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GENERAL AND SPECIFIC COMBINING ABILITIES AND THEIR INTERACTIONS WITH THREE NITROGEN LEVELS FOR GRAIN YIELD AND RELATED TRAITS IN BREAD WHEAT (*Triticum aestivum* L.)

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ABSTRACT

This study was carried out in 2003/2004 and 2004/2005 growing seasons at the experimental Farm, Faculty of Agriculture, Kafr El-Sheikh, Tanta University

Six bread wheat cultivars, were crossed in one half diallel crosses mating design to study combining ability and heterosis and their interactions with nitrogen fertilizer levels (40, 60 and 80 kg N/feddan). Heading and maturity dates, plant height (cm), spike length (cm), number of grains/spike, spike weight (g), 1000-grain weight (g) traits were evaluated:

1. Nitrogen fertilizer levels measures were found to be highly significant for all studied traits. The mean values were higher at the high nitrogen level than the low level for all studied traits. Genotypes (parents and crosses), parents vs. crosses mean squares exhibited highly significance for all studied traits under the three nitrogen levels and the combined data.
2. The best general combiners for grain yield and one or more of its attributes were Sakha 94, Gem. 7 and Sakha 93, while the best general combiners for earliness and shortness were Sakha 61 and Sakha 93.
3. General and specific combining abilities and their interactions with nitrogen fertilizer levels were found to be highly significant for all studied traits under the three nitrogen levels and the combined data. This finding indicated that both additive and non-additive genetic variances were important in the inheritance of all studied traits.
4. The hybrid combinations (Gem. 7 x Sids 1) and (Gem. 7 x Gem. 9) showed highly significant desirable S.C.A. effects for heading date under 40, 60 kg nitrogen and the combined data, while the crosses (Sakha 61 x Sids 1) and (Sakha 93 x Gem. 7) showed highly significant desirable S.C.A. effects for maturity date under 60 and 80 kg nitrogen as well as the combined data. For grain yield/plant the cross (Sids 1 x Gem. 9) had significant positive specific combining ability effects under 60 kg nitrogen and the combined data.
5. The GCA/SCA ratios revealed that additive gene effects were of greater importance in the inheritance of all studied traits.
6. Eight crosses exhibited highly significant positive heterosis percentages over mid-parents under three nitrogen levels and the combined data, while none of the hybrids significantly out yielded its higher parent.

INTRODUCTION

Wheat is considered as the most important winter crop in Egypt and essential edible crop in the world. The major objective of wheat breeder is to produce new genotypes with high yielding ability for grain yield per unit area, to increase the productivity to face the gap between the production and consumption in Egypt.

Environmental fluctuations highly influence the phenotypic expression of quantitative traits. The environmental factors usually change daily, hence studying genotype-environment interactions for plant breeders is of prime importance to avoid this effect and to select the elite materials.

Diallel cross mating designs of Griffing (1956) are widely and extensively used to estimate the combining ability and types of gene actions, which is considered as a main objective for any plant breeding scheme for developing the materials which gave superior performance over a series of environments.

The objectives of the present study were to estimate:

1. The superior parents and cross combinations from half 6 x 6 diallel crosses of bread wheat parental genotypes.
2. The magnitudes of both general and specific combining abilities and their interactions with three nitrogen fertilizer levels as three different environmental conditions.
3. Amounts of heterosis for grain yield plant.

MATERIALS AND METHODS

The present study was conducted during the two growing seasons of 2003/2004 and 2004/2005 at the experimental Farm, Faculty of Agriculture, Kafr El-Sheikh, Tanta University.

Six common wheat varieties were used to establish the experimental materials for this study namely, Sakha 61, Sakha 93, Sakha 94, Gemeiza 7, Gemeiza 9 and Sids 1 were selected from National Wheat Program (NWP).

The six parental varieties were crossed among them according to diallel cross, mating design excluding reciprocal in 2003/2004 season. The parental varieties and their possible 15 crosses were sown in the growing season of 2004/2005 under three nitrogen fertilizer levels, i.e. 40, 60 and 80 kg N/feddan. The experimental design was split plot design with three replications. The three nitrogen levels were randomly arranged to the main plots and the 21 genotypes distributed in sub plots. The number of field plots for every replicate was 63 plots, each plot consisted of two-rows 2 m long with 30 cm between rows. Plants were spaced at 20 cm apart. All the cultural practices were followed as recommended for wheat production. Ten guarded plants were randomly sampled from each plot to provide measurements for the traits; heading date (days from planting to 50% heading), maturity date (days from planting to maturity of the main specific in which the peduncle color turned yellow), plant height (cm), spike length (cm), number of grains/spike, spike weight (g), 1000-grain weight (gm) and grain yield per plant (g).

The ordinary analysis of variances of a split plot design were done according to Steel and Torrie (1980).

Estimates of both general and specific combining abilities were computed according to Griffing (1956), method (2) model (1). Heterosis was expressed for grain yield/plant as percent deviation of the F_1 performance versus the mid-parents and the better parent values, respectively.

RESULTS AND DISCUSSION

Analyses of variance:

The mean squares of nitrogen fertilizer levels, genotypes and their interactions were highly significant for all studied traits, parents vs. crosses mean squares as an indication to the heterosis overall crosses were found to be highly significant for all studied traits. This finding indicated the presence of considerable variability among genotypes. This provides a wide range of genetic variability for improving yield and other important traits as shown in Table 1.

These findings are in harmony with those previously obtained by Hendawy (1989), Mahrous (1998), Abd El-Aty (2000), Abd El-Aty (2004), Moussa (2005) and Salama *et al.* (2005).

Data in Table 2 presented the mean square values of general and specific combining abilities. The interactions of nitrogen fertilizer levels with general and specific combining ability. Parents, crosses, parents vs. crosses were found to be significant or highly significant for all studied traits except maturity date, 1000 grain weight (g) and grain yield/plant (g) for (parents vs. crosses). This results cleared that the behaviour of these types of gene action (GCA and SCA) varied from level of nitrogen to another level and the combined data and also indicates, variation in response of hybrids to nitrogen levels. Similar results were obtained by Shalaby *et al.* (1980), Hendawy (1989) and Moussa (2005).

Mean performances:

The mean performances of the parents and their F_1 crosses under nitrogen levels and their combined data are presented in Table 3.

The overall mean values for parents and crosses were higher at the higher nitrogen level than those at the low level for all studied traits. In this respect, Frey (1964) and Frey and Maldonado (1967), defined the stress environment as the one in which mean performance for certain attributes is low.

In the same time, Sakha 61 and Sakha 93 were the earliest varieties, while Sids 1 and Gem. 9 were the latest varieties. Sakha 61 was the shortest plant, while Sids 1 and Sakha 94 were the tallest cultivar.

The highest yielder variety was Sakha 94 followed by Gem. 7 and Sakha 93, while the least yielder varieties were Sakha 61 and Sids 1. The highest yields of all parental varieties were obtained under the higher nitrogen level. Also, the same trend of increase of yield components are in the same directions.

Generally, it could be noticed that the increasing of nitrogen amounts led to significant increases for all studied traits.

The two crosses (Sakha 61 x Sakha 93) and (Sakha 61 x Gem 7) were the earliest heading and maturity dates under the three nitrogen levels and combined data.

Table 1: The estimates of the mean square estimates of split plot design for all studied traits.

Source of variation	d.F	Heading date (day)	Maturity date (day)	Plant height (cm)	Spike length (cm)	No. of grains/ spike	Spike weight (g)	1000-grain weight (g)	Grain yield/plant (g)
Replication	2	13.37*	4.97*	15.44*	0.571*	23.35*	0.117**	13.82*	15.24**
Nitrogen levels	2	267.47**	356.33**	901.44**	26.11**	596.87**	0.730**	455.75**	280.80**
Error (A)	4	1.94	0.37	3.06	0.041	2.41	0.003	1.16	0.259
Genotypes (sub.)	20	216.25**	203.55**	474.05**	4.27**	76.31**	0.100**	65.66**	51.06**
Parents	5	406.42**	355.62**	906.33**	8.09**	155.38**	0.209**	131.16**	106.48**
Crosses	14	159.60**	159.79**	342.46**	3.07**	52.21**	0.061**	42.49**	33.97**
Parents vs. crosses	1	58.67**	55.89**	154.87**	2.06**	18.31**	0.125**	62.61**	13.38**
Genotypes x nitrogen	40	1.97**	2.69**	3.30**	0.135**	2.35**	0.007*	1.32**	1.14**
Error (B)	120	0.407	0.449	0.457	0.029	0.592	0.004	0.581	0.443

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

Table 2:The mean squares for genotypes, general and specific combining ability and their interactions with nitrogen levels in diallel analysis for all the studied traits under the three levels of nitrogen and combined data.

Source of variance	d.F		Heading date (day)				Maturity date (day)			
	Single	Comb.	40 kg N	60 kg N	80 kg N	Comb.	40 kg N	60 kg N	80 kg N	Comb.
Genotypes	20	20	91.80**	63.18**	65.22**	216.25**	82.04**	71.42**	55.46**	203.55**
GCA	5	5	360.97**	243.87**	257.56**	851.03**	322.08**	277.44**	215.96**	798.10**
SCA	15	15	2.08**	2.95**	1.10**	4.66**	2.04**	2.74**	1.96*	5.37**
Genotypes x nitrogen	-	40	-	-	-	3.945**	-	-	-	5.374**
GCA x nitrogen	-	10	-	-	-	11.37**	-	-	-	17.38**
SCA x nitrogen	-	30	-	-	-	1.47**	-	-	-	1.37**
Parents x nitrogen	-	10	-	-	-	3.79*	-	-	-	7.19**
Crosses x nitrogen	-	28	-	-	-	4.19**	-	-	-	5.06**
Par vs. cross x nitrogen	-	2	-	-	-	1.39*	-	-	-	0.610
Error	40	120	0.545	0.424	0.252	0.407	0.473	0.475	0.399	0.449
GCA/SCA			23.76	10.84	31.67	23.04	21.38	13.43	14.77	18.75

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

Table 2: Continued.

Source of variance	d.F		Plant height (cm)				Spike length (cm)			
	Single	Comb.	40 kg N	60 kg N	80 kg N	Comb.	40 kg N	60 kg N	80 kg N	Comb.
Genotypes	20	20	156.92**	145.62	178.11**	474.05**	1.39**	1.41**	1.74**	4.27**
GCA	5	5	606.78**	573.18**	697.09**	1661.39**	4.568**	5.54**	8.84**	18.48**
SCA	15	15	8.98**	3.10**	5.12**	11.60**	0.32**	0.04**	0.04**	8.207**
Genotypes x nitrogen	-	40	-	-	-	6.60**	-	-	-	0.266**
GCA x nitrogen	-	10	-	-	-	15.66**	-	-	-	0..464**
SCA x nitrogen	-	30	-	-	-	3.59**	-	-	-	0.193**
Parents x nitrogen	-	10	-	-	-	3.77**	-	-	-	0.167**
Crosses x nitrogen	-	28	-	-	-	7.81***	-	-	-	0.292**
Par vs. cross x nitrogen	-	2	-	-	-	3.81*	-	-	-	0.447**
Error	40	120	0.4381	0.461	0.473	0.457	0.053	0.013	0.019	0.029
GCA/SCA			11.13	24.31	17.56	20.15	15.11	19.43	25.37	0.251

Table 2: Cont.

Source of	d.F		No. of grains/spike				Spike weight (g)			
Genotypes	20	20	22.75**	25.59**	32.67**	76.31**	0.043**	0.029**	0.042**	0.100**
GCA	5	5	82.71**	94.06**	126.12**	29.21**	0.136**	0.087**	0.139**	0.343**
SCA	15	15	2.76**	2.76**	1.52*	3.67*	0.011*	0.010*	0.009	0.019**
Genotypes x nitrogen	-	40	-	-	-	4.70**	-	-	-	0.014**
GCA x nitrogen	-	10	-	-	-	8.68**	-	-	-	0.021**
SCA x nitrogen	-	30	-	-	-	3.37**	-	-	-	0.011**
Parents x nitrogen	-	10	-	-	-	3.53**	-	-	-	0.009
Crosses x nitrogen	-	28	-	-	-	5.21**	-	-	-	0.013**
Par vs. cross x nitrogen	-	2	-	-	-	3.41*	-	-	-	0.053**
Error	40	120	0.749	0.392	0.633	0.592	0.005	0.004	0.005	0.005
GCA/SCA		-	4.11	4.47	12.02	10.20	1..82	1.26	2.32	2.47

Table 2: Cont.

Source of	d.F		1000-grain/weight (g)				Grain yield/plant (g)			
Genotypes	20	20	23.78**	24.94**	19.59**	65.66**	17.80**	16.22**	198.33**	51.06**
GCA	5	5	87.28**	93.21**	71.31**	246.50**	66.71**	62.285**	75.79**	199.87**
SCA	15	15	2.81**	2.19**	2.35**	5.38**	1.49**	0.857	0.509	1.46**
Genotypes x nitrogen	-	40	-	-	-	2.65**	-	-	-	2.29**
GCA x nitrogen	-	10	-	-	-	5.30**	-	-	-	4.91**
SCA x nitrogen	-	30	-	-	-	1.77**	-	-	-	1.41**
Parents x nitrogen	-	10	-	-	-	1.84*	-	-	-	2.040**
Crosses x nitrogen	-	28	-	-	-	3.09**	-	-	-	2.53**
Par vs. cross x nitrogen	-	2	-	-	-	0.54	-	-	-	0.18
Error	40	120	0.652	0.568	0.523	0.581	0.497	0.425	0.406	0.43
GCA/SCA		-	4.54	5.82	4.09	5.94	6.26	10.67	25.32	17.71

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

Table 3:The mean performances of parents and F_1's for all studied traits in the three levels of nitrogen and combined data.

Genotypes	Heading date (day)				Maturity date (day)				Plant height (cm)				Spike length (cm)			
	40 kg N	60 kg N	80 kg N	Comb.	40 kg N	60 kg N	80 kg N	Comb.	40 kg N	60 kg N	80 kg N	Comb.	40 kg N	60 kg N	80 kg N	Comb.
Sakha 61	85.67	88.44	89.33	88.44	140.00	143.33	145.00	142.78	89.00	92.00	95.00	92.00	10.67	11.50	12.27	11.48
Sakha 93	90.33	92.89	93.30	92.69	141.33	143.00	149.00	144.44	90.33	93.67	98.67	94.22	10.33	11.00	11.63	10.94
Gem. 7	92.00	94.00	94.44	94.44	151.67	154.33	155.67	153.89	102.67	105.67	110.33	106.22	9.17	9.63	10.30	9.70
Sids 1	102.00	103.33	103.56	103.56	152.33	155.00	157.33	154.89	112.00	113.67	118.33	114.67	8.50	9.00	9.63	9.04
Gem. 9	103.33	104.00	104.67	104.67	155.00	155.67	159.67	156.76	106.33	108.67	114.00	109.67	10.33	11.00	12.07	11.13
Sakha 94	101.67	102.33	102.56	102.56	55.33	156.67	158.00	156.67	110.33	114.67	120.33	115.11	9.17	10.00	11.00	10.06
Sakha 61x Sakha 93	85.67	89.67	89.00	89.00	139.67	140.67	145.33	141.89	91.00	95.33	97.67	94.67	10.63	11.33	12.23	11.40
Sakha 61 x Gem. 7	88.00	90.67	90.33	90.33	144.00	147.33	148.00	146.44	98.00	100.00	104.00	100.67	10.20	10.70	11.43	10.76
Sakha 61 x Sids. 1	91.67	94.33	94.22	94.22	144.00	148.67	149.67	146.78	105.00	104.87	108.00	105.89	9.90	10.50	11.10	10.50
Sakha 61 x Gem. 9	93.00	95.67	95.44	95.44	146.33	147.33	150.67	148.11	99.33	102.33	107.00	102.89	10.83	11.53	12.33	11.57
Sakha 61x Sakha 94	92.00	95.33	94.33	94.33	146.33	150.00	150.67	149.00	102.33	105.00	109.00	105.44	10.47	10.97	11.73	11.06
Sakha 93 x Gem. 7	89.67	91.00	92.11	92.11	144.67	148.33	151.33	147.44	99.00	101.00	106.33	102.11	10.50	10.40	11.23	10.71
Sakha 93 x Sids 1	94.33	97.00	97.00	97.00	145.33	147.67	152.00	148.33	104.00	104.33	110.00	106.1	9.93	10.23	10.80	10.32
Sakha 93 x Gem. 9	95.33	97.33	97.56	97.56	148.33	147.87	152.33	148.78	100.00	102.67	109.33	104.00	10.60	11.17	12.07	11.34
Sakha 93x Sakha 94	94.67	95.67	96.33	96.33	147.00	148.67	153.33	149.67	103.33	105.67	112.33	107.11	10.40	10.80	11.67	10.69
Gem. 7 x Sids 1	96.00	96.67	94.40	97.49	151.33	153.33	155.67	153.44	110.00	111.67	114.67	112.11	9.13	96.53	10.10	9.59
Gem. 7 x Gem. 9	96.67	96.67	98.00	98.00	152.67	153.67	156.33	154.22	106.67	108.67	114.00	109.78	10.10	10.23	11.27	10.53
Gem. 7 x Sakha 94	95.667	98.33	97.89	97.89	153.33	154,33	156.67	154.78	109.33	111.67	118+.33	113.11	10.20	9.63	10.70	10.24
Sids 1 x Gem. 9	101.67	102.33	103.11	103.11	153.33	154.33	156.67	154.78	109.67	112.67	119.67	114.00	9.73	10.30	10.70	10.24
Sids 1 x Sakha 94	101.67	101.67	102.22	102.22	153.67	155.67	157.33	155.56	115.0	1174.00	121.67	117.89	8.73	9.70	10.43	9.62
Gem. 9 x Sakha 94	102.00	102.33	102.89	102.89	155.67	155.67	157.67	150.33	109.67	112.33	120.00	114.00	9.77	10.63	11.60	10.67
Mean of parents	95.83	97.50	97.98	97.76	149.3	151.3	154.1	151.6	104.2	106.3	111.4	107.3	9.69	10.3	11.1	10.4
Mean of crosses	94.53	96.31	98.73	96.53	148.2	149.9	152.9	150.4	103.4	105.8	110.8	106.7	10.10	10.5	11.3	10.6
L.S.D. 0.05	1.21	1.07	0.83	0.85	1.13	1.14	1.04	1.96	1.09	1.12	1.13	1.03	0.38	0.19	0.23	0.22
0.01	1.63	1.44	1.11	1.14	1.52	1.52	1.39	1.28	1.46	1.50	1.22	1.38	0.51	0.25	0.31	0.30

Table 3: Cont.

Genotypes	No. of grains/spike				Spike weight (g)				1000-grains/weight (g)				Grain yield/plant (g)			
	40 kg N	60 kg N	80 kg N	Comb.	40 kg N	60 kg N	80 kg N	Comb.	40 kg N	60 kg N	80 kg N	Comb.	40 kg N	60 kg N	80 kg N	Comb.
Sakha 61	45.07	49.00	53.00	49.22	2.50	2.60	2.73	2.61	45.33	47.00	50.67	47.67	21.00	22.33	23.67	22.33
Sakha 93	51.00	59.00	58.00	54.0	2.53	2.53	2.70	2.59	46.00	46.33	50.33	47.56	24.00	26.33	29.00	26.44
Gemmiza 7	41.00	40.33	46.00	43.33	2.70	2.77	3.00	2.62	51.67	53.67	57.00	54.11	25.00	27.00	28.33	26.78
Sids 1	47.00	48.0	52.00	49.00	2.30	2.40	2.60	2.43	44.00	47.00	48.67	46.56	21.33	24.00	25.67	23.67
Gemmiza 9	51.00	54.00	59.00	54.67	2.47	2.57	2.60	2.61	41.33	43.33	47.33	44.00	22.33	25.00	26.00	25.11
Sakha 94	48.00	54.78	55.33	511.78	2.30	2.40	2.50	2.40	41.00	43.00	46.33	43.44	30.00	32.00	34.67	32.22
Sakha 61x Sakha 93	49.00	413.33	55.67	51.33	2.60	2.60	2.77	2.66	46.33	47.33	52.00	48.56	23.00	25.00	27.33	25.11
Sakha 61 x Gem. 7	45.00	48.89	50.67	49.89	2.77	2.70	2.97	2.81	50.00	52.00	55.00	52.33	23.33	26.33	26.67	25.44
Sakha 61 x Sids. 1	46.00	41.67	52.00	49.22	2.53	2.67	2.7	2.66	46.00	47.33	50.67	48.00	21.33	23.67	26.00	23.67
Sakha 61 x Gem. 9	50.00	52.4	56.00	52.67	2.53	2.70	2.80	2.66	45.00	46.33	50.00	47.11	22.67	23.33	26.33	24.11
Sakha 61x Sakha 94	48.00	52.4	54.33	51.44	2.53	2.57	2.67	2.59	44.0.33	48.00	50.33	46.69	27.00	27.67	29.67	28.11
Sakha 93 x Gem. 7	46.33	49.98	51.00	48.78	2.70	2.73	2.83	2.76	49.33	50.67	54.00	51.33	26.00	27.00	29.00	27.33
Sakha 93 x Sids 1	51.00	51.00	54.33	52.11	2.53	2.57	2.67	2.59	46.00	46.67	51.00	47.89	23.33	25.67	28.00	25.67
Sakha 93 x Gem. 9	51.00	53.67	59.67	54.76	2.50	2.57	2.67	2.58	45.33	46.33	51.33	47.67	24.00	26.33	29.33	26.56
Sakha 93x Sakha 94	52.00	54.67	57.00	54.56	2.53	2.57	2.67	2.59	46.33	46.33	50.00	47.56	26.00	29.33	32.33	29.22
Gem. 7 x Sids 1	45.00	46.33	50.00	47.11	2.60	2.67	2.80	2.69	50.00	51.33	54.00	51.76	24.00	26.00	27.33	25.78
Gem. 7 x Gem. 9	48.00	49.67	54.00	50.57	2.53	2.73	2.73	2.67	47.33	50.33	53.00	50.22	24.00	27.00	26.33	26.44
Gem. 7 x Sakha 94	45.00	48.00	52.00	48.33	2.50	2.70	2.77	2.66	46.67	51.33	52.67	50.22	29.00	30.00	31.67	30.22
Sids 1 x Gem. 9	49.00	51.33	56.00	52.11	2.40	2.60	2.67	2.56	43.00	45.33	50.00	46.11	22.67	25.67	27.67	25.33
Sids 1 x Sakha 94	468.67	50.56	53.00	50.56	2.37	2.53	2.57	2.49	44.00	46.33	49.00	46.44	25.67	27.67	31.00	28.11
Gem. 9 x Sakha 94	50.00	54.69	57.00	53.89	2.43	2.57	2.70	2.57	42.33	44.67	49.00	45.33	27.00	29.00	31.33	29.11
Mean of parents	47.3	49.83	53.89	50.33	2.47	2.54	2.72	2.58	44.9	46.7	50.1	47.2	23.9	26.1	28.2	26.1
Mean of crosses	48.3	50.62	54.18	51.02	2.54	2.63	2.74	2.63	46.1	47.9	51.5	48.5	24.6	26.6	28.8	26.7
L.S.D. 0.05	1.43	1.03	1.31	0.97	0.12	0.10	0.12	0.02	1.33	1.24	1.19	1.44	1.16	1.08	1.05	0.75
0.01	1.91	1.38	1.75	1.29	0.16	0.13	0.16	0.07	1.78	1.66	1.59	1.93	1.55	1.44	1.41	1.00

Concerning, plant height traits the best three crosses were (Sids 1 x Gem. 9), (Gem. 9 x Sakha 94) and (Sids 1 x Sakha 94). The crosses (Sakha 61 x Sakha 93), (Sakha 651 x Gem. 9) and (Sakha 3 x Gem. 9) had taller spike length, where the highest number of grains/spike were found in crosses (Gem. 9 x Sakha 94), (Sakha 93 x Gem. 9) and (Sakha 93 x Sakha 984) and five crosses were superior in 1000-grains weight, the heaviest cross was (Sakha 61 x Sakha 93) while the lowest cross was found in (Gem. 9 x Sakha 94).

In this respect, the crosses (Sakha 61 x Sakha 94), (Gem. 9 x Sakha 94), (Sakha 93 x Sakha 94) and (Gem. 7 x Sakha 94) had higher grain yield/plant at the three levels of nitrogen fertilizer and the combined data.

In general, the results indicated that the increasing of nitrogen level from 40 to 80 kg nitrogen/fed. increased the mean performances of all studied traits.

It could be concluded that the differences among these genotypes might be attributed to the genetical differences among them and their interaction with environmental conditions such as nitrogen levels. These results were coincident with those reported by Hendawy (1989), Shalaby *et al.* (1993) and Moussa (2005).

Combining ability:

Data in Table 2 showed that the mean squares of genotypes as well as their portions general and specific combining abilities and their interactions with nitrogen levels were highly significant for all studied traits at the three nitrogen levels and their combined data. These findings indicated that GCA and SCA effects of parents and their F_1 crosses were inconsistent across nitrogen levels.

Ratios of general relative to specific combining ability exceeded the unit for all studied traits under the three nitrogen levels and the combined data except spike length (cm) at combined data, indicating that additive gene effects were more important in the inheritance of all studied traits. Similar result were also obtained by Hendawy (1989), Darwish (1992), Hamada *et al.* (1997), Hendawy (1998), El-Beially and El-Sayed (2002), Moussa (2005) and Seleem (2006).

General combining ability effects:

The general combining ability effects are presented in Table 4. High positive values of G.C.A. effects could be of interest in all studied traits except heading and maturity dates which were negative. Data revealed that the parents; Sakha 61 and Sakha 93, were good combiners for earliness, so such negative G.C.A. effects revealed that these varieties might be the best general combiners for earliness. Sakha 61 and Sakha 93 genotypes were the best donors for shortness, while Sids 1 and Sakha 94 were the best combiners for tallness. For spike length, parents Sakha 61 and Sakha 93 were considered the best combiners. Gem. 9 followed by Sakha. 93 showed the highest significant positive effects of G.C.A. number of grains/spike. For spike weight and 1000 grain weight; variety Gem. 7 was considered the best good combiners. Sakha 93, Gem. 7 and Sakha 94 were good combiners for grain yield/plant.

Table 4:The estimates of general combining ability effects for traits under three levels of nitrogen and their combined data.

Parents	Heading date (day)				Maturity date (day)				Plant height (cm)				Spike length (cm)			
	40 kg N	60 kg N	80 kg N	Comb.	40 kg N	60 kg N	80 kg N	Comb.	40 kg N	60 kg N	80 kg N	Comb.	40 kg N	60 kg N	80 kg N	Comb.
Sakha 61	-5.33**	-4.08**	-4.81**	-4.74**	-4.93*-	-4.22**	-4.81**	-4.57**	-6.33**	-6.22**	-7.57**	-6.71**	0.442**	0.596**	0.58**	0.538**
Sakha 93	-3.00**	-2.56**+	-2.18**	-2.55**	4.26*	-4.43	-2.56**	-3.785**	-5.79**	-5.60*	-5.40**	-5.60**	0.388**	0.308**	0.31**+	0.336**
Gem. 7	-1.79**	-1.96**	-1.31**	-1.89**	1.19*	1.40**	0.82**	1.14**	0.500**	0.403*	0.22	0.38	-0.171**	-0.412**	-0.43**	-0.338*
Sids 1	3.13**	2.71**	2.78**	2.88**	1.57*	1.90**	1.65**	1.71**	5.42**	4.57**	4.31**	4.76**	-0.675**	-0.625**	-0.80**	-0.699**
Gem. 9	3.88**	3.17**	3.53**	3.52**	3.07*	2.19**	2.53**	2.60**	1.741**	1.86**	3.72**	2.10**	0.258**	0.325**	0.42**	0.333**
Sakha 94	3.13**	2.63**	1.99**	2.58**	3.36*	3.15**	2.36**	2.96**	4.50**	4.99**	5.72**	5.07**	-0.242**	-0.192**	-0.08**	-0.171**
S.E. gi 0.05	0.278	0.245	0.188	0.1980	0.259	0.259	0.238	0.218	0.249	0.256	0.259	0.742	0.088	0.045	0.053	0.050
0.01	0.371	0.377	0.252	0.250	0.346	0.346	0.318	0.292	0.333	0.342	0.345	0.992	0.118	0.060	0.071	0.066
S.E. gi-gj 0.05	0.430	0.370	0.293	0.136	0.301	0.402	0.369	0.338	0.386	0.396	0.401	0.364	0.136	0.064	0.083	0.078
0.01	0.578	0.507	0.391	0.181	0.402	0.537	0.493	0.452	0.516	0.529	0.536	0.486	0.181	0.085	0.111	0.105

Table 4: Cont..

Parents	No. of grains/spike				Spike weight (g)				1000-grain/weight (g)				Grain yield/plant (g)			
	40 kg N	60 kg N	80 kg N	Comb.	40 kg N	60 kg N	80 kg N	Comb.	40 kg N	60 kg N	80 kg N	Comb.	40 kg N	60 kg N	80 kg N	Comb.
Sakha 61	-0.819**	-0.47**	-0.50**	0.597**	0.043**	0.02*	0.04**	0.035**	0.236	0.01	0.236	0.162	-1.44**	-1.85**	-2.14**	-1.81**
Sakha 93	1.93**	1.36**	1.88**	1.72**	0.039**	-0.02*	-0.02*	0.002	0.611**	-0.36*	0.194	0.148	-0.074**	0.07	0.44**	0.15
Gem. 7	-3.07**	-3.22**	-3.83**	-3.31**	0.110**	0.10**	0.12**	0.112**	3.28**	3.76**	3.15**	3.40**	0.68**	0.81**	-0.09	0.40**
Sids 1	-0.278	-1.06**	-1..17**	-0.83**	-0.074**	-0.05**	-0.09**	-0.06**	-0.43**	-0.24	-0.68**	-0.449**	-1.40**	-1.10**	-1.14**	-1.21**
Gem. 9	1.764**	2.07*	2.75	2.19**	-0.036*	0.007	0.010	-0.01	-1.85**	-1.65**	-1.18**	-1.56**	-0.74**	-0.51**	-0.18	-0.48**
Sakha 94	0.472**	1.32**	0.67**	0.82**	-0.082**	-0.06**	-0.09**	-0.08**	-1.85**	-1.53**	-1.72**	-1.70**	2.97**	2.78**	3.11**	2.95**
S.E. gi 0.05	0.326	0.236	0.299	0.220	0.028	0.020	0.029	0.20	^.304	0.284	0.273	0.191	0.266	0.246	0.239	0.171
0.01	0.435	0.315	0.400	0.295	0.038	0.027	0.038/	0.027	0.406	0.379	0.364	0.255	0.355	0.328	0.321	0.229
S.E. gi-gj 0.05	0.504	0.365	0.464	0.342	0.040	0.035	0.040	0.020	0.471	0.439	0.427	0.295	0.411	0.380	0.372	0.265
0.01	0.674	0.488	0.620	0.457	0.054	0.047	0.054	0.026	0.629	0.587	0.564	0.394	0.549	0.508	0.497	0.354

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

It was also noticed that the genotype with high G.C.A. effects for grain yield/plant was also of good combiners for one or more of the attributes contributing to yield, at three nitrogen levels and their combined data. These findings were also found by El-Shamarka (1980), Hendawy (1989), Abd El-Aty (2000) and Moussa (2005).

Specific combining ability effects:

Estimates of the specific combining ability effects for the 15 crosses at the three nitrogen levels and their combined data are presented in Table 5.

The significant desirable S.C.A. effects found under low or high nitrogen levels and the combined data could be only discussed herein.

The cross (Sakha 61 x Sids 1) showed highly significant negative S.C.A. effects for heading date under 40, 60 kg nitrogen/feddan and the combined data, while the crosses (Gem. 7 x Sids 1) and (Gem. 7 x Gem. 9) exhibited either significant or highly significant negative S.C.A. effects under 60, 80 kg nitrogen/feddan and combined data. For maturity date crosses (Sak. 61 x Sid. 1) and (Sak. 93 x Gem. 7) exhibited significant or highly significant S.C.A. effects under 40, 60 kg nitrogen/feddan and the combined data. Only two crosses (Sak. 61 x Gem. 9) and (Sid. 1 x Sak. 94) exhibited significant or highly significant desirable S.C.A. effects for plant height under 60, 80 kg nitrogen as well as the combined data and three nitrogen levels and combined data, respectively. For number of grains/spike three crosses (Sak. 61 x Gem. 7), (Sak. 93 x Sak. 94) and (Gem. 7 x Gem. 9) showed highly significant positive S.C.A. effects under 40, 60 kg nitrogen and the combined data. The cross (Sak. 93 x Gem. 9) showed highly significant positive S.C.A. effects for 1000 grain weight under 60, 80 kg nitrogen and the combined data, while the crosses (Sak. 93 x Sak. 94) and (Gem. 7 x Sid. 1) exhibited highly significant positive effects under only 40 kg nitrogen and the combined data.

Concerning grain yield/plant the cross (Sid. 1 x Gem. 9) showed positive and significant specific combining ability effects under 60 kg nitrogen and the combined data, indicating the presence of non-additive gene action in the inheritance of these traits. Therefore, delaying selection to late generations for such traits would be more successful. Similar results were obtained by Hendawy (1989); Hendawy (1994); El-Shami *et al.* (1996); Abd El-Aty (2000); Tolba (2000) and Moussa (2005).

Heterosis effects:

The mean squares of crosses and parents vs. crosses showed highly significance. This finding indicated the presence of heterosis in F_1 generation, Table 1. Also, the parents vs. crosses x nitrogen interaction was significant, indicating that heterosis was inconsistent across different nitrogen levels which reflects the importance of selection of hybrids for each nitrogen level to maximize the yielding ability as shown in Table 2.

Percentage of heterosis over both mid-parents and better parent values for grain yield only in each nitrogen level and the combined data are presented in Table 6. Eight crosses exhibited highly significant positive heterosis percentages over mid-parents under three the nitrogen levels and the combined data.

Table 5: The estimates of specific combining ability effects for F_1 crosses in all the studied traits and each of nitrogen levels and combined data.

Crosses		Heading date (day)				Maturity date (day)				Plant height (cm)			
		40 kg N	60 kg N	80 kg N	Comb.	40 kg N	60 kg N	80 kg N	Comb.	40 kg N	60 kg N	80 kg N	Comb.
Sakha 61 x Sakha 93		-0.905*	-0.506	-0.363	-0.591*	0.321	-1.030**	-0.560	-0.423	0.351	1.280**	-0.250	0.226
Sakha 61 x Gem. 7		0.220	-0.006	-0.571*	-0.119	-0.804*	-0.196	-1.27**	-0.756*	0.357	-0.050	0.458	0.254
Sakha 61 x Sids 1		-1.03**	-1.01**	-0.321	-0.786**	-1.179**	-1.36**	-0.44	-0.992**	2.440**	0.446	0.375	1.087**
Sakha 61 x Gem. 9		-0.446	-0.131	-0.071	-0.216	-0.345	-0.988**	-0.31	-0..548	0.282	0.821*	0.958**	0.754*
Sakha 61 x Sakha 94		-0.696	0.077	-0.530*	-0.383	0.637	0.720*	-0.14	-0.020	0.690*	0.363	-0.042	0.337
Sakha 93 x Gem. 7		-0.446	-1.30**	0.137	-0.536*	-0.804*	-0.988*	-0.185	-0.659*	0.815*	0.321	0.625	0.587
Sakha 93 x Sids 1		-0.696	0.036	0.054	-0.202	-0.512	-0.155	-0.351	-0.339	0.899*	-0.512	0.208	0.198
Sakha 93 x Gem. 9		-0.448	-0.089	-0.363	-0.300	-1.012**	-0.446	-0.893**	-0.784**	0.607	0.530	1.125**	0.754*
Sakha 93 x Sakha 94		-0.363	-1.214**	-0.155	-0.577*+	-0.637	-0.405	0.274	-0.256	1.149**	0.405	1.125**	0.893**
Gem. 7 x Sids 1		-0.238	-0.798*	-0.821***	-0.619*	0.30	-0.321	-0.060	-0.14	0.607	0.821*	-0.76*	0.226
Gem. 7 x Gem. 9		-0.321	-1.256**	-0.571	-0.716**	-0.137	-0.280	-0.268	-0.228	0.982**	0.530	0.167	0.560
Gem. 7 x Sakha 94		-0.571	0.952*	-0.030	0.117	0.238	-.571	0.232	-0.034	0.857*	0.405	1.500**	0.921**
Sids 1 x Gem. 9		-0.238	-0.258	0.012	-0.161	0.155	-0.113	-0.768*	-0.242	-0.935**	0.363	1.750**	0.393
Sids 1 x Sakha 94		0.512	-0.381	-0.446	-0.105	0.196	0.262	0.065	0.175	1.607**	1.571*	0.750*	1.310**
Gem. 9 x Sakha 94		0.095	-0.173	-0.196	-0.091	0.696	-0.030	-0.476	0.063	-0.018	-0.387	0.667	0.087
LSD (sij)	0.05	0.763	0.673	0.519	0.517	0.711	0.713	0.653	0.581	0.684	0.4702	0.711	0.625
	0.01	1.020	1.018	0.693	0.683	0.950	0.953	0.873	0.761	0.914	0.938	0.950	0.823
LSD (sij-skl)	0.05	1.054	0.930	0.716	0.717	0.982	0.985	0.902	0.803	0.945	0.911	0.982	0.814
	0.01	1.410	1.243	0.958	0.941	1.313	1.316	1.206	1.057	1.264	1.218	1.313	1.138

Table 5: Cont.

Crosses		Spike length (cm)				No. of grains/spike				Spike weight (g)			
		40 kg N	60 kg N	80 kg N	Comb.	40 kg N	60 kg N	80 kg N	Comb.	40 kg N	60 kg N	80 kg N	Comb.
Sakha 61 x Sakha 93		-0.172	-0.040	0.093	-0.039	-0.095	-1.95**	0.196	-0.617*	0.001	-0.01	0.011	-0.001
Sakha 61 x Gem. 7		-0.047	0.050	0.035	0.013	0.905*	1.30**	0.696	0.966**	0.095*	-0.03	0.074*	0.046*
Sakha 61 x Sids 1		0.157	0.060	0.88	0.096	-0.887	0.80*	-0.429	-0.173	0.046	0.09**	0.053	0.062**
Sakha 61 x Gem. 9		0.157	0.150*	0.069	0.131	1.071*	0.01	-0.345	0.244	0.009	0.06*	0.024	0.032
Sakha 61 x Sakha 94		0.290*	0.09	-0.015	0.124	0.363	0.76*	0.071	0.397	0.055	0.01	-0.01	0.015
Sakha 93 x Gem. 7		0.307*	0.04	0.096	0.147*	-0.512	0.46	-1.345**	-0.464	0.034	0.042	-0.005	0.024
Sakha 93 x Sids 1		0.245*	0.06	0.031	0.120	1.363**	0.30	-0.470	0.397	0.051	0.030	0.007	0.029
Sakha 93 x Gem. 9		0.176	0.07	0.065	0.110	-0.679	-0.16	0.946*	0.036	-0.020	-0.029	-0.055	-0.035
Sakha 93 x Sakha 94		0.276*	0.02	0.161*	0.159*	1.613**	1.59**	0.363	1.188**	0.059	0.042	0.045	0.049*
Gem. 7 x Sids 1		0.003	0.10	0.073	0.060	0.363	0.214	0.696	0.425	0.046	0.009	0.003	0.019
Gem. 7 x Gem. 9		0.036	-0.16*	0.027	-0.026	1.321**	0.423	0.780	0.841**	-0.58	0.017	-0.126**	-0.056*
Gem. 7 x Sakha 94		0.636**	-0.03	-0.044	0.186**	-0.387	-0.49	0.863*	-0.006	-0.045	0.055	0.007	0.006
Sids 1 x Gem. 9		0.174	0.130*	-0.173*	0.045	-0.470	-0.06	0.321	-0.075	-0.006	0.038	-0.014	0.006
Sids 1 x Sakha 94		-0.326**	0.050	0.056	-0.073	0.488	-0.660*	-0.595	-0.256	0.005	0.042	-0.014	0.011
Gem. 9 x Sakha 94		-0.226	0.030	0.010	-0.061	-0.220	0.880**	-0.512	0.050	0.034	0.017	0.057	0.036
LSD (sij)	0.05	0.239	0.119	0.146	0.135	0.895	0.647	0.823	0.586	0.076	0.0661	0.073	0.043
	0.01	0.321	0.160	0.195	0.167	1.196	0.865	1.099	8.810	0.101	0.061	6.097	0.058
LSD (sij-skl)	0.05	0.331	0.184	0.202	0.194	1.236	0.894	1.136	0.812	0.105	0.086	0.103	0.061
	0.01	0.443	0.219	0.270	0.259	1.653	1.195	1.519	1.069	0.140	0.115	0.138	0.078

Table 5:Cont.

Crosses	1000-grains/weight (g)				Grain yield/plant (g)			
	40 kg N	60 kg N	80 kg N	Comb.	40 kg N	60 kg N	80 kg N	Comb.
Sakha 61 x Sakha 93	-0.292	0.125	0.506	0.113	0.101	0.286	0.393	0.260
Sakha 61 x Gem. 7	0.708	0.667	0.548	0.641*	-0.315	1.0077**	0.268	0.343
Sakha 61 x Sids 1	0.417	0.000	0.048	0.155	-0.232	0.119	0.643	0.177
Sakha 61 x Gem. 9	0.833	0.417	-0.119	0.377	0.435	-0.798*	0.018	-0.115
Sakha 61 x Sakha 94	0.167	-0.042	0.756*	0.294	1.060**	0.244	0.060	0.454
Sakha 93 x Gem. 7	-0.333	-0.292	-0.411	-0.345	0.976**	-0.173	0.018	0.274
Sakha 93 x Sids 1	0.042	-0.292	0.423	0.058	0.393	0.202	0.060	0.218
Sakha 93 x Gem. 9	0.792	0.792*	1.256**	0.946**	0.393	0.286	0.435	0.371
Sakha 93 x Sakha 94	1.792**	0.667	0.464	0.974**	-1.315**	-0.006	0.143	-0.393
Gem. 7 x Sids 1	1.375**	0.250	0.464	0.696**	0.310	-0.006	-0.065	0.079
Gem. 7 x Gem. 9	0.125	0.667	-0.036	0.252	-0.357	0.411	-0.024	0.010
Gem. 7 x Sakha 94	-0.542	1.542**	0.173	0.391	0.935*	0.119	0.018	0.357
Sids 1 x Gem. 9	-0.500	-0.333	0.798*	-0.012	0.393	0.786*	0.351	0.510*
Sids 1 x Sakha 94	0.500	0.542	0.339	0.460	-0.315	-0.506	0.393	-0.143
Gem. 9 x Sakha 94	0.250	0.292	0.839*	0.460	0.351	0.244	-0.232	0.121
LSD (sij) 0.05	0.835	0.779	0.748	0.507	0.729	0.674	0.658	0.455
0.01	1.116	1.042	0.999	6.667	0.974	0.901	0.881	0.599
LSD (sij-skl) 0.05	1.153	1.077	1.03	0.701	1.007	0.932	0.911	0.629
0.01	1.541	1.439	1.38	0.922	1.346	1.245	1.217	0.828

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

On the other side, as show in Table 6, three crosses, one cross, two crosses and two crosses, insignificantly outyielded the better parent at 40, 60, 80 kg N and combined data respectively. However one cross only (Sak. 93 x Gem. 9) significantly surpassed the better parent at combined data. Concerning these two parents of that cross they showed the best parents in the yielding ability. Generally the crosses Sak. 61 x Gem. 7, Sak. 61 x Sak. 94, Sak. 93 x Gem. 9 and Sid 1 x Gem. 9 were the best crosses under three nitrogen levels and the combined data. The same trend was previously reported by Bedair *et al.* (1979); El-Shami *et al.* (1996), Hendawy (1989), Abd El-Aty (2000) and Moussa (2005).

Table 6: Percentage of heterosis versus the mid-parents and the better parent for grain yield/plant under three nitrogen levels and the combined data.

Crosses	40 kg		60 kg		80 kg		Combined	
	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P
Sak. 61 x Sak. 93	2.22**	-4.17	2.74**	-5.06*	3.80**	-5.75**	2.96**	-5.04*
Sak. 61 x Gem. 7	1.45**	-6.67**	6.76**	-2.47	2.56**	-5.88**	3.62**	-5.01*
Sak. 61 x Sid. 1	0.79**	0.01	2.16**	-1.39	5.41**	1.30	2.90**	0.01
Sak. 61 x Gem. 9	4.62**	1.52	-1.41**	-6.67**	1.94**	-5.45**	1.64**	-3.98
Sak. 61 x Sak. 94	5.88**	-10.00**	1.84**	-13.54**	1.71**	-14.42**	3.05**	-12.76**
Sak. 93 x Gem. 7	6.12**	4.00	1.025**	0.01	1.16*	0.01	2.71**	2.06
Sak. 93 x Sid. 1	2.94**	-2.79**	1.99**	-2.53	2.44**	-3.45	2.44**	-25.94
Sak. 93 x Gem. 9	3.60**	0.01	2.60**	0.01	2.92**	1.13	3.02**	0.42**
Sak. 93 x Sak. 94	-3.70**	-13.33**	0.57	-8.33**	1.57**	-6.73**	-0.38	-9.31**
Gem. 7 x Sid. 1	3.60**	-4.00	1.96**	-3.70	1.23**	-3.53	2.20**	-3.73
Gem. 7 x Gem. 9	1.41**+	-4.00	3.85**	0.01	0.59	0.01	1.93**	-1.27
Gem. 7 x Sak. 94	5.45**	-3.33	1.69**	-6.25**	0.53	-8.65**	2.45**	-6.21**
Sid. 1 x Gem. 9	3.82**	1.52	4.76**	2.67	3.11**	-1.19	3.87**	0.88
Sid. 1 x Sak. 94	0.00	-14.44**	-1.19*	-13.54**	2.76**	-10.56**	0.60*	-12.76**
Gem. 9 x Sak. 94	3.16**	-10.00**	1.75*	-9.38**	0.01	-9.62**	1.55**	-.9.66**

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

With regard to the values of (r) in the Table 7 for number of traits of yield component each with the combined data it is noticed that all (r) values for the traits mentioned in the table were significantly correlated with the combined data with significantly correlated with the combined data with the exception of heading date (day) which was not significant. This means that N_1 environment is the suitable condition for estimating SCA. On the other side these correlation coefficients among the same traits and the combined data in either N_2 or N_3 conditions showed only four value with highly significant in N_2, and these values only in N_3 compared with six values in N_1 highly significant values of (r), indicating the superiority of N_1 conditions over N_2 or N_3 in SCA.

Table 7: The estimates of simple correlation coefficients (r) of s.c.a. among data in the combined (as standard) and each of N_1, N_2 and N_3 of some traits of yield components, as well as the diallel correlation coefficient among N_1, N_2, N_3 and combined (SCA) for grain yield/plant.

Nitrogen levels	HD (day)	MD (day)	Plant height	Spike length	Number of grains/ spike	Spike weight	1000-grains weight	Grain yield/plant				
									N_1	N_2	N_3	Combined
N_1	0.481	0.764**	0.670**	0.922**	0.759**	0.796**	0.850**	N_1	-	0.78	0.304	0.694**
N_2	0.834**	0.686**	0.505	0.307	0.725**	0.410	0.626*	N_2	-	-	0.164	0.598*
N_3	0.335	0.564*	0.446	0.123	0.462	0.925**	0.522*	N_3	-	-	-	0.165

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

On the other hand, and with regard to the grain yield/plant the diallel simple correlation coefficients (r,s) among N_1, N_2, N_3 and combined data of SCA indicated that the higher significant value of (r) was obtained from N_1 with combined followed by N_2 with combined and the smallest one which is not significant was obtained from the correlation between the N_3 and the combined data. This indicates that, (as mentioned above relative to the other yield component traits in the same tables that N_1 environment is the best condition for estimating SCA for grain yield and the other studied traits.

Concerning the values of (r) among N_1 and N_2, N_3 it is shown that there is no relationship among the N_1, N_2, N_3 levels in estimating SCA where the values of (r) were not significant either positive or negative.

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القدرة العامة والخاصة على التآلف وتفاعلهما مع ثلاث مستويات من التسميد الازوتى على المحصول وبعض الصفات المرتبطه به فى قمح الخبز

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اجريت هذه الدراسة فى مزرعة كلية الزراعة ـ جامعة كفرالشيخ خلال موسمى النمو ٢٠٠٣/ ٢٠٠٤ و٢٠٠٤/٢٠٠٥. وقد استخدمت ستة أصناف من قمح الخبز واجريت كل التهجينات الممكنة بين الاباء مما أدى الى الحصول على خمسة عشرة هجينا فيما عدا الهجن العكسية بغرض تقدير القدرة على الائتلاف وقوة الهجين وتفاعلاتها مع ثلاث مستويات من التسميد الازوتى (٤٠ ، ٦٠ ، ٨٠ كجم نتروجين/فدان) وتم دراسة الصفات هما عدد الايام حتى طرد السنابل ، عد الايام حتى النضج ، ارتفاع النبات، طول السنبلة ، عدد حبوب السنبلة ، وزن حبوب السنبلة ، وزن ١٠٠٠ حبة ومحصول الحبوب/نبات.

ويمكن تلخيص أهم النتائج المتحصل عليها فى الاتى:

١- كان التباين الراجع الى مستويات التسميد الازوتى عالى المعنوية لجميع الصفات المدروسة ، وكانت قيم متوسطات الاباء والهجن الناتجة عنها أعلى تحت المتسوى العالى عن المستوى المنخفض من التسميد النروجينى لجميع الصفات المدروسة ، وكان التباين الراجع الى الاباء والهجن وقوة الهجين عالى المعنوية لجميع الصفات المدروسة فى الثلاث مستويات من التسميد الازوتى والتحليل المشترك لهما.

٢- كانت الاصناف سخا ٩٤ ، جميزه ٧ وسخا ٩٣ أحسن الاباء للقدرة العامة على الائتلاف لمحصول الحبوب للنبات وواحدة أكثر من الصفات الاخرى ، بينما كان الصنفان سخا ٦١ ، سخا ٩٣ من أفضل الأصناف من حيث التبكير وقصر النبات.

٣- كانت التباينات الراجعة الى القدرة العامة والخاصة على الائتلاف وكذلك تفاعل كل منهما مع مستويات التسميد الازوتى كان عالى المعنوية لجميع الصفات المدروسة مع مستويات التسميد الثلاث ، ما يدل على أهمية كل من الفعل الجينى المضيف والغير مضيف فى وراثة جميع الصفات المدروسة.

٤- أظهر الهجينان (جميزة ٧ ، سدس ١) ، وجميزه ٧ × جميزه ٩) قدرة خاصة على التآلف لصفة عدد الايام حتى طرد السنابل وذلك تحت مستويات التسميد ٤٠ ، ٦٠ كجم والتحليل المشترك لهما فى حين كان الهجينان (سخا ٦١ × سدس ١) ، (سخا ٩٣ × جميزه ٧) ذات قدرة خاصة على التآلف لصفة عدد الايام حتى النضج تحت مستويات التسميد ٦٠ ، ٨٠ كجم والتحليل المشترك لهما. فى حين أظهر الهجين (سدس ١ × جميزه ٩) قدرة خالة على التآلف تحت المستويات ٦٠ كجم والتحليل المشترك.

٥- أظهرت النسبة بين تباين القدرة العامة الى تباين القدرة الخاصة على التآلف والتى زادت عن الوحدة وكان التباين الوراثى المضيف هو الاكثر اهمية فى دراسة جميع الصفات المدروسة.

٦- اعطت ثمانية هجين قوة هجين ملحوظه لصفة محصول الحبوب وذلك بالنسبة لمتوسط الابوين الداخلين فى كل الهجين تحت المستويات الثلاث من التسميد الازوتى.