Estimation of Heterosis and Combining Ability in Soybean Among Top Crosses Analysis

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ABSTRACT

Ten attributes were measured in F_1 soybean crosses and their parents a two testers top crossed eight lines. Two testers (males) genotypes used namely L86-K-73 and D89-8940 and eight lines (females) used namely L-113Z, Giza111, Giza22, PI416937, Linford, L- 160Z, L-105Z and L-117Z. F_1 hybrids gave average heterosis values over their midparent and better parent of (18.98%, 8.89%) for plant height, (59.46%, 50.02%) for number of branches /plant,(80.01%,8.85%) for number of seeds/plant ,(72.46%,71.18%) for number of pods/plant ,(10.94%,4.41%) for number of seeds/pod ,(13.58%,4.67%) for 100-seed weight and (95.26,84.65) for seed yield/plant.

Some hybrids were earlier in flowering and maturity than their later parents. The mean squares due to parents, crosses and males by females were found to be highly significant for all the studied traits. Relative estimates of the variance due to general combining ability (δ^2gca) and specific combining ability (δ^2sca) indicated that (δ^2sca) played a major role in the inheritance of all traits.

The first (L86-K-73) gave the negative disarble value and higher significant ĝi effects than the second tester (D89-9840) for earliness traits. The second tester gave the highest positive significant ĝi effects than the other tester for yield components character. The female line (L.105Z) behaved as good combiner for all traits expect 100-seed weight followed by line (L-160Z). Significant "sca" effects were detected for plant height, number of seeds/plant, number of pods/plant and seed yield/plant in top cross (D89-8940 X Linford).

Key words: top crosses, heterosis, combining ability and soybean

INTRODUCTION

The soybean (*Glycine max (L.) Merrill*), a native of eastern Asia, is one of oldest crops of that area and it considered as a vital leguminous crop.

The soybean is a crop with many uses .It provides human food, animal feed and materials for many industrial uses .As a source of protein, oil, and fat, it compliments the contribution of most other major crop.

In Egypt, soybean is an important food legume crop because the quantity of oil seeds production including other oil crops, i.e., sesame, flax and peanut, is far from being sufficient for excessive demand. Therefore, Egyptian plant breeders intensified their efforts to increase soybean yield and yield components to meet the increasing demanded for oil and protein production.

Information about the type and magnitude of genetic variation and the relative importance of additive and non-additive gene action types would assist soybean breeders in carrying out the most suitable breeding programs for soybean improvement.

The combining ability analysis gives very useful information with regard to selection of parents based on the performance of their hybrids for the development of hybrids.

Moreover, this analysis gives the nature and magnitude of various types of gene action involved in the expression of quantitative traits (El-Hosary *et al.*, 1994, Bastawisy *et al* (1997) Mansour *et al.*2003 and Agrawal *et al* .2005).

The use of widely diverse germplasm in breeding programs has studied in many crop species. Many authors suggested that genetic diversity was the key to obtaining hybrid vigor. The crosses made in this study were from geographically diverse habitats. It was believed that they were from genetically diverse parents, as confirmed by the work of Paschal and Wilcox (1975).

The objectives of this were: is to determine the magnitude of heterosis for yield and its components and the other agronomic characters, and ii) to estimate the relative importance of general combining ability "gca" and specific combining ability "sca" in a set of top crosses involving new local varieties and exotic parental strains.

MATERIALS AND METHODS

This investigation was carried out at Iti-Elbaroud Agricultural Research Station during 2009 and 2010 summer seasons. Eight female lines or varieties of soybean were top crossed to each of two different male testers. The females were L-117Z, Giza111, Giza22, PI416937, Linford, L-160Z, L-105Z and L-117Z. The male testers were L86-K-73and D89-8940. Table (1) demonstrates a brief description of their genotypes i.e., maturity group, country origin, growth habit and flower color.

In 2009 summer season, 16 top crosses were made and in the following season2010, ten parental lines or varieties and 16 top crosses were evaluated in randomized complete block design with three replications. Each plot consisted of three ridges of 3m length and 60 cm width. Hills were spaced 20 cm with one seed per hill in one side of the ridges. Flowering time (in days) was calculated as number of days for the appearance one of first flower, maturity time (in days) was recorded at 95% pod maturity, and maturity period in days from flowering time to maturity time. At harvest, ten guarded plants were taken at random from each experimental plot to provide measurements for the following characteristics plant height, number of branches /plant, number of seeds/plant, number of seeds/pod, 100-seed weight (gm) and seed yield/plant (gm).

Table (1): Maturity group, country of origin, growth habit and flower color of the studied soybean Genotypes.

Genotypes	Maturity group	Country of origin	Growth habit	Flower color
Testers				
L86-k-73	I	U. S. A	Indeterminate	White
D89-8940	VII	U. S. A	Indeterminate	White
Lines				
L-113Z	II	Egypt	Indeterminate	Purple
Giza 111	IV	Egypt	Indeterminate	Purple
Giza22	IV	Egypt	Indeterminate	Purple
PI416937	V	U. S. A	Determinate	Purple
Linford	II	U .S. A	Indeterminate	White
L-160Z	III	Egypt	Indeterminate	White
L-105Z	V	Egypt	Indeterminate	White
L-117Z	III	Egypt	Indeterminate	White

Heterotic effects were computed as the percentage deviation of F_1 mean performance from mid and better parents (Mather and Jinks, 1971). Combining ability analysis was conducted based on the procedure developed by Kempthorne (1957). These methods were applied as described in detail under title (line X tester analysis) by Singh and Choudhary (1976).

RESULTS AND DISCUSSION

The analysis of variance for the studied traits is presented in table (2). Results indicated that genotypes, parents and crosses mean squares were highly significant for all studied characters indicating wide diversity between the parental genotypes of this study. Also, highly significant mean squares for parent's v.s. crosses as an indication of average heterosis were estimates for all crosses. There were highly significant mean squares of lines by testers interaction were obtained, indicating that females did not express identical orders of ranking for the performance of their crosses with each tester.

The estimates of the variance due to general combining ability (δ^2gca) and specific combining ability (δ^2sca) presented in Table (2) showed that (δ^2sca) played a major role in the inheritance, for all studied traits except number of seeds/pod, these estimates indicated the predominance of non-additive gene action.

Similar results were reported by Kaw and Menon (1983) El-Hosary *et al.*(1997), Mansour *et al* (2003) and Reda (2010).

The mean performance of the two tester, eight lines and sixteen top crosses were presented in Table (3). It is clear that parent (L86-K-73) behaved as the earliest one for maturity (100.33days) followed by parental variety Linford (102.33days). Parental line 105Z gave the highest values for plant height (99.3cm),number of seeds/plant (783.45), number of pods/plant (301.53) and number of seeds/pod (2.6). The line L113Z expressed the highest value for 100-seed weight (17gm), parental line 160Z was the best for seed yield/plant since it gave the highest mean value followed by line 117Z(83.4and 75.43) respectively.

It is also clear from data in Table (3) that the F_1 top crosses for all traits studied showed wide variation between parents and their F_1 hybrids variations attributed to genetic diversity of the parents and their F_1 top crosses. The top cross (L86-K-73 x Linford) expressed the lowest value for all earliness traits (31,103 and72days) while the top cross (D89-8940 x PI416937) gave highest value(46.67,139.33 and 92.67days) number of days to flowering, number of days to maturity and maturity period, respectively. The top cross (D89-8940 x L-105Z) had the highest mean values for number of seeds/plant and number of pods/plant (957.54and 399.53), respectively. The top cross (D89-8940 X L-160Z) expressed the highest value for seed yield/plant (106.4 gm).

Heterosis value measured from mid and better parent values are presented in Tables (4 and 5). The results in Table (4) indicated that of F_1 top crosses for flowering dates, all crosses produced from parental tester D89-8940 with all lines (females) exhibited highly significant negative heterosis to mid-parent values.

For plant height, all top crosses expressed significant positive heterotic effects relative to mid-parent values.

Significantly positive heterotic effects relative to the better parent showed from ten top crosses for the plant height.

In Table (5), concerning that for number of branches/plant the, all top crosses expressed highly significant positive heterotic effects to relative to mid and better parent values except top cross (D89-8940 x Linford) exhibited insignificanteffect to better parent.

With respect to number of seeds/plant with the exception of top crosses (D89-8940xL-113Z) and (D89-8940xPI416937), all top crosses expressed significant positive heterotic effects relative to mid and better parent.

Concerning number of pods/plant all crosses exhibited highly significant positive heterotic effects relative to mid-parent and significant positive or negative were showed relative to better parent.

Regarding seed yield/plant, all top crosses showed significantly positive heterotic effects relative to mid and better parent. The top cross (L86-K-73 x PI416937) gave the highest value followed by cross (L86-K-73 x L-113Z).

Regarding 100-seed weight, all top crosses exhibited significant positive heterotic effects relative to mid-parent except the two crosses (L86-K-73 x L-113Z) and (D89-8940 x L-113Z). These results were in agreement with those obtained by the following investigators, Mehta *et al.* (1984), Halvankar and Patel (1992), Bastawisy *et al.* (1997), Mansour *et al.*(2002), Hoda *et al.*(2006),and El-Garhy *et al.*(2008).

Estimates of general combining ability effects (gi) are presented in Table (6) Results showed that tester (D89-8940) gave the highest positive (gi) effect than the other tester (L86-K-73) for all studied traits except 100-seed weight and number of seeds/pod. Therefore, the second tester (D89-8940) could be considered as excellent tester inbreeding for plant height, number of branches/plant.

The female line (L-105) behaved as good combiner for the plant height, number of branches/plant, number of seeds/plant, number of pods/plant and seed yield /plant. Moreover, the female PI416937 expressed highly significant positive (ĝi) effects for number of days to flowering, number of days to maturity and maturity period. These results suggested that a greater opportunity for selection would be possible for yield and its components.

Specific combining ability effect of the top crosses (ŝij) was computed for all the studied traits as shown in Table (7). The result indicated that the crosses (L86-K-73 X PI416937),(L86-K-73 X L-105Z) and (D89-8940 X Giza22) had significant positive SCA effects for flowering date. Also the top cross (D89-8940 XL-113Z) exhibited the highly significant positive SCA effects for number of days to maturity and seed yield/plant. The top cross (D89-8940 X Linford) exhibited the highest value and significant positive SCA effects for plant height, number of seed/plant, number of pods/plant and seed yield/plant.

If crosses showing high SCA effects involve only one good combiner, such combinations would throw out desirable transgressive segregates providing that additive genetic system. The good combiner and complementary and epestatic effects presented in the crosses act in the same direction to reduce undesirable plant characteristics and maximize the character in view.

Similar results were obtained by El-Hosary and Sedhom (1988), Bastawisy *et al.* (1997), Habeeb(1998), Mansour *et al*, (2002), Mansour *et al.*(2003) and Reda(2010).

Hence, it could be concluded that these top crosses offer possibility improving seed yield in soybean. These findings revealed that hybridization program based on these materials would be useful.

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Table (2): Mean squares from the ordinary analysis of variance and estimates of the general and specific combining abilities variance (δ^2gca and δ^2sca) for all studied traits in soybean top crosses.

S.O.V	d.f	No of days to flowering	No of days to maturity	Maturity period	Plant height (cm)	No. of branches / plant	No. of seeds /plant	No. of pods /plant	No. of seeds /pod	100-seed Weight (gm)	seed yield /plant (gm)
Replications	2	2.02	0.01	2.51	0.21	0.01	18.68	176.69	0.01	0.01	1.39
Genotypes	25	248.21**	546.24**	122.09**	305.52**	1.13**	96675.35**	15682.97**	0.06**	6.39**	1276.28**
Crosses	15	142.92**	427.64**	131.42**	180.94**	0.67**	39895.17**	5966.92**	0.03**	2.49**	440.72**
Parents	9	447.94**	801.19**	112.43**	450.23**	0.49**	104155.46**	17363.92**	0.12**	13.48**	982.93**
Female (Lines)	8	74.81**	342.21**	121.57**	249.24**	1.11**	64235.24**	7541.45**	0.05**	4.77**	727.46**
Male(Testers)	1	1250.5**	3763.02**	918.75**	604.22**	1.58**	107043.96**	25364.87**	0.02*	1.54**	910.89**
Parents vs crosses	1	29.82**	30.60**	69.01**	871.86**	13.69**	881057.25**	146295.06**	0.04*	1.08**	16450.15**
Female X Male	7	52.81**	36.59**	28.80**	52.17**	0.11	5962.39**	1621.26**	0.01	0.35**	86.8**
Error	50	12.18	2.28	2.35	2.46	0.07	544.61	264.88	0.01	0.08	2.59
δ2gca		2.56	11.16	2.92	3.66	0.02	963.99	123.52	0.001	0.06	10.05
δ2sca		13.54	11.44	8.82	16.57	0.01	1805.93	452.13	0.001	0.09	28.07

NS:Not significant *and** significant at0.05 and 0.01 levels of probability, respectively.

Table (3): Mean performance of 16 top crosses between eight lines and two testers for studies characters in soybean.

Genotypes	No of days to flowering	No of days to maturity	Maturity period	Plant height (cm)	No. of branches / plant	No. of seeds /plant	No. of pods /plant	No. of seeds /pod	100-seed weight (gm)	Seed yield/plant (gm)
T1-L86-k-73	30.67	100.33	69.67	67.13	1.97	338.90	156.99	2.17	11.13	37.73
T2-D89-8940	70.67	152.00	81.33	81.23	2.53	696.80	349.21	2.00	10.00	69.57
L1- L-113Z	31.33	104.33	73.00	66.63	2.00	271.96	120.38	2.27	17.00	46.23
L2-Giza 111	39.33	119.33	80.00	88.87	2.63	546.78	222.09	2.47	13.07	71.43
L3-Giza22	40.00	120.00	80.00	88.40	2.57	541.82	226.05	2.40	13.00	70.43
L4-PI416937	46.67	134.33	87.67	65.00	3.00	337.80	159.35	2.11	12.53	42.33
L5-Linford	29.33	102.33	73.00	65.90	1.63	326.44	142.08	2.30	10.73	35.03
L6-L-160Z	34.00	114.67	80.67	88.30	2.53	721.28	289.00	2.50	11.67	83.40
L7-L-105Z	44.67	133.33	88.67	99.30	2.60	783.45	301.53	2.60	9.53	74.67
L8-L-117Z	35.00	115.00	80.00	78.70	2.23	592.71	237.47	2.50	12.83	75.43
T1xL1	31.33	104.67	73.33	73.07	2.30	532.79	228.82	2.33	13.97	74.40
T1xL2	34.67	113.67	79.33	91.30	3.27	725.70	302.88	2.40	13.00	94.30
T1xL3	33.67	113.33	79.33	83.60	3.47	706.36	299.43	2.37	13.10	92.50
T1xL4	44.33	128.00	83.67	74.32	3.23	609.32	272.78	2.23	12.83	78.17
T1xL5	31.00	103.00	72.00	70.77	2.30	522.92	218.34	2.40	11.27	58.87
T1xL6	32.33	105.00	72.67	92.47	3.23	815.83	322.10	2.53	12.03	98.17
T1xL7	39.33	118.67	79.33	89.03	3.33	811.96	325.53	2.50	11.60	94.10
T1xL8	33.67	109.67	76.00	83.63	3.27	771.34	321.69	2.40	12.77	98.47
T2xL1	44.00	129.00	85.00	82.90	3.23	655.22	276.76	2.37	13.57	88.80
T2xL2	45.67	130.67	85.00	94.63	3.53	772.77	317.79	2.47	12.77	98.63
T2xL3	46.00	128.67	82.67	93.90	3.73	760.31	321.49	2.37	12.23	93.00
T2xL4	46.67	139.33	92.67	85.03	3.53	699.86	318.68	2.20	12.23	85.60
T2xL5	42.33	125.00	82.67	85.50	3.47	735.70	329.72	2.23	11.37	83.57
T2xL6	41.33	121.67	80.33	88.17	3.30	879.16	356.53	2.47	12.10	106.40
T2xL7	45.33	141.67	96.33	97.10	3.70	957.54	399.53	2.40	10.47	100.10
T2xL8	40.67	121.67	81.00	87.70	3.80	791.25	338.88	2.33	12.97	102.57
L.S.D 0.05	5.70	2.47	2.51	2.56	0.42	38.11	26.58	0.17	0.47	2.63
L.S.D 0.01	7.59	3.29	3.34	3.41	0.55	50.81	35.44	0.22	0.62	3.51

Table (4): Percentage values of heterotic effects relative to mid and better parents for earliness and growth traits in soybean.

Crosses	No of days to flowering		No of days to maturity		Maturity period		Plant height (cm)		No. of branches / plant	
	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P
T1XL1	2.13	2.15	2.29	4.33*	2.79	5.25*	9.63**	8.85**	15.95**	15.00**
T1XL2	-0.94	13.04**	3.50*	13.3**	6.01**	13.87**	17.05**	2.73	42.04**	24.08**
T1XL3	-4.71*	9.78**	21.03**	32.84**	6.01**	13.87**	13.33**	-5.43**	52.93**	35.06**
T1XL4	14.64**	44.54**	9.09**	27.58**	6.36**	20.09**	12.46**	10.68**	30.18**	7.77**
T1XL5	3.33	5.69*	1.64	2.66	0.93	3.34*	6.4**	5.42**	26.32**	16.93**
T1XL6	-0.02	5.41*	-2.32	4.65*	-3.34*	4.31*	18.98**	4.72*	43.69**	27.64**
T1XL7	4.41*	29.23**	-0.14	16.29**	0.20	13.87**	6.99**	-10.34**	45.96**	28.19**
T1XL8	2.71	9.78**	1.86	9.31**	1.55	9.09**	14.69**	6.26**	55.57**	46.31**
T2XL1	-13.73**	40.44**	0.65	23.65**	10.15**	16.44**	12.13**	2.06	42.64**	27.69**
T2XL2	-16.93**	16.12**	-3.69*	9.50**	5.37*	6.25**	11.26**	6.48**	36.78**	34.18**
T2XL3	-16.88**	15.00**	-5.39**	7.23**	2.49	3.34*	10.71**	6.22**	46.39**	45.42**
T2XL4	-20.45**	0.00	-2.68	3.72*	9.67**	13.94**	16.3**	4.68*	27.71**	17.77**
T2XL5	-15.34**	44.32**	-1.70	22.15**	7.14**	13.25**	16.22**	5.26**	18.43**	-2.61
T2XL6	-21.03**	21.56	-8.88**	6.10**	-0.13	-0.42	4.02*	-0.15	30.28**	30.28**
T2XL7	-21.40**	2.24	11.41**	38.32**	13.33**	6.15**	7.57**	-2.22	44.17**	42.31**
T2XL8	-23.02**	16.20**	-8.75**	6.10**	0.41	1.25	9.67**	7.97**	59.46**	50.02**

T1-L86-K-73 L1- L-113Z L2- Giza111 L3- Giza22 L4-PI-416937
T2-D89-8940 L5- Linford L6- L-160Z L7- L105Z L8- L-117Z
NS:Not significant *and** significant at0.05 and 0.01 levels of probability, respectively.

Table (5): Percentage values of heterotic effects relative to mid and better parents for yield and its components traits in soybean.

Crosses	No. of seed /plant		No. of pods /plant		No. of seed /pod		100-seed Weight (gm)		Seed yield/plant (gm)	
	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P	B.P	M.P
T1XL1	74.44**	57.21**	65.10*	45.76**	5.23*	2.91	-0.70	-17.8**	77.21**	60.92**
T1XL2	63.88**	32.72**	59.80**	36.38**	3.58*	-2.72	7.44**	-0.51	72.28**	32.01**
T1XL3	60.41**	30.37**	56.34**	27.58**	3.66*	-1.38	8.57**	0.77	71.03**	13.33**
T1XL4	80.01**	79.80**	72.46**	71.18**	4.49*	3.05*	8.45**	2.39	95.26**	84.69**
T1XL5	57.19**	54.30**	46.01**	39.08**	7.45**	4.35*	3.05*	1.20	61.8**	56.01**
T1XL6	53.90**	13.11**	44.44**	11.45**	8.55**	1.32	5.55*	3.14*	62.08**	17.71**
T1XL7	44.69**	3.64*	41.99**	7.96**	4.89*	-3.85*	12.26**	4.19*	67.44**	26.03**
T1XL8	65.59**	30.14**	63.10**	35.46**	2.85*	-4.01*	6.54**	-0.51	74.02**	30.55**
T2XL1	35.27**	-5.97*	17.87**	-20.75**	10.94**	4.41*	0.50	-20.1**	53.37**	27.65**
T2XL2	24.28**	10.90**	11.25**	-9.0**	8.04**	0.00	10.69**	-2.3	39.90**	38.08**
T2XL3	22.77**	9.11**	11.77**	-10.80**	7.59**	-1.38	6.37**	-0.06	32.86**	23.04**
T2XL4	35.29**	0.44	25.33**	-8.74**	7.13**	4.41*	8.85**	-2.39	52.99**	23.05**
T2XL5	43.80**	5.58*	34.23**	-5.58*	3.86*	-2.91	9.95**	5.91*	59.78**	20.12**
T2XL6	23.99**	21.89**	11.73**	7.10**	9.64**	-1.32	11.69**	3.71*	39.11**	27.58**
T2XL7	29.37**	22.21**	22.79**	14.41**	4.35*	-7.69**	7.17**	4.67*	38.80**	34.06**
T2XL8	22.72**	13.55**	15.53**	-2.96	3.69*	-6.68**	13.85**	1.04	41.47**	35.97**

T1-L86-K-73 L1- L-113Z L2- Giza111 L3- Giza22 L4-PI-416937
T2-D89-8940 L5- Linford L6- L-160Z L7- L105Z L8- L-117Z
NS:Not significant *and** significant at0.05 and 0.01 levels of probability, respectively.

Table (6): Estimates of general combining ability effects for the studied traits in soybean top crosses.

Parents	No of days to flowering	No of days to maturity	Maturity period	Plant height (cm)	No. of branches / plant	No. of seeds /plant	No. of pods /plant	No. of seeds /pod	100-seed Weight (gm)	Seed yield/plant (gm)
Male(testers)										
1-L86-k-73	-5.15**	-8.85**	-4.38**	-3.55**	-0.18**	-47.22**	-22.99**	0.02	0.18**	-4.36**
2-D89-8940	5.15**	8.85**	4.38**	3.55**	0.18**	47.22**	22.99**	-0.02	-0.18**	4.36**
S.E.(gi)	1.43	0.62	0.63	0.64	0.10	9.53	6.64	0.04	0.12	0.66
S.E.(gi-gj)	2.02	0.87	0.87	0.91	0.15	13.47	9.4	0.06	0.17	0.93
Female(line)										
1- L-113Z	-1.23	-4.02**	-2.17**	-7.84**	-0.47**	-140.2**	-56.64**	-0.03	1.38**	-8.88**
2-Giza 111	1.27	1.31*	0.83	7.15**	0.17	14.99**	0.9	0.06	0.5**	5.99**
3-Giza22	-4.06**	0.15	-0.33	2.93**	0.37**	-0.92	1.02	-0.01	0.28*	2.27**
4-PI416937	6.60**	12.81**	6.83**	-6.15**	0.15	-79.66**	-13.7**	-0.16**	0.14	-8.59**
5-Linford	-2.23	-6.85**	-4.00**	-7.69**	-0.85**	-104.9**	-35.4**	-0.06	-1.08**	-19.26**
6-L-160Z	-2.06	-7.52**	-4.83**	4.5**	0.04	113.3**	29.88**	0.13**	-0.33**	11.81**
7-L-105Z	3.44*	9.31**	6.50**	7.25**	0.29**	150.5**	53.09**	0.08	-1.36**	6.62**
8-L-117Z	-1.73	-5.19**	-2.83**	-0.15	0.3**	47.03**	20.85**	-0.01	0.48**	10.04**
S.E.(gi)	2.85	1.23	1.25	1.28	0.21	19.05	13.29	0.08	0.23	1.32
S.E.(gi-gj)	4.03	1.74	1.77	1.81	0.29	26.45	18.79	0.12	0.32	1.86

NS:Not significant *and** significant at0.05 and 0.01 levels of probability, respectively.

Table (7): Estimates of specific combining ability effects for the studied traits in soybean top crosses.

Crosses	No of days to flowering	No of days to maturity	Maturity period	Plant height (cm)	No. of branches / plant	No. of seeds /plant	No. of pods /plant	No. of seeds /pod	100-seed Weight (gm)	Seed yield/plant (gm)
L86-k-73x L-113Z	-1.23	-3.31**	-1.46	-1.37	-0.29	-13.99	-0.98	-0.04	0.02	-2.84**
L86-k-73xGiza111	-0.4	0.35	1.54	1.88*	0.05	23.69	15.53	-0.05	-0.06	2.19*
L86-k-73xGiza22	-6.06**	1.19	2.71**	-1.6	0.05	20.25	11.96	-0.02	0.25	4.12**
L86-k-73xPI416937	3.94**	3.19**	-0.13	-1.82*	0.03	1.96	0.04	-0.01	0.12	0.64
L86-k-73xLinford	-0.56	-2.15*	-0.96	-3.82**	0.1	-59.2**	-32.7**	0.06	-0.23	-7.99**
L86-k-73xL-160z	0.60	0.52	0.54	5.7**	0.15	15.56	5.77	0.01	-0.21	0.24
L86-k-73xL-105z	2.10*	-2.65**	-4.1**	-0.49	-0.01	-25.57*	-14.01	0.03	0.39*	1.36
L86-k-73xl-117z	1.60	2.85**	1.88*	1.52	-0.9	37.3**	14.39	0.01	-0.28	2.31*
D89-8940xL113z	1.23	3.31**	1.46	1.37	0.29	13.99	0.98	0.04	-0.02	2.84**
D89-8940x Giza111	0.4	-0.35	-1.54	-1.88*	-0.05	-23.69	-15.53	0.05	0.06	-2.19*
D89-8940x Giza22	6.06**	-1.19	-2.7**	1.6	-0.05	-20.25	-11.96	0.02	-0.25	-4.12**
D89-8940x PI416937	-3.94**	-3.19**	0.13	1.82*	-0.03	-1.96	-0.04	0.01	-0.12	-0.64
D89-8940x Linford	0.56	2.15*	0.96	3.82**	-0.1	59.2**	32.7**	-0.06	0.23	7.99**
D89-8940xL-160z	-0.6	-0.52	0.54	-5.7**	-0.15	-15.56	-5.77	-0.01	0.21	-0.24
D89-8940xL--105z	-2.1*	2.65**	4.13**	0.49	0.01	25.57*	14.01	-0.03	-0.39*	-1.36
D89-8940xl-117z	-1.6	-2.85**	1.88*	-1.52	0.9	-37.3**	-14.39	-0.01	0.28	2.31*
S.E.(sij)	4.03	1.74	1.77	1.81	0.29	26.95	18.79	0.12	0.33	1.86
S.E.(sij - skj)	5.7	2.47	2.51	2.56	0.42	38.11	26.58	0.17	0.45	2.63

NS:Not significant *and** significant at0.05 and 0.01 levels of probability, respectively.

الملخص العربي

تقدير قوة الهجين والقدرة على التآلف فى الهجن القمية لمحصول فول الصويا

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أجري هذه البحث بهدف دراسة قوة الهجين والقدره على التآلف لمجموعه من الهجن القميه فى فول الصويا بين كشافين وهما L86-K-73,D89-8940 كآباء مع ثمانيه سلالات وأصناف استخدمت كأمهات هي:

1- L-113Z
2- Giza111
3- Giza22
4- PI416937
5- Linford
6- L-160Z
7- L-105Z
8- L117Z

الموسم الاول تم عمل التهجينات القميه وفى الموسم الثانى تم مقارنة الهجن القمية مع الآباءوالأمهات.

وشملت الدراسة صفات ميعاد التزهير وميعاد النضج وفترة النضج وطول النبات وعدد فروع النبات وعدد بذور النبات وعدد القرون للنبات وعدد البذور للقرن ووزن المائة بذرة وكذلك وزن بذور النبات.

ويمكن إيجاز النتائج المتحصل عليها كالتالى:

1- كان تباين الآباء وتباين الهجن القمية وتباين التفاعل بين الكشافين والسلالات معنويا لكل الصفات المدروسة.

2- كان تباين القدرة الخاصة والعامة على التآلف معنويتين لكل الصفات المدروسة مما يشير إلى أهمية التأثير المضيف وغير المضيف للفعل الجينى على توريث الصفات تحت الدراسة.

3- كانت قوة الهجين عالية لكل من متوسط الأبوين والآب الأفضل لصفات طول النبات تراوحت بين 8.85 -18.98% وكذلك (50.02-59.46%) لصفة عدد الفروع على النبات. وبالنسبة لوزن محصول النبات كانت قوة الهجين (84.65-95.26%) وكذلك لمعظم الصفات الأخرى.

4- كما أوضحت النتائج أن بعض الهجن مبكرة فى صفات ميعاد التزهير وميعاد النضج وذلك عن الأب المتأخر.

5- أوضحت قيم القدرة العامة على التآلف أن الكشاف L86-K-73 أفضل من الكشاف D89-8940 من حيث التبكير ولكن الكشاف الأخير كان الأفضل فى صفات المحصول ومكوناتة. وكانت أفضل الأمهات هى السلالة L-105Z لجميع الصفات المدروسة عدا صفة وزن 100 بذرة.

6- أعطى الهجين القمى (D89-8940 x Linford) أفضل النتائج لصفات طول النبات -عدد البذور للنبات - عدد القرون للنبات ووزن بذور النبات.