GENETICAL ANALYSIS OF SOME ECONOMIC TRAITS IN FLAX (*Linum usitatissimum* L.)

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ABESTRACT: *The main objectives of the present study are to evaluate six different flax genotypes [P_1 (Giza 8), P_2 (Sakha 2), P_3 (Sakha 4), P_4 (Ilona), P_5 (S. 22) and P_6 (Sakha 3)] and their F_1 crosses (including the reciprocal crosses) under three different nitrogen levels (30, 45 and 60 kg Nitrogen/faddan). Data were recorded on days to maturity, seed yield per plant (gm), seed index, straw yield/plant and oil %. The magnitude of both general and specific combining abilities were estimated for all traits, but gene action effects and genetically graphical analysis were done only for the two later traits. The obtained data revealed that the most desirable and/or highest mean performances for all parents and crosses were defined in all traits studied under the three nitrogen levels and their combined data.*

The mean squares associated with general (G.C.A) and specific (S.C.A) combining ability effects were found to be highly significant for most studied traits in the three nitrogen levels and their combined data, this mean the importance role of both (G.C.A) and (S.C.A) effects controlling in the inheritance of all traits, but the first one were the greatest one. Based on the combined data, the best general combiners were detected in the parental cultivar Ilona (P_4) for days to maturity; in Sakha 2 (P_2) for straw yield/plant, seed index and seed yield per plant and in S. 22 (P_5) for oil %. Also, based on the combined data of specific combining ability, the most desirable and/or highest values were defined in five crosses (P_3 x P_4, P_3 x P_5, P_2 x P_1, P_4 x P_6 and P_6 x P_4) for straw yield/plant, and in two crosses (P_1 x P_3 and P_4 x P_1) for oil %.The analysis of gene action effects for straw yield/plant and oil % showed that the additive variances (D) and dominance components ($\hat{H}1$) were significant for the two traits studied in the three nitrogen fertilizing levels. Also, the ratios of recessive and dominant genes for both traits were markedly differed in each parents under the different nitrogen levels. Degrees of partial dominance, complete dominance and over dominance effects were also sharply differed under the three nitrogen levels for both traits.

In general, the third nitrogen level (60 kg N/faddan) gave the highest and/or the most desirable mean performances and different genetic components for most studied traits. 60 and 30 kg N/faddan gave the maximum gain for straw yield and oil %, respectively.

keywords: *Flax breeding, combining abilities and gene action analysis.*

INTRODUCTION

Flax was the chief fiber crop in Egypt before the growing cotton on a commercial scale; it is grown as a dual purpose crop for both fiber and oil. Flax fiber and oil are used for industrial and textile purposes. Both products play prominent role in Egyptian national economy as an export as well as local products. In Egypt, the gap between the production oil and local requirements increased, because it is difficult to increase flax area due to great competition from the other winter crops. The gab could be minimized partly by increasing flax yield per unit area through planting high-yielding cultivars and by optimizing the agricultural practices for growing flax. Some investigators examined the importance role of gene action components in the inheritance of different trait of flax. Bhateria, et al (2006), found that the additive as well as non-additive gene effects played significant role in the inheritance of yield and related traits with preponderance of non-additive gene effects for all the traits studied. Singh *et al.*, (2008), suggested that additive gene action was important for yield attributing characters except for 100-seed weight., where non-additive gene action was predominant. On the other hand, combining ability analysis is the most widely used as a biometrical tool for classifying lines in terms of their ability to combine in hybrid combinations In this regard, Abo-Kaied, (2002), found that, both general (GCA) and specific combining ability (SCA) variances were highly significant. General combining ability (GCA) effects were more important than the specific (SCA) combining ability effects for fiber percentage, seed index and days to maturity. On the other hand, the specific (SCA) combining ability effects were more effective than the general combining ability (GCA) effects for straw yield per plant, seed yield per plant, and oil percentages. Singh *et al* (2004) cleared that in the F_1 and F_2 generations, the estimates of specific combining ability (SCA) variances were higher than general combining ability (GCA) variances for all quality traits studied. The ratio of (GCA) and (SCA) variances indicated that non-additive genes affected 1000-seed weight, oil content and traits in both generations. Srivastava, *et al* (2007), showed that the variances due to general combining ability (GCA) and specific combining ability (SCA) were highly significant for all the studied traits except number of primary branches in F_1.

The main objectives of the present study are to evaluate some different flax genotypes and their resulted crosses (including the reciprocal crosses) under three different nitrogen levels (30, 45 and 60 kg Nitrogen/faddan) for some agronomical and technological traits. And study the magnitude of both general and specific combining abilities and their interactions with the three different nitrogen fertilization levels and studying the nature of gene actions controlling of two importance traits, straw yield per plant (kg) and oil percentage under three nitrogen fertilization levels.

MATERIALS AND METHODS

All possible crosses were made, including the reciprocal crosses in a set of diallel mating design involving six parental flax genotypes P_1 (Giza 8), P_2 (Sakha 2), P_3 (Sakha 4), P_4 (Ilona), P_5 (S. 22) and P_6 (Sakha 3). The 36 entries (six parents and their thirty F_1 hybrids were tested under 30, 45 and 60 Kg Nitrogen per faddan).

Variances and effects of general and specific were computed according to Griffing 1956- Method 1- Model 1. Ten individual guarded plants were chosen at random to recording the following characters: for days to maturity, straw yield/plant, seed yield per plant (gm), seed index and oil%. Combined analysis of the three nitrogen fertilization level experiments was carried out whenever the homogeneity of test as outlined by Snedecor and Cochran (1982).

The computed genetical parameters were, combining ability (General and specific combining ability) estimates were determined by employing Griffing (1956) diallel cross analysis designated as method 1 model 1. The Gene action parameters and genetically graphical analysis were done according to Hayman methods (1954a and b).

RESULTS AND DISSCUSION

1- Mean performances:

The mean performances of all genotypes (six parents and their resulted thirty crosses) at the three nitrogen fertilization levels as well as their combined data are presented in Table (1). The most desirable and/or highest mean performances for all parents in all traits studied under the three nitrogen levels and their combined data were defined. It was identified for days to maturity in P_2, P_4 and P_6; for straw yield/plant in P_2; for seed index and seed yield/plant in P_1 and P_2 and for oil percentage in P_5 and P_1. The most desirable and/or highest mean performances for all crosses in all traits studied under the three nitrogen levels and their combined data were defined. It was identified for days to maturity (toward earliness) in the two crosses (P_1 x P_4) and (P_5 x P_6); for straw yield/plant, the highest mean values were detected in the two crosses (P_2 x P_4) and (P_4 x P_2); for seed index in the two crosses (P_1 x P_2) and (P_2 x P_1), for seed yield/plant in three crosses (P_2 x P_1), (P_2 x P_4) and (P_3 x P_4) ; the three crosses (P_1 x P_3), (P_4 x P_1) and (P_5 x P_1) gave the highest mean values of oil percentage.

Generally, the most superior crosses for the economic traits were detected in the two crosses (P_2 x P_4) and (P_4 x P_2)for straw yield/plant, in (P_3 x P_4) for seed yield/plant and (P_1 x P_3) for oil %.

Table (1): The genotypes mean performance under the three nitrogen fertilization levels and their combined data for all studied traits.

Entries	Days to maturity (days)				Straw yield / plant (g)				Seed index (gm)			
Parents												
	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.
P_1	130.3	132.3	132.7	131.8	2.520	2.800	2.870	2.730	9.430	10.42	10.55	10.13
P_2	124.3	125.3	126.3	125.3	2.780	3.100	3.190	3.020	7.960	8.850	9.000	8.600
P_3	128.3	129.3	130.7	129.4	2.110	2.320	2.360	2.260	4.150	4.270	4.430	4.280
P_4	124.3	125.3	125.3	125.0	2.050	2.240	2.280	2.190	3.930	4.070	4.210	4.070
P_5	130.3	132.3	133.3	132.0	2.550	2.840	2.910	2.770	4.920	5.340	5.580	5.280
P_6	123.7	124.7	125.7	124.7	2.070	2.290	2.320	2.230	3.950	4.140	4.330	4.140
Parent means	126.9	128.2	129.0	128.0	2.347	2.598	2.655	2.533	5.723	6.182	6.350	6.083
Crosses												
$P_1 \times P_2$	128.7	129.7	129.7	129.3	2.510	2.780	2.870	2.720	8.760	9.330	9.450	9.180
$P_2 \times P_1$	128.7	129.7	130.3	129.6	2.550	2.790	2.850	2.730	8.730	9.350	9.470	9.180
$P_1 \times P_3$	129.7	130.3	131.7	130.6	2.460	2.750	2.840	2.680	5.830	6.180	6.310	6.110
$P_3 \times P_1$	126.3	128.3	129.3	128.0	2.500	2.780	2.850	2.710	6.000	6.260	6.380	6.210
$P_1 \times P_4$	125.7	128.3	128.7	127.6	2.600	2.830	2.920	2.780	7.810	8.090	8.200	8.030
$P_4 \times P_1$	127.7	129.3	129.7	128.9	2.640	2.890	2.980	2.840	7.970	8.220	8.390	8.190
$P_1 \times P_5$	128.3	128.3	129.3	128.7	2.590	2.940	3.000	2.840	7.060	7.480	7.590	7.380
$P_5 \times P_1$	126.7	129.3	129.3	128.4	2.610	2.900	2.930	2.810	7.260	7.760	7.920	7.650
$P_1 \times P_6$	129.3	130.7	131.7	130.6	2.280	2.730	2.730	2.580	6.800	7.500	7.620	7.310
$P_6 \times P_1$	129.3	131.3	132.3	131.0	2.250	2.720	2.810	2.590	6.890	7.540	7.670	7.370
$P_2 \times P_3$	126.7	128.7	128.7	128.0	2.340	2.650	2.710	2.570	7.720	8.300	8.450	8.160
$P_3 \times P_2$	125.3	129.7	130.3	128.4	2.300	2.580	2.650	2.510	7.410	7.850	7.970	7.740
$P_2 \times P_4$	126.3	131.3	132.3	130.0	2.910	3.170	3.280	3.120	7.480	7.970	8.100	7.850
$P_4 \times P_2$	126.3	130.3	131.3	129.3	2.920	3.170	3.180	3.090	7.520	8.250	8.370	8.050
$P_2 \times P_5$	129.7	130.7	131.3	130.6	2.640	2.970	3.040	2.880	8.130	8.490	8.620	8.410
$P_5 \times P_2$	127.3	130.3	131.7	129.8	2.620	2.990	3.030	2.880	7.920	8.280	8.420	8.210
$P_2 \times P_6$	127.0	128.7	129.7	128.5	2.460	2.680	2.800	2.650	7.090	7.600	7.750	7.480
$P_6 \times P_2$	128.7	129.3	130.3	129.4	2.550	2.720	2.720	2.660	7.100	7.500	7.690	7.430
$P_3 \times P_4$	126.3	129.3	129.3	128.3	2.490	2.630	2.680	2.600	8.100	8.540	8.690	8.440
$P_4 \times P_3$	125.3	129.3	130.3	128.3	2.420	2.660	2.730	2.600	7.160	7.500	7.600	7.420
$P_3 \times P_5$	128.7	129.3	130.3	129.4	2.390	2.790	2.890	2.690	7.960	8.400	8.530	8.300
$P_5 \times P_3$	129.3	130.3	130.0	129.9	2.430	2.800	2.810	2.680	8.090	8.430	8.550	8.360
$P_3 \times P_6$	126.7	128.3	129.3	128.1	2.160	2.470	2.550	2.390	7.110	7.420	7.540	7.360
$P_6 \times P_3$	128.3	130.3	131.7	130.1	2.170	2.390	2.460	2.340	7.230	7.600	7.770	7.530
$P_4 \times P_5$	127.3	128.7	129.3	128.4	2.480	2.710	2.790	2.660	7.020	7.300	7.450	7.260
$P_5 \times P_4$	126.7	129.3	129.7	128.6	2.490	2.720	2.810	2.670	7.160	7.450	7.590	7.400
$P_4 \times P_6$	126.0	129.7	130.7	128.8	2.660	2.840	2.940	2.810	7.180	8.300	8.440	7.970
$P_6 \times P_4$	127.7	128.3	129.3	128.4	2.650	2.840	2.950	2.810	7.410	8.620	8.750	8.260
$P_5 \times P_6$	125.7	127.7	129.3	127.6	2.170	2.470	2.560	2.400	7.960	8.370	8.490	8.270
$P_6 \times P_5$	128.3	129.3	130.3	129.3	2.210	2.460	2.560	2.410	7.980	8.480	8.600	8.350
Cross means	127.5	129.5	130.2	129.1	2.482	2.761	2.831	2.690	7.461	7.945	8.079	7.829
General mean	127.2	128.9	129.6	128.6	2.415	2.680	2.743	2.612	6.592	7.064	7.215	6.956
L.S.D. %5	0.931	0.851	0.844	0.876	0.111	0.122	0.138	0.124	0.247	0.383	0.358	0.335
L.S.D. %1	1.235	1.129	1.119	1.162	0.148	0.162	0.183	0.165	3.280	0.508	0.475	0.444

Table (1): cont.

Entries	Seed yield / plant (gm)				Oil percentage			
	Parents							
	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb
P_1	0.860	1.470	1.780	1.370	38.39	38.15	38.06	38.20
P_2	0.640	1.150	1.380	1.060	37.43	37.33	37.32	37.36
P_3	0.170	0.220	0.240	0.210	36.09	36.06	35.97	36.04
P_4	0.180	0.260	0.260	0.230	33.46	33.36	33.27	33.36
P_5	0.520	0.810	1.010	0.780	41.86	41.26	40.11	41.08
P_6	0.190	0.240	0.270	0.230	34.99	34.97	34.91	34.96
Parent means	0.427	0.692	0.823	0.647	37.04	36.86	36.61	36.83
	Crosses							
$P_1 \times P_2$	1.490	1.910	2.120	1.840	39.9	38.66	34.72	37.76
$P_2 \times P_1$	1.270	2.530	2.190	2.000	42.02	41.47	40.66	41.38
$P_1 \times P_3$	0.850	1.180	1.430	1.150	44.64	44.06	42.56	43.75
$P_3 \times P_1$	1.030	1.390	1.710	1.380	41.47	39.14	36.55	39.05
$P_1 \times P_4$	1.500	1.790	2.050	1.780	41.99	40.9	38.5	40.46
$P_4 \times P_1$	1.510	1.920	2.110	1.850	43.85	42.67	41.2	42.57
$P_1 \times P_5$	1.380	1.870	2.120	1.790	42.96	41.99	40.57	41.84
$P_5 \times P_1$	1.260	1.570	1.960	1.600	42.83	42.95	42.72	42.83
$P_1 \times P_6$	0.930	1.280	1.550	1.250	38.02	38.57	37.47	38.02
$P_6 \times P_1$	1.060	1.380	1.660	1.370	37.49	37.15	36.93	37.19
$P_2 \times P_3$	1.530	1.950	2.250	1.910	39.26	38.98	38.03	38.76
$P_3 \times P_2$	1.150	1.290	1.920	1.450	38.7	38.87	38.45	38.67
$P_2 \times P_4$	1.540	2.240	2.510	2.100	40.82	40.46	39.88	40.39
$P_4 \times P_2$	1.350	1.500	1.750	1.530	41.65	41.31	40.82	41.26
$P_2 \times P_5$	1.420	1.580	2.020	1.670	43.02	41.77	39.51	41.43
$P_5 \times P_2$	1.510	1.940	2.230	1.890	43.39	41.92	40.01	41.77
$P_2 \times P_6$	1.040	1.540	1.950	1.510	41.93	41.06	40.25	41.08
$P_6 \times P_2$	1.350	1.510	1.540	1.470	41.38	40.54	39.92	40.61
$P_3 \times P_4$	1.990	2.160	2.520	2.220	40.95	40.00	38.72	39.89
$P_4 \times P_3$	1.420	1.620	1.760	1.600	39.86	39.72	39.41	39.66
$P_3 \times P_5$	1.350	2.020	2.360	1.910	41.9	40.76	38.88	40.51
$P_5 \times P_3$	1.380	1.400	1.820	1.530	43.36	40.98	38.35	40.90
$P_3 \times P_6$	1.170	1.370	1.690	1.410	40.29	40.24	39.32	39.95
$P_6 \times P_3$	1.200	1.330	1.480	1.340	39.87	39.4	39.32	39.53
$P_4 \times P_5$	1.200	1.590	1.850	1.550	38.21	38.87	37.6	38.23
$P_5 \times P_4$	1.180	1.330	1.760	1.420	41.73	41.52	40.42	41.22
$P_4 \times P_6$	1.450	1.890	2.130	1.820	41.15	41.71	40.46	41.11
$P_6 \times P_4$	1.430	1.920	2.120	1.820	41.18	40.72	40.72	40.87
$P_5 \times P_6$	0.980	1.400	1.880	1.420	40.52	38.75	37.24	38.84
$P_6 \times P_5$	1.480	1.580	1.890	1.650	39.92	40.1	40.16	40.06
Cross means	1.313	1.666	1.944	1.641	41.14	40.51	39.31	40.32
General mean	0.870	1.179	1.384	1.144	39.09	38.69	37.96	38.58
L.S.D. %5	0.307	0.583	0.550	0.550	0.879	1.247	1.427	1.206
L.S.D. %1	0.407	0.774	0.730	0.730	1.166	1.654	1.893	1.600

N_1 , N_2 and N_3 = 30, 45 and 60 Kg N/fed, respectively
Comb = combined data.

2 –Variances of Combining abilities:

The mean squares associated with general and specific combining ability were significant and/or highly significant for all traits (Table 2). The ratios of (GCA / SCA) exceeded the unity were detected for days to maturity at N_1 and the combined analysis, straw yield per plant at N_1, N_2, N_3 and the combined analysis, it mean that, the additive and additive by additive types of gene action were greater importance in the inheritance in these cases. On the other hand, these ratios were less than the unity and detected in the remaining cases. At the same time, few cases exhibited equal the unity, such as seed index at N_1, N_2, N_3 and the combined analysis. In this concern, for general and specific combining ability, Thakur and Bhateria (1991), revealed that (SCA) variances were relatively large for all eight characters studied except plant height in the F_2. Abo-Kaied *et al.* (2002), indicated that general combining ability /specific combining ability mean squares indicated that both additive and non-additive gene effects governed the inheritance of seed yield per plant and its three component traits. However, additive was more important than non-additive genetic variance in the genetic expression of 1000-seed weight, seed yield per plant. Abo El-Komsan *et al.* (2003), The additive effects were more important than the non-additive effects for fiber percentage, seed index and days to maturity. On the other hand, the non-additive effects were more effective than the additive effects for straw yield per plant, seed yield per plant, and oil%. Swarnkar *et al.* (2003), obtained significant mean squares due to general (GCA) and specific combining abilities for all the characters except few cases. in F_1. The general productivity ratio indicated the involvement of non-additive gene action for all the characters except number of days to maturity in the F_1 and F_2 generations. Srivastava *et al.* (2007), revealed that the variances due to general combining ability (GCA) and specific combining ability (SCA) were highly significant for all the traits except number of primary branches in F_1. The general productivity ratio (GPR) depicted that the presence of predominantly large amounts of non-additive gene action. Singh *et al.* (2008), obtained high magnitude of (GCA) and (SCA) effects for all traits indicated the presence of both additive and non-additive gene interactions for the maintenance of different traits. Singh *et al.* (2009), revealed the importance role of non-additive gene action in the inheritance of all the traits. Mean squares of interactions between the three nitrogen fertilization levels and general, specific combining ability were significant for all traits studied except for plant height for general combining ability; and no. of capsules per plant for specific combining ability; and technical length, straw yield per plant and seed index for reciprocal; seed weight for general and specific combining ability with three nitrogen fertilization levels indicating that, the magnitude of additive and additive by additive types of gene action were varied from fertilizing level to another as shown before. Mean squares of (S.C.A.) x levels / (S.C.A.) were much higher than (G.C.A.) x levels / (G.C.A.)

Table (2): Mean square estimates of ordinary analysis and combining ability analysis for all traits studied for nitrogen fertilization level and their combined data.

Source of variance	d.f		Days to maturity (days)				Straw yield per plant (g)				Seed index (gm)			
	Single	Comb	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.
G.C.A.	5	5	8.577**	4.010**	3.428**	44.37**	0.173**	0.187**	0.191**	1.628**	2.699**	3.373**	3.354**	28.08**
S.C.A.	15	15	2.716**	4.546**	5.276**	33.95**	0.052**	0.056**	0.060**	0.488**	2.790**	3.341**	3.289**	28.04**
Reciprocal	15	15	1.415**	0.633**	0.704**	5.500**	0.001	0.001	0.002	0.004*	0.041**	0.057**	0.062**	0.468**
G.C.A. x levels	10	10				1.840**				0.013**				0.101**
S.C.A. x levels	30	30				1.830**				0.007**				0.110**
Reciprocal x levels	30	30				1.380**				0.003				0.006
G.C.A. x levels/G.C.A.						0.041				0.008				0.004
S.C.A. x levels/S.C.A.						0.054				0.014				0.004
Reciprocalxlevel/Reci						0.251				0.750				0.013
G.C.A. / S.C.A.			3.158	0.882	0.650	1.307	3.327	3.339	3.183	3.336	0.967	1.010	1.020	1.001
Error ($\sigma^2 e$)	70	210	0.109	0.091	0.09	0.097	0.0016	0.002	0.0023	0.002	0.008	0.018	0.016	0.014

Table (2): cont.

Source of variance	d.f		Seed yield per plant (gm)				Oil percentage			
	Single	Comb	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.
G.C.A.	5	5	0.076**	0.287**	0.374**	1.889**	8.876**	5.915**	2.333**	46.94**
S.C.A.	15	15	0.339**	0.443**	0.633**	4.113**	10.44**	7.806**	6.086**	68.76**
Reciprocal	15	15	0.033*	0.081*	0.085*	0.431**	1.215**	1.662**	3.412**	16.08**
G.C.A. x levels	10	10				0.161**				2.217**
S.C.A. x levels	30	30				0.065**				2.117**
Reciprocal x levels	30	30				0.083**				1.396**
G.C.A. x levels/G.C.A.						0.085				0.047
S.C.A. x levels/S.C.A.						0.016				0.031
Reciprocal x level/Recip						0.193				0.087
G.C.A. / S.C.A.			0.224	0.648	0.591	0.459	0.850	0.758	0.383	0.683
Error	70	210	0.012	0.043	0.038	0.031	0.098	0.197	0.257	0.184

* and ** significant at 0.05 and 0.01 levels of probability respectively.
Comb = combined analysis.
N_1 , N_2 and N_3 = 30, 45 and 60 Kg N/fed, respectively

for all traits studied were significant except seed index, seed yield per plant and oil percentage. On the other hand, mean squares of reciprocal x levels / Reciprocal were much higher than (S.C.A.) x levels / (S.C.A.) for all traits studied were significant except days to flowering, plant height and technical length. In this concern, Mishra and Rai (1996), observed highly significant variation for GCA and SCA x E for all the characters, and SCA and GCA x E for all the traits except oil content. Abo-Kaied (2002), suggested predominance of additive gene effects in the genetic control of the traits straw yield per plant, Specific (SCA) combining ability and (SCA) x environment interactions were greater than general combing ability (GCA) and (GCA) x environment interactions, indicating that non-additive gene effects were stable over environments, whereas additive effects were much influenced by environments. Abo-Kaied *et al.* (2002), revealed that significant (GCA) x environments interaction indicated that the additive effects were not stable over environments, hence more than one test environment is required to obtain reliable information for seed yield per plant and its components. On the contrary, (SCA) x environment interaction was not significant for seed yield per indicating that the non-additive effects governing these cases were less distorted by environmental fluctuations.

3- General and specific combining ability effects:

3- a - General combining ability effects:

Estimates of general combining ability effects ($\hat{g}i$) for individual parental genotype in each trial at the three nitrogen fertilization levels as well as their combined data are presented in Table (3). The parental cultivar, Giza 8 (P_1) showed highly significant positive undesirable ($\hat{g}i$) effects for days to maturity at N_1, N_2 and N_3 as well as their combined analysis. On the contrary, it showed highly significant and/or significant positive desirable ($\hat{g}i$) effects for straw yield per plant and seed index at N_1, N_2 and N_3 as well as their combined analysis. Also, seed yield per plant at N_2, N_3 and the combined analysis and oil percentage at N_1, N_2 and the combined analysis, showed the same trends for this trait. The data indicated that Giza 8 (P_1) provide to be the second highest combiner for straw yield per plant, seed index, seed yield/plant and oil percentage. The parental cultivar Sakha 2 (P_2) exhibited highly significant and/or significant positive desirable ($\hat{g}i$) effects for straw yield per plant, seed index and seed yield per plant at N_1, N_2 and N_3 as well as their combined analysis. While the significantly negative effects were detected for days to maturity at N_1, N_2, N_3 and the combined analysis. The data indicated that Sakha 2 (P_2) provide to be the first highest general combiner for straw yield per plant, seed index and seed yield per plant. The parental cultivar Sakha 4 (P_3) expressed highly significant and/or significant positive ($\hat{g}i$) effects for days to maturity at N_3 and the combined analysis. However, it gave highly significant and/or significant negative effects for

Table (3): Estimates of general combining ability effects for the parental varieties evaluated under the nitrogen fertilization level and their combined data.

Source of variance	Days to maturity (days)				Straw yield per plant (g)				Seed index (gm)			
	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.
Giza 8	1.046**	0.732**	0.674**	0.784**	0.044**	0.077**	0.075**	0.066**	0.493**	0.559**	0.551**	0.534**
Sakha 2	-0.426**	-0.185*	-0.176*	-0.262**	0.153**	0.157**	0.157**	0.156**	0.643**	0.731**	0.735**	0.703**
Sakha 4	0.074	1.120	0.157*	0.117*	-0.137**	-0.139**	-0.144**	-0.140**	-0.430**	-0.869**	-0.669**	-0.623**
Ilona	-1.204**	-0.646**	-0.759**	-0.836**	0.073**	0.013	0.019	0.035**	-0.282**	-0.289**	-0.293**	-0.288**
L . 22	0.852**	0.565**	0.574**	0.664**	0.018	0.051**	0.053**	0.041**	0.028	-0.047	-0.047	-0.022**
Sakha 3	-0.343**	-0.685**	-0.370**	-0.466**	-0.151**	-0.158**	-0.159**	-0.156**	-0.452**	-0.386**	-0.377**	-0.405**
L.S.D. 5% ($\hat{g}_i$)	0.174	0.159	0.157	0.094	0.021	0.023	0.026	0.013	0.046	0.071	0.067	0.036
L.S.D. 1%. ($\hat{g}_i$)	0.230	0.210	0.209	0.125	0.028	0.030	0.034	0.018	0.061	0.095	0.089	0.048
L.S.D. 5% ($\hat{g}_i$- $\hat{g}_j$)	0.269	0.246	0.244	0.146	0.032	0.035	0.040	0.021	0.071	0.110	0.103	0.056
L.S.D. 1% ($\hat{g}_i$- $\hat{g}_j$)	0.357	0.326	0.323	0.194	0.043	0.047	0.053	0.027	0.096	0.147	0.137	0.074

Table (3): cont.

Source of variance	Seed yield per plant (gm)				Oil percentage			
	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.
Giza 8	0.002	0.142*	0.165**	0.103**	0.517**	0.423**	0.138	0.359**
Sakha 2	0.080**	0.187**	0.228**	0.165**	0.122	0.077	0.048	0.082
Sakha 4	-0.050	-0.157**	-0.150**	-0.119**	-0.232**	-0.377**	-0.400**	-0.336**
Ilona	0.080**	0.036	-0.012	0.035	-0.602**	-0.349**	-0.173	-0.374**
L . 22	0.016	-0.010	0.001	0.002	1.319**	1.111**	0.779**	1.069**
Sakha 3	-0.126**	-0.197**	-0.232**	-0.185**	-1.124**	-0.884**	-0.393**	-0.800**
L.S.D. 5% ($\hat{g}_i$)	0.057	0.109	0.103	0.053	0.164	0.232	0.266	0.130
L.S.D. 1%. ($\hat{g}_i$)	0.076	0.144	0.136	0.071	0.217	0.308	0.353	0.172
L.S.D. 5% ($\hat{g}_i$- $\hat{g}_j$)	0.089	0.168	1.589	0.083	0.254	0.360	0.412	0.201
L.S.D. 1% ($\hat{g}_i$- $\hat{g}_j$)	0.117	0.223	2.107	0.110	0.337	0.478	0.547	0.267

* and ** significant at 0.05 and 0.01 levels of probability respectively. Comb. = combined analysis.
N_1 , N_2 and N_3 = 30, 45 and 60 Kg N/fed, respectively

straw yield per plant, seed index and oil percentage at N_1, N_2, N_3 and the combined analysis. Also, seed yield per plant at N_2, N_3 and the combined analysis showed the same trends for this trait. The parental cultivar Ilona (P_4) expressed highly significant negative desirable (ĝi) effects for days to maturity at N_1, N_2, N_3 and the combined analysis. It also showed highly significant and/or significant positive (ĝi) effects for seed yield per plant at N_1, straw yield per plant at N_1 and the combined analysis. The data indicated that Ilona (P_4) provide to be the first highest general combiner for days to maturity. The parental cultivar S.22 (P_5) showed highly significant positive (ĝi) effects for days to maturity and oil percentage at N_1, N_2, N_3 and the combined analysis, straw yield per plant at N_2, N_3 and the combined analysis. However, it gave highly significant negative effects for seed index at the combined analysis. The data indicated that S.22 (P_5) provided to be the first highest general combiner for oil percentage. The parental cultivar Sakha 3 (P_6) exhibited highly significant negative effects for days to maturity, straw yield per plant, seed index, seed yield per plant and oil percentage at N_1, N_2, N_3 and the combined analysis. The data indicated that Sakha 3 (P_6) provide to be the second highest general combiner for days to maturity.

3- b- Specific combining ability effects:

Estimates of specific combining ability (Ŝij) effects for the thirty crosses (Table 4) were defined as follows: For days to maturity, six crosses (P_3 x P_1), (P_1 x P_4), (P_1 x P_5), (P_5 x P_1), (P_3 x P_6) and (P_5 x P_6) at three fertilizing levels as well as their combined dated, two crosses (P_1 x P_2) and (P_5 x P_3) at N_3, three crosses (P_2 x P_3), (P_3 x P_5) and (P_4 x P_5) at N_2, N_3 and their combined data, one cross (P_3 x P_2) at N_1 and the combined data and two crosses (P_5 x P_2) and (P_4 x P_3) at N_1, exhibited highly significant and/or significant desirable negative (Ŝij) effects. The data indicated that the highest values for this trait for the five crosses (P_3 x P_1), (P_1 x P_5), (P_5 x P_1) and (P_5 x P_6). For straw yield/plant, three crosses (P_2 x P_4), (P_4 x P_6) and (P_6 x P_4) at N_1, N_3 and the combined dated, one crosses (P_4 x P_2) at N_1 and the combined data and one cross (P_3 x P_5) at the combined data, exhibited significant desirable positive (Ŝij) effects for this trait. For seed index, fourteen crosses (P_1 x P_2), (P_2 x P_1), (P_4 x P_1), (P_2 x P_3), (P_3 x P_4), (P_4 x P_3), (P_3 x P_5), (P_5 x P_3), (P_3 x P_6), (P_6 x P_3), (P_4 x P_6), (P_6 x P_4), (P_5 x P_6) and (P_6 x P_5) at the three nitrogen fertilization levels as well as their combined data, one cross (P_1 x P_4) at N_1, N_2 and the combined data, one cross (P_4 x P_2) at the combined data, two crosses (P_2 x P_5) and (P_4 x P_5) at N_1 and the combined data and one cross (P_4 x P_5) at N_1, exhibited significant desirable positive (Ŝij) effects. The seven crosses (P_3 x P_4), (P_3 x P_5), (P_5 x P_3), (P_4 x P_6), (P_6 x P_4), (P_5 x P_6) and (P_6 x P_5) had the highest significant positive (Ŝij) effects values for this trait. As for seed yield/plant seven crosses (P_2 x P_3), (P_2 x P_4), (P_3 x P_4), (P_3 x P_5), (P_4 x P_6), (P_6 x P_4) and (P_6 x P_5) at the three fertilizing levels as well as their combined dated, one cross (P_2 x P_1) at N_2, N_3 and the combined data, three crosses (P_1 x P_2), (P_2 x P_5) and (P_6 x P_2) at N_1,

Table (4): Estimates of specific combining ability effects for thirty crosses evaluated under three nitrogen fertilization level and their combined data.

Entries	Days to maturity (days)				Straw yield / plant (g)				Seed index (gm)			
	Crosses											
	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.
$P_1 \times P_2$	0.68**	-0.15	-0.77**	-0.08	-0.15	-0.18	-0.17	-0.17**	0.45**	0.39**	0.38**	0.41**
$P_2 \times P_1$	0.68**	-0.15	-0.10	0.14	-0.10	-0.18	-0.19	-0.16*	0.42**	0.41**	0.40**	0.41**
$P_1 \times P_3$	1.18**	0.21	0.90**	0.76**	0.09	0.08	0.10	0.09	-1.41**	-1.46**	-1.46**	-1.44**
$P_3 \times P_1$	-2.16**	-1.79**	-1.44**	-1.79**	0.13	0.11	0.11	0.12	-1.23**	-1.39**	-1.40**	-1.34**
$P_1 \times P_4$	-1.55**	-1.12**	-1.19**	-1.28**	0.02	0.01	0.03	0.02	0.43**	0.16*	0.15	0.25**
$P_4 \times P_1$	0.45*	-0.12	-0.19	0.05	0.08	0.07	0.09	0.08	0.58**	0.30**	0.34**	0.41**
$P_1 \times P_5$	-0.94**	-2.23**	-1.85**	-1.67**	0.07	0.08	0.07	0.07	-0.63**	-0.69**	-0.71**	-0.68**
$P_5 \times P_1$	-2.60**	-1.23**	-1.85**	-1.90**	0.09	0.04	0.00	0.05	-0.43**	-0.40**	-0.38**	-0.40**
$P_1 \times P_6$	1.26**	1.35**	1.43**	1.35**	-0.07	0.08	0.02	0.01	-0.41**	-0.33**	-0.35**	-0.36**
$P_6 \times P_1$	1.26**	2.02**	2.09**	1.79**	-0.10	0.07	0.09	0.02	-0.33**	-0.29**	-0.30**	-0.30**
$P_2 \times P_3$	-0.35	-0.54**	-1.35**	-0.75**	-0.14	-0.10	-0.11	-0.11	0.33**	0.48**	0.50**	0.44**
$P_3 \times P_2$	-1.69**	0.46*	0.32	-0.30**	-0.18*	-0.18	-0.17	-0.17**	0.02	0.03	0.02	0.02
$P_2 \times P_4$	0.59**	2.80**	3.23**	2.21**	0.23**	0.26	0.30*	0.26**	-0.05	-0.13	-0.13	-0.10*
$P_4 \times P_2$	0.59**	1.80**	2.23**	1.54**	0.23**	0.27	0.21	0.24**	-0.02	0.15	0.14	0.09*
$P_2 \times P_5$	1.87**	1.02**	0.90**	1.26**	0.01	0.03	0.03	0.02	0.29**	0.15	0.14	0.20**
$P_5 \times P_2$	-0.46*	0.69**	1.23**	0.49**	-0.01	0.05	0.02	0.02	0.08	-0.06	-0.06	-0.01
$P_2 \times P_6$	0.40*	0.27	0.18	0.28*	-0.00	-0.05	0.00	-0.02	-0.27**	-0.40**	-0.39**	-0.36**
$P_6 \times P_2$	2.07**	0.94**	0.84**	1.28**	0.09	-0.02	-0.08	-0.00	-0.26**	-0.50**	-0.45**	-0.41**
$P_3 \times P_4$	0.09	0.49**	-0.10	0.16	0.09	0.02	0.01	0.04	1.64**	1.74**	1.76**	1.72**
$P_4 \times P_3$	-0.91**	0.49**	0.90**	0.16	0.02	0.05	0.06	0.04	0.70**	0.70**	0.68**	0.69**
$P_3 \times P_5$	0.37	-0.62**	-0.44*	-0.23*	0.05	0.14	0.18	0.13*	1.19**	1.36**	1.35**	1.30**
$P_5 \times P_3$	1.04**	0.38*	-0.77**	0.22*	0.09	0.15	0.10	0.11	1.32**	1.39**	1.38**	1.36**
$P_3 \times P_6$	-0.44*	-0.37*	-0.49**	-0.43**	-0.01	0.04	0.05	0.03	0.82**	0.72**	0.69**	0.74**
$P_6 \times P_3$	1.23**	1.63**	1.84**	1.57**	-0.01	-0.05	-0.04	-0.03	0.94**	0.90**	0.92**	0.92**
$P_4 \times P_5$	0.32	-0.62**	-0.52**	-0.28*	-0.07	-0.08	-0.08	-0.08	0.11*	-0.02	-0.00	0.03
$P_5 \times P_4$	-0.35	0.05	-0.19	-0.16	-0.06	-0.08	-0.06	-0.07	0.25**	0.13	0.14	0.17**
$P_4 \times P_6$	0.18	1.63**	1.76**	1.19**	0.26**	0.25	0.28*	0.27**	0.74**	1.32**	1.32**	1.13**
$P_6 \times P_4$	1.84**	0.30	0.43*	0.86**	0.27**	0.25	0.29*	0.27**	0.97**	1.66**	1.60**	1.41**
$P_5 \times P_6$	-2.21**	-1.48**	-0.91**	-1.53**	-0.16*	-0.16	-0.14	-0.15*	1.21**	1.15**	1.13**	1.16**
$P_6 \times P_5$	0.45*	0.19	0.09	0.24*	-0.12	-0.17	-0.14	-0.14*	1.24**	1.26**	1.23**	1.24**
L.S.D. %5sij	0.396	0.362	0.358	0.215	0.047	0.052	0.059	0.030	0.105	0.163	0.152	0.082
L.S.D. %1sij	0.525	0.480	0.476	0.285	0.063	0.069	0.078	0.040	0.139	0.216	0.202	0.109
L.S.D.%5sij-sik	0.601	0.549	0.545	0.326	0.072	0.079	0.089	0.046	0.160	0.247	0.231	0.125
L.S.D.%1sij-sik	0.797	0.729	0.722	0.433	0.095	0.105	0.118	0.061	0.212	0.328	0.307	0.165
L.S.D.%5sij-skl	0.538	0.491	0.487	0.292	0.064	0.071	0.080	0.041	0.143	0.221	0.207	0.112
L.S.D.%1sij-skl	0.713	0.652	0.646	0.387	0.085	0.094	0.106	0.055	0.189	0.293	0.274	0.148

Table (4): cont.

Entries	Seed yield / plant (gm)				Oil percentage			
	Crosses							
	N_1	N_2	N_3	Comb.	N_1	N_2	N_3	Comb.
P_1 x P_2	0.25**	0.08	-0.04	0.09	-1.22**	-1.74**	-4.33**	-2.43**
P_2 x P_1	0.02	0.70**	0.75**	0.49**	0.95**	1.07**	1.62**	1.21**
P_1 x P_3	-0.27**	-0.31*	-0.35**	-0.31**	3.87**	4.11**	3.96**	3.98**
P_3 x P_1	-0.09	-0.10	-0.07	-0.09	0.71**	-0.81**	-2.05**	-0.72**
P_1 x P_4	0.26**	0.11	0.13	0.17**	1.60**	0.93**	-0.33	0.73**
P_4 x P_1	0.26**	0.24	0.19	0.23**	3.45**	2.70**	2.37**	2.84**
P_1 x P_5	0.20**	0.24	0.18	0.21**	0.63**	0.56*	0.79*	0.66**
P_5 x P_1	0.08	-0.07	0.03	0.01	0.52**	1.52**	2.93**	1.66**
P_1 x P_6	-0.11	-0.17	-0.15	-0.14*	-1.85**	-0.87**	-1.14**	-1.29**
P_6 x P_1	0.02	-0.07	-0.04	-0.03	-2.40**	-2.29**	-1.68**	-2.12**
P_2 x P_3	0.34**	0.41**	0.40**	0.38**	-1.11**	-0.62*	-0.48	-0.74**
P_3 x P_2	-0.05	-0.24	0.08	-0.07	-1.67**	-0.73**	-0.06	-0.82**
P_2 x P_4	0.22**	0.51**	0.52**	0.42**	0.82**	0.83**	1.14**	0.93**
P_4 x P_2	0.03	-0.22	-0.23*	-0.14*	1.90**	1.68**	2.09**	1.89**
P_2 x P_5	0.16*	-0.10	0.02	0.03	1.10**	0.69*	-0.18	0.54**
P_5 x P_2	0.25**	0.26*	0.23	0.25**	1.47**	0.84**	0.32	0.88**
P_2 x P_6	-0.08	0.04	0.19	0.05	2.45**	1.97**	1.73**	2.05**
P_6 x P_2	0.23**	0.02	-0.22	0.01	1.90**	1.45**	1.41**	1.59**
P_3 x P_4	0.80**	0.78**	0.91**	0.83**	1.30**	0.83**	0.43	0.85**
P_4 x P_3	0.22**	0.23	0.15	0.20**	0.21	0.55*	1.12**	0.63**
P_3 x P_5	0.22**	0.69**	0.75**	0.55**	0.33	0.13	-0.36	0.03
P_5 x P_3	0.25**	0.07	0.20	0.17**	1.79**	0.35	-0.89**	0.42**
P_3 x P_6	0.18**	0.22	0.30*	0.23**	1.17**	1.60**	1.25**	1.34**
P_6 x P_3	0.21**	0.18	0.09	0.16**	1.25**	0.76**	1.25**	1.09**
P_4 x P_5	-0.06	0.06	0.09	0.03	-2.99**	-1.79**	-1.87**	-2.22**
P_5 x P_4	-0.09	-0.20	0.00	-0.09	0.53**	0.86**	0.95**	0.78**
P_4 x P_6	0.33**	0.55**	0.61**	0.49**	2.39**	3.05**	2.17**	2.54**
P_6 x P_4	0.31**	0.58**	0.60**	0.49**	2.42**	2.05**	2.42**	2.30**
P_5 x P_6	-0.08	0.11	0.34**	0.12*	-0.15	-1.38**	-2.01**	-1.18**
P_6 x P_5	0.43**	0.29*	0.35**	0.35**	-0.70**	-0.03	0.92**	0.06
L.S.D. %5sij	0.130	0.248	0.234	0.122	0.373	0.530	0.606	0.296
L.S.D. %1sij	0.173	0.329	0.310	0.161	0.495	0.703	0.805	0.393
L.S.D.%5sij-sik	0.198	0.377	0.355	0.185	0.567	0.805	0.921	0.450
L.S.D.%1sij-sik	0.263	0.500	0.471	0.245	0.753	1.068	1.222	0.596
L.S.D.%5sij-skl	0.177	0.337	0.218	0.165	0.507	0.720	0.824	0.402
L.S.D.%1sij-skl	0.235	0.447	0.421	0.219	0.673	0.955	1.093	0.533

*** and ** significant at 0.05 and 0.01 levels of probability respectively.**
N_1 , N_2 and N_3 = 30, 45 and 60 Kg N/fed, respectively

one cross (P_5 x P_2) at N_1, N_2 and the combined data, one cross (P_3 x P_6) at N_1, N_3 and the combined data, six crosses (P_1 x P_4), (P_4 x P_1), (P_1 x P_5), (P_4 x P_3), (P_5 x P_3) and (P_6 x P_3) at N_1 and the combined data and one cross (P_5 x P_6) at N_3 and the combined data, exhibited highly significant and/or significant desirable positive ($\hat{S}ij$) effects for this trait. The two crosses (P_3 x P_4) and (P_3 x P_5) had the highest significant positive ($\hat{S}ij$) effects values for this trait. For oil percentage, fourteen crosses (P_2 x P_1), (P_1 x P_3), (P_4 x P_1), (P_1 x P_5), (P_5 x P_1), (P_2 x P_4), (P_4 x P_2), (P_2 x P_6), (P_6 x P_2), (P_3 x P_6), (P_6 x P_3), (P_5 x P_4), (P_4 x P_6) and (P_6 x P_4), one cross (P_3 x P_1) at N_1, four crosses (P_1 x P_4), (P_2 x P_5), (P_5 x P_2) and (P_3 x P_4) at N_1, N_2 and the combined data, one cross (P_4 x P_3) at N_2, N_3 and the combined data, one cross (P_5 x P_3) at N_1 and the combined data and one cross (P_6 x P_5) at N_3, exhibited highly significant and/or significant desirable positive ($\hat{S}ij$) effects for this trait. The two crosses (P_1 x P_3) and (P_4 x P_1) had the highest significant positive ($\hat{S}ij$) effects values for this trait.

4- Nature of gene actions for straw yield/plant and oil percentage:

The computed genetic parameters nature inheritance of gene actions for straw yield/plant and oil percentage are presented in (Table 5) using Hayman analysis (1954 a and b).

The obtained data showed that the additive variances (D) were significant for the two traits studied in the three nitrogen fertilizing levels. These results indicated that the additive gene effects played the major role in the inheritance for these two traits under the three fertilizing levels (Table 5). Significant values for the dominance components ($\hat{H}1$) were obtained for both traits. Values of ($\hat{H}1$) were large in magnitude than the respective (D) for oil percentage under the three nitrogen fertilization levels. This result revealed that non-additive type of gene action was the most prevalent genetic component for the inheritance of this trait. The contradiction in magnitude obtained between (D) and (G.C.A.) estimate for traits studied may be attributed to the great role of both allelic and non-allelic genetic types of the expression of most traits under the three nitrogen fertilization levels. Theoretically, ($\hat{H}2$) should be equal to and or less than ($\hat{H}1$) (Hayman, 1954). The smaller ($\hat{H}2$) than ($\hat{H}1$) for both traits studied under three nitrogen fertilizing levels in this study may be indicated that, presence of positive (u) and negative allele frequencies at the loci for the previous cases in question are not equal in proportion in the parents. The overall dominance effects of heterozygous loci ($\hat{h}^2$) values were found to be significant for both traits studied at the three nitrogen fertilizing levels. This result indicated that the effect of dominance may be due to heterozygosis and the dominance was unidirectional. The covariance of additive and dominance (F) was found to be significant only for straw yield/plant. and not yet for oil percentage at N_1 and N_2, it could be concluded that an equality of the relative frequencies of dominant and recessive alleles were exciting in the parents for this trait at these two fertilizing levels. The expected environmental component of variation (Ê) was found to be non significant for both traits studied. The relative size of (D) and (Ĥ1) as $(\hat{H}1/D)^{1/2}$ can be used as a weight measure of the average degree of dominance at each locus. The results showed that the presence of over dominance for straw yield/plant at N_1 and oil percentage under three nitrogen fertilizing levels, while the dominance ratios $(\hat{H}1/D)^{1/2}$ were found to be nearly equal unity for straw yield/plant at N_2 and N_3 indicating the presence of complete dominance. However, if we found the ratio less than unity this well indicate the presence of partial dominance. The average frequency of negative vs. positive alleles in parental populations was detected by computing the ratio (Ĥ2/4Ĥ1). The obtained values were largely deviating from one quarter for both traits studied under three nitrogen fertilizing levels, indicating that negative and positive alleles were equally distributed among the parents. The ratio $[KD/Kr\ (4\ D\hat{H}_1)^{1/2} + F\ /\ (4\ D\hat{H}_1)^{1/2} - F]$ were more than unity for both traits studied under the three fertilizing levels. These data showed that the proportion of dominant alleles are greater in the parents than the recessive ones for these traits. The correlation coefficient (r) value between the order of dominance (Vr, Wr) and parental measurements were highly significant.

Table (5): Estimates of genetic and environmental components of variation and some of its derived actions in F_1 diallel cross analysis for two traits studied at the three nitrogen fertilization levels.

Entries	Straw yield / plant (g)			Oil percentage		
	N_1	N_2	N_3	N_1	N_2	N_3
D	0.092** ± 0.012	0.127** ± 0.011	0.145** ± 0.012	8.56** ± 1.81	7.34** ± 1.64	5.72** ± 1.42
Ĥ1	0.133** ± 0.031	0.135** ± 0.028	0.149** ± 0.030	22.89** ± 4.60	17.67** ± 4.15	14.85** ± 3.61
Ĥ2	0.045** ± 0.019	0.070** ± 0.017	0.080** ± 0.018	20.77** ± 4.11	15.23** ± 3.71	11.87** ± 3.23
$\hat{h}^2$	0.090** ± 0.028	0.100** ± 0.025	0.104** ± 0.027	47.43** ± 2.76	36.90** ± 2.50	20.23** ± 2.17
F	0.077** ± 0.030	0.098** ± 0.027	0.123** ± 0.029	7.75 ± 4.42	7.88 ± 4.00	7.97** ± 3.48
Ê	0.002 ± 0.005	0.002 ± 0.004	0.003 ± 0.004	0.05 ± 0.68	0.19 ± 0.62	0.15 ± 0.54
$(H1/D)^{1/2}$	1.20	1.03	1.01	1.63	1.55	1.61
$(H_2/4\ H_1)$	0.17	0.18	0.18	0.23	0.22	0.20
KD/Kr	2.06	2.20	2.45	1.77	2.06	2.52
YD	2.30	2.53	2.58	33.58	33.79	34.06
Yr	2.45	2.75	2.83	43.14	43.20	43.01
r	-0.39**	-0.43**	-0.44**	-0.81**	-0.75**	-0.62**
t2	0.12	0.05	0.09	3.18	3.17	0.72
b	0.65	0.82	0.81	0.34	0.40	0.47

In general, with respect to the majority of the nature gene effects governed different traits in flax were discussed in detail by many investigators and from them as presented in the review of literature, Pavlova (1988), found that, the dominance parameter was significant for the characters with over dominance effects including oil % and straw yield/hectare. Over dominance effect found to be significant for seed weight/plant and 1000-seed weight. Singh *et al.* (1991), they found that the effect due to epistasis was non-significant for all traits including oil % and straw yield/hectare, whereas additive and dominance component effects were significant for all other characters. Tak (1994), revealed that, seed yield was mainly controlled by duplicate type gene effects, while for oil content, complementary type gene effects were more important. In general, there was a predominance of non-additive gene action for the two traits, although additive gene action was also present. Patel *et al.* (1997 a), cleared that the preponderance of additive gene effects was observed some trait including oil yield. In other ward, additive genetic effect was significant for oil content, whereas significant dominance genetic effect was seen for harvest index. Patel *et al.* (1997 b); Patel *et al.* (1998 c); Patel and Gupta (1997 d), revealed the importance of both additive and non-additive type of gene action in the inheritance of all the characters studied. However, preponderance of additive components was observed for some important trait and seed oil content, and a preponderance of dominance components for harvest index and oil yield per plant. Popescu *et al.* (1998), showed that both additive and dominance effects were involved in the inheritance of straw yield and oil % traits, dominance being however prevalent. The gene or the group of dominant genes involved in the genetic control of straw content operate after an "over dominance" type genetic mechanism, dominance being unidirectional and dominant alleles having an increasing effect on it. Also, both types of genetic effects (additive and dominance) which are governing this trait were very affected by the environmental conditions, Yadav and Gupta (1999 a), revealed over dominance effect was involved for some traits including oil content and harvest index. Patel *et al.* (2002 a), showed that, oil yield per plant was governed by both additive as well as dominance gene effects, with preponderance of additive gene effect for oil yield per plant. Asymmetrical distribution of increasing and decreasing alleles was noticed for all the traits except oil yield. The population improvement through reciprocal recurrent selection or biparental mating is suggested for increasing seed and oil yield. Bhateria *et al.* (2006), obtained considerable genetic variation for all the traits studied including straw and oil yield. The preponderance of non-additive gene effects for all the studied traits were detected.

Our previously results might be agreed and/or disagreed with those obtained by Nemours studies as shown before. It might be due to the different genetic materials and genetically analysis methods used.

5 - Graphical analysis

a- Straw yield/plant:

The graphical analysis purposed by Hayman (1954 a and b) was herein used for Straw yield/plant (Figures 1, 2 and 3). Hayman (1954 a and b) cleared that, complementary type or epistasis generally reduces the covariance (Wr) disproportion ally more than the variance (Vr) causing the slope of the regression line (b) to be less than unity. In our case, this assumption is valid under the three nitrogen levels where, the values of regression coefficient (b) were: (b_1 = 0.65± 0.05) at N_1; (b_2 = 0.82± 0.028) at N_2 and (b_3 = 0.81± 0.027) at N_3. So, this assumption is valid under the three nitrogen levels, and the slope of the regression line (b) to be less than unity. Also, under N_1 and N_2 regression line (b) passed through the origin point, dominance is complete, meanwhile in N3, the regression line intercepted the (Wr) axis above the origin point, partial dominance is exciting.Also,at N_1, the parent P_4 possessed recessive genes, where it fall farther from the origin. Furthermore, the parents P_2 and P_6 possessed equal frequencies of dominant and recessive genes, where they occupied in intermediate position. Meanwhile, the parents P_1, P_3 and P_5 possessed more dominant genes, where they located nearer to the origin. With respect to N_2 and N_3, the parent P_4 also possessed recessive genes, where it fall farther from the origin, the parents P_2, P_3, P_5 and P_6 possessed equal frequencies of dominant and recessive genes, where they occupied an intermediate position. Finley, the parent P_1 possessed more dominant genes, where it located nearer to the origin.

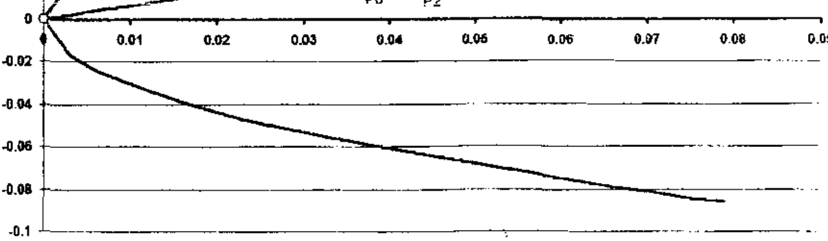

Fig. 1. graphical analysis for straw yield/plant at N_1.

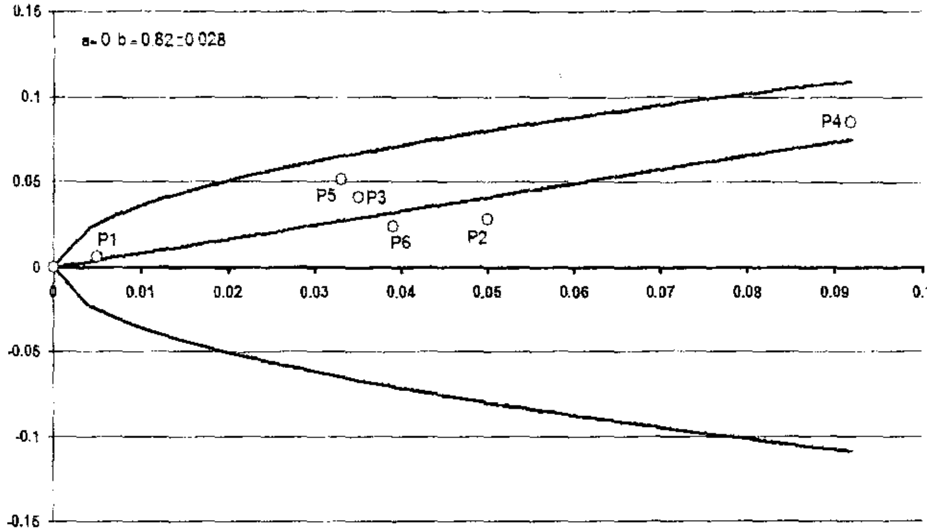

Fig. 2. graphical analysis for straw yield/plant at N_2.

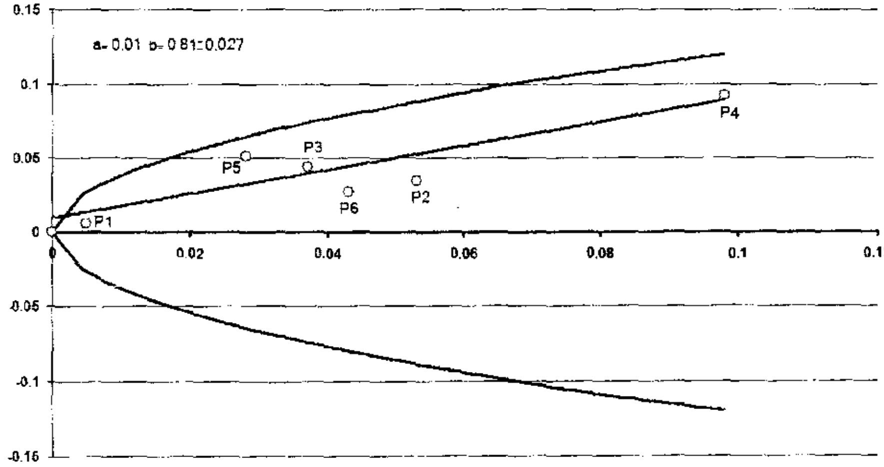

Fig. 3. graphical analysis for straw yield/plant at N_3.

b - Oil percentage:

For Oil percentage (Figures 4, 5 and 6) the slope of the regression lines (b) were less than unity, where the values of regression coefficient (b) were : (b_1 = .0.34 ± 0.03) at N_1; (b_2 = 0.40 ± 0.02) at N_2 and (b_3 = 0.47 ± 0.04) at N_3.Also, in N1 the regression line intercepted the (Wr) axis above the origin point, partial dominance is exciting. Meanwhile, under N2 the regression passed through the original point , so complete dominance was exciting. Under N3, the regression line intercepted the (Wr) axis below the origin, over dominance was exciting. On the other side, under N_1, the parent P_4 only possessed recessive genes, where it fall farther from the origin. Furthermore, in N_1, the parents P_1, P_2, P_3 and P6 possessed equal frequencies of dominant and recessive genes, where they occupied an intermediate position, also the parent P_5 possessed more dominant genes, where it located nearer to the origin. With respect to N_2, approximately the same direction was found. Moreover, under N_3 the parent P_4 only possessed recessive genes, where it fall farther from the origin, the parent P_6 only equal frequencies of dominant and recessive genes, where it occupied an intermediate position. Finley, at N_3, the parents P_2, P_3 and P_5 possessed more dominant genes, where they located nearer to the origin.

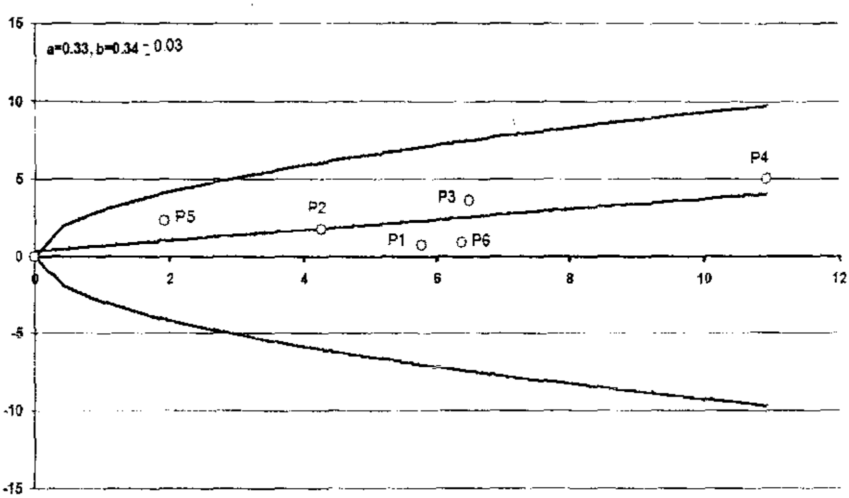

Fig. 4. g graphical analysis for oil percentage at N_1.

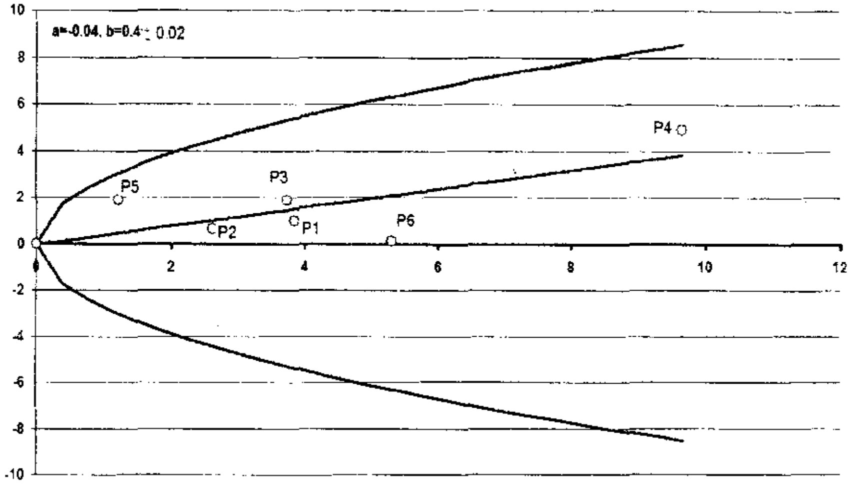

Fig. 5. graphical analysis for oil percentage at N_2.

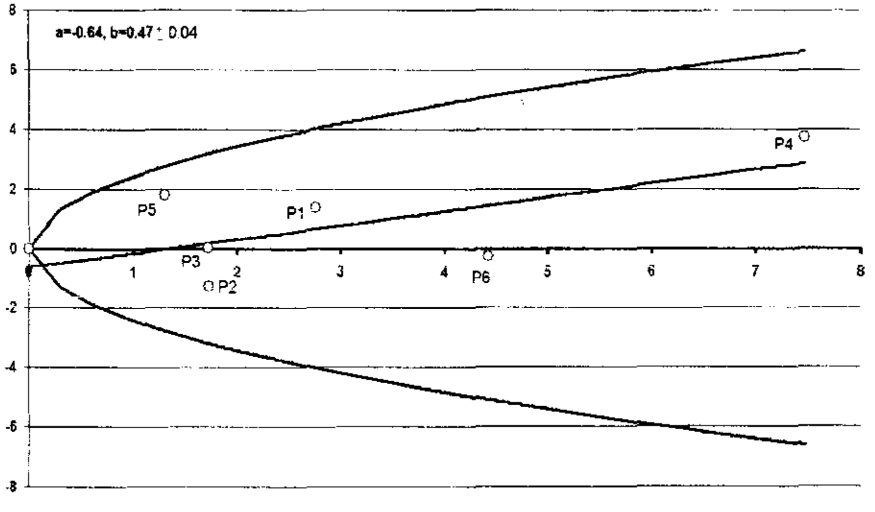

Fig. 6. graphical analysis for oil percentage at N_3.

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التحليل الوراثى لبعض الصفات الاقتصادية فى الكتان

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الملخص العربى

أجريت هذه الدراسة خلال موسمى ٢٠٠٧/٢٠٠٦ و ٢٠٠٨/٢٠٠٧ في محطة البحوث الزراعية بالجميزه. بهدف دراسة النقاط التالية:

١- تقييم بعض التراكيب الوراثية المحلية والمستوردة من الكتان والهجن الناتجة منها تحت ثلاثة مستويات تسميد نيتروجينى مختلفة (٣٠ و ٤٥ و ٦٠ كجم نيتروجين / فدان) لبعض الصفات الخضرية والتكنولوجية.

٢- دراسة كل من القدرة العامة والخاصة وتفاعلاتها مع الثلاثة مستويات المختلفة من التسميد النيتروجيني لجميع الصفات المدروسة.

٣- دراسة طبيعة توارث الفعل الجينى لصفتى محصول القش والنسبة المئوية للزيت المختلفة تحت معدلات التسميد النتروجين الثلاثة.

ولتحقيق هذه الأهداف تم في الموسم الأول عمل كل الهجن الممكنه بما في ذلك الهجن العكسيه في تصميم الهجن التبادليه متضمنة ستة تراكيب وراثيه من الكتان كآباء هى . جيزة ٨، سخا ٢، سخا ٤، ايلونا، س٢٢ و سخا ٣). وفي الموسم الثاني ٢٠٠٨/٢٠٠٧ أجريت ثلاثة تجارب منفصلة ومتجاورة، تشتمل كل واحدة منها على ٣٦ تركيبا وراثيا (الآباء الستة والثلاثون هجينا الناتجة منها). وقد اختبرت التراكيب الوراثية فى ثلاثة تجارب كل منها تمثل مستويات التسميد النتروجينى الثلاثة٣٠ و٤٥ و ٦٠ كجم نيتروجين للفدان. وقد نفذت التجارب الثلاثة كل على حدة فى تصميم القطاعات الكاملة العشوائية بثلاثة مكررات.

وأخذت البيانات للصفات التالية : عدد الأيام حتى النضج، محصول القش للنبات، معامل البذور ومحصول البذور/نبات والنسبة المئوية للزيت.

وقد قدرت قيم التباينات وتأثيرات القدرة العامة والخاصة على التآلف والهجن العكسية (تـــم حسابها وفقا لطريقة جريفينج (١٩٥٦) الطريقة الأولى – الموديل الأول).وقدرت قيم الفعل الجينى ورسومها البيانية بطرق هايمن (١٩٥٤ ا,ب).

ويمكن تلخيص أهم النتائج المتحصل عليها كمايلى :

١- كان هناك تباين واضح فى متوسطات التراكيب الوراثيه الأبويه والهجن وللصفات المختلفة تحت مستويات التسميد وفى التحليل المشترك. و كان التأثير الأمى واضحاً فى متوسطات بعض الهجن.

٢- كانت تأثيرات القدرة العامة على التآلف موجبة أو مرغوبة ومعنوية فى الصنف الأبـــوى سخا ٢(P_2) والسلالة الأبوية س٢٢ (P_5) لأغلب الصفات المدروســـة تحـــت مـــستويات التسميد الثلاثه المختلفة وفى التحليل المشترك.

٣- بناءً على نتائج التحليل المشترك، كانت تأثيرات القدرة الخاصة علـــى التـــآلف موجبـــة أو مرغوبة ومعنوية لصفة محصول قش النبات فى ثلاثـــة هجـــن (P_2 x P_4, P_4 x P_6 و P_6 x P_4) عند المستوي التسميدي الأول، الثالث وتحليلهم المشترك، فى هجـــين واحـــد (P_4 x P_2) عند المستوى التسميدى الأول والتحليل المشترك وفى هجين واحـــد (P_3 x P_5) عند التحليل المشترك. وقد أعطت الخمسة هجن P_3 x P_4, P_3 x P_5, P_2 x P_1, P_4 x P_6 و P_6 x P_4) أعلى القيم للتأثيرات المعنوية الموجبه لهذه الصفه. أمـــا بالنـــسبة لصفة النسبة المئوية للزيت فقد أظهر الأربعة عشرة هجينـــا (P_2 x P_1, P_1 x P_3, P_4 x P_1, P_1 x P_5, P_5 x P_1, P_2 x P_4, P_4 x P_2, P_2 x P_6, P_6 x P_2, P_3 x P_6, P_5 x P4, P4 x P_6, P_6 x P_4 و P_6 x P_3) تأثيرات موجبه عاليـــة المعنويـــه ومرغوبة عند المـــستويات التـــسميدية الثلاثة وتحليلهم المـــشترك، فـــى حـــين أعطـــى الهجين (P_3 x P_1) عند المستوى التسميدى الأول, الأربعة هجن P_1 x P_4, P_2 x P_5, P_5 x P_2 و P_3 x P_4) عند المستوى التسميدى الأول, الثانى والتحليل المشترك, الهجين (P_4 x P_3) عند المستوى التسميدى الثانى, الثالث والتحليل المشترك، الهجـــين (P_5 x P_3) عند المستوى التسميدى الأول والتحليل المشترك والهجين (P_6 x P_5) عند المستوى

التسميدى الثالث تأثيرات موجبة معنوية مرغوبة لهذه الصفه وأعطـى الهجينان $P_4 x$ ($P_1 x P_3$ و P_1) أعلى القيم الموجبه لهذه الصفه.

٤ – أظهرت تحليلات طبيعة الفعل الجينى لصفتى القش/نبات والنسبة المئويـة للزيـت بـأن تأثيرات الفعل الجينى الوراثى المضيف (D) هى السائدة والمهمـة فـى تـوارث هـاتين الصفتين تحت مستويات التسميد الثلاثة. كذلك كانت التأثيرات الوراثية الـسيادية ($\hat{H}1$) معنوية للصفتين.

وأظهرت نتائج الرسوم البيانية الوراثية للآباء كل على حدة لصفتى محـصول القـش/نبـات والنسبة المئوية للزيت بأن نسب درجات السيادة قد تراوحت بين السيادة الكاملة والجزئيـة والفائقة عند مختلف معدلات التسميد النتروجينى.

٥ – كانت معدلات التسميد ٦٠ كجم/فدان هى أفضل المعاملات السمادية لجميع الصفات فيمـا عدا صفة النسبة المئوية لمحصول الزيت ، وقد تفوقت المعاملة السمادية ٣٠كجـم/فـدان للحصول على أعلى عائد.