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INHERITANCE OF GRAIN YIELD AND OIL CONTENT IN NEW MAIZE HIGH OIL SINGLE-CROSSES

F. H. S., Soliman[1], SH. A. Shafay[2], A. I. El-Agamy[2] and M. A. Mostafa[1]

[1] Maize Res. Prog., Field Crops Research Institute ARC, EGYPT
[2] Department of Agronomy, Faculty of Agric, Al-Azhar Univ., Cairo.

ABSTRACT

Fourteen yellow maize inbred lines derived from different segregating generations of Pop. Sk-21, Pop.59E and local open pollinated variety were top crossed to each of three inbred tester lines, T-1, T-2, and T-3, which were derived from Iowa High Oil Syn#1 (B.1934), Iowa High Oil Syn#2 (B.1935) and a local variety, respectively at South Valley Agric. Res. Station, Toshka region under drip irrigation system in 2003 season. Top crosses were evaluated in field trials at Sakha and Sids Agric. Res. Stations during 2004 season. Data for grain yield, oil percentage and oil yield were collected to estimate the combining ability effects, type of gene action and select the most superior promising single cross(es).

Results indicated that significant of mean squares were detected due to the top crosses, parental inbred lines, tester lines and line x tester interactions for the three traits at each location and for their combined analysis, except tester lines at each location and combined across locations as well as parental inbred lines at Sids for oil yield. However, combined data over the two locations indicated that 9 out of the 42 single crosses i.e. (L-1 x T-1), (L-5 x T-1), (L-8 x T-1), (L-11 x T-1), (L-2 x T-2), (L-11 x T-2), (L-1 x T-3), (L-10 x T-3) and (L-13 x T-3) manifested significantly higher oil% and oil yield by at least 2.1 times than the three commercial single crosses. In the same time, these crosses, except (L-1 x T-1) and (L-2 x T-2) did not differ insignificantly in grain yield from the best commercial single cross (SC Pion3084). These crosses should be further tested for possible commercialization to improve maize productivity and oil content. Also, they might be of interest in the national breeding program for developing good new high oil inbred lines and/or composite varieties.

The best general combiner in the combined data across locations were obtained from 4, 5 and 3 parental inbred lines toward high grain yield, high oil (%) and high oil yield, respectively. Moreover, one of them (L-1) could be considered the best combiner for the three studied traits. The highest desirable SCA effects resulted from 12, 13 and 5 top-crosses for the previous three traits, respectively. However, the top-crosses (L-2 x T-2), (L-9 x T-2), (L-10 x T-3) and (L-13 x T-2) had the best specific combining ability for the three studied traits.

The magnitude of dominant genetic variances was considered to be the major source of the total genetic variance responsible for the inheritance of the three studied traits at both locations and combined over locations, except grain yield at Sakha.

Key words: ***Maize, Top-cross, Combining ability, Grain yield, Oil content.***

INTRODUCTION

High oil content is a desirable character of maize grain because of high caloric demand in feeding poultry and livestock. Also, corn oil is very useful for human nutrition because its high content of favorable essential polyunsaturated fatty acids. The first experiments on inheritance of the oil content of the corn kernel has begun with the local maize variety "Burr

White" by Hopkins at the university of Illinois in 1898 (Leng 1962). Percent oil in the kernel is a function of percent germ in the kernel and percent oil in the germ, because very little oil is present in the endosperm and they contributed by the genetic makeup (Pamin *et al* 1986). Therefore, with selection for high oil, oil content increases at rates parallel to increase in percent germ. This increase of percent germ was due to over all reduction in kernel size that began after percent oil reached 8.3%. According to Cromwell (2000) and Thomison *et al* (2003), the 2.25 fold higher content of oil compared with starch results in more metablizable energy. In high oil corn, metablizable energy level in grain approximately 150 k cal/kg (Cromwell 2000), and averaged 130 k cal/kg (Thomison *et al* (2003) more in top-cross blend compared with the ordinary hybrids. Successful developments of improved maize hybrids with good performance for grain yield and oil content is dependent on accurate evaluation of inbred lines under selection. Several high oil maize hybrids have been developed with high grain yield compared to commercial hybrids. In this respect, Jugnheimer and Williems (1959) indicated that two new corn hybrids produced 30% more oil with similar to standard hybrids in grain yield and other agronomic traits. Alexander (1974) reported that high oil hybrid (R802A x R806) gave the same grain yield as an average of four popular commercial hybrids, since oil content was 8.5 and 4.2%, respectively. Miller *et al* (1981) found that seven cycles of high intensity selection for oil content with a large effective population size in an open pollinated variety " Reid Yellow Dent" were effective in increasing oil content up to 10% without significant correlation effects on grain yield. Gajic and Savic (1983) reported that one of the examined corn hybrids (7% oil) was present in the group of the highest yielding commercial hybrids (4.5% oil). They added that the feasibility of developing corn hybrids having 8% oil content and grain yield over ten ton/ha. Misevic *et al* (1989) and Soliman *et al* (1999) found that grain yield of population crosses with intermediate oil percentage indicated that the heterotic pattern could be used for developing hybrids with 7 to 9% oil and grain yield close to the elite hybrids.

Egyptian Total oil production in Egypt has become insufficient to face the increasing requirement. Therefore, developing better performing maize hybrids with high grain oil content is considered among the main objective of the Egyptian Maize Breeding Program at ARC. In this respect, the present study was designed to:

a) Estimate both general (GCA) and specific (SCA) combining ability effects and variances among 14 inbred lines top-crossed with 3 inbred tester lines and their interactions with locations for grain yield, oil percentage. oil yield and other agronomic traits.

b) Determine the important types of gene action.

c) Selecting the best inbred lines to be utilized in hybrid breeding program and/or to be used in developing new improve synthetic variety.

d) Identify the most promising high oil and high yielding single cross hybrid(s) for possible commercial release to Egyptian Farmers.

MATERIALS AND METHODS

The present study was conducted at Sids (Middle of Egypt), South Valley (Toshka Region) and Sakha (North of Egypt) Experimental Research Stations, Agricultural Research Center during the period of 2002 to 2004 seasons.

Fourteen parental inbred lines and three tester lines derived by National Maize Research Program (NMRP), Field Crops Research Institute, Agricultural Research Center were chosen on the base of their good performance, high oil content and highly positive combining ability effects for grain yield and oil content (Soliman *et al* 2001). All materials used were yellow, dent of grain type. Pedigree, genetic base and the origins of these inbreds (Soliman *et al*, 1999 and 2001a) are presented in Table 1.

Table 1. Pedigree and base populations of the 14 parental inbred lines and the 3 tester lines.

parents		Pedigree	Base population
Parental inbred lines	L-1	63-2-1-1	Pop.SK-21 (Developed by NMRP, Egypt)
	L-2	53-3-2-1	
	L-3	61-1-2-1	
	L-4	114-2-1-1	
	L-5	132-1-1-1	
	L-6	152-1-1-2	
	L-7	7-1-1-1	Pop.59 E (Imported from Thailand)
	L-8	7-3-2-1	
	L-9	31-5-1-1	
	L-10	3-1-2-1-1-1-1	
	L-11	4-1-1-4-2-1-1	
	L-12	10-3-3-1-1-1-1	
	L-13	18-2-3-1-1-1-1	
	L-14	62-2-1-2-1	Local open pollinated variety (unknown origin)
Tester inbred lines	T-1	2-1-1-1-1	Iowa high oil Syn#1 (B.1934), USA
	T-2	3-1-3-2-1	Iowa high oil Syn#2 (B.1935), USA
	T-3	2-3-2-1-1-1	Local open pollinated variety (unknown origin)

In 2002 season at Sids Agric. Res. Station, the fourteen parental inbred lines along with the three inbred tester lines were planted in two ridges each. Self pollination was done to increase quantities of their seeds in addition to perform the advanced inbreeding generation of each lines. At maturity lines were harvested separately and kept in the farmyard until dried. An equal number of kernels from the middle part of each ear within each line were carefully shelled and bulked.

In 2003 season at South Valley Agric. Res. Station, Toshka Region, seeds representing each of the 14 parental inbred lines along with the three inbred tester lines were planted under drip irrigation system in separate plots. Plots consisted of 15 rows, 6 m long, one-meter width and 50 cm spaces between drippers. One row was used for sib-mating and the other for top-crossing. At flowering time, top-crosses were constituted by collecting a bulk of pollen grain from each tester (at least 100-plants) and then hand pollinating the respective lines. At harvest, the 42 top crosses along with the 14 parental lines and the 3 tester lines were harvested, shelled separately and stored in a cooling room.

In 2004 season, experiments were conducted at Sids and Sakha Agric, Res. Stations to evaluate the resultant 42 top crosses along with the three commercial single crosses i.e. SC Giza 155, SC Pion 3080 and SC Pion 3084. The experimental design was randomized complete block with 6 replications. Plot size was one ridge, 6 m long and 80 cm apart. Three seeds were hand planted in hills spaced 25 cm within the ridge on 25 and 16/5/04 at Sakha and Sids stations, respectively and hills were thinned to one plant/hill providing a plant population density of 21000 plants/feddan (one feddan=4200 m^2). All cultural practices were applied as recommended in the research stations. Among the 6 replications, 4 of them were used to determine grain yield and the other two replications were used to determine oil content, since plants inside each genotype were sib-mated to avoid any harmful effect of xenia on oil content (Misevic and Alexander 1989, Misevic *et al* 1989, Lambert *et al* 1998 and Soliman *et al* 1999 and 2001a).

Studied characters were

1- **Grain yield/fed** was adjusted to 15.5% grain moisture % and expressed in ardab/Feddan (one ardab=140 kg).

2- **Oil percentage**: an equal volume of kernels from the middle part of each ear from each plot was shelled and bulked for oil analysis. Percent oil was measured as an average of two samples of approximately 10 grams according to the method described in AOAC (1975) using hexane as a solvent. Oil percentage is expressed on a dry weight basis.

3- **Oil yield (kg/fed)** was calculated from the average grain yield of each entry in the first and second replication and also in the third and fourth replication, and then multiplied by oil percentage of the same entry of the fifth and sixth replicates, respectively.

Statistical analysis for separate locations and the combined analysis across locations was done according to Mcintosh (1983) using the MSTATC computer program followed by combining ability analysis according to Kempthorne (1957) as explained by Singh and Chaudhary (1979). Genotypes sum of squares and their interaction with location were partitioned into crosses, checks and crosses *vs.* checks. Also, sum of squares due to crosses and their interaction with location were further partitioned into their components, *i.e.* lines, testers and lines x tester interactions

Combining ability analysis was done for the single locations and their combined according to Kempthorne (1957) method. His design is related to design of Comstok and Robinson (1952). General (GCA), specific (SCA) combining ability effects and their standard errors are estimated according to Singh and Chaudhary (1979

From the expectation of the mean squares, half-sib and full-sib covariance are calculated, and hence the variance due to general (GCA) and SCA combining ability are estimated according to Singh and Chaudhary (1979).

RESULTS AND DISCUSSION

Analysis of variance:

Mean squares due to 14 parental inbred lines, three tester lines and their 42 top-crosses for the three traits at Sakha, Sids locations and for combined data over locations are presented in Table 2.

Combined data over the two locations (Table 2) indicated that highly significant difference between the two locations for the three studied traits. Such results indicated that these traits were affected by environmental factors.

Highly significant differences were detected among the 42 top crosses for the three traits at each location and their combined analysis. In addition, partitioning sum of square of crosses to lines, testers and lines x testers interaction, (Table 2) revealed that significant or highly significant differences were found among each of them for the three studied traits at each location and combined over locations, except tester lines at each location and combined over locations, as well as parental inbred lines at Sids for oil yield. These results indicated that a great diversity existed among parental lines and among tester lines, which contributed to the variability among their top-crosses. Moreover, variance due to tester lines contributed much more than variance due to parental lines for the genetic

Table 2 Mean squares of line x tester analysis for grain yield (ard/fed), oil (%) and oil yield (kg/fed) at Sakha, Sids and combined over locations in 2004 season.

SOV	Grain yield			Oil				
	DF	Sakha	Sids	DF	(%) Sakha	(%) Sids	Yield Sakha	Yield Sids
Replicates (Rep)	3	27.82**	3.98	1	0.0001	1.11*	7674.8	3058.2
Genotypes (G)	44	73.49**	39.91**	44	7.64**	6.54**	23972.0**	11172.1**
Crosses (C)	41	69.15**	40.05**	41	4.58**	4.32**	20047.7**	10211.7**
Checks (Ch)	2	11.52	8.16	2	1.15*	1.06**	3955.5	3329.8*
C vs. Ch	1	374.45**	97.56**	1	146.34**	108.8**	224901.2**	66234.8*
Lines (L)	13	85.58**	19.64**	13	5.29**	2.73**	16548.4**	5335.1
Testers (T)	2	227.48**	29.31**	2	2.17**	0.99*	6432.8	1260.2
L x T	26	48.76**	57.49**	26	4.41**	5.36**	22844.6**	13338.6**
Error	132	5.97	5.92	44	0.46	0.26	5649.0	4637.6
CV %		6.92	9.81		6.94	5.56	16.31	23.02
Combined								
Locations (Loc)	1	9891.97**		1	18.50**		1237065.3**	
Rep./Loc.	6	15.90		2	0.56		5766.5	
G	44	83.03**		44	9.89**		23987.5**	
C	41	79.53**		41	4.32**		18909.5**	
Ch	2	11.13		2	2.13**		6271.1*	
C vs. Ch	1	370.25**		1	253.71**		267618.4**	
L	13	79.44**		13	4.65**		14178.6**	
T	2	97.39**		2	2.62**		5976.6	
L x T	26	80.50**		26	4.29**		22269.8**	
G x Loc.	44	30.37**		44	4.29**		11156.6**	
C x Loc.	41	29.67**		41	4.57**		11349.9**	
Ch x Loc	2	26.63**		2	0.08		1017.1	
C vs. Ch x Loc	1	66.60**		1	1.39**		23517.6**	
L x Loc	13	25.77**		13	3.37**		7704.9**	
T x Loc	2	159.40**		2	.53		1716.4	
L x T x Loc	26	25.75**		26	5.48**		13913.4**	
Pooled error	264	5.95		88	0.36		5153.3	
CV %		8.11			6.30		18.9	

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

variance among crosses for grain yield/fed, but the opposite was true for oil percentage and oil yield/fed in each location and combined analysis.

Combined analysis of variance (Table 2) showed that the mean squares due to interaction of crosses with locations and its components *i.e.* lines, testers and lines x testers were highly significant for the three studied traits, except the interaction of tester x locations for oil % and oil yield. These results indicated that parental lines and tester lines had a great diversity which contributed to the differences their cross behavior under different environmental conditions.

Mean performance:

Grain yield (ard/fed):

Mean grain yield of the 42 top-crosses and their 14 parental lines and the 3 tester lines as well as three commercial check hybrids are presented in Table 3.

In general, results in Table (3) indicated that average grain yield at Sakha (34.92 ard/fed) was highly significant higher than that at Sids (24.55 ard/fed). This result may be due to the differences in environmental conditions between the two locations.

Mean grain yield of the parental lines in their crosses with the three testers (Tables 3) was significantly higher at Sakha than that at Sids. The inbred line L-11 showed the highest grain yield in their crosses with testers (41.25, 26.95 and 34.10 ard/fed at Sakha, Sids and their combined analysis, respectively). At Sids location, there were insignificant differences in grain yield among crosses of L-1, L-5, L-8, L10 and L-11 with testers, which ranged from 26.95 to 25.18 ard/fed. On the other hand, crosses of L-12 with testers at each location and combined over locations as well as crosses of L-7 and L-9 with testers at Sids and combined over locations produced the lowest grain yield/fed.

Respecting to the tester lines (Table 3), crosses of T-1 manifested significantly the highest grain yield (37.12 and 30.55 are/fed) at Sakha and combined data, respectively and crosses of T-3 (25.36 ard/fed) at Sids. On the other direction, crosses included T-3, T-1 and T-2 gave the lowest grain yield of 31.37, 23.99 and 28.72 ard/fed at Sakha, Sids and combined analysis, respectively. The difference between crosses of T-1 and crosses of T-2 at Sids and crosses of T-1 and crosses of T-3 in combined analysis was insignificant.

Regarding the 42 top-crosses (single crosses) grain yield (Table 3) ranged from 26.22 ard/fed for (L-12 x T-2) to 45.58 ard/fed for (L-11 x T-2) at Sakha, from 17.94 ard/fed for (L-9 x T-1) to 29.94 ard/fed for (L-10 x T-1) at Sids, and from 23.34 ard/fed for (L-10 x T-2) to 36.07 ard/fed for (L-11 x T-2) in the combined analysis. However, the highest grain yields were resulted from 4, 12 and 5 out of the 42 top-crosses (more than 40.00, 27.00 and 34.00 ard/fed at Sakha, Sids and combined analysis over locations, respectively). In contrast, 6, 6 and 5 out of the 42 top-crosses gave the lowest grain yield (less than 30.0, 20.0 and 26.0 ard/fed at Sakha, Sids and combined analysis over locations, respectively). Moreover, the most

Table 3. Mean grain yield (ard/fed) for 42 top-crosses and 3 commercial single crosses as checks evaluated at Sakha, Sids and combined over locations in 2004 season.

Parents	Sakha				Sids				Combined			
	T-1	T-2	T-3	Mean	T-1	T-2	T-3	Mean	T-1	T-2	T-3	Mean
L-1	38.91	32.54	37.83	36.43	26.45	21.75	27.99	25.40	32.68	27.14	32.91	30.91
L-2	36.77	37.58	36.67	37.00	23.71	27.31	22.54	24.52	30.24	32.45	29.60	30.76
L-3	36.84	36.15	33.57	35.52	20.23	25.47	25.45	23.72	28.54	30.81	29.51	29.62
L-4	34.24	34.97	33.86	34.36	24.18	21.75	27.62	24.52	29.21	28.36	30.74	29.44
L-5	39.22	34.18	34.79	36.06	27.28	28.75	19.50	25.18	33.25	31.46	27.14	30.62
L-6	36.37	32.25	30.07	32.90	23.33	28.19	21.41	24.31	29.85	30.22	25.74	28.60
L-7	37.49	28.55	32.36	32.80	28.42	19.09	21.46	22.99	32.96	23.82	26.91	27.90
L-8	38.72	29.96	34.11	34.26	29.72	21.93	28.70	26.78	34.22	25.95	31.40	30.52
L-9	36.10	33.20	29.53	32.94	17.94	26.06	23.70	22.57	27.02	29.63	26.62	27.76
L-10	37.84	27.63	43.51	36.33	29.92	19.05	29.69	25.22	32.38	23.34	36.60	30.77
L-11	42.79	45.58	35.39	41.25	26.46	26.56	27.84	26.95	34.62	36.07	31.61	34.10
L-12	35.44	26.22	28.43	30.03	22.13	24.25	25.16	23.85	28.78	25.23	26.79	26.93
L-13	34.03	33.77	40.29	36.03	19.39	25.12	28.03	24.18	26.71	29.44	34.16	30.10
L-14	34.85	31.60	32.34	32.93	19.71	24.63	26.00	23.45	27.28	28.12	29.17	28.19
Mean	37.12	33.16	31.37	34.92	23.99	24.28	25.36	24.55	30.55	28.72	29.92	29.72
Checks												
SC Gz 155	38.8				28.4				33.6			
SC Pion3080	41.7				24.1				32.9			
SC.Pion3084	41.7				28.6				35.2			
LSD 5% for												
Lines (L)	1.96				2.17				1.46			
Testers (T)	0.91				1.01				0.68			
L x T	3.40				3.76				1.79			
Genotypes (G)	3.39				3.37				2.39			
Loc x L	2.07											
Loc x T	0.96											
Loc x L x T	3.59											
Loc x G	3.38											

superior and promising top-crosses (single crosses) were (L-11 x T-1), (L-11 x T-2) and (L-10 x T-3) which ranged from 42.79 to 45.58 ard/fed at Sakha, (L-8 x T-1), (L-10 x T-1), (L-5 x T-2), (L-10 x T-3) and (L-10 x T-3) which ranged from 28.70 to 29.92 ard/fed at Sids, and (L-11 x T-2) and (L-10 x T-3) which gave 36.07 and 36.60 ard/fed in the combined data over locations, respectively. These single crosses outyielded the best commercial check hybrid SC-Pion 3084 with a minimum of 0.15 and maximum of 3.88 ard/fed.

Oil percentage

Mean oil (%) in grains of the 42 top-crosses, their 14 parental lines and the 3 testers as well as the three commercial check hybrids are presented in Table (4).

Based on combined data, Tables (2 and 4) indicated that mean oil (%) was significantly higher at Sakha (10.1%) than at Sids (9.4 %). This result indicated that oil (%) was affected by the different environmental conditions between the two locations.

Concerning the parental lines in cross combinations with the three testers (Table 4) indicated that the highest desirable cross combinations with testers unrelated parental lines L-5 and L-12 in both locations and combined over locations, L-1 at Sakha and combined, L-7 at Sakha and L-8 at Sids, since they manifested the highest oil (%). In the contrary, crosses unrelated L-10 and L-13 at Sakha and combined, L-6 at Sids and combined, and L-3 and L-7 at Sids had the lowest oil %.

Regarding to crosses of tester lines with all parental lines (Tables 2 and 4) indicated that crosses including T-2 expressed the highest oil (%) of 10.4, 9.5 and 9.9, while crosses including T-1 gave the lowest percentage of 9.9, 9.2 and 9.5 at Sakha, Sids and combined data, respectively. However, the differences between crosses of T-1 and crosses of T-3 at Sakha, and between crosses T-2 and crosses of T-3 at Sids and combined data were insignificant.

Data in Table (4) indicated that 7, 3 and 6 top-crosses (single-crosses) manifested the highest oil% with a minimum of 12.0, 12.2 and 11.0%, and maximum of 13.1, 12.5 and 11.6% at Sakha, Sids and combined data, respectively. In the contrary, 4, 5 and one crosses had the lowest oil% at Sakha, Sids and across locations, respectively.

Comparing the 42 top-crosses (single crosses) with the three check commercial single crosses for oil content (Tables 2 and 4) indicated that all top-crosses significantly exceeded the best commercial hybrids SC.Gz.155 (4.3, 4.1 and 4.2%) with minimum of 3.1, 2.3 and 3.6%, and maximum of 8.8, 8.4 and 7.4% at Sakha, Sids and across locations, respectively.

Table 4. Mean grain oil (%) for 42 top-crosses and 3 commercial single crosses as checks evaluated at Sakha, Sids and combined over locations in 2004 season.

Parents	Sakha				Sids				Combined			
	T-1	T-2	T-3	Mean	T-1	T-2	T-3	Mean	T-1	T-2	T-3	Mean
L-1	11.4	10.9	11.0	11.1	7.6	10.0	11.1	9.6	9.5	10.4	11.0	10.3
L-2	9.4	12.2	7.7	9.8	8.9	10.8	9.7	9.8	9.1	11.5	8.7	9.8
L-3	9.3	10.8	10.8	10.3	12.2	6.4	8.2	8.9	10.7	8.6	9.5	9.6
L-4	8.6	9.0	12.8	10.1	9.8	6.7	8.8	8.4	9.2	7.8	10.8	9.3
L-5	10.6	13.1	10.5	11.4	12.5	9.6	9.5	10.5	11.6	11.3	10.0.	11.0
L-6	10.7	8.4	9.8	9.6	6.4	9.7	8.7	8.3	8.5	9.0	9.2	8.9
L-7	12.1	10.8	12.0	11.6	6.4	10.0	9.6	8.7	9.2	10.4	10.8	10.1
L-8	8.6	9.9	11.5	10.0	9.5	12.5	8.9	10.3	9.0	11.2	10.2	10.1
L-9	10.1	10.5	7.4	9.3	8.7	11.0	8.5	9.4	9.4	10.7	8.0	9.4
L-10	7.5	8.6	9.7	8.6	9.6	9.2	10.0	9.6	8.5	8.9	9.9	9.1
L-11	8.7	11.0	11.2	10.3	9.7	8.4	10.0	9.4	9.2	9.7	10.6	9.8
L-12	12.1	12.0	8.9	11.0	8.7	11.1	10.8	10.2	10.4	11.5	9.9	10.6
L-13	8.9	8.0	9.4	8.8	9.3	8.1	10.6	9.3	9.1	8.0	10.0	9.0
L-14	10.0	10.5	7.4	9.3	9.2	9.8	8.7	9.2	9.6	10.1	8.1	9.3
Mean	9.9	10.4	10.0	10.1	9.2	9.5	9.5	9.4	9.5	9.9	9.8	9.7
Checks												
SC Gz 155	4.3				4.1				4.2			
SC.Pion3080	4.0				3.8				3.9			
SC.Pion3084	4.0				3.9				4.0			
LSD 5% for												
Lines (L)	0.79				0.59				0.49			
Testers (T)	0.37				0.27				0.23			
L x T	1.37				1.02				0.60			
Genotypes (G)	1.32				0.99				0.83			
Loc x L	0.70											
Loc x T	NS											
Loc x L x T	1.21											
Loc x G	1.17											

Oil yield (Kg/fed)

Mean oil yield (Kg/fed) of the 42 top-crosses, their 14 parental lines and the 3 tester lines as well as the three commercial check hybrids are presented in Table 5.

Combined data, (Tables 2 and 5) showed that mean oil yield was significantly higher at Sakha (473.5 Kg/fed) than at Sids (304.4Kg/fed). These results clearly indicated that oil yield was affected by the different environmental factors between the two locations.

Considering crosses of parental lines with the three tester lines, Tables (2 and 5) showed that insignificant differences were detected among the parental lines at Sids location. However, the most preferable parental lines in crosses were L-1, L-5 and L-11 at Sakha and across locations, L-2, L-3. L-4 and L-7 at Sakha, and L-8 at Sids, since they manifested the highest oil yield. On the other side, crosses of L-3, L-6 and L-7 at Sids and crosses of L-14 at Sakha and over locations had the lowest oil yield.

Insignificant differences were obtained for oil yield between crosses of the three tester lines at both locations and over locations (Tables 2 and 5).

Results presented in Table (5) indicated that mean oil yield ranged from 644.7 for the top-cross (L-2 x T-2) to 291.6 Kg/fed for the top-cross (L-10 x T-2) at Sakha, from 451.8 for the top-cross (L-5 x T-1) to 173.2 Kg/fed for the top-cross (L-10 x T-2) at Sids and from 513.5 for the top-cross (L-2 x T-2) to 232.4 Kg/fed for top-cross (L-10 x T-2) in combined data over locations. However, the number of the top-most favorable crosses for high oil yield (more than 500, 310 and 435 Kg/fed) was 17, 9 and 13 crosses at Sakha, Sids and combined over locations, respectively.

From the previous results, it is concluded that combined data over the two locations (Tables 3, 4 and 5) indicated that 9 out of the 42 single crosses i.e. (L-1 x T-1), (L-5 x T-1), (L-8 x T-1), (L-11 x T-1), (L-2 x T-2), (L-11 x T-2), (L-1 x T-3), (L-10 x T-3) and (L-13 x T-3) manifested significantly higher oil% and higher oil yield by at least 2.1 times than the three commercial single crosses. In the same time, these crosses, except (L-1 x T-1) and (L-2 x T-2) did not differ significantly in grain yield than the best commercial single (SC Pion3084). These crosses should be further tested for possible commercialization to improve maize productivity and oil content. Also, they might be of interest in breeding programs for developing good new high oil inbred lines and/or composite varieties. Similar results were reported by Jugnheimer and Williems (1959), Alexander (1974), Miller *et al* (1981), Gajic and Savic (1983), Misevic *et al* (1989), Report of Ohio Sate University (1999), Soliman *et al* (1999), Cromwell (2000) and Thomison *et al* (2003).

Table 5. Mean grain oil yield (Kg/fed) for 42 top-crosses and 3 commercial single crosses as checks evaluated at Sakha, Sids and combined over locations in 2004 season.

Parents	Sakha				Sids				Combined			
	T-1	T-2	T-3	Mean	T-1	T-2	T-3	Mean	T-1	T-2	T-3	Mean
L-1	642.6	492.3	475.5	536.8	262.1	305.0	405.3	324.1	452.4	398.7	440.2	427.4
L-2	417.1	644.7	360.9	474.2	295.3	382.3	281.2	319.6	356.2	513.5	321.1	396.9
L-3	437.4	524.9	490.7	484.3	289.3	198.0	292.7	266.1	363.4	361.5	391.7	372.2
L-4	383.2	434.0	604.1	473.8	316.7	183.8	341.3	280.6	350.0	308.9	472.7	377.2
L-5	572.4	642.0	449.8	554.7	451.8	324.0	204.8	326.9	512.0	483.0	327.3	440.8
L-6	511.9	412.0	400.6	441.5	189.9	309.6	313.2	270.9	350.9	360.8	356.9	356.2
L-7	611.5	432.0	544.2	529.2	187.1	300.4	289.9	259.1	399.3	366.2	417.1	394.2
L-8	485.8	416.1	503.5	468.5	389.6	388.0	239.2	338.9	437.7	402.0	371.3	403.7
L-9	400.6	559.3	296.1	418.7	273.9	413.7	243.5	310.4	337.3	486.5	269.8	364.7
L-10	402.0	291.6	619.1	437.6.	370.2	173.2	313.8	285.7	386.1	232.4	466.5	361.7
L-11	521.0	581.0	516.9	539.6	368.4	293.7	367.2	343.1	444.7	437.4	442.0	441.4
L-12	589.2	402.6	316.8	436.2	303.7	393.7	235.7	341.0	446.5	398.1	276.2	373.6
L-13	427.2	378.9	523.0	443.0	303.7	271.0	396.6	325.1	365.5	325.0	459.8	384.1
L-14	399.6	432.0	340.7	390.8	262.3	353.3	194.7	270.1	331.0	392.6	267.7	330.4
Mean	485.7	474.4	459.9	473.5	304.5	306.3	294.0	304.4	395.1	390.3	377.0	387.5
Checks												
SC.Gz 155	233.6				163.0				198.3			
SC.Pion3080	233.5				128.2				180.8			
SC.Pion3084	233.5				156.2				194.9			
LSD 5% for												
Lines (L)	83.48				NS				30.0			
Testers (T)	NS				NS				NS			
L x T	144.6				61.0				72.1			
Genotypes (G)	147.6				133.5				99.5			
Loc x L	83.2											
Loc x T	NS											
Loc x L x T	144.1											
Loc x G	140.7											

Combining ability effects

Estimates of general (GCA) and Specific (SCA) combining ability effects for grain yield (ard/fed), oil% and oil yield (kg/fed) at Sakha, Sids and across locations are presented in Tables (6, 7, 8 and 9).

Grain yield (ard/fed)

Comparing GCA effects among the 14 parental inbred lines (Table 6) showed that L-11 was considered to be the best general combiner, since it expressed highly significant and positive GCA effects at both and across locations. In addition, parental inbred lines L-1 and L-10 at Sakha and combined over locations, as well as L-2 at Sakha and L-8 at Sids also exhibited significantly positive (desirable) GCA effects for grain yield. These inbred lines produced the highest mean grain yield/fed (Table 3) and they could be utilized in breeding program for developing new high yielding hybrids. On the other direction the poorest GCA effects were obtained for parental inbred lines L-7 and 9 at both and across locations, as well as L-6. L-12 and L-14 at Sakha and across locations. They also gave the lowest grain yield/fed. as shown in Table 3.

Concerning the tester lines, results in Table 6 revealed that T-1 at Sakha and across location, and T-3 at Sids exhibited significantly positive GCA effects in relation to high yielding ability (Table 3). In contrast with that, T-2 at Sakha and across locations gave significantly negative GCA effects (undesirable) for the lowest grain yield (Table 3).

Regarding to specific combining ability effects, results in Table 7 indicated that 6, 9 and 12 out of the 42 top-crosses manifested the best SCA effects (significantly positive) at Sakha, Sids and across locations, respectively. However, three out of them *i.e.* (L-7 x T-1), (L-10 x T-3) and (L-13 x T-3) were the most favorable top-crosses for SCA effects in grain yield at both and across locations. These crosses should be further evaluated for possible commercialization to improve maize productivity. Also, they might be of interest in breeding programs for developing good new inbred lines and/or composite varieties. On the other hand, 7, 11 and 9 out of the 42 top-crosses manifested unfavorable SCA effects (significantly negative estimates) for grain yield at Sakha, Sids and across locations, respectively.

Oil% in grain

Estimates of general (GCA) combining ability effects for grain oil% of parental lines (Table 6) confirmed that the best general combiners over the three testers (significantly positive GSA estimates) were L-5 and L-12 at both and across locations and combined, L-1 at Sakha, and L-8 at Sids and across locations. They also expressed the highest oil% (Table 4). This result indicated that the previous lines had favorite genes and gene actions for high oil%. On the other direction, L-9, L-10, L-13 and L-14 at Sakha and

Table 6. Estimates of general combining ability effects ($\hat{g}_i$) of 14 parental inbred lines and three testers lines for the three traits at Sakha, Sids and combined over locations, in 2004 season.

Parents		Grain yield/fed			Oil (%)			Oil yield/fed		
		Sakha	Sids	Comb.	Sakha	Sids	Comb.	Sakha	Sids	Comb.
Lines	L-1	1.51*	0.85	1.18*	0.99**	0.16	0.57**	83.18**	28.80*	55.69**
	L-2	2.10**	-0.02	1.03*	-0.33	0.41	0.04	-0.76	20.63	9.93
	L-3	0.61	-0.83	-0.11	0.19	-0.47	-0.14	9.32	-37.24**	-13.96
	L-4	-0.56	-0.03	-0.30	0.04	-0.97**	-0.47**	-1.28	-22.48	-11.88
	L-5	1.15	0.63	0.89	1.32**	1.13**	1.22**	79.32**	23.77	51.74*
	L-6	-2.02**	-0.23	-1.13*	-0.46	-1.12**	-0.79**	-33.55	-32.20*	-32.87
	L-7	-2.12**	-1.55*	-1.83**	1.54**	-0.72**	0.41*	54.21	-43.98**	5.12
	L-8	-0.65	2.24**	0.79	-0.10	0.88**	0.39*	-6.57	35.83**	14.63
	L-9	-1.98**	-1.98*	-1.98**	-0.73*	-0.01	-0.37*	-56.34	7.28	-24.53
	L-10	1.41*	0.68	1.04*	-1.46**	0.19	-0.64*	-37.46	-17.34	-27.40
	L-11	6.33**	2.41**	4.37**	0.22	-0.04	0.09	64.62*	40.02**	52.32*
	L-12	-4.89**	-0.70	-2.79**	0.92**	0.81**	0.87**	-38.83	7.94	-15.45
	L-13	1.11	0.36	0.37	-1.35**	-0.07	-0.71**	-32.01	22.00	-5.01
	L-14	-1.99*	-1.10	-1.54**	-0.80**	-0.16	-0.48**	-84.25**	-33.03*	-58.64**
Testers	T-1	2.20**	-0.55	0.82*	-0.23	-0.22*	-0.22**	15.39	2.65	9.02
	T-2	-1.76**	-0.27	-1.01**	0.31*	0.11	0.21**	-0.49	4.98	2.25
	T-3	-0.44	0.82*	0.19	-0.08	0.11	0.01	-14.91	-7.63	-11.27
LSD 5% for lines										
$\hat{g}_i$		1.39	1.54	1.04	0.56	0.42	0.35	59.0	24.9	41.6
$\hat{g}_i - \hat{g}_j$		1.96	2.17	1.46	0.79	0.59	0.49	83.5	35.2	58.8
LSD 5% for testers										
$\hat{g}_i$		0.64	0.71	0.48	0.26	0.19	0.16	27.3	11.5	19.3
$\hat{g}_i - \hat{g}_j$		0.91	1.01	0.68	0.37	0.27	0.23	38.6	16.3	27.2

Table 7. Estimates of specific combining ability effects ($\hat{S}_{ij}$) of the 42 top-crosses for grain yield/fed at separate location and combined over locatins, in 2004 season.

Parents	Sakha			Sids			Combined		
	T-1	T-2	T-3	T-1	T-2	T-3	T-1	T-2	T-3
L-1	0.29	-2.13	1.84	1.61	-3.38**	1.77	0.95	-2.76**	1.81*
L-2	-2.43*	2.33	0.10	-0.25	3.06*	-2.80*	-1.34	2.69**	-1.35
L-3	-0.88	2.39	-1.51	-2.93*	2.02	0.91	-1.90	2.20*	-0.30
L-4	-2.31	2.38	-0.06	0.21	-2.50	2.28	-1.05	-0.06	1.11
L-5	0.46	-0.12	-0.84	2.66*	3.84**	-6.50**	1.81*	1.86*	-3.67**
L-6	1.28	1.11	-2.38	-0.43	4.15**	-3.72**	0.43	2.63**	-3.06**
L-7	2.50*	-2.49*	-0.01	5.98**	-3.63**	-2.35	4.24**	-3.06**	-1.18
L-8	2.26	-2.54*	0.28	3.49**	-4.59**	1.10	2.88**	-3.57**	0.69
L-9	0.96	2.02	-2.98**	-4.07**	3.76**	0.32	-1.56	2.89**	-1.33
L-10	-0.69	-6.93**	7.62**	2.25	-5.91**	3.65**	0.78	-6.42**	5.64**
L-11	-0.66	6.09**	-5.43**	0.06	-0.13	0.07	-0.30	2.98**	-2.68**
L-12	3.22**	-2.05	-1.17	-1.17	0.67	0.50	1.03	-0.69	-0.34
L-13	-4.20**	-0.50	4.70**	-4.24**	1.20	3.04*	-4.22**	0.35	3.87**
L-14	-0.28	0.43	-0.15	-3.18**	1.45	1.73	-1.73	0.94	0.79
LSD 5% for									
$\hat{S}_{ij}$		2.41			2.66			1.79	
$\hat{S}_{ij}-\hat{S}_{kl}$		3.40			3.76			2.54	

across locations, L-4 and L-6 at Sids and across locations, L-3 and L-7 at Sids were the poorest GCA effects regarding oil% as showing significantly negative GCA estimates in relation to lowering oil% of their crosses combination (Table 4).

For inbred tester lines, results in Table (6) showed that top-crosses involving T-2 had the best desirable GCA effects for oil% (0.31*and 0.21**) and possessed significantly the highest oil of 10.4 and 9.9% (Table 4) at Sakha and across locations, respectively. This indicated that tester line T-2 had a high frequency of favorable dominance alleles, which contributed to high oil% in top-crosses. On the opposite, T-1 at Sids and over locations (Table 6) showed significantly negative GCA effects (undesirable) for oil%, which connected with the results in Table 6 for the lowest oil%.

In consideration of SCA effects, results in Table 8 indicated that 9, 12 and 13 out of the 42 top-crosses exhibited significantly positive SCA effects at Sakha, Sids and over locations, respectively. However, the best out of them were 3 crosses (L-4, L-10 and L-11 crosses with T-3) at Sakha and across locations, and 8 crosses *i.e.*(L-3 x T-1), (L-5 x T-1), L-8 x T-2), (L-9 x T-2) (L-12 x T-2), (L-1 x T-3), (L-7 x T-3) and (L-13 x T-3) at Sids and across locations. Moreover, the top-cross (L-2 x T-2) was the most superior and promising single cross since it had highly significant and positive SCA effects for oil% at both and across locations. Also, this cross highly significant outyielded the thee commercial single crosses at both and across (Table 4). On the other side, 11, 14 and 9 out of 42 top-crosses had the poorest SCA effects for oil% (significantly negative estimates) at Sids, Sakha and combined over locations, respectively.

Oil yield (Kg/fed)

Estimates of general (GCA) combining ability effects for parental lines (Table 6) confirmed that the most superior general combiners (significantly positive GSA effects) for oil yield were L-1 and L-11 at both and across locations, L-5 at Sakha and across locations and L-8 at Sids. They also expressed the highest oil yield (Table 5) with a Maximum of 539.6 Kg/fed for L-11 at Sakha and minimum of 324.1 Kg/fed for L-1 at Sakha. This result indicated that the previous lines had favorable genes for high oil yield. In contrast with that, L-14 at both and across locations, L-3, L- 6 and L-7 at Sids had the worst GCA effects (significantly negative estimates) toward the lowest oil yield in their hybrids (Table 5).

No significant GCA effects (either positive or negative estimates) were obtained for the three tester lines (Table 6) for oil yield at both and across locations. These results are in conformity with the results obtained in (Table 5).

Table 8. Estimates of specific combining ability effects ($\hat{S}_{ij}$) of the 42 top-crosses for oil % at separate location and combined over locations, in 2004 season.

Parents	Sakha			Sids			Combined		
	T-1	T-2	T-3	T-1	T-2	T-3	T-1	T-2	T-3
L-1	0.53	-0.51	-0.02	-1.72**	0.31	1.41**	-0.59	-0.10	0.69*
L-2	-0.10	2.11**	-2.00**	-0.72*	0.91*	-0.19	-0.41	1.51**	-1.10**
L-3	-0.77	0.19	0.58	3.52**	-2.66**	-086*	1.37**	-1.23**	-0.14
L-4	-1.27**	-1.46**	2.73**	1.62**	-1.86**	0.24	0.17	-1.66**	1.49**
L-5	-0.55	1.36*	-0.80	2.22**	-1.06**	-1.16**	0.83**	0.15	-0.98**
L-6	1.28**	-1.56**	0.28	-1.63**	1.34**	0.29	-0.18	-0.11	0.29
L-7	0.68	-1.11*	0.43	-2.03**	1.19**	0.84	-0.68*	0.04	0.64*
L-8	-1.14*	-0.43	1.56**	-0.58	2.09**	-1.51**	-0.86**	0.83*	0.03
L-9	1.00*	0.86	-1.85**	-0.50	1.48**	-0.98*	0.25	1.17**	-1.41**
L-10	-0.87	-0.31	1.18*	0.20	-0.53	0.33	-0.34	-0.42	0.75*
L-11	-1.40**	0.41	1.00*.	0.53	-1.09**	0.56	-0.44	-0.34	0.78*
L-12	1.35**	0.66	-2.00**	-1.27**	0.76*	0.51	0.04	0.71*	-0.75*
L-13	0.36	-1.08*	0.71	0.22	-1.36**	1.14**	0.29	-1.22**	0.93**
L-14	0.91	0.87	-1.79**	0.15	0.48	-0.63	0.53	0.67*	-1.21**
LSD 5% for									
$\hat{S}_{ij}$		0.97			0.72			0.60	
$\hat{S}_{ij}$ - $\hat{S}_{kl}$		1.37			1.02			0.85	

Results of specific combining ability effects for oil yield of the 42 top-crosses (Table 9) revealed that 6, 15 and 5 crosses were the best specific combiners for oil yield at Sakha, Sids and across locations, respectively. Three out of them *i.e.* (L-2 x T-2), (L-9 x T-2) and (L-4 x T-3) were considered to be the best top-crosses (single crosses), since they manifested highly significant and positive SCA effects and high per se oil yield (Table 5) at both and across locations. On the other direction 4, 11 and 4 crosses exhibited significantly negative estimates SAC effects (unfavourable) for oil yield at Sakha, Sids and across locations, respectively.

From the previous results, combined over locations (Table 6) indicated that the best general combiners were L-2, L-10 and T-1 for grain yield, L-7, L-8, L-12 and T-2 for oil%, L-11 for grain and oil yield, and L-5 for both oil% and oil yield. In addition, L-1 is considered to be the most superior and preferable general combiner for the three studied traits. These lines might be of interest in breeding programs for developing high yielding and oil content of a good new composite variety or in breeding programs for developing new hybrid (s). Furthermore, combined data (Tables 7, 8 and 9) indicated that four top-crosses (single crosses) i.e. (L-2 x T-2), (L-9 x T-2), (L-10 x T-3) and (L-13 x T-3) are considered to be the best specific combiners for the three traits. These crosses might be of usefulness in breeding programs for developing new lines and/or new composite varieties of high grain yield and high oil content

Genetic variance for grain yield/fed, oil % and oil yield/fed

Robinson *et al* (1955) pointed out that any negative estimates of additive (σ^2A) or dominance (σ^2D) variance is considered to be equal zero. These negative estimates could be due to sampling error and/or assortment mating, which resulted from the difference in flowering time when developing the top-crosses.

Estimate of additive (σ^2A) and dominance (σ^2D) variance and their interactions with locations for grain yield (ard/fed), oil% and oil yield (kg/fed) at each location and combined over location are presented in Table (10).

The magnitude of additive (σ^2A) genetic variances for parental inbred lines and tester lines were either estimated negative (negligible) or smaller values than dominance (σ^2D) genetic variance in terms of the three studied traits at both locations and combined data, except grain yield at Sakha. These results indicated that (σ^2D) is considered to be the major source of the total genetic variance responsible for the inheritance of the three studied traits. These results are in conformity with those of El-Zeir *et al* (2000), Sadek *et al* (2000, 2001 and 2002), Soliman (2000 a and b), Soliman *et al*

Table 9. Estimates of specific combining ability effects ($\hat{S}_{ij}$) of the 42 top-crosses for oil yield/fed at separate location and combined over locations, in 2004 season.

Parents	Sakha			Sids			Combined		
	T-1	T-2	T-3	T-1	T-2	T-3	T-1	T-2	T-3
L-1	133.5*	-65.4	-68.1	-72.4**	-8.6	81.0**	30.5	-37.0	6.4
L-2	-72.5	170.9**	-98.4	-18.6	53.6*	-34.9	-45.6	112.3**	-66.7
L-3	-62.3	41.1	21.2	20.8	-72.8**	52.1*	-20.8	-15.9	36.7
L-4	-106.0*	-39.3	145.2**	33.5	-101.8**	68.3**	-36.3	-70.5	106.8**
L-5	2.2	89.8	-90.0	122.3**	-7.9	-114.4**	62.3	40.0	-102.2**
L-6	55.0	-29.0	-26.0	-83.6**	33.7	49.9*	-14.3	2.3	12.00
L-7	66.9	-96.7	29.9	-74.7**	36.3	38.4	-3.9	-30.2	34.1
L-8	1.9	-51.9	49.9	48.0*	44.1*	-92.1**	25.0	-3.9	-21.1
L-9	-33.5	141.1**	-107.6*	-39.1	98.4**	-59.3*	-36.3	119.7**	-83.4*
L-10	-51.0	-145.4**	196.4**	81.8**	-117.5**	35.7	15.4	-131.5**	116.1**
L-11	-34.1	41.9	-7.8	22.6	-54.4*	31.7	-5.7	-6.2	11.9
L-12	137.6**	-33.1	-104.5*	-10.0.	77.7**	-67.7**	63.8	22.3	-86.1*
L-13	-31.2	-63.7	94.9	-20.1	-59.0**	79.1**	-25.7	-61.4	87.0*
L-14	-6.6	41.7	-35.1	-10.5	78.2**	-67.7**	-8.5	60.0	-51.4
LSD 5% for									
$\hat{S}_{ij}$		102.0			43.1			72.1	
$\hat{S}_{ij}$ - $\hat{S}_{kl}$		144.6			61.0			101.9	

Table 10. Estimates of genetic variance components for grain yield/fed, Oil % and oil yield/fed at separate locations and combined over locations, in 2004 season.

Genetic variance components	Grain yield/fed	Oil %	Oil yield/fed
Sakha			
σ^2 A for lines (L)	12.27	0.59	-4197.5
σ^2 A for testers (T)	12.77	-0.32	-2344.6
σ^2 D for (L x T)	10.68	1.96	8500.9
Sids			
σ^2 A (L)	-12.62	-1.76	-5335.7
σ^2 A (T)	-2.01	-0.67	-1725.5
σ^2 D (L x T)	12.53	2.55	4185.0
Combined			
σ^2 A (L)	-0.18	0.12	-2697.1
σ^2 A (T)	0.60	-0.12	-1163.8
σ^2 D (L x T)	9.23	0.98	4216.0
σ^2 A x loc. (L)	0.01	-1.41	-4139.0
σ^2 A x loc. (T)	9.54	-0.71	-1742.4
σ^2 D x loc. (L x T)	4.78	2.55	4253.9

A negative values is considered to be equal zero (Robinson et al 1955)

(2001), El-Shenawy *et al* (2003), Gabr (2003), Abd El-Moula *et al* (2004) and Abd El-Moula (2005) for grain yield, Dudley *et al* (1977), Rajni *et al* (1984) and Soliman *et al* (2001) for oil content. They reported that non-additive gene action was involved and comprised most of genetic the variance in the inheritance of grain yield and oil content. On the other side, Misevic *et al* (1989), El-Itriby *et al* (1990), Salama *et al* (1995), Soliman *et al* (1995), Soliman and Sadek (1999), Soliman *et al* (2001 b). Amer *et al* (2003) and Mahmoud and Abd El-Azeem (2004) indicated that σ^2gca (additive genetic variance) exceeded that of σ^2sca (non-additive genetic variance) for grain yield. In addition, Abd El-Azeem *et al* (2004) reported that both σ^2A and σ^2D were showed similar in the inheritance of grain yield. El-Rouby and Penny (1967), Ponelcit and Bauman (1970), Miller *et al* (1981) and Misevic *et al* (1989) indicated that additive genetic effect was much more important than non-additive in the inheritance of oil content.

Combined data (Table 10) revealed that the magnitude of additive variance x locations (σ^2A x loc) interaction for parental inbred lines was either smaller than dominance x locations (σ^2D x loc) interaction for grain yield or exhibited negative estimates in case of oil% and oil yield. These results indicated that variance due to dominance (σ^2D) was more affected by environmental conditions than σ^2A. Similar results were reported by Dudley *et al* (1977), Rajni *et al* (1984) and Soliman *et al* (2001) for high oil content. In contrast with that, σ^2A was more influenced by locations than σ^2_D as concluded by Salama *et al* (1995). Soliman *et al* (1995), El-Zeir *et al* (2000). Sadek *et al* (2001), El-Shenawy *et al* (2003) and Abd El-Azeem *et al* (2004) for grain yield, El-Rouby and Penny (1967), Poneleit and Bauman (1970), Miller *et al* (1981) and Misevic *et al* (1989) for high oil content.

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وراثة صفات المحصول ومحتوى الزيت في هجن فردية جديدة من الذرة الشامية عالية الزيت

فتحي حسـن سيد سليمان[1]، شافعي عبد الفتاح شافعي[2]، أحمد إبراهيم العجمي[2] و محمود عبد الفتاح مصطفى[1]

[1] برنامج الذرة الشامية- معهد بحوث المحاصيل الحقلية- مركز البحوث الزراعية
[2] قسـم المحاصيل- كلية الزراعة- جامعة الأزهر- القاهرة

تم عمل التهجين القمى ت ل 14 سلالة تربية داخلية من الذرة الشامية ناتجة من عدد مختلف من الأجيال الانعزالية من مجتمع سخا-21، E 59 وصنف محلى مفتوح التلقيح مع 3 سلالات تربية داخلية وهى ك-1، ك-2 و ك-3 مستنبطة من الصنف التخليقى أيوا عالى الزيت-1 (ب 1934)، الصنف التخليقى أيوا عالي الزيت-2 (ب 1935) و صنف محلى على الترتيب وذلك بمحطة البحوث الزراعية لجنوب الوادي بمنطقة توشكي تحت نظام الري بالتنقيط خلال موسم 2003. قيمت الهجن القمية الناتجة في تجارب حقلية بمحطتي سخا وسدس للبحوث والتجارب الزراعية في موسم 2004 بهدف تقدير القدرة العامة والخاصة على التآلف، وتأثير الفعل الجينى في وراثة صفات محصول الحبوب (إردب/فدان)، النسبة المئوية الزيت في الحبوب ومحصول الزيت (كجم/فدان) وتحديد أفضل الهجن الفردية المبشرة لاختبارها في تجارب حقلية متقدمة تمهيدا لإنتاجها تجاريا.

أشارت نتائج تحليل التباين إلى وجود فروق عالية المعنوية بين الهجن القمية وبعضها وفروق معنوية أو عالية المعنوية بين السلالات الأبوية، السلالات الكشافة والتفاعل بين السلالات الأبوية والسلالات الكشافة للثلاث صفات في كل من موقعي الدراسة والتحليل المشترك فيما عدا صفة محصول الزيت للسلالات الكشافة لموقعي الدراسة والتحليل المشترك والسلالات الأبوية في سدس.

أوضحت نتائج التحليل المشترك للجهتين تفوق الهجن القمية (الفردية) (ل-1 × ك-1)، (ل-5 × ك-1)، (ل-8 × ك-1)، (ل-11 × ك-1))، (ل-2 × ك-2)، (ل-11 × ك-2)، (ل-1 × ك-3)، (ل-10 × ك-3) و(ل- 13× ك-3) معنويا على الثلاث هجن الفردية التجارية لصفتي النسبة المئوية الزيت ومحصول

الزيت (بما لايقل عن 210%). هذه الهجن عدا الهجينين (ل-10 × ك-3) و(ل- 13× ك-3) تساوت في محصول الحبوب بالإردب/فدان مع إنتاجية أفضل الهجن الفردية التجارية. هذه الهجن سوف تختبر في تجارب متقدمة لإمكان استخدامها على نطاق تجارى أو استخدامها في برامج التربية لاستنباط سلالات أو أصناف تركيبية جيدة عالية في نسبة الزيت ومحصول الحبوب.

أفضل السلالات الأبوية في قدرتها العامة على التآلف من خلال التحليل المشترك للجهتين كان عددها 4، 5 و 3 لمحصول الحبوب العالي وأعلى نسبة مئوية للزيت ومحصول الزيت العالي على الترتيب. وتعتبر السلالة ل-1 أفضلهم للثلاث صفات مجتمعه. أظهر عدد 12، 13 و 5 هجن قمية أفضل قيم معنوية وموجبة للقدرة الخاصة على التآلف من خلال التحليل المشترك للجهتين وذلك للثلاث صفات على الترتيب. وكان أفضلهم الهجن (ل-2 × ك-2)، (ل-9 × ك-2)، (ل-10 × ك-3) و (ل-13 × ك-3) للثلاث صفات مجتمعه.

وقد أوضحت النتائج أن التباين الوراثي الغير مضيف كان أعلى وأهم من التباين الوراثي المضيف في وراثة الثلاث صفات في كلا من الجهتين والتحليل المشترك فيما عدا محصول الحبوب في سخا.