GENE ACTION AND INHERITANCE OF SOME QUANTITATIVE AND QUALITATIVE TRAITS IN THREE BREAD WHEAT CROSSES

Morad[*], S.S. B; H. E .Yassien[*], A. M. Moussa; and A. S.A. Mahmoud****

[*]Fac. of Agric, Al-Azhar Univ. and **ARC. FCRI. Egypt.

ABSTRACT

The six populations i.e., P_1, P_2, F_1, F_2, BCI and BCII of the three crosses (Sids 4 x Sids 1) (Sids 1x Giza 168) and (Giza 168x Gemmeiza 9) were used to estimate genetic variance, gene action, heterosis, inbreeding depression, heritability and genetic advance for the days to heading, days to maturity and plant height as well as yield and its components traits. The experiment was conducted at Sids Agric. Res. Stan. (Beni suef governorate) during the three successive growing seasons 2003 / 2004, 2004 / 2005 and 2005 / 2006.Significant positive heterosis effects relative to mid parent values were obtained for number of spikelets / spike, number of kernels / spike, grain yield / spike and grain yield / plant in the three crosses and for 1000-kernel weight in the 2nd and 3rd cross. Significant negative heterosis effects were found for days to heading, days to maturity and plant height in the three crosses, and for number of spikes / plant in the 2nd cross. Significant negative inbreeding depression were detected for days to heading, days to maturity and number of spikes / plant in the three crosses, for plant height in the 2nd and 3rd crosses and for1000-kernel weight in the 1st and 3rd crosses. Significant positive inbreeding depression were obtained for number of spikelets /spike, number of kernels / spike and grain yield / spike in the three crosses, for 1000-kernel weight in the 2nd cross and for grain yield / plant in the 2nd and 3rd cross. The additive type of gene action was significant either positive or negative for all traits except days to heading, days to maturity and1000-kernel weight in the 3rd cross, plant height, number of spikelets/ spike and grain yield / spike in the 2nd and 3rd crosses and grain yield / plant in the 2nd cross. Dominance effects were significant either positive or negative for all traits except plant height, number of spikelets / spike and 1000-kernel weight in the 3rd cross, number of spikes / plant in the 2nd cross and grain yield / spike in the 1st cross. The additive x additive gene effects were significant for all studied traits except plant height in the 1st and 3rd crosses, number of spikes / plant in the 1st cross as well as number of spikelets / spike and 1000- kernel weight in the 3rd cross. The additive x dominance gene effects exhibited significant for the majority traits except days to heading in the 2nd cross, plant height and number of spikelets / spike and 1000-kernel weight in the 3rd crosses and grain yield / spike in the 2nd and 3rd crosses. The dominance x dominance gene effects were found to be significant either positive or negative for all traits expect plant height in the 3rd cross. High to moderate heritability values in broad sense were detected for most studied traits. Moderate heritability values in narrow sense were detected for most studied traits except tw cases. These results ascertained that both additive and non–additive genetic variance were important in the existence of variability in these traits.

Key words: Gene action, inheritance, quantitative and qualitative traits, genetic variance, gene action, heterosis.

INTRODUCTION

Wheat is the most important cereal crop in Egypt and world. Also, it provides a major source of energy, protein and dietary fiber in human nutrition. In Egypt, remarkable progress has been made to develop new varieties possessing high yield potentiality, tolerance to biotic and abiotic stresses to increase the local production and to minimize the gap between national production and total consumption, so more attention efforts should be made with respect to solve this problem. Wheat breeders are largely concerned with obtaining information concerning the genetic systems controlling quantitative characters using statistical techniques, which enable them to test for epistasis and obtain precise and unbiased estimates of the additive and dominance components of genetic variation. Many investigators studied the type of gene effect in wheat genotypes and reported that partial dominance was relatively more important than additive in the inheritance of grain yield, while additive genetic effects were predominant in the expression of heading date, plant height and kernel weight. Also, high values of heritability and insignificant epistatic effect were detected in the inheritance of these traits **Singh *et al*. (1985).** On the other hand, **Amawate and Behl (1995)** revealed that dominance gene effects were more important than additive ones in most traits which showed presence of both types of gene effects. Results of **Sharma *et al.* (1998)** and **Yadav and Narsinghani (1999)** indicated that additive gene effects were predominant for yield and yield components, though non-additive gene effects were also important. This investigation was planned to study the nature of gene action and other genetic parameters i.e., heterosis, heritability, genetic advance under selection and inbreeding depression of yield and yield components and earliness in six hexaploid wheat crosses by using their six populations i.e., P_1, P_2, F_1, F_2, BCI, BCII.

MATERIALS AND METHODS

The present investigation was carried out at Sids Agricultural Research Station, ARC, Ministry of Agric, Egypt, during the successive growing seasons of 2003 / 2004, 2004 / 2005 and 2005 / 2006. Pedigree of the used parental genotypes of hexaploid wheat (***Triticum aestivum,* L**.) was presented in Table (1).

Table (1): The name, origin and pedigree of wheat genotypes used in this study.

Name	Origin	Pedigree
Sids 4	Egypt	Maya"s"/Mons"s"//CMH74A.592/3/Giza157*2 SD10002-140sd-3sd-1sd-0sd
Sids 1	Egypt	HD 2172/Pavon's'//1158.57/Maya 74's'
Giza 168	Egypt	MRL / BUC // Seri 82 CM 93046-8M-0Y-0M-2Y-0B
Gemmeiza 9	Egypt	Ald"s"/Huac"s"//CMH74 A.630/Sx CGM583-5GM-2GM-0GM

In 2003 / 2004 season, the parents were grown in three sowing dates with 12 to 15 days intervals to produce hybrid seeds of the three crosses namely; Sids 4 X Sids 1 (cross I), Sids 1 X Giza 168 (cross II), Giza 168 X Gemmeiza 9 (cross III). In 2004 / 2005 season, the parents were grown again and crossed to obtain more F_1 seeds, and the F_1 plants were back-crossed for both parents to obtain BCI (P_1 X F_1) and BCII (P_2 X F_1) and some of F_1 plants were selfed to obtain F_2 generation seeds. In 2005 / 2006 season, the six populations i.e., F_1, F_2 and the two backcrosses of each cross of the three intra-specific crosses were widely spaced sowing as individual plants in a Randomized Complete Block Design with four replicates. Each genotype was grown individually in rows 3 m. long and 30 cm. apart and 10 cm. within rows. Each plot contained two rows of each of the parents and F_1, three rows of BCI, BCII in addition to eight rows of the F_2 generation of every cross. The recommended agronomic practices for growing wheat were carried out. Data were taken on the individual plants of the six populations for the three crosses. At harvesting, the data were obtained from 80, 80, 80, 240, 120 and 120 guarded individual plants for P_1, P_2, F_1, F_2, BCI and BCII of each cross, respectively. The studied traits were : days to heading, days to maturity, plant height, number of spikes / plant, number of spikelets / spike, number of kernels / spike, grain yield / spike, 1000-kernel weight and grain yield / plant.

Statistical and genetic analysis:

The A, B, C, and D scaling tests as outlined by **Mather (1949)** and **Hayman and Mather (1955)** were applied to test the presence of non-allelic interaction. The values of A, B, C and D should be equal to zero within the limits of this standard error. The analysis was proceeded to compute the interaction types involved the six parameters genetic model of **Hayman (1958) and Jinks and Jones (1958).** Heritability percentage in broad and narrow sense was computed as outlined by **Mather & Jenks (1982)**. The expected genetic advance under selection (Δg) was computed according to **Johnson *et al.* (1955).** Also, the expected gain was expressed as a percentage of F_2 mean (Δg %) according to **Miller *et al.* (1958)**. Values of F_1 heterosis relative to mid-parent were calculated according to **Bhatt (1971).** Inbreeding depression (I.D %) was calculated as the difference between the F_1 and F_2 means expressed as a percentage of the F_1 mean.

RESULTS AND DISCUSSION

Significant genetic variance was detected for all studied traits in the three crosses therefore other genetical parameters were estimated. Also differences between the two parents in each cross were significant for all studied traits. The existence of significant genetic variability in spite of the significant differences between the parents obtained herein in most traits may suggest that the genes of like effects were not completely associated in the parents i.e., these genes are dispersed .

Mean performance:

Means and variances of the studied traits in the six populations P_1, P_2, F_1, F_2, BCI and BCII for the three crosses are presented in Table 2. The analysis of variance indicated that there were significant differences among the studied generations in all traits under study hence, the needed parameters were computed. Data presented and tabulated proved that most of segregating populations were in medium values between the two respective parents for all studied traits with exception of few cases which were higher or lower in the magnitude than the respective parents.

Gene action:

The choice of the most efficient breeding procedures depends, to large extent, on the knowledge of the genetic system controlling the traits to be selected. The estimates of various types of gene effects contributing to the genetic variability are presented in Table 3. Nature of gene action was also studied according to relationships illustrated by **Gamble (1962).** All traits under study were significant for scaling tests A, B, C and /or D in the three crosses. Concerning scaling test D, all traits under study were insignificant except for days to heading in the 3rd cross, days to maturity in the 2nd and 3rd crosses, for plant height in the 1st and 2nd crosses, for number of spikes / plant, 1000-kernel weight and grain yield / plant only in the 2nd cross and for number of spikelets /spike in the 1st one. Similar results were obtained by **Al-Kaddoussi (1996), Hamada (2003), Hendawy (2003), Singh (2003), Garole and Monpara (2005), Ashour *et al.* (2006), Naeem and Chowdhry (2006) and Kavar *et al.* (2007).** Also, the major contribution by dominance gene effects to variation of some traits in these crosses indicated by the relative magnitude of the parameter (d) to the parameter(m). In addition, the estimates of dominance effects were significant except for grain yield / spike in the 1st cross, for number of spikes /plant in the 2nd cross and for plant height, number of spikelets / spike and 1000-kernel weight in the 3rd cross, indicating the importance of dominance gene effects in the inheritance of these traits. Significant additive (a) and dominance (d) components indicated that both additive and dominance effects were important for most traits. Similar conclusion was prevlously obtained by **Al-Kaddoussi (1996), Hamada (2003), Hendawy (2003), Singh (2003), Garole and Monpara (2005), Ashour *et. al.* (2006), Naeem and Chowdhry (2006) and Kavar e*t al.* (2007).**

Significant estimates for epistatic gene effects for one or more of the three epistasis types were exhibited in the three crosses for all studied traits, except additive x additive (aa) for plant height and number of spikes / plant in the cross, spikecetes/spike in the 3rd cross and for plant height, number of spikelets / spike and 1000-kernel weight, additive x dominance (ad) for days to heading and grain yield / spike in the 2nd cross and in the 3rd cross for plant height, number of spiketits / spike grain yield/ spike and 1000-kernel weight in the 3rd crossand dominance x dominance (dd) for plant height in the 3rd cross. Generally, the absolute magnitudes of the epistatic effects were larger than the additive or

Table (2): Mean ($\bar{X}$) and variance (S^2) of six populations of the three bread wheat crosses I, II and III for the all studied traits.

Character	Cross	Statistical parameter	P_1	P_2	F_1	F_2	BCI	BCII
Days to heading	I	$\bar{X}$	70.90	103.55	83.15	91.76	93.48	96.93
		S^2	2.91	3.97	2.95	31.51	23.18	20.97
	II	$\bar{X}$	103.5	95.11	81.03	94.58	98.31	94.13
		S^2	3.97	3.76	2.34	21.73	17.45	13.10
	III	$\bar{X}$	95.11	101.43	90.30	95.12	94.03	93.21
		S^2	3.76	3.88	2.42	35.02	27.37	29.78
Days to maturity	I	$\bar{X}$	136.3	152.95	143.89	146.47	148.71	152.7
		S^2	2.66	3.46	1.68	28.96	19.59	22.15
	II	$\bar{X}$	152.9	144.84	140.93	145.43	147.79	145.6
		S^2	3.46	3.12	1.39	19.51	13.66	12.78
	III	$\bar{X}$	114.8	151.19	139.71	144.02	142.07	143.1
		S^2	3.12	2.20	2.02	31.50	23.41	27.32
Plant height(cm)	I	$\bar{X}$	104.1	132.38	115.63	115.26	108.75	119.2
		S^2	14.86	13.31	11.77	94.42	68.92	81.95
	II	$\bar{X}$	132.4	109.56	101.68	104.28	113.31	114.6
		S^2	13.31	15.65	13.26	102.91	76.67	87.39
	III	$\bar{X}$	109.5	109.06	107.13	109.72	108.88	109.7
		S^2	15.65	13.86	12.82	126.00	96.45	81.79
Number of spikes/Plant	I	$\bar{X}$	4.78	20.33	12.39	13.79	12.44	16.81
		S^2	3.73	4.26	2.97	32.82	20.08	24.58
	II	$\bar{X}$	20.33	15.16	12.93	14.68	15.26	16.84
		S^2	4.26	3.88	2.81	38.17	27.44	25.68
	III	$\bar{X}$	15.16	16.48	15.88	18.04	13.60	15.82
		S^2	3.88	3.02	2.99	34.20	25.47	27.97
Number of spikelet's/spike	I	$\bar{X}$	25.31	21.59	24.56	22.33	24.64	25.70
		S^2	0.83	0.65	0.45	11.80	8.74	6.99
	II	$\bar{X}$	21.59	24.43	24.07	22.94	23.74	23.65
		S^2	0.65	1.70	0.66	10.02	9.40	7.71
	III	$\bar{X}$	24.43	24.86	24.73	23.44	23.04	22.95
		S^2	0.79	1.01	0.74	16.65	10.27	12.16
Number of kernels/spike	I	$\bar{X}$	98.41	65.51	92.95	79.62	84.69	78.79
		S^2	11.13	8.91	5.62	92.97	66.69	70.04
	II	$\bar{X}$	65.51	75.89	89.14	70.53	78.57	81.48
		S^2	10.25	8. 91	7. 02	76.82	61.88	55.87
	III	$\bar{X}$	75. 89	72.65	84.24	71.52	71.69	76.28
		S^2	8. 91	9. 58	5.73	102.85	91.49	75.23

I- Sids 4 x Sids 1, II- Sids 1x Giza 168 and III- Giza 168 x Gemmeiza 9

Table (2): cont

Character	Cross	Statistical parameter	P_1	P_2	F_1	F_2	BCI	BCII
Grain yield/spike(g)	I	$\bar{X}$	4.01	2.93	3.90	3.66	3.48	3.64
		S^2	0.09	0.06	0.05	0.31	0.18	0.28
	II	$\bar{X}$	2.93	2.84	3.87	3.13	3.88	3.77
		S^2	0.06	0.08	0.05	0.35	0.22	0.28
	III	$\bar{X}$	2.84	3.04	3.45	3.37	3.42	3.57
		S^2	0.08	0.07	0.05	0.47	0.21	0.50
1000-kernel weight(g)	I	$\bar{X}$	46.82	40.47	43.91	46.51	40.58	47.67
		S^2	4.43	5.53	4.35	36.03	27.44	30.00
	II	$\bar{X}$	40.47	42.34	47.72	43.71	50.19	48.28
		S^2	5.53	4.00	3.72	39.09	27.93	26.08
	III	$\bar{X}$	42.34	41.66	42.60	47.63	46.96	46.34
		S^2	4.00	4.53	3.07	44.35	39.59	31.95
Grain yield/plant(g)	I	$\bar{X}$	16.92	34.13	35.61	35.78	31.79	40.63
		S^2	15.70	16.78	11.19	94.50	89.69	78.65
	II	$\bar{X}$	34.13	30.28	45.42	44.94	40.80	37.05
		S^2	16.78	13.60	10.65	99.41	72.28	76.52
	III	$\bar{X}$	30.28	30.48	36.25	35.60	35.17	34.61
		S^2	13.60	18.53	15.57	107.01	89.58	91.56

I- Sids 4 x Sids 1, II- Sids 1x Giza 168 and III- Giza 168 x Gemmeiza 9

dominance gene effects in most cases. Therefore, it could be concluded that epistatic effect was important as a major contributor in the performance of these cases. These results agree with the idea that the inheritance of quantitative traits is generally more complex than single qualitative ones. Similar results were obtained by **Yadav and Narsinghani (1999) and Darwish and Ashoush (2003), Hamada (2003), Ashok and Sharma (2005) and Saharan and Singh (2009).**

Heterosis:

Significant or highly significant positive heterotic effects relative to mid parent values (Table 4) were obtained for number of spikelets / spike, number of kernels / spike, grain yield / spike and grain yield / plant in the three crosses and for 1000-kernel weight in the 2nd and 3rd crosses. Also, significant or highly significant negative heterotic effects relative to mid parent were detected for days to heading, days to maturity and plant height in the three crosses and for number of spikes / plant in the second cross. Negative heterosis estimates for days to heading and days to maturity is preferable from the point of view of wheat breeder. However, in wheat earliness is favorable for escaping destructive injuries caused by stress conditions. Hence, it could be concluded that the three populations are valuable in breeding for earliness. Similar results were reported by **Hamada (2003).** Highly significant negative heterosis for plant height was found in the three crosses. This result is important to obtain semi dwarf bread wheat which resistant to lodging. This result is in agreement with that obtained by **El-Seidy and Hamada (2000)** and **Hamada (2003).** Significant positive heterotic effects were obtained for most yield and yield components in the three crosses. This result reflected the large diversity of parent's genetic constitution. Similar results were reported by **El-Hosary *et al.* (2000).**

Inbreeding depression:

Highly significant positive inbreeding depression values were obtained for number of spikelets / spike, number of kernels / spike and grain yield / spike in the all crosses (Table 4). Also, significant positive values were detected for 1000-kernel weight in the 2nd cross and for grain yield / plant in the 2nd and 3rd crosses**.** On the other hand, significant negative values were obtained for days to heading, days to maturity, and number of spikes / plant in the all crosses and for plant height in the 2nd and 3rd crosses. Significant effects for both heterosis and inbreeding depression were associated for most cases**.** This was logical, since the expression of heterosis in F_1 will be followed by considerable reduction in F_2 performance.

Insignificant heterosis and significant inbreeding depression values were obtained for number of spikes / plant in the 1st and 3rd crosses and 1000-kernel weight only in the 1st one (Table 4).

Heritability estimates:

Heritability in board sense for the studied traits were estimated (Table 4). High heritability values were detected for all studied traits in the three crosses. Similar results had been reported by **Hamada (2003)** for days to heading, days to maturity, plant height, number of spikes / plant, 1000-kernel weight and grain yield / plant. However, data indicated that H^2b ranged from 95.08 for number of spikelets / spike in the 3rd cross to 79.45 for grain yield/spike in the1st cross. Moderate heritability were estimated for plant height and grain yield / spike in the three crosses, for days to heading and number of kernel / spike in the 1st and 2nd crosses, for days to maturity and 1000-kernel weight in the 1st cross ,for grain yield / plant in the 2nd cross and for number of spikes / plant in the 3rd cross. Results ascertained those both additive and non-additive genetic variances were important and play a key role in the inheritance of the traits under study. Similarly in magnitude between values for both broad and narrow means was also reached before by **Al-Kaddoussi and Eissa (1990), Al-Kaddoussi (1996), Menshawy (1996), Ozkan *et al.* (1997), Shehab El-Din (1997), Salama (2000), Awaad (2002), Hamada *et al.* (2002), Hamada (2003), Yadav *et al.* (2003), Tammam (2005), Abd El-Aty and Katta (2007). El-Borhamy *et al.* (2008) and Nawracaa *et al.* (2008).**

Expected genetic gain (∆g):

The values for expected genetic advance reported in Table 4 show the possible gain from selection as percent increase in the F_3 families over their selected F_2 plants. Genetic gain was higher for plant height and number of kernels / spike in the three crosses and grain yield / plant in the 2nd cross. Moderate gain was estimated for days to heading, days to maturity, number of spikes / plant and 1000 kernel weight in the three crosses and for number of spikelets / spike and grain yield / plant in the 1st and 3rd crosses. Relatively low gain was estimated for other cases (Table 4). For grain yield / plant, one cross only (cross II) gave high value of genetic advance (10.33) where the other two crosses showed medium values and ranged from 4.38 for (cross I) to 6.55 for (cross III). In general, cross III showed the highest values with comparing

table 3

Cont. table 3

Table (4): Heterosis, inbreeding depression (I.D %), heritability percentage in broad (H^2b) and narrow senses (h^2n) and expected genetic advance from selection (Δ g and Δ g %) for the three crosses for all studied traits.

Character	Crosses	Heterosis	I.D %	H^2b	h^2n	Δg	Δg %
Days to heading	**I**	-4.67**	-10.36**	89.85	59.87	6.92	7.54
	II	-18.42**	-16.72**	85.73	59.48	5.71	6.04
	III	-8.11**	-5.33**	91.10	36.80	4.49	4.72
Days to maturity	**I**	-0.53**	-1.80**	91.81	55.85	6.19	4.23
	II	-5.35**	-3.19**	88.01	64.50	5.87	4.04
	III	-5.60**	-3.08**	92.58	38.98	4.51	3.13
Plant height(cm)	**I**	-2.19**	0.32	86.31	40.22	8.05	6.98
	II	-15.95**	-2.56**	86.52	40.58	8.48	8.13
	III	-2.00**	-2.42**	89.06	58.55	13.54	12.34
Number of spikes/Plant	**I**	-1.29	-11.29**	89.38	63.91	7.54	54.71
	II	-27.13**	-13.57**	90.99	60.83	7.74	52.73
	III	0.36	-13.66**	90.58	43.75	5.27	29.21
Number of spikelet's/spike	**I**	4.74**	9.08**	90.00	59.80	4.60	33.71
	II	4.61**	4.68**	91.68	22.33	1.84	14.70
	III	0.33*	5.19**	92.49	58.87	5.06	35.15
Number of kernels/spike	**I**	13.41**	14.34**	94.99	66.70	4.72	21.14
	II	26.08**	20.88*8	90.81	29.26	1.91	8.32
	III	13.42**	15.10**	95.08	65.29	5.49	23.41
Grain yield/spike(g)	**I**	12.21**	6.11**	91.59	52.94	10.52	13.21
	II	34.35**	19.33**	89.19	46.72	8.44	11.96
	III	17.13**	2.09**	92.72	37.90	7.92	11.07
1000-kernel weight(g)	**I**	0.61	-5.92**	79.45	52.40	0.60	16.49
	II	15.25**	8.42**	82.01	55.13	0.67	21.36
	III	1.42*	-11.83**	86.37	50.90	0.72	21.33
Grain yield/plant(g)	**I**	39.50**	-0.49	87.05	40.56	5.02	10.78
	II	41.05**	1.06**	89.14	61.83	7.96	18.22
	III	20.39**	2.06**	91.73	38.67	5.30	11.14

I- Sids 4 x Sids 1, II- Sids 1x Giza 168 and III- Giza 168 x Gemmeiza 9
***and ** indicate significant at 0.05 and 0.01 levels of probability, respectively.**

to the other crosses with plant height, spike length, number of spikelets / spike and grain yield / spike.

Quantitative characters having high heritability values may be of great help for selection based on phenotypic performance. Paradoxically, **Johanson *et al.*, (1955)** in their studies in Soybean reported that heritability estimates along with genetic gain are usually more useful than the heritability values alone in predicting the resultant for selecting the best individuals. On the other hand, **Al-Kaddoussi and Eissa (1990)** pointed out that high heritability is not always associated with high genetic advance, but to make effective selection, high heritability should be associated with high genetic gain. Similar results were obtained by **Liu and Ma (1994), Johanson *et al.* (1955), Al-Kaddoussi (1996), Dhanda and Sethi (1996), Ozkan *et al.* (1997), Hagras (1999), Ghimiray and Sarkar (2000), Hamada (2003), Hendawy (2003), Said (2003), Yadav *et al.* (2003), Tammam (2005), Ashour *et al.* (2006), Kavar *et al.* (2007) and Lokendra *et al.* (2007).**

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التفاعل الجيني والتوريث لبعض الصفات الكمية والوصفية لثلاث هجن من قمح الخبز

سمير سيد بيومى مراد* وحمزة السيد يسن* و على مصطفى موسى**

و أشرف صلاح عبد الحميد محمود**

***كلية الزراعة - جامعة الازهر و **معهد بحوث المحاصيل الحقلية- مركز البحوث الزراعية**

أجري هذا البحث في محطة البحوث الزراعية بسدس خلال المواسم (٢٠٠٣/٢٠٠٤، ٢٠٠٥/٢٠٠٦، ٢٠٠٦/٢٠٠٧) بهدف دراسة تأثير الفعل الجيني. قوة الهجين. الإنخفاض الناشئ عن التربية الداخلية .درجة التوريث والتحسين الوراثي المتوقع للصفات: تاريخ التزهير – تاريخ النضج- إرتفاع النبات – عدد السنابل / النبات– عدد السنيبلات / سنبلة – عدد الحبوب/ سنبلة - وزن الحبوب /سنبلة - وزن ال١٠٠٠حبه – محصول الحبوب /النبات لثلاثة هجن من قمح الخبز وهي (سدس ٤×سدس ١) ، (سدس ١× جيزة ١٦٨) و(جيزة ١٦٨× جميزة ٩)، وأختبر لكل هجين العشائر الستة وهى الاباء والجيلين الاول والثاني والهجينين الرجعيين لكلا الابوين ، وتم تقييم العشائر الستة لكل هجين في تجربة قطاعات كاملة العشوائية ذات أربعة مكررات ، وفيم يلي أهم النتائج المتحصل عليها :

- أظهرت النتائج وجود معنوية موجبة لقوة الهجين المنسوبة لمتوسط الابوين لصفات عدد السنيبلات / سنبلة وعدد الحبوب / سنبلة ووزن الحبوب/ سنبلة ومحصول الحبوب / نبات في الثلاث هجن، صفة وزن الـ١٠٠٠حبة في الهجنين الثاني والثالث، بينما أظهرت النتائج وجود معنوية سالبة لقوة الهجين لصفات تاريخ التزهير وتاريخ النضج وارتفاع النبات في الثلاث هجن، صفة عدد السنابل / نبات في الهجين الثاني.
- توجد معنوية سالبة للتأثير الناشئ عن التربية الداخلية لصفات تاريخ التزهير وتاريخ النضج وعدد السنابل / نبات في الثلاث هجن ، صفة ارتفاع النبات في الهجينين الثاني والثالث ، صفة وزن الـ١٠٠٠ حبة في الهجينين الاول والثالث، بينما أظهرت النتائج وجود معنوية موجبة لصفات عدد السنيبلات / سنبلة وعدد

الحبوب / سنبلة ووزن الحبوب/ سنبلة في الثلاث هجن ، صفة وزن الـ ١٠٠٠ حبة في الهجين الثاني، محصول الحبوب / نبات فى الهجينين الثاني والثالث.

- أوضحت النتائج معنوية تأثير الفعل الجيني المضيف لمعظم الصفات في الثلاث هجن عدا تاريخ التزهير وتاريخ النضج ووزن الـ١٠٠٠ حبة في الهجين الثالث، إرتفاع النبات وعدد السنيبلات / سنبلة ووزن حبوب / سنبلة في الهجين الثانى والثالث، محصول الحبوب / نبات في الهجين الثاني.
- أظهر تأثير الفعل الجيني السيادي معنوية موجبة لمعظم الصفات عدا إرتفاع النبات وعدد السنيبلات/ سنبلة ووزن الـ١٠٠٠ حبة في الهجين الثالث ، عدد السنابل / نبات في الهجين الثاني ، وزن الحبوب / سنبلة في الهجين الاول.
- كان تأثير الفعل الجيني من النوع (المضيف × المضيف) معنوياً لمعظم الصفات عدا صفة إرتفاع النبات في الهجين الاول والثالث، عدد السنابل / نبات في الهجين الاول، عدد السنيبلات / سنبلة ووزن الـ١٠٠٠ حبة في الهجين الثالث. كما أظهر التفاعل الجيني من النوع (المضيف × السيادي) معنوية لكل الصفات عدا تاريخ التزهير فى الهجين الثاني ،إرتفاع النبات وعدد السنيبلات / سنبلة ومحصول السنبلة ووزن الـ١٠٠٠حبة في الهجين الثالث ، ووزن الحبوب / سنبلة في الهجينين الثاني والثالث ، بينما كان التفاعل الجيني من النوع (السيادي × السيادي) معنوياً لمعظم الصفات عدا إرتفاع النبات في الهجين الثالث.
- أظهرت درجة التوريث بمعناها الواسع قيم مرتفعة ومتوسطة لمعظم الصفات تحت الدراسة، بينما أظهرت درجة التوريث بمعناها الضيق قيم متوسطة لمعظم الصفات وهذا يوضح أهمية الفعل الجيني المضيف في وراثة تلك الصفات مع إمكانية الإنتخاب لها في الأجيال المبكرة.
- وجود قيم مرتفعة للتحسين الوراثي المتوقع لصفة إرتفاع النبات وعدد الحبوب/ سنبلة في الهجن الثلاثة ، محصول الحبوب / نبات في الهجين الثانى، بينما كان التحسين الوراثي المتوقع ذات قيم متوسطة لصفة تاريخ التزهير وتاريخ النضج وعدد السنيبلات/ سنبلة ومحصول الحبوب للنبات فى الهجينين الاول والثالث ، في حين أظهرت صفة وزن الـ١٠٠٠ حبة قيم منخفضة للتحسين الوراثي المتوقع فى الثلاث هجن.
- يمكن الاستفادة من هذا البحث في تحسين هذه الصفات من خلال استخدام طرق التربية التقليدية العادية مع اتباع طريقة الانتخاب بالنسب كوسيلة فعالة فى هذا المجال، بالإنتخاب في الأجيال الإنعزالية المبكرة لصفة التبكير والصفات المحصولية الهامة وذلك للحصول علي سلالات مبكرة النضج عالية المحصول.