Breeding for Yield and Its Components in Some Bread Wheat Crosses (*Triticum Aestivum*)

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ABSTRACT

A half diallel cross among seven common wheat varieties and lines were evaluated in both F1 and F2 generations in Etay El-Baroud Agricultural Research station during the three successive seasons ,2003/2004,2004/2005 and 2005/2006 to study some breeding parameters. The experimental design of randomized complete blocks with three replications was used. Seven characters were studied, i.e. plant height (cm.), spike length (cm.) , number of spikes per plant , number of kernels per spike ,1000 kernels weight (g) , grain yield /plant (g) and total plant Weight.

Test of significance indicated that the mean squares of genotypes were highly significant for the plant height, number of spikes/plant, spike length, number of kernels/spike, 1000- kernels weight and grain yield/plant in F_1 and F_2 generations. The significance of the mean squares indicated the presence of true differences among these genotypes . Mean squares due to parents and crosses were highly significant for all traits in F_1 and F_2 generations except number of spikes /plant in the F_2 generation.

Parents vs crosses mean squares as an indication to average heterosis overall crosses were found to be highly significant for all traits studied in F1 and F2 generations except number of spikes/plant, spike length, 1000 kernel weight and grain yield /plant in the F2 generation.

The analysis of variance of general combining ability (GCA) and specific combining ability (SCA) values mean squares were found to be highly significant for all studied traits in the F_1 and F_2 generations, Also GCA/SCA variances were found to be greater than unity for all studied traits except number of spikes /pant in the F_1 hybrid , indicating that additive and additive x additive types of gene action were of greater importance in the inheritance of all characters studied .

The additive variances (D) were significant for all traits, except number of spikes/plant and 1000 grains weight in the F_2 and grain yield /plant in the F_1 and F_2 generations. These results indicated that the additive gene effects played a major role in the inheritance for all traits in F_1 and F_2 generations. Dominance components of variation (H_1) were highly significant and greater than D also, for all traits in both generations. The component of variation due to the dominance effects associated with gene distribution (H_2) was highly significant and greater than D for all traits in F_1 and F_2 generations. All H_2 values were smaller than H_1 values for all traits indicating unequal allele frequency. The overall dominance effects of heterozygous loci (h^2) were significant for all traits in F_1 and F_2 generations except for plant height in F_1 and F_2, and number of spikes /plant, 1000 kernel weight and grain yield /plant in the F_2 generation. The covariance of additive and dominance (F) was not significant for all traits in F_1 and F_2 generations except plant height in the F_2 ,number of spikes/plant in the F_1 and number of kernels /spike in the F_1 and F_2 generation. The relative size of (D) and (H_1) estimated as $(H_1/D)^{1/2}$ can be used as a weight measure of the average degree of dominance at each locus, showed the presence of over dominance for all traits in both generations.

Low heritability values in narrow sense were detected for all traits in both generations except spike length and 1000 kernel weight in the F_1 and F_2 generations which gave high value

INTRODUCTION

Wheat is one of the most important. cereal crops in Egypt , either as a staple food grain for human or as a major source of straw fodder for animal feeding.(In season 2005,the total cultivated area of wheat was about 3.1 million faddan ,with an average yield of about 18.2 ardab /feddan. Increasing wheat production per unit area could be possible rather than increasing the area devoted for wheat production due to limitations of arable land and irrigation water The main goal of the Egyptian National Wheat Program is to develop high yielding.This can be achieved through ,genetic studies of heterosis ,combining ability and genetic components for wheat genotypes to select proper lines from good crosses .

Breeders of self pollinated crops are confronted by two major problems: the first, is identifying the best parental combinations that will result in the highest percentage of desirable progeny ,and the second being effective in selecting in early generations .Creating genetic variability and identifying the most promising parental combinations is a difficult task due to the large amount of available germplasm. This is particularly true when attempting to improve quantitatively inherited traits such as grain yield where many genes are involved and a large environmental influence is present.

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Exploitation of heterosis is considered to be one of the outstanding ach evements of plant breeding .In a self pollinated crops lil e wheat the scope for utilization of heterosis depends mainly upon the direction and magnitude of heten sis. The heterosis over better parent may be useful ir identifying true heterotic hybrid combinations but hese hybrids can be of immense practical value if th y show the best cultivars of the area (Prasad et al.,1998) .

Combining ability analysis is the most widely used biometrical t ol for giving an indication of the relative magnitude of genetic variance .These also provide a guidelin for selection of elite parents and desirable cross con binations to be used in formulation of a systematic bree ling program for rapid improvement .

The objec ives of the present study are to establish ;(I) The pc tentiality of heterosis expression for plant height ,spike length , number of spikes /plant ,number of grains / pike ,1000-grain weight, total plant weight and grain yie d /plant (ii) Estimate the magnitude of both general and specific combining ability.(iii)Gene action and the impc tance which should be given to this materials in a bree ling program by evaluating seven wheat varieties acc rding to their general combining ability effects and determine which crosses can be selected for improvi g wheat genotypes.

MATERIALS AND METHODS

This investigation was carried out at Etay El-Baroud Agric. Res. station, during the three successive seasons, 2003/2004, 2004/2005 and 2005/2006. Seven common wheat varieties and lines *(Triticum aestivum L. em Thell)* representing a wide divergent were selected for this study. The names, pedigree and code number of these varieties/and lines are presented in table (1).

In 2003/2004 season, grains for each of the parental varieties were sown at various dates in order to over come the difference in time of flowering during this season. All possible cross combinations without reciprocals were made among the seven genotypes, giving the twenty one crosses.

In 2004/2005 season, the obtained hybrid grains from-each of the twenty one crosses were sown in 18th November in randomized complete block design with three replication. In 2005/2006 season, parents and F2 diallel crosses were sown in 24th November in randomized complete block design with three replications. In both seasons of evaluation, i.e., 2004/05 for F1 and 2005/2006 for F2 generation, each plot consisted of two rows of F1 and six rows of F2. Each row was two meters long and 30 cm apart and plant within row was 20 cm apart. Ray method of planting was used in this concern. The other cultural practices of growing wheat were properly practiced as recommended. Data for the following traits recorded on 10 and 60 individual guarded plants, sown at random from each plot for F1 and F2, respectively. Plant height (cm) spike length (cm), no. of spikes/plant, number of kernels/spike, total plant weight (g), grain yield/plant (g) and 1000-kernel weight (gm) were studied.

Table 1. The name and pedigree of the studied parental bread wheat varieties and lines .

No.	Name	Pedigree	Origin
P_1	Line 1	Primia/PFau/Milan	CIMMYT
P2	Gemmieza	Ald"s"/Huac//cmh 74A. 630/Sx CGM4583-5GM-76M-0GM	Egypt
P_3	Sakha 61	INia/RL 4220//7c/4r"s"CM5430-25-55-0-05.	Egypt
P_4	Sakha 93	Sakha 92/TR810328 S8871-15-25-15-205	Egypt
P_5	Line 2	P Fau/Milan	CIMMYT
P_6	Line 3	BORL 95/LAJ 3302	CIMMYT
P_7	Line 4	D630/Heinev///ERA/3Buc/4/LiRa/S/SPP/61 Giza144 // pin"s"/ bow"s"	CIMMYT

Heterosis (H); according to the formulas adopted by Bhatt (1971) as follow : Heterosis (%) over better parent

$$\text{value} = \frac{\bar{F}1 - \bar{BP}}{\bar{BP}} x100$$

Differences between the parental lines and their F1 hybrids were tested for significance using the LSDmean values of genotypes test at 0.05 and 0.01 level of probability.

Estimates of both general and specific combining ability were calculated according to Griffing (1956) as method 2, model 1 for F1 and F2 generations.

The diallel analysis as described by Hayman, (1954),and Mather and Jinks (1971) was performed for each generation. The analysis involves the computation of variance of the parental means (VoLo = VP), variance of the components of each array (Vr) and covariance of the parents with their offspring in each array (Wr). The estimated genetic components under this model are D (the component of variation due to additive effects), F (the covariance of dominance and additive effects in a single array), H_1 (the component of variation due to dominance effects), and H_2 (a dominance measure indicating a symmetry of positive and negative effects of genes). These components were used for computation the genetic parameters according to Mather and Jinks (1971).

RESULTS AND DISCUSSION

Analysis of variance, means and heterosis:

Analysis of variance for the plant height, number of spikes/plant, spike length, number of kernels/spike, 1000- kernels weight, grain yield/plant and total plant weight are presented in Table (2). Test of significance indicated that the mean squares of genotypes were highly significant for all traits in F_1 and F_2 generations. The significance of the mean squares indicated the presence of true differences among these genotypes. Mean squares due to parents and crosses were highly significant for all traits in F_1 and F_2 generations except number of spikes and total plant weight /plant in the F_2 generation. These findings indicate that parental varieties and /or lines differed in their mean performance in all traits test . Similar results were previously drawn by Yadav *et al.*, (1998), Afiah *et al.*, (2000), Darwish (2003) , and Darwish *et al.*, (2006) .

The mean performance of the seven parental genotypes of wheat in the F_1 and F_2 generations are presented in Table (3) .The parental line1 (P_1) ranked the first for grain yield /plant and the second for spike length and 1000 grains weight . The parental cultivar Gemmeiza 9 (P_2) ranked the second for number of spikes /plant and the third for grain yield /plant .The parental cultivar Sakha 61 (P_3) ranked the first for number of spikes /plant and 1000 grain weight and the second for plant height. The parental cultivar Sakha 93 (P_4) ranked the second for grain yield /plant and the third for plant height and number of kernels /spike, while the fourth for 1000 kernel weight . The parental line (P_5) ranked the first for spike length and number of kernels /spike. The parental line (P_6) ranked the third for spike length and number of spikes /plant .The parental line (P_7) ranked the first for plant height and the second for number of grains /spike and 1000 kernel weight .

The mean performance of the tested twenty one crosses in the F_1 and F_2 generations are presented in Table (3) . For plant height, the best two crosses were P_4 x P_7 and P_6 x P_7 in the F_1 and F_2 generations. The four crosses P_1 xP_2, P_1 xP_3, P_2 xP_5 and P_2 x P_7 possessed the highest number of spikes /plant in the F_1 and F_2 generations, while the five crosses P_1 xP_5 , P_1 xP_7 , P_4 xP_5 , P_4 xP_7 ,and P_5 xP_7 possessed the highest spike length .For number of grains /spike the best three crosses P_4 xP_7 ,P_5xP_6 and P_5 xP_7 were found in the F_1 and F_2 generations. The four crosses P_1 xP_2 ,P_4 xP_7 ,P_5 xP_6 and P_6 xP_7 possessed the highest 1000- grain weight values in the F_1 and F_2 generation . The two crosses P_1 xP_2 and P_2 xP_4 possessed the highest grain yield /plant values in the F_1 and F_2 generations. However one cross P_5 xP_7 gave the lowest values of grain yield /plant in the F_1 and F_2 generations.

Heterosis effects :

Parents vs crosses mean squares (Table 2) as an indication to average heterosis overall crosses were found to be highly significant for all traits studied in F_1 and F_2 generations except number of spikes/plant ,spike length ,1000 kernel weight and grain yield /plant in the F_2 generation .The F_1 heterosis values for the seven characters are given in Table 4) . The degree of expression of heterosis was different for among characters. Heterosis over better parent for plant height ranged from to 3.96% in (P_1 x P_2) cross to –13.17 % in cross (P_2x P_6) . Significant heterosis relative to better parents for this trait was obtained in six crosses out of the 21 crosses . These results agree with those reported by Darwish (1992), Ashoush (1996), Tawfelis (1997) , Hendawy (1999), Ashoush et al , (2001) and Darwih etal., (2006) .

With regard to number of spikes /plant , the better parent heterosis was mostly positive and significant or highly significant in the F_1 heterosis crosses . Relative to

ible 2. The observed mean squares from analysis for all studied traits characters in F_1 and F_2 generations.

Source of variation	d.F	Plant height (cm)		No. of spikes/ plant		Spike length (cm)		No. of kernels/ spike		1000-kernel weight (g)		Grain yield (g/plant)		Total plant weight (g)	
		F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
p.	2	1.69	7.56	0.43	0.14	0.42	0.05	0.63	12.62	2.46**	10.80	4.00	24.16	69.00	121.80
notypes (G)	27	69.41**	67.70**	20.50**	10.94**	4.36**	2.20**	180.11**	94.52**	63.6**	45.40**	215.50**	102.32**	635.40**	2024.7**
rents (P)	6	61.30**	117.30**	9.89**	2.98	6.14**	2.16**	123.94**	99.16**	36.49**	16.40*	64.96**	51.8**	232.90**	201.18
osses	20	73.70**	37.80**	3.95**	13.61**	3.09**	2.14**	143.96**	94.87**	70.24**	56.30**	209.60**	121.82*	606.60**	2319.50**
s. F1	1	30.40**	368.40**	416.5**	4.44	19.12**	0.71	1240.10**	59.72**	93.31**	1.02	1235.60**	15.30	3626.6**	2072.00**
A	7	143.78**	129.2**	3.83**	12.60**	12.8**	6.71**	224.40**	150.60**	125.6**	87.70**	250.56**	202.79*	749.60**	1826.3**
A	27	48.16**	50.18**	25.33**	10.46**	1.95**	0.90**	167.40**	78.48**	95.88**	33.20**	205.46**	73.62**	602.70**	2081.5**
or	54	3.07	4.74	1.12	4.08	0.234	0.39	3.28	8.99	2.57	6.83	5.56	17.30	43.4	107.45
GCA/SCA		2.99	2.58	0.15	1.21	6.56	7.46	1.34	1.92	1.31	2.64	1.22	2.76	1.24	0.88

and ** significant at 0.05 and 0.01 levels of probability respectively.

le 3. The genotypes mean performance and inbreeding depression for all studied characters in F_1 and F_2 generations.

otypes	Plant height (cm)			No. of spikes/plant			Spike length (cm)			No. of kernels/spike			1000-kernel weight (g)			Grain yield/plant (g)			Total plant weight (g).		
	F_1	F_2	ID	F_1	F_2	ID	F_1	F_2	ID	F_1	F_2	ID	F_1	F_2	ID	F_1	F_2	ID	F_1	F_2	ID
P_1	113	110	-	16.33	17.7	-	14.4	13.43	-	50	58.0	-	49.6	48.5	-	59.0	58.5	-	206.7	193.3	-
P_2	111	112	-	19.66	13.3	-	11.8	12.4	-	53.0	55.6	-	45.52	44.2	-	52.3	56.0	-	182.7	180.0	-
P_3	108	110	-	19.67	12.0	-	11.3	11.50	-	55.3	54.0	-	50.4	49.5	-	47.3	48.3	-	186.7	181.6	-
P_4	106	107.5	-	18.66	16.7	-	13.4	12.7	-	63.6	62.6	-	47.8	47.5	-	56.3	56.5	-	189.3	186.6	-
P_5	119	126	-	18.66	15.3	-	15.2	14.5	-	70.6	69.6	-	41.38	454.6	-	46.3	49.0	-	200.6	200	-
P_6	110	112	-	19.33	17.3	-	14.2	13.17	-	59.0	56.6	-	43.6	45.6	-	49.6	57.0	-	195.3	186.7	-
P_7	108	108.5	-	18.66	16.3	-	13.46	13.76	-	62.3	65.3	-	49.9	49.96	-	50.0	49.7	-	201.7	200.0	-
P_1 x P_2	119	105	11.67	24.30	19.6**	19.34	15.0	12.53	16.47**	79.6	62.3	21.73**	51.53	49.0	4.91**	65.7	59.7	9.13*	247.0	226	8.5**
P_1 x P_3	117	107	8.54**	23.6	17.0**	27.96**	14.6	13.10	10.27**	69.3	61.9	10.69**	51.53	48.5	5.88	55.7	50.2	9.87*	203.7	175	14.09**
P_1 x P_4	117	113	3.42*	26.0	14.8**	43.08**	14.66	12.33	15.89**	66.6	60.5	9.16**	51.93	45.6	12.19**	68.0	47.7	29.85**	221.0	130	41.18**
P_1 x P_5	119	111	6.72**	24.00	15.4**	35.83**	15.66	14.0	10.60**	71.0	66.3	6.62*	47.47	45.0	5.20	65.0	50.3	22.61**	201.2	145	27.93**
P_1 x P_6	116	110	5.17**	23.00	15.2**	33.91**	15.03	13.76	8.45**	66.6	56.3	15.46**	51.62	44.5	13.79**	64.3	49.9	22.39**	215.0	168	21.86
P_1 x P_7	115	108	6.09**	23.00	13.8*	40.00**	15.83	14.93	5.68	72.6	64.0	11.85**	45.30	49.13	-8.45**	54.3	44.2	18.6**	225.0	177	21.33
P_2 x P_3	110	107	2.73	22.33	17.00**	23.87**	12.07	12.3	-1.91	70.0	63.6	9.14**	60.0	44.0	26.66**	65.3	54.3	16.84**	203.3	176	13.43*
P_2 x P_4	112	108	3.57**	22.33	18.4	17.06	14.0	12.0	14.28*	47.0	44.0	6.38	45.9	43.3	5.66	73.0	64.3	11.92*	200.0	188	6.0
P_2 x P_5	112	110	1.78	25.00	19.3	22.80**	14.86	13.50	9.15**	74.3	59.0	20.59**	50.0	44.2	11.60*	65.3	49.0	24.96**	320.0	180	43.75**
P_2 x P_6	97	112	-15.46**	23.00	17.8	21.61**	13.0	13.0	0.00	65.0	64.3	1.08	40.5	37.83	6.59	38.0	55.4	-45.79**	200.0	166	17.0**
P_2 x P_7	114	104	8.77**	23.3	18.3	21.46**	15.23	12.84	15.69**	70.3	57.3	18.49**	50.0	46.5	7.0	67.3	55.1	18.13	213.3	200	6.23
P_3 x P_4	108	106	1.85	22.00	16.3	25.91**	13.0	12.20	6.15	62.6	62.6	0.00*	44.33	43.50	1.87	63.6	62.4	1.89	200.0	193	3.5
P_3 x P_5	113	107	5.31**	23.00	16.8	26.95**	15.0	12.3	18.0**	70.0	59.3	15.28**	52.0	47.0	9.6**	60.0	49.86	16.90	200.0	203	-1.5
P_3 x P_6	113	109	3.54*	23.00	11.6	49.56**	13.83	12.67	8.39*	65.6	62.0	5.49	45.0	45.0	0.0	63.0	44.8	28.89**	210.0	105.6	49.71**
P_3 x P_7	109	102	6.42**	23.00	15.0	34.78**	14.17	14.10	0.49	70.0	64.0	8.57**	49.86	47.16	5.41	64.0	52.8	17.5	180.0	160	11.11
P_4 x P_5	114	110	3.51*	23.33	16.8	27.99**	15.02	14.3	4.79	72.3	59.6	17.56**	46.0	45.5	1.09	63.0	57.50	8.73	226.6	178	21.45**
P_4 x P_6	115	110	4.35**	21.00	14.8	29.52**	13.5	13.0	3.70	62.0	65.0	-4.84	43.00	42.76	0.56	57.67	59.7	-3.52	220.0	122.3	44.41*
P_4 x P_7	108	100	7.41**	22.66	12.86	43.24**	15.37	14.33	6.76*	81.3	70.3	13.53*	52.9	49.7	6.05	65.62	42.5	35.23**	195.0	156	20.0**
P_5 x P_6	114	105	7.89**	23.00	14.0	39.13**	15.03	14.0	6.85*	78.6	70.0	10.94**	52.0	52.0	0.00	51.0	45.00	11.76*	216.0	158	26.85*
P_5 x P_7	113	107	5.31**	22.33	13.40	40.0**	15.42	14.0	9.21**	74.3	68.6	7.67**	53.12	52.0	2.11	44.0	42.5	3.41	210.0	160	23.81**
P_6 x P_7	107	101	5.61**	21.33	16.40	23.11**	16.12	13.0	19.35**	68.6	65.0	5.25	58.22	48.6	16.52**	55.0	44.01	19.98	200.0	167.6	16.5**
S.D. 5%	2.86	3.55	-	3.05	3.29	-	0.79	1.019	-	2.957	4.896	-	2.61	4.26	-	3.85	6.79	-	10.75	16.93	-
S.D. 1%	3.81	4.73	-	4.06	4.38	-	1.05	1.356	-	3.933	6.51	-	3.48	5.67	-	5.12	9.03	-	14.3	22.51	-

d ** significant at 0.05 and 0.01 levels of probability respectively.

'able 4. Percentages of heterosis over better-parent (BP) for all studied traits in F_1 generation.

Crosses	Plant height (cm)	No. of spikes/plant	Spike length (cm)	No. of kernels/spike	1000-kernel weight (g)	Grain yield/plant (g)	Total plant weight (g).
	F_1	F_1	F_1	F_1	F_1	F_1	F_1
$P_1 \times P_2$	5.31**	23.60**	4.17	50.19**	3.89	11.24**	19.50**
$P_1 \times P_3$	3.54**	19.98**	1.39	25.32**	2.24	-5.04*	-1.45
$P_1 \times P_4$	3.54**	39.33**	1.80	4.62*	4.70	15.25**	6.93**
$P_1 \times P_5$	0.00	28.62**	3.03	0.57	-4.29	10.16**	-2.41
$P_1 \times P_6$	2.65*	18.99**	4.37	12.88**	4.07**	8.98*	4.03
$P_1 \times P_7$	1.77	23.26**	9.93*	16.53**	-9.22**	-7.91**	8.87**
$P_2 \times P_3$	-0.95	13.52**	2.29	26.58**	19.85**	24.84**	8.92**
$P_2 \times P_4$	0.59	13.58*	4.48	-26.10**	-3.97*	29.58**	5.63*
$P_2 \times P_5$	-5.88**	27.16**	-2.24	5.24**	9.84**	24.84	59.52**
$P_2 \times P_6$	-12.61**	16.99**	-9.72**	10.16	-11.03**	-27.38**	2.38
$P_2 \times P_7$	2.70	18.51**	13.15**	12.84*	0.20	28.66**	5.78*
$P_3 \times P_4$	0.00	11.84**	-2.80	-1.57**	-12.04**	12.97**	5.63*
$P_3 \times P_5$	-5.4**	16.93**	-1.32	-0.58	3.17	26.76	-0.30
$P_3 \times P_6$	2.73**	16.93**	-2.61	11.19**	-10.71**	27.02	7.51**
$P_3 \times P_7$	0.92	16.93**	5.27	12.36*	-1.06	28.00**	-10.74**
$P_4 \times P_5$	-4.20**	25.03**	-1.18	2.41	-3.89	11.83**	12.95**
$P_4 \times P_6$	4.54**	8.64*	-4.93	-2.52*	-10.04	2.36	12.63**
$P_4 \times P_7$	0.00	21.44**	14.19**	27.83**	6.01*	16.56**	-3.31
$P_5 \times P_6$	-4.20**	18.97**	-1.12	11.33**	19.27**	2.68	7.64**
$P_5 \times P_7$	-5.4**	19.67**	1.45	5.54	6.45**	-12.00**	4.13
$P_6 \times P_7$	-2.73	10.35**	13.52**	10.11	16.67**	10.00**	-0.826

** significant at 0.05 and 0.01 levels of probability respectively.

better parent ranged from 8.60% in cross (P_4 x P_6) to 42.80% in cross (P_1 x P_2).

For spike length , heterosis relative to better parent was greater for 4 crosses out of 21 positive heterosis to better parent value ranged from 1.34% for cross (P_1 x P_7) to 13.58% for cross (P_6 x P_7) , These results agree with those found by Abd el Sabour et al., (1993) , Hamada (1993), Ashoush (1996) and Ashoush et al., (2001)

Concerning number of kernels /spike, 14 crosses out of 21 exhibited significant positive heterosis in most cases and highly significant heterosis based on better parents. The heterosis values of these crosses over better parent ranged from 3.96 % for cross (P_3 x P_7) to 36.52% for cross (P_1 x P_2) .

For 1000-kernel weight, six crosses exhibited positive and significant heterosis based on better parent. Heterosis ranged from 5.94% for cross (P_4 x P_7) to 20.16% for cross (P_1 x P_7) .

For grain yield /plant, 12 crosses out of 21 exhibited positive in most cases and highly significant. The heterosis values over better parent for this trait ranged from 9.03% for cross (P_1 x P_6) to 29.58% for cross (P_2 x P_4) .These results are in agreement with those reported by Ashoush (1996), El-Siedy et al., (1997) , Ashoush et al., (2001) , and El-Siedy et al., (2000) .

Percentage of inbreeding depression in F_2 generation for characters studied (Table 3). Results of inbreeding, fifteen, nineteen, fourteen, sixteen, eight, twelve and fourteen crosses showed significantly or a result of inbreeding of plant height, no. of spikes/plant, spike length, no. of kernel/spikes 1000-kernel weight, grain yield/plant and total plant weight , respectively. If high heterosis in is followed by inbreeding in F_2 performance, it indicates the presence of non-additive gene action. But, if is same in F_1 and F_2, it mean presence of additive gene action. Similar, results were obtained by Singh *et al.* (1984) and Samar El-Shakess (2003).

Combining ability effects:

Table (2) shows the analysis of variance of general combining ability (GCA) and specific combining ability (SCA) values mean squares were found to be highly significant for all studied traits in the F_1 and F_2 generations, which would indicate the importance of both additive and non-additive genetic variance in determining the performance of all studied characters. Also GCA/SCA variances were found to be greater than unity for all studied traits except number of spikes /pant in the F_1 and total plant weight in F_2 hybrid , indicating that additive and additive x additive types of gene action were more important in the inheritance of all characters studied . The presence of both additive and non-additive gene action would suggest that breeding procedures which are known to be effective in shifting gene frequency when both additive and non-additive genetic variances are involved would be successful in improving all traits under investigation. The obtained results are in harmony with those previously reached by Ashoush , (1996), Awaad , (2001), and Darwish *et al.*, (2006) .

General combining ability effects (GCA)

Estimates of general combining ability effects for parents are presented in Table (5). High positive values would be of interest in all studied traits except plant height were negative values would be useful from the breeder point of view. Results indicated that the parental Line (P_1) showed highly significant positive general combining ability effects for spike length and grain yield /plant in the F_1 hybrid and 1000 kernel weight in the F1 and F2 generations .The cultivar Gemmeiza 9 (P_2) exhibited highly significant negative general combining ability effects for plant height in the F_1 hybrid, and significant positive general combining ability effects for number of spikes /plant in the F_1 generation and grain yield /plant in the F_1 and total plant weight in F_2 generations proving to be good combiner for this trait . The cultivar Sakha 61 (P_3) exhibited highly significant negative general combining ability effects for plant height in the F_1 and F_2 generations and significant positive general combining ability effects for number of spikes /plant in the F_1 hybrid . The cultivar Sakha 93 (P_4) showed highly significant negative general combining ability effects for plant height in the F1 hybrid. Also it exhibited highly positive general combining ability effects for grain yield /plant in the F_1 and F_2 generations. The parental line (P_5) showed highly significant positive general combining ability effects for total plant weight, spike length and number of kernels /spike in the F_1 and F_2 generations proving to be good combiner for developing number of kernels /spike .The parental line (p_6) showed highly significant negative general combining ability effects for plant height in the F1 hybrid proving to be good combiner for this trait. The parental line (p_7) showed highly significant negative general combining ability effects for plant height in the F1 and F2 generations while it gave showed significant positive general combining ability effects for spike length number of kernels /spike and 1000 kernel weight in the F_1 and F_2 generations proving to be good combiner for these trait. It could be concluded that the mean performance of the parental lines could be considered as good indication of their general combining ability effects for most traits under investigation these results are in agreement with those reported by Ashoush et al., (2001), Darwish *et al.*, (2006) and Salem Nagwa et al., (2006).

Table 5. Estimates of general combining ability effects of parents for all studied traits in F_1 and F_2 generations.

Parents	$\hat{g}i$	Plant height (cm)		No. of spikes/plant		Spike length (cm)		No. of kernels/spike		1000-kernel weight (g)		Grain yield/plant (g)		Total plant weight (g).	
		F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
P_1	g_i	3.603**	0.829*	0.238	0.0268	0.59**	0.204	0.116	-0..675	1.914**	1.452	2.891**	0.362	8.656**	2.079
P_2	g_i	-1.286**	0.194	-0.725**	1.396**	-0.732**	-0.525**	-3.254**	-3.504**	-1.769**	-2.133	1.513**	3.776**	0.026	11.82**
P_3	g_i	-1.175**	-1.054**	0.386*	-0.085	-1.017**	-0.666**	-2.032**	-1.371*	-0.019	-0.155*	0.065	-0.52	-8.714**	-1.513
P_4	g_i	-1.138**	-0.528	-0.058	-0.136	-0.210*	-0.222	-1.365**	-0.719	-1.651**	-1.118*	4.217**	3.470**	-0.825	-5.439**
P_5	g_i	3.122**	3.769**	0.0238	-0.315	0.794**	0.567**	4.487**	3.151**	0.269	0.349	-2.746	-2.070**	2.989*	3.820*
P_6	g_i	-1.505**	0.305	0.127	-0.446	0.076	0.045	-1.33	0.225	-1.992**	-1.451**	-4.153*	-1.659*	0.323	-14.25**
P_7	g_i	-1.619**	-3.510**	-0.0206	-0.682	0.579**	0.597**	3.376**	2.852**	5.784**	3.056**	-1.709**	-3.361**	-2.455*	3.487
..S.D. (gi)	5%	0.624	0.775	0.376	0.720	0.172	0.222	0.645	1.084	0.572	0.931	0.839	1.482	2.348	3.692
S.D. (gi)	1%	0.829	1.031	0.500	0.957	0.229	0.295	0.858	1.442	0761	1.238	1.117	1.9671	3.122	4.910
S.D. (gi-gj)	5%	0.953	1.184	0.576	1.100	0.263	0.340	0.986	1.100	0.874	1.422	1.283	2.263	3.587	5.642
S.D. (gi-gj)	1%	1.269	1.525	0.749	1.463	0.351	0.452	1.312	1.46	1.162	1.891	1.706	3.010	4.770	5.704

d ** significant at 0.05 and 0.01 levels of probability respectively.

Specific combining ability effects (SCA):

Specific combining ability effects (SCA) for all crosses with respect to the studied traits are given in Table (6). Results indicated that only cross P_6 x P_7 showed significant negative desirable specific combining ability effects for plant height in the F_1 and F_2 generations., while the two crosses (P_2 x P_6 and P_3 x P_4) in the F_1 generation and seven crosses (P_1 x P_2 ,P_1 x P_5, P_2 x P_5, P_3 x P_5, P_3 x P_7, P_4 x P_7, and P_5 x P_6) in the F_2 generation exhibited significant negative effects for plant height . It is of interest to mention that the parental P_2, P_3 ,P_4 ,P_6 and P_7 were found to be excellent combiners for this trait . Similar results were obtained by Mitkees (1981), Singh (1990) and Darwish *et al.*, (2006) .

Line1 x gemmiza 9 in the F_1 and F_2 generations and eleven crosses (P_1 x P_3, P_1 x P_4, P_1 x P_5, P_1 x P_6, P_1 x P_7,P_2 x P_3 ,P_2 x P_4, P_2 x P_6, P_2 x P_7, P_3 x P_4 and P_3 x P_7) in the F_1 hybrid exhibited significant positive effects for number of spikes /plant . These results agree with those found by Ashoush , (1996) , Ashoush , *et al* ., (2001) Darwish *et al.*, (2006) and Salem Nagwa *et al.*, (2006).

Concerning spike length one cross P_3 x P_5 exhibited significantly positive (Sij) effects in the F_1 and F_2 generations ; seven crosses(P_1 x P_2, P_1x P_3, P_2 x P_5, P_2 x P_7, P_3 x P_6, and P_6 x P_7) in the F1 hybrid and four crosses (P_1 x P_7, P_3 x P_7, P_4 x P_5, and P_4 x P_7)in the F2 generation. Theses results agree with those found by Abd El Sabour *et al* ., (1993) , El Seidy *et al* ., (2000) , Ashoush *et al.*, (2001) and Darwish *et al* ., (2006) .

With regard to number of kernels/spike six crosses (P_1 x P_2, P_2 x P_3, P_2 x P_6, P_4 x P_6, P_4 x P_7 and P_5 x P_6) in the F_1 and F_2 generations, and four crosses (P_1 x P_3, P_2 x P_5 ,P_2 x P_7 and P_3 x P_4) in the F_1 hybrid exhibited significantly positive (Sij) effects. Also, this crosses was previously found exhibited significant useful heterosis for this trait. Theses results agree with those found by Wagoire *et al.*, (1998) and Ashoush *et al.*, (2001).

For 1000- grains weight seven crosses (P_1 x P_2 ,P_1 x P_7,P_2 x P_5 ,P_3 x P_5 ,P_4 x P_7,P_5 x P_6 and P_6 x P_7); three crosses (P_1 x P_2, P_1 x P_7 and P_5 x P_6) exhibited significantly positive (Sij) effects in the F_1 and F_2 generations The parental P_1 and P_7 were found to be the best combiners for this trait, therefore the hybrids combinations P_1 x P_2 ,P_1 x P_7,P_2 x P_5 , P_4 x P_7 and P_6 x P_7); could be practical importance in a breeding program for developing either hybrid wheat or pure lines since it surpassed the best performing parents for 1000-grain weight in the F_1 and F_2 generations. Similar results were obtained by Sing (1990) , Ashoush , (1996) , Ashoush *et al.*, (2001) , Darwish *et al.*, (2006) and Salem Nagwa *et al.*, (2006).

For grain yield/ plant, three crosses(P_2xP_4, P_3xP_7, and P_4xP_5) exhibited significantly positive specific combining ability effects in the F_1 and F_2 generations . Also, eleven crosses ability effects in the F1 hybrid (P_1xP_2, P_1xP_4, P_1xP_5, P_1xP_6, P_2xP_3, P_2xP_5, P_2xP_7, P_3xP_5, P_3xP_6, P_4xP_7 and P_6xP_7) and two crosses (P_3xP_4, and P_4xP_6)in the F_2 generation are considered to be promising hybrid for varietals improvement purpose at as they showed high significant positive values of specific combining ability effects in the F_1 and F_2 generations data involved three good general combiner parents. In such hybrids, it would be expected that diverse genes contributing to the better general combining ability effects of the parents are available in the hybrids and in the segregating generation, these are likely to give transgressive segregate. These results agree with those found by Hamada , (1993) , El siedy *et al.*, (2000) , Ashoush et al., (2001) and Salem Nagwa et al., (2006).

The results obtained here concerning general and specific combining ability effects would indicate that the excellent hybrid combinations were obtained from the three possible combinations between the parents of high and low general combining ability effects i.e high x high, high x low and low x low. It could be concluded that general combining ability effects were generally unrelated to the specific combined ability of their respective crosses. This conclusion was also drawn by Mitkees (1981) , Sing (1990) , Darwish , (2003) and Darwish *et al* ., (2006).

Genetic components and heritability:

Data presented in Table (7) revealed that the additive componend (D) were significant for all traits, except number of spikes/plant and 1000 grains weight and total plant weight in the F_2 and grain yield /plant in the both F_1 and F_2 generations. These results indicated that the additive gene effects played a major role in the inheritance for all traits in F_1 and F_2 generations. A dominance component of variation (H1) was highly significant and greater than D also , for all traits in both generations.

The component of variation due to the dominance effects associated with gene distribution (H_2) was highly significant and greater than D for all traits in F_1 and F_2 generations. All H_2 values were smaller than H_1 values for all traits except for total plant weight in F2 generation indicating unequal allele frequency in the parents. The overall dominance effects of heterozygous loci (h^2) were significant for all traits in F_1 and F_2 generations except for plant height in F_1 and F_2, and number of spikes /plant, 1000 kernel weight and grain yield /plant in the F_2 generation These results are in agreement with those by Hamada (1993), Abdel-Sabour [redacted]ble 6. Estimates of specific combining ability of effects for studied crosses in F_1 and F_2 generations.

Crosses	Plant height (cm)		No. of spikes/plant		Spike length (cm)		No. of kernels/spike		1000-kernel weight (g)		Grain yield/plant (g)		Total plant weight (g).	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
$P_1 \times P_2$	3.57**	-14.22**	1.96**	1.825*	0.93*	-0.357	15.10**	5.19**	2.632**	2.72*	3.13*	3.641	32.22**	35.56**
$P_1 \times P_3$	2.46**	-0.968	1.85**	0.739	0.81**	0.350	3.55**	2.26	1.283	0.216	-5.43	-1.628	-2.37	1.23
$P_1 \times P_4$	2.76**	4.17**	1.63**	-1.443	0.07	-0.861*	0.21	0.147	-1.592	-1.688	2.75*	-8.153**	7.074*	-40.51*/*
$P_1 \times P_5$	-0.17	-2.12*	3.67**	-0.644	0.07	0.012	-1.31	2.11	1.264	-3.75**	6.72**	0.053	-16.074*	-34.76**
$P_1 \times P_6$	2.13*	0.39	1.78**	-0.796	0.16	0.306	0.18	-4.96**	-3.37	-2.453	7.46**	-0.744	-0.074	6.97
$P_1 \times P_7$	0.90	2.488	1.11*	-1.847	-0.15	0.920**	1.42	0.036	5.546**	7.67**	-4.98**	-4.736*	12.70**	-2.10
$P_2 \times P_3$	0.35	-1.01	1.48**	-0.389	-0.42	0.280	7.58**	6.795**	-1.06	-0.666	5.54**	-0.957	5.93	-8.12
$P_2 \times P_4$	2.31*	-0.531	1.26*	1.096	-0.65*	-0.465	-16.1**	-13.52**	-0.328	-0.369	9.06**	5.104**	-5.29	8.08
$P_2 \times P_5$	-1.62	-2.49*	0.963	2.18*	0.51*	0.246	5.39**	-2.34	3.285**	2.06	8.35**	-4.684*	10.89**	-9.51
$P_2 \times P_6$	-12.65**	3.302**	3.74**	0.823	-0.638*	0.269	1.88**	5.86**	-4.485	-5.536**	-17.52**	1.267	-6.44	-4.76
$P_2 \times P_7$	4.46**	-1.216	2.07**	1.54	1.09**	-0.450	2.51**	-3.80*	-0.767	-1.31	9.32**	2.705	9.67**	10.82*
$P_3 \times P_4$	-2.13**	-0.949	1.15**	0.476	-0.07	-0.124	3.36**	3.01	-2.742	-2.147	1.17	7.50*/*	3.44	26.42**
$P_3 \times P_5$	-0.73	-3.48**	-0.48	1.155	0.93**	3.780**	-0.16	-4.19**	3.536**	-0.147	9.46**	0.476	-0.37	27.16**
$P_3 \times P_6$	3.90**	1.55	0.630	-3.85**	0.48*	0.076	1.32	1.39	-1.735	-0.347	8.87**	-9.35*	12.29**	-52.43**
$P_3 \times P_7$	-0.32	-2.301*	1.296*	-0.311	0.312	0.957**	0.95	0.732	-2.64**	-2.688	7.43**	4.753*	-14.92**	-15.84**
$P_4 \times P_5$	0.24	-1.772	-1.93**	1.206	0.19	0.743*	1.50	-4.52**	-0.832	-0.651	3.31**	4.117*	18.40**	5.75
$P_4 \times P_6$	5.53**	2.03	-0.93	0.662	-0.66**	-0.35	1.99**	3.747*	-1.403	-1.618	-0.611	5.87*	14.41**	-31.84*
$P_4 \times P_7$	-1.02	-3.94*	1.07	-2.394*	0.70**	0.746*	11.62**	6.47**	2.016**	0.842	4.94**	-9.589**	-7.81*	-15.25**
$P_5 \times P_6$	0.27	-7.61**	0.778	-1.317	-0.13	0.126	7.806**	4.87*	5.51**	6.82**	-0.315	-3.254	1.59	-5.10
$P_5 \times P_7$	-0.62	-1.958	0.444	-1.678	-0.20	-0.376	-1.23	6.877	0.899	1.643	-9.76**	0.984	3.39	-20.51
$P_6 \times P_7$	-2.32*	-4.66**	-0.444	1.450	1.22*	-0.520	-1.083	0.136	7.728**	0.042	2.648	-2.945	-3.96	4.56
[redacted].D. 5% sij	1.54	1.919	0.933	1.782	0.426	0.551	1.59	2.64	1.416	2.304	2.078	3.66	5.81	9.14
1% sij	2.05	2.55	1.21	2.372	0.567	0.733	2.212	3.51	1.88	3.06	2.764	4.88	7.73	12.15
[redacted]. 5% (sij-sij)	2.05	2.649	1.288	9.459	0.588	0.761	2.206	3.64	1.954	3.18	2.868	5.06	8.02	12.15
[redacted]% (sij-sij)	2.13	3.52	1.674	3.271	0.782	1.012	2.934	4.85	2.599	4.23	3.815	6.73	10.62	16.78
[redacted]. 5% (sij-sik)	2.69	3.351	1.629	.11	0.744	0.463	2.790	4.61	2.472	4.08	3.628	6.4	10.14	15.95
[redacted]% (sij-sik)	3.58	4.457	2.118	4.138	0.99	1.280	3.711	6.13	3.28	5.35	4.526	8.52	13.49	21.22

significant at 0.05 and 0.01 levels of probability respectively.

'able 7. Estimates of genetic components of variation in a diallel wheat in F_1 and F_2 for studied crosses.

Character components	Plant height (cm)		No. of spikes/plant		Spike length (cm)		No. of kernels/spike		1000-kernel weight (g)		Grain yield/plant (g)		Total plant weight (g).	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
D	19.92**	37.55**	2.931**	0.00	1.96**	0.738**	39.48**	82.39**	11.308*	4.65	19.82	11.43	62.63**	31.07
H_1	64.64**	62.55**	23..27**	13.58**	2.02**	0.923**	192.13*	150.3**	68.82**	53.71**	248.0**	94.5**	723.4**	277.5**
H_2	54.84**	45.74**	20.25**	8.56**	1.786**	0.87**	182.05*	89.56**	46.63**	41.01**	226.19**	76.30**	619.00**	2282.5**
h^2	5.038	68.05	77.548**	0.361	3.530**	6.520**	16.26**	64.13**	16.9**	0.375	229.64**	0.740	673.6**	1301.94**
F	8.79	37.38**	5.540**	1.450	0.304	-0.233	16.25**	121.13**	8.21	-2.46	-4.18	-7.27	23.950	86.71
E	1.02	1.613	0.365	1.313**	8.16**	0.126	0.365	3.04	0.855	0.787	1.833	5.84*	15.02	35.98
$(H_1/D)^{1/2}$	1.88	1.290	2.812	1.304	1.014	1.118	2.817	1.35	2.466	3.39	3.540	2.870	3.398	9.44
$(H_2/4H_1)$	0.199	0.182	0.217	0.157	0.221	0.232	0.217	0.148	-0.169	0.191	0.227	0.202	0.213	0.206
$[(4DH_1)^{1/2} + F]/[(4DH_1)^{1/2} - F]$	1.149	1.572	1.480	-1.0	1.092	0.849	1.480	1.916	1.185	0.913	0.966	0.879	1.067	1.186
h^2/H_2	0.091	1.487	3.824	4.21	1.979	7.45	3.829	0.716	0.362	-1.16	1.015	-7.523	1.088	0.570
h (n.s)	0.452	0.394	0.036	0.341	0.64	0.596	0.036	0.302	0.50	0.473	0.283	0.425	0.296	0.262
t^2	1.85	8.069	1.524	3.05	0.461	1.114	1.424	5.868	6.305	37.7	39.70	1.812	1.92	25.64

and ** significant at 0.05 and 0.01 levels of probability respectively.

et al (1993), Nostafa , (2002), Seleam (2005) and Darwish *et al.*, (2006) .

The covariance of additive and dominance (F) was not significant for all traits in F_1 and F_2 generations except plant height in the F_2 ,number of spikes/plant in the F_1 and number of kernels /spike in the F_1 and F_2 generation, It could be generally concluded that an equality of the relative frequencies of dominant and recessive alleles in the parents for all traits. These findings were in line with those reached by Ashoush (1996).

The relative size of (D) and (H_1) estimated as $(H_1/D)^{1/2}$ can be used as a weight measure of the average degree of dominance at each locus, showed the presence of over dominance for most traits in both generations. Similar results were obtained by Hamada (1993), Ashoush (1996) and Darwish *et al.*, (2006) .

The mean values of UV over all loci (H_2 / $4H_1$) were slightly below the maximum value of 0.25, which arises when U = V = 0.5 over all loci, indicating that the positive and negative alleles were not equally distributed among the parents for all traits in both generations.

The ratio KD/KR = $(4DH_1)^{1/2} + F/ (4DH_1)^{1/2} - F$ were more than unity for almost all traits in both generations, confirming presence of excess of dominant genes which govern these traits. The h^2/H_2 values for all studied traits in both generations suggest that there were one or more pairs of genes affecting the inheritance of these traits. These results are in agreement with those reported by Ashoush (1996) and Darwish *et al.*, (2006) .

Heritability estimates in narrow sense for all traits are given in Table (7). Low heritability values in narrow sense were detected for all traits in both generations except spike length and 1000 kernel weight in the F_1 and F_2 generations which gave high value, indicating that most of the genetic variances are due to non- additive genetic effects. This finding supported the previous results regarding the genetic components where the H_1 estimates played greater role in Tables (7). Therefore, the bulk method program for most traits might be quite promising. Similar results reported by Sing *et al* ., (1984) , Ashoush , (1996) , Mostafa (2002) and Darwishet al ., (2006) .

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الملخص العربي

التربية للمحصول ومكوناته فى بعض هجن قمح الخبز

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تم تقييم الهجن الناتجة من التهجين أحادى الجهة لسبعة أصناف وسلالات من قمح الخبز للجيل الأول والثانى ، وذلك بمحطة البحوث الزراعية بإيتاي البارود ، مركز البحوث الزراعية خلال ثلاث مواسم هي : ٢٠٠٣/٢٠٠٤م ، ٢٠٠٤/٢٠٠٥م ، ٢٠٠٥/٢٠٠٦م فى تصميم قطاعات كاملة العشوائية ذات ثلاث مكررات. بهدف التربية لزيادة المحصول عن طريق تحسين مكونات المحصول وأخذت القراءات على صفات طول النبات -طول السنبلة – عدد السنابل – عدد الحبوب فى السنبلة -وزن الألف حبة – محصول الحبوب للنبات -المحصول الكلى للنبات.

وكانت أهم النتائج المتحصل عليها كالتالى:

١- كان التباين الراجع إلى كل من التراكيب الوراثية والأباء والهجن وقوة الهجين معنوية لكل الصفات المدروسة ماعدا صفة عدد السنابل للأباء فى الموسم الأول ، وصفة محصول النبات الكلى فى الموسم الثانى ، وكذلك الأباء مقابل الهجن لصفات عدد السنابل للنبات وطول السنبلة فى الجيل الأول ووزن الألف حبة ومحصول الحبوب للنبات فى الجيل الثانى. كما أعطى الأب الأول (P_1) أفضل الأباء فى صفة محصول الحبوب للنبات ومحصول النبات الكلى فى كلا الموسمين وصفة عدد السنابل للنبات فى الموسم الثانى. كما أعطى الأب (P_3) أحسن الأباء لصفة عدد السنابل للنبات ووزن ألف حبة فى الموسم الأول ، والأب (P_5) أعطى أعلى القيم لصفة طول النبات وطول السنبلة فى كلا الموسمين. وكما أعطى (P_7) أعطى أفضل الأباء لصفة وزن ألف حبة فى الموسم الثانى. كما كانت أحسن الهجن ($P_1 \times P_2$) ، ($P_2 \times P_3$) ، ($P_2 \times P_7$) فى الجيل الأول والثانى.

٢- كان التباين الراجع للقدرة العامة والخاصة على التآلف معنويا لكل الصفات المدروسة فى الجيل الأول والثانى. كما كانت نسبة القدرة العامة على القدرة الخاصة تزيد عن الوحدة فى كل الصفات عدا صفة عدد السنابل فى الجيل الأول. ومحصول النبات الكلى فى الجيل الثانى. مما يدل على أهمية التأثير المضيف فى هذه الصفات.

٣- كانت أفضل الأباء فى القدرة العامة على التآلف فى الموسم الأول والثانى (P_2) ، (P_4) محصول الحبوب للنبات (P_5) ، (P_7) لصفات طول السنبلة وعدد الحبوب فى السنبلة ووزن ألف حبة. أعطت ١٢ هجين فى الجيل الأول والهجن ($P_2 \times P_3$) ، ($P_3 \times P_4$) ، ($P_3 \times P_7$) ، ($P_4 \times P_7$) فى الجيل الثانى قدرة خاصة موجبة ومعنوية لصفة محصول الحبوب للنبات.

كان التباين الراجع للإضافة معنويا لصفات طول النبات وطول السنبلة وعدد الحبوب فى السنبلة فى كلا الجيلين ولصفات عدد السنابل للنبات ووزن ألف حبة ومحصول النبات الكلى فى الجيل الأول. مما يوضح أن التأثير الراجع للإضافة هو السائد فى هذه الصفات.

كان التباين الراجع للتأثير السيادى معنويا لكل الصفات فى كلا الجيلين ، كما كان التأثير الراجع للسيادة أكبر من تأثير الإضافة لكل الصفات فى كلا الجيلين. وأيضا كان التأثير الراجع للسيادة الفائقة معنويا لكل الصفات فى كلا الجيلين.

كانت العوامل المضيفة ذات أهمية فى وراثة معظم الصفات المدروسة ويرجع ذلك لأن القدرة على الإئتلاف كانت أكبر من القدرة الخاصة على الإئتلاف فى معظم الصفات المدروسة. كما أوضحت الدراسة أن توزيع الجينات الموجبة والسالبة كانت غير منتظمة لكل الصفات فى كلا الجيلين.

كما أظهرت النتائج أن قيم التوريث تراوحت من منخفضة إلى متوسطة فى كلا الصفات فى كلا الجيلين وكانت لصفة طول السنبلة (٠,٦٤) ، (٠,٦٠) فى الجيل الأول والثانى على التوالي .