RESULTS and DISCUSSION

The present investigation was carried out to study heterosis, combining ability, simple correlation, path analysis, regression analysis and the prediction of possible double crosses yield. Two sets of diallel crosses were used in this concern. The hybrids for each diallel set and D.C. 204 were sowin under three nitrogen fertilizer levels, i.e. 40, 80 and 120 Kg N/fed. in three adjacent experiments, respectively. A randomized complete block design with three replications was carried out.

Data were recorded on all genotypes for yield, yield components and some growth attributes.

For better respresentation and discussion of the results obtained, it was preferred to out-line the results into two main parts; agronomic attributes, as well as yield and its components.

I. Agronomic Attributes

1.1. Ordinary analysis and mean performance :

A. First diallel set :

The analysis of variance for each of the three nitrogen levels as well as the combined analysis for tasseling date, silking date, plant height, ear height, leaf area and fusk of ear is presented in Table (6).

Results indicate that nitrogen levels mean squares were highly significant for all of the studied traits indicating an overall differences between the three levels of nitrogen.

Results in Table (7) indicate the effect of nitrogen fertilizer levels on the growth characters.

It is clear that number of days from sowing to tasseling or silking increased significantly with increasing nitrogen levels up to 120 Kg/fed. in the combined analysis

Nitrogen fertilizer levels showed significant influence in plant height, ear height, L.A. and husk of ear in the combined analysis. These traits were successively significant increased with increase in the rate of nitrogen fertilizer from 40 up to 120 Kg N/fed.

It could be concluded that nitrogen fertilizer levels showed positive effect on the previous traits on maize plant, indicating the important role of the essential element in plant growth. The increase in these traits may be due to the stimulating effect of nitrogen on metabolic process in maize plant. These results are in agreement with those obtained by Baza (1981), Shafshak et al. (1981), Abou-Khadrah (1984), Gomaa (1985), Abdel-Aziz et al. (1986), Badr (1987), El-Noemani et al. (1989) for plant height, Shafshak et al. (1981), Gouda (1982), Aly (1983), El-Shaer et al. (1986), Kheder (1986), Badr (1987) for ear height, Kheder (1986), Baza (1981), Shafshak et al. (1981), Gouda (1982), Tantawy (1983), Aly (1983), Moursi et al. (1983), Abo-Khadrah (1984), Soliman (1986), El-Kholy (1987), El-Noemani et al. (1989) for leaf area.

Highly significant genotypes mean squares were detected for all the studied traits at the three nitrogen fertilizer levels as well as the combined analysis (Table 6). Also, highly significant F_1 hybrids and nitrogen fertilizer levels interaction mean squares were significant for all the studied traits. Such results indicated that the performance of F_1 hybrids differed from nitrogen levels to another.

Mean performances of F_1 hybrids and D.C. 204 at each nitrogen fertilizer level as well as the combined over the three nitrogen fertilizer levels are presented in Table (8). The earliness of tasseling and silking dates was detected by cross 5 x 7. Earliness, if found in maize, is favourable for escaping destructive injuries caused by Sesamia cretica Led, Chilo simplex But, and Pyrausta nubilalis Hb.

For plant and ear heights, both crosses (2 x 7) and (2 x 8) gave the lowest values. However, the highest values for both traits were recorded by cross (1 x 4) and for plant height by cross 3 x 7 at the combined analysis. The shortness in maize decreased the lodging degree and increased the yield potentiality.

The highest values for leaf area and ear husk were recorded by cross (4 x 5) and (3 x 5), respectively in the combined analysis. The high value for leaf area is the important trait to obtain the high grain yield. Also, the high value of ear husk is protected the grain from birds and insects. The lowest values were recorded by crosses (3 x 5) and (4 x 6) for leaf area and ear husk, respectively in the combined analysis.

The interaction between crosses and nitrogen levels was significant for all traits. Since these interaction resulted inchanges in ranking and differences in the results, many desirale crosses for 40 N Kg/fed. would be descarded if tested in the high level of nitrogen 120 Kg/fed. Table (8).

B. Second diallel set :

The analysis of variance for each of the three nitrogen fertilizer levels as well as the combined data for tasseling date, silking date, plant height, ear height, leaf area and husk of ear is presented in Table (9).

Mean squares due to nitrogen fertilizer levels were significant for all the studied traits, revealing that these traits were unstable under different nitrogen fertilizer levels.

Data presented in Table (10) indicate that nitrogen-fertilizer showed significant effect on the agronomic attributes under study.

All the studied traits, significantly increased as the nitrogen levels increased. The increase in these traits of maize may be due to the stimulating effect of nitrogen or metabolic process. It could be concluded that maize yield potentiality was determined early by leaf area and other growth attributes, which were in turn affected by nitrogen fertilization. This can be due to that leaf area and other attributes are affected by several factors as water supply, average temperature, and some nutrient elements particulary nitrogen supply. Nitrogen plays an important role in yield determination and is in agreement with those obtained by Kheder (1986) for tasseling and silking date, Balko and Russel (1980), Shafshak et al. (1981)l, Abou-Khadrah

(1984), Gomaa (1985), Abdel-Aziz et al. (1986), Badr (1987), El-Noemani et al. (1989) for plant height, Shafshak et al. (1981), Gouda (1982), Aly (1983), El-Shaer et al. (1986), Kheder (1986)1, Badr (1987) for ear height, Baza (1981), Gouda (1982), Moursi et al. (1983), Abo-Khadrah (1984), Kheder (1986), Badr (1987), El-Noemani et al. (1989) for leaf area.

Table (9) shows that mean squares for F_1 hybrids were highly significant for all studied traits in the separate nitrogen fertilizer levels as well as in the combined data. Mean squares due to interaction between F_1 hybrids and nitrogen fertilizer levels were significant for ear height, L.A. and ear husk, indicating that F_1 hybrids behaved some what differently from nitrogen level to another. On the contrary, insignificant mean squares due to interaction between F_1 hybrids and nitrogen fertilizer levels were detected for the other traits. This result, therefore, might revealed the high repeatability of the tested crosses under different nitrogen fertilizer levels.

The mean performances of the tested 21 crosses at each nitrogen fertilizer levels as well as the combined data are presented in Table (11). The cross (1 x 5) was the best of the tested crosses for silking date, tasseling date and its was moderate for the other attributes. The cross (1 x 4) had the lowest values for plant and ear heightes. On the other hand, the late of tasseling and silking dates were obtained by cross (2 x 3). The crosses (3 x 5), (3 x 6), (4 x 5) and (4 x 6) gave the highest values for plant and ear height than the other crosses. For ear height the values were increased by increasing nitrogen fertilizer levels in all crosses except for the cross (1 x 4). The highest values of L.A. was recorded by D.C. 204 and cross (4x6). However, the lowest value was detected by cross (5 x 6). Also, the ranking of crosses values was different from nitrogen fertilizer to another. For ear husk, the highest values was recorded by cross (5x6), but without significant superiority over the D.C. 204.

1.2. Combining ability mean squares :

A. First diallel cross :

Analysis of variance for combining ability as outlined by Griffing's (1956) method 4 model-1 in each nitrogen fertilizer level as well as their combined results for all the growth attributes is shown in Table (12). Variances of general and specific combining abilities have been determined and related to the possible types of gene action involved (Spraque and Tatum, 1942).

The mean squares associated with general and specific combining abilities were highly significant for all traits. To get an idea about the producted performance of a single-cross progeng in each trait, the relative size of general to specific combining ability mean squares may be helpful. High ratios which largely exceed the unity were obtained in all the growth attributes. Such results indicated that additive and additive X aditive types of gene action were more important than non-additive effects in controlling these characters under the three nitrogen fertilizer levels.

B. Second diallel set :

Analysis of variance for combining lability in separate nitrogen fertilizer levels as well as their combined results for all the growth attributes is shown in Table (13).

The variance associated with general combining ability (g.c.a.) was significant for all the studied traits. Specific combining ability (s.c.a.) variances were significant for all the studied traits except for plant height at 40 Kg N/fed. For this exceptional case, it is evident that most of genetic variability were due to additive type of gene action. For the other cases, both additive and nonadditive gene effects were involved in determining the performance of single cross progeny. High gca/sca ratios which exceeded the unity were detected for all these studied traits in the three nitrogen fertilizer levels as well as in the combined results except ear height at 80 Kg N/fed. Such results indicated that additive and additive X additive types of gene action were more important than non additive effects in controling these characters. For the ear height at 80 Kg N/fed. both additive and non-additive gene effects were important in the inheritance of this case.

The genetic variance was previously reported to be mostly due to additive type of gene action for, earliness [Eberhart et al., (1966); Stuber et al., (1966); Mukherjes et al., (1971)]; Shehata et al., (1975); Abo-El-Fadhl, (1978); Sedhum, (1984), Mohamed, (1984); Nawar and El-Hosary, (1985); El-Hosary, (1988 a,b), Nawar et al., (1988); Badr, (1989), Mahmoud (1989); El-Hosary et al., (1990); Ear height [Robinson et al., (1949), Stuber et al., (1966); Castro et al., (1968)]; El-Rouby et al., (1973), Dhillon and Singh (1976); Mohamed (1979), Mohamed (1984); Abo-Dheaf (1987); El-Hosary (1988 a,b), Nawar et al., (1988); Bader (1989); Mahmoud (1989); El-Hosary et al., (1990)]. Plant height [Castro et al., (1968); Dhillon and Singh (1976)]; Mohamed (1979)]; Nawar and El-Hosary (1985); El-Hosary (1988 a,b); Badr (1989); Mahmoud (1989)]. L.A. [Mason and Zuber (1976); Ragheb (1985)]; El-Hosary et al., (1990-a)] and Ear husk [El-Hosary (1988 a,b); El-Hosary et al., (1990). The non additive genetic variance was previously reported to be most prevelent for earlines [Jones (1954); El-Hosary (1985); El-Hosary (1988)], Plant height [Danial (1969); Abo-El-Fadhl, (1978); Mourad, (1978); Mohamed (1984); Morshed, (1984); El-Hosary (1985); Ragheb (1985); Abo-Deaf, (1987); El-Hosary, (1988); El-Hosary (1990-a)]. Ear height [Robinson, (1968); Abo-El-Fadhl, (1978); Ramamurthy, (1980); Mohamed (1984); Morshed, (1984)]; El-Hosary (1985); Ragheb (1985); El-Hosary (1988)] and ear husk El-Hosary (1985).

Significant (g.c.a.) and (s.c.a.) by nitrogen fertilizer levels mean squares were obtained for all studied attributes in the first and second diallel set, indicating that the magnitude of gca and sca varied from nitrogen fertilizer levels to another. It is fairly evident that ratio for sca X nitrogen-levels/sca was higher than ratio of gca X nitrogen-levels/gca for all the studied attributes in both diallel setes. Such results indicated that non additive type of gene action was more influenced by the environmental conditions than additive genetic effects. These conclusions are in well agreement with those reported by Gilbert (1958). These results are in harmony with those previously reached by El-Hosary, (1985); Nawar, (1985). On the contrary, Matzinger et al. (1959); Baghal, (1968); Castro et al. (1968); Hallauer (1971); Nawar and El-Hosary (1984); El-Hosary (1988 a & b); Nawar et al. (1988)

Badr (1989); Mahmoud (1989) they suggested that the additive effects were more biased by interaction with environments than the non-additive effects.

1.3. General combining ability effects :

A. First diallel cross :

Estimation of the general combining ability ($\hat{g}_i$) effects for individual parental lines in each trait at the three nitrogen fertilizer levels and the combined analysis are shown in Table (14). General combining ability effects estimated herein were found to differ significantly from zero in all cases. High negative values would be of interest under all the traits in question except L.A. and ear husk were high positive ones would be useful from the breeder point of view. The parental line G. 307A and M. 50 showed significant negative ($\hat{g}_i$) effects for tasseling and silking dates, indicating that these parental lines could be considered as good combiners for developing early genotypes. Parental inbred lines M. 44 and M. 70_C showed significant negative ($\hat{g}_i$) effect for height of plant and ear, revealing that these parental lines could be considered as good combiners for releasing short lines or hybrids and low of ear height. While, M. 103, M. 50 and M. 33 showed significant positive ($\hat{g}_i$) effect for L.A. Also, the parental inbred lines M. 50, M. 41 and G. 307A appeared to be good combiners for ear husk.

B. Second diallel set :

Estimation of the ($\hat{g}_i$) effects for individual parental line in each trait at the three nitrogen fertilizer levels and the combined anaylysis are presented in Table (15). The parental lines M. 28, M.50 and M. 33 showed significant negative ($\hat{g}_i$) effects at the three nitrogen fertilizer levels as well as the combined analysis for tasseling and silking dates, revealing that these lines could be considered as good combiners for developing early inbred lines. The parental lines M.28 and M.41 for plant height; and M.28 for ear height had significant negative ($\hat{g}_i$) effects at the three nitrogen levels as well as the combined analysis, indicating that these parental inbred lines could be considered as good combiners for releasing short plant and lower ear. Releasing short plant and lower ear may be of special interest and parental line M.28 will be an excellent parent in such purpose as it gave negative ($\hat{g}_i$) effects for both traits. Inbred line M.103 seemed to be the best combiner for leaf area at the three nitrogen fertilizer levels as well as the combined analysis. Inbred line M.104 seemed to be the second best combiner for leaf area. The parental line M.33 and M.28 showed significant positive ($\hat{g}_i$) effects for ear husk at the three nitrogen fertilizer levels as well as the combined analysis, indicating that these inbred lines could be considered as good combiners for releasing large ear husk.

1.4. Specific combining ability effect (s.c.a. effects) :

A. First diallel cross :

Estimates of s.c.a. effects in twenty eight crosses for the studied attributes at 40, 80, 120 Kg N/fed. as well as at the combined analysis are presented in Table (16).

For tasseling date, eight, four, five and seven combinations showed significantly negative s.c.a. effect at 40, 80, 120 Kg N/fed. and the combined analysis, respectively. On the same order, however, six, six, five and nine crosses had significant positive s.c.a. effect. Insignificant s.c.a. effect was detected in the other crosses.

With respect to silking date, seven, five, four and eight combinations had significant negative s.c.a. effect at 40, 80, 120 Kg N/fed. and in the combined analysis, respectively. On the same order, however, eight, six, three and nine crosses had significant positive s.c.a. effect.

Generally, both crosses (2 x 4) and (1 x 6) had the highly significant negative values of s.c.a. effect in the three nitrogen fertilizer levels as well as in the combined analysis for earliness and these crosses could be considered as the best ones for earliness.

Regarding plant height, six, nine, two and ten combinations showed significant negative s.c.a. effect at 40, 80, 120 kg N/fed. and in the combined analysis, respectively. In the same order, seven, seven, four and seven crosses had significant positive s.c.a. effect. Insignificant s.c.a. effect was detected in the rest cases. The cross (3 x 6) gave the heighest desirale s.c.a. effect for this trait followed by crosses (1 x 5) and (2 x 7).

Considering ear-height, seven, seven, four, and nine crosses had significant negative s.c.a. effect at 40, 80, 120 Kg N/fed. and the combined analysis, respectively. The crosses (1 x 2) and (2 x 7) had the heighest desirable s.c.a. effect for this traits and these crosses could be considered as the best ones for earliness.

For leaf area, nine crosses at 40 Kg N/fed. and eleven crosses at 80, 120 Kg N/fed. and twelve hybrids at the combined analysis had the desirable s.c.a. effect. The cross (4 x 5) gave the s.c.a. effect followed (2 x 8) and then by (5 x 7). These crosses could be considered as the best ones for increasing leaf area in the genotypes.

With respect to ear husk, ten, seven, six and nine combinations showed significant positive s.c.a. effect at 40, 80, 120 Kg N/fed. as well as the combined analysis, respectively. The cross (2 x 7) gave the heighest s.c.a. effect followed by (3 x 5) and then by (1 x 3).

B. Second diallel cross :

Specific combining ability effects were only computed whenever significant s.c.a. variances were obtained (Table 17).

For tasseling and silking dates the most desirable s.c.a. effects were recorded for the four crosses (1x7), (2x5), (3.4) and (3x7)in the three nitrogen fertilizer levels as well as in the combined analysis. While, the crosses (1x5) and (2x6) had the desirable s.c.a. effects for tasseling date in the three nitrogen levels as well as the combined analysis. Generally, these four crosses had the highly significant negative values of s.c.a. effect and these crosses could be considered as the best ones for earliness.

With respect to plant height, the crosses (1x4), (1x7) and (2x6) had significant negative s.c.a. effects in 80 and 120 Kg N/fed. as well as in the combined analysis. Insignificant s.c.a. effect was detected in the most crosses.

Table (6) : Observed mean squares from analysis of variance for agronomic attributes in the first diallel set.

Sources of variation	D.F.		Tasseling date				Silking date				Plant height			
			Kg. N/fed.				Kg. N/fed.				Kg. N/fed.			
	S.	C.	40	80	120	Comb.	40	80	120	Comb.	40	80	120	Combined
Fertilizer	-	2				215.512**				243.349**				9945.885**
Replication	2	6	1.109	0.094	0.594	0.599	0.875	0.156	0.297	0.442	21.500	6.000	1.750	9.750
Genotypes	27	27	13.326**	10.383**	10.150**	30.645**	13.780**	10.373**	9.021**	29.633**	368.148**	412.704**	285.667**	821.847**
Genotypes X Fert.	-	54				1.608**				1.770**				122.335**
Error	54	162	1.058	0.564	0.842	0.821	0.832	0.636	0.878	0.782	35.981	16.519	32.074	28.191

Table (6) : Cont.

Sources of variation	D.F.		Ear height				Leaf area				Husk of ear			
			Kg. N/fed.				Kg. N/fed.				Kg. N/fed.			
	S.	C.	40	80	120	Comb.	40	80	120	Comb.	40	80	120	Combined
Fertilizer	-	2				2478.968**				151184.2**				41.766**
Replication	2	6	6.438	25.813**	18.750*	17.000*	528	270**	52	283.333	0.190	1.298	0.226	0.571
Genotypes	27	27	88.880**	58.551**	43.815**	150.535**	11523.19**	12215.11**	10998.07**	30486.81**	9.198**	8.305**	10.361**	25.769**
Gentoypes X Fert.	-	54				20.354**				2124.777**				1.041**
Error	54	162	11.182	4.414	4.428	6.675	270.259	53.407	82.667	135.444	0.314	0.421	0.522	0.419

* and ** Significant at the probability level of 5 % and 1 %, respectively.

Table (7) : The mean values of agronomic attributes of maize as affected by nitrogen fertilizer levels in the first diallel set. (Combined)

Fertilizer levels	Tasseling date	Silking date	Plant height	Ear height	Leaf area	Husk of ear
40	c* 63.286	c 67.274	c 236.786	c 107.583	c 601.964	b 3.167
80	b 65.345	b 69.440	b 249.941	b 114.964	b 650.060	a 4.369
120	a 66.440	a 70.631	a 258.405	a 118.298	a 686.548	a 4.417

* Means designeted by the same later are not significantly different at the 5 % level according to Duncan's.

Table (9) : Observed mean squares from analysis of variance for agronomic attributes in the second diallel set.

Sources of variation	D.F.		Tasseling date				Silking date				Plant height			
			Kg. N/fed.				Kg. N/fed.				Kg. N/fed.			
	S.	C.	40	80	120	Comb.	40	80	120	Comb.	40	80	120	Combined
Fertilizer	-	2				106.862**				139.148**				4475.590**
Replication	2	6	0.781	0.820	1.859	1.154	0.219	1.734	3.000*	1.651*	324.625*	255.750*	22.875	201.083**
Genotypes	20	20	11.064**	9.363**	9.253**	28.243**	11.650**	8.231**	9.605**	27.932**	250.388**	254.413**	319.963**	748.683**
Genotypes X Fert.	-	40				0.719				0.777				38.039
Error	40	120	0.644	0.759	0.623	0.675	0.873	0.680	0.634	0.729	78.6	51.481	42.438	57.506

Table (9) : Cont.

Sources of variation	D.F.		Ear height				Leaf area				Husk of ear			
			Kg. N/fed.				Kg. N/fed.				Kg. N/fed.			
	S.	C.	40	80	120	Comb.	40	80	120	Comb.	40	80	120	Combined
Fertilizer	-	2				3489.826**				114272.93**				47.635**
Replication	2	6	260.125**	45.813	92.063	132.667**	10154.0*	10301.000**	2433.000	7629.333**	0.778	1.762*	1.730	1.423**
Genotypes	20	20	260.291**	112.016**	117.509**	407.085**	7756.3**	11645.100**	9771.200**	23494.593**	6.521**	7.443**	9.930**	21.190**
Genotypes X Fert.	-	40				41.366*				2839.004*				1.352**
Error	40	120	28.177	22.792	31.314	27.427	1972.6	1356.350	1569.650	1632.867	0.344	0.512	0.547	0.467

* and ** Significant at the probability level of 5 % and 1 %, respectively.

Table (10) : The mean values of agronomic attributes of maize as affected by nitrogen fertilizer levels in the second diallel set.

Fertilizer levels	Tasseling date	Silking date	Plant height	Ear height	Leaf area	Husk of ear
40	c* 61.920	c 65.794	c 237.984	c 99.603	c 638.762	c 3.063
80	b 63.302	b 67.413	b 246.381	b 108.540	b 682.079	b 4.286
120	a 64.524	a 68.762	a 254.841	a 114.381	a 723.937	a 4.746

* Means designeted by the same later are not significantly different at the 5 % level according to Duncan's.

No.	Crosses	Tasseling date	Silking date	Plant height	Ear height				Leaf area				Husk of ear			
					Kg. N/fed.				Kg. N/fed.				Kg. N/fed.			
		Comb.	Comb.	Comb.	40	80	120	Comb.	40	80	120	Comb.	40	80	120	Combined
1	1 x 2	g-h* 62.1	j 65.9	b-g 251.1	a-b 111.7	a-d 112.7	a-d 118.3	a-c 114.2	b-d 649.0	b-d 706.3	a-c 769.6	b-d 708.3	b-c 4.6	b 6.3	a-b 7.0	c-d 4.7
2	1 x 3	e-h 62.9	h-j 66.6	i-k 239.7	f-h 86.3	e-g 98.3	d-e 108.3	j-k 97.6	b-d 639.6	c-f 665.3	b-e 731.0	d-f 678.6	d-f 3.3	b-d 5.0	b-d 5.7	e-f 3.3
3	1 x 4	d 64.1	d-f 68.0	i 230.1	h 80.3	e-g 102.3	f 96.7	k 93.1	d-e 568.6	b-e 682.3	a 813.3	b-f 688.1	d-f 3.3	b-d 5.0	b-d 5.7	e-f 3.3
4	1 x 5	j 59.4	k 64.1	h-k 242.6	a-e 103.3	a-e 110.0	a-e 117.7	c-f 110.3	c-e 576.6	g-h 585.0	g-h 628.6	h-i 596.7	f 2.3	e-g 3.3	e-g 4.0	g 2.3
5	1 x 6	i 60.7	k 64.6	a-f 252.7	b-e 101.7	b-f 106.7	a-e 114.3	d-g 107.5	b-e 623.3	b-e 656.3	c-e 727.0	d-f 678.8	a-b 5.3	b 5.6	b-d 5.7	b 5.3
6	1 x 7	i 60.2	k 64.2	m 223.0	g-h 81.3	e-g 101.7	c-e 110.7	j-k 97.8	a-c 663.3	b-d 700.3	b-e 731.3	b-d 698.3	e-f 3.0	f-g 3.0	f-g 3.7	e-g 3.0
7	2 x 3	a 66.2	a 70.1	e-h 247.6	d-e 97.0	a-e 109.0	a-e 114.3	e-h 106.7	a-c 668.3	b-e 684.3	a-b 803.6	b-d 718.7	c-e 3.6	d-f 4.0	d-f 4.7	e 3.0
8	2 x 4	b 65.1	b-c 69.0	c-h 249.2	d-e 96.3	d-g 103.7	b-e 112.7	h-i 104.0	b-d 648.3	b-d 706.0	c-e 727.3	b-e 693.8	f 2.3	e-g 3.3	g 2.0	g 2.3
9	2 x 5	h 62.0	i-j 66.1	e-i 246.7	a-c 108.3	a-d 111.7	a-c 120.7	a-c 113.5	b-e 598.3	f-h 607.3	f-h 646.6	g-h 617.4	d-f 3.3	b-c 5.3	b-d 6.0	e-f 3.3
10	2 x 6	e-h 62.6	h-j 66.6	b-h 250.0	f-g 89.7	e-g 96.3	b-e 112.7	i-j 99.5	b-e 606.3	e-h 627.0	b-e 730.6	e-g 654.6	c-f 2.6	c-e 4.3	b-d 6.0	f-g 2.7
11	2 x 7	b-c 65.0	a-c 69.2	g-j 243.9	c-e 99.7	a-b 115.0	a-b 121.7	b-d 112.1	b-e 624.6	d-g 644.6	e-g 665.6	f-g 645.0	d-f 3.3	e-g 3.6	e-g 4.0	e-f 3.3
12	3 x 4	b-d 64.6	c-d 68.7	a-f 253.0	e-f 94.7	a-e 110.7	c-e 110.3	f-h 105.2	a-b 685.3	b-d 710.6	a-c 782.3	b-c 726.1	g 1.3	g-h 2.3	g 2.7	h 1.3
13	3 x 5	b-c 65.0	b-c 69.1	a-d 256.1	a-b 110.3	a-c 113.7	a-c 121.0	a-c 115.0	c-e 576.6	d-g 647.0	d-g 671.6	g-h 631.7	b-d 4.3	b 5.6	b-d 6.0	d 4.3
14	3 x 6	e 63.3	e-g 67.7	a-d 255.8	a 112.3	a 116.3	a-c 119.7	a-b 116.1	a-b 690.6	b 746.3	a-c 761.6	b 732.8	b 5.0	b 5.6	a-c 6.7	b-c 5.0
15	3 x 7	f-h 62.2	i-j 66.3	k-l 235.2	d-f 95.3	e-g 102.7	e 107.0	h-j 101.6	a-b 684.6	b-c 718.0	a-c 770.3	b-c 724.3	g 1.3	b-c 5.3	a-c 6.7	h 1.3
16	4 x 5	c-d 64.2	c-e 68.3	a-e 253.3	a-c 107.7	a-b 115.7	a-b 122.0	a-c 115.1	b-e 606.3	d-g 644.0	c-f 707.6	e-g 652.6	g 1.3	g-h 2.6	f-g 3.7	h 1.3
17	4 x 6	b-d 64.6	c-d 68.7	a-b 257.4	a-c 107.7	a 117.7	a-c 120.7	a-c 115.3	a 748.6	a 863.0	a-c 755.3	a 789.0	e-f 2.6	f-g 3.0	f-g 3.3	f-g 2.7
18	4 x 7	b 65.2	a-b 69.7	j-k 237.7	c-e 98.3	c-f 105.3	b-e 113.3	e-h 105.6	a-b 689.3	b 739.3	a-d 742.0	b-d 723.5	g 1.0	h 1.6	h 1.0	h 1.0
19	5 x 6	e-h 62.7	h-j 66.6	a-c 256.3	a-e 102.7	a-d 112.7	a-e 117.3	b-e 110.8	e 542.0	h 576.0	h 587.0	i 568.3	a 6.3	a 8.0	a 7.7	a 6.3
20	5 x 7	e-f 63.0	g-i 67.0	f-j 245.0	a-d 105.3	a-d 112.0	a-e 115.3	b-e 110.8	b-d 637.3	b-e 690.0	b-e 729.3	c-f 685.5	g 1.0	g-h 2.3	h 1.7	h 1.0
21	6 x 7	e 63.2	f-h 67.4	d-h 248.1	b-e 101.7	c-f 105.3	d-e 108.0	f-h 105.0	a-b 686.3	b-e 694.3	c-e 720.3	b-d 700.3	e-f 2.6	c-e 4.3	c-e 5.3	f-g 2.7
D.C.	204	e-g 62.9	g-i 66.9	a 259.4	a 112.3	a 118.3	a 124.7	a 118.4	a 742.6	a 807.0	a 815.0	a 807.0	a-b 5.3	b 6.0	a-c 6.7	a-b 6.0

Table (12) : Observed mean squares for general and specific combining ability from diallel cross analysis for agronomic attributes in the first diallel set.

Sources of variation	D.F.		Tasseling date				Silking date				Plant height			
			Kg. N/fed.				Kg. N/fed.				Kg. N/fed.			
	S.	C.	40	80	120	Comb.	40	80	120	Comb.	40	80	120	Combined
G.C.A. (1)	7		10.553**	9.272**	9.179**	9.385**	11.438**	9.406**	8.071**	9.005**	233.571**	317.036**	273.857**	237.52**
S.C.A. (2)	20		2.293**	1.427**	1.355**	1.312**	2.198**	1.376**	1.234**	1.293**	83.917**	74.754**	32.700**	40.145**
G.C.A. x Fer.	-	14				9.824**				9.955**				293.472**
S.C.A. x Fer.	-	40				1.882**				1.757**				75.612**
Error	54	162	0.353	0.188	0.281	0.091	0.277	0.212	0.293	0.087	11.994	5.506	10.691	3.132
Ratio G.C.A./S.C.A.			4.615	6.497	6.774	7.152	5.203	6.835	6.540	6.963	10.473	4.241	8.374	5.916

Table (12) : Cont.

Sources of variation	D.F.		Ear height				Leaf area				Husk of ear			
			Kg. N/fed.				Kg. N/fed.				Kg. N/fed.			
	S.	C.	40	80	120	Comb.	40	80	120	Comb.	40	80	120	Combined
G.C.A.	7		47.902**	35.563**	25.705**	32.676**	8135.429**	9562.286**	8516.286**	8257.897**	7.831**	6.708**	9.189**	7.711**
S.C.A.	20		23.230**	13.901**	10.720**	11.144**	2338.033**	2150.000**	1968.433**	1682.758**	1.398**	1.389**	1.446**	1.166**
G.C.A. x Fer.	-	14				38.247**				8978.051**				8.007**
S.C.A. x Fer.	-	40				18.354**				2386.854				1.533**
Error	54	162	3.727	1.471	1.476	0.742	90.086	17.802	27.556	15.049	0.105	0.140	0.174	0.046
Ratio G.C.A./S.C.A.			2.062	2.558	2.397	2.932	3.479	4.447	4.326	4.907	5.601	4.829	6.354	6.613

* and ** Significant at the probability level of 5 % and 1 %, respectively.

(1) G.C.A. refers to general combining ability.

(2) S.C.A. refers to specific combining ability.

Sources of variation	D.F.		Tasseling date				Silking date				Plant height			
			Kg. N/fed.				Kg. N/fed.				Kg. N/fed.			
	S.	C.	40	80	120	Comb.	40	80	120	Comb.	40	80	120	Combined
G.C.A. (1)	6		7.578**	7.341**	7.401**	7.402**	9.216**	6.633**	7.250**	7.518**	165.458**	184.667**	272.292**	200.871**
S.C.A. (2)	14		1.892**	1.313**	1.234**	1.311**	1.598**	1.077**	1.467**	1.212**	48.321	42.006*	35.667*	32.751**
G.C.A. x Fertilizer		12				7.609**				7.790**				210.772**
S.C.A. x Fertilizer		28				1.564**				1.465**				46.621**
Error	40	120	0.215	0.253	0.208	0.075	0.291	0.227	0.211	0.081	26.200	17.160	14.146	6.389
Ratio G.C.A./S.C.A.			4.164	5.591	5.997	5.646	5.767	6.158	4.942	6.205	3.424	4.396	7.634	6.133

Table (13) : Cont.

Sources of variation	D.F.		Ear height				Leaf area				Husk of ear			
			Kg. N/fed.				Kg. N/fed.				Kg. N/fed.			
	S.	C.	40	80	120	Comb.	40	80	120	Comb.	40	80	120	Combined
G.C.A.	6		115.234**	36.823**	55.469**	61.288**	5149.000**	7501.000**	7050.334**	5853.842**	4.433**	4.425**	6.488**	4.974**
S.C.A.	14		74.562**	37.560**	32.185**	38.349**	1486.762*	2330.572**	1631.381**	1220.511**	1.205**	1.648**	1.948**	1.232**
G.C.A. x Fertilizer		12				73.118**				6923.246**				5.186**
S.C.A. x Fertilizer		28				52.977**				2114.102**				1.785**
Error	40	120	9.392	7.597	10.438	3.047	657.533	452.117	523.217	181.429	0.115	0.171	0.182	0.052
Ratio G.C.A./S.C.A.			1.545	0.980	1.723	1.598	3.463	3.218	4.321	4.796	3.678	2.685	3.330	4.040

* and ** Significant at the probability level of 5 % and 1 %, respectively.

(1) G.C.A. refers to general combining ability.

(2) S.C.A. refers to specific combining ability.

Table (14) : Estimates of general combining ability effects at the three nitrogen levels as well as in the combined analysis in the first diallel set.

Parental	Tasseling date				Silking date				Plant height				Ear height			
	Kg. N/fed.				Kg. N/fed.				Kg. N/fed.				Kg. N/fed.			
	40	80	120	Comb.	40	80	120	Comb.	40	80	120	Comb.	40	80	120	Comb.
Moshtohor 28	0.556*	0.097	-0.125	0.176	0.514*	0.319	-0.125	0.236*	1.639	2.903**	7.694**	4.078**	2.264**	1.2.08*	2.708**	2.060**
Moshtohor 44	1.000**	0.819**	0.931**	0.916**	1.125**	1.042**	1.319**	1.162**	-7.528**	-9.986**	-5.806**	-7.773**	-4.014**	-4.514**	-3.403**	-3.977**
Giza 307-A	-1.500**	-1.181**	-1.069**	-1.250**	-1.431**	-1.236**	-1.069**	-1.245**	9.472**	7.292**	4.583**	7.115**	2.264**	0.319	-0.458	0.708*
Moshtohor 103	1.833**	1.542**	1.542**	1.639**	1.792**	1.431**	1.153**	1.458**	6.861**	3.792**	2.861*	4.504**	2.653**	1.764**	2.153**	2.190**
Moshtohor 50	-2.056**	-2.347**	-2.403**	-2.268**	-2.153**	-2.347**	-2.181**	-2.227**	1.250	8.625**	8.083**	5.986**	-0.125	2.764**	1.486**	1.375*
Moshtohor 33	0.944**	0.486**	0.542*	0.657**	1.181**	0.264	0.431*	0.625**	-7.139**	-3.153**	-3.528**	-4.606**	-1.514*	-0.125	0.042	-0.532
Moshtohor 41	-0.444	-0.181	0.097	-0.176	-0.486*	-0.236	-0.014	-0.245*	0.306	0.958	-3.528**	-0.754	2.319**	1.264**	-0.625	0.986**
Moshtohor 70C	-0.333	0.764**	0.486*	0.305**	-0.542*	0.764**	0.486*	0.236*	-4.861*	-10.431**	-10.361**	-8.551**	-3.847**	-2.681**	-1.903**	-2.810**
L.S.D. 5 % ($\hat{g}_i - \hat{g}_j$)	0.692	0.506	0.618	0.341	0.614	0.537	0.631	0.333	4.040	2.737	3.815	2.002	2.252	1.415	1.417	0.974
L.S.D. 1 % ($\hat{g}_i - \hat{g}_j$)	0.927	0.677	0.827	0.447	0.821	0.718	0.844	0.437	5.406	3.663	5.104	2.625	3.013	1.893	1.896	1.278

* and ** Significant differences from zero at 5 % and 1 % levels of probability, respectively.

Table (14): Cont.

Parental	Leaf area				Husk of ear			
	Kg. N/fed.				Kg. N/fed.			
	40	80	120	Comb.	40	80	120	Combined
ıoshtohor 28	-40.347**	-57.569**	-38.695**	-45.537**	-0.250*	0.069	0.458**	0.092
ıoshtohor 44	-54.736**	-31.292**	-28.750**	-38.259**	0.194	-0.042	0.236	0.129
iza 307-A	-32.125**	-42.736**	-56.750**	-43.870**	0.528**	0.458**	0.458**	0.481**
loshtohor 103	44.597**	49.986**	28.917**	41.166**	-1.417**	-1.431**	-2.208**	-1.685**
oshtohor 50	27.653**	38.597**	30.694**	32.314**	1.583**	1.569**	1.292**	1.481**
oshtohor 33	25.319**	31.153**	49.472**	35.314**	-1.806**	-1.542**	-1.597**	-1.648**
oshtohor 41	15.764**	4.042*	2.472	7.426**	0.972**	0.847**	1.014**	0.944**
oshtohor 70C	13.875**	7.819**	12.639**	11.444**	0.194	0.069	0.347*	0.204*
S.D. 5 % ($\hat{g}_i - \hat{g}_j$)	11.074	4.923	6.125	4.389	0.377	0.437	0.486	0.242
S.D. 1 % ($\hat{g}_i - \hat{g}_j$)	14.817	6.586	8.195	5.756	0.505	0.584	0.651	0.318

* and ** Significant differences from zero at 5 % and 1 % levels of probability, respectively.

Table (15) : Estimates of general combining ability effects at the three nitrogen levels as well as in the combined analysis in the second diallel set.

Parental	Tasseling date				Silking date				Plant height				Ear height			
	Kg. N/fed.				Kg. N/fed.				Kg. N/fed.				Kg. N/fed.			
	40	80	120	Comb.	40	80	120	Comb.	40	80	120	Comb.	40	80	120	Comb.
Moshtohor 101	-2.238**	-1.895**	-1.962**	-2.032**	-2.552**	-1.762**	-2.048**	-2.1206**	-7.848**	-6.924**	-8.810**	-7.860**	-6.590**	-3.914**	-4.057*	-4.854**
Moshtohor 54	0.962**	0.705**	0.438*	0.701**	0.781**	0.505 *	0.486*	0.5906**	2.886	0.276	2.857	2.006	1.010	-0.581	2.676	1.035
Moshtohor 104	1.029**	0.905**	0.838**	0.924**	1.048**	0.905**	0.752**	0.9016**	2.352	1.543	1.457	1.814	-0.324	-0.114	-1.124	-0.521
Moshtohor 103	1.362**	1.705**	1.905**	1.657**	1.514**	1.705**	1.819**	1.6793**	0.619	2.076	-1.276	0.473	-2.524	0.819	-2.257	-1.320
Giza 307 - A	-0.638**	-0.829**	-0.429*	-0.632**	-0.619**	-0.695**	-0.314	-0.5426**	3.352	3.610*	5.990**	4.317**	8.010**	4.886**	5.543**	6.146**
Moshtohor 50	-0.438*	-0.562*	-0.495*	-0.476**	-0.352	-0.629**	-0.514**	-0.4983**	6.752**	8.476**	9.924**	8.384**	3.610**	0.752	1.276	1.879**
Giza 102	-0.038	-0.029	-0.295	-0.121	0.181	-0.029	-0.181	-0.0096	-8.114**	-9.057**	-10.143**	-9.104**	-3.190*	-1.848	-2.057	-2.365**
L.S.D. 0.05 $(g_i - g_j)$	0.592	0.642	0.582	0.339	0.689	0.608	0.587	0.352	6.542	5.294	4.807	3.133	3.917	3.523	4.129	2.163
L.S.D. 0.01 $(g_i - g_j)$	0.792	0.860	0.779	0.445	0.922	0.814	0.785	0.462	8.753	7.084	6.432	4.108	5.241	4.713	5.525	2.837

* and ** Significant differences from zero at 5 % and 1 % levels of probability, respectively.

Tabl (15) : cont

Parental	Leaf area				Husk of ear			
	Kg. N/fed.				Kg. N/fed.			
	40	80	120	Comb.	40	80	120	Combined
Moshtohor 101	-22.381*	-13.362	11.476	-8.089	0.724**	0.524**	0.638**	0.628**
Moshtohor. 54	-7.514	-23.362*	0.010	-10.288	0.324*	0.257	0.371*	0.317**
Moshtohor 104	22.552*	15.838	35.410**	24.6**	0.124	0.457*	0.771**	0.450**
Moshtohor 103	22.819*	50.571**	36.876**	36.815**	-1.276**	-1.543**	-1.895**	-1.571**
Giza 307 - A	-59.048**	-68.629**	-74.524**	-67.460**	0.057	0.324	0.105	0.162
Moshtohor 50	12.952	20.105*	-12.324	6.911	1.257**	1.057**	1.238**	1.184**
Giza 102	30.619**	18.838*	3.076	17.511**	-1.210**	-1.076**	-1.229**	-1.171**
L.S.D. 0.05								
$(\hat{g}_i - \hat{g}_j)$	32.775	27.178	29.237	16.697	0.433	0.527	0.545	0.282
L.S.D. 0.01								
$(\hat{g}_i - \hat{g}_j)$	43.852	36.363	39.118	21.893	0.579	0.706	0.730	0.370

* and ** Significant differences from zero at 5 % and 1 % levels of probability, respectively.

Table (16) : Estimates of specific combining ability effects for the crosses studies at the three nitrogen fertilizer levels as well as in the combined analysis in the first diallel set.

No.	Crosses	Tasseling date				Silking date				Plant height				Ear height			
		Kg. N/fed.				Kg. N/fed.				Kg. N/fed.				Kg N/fed.			
		40	80	120	Comb.	40	80	120	Comb.	40	80	120	Comb.	40	80	120	Comb.
1	1 x 2	2.159**	1.738**	1.421**	1.772**	1.754**	1.532**	1.508**	1.598**	0.770**	7.143**	-2.627	1.762	1.167	1.341	-1.270	0.412
2	1 x 3	0.659	0.071	-0.246	0.161	0.976*	0.143	-0.437	0.227	-1.230	-0.468	-8.683**	-3.460*	-3.444*	-4.492*	-6.214**	-4.716**
3	1 x 4	0.992	0.683	0.476	0.717**	0.421	0.476	0.008	0.301	7.048*	4.698*	6.040*	5.928**	1.833	5.063**	8.175**	5.023**
4	1 x 5	0.548	0.238	0.087	0.291	0.698	0.587	0.341	0.542*	-16.341**	-9.802**	5.817*	-6.775**	-2.722	-1.937	-1.825	-2.161**
5	1 x 6	-2.119**	-1.262**	-1.524**	-1.177**	-1.968**	-1.357**	-1.603**	-1.642**	7.381*	-2.691	-2.238	0.817	3.000	-0.381	-1.048	0.777
6	1 x 7	-2.397**	-0.929*	-0.413	-1.246**	-2.302**	-1.190**	-0.492	-1.328**	-3.064	0.198	2.095	-0.257	4.167*	0.563	2.286*	2.338**
7	1 x 8	0.159	-0.540	0.198	-0.061	0.421	-0.190	0.675	0.302	5.436	0.921	-0.405	1.984	-4.000*	-0.159	-0.103	-1.420
8	2 x 3	-1.119*	-0.651	-0.635	-0.801**	1.302**	-0.913	0.119	-0.698**	5.936*	11.087**	10.817**	9.280**	3.500*	5.230**	3.563**	4.097**
9	2 x 4	-1.786**	-3.040**	-2.913**	-2.579**	-2.190**	-2.579**	-2.770**	-2.513**	-2.786	2.254	1.873	0.447	0.778	0.786	-1.048	0.172
10	2 x 5	-1.897**	-0.151	-0.635	-0.894**	-1.579**	-0.468	-0.770	-0.939**	12.492**	1.754	-0.349	4.632**	4.889**	1.119	2.619**	2.875**
11	2 x 6	2.437**	1.349**	1.421**	1.735**	2.087**	1.921**	0.952*	1.653**	-0.119	-5.802**	-3.071	-2.997*	-1.722	-1.659	-0.270	-1.217
12	2 x 7	1.492**	1.349**	0.865	1.235**	1.754**	1.421**	0.730	1.301**	-5.230	-11.579**	-1.738	-6.182**	-6.222**	-3.714**	-2.270*	-4.068**
13	2 x 8	-1.286*	-0.595	0.476	-0.468	-0.524	-0.913	0.230	-0.402	-11.064**	-4.857*	-4.905	-6.942**	-2.389	-3.103**	-1.325	-2.272**
14	3 x 4	0.714	-0.373	0.421	0.254	1.365**	0.365	0.619	0.783	-0.452	0.976	3.151	1.225	0.167	0.286	3.008**	1.153
15	3 x 5	1.603**	0.849*	1.032*	1.161**	0.976*	0.810*	0.952*	0.912**	-3.175	-11.190**	-1.071	-5.145**	-7.056**	-5.381	-1.992	-4.809**
16	3 x 6	-0.063	-0.317	0.087	-0.097	-0.357	-0.468	-0.325	-0.383	-10.119**	-13.079**	-5.460	-9.552**	-0.667	-3.825**	-1.548	-2.013**
17	3 x 8	-1.341*	0.683	0.532	-0.042	-1.357**	0.698	0.786	0.042	15.436**	14.476**	5.540	11.817**	5.500**	3.786**	1.786	3.690**
18	3 x 8	-0.452	-0.262	-1.190*	0.634*	-0.302	-0.635	-1.714**	-0.883**	-6.397*	-1.802	-4.294	-4.164**	2.000	4.397**	1.397	2.598**
19	4 x 5	0.270	-0.206	0.421	0.161	0.754	-0.190	0.397	0.320	-1.564	1.310	-4.016	-1.423	-4.778**	-1.825	-1.270	-2.624**
20	4 x 6	-1.064*	0.294	0.143	-0.209	-0.579	-0.135	0.452	-0.087	0.492	-4.579*	2.262	-0.608	2.611	-1.603	-0.492	1.568*
21	4 x 7	1.325*	1.294**	0.921*	1.180**	1.421**	1.032*	0.563	1.005**	-1.952	-6.024**	-11.738**	-6.571**	-0.556	-2.325*	-5.159**	-2.680**
22	4 x 8	-0.452	1.349**	0.532	0.476	-1.190*	1.032	0.730	0.190	-0.786	1.365	2.429	1.002	-0.056	-0.381	-3.214**	-1.217
23	5 x 6	0.159	0.516	1.087*	0.587*	0.365	0.310	0.786	0.487*	-9.230**	13.587**	-2.960	0.465	-4.611**	5.397**	-0.159	0.209
24	5 x 7	-0.786	-0.817*	-1.135*	-0.912**	-1.302**	-0.857*	-1.103*	-1.087**	2.992	-3.857	1.040	0.058	3.556*	-1.325	0.841	1.024
25	5 x 8	0.103	-0.429	-0.857	-0.394	0.087	-0.190	-0.603	-0.235	14.825**	8.198**	1.540	8.187**	10.722**	3.952**	1.786	5.486**
26	6 x 7	0.214	-1.317**	-1.413**	-0.838**	0.365	-1.135**	-0.714	-0.494	2.714	11.587**	5.317	6.539**	0.611	4.897**	2.286*	2.598**
27	6 x 8	0.436	0.738	0.198	0.457	0.087	0.865*	0.452	0.468	8.881**	0.976	6.151*	5.336**	0.778	-2.825**	1.230	-0.272
28	7 x 8	1.492**	-0.262	0.643	0.624*	1.421**	0.032	0.230	0.561*	-10.897**	-4.802*	-0.516	-5.405**	-7.056**	-1.881	0.230	-2.902**
L.S.D. 5 % $(S_{ij} - S_{ik})$		1.549	1.131	1.382	0.763	1.373	1.201	1.411	0.746	9.035	6.122	8.531	4.478	5.037	3.164	3.169	2.179
L.S.D. 1 % $(S_{ij} - S_{ik})$		2.072	1.513	1.849	1.000	1.837	1.607	1.888	0.978	12.089	8.191	11.414	5.871	6.739	4.234	4.241	2.857
L.S.D. 5 % $(S_{ij} - S_{kl})$		1.385	1.012	1.236	0.682	1.228	1.074	1.262	0.667	8.081	5.475	7.630	4.005	4.505	2.830	2.835	1.949
L.S.D. 1 % $(S_{ij} - S_{kl})$		1.854	1.354	1.654	0.895	1.643	1.437	1.689	0.875	10.813	7.326	10.209	5.251	6.027	3.787	3.793	2.556

* and ** Significant differences from zero at 5 % and 1 % levels of probability, respectively.

Table (16) : cont.

No.	Crosses	Leaf area				Husk of ear			
		Kg. N/fed.				Kg. N/fed.			
		40	80	120	Comb.	40	80	120	Combined
1	1 x 2	58.119**	13.801**	-25.103**	15.605**	-1.778**	-0.397	-2.444**	-1.539**
2	1 x 3	26.175**	13.913**	0.897	13.661**	1.222**	1.437**	1.000**	1.219**
3	1 x 4	-18.881*	- 5.143	13.564**	- 3.486	0.833**	-0.008	0.667	0.497**
4	1 x 5	-26.937**	-12.421**	9.119*	-10.079**	1.167**	0.325	0.500	0.664**
5	1 x 6	-51.603**	-39.976**	-39.992**	-43.857**	-0.111	-0.563	0.389	-0.021
6	1 x 7	1.619	- 5.198	-27.659**	-10.412**	-0.222	0.048	0.444	0.090
7	1 x 8	11.508	35.024**	69.175**	38.569**	-1.111**	-0.841*	-0.556	-0.836**
8	2 x 3	1.897	5.635	20.619**	9.383**	-0.222	-1.119**	-0.778*	-0.706**
9	2 x 4	-43.159**	-39.087**	-13.048**	-31.764**	0.056	0.437	0.556	0.349
10	2 x 5	-56.548**	-71.032**	-68.825**	-65.468**	-1.278**	-1.563**	0.722*	-0.706**
11	2 x 6	12.786	45.746**	58.730**	39.087**	0.444	-0.119	0.611	0.312
12	2 x 7	-56.325**	10.190**	- 5.270	-17.135**	2.000**	1.825**	1.333**	1.719**
13	2 x 8	83.230**	34.746**	32.897**	50.291**	0.778**	0.937**	0.000	0.571**
14	3 x 4	7.230	23.357**	37.286**	22.624**	-0.611*	-0.730*	-0.667	-0.669**
15	3 x 5	-55.492**	-69.587**	-73.492**	-66.190**	1.056**	1.603**	1.500**	1.386**
16	3 x 6	23.175**	12.524**	4.397	13.365**	-0.889**	-1.286**	-1.278**	-1.151**
17	3 x 8	46.064**	39.968**	33.397**	39.809**	0.000	-0.008	0.111	0.034
18	3 x 8	-49.048**	-25.810**	-23.103**	-32.653**	-0.556*	0.103	0.111	-0.114
19	4 x 5	74.452**	124.024**	33.841**	77.439**	-1.667**	-1.841**	-1.500**	-1.669**
20	4 x 6	48.119**	- 5.532	-25.270**	5.772	1.056**	0.937**	0.389	0.794**
21	4 x 7	-43.659**	-67.754**	-34.936**	-48.783**	-0.056	0.214	-0.222	-0.021
22	4 x 8	-24.103**	-29.865**	-11.436*	-21.801**	0.389	0.992**	0.778*	0.719**
23	5 x 6	-11.936	0.524	62.952**	17.180**	-0.944**	0.603	-1.778**	-0.706**
24	5 x 7	50.619**	25.968**	57.286**	44.624**	0.611*	0.214	-0.056	0.256
25	5 x 8	25.841**	2.524	-20.881**	2.494	1.056**	0.659*	0.611	0.775**
26	6 x 7	14.286	0.079	-18.492**	- 1.375	-0.667*	-0.008	0.500	-0.058
27	6 x 8	-34.825**	-13.365**	-42.325**	-30.171**	1.111**	0.437	1.167**	0.905**
28	7 x 8	-12.603	- 3.254	- 4.325	- 6.727*	-1.667**	-2.286**	-2.111**	-2.021**
L.S.D. 5 % (S_{ii} - S_{ik})		24.763	11.008	13.696	9.815	0.844	0.977	1.088	0.542
L.S.D. 1 % (S_{ij} - S_{ik})		33.133	14.728	18.324	12.870	1.129	1.307	1.456	0.711
L.S.D. 5 % (S_{ij} - S_{kl})		22.149	9.846	12.250	8.779	0.754	0.874	0.973	0.485
L.S.D. 1 % (S_{ij} - S_{kl})		29.635	13.173	16.390	11.512	1.010	1.169	1.303	0.636

* and ** Significant differences from zero at 5 % and 1 % levels of probability, respectively.

Table (17) : Estimates of specific combining ability effects for the crosses studies at the three nitrogen fertilizer levels as well as in the combined analysis in the secon diallel set.

No.	Crosses	Tasseling date				Silking date				Plant height			Ear height			
		Kg. N/fed.				Kg. N/fed.				Kg. N/fed.			Kg. N/fed.			
		40	80	120	Comb.	40	80	120	Comb.	80	120	Comb.	40	80	120	Comb.
1	1 x 2	-0.644	0.556	0.667	0.193	-0.356	0.178	0.467	0.096	9.933**	7.111*	10.562**	17.644**	8.622**	5.333*	10.533**
2	1 x 3	0.956*	0.689	0.267	0.637**	0.044	0.778	0.533	0.451*	0.333	2.844	- 0.659	- 6.356*	-6.178**	-0.867	-4.467**
3	1 x 4	1.956**	0.889*	0.867*	1.237**	1.578**	0.978*	0.800*	1.118**	-12.200**	-10.889**	- 8.103**	-10.156**	- 3.111	-11.400**	-8.222**
4	1 x 5	-0.712	-1.244**	-1.467**	-1.141**	0.044	-0.622	-1.067**	-0.548*	-0.067	1.978	-0.303	2.311	0.489	1.800	1.533
5	1 x 6	-0.578	0.156	0.267	-0.052	-0.222	-0.356	0.133	-0.148	6.400	4.711	5.740**	5.044	1.289	2.733	3.022*
6	1 x 7	-0.978*	-1.044*	-0.600	-0.874**	-1.089*	-0.956*	-0.867*	-0.970**	-4.400	-6.556*	-6.437**	-8.489**	-1.111	2.400	-2.400
7	2 x 3	1.422**	1.422**	1.200**	1.348**	1.378**	1.178**	1.333**	1.296**	-0.867	-5.822	-2.637	-3.289	1.156	-1.600	-1.244
8	2 x 4	0.089	-0.711	-0.867*	-0.496*	-0.089	-0.622	-1.067**	-0.592**	-2.400	3.578	0.340	-1.756	-5.111*	-2.800	-3.222*
9	2 x 5	-1.244**	-1.511**	-1.200**	-1.318**	-0.956*	-1.222**	-1.600**	-1.259**	-5.600	-3.356	-6.059**	-0.289	-1.178	-1.933	-1.133
10	2 x 6	-1.113**	-0.778	-0.800*	-0.896**	-1.556**	-0.622	-0.400	-0.859**	-7.467*	-8.622**	-6.792**	-14.556**	-12.378**	-5.667*	-10.867**
11	2 x 7	1.489**	1.022*	1.000*	1.170**	1.578**	1.111**	1.267**	1.318**	6.400	7.111*	4.585*	2.244	8.889**	6.667*	5.933**
12	3 x 4	-1.644**	-1.244**	-0.933*	-1.273**	-1.356**	-1.356**	-1.000*	-1.237**	5.000	3.978	4.340*	-2.089	1.422	-0.667	-0.444
13	3 x 5	1.356**	1.289**	1.733**	1.459**	1.444**	1.044*	1.800**	1.429**	2.800	0.711	3.607	3.044	0.356	2.200	1.866
14	3 x 6	0.156	-0.644	-0.533	-0.341	0.511	-0.022	-0.667	-0.059	-2.733	3.778	-0.792	9.444**	7.156**	5.133	7.244**
15	3 x 7	-2.244**	-1.511**	-1.733**	-1.829**	-2.022**	-1.622**	-2.000**	-1.881**	-4.533	-5.489	-3.859	-0.756	-3.911	-4.200	-2.955*
16	4 x 5	-0.978*	0.489	0.333	-0.052	-1.022**	0.244	0.400	-0.126	3.933	-1.889	2.140	2.578	1.422	4.333	2.777*
17	4 x 6	0.489	-0.111	0.067	0.148	0.711	-0.156	-0.067	0.162	6.733	1.844	2.185	6.978**	7.556**	7.267**	7.267**
18	4 x 7	0.089	0.689	0.533	0.437*	0.178	0.911*	0.933*	0.674**	-1.067	2.578	-0.103	4.444	-2.178	3.267	1.844
19	5 x 6	0.489	0.756	0.400	0.548*	-0.156	0.578	0.400	0.274	-3.800	-0.756	-2.770	-8.556**	-1.511	-3.867	-4.644**
20	5 x 7	1.089**	0.222	0.200	0.503*	0.644	-0.022	0.067	0.229	2.733	3.311	3.385	0.911	0.422	-2.533	-0.400
21	6 x 7	0.556	0.622	0.600	0.592**	0.711	0.578	0.600	0.629**	0.867	-0.956	2.429	1.644	-2.111	-5.600*	-2.022
L.S.D. 0.05 (S_{ij} - S_{ik})		1.184	1.285	1.165	0.678	1.378	1.216	1.174	0.705	10.589	9.614	6.266	7.834	7.046	8.259	4.327
L.S.D. 0.01 (S_{ij} - S_{ik})		1.584	1.720	1.559	0.890	1.844	1.628	1.571	0.925	14.168	12.864	8.216	10.482	9.427	11.050	5.674
L.S.D. 0.05 (S_{ij} - S_{kl})		1.025	1.113	1.009	0.588	1.194	1.053	1.017	0.611	9.171	8.326	5.427	6.784	6.102	7.152	3.747
L.S.D. 0.01 (S_{ij} - S_{kl})		1.372	1.489	1.350	0.771	1.597	1.409	1.361	0.801	12.270	11.140	7.116	9.077	8.164	9.569	4.914

* and ** Significant differences from zero at 5 % and 1 % levels of probability, respectively.

No.	Crosses	Leaf area				Husk of ear			
		Kg. N/fed.				Kg. N/fed.			
		40	80	120	Comb.	40	80	120	Combined
1	1 x 2	40.133	60.978**	34.245	45.118*	0.556	1.267**	1.244**	1.022**
2	1 x 3	0.733	-19.222	-39.822*	-19.437	-0.578**	-0.267	-0.489	-0.445*
3	1 x 4	-70.533**	-36.955*	41.044*	-22.148*	0.822**	1.733**	2.178**	1.578**
4	1 x 5	19.333	-15.089	-32.222	- 9.326	-1.511**	-1.800**	-1.489**	1.600**
5	1 x 6	- 6.000	- 2.489	3.911	- 1.526	0.289	-0.200	-0.956**	-0.289
6	1 x 7	16.333	12.778	- 7.156	7.318	0.422	-0.733*	-0.489	-0.267
7	2 x 3	14.533	9.778	44.311*	22.874*	0.156	-1.000**	-1.222**	-0.689**
8	2 x 4	- 5.733	- 3.289	-33.489	-14.170	0.222	0.333	-0.556	-0.0003
9	2 x 5	26.133	17.245	- 2.755	13.541	-0.111	0.467	0.778*	0.378*
10	2 x 6	-37.867	-51.822**	19.044	-23.548*	-1.978**	-1.267**	-0.356	-1.200**
11	2 x 7	-37.200	-32.889	-61.356**	-43.815**	1.156**	0.200	0.111	0.489**
12	3 x 4	1.200	-37.822*	-13.889	-16.837	-0.578*	-0.867*	-0.956**	-0.800**
13	3 x 5	-25.600	17.711	-13.156	- 7.015	1.089**	0.600	0.378	0.689**
14	3 x 6	16.400	28.311	14.644	19.785	0.556	-0.133	-0.089	0.111
15	3 x 7	- 7.267	1.245	7.911	0.629	-0.644*	1.667**	2.378**	1.134**
16	4 x 5	3.800	-20.022	21.378	1.718	-0.511	-0.400	0.711*	-0.067
17	4 x 6	74.133**	110.244**	6.844	63.740**	-0.378	-0.800*	-0.756*	-0.645**
18	4 x 7	- 2.867	-12.156	-21.889	-12.304	0.422	0.000	-0.622	0.067
19	5 x 6	-50.667*	-57.555**	-50.089*	-52.770**	1.956**	2.333**	1.578**	1.955**
20	5 x 7	27.000	57.711**	76.844**	53.851**	-0.911**	-1.200**	-1.956**	-1.355**
21	6 x 7	4.000	-26.689	5.645	- 5.681	-0.444	0.067	0.578	0.067
L.S.D. 0.05 $(S_{ij} - S_{ik})$		65.551	54.356	58.474	33.394	0.866	1.055	1.091	0.565
L.S.D. 0.01 $(S_{ij} - S_{ik})$		87.705	72.726	78.236	43.787	1.158	1.410	1.460	0.741
L.S.D. 0.05 $(S_{ij} - S_{kl})$		56.769	47.074	50.640	28.920	0.750	0.914	0.945	0.489
L.S.D. 0.01 $(S_{ij} - S_{kl})$		75.954	62.982	67.754	37.920	1.003	1.221	1.264	0.641

* and ** Significant differences from zero at 5 % and 1 % levels of probability, respectively.

Considring ear-height, five, three, three and three crosses had significantly negative s.c.a. effect in the 40, 80, 120 Kg N/fed. and the combined analysis, respectively. The cross (2x6) behaved as the most desirable s.c.a. effect between twenty one crosses followed by cross (1x4) for plant and ear heights (Table 17).

Regarding leaf area, the cross (4x6) in 40 Kg N/fed. and three crosses in 80, 120 Kg N/fed. and four hybrids at the combined analysis had significantly positive s.c.a. effect. On the contrary, two, four, three and four crosses had a negative and significant s.c.a. effect in 40, 80, 120 Kg N/fed. as well as the combined analysis, respectively. Insignificant s.c.a. effect was detected in the rest cases.

Regarding ear husk, four, four, six and seven crosses had a significant positive s.c.a. effect in 40, 80, 120 Kg N/fed. and the combined analysis.

From the forgoing results, the cross (2x6) behaved as the most desirable cross between twenty-one crosses for earliness, plant and ear heightes. While, the cross (1x2) expressed the desirable cross for leaf area and ear husk (Table 17).

2. Yield and Yield Components

2.1. Ordinary analysis and mean performences :

A. First diallel set :

The analysis of variance for each the three nitrogen fertilizer levels for yield and yield components, i.e., number of ears/plant, ear length, ear diameter, number of rows/ear, number of kernels/row, 100-kernel weight and grain yield/plant, is presented in Table (18).

Results indicated that nitrogen fertilizer levels mean squares were highly significant for all traits except no. of ears/plant, revealing that differences among the effect of the three nitrogen fertilizer levels. Reslults revealed that differences between the averages of these mention characters were significantly affected by nitrogen fertilizer levels (Table 19). The results showed that, the highest mean values for all traits were obtained by plants received 120 Kg N/fed. This result might be attributed to the pronounced improvement of yield components and growth attributes by increasing N-level, which in turn increased the yield of maize.

Significant crosses mean squares were detected for all the studied traits except no. of ears/plant at 40, 80, 120 Kg N/fed. and the combined analysis. Significant mean squares due to interaction between F_1 crosses and nitrogen fertilizer level were detected for ear diameter, no. of rows/ear, 100-kernel weight and grain yield/plant. Such results indicated that these hybrids varied in their response to environmental fluctuations.

Mean performances of F_1 crosses at each nitrogen fertilizer levels and at the combined analysis over the three nitrogen levels are presented in Table (20). Two, three, six, ten and eight hybrids expressed high mean values over the three experiments when compared with the D.C. 204 for, no. of ears/plant, ear diameter, no. of rows/ear, 100-kernel weight and grain yield/plant, respectively (Table 20).

The two crosses (1x7) and (3x8) had the highest mean values for no. of ears/plant.

None of the hybrids had superiority over the D.C. 204 for the ear length.

The crosses (1x5), (3x5), (4x5), (5x6), (5x7) and (5x8) had the highest no. of rows/ear when compared with D.C. 204. Also, three crosses of the previous crosses gave the highest diameter of ear Table (20).

The hybrid (3x4) had the highest no. of kernels/row, but without significant superiority over those of (1x3), (3x6) and D.C. 204. The lowest number of kernels/row recorded by hybrid (2x4).

The hybrid (3x4) recorded the highest 100-kernel weight. However, the lowest 100-kernel weight was recorded by hybrid (1x3).

For grain yield/plant, the hybrid (3x4) gave the highest mean value followed by cross (4x5) and then by cross (5x6).

One, two, eight, and six hybrids at 40 Kg N/fed.; two, five, five and seven hybrids at 80 Kg N/fed. and two, nine, eight and nine hybrids at 120 Kg N/fed. expressed high mean values when compared with D.C. 204 for ear diameter, no. of rows/ear, 100-kernel weight and grain yield/plant, respectively (Table 20). The fluctuation of hybrids from nitrogen level to another were detected. The hybrids (4x5), (3x5) and (1x5) gave the highest value at 40, 80 and 120 Kg N/fed. for ear diameter, respectively (Table 20). Also the other traits such grain yield/plant the crosses (3x4), (4x5) and (3x4) had the highest values at 40, 80 and 120 Kg N/fed. respectively. These results would be due to significance of the interaction between hybrids and nitrogen levels.

B. Second diallel set :

Analysis of variance for all the traits studied in each of the three experiments and the combined analysis are presented in Table (21).

Nitrogen fertilizer levels mean squares were highly significant for yield and yield components except no. of ears/plant, indicating an overall differences between the three nitrogen levels.

The yield is a function of integrated metabolic processes of the plant. Consequently, the influence of nitrogen on the yield of maize could be interpreted on the basis of nitrogen effect on the growth attributes of maize plant (Table 10). The increase of the ear diameter, no. of rows/ear and no. of kernels/row might account much for the increase in the grain yield with increase in nitrogen supply to plant.

Furthermore, the increase in the yield with increase in nitrogen supply might owe much to the increase in leaf area which could be considered as a criterion for the photosynthetic efficiency of the plant.

Results presented in Table (22) show the effect of nitrogen fertilization on yield and yield components. Number of ears/plant and number of rows/ear were not affected by the effect of nitrogen fertilizer levels under study. While, grain yield/plant and some of its components were increased significantly by increasing levels of nitrogen fertilizer from 40 up to 80 Kg N/fed. Similar results were obtained by Baza (1981), Shafshak et al. (1981), Gouda (1982), Salem et al. (1982), Aly (1983); Salwaa (1985), Abdel-Aziz et al. (1986) and Badr (1987). Such effect might have resulted from the increase in agronomic attributes, especially, the increase in leaf area (Table 10).

Significant hybrid mean squares were obtained for all cases except number of ears/plant at 40, 80 and 120 Kg N/fed. as well as at the combined, ear length at 40 and 120 Kg N/fed., ear diameter at 40 and 80 Kg N/fed., and number of kernels/row at 80 and 120 Kg N/fed. as well as the combined data. Significant interaction between hybrids and the level of nitrogen mean squares were obtained for 100-kernel weight and grain yield/plant (Table 21). Such results indicated that these hybrids varied in their response to nitrogen levels.

The mean performances of 21 hybrids at the combined analysis over the three experiments are presented in Table (24). The highest mean values for ear length was detected by (4x7), (1x3), (1x4), (2x4), (3x6) and D.C. 204. While, the cross (4x6) had the highest ear diameter, but without superiority over those of crosses (1x3), (2x6), (3x6), (3x7), (5x6), (6x7) and D.C. 204. The cross (2x6) had the highest number of rows/ear but without significant superiority over the recorded by crosses (3x6), (4x6) and (5x6). For 100-kernel weight, none the hybrids surpassed the D.C. 204.

For grain yield/plant, the highest value was recorded by the three crosses i.e. (4x6), (3x6) and (4x7). However, the lowest value was record by cross (5x6).

Hybrid performances for 100-kernel weight and grain yield/ plant at the three nitrogen levels are presented in Table (23). The crosses (1x3), (1x6) and (3x4) had the highest value for 100-kernel weight at 40, 80 and 120 Kg N/fed., respectively. While, the crosses (1x3), 4x6) and (4x5) expressed the highest grain yield/plant at 40, 80 and 120 Kg N/fed., respectively. This result could be attributed to significant interaction between nitrogen level and hybrids in both traits mean squares (Table 21).

2.2. Heterosis :

A. First diallel set :

Heterosis expressed as the percentage deviation of F_1 mean performance from D.C. 204 (check variety) average value for grain yield at 40, 80 and 120 Kg N/fed. in combined analysis, are presented in Table (25).

Thirteen, eleven, thirteen and fourteen, F_1 crosses exhibited significantly heterotic effects from D.C. 204 at 40, 80 and 120 Kg N/fed. and over the three experiments, respectively. In the same order, six, seven, eight,and nine F_1 hybrids, significantly out-yielded the check variety by 10.16 to 19.2, 12.08 to 42.22, 9.10 to 32.18 and 4.97 to 34;41 % respectively. The five crosses (3x4), (4x5), (5x6), (7x8) and (1x2) out yielded the D.C. 204 by 34.41, 26.90, 18.87, 17.47 and 13.56 %, respectively over the three nitrogen levels.

It could be concluded that these F_1 hybrids offer possibility for improving grain yield of maize. This finding revealed that a hybrid program based on these material will be effective.

B. Second diallel set :

Heterosis expressed as percentage deviation of F_1 hybrids mean performance from D.C. 204 (check variety). Average value of heterosis for grain yield at 40, 80, and 120 Kg N/fed. and the combined analysis are presented in Table (26).

The results showed that, one, four, two and six F_1 hybrids outyielded than the check variety D.C. 204, at 40, 80 and 120 Kg N/fed. and over the three nitrogen levels, respectively. In the same order, the ranged of heterosis ranged from -25.72 to 22.996, -11.15 to 35.89, -19.50 to 22.13 and -18.2 to 20.80 %. The four F_1 hybrids (4x6), (3x6), (2x6) and (2x4) significantly out yielded the check variety by 12.16 to 20.79 % with a mean value 15.82 % over the three nitrogen fertilizer levels. Hence, it could be concluded that four mention crosses offer possibility for increasing grain yield of maize. These findings revealed that a hybrid program based or these material would be useful. Also, the most considerable heterosis were generally detected from combinations involving parental inbred lines that are very diverse in origen and widely different in their mean performances.

Many investigators reported high heterosis for yield of maize; i.e. Krolikowski (1969) and (1973), El-Rouby and Galal (1972), Dhillon and Singh (1977), El-Rouby et al. (1979), Mohamed (1979) and (1984), El-Hennawy (1980), Ragheb (1985), Nawar et al. (1986), Parsad and Singh (1968), Abo-Dheaf (1987), Mohamed and Yasien (1987), El-Hosary

(1988), (1988 a,b) and (1989), Nawar et al. (1988), Badr (1989), Mahmoud (1989), El-Hosary et al. (1990), Galal et al. (1990) and Beck et al. (1991).

2.3. Combining ability mean squares :

A. First diallel set :

The analysis of variance for combining ability at each nitrogen fertilizer level as well as at the combined analysis for yield and yield components is presented in Table (27). The variance of general combining ability includes the additive genetic portion while specific combining ability is representes the nonadditive genetic portion of the total variance arising largely from dominance and epistatic deviations. The mean squares due to general and specific combining ability were highly significant in all traits except number of ears/plant.

If both general and specific combining ability mean squares are significant, one may ask which type and/or types of gene action are important in determining the performance of single-cross progeny. To overcome such situation the size of mean suqares can be used to assume the relative importance of general and specific combining ability. For all traits general combining ability and specific combining ability mean squares were highly significant except number of ears/plant. Hence, g.c.a./s.c.a. ratio was used as measure to reveal the nature of genetic variance involved.

For ear diameter, number of rows/ear, and number of kernels/ row at 40, 80 and 120 Kg N/fed. as well as at the combined analysis, high ratios which largely exceeded the unity were obtained, indicating that a large part of the total genetic variability associated with these traits was a result of additive and additive by additive gene action.

100-kernel weight at the three nitrogen levels and at the combined analysis, grain yield/plant at 40 and 80 Kg N/fed. and the combined analysis, and ear length at 40 and 120 Kg N/fed., on the other side, showed g.c.a./s.c.a. ratios less than unity. Therefore, it could be concluded that the large portion of the total genetic variability associated with these cases was due to non-additive gene action. The largest heterotic magnitude expressed in grain yield/plant as the diviation of particular F_1 mean performance from D.C. 204, may strengthened the conclusion about the importance of non-additive gene effect in the inheritance of this trait.

Ear length at 80 Kg N/fed. and the combined analysis and grain yield/plant at 120 kg N/fed. had g.c.a./s.c.a. ratio was equal to unity, indicating that additive and non-additive types of gene action were important the same in the performance of these cases.

For the exceptional case, the nonadditive type of gene action was the important part of the total genetic variability.

B. Second diallel set :

Analysis of variance for combining ability in each nitrogen fertilizer levels as well as at their combined results for yield and yield components, is shown in Table (28).

The variance associated with general combining ability (g.c.a.) was significant for number of rows/ear, 100-kernel weight, and grain yield/plant in the three nitrogen levels as well as in the combined data, and ear diameter at 120 Kg N/fed. and the combined analysis and ear length in the combined analysis. Specific combining ability (s.c.a.) variances were significant for 100-kernel weight, grain yield/ plant in the three nitrogen fertilizer levels and in the combined analysis, ear length at 80 Kg N/fed. and the combined data, ear diameter at 120 kg N/fed., number of rows/ear at 120 Kg N/fed. and the combined analysis and number of kernels/row at 40 Kg N/fed.

It is evident that additive type of gene action was the more important part of the total genetic variability for number of rows/ear at 40 and 80 Kg N/fed. and ear diameter at the combined analysis. However, for ear length at 80 Kg N/fed. and number of kernels at 40 Kg N/fed., the non-additive type of gene action was the more important part of the total genetic variability. For the other studied cases, both additive and non-additive gene effects were involved in determining the performance of single cross progency. Also, when g.c.a./s.c.a. ratio was used, it was found that, 100-kernel weight at 40 Kg N/fed. exhibited low g.c.a./s.c.a. ratio of less than unity, indicating the predominance of non-additive gene action in the inheritance of this case.

On the other hand, high g.c.a./s.c.a. ratios which exceeded the unity were detected for the other cases. Such results indicated that additive and additive X additive types of gene action were more important than non-additive effects incontroling thse cases.

These results are in the same line of those reported by Sprague (1964), Stuber et al. (1966), Singh et al. (1971); Ragheb (1985), Abo-Dheaf

(1987), El-Hosary (1988), and Mokbel (1988) where they found that both additive and non-additive gene effect are important in controling yield and most of yield components.

Gamble (1962), Krolikowski (1969), Mukherjee et al. (1970), Rashed (1977), El-Hosary (1985), Nawar and El-Hosary (1985), Atia (1986), Mahmoud (1989), El-Absawy (1990) and El-Hosary et al. (1990) pointed out that non-additive variation was the only predominant type of gene action for yield and most yield components.

On the other hand, the abundant of additive gene effects for maize yield and it components was recorded by Lonnquist and Gardner (1961), Hallauer (1968) and (1971), Manoliu (1969), Sentz (1971) El-Rouby and Galal (1972), El-Rouby et al. (1973), Tkachenko and Goncharenko (1973), Mohamed (1979), Nawar and El-Hosary (1985), Atia (1986), El-Hosary (1986), (1987), (1988) and (1989)l,Badr (1989), Galal et al. (1990) and Beck et al. (1991).

In both diallel sets, the mean squares of interaction between the three nitrogen fertilizer levels and both types of combining ability were significant for yield and yield components Table (27 and 28). Such result indicated that the magnitude of all types of gene action varied from nitrogen level to another. It is fairly evident that ratio for s.c.a. X N-levels/s.c.a. was much higher than ratio of g.c.a. X N-levels/g.c.a. for all the studied traits in both diallel sets except for grain yield/plant in the first diallel set. Such results indicated that non-additive type of gene action was more influenced by the nitrogen fertilizer levels than additive genetic effects. These conclusion are in well agreement with those reported by Gilbert (1958). These results are in harmony with those previously reported by El-Hosary (1985) and Nawar (1985), where the non-additive effects were reported to be more biased by interaction with environments than additive ones.

2.4. General combining ability effects :

A. First diallel set :

Estimation of the general combining ability ($\hat{g}_i$) effects for individual parental line in each trait at the three fertilizer levels as well as at the combined analysis are presented in Table (29). Theoretically an estimate of general combining ability effect of inbred line is not an absolute value. It actually depends upon the group of inbred lines to which this particular inbred line was crossed in the diallel crossing system. If the inbred line is exactly average in its ($\hat{g}_i$) effect, the expected estimate ($\hat{g}_i$) would be zero. Significant departure from zero, wherever the diraction, would indicate that the inbred line is much better or much poorer than the over all average of the parental inbred lines involved in the test. High positive values would be of interest under all traits of yield and yield components.

The parental inbred line M.28 seemed to be good combiner for number of kernels/row. It, on the contrary, expressed either significantly negative or nonappreciable positive ($\hat{g}_i$) values for the other traits. While, the parental inbred line M.44 behaved as the best combiner for 100-kernel weight in the three nitrogen levels and the combined analysis. It, however, exhibited either significant negative or insignificant for the other traits. The parental inbred line G. 307A expressed as the second good combiner for number of kernels/row at 40 and 80 Kg N/fed. as well as the combined data and grain yield/plant at 40 Kg N/fed. It was around the average or significant negative for the other traits. The parental inbred line M. 103 gave the highest positive ($\hat{g}_i$) values for, ear length, 100-kernel weight, and grain yield/plant at the three nitrogen levels as well as the combined analysis, and the second one for ear diameter at 80 Kg N/fed. and number of rows/ ear at 80 and 120 kg N/fed. as well as the combined data. It was around the average for the other cases. The parental inbred line M.50 gave the highest positive ($\hat{g}_i$) values for ear diameter and number of rows/ear in the three nitrogen levels as well as the combined analysis. Also, it seemed to be the second good combiners for grain ield/plant at 80 and 120 Kg N/fed. and the combined analysis. It, the contrary, expressed either significant negative or intermediate value for the rest cases. The parental inbred line M.33 expressed significant positive of ($\hat{g}_i$) value for number of rows/ear at 40 and 120 Kg N/fed. and the combined analysis, number of kernels/row and grain yield/plant at 40 Kg N/fed. and the combined analysis. It, was around the average for the other cases. The parental inbred line M.41 had significant positive ($\hat{g}_i$) value for 100-kernel weight at 80 Kg N/fed. as well as the combined analysis. It, on the contrary, expressed either significant negative or non-appreciable positive ($\hat{g}_i$) values for the other cases. The parental inbred line M.70_C had a significant negative or insignificant ($\hat{g}_i$) values for all the studied traits.

B. Second diallel set :

Estimates of general combining ability ($\hat{g}_i$) effects for individual parental inbred line in each trait are shown in Table (30).

The parental inbred line Moshtohor-101 had significant positive ($\hat{g}_i$) effect for ear length and 100-kernel weight at the combined analysis and 100-kernel weight at 40 Kg N/fed. It was around the average for the other cases. The parental inbred line Moshtohor 54 had significant positive ($\hat{g}_i$) effect only for grain yield/plant at 80 Kg N/fed., It, on the contrary, expressed either significantly negative or non-appreciable ($\hat{g}_i$) effect for the other cases. The parental inbred line Moshtohor 104 seemed to be the best combiner for 100-kernel weight in the three nitrogen levels as well as the combined data. Also, it had significant positive ($\hat{g}_i$) effect for grain yield/plant at 40 Kg N/fed. and the combined analysis. However, it gave insignificant ($\hat{g}_i$) effect for the other cases. The parental inbred line Moshtohor 103 appeared to be one of the good combiner for ear length at the combined analysis and 100-kernel weight and grain yield/plant at 120 Kg N/fed., and the combined analysis. Also, it gave significant positive for grain yield/plant and ear diameter at 80 Kg N/fed. and 120 Kg N/fed., respectively. On the other hand, expressed either insignificant or significant negative for other cases. The parental inbred line G. 307A seemed to be a poor one of the all studied traits. The parental inbred line Moshtohor 50 seemed to be the best combiner for ear diameter at 120 Kg N/fed. and the combined analysis, number of rows/ear at the three nitrogen fertilizer levels as well as at the combined analysis, and 100-kernel weight at 80 Kg N/fed. Meanwhile, it gave significant positive ($\hat{g}_i$)

effect for grain yield/plant at 80 Kg N/fed. and the combined data. It almost was around the average for the rest cases. The parental inbred line G. 102 expressed either significant negative or non-apperciable positive ($\hat{g}_i$) effect for all the studied traits.

2.5. Specific combining ability effects :

A. First diallel set :

estimates of the specific combining ability effects in the twenty-eight crosses for the yield and its components at 40, 80 and 120 Kg N/fed. and at the combined analysis are presnted in Table (31). Appreciable effects were more prevalent for grain yield/plant than for any of its components.

For number of ears/plant, the most desirable s.c.a. effects were recorded by the crosses (1x7), (2x5) and (3x8) in the combined analysis.

For ear length, four crosses at 40, 80 and 120 Kg N/fed. and eight crosses at the combined analysis exhibited significant positive s.c.a. effects. Results indicated that cross (3x4) had significant positive s.c.a. effects at the three nitrogen fertilizer llevels as well as the combined analysis. Meanwhile, the cross (2x5) gave the highest s.c.a. value at the combined analysis and significant positive s.c.a. effect at 40 and 120 Kg N/fed. Also, the cross (3x4) seemed to be the best combination for this trait at the three nitrogen levels as well as the combined analysis. Moreover, this crosses behaved as the most desirable crosses among the studied twenty-eight hybrids. It is clear that only cross (4x6) showed significant negative s.c.a. effect at the three nitorgen levels as well as the combined analysis.

Six, eight, eight and eleven crosses had significant positive s.c.a. effects for the ear diameter at 40, 80 and 120 Kg N/fed. as well as the combined analysis, respectively. Both crosses (1x2) and (4x5) produced the highest s.c.a. values for this trait at the combined analysis. Also, the first cross gave significant positive s.c.a. effects at the three nitrogen levels and the combined analysis.

For number of rows/ear, five, three, four and five hybrids showed significant positive s.c.a. effects at 40, 80 and 120 Kg N/fed. as well as the combined analysis, respectively. The cross (7x8) produced the highest s.c.a. value for this trait at the combined analysis and the second one at 40 Kg N/fed. and third one at 80 and 120 Kg N/fed. In addition gave significant positive s.c.a. effect at 120 Kg N/fed. Also, the hybrid (5x6) had the second one for s.c.a. effect for the trait in question.

Results also indicated that; eight, five, seven and eight crosses showed significant positive s.c.a. estimtes for number of kernels/row at 40, 80 and 120 Kg N/fed. as well as the combined analysis, respectively. However, both crosses (3x4) and (7x8) seemed to be the best F_1-hybrids for the trait in question.

For 100-kernel weight; nine, nine, six, and thirteen combinations showed significant positive s.c.a. effects at 40, 80 and 120 Kg N/fed. as well as the combined analysis, respectively. Generally, the cross (3x4) had the heaviest grain weight. While, the cross (1x3) and (3x5) had the slightest one over the three nitrogen levels.

Regarding grain yield/plant, nine, eight, six and ten crosses showed significant positive s.c.a. estimates at 40, 80 and 120 kg N/fed. and the combined analysis, respectively. In conclusion, the best combinations were; (3x4), (4x5), (5x6), (7x8) and (1x2). These crosses, also, gave the highest useful heterosis relatively to D.C. 204 (Table 25).

In all traits, the values of s.c.a. effect were mostly differed from nitrogen level to another. This finding coincided with that reached above for significant s.c.a. by nitrogen levels mean squares (Table 27).

B. Second diallel set :

Estimates of the specific combining ability effects in twenty-one crosses for the yield and its components at 40, 80 and 120 Kg N/fed. as well as the combined analysis are presented in Table (32).

For ear length, the most desirable s.c.a. effects were recorded for the two crosses (1x3) and (4x7) in 80 Kg N/fed. as well as the combined data.

Concerning ear diameter, only cross (2x6) showed significant positive s.c.a. effects.

Two and five crosses had significant positive s.c.a. effect for number of rows/ear at 120 Kg N/fed. and the combined data, respectively. Meanwhile, the cross (2x6) produced the highest s.c.a. value for this trait.

It is clear that only cross (1x7) showed significant positive s.c.a. effects for number of kernels/row at 40 Kg N/fed. Moreover, this cross behaved as the most desirable s.c.a. among the studied twenty-one hybrids.

Results also indicated. that six, five, five and six hybrids showed significant positive s.c.a. effects for 100-kernel weight at 40, 80 and 120 Kg N/fed. as well as the combined data, respectively. Also, the best combinations for this trait were (2x5), (4x7) and (5x7) at 40 and 80 Kg N/fed. and the combined data.

Regarding grain yield/plant five, two, two and six crosses showed significant positive s.c.a. effects at 40, 80 and 120 Kg N/fed. and the combined analysis, respectively. In conclusion, the best combinations were (4x6), (3x6) and (2x6). These crosses also had the highest out yielded from D.C. 204 (Table 26). Also, these crosses involved at lest one good combiner for grain yield/plant. Such combinations would throw out desirable transgressive segregats providing that the additive genetic system present in the good combiner, and complementary and epistatic effects present in these crosses act in the same direction to reduce undesirable plant characteristics and maximize the character in view. These cross might be of prime importance in breeding programs whether towards hybrid maize production or for production inbred lines procedures.

Table (18): Observed mean squares from analysis of variance for yield and yield components in the first diallel set.

Sources of variation	D.F.		No. of ears/plant				Ear length				Ear diameter				No. of rows/ear			
			Kg. N/fed.				Kg. N/fed.				Kg. N/fed.				Kg. N/fed.			
	S.	C.	40	80	120	Comb.	40	80	120	Comb.	40	80	120	Comb.	40	80	120	Combined
Fertilizer	-	2				0.013				157.414**				8.166**				46.678**
Replication	2	6	0.029*	0.005	0.002	0.012	1.856	3.845**	0.518	2.072*	0.208	0.125	0.312**	0.215**	0.559	2.436**	1.254*	1.416**
Genotypes	27	27	0.008	0.008	0.007	0.014**	4.733**	2.868**	4.232**	9.217**	0.404**	0.296**	0.391**	0.853**	3.661**	3.691**	4.757**	10.774**
Genotypes X Fert.	-	54				0.004				1.307				0.119**				0.667**
Error	54	162	0.008	0.005	0.007	0.006	1.140	0.758	0.962	0.953	0.075	0.045	0.059	0.059	0.283	0.362	0.333	0.326

Table (18): Cont.

Sources of variation	D.F.		No. of kernels/row				Weight of 100-kernel				Grain yield/plant			
			Kg. N/fed.				Kg. N/fed.				Kg. N/fed.			
	S.	C.	40	80	120	Comb.	40	80	120	Comb.	40	80	120	Combined
Fertilizer	-	2				507.120**				594.261**				87336.310**
Replication	2	6	1.934	3.285	1.133	2.117	2.656	1.297	0.188	1.380	147.625	1073.75**	223.25	481.5416**
Genotypes	27	27	21.475**	15.073**	23.208**	55.277**	43.395**	40.252**	48.654**	119.093**	2296.991**	3610.408**	3985.5**	8208.756**
Genotypes X Fert.	-	54				2.239				6.603**				842.070**
Error	54	162	2.360	3.096	1.993	2.483	2.037	2.989	3.166	2.730	99.755	170.111	179.815	149.893

* and ** Significant at the probability level of 5 % and 1 %, respectively.

Table (19) : The mean values of yield and its components of maize as affected by nitrogen fertilizer levels in the first diallel set.

Fertilizer levels	No. of ears/ plant	Ear length	Ear diameter	No. of rows/ear	No. of kernels/row	Weight of 100-kernel	Grain yield/plant
40	a * 1.014	c 17.592	c 4.549	c 13.024	c 35.279	c 42.488	c 208.845
80	a 1.015	b 19.367	b 4.933	b 13.800	b 38.225	b 45:881	b 246.857
120	a 1.016	a 20.296	a 5.168	a 14.514	a 40.081	a 47.845	a 272.964

* Means designeted by the same later are not significantly different at the 5 % level according to Duncen's.

Table (21): Observed mean squares from analysis of variance for yield and its components in the second diallel set.

Sources of variation	D.F.		No. of ears/plant				Ear length				Ear diameter				No. of rows/ear			
			Kg. N/fed.				Kg. N/fed.				Kg. N/fed.				Kg. N/fed.			
	S.	C.	40	80	120	Comb.	40	80	120	Comb.	40	80	120	Comb.	40	80	120	Combined
Fertilizer	-	2				0.004				64.001**				2.473**				8.268**
Replication	2	6	0.040	0.035	0.011	0.029	6.113	10.563**	4.133	6.937**	0.214	0.539*	0.122	0.292	1.333	1.031	0.122	0.829
Genotypes	20	20	0.014	0.011	0.016	0.016	4.162	3.311*	3.590	7.669**	0.192	0.203	0.408**	0.516**	1.541**	2.077**	2.678**	5.363**
Genotypes X Fer.	-	40				0.013				1.697				0.143				0.467
Error	40	120	0.016	0.013	0.012	0.014	2.488	1.682	2.149	2.106	0.161	0.157	0.121	0.146	0.454	0.657	0.237	0.449

Table (21) : Cont.

Sources of variation	D.F.		No. of kernels/row				Weight of 100-kernel				Grain yield/plant			
			Kg. N/fed.				Kg. N/fed.				Kg. N/fed.			
	S.	C.	40	80	120	Comb.	40	80	120	Comb.	40	80	120	Combined
Fertilizer	-	2				309.823**				69.190**				48868.105**
Repmlication	2	6	10.621	42.258*	21.105	24.662*	4.398	16.445	2.730	7.858	25.000	2530.750*	296.250	950.667
Genotypes	20	20	15.300*	5.809	13.964	13.622	55.521**	32.464**	40.488**	82.124**	2213.200**	3761.100**	2903.025**	5354.461**
Genotypes X Fer.	-	40				10.726				22.174**				1761.432**
Error.	40	120	8.179	9.761	8.474	8.805	3.780	5.244	4.530	4.518	351.600	702.975	736.125	596.900

* and ** Significant at the probability level of 5 % and 1 %, respectively.

Table (22) : The mean values of yield and its components of maize as affected by nitrogen fertilizer levels in the second diallel.

Fertilizer levels	No. of ears/plant	Ear length	Ear diameter	No. of rows/ear	No. of kernels/row	Weight of 100-kernel	Yield of grain/plant
40	a * 1.024	b 17.521	b 4.981	a 14.362	b 34.802	b 43.159	b 220.667
80	a 1.028	a 19.051	ab 5.257	a 14.959	a 38.195	a 45.254	a 272.079
120	a 1.023	a 19.422	a 5.365	a 14.987	a 38.971	ab 44.159	a 264.937

* Means designeted by the same later are not significantly different at the 5 % level according to Duncan's.

Table (23) : The genotype mean performance for yield and its components under three nitrogen levels in the second diallel set.

No.	Crosses	Weight of 100-kernel			Grain yield/plant		
		40	80	120	40	80	120
1	1 x 2	d-h 42.3	b-f 45.7	a-c 47.0	b-e 216.7	c-f 269.0	b-f 265.3
2	1 x 3	a 53.3	b-f 45.0	b-d 45.0	a-b 250.7	b-d 293.0	a-d 280.3
3	1 x 4	b 47.7	b-d 47.7	a-c 47.3	c-f 210.3	d-f 254.7	c-f 243.3
4	1 x 5	b-c 46.0	b-e 46.7	a-c 47.0	c-f 211.3	e-f 235.0	b-f 256.0
5	1 x 6	b-c 46.0	a 52.0	e-f 40.3	a-c 239.3	c-e 285.0	b-e 269.7
6	1 x 7	h-i 39.3	h-i 39.7	e-f 40.3	b-e 215.3	d-f 248.0	b-f 261.3
7	2 x 3	b-e 44.7	a-b 49.0	c-e 43.3	b-c 235.7	c-f 277.3	b-f 260.7
8	2 x 4	e-h 41.7	e-h 43.0	b-d 44.0	b-d 228.3	a 353.3	c-f 254.3
9	2 x 5	b-d 45.3	b-d 47.7	d-e 41.7	b-d 231.3	d-f 245.7	c-f 245.0
10	2 x 6	e-h 42.0	b-f 45.3	b-d 45.0	a-c 243.0	b-d 296.7	a-b 307.3
11	2 x 7	i 37.3	i 38.7	f-g 37.7	e-h 192.3	d-f 257.0	e-f 223.0
12	3 x 4	e-h 41.7	a-c 48.3	a 50.0	f-h 178.3	c-f 280.7	a-d 293.0
13	3 x 5	g-i 40.0	f-i 41.7	b-d 45.0	b-d 232.0	d-f 253.3	d-f 241.7
14	3 x 6	c-g 43.0	a-c 48.3	a-c 46.0	a 271.0	a-c 316.0	a-d 282.7
15	3 x 7	f-h 41.0	b-f 45.0	a-c 46.7	b-d 232.0	d-f 253.7	b-f 262.7
16	4 x 5	g-i 40.0	e-h 43.3	a-c 46.3	g-h 172.7	e-f 239.7	a 323.7
17	4 x 6	b-e 45.0	b-e 46.7	a-c 47.3	a-c 239.3	a-b 340.7	a 320.3
18	4 x 7	b-c 46.0	b-e 47.0	a-b 48.0	b-d 230.0	a-c 310.0	a-c 295.0
19	5 x 6	j 33.0	g-i 40.7	g 36.0	h 163.7	f 231.0	f 215.0
20	5 x 7	b 47.0	c-g 44.0	f-g 39.3	a-c 242.7	e-f 239.0	f 213.3
21	6 x 7	b-f 44.0	b-f 45.0	b-d 44.0	c-g 198.0	e-f 235.0	c-f 250.0
D.C.	204	b-d 45.3	b-f 46.0	a-c 46.3	b-d 220.3	d-f 260.0	b-f 265.0

* Means designeted by the same later are not significantly different at the 5 % level according to Duncen's.

Table (24) : The genotype mean performance for yield and its components for combined analysis in the second diallel set.

No.	Crosses	Ear length		Ear diameter		No. of rows/ear		Weight of 100-kernel		Grain yield/plant	
1	1 x 2	17.8	d-g	5.2	b-f	14.9	b-f	45.0	b-e	250.3	d-g
2	1 x 3	20.2	a-b	5.3	a-e	15.3	b-e	47.8	a	274.7	b-e
3	1 x 4	19.6	a-c	5.2	b-f	14.5	c-g	47.6	a	236.1	f-g
4	1 x 5	18.7	b-f	5.1	c-g	14.2	e-g	46.6	a-c	234.1	f-g
5	1 x 6	18.9	b-e	5.1	c-g	15.3	b-e	46.1	a-d	264.7	c-e
6	1 x 7	19.0	b-d	5.1	c-g	14.6	c-g	39.8	g	241.6	e-g
7	2 x 3	18.9	b-d	4.9	d-g	14.7	c-g	45.7	a-d	257.9	c-f
8	2 x 4	19.3	a-d	5.1	b-g	14.6	c-g	42.9	e-f	278.7	a-c
9	2 x 5	17.8	d-g	4.8	g	13.9	f-g	44.9	b-e	240.7	e-g
10	2 x 6	17.7	e-g	5.5	a-b	16.6	a	44.1	d-f	282.3	a-c
11	2 x 7	18.0	c-g	4.8	f-g	13.8	f-g	37.9	g-h	224.1	g-h
12	3 x 4	17.1	f-g	5.1	c-g	14.3	c-g	46.7	a-b	250.7	d-g
13	3 x 5	18.5	c-g	5.1	c-g	14.4	c-g	42.2	f	242.3	e-g
14	3 x 6	19.2	a-e	5.6	a-b	16.1	a-b	45.8	a-d	289.9	a-b
15	3 x 7	18.6	b-f	5.3	a-e	14.0	e-g	44.2	d-f	240.4	e-g
16	4 x 5	18.9	b-e	5.0	d-g	14.3	d-g	43.2	e-f	245.3	e-g
17	4 x 6	18.8	b-e	5.7	a	15.6	a-c	46.3	a-d	300.1	a
18	4 x 7	20.7	a	5.2	b-f	14.7	c-g	47.0	a-b	278.3	a-c
19	5 x 6	16.9	g	5.5	a-c	15.5	a-d	36.6	h	203.2	h
20	5 x 7	18.0	c-g	4.9	e-g	13.6	g	43.4	e-f	231.7	f-g
21	6 x 7	19.0	b-d	5.4	a-d	14.9	b-f	44.3	c-f	227.7	g
D.C.	204	20.7	a	5.6	a	14.9	c-g	45.9	a-d	248.4	e-g

Table (25) : Percentage of heterosis over check variety D.C. 204 for the grain yield in the first diallel set.

No.	Crosses	40	80	120	Combined
1	1 x 2	13.492**	13.333**	13.846**	13.568**
2	1 x 3	-11.111**	-19.167**	-17.308**	-16.103**
3	1 x 4	1.587	12.083**	11.667**	8.826**
4	1 x 5	- 6.349	- 3.472	9.615*	0.470
5	1 x 6	10.159*	8.055	6.538	8.122**
6	1 x 7	- 0.318	- 1.805	- 0.257	- 1.220
7	1 x 8	- 3.333	-11.389*	- 7.949	- 7.747**
8	2 x 3	1.429	- 1.528	- 5.641	- 2.159
9	2 x 4	-13.968**	5.417	7.692	0.516
10	2 x 5	3.175	- 3.333	8.333	2.864
11	2 x 6	- 8.413*	- 3.611	23.718**	4.976*
12	2 x 7	-27.937**	-27.500**	-29.359**	-28.309**
13	2 x 8	0.794	- 2.083	- 8.205	- 3.474
14	3 x 4	34.762**	36.528**	32.180**	34.413**
15	3 x 5	-22.063**	- 2.917	-17.308**	-13.849**
16	3 x 6	3.968	- 3.333	0.128	0.094
17	3 x 7	- 1.746	8.333	2.820	3.333
18	3 x 8	7.460	1.111	- 1.795	1.925
19	4 x 5	13.968**	42.222**	23.205**	26.901**
20	4 x 6	- 3.968	- 4.167	7.051	0.000
21	4 x 7	- 1.429	1.389	9.103*	3.380
22	4 x 8	-21.111**	-12.917**	- 4.487	-12.254**
23	5 x 6	19.206**	15.695**	21.538**	18.873**
24	5 x 7	- 2.699	12.222**	25.385**	12.629**
25	5 x 8	- 2.063	0.417	4.231	1.080
26	6 x 7	- 3.492	- 0.833	0.513	- 1.127
27	6 x 8	-10.794**	2.361	6.538	0.000
28	7 x 8	15.397**	18.889**	17.820**	17.465**

Table (26) : Percentage of heterosis over check variety D.C. 204 for grain yield in the second diallel set.

No.	Crosses	40	80	120	Combined
1	1 x 2	- 1.664	3.461	0.126	0.760
2	1 x 3	13.767	12.692	5.786	10.555*
3	1 x 4	- 4.539	- 1.923	- 8.176	- 4.964
4	1 x 5	- 4.085	- 9.615	- 3.396	- 5.769
5	1 x 6	8.623	9.615	1.761	6.530
6	1 x 7	- 2.269	- 4.615	- 1.383	- 2.772
7	2 x 3	6.959	6.667	- 1.635	3.802
8	2 x 4	3.631	35.897**	- 4.025	12.164**
9	2 x 5	4.992	- 5.513	- 7.547	- 3.130
10	2 x 6	10.288	14.102	15.975	13.641**
11	2 x 7	-12.708	- 1.153	-15.849	- 9.794*
12	3 x 4	-19.062**	7.948	10.566	0.895
13	3 x 5	5.295	- 2.564	- 8.804	- 2.459
14	3 x 6	22.996**	21.538*	6.667	16.682**
15	3 x 7	5.295	- 2.435	- 0.880	0.403
16	4 x 5	-21.634**	- 7.820	22.138**	- 1.252
17	4 x 6	8.623	31.026**	20.880**	20.796**
18	4 x 7	4.387	19.231*	11.321	12.030**
19	5 x 6	-25.718**	-11.153	-18.867*	-18.202**
20	5 x 7	10.136	- 8.076	-19.496*	- 6.752
21	6 x 7	-10.136	- 9.615	- 5.660	- 8.362

S.O.V.	D.F.		No. of ear/plant	Ear length				Ear - diameter				No. of rows/ear			
	S.	C.	Combined	40	80	120	Comb.	40	80	120	Comb.	40	80	120	Comb.
G.C.A. (1)	7	-	0.001	1.391**	0.967**	1.240**	1.076**	0.230**	0.232**	0.289**	0.229**	3.325**	3.484**	4.660**	3.615**
S.C.A. (2)	20	-	0.002**	1.643**	0.952**	1.471**	1.005**	0.102**	0.052**	0.075**	0.047**	0.484**	0.442**	0.510**	0.350**
G.C.A. x fertilizer	-	14	0.003**				1.261**				0.260**				3.927**
S.C.A. x fertilizer	-	40	0.003**				1.529**				0.090**				0.541**
Error			0.0007	0.380	0.253	0.321	0.106	0.025	0.015	0.020	0.007	0.094	0.121	0.111	0.036
Ratio G.C.A./S.C.A.	54	126	0.315	0.846	1.015	0.842	1.070	2.254	4.461	3.853	5.872	6.869	7.882	9.137	10.328
G.C.A. x F./S x F.			0.757				0.824				2.888				7.258

Table (27) : Cont.

S.O.V.	D.F.		No. of Kernels/row				Weight of 100-kernel.				Grain yield/plant			
	S.	C.	40	80	120	Comb.	40	80	120	Comb.	40	80	120	Combined
G.C.A. (1)	7		12.271**	8.304**	11.001**	9.842**	8.179**	10.638**	12.221**	9.396**	197.429**	1105.143**	1422.214**	634.749**
S.C.A. (2)	20		5.369**	3.877**	6.593**	4.846**	16.665**	14.390**	17.617**	14.575**	964.546**	1237.883**	1295.700**	1009.151**
G.C.A. x fertilizer	-	14				6.859**				10.821**				1045.018**
S.C.A. x fertilizer	-	40				3.595**				17.048**				1244.489**
Error	54	162	0.787	1.032	0.664	0.276	0.679	0.996	1.055	0.303	33.252	56.704	59.938	16.655
Ratio G.C.A./S.C.A.			2.285	2.697	1.668	2.030	0.490	0.739	0.693	0.644	0.204	0.892	1.097	0.628
Ratio G.C.A. x S.C.A. x F.						1.907				0.634				0.839

* and ** Significant at the probability level of 5 % and 1 %, respectively.

(1) G.C.A. refers to general combining ability.

(2) S.C.A. refers to specific combining ability.

Table (29) : Estimates of general combining ability effects at the three nitrogen fertilizer levels as well as in the combined analysis in the first diallel set.

Parental	Ear length				Ear diameter				No. of rows/ear				No. of kernels/row			
	Kg. N/fed.				Kg. N/fed.				Kg. N/fed.				Kg. N/fed.			
	40	80	120	Comb.	40	80	120	Comb.	40	80	120	Comb.	40	80	120	Comb.
Moshtohor 28	0.510*	0.017	0.124	0.217	-0.204**	-0.149**	-0.151**	-0.168**	-0.422**	0.017	-0.289*	-0.231**	0.964**	1.704**	2.656**	1.774**
Moshtohor 44	-0.811**	-0.428*	-0.539*	-0.592**	-0.198**	-0.229**	-0.251**	-0.226**	-0.989**	-1.106**	-1.122**	-1.072**	-1.058**	-0.940*	-1.400**	-1.132**
Giza 307 - A	-0.307	-0.556**	-0.773 **	-0.554**	0.221**	0.104*	-0.029	0.098**	-0.039	-0.139	-0.800**	-0.326**	2.442**	1.710**	0.378	1.510**
Moshtohor 103	0.571*	0.728**	0.656**	0.651**	-0.027	0.101*	0.104	0.059	0.089	0.344*	0.411**	0.281**	-0.536	-0.762	0.061	-0.412*
Moshtohor 50	-0.375	-0.136	-0.038	-0.183	0.360**	0.367**	0.465**	0.397**	1.578**	1.506**	1.644**	1.576**	-1.558**	-0.524	-0.894**	-0.993**
Moshtohor 33	0.185	0.272	0.214	0.223	-0.057	0.056	0.060	0.019	0.294*	0.100	0.611**	0.335**	1.458**	0.588	0.622	0.889**
Moshtohor 41	-0.092	-0.014	0.161	0.018	-0.032	-0.177**	-0.107	-0.105**	-0.317**	-0.650**	-0.456**	-0.474**	-0.847*	-0.574	0.150	-0.423*
Moshtohor 70 C	0.319	0.117	0.195	0.210	-0.063	-0.072	-0.090	-0.075*	-0.194	-0.072	0.000	-0.088	-0.864*	-1.201*	-1.572**	-1.212**
L.S.D. 5 % $(\hat{g}_i - \hat{g}_j)$	0.719	0.586	0.660	0.368	0.184	0.142	0.164	0.094	0.358	0.405	0.388	0.214	1.034	1.185	0.951	0.594
L.S.D. 1 % $(\hat{g}_i - \hat{g}_j)$	0.962	0.784	0.883	0.483	0.246	0.190	0.219	0.124	0.479	0.542	0.520	0.281	1.384	1.585	1.272	0.779

* and ** Significant differences from zero at 5 % and 1 % levels of probability, respectively.

Table (29):Cont.

Parental	Weight of 100-kernel				Grain yield/plant			
	Kg. N/fed.				Kg. N/fed.			
	40	80	120	Comb.	40	80	120	Combined
Moshtohor 28	-0.569	-1.861**	-0.597	-1.009**	2.792	-8.944**	-8.125**	- 4.759**
Moshtohor 44	2.097**	2.306**	2.458**	2.287**	-9.653**	-15.722**	-10.625**	-12.000**
Giza 307 - A	-0.847*	-0.417	-1.986**	-1.083**	5.792*	- 0.389	-18.125**	-4.240**
Moshtohor 103	0.819*	0.806*	0.903*	0.842**	4.792*	24.222**	22.319**	17.111**
Moshtohor 50	-1.736**	-1.139**	-1.486**	-1.453**	2.458	16.333**	17.375**	12.055**
Moshtohor 33	0.042	-0.528	-0.431	-0.305	3.681	-2.333	13.486**	4.944**
Moshtohor 41	0.542	1.083**	0.736	0.787**	-6.431**	-3.722	- 3.847	- 4.667**
Moshtohor 70	-0.347	-0.250	0.403	-0.064	-3.431	-9.444**	-12.458**	- 8.444**
L.S.D. 5 % ($\hat{g}_i - \hat{g}_j$)	0.961	1.164	1.198	0.622	6.728	8.786	9.033	4.618
L.S.D. 1 % ($\hat{g}_i - \hat{g}_j$)	1.286	1.558	1.603	0.816	9.002	11.755	12.086	6.055

* and ** Significant differences from zero at 5 % and 1 % levels of probability, respectively.

Table (30) : Estimates of general combining ability effects at the three nitrogen levels as well as in the combined analysis in the second diallel set.

Parental	Ear-length	Ear-diameter		No. of rows/ear				Weight of 100-kernel				Grain yield / plant			
	Combined	120	Combined	40	80	120	Combined	40	80	120	Combined	40	80	120	Combined
Moshtohor 101	0.445*	-0.031	-0.032	0.092	-0.017	0.049	0.041	3.143**	1.029	0.410	1.527**	3.933	-9.562	-2.724	-2.784
" 54	-0.491*	-0.178*	-0.125*	0.032	0.070	-0.158	-0.018	-1.124*	-0.438	-1.257*	-0.940**	4.667	13.305*	-6.790	3.727
" 104	0.126	0.115	0.036	-0.034	0.130	0.115	0.070	0.943*	1.162*	2.210**	1.438**	15.133**	8.305	6.276	9.904**
" 103	0.493*	0.175*	-0.0.45	-0.334*	0.084	0.102	-0.105	0.610	0.895	3.610**	1.705**	-13.000**	29.305**	28.010**	14.771*
Giza 307 - A	-0.600**	-0.278**	-0.163**	-0.434*	-0.377	-0.838**	-0.549**	-1.524**	-1.505**	-1.924**	-1.651**	-14.067**	-37.762**	-18.990**	-23.606**
Moshtohor 50	-0.269	0.295**	0.316**	1.112**	1.056**	1.175**	1.114**	-1.190*	1.295*	-1.257*	-0.384	6.067	14.371*	11.076	10.504**
Giza 102	0.296	-0.098	-0.076	-0.434	-0.777**	-0.445**	-0.552**	-0.857**	-2.438**	-1.790**	-1.695**	-2.733	-17.962**	-16.857*	-12.517**
L.S.D. 5 % ($g_i - g_j$)	0.599	0.256	0.156	0.497	0.598	0.358	0.274	1.434	1.689	1.570	0.878	13.837	19.566	20.022	10.095
L.S.D. 1 % ($g_i - g_j$)	0.786	0.343	0.205	0.665	0.800	0.480	0.359	1.919	2.261	2.101	1.151	18.514	26.178	26.788	13.237

* and ** Significant differences from zero at 5 % and 1 % levels of probability respectively.

... studied at the three nitrogen fertilizer levels as well as in the combined analysis in the first diallel set.

No.	Crosses	No. of ears/plant	Ear length				Ear diameter				No. of rows/ear			
			Kg. N/fed.				Kg. N/fed.				Kg. N/fed.			
		Combined	40	80	120	Comb.	40	80	120	Comb.	40	80	120	Comb.
1	1 x 2	-0.023	0.710	0.711	1.169*	0.863**	0.387**	0.246*	0.302*	0.311**	0.787**	0.556	0.897**	0.746**
2	1 x 3	0.012	-0.395	0.172	-0.981*	-0.401	0.101	0.046	-0.054	0.031	-0.029	0.322	0.108	0.133
3	1 x 4	-0.025	-0.006	-0.444	0.590	0.046	-0.101	-0.017	-0.121	-0.079	-0.290	-0.161	-0.170	-0.207
4	1 x 5	-0.032	-1.726**	-0.914*	-0.716	-1.118**	-0.638**	-0.084	0.585**	-0.045	-0.179	-0.322	0.130	-0.123
5	1 x 6	-0.003	0.847	-0.056	-0.052	0.246	0.112	0.027	-0.343**	-0.068	0.504	0.483	-0.170	0.272
6	1 x 7	0.080**	0.524	0.631	-0.195	0.320	0.154	0.060	-0.176	0.012	-0.152	-0.167	-0.970**	-0.429**
7	1 x 8	-0.009	0.047	-0.100	0.184	0.043	-0.015	-0.278*	-0.193	0.162*	-0.640*	-0.711*	0.175	-0.392*
8	2 x 3	-0.023	0.793	-0.583	-0.850	-0.213	0.029	0.013	0.179	0.073	0.437	0.311	0.141	0.296
9	2 x 4	-0.005	-0.318	-0.667	-0.080	-0.355	-0.191	0.129	-0.154	-0.072	0.376	0.961**	0.197	0.511**
10	2 x 5	0.051*	1.428**	0.631	1.882**	1.313**	-0.044	-0.204	-0.382**	-0.210**	-1.346**	-1.333**	-0.903**	-1.194**
11	2 x 6	0.014	1.101*	0.522	0.929	0.850**	0.240	-0.026	0.357**	0.190**	-0.263	-0.261	1.397**	0.291
12	2 x 7	-0.010	-2.068**	-0.125	-1.265*	-1.152**	-0.599**	-0.460	-0.343**	-0.527**	-0.618*	-0.711*	-1.203**	-0.844**
13	2 x 8	-0.003	-1.646**	-0.489	-1.785**	-1.306**	0.179	0.302**	0.040	0.173*	0.626*	0.478	-0.525	0.193
14	3 x 4	-0.012	2.211**	2.294**	2.088**	1.210**	0.057	-0.004	0.090	0.047	0.193	0.261	0.341	0.265
15	3 x 5	-0.033	-1.410**	-0.858*	-0.485	-0.421	0.137	0.196	-0.071	0.087	0.704**	0.500	0.241	0.481**
16	3 x 6	-0.024	-0.337	0.117	0.296	0.160	-0.413	-0.360**	-0.198	-0.323**	-1.146**	-1.061**	-0.925**	-1.044**
17	3 x 7	-0.016	-0.993	-0.681	-0.551	-0.556*	-0.071	0.007	-0.032	-0.032	0.032	-0.144	0.141	0.009
18	3 x 8	0.098**	0.130	-0.761	0.482	0.041	0.160	0.102	0.085	0.115	-0.190	-0.189	-0.048	-0.142
19	4 x 5	0.036	0.546	-0.625	-2.247**	-0.775**	0.518**	0.266*	0.196	0.326**	0.310	0.017	-0.437	-0.036
20	4 x 6	0.030	-2.215**	-1.700**	-1.600**	-1.838**	-0.065	-0.090	0.135	-0.006	-0.074	-0.378	-0.203	-0.218
21	4 x 7	0.012	-0.004	-0.081	0.287	0.067	0.242	-0.056	0.035	0.073	0.071	-0.361	0.930**	0.213
22	4 x 8	-0.035	-0.215	0.922**	0.963	0.556*	-0.460**	-0.228*	-0.182	-0.290**	-0.585*	-0.339	-0.659*	-0.527**
23	5 x 6	0.022	0.218	0.964*	0.471	0.551*	0.149	0.110	-0.293*	-0.011	1.104**	1.028**	0.230	0.787**
24	5 x 7	-0.015	0.145	0.950*	1.381**	0.825**	-0.144	-0.123	-0.060	-0.109	-0.618*	0.178	0.497	0.019
25	5 x 8	-0.030	0.798	-0.147	-0.286	0.121	0.021	-0.162	0.024	-0.039	0.026	-0.067	0.241	0.066
26	6 x 7	-0.034	0.948	-0.558	-0.072	0.106	0.140	0.322**	0.346**	0.269**	0.198	0.283	-0.270	0.070
27	6 x 8	-0.004	-0.562	0.711	0.028	0.059	-0.163	0.016	-0.004	-0.050	-0.324	-0.094	-0.059	-0.159
28	7 x 8	-0.015	1.448**	-0.136	0.414	0.575*	0.279*	0.249*	0.229	0.252**	1.087**	0.922**	0.875**	0.961**
L.S.D. 5 % ($S_{ij} - S_{ik}$)		0.066	1.608	1.311	1.477	0.823	0.412	0.318	0.367	0.211	0.801	0.905	0.869	0.480
L.S.D. 1 % ($S_{ij} - S_{ik}$)		0.087	2.151	1.754	1.976	1.080	0.551	0.426	0.491	0.277	1.071	1.212	1.163	0.629
L.S.D. 5 % ($S_{ij} - S_{kl}$)		0.059	1.438	1.173	1.321	0.736	0.368	0.284	0.328	0.189	0.716	0.810	0.777	0.429
L.S.D. 1 % ($S_{ij} - S_{kl}$)		0.078	1.924	1.569	1.767	0.966	0.493	0.381	0.439	0.248	0.958	1.084	1.040	0.563

* and ** Significant differences from zero at 5 % and 1 % levels of probability, respectively.

Table (31) : Cont.

No.	Crosses	No. of kernels/row				Weight of 100-kernel				Grain yield/plant			
		Kg. N/fed.				Kg. N/fed.				Kg. N/fed.			
		40	80	120	Comb.	40	80	120	Comb.	40	80	120	Combined
1	1 x 2	2.016*	1.978*	1.297	1.763**	3.984**	2.008	0.627	2.206**	36.349**	49.809**	41.786**	42.648**
2	1 x 3	1.716*	0.228	-1.048	0.298	-5.738**	-7.603**	-6.929**	-6.756**	-30.767**	-43.524**	-31.714**	-35.333**
3	1 x 4	-2.706**	-1.633	0.636	-1.234**	-1.071	-0.825	-1.484	1.126*	-3.095	6.865	3.175	2.315
4	1 x 5	0.383	1.928*	4.325**	2.212**	1.151	2.119*	3.571**	2.280**	-17.429**	-22.579**	2.786	-12.407**
5	1 x 6	2.066**	-0.183	-0.959	0.308	1.040	1.841*	0.849	1.243**	16.016**	23.754**	- 1.325	12.815**
6	1 x 7	1.362	-0.556	-1.620*	-1.179**	3.206**	3.230**	3.016**	3.150**	4.127	1.476	- 1.659	1.314
7	1 x 8	-2.112**	-1.761*	-2.631**	-2.168**	-2.571**	-0.770	0.349	-0.997*	-5.206	-15.802*	-13.048	-11.352**
8	2 x 3	2.938**	1.606	2.475**	2.339**	-2.738**	-2.770**	-2.651**	-2.719**	8.016	5.587	1.119	4.907
9	2 x 4	-0.417	-0.322	-0.475	-0.404	-3.738**	-0.659	1.460	-0.979*	-23.317**	-2.357	-4.659	-10.111**
10	2 x 5	-1.162	-2.528**	-0.487	-1.392**	4.817**	3.952**	4.183**	4.317**	15.016**	-15.468*	1.952	0.500
11	2 x 6	-1.679*	-0.539	2.063**	-0.051	0.040	2.341**	1.460	1.280**	-10.540**	2.532	45.841**	12.611**
12	2 x 7	-1.606*	-0.844	-4.331**	-2.260**	-5.127**	-6.270**	-5.040**	-5.479**	-41.429**	-53.413**	-74.825**	-56.555**
13	2 x 8	-0.090	0.650	-0.542	0.006	2.762**	1.397	-0.040	1.373**	15.905**	13.309*	-11.214	6.000
14	3 x 4	3.016**	3.828**	2.414**	3.086**	8.540**	7.063**	7.238**	5.528**	63.571**	56.976**	66.508**	62.351**
15	3 x 5	-4.662**	-2.211*	-2.198**	-3.023**	-6.905**	-3.659**	-8.373**	-6.312**	-53.429**	-29.802**	-57.214**	-46.815**
16	3 x 6	0.921	1.378	1.252	1.183**	0.651	-0.937	0.905	0.206	0.016	-12.135	- 7.992	- 6.703
17	3 x 7	-3.206**	-3.228**	-2.342**	-2.925**	3.151**	5.452**	7.071**	5.224**	-1.873	17.254**	16.341*	10.574**
18	3 x 8	-0.723	-1.600	-0.553	-0.958*	3.040**	2.452**	2.738**	2.743**	14.460**	5.643	12.952	11.018**
19	4 x 5	1.449	1.161	-4.348**	-0.579	3.429**	1.119	0.071	1.539**	23.238**	53.921**	7.675	28.278**
20	4 x 6	-1.934*	-2.517**	-1.898**	-2.116**	-2.349**	-0.825	-0.317	-1.163*	-15.651**	-38.746**	-30.437**	-28.278**
21	4 x 7	1.705*	0.411	3.041**	1.719**	-1.849*	-2.770**	-4.817**	-3.145**	-0.206	-24.024**	- 7.770	-10.666**
22	4 x 8	-1.112	-0.928	0.630	-0.470	-2.960**	-2.103**	-2.151*	-2.738**	-44.540**	-52.635**	-34.492**	-43.889**
23	5 x 6	0.821	-0.089	-0.609	0.041	1.206	-0.214	1.071	0.687	35.349**	16.810*	12.175	21.444**
24	5 x 7	1.227	1.772*	3.464**	2.154**	-2.294**	-1.492	-1.095	-1.627**	-0.540	9.865	39.508**	16.277**
25	5 x 8	1.944*	-0.033	-0.148	0.587	-1.405	-1.825*	0.571	-0.886	-2.206	-12.746	-6.881	-7.277*
26	6 x 7	0.477	0.361	-0.653	0.061	0.595	-1.103	-0.817	-0.441	-3.429	- 2.802	-21.270**	- 9.167**
27	6 x 8	-0.673	1.589	0.802	0.572	-1.183	-1.103	-3.151**	-1.812**	-21.762**	10.587	3.008	- 2.722
28	7 x 8	2.766**	2.083*	2.441**	2.430**	2.317**	2.952**	1.683	2.317**	43.349**	51.643**	49.675**	48.222**
L.S.D. 5 % ($S_{ij} - S_{ik}$)		2.314	2.650	2.126	1.329	2.150	2.604	2.680	1.392	15.045	19.647	20.199	10.326
L.S.D. 1 % ($S_{ij} - S_{ik}$)		3.096	3.546	2.845	1.743	2.867	3.484	3.586	1.826	20.129	26.286	27.026	13.540
L.S.D. 5 % ($S_{ij} - S_{kl}$)		2.069	2.370	1.902	1.188	1.923	2.329	2.397	1.245	13.456	17.572	18.067	9.236
L.S.D. 1 % ($S_{ij} - S_{kl}$)		2.769	3.171	2.544	1.559	2.573	3.116	3.207	1.633	18.004	23.511	24.172	12.110

Table (32) : Estimates of specific combining ability effects for the crosses studied at the three nitrogen fertilizer levels as well as in the combined analysis in the second diallel set.

No.	Crosses	Ear-length		Ear diameter	No. of rows/ ear		No. of kernels /row	Weight of 100-kernel				Grain yield / plant			
		80	Combined	120	120	Combined	40	40	80	120	Combined	40	80	120	Combined
1	1 x 2	-0.702	-0.819*	0.244	0.256	0.141	0.909	-2.844**	-0.178	3.689**	0.222	-12.600	-6.822	9.911	-3.170
2	1 x 3	1.271*	0.980*	0.084	0.449	0.374*	-1.111	6.089**	-2.444*	-1.778	0.622	10.933	22.178	11.844	14.985*
3	1 x 4	-0.756	-0.004	-0.042	-0.038	-0.160	-2.051	0.756	0.489	-0.844	0.133	-1.263	-37.155**	-46.889**	-28.437**
4	1 x 5	0.431	0.157	0.278	0.136	-0.105	0.056	1.222	1.889	4.356**	2.489**	0.800	10.244	12.778	7.940
5	1 x 6	0.311	0.092	-0.696	-1.211	0.614**	-0.838	0.889	4.422**	-2.978**	0.777	8.667	8.111	- 3.622	4.385
6	1 x 7	-0.556	-0.406	0.131	0.409	0.364*	3.036*	-6.111**	-4.178**	-2.444*	-4.244**	- 6.533	3.444	15.978	4.296
7	2 x 3	0.258	0.611	-0.036	0.056	-0.153	0.702	1.689	3.022**	-1.778	0.977	-4.800	-16.355	- 3.756	- 8.303
8	2 x 4	1.031	0.665	0.004	-0.264	-0.001	2.196	-0.978	-2.711*	-2.511*	-2.066**	16.000	38.645**	-31.822	7.607
9	2 x 5	-0.116	0.204	-0.576**	-1.124**	-0.334	-1.031	4.822**	4.356**	0.689	3.289**	20.067*	- 1.955	5.844	7.985
10	2 x 6	-1.036	-0.237	0.518**	1.329**	0.779**	0.676	1.156	-0.778	3.356**	1.244*	11.600	- 3.089	38.111**	15.540*
11	2 x 7	0.564	-0.425	-0.156	-0.251	-0.432*	-3.451*	-3.844**	-3.711**	-3.444**	-3.666**	-30.267**	-10.422	-18.289	-19.659**
12	3 x 4	-2.596**	-2.173**	0.078	-0.271	-0.411*	-2.658	-3.044**	1.022	0.022	-0.666	-44.467**	-29.022*	- 6.222	-26.570**
13	3 x 5	0.258	0.321	-0.169	-0.231	0.144	1.882	-2.578**	-3.244**	0.556	-1.755**	10.267	10.711	-10.555	3.474
14	3 x 6	1.338*	0.701	-0.042	0.256	0.179	2.189	0.089	0.622	0.889	0.533	29.133**	21.245	0.378	16.918*
15	3 x 7	-0.529	-0.442	0.084	-0.258	-0.132	-1.004	-2.244*	1.022	2.089*	0.289	-1.067	- 8.756	8.311	- 0.504
16	4 x 5	0.764	0.409	0.104	0.516*	0.163	0.409	-2.244*	-1.311	0.489	-1.022	-20.933*	-23.955	49.711**	1.607
17	4 x 6	0.111	-0.111	0.098	-0.131	-0.178	2.249	2.422*	-0.778	0.822	0.822	25.600**	24.911	16.311	22.274**
18	4 x 7	1.444*	1.212**	-0.242	0.189	0.588**	-0.144	3.089**	3.289**	2.022	2.800**	25.067**	26.578*	18.911	23.518**
19	5 x 6	-0.569	-0.799*	0.151	0.276	0.177	-3.578*	-7.444**	-4.378**	-4.978**	-5.600**	-49.000**	-17.689	-42.002**	-36.237**
20	5 x 7	-0.769	-0.293	0.211	0.429	-0.045	2.262	6.222**	2.689*	-1.111	2.600**	38.800**	22.644	-15.756	15.229*
21	6 x 7	-0.156	0.353	-0.029	-0.518*	-0.343	-0.698	2.889**	0.889	2.889**	2.222*	-26.000**	-33.489*	- 9.156	-22.881**
L.S.D. 5 % $(S_{ij} - S_{ik})$		1.914	1.199	0.512	0.717	0.548	4.220	2.869	3.379	3.141	1.756	27.675	39.132	40.044	20.190
L.S.D. 1 % $(S_{ij} - S_{ik})$		2.561	1.572	0.686	0.960	0.719	5.647	3.839	4.522	4.202	2.303	37.028	52.357	53.577	26.474
L.S.D. 5 % $(S_{ij} - S_{kl})$		1.657	1.038	0.444	0.621	0.475	3.655	2.485	2.927	2.720	1.521	23.967	33.889	34.679	17.485
L.S.D. 1 % $(S_{ij} - S_{kl})$		2.218	1.361	0.594	0.831	0.623	4.890	3.324	3.916	3.639	1.994	32.067	45.342	46.399	22.927

3. Association Studies

3.1. First Diallel Set :

3.1.1. Simple phenotypic correlations :

Simple correlation coefficients between grain yield/plant and each of its components i.e. number of rows/ear, number of kernels/row and 100-kernel weight were computed on the 28 hybrids at 40, 80 and 120 Kg N/fed. (Table 33). The phenotypic association between these main components was also included.

Significant positive phenotypic correlation values were detected between grain yield/plant and each of its components at 120 Kg N/fed. and each of number of rows/ear and 100-kernel weight at 80 Kg N/fed., and 100-kernel weight at 40 Kg N/fed. This result indicates that selection for one or more of these components would be accompanied by high grain yield/plant. Generally, these correlations indicate that the associations between grain yield and other traits were different from nitrogen level to another. The significant hybrid X nitrogen level interaction for yield would suggest that selection of genotypes will be varied under different nitrogen levels. Although it is diffecult to prove the need for separate breeding program unique set of environment. The results from this study indicate that the development and testing of genotypes interested for 120 Kg N/fed. should be practiced for maximum progress. The present results are in agreement with those obtained by; Mohamed (1984), Nawar et al. (1984), El-Hosary et al. (1989) and Sary et al. (1990) for number of rows/ear, number of kernels/row and 100-kernel weight. El-Marakby (1964), Shaher (1982) and Eraky et al. (1983) for number of kernels/row and 100-kernel weight. Mohamed and Yasien (1987) for number of rows/ear.

3.1.2. Linear regression :

The relative contributions of the three characters in grain yield using multiple linear regression analysis for each nitrogen level are presented in Table (34).

The 100-kernel weight was the most important trait in determining grain yield/plant at 40 Kg N-level. While, the number of rows/ear and 100-kernel weight were the important traits in determining grain yield/plant, followed by number of kernels/row at 80 and 120 Kg N/fed.

3.1.3. Path coefficient analysis :

To calculate path coefficient, simple correlation coefficients were made between all possible pairs of the following characters; grain yield/plant, number of rows/ear, number of kernels/row and 100-kernel weight (Table 35). The nature of the interrelated variables system used in connection with grain yield/plant is represented diagrmatically in Figure (1). Partitioning of simple correlation coefficients between grain yield/plant and some of other yield components in the three nitrogen levels are presented in Table (35).

Number of rows/ear had a high and positive direct effect on yield by value of 0.321, 0.648 and 0.656 at 40, 80 and 120 Kg N/fed., respectively. While, it is indirect effect was not important through number of kernels/row in three levels of nitrogen and/or 100-kernel weight in three nitrogen levels.

Number of kernels/row had a positive direct effect on yield at the three nitrogen levels. Small indirect effect through number of rows/ear or 100-kernels weight were reached at the three nitrogen levels.

Weight of 100-kernel had a large and positive direct effect on grain yield/plant at the three nitrogen levels.

The coefficients of determination were calculated for the direct and indirect effects of the three yield factors studied, transformed into percentages in order to evaluate these factors according to their importance as sources of variation in plant yield results presented in descending order shown in Table (36). The results revealed that the most important sources of variation for plant yield were: The direct effect of 100-kernel weight, direct effect of number of rows/ear and number of kernels/row at the three nirogen levels.

These the three sources account for approximately 28.8, 95.52 and 84.94 at 40, 80 and 120 Kg N/fed., respectively. This result concide with the result in (Table 34). Therefore, it could be concluded that selection program for grain yield based upon number of rows/ear, 100-kernel weight and number of kernels/row would be fruitful. These characters were positively correlated with grain yield.

In this connection, Mohamed (1984) reported that the most important sources of varation in plant yield was the direct effect of number of kernels/row and its indirect through weight of 100-kernel, since these sources along account for approximately 63.5% and 67.4% of grain yield variation in the early and late seasons, respectively.

The direct contribution of 100-kernel weight was 9.27 % and 7 % of the variationof grain yield at the early and late seasons, respectively. Noureldin et al. (1984) indicated that the both direct and indirect effect of characters on grain yield could be arranged in descending order as follows: number of kernels/row, weight of 100-kernel and number of rows/ear. El-Hosary et al. (1989) found that the most important sources of variation for plant yield (71.63 %) in the first set were: direct effect of 100-kernel weight, direct effect of number of rows/ear, and indirect effect of number of kernels/row through 100-kernel weight. While, in the second set, the main sources of variation (61.88 %) were: direct effect of number of rows/ear, direct effect of number of kernels/row, and the indirect effect of number of rows/ear via number of kernels/row.

3.2. Second Diallel Set :

3.2.1. Simple phenotypic correlations :

The simple correlation coefficient between individual plant yield and each of the main components i.e.,number of rows/ear, number of kernels/row and 100-kernel weight and between each other, were calculated within each nitrogen levels. Studying the association between plant yield and main yield components gives very useful information to the plant breeder who wants to incorporate desirable components.

Table (37) shows significant positive phenotypic correlation values were found between grain yield/plant and number of rows/ear at 80 Kg N/fed. and number of kernels/row at 40 Kg N/fed.; and 100-kernel weight at 40 and 120 Kg N/fed. The present results are in agreement with those obtained by; Mohamed (1984), Nawar (1984), El-Hosary et al. (1989) and Sary et al. (1990) for number of rows/ear, number of kernels/row and 100-kernel weight. El-Marakby (1964), Shaher (1982) and Eraky et al. (1983) for number of kernels/row and 100-kernel weight. Mohamed and Yasien (1987) for number of rows/ear.

3.2.2. Linear regression :

The relative contributions of the three characters in grain yield using multiple linear regression analysis for each nitrogen level are presented in Table (38).

100-kernel weight was the most important trait in determining grain yield/plant at 40 and 120 Kg N/fed. While, the number of rows/ear was the important trait at 80 Kg N/fed. and it the second and third one at 120 and 40 Kg N/fed., respectively.

Number of kernels/row was the second important trait in determining grain yield/plant at 40 and 80 Kg N/fed.

3.2.3. Path coefficient analysis :

Partitioning of simple correlation coefficients between grain yield and some other yield components in the three nitrogen levels are presented in Table (39).

Number of rows/ear had the most direct effect on yield by values 0.382, 0.405 and 0.389 at 40, 80 and 120 Kg N/fed., respectively. Also, its indirect effects are important through 100-kernel weight at 120 Kg N/fed.

Number of kernels/row had a large and positive direct effect on yield by 0.456 and 0.383 at 40 and 80 Kg N/fed., respectively. The highest indirect effects were found through 100-kernel weight at 120 Kg N/fed.

100-kernel weight had a large and positive direct effect on yield by values of 0.541, 0.59 at 40 and 120 Kg N/fed., respectively. Whereas, it had a positive direct effect on yield by (0.279) at 80 Kg N/fed. Also, it indirect effects are important through number of rows/ ear at 80 Kg N/fed.

The coefficients of determination were calculated for the direct and indirect effects of the three yield factors studied and transformed into percentages in order to evaluate these factors as to their importance as sources of variation in plant yield. The component in percent for grain yield variation in the three nitrogen levels are presented in Table (40). From this table, it could be concluded that the most important sources of variation in plant yield are :

(1) The direct effect of 100-kernel weight at 40 and 120 Kg N/fed. followed by direct effect at number of kernels/row and number of rows/ear at 40 and 120 Kg N/fed., respectively and then by number of rows/ear at 40 Kg N/fed.

(2) The direct effect of number of rows/ear followed number of kernels/ row and then by 100-kernel weight at 80 Kg N/fed.

The direct effect for the three yield components studied alone account for approximately 64.65 and 38.83 % at 40 and 80 Kg N/fed., respectively of grain yield/plant variation. While, the direct

Table (33) : Simple correlation coefficients among four characters studied at the three nitrogen fertilizer levels in the first diallel set.

Characters	40 Kg. N/fed.			80 Kg. N/fed.			120 Kg. N/fed.		
	No. of rows/ear	No. of kernels/ row	Weight of 100- kernel	No. of rows/ear	No. of kernels/ row	Weight of 100- kernel	No. of rows/ear	No. of kernels/ row	Weight of 100- kernel
Grain yield	0.2565	0.2829	0.3459*	0.5202**	0.2863	0.4981**	0.6101**	0.3832**	0.4893**
No. of rows/ear		0.0425	-0.1975		0.1625	-0.2472		0.1625	-0.1538
No. of kernels/row			0.1578			-0.1071			0.0075
Weight of 100-kernel									

* and ** Significant probability levels at 5 % and 1 %, respectively.

Table (34) : The relative contributions of 3 characters in grain yield using multiple linear regression analysis at the nitrogen fertilizer levels in the first diallel set.

Characters	40 Kg N/fed.			80 Kg N/fed.			120 Kg N/fed.		
	Regression coefficient	Standard error	Relative R^2% contribution	Regression coefficient	Standard error	Relative R^2% contribution	Regression coefficient	Standard error	Relative R^2% contribution
No. of rows/ear	12.857	7.1165	11.97	20.2748	3.3158	60.90**	18.9962	2.7618	66.34**
No. of kernels/row	3.459	2.9155	5.54	3.9364	1.5990	20.16*	3.5760	1.2388	25.77**
Weight of 100-kernel	4.364	2.0902	15.37*	6.4927	0.9965	63.88**	5.3236	0.8522	61.92**
Y - intercept =	-273.2212			-481.2237			-400.8146		
Standard error of set. =	39.9086			18.3332			17.6104		
Adjusted R squared =	0.1811			0.7206			0.7666		
R squared =	0.2721			0.7517			0.7925		
Multiple R =	0.5217			0.8670			0.8902		

*, ** Significant at 5 %, 1 % Prob. respectively.

$$\hat{y} = a_0 + b_1 x_1 + b_2 x_2 + b_3 x_3$$

$$y = 273.2212 + 12.857 x_1 + 3.459 x_2 + 4.364 x_3$$

$$y = -481.2237 + 20.2748 x_1 + 3.9364 x_2 + 6.4927 x_3$$

$$y = -400.8146 + 18.9962 x_1 + 3.576 x_2 + 5.3236 x_3$$

Table (35) : Partitioning of simple correlation coefficients between grain yield and some other yield components at the three nitrogen fertilizer levels in the first diallel set.

Sources	Correlation Kg. N/fed. 40	80	120
I. Grain yield V_s number of rows per ear :			
Direct effect	0.321	0.648	0.656
Indirect via number of kernels per row	0.009	0.041	0.044
Indirect via weight of 100-kernel	-0.074	-0.169	-0.090
Total correlation (r_{y_3})	0.256	0.520	0.610
II. Grain yield V_s number of kernels per row :			
Direct effect	0.210	0.254	0.272
Indirect via number of rows per ear	0.013	0.106	0.107
Indirect via weight of 100-kernel	0.059	-0.074	0.004
Total correlation (r_{y_4})	0.282	0.286	0.383
III. Grain yield V_s weight of 100-kernel :			
Direct effect	0.375	0.685	0.588
Indirect via number of rows per ear	-0.063	-0.160	-0.101
Indirect via number of kernels per row	0.033	-0.027	0.002
Total correlation (r_{y_5})	0.345	0.498	0.489

Figure (1)

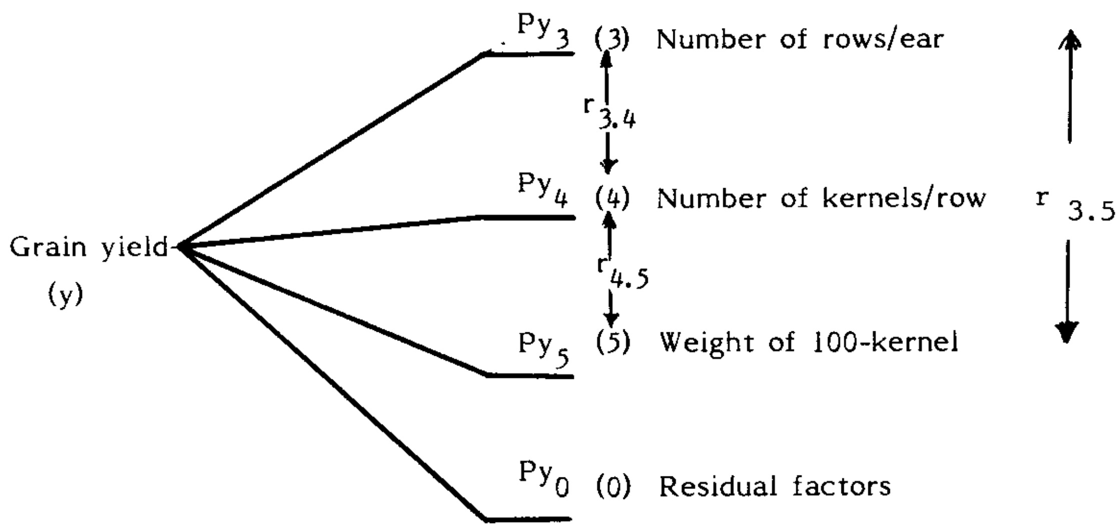

Figure (1) : Apth diagram and coefficients of factors influencing individual grain yield/plant.

P = Path coefficient.

r = Simple correlation coefficient.

Py_3, Py_4 ... etc. = Path coefficient of number of rows/ear (X_3), number of kernels/row (X_4) .. etc. on individual grain yield (y).

$r_{3.5}$ = Simple correlation between number of rows/ear (X_3) and weight of 100-kernel (X_5).

Table (36) : The components in percent for grain yield variation at the three nitrogen fertilizer levels in the first diallel set.

Source of variation		Coefficients of determination	Percentage contributed
	40 Kg. N/fed.		
1.	Weight of 100-kernel	0.1406	14.06
2.	Number of rows/ear	0.1030	10.30
3.	Number of rows/ear X weight of 100-kernel	-0.0475	-4.75
4.	Number of kernels/row	0.0443	4.43
5.	Number of kernels/row X weight of 100 kernel	0.0248	2.48
6.	Number of rows/ear X number of kernels/row	0.0057	0.57
7.	Residual factors	0.6341	63.41
	Total	1.0000	100.00
	80 Kg. N/fed.		
1.	Weight of 100-kernel	0.470	47.01
2.	Number of rows/ear	0.4204	42.04
3.	Number of rows/ear X weight of 100-kernel	-0.2198	-21.98
4.	Number of kernels/row	0.0647	6.47
5.	Number of rows/ear X number of kernels/row	0.0535	5.35
6.	Weight of kernels/row X weight of 100-kernel	-0.0373	-3.73
7.	Residual factors	0.2483	24.83
	Total	1.0000	100.0
	120 Kg. N/fed.		
1.	Number of rows/ear	0.4303	43.03
2.	Weight of 100-kernels	0.3445	34.45
3.	Number of rows/ear X weight of 100-kernel	-0.1184	-11.84
4.	Number of kernels/row	0.0745	7.45
5.	Number of rows/ear X number of kernel/row	0.0581	5.81
6.	Number of kernels/row X weight of 100-kernel	0.0023	0.23
7.	Residual factors	-0.0284	-2.84
	Total	1.0000	100.00

Table (37) : Simple correlation coefficients among four characters studied at the three nitrogen fertilizer levels on the second diallel set.

Characters	40 Kg N/fed.			80 Kg N/fed.			120 Kg N/fed.		
	No. of rows/ear	No. of kernels/row	Weight of 100-kernel	No. of rows/ear	No. of kernels/row	Weight of 100-kernel	No. of rows/ear	No. of kernels/row	Weight of 100-kernel
Grain yield	0.3423	0.5341**	0.5816**	0.511**	0.3613	0.3092	0.5094	0.1719	0.6684**
No. of rows/ear		-0.0042	-0.0712		0.0838	0.2656		0.0869	0.2029
No. of kernels/row			0.1468			-0.2011			0.2710
Weight of 100-kernel									

** Significant at the probability level of 1 %.

Table (38) : The relative contributions of 3 characters in grain yield using multiple linear regression analysis at the three nitrogen fertilizer levels in the second diallel set.

Characters	40 Kg N/fed.			80 Kg N/fed.			120 Kg N/fed.		
	Regression coefficient	Standar error	Relative R^2% contribution	Regression coefficient	Standar error	Relative R^2% contribution	Regression coefficient	Standar error	Relative R^2% contribution
No. of rows/ear	13.820	5.243	29.01**	17.227	8.156	20.79*	12.863	5.206	26.42*
No. of kernels/row	5.487	1.678	38.62**	9.755	4.800	19.54*	-0.337	2.319	00.12
Weight of 100-kernel	3.476	0.810	46.77**	3.011	2.106	10.73	5.043	1.386	43.80**
Y-intercept =		-318.814			-494.358			-137.368	
Standard error of set =		16.763			28.954			21.524	
Adjusted R squared =		0.619			0.331			0.521	
R squared =		0.676			0.432			0.593	
Multiple R =		0.822			0.657			0.770	

*, ** Significant at 1 %, 5 % prop. respectively.

$$\hat{y} = a_0 + b_1 x_1 + b_2 x_2 + b_3 x_3$$

$$y = -318.814 + 13.820 X_1 + 5.487 x + 3.476 x_3$$

$$y = 494.358 + 17.277 X_1 + 9.755 x_2 + 3.011 X_3$$

$$y = -137.368 + 12.836 x_1 + (-0.337) x_2 + 5.043 X_3$$

Table (39) : Partitioing of simple correlation coefficients between grain yield and some other yield components in the second diallel set.

Sources	Correlation Kg. N/fed. 40	80	120
I. Grain yield V_s number of rows per ear :			
Direct effect (Py_3)	0.382	0.405	0.389
Indirect via number of kernels per row	-0.002	0.032	0.002
Indirect via weight of 100-kernel	-0.038	0.074	0.118
Total correlation (r_{y_3})	0.342	0.511	0.509
II. Grain yield V_s number of kernels per row:			
Direct effect	0.456	0.383	0.016
Indirect via number of rows per ear	-0.001	0.034	0.034
Indirect via weight of 100-kernel	0.079	-0.056	0.121
Total correlation (r_{y_4})	0.534	0.361	0.171
III. Grain yield V_s weight of 100-kernel :			
Direct effect	0.541	0.279	0.585
Indirect via number of rows per ear	-0.027	0.107	0.079
Indirect via number of kernels per row	0.067	-0.077	0.004
Total correlation (r_{y_5})	0.581	0.309	0.668

Table (40) : The components in percent for grain yield variation at the three nitrogen fertilizer levels in the second diallel set.

Source of variation	Coefficient of determination	Percentage contributed
40 Kg. N/fed.		
1. Weight of 100-kernel	0.2928	29.28
2. Number of kernels/row	0.2079	20.79
3. Number of rows/ear	0.1459	14.59
4. Number of kernels/row X weight of 100-kernel	0.0724	7.24
5. Number of rows/ear X weight of 100-kernel	-0.0294	-2.94
6. Number of rows/ear X number of kernels/row	-0.0015	-0.15
7. Residual factors	0.2501	25.01
Total	1.0000	100.00
80 Kg. N/fed.		
1. Number of rows/ear	0.1635	16.35
2. Number of kernels/row	0.1470	14.70
3. Weight of 100-kernel	0.0779	7.79
4. Number of rows/ear X weight of 100-kernel	0.0599	5.99
5. Number of kernels/row X weight of 100-kernel	-0.0430	-4.30
6. Number of rows/ear X number of kernels/row	0.0260	2.60
7. Residual factors	0.4827	48.27
Total	1.0000	100.00
120 Kg. N/fed.		
1. Weight of 100-kernel	0.3423	34.23
2. Number of rows/ear	0.1513	15.13
3. Number of rows/ear X weight of 100-kernel	0.0923	9.23
4. Number of kernels/row X weight of 100 kernel	0.0051	0.51
5. Number of rows/ear X number of kernels/row	0.0011	0.11
6. Number of kernels/row	0.0003	0.03
7. Residual factors	0.4077	40.77
Total	1.0000	100.0

effect for 100-kernel weight and number of rows/ear account for approximately 49.357 % at 120 Kg N/fed. Other important sources of grain yield were the indirect effects of number of rows/ear X 100-kernel weight at 80 and 120 Kg N/fed. and number of kernels/row X 100-kernel weight at 40 Kg N/fed. Other sources in variation are negligible as shown in Table (40). Such apparent contradiction in results could be attributed to different environmental effects on genotypes. The results obtained for this analysis agree to some extent with those of multiple linear regression analysis presented in Table (38). In this connection, Sary et al. (1990) found that the most important sources of variation in plant yield were the direct effect of number of kernels/row and its indirect effect through number of rows/ear and through 100-kernel weight. These the three sources alone account for approximately 82.18 % and 63.03 % at the early and late planting dates, respectively.

4. Prediction of Double Cross Yield

Prediction of double cross yield helps the plant breeder to choose the best double cross in hybrid maize programe. Mohamed (1984) reported good correlation between the prediction and the actual double crosses yield.

In the first diallel cross set 210 double crosses will be obtained. The results indicated that the best eleven double crosses were : (1x3) (2x4), (1x3) (4x6), (1x5) (2x4), (1x5) (4x6), (2x4) (3x5), (3x5) (4x6), (3x5) (4x7), (3x5) (4x8), (3x7) (4x8), (4x6) (5x7) and (4x8) (5x7) at 40, 80 and 120 Kg N/fed. as well as the combined data. Moreover, these crosses significantly out-yield the check hybrid variety (D.C. 204) by 11.68, 17.73, 14.77 and 14.85 % at 40, 80 and 120 Kg N/fed. as well as the combined data, respectively.

In the second diallel set 105 double crosses will be obtained. The results indicated that the best seven double crosses were: (1x4) (2x6), (1x6) (3x4), (1x6) (2x3), (2x3) (4x6), (2x6) (3x4), (3x4) (6x7) and (3x7) (4x6) over the three nitrogen levels. Moreover, these crosses significantly out-yield the check variety (D.C. 204) by 7.32, 17.07, 6.54 and 11.51 % at 40, 80 and 120 kg N/fed. as well as the combined data, respectively. Hence, it could be concluded that these previous double crosses offer a possibility for increasing grain yield of maize especially at 80 Kg N/fed. The single crosses (3x4), (4x5), (5x6) and (7x8) in the first set, and (4x6), (3x6), (2x6) and (2x4) in the second set were the best hybrids for using as females in preduction of double crosses where they gave the highest grain yield mean values. Moreover, the differences between dates of tasseling and silking among these single crosses were small revealing the possibility of double cross production for the practical use.