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TOP CROSSES ANALYSIS FOR YIELD AND ITS COMPONENTS IN SOYBEAN (*Glycine max* "L." Merrill)

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ABSTRACT: *Seven genotypes of soybean (Glycine max (L.) Merrill) namely, Giza82, Giza35, H57Z, Hartwig, L86-K-73, Holladay and PI416937, were used as females top crossed to each of the two different genetic base testers (male), Giza83 and Toano. The following characteristics were measured: plant height, number of branches per plant, number of days to flowering, number of days to maturity, number of pods per plant, number of seeds per pod, number of seeds per plant, 100-seed weight and seed yield per plant. 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 (δ2 gca) and specific combining ability (δ2 sca) indicated that (δ2 sca) played a major role in the inheritance of all traits. The parental Giza83 (male) gave the highest positive significant "ĝi" effect than the other male; Toano, for yield component characters. The female lines Giza35, H57Z and Holladay behaved as good combiners for plant height, number of branches per plant, number of days to flowering, number of days to maturity, number of seeds per pod and number of seeds per plant. Significant positive "sca" effects were detected for plant height, number of pods per plant, number of seeds per plant and seed yield per plant in four top crosses; i.e., (Giza83 x Giza35), (Giza83x x H57Z), (Giza83 x Holladay) and (Toano x Giza82).*

All crosses showed highly significant positive heterotic effects relative to the mid and the better parent for yield and its components.

Key words: *top cross, heterosis, specific and general combining ability, soybean.*

INTRODUCTION

The combining ability analysis gives very useful information with regard to selection of parents based on 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).

The use of widely diverse germplasm in breeding programs has been 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). In self fertilizing crops where commercial exploitation of heterosis, is not feasible, the breeder will primarily be interested in higher magnitude of additive genetic variance for establishing superior genotypes. With regard to combining ability effects, several authors found the significance of both general and specific combining ability effects for important agronomic traits, yield and its components (Ma *et al.*, 1983; Kunta *et al.*, 1985; Cruz *et al.*, 1987; El-Hosary *et al.*, 1994; Bastawisy *et al.*, 1997 and Mansour *et al.*, 2002).

The objectives of this study were: i) to determine the magnitude of heterosis for yield and its components and 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

Seven female lines of soybean were top crossed to each of two different male testers. The females were Giza82, Giza35, H57Z, Hartwig, L86-K-73, Holladay and PI416937. The male testers were Giza83 and Toano. Table (1) demonstrates a brief description of these genotypes, i.e., maturity group, growth habit, flower colour and origin.

In 2001 summer season, 14 top crosses were made at Itai El-Baroud Agricultural Research Station. In the following season 2002, nine parental lines and 14 top crosses were evaluated in a randomized complete block design with three replications. Each plot consisted of three ridges of 3 m 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 recorded at 50% flowering of plants and maturity time (in days) was recorded at 95% pod maturity. 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 per plant, number of pods per plant, number of seeds per pod, number of seeds per plant, 100-seed weight and seed yield per plant.

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

Table (1):Maturity group, growth habit, flower colour and origin of the soybean genotypes.

Genotype	Maturity group	Growth habit	Flower colour	Origin
Giza 82	II	Indeterminate	Purple	Egypt
Giza 35	III	Indeterminate	Purple	Egypt
H57Z	V	Indeterminate	Purple	Egypt
Hartwig	V	Indeterminate	White	U.S.A
L86-K-73	I	Indeterminate	White	U.S.A
Holladay	V	Indeterminate	Purple	U.S.A
PI416937	V	Determinate	Purple	U.S.A
Giza 83	II	Indeterminate	White	Egypt
Toano	V	Indeterminate	Purple	U.S.A

RESULTS AND DISCUSSION

The results of analysis of variance (Table 2) showed that mean squares due to genotypes, parents and crosses were found to be highly significant for all the studied characters. The results confirmed the existence of genetic diversity in the genotypes studied. Mean squares for parent vs. crosses as an indication of average heterosis were estimated for all crosses. There were highly significant differences among mean squares for all the studied traits. Highly significant mean squares of females by males interaction were obtained, indicating that females did not express identical orders of ranking for the performance of their crosses with each tester (male).

The estimates of the variance due to general combining ability (δ^2 gca) and specific combining ability (δ^2 sca) presented in Table (2) showed that (δ^2 sca) played a major role in the inheritance, for all of the studied traits. These results support the findings of Kaw and Menon (1983), Cruz *et al.*(1987), Harer and Deshmukh (1991) and El-Hosary *et al.*(1994). Values of (gca) effects "ĝi" for individual testers (males) and lines (females) in each trait are presented in Table (3). The first tester Giza 83 gave the highest positive "ĝi" effect than other tester Toano for the following traits: number of pods per plant, number of seeds per pod and number of seeds per plant. Therefore, the first tester Giza83 could be considered as an excellent tester in breeding for no. of pods per plant, no. of seeds per pod and no. of seeds per plant. The female line Giza35 behaved as good combiner for the same traits. Moreover, the female line Holladay expressed highly significant positive "ĝi" effects for plant height, number of branches per plant, number of days to flowering, number of days to maturity and seed yield per plant. On the other hand, the female

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

S.O.V	d.f	Plant height	No. of branches /plant	No. of days to flowering	No. of days to maturity	No. of pods /plant	No. of seeds /pod	No. of seeds /plant	100-seed weight	Seed yield /plant
Replications	2	8.1	0.03	0.36	0.71	31.31	0.0006	140.98	1.71	6.39
Genotypes	22	398.76**	3.9**	172.08**	493.57**	10618.67**	0.103**	65519.99**	23.39**	2441.86**
Parents	8	409.31**	4.42**	268.04**	603.83**	614.51**	0.121**	86674.22**	22.70**	92.46**
Crosses	13	337.67**	1.45**	109.17**	457.89**	7236.82**	0.047**	43563.93**	14.01**	1475.13**
Male (tester)	1	8.09	0.15	184.38**	180.21**	6158.18**	0.063**	51438.10**	64.56**	62.81
Female (line)	6	526.99**	0.95*	157.32**	732.61**	8025.48**	0.064**	50092.71**	16.75**	2063.55**
Male x female	6	203.23**	2.17**	48.49**	229.44**	6627.92**	0.027**	35722.79**	2.85**	1122.10**
Parent vs. cross	1	1108.50**	31.69**	222.23**	85.27**	134616.07**	0.699**	842601.55**	150.91**	33804.48**
Error	44	4.58	0.13	1.07	2.23	166.01	0.002	827.56	0.6	16.52
δ^2 gca		4.38	0.02	1.98	7.44	19.84	0.001	255.48	0.36	11.50
δ^2 sca		66.23	0.68	15.81	75.81	2153.97	0.008	11631.74	0.75	368.52

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

Table (3): Estimates of general combining ability effects for the studied traits in soybean.

Parent	Plant height (cm)	No. of branches /plant	No. of days to flowering	No. of days to maturity	No. of pods /plant	No. of seeds /pod	No. of seeds /plant	100-seed weight (g)	Seed yield /plant (g)
Male (tester)									
Giza83	-0.44	0.06	-2.01**	-2.07**	12.11**	0.04**	34.99**	-1.24**	-1.22
Toano	0.44	-0.06	2.01**	2.07**	-12.11**	-0.04**	-34.99**	1.24**	1.22
S.E. (ĝi)	0.57	0.10	0.23	0.33	3.44	0.01	6.28	0.21	1.09
S.E. (ĝi - ĝj)	0.66	0.11	0.32	0.46	3.98	0.01	8.88	0.24	1.25
Female (line)									
Giza82	5.04**	-0.49**	-5.29**	-14.33**	-18.14**	-0.01	-46.30**	2.88**	-2.31
Giza35	6.78**	-0.42**	-4.29**	0.67	49.45**	0.16**	146.62**	1.62**	-35.12**
H57Z	-1.57	0.58**	8.05	12.67**	2.94	0.12**	27.43**	-1.38**	2.15
Hartwig	-10.06**	0.19	-0.45	3.67**	-55.43**	-0.01	-129.10**	-0.32	23.84**
L86-K-73	-10.04**	-0.24	-4.45**	-16.16**	41.65**	-0.11**	72.67**	-1.72**	-7.61**
Holladay	14.99**	0.29*	4.88**	6.34**	-20.85**	-0.10**	-60.26**	-0.18	12.00**
PI416937	-5.14**	0.09	1.55**	7.17**	0.38	-0.05*	-11.06	-0.91**	7.05**
S.E. (ĝi)	0.87	0.15	0.42	0.61	5.26	0.02	11.74	0.32	1.66
S.E. (ĝi - ĝj)	1.24	0.21	0.60	0.86	7.44	0.03	16.61	0.45	2.35

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

variety Giza82 expressed highly significant negative "ĝi" effects for all the studied traits, except plant height and 100-seed weight. These results suggested that a greater opportunity for selection would be possible for yield and its components.

Specific combining ability effect "sij" of the top crosses were computed for all the studied traits as shown in Table (4). The desirable inter- and intra-allelic interactions were represented by four top crosses; (Giza 83 x Giza 35), (Giza 83 x H57Z), (Toano x Giza 82) and (Toano x L86-K-37) for number of pods per plant, number of seeds per plant and seed yield per plant. The four crosses; (G.83 x G.82), (Giza 83 x L86-K-73), (Toano x H57Z) and (Toano x Holladay) were superior for number of days to flowering and maturity. Similar results were obtained by El-Hady *et al.*(1991), El-Hosary *et al.*(1994), Bastawisy *et al.*(1997) and Mansour *et al.*(2002).

The mean performance of the 23 genotypes are given in Table (5). Wide variations between parents and between their F_1 crosses for all the studied traits were observed. These variations might be primarily attributed to genetic diversity among parents for all studied traits. The parental variety Giza82 behaved as the earliest for maturity (97 days). It produced significantly higher seed yield per plant (32.34 g) and 100-seed weight (19.9 g). However, the parental line PI416937 was the latest one for maturity (135.33 days), and it gave highest value for number of seeds per plant (209.11). The parental variety Giza35 was the tallest (77.2 cm).

The obtained results indicated that top cross (Giza 83 x Giza 35) gave the highest value for number of pods per plant, number of seeds per pod, number of seeds per plant and seed yield per plant (260.93, 2.45, 638.98 and 120.26 g), respectively. However, the top cross (Toano x Hartwig) had the lowest value for the same traits (95.67, 2.24, 213.62 and 40.889), respectively. The top cross (Toano x L86-K-73) was the earliest for maturity date (96.67 days), however, the top cross (Toano x H57Z) was the latest one (144 days).

Heterosis expressed as the percentage deviation of F_1 mean performance from its mid and better parent average values for all the studied traits, are presented in Table (6). For plant height, eleven and seven top crosses significantly exceeded positive the mid and better parent. It was clear that the top crosses (Toano x Giza 82), (Toano x PI416937) and (Giza 83 x Holladay) gave the highest heterosis for plant height (57.41, 43.92 and 40.99%), respectively.

For number of branches per plant, all top crosses expressed significant positive heterotic effects relative to mid and better parent values, except the top cross (Toano x H57Z) which exhibited negative heterosis over better value and insignificant for top cross (Giza 83 x Giza 35).

Table (4): Estimates of specific combining ability effects for the top crosses studied in soybean.

Crosses	Plant height (cm)	No. of branches /plant	No. of days to flowering	No. of days to maturity	No. of pods /plant	No. of seeds /pod	No. of seeds /plant	100-seed weight (g)	Seed yield /plant (g)
1. Giza83 x Giza82	-10.59**	-0.04	1.43*	5.90**	-48.78**	-0.01	-115.42**	0.95*	-19.11**
2. Giza83 x Giza35	5.84**	-0.94**	-1.90**	-0.76	33.26**	-0.07*	70.69**	0.33	14.67**
3. Giza83 x H57Z	-0.51	0.96**	-2.57**	-8.43**	27.96**	0.02	71.79**	-0.90*	7.76**
4. Giza83 x Hartwig	2.41	0.37	2.26**	-2.10*	2.91	0.04	8.96	-0.08	3.30
5. Giza83 x L86-K-73	2.82*	-0.09	3.60**	10.07**	-43.83**	-0.01	-100.20**	-0.47	-19.34**
6. Giza83 x Holladay	4.74**	0.17	-4.07**	-4.10**	10.77	0.11**	37.20*	0.71	9.14*
7. Giza83 x PI416937	-4.61**	-0.43*	1.26*	-0.60	17.73*	-0.08*	26.17	-0.54	3.58
8. Toano x Giza82	10.59**	0.04	-1.43*	-5.90**	48.78**	0.01	115.42**	-0.95*	19.11**
9. Toano x Giza35	-5.84**	0.94**	1.90**	0.76	-33.26**	0.07*	-70.69**	-0.33	-14.67**
10. Toano x H57Z	0.51	-0.96**	2.57**	8.43**	-27.96**	-0.02	-71.79**	0.90*	-7.76**
11. Toano x Hartwig	-2.41	-0.37	-2.26**	2.10*	-2.91	-0.04	-8.96	0.08	-3.30
12. Toano x L86-K-73	-2.82*	0.09	-3.60**	-10.07**	43.83**	0.01	100.20**	0.47	19.34**
13. Toano x Holladay	-4.74**	-0.17	4.07**	4.10**	-10.77	-0.11**	-37.20*	-0.71	-9.14**
14. Toano x PI416937	4.61**	0.43*	-1.26*	0.60	-17.73	0.08*	-26.17	0.54	-3.58
S.E. (S ÎĴ)	1.24	0.21	0.60	0.86	7.44	0.03	16.61	0.45	2.35
S.E. (S ÎĴ- S ÎĴ)	1.75	0.30	0.85	1.22	10.52	0.04	23.49	0.63	3.32

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

Table (5): Mean performance of 14 top crosses between seven lines and two testers for the studied characters in soybean.

Genotypes	Plant height (cm)	No. of branches /plant	No. of days to flowering	No. of days to maturity	No. of pods /plant	No. of seeds /pod	No. of seeds /plant	100-seed weight (g)	Seed yield /plant (g)
T_1 Giza83	48.53	3.97	36.67	111.67	74.66	2.15	160.78	13.75	22.14
T_2 Toano	47.27	3.33	54.67	130.67	65.79	1.93	126.70	16.56	22.11
L_1 Giza82	53.14	4.07	34.00	97.00	74.62	2.17	161.72	19.90	32.34
L_2 Giza35	77.20	4.17	35.67	111.33	71.25	2.33	166.11	17.57	29.12
L_3 H57Z	55.13	7.03	51.00	128.33	90.32	2.32	209.60	13.41	27.12
L_4 Hartwig	57.97	4.03	55.67	125.67	55.30	2.24	123.64	14.14	17.57
L_5 L86-K-73	45.33	3.50	34.33	99.00	88.71	2.03	180.18	10.63	19.08
L_6 Holladay	68.03	3.03	51.33	128.00	61.40	1.70	104.45	16.35	17.07
L_7 PI416937	40.10	3.03	51.33	135.33	98.39	2.15	209.11	13.65	28.52
Giza83 x Giza82	56.97	4.93	35.33	110.33	111.29	2.34	259.95	20.74	53.67
Giza83 x Giza35	75.13	4.10	33.00	118.67	260.93	2.45	638.98	18.85	120.26
Giza83 x H57Z	60.43	7.00	44.67	123.00	209.12	2.49	520.90	14.62	76.09
Giza83 x Hartwig	54.87	6.03	41.00	120.33	125.69	2.40	301.54	16.50	49.93
Giza83 x L86-K-73	55.30	5.13	38.33	112.67	176.04	2.24	394.15	14.71	58.74
Giza83 x Holladay	82.17	5.93	40.00	121.00	168.14	2.38	399.41	17.42	67.61
Giza83 x PI416937	52.77	5.13	42.00	125.33	196.32	2.22	436.80	15.45	67.01
Toano x Giza82	79.03	4.90	36.67	102.67	184.64	2.28	420.81	21.31	89.45
Toano x Giza35	64.33	5.87	41.00	124.33	170.19	2.51	427.61	20.67	88.48
Toano x H57Z	62.33	4.97	54.00	144.00	128.98	2.38	307.32	18.90	58.11
Toano x Hartwig	50.93	5.17	40.67	128.67	95.67	2.24	213.62	19.14	40.88
Toano x L86-K-73	50.54	5.20	35.33	96.67	239.49	2.19	524.55	18.13	94.98
Toano x Holladay	73.73	5.47	52.33	133.33	122.39	2.07	253.43	18.48	46.88
Toano x PI416937	62.87	5.87	43.67	130.67	136.65	2.30	314.46	19.00	57.40
$L.S.D_{0.05}$	3.49	0.59	1.69	2.44	21.04	0.07	46.98	1.26	6.64
$L.S.D_{0.01}$	4.65	0.79	2.25	3.24	27.98	0.09	62.48	1.68	8.83

Table (6): Percentage values of heterotic effects relative to mid and better parents for all the studied traits in soybean.

Crosses	Plant height (cm)		No. of branches /plant		No. of days to flowering		No. of days to maturity		No. of pods /plant		No. of seeds /pod		No. of seeds /plant		100-seed weight (g)		Seed yield /plant (g)	
	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P
Giza83 x Giza82	12.08**	7.21	22.64**	21.13**	-0.03	3.91	5.75**	13.74**	49.10**	49.06**	8.33**	7.83**	61.21**	60.74**	23.27**	4.22	97.03**	65.96**
Giza83 x Giza35	19.50**	-2.68	0.74	-1.68	-8.76**	-7.49**	6.43**	6.59**	257.68**	249.49**	9.38**	5.15**	290.94**	284.67**	20.37**	7.29*	369.22**	312.98**
Giza83 x H57Z	18.59**	9.61*	27.27**	-0.43	1.89	21.82**	2.50**	10.15**	153.51**	131.53**	11.41**	7.33**	181.28**	148.52**	7.66*	6.33	208.93**	180.57**
Giza83 x Hartwig	3.04	-5.35	50.75**	49.63**	-11.20**	11.81**	1.4	7.75**	93.43**	68.35**	9.34**	7.14**	112.04**	87.55**	18.32**	16.69**	151.47**	125.52**
Giza83 x L86-K-73	17.84**	13.95**	37.35**	29.22**	7.97**	11.65**	6.96**	13.81**	115.51**	98.44**	7.18**	4.19**	131.20**	118.75**	20.67**	6.98	185.01**	165.31**
Giza83 x Holladay	40.99**	20.78**	69.43**	49.37**	-9.09**	9.08**	0.97	8.35**	147.16**	125.21**	23.64**	10.69**	201.17**	148.42**	15.75**	6.54	244.86**	205.37**
Giza83 x PI416937	19.08**	8.74	46.57**	29.23**	-4.55*	14.53**	1.48	12.23**	126.89**	99.53**	3.26*	3.26*	136.17**	108.89**	12.77**	12.36**	164.55**	134.96**
Toano x Giza82	57.41**	48.72**	32.43**	20.39**	-17.29**	7.85**	-9.81**	5.85**	163.00**	147.44**	11.22**	5.07**	191.80**	160.21**	16.90**	7.09*	228.54**	176.59**
Toano x Giza35	3.37	-16.67**	56.53**	40.77**	-9.23**	14.94**	2.75*	11.68**	148.38**	138.86**	17.84**	7.73**	192.07**	157.43**	21.13**	17.64**	245.42**	203.85**
Toano x H57Z	21.74**	13.06**	-4.05	-29.30**	2.19	5.88**	11.20**	12.21**	65.24**	42.80**	5.65**	2.59	82.77**	46.62**	26.13**	14.13**	136.08**	114.27**
Toano x Hartwig	-3.21	-12.14**	40.49**	28.29**	-26.28**	-25.61**	0.39	2.38*	58.01**	45.42**	7.43**	0.00	70.66**	68.60**	24.69**	15.58**	106.05**	84.89**
Toano x L86-K-73	9.14**	6.90	52.27**	48.57**	-20.60**	2.91	-15.82**	-2.35	210.02**	169.97**	10.61**	7.88**	241.86**	191.13**	33.36**	9.48*	361.18**	329.58**
Toano x Holladay	27.89**	8.38**	60.26**	64.26**	-1.26	1.95	3.09**	4.15**	92.45**	86.03**	14.05**	7.25**	119.28**	100.02**	12.31**	11.59**	139.31**	112.03**
Toano x PI416937	43.92**	33.01**	84.59**	76.28**	-17.60**	-14.92**	-1.75*	0.00	66.86**	38.69**	12.75**	6.98**	87.28**	50.38**	25.79**	14.73**	126.74**	101.26**

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

Concerning flowering date, most of the top crosses expressed significant negative or insignificant heterotic effects relative to mid parent values, except the top cross (Giza 83 x L86-K-73) which exhibited significant positive value. Heterotic effects relative to better parent values for flowering and maturity dates, were observed in most top crosses which exhibited significantly positive heterotic effects, except top crosses (Giza 83 x Giza 35), (Toano x Hartwig) and (Toano x PI416937) exhibited significant negative heterosis for flowering date. Also top cross (Toano x L86-K-73) showed significant negative heterosis for maturity date.

For 100-seed weight, all top crosses showed significantly positive heterotic effects relative to mid parent value. While, top crosses (Giza 83 x Giza 82), (Giza 83 x H57Z), (Giza 83 x L86-K-73) and (Giza 83 x Holladay) showed insignificant heterotic effects relative to better parent value.

Regarding yield and its components, all top crosses exhibited significantly positive heterotic effects relative to mid and better parent. The top cross (Toano x L86-K-73) gave the highest value for these traits followed by cross (G.83 x G.35).

Hence, it could be concluded that these top crosses offer possibility for improving seed yield in soybeans. These findings revealed that a hybridization program based on these materials would be useful. Similar results were obtained by Weber *et al.*(1970), Paschal and Wilcox (1975), Halvankar and Patil (1992), Bastawisy *et al.*(1997), Habeeb (1998) and Mansour *et al.*(2002).

The cross (Toano x L86-K-73) showed highest and significant positive (sca) effects for seed yield per plant, no. of seeds per plant and no. of pods per plant. The highest seed yield, no. of seeds per pod and no. of pods per plant, earliest date to maturity and highly significant positive heterotic effects were also obtained from the same cross. Therefore, the cross (Toano x L86-K-73) can be used in the breeding program for improving soybean.

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تحليل الهجن القمية للمحصول ومكوناته فى فول الصويا

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الملخص العربى

أجـرى هـذا البحث بمحطة إيتاى البارود للبحوث الزراعية عامى ٢٠٠١ و ٢٠٠٢ بهدف دراسة قوة الهجين والقدرة على التآلف لمجموعة من الهجن القمية فى فول الصويا بين كشـافين همـا جـيزة٨٣ و Toano كآباء وسبع سلالات وأصنـاف أخرى هى جيـزة٨٢، جيـزة٣٥ ، H57Z، Hartwig، L86-K-73، Holladay، PI416937 استخدمت كأمهات. فى الموسم الأول تم عمل التهجينات القمية وفى الموسم الثانى تم مقارنة الهجن القمية والآباء. وشـملت الدراسـة صفات طول النبات وعدد فروع النبات وميعاد التزهير وميعاد النضج وعدد قـرون النـبات وعدد البذور فى القرن وعدد البذور فى النبات ووزن ١٠٠ بذرة ووزن بذور النبات. ويمكن إيجاز النتائج المتحصل عليها كالتالى:

- كـان تباين الآباء وتباين الهجن القمية وتباين التفاعل بين الكشافين والسلالات معنوياً لكل الصفات المدروسة.
- سـاهم تبايـن القدرة الخاصة على التآلف بدور كبير فى وراثة كل الصفات المدروسة مما يعنى أن التباين الراجع للعوامل غير المضيفة كان مهماً فى وراثة جميع الصفات تحت الدراسة.
- أوضـحت قيم القدرة العامة على التآلف أن الكشاف جيزة ٨٣ أفضل من الكشاف Toano وكذلك كانت أفضل الأمهات هى جيزة٣٥ و H57Z وذلك لصفات المحصول ومكوناته.
- كان الهجين القمى (جيزة٨٣ × جيزة٣٥) أفضل الهجن القمية فى صفات عدد قرون النبات وعـدد البذور فى القرن وعدد البذور للنبات وكذلك وزن محصول بذور النبات. كما أن الهجين القمـى (Toano x Hartwig) أقل الهجن لهذه الصفات السابقة.

- كانـــت قـــيم قوة الـهجين الخاصة بصفات المحصول ومكوناته معنوية موجبة لمعظم الـهجن القمية.
- أظهـــرت الدراسة أن الـهجين القمى (Toano x L86-K-73) تميز بإرتفاع قيم المحصول والتبكـــير فى النضج كما أنه يتميز بقدرة خاصة على التآلف، وقوة هجين عالية بالنسبة للأب الأفضل.