0.96**	0.35	-0.30*	0.12	-0.14	-0.01
P5	-1.04**	-0.24	-0.64	-3.28**	-1.21**	-2.25**	-0.04	-0.10	-0.07
P6	0.33*	0.31	0.32	-0.55	-0.87**	-0.71**	-0.18	-0.14	-0.16
LSD gi 5%	0.32	1.91	0.64	0.60	0.62	0.29	0.33	0.38	0.17
LSD gi 1%	0.42	2.55	0.85	0.80	0.83	0.38	0.45	0.51	0.22
LSD gi-gj	0.49	2.96	1.04	0.93	0.96	0.47	0.52	0.59	0.27
LSD gi-gj	0.65	3.96	1.38	1.24	1.29	0.62	0.69	0.79	0.36
	No. of grains/spike			200-kernel weight			Grain yield/plant		
	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.
F_1									
P1	-2.59**	-2.04**	-2.32**	0.95**	0.70**	0.83**	-3.30**	2.03**	-0.64**
P2	3.31**	0.87	2.09**	-0.17**	0.13**	-0.02	-0.01	0.15	0.07
P3	-1.62**	-2.06**	-1.84**	0.05	0.05	0.05*	1.68**	-0.18	0.75**
P4	1.02	3.72*	2.37**	0.03	0.10**	0.07**	2.26**	-0.35	0.96**
P5	-0.04	0.68	0.32	-0.56**	-0.55**	-0.56**	-0.66	0.58*	-0.04
P6	-0.08	-1.16*	-0.62*	-0.29**	-0.44**	-0.37**	0.03	-2.21**	-1.09**
LSD gi 5%	1.07	1.05	0.50	0.10	0.07	0.04	0.78	0.48	0.31
LSD gi 1%	1.44	1.41	0.66	0.14	0.10	0.06	1.05	0.64	0.41
LSD gi-gj	1.66	1.63	0.81	0.16	0.11	0.07	1.21	0.74	0.49
LSD gi-gj	2.23	2.18	1.08	0.21	0.15	0.09	1.62	1.00	0.66
P1	-2.86**	-1.38**	-2.12**	0.94**	0.76**	0.85**	-2.20**	1.97**	-0.11
P2	0.08	-2.68**	-1.30**	-0.23**	0.02	-0.11**	-1.54**	-0.37	-0.96**
P3	-4.89**	-2.47**	-3.68**	-0.01	-0.04	-0.03	1.16**	0.35	0.75**
P4	3.28**	4.74**	4.01**	0.08	0.09	0.08**	2.34**	0.58	1.46**
P5	1.29	0.24	0.77**	-0.41**	-0.42**	-0.42**	0.28	0.05	0.16
P6	3.10**	1.55**	2.33**	-0.36**	-0.40**	-0.38**	-0.03	-2.57**	-1.30**
LSD gi 5%	1.38	0.90	0.55	0.10	0.09	0.05	0.75	0.63	0.33
LSD gi 1%	1.84	1.21	0.73	0.14	0.13	0.06	1.01	0.85	0.43
LSD gi-gj	2.13	1.40	0.89	0.16	0.15	0.08	1.16	0.98	0.53
LSD gi-gj	2.85	1.87	1.18	0.21	0.20	0.10	1.56	1.31	0.70

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

Specific combining ability effects

Specific combining ability effects ŝij of both F_1 and F_2 for all characters are presented in Table 6. The data show highly significant desirable ŝij values for some crosses in the F_1 than F_2 generation. This result is expected and indicating inbreeding depression in the F_2 reducing the non-additive or increased the additive portion.

Table 6. Estimates of specific combining ability effects of the parental combination for all studied traits in F_1 and F_2 generations.

F_1	Days to maturity (days)			Plant height (cm)			No. of spikes /plant		
	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.
1x2	1.78**	-1.32**	0.23	-2.87	-2.70**	-2.79**	1.01*	-0.15	0.43
1x3	-0.18	-1.90**	-1.04**	0.84	-0.64	0.10	-0.03	-3.04**	-1.53**
1x4	-0.43	-0.19	-0.31	0.63	1.11	0.87	0.47	-0.47	0.00
1x5	0.99*	-1.40**	-0.21	7.07**	4.52**	5.79**	-0.86	3.49**	1.32**
1x6	-1.30**	-1.82**	-1.56**	4.07**	3.12**	3.59**	0.40	-2.20**	-0.90**
2x3	0.70	-2.19**	-0.75**	-1.14	0.68	-0.23	0.40	-0.43	-0.02
2x4	1.11**	-0.15	0.48	0.35	2.95**	1.65	0.65	1.22**	0.94**
2x5	-0.47	-2.36**	-1.41**	4.15**	0.88	2.52**	1.71**	-0.76	0.47
2x6	-2.43**	-1.44**	-1.93**	1.46	3.06**	2.26**	-0.58	-0.14	-0.36
3x4	-0.51	0.93*	0.21	5.05**	5.22**	5.13**	0.07	-0.30	-0.12
3x5	0.90*	0.06	0.48	1.75	1.22	1.48	-0.74	-0.89*	-0.81**
3x6	-1.05**	-0.69	-0.87**	2.43	3.40**	2.92**	2.65**	3.03**	2.84**
4x5	-1.68**	1.10*	-0.29	7.31**	3.51**	5.41**	1.17**	0.30	0.74*
4x6	-0.30	0.35	0.02	-2.82	-1.93*	-2.37**	-0.73	1.42**	0.34
5x6	0.11	0.14	0.13	-2.09	-2.82**	-2.45**	-0.54	-0.03	-0.29
LSD Sij 5%	0.75	0.86	0.56	2.93	1.73	1.68	0.87	0.86	0.60
LSD Sij 1%	1.00	1.15	0.74	3.92	2.32	2.22	1.16	1.15	0.80
LSD sij-sik 5%	1.11	1.28	0.83	4.38	2.58	2.50	1.29	1.29	0.90
LSD sij-sik 1%	1.49	1.71	1.11	5.86	3.46	3.32	1.73	1.72	1.19
LSD sij-skl 5%	1.03	1.18	0.32	4.05	2.39	0.95	1.20	1.19	0.34
LSD sij-sik 1%	1.38	1.58	0.42	5.42	3.20	1.25	1.60	1.60	0.45

Table 6. Cont.

F_1	No. of grains/spike			200-kernel weight			Grain yield/plant		
	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.
1x2	2.09	0.48	1.29	0.40**	0.18	0.29**	3.16**	-0.81	1.18
1x3	3.41*	2.36	2.89**	0.27	0.52**	0.40**	1.93	-4.81**	-1.44*
1x4	0.94	-2.38	-0.72	0.17	0.11	0.14	-0.41	-6.49**	-3.45**
1x5	3.60*	-1.51	1.05	0.36*	0.35**	0.36**	-0.66	-3.58**	-2.12**
1x6	-3.00*	-1.36	-2.18*	0.55**	0.42**	0.49**	2.00	-3.87**	-0.93
2x3	6.49**	6.12**	6.30**	-0.55**	-0.73**	-0.64**	-1.36	-1.89**	-1.62*
2x4	-6.79**	-10.16**	-8.47**	0.23	0.16	0.19*	1.07	1.47*	1.27*
2x5	2.41	5.56**	3.99**	-0.04	-0.19	-0.12	2.48*	2.93**	2.71**
2x6	-3.32*	0.97	-1.17	0.41**	0.66**	0.54**	3.46**	6.44**	4.95**
3x4	3.41*	3.23*	3.32**	0.53**	-0.22*	0.16	-1.60	-0.22	-0.91
3x5	-10.42**	-6.41**	-8.41**	-0.01	0.92**	0.46**	2.90**	1.35*	2.12**
3x6	-2.50	-1.66	-2.08*	0.54**	0.28**	0.41**	3.94**	11.12**	7.53**
4x5	-7.79**	1.51	-3.14**	-0.24	0.13	-0.05	3.14**	4.27**	3.71**
4x6	-3.22*	-7.86**	-5.54**	-0.16	-0.07	-0.11	-2.09	-2.13**	-2.11**
5x6	0.17	-3.53*	-1.68	0.45**	0.38**	0.42**	-6.34**	-8.93**	-7.63**
LSD Sij 5%	2.95	2.89	2.03	0.28	0.20	0.17	2.15	1.32	1.24
LSD Sij 1%	3.95	3.87	2.70	0.38	0.26	0.22	2.87	1.77	1.65
LSD sij-sik 5%	4.40	4.32	3.04	0.42	0.30	0.25	3.20	1.97	1.85
LSD sij-sik 1%	5.89	5.78	4.03	0.56	0.40	0.34	4.29	2.64	2.46
LSD sij-skl 5%	4.08	4.00	1.15	0.39	0.27	0.10	2.97	1.82	0.70
LSD sij-sik 1%	5.45	5.35	1.52	0.52	0.37	0.13	3.97	2.44	0.93

Table 6. Cont.

F_2	Days to maturity (days)			Plant height (cm)			No. of spikes/plant		
	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.
1x2	2.29**	-0.24	1.03	-0.25	-1.23	-0.74	-0.09	0.25	0.08
1x3	0.25	-10.32**	-5.04**	1.58	-1.25	0.17	-1.41**	-2.52**	-1.96**
1x4	3.25**	2.05	2.65*	-4.65**	-0.10	-2.38**	1.10*	0.63	0.86*
1x5	-1.38**	-2.65	-2.01	11.95**	6.08**	9.01**	0.35	-1.09*	-0.37
1x6	-2.75**	-2.86	-2.81*	2.73**	-1.53	0.60	0.08	-0.16	-0.04
2x3	1.04*	-0.24	0.40	-3.67**	-1.82*	-2.75**	0.04	-0.38	-0.17
2x4	-2.62**	-1.20	-1.91	-2.81**	3.74**	0.46	0.57	1.12*	0.85*
2x5	0.75	-1.24	-0.24	0.20	-5.03**	-2.42**	-0.53	-0.72	-0.63
2x6	-0.29	-0.78	-0.54	-2.54**	2.72**	0.09	-0.86	-0.54	-0.70*
3x4	-0.33	2.72	1.19	4.05**	3.20**	3.63**	-0.76	-0.38	-0.57
3x5	-0.96*	0.35	-0.31	5.78**	2.53**	4.15**	0.47	-0.55	-0.04
3x6	0.67	1.47	1.07	-1.63	0.81	-0.41	1.51**	1.75**	1.63**
4x5	2.71**	0.72	1.71	8.11**	2.79**	5.45**	0.58	0.18	0.38
4x6	-2.33**	-1.82	-2.08	-6.07**	0.47	-2.80**	-0.54	0.25	-0.14
5x6	-1.96**	-1.86	-1.91	-0.98	-3.16**	-2.07**	-0.18	0.21	0.02
LSD Sij 5%	0.87	5.24	2.62	1.64	1.71	1.17	0.91	1.05	0.69
LSD Sij 1%	1.16	7.01	3.47	2.20	2.29	1.55	1.22	1.41	0.91
LSD sij-sik	1.29	7.82	3.90	2.45	2.55	1.74	1.36	1.57	1.02
LSD sij-sik	1.73	10.46	5.18	3.28	3.41	2.31	1.83	2.10	1.36
LSD sij-skl	1.20	7.24	1.48	2.27	2.36	0.66	1.26	1.45	0.39
LSD sij-sik	1.60	9.69	1.96	3.04	3.16	0.87	1.69	1.95	0.51

F_2	No. of grains/spike			200-kernel weight			Grain yield/plant		
	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.	35 kg N/fed.	75 kg N/fed.	Comb.
1x2	5.40**	-1.64	1.88	0.58**	0.08	0.33*	2.03	-7.57**	-2.77**
1x3	-7.35**	0.32	-3.51**	-0.11	-0.37**	-0.24*	-3.42**	-10.61**	-7.02**
1x4	5.44**	2.47	3.95**	-0.36*	-0.50**	-0.43**	2.96**	0.80	1.88**
1x5	2.04	1.70	1.87	0.12	0.24	0.18	3.70**	-3.44**	0.13
1x6	-1.40	0.50	-0.45	0.51**	0.43**	0.47**	-1.08	-3.16**	-2.12**
2x3	-2.07	3.06*	0.50	-0.37*	-0.41**	-0.39**	1.41	3.50**	2.46**
2x4	-5.44**	-7.81**	-6.63**	-0.01	-0.26	-0.14	-3.20**	-0.82	-2.01**
2x5	-3.93*	-2.22	-3.08**	0.26	0.26*	0.26**	-2.50*	1.62	-0.44
2x6	-1.65	-0.24	-0.95	-0.53**	-0.32*	-0.43**	1.81	2.89**	2.35**
3x4	4.46*	3.22*	3.84**	-0.25	0.10	-0.08	-5.89**	-0.03	-2.96**
3x5	-6.39**	-6.94**	-6.67**	0.11	0.25	0.18	3.10**	2.82**	2.96**
3x6	-3.77	-4.27**	-4.02**	0.90**	0.56**	0.73**	6.15**	9.85**	8.00**
4x5	-8.89**	-6.38**	-7.63**	-0.01	0.04	0.02	3.86**	1.03	2.44**
4x6	-5.33**	-7.21**	-6.27**	-0.26	-0.35**	-0.31**	-2.48*	-2.32*	-2.40**
5x6	3.51	3.84**	3.68**	0.65**	0.61**	0.63**	-4.98**	-7.62**	-6.30**
LSD Sij 5%	3.78	2.48	2.23	0.28	0.26	0.19	2.06	1.74	1.33
LSD Sij 1%	5.06	3.31	2.95	0.38	0.35	0.25	2.76	2.32	1.76
LSD sij-sik	5.64	3.69	3.32	0.42	0.39	0.28	3.08	2.59	1.98
LSD sij-sik	7.55	4.94	4.41	0.56	0.52	0.37	4.12	3.47	2.63
LSD sij-skl	5.23	3.42	1.26	0.39	0.36	0.11	2.85	2.40	0.75
LSD sij-sik	6.99	4.58	1.67	0.52	0.48	0.14	3.82	3.21	0.99

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

As for days to maturity the crosses P1xP6, P2xP6, P3xP6 and P4xP5 under 35 kg N/fed., and P1xP2, P1xP3, P1xP5, P1xP6, P2xP3, P2xP5 and P2xP6 under 75 kg N/fed., in F_1 generation and the crosses of P1xP5, P1xP6, P2xP4, P3xP5, P4xP6 and P5xP6 gave significant and negative ŝij effects. With regard to plant height, five and seven crosses expressed significant and positive ŝij effects at F_1 generation, under 35, 75 kg/fed, respectively. Five and six crosses expressed significant and positive ŝij effects at F_2 generation, under 35, 75kg/fed, respectively.

Such results indicate that the crosses P1xP2, P2xP5, P3xP6 and P4xP5 under 35 kg N/fed., crosses P1xP5, P2xP4, P3xP6 and P4xP6 under 75 kg N/fed., of F_1 and crosses P1xP4 and P3xP6 under 35 kg N/fed., crosses P2xP4 and P3xP6 under 75 kg N/fed., of F2 recorded the highest desirable ŝij effects. The other crosses had either significantly negative or insignificant ŝij effects for these characters. As for No of grains spike^{-1}, the crosses P1xP3, P2xP3 and P3xP4 under 35 kg N/fed., P2xP3, P2xP5 and P3xP4 under 75 kg N/fed., in F_1 generation and the crosses P1xP2, P1xP4 and P3xP4 under 35 kg N/fed., P2xP3, P3xP4 and P5xP6 under 75 kg N/fed., in F_2 generation gave significant and positive ŝij effects for this trait.

For 200-kernel weight, crosses p1xp2, p1xp5, p1xp6, p2xp6, p3xp6 and p5xp6 under 35 kg N/fed., crosses p1xp3, p1xp5, p1xp6, p2xp6, p3xp5, p3xp6 and p5xp6 under 75 kg N/fed., in F1 generation, had significant positive ŝij effects., crosses p1xp2, p1xp6, p3xp6 and p5xp6 under 35 kg N/fed., crosses p1xp6, p2xp5, p3xp6 and p5xp6 under 75 kg N/fed., in F_2 generation, had significant positive ŝij effects.,

For grain yield plant^{-1}, cross p1xp2 under 35 kg N/fed., cross p2xp4 under 75 kg N/fed., crosses p2xp5, p2xp6, p3xp5, p3xp6 and p4xp5 under both nitrogen levels in F_1 generation, crosses p1xp4, p1xp5, p3xp5, p3xp6 and p4xp5 under 35 kg N/fed., crosses p2xp3, p2xp6, p3xp5 and p3xp6 under 75 kg N/fed., in F_2 generation, had significant positive ŝij effects. The crosses P3xP6 gave the highest desirable ŝij effects in both generations.

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 وراثيه على بعض هجن القمح تحت مستويين من النيتروجين

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يهدف البحث الى اختيار الهجن المتميزة لاستخدامها فى تحسين محصول حبوب القمح فى مصر ودراسة قوة الهجين والقدرة على التالف للمحصول ومكوناته فى الجيلين الاول والثانى تحت مستوين من التسميد النيتروجينى. اجرى التهجين النصف تبادلى بين ستة تراكيب وراثيه من قمح الخبز فى موسم٢٠١٦-٢٠١٧ وتم انتاج بذور الجيل الاول و الثانى وقيمت الاباء والجيل الاول والثانى معا فى تصميم القطاعات الكاملة العشوائية بثلاث مكرارات للمحصول ومكوناته فى موسم (٢٠١٨|٢٠١٩). كان التباين الراجع الى التراكيب الوراثية (الاباء – الهجن) معنويا فى الجيل الاول والثانى فى معظم الصفات. وايضا كانت قوه الهجين معنوية فى كل الصفات تحت الدراسة. تراوحت قيمة قوة الهجين الموجبة والمعنوية مقارنة بالاب الافضل من ٦,٢٢ الى ٣٨,٩١ % فى الجيل الاول. وكان الهجينان (p1 x p2),(p3 x p6) هما الافضل فى وزن حبوب النبات. وكان التباين الراجع للقدرة العامة والخاصة على التالف معنويا لكل الصفات المدروسه والنسبه بينهم تشير الى اهمية الفعل الجينى المضيف فى توريث جميع الصفات تحت الدراسة. واظهرت الاباء (P1 وP4) قدرة عالية على التالف ومرغوبة لمعظم الصفات تحت الدراسة. اعطت الهجن الثلاثة (P1 X P5, P3 X P6 , P4 X P5) تاثيرات قدرة خاصة على التالف عالية المعنوية لوزن محصول حبوب النبات فى كل من الجيل الاول والثانى. ويمكن استخدام تلك الهجن فى برنامج التربية.

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