Diallel Crosses Anlysis of F_2 Generation in Soybean [*Glycia Max* (L.) Merril]

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ABSTRACT

A half diallel of F_2 generation crosses involving six parental varieties of soybean was evaluated to estimate the heterosis and combining ability for earliness, resistance to cotton leaf worm, yield and yield components. Significant genotypes, parents, F_1 hybrids and P.V.S. F_1 hybrids mean squares were detected for all characters except number of days to maturity and number of pods per plant in parent vs F_1 hybrids, P_4 behaved as earliest one, P_3 was the top of the tested parental variety for yield and yield components. The crosses (P_1 x P_3) and (P_5 x P_6) gave the highest mean value for yield. Variances with general and specific combining ability (GCA) were significant for all studies characters except for number of seeds per pod in (SCA). The magnitudes of the ratio of GCA/SCA revealed that additive and additive types of gene action were the more important expression for all characters except plant height.

P_4 and P_6 had significant negative ($\hat{g}i$) effects for flowering date, maturity date, and maturity period and proved to be good combiners for earliness. P_1 and P_3 had significant positive ($\hat{g}i$) effects for seed yield per plant, 100- seed weight and number of seeds per plant.

For infection ratio of the cotton leaf worm defoltion P_3 and P_4 considerable significant negative ($\hat{g}i$) effects. For plant height and number of seeds per plant (P_1 and P_5) had considerable significant positive ($\hat{g}i$) effects. The highest desirable SCA effects were in cross (5 x 6) for earliness, yield and most component, the cross (1 x 4) gave the highly significant positive SCA effects for seed yield per plant and number of seeds per plant, the cross (4 x 5) gave significant positive (SCA) effects for seed yield per plant. Also, it gave negative number of days to maturity, and the crosses (1 x 3), (2 x 3) and (2 x 4) were the best natural tolarance to cotton leaf worm. Heterotic effects for better parent were the two crosses (4 x 5) and (5 x 6) showed the significant positive effects for seed yield per plant and must component and significant negative for number of days to maturity. also, the crosses (P_1 x P_3), (P_2 x P_3) and (P_2 x P_4) showed the heterotic effects for tolarance to cotton leaf worm.

Keywords: Soybean, heterosis, combining ability, yield.

INTRODUCTION

Soybean [*Glycine max* L.) Merril] is grown to some extend in most parts of the world and is a primary source of vegetable oil and protein. Improvement of earliness, resistance to cotton leaf worm and high yield potential are the primary objectives of soybean breeding programs in Egypt. The infection ratio of cotton leaf worm in yield is one of the most important characters because soybean is very sensitive to the worm infections. The breeding system needs to be fitted to the type of gene action to maximize the result of improvement . In self-pollinated crops such as soybean hybridization is difficult and the number of hybrid seeds obtained is often too small to evaluate diallel crosses. In this investigation, the results obtained for diallel F_2 were compared with the previous results of diallel F_1 as reported by El-Hosary *et al.* (2003). Better information could be obtained when both F_2 and F_1 generations are compared in the same year Hays *et al.* (1955) reported that the F_1 can not be used only to determine the potentiality of groups of crosses satisfactorily, since the amount of hybrid seed is very limited and consequently, dense planting is restricted and thus, F_2 analysis might be used for self pollinated plants. Several authors for some important agronomic characters in soybean (Bastawisy (1988), El-Refay and Radi (1991), Bastawisy(1998), Soliman *et al.* (2005). The aim of this investigation was to estimate the remaining heterosis and general and specific combining ability (GCA and SCA) in F_2 generation for number of days to flowering , number of days to maturity, maturity period,tolarance to cotton leaf worm insect, seed yield and major yield attributes is soybean.

MATERIALS AND METHODS

The genetic materials used in this investigation as parents included six soybean varieties, representing a wide range of diversity for several agronomic characters. The names, pedigree and origin of these varieties or line are presented in Table (1).

All possible cross combinations excluding reciprocals, were made between the six parental genotypes through study El-Hosary *et al.* (2003). In 2004 season, the six parents and their F_2 hybrids were grown in a randomized complete block design with three replications at Faculty of Agriculture, Minufiya University, Shebin El-Kom. Seeds were sown in hills and spaced at 20 cm with two seeds per hill on one side of the ridge Hills were thinned to one plant after 21 days from planting. Each plot consisted of ten ridges of four m length and 60 cm width. The commonly known"Herati" method of sowing was used in which the soil was irrigated before planting. The cultural practices

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Cultivar	Maturity Group	Country of origin	Growth habit	Flower color
Elgin	V	United States	Determinate	Purple
P_1 416937	V	United States	Determinate	Purple
Giza 21	IV	Egypt	Indeterminate	Purple
L86. K-73	I	United States	Indeterminate	White
Lamur	VI	United States	Indeterminate	White
Giza 83	I	Egypt	Indeterminate	White

Cited from origins and pedigrees of public soybean varieties in the United States and Canada "USDA, ARS, Techn. Bull. No. 1746, 1988

of growing soybean were properly done.

The characters studied were: No. of days to flowering , no. of days to maturity, maturity period, no. of branches per plant, plant height (PH) cm, first pod height (cm), No. of pods per plant, no. of seeds per plant, no. of seeds per pod, seed yield per plant (g), 100-seed weight (g) and natural tolarance to cotton leaf worm was evalutied by infection ratio of the cotton leaf worm % or (leaf feeding damage foliage loss) or defoliation %. If infection ratio was less than 20% its considered insect resistance ;visul ratings of prcent defoliation were recorded,as the avarge of three times every seven days beginning two weeks after flowering,on eash plant in the field experiment without insect control under the natural field infection.Astandard area diagran for esimation the percentage of defoliation was reported by smith and Brim,(1979) as sown in Figure 1.

The data were recorded for the first three characters on all guarded plants per plot, while the remaining characters were estimated from 100 guarded plants as a random sample from each plot.

General and specific combining ability estimate were obtained by employing Griffing's (1956) diallel cross analysis designated as method 2 model 1. Remaining heterosis was expressed as the percentage deviation of F_2 mean performance from better parent.

RESULTS AND DISCUSSION

For better representation and discussion of the results obtained, it was preferred to outline these results into three parts; i.e. analysis of variance, heterosis, and combining ability.

Analysis of variance:

Table (2) pertinent portions of analysis of variance for all characters studied in the F_2 generation.

Results indicated that genotypes mean squares were highly significant for all the studied characters. Results also showed that mean squares due to parents and F_2 hybrids were highly significant in all characters. Such results indicated that the tested genotypes varied from each other.

The mean performance of six parents of soybean is present in Table (3).

The parental variety(P_1) expressed the highest value for number of pods per plant. The parental line (P_2) showed the highest values for number of branches per plant. Also, it gave the lowest value for plant height.

The parental variety (P_3) was the top of the tested parents for plant height, number of seeds/plant, 100-seed weight, and seed yield / plant. Also, it gave the lowest values for infection ratio of the cotton leaf worm.

The parental line (P_4) gave the lowest values for number of days to flowering , number of days to maturity, maturity period, and first pod height. The parental variety (P_6) expressed the highest value for number of seeds per pod.

Mean performance of hybrids are presented in Table (3). The cross (P_4 x P_6) gave the lowest values for number of days to flowering , number of days to maturity, and maturity period. For number of branches per plant the four crosses (P_1 x P_2), (P_1 x P_4), (P_3 x P_5) and (P_4 x P_5) exhibited the highest value for this character .

For plant height, the cross (P_2 x P_5) gave the lowest values. The two crosses (P_1 x P_2) and (P_5 x P_6) the highest values for number of pods per plant. For number of seeds per plant, the four crosses (P_1 x P_2), (P_1 x P_5), (P_1 x P_6) and (P_5 x P_6) gave the highest values for this measurement. While, for number of seeds per pod, the cross (P_3 x P_4) gave the highest value. Moreover, the crosses (P_1 x P_3) and (P_5 x P_6) exhibited the highest values for seed yield per plant, while the two crosses (P_1 x P_3) and (P_4 x P_5) gave the heaviest seeds for 100- seed weight.

For infection ratio of the cotton leaf worm difolialion the four crosses (P_1 x P_3), (P_2 x P_3), (P_3 x P_5) and (P_3 x P_6) gave the lowest values for this character .The results showed signifacant positive correlation coefficients between seed yield per plant and eash

Table 2. Mean squares from the ordinary analysis of variance and combining ability analysis.

Source	d.F	No. of days to flowering	No. of days to maturity	Maturity period	No. of branches per plant	Plant height (cm)	First pod height (cm)	No. of pods per plant	No. of seeds per plant	No. of seeds per pod	Seed yield per plant (gm)	Weight of 100-seed (gm)	Infection ratio of the cotton leaf worm
Reps	2	7.76	14.98	3.76	0.38	26.86	1.69	125.3	283.3	0.0034	23.28	0.378	0.3345
Genotypes	20	113.58**	322.34**	79.68**	2.132**	723.69**	3.414**	2389.9**	8220.1**	0.132**	284.70**	10.676**	117.07**
Parents (P)	5	257.3**	618.5**	104.00**	2.181**	1536.7**	6.064**	2934.8**	9146.**	0.3168**	474.9**	19.4**	200.35**
F_1 hybrid	14	60.88**	239.5**	70.8**	1.975**	456.39**	2.486**	2365.2**	77703.4**	0.062**	233.26**	7.977**	89.69**
PVS F_1	1	74.5**	0.37	82.5**	4.09**	400.81**	4.49**	11.2	9888.9**	0.1856**	53.68**	4.834**	84.05**
GCA	5	255.3**	1037.3**	215.95**	2.101**	2104.46**	3.5**	4967.05**	13209.5**	0.318**	642.35**	21.4**	380.8**
SCA	15	66.35**	90.00**	34.26**	2.14**	263.4**	3.386**	1530.85**	6557.02**	0.070	165.48**	7.06**	29.15**
Error	40	5.9	7.32	5.63	0.393	10.54	0.736	52.33	133.63	0.0216	9.25	0.589	3.06
GCA/SCA		3.84	11.52	6.30	1.0	8.0	1.03	3.246	2.01	4.54	3.88	3.03	13.06

* and ** significant differences at 5% and 1% levels of probability, respectively.

Table 3. Mean values of genotypes for all characters studied.

Genotype		No. of days to flowering	No. of days to maturity	Maturity period	No. of branches per plant	Plant height (cm)	First pod height (cm)	No. of pods per plant	No. of seeds per plant	No. of seeds per pod	Seed yield per plant (gm)	Weight of 100-seed (gm)	Infection ratio of the cotton leaf worm
Elgin	P_1	52	130	80	5.2	70.0	7.00	170	289	1.6	46.0	16.00	30.0
P_1 416937	P_2	52	135	85	6.0	48.0	8.30	148	296	2.00	44.4	15.0	26.6
Giza 21	P_3	39	120	83	5.0	105.0	8.33	153	330	2.20	53.6	16.4	11.0
L86 K-73	P_4	32	101	72	3.8	61.5	5.0	100	220	2.20	29.5	13.4	14.0
Lamur	P_5	50	129	81	5.2	100.0	9.06	145	307	2.12	35.00	11.36	18.0
Giza 83	1 x 6	34	105	74	4.0	65.0	7.66	92	193	2.50	24.0	11.91	12.0
Elgin x P_1 16937	1 x 2	45	132	87	6.3	66.5	7.0	173	355	2.05	47.6	13.4	25.0
Giza 21	1 x 3	35	122	87	5.0	75.0	8.83	148	341	2.30	56.3	16.5	10.0
L 86 K-73	1 x 4	40	125	85	7.1	67.0	9.0	136	313	2.30	48.5	15.5	20.0
Lamur	1 x 5	42	127	85	5.6	66.0	7.46	161	334	2.10	50.0	14.8	22.0
Giza 83	1 x 6	44	130	86	5.8	67.0	9.23	132	297	2.25	44.6	15.0	18.0
P_1 416937 x Giza	2 x 3	45	127	82	4.5	79.0	7.83	160	336	2.10	45.0	13.4	10.0
21	2 x 4	38	120	82	5.2	54.0	6.0	120	264	2.20	27.0	10.2	15.0
L86 K-73	2 x 5	40	122	82	4.5	42.0	8.0	125	274	2.20	35.6	13.00	25.0
Lamur	2 x 6	37	116	79	4.3	60.0	9.0	100	210	2.10	27.3	13.0	20.0
Giza 83	3 x 4	35	113	78	5.3	71.0	8.0	110	275	2.50	36.3	13.2	12.0
Giza 21 x L86 K-73	3 x 5	42	125	83	6.2	90.0	8.33	134	295	2.20	39.8	13.5	10.0
Lamur	3 x 6	33	108	75	5.3	85.0	8.0	112	280	2.50	37.2	13.9	10.0
Giza 83	4 x 5	42	123	81	6.3	81.0	9.0	118	271	2.30	44.4	16.4	15.0
L 86 K-73 x Lamur	4 x 6	30	100	70	4.5	61.5	8.0	105	252	2.40	32.8	13.0	11.33
Giza 83	5 x 6	34	110	76	5.3	75.0	7.0	200	420	2.10	52.0	12.4	15.0
Lamur x Giza 83													
L.S.D 5%		4.008	4.46	3.915	1.034	5.35	1.415	11.89	19.07	0.242	5.018	1.266	2.885
L.S.D. 1%		5.362	5.97	5.238	1.384	7.167	1.894	15.9	25.52	0.324	6.71	1.964	3.862
r		0.331	0.51**	0.55**	0.53**	0.32	0.26	0.79**	0.85**	-0.08	--	0.73**	0.123

* and ** significant differences at 5% and 1% levels of probability, respectively.
r = Correlation between yeild and all studied characters

of no. of days to maturity ,maturity peried ,no.of branches per plant , no.of pods per plant, no. of seeds per plant, and 100-seed weight.This results indicoter to be useful in planing breeding program evaluating breeding materials. However, the most rapid and effective .Besides.it is an evident that selection in soybean.For agronomic and yield all attributes associated with yields might lead to the deviopment of high yielding plant taypes.

Heterosis:

Remaining heterosis expressed as the percentage deviation of F_2 mean performance from better parent value for all studied characters are presented in Table (3).

Mean squares for parent vs. crosses as an indication to average heterosis overall crosses was appreciable magnitude except for number of days to maturity and number of pods per plant.

With regard to number of days to flowering three crosses
(P_1 x P_2), (P_2 x P_5) and (P_1 x P_5) gave significant negative heterotic effects relative to better parent value. Also, for number of days to maturity, the nine crosses gave significant negative heterotic effects relative to parent value. The crosses (P_2 x P_4), (P_2 x P_6) and (P_5 x P_6) showed the best heterotic effects.

For number of branches per plant, the two crosses (P_1 x P_4) and
(P_4 x P_5) showed the high significant positive heterotic effects. For plant height, eleven parental combinations expressed significant negative heterotic effects. The (P_1 x P_5), (P_2 x P_5) and (P_4 x P_6) showed the best heterotic effects. The cross (P_5 x P_6) gave the significant positive heterotic effects for number of pods per plant. For number of seeds per plant the crosses (P_1 x P_2), (P_1 x P_4), (P_1 x P_5), (P_4 x P_6) and (P_5 x P_6) gave the significant positive heterotic effects. The cross (P_3 x P_4) showed the high significant positive heterotic effects for number of seeds per pod. While, the two crosses (P_1 x P_5) and (P_5 x P_6) gave the high significant positive heterotic effects for seed yield per plant. For 100 seed weight the cross (P_4 x P_5) showed the significant positive heterotic effects. For infection ratio of the cotton leaf worm defoliation ten crosses significant negative surpassed the better parent. The (P_1 x P_3), (P_2 x P_3) and (P_2 x P_4) showed the best heterotic effects. Significant hybrid vigour was previously reported in the F_2 for seed yield per plant by El-Hosary *et al.*(2003) in faba bean, for flowering date, first pod height seed yield and no of pods per plant by Bastawisy (1988), for seed yield and plant height by Loiselle *et al.* (1990), for flowering and maturity date, plant height, number of seeds per pod and 100 seed weight by El-Refay and Radi (1991), flowering date, maturity period, first pod height, number of branches per plant, plant height, number of pods per plant, number of seeds per plant, and 100 seed yield by Bastawisy (1998), flowering date, maturity period, first pod height, number of branches per plant, plant height, number of pods, number of seeds per plant, and seed yield by El-Seidy and Khattab (2001) and Soliman *et al.* (2005),defoliation by Abou-Tour (1986),and Habeeb (1988).

Generally, the heterotic effects for better parent were the two crosses (P_4 x P_5) and (P_5 x P_6) showed the high positive significant for seed yield per plant and most component. Also, its gave negative heterotic effects for number of days to maturity and the crosses (P_1 x P_3), (P_2 x P_3) and (P_2 x P_4) showed the best heterotic effects for infection ratio of the cotton leaf worm.

Combining ability:

Analysis of variance for combining ability as analyzed by Grifing (1956) method 2 model I in each for all the studied characters is presented in Table (2). The mean squares associated with general and specific combining ability were significant for all characters studied except number of seeds/pod in specific combining ability (SCA). High (GCA/SCA) ratio largely exceed the unity were obtained for all characters studied except plant height indicating that the largest part of total genetic variability associated with those measurements was result additive and additive x additive types of gene action. Similar results were reported by for plant height, however, non additive gene action importance as a major contributor in the inheritance of both characters Similar results were recorded by Bastawisy (1998), Cho and Scott (2000), El-Seidy and Khattab (2001), Soliman *et* a. (2005), and El-Sayed *et al.* (2005).Hawer,the additive gentic estimates were highly significantly for defolation by Abou-Tour (1986), and Habeeb *et al.* (1988) .The results indicate the potentiaity of improving the performance by using pedigree selection program .Estimates of general combining ability effects ($\hat{g}i$) for individual parental varieties/or lines in each character are presented in Table (5).

Highly positive values would be of interest under all characters in question except for flowering date, maturity date, maturity period, first pod height, and infection ratio of the leaf worm, where high negative value would be useful for the breeders point of via. The parent's (P_4) and (P_6) had the significant negative ($\hat{g}i$) effects for flowering date, maturity period and

Table 4. Percentages of remaining heterotic effects relative to better parent for the characters studied.

Crosses		No. of days to flowering	No. of days to maturity	Maturity period	No. of branches per plant	Plant height (cm)	First pod height (cm)	No. of pods per plant	No. of seeds per plant	No. of seeds per pod	Seed yield per plant (gm)	Weight of 100-seed (gm)	Infection ratio of the cotton leaf worm
Elgin x P_1 16937	1 x 2	-10.0*	-2.22	8.75**	5.00	-5.00	14.28	1.76	19.0**	2.5	3.47	-21.76**	-16.66**
Giza 21	1 x 3	5.40	-6.15**	8.75**	-3.85	-28.57**	21.42*	-12.94**	1.18	1.54	-3.92	-8.04*	-66.66**
L 86 K-73	1 x 4	33.33**	-3.85*	6.25*	36.54**	-4.28	28.57**	-20.0**	8.30*	1.54	5.43	-8.82*	-33.00**
Lamur	1 x 5	-12.5*	-2.31	6.25*	7.69	-44.0**	25.71*	-5.29	10.09**	-0.943	8.69	-12.94**	-26.66**
Giza 83	1 x 6	37.5**	0.00	7.5**	11.54	-4.28	25.71*	-22.35**	2.26	-13.46**	-3.04	-11.26**	-40.0**
P_1 416937 x Giza 21	2 x 3	21.16**	-5.46**	-1.20	-25.0**	-24.76**	-6.02	4.57	-0.29	-1.54	-23.20**	-22.98**	-62.4**
L86 K-73	2 x 4	26.66**	-11.1**	17.40**	-13.53	-12.29**	20.0	-18.92**	-0.67	-1.54	-32.43**	-32.0**	-62.4**
Lamur	2 x 5	-16.66**	-9.63**	12.34	-25.0**	-585.0**	3.61	-15.54**	-26.95**	3.77	-19.81**	-20.00**	43.64**
Giza 83	2 x 6	15.63*	-14.10**	8.22**	-28.3**	-7.69	20.0	-32.43**	-29.1**	-19.2**	-38.51**	-13.33**	-24.81**
Giza 21 x L86 K-73	3 x 4	16.66*	-5.83**	11.43**	6.0	-32.38**	56.0**	-28.10**	-81.39**	13.63**	-38.05**	-24.13**	-14.28
Lamur	3 x 5	13.51*	-3.10	2.47	19.23	-14.28**	2.41	-12.41**	-12.46**	3.77	-32.08**	-22.4**	-44.4**
Giza 83	3 x 6	3.12	-5.76	4.11	6.0	-19.04**	0.00	-26.79**	-16.91**	-3.84	-36.52**	-23.56**	-16.66
L 86 K-73 x Lamur	4 x 5	40.0**	-4.65**	15.71**	21.15**	-19.00**	80.00**	-18.62**	-11.72**	8.49	26.85**	22.38**	-16.66*
Giza 83	4 x 6	0.00	-4.76	0.00	12.5	-53.8**	60.0**	5.0	14.45**	-7.69	11.18	2.98	-14.07
Lamur x Giza 83	5 x 6	6.25	-14.72**	4.10	1.92	-25.0**	-6.66	37.93**	36.80**	-19.23**	48.57**	7.47	5.55

* and ** significant differences at 5% and 1% levels of probability, respectively.

Table 5. Estimates of general combining ability effects.

Parents		No. of days to flowering	No. of days to maturity	Maturity period	No. of branches per plant	Plant height (cm)	First pod height (cm)	No. of pods per plant	No. of seeds per plant	No. of seeds per pod	Seed yield per plant (gm)	Weight of 100-seed (gm)	Infection ratio of the cotton leaf worm
Elgin	P_1	-0.875	7.041**	3.333**	0.429*	-1.666	0.097	17.830**	20.95**	-0.1556**	6.455**	1.455**	4.833**
P_1 416937	P_2	4.500**	6.761**	2.333**	0.00416	-12.166**	-0.0027	3.33	-2.916	-0.0985*	-2.006	-0.569*	9.00**
Giza 21	P_3	-0.625	-0.583	0.958	-0.0583	14.395**	0.1680	2.83	18.33**	0.0700	5.597**	0.892**	-5.541**
186 K-73	P_4	-3.000**	-7.330**	-3.416**	-0.1208	-4.666**	-0.7025*	-19.79**	-29.916**	0.082	-4.919**	-0.307	-1.823**
Lamur	P_5	3.375**	3.166**	0.7083	0.1916	7.395**	0.4429	101.75**	19.70**	-0.0165	0.538	-0.592*	0.833*
Giza 83	P_6	-3.375**	-2.208*	-3.916**	-0.445*	-2.041	-0.0075	-14.29**	-26.16**	0.1388**	-5.681**	-0.879**	2.250**
L.S.D. 5%		1.584	1.764	1.547	0.408	2.117	0.5595	4.718	7.539	0.0958	1.9837	0.550	1.140
L.S.D. 1%		2.119	2.361	2.07	0.547	2.83	0.7486	6.312	10.08	0.1282	2.654	0.6692	1.526
L.S.D. 5% (gi-g$\hat{}$i)		2.454	2.733	2.397	0.633	3.280	0.866	7.311	11.681	0.1485	3.07	0.775	1.767
L.S.D. 1% (gi-g$\hat{}$i)		3.283	3.657	3.207	0.8475	4.389	1.159	9.780	15.628	0.1987	4.119	1.032	2.365

* and ** significant differences at 5% and 1% levels of probability, respectively.

Table 6. Estimates of specific combining ability effects for the crosses studied.

Crosses		No. of days to flowering	No. of days to maturity	Maturity period	No. of branches per plant	Plant height (cm)	First pod height (cm)	No. of pods per plant	No. of seeds per plant	No. of seeds per pod	Seed yield per plant (gm)	Weight of 100-seed (gm)	Infection ratio of the cotton leaf worm
Elgin x P_1 416937	1 x 2	2.945	-0.9116	1.066	0.614	9.641*	-0.013	16.5*	43.48**	0.098	2.233	-1.435	-0.453
Giza 21	1 x 3	-7.050*	-4.410	2.440	-0.623	-2.80	0.3158	-8.00	8.23	0.179	3.328	0.203	-5.911**
L86 K-73	1 x 4	5.445*	5.388	4.816*	1.539*	2.671	1.6866	2.625	28.48*	0.167	13.845**	0.403	0.422
Lamur	1 x 5	1.070	3.1616	0.69	-0.273	-10.42**	-0.659	-2.25	38.50**	0.087	2.070	-0.013	-0.286
Giza 83	1 x 6	9.820**	11.21**	6.316	0.689	0.0166	0.886	-6.87	8.732	0.061	2.907	0.475	-1.203
P_1 16937 x Giza 21	2 x 3	2.695	1.713	-1.558	-0.698	6.79	-0.284	18.5*	27.11*	-0.02	0.490	-0.873	-5.078***
L 86 K-73	2 x 4	-1.93	1.463	2.816	0.065	0.142	-1.213	1.125	3.356	0.067	-6.990	-2.872	-3.745*
Lamur	2 x 5	-6.305*	-22.036	-1.308	-0.948	-23.92**	-0.359	-23.75**	-36.29**	0.187	-3.867	0.213	3.546*
Giza 83	2 x 6	-2.555	-1.660	-4.308	-0.811	3.516	1.086	-24.375**	-54.39*	-0.146	-5.930	0.498	1.630
Giza 21 x L86 K-73	3 x 4	0.195	0.963	0.191	0.226	-9.420**	0.415	-8.375	-6.893	0.142	-5.296	-1.335	2.296
Lamur	3 x 5	0.820	-12.536	1.066	0.814	-2.483	-0.030	-14.25	-36.518*	-0.08	-7.272	-0.750	-1.91
Giza 83	3 x 6	-1.430	-3.16	-2.300	0.551	1.954	-0.584	-11.875*	-5.643	0.085	-3.634	-120.6	1.171
L86 K-73 x Lamur	4 x 5	3.195	-7.786	3.442	0.976	9.579*	1.340	-7.625	-3.268	0.049	7.845*	3.350**	-0.578
Giza 83	4 x 6	-2.055	-4.41	-2.933	-0.186	-2.483	0.786	3.75	19.606	-0.027	2.483	0.235	-0.828
Lamur x Giza 83	5 x 6	-4.430	-19.91**	-1.058	-0.498	-1.045	-1.484	68.87**	132.8**	-0.207	16.20**	-0.0791	-0.203
L.S.D. 5%		4.908	5.46	4.79	1.266	6.561	1.733	14.62	23.36	0.297	6.146	1.551	3.533
L.S.D. 1%		6.56	7.315	6.415	1.695	8.778	2.319	19.56	31.257	0.397	8.22	2.075	4.730
L.S.D. 5% (sij-sij)		6.493	7.233	6.343	1.676	8.679	2.293	19.34	28.613	0.3637	7.528	1.899	4.329
L.S.D. 1% (sij-sij)		8.68	9.677	8.48	2.242	11.613	2.841	23.82	38.28	0.54	10.07	2.542	5.793
L.S.D. 5% (sij-sik)		3.88	4.32	3.791	1.0016	5.187	1.370	11.552	18.469	0.234	4.859	1.226	2.794
L.S.D. 1% (sij-sik)		5.19	5.783	5.07	1.310	6.44	1.833	15.46	24.71	0.313	6.51	1.640	3.739

* and ** significant differences at 5% and 1% levels of probability, respectively.

proved to be good combiners for earliness. Also, (P_4) and (P_6) had the significant negative ($\hat{g}i$) effects for infection ratio of the leaf worm. While (P_4) had significant negative ($\hat{g}i$) effect for first pod height. The parental (P_6) had the significant positive ($\hat{g}i$) effects for number of seeds. The parental (P_1) gave the best combiner for number of branches per plant, number of pods per plant, number of seeds per plant, seed yield per plant and 100- seed weight.

The parental (P_3) good combiner for plant height, number of seeds per plant, and number of seeds yield per plant. The parental (P_5) gave the highly significant positive effects for plant height, number of pods per plant, and number of seeds per plant. It is interest for plant breeder to ask whether the $\hat{g}i$ for a parent agrees with its own performance or where some parents are more potent when crossed than would be expected from their own performance.

GCA effects were previously reported in soybean by Lambert and Kilen 1984, Radi and El-Refay (1998), El-Seidy and Khattab (2001) and Soliman *et al.* (2005).

Specific combining ability effects were only commuted wherever significant SCA variance were obtained Table (6). For all characters, the absolute general higher than the specific combining ability values of the corresponding crosses, indicating the predominate of the additive genetic variance. The ascertained the previous conclusion drawn on combining ability mean squares basis. For number of days to flowering , the two crosses (P_1 x P_2) and (P_2 x P_5) had significant negative SCA effects. For maturity date the four crosses (P_2 x P_5), (P_3 x P_5), (P_4 x P_5) and (P_5 x P_6) gave significant negative SCA effects. With regard to the number of branches per plant the cross (1 x 4) expressed significant positive SCA effects. For plant height the three crosses (P_1 x P_2), (P_2 x P_3) and
(P_4 x P_5) gave the significant positive SCA effects. Regarding for number of pod per plant, three crosses (P_1 x P_2), (P_2 x P_3) and (P_5 x P_6) had significant positive SCA effects. Five crosses (P_1 x P_2), (P_1 x P_4), (P_1 x P_5), (P_2 x P_3) and (P_5 x P_6) had significant positive SCA effects for number of seeds per plant. For seed yield per plant the crosses (P_1 x P_4), (P_1 x P_5) and (P_5 x P_6) had significant positive SCA effects. For 100 seed weight the cross (P_4 x P_5) gave the significant positive SCA effect. For infection ratio of the cotton leaf worm defliation the three crosses (P_1 x P_3), (P_2 x P_3) and (P_2 x P_4) had significant negative SCA effects.

Generally, low values of SCA effects were detected in the F_2. This may be expected because in breeding depression in the F_2 reduced the SCA effecs Mather and Jinks,(1971).

It could be concluded the cross (P_5 x P_6) gave the best for number seed per plant, number of pods per plant, and seed yield per plant. Also, it gave the lowest value for earliness, the cross (P_1 x P_4) gave the good cross for yield, plant height and weight of 100 seed, the cross (P_4 x P_5) gave the positive significant SCA effects for seed yield and negative significant SCA effects for number of days to maturity and the crosses (P_1 x P_3), (P_2 x P_3) and (P_2 x P_4) were the best natural tolarance to cotton leaf worm.

These crosses might be of interest in breeding programs towards pure line varieties as most of them involve at lest one good combiner for the character in question. Also, these results indicate the possibility of selection for improvement of seed yield per plant by selection of any component of yield where high additive type of gene action was prevalent.

The results obtained from F_2 generation were relatively similar to those of F_1 generation crosses previously reported for the same breeding material of soybean.

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الملخص العربي

تحليل الهجن التبادلية للجيل الثانى فى فول الصويا

ابراهيم حسينى ابراهيم درويش

أجرى هذا البحث بمزرعة كلية الزراعة بشبين الكوم ـــ جامعة المنوفـــية بهدف دراسة قوة الهجين والقدرة على الائتلاف فى الجيل الـــثانى الناتجة من الهجن التبادلية النصفية بين ست اصناف متباينة وراثيا من فول الصويا.

ودونـــت البيانات على صفات. ميعاد التزهير، وميعاد النضج، وفـــترة النضج، وعدد الفروع بالنبات، وطول النبات، ووزن المائة بذرة ومحصول النبات ونسبة الاصابة بدودة ورق القطن.من خلال نسبة الاصابة بدودة ورق القطن (المساحة المستهلكة من الورقة)

ويمكن تخليص أهم النتائج المتحصل عليها كما يلى:

١- كـــان التباين الراجع للتراكيب الوراثية والاباء والهجن والاباء مقابل الهجن معنويا لكل الصفات عدا صفتى ميعاد النضج وعدد القرون للنبات فى (الاباء مقابل الهجن). وكان الاب (P_4) ابكر الابـــاء، بيـــنما كـــان الاب (P_3) اعلاهم فى المحصول ومعظم مكوناته كما كان الاقل الاباء اصابة بدودة ورق القطن. كما كانـــت الهجـــن ($P_1 \times P_3$)، ($P_5 \times P_6$) احسن الهجن لصفة محصول البذور للنبات.

٢- كـــان التـــباين الـــراجع لكل من القدرة العامة والخاصة على الائـــتلاف معـــنويا لكل الصفات ما عدا صفة عدد البذور فى القـــرن فى القـــدرة الخاصة على الائتلاف وكانت النسبة بين القـــدرة العامة والخاصة على الائتلاف ذات قيمة تفوق الوحدة لكـــل الصـــفات عدا صفه طول النبات مما يدل على ان الجزء الاكبر بين الاختلافات الوراثية المرتبطه بهذه الصفات يرجع الى فعل الجينات من النوع المضيف والتفوقى من الطراز المضيف X المضيف.

٣- اظهر الابوين (P_4, P_6) قدرة عامة معنويه سالبة على الائتلاف لصـــفات ميعاد التزهير وميعاد النضج وفترة النضج. كما أظهر الابوين (P_1, P_3) قدرة عامة معنويه موجبه على الائتلاف لصفة محصول البذور للنبات ووزن الـــ ١٠٠ بذرة كما أظهر الاب (P_3) فى نفـــس الوقت قدرة عامة معنوية وسالبة على الائتلاف لصفة نسبة الاصابة بدودة ورق القطن (المساحة المستهلكة من الورقة).

٤- كان الهجين ($P_5 \times P_6$) احسن التراكيب الوراثية وذلك للقدرة الخاصه على الائتلاف لصفة المحصول ومعظم مكوناته فى نفس الوقت كان مبكر النضج ، كما اعطى الهجين ($P_1 \times P_4$) قدرة خاصـــة موجـــبه ومعنويه لصفة محصول البذور للنبات وعدد الـــبذور للنـــبات. كما اعطى الهجين ($P_4 \times P_5$) قدره خاصة موجـــبه ومعنويه لصفة المحصول وفى نفس الوقت اعطى قدرة خاصة معنوية سالبة لصفة ميعاد النضج.

٥- أعطـــى الهجيـــنين ($P_5 \times P_4$), ($P_6 \times P_5$) قوة هجين موجبة ومعنوية للمحصول ومعظم مكوناته وكذلك افضل قوة هجين ســـالبة ومعنوية لصفة ميعاد النضج. كما اعطت الهجن ($P_4 \times P_1$), ($P_3 \times P_2$), (P_2) قوة هجين معنويه وسالبة لصفة نسبـــة الاصـــابة بـــدودة ورق القطن (المساحة المستهلكة من الورقة).

٦-تشير النتائج.على وجود ارتباط موجب ومعنوى بين المحصول و كـــل من صفات عدد الأيام حتى النضج و فترة النضج وعدد الفـــروع للنـــبات وعدد القرون بالنبات ووزن المائة بذرة. مما يمكن الانتخاب لهذة الصفات لتحسين المحصول.

٧- يمكـــن الاســـتفادة من هذا البحث فى استنباط سلالات عالية المحصول ومبكرة النضج ومقاومة لدودة ورق القطن.