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HETEROSIS AND PHENOTYPIC CORRELATION FOR OIL, PROTEIN AND STARCH CONTENT IN 81 MAIZE INBREDS, HYBRIDS AND POPULATIONS

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ABSTRACT

Eighty one maize genotypes were used in this investigation. They included 31 inbreds, 22 single-crosses, 13 three-way crosses and 15 populations. The objectives of the study were (1) to compare the studied genotypes for their content of oil, protein and starch,(2) to estimate mid-and high-parent heterosis for studied hybrids ,(3) to study if any correlation exists among oil, protein and starch and (4) to determine the population(s) that can be used as a source for developing inbreds with high oil and /or protein content. Results showed significant differences among the tested genotypes for oil, protein and starch content. Inbred Gm-2, SC-155, TWC-352 and population 59 had the highest oil content where they produced 5.25, 5.53, 5.78 and 7.74 %, respectively. Regarding protein content, inbred Gm-22 (12.08%), SC-51 (9.35%) TWC-327 (10.28%) and population Sk-21 (9.43%) had the highest content. Based on these results, populations 59 and Sk-21 can be used as a good source for developing inbred lines with high oil and /or protein content. With respect to starch content, inbred Gm-4, SC-120, TWC-310 and population DTP-1 produced the highest starch content (74.5, 76.0, 75.3 and 75.9%, respectively). Average of oil and protein content was higher in yellow hybrids as compared to white hybrids while the opposite trend was found for starch content. The highest mid-parent positive heterosis for oil content was obtained for TWC-352 (52.8%) and SC-26 (52.7%). Concerning protein content, TWC-327 and SC-24 gave the highest positive mid-parent heterosis (37.1 and 35.2%, respectively). SC-124 and TWC-310 showed the highest positive mid-parent heterosis for starch content where they had 8.5 and 7.3%, respectively. The results showed that the highest positive heterosis values were obtained for both oil and protein content, while heterosis for starch content was small. This finding is important from a breeding and economic point of view. Estimates of phenotypic correlation coefficients manifested significant negative correlation (-0.55) between oil and protein content and insignificant positive correlation (0.29) between oil and starch content in the studied genotypes.

Key Words: *Maize, Oil, Protein, Starch, Heterosis, Correlation.*

INTRODUCTION

Development of maize hybrids with high oil content has become one of the most urgent needs for the Egyptian agriculture. This is because Egypt's oil production has become insufficient to face the increasing demand. Egypt's annual oil imports are around 660 thousand tons, which represent about 90% of the total oil requirements. High oil corn hybrids are generally considered to have a kernel oil concentration greater than 6%. Conventional corn hybrids usually have oil percentags rangeing from 3.5 to 5.0% (Watson 1987).Some high-oil corn hybrids contains 150-200 % more oil than normal corn (Watson 1987 and Lambert 2001). Production of high-oil maize hybrids requires availability of source germplasm or breeding stocks that have high oil content. High oil corn is attractive as a livestock feed because it has greater energy value than normal corn and can replace the more expensive feed sources of fats and proteins. Feeding trials with high-oil corn indicated that it had improved feed efficiency and resulted in an increased rate of gain as compared with conventional corn (Alexander 1988 and Lambert 2001). Although maize is mainly considered as a carbohydrate source, it is also an important protein source because of its considerable tota' protein yield per hectare (Bjarnason and Vasal 1992). Grain protein content in ordinary maize is about 8 - 11 % (Alexander 1988). Some strains that were developed from Illinois high protein populations (IHP) reached 32% protein (Dudley and Lamdert 1992). The Kernel development. shortly after pollination, proceeds very rapidly with the endosperm devclops at a much more rapid rate than the germ. By 15 days after pollination (DAP) the endosperm and germ develop to a size that chemical determinations can be made (Kiesselbach 1949). In development of normal kernels. oil concentration can be detected 15 DAP and continues to increase to about 45 DAP and then remains relatively constant up to physiological maturity or black layer (Ingle *et al* 1965). A comparison of the rate of oil accumulation in kernels of a high - oil inbred and a normal inbred showed a higher rate of oil accumulation for the high - oil inbred occurring during the 15 to 45 DAP period. Both inbreds had relatively constant rate of oil accumulation from 45 DAP to the black layer stage. Misevic *et al* (1987) compared the rate of oil accumulation in the whole kernel of 3 groups of maize hybrids that have total oil concentrations of 5,7 and 9%. Significant differences in the rate of oil accumulation among the three groups were observed with the highest accumulation rate for the 9% oil hybrids and the lowest for the 5% oil hybrids. They found that high oil maize genotypes contain slightly larger oil bodies and also a greater number of oil bodies. Usually high - oil hybrids have a larger germ size.

Conventional corn hybrids usually have starch percentage range from 60 - 75 % with higher values in white dent corn as compared to yellow flint corn. Many studies had indicated that breeding selection efforts can modify proportion of starch, oil and protein (Dudly *et al* 1977).

Estimates of genotypic and phenotypic correlations that exist among important characters as carbohydrates, oil and protein are useful in planning of breeding programs and evaluating breeding materials more efficiently. It can facilitate the interpretation of results already obtained. Weiss *et al* (1952) and Miller *et al* (1951) reported significant positive correlation among high protein and low oil content in maize.

The objectives of this study were (1) to compare the commercial inbred lines, single- and three-way crosses used in the study for their content of oil, protein and starch, (2) to estimate mid-and high-parent heterosis for the studied hybrids, (3) to study correlation among oil, protein and starch content and (4) to determine the population (s) that can be used as a source for developing inbreds with high oil and / or protein content.

MATERIALS AND METHODS

Materials that were used in this study (Tables 1 and 2) consisted of 81 different maize genotypes including 3 groups of genotypes i.e., 31 inbred lines (18 white and 13 yellow), 35 single and three way-crosses (29 white and 6 yellow) and 15 populations (5 white and 10 yellow). The materials ware taken from the harvest of commercial maize hybrids in isolation from each other or from the maize breeding nursery, under controlled pollination, at Nubaria Res. Station (for inbreds and populations) in 2004 and seed analysis was undertaken during 2005 Four representative kernel samples were taken from each genotype to determine oil, protein and starch content. Samples were dried until reaching a constant weight in a vacuum at 60° C for 6 hours. Oil percentage in the whole kernel was determined using Soxhlet apparatus according to the method described by A.O.A.C. (1980). The nitrogen content, on a dry weight basis, was determined using the improved Kjeldahl method. Crude protein content was then calculated by multiplying nitrogen content by a factor of 6.25 (A.O.A.C. 1980). The starch content in corn kernels was determined using the procedure described by A.O.A.C. (1980). A completely randomized design was used.

Analysis of variance was carried out separately for each of the three groups of genotypes (inbreds, single and three-way crosses and populations). Statistical analysis and correlation coefficients were carried out according to Steel and Torrie (1980). Mid-and high-parent heterosis were calculated for each hybrid according to Falconer (1985).

RESULTS AND DISCUSSION

Highly significant differences were found among inbred lines, single and three-way crosses and populations for oil, protein, and starch content (%)(Table 3). This indicated that these groups of genotypes differed genetically.

Mean performance

Comparing averages of white and yellow inbreds, no significant differences were found for oil and protein content, while significant differences were found between average starch content of white and yellow inbreds (Table. 4). Average oil, protein and starch content of white inbreds were 3.84%, 8.26% and 70.5%, respectively, while yellow inbreds had 3.59 %, 8.0 % and 64.0 %, respectively. Inbred Gm.18 and Gz-650 had the lowest oil content (1.32 and 2.08%, respectively) while inbreds Gm-2 and Gz-631 gave the highest oil content (5.25 % for both inbreds). The highest

Table 1. Genetic constitution of the hybrids involved in the study.

S.C.		Parents		T.W.C.	Parents	
		Female	Male		Female	Male
SC-10	(w)	Sd-7	Sd-63	TWC-310 (w)	SC-10	Sd-34
SC-11	(w)	Gm-4	Sd-7	TWC-311 (w)	SC-21	Sd-34
SC-12	(w)	Gm-21	Sd-7	TWC-314 (w)	SC-24	Sd-34
SC-13	(w)	Gm-4	Gm-30	TWC-320 (w)	SC-120	Sd-34
SC-14	(w)	Sd-63	Gm-30	TWC-321 (w)	SC-21	Sd-7
SC-15	(w)	Sd-7	Gm-30	TWC-322 (w)	SC-22	Sd-7
SC-21	(w)	Gm-2	Sd-63	TWC-323 (w)	SC-23	Sd-7
SC-22	(w)	Gm-21	Sd-63	TWC-324 (w)	SC-24	Sd-7
SC-23	(w)	Gm-4	Sd-63	TWC-325 (w)	SC-25	Sd-7
SC-24	(w)	Gm-18	Sd-63	TWC-326 (w)	SC-26	Sd-7
SC-25	(w)	Gm-14	Sd-63	TWC-327 (w)	SC-27	Sd-7
SC-26	(w)	Gm-22	Sd-63	TWC-351 (Y)	SC-51	Gm-1021
SC-27	(w)	Gm-27	Sd-63	TWC-352 (Y)	SC-52	Gm-1021
SC-120	(w)	Sd-63	Sd-34			
SC-122	(w)	Gz-628	Gz-603			
SC-123	(w)	Gz-628	Gz-602			
SC-124	(w)	Gz-629	Gz-603			
SC-129	(w)	Gz-612	Gz-628			
SC-51	(Y)	Gm-1004	Gm-1001			
SC-52	(Y)	Gm-1004	Gm-1002			
SC-155	(Y)	Gm-1002	Gm-1021			
SC-161	(Y)	Gz-650	Gz-617			

Table 2. Source of the 15 populations involved in the study

POPULATION		Source	POPULATION		Source
Pop-33	(Y)	CIMMYT	Composite-5	(W)	Egyptian
Pop-44	(Y)	CIMMYT	Composite -45	(Y)	Egyptian
Antigua	(Y)	CIMMYT	Giza-2	(W)	Egyptian
DTP-1	(W)	CIMMYT	Sakha-21	(Y)	Egyptian
DTP-2	(W)	CIMMYT	AED*	(W)	Egyptian
AE	(Y)	Turkish	N.Y.P**	(Y)	Egyptian
Arify	(Y)	Turkish	Pop-59	(Y)	Egyptian
ADA	(Y)	Turkish			

(*) (American Early Dent)
(**) (Nubaria yellow population)

Table 3. Mean squares for oil, protein and starch for inbreds, single- and three-way crosses and populations evaluated in 2005.

S.O.V.	d.f.	Mean squares		
		Oil	Protein	Starch
A- Inbreds				
Inbreds	**30**	**3.931****	**8.656****	**63.034****
Error	**93**	**0.092**	**0.248**	**2.523**
B- Single and three-wayscrosses				
Hybrids	**34**	**6.965****	**9.532****	**115.88****
Error	**105**	**0.374**	**0.546**	**0.588**
C- Populations				
Populations	**14**	**6.117****	**3.764****	**29.215****
Error	**45**	**1.153**	**0.738**	**3.588**

protein content was obtained from inbred Gm-22 (12.08 %) and inbred Gm-30 (10.6 %) while the lowest protein content was obtained from inbreds Sd-62 and G-631 (6.25 % and 6.22 %) respectively. Inbreds Gm-4 and Gm-22 had the highest starch content (74.5 and 72.6 %, respectively), while inbreds Gz-649 and Gz-650 had the lowest starch values (60.8 and 60.9 %, respectively). It was noticed in few cases that inbreds with low oil content had also low protein content. This was clear in inbreds Gm-18, Sd-62 and Gz-631.Also, some genotypes had high protein and high oil content as in inbreds Gm-2, Gm-30 and Gm-1001.

Average oil content (Table 5) in yellow hybrids was significantly higher than that of white hybrids. SC-155 had the highest oil content (5.53%) while SC-24 had the lowest oil content (2.92 %), which could be due to the low oil content (1.32%) of its female parent (Gm-18). The three-way cross TWC- 352 had the highest oil content (5.78 %). Results for protein content indicated that average protein content in yellow hybrids (8.70 %) was significantly higher than that of white hybrids (7.83 %). The TWC-327 had the highest protein content (10.28 %), while SC.14 had the lowest protein content (6.80 %).

Results of starch content in the studied hybrids (Table 5) showed that average starch content in white hybrids (73.1 %) was significantly higher than that of yellow hybrids (62.9 %). The single-cross SC-52 had the

Table 4. Mean content of oil, protein and starch (%) in grains of 31 maize inbreds evaluated in 2005.

INBRED		OIL%	PROTEIN%	STARCH%
Gm-2	(W)	5.25	9.60	71.0
Gm-4	(W)	3.55	7.11	74.5
Gm-14	(W)	4.63	8.13	72.5
Gm-18	(W)	1.32	5.13	70.9
Gm-21	(W)	3.90	9.98	70.8
Gm-22	(W)	3.40	12.08	72.6
Gm-27	(W)	5.15	8.07	71.6
Gm-30	(W)	4.31	10.60	66.7
Sd-7	(W)	3.38	6.95	70.0
Sd-34	(W)	3.67	8.65	70.0
Sd-58	(W)	4.28	6.94	67.4
Sd-62	(W)	2.60	6.25	69.9
Sd-63	(W)	4.01	7.48	70.6
Gz-602	(W)	4.54	9.63	71.0
Gz-603	(W)	3.41	6.85	71.1
Gz-612	(W)	3.62	6.91	70.3
Gz-628	(W)	4.17	8.38	69.2
Gz-629	(W)	3.98	9.93	67.6
Average		3.84	8.26	70.5
Gz-614	(Y)	4.06	8.85	67.7
Gz-617	(Y)	4.62	7.20	66.5
Gz-630	(Y)	2.45	8.44	62.4
Gz-631	(Y)	2.25	6.22	63.0
Gz-638	(Y)	3.13	7.07	64.5
Gz-645	(Y)	4.43	7.89	61.4
Gz-647	(Y)	2.57	7.80	68.1
Gz-649	(Y)	2.50	8.64	60.8
Gz-650	(Y)	2.08	9.72	60.9
Gm-1001	(Y)	4.29	9.45	63.7
Gm-1002	(Y)	5.25	7.78	65.2
Gm-1004	(Y)	4.66	7.70	64.0
Gm-1021	(Y)	4.35	7.28	64.1
Average		3.59	8.00	64.0
L.S.D. (0.05)		0.36	0.47	1.05

Table 5. Mean content of oil, protein and starch (%) in grains of 22 maize single-crosses and 13 three-way crosses evaluated in 2005.

HYBRID		OIL%	PROTEIN%	STARCH%
SC-10	(W)	3.63	7.33	70.0
SC-11	(W)	4.88	7.78	72.8
SC-12	(W)	5.24	7.30	75.0
SC-13	(W)	4.75	8.75	75.0
SC-14	(W)	5.48	6.80	69.5
SC-15	(W)	3.72	7.31	70.8
SC-21	(W)	3.69	7.78	70.8
SC-22	(W)	4.26	6.91	68.5
SC-23	(W)	4.50	7.39	71.4
SC-24	(W)	2.92	8.53	74.2
SC-25	(W)	4.53	8.35	75.5
SC-26	(W)	4.91	9.24	70.3
SC-27	(W)	3.71	7.78	74.3
SC-120	(W)	4.15	7.49	76.0
SC-122	(W)	4.37	8.35	75.3
SC-123	(W)	3.46	7.66	73.9
SC-124	(W)	4.41	7.21	75.3
SC-129	(W)	4.40	6.96	74.8
Average.	(W)	4.28	7.72	73.0
SC-51	(Y)	4.17	9.35	63.9
SC-52	(Y)	3.72	8.31	60.0
SC-155	(Y)	5.53	7.90	61.9
SC-161	(Y)	4.80	8.62	64.8
Average	(Y)	4.56	8.55	62.7
L.S.D. (0.05)		0.56	0.47	0.66
TWC- 310	(W)	3.59	7.47	75.3
TWC- 311	(W)	4.84	6.88	74.7
TWC- 314	(W)	3.15	7.62	70.2
TWC- 320	(W)	3.98	9.38	71.1
TWC- 321	(W)	3.90	7.64	72.1
TWC- 322	(W)	4.88	8.77	75.1
TWC- 323	(W)	5.04	7.20	73.9
TWC- 324	(W)	4.29	8.65	70.8
TWC- 325	(W)	3.21	7.28	74.4
TWC- 326	(W)	3.81	8.98	74.1
TWC- 327	(W)	3.00	10.28	71.9
Average	(W)	3.97	8.20	73.1
TWC-351	(Y)	5.34	9.07	63.9
TWC-352	(Y)	5.78	8.93	62.3
Average	(Y)	5.56	9.00	63.1
L.S.D. (0.05)		0.39	0.35	0.62

lowest starch content (60 %) while SC.25 had the highest content (75.5%).

Comparing white and yellow groups of populations, showed no significant differences between the average content of the two groups for oil and protein contents (Table 6). However, significant differences existed between yellow and white populations for starch content. Population-59 (Y), Giza-2 (W), and DTP-2 (W) had the highest oil content (7.74, 6.17 and 5.57%, respectively). Populations SK-21 (Y), Pop-59 (Y) and DTP-1 (W) produced the highest protein content (9.43, 8.77 and 8.50%, respectively). On the other hand, populations DTP-1 (W), AE (Y) and AED (W) had the highest starch content (75.9, 74.1 and 73.9%, respectively).

Table 6. Mean content of oil, protein and starch (%) in grain of 15 maize populations evaluated in 2005.

POPULATION		OIL%	PROTEIN%	STARCH%
Pop-33	(Y)	4.80	6.88	73.8
Pop-44	(Y)	4.14	8.55	73.5
Antigua	(Y)	4.83	6.50	72.9
AE	(Y)	4.46	6.87	74.1
Arify	(Y)	4.29	7.04	73.7
ADA	(Y)	4.77	7.19	72.0
Composite -45	(Y)	4.91	8.65	67.8
Sakha- 21	(Y)	5.27	9.43	73.9
(N.Y.P)*	(Y)	5.05	7.19	71.8
Pop-59	(Y)	7.74	8.77	71.0
Average (Y)		5.03	7.71	72.5
DTP-1	(W)	5.20	8.50	75.9
DTP-2	(W)	5.57	6.03	68.5
Composite-5	(W)	5.26	7.16	67.2
Giza-2	(W)	6.17	7.50	63.0
(AED)**	(W)	4.51	6.71	73.9
Average(W)		5.34	7.18	69.7
Grand Mean		5.13	7.53	71.5
L.S.D. (0.05)		0.66	0.89	2.01

(*) Nubaria yellow population.
(**) American Early Dent population.

Mid-and high parent heterosis

Mid-and high-parent heterosis of single crosses for oil, protein and starch are presented in Table (7). For oil content, based on mid-and high-parent values, !4 out of 22 single-crosses had significant positive specific heterosis values. The highest mid-parent heterosis for oil % was obtained for SC-26 (52.69%) while the highest high-parent heterosis was produced by SC-11 (37.46%). Regarding heterosis for oil content of three-way crosses (Table 8), results revealed that 8 out of 13 TWC manifested significant positive mid-parent heterosis, while only 4 three- way crosses had positive high parent heterosis. TWC-352 (Y) and TWC-324 (W) revealed the highest mid-parent heterosis for oil content (52.8 and 47.9%, respectively). The highest value for high- parent heterosis for oil content was obtained from TWC-352 (38.29%). High positive heterosis values indicated that dominance or overdominance effects in the superior crosses act for maximizing oil content in the F_1- hybrid.

Table 7. Mid - and high-parent heterosis % for 22 single-crosses evaluated in 2005 for oil, protein and starch content of maize grain.

HYBRID	OIL		PROTEIN		STARCH	
	Mid-P.	High -P.	Mid-P.	High -P.	Mid-P.	High -P.
SC-10	-1.76**	-9.48**	1.52**	-2.01**	-0.99**	-1.13**
SC-11	40.84**	37.46**	10.67**	9.42**	0.14	-2.28**
SC-12	43.96**	34.36**	-13.81**	-26.85**	5.93**	5.93**
SC-13	20.87**	10.21**	-1.24**	-17.45**	4.75**	0.67**
SC-14	42.34**	27.15**	-22.55**	-35.85**	-0.43**	-1.84**
SC-15	-10.58**	-13.92**	-2.27**	-31.04**	1.58**	0.28*
SC-21	-20.30**	-29.71**	-8.90**	-18.96**	0.00	-0.28*
SC-22	7.58**	6.23**	-20.85**	-30.76**	-3.11**	-3.25**
SC-23	19.05**	12.22**	1.23**	-1.20**	-1.65**	-4.16**
SC-24	9.36**	-27.18**	35.18**	14.04**	4.80**	4.65**
SC-25	-29.33**	-48.52**	6.91**	2.71**	5.45**	4.14**
SC-26	52.69**	22.44**	-5.52**	-23.51**	-1.82**	-3.17**
SC-27	-19.00**	-27.96**	0.00	-3.59**	4.50**	3.77**
SC-120	8.07**	3.49**	-7.19**	-13.41**	7.50**	7.34**
SC-122	15.30**	4.80**	9.58**	-0.36**	7.26**	5.91**
SC-123	-20.64**	-23.79**	-15.08**	-20.46**	5.42**	4.08**
SC-124	19.19**	10.80**	-14.06**	-27.39**	8.50**	5.91**
SC-129	12.82**	5.52**	-9.02**	-16.95**	-10.03**	-10.67**
SC-51	-6.92**	-10.52**	8.97**	-1.06**	0.00	-0.16**
SC-52	-25.6**	-29.14**	7.36**	6.81**	-5.57**	-6.44**
SC-155	15.21**	5.33**	4.91**	1.54**	-4.18**	-5.06**
SC-161	43.28**	3.90**	1.89**	-11.32**	1.73**	-2.56**

** indicates significance at 1 % probability level.

Regarding mid-and high-parent heterosis for protein content of the 22 single-crosses (Table 7), results showed that 11 and 5 single-crosses had significant positive mid-and high-parent heterosis, respectively. SC-24 had the highest positive values for mid-and high-parent heterosis for protein content (35.18 and 14.04%, respectively) followed by SC-11 (10.67 and 9.42%, respectively). For the 13 three-way crosses (Table 8), results manifested that 8 and 5 three-way crosses revealed significant positive mid-and high-parent heterosis, respectively in protein content. TWC-327 and TWC-324 had the highest positive mid-parent (37.07 and 32.67%) and high-parent (27.26 and 15.64%) heterosis values for protein content. Similar results were obtained by Misevic *et al* (1989) and Soliman *et al* (1999). It is important to find out single-and three-way crosses that give positive heterosis for both oil and protein content since normally the two traits are negatively correlated. However, results of this study revealed that SC-11, SC-155 and TWC-324 showed significant positive heterosis for both traits, which is very important from an economic point of view. Results of mid-and high-parent heterosis for starch content of the 22 and 13 single-and three-way crosses are presented in Tables (7 and 8) respectively. Single-crosses, 12 and 10 single-crosses showed significant positive mid-and high-parent heterosis, respectively for starch %. SC-124 revealed the highest positive mid-and high-parent heterosis for starch content (8.50 and 5.91% respectively). In addition, TWC-310 revealed the highest positive mid-and high-parent heterosis for starch content (7.26 and 6.66%, respectively). Comparing values of mid-and high-parent heterosis for oil, protein and starch of single-and three-way crosses, it was noticed that heterosis values, in general, were much higher for oil and protein content as compared to heterosis values for starch content, which indicates that dominance effects play an important role for oil and protein content in the production of the studied hybrids. Paterniani and lonnquist (1963) and Hallauer and Miranda (1981) mentioned that the greater values of specific heterosis are exhibited for varieties that have divergence in genes showing dominance effects.

Phenotypic correlation

Phenotypic correlation coefficients among grain oil, protein and starch are presented in Table (9). Results exhibited negative significant correlation(-0.55) between grain oil and protein content. Moreover, insignificant positive correlation was found between oil and starch content. Negligible insignificant negative correlation was also found between grain protein and starch content. These results would affect breeder's decision if selection is practiced in populations to improve grain oil and / or protein content.

Table 8. Mid - and high-parent heterosis % for 13 three-way crosses evaluated in 2005 for oil, protein and starch content.

HYBRID	OIL		PROTEIN		STARCH	
	Mid-p.	High-p.	Mid-p.	High-p.	Mid-p.	High-p.
TWC-310	-2.71**	-10.47**	-2.86**	-13.64**	7.26**	6.66**
TWC-311	12.30**	-7.81**	-19.77**	-28.33**	5.96**	5.21**
TWC-314	5.00**	-21.45**	7.63**	-11.91**	-0.43	-0.99**
TWC-320	5.29**	-0.75**	13.56**	8.44**	1.28**	0.71**
TWC-321	-7.36**	-25.71**	-4.62**	-20.42**	2.27**	1.55**
TWC-322	29.79**	21.70**	7.74**	12.12**	7.94**	7.49**
TWC-323	38.08**	25.69**	0.28	-3.74**	3.07**	-0.81**
TWC-324	47.93**	6.98**	32.67**	15.64**	0.43	-0.14
TWC-325	-19.95**	-30.67**	-3.19**	-10.46**	4.79**	2.62**
TWC-326	5.83**	-4.99**	1.58**	-25.66**	4.22**	2.07**
TWC-327	-28.23**	-41.75**	37.07**	27.26**	1.70**	0.42
TWC-351	-10.84**	-15.24**	19.50**	16.58**	0.00	-0.31
TWC-352	52.84**	38.29**	17.65**	14.78**	-3.26**	-4.45**

** indicates significance at 1 % probability level.

Table 9. Phenotypic correlation coefficients for oil, protein and starch of the 82 genotypes evaluated in 2005.

Character	Protein	Starch
Oil	-0.554*	0.292
Protein		-0.088

REFERENCES

Alexander, D.E. (1988). Breeding nutritional and industrial types. p. 869-880.In:G.F: Sprague and J. W. Dudley (ed.) Corn and Corn improvement. 3rd ed. Agron. Monogr. 18. ASA, CSSA, and SSSA, Madison, WI, USA.

A. O. A. C. (1980). Official methods of analysis of the Association of Official Agriculture Chemists.12th Ed. Published by A. O. A. C., Washington D. C.,USA.

Bjarnason M. and S. K. Vasal (1992). Breeding of quality protein maize (QPM).Plant Breed.Rev.181-216.

Dudley J. W., R. G. Lambert and I. A. Roche (1977). Genetic analysis of crosses among corn strains divergently selected for percent oil and protein. Crop Sci. 17: 111-117.

Dudley J. W., R. G. Lambert (1992). Ninety generations of selection for oil and protein in maize. Maydica 37:81-87.

Falconar, D. S. (1985). Introduction to Quantitative Genetics. 2nd ed. Longman Group Limited, London and New York, USA.

Halluer, A. R. and J. B. Miranda (1981). Quantitative Genetics in Maize Breeding. Iowa State Uni., Press. Ames., Iowa, USA.

Ingle, J., D. Bietz, and R. H. Hageman (1965). Changes in composition during development and maturation of maize seeds. Plant Physiol. 40: 832-835.

Kiesselbach,T.A. (1949). The structure and reproduction of corn. Res. Bul. 161, Univ. of Nebraska, USA.

Lambert, R.J.(2001). High-oil hybrids. P. 131-154. In: A. R. Hallauer (ed).Specially Corns. CRC Press, Boca Raton, FL, USA.

Misevic, D., A. Maric, D. E. Alexander, J. Dumanvic and S. Ratkovic (1989). Population crosses diallel among high oil populations of maize. Crop Sci. 29: 613-617.

Misevic, D., D. E. Alexander, J. Dumanvic, B. Kerecki and S. Ratkovic(1987). Grain filling and oil accumulation of high-oil and standard maize hybrids.Genetika 19: 27-30.

Miller, R. L., J. W. Dudley and D. E. Alexander(1981). High intensity selection for percent oil in corn. Crop Sci. 21:433-437.

Paterniani, E. and J. H. Lonnquist (1963). Heterosis in interracial crosses of corn (Zea *mays* L.). Crop Sci. 3: 504-507.

Soliman, F. H. S., A. A. Mahmoud, F. A. El-Zeir and E. A. Amer(1999). Heterosis in varietal crosses among eight maize varieties for high oil. Egypt. J. Appl. Sci. 14(12); 557-573.

Steel, R. G. and J. H. Torrie (1980). Principles and Procedures of Statistics. Mc Graw Hill Inc., New York, USA.

Watson, S. A. (1987). Structure and composition in corn chemistry and technology. Watson, S. A. (ed.). Chemistry and Technology.American Association of Cereal Chemists, St. Paul, MN, USA.1987. P: 53-82.

Weiss, M. G., C. R. Weber, L. F. Williams and A. H. Probst (1952). Correlation of agronomic characters and temperature with seed compositional characters in soybeans as influenced by variety and time of planting. Agron. J. 44:289-297

قوة الهجين ومعامل الارتباط لمحتوى الحبة من الزيت والبروتين والنشا في ٨١ سلالة وهجين وعشيرة من الذرة الشامية

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تم استخدام ٨١تركيب وراثي لمحصول الذرة الشامية في هذا البحث شملت ٣١سلالة ، ٢٢هجين فردي ، ١٣هجين ثلاثي بالإضافة إلي ١٥عشيرة وكانت أهداف الدراسة هي:

١-تقدير محتوي حبوب هذه التراكيب الوراثية من الزيت والبروتين والنشا ومقارنتها ببعضها.

٢-تقدير قوة الهجين للهجن الداخلة في الدراسة بالنسبة لمتوسط الأبوين وكذلك للأب الأعلا في الصفة تحت الدراسة.

٣-تقدير معامل الارتباط بين صفات الزيت والبروتين والنشا في الحبوب.

٤-تحديد العشيرة أو العشائر التي يمكن أن تستخدم كمصدر لعزل سلالات ذرة شامية عالية في محتواها من الزيت أو البروتين أو كلاهما.

أظهرت النتائج أن هناك اختلافات معنوية بين كل المواد المختبرة لصفة الزيت والبروتين والنشا وأن السلالة جميزة 2 والهجين الفردي 155 والهجين الثلاثي 352 والعشيرة 59 أعطت أعلي نسبة زيت حيث كان نسبة الزيت بكل منها هي 5.25 ، 5.53 ، 5.78 ، 7.74 % علي التوالي، كما أن السلالة جميزة 22 والهجين الفردي 51 والهجين الثلاثي 327 والعشيرة سخا 21 أعطت أعلا محتوي من البروتين حيث أعطت 12.08 ، 9.35 ، 10.28 ، 9.43 % بروتين علي التوالي. ومن هذه النتائج فانه يمكن استخدام العشيرة 59 وعشيرة سخا 21 في استنباط سلالات عالية في الزيت أو البروتين أو كلاهما. بالنسبة لصفة محتوي الحبوب من النشا أوضحت النتائج أن السلالة جميزة 4 والهجين الفردي 25 والهجين الثلاثي 310 والعشيرة 1 - DTP قد أعطت أعلي محتوي من النشا (74.5 ، 75.5 ،75.3 ، 75.9 % علي التوالي). وكان متوسط محتوي الزيت والبروتين في مجموعة الهجن الصفراء أعلا معنويا من مجموعة الهجن البيضاء أما بالنسبة لمحتواهم من النشا فكانت مجموعة الهجن البيضاء أعلا معنويا من مجموعة الهجن الصفراء. كما أوضحت النتائج أن الهجين الثلاثي 352 أعطي أعلي قوة هجين لصفة النسبة المئوية للزيت حيث كانت قوة الهجين 52.8 %. كما أن أعلي قوة هجين موجبة محسوبة علي أساس متوسط محتوي الأبوين من الزيت كانت للهجين الثلاثي 352 والهجين الفردي 26 حيث بلغت 52.8 ، 52.7 % علي التوالي. أما بالنسبة لصفة محتوي البروتين فإن أعلي قوة هجين موجبة فكانت للهجين الثلاثي 327 والهجين الفردي 11 حيث أعطت 37.1 ، 35.2 % علي التوالي. الهجين الفردي 124 والهجين الثلاثي 310 أعطت أعلي قوة هجين موجبة معنويا بالنسبة لصفة محتوي النشا حيث كانت 8.5 ، 7.3 % علي التوالي.

أوضحت الدراسة أن أعلا قيم لقوة الهجين تم الحصول عليها لصفتي محتوي الزيت ثم صفة محتـــوي البروتين أما قوة الهجين لمحتوي النشا فكانت صغيرة.

أوضحت نتائج معامل الارتباط المظهري أن هناك ارتباط سالب معنوي قدرة (-0.55) ما بين محتـــوي الزيت والبروتين في الحبوب كما أوضحت النتائج وجود ارتباط موجب غير معنوي بين محتوي الزيت والنشا فـــي الحبوب. وهذه النتائج تعتبر مهمة بالنسبة لمربي النبات عند الانتخاب في العشائر لإنتـــاج ســـلالات عاليـــة فـــي محتواها من الزيت أو البروتين أو كلاهما.

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