DIALLEL ANALYSIS OF SOME QUANTITATIVE TRAITS IN SEVEN WHITE INBRED LINES OF MAIZE UNDER THREE NITROGEN LEVELS

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ABSTRACT

A half diallel cross was made among seven white inbred lines of corn, the resulted crosses and check hybrid (SC10) were tested under three nitrogen levels; i.e. 60, 90, 120 kg N/feddan. The aim of this study was to estimate the heterotic effects, general combining ability (GCA), specific combining ability (SCA) effects and their interactions with the three nitrogen levels, and also to identify the most superior genotypes for different studied traits. The studied traits were tasseling and silking dates, plant and ear heights, ear length, ear diameter, number of rows/ear, number of kernels/row and grain yield/plant and /fed. The obtained results could be summarized as follows:

1) Generally, increasing nitrogen levels lead to significant increases for all the studied traits.
2) Significant mean square values were obtained for nitrogen levels, genotypes and their interactions for all the studied traits.
3) Nitrogen levels interactions with combining ability (GCA and SCA x N) were significant for all the studied traits, with some exceptions.
4) The ratios of GCA/SCA effects were less than unity for all the studied traits except of grain yield/plant or /fed. This means that non-additive effects played the major role in the inheritance of these traits under separate nitrogen levels and their combined.
5) The L90 for earliness, L2 and L90 for short plant, L2 and L68 for ear length, L90 for number of rows/ear, L38 and L68 for grain yield/plant and /fed seemed to be the best general combiners.
6) The combinations (L2 x L37) for silking date, (L2 x L85) and (L17 x L37) for short plant, (L2 x L85), (L2 x L90) and L38 x L86) for short ear height, (L17 x L68) for ear length, (L37 x

L85) for ear diameter, (L17 x L90), (L37 x L85) and (L38 x L68) for number of rows, (L2 x L38), (L37 x L38) and (L37 x L90) for number of kernels/row and crosses (L37 x L38); (L17 x L68) and (L37 x L38) for grain yield/plant or /fed. had the most desirable SCA effects for these traits under all conditions.

7) Desirable useful heterosis relative to the check hybrid (SC10) under the three nitrogen levels and the combined data were found in the single crosses (L68 x L90), (L2 x L85) and (L2 x L90) for short plant, (L17 x L68) for ear length, and (L17 x L38) and (L37 x L38) for grain yield/plant or /fed. These prospective and new crosses may be used efficiency for improving yielding ability in maize breeding programmes.

INTRODUCTION

Successful development of improved maize (*Zea mays* L.) hybrids is depended upon accurate evaluation of inbred lines under different environments.

The diallel analysis procedure suggested by Griffing (1956) is the most common procedure to evaluate the combining ability of lines and to determine the usefulness of lines in hybrid development showing the superior performance of those hybrids under different environmental conditions. The environmental factors are usually daily changed, hence, the studying of genotype environment interaction for plant breeders is of prime importance for devoting these effects which help in selecting the elite materials, however, nitrogen fertilization is one important factor which plays an important role in maize production.

The objectives of this investigation were to study:

1) The evaluation of seven inbred lines of maize and their crosses in order to choose the best hybrids of them.
2) The general and specific combining ability effects were estimated of the seven lines and their interactions with nitrogen levels, as well as the useful heterosis.

MATERIALS AND METHODS

The present study was carried out at Experimental Farm, Faculty of Agriculture, Kafr El-Sheikh University.

Seven inbred lines of maize were used namely, L2 (P1), L17 (P2), L37 (P3), L38 (P4), L68(P5), L85 (P6) and L90 (P7). Inbred lines were obtained from the Maize Research Section, Agriculture Research Center, Cairo, Egypt. The name, pedigree and code number of these lines are presented in Table (1).

The half diallel crosses among the seven lines was used producing 21 crosses in 2005 season.

In 2006 season the 21 hybrids and single cross 10 as a check (all accounted of 22 genotypes) were evaluated under three nitrogen levels i.e., 60 (N1), 90 (N2) and 120 (N3) kg N/fed. The experimental design was split plot with three replicates, where the three nitrogen levels were randomly arranged to the main plots and the 22 hybrids were distributed in sub-plots.

All cultural practices were applied as recommended, random samples of 10 guarded plants in each plot which is designed as field plot were taken to evaluate, tasseling date, silking date (days), plant height (cm), ear height (cm), ear length (cm), ear diameter (cm), number of rows/ear, number of kernels/row, weight of 100 kernels (gm) and grain yield/plot which was transferred later to ardab/fed (one ardab = 140 kg of grains) adjusted to 15.5% moisture content.

The obtained data were statistically analyzed and mean separation was done using LSD according to Steel and Torrie (1980) for each nitrogen level. The combined analysis of the three nitrogen levels was done wherever, homogeneity of variance was not significant.

Relative increasing rate (agronomic heterosis) was measured by comparing each hybrid with the check hybrid (single cross 10). Combining ability was computed using Griffing (1956) method 4 model 1.

RESULTS AND DISCUSSION

The ordinary statistical analysis of variance for the studied traits are presented in Table (2).

The mean squares of nitrogen fertilizer levels, genotype and genotypes x nitrogen levels interaction were significant or highly significant for all the studied traits.

Data in Table (3) presented the analysis of variance for all the studied traits in each nitrogen level and their combined data.

Table (1): The name and pedigree of the studied parental lines:

No.	Pedigree
P_1(L-2)	G-4 AE
P_2 (L-17)	G-268 Jellicarse (from R selection)
P_3 (L-37)	G-507 A Improved by BC with (64 x 213)
P_4 (L-38)	G-=516 Improved by BC with (210 x K61)
P_5 (L-68)	R9-24 g.s. (Syn. Laposta x 303) (G216 x Mo2RF)
P_6 (L-85)	R9-42 g.s. (Sagnjnan x 307) (SC-14)
P_7 (L-90)	R9-47 g.s (Beida x 3.7) (SC.14)

Table (2): Observed mean squares of split plot design for all the studied traits.

S.O.V.	D.F.	Tasseling date	Silking date	Plant height	Ear height	Ear length	Ear diameter	No. of raws/ear	No. of kernels/row	Grain yield/plant	Grain yield/fed
Replications	2	3.535**	1.10	93.38*	68.06*	0.123	0.116**	0.408*	29.10**	371.71**	27.39**
Nitrogen	2	110.323**	106.10**	5982.06**	2616.02**	72.68**	4.270**	19.48**	337.67**	6409.86**	203.45**
Error a	4	0.875	0.940	25.21	30.96	1.385	0.071	0.551	12.35	35.80	1.90
Genotype g	21	2.769**	7.172**	388.08**	313.02*	7.159**	0.105**	1.194**	81.35**	1431.68**	48.38**
Nitrogen x genotype	42	1.313*	0.763*	58.67*	48.14*	0.728*	0.115*	0.837*	12.87*	66.63*	3.22*
Error b	126	0.417	0.695	28.07	19.75	0.823	0.021	0.125	5.63	30.11	0.805
C.V. %		2.32	2.35	2.20	3.38	4.84	3.25	4.24	5.70	5.38	3.22

*, ** significant and highly significant at 0.05 and 0.01, respectively.

Table (3): The mean squares for genotypes, general and specific combining ability and their interaction with nitrogen levels in diallel analysis for all the studied traits under the three levels of nitrogen and combined data.

S.O.V.	D.F.		Tasselling date				Silking date				Plant height (cm)			
	Single	Comb	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.
Replications	2	8	1.714	2.111*	0.619	5.343*	1.159	0.762	0.905	6.045**	35.921	112.87*	12.19	599.49**
Crosses	20	20	2.776**	1.587**	1.105	2.804*	3.563**	3.243**	2.286**	7.518**	181.02**	143.26**	137.54**	332.96**
GCA	6	6	2.697**	2.166**	1.059	3.852*	4.410**	2.964**	2.262*	7.29**	304.84**	281.29**	213.79**	614.09**
SCA	14	14	2.898**	1.341*	1.125	2.358	3.615**	3.363**	2.295*	7.514**	127.95**	84.11**	104.87**	212.47**
Crosses x nitrogen	-	40	-	-	-	2.66**	-	-	-	1.574**	-	-	-	128.86**
GCA x nitrogen	-	12	-	-	-	2.07**	-	-	-	2.346**	-	-	-	185.83**
SCA x nitrogen	-	28	-	-	-	2.919**	-	-	-	1.243**	-	-	-	104.46**
Error	40	120	0.698	0.594	0.852	0.213	0.809	0.612	0.955	0.197	27.47	24.84	32.14	8.463
GCAxSCA			0.19	0.34	0.18	0.33	0.19	0.17	0.18	0.19	0.50	0.72	0.43	0.58
(GCAxN)/GCA			-	-	-	0.537	-	-	-	0.32	-	-	-	0.302
(SCA x N)/SCA			-	-	-	1.229	-	-	-	0.163	-	-	-	0.391

*, ** significant and highly significant at 0.05 and 0.01, respectively.

Table (3): Cont.

S.O.V.	D.F.		Ear height (cm)				Ear length (cm)				Ear diameter (cm)			
	Single	Comb	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.
Replications	2	8	78.58*	30.11	1.206	262.86**	0.904	0.972	1.281	3.573*	0.009	0.155**	0.069*	0.223**
Crosses	20	20	136.46**	134.89**	115.88**	276.87**	3.952**	2.594**	2.155**	7.366**	0.036	0.053*	0.053**	0.108*
GCA	6	6	62.66**	32.30**	146.35**	116.93*	4.278**	3.525**	3.27*	10.95**	0.015	0.048*	0.084**	0.099*
SCA	14	14	168.09**	178.85**	102.83**	345.42**	3.813**	2.196*	1.677	2.832**	0.045	0.054*	0.039*	0.108*
Crosses x nitrogen	-	40	-	-	-	110.36**	-	-	-	1.335**	-	-	-	0.034**
GCA x nitrogen	-	12	-	-	-	124.38**	-	-	-	0.123	-	-	-	0.048**
SCA x nitrogen	-	28	-	-	-	104.35**	-	-	-	0.854**	-	-	-	0.030**
Error	40	120	17.45	10.46	32.79	5.259	0.490	0.835	1.219	0.178	0.028	0.019	0.018	0.007
GCAxSCA			0.34	0.03	0.30	0.07	0.23	0.34	0.48	0.38	0.03	0.18	0.47	0.18
(GCAxN)/GCA			-	-	-	1.063	-	-	-	0.01	-	-	-	0.484
(SCA x N)/SCA			-	-	-	0.302	-	-	-	0.317	-	-	-	0.278

*, ** significant and highly significant at 0.05 and 0.01, respectively.

Table (3): Cont.

S.O.V.	D.F.		No. of rows/ear				No. of kernels/row				Grain yield/plant (g)				Grain yield/fed (ardab)			
	Single	Comb	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.
Replications	2	8	0.183	0.096	0.539**	0.985*	20.02**	2.683	26.33*	23.02*	175.40*	119.15*	94.12*	586.2**	7.716**	10.257**	6.03**	22.80**
Crosses	20	20	0.842**	0.445*	0.397**	1.201**	36.249**	31.89**	23.54**	83.75**	705.11**	452.50**	356.34**	1411.79**	20.23**	17.46**	13.16**	48.30**
GCA	6	6	0.669*	0.513*	0.348**	1.089*	15.594**	18.68*	16.03*	38.66**	1628.54**	1008.9**	880.59**	3383.4**	46.35**	36.12**	31.97**	112.24**
SCA	14	14	0.915**	0.417	0.417**	1.251**	45.102**	37.55**	26.76**	103.10**	309.36**	214.01**	131.66**	566.82**	9.042**	9.465**	5.097**	20.89**
Crosses x nitrogen	-	40	-	-	-	0.483**	-	-	-	7.927**	-	-	-	102.6**	-	-	-	2.55**
GCA x nitrogen	-	12	-	-	-	0.441**	-	-	-	11.704**	-	-	-	134.6**	-	-	-	2.20**
SCA x nitrogen	-	28	-	-	-	0.498**	-	-	-	6.312**	-	-	-	88.21**	-	-	-	2.71**
Error	40	120	0.313	0.234	0.098	0.047	3.786	7.339	5.983	1.02	39.10	24.37	24.07	9.746	0.985	0.626	0.680	0.282
GCAxSCA			0.14	0.26	0.20	0.18	0.07	0.09	0.11	**0.07**	1.09	0.97	1.41	1.20	1.04	0.78	1.30	1.07
(GCAxN)/GCA			-	-	-	0.404	-	-	-	**0.303**	-	-	-	0.039	-	-	-	0.019
(SCA x N)/SCA			-	-	-	0.348	-	-	-	**0.061**	-	-	-	0.156	-	-	-	0.129

*, ** significant and highly significant at 0.05 and 0.01, respectively.

Highly significant mean square values were obtained for crosses, general and specific combining ability for the studied traits except mean squares of crosses GCA and SCA for tasseling under N3 and SCA in the combined data for this trait.

The interaction mean squares of nitrogen fertilizer levels with crosses, general and specific combining abilities were significant or highly significant for the studied traits except GCA for ear length.

These results indicated that the behaviour of the tested crosses as well as the estimates of general and specific combining ability were sharply fluctuated from nitrogen level to another and they had no stable trend either under high or low nitrogen levels.. The same results were confirmed by Nawar *et al.* (1990), Sedhom (1992), El-Shamarka (1995), El-Hosary *et al.* (1999), Al-Absawy (2000) and Abd El-Aty and Darwish (2006).

Mean performance:

The mean performance of the crosses at separate N–level and their combined data over the three nitrogen levels are presented in Table (4).

The overall mean values for the crosses were higher under the high nitrogen levels (120 kg N/fed.) than those under the two other nitrogen levels (60 or 90 kg N/fed.) for all the studied traits. Similar results obtained by Nawar *et al.* (1992), Younis (1994), Hassan (1995), Mohamed (1999).

The results in the Table (4) indicate that, generally, the gradual increase of nitrogen fertilization from 90 kg N/fed (N_1) to 120 kg N/fed delayed the tasseling or silking date and caused a significant increase in plant and ear height, ear length and diameter, number of rows/ear, number of kernels/row, grain yield/plant and grain yield/fed.

The earliest cross for tasseling date was (L85 x L90), and crosses (L17 x L90), (L38 x L68), (L38 x L85), (L68 x L90) and (L85 x L90) for silking date, where they exhibited the lowest mean values (days) under the three nitrogen levels and combined data compared with the check hybrid S.C.10.

Table (4): Mean performance of 21 crosses resulted from seven inbred lines of maize and check hybrid (single cross 10) evaluated at three nitrogen levels and their combined for all the studied traits.

Crosses	Tasseling date				Silking date				Plant height (cm)			
	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.
L2 x L17	63.67	64.33	65.33	64.44	66.00	66.67	67.67	66.78	237.67	241.00	255.00	244.56
L2 x L37	62.00	65.00	65.67	64.22	63.66	65.00	66.67	65.11	230.67	238.33	250.00	239.69
L2 x L38	63.00	64.33	65.00	64.11	65.00	66.67	67.67	66.45	220.00	239.33	246.67	235.33
L2 x L68	64.00	65.33	66.00	65.11	65.33	66.33	67.33	66.33	228.33	244.33	251.00	241.22
L2 x L85	63.67	64.67	65.00	64.45	65.67	66.67	67.67	66.67	211.00	224.67	230.00	221.89
L2 x L90	63.33	64.67	65.00	64.33	65.00	66.00	67.00	66.00	218.33	225.07	235.00	226.33
L17 x L37	64.00	64.33	67.00	65.11	66.67	69.67	70.33	68.89	232.33	237.67	246.00	238.67
L17 x L38	63.67	65.33	66.00	65.00	65.00	66.33	67.33	66.22	233.33	245.00	251.67	243.33
L17 x L68	63.67	64.67	65.67	64.67	64.33	67.00	68.00	66.44	236.33	246.00	250.67	244.33
L17 x L85	63.33	65.00	66.33	64.88	65.00	66.00	67.67	66.22	232.33	241.00	249.33	240.88
L17 x L90	62.67	65.33	65.33	64.44	64.00	65.00	66.67	65.22	235.00	239.33	255.00	243.11
L37 x L38	64.33	63.33	65.33	64.33	66.00	66.67	67.33	66.67	231.67	246.00	257.67	245.11
L37 x L68	63.33	65.00	66.00	64.78	66.33	67.00	67.67	67.00	238.33	249.33	254.67	247.44
L37 x L85	63.33	65.00	65.33	64.55	65.67	66.33	67.33	66.44	240.00	255.00	258.33	251.11
L37 x L90	63.67	64.67	65.33	64.56	66.00	67.00	66.67	66.56	221.67	238.33	251.67	237.22
L38 x L68	61.33	65.33	64.67	63.44	63.33	65.33	67.33	65.33	234.33	248.33	255.87	246.18
L38 x L85	61.00	62.33	66.00	63.11	63.33	66.00	67.33	65.55	238.33	245.00	251.67	245.00
L38 x :L90	63.67	64.00	66.67	64.78	65.67	66.67	68.33	66.89	225.00	240.00	251.00	238.67
L68 x L85	63.00	65.00	65.33	64.44	65.67	67.33	68.33	67.11	235.00	241.00	251.00	242.33
L68 x L90	62.00	64.33	65.00	63.78	63.33	65.00	66.00	64.78	240.00	244.00	252.87	245.56
L85 x L90	61.33	63.67	65.00	63.33	63.33	65.33	66.67	65.11	231.00	239.33	246.33	238.89
SC10	62.00	64.00	65.67	63.88	65.00	66.33	68.00	66.44	231.67	235.00	250.00	238.89
L.S.D. 0.05	1.378	1.271	1.522	0.782	1.483	1.290	1.612	0.824	8.649	8.220	9.35	4.895
0.01	1.845	1.702	2.035	1.030	1.986	1.727	2.154	1.084	11.572	11.03	12.49	6.443

Table (4): Continued

rosses	Ear height (cm)				Ear length (cm)				Ear diameter (cm)			
	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.
L2 xL17	125.67	137.00	139.67	134.11	16.20	17.27	19.70	17.72	4.07	4.43	4.73	4.41
L2 x L37	128.67	134.67	141.00	134.78	16.83	18.07	19.20	18.03	4.07	4.16	4.40	4.21
L2 x L38	138.33	141.00	144.33	141.22	17.40	18.10	18.43	17.98	4.27	4.43	4.60	4.43
L2 x L68	135.00	140.33	137.67	137.67	18.40	18.83	19.47	18.90	4.20	4.46	4.56	4.41
L2 x L85	112.67	120.67	126.00	119.78	17.73	19.27	20.07	19.02	4.23	4.33	4.56	4.37
L2 x L90	112.33	120.00	129.33	120.55	16.73	18.20	19.13	18.02	4.17	4.43	4.56	4.39
L17 x L37	120.00	124.33	141.00	128.44	18.20	20.50	21.20	19.96	4.03	4.26	4.53	4.27
L17 x L38	124.33	128.00	139.33	130.55	19.20	19.77	20.33	19.77	4.20	4.36	4.56	4.37
L17 x L68	126.67	135.00	144.00	135.22	20.13	20.27	21.82	20.76	4.30	4.60	4.83	4.58
L17 x L85	130.00	137.67	141.00	136.22	17.00	18.27	19.00	18.09	4.20	4.50	4.76	4.49
L17 x L90	125.33	137.67	148.67	137.22	17.77	18.90	20.00	18.89	4.30	4.66	4.76	4.57
L37 x L38	130.00	138.00	145.33	137.78	17.13	18.00	20.07	18.40	4.23	4.60	4.76	4.53
L37 x L68	128.33	132.33	135.67	132.11	19.23	20.00	20.73	19.99	4.37	4.56	4.76	4.56
L37 x L85	126.33	133.67	142.00	134.00	18.97	19.47	20.30	19.58	4.40	4.70	4.86	4.65
L37 x L90	119.33	128.33	134.33	127.33	17.37	18.00	19.20	18.19	4.33	4.56	4.80	4.56
L38 x L68	115.00	119.33	128.33	120.89	16.37	17.67	18.37	17.42	4.23	4.63	4.90	4.59
L38 x L85	121.67	128.00	130.00	126.56	19.00	19.50	20.23	19.57	4.13	4.50	4.83	4.49
L38 x :L90	125.00	127.67	130.33	127.67	16.43	17.67	19.33	17.81	4.07	4.50	4.73	4.43
L68 x L85	132.00	135.00	134.33	133.78	17.13	19.30	20.33	18.92	4.10	4.36	4.63	4.36
L68 x L90	128.33	138.33	141.00	135.89	17.43	18.77	19.67	18.62	4.17	4.46	4.80	4.48
L85 x L90	121.67	131.67	135.00	129.45	15.93	18.00	19.73	17.89	4.03	4.43	4.76	4.41
SC10	123.33	131.67	138.33	131.11	19.03	19.33	19.43	19.26	4.20	4.53	4.70	4.48
L.S.D. 0.05	6.894	5.337	9.444	4.106	1.155	1.507	1.821	0.838	0.276	0.227	0.221	0.134
0.01	9.224	7.130	12.623	5.405	1.545	2.014	2.434	1.103	0.369	0.304	0.296	0.176

Table (4): Continued

	No. of rows/ear				No. of kernels/row				Grain yield/plant (kg)				Grain yield/fed. (ardab)			
	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.
L2 xL17	12.90	13.87	15.60	14.12	33.33	35.00	42.67	37.00	161.00	167.57	173.43	167.33	27.60	28.73	29.75	28.69
L2 x L37	13.53	14.20	14.83	14.19	40.33	41.00	41.67	41.00	136.33	158.97	164.67	153.32	23.37	27.23	28.16	26.25
L2 x L38	14.00	14.60	15.00	14.53	41.67	44.33	46.00	44.00	150.50	160.33	170.50	160.44	25.80	27.47	29.55	27.61
L2 x L68	14.20	14.47	15.03	14.57	40.67	42.00	44.33	42.33	156.63	169.50	178.90	168.34	26.83	29.07	30.67	28.86
L2 x L85	14.19	14.70	14.97	14.62	38.00	39.67	41.67	39.78	148.30	156.47	163.30	156.02	25.73	26.90	27.96	26.86
L2 x L90	14.00	14.50	14.97	14.49	32.67	35.33	38.33	35.44	136.10	142.30	153.60	144.00	23.33	24.50	26.30	24.71
L17 x L37	13.87	14.43	15.03	14.44	31.00	35.00	38.33	34.78	130.10	137.97	158.00	142.02	22.57	23.63	26.74	24.31
L17 x L38	14.07	14.60	15.30	14.66	42.67	43.67	47.67	44.67	182.00	179.67	191.83	184.50	31.40	32.87	33.43	32.57
L17 x L68	14.10	14.43	14.93	14.49	42.33	44.33	47.00	44.55	172.73	180.73	185.00	179.49	29.00	31.17	32.71	30.96
L17 x L85	14.47	14.70	14.93	14.70	41.33	44.00	44.67	43.33	144.03	158.73	167.00	156.59	24.67	27.20	28.68	26.85
L17 x L90	15.03	15.27	15.80	15.37	41.67	43.00	43.67	42.78	133.77	152.30	165.00	150.36	23.47	26.07	28.68	25.74
L37 x L38	13.77	14.33	15.53	14.54	42.00	44.00	46.33	44.11	176.83	181.20	190.67	182.90	30.30	32.57	33.02	31.96
L37 x L68	13.67	14.03	14.90	14.20	41.33	44.00	47.00	44.11	159.73	169.80	173.63	167.72	27.20	28.93	29.67	28.60
L37 x L85	14.77	14.93	15.67	15.12	42.67	45.67	46.00	44.78	142.67	162.57	167.67	157.64	24.47	27.57	28.78	26.94
L37 x L90	14.67	15.27	15.80	15.25	43.00	44.00	48.33	45.11	127.17	145.07	162.33	144.86	21.80	24.90	27.63	24.78
L38 x L68	15.00	15.33	15.77	15.37	37.00	38.67	42.00	39.22	169.13	176.50	182.33	176.98	28.73	30.00	32.23	30.35
L38 x L85	13.20	14.97	14.60	14.26	38.00	38.67	42.33	39.67	156.93	170.50	177.67	168.36	26.90	29.20	30.46	28.85
L38 x :L90	14.33	14.77	15.33	14.81	39.67	42.00	44.00	41.89	151.23	160.47	166.00	159.30	25.93	27.53	28.56	27.34
L68 x L85	14.00	14.33	14.93	14.42	37.00	40.00	42.67	39.89	156.17	168.40	179.00	167.86	26.77	28.87	30.70	28.78
L68 x L90	14.11	14.63	15.20	14.64	41.00	43.00	46.67	43.56	142.83	156.00	160.67	153.17	24.50	26.47	27.21	26.06
L85 x L90	14.20	14.53	14.90	14.54	38.33	42.00	43.67	41.33	142.53	153.23	159.67	151.81	24.43	26.27	27.29	25.99
SC10	14.43	15.20	15.33	14.98	42.00	42.67	42.00	42.22	168.00	175.43	183.67	175.70	28.87	30.07	31.40	30.11
L.S.D. 0.05	0.923	0.798	0.516	0.438	3.202	4.486	4.034	2.192	10.31	8.142	8.092	5.069	1.637	1.305	1.360	0.829
0.01	1.235	1.066	0.690	0.577	4.285	5.996	5.392	2.886	13.81	10.883	10.816	6.674	2.191	1.744	1.818	1.091

For plant and ear height the two hybrids (L2 x L85) and (L2 x L90) gave the lowest values (cm) under the three nitrogen levels and the combined data.

Regarding to ear length (cm), the crosses (L17 x L38), (L17 x L68) and (L37 x L68) gave the highest mean values under the three nitrogen levels and their combined data.

With respect to ear diameter (cm), eight crosses (L17 x L68), (L17 x L85), (L17 x L90), (L37 x L38), (L37 x L68), (L37 x L85), (L37 x L90) and (L38 x L68) showed the highest mean values under the three nitrogen levels and their combined data.

Concerning, number of rows/ear the best three crosses were (L17 x L90), (L37 x L90) and (L38 x L68), where the highest number of kernels/row were found in crosses (L17 x L38), (L17 x L68), (L37 x L85) and (L37 x L90).

In this respect, the crosses (L17 x L38), (L17 x L68), (L37 x L38) and (L38 x L68) had higher grain yield/plant or per feddan at the three levels of nitrogen fertilizer and the combined data.

In general, the results indicated that the increasing of nitrogen level from 60 to 120 kg N/fed increased the mean performance of all the studied traits.

In general, these results were agreed with those obtained by Salem (1968), Nawar *et al.* (1990), Sedhom (1992), Younis *et al.* (1994), Hassan (1995), Mohamed (1999), El-Absawy (2000) and Abd El-Aty and Darwish (2006). They showed that the overall mean performances were higher at the high nitrogen level (120 kg N/fed) than those at low levels (60 kg N/fed) for most studied traits.

Combining ability:

Data in Table (3) showed that the mean squares of general and specific combining abilities and their interactions with nitrogen levels were highly significant for all the studied traits with some exception under the three nitrogen levels and their combined data.

It was evident that both additive and non-additive gene effects were involved in determining the performance of these single crosses.

The ratios of GCA/SCA effects were less than unity for all the studied traits except of grain yield/plant or /fed. This means that non-additive effects played the major role in the inheritance of these traits. Consequently, non additive type of gene action appeared to be the largest component of genetic variability for most traits. These results were coincidence with those reported by El-Itriby *et al.* (1981), Nawar and El-Hosary (1984), El-Hosary (1985) and Sedhom (1992).

The SCA x N/SCA mean squares were more than the GCA x N/GCA for tasseling date, plant height, ear length, number of kernels, grain yield/plant and grain yield/fed. This would indicate that SCA exhibited a greater degree of interaction with nitrogen than GCA for these traits. Similar results were obtained by Rojas and Sprague (1952), who reported that, the variance component for the interaction by environment with SCA was greater than the interaction with GCA.

As long the desirable values of either GCA or SCA must be negative for both tasseling and silking (earliness) as well as for plant and ear height. So, it will be mentioned greatly especially the lines exhibited these negative values in most of the nitrogen levels as will be shown in the following:

General combining ability effects:

General combining ability effects are presented in Table (5). Tasseling date under N1 showed significant negative value for GCA effects for line L85, while L38 exhibited highly significant negative GCA effects under N_2.

The parental line L90 showed significant negative values of GCA effects for silking date under the three nitrogen levels and the combined data.

The parental lines L2 and L90 showed significant negative GCA effects for plant height (towards short plants) under the three nitrogen levels and the combined data except line L90 under N3.

Significant negative GCA effects for ear height were shown with L38 under N_2, L85 under N_3 and L90 under N_1 and the combined data. However, for ear length, L17 under the three N levels and the combined data, L37 under N_1 and the combined analysis and L68 under N_1, N_2 and the combined data.

With regard to the other traits which the desirable values of GCA and SCA of them must be positive, it could be noticed that, for number of rows/ear, the L90 exhibited significant positive GCA values under the three N levels and the combined data.

Table (5): Estimates of general combining ability effects of parental inbred lines for all the studied characters under three nitrogen levels, and their combined data.

Inbred lines		Tasseling date				Silking date				Plant height (cm)			
		N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.
L2		0.276	0.257	-0.285	0.067	0.171	-0.190	-0.171	-0.064	-7.981**	-6.971**	-6.523**	-6.46**
L17		0.542**	0.390*	0.447	0.467*	0.238	0.476*	0.561*	0.425*	4.219**	0.361**	1.476	1.740
L37		0.476*	0.057	0.247	0.267	0.904**	0.676**	0.228	0.603**	1.752	3.295**	3.609*	2.606*
L38		-0.257	-0.676**	0.047	-0.289	-0.295	-0.123	0.095	-0.108	-0.647	3.095*	2.809*	1.473
L68		-0.190	0.323	-0.152	0.001	-0.295	-0.057	-0.038	-0.130	5.285**	4.961**	3.076*	4.162**
L85		-0.523*	-0.276	-0.085	-0.311	-0.228	-0.123	0.028	-0.108	0.352	-0.438	-2.720	-0.238
L90		-0.323	-0.076	-0.219	-0.200	-0.495*	-0.657**	-0.704**	-0.619**	-2.981*	-4.304**	-1.723	-3.283**
L.S.D. Gi	0.05	0.403	0.372	0.444	0.386	0.434	0.378	0.471	0.369	2.53	2.41	2.73	2.43
	0.01	0.539	0.447	0.594	0.516	0.580	0.505	0.629	0.494	3.38	3.22	3.66	3.25
L.S.D. Gi-Gj	0.05	0.616	0.568	0.680	0.589	0.663	0.577	0.930	0.566	3.86	3.67	4.18	3.69
	0.01	0.833	0.759	0.909	0.788	0.886	0.771	1.24	0.756	5.16	4.91	5.59	4.94

*, ** significant and highly significant at 0.05 and 0.01, respectively.

Table (5): Continued

Inbred lines		Ear height (cm)				Ear length (cm)				Ear diameter (cm)			
		N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.
L2		0.433	0.523	-1.447	0.806	-0.517**	-0.556*	-0.592*	-0.611**	-0.034	-0.118	-0.157**	-0.098**
L17		0.304	1.723*	5.685**	2.184*	0.522**	0.490*	0.627*	0.569**	-0.014	-0.004	-0.003	-0.010
L37		0.438	0.057	2.819*	0.718	0.369*	0.303	0.347	0.363*	0.052	0.001	-0.017	0.011
L38		0.771	-1.809*	-1.514	-1.238	-0.070	-0.362	-0.439	-0.269	-0.007	0.035	0.036	0.019
L68		0.291**	1.857*	-0.847	0.940	0.562**	0.463*	0.294	0.463*	0.039	0.048	0.056	0.046
L85		-1.228	-0.876	-3.381*	-0.860	-0.023	0.257	0.141	0.069	-0.014	-0.004	0.042	0.013
L90		-3.685**	-1.476	-1.314	-2.549*	-0.843**	-0.596**	-0.379	-0.584**	-0.021	0.041	0.042	0.019
L.S.D. Gi	0.05	2.02	1.56	2.75	1.92	0.337	0.440	0.532	0.354	0.081	0.067	0.065	0.068
	0.01	2.69	2.08	3.67	2.56	0.451	0.589	0.710	0.473	0.108	0.089	0.086	0.092
L.S.D. Gi-Gj	0.05	1.06	2.38	4.22	2.43	0.516	0.673	0.814	0.537	0.123	0.101	0.098	0.106
	0.01	1.42	3.18	5.64	3.92	0.690	0.899	1.089	0.718	0.650	0.135	0.132	0.143

*, ** significant and highly significant at 0.05 and 0.01, respectively.

Table (5): Continued

Inbred lines		No. of rows/ear				No. of kernels/row				Grain yield/plot (kg)				Grain yield/fed. (ardab)			
		N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.
L2		-0.356*	-0.270*	-0.150*	-0.264**	-0.847**	-2.209**	-1.923**	-1.771**	-3.754*	-3.731**	-4.485**	-3.806**	-0.541*	-0.779**	-0.846**	-0.69[illegible]**
L17		-0.029	-0.077	0.089	-0.004	-0.714	-0.676	-0.057	-0.571	3.199*	0.635	2.687*	2.100	0.465	0.382*	0.672**	0.50[illegible]*
L37		-0.062	-0.097	0.122	-0.011	0.885	1.057	0.676	0.784	-6.961**	-3.644**	-1.965	-4.264**	-1.134**	-0.583**	-0.525*	-0.75[illegible]**
L38		-0.042	0.0182	0.076	0.074	1.019*	0.590	0.809	0.718	15.799**	10.975**	11.034**	12.529**	2.739**	2.376**	2.126**	2.401**
L68		0.097	-0.090	-0.077	-0.022	0.685	0.723	1.076	0.740	9.919**	9.428**	7.147**	8.758**	1.532**	1.349**	1.313**	1.388[illegible]**
L85		0.043	0.096	-0.230**	-0.035	-0.114	0.323	-0.657	0.073	-3.401*	-0.778	-2.505*	-2.044	-0.451	-0.350	-0.550**	-0.4[illegible]4
L90		0.350*	0.256*	0.169*	0.261**	0.085	0.190	0.076	0.0[illegible]9	-14.80**	-12.88**	-11.91**	-13.27**	-2.581**	-2.403**	-2.189**	-2.40[illegible]**
L.S.D. Gi	0.05	0.269	0.224	0.149	0.179	0.935	1.31	1.179	0.844	3.02	2.38	2.36	2.62	0.478	0.382	0 397	0.4[illegible]2
	0.01	0.359	0.294	0 199	0.240	1.25	1.76	1.577	1.128	4.03	3.19	3.16	3.48	0.639	0.510	0.532	0.59[illegible]1
L.S.D. Gi-Gj	0.05	0.412	0.270	0.230	0.276	1.43	2.01	1.803	1.231	4.61	3.64	3.62	3.97	0.731	0.582	0.608	0.67[illegible]7
	0.01	0.551	0.360	0308	0.369	1.91	2.68	2 410	1.730	6.16	4.86	4.83	5.32	0.977	0.778	0.813	0.90[illegible]5

*, ** significant and highly significant at 0.05 and 0.01, respectively.

For grain yield per plant or per feddan, two inbred lines; L38 and L68 showed highly significant positive value of GCA under the three N levels and the combined data indicating that these two lines could contribute high yield in the crosses in which they share.

In general, no stable trend was noticed in values of GCA effects with increasing nitrogen levels through all the studied traits.

The inbred lines which had the highest mean performance as mentioned before (Table 4) and also at the same time showed desirable and significant values of GCA effects under the three nitrogen levels and their combined data (Table 5), may be useful in improving maize breeding programmes in many directions.

b) Specific combining ability:

Specific combining ability effects of single crosses for all the studied traits under the three nitrogen levels and the combined are presented in Table (6).

The values of SCA effects were widely changed from nitrogen level to another. The results indicated that the best SCA effects for number of days to 50% silking was detected in cross L2 x L37 under N_1, N_2 and the combined data. For plant height, the best crosses were L2 x L85 and L17 x L37, while for ear height, the crosses (L2 x L85), (L2 x L90), (L2 x L37) and (L38 x L68), which exhibited significant and negative SCA effects.

The best cross for ear length was (L17 x L68), it showed highly significant positive SCA effects under N_1, N_2 and the combined data. Also, significant positive SCA effects were obtained from cross (L37 x L85) under N_1. While, the crosses (L17 x L90) under N_1 and N_2, (L37 x L85) under the three N levels and the combined data showed highly significant positive SCA effects for ear diameter.

For number of rows/ear, the crosses (L17 x L90) and (L37 x L85) under N_1, N_3 and their combined, and (L38 x L68) under the three nitrogen levels plus their combined data are considered the promising hybrids for improving number of rows/ear, where they showed significant positive SCA effects.

With respect to number of kernels/row, significant positive SCA effects were obtained from; (L2 x L38) under all conditions, (L17 x L38) and (L37 x L90) under N_1, N_3 and combined data,

Table (6): Estimates of specific combining ability effects (SCA) for all crosses under the three nitrogen levels and their combined data for all the studied traits.

Crosses	Tasseling date				Silking date				Plant height (cm)			
	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.
L2 xL17	-0.200	0.822*	-0.400	-0.459	0.0622	0.001	-0.200	0.141	10.44**	6.244*	10.00**	8.244**
L2 x L37	-1.800**	0.178	0.133	-0.482	-2.378**	-1.867**	-0.866	-1.704**	5.91*	0.644	2.87	2.489
L2 x L38	-0.067	0.244	-0.333	-0.037	0.156	0.600	0.266	0.341	-2.36	1.844	0.33	-0.711
L2 x L68	0.867*	0.244	0.866	0.674	0.489	0.200	0.066	0.252	0.04	4.978*	4.40	2.489
L2 x L85	0.867*	0.178	-0.233	0.207	0.756	0.600	0.333	0.563	-12.36**	-9.289**	-10.80**	-7.556**
L2 x L90	0.333	-0.022	-0.066	0.096	0.356	0.467	0.400	0.407	-1.69	-4.422	-6.80*	-4.956
L17 x L37	-0.067	-0.622	0.733	0.007	0.556	2.133**	2.066**	1.585**	-4.62	-7.356**	-9.13**	-6.711**
L17 x L38	0.330	1.111**	-0.066	0.452	0.089	-0.400	-0.800	-0.370	-1.22	0.178	-2.67	-0.911
L17 x L68	0.267	-0.556	-0.200	-0.170	-0.578	0.200	0.000	-0.126	-4.16	-0.689	-3.93	-2.600
L17 x L85	0.267	0.378	0.400	0.363	0.022	-0.733	-0.400	-0.370	-3.22	-0.289	0.53	-1.644
L17 x L90	-0.600	0.511	-0.466	-0.193	-0.711	-1.200**	-0.666	-0.859*	2.78	1.911	5.20	3.622
L37 x L38	1.067**	-0.556	-0.533	-0.015	0.422	-0.267	-0.466	-0.104	-0.42	-1.756	1.20	0.001
L37 x L68	0.000	0.111	0.333	0.141	0.756	0.000	0.000	0.252	0.31	-0.289	-2.07	-0.356
L37 x L85	0.333	0.711	-0.400	0.230	0.022	-0.600	-0.400	-0.326	6.91**	10.778**	7.40**	7.711**
L37 x L90	0.467	0.178	-0.266	0.119	0.622	0.600	-0.333	0.296	-8.09**	-2.022	-0.27	-3.133
L38 x L68	-1.267**	0.178	-0.800	-0.637	-1.044*	-0.867*	-0.200	-0.704	-1.29	-1.089	-0.27	-0.556
L38 x L85	-1.267**	-1.222**	0.466	-0.659	-1.111*	-0.133	-0.266	-0.504	7.64**	0.978	1.53	7.733**
L38 x :L90	1.200**	0.244	1.266**	0.896*	1.989**	1.067**	1.466**	1.341**	-2.36	-0.156	-0.13	-0.556
L68 x L85	0.667	0.444	0.000	0.385	1.222**	1.133**	0.866	1.074**	-1.62	-1.889*	0.60	-2.622
L68 x L90	-0.533	-0.422	-0.200	-0.393	-0.844	-0.667	-0.733	-0.748	6.71**	1.978	1.27	3.644
L85 x L90	-0.867*	-0.487	-0.266	-0.526	-9.11*	-0.267	-0.133	-0.437	2.64	2.711	0.73	1.378
LSD_{sij} 0.05	0.794	0.733	0.879	0.762	0.854	0.743	0.929	0.729	4.98	4.744	5.393	4.798
0.01	1.06	0.980	1.175	1.017	1.142	0.943	1.242	0.975	6.67	6.342	7.209	6.412
$LSD_{Sij-sik}$ 0.05	1.23	1.137	1.361	1.180	1.33	1.153	1.440	0.634	7.73	1.290	8.363	7.41
0.01	1.64	1.520	1.820	1.577	1.77	1.541	1.925	0.848	10.33	1.725	11.176	9.92
$LSD_{Sij-Ski}$ 0.05	1.07	0.984	1.178	1.022	1.15	0.997	1.246	0.979	6.69	6.367	7.23	6.44
0.01	1.42	1.315	1.574	1.366	1.53	1.334	1.665	1.309	8.94	8.510	9.67	8.60

*, ** significant and highly significant at 0.05 and 0.01, respectively.

Table (6): Cont..

Crosses	Ear height (cm)				Ear length (cm)				Ear diameter (cm)			
	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.
L2 xL17	-0.16	2.91	-2.111	-0.690	-1.453**	-1.420	-0.162	-0.960**	-0.080*	0.080	0.191**	0.059
L2 x L37	2.71	2.24	2.089	1.44	-0.667*	-0.433	-0.382	-0.440	-0.146**	-0.193*	-0.128*	-0.16*
L2 x L38	12.04**	10.44**	9.756**	9.84**	0.340	0.267	-0.362	0.133	0.113**	0.040	0.017	0053
L2 x L68	6.51**	6.11**	2.422	4.11*	0.707*	0.173	-0.062	0.324	0.000	0.060	-0.035	0.004
L2 x L85	-11.62**	-10.82**	-6.711*	-5.20**	0.627	0.813	0.691	0.451	0.0867*	-0.020	-0.022	0.037
L2 x L90	-9.49**	-10.89**	-5.444*	-9.51**	0.447	0.600	0.278	0.493	0.026	0.033	-0.022	0.008
L17 x L37	-5.82**	-9.29**	-5.044	-6.27**	-0.340	0.553	0.398	0.311	-0.200	-0.206**	-0.148*	-0.18*
L17 x L38	-1.82	-3.76	-2.378	-2.20	1.100**	0.887*	0.318	0.742*	0.026	-0.140*	-0.168*	-0.09
L17 x L68	-1.69	-0.42	1.622	0.29	1.400**	0.560	1.118*	1.000**	0.080*	0.080	0.077	0.082
L17 x L85	5.84**	4.98**	1.156	3.09	-1.147**	-1.233	-1.596**	-1.273**	0.033	0.033	0.024	0.026
L17 x L90	3.64	5.58**	6.756*	5.78**	0.440	0.253	-0.076	0.180	0.140**	0.153*	0.024	0.108
L37 x L38	3.71	7.91**	6.489*	6.49**	-00.813*	-0.693	0.331	-0.418	-0.006	0.086	0.044	0.044
L37 x L68	-0.16	-1.42	-3.844	-1.36	0.653	0.480	0.264	0.440	0.080*	0.040	0.024	0.050
L37 x L85	2.04	2.64	5.022	2.33	0.973**	0.153	-0.016	0.442	0.166**	0.226**	0.137*	0.173*
L37 x L90	-2.49	-2.09	-4.711	-2.64	0.193	-0.460	-0.596	-0.313	0.106**	0.046	0.071	0.077
L38 x L68	-13.82**	-12.56**	-6.844*	-10.62**	-1.773**	-1.187	-1.316*	-1.451**	0.006	0.073	0.104	0.064
L38 x L85	-2.96	-1.16	-2.644	-3.16	1.447**	0.853	0.704	1.053**	-0.040	-0.006	0.051	-0.003
L38 x :L90	2.84	-0.89	-4.378	-0.36	-0.33	-0.127	0.324	-0.060	-0.100*	-0.053	-0.048	-0.006
L68 x L85	5.18*	2.18	1.022	1.89	-1.053**	-0.173	0.071	-0.333	-0.120**	-0.153*	-0.168*	-0.15*
L68 x L90	3.98	6.11**	5.622*	5.69**	0.067	0.147	-0.076	0.020	-0.046	-0.100	-0.002	-0.047
L85 x L90	1.51	2.18	2.156	1.04	-0.847*	-0.413	0.144	-0.320	-0.126**	-0.080	-0.022	-0.081
LSD_{Sij} 0.05	3.96	3.038	5.43	3.77	0.67	0.869	1.050	0.695	0.078	0.131	0.127	0.137
0.01	5.29	4.105	7.26	5.05	0.89	1.161	1.404	0.929	0.105	0.176	0.170	0.184
$LSD_{Sij-sik}$ 0.05	6.16	4.767	8.44	5.86	1.03	1.347	1.628	1.077	0.244	0.204	0.198	0.212
0.01	8.24	6.372	11.29	7.83	1.378	1.800	2.176	1.439	0.327	0.273	0.265	0.284
$LSD_{Sij-Skl}$ 0.05	5.33	4.131	7.31	5.07	0.893	1.165	1.409	0.931	0.212	0.176	0.172	0.184
0.01	7.13	5.520	9.77	6.78	1.193	1.558	1.805	1.245	0.284	0.235	0.229	0.246

*, ** significant and highly significant at 0.05 and 0.01, respectively.

Table (6): Cont..

Crosses	No. of rows/ear				No. of kernels/row				Grain yield/plant (g)				Grain yield/fed. (ardab)			
	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.
L2 xL17	-8.11**	-0.400	0.468**	-0.243	-3.422**	-3.511**	0.600	-2.32**	10.28**	8.36**	4.09	7.41**	1.780**	1.162**	0.489	1.120**
L2 x L37	-0.144	-0.046	-0.331*	-0.170	1.978*	0.756	-1.133	0.326	-4.22	4.04	-0.02	-0.24	-0.853	0.629	0.093	-0.06
L2 x L38	0.302	0.073	-0.117	0.090	3.178**	4.556**	3.067*	3.39**	-12.82**	-9.21**	-7.19**	-9.91**	-2.293**	-2.098**	-1.165*	-1.88**
L2 x L68	0.362	0.213	0.068	0.219	2.511**	2.089	1.133	1.70*	-0.80	1.50	5.10*	1.76	-0.053	0.529	0.761	0.389
L2 x L85	0.382	0.260	0.155	0.244	0.644	0.156	0.200	1.37	4.18	-1.32	-0.85	1.53	0.860	0.062	-0.079	0.411
L2 x L90	-0.091	-0.100	-0.244	-0.141	-4.889**	-4.044**	-3.867**	-4.47**	3.38	-3.38	-1.14	-0.55	0.560	-0.284	-0.099	0.024
L17 x L37	-0.137	-0.006	-0.371*	-0.174	-8.489**	-6.778**	6.333**	-7.16**	-17.41**	-21.32**	-13.86**	-17.45**	-2.660**	-4.124**	-2.845**	-3.204**
L17 x L38	0.042	-0.120	-0.057	-0.047	3.044**	2.356	2.867*	2.86**	11.73**	5.76*	6.97**	8.24**	2.300**	2.149**	1.199**	1.891**
L17 x L68	-0.064	-0.013	-0.271	-0.119	3.044**	2.889*	1.933	2.73**	8.34*	8.37**	4.03	7.00**	1.10*	1.476**	1.283**	1.304**
L17 x L85	0.355	0.066	-0.117	0.106	2.844**	2.956*	1.333	2.17*	-7.04*	-3.42	-4.32	-5.10	-1.213*	-0.791	-0.884	-0.984*
L17 x L90	0.615*	0.473	0.348*	0.477**	2.978**	2.089	-0.400	1.66	-5.90	2.25	3.09	-0.10	-1.313*	0.129	0.759	-0.127
L37 x L38	-0.224	-0.366	0.142	-0.152	0.778	0.956	0.800	0.948	16.72**	11.57**	10.46**	13.00**	2.800**	2.816**	1.981**	2.551**
L37 x L68	-0.464	-0.393*	-0.337*	-0.401	0.444	0.822	1.200	0.926	5.50	1.72	-2.65	1.61	0.907	0.209	-0.553	0.198
L37 x L85	0.688*	0.320	0.582**	0.535**	2.578**	2.889*	1.933	2.66**	1.76	4.69*	1.00	2.31	0.187	0.542	0.414	0.353
L37 x L90	0.282	0 493	0.315*	0.362*	2.711**	1.356	3.533**	2.64**	-2.34	-0.70	5.07	0.76	-0.380	-0.071	0.910	0.167
L38 x L68	0.848**	0.626	0.575**	0.682**	-4.022**	-4.044**	-3.933**	-3.896**	-7.86*	-6.20*	-3.99	-5.93	-1.433**	-1.684**	-0.645	-1.24**
L38 x L85	-0.897**	0.073	-0.437**	-0.466*	-2.222*	-3.644**	-1.867	-2.785**	-6.74*	-2.00	-2.00	-3.75	-1.253	-0.784	-0.551	-0.896*
L38 x :L90	-0.071	-0.286	-0.104	-0.156	-0.756	-0.178	-0.933	-0.519	-1.04	0.08	-4.26	-1.65	-0.120	-0.398	-0.819*	-0.427
L68 x L85	-0.237	-0 286	0.048	-0.154	-2.889**	-2.444	-1.800	-2.590**	-1.62	-2.55	3.22	-0.49	-0.180	-0.091	0.502	0.051
L68 x L90	-0.444	-0.146	-0.084	-0.227	0.911	0.689	1.467	1.13	-3.56	-2.84	-5.71*	-3.95	-0.347	-0.438	-1.349**	-0.702
L85 x L90	-0.291	-0.433	-0.231	-0.314	-0.956	0.089	0.200	-0.43	9.46**	4.60	2.95	5.50*	1.600**	1.062**	0.598	1.064*
LSD_{Sij} 0.05	0.531	0.545	0.296	0.356	1.846	2.586	2.323	1.67	5.94	4.686	4.667	5.13	0.943	0.751	0.783	0.875
0.01	0.710	0.729	0.396	0.475	2.468	3.456	3.105	2.23	7.94	6.264	6.24	6.86	1.260	1.004	1.048	1.169
$LSD_{Sij-sik}$ 0.05	0.824	0.612	0.461	0.553	2.848	3.990	3.596	2.57	9.22	7.272	7.23	7.96	1.462	1.165	1.216	1.353
0.01	0.901	0.840	0.616	0.740	3.807	5.350	4.806	3.43	12.33	9.720	9.67	10.64	1.954	1.558	1.625	1.809
$LSD_{Sij-Skl}$ 0.05	0.713	0.795	0.399	0.478	2.478	3.474	3.110	2.22	7.98	6.306	6.26	6.89	1.266	1.010	1.052	1.172
0.01	0.953	0.811	0.535	0 640	3.313	3.644	4.158	2.97	10.67	8.429	8.37	9.21	1.693	1.350	1.406	1.566

*, ** significant and highly significant at 0.05 and 0.01, respectively.

while, (L17 x L68), (L37 x L85) and (L37 x L85) under N_1, N_2 and the combined data.

Concerning grain yield per plant or per fed, the crosses (L17 x L38), (L17 x L68) and (L37 x L38) exhibited significant positive SCA effects under the three nitrogen levels and the combined data. It is concluded that the crosses tested herein can be used immediately to increase yield potentiality of maize crop since they had one or more inbred lines which contribute desirable characters wanted in the crosses.

Nawar *et al.* (1992), Sedhom (1992), El-Shamarka *et al.* (1994); El-Absay (2000), Abdel-Sattar *et al.* (1999) and Abd El-Aty and Darwish (2006) found that some crosses gave desirable SCA effects for most traits.

Useful heterosis (economic heterosis):

Useful or economic heterosis refers to the superiority of any cross for any trait under study relative to the check SC10 under any levels of N.

Heterosis relative to the check hybrid (SC10) for all the studied traits are presented in Table (7). Desired heterotic values towards earliness were obtained from the cross (L68 x L90), while towards short plants were obtained from the crosses (L2 x L85) and (L2 x L90) and crosses (L2 x L85), (L2 x L90) and (L38 x L68) short ear height,, where they gave significant negative values relative to check cross under the three N levels and the combined data. The cross (L17 x L68) gave desirable heterotic effects for ear length under three N levels and the combined data.

The crosses (L17 x L38) and (L37 a L38) gave the highest desirable and significant positive values of economic heterosis for grain yield/plant or /fed., relative to the check under the three N levels and their combined data.

Significant negative heterotic effects for earliness was previously detected by El-Hosary *et al.* (1999), El-Absay (2000), Khalil (2001) and Abd El-Aty and Darwish (2006), while significant positive heterotic effects for grain yield/plant or /fed was previously detected by Abd El-Aty (1987), Nawar *et al.* (1990), El-Hosary *et al.* (1999), El-Absay (2000) and Abd El-Aty and Darwish (2006).

Table (7): Heterosis percentage (economic heterosis) relative to check hybrid single cross 10 under the three nitrogen and their combined for all the studied traits.

Crosses	Tasseling date				Silking date				Plant height (cm)			
	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.
L2 xL17	2.694*	0.516	-0.518	1.038	1.538	0.513	-0.485	0.512	2.589	2.553	2.00	2.373
L2 x L37	0.00	1.563	0.00	0.689	-2.062	-2.005*	-1.956	-2.002	-0.432	1.417	0.00	2.335
L2 x L38	1.613	0.516	-1.021	0.517	0.00	0.513	-0.485	0.015	-5.037**	1.843	-1.332	-1.490
L2 x L68	3.226*	2.078*	0.503	2.085	0.508	0.00	-0.985	-0.166	-1.442	3.970*	0.4	0.975
L2 x L85	2.694*	1.047	-1.021	1.050	1.031	0.513	-0.485	0.346	-8.922**	-4.396*	-8.00**	-7.116**
L2 x L90	2.145	1.047	-1.021	0.862	0.00	-0.498	-1.471	-0.662	-5.758**	-3.970*	-6.00**	-5.258**
L17 x L37	3.226*	0.516*	0.503	2.085	2.569*	5.035*	3.426	3.688*	0.285	1.136	-1.6	-0.092
L17 x L38	2.694*	2.078	0.00	1.913	0.00	0.00	-0.985	-0.331	0.717	4.256	0.668	1.859
L17 x L68	2.694*	1.047*	1.005	1.395	-1.031	1.010	0.00	0.00	2.011	4.681**	0.268	2.277
L17 x L85	2.145	1.563	-0.518	1.725	0.00	-0.498	-0.485	-0.331	0.285	2.553	-0.268	0.833
L17 x L90	1.081	2.078	-0.518	1.038	-1.538	-2.005*	-1.956	-1.836	1.437	1.843	2.00	1.766
L37 x L38	3.458*	-1.047	0.503	0.862	1.538	0.513	-0.985	0.346	0.00	4.681**	3.068	2.604
L37 x L68	2.145	1.563	-0.518	1.568	2.046	1.010	-0.485	0.843	2.875	6.098	1.868	3.579*
L37 x L85	2.145	1.563	-0.518	1.207	1.031	0.00	-0.985	0.00	2.596	8.511**	3.332	5.115**
L37 x L90	2.894*	1.047	-1.523	1.223	1.538	1.010	-1.956	0.181	-4.316*	1.417	0.668	-0.699
L38 x L68	-1.081	0.516*	0.503	-0.533	-2.569*	-1.508	-0.985	-1.671	1.148	5.672**	2.348	3.052
L38 x L85	-1.613	-2.609	-0.503	-1.050	-2.569*	-0.498	-0.985	-1.339	2.875	4.256*	0.668	2.558
L38 x :L90	2.694*	0.00	1.523	1.568	1.031	0.513	0.485	0.677	-2.879	2.128	0.4**	-0.092
L68 x L85	1.613	1.563	-0.518	1.038	1.031	1.508	0.485	1.008	1.437	2.553	0.4**	1.439
L68 x L90	0.00	0.516	-1.021	0.00	-2.569*	-2.005*	-2.941*	-2.499**	3.596	3.829*	1.068	2.792
L85 x L90	-1.081	-0.516	-1.021	-0.706	-2.569*	-1.508	-1.956	-2.002	-0.289	1.843	-1.468	0.00

*, ** significant and highly significant at 0.05 and 0.01, respectively.

Table (7): Cont..

Crosses	Ear height (cm)				Ear length (cm)				Ear diameter (cm)			
	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.
L2 xL17	1.897	4.048*	0.969	2.288	-14.737**	-10.657**	1.389	-7.996	-3.09	-2.21	0.64	-1.56
L2 x L37	4.329	2.228	1.930	2.799	-11.421**	-6.518	-1.184	-6.386	-3.09	-8.17	-6.38	-6.03
L2 x L38	12.162**	7.086**	4.337	7.711**	-8.421**	-6.36	-5.147	-6.646	1.67	-2.21	-2.13	-1.12
L2 x L68	9.462	6.577**	-0.477	5.003	-3.158	-2.587	0.206	-1.869	0.00	-1.55	-2.98	-1.56
L2 x L85	-8.643**	-8.354**	-8.913*	-8.642**	-6.684*	-0.310	3.294	-1.246	0.71	-4.42	-2.98	-2.46
L2 x L90	-8.919**	-8.863**	-6.506	-8.054**	-11.947**	-5.846	-1.544	-6.438	-0.71	-2.21	-2.98	-2.01
L17 x L37	-2.700	-5.575**	1.930	-2.036	-4.211	6.053	9.109	3.634	-4.05	-.596	-3.62	-4.69
L17 x L38	0.811	-2.787	0.723*	-0.427	1.053	2.276	4.632	2.648	0.00	-3.75	-2.98	-2.46
L17 x L68	2.708	2.529	4.099	3.135	5.947	4.863	12.558**	7.788*	0.02	1.55	2.77	2.23
L17 x L85	5.408	4.557*	1.930	3.897	-10.526**	-5.483	-2.213	-6.075	0.00	-0.66	1.28	0.22
L17 x L90	1.622	4.557*	7.475*	4.660	-6.474*	-2.225	2.934	-1.921	0.02	2.87	1.28	2.01
L37 x L38	5.408	4.807*	5.060	0.802	-9.842**	-6.880	3.294	-4.465	0.71	1.55	1.28	1.116
L37 x L68	4.054	0.501	-1.923	0.763	1.211	3.466	6.690	3.79	4.05	.66	1.28	1.79
L37 x L85	2.432	1.519	2.653	2.204	-0.158	0.724	4.478	1.661	4.76	3.75	3.40	3.79
L37 x L90	-3.243	-2.537	-2.892	-2.883	-8.579**	-6.880	-1.184	-5.555	3.09	0.66	2..08	1.79
L38 x L68	-6.754*	-9.372**	-7.229*	-7.795**	-13.842**	-8.58*	-5.455	-9.294*	0.71	2.21	4.26	2.46
L38 x L85	-1.346	-2.788	-6.022	-3.470	0.001	0.879	4.117	1.609	-0.02	-0.66	2.77	0.22
L38 x :L90	1.354	-3.038	-5.783	-2.624	-13.526**	-8.58*	-0.515	-7.529*	-3.09	-0.66	0.64	-1.12
L68 x L85	7.029*	2.529*	-2.892	2.036	-9.842**	-0.155	4.632	-1.765	-.238	-3.75	-1.49	-2.68
L68 x L90	4.054	5.058	1.930	3.646	-8.263**	-2.897	1.235	-3.323	-0.71	-1.55	2.08	0.00
L85 x L90	-1.346	0.001	-2.407	-1.266	-16.158**	-6.880	1.544	-7.113	-4.05	-2.21	1.28	-1.56

*, ** significant and highly significant at 0.05 and 0.01, respectively.

Table (7): Cont..

Crosses	No. of rows/ear				No. of kernels/row				Grain yield/plant (g)				Grain yield/fed. (ardab)			
	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.
L2 xL17	-10.60**	-8.75**	1.761	-5.741*	-20.64**	17.98**	1.59	-12.36*	-4.17	-4.81	-5.44*	10.22**	-4.29	-4.46*	-5.25*	-4.72
L2 x L37	-6.237	-6.579*	-3.262	-5.274*	-3.0976	-3.91	-0.78	-2.89	-18.85**	-.938**	-10.34**	0.99	-19.05**	-9.44**	-10.32**	-12.82**
L2 x L38	-2.676	-3.947	-2.152	-3.004	-0.786	3.89	9.52	4.22	-10.42**	-8.61**	-7.17**	5.68	-10.63**	-3.65**	-5.89**	-8.30**
L2 x L68	-1.594	-4.803	-1.957	-2.737	-3.166	-1.57	5.55	0.26	-6.77*	-3.38	-2.59	10.89**	-7.06*	-0.03	-2.32	-.415
L2 x L85	-1.663	-3.289	-2.348	-2.403	-9.524*	-7.03	-0.79	-5.78	-11.73**	-10.81**	-11.09**	2.77	-10.87**	-0.11**	-10.96**	-10.79**
L2 x L90	-2.979	-4.605	-2.348	-3.271	-22.21**	-17.20**	-8.74	-16.06**	-18.99**	-18.89**	-16.37**	-5.14	-11.19**	-0.19**	-16.24**	-17.93**
L17 x L37	-3.881	-5.066	-1.957	-3.605	-26.19**	17.98**	-8.74**	-17.62**	-22.56**	-21.35**	-13.98**	-6.45*	-21.82**	-27.25**	-14.84**	-19.26**
L17 x L38	-2.495	-3.947	-0.196	-2.136	1.595	2.34	13.5*	5.80	8.33	2.42	4.44*	21.53**	8.76**	9.31**	6.46**	8.17*
L17 x L68	-2.287	-5.066	-2.609	-3.271	0.786	3.89	11.90	5.52	2.82	3.02	0.72	18.23**	0.45	3.66	4.17	2.82
L17 x L85	0.277	-3.289	-2.609	-1.869	-1.595	3.116	6.36	2.63	-14.27**	-9.52**	-9.08**	3.15	-14.54**	-9.54**	-8.66**	-10.83**
L17 x L90	4.158	0.461	3.066	2.603	-0.785	0.77	3.98	1.32	-20.38**	-13.18**	-10.16**	-0.96	-22.16	-13.30**	-8.66**	-14.51**
L37 x L38	-4.574	-5.724*	1.305	-2.937	0.00	3.12	10.31*	4.48	5.26*	3.29*	3.81*	20.48**	4.95	8.31**	5.16	6.14*
L37 x L68	-5.267	-7.697**	-2.805	-5.207*	-1.595	3.12	11.90**	4.48	-4.92	-3.21	-5.47*	10.48**	-5.78*	-3.69	-5.51*	-5.01*
L37 x L85	2.356	-1.776	2.218	0.935	1.595	7.03	9.52	6.06	-15.08**	-7.33**	-8.71**	3.84	-15.24	-8.31**	-8.34**	-10.53**
L37 x L90	1.663	0.461	3.066	1.802	2.381	3.12	15.07*	6.85	-24.30**	-17.31**	-11.62**	-4.58	-24.49**	-17.19**	-12.01**	-17.70**
L38 x L68	3.950	0.855	2.870	2.603**	-11.90	-9.37	0.00	-7.11	0.67	0.61	0.90	16.58**	-0.48	-0.23	2.64	0.79
L38 x L85	-8.524**	-1.513	-4.762**	-4.806*	-9.52	-9.37	0.79	-6.04	-0.06*	-2.81	-3.27	10.90**	-6.82	-2.89	-2.99	-4.18
L38 x :L90	-0.693	-2.829	0.00	-1.135	-5.548	-1.57	4.76	-0.78	-9.98**	-8.53**	-9.62**	4.89	-10.18**	-2.45**	-9.04**	-9.19**
L68 x L85	-2.979	-5.724*	-2.609	-3.738**	-11.90	-6.26	1.59	-5.52	-7.04*	-4.01	-2.54	10.57**	-7.27*	-3.99	-2.23	-4.42
L68 x L90	-2.87	-3.75	-0.848	-2.269	-2.38	0.77	11.12*	3.17	-14.98**	-11.01**	-12.52**	0.89	-15.14**	-0.12**	-13.34**	-13.45**
L85 x L90	-1.594	-4.408	-2.805	-2.937*	-8.74	-1.57	3.98	-2.11	-15.16**	-12.65**	-13.07**	0.00	-15.38**	-12.64**	-13.09**	-13.68**

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تحليل الهجين الدورى بين سبعة سلالات من الذرة الشامية البيضاء لبعض الصفات الكمية تحت ثلاث مستويات من التسميد النيتروجينى

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يهدف هذا البحث إلى تقييم سبعة سلالات جديدة والهجن الناتجة منها باستخدام التهجين الدورى بالإضافة إلى الهجين الفردى عشرة وذلك تحت ثلاث مستويات من التسميد الأزوتى ، بالإضافة إلى تقدير كل من قيم القدرة العامة والخاصة على الإئتلاف وكذلك قوة الهجين والتفاعل بينها وبين التسميد النيتروجينى ، وذلك بمزرعة كلية الزراعة ــ جامعة كفرالشيخ خلال موسمى الزراعة ٢٠٠٥ ، ٢٠٠٦م.

ويمكن تلخيص النتائج فيما يلى:

١- بزيادة مستوى التسميد النيتروجينى من ٦٠ إلى ١٢٠ وحدة للفدان زادت قيم المتوسطات المتحصل عليها لجميع الصفات المدروسة.

٢- كان التباين الراجع إلى مستويات التسميد ، والتراكيب الوراثية والتفاعل بينهما عالى المعنوية لجميع الصفات تحت الدراسة.

٣- كانت تباينات تفاعل القدرة العامة والخاصة على الإئتلاف مع مستويات التسميد الأزوتى عالية المعنوية.

٤- أظهرت النتائج أهمية الفعل الجينى المضيف وغير المضيف فى توريث جميع الصفات المدروسة إلا أن الفعل الجينى غير المضيف كان أكثر أهمية فى توريث جميع الصفات عدا صفة محصول الحبوب للنبات والفدان.

٥- أظهرت تأثيرات القدرة العامة تحت مستويات التسميد المختلفة اختلافا معنويا وكانت السلالة ل.٩ أحسن الأباء لصفة التبكير والسلالتين ل٢ ، ل٦٨ لصفة قصر النبات ، والسلالتين ل٢ ، ل.٩ لطول الكوز والسلالة ل.٩ لصفة عدد الصفوف للكوز ، والسلالتين ل٣٨ ، ل٦٨ لمحصول النبات الفردى وكذلك محصول الفدان من الحبوب.

٦- أظهرت نتائج القدرة الخاصة على الإئتلاف أن هناك هجين مبكرهو (ل٢ × ل٣٧) ، وهجينان لقصر النبات (ل٢ × ل٨٥) و (ل١٧ × ل٣٧) وثلاثة هجن قصيرة الكوز (ل٢ × ل٨٥) و (ل٢ × ل.٩) و(ل٣٨ × ل٨٦) وهجين لطول الكوز (ل١٧ × ل٦٨) وأخر لقطر الكوز (ل٣٧ × ل٨٥) وثلاثة هجن لعدد صفوف الكوز (ل١٧ × ل.٩) و (ل٣٧ × ل٨٥) و (ل٣٨ × ل٦٨) وثلاثة أخرى لعدد حبوب الصف (ل٢ × ل٣٨) و (ل٣٧ × ل٣٨) و (ل٣٧ × ل.٩) بالإضافة إلى ثلاثة هجن لمحصول النبات والفدان من الحبوب (ل٣٧ × ل٣٨) و (ل١٧ × ل٦٨) و (ل٣٧ × ل٣٨) حيث تفوقت جميع هذه الهجن فى هذه الصفات على الصنف المقارن هجين فردى ١٠.

٧- كانت أعلى التأثيرات المرغوبة لقوة الهجين فى صفة التبكير الهجين الفردى (ل٦٨ × ل.٩) لصفة الكوز المنخفض الهجن (ل٦٨ × ل.٩) ، (ل٢ × ل٨٥) والهجين (ل٢ × ل٣٨) وصفة محصول الحبوب للنبات سواء للنبات الفردى أو للفدان الهجينان (ل١٧ × ل٣٨) ، (ل٣٧ × ل٣٨) وهذه الهجن تبشر بإمكانية استخدامها فى برامج تحسين محصول الذرة الشامية.