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VARIATIONS AMONG MAIZE (*Zea mays*, L.) S1-FAMILIES UNDER VARIABLE NITROGEN FERTILITY LEVELS

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ABSTRACT

The present study was carried out at the Agricultural Experiment Station, Alexandria University, Alexandria, during the summer seasons of 2004 and 2005.The main objective of the present study was to examine the variation among S_1- families in ear yield and related traits under variable nitrogen fertilizer levels. In 2004 summer season, an isolated plots of about 0.10 ha was planted with the base population (Alex. 5). Before flowering 300 plants were selected and selfed to produce S_1 seeds. At harvest, the heaviest 90 selfed ears were selected and each ear was considered as an S_1-line.In summer season of 2005, 90 S_1-families were evaluated in six sets, each included 15 S_1-family, replicated two times. Each replicate was divided to three main plots. The main plots received 60, 90 and 120 kilogram nitrogen per faddan. Whereas, the sub-plots received the 15 tested S_1-families.

The most important obtained results from this study could be summarized as follows:

1. *The variations among S_1-families in ears yield/ plot was highly significant, indicating the potentiality for further selection. Also, the interaction between populations and nitrogen levels was significant ($p \geq 0.01$).*
2. *The obtained figures indicated the presence of significant genetic variations between S_1-families for all studied yield and yield components characters (ears yield/ plot, ear length, ear width, number of rows/ ear, number of kernels/ row and 100-kerenl weight). Genetic variations were also significant for plant and ear height.*
3. *The largest phenotypic coefficient of variability was expressed for ears yield/ plot (17.08%).*
4. *Estimates of heritability for yield and yield components were relatively low (from 27.26% to 48.17%). Also, estimates of heritability for agronomic characters were very low (from 6.94% to 18.96%).*

Key words; S_1- Family, Variability, nitrogen fertility, heritability.

INTRODUCTION

Maize (*Zea mays* L.) is one of the most important summer crops in Egypt, occupying around 30% of the cultivated area. It is used to supplement food and feed. In addition, it is a major component in several important industries such as corn oil, starch and sucrose-sugar. Maize productivity in Egypt in the last ten years has increased, where, reached 8.0 tons per hectare. Consequently, total national production of maize is about 6.0 million tons, mostly of white grains. The annual domestic demand is about 8.0 million tons. Accordingly, about 2.0 million tons are annually imported, all of yellow grains and totally consumed in feed industry. In order to reduce imports, governmental efforts are devoted to increase the total production through the use of high yielding hybrids.

Nitrogen – use efficiency in maize (*Zea mays* L.) has been defined as grain produced (GW) per unit of nitrogen applied (NA) and expressed as GW/Na (Moll *et al.*, 1982). While,

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Sattelmacher *et al.*, (1994) reported that, nitrogen-use efficiency is defined as the ability of a genotype to produce superior grain yields under low soil nitrogen conditions in comparison with other genotypes.Genotypic differences in nitrate absorption and partitioning of nitrogen among plant parts in maize had been reported (Chevalier and Schrader, 1977). They reported significant differences in NO_3^- uptake per plant among the ten tested genotypes (Four inbred lines and six F_1 hybrids derived from their half diallel), but there was no relationship between NO_3^- removed by F_1 hybrids and that removed by their inbred parents. Their results indicated that the reduced nitrogen concentration of stems and leaf sheeths was higher in inbreds than in hybrids. Thus, inbred may be more efficient at reducing nitrogen than hybrids, or less efficient at remobilizing this nitrogen to the ear.

Genotypic variation and relationships among nitrogen-related traits in maize hybrid progenies had been reported (Rizzi *et al.*, 1995). Their results showed that, wide differences exist in the sample of inbred lines evaluated for the nitrogen-related traits examined in this study, particularly with regard to NO_3-N content in plants at anthesis. Moreover, genotypic variances and heritability estimates for these traits were sufficiently large to suggest that selection to improve nitrogen-use efficiency should be possible. This may be of some value in breeding programs aiming to produce maize plants that take up and use NO_3 from moderately fertile soils more efficiently. The results also confirmed that, maize plants can accumulate excess stalk NO_3-N in heavily fertilized soils, which might temper the need for postanthesis nitrogen. No significant negative correlations between grain yield and plant nitrogen-related traits were observed at either of the nitrogen levels.One hundred forty-four half-sib families were evaluated in N- and N+ environments (Santos *et al.*, 1995). Their results suggested that, the best strategy for development of material adapted to nitrogen stress is selection in nitrogen-environments. Analysis of variance indicated genetic differences between families. There was sufficient genetic variability for improvement in both environments. The estimate for additive variance was lower in the N- than in the N+ environment. The expected genetic progress was 12.8 g/plant in the N- environment, which was 66% of that in the N+ one.

Identification of maize lines with contrasting responses to applied nitrogen had been reported (Medici *et al*, 2005). Their results revealed that, the interactive behavior of all the traits cited indicates that, they have different genetic controls at each nitrogen level. The existence of genotype-environment interaction may mean that, the best genotype at a low nitrogen level was not the best at a high nitrogen level, and that, the physiological mechanisms as well the genes required for high performance were to some extent different. These results also demonstrate that, the response to nitrogen of these traits was under separate controls for each one, because they did not exhibit consistency in the tested lines. The correlations indicated that, the anthesis-silking interval and prolificacy were associated more with grain yield at low-nitrogen availability, supporting the idea that, these traits can be used to select maize tolerant to low-nitrogen soils. The contrasting responses to nitrogen availability indicated that, these lines are important plant materials for use in further studies of nitrogen use efficiency.

The main objectives of the present study was to:

i) examine the variation among S_1- families in ear yield and related traits under variable nitrogen fertility levels
ii) Estimate heritability and expected gain from selection for yield, yield components and plant characters.

MATERIALS AND METHODS

The present study was carried out at the Agricultural Experiment Station, Alexandria University, Alexandria, during the summer seasons of 2004 and 2005.

Base Population

Alexandria 5 population, which is a multi-line yellow seed synthetic developed by the Crop Science Department, Alexandria University, for earliness and reasonable yield.

S_1-families

In 2004 summer season, an isolated plots of about 0.10 ha was planted with the base population (Alex. 5). Before flowering, 300 plants were selected and selfed to produce S_1 seeds. At harvest, the heaviest 90 selfed ears were selected and each ear was considered as an S_1-line.

Families evaluation

In summer season of 2005, 90 S_1-families were evaluated in six sets, each included 15 S_1-families, replicated two times. Each replicate was divided to three main plots. The main plots received 60, 90 and 120 kilogram nitrogen per faddan. Whereas, the sub-plots received the 15 tested S_1-families. **Table (1)** illustrate the form of combined analysis of variance across sets by the analysis of variance procedure for split-plot design. S_1-lines were considered random effect, while nitrogen levels were considered fixed effect.

The plot size was 2.1 m^2 representing one row 3.0 meters long and 0.7 m apart.

Table (1): Form of combined analysis of variance for sets with nitrogen and S_1-lines as split-plot design.

Source of variance	d.f.	M.S	E.M.S.
Sets (S)	5		
Reps./Sets (Ea)	6		
Nitrogen (N)	2		
N X S	10		
Nitrogen × Sets/ Reps. (Eb)	12		
Lines/Sets	84	M_3	$\sigma^2_e + rn\sigma^2_L$
Lines× Nitrogen/ Sets	168	M_2	$\sigma^2_e + r\sigma^2_{LN}$
Reps× lines× Nitrogen/ Sets (Ec)	252	M_1	σ^2_e

Where;

S= number of sets

σ^2_e = error variance which represents environmental variation.

σ^2_L= variance component among S_1 and is a function of the genetic variance.

r = number of replications.

$\sigma^2_L (S_1) = a\,\sigma_A^2 + b\sigma_D^2$

Where a and b are unknown and their values would depend on the gene frequency of the original population. Assuming that dominance variance (σ^2_D) is less important than additive genetic variance, (Hallauer and Miranda, 1981). The expected value of σ^2L (S_1) would be reduced to:

$$\sigma^2_L (S_1) = \sigma^2_A$$

The variance components were calculated from the observed mean squares as follows;

$\sigma^2_L (S_1) = M_3\text{-}M_1/rn$

$\sigma^2_{LN} = M_2\text{-}M_1/r$

$\sigma^2_e = M_1$

$\sigma^2_{ph} = \sigma^2_L + \sigma^2_e/6$

Genetic components of variations were estimated as follows;

-Heritability (H) = σ^2_L/σ^2_{ph} (Hallauer and Miranda, 1981).

Where;

σ^2_L = the genetic variation among S_1-lines.

σ^2_{ph} = the phenotypic variation.

- **Predicted selection response** was calculated using the formula adapted by Falconer (1981) as follows:

$$\Delta G_{(\alpha)} = K_\alpha . H. \sigma_{ph}$$

Where;

K_α= the selection differential for α selection intensity ($K_{0.10}$ = 1.76)

σ_{ph}: square root of phenotypic variation.

- **The percentage of predicted genetic advance under selection response (G%)** was calculated as;

$$G\,\% = \frac{\Delta G}{\overline{X}} \times 100$$

Where;

$\overline{X}$= the overall mean

- **The C.V. values for the phenotypic and genotypic variation** were calculated as follows:

$$P.C.V. = \frac{\sqrt{\sigma^2_{ph}}}{\overline{X}} X100$$

$$G.C.V. = \frac{\sqrt{\sigma^2_L}}{\overline{X}} X100$$

RESULTS AND DISCUSSION

The base population for the recent study was (Alexandria 5) a multi-line yellow seed synthetic developed by the **Crop Science Department, Alexandria University**. Divergent S_1-line selection for nitrogen use-efficiency was examined. Three synthetics were obtained at the end of the selection schemes. These were; a) C_1S_1 (L); cycle one of S_1-family selection for low nitrogen input, b) C_1S_1 (M); cycle one of S_1-family selection for moderate nitrogen input and c) C_1S_1 (H); cycle one of S_1-family selection for high nitrogen input.

S_1-Families evaluation:

Table (2) show the range (g/ plot), overall mean (g/ plot) and coefficient of variability (C.V.) for ears yield/ plot of 90 S_1-families evaluated under three nitrogen regimes, i.e., low (60 kg N/ faddan), moderate (90 kg N/ fadden) and high (120 kg N/ faddan). Range of variation in ears yield per plot varied for S_1-Families with variable nitrogen input. Where, a range of 1733 g/ plot (From 352 to 2085 g/ plot) was recorded with low Nitrogen input versus a range of 1994 g/ plot (From 228 to 2222 g/ plot) with high nitrogen input. The highest producing S_1-family produced as great ears yield as 6, 5 and 9 times that of the lowest producing S_1-family under gradient nitrogen supply (2085, 2550 and 1994 versus 352, 550 and 228 g/ plot, respectively). In the meantime, the mean of the superior selected ten percent

S_1-families were 148, 149 and 164 percent of the respective overall mean for low, medium and high nitrogen environments, respectively.

Table (3) illustrated the analysis of variance for ears yield/ plot of the evaluated S_1-families as combined across sets by the procedure for split-plot design, where, S_1-families were considered of random effect, while nitrogen levels were considered fixed. The variations among S_1-families in ears yield/ plot was significant, indicating the potentiality for further selection.

Significant differences among the tested S_1-families were further indicated by many grain yield components, namely; ear length, ear width, 100-kernel weight, number of rows/ ear, shelling percentage and moisture percent. The frequency distribution for yield of ears per plot of the 90 evaluated S_1-families under the three nitrogen regimes are presented in Table (4) for Low nitrogen input, Table (5) for medium nitrogen input and Table (6) for high nitrogen input. The average ears yield/ plot of the upper 10% S_1-families were 1955, 2156 and 1950 (g/ plot) under the three descending nitrogen levels, respectively.

The estimate of genetic variability among S_1-families was assumed to be equal to the additive genetic variance (σ^2_A). Estimates of additive genetic variance (σ^2_A), environmental plot variance (σ^2_e) were calculated from the analysis of variance of families evaluation's experiment (Table 7). Generally, the obtained figures indicated the presence of significant genetic variations within S_1-families for all studied yield and yield components characters (ears yield/ plot, ear length, ear width, number of rows/ ear, number of kernels/ row and 100-kerenl weight). Genetic variations were also significant for plant and ear heights. In the meantime, the magnitude of environmental variance was relatively high. This had contributed to the obtained values of the phenotypic coefficient of variability indicated in Table 7. The largest phenotypic coefficient of variability expressed for ears yield/ plot (17.08%). Meanwhile, 100-kernel weight, number of kernels/ row and ear length was the most phenotypically variable yield components with P.C.V. values descending as 10.6, 9.94 and 8.4%, respectively. Genotypic variability expressed as G.C.V. % followed similar trend.

The coefficient of genetic variability calculated as a ratio of the square root of the variance component of S_1-families (σ^2_{S1}) to the mean of the experiment. The obtained value for genetic coefficient of variability was 8.92 percent, indicating a reasonable genetic variability within the tested families.

Table (2): Range, overall means, mean of selected families, coefficient of variability (C.V.%) for yield of ears/ plot of families evaluation experiment:

Statistic	Value		
	Low nitrogen (60 kgN/ faddan)	medium nitrogen (90 kgN/ faddan)	High nitrogen (120 kgN/ faddan)
Range (g/ plot)	352 - 2085	550 - 2550	228 - 2222
Overall mean (g/ plot)	1319	1445	1189
Mean of selected Families (g/ plot)	1955	2156	1950
Coefficient of variability(C.V.%)	28.97	27.34	37.42

Table (3): Analysis of variance for yield and yield components of S_1-families during 2004 season combined over sets.

S.O.V	d.f.	Mean squares											
		Ear yield (g/ plot)	Ear length (cm)	Ear width (cm)	100-kernel weight (g)	Number of rows/ ear	Number of kernels/ row	Shelling percent (%)	Plant height (cm)	Ear height (cm)	% moisture	50% tasselling	50% silking
Sets (S)	5	2432.714**	28.469**	1.8402**	83.862**	19.312**	228.776**	135.338$^{n.s}$	5799**	1773**	4.372**	22.149**	63.730**
Reps./s (Ea)	6	555065	3.499	0.2468	83.399	2.658	16.129	107.407	1728	246	1.215	8.918	5.087
Nitrogen (N)	2	3017309**	27.885*	1.6867$^{n.s}$	3.855$^{n.s}$	10.400*	147.488*	37.370$^{n.s}$	3627**	821$^{n.s}$	0.216$^{n.s}$	14.846$^{n.s}$	22.451$^{n.s}$
S × N	10	524076$^{n.s}$	17.647*	1.2633$^{n.s}$	31.620$^{n.s}$	7.186*	85.966$^{n.s}$	119.963$^{n.s}$	2097*	857$^{n.s}$	1.474*	9.528$^{n.s}$	18.556$^{n.s}$
N × S/ Reps Error (b)	12	388979	4.408	0.6338	23.683	1.877	36.194	113.730	526	466	0.383	7.774	11.131
Lines/S (L)	84	309401*	7.654*	0.4416*	35.720**	4.008*	37.209$^{n.s}$	114.395*	616*	252$^{n.s}$	2.296**	1.998$^{n.s}$	3.419$^{n.s}$
L × N/S	168	259922*	5.841**	0.5364*	29.311**	4.046**	39.128*	135.077**	665*	232*	1.636*	2.508*	3.757$^{n.s}$
L×R×N/ sets Error (c)	252	225049	5.564	0.4327	18.538	2.7066	28.645	85.147	573	204	1.197	2.373	3.977

*** and **; indicates significance at 0.05 and 0.01 levels of probability, respectively.**

n.s.; not significantly different.

Table (4): Means of ears yield for the 90 tested S_1-families evaluated under 60 kilogram nitrogen/ faddan:

S_1-family No.	Yield of ears (g)	S_1-family No.	Yield of ears (g)	S_1-family No.	Yield of ears (g)	S_1-family No.	Yield of ears (g)
1	1352	27	(1887)	53	1096	79	(1895)
2	896	28	1766	54	957	80	1445
3	1587	29	1682	55	1372	81	1205
4	1037	30	352	56	1025	82	1188
5	1127	31	1307	57	1320	83	1643
6	1668	32	675	58	1606	84	1363
7	955	33	1466	59	1063	85	1207
8	837	34	1231	60	1025	86	(1906)
9	1753	35	750	61	(1996)	87	1525
10	587	36	1748	62	928	88	1466
11	1066	37	1385	63	1695	89	1340
12	1666	38	993	64	1242	90	1325
13	1347	39	1225	65	1625		
14	1778	40	1093	66	1053		
15	1427	41	1478	67	1352		
16	(1991)	42	1237	68	875		
17	1703	43	1251	69	733		
18	712	44	1537	70	741		
19	1272	45	1478	71	1301		
20	1402	46	1540	72	560		
21	593	47	(2012)	73	1692		
22	(2085)	48	1638	74	1160		
23	900	49	1295	75	1273		
24	1500	50	1137	76	(1920)		
25	1660	51	1153	77	(1903)		
26	1312	52	686	78	1517		

Table (5): Means of ears yield for the 90 tested S_1-families evaluated under 90 kilogram nitrogen/ faddan:

S_1-family No.	Yield of ears (g)	S_1-family No.	Yield of ears (g)	S_1-family No.	Yield of ears (g)	S_1-family No.	Yield of ears (g)
1	1257	27	1300	53	1727	79	1145
2	1220	28	1898	54	(2213)	80	1245
3	1125	29	1236	55	1102	81	(2350)
4	(2120)	30	1482	56	1631	82	1526
5	816	31	912	57	975	83	1446
6	981	32	1987	58	1210	84	1287
7	1460	33	550	59	1437	85	1017
8	1875	34	1987	60	1731	86	1791
9	1512	35	1493	61	1111	87	1002
10	1746	36	1975	62	1226	88	1683
11	966	37	1737	63	1615	89	1566
12	1205	38	1550	64	897	90	1115
13	1305	39	1306	65	947		
14	1741	40	1640	66	1407		
15	1316	41	1685	67	1877		
16	(2130)	42	968	68	842		
17	1426	43	1932	69	1061		
18	(2020)	44	1360	70	1108		
19	(1992)	45	1390	71	835		
20	1495	46	1780	72	1283		
21	1258	47	1250	73	1182		
22	(2550)	48	(2008)	74	1408		
23	1150	49	1307	75	1777		
24	1390	50	1371	76	1375		
25	1750	51	1553	77	1661		
26	(2027)	52	1040	78	750		

Table (6): Means of ears yield for the 90 tested S_1-families evaluated under 120 kilogram nitrogen/ faddan:

S_1-family No.	Yield of ears (g)	S_1-family No.	Yield of ears (g)	S_1-family No.	Yield of ears (g)	S_1-family No.	Yield of ears (g)
1	1333	27	885	53	1362	79	1087
2	1410	28	1080	54	1582	80	525
3	1578	29	(1888)	55	978	81	(2222)
4	1376	30	(1852)	56	(1825)	82	902
5	550	31	900	57	1500	83	1363
6	1043	32	763	58	1147	84	1366
7	1475	33	833	59	1170	85	1252
8	(1826)	34	737	60	1578	86	1361
9	1181	35	1016	61	228	87	1781
10	833	36	1153	62	637	88	1095
11	1032	37	1175	63	1130	89	616
12	1103	38	1113	64	316	90	1032
13	1085	39	1072	65	1036		
14	1366	40	778	66	1576		
15	1250	41	1480	67	858		
16	1347	42	482	68	566		
17	1628	43	756	69	475		
18	1666	44	1250	70	395		
19	1341	45	(1895)	71	312		
20	1050	46	1507	72	390		
21	1596	47	(1850)	73	500		
22	961	48	855	74	1282		
23	1737	49	1791	75	1177		
24	1213	50	1638	76	(2175)		
25	(2016)	51	1578	77	1116		
26	1475	52	1300	78	1041		

Table (7): Estimates of genetic variance (σ^2_L), environmental variance (σ^2_e), narrow-sence heritability (H), expected gain from selection (Δg), relative gain from selection (G%), phenotypic and genotypic coefficients of variability (P.C.V. and G.C.V.%).

Character	σ^2_L	σ^2_e	H	Δg	G%	P.C.V.%	G.C.V.%
I- Yield and yield components							
Ear yield/ plot (g)	14058*	37508	27.26	108.94	8.19	17.08	8.92
Ear length (cm)	0.348*	0.927	27.29	0.542	4.012	8.35	4.36
Ear width (cm)	1.48×10^{-3}*	0.0721	2.01	4.143×10^{-3}	0.096	6.29	0.89
Number of rows/ ear	0.217*	0.451	32.48	0.46	3.38	6.01	3.43
Number of kernels/ row	$1.42^{n.s}$	4.77	22.94	1.00	4.01	9.94	4.76
100-kernel weight (g)	2.863**	3.08	48.17	2.066	8.97	10.58	7.34
II- Agronomic characters:							
Plant height (cm)	7.132*	95.55	6.94	1.237	0.65	5.34	1.40
Ear height (cm)	$7.967^{n.s}$	34.047	18.96	2.162	2.52	7.57	3.29
% Moisture	0.183	0.199	47.86	0.520	3.530	4.20	2.90
50% tasselling	$-0.0625^{n.s}$	0.3955	-18.76	-0.19	-0.30	0.92	---
50% silking	$-0.093^{n.s}$	0.66	-16.40	-0.217	-0.327	1.13	---

* and **; indicate significance at 0.05 and 0.01 levels of probability, respectively.
n.s.; not significantly different.

Moreover, estimates of heritability for yield and yield components were relatively low, where, ranged from 48.17% for 100-kerenl weight to 2.01% for ear width. This simply means that about 27% of variability in ears yield/ plot is of inherent nature. Estimates of heritability for agronomic characters were very low, where, reached 6.94 and 18.96% for plant height and ear height, respectively. The available review about the magnitude of heritability estimates in maize is variable. Nawar *et al.* (1983) reached narrow-sence estimates in Alexandria- 1 Synthetic of 63.9% for ear height, 57.4% for plant height, 50.5% for ear height, 44.4% for grain yield and 32.9% for ear width. Moreover, Nawar (1985) in the composite variety (Sheddwan-3) obtained high estimates for narrow-sence heritability of plant height (87.0%), ear height (73.0%) and number of kernels/ row (91.0%). While, the obtained estimates for yield was low amounted to 34.0%. EL-Hosary (1987) in Cairo-1 maize population, showed that, narrow-sence heritability ranged from 67.09% for number of kernels/ row to 23.53% for number of rows/ ear. Arha *et al.* (1990) recorded high values for heritability of plant and ear heights and ear length. Nawar *et al.* (1995a) in Giza-2 population reached estimates of heritability of 46% for yield, 8% for number of rows/ ear, 5% for number of kernels/ row, 13% for 100-kernels weight, 37% for ear length, 11% for ear diameter, 21% for plant height, 43% for ear height, 96% and 94% for tasseling and silking date, respectively. Furthermore, Nawar *et al.* (1995b) in composite-5, recorded a narrow-sence heritability value of 10% for yield. EL-Sheikh and Ahmed (2000) obtained a narrow-sence heritability ranged between 31.5% for days to silking to 80.5% for grain yield in one cross and from 42.9% for plant height to 89.9% for grain yield in another cross of maize.

In addition, the expected gain in ears yield from selecting the upper 10% S_1-families reached 8.19% of the base population which amounted to 108.9 g/ plot. Expected correlated relative gain in yield components ranged from about 9% for 100- kernel weight to about 4% for number of kernels/ row and ear length. The effectiveness of S_1-family selection were reported by many workers, (Moll *et al.*, 1987, Kling *et al.*, 1996 and Kamara *et al.*, 2003).

In Conclusion;

1. The variations among S_1-families in ears yield/ plot was highly significant, indicating the potentiality for further selection. Also, the interaction between populations and nitrogen levels was significant ($p \geq 0.01$).
2. The obtained figures indicated the presence of significant genetic variations between S_1-families for all studied yield and yield components characters (ears yield/ plot, ear length, ear width, number of rows/ ear, number of kernels/ row and 100-kerenl weight). Genetic variations were also significant for plant and ear height.
3. The largest phenotypic coefficient of variability had expressed for ears yield/ plot (17.08%).
4. Estimates of heritability for yield and yield components were relatively low (from 27.26% to 48.17%). In addition, estimates of heritability for agronomic characters were very low (from 6.94% to 18.96%).

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الملخص العربى

التصنيفات بين سلالات الجيل الأول للتلقيح الذاتي تحت مستويات متنوعة من التسميد الآزوتى فى الذرة الشامية

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تمت الدراسة الحالية علي محصول الذرة الشامية بمحطة البحوث الزراعية التابعة لجامعة الإسكندرية، بالإسكندرية خلال موسم الصيفي للسنوات ٢٠٠٤ و ٢٠٠٥ بهدف إختبار الإختلافات بين عائلات الجيل الأول للتلقيح الذاتي من حيث (S_1) من حيث محصول الكيزان والصفات المرتبطة وذلك تحت مستويات مختلفة من التسميد الأزوتي.

زرعت عشيرة الأساس للدراسة (إسكندرية ٥) في قطع حقلية معزولة مساحتها حوالي ٠,١ هكتار خلال صيف عام ٢٠٠٤. قبل الإزهار تم إختيار ٣٠٠ نبات لقحت ذاتياً لإنتاج حبوب ذاتية الإخصاب. وعند الحصاد تم إختيار أثقل٩٠ كوز ذاتي الإخصاب، حيث أعتبرت حبوب كل كوز عائلة ذاتية التلقيح لجيل واحد (S_1-line). خلال موسم صيف ٢٠٠٥، تم تقييم عائلات الجيل الأول للتلقيح الذاتي (٩٠ عائلة) في ستة مجموعات (sets) كل مجموعة تضم ١٥ عائلة فى مكررتين. وقد قسمت كل مكررة إلي ثلاثة قطع رئيسية عوملت بمستويات ٦٠ أو ٩٠ أو ١٢٠ وحدة أزوت للفدان. أما القطع الفرعية داخل كل قطعة رئيسية فقد زرع فيها عائلات الجيل الأول للتلقيح الذاتي. ، ويمكن تلخيص أهم النتائج المتحصل عليها في التالي:-

١. الإختلافات بين عائلات الجيل الأول للتلقيح الذاتي في صفة محصول الكيزان للوحدة التجريبية، كانت عالية المعنوية، مما يدل علي إمكانية الإنتخاب المستقبلي، وأيضاً كان تفاعل العائلات مع مستويات التسميد الأزوتي معنوياً (مستوي معنوية ٠,١).
٢. دلت البيانات المتحصل عليها علي وجود تباين وراثي معنوي بين عائلات الجيل الأول للتلقيح الذاتي المختبرة، في صفات المحصول ومكوناته وكذلك صفات إرتفاع النبات والكوز.
٣. أعلي قيمة لمعامل الإختلاف المظهري سجلت لصفة محصول الكيزان للوحدة التجريبية حيث بلغت ١٧,٠٨%.
٤. تقديرات معامل التوريث بالمعنى الضيق لصفات المحصول ومكوناته كانت منخفضة نسبياً (من ٢٧,٢٦ إلي ٤٨,١٧ %). كما كانت تقديرات معامل التوريث للصفات المحصولية منخفضة جداً (من ٦,٩٤ إلي ١٨,٩٦%).