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GENETICAL ANALYSIS OF SOME AGRONOMIC CHARACTERS IN WHEAT

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ABSTRACT

Three crosses of wheat, sids. 1 X Yacora (I), RCB 143 X Sakha 93 (II) and RCB122X sids.6 (III), and their six population (P1, P2, F1, F2, BC1 and BC2) were evaluated for some agronomic characters.

Significant positive heterotic effects were obtained for plant height, number of spikes, number of kernels/spike, 1000-kernel weight, biological yield, grain yield/plant and harvest index in the three crosses, straw yield in the first and third cross and maturity date in the second cross. Significant negative heterotic effects or insignificant were detected in the other traits.

Significant negative in breeding depression (ID%) were found for maturity date in the first cross. Insignificant (ID%) values were detected for biological yield/plant and straw yield/plant in the third cross. Significant positive (ID%) values were obtained in other traits.

The additive gene effects were higher in magnitude than dominance type in plant height in the thee crosses, maturity date and number of kernels/spike in the first and third cross and number of spikes/plant, biological and straw yields/plant in the second and third cross. On the other hand the major contribution by dominance gene effects relative to additive ones were obtained for other cases. In significant F2 deviation (E1), backcross deviation (E2) and the various estimates for epistatic gene action (aa, ad, dd) were detected for number of spikes/plant in the third cross, grain yield/plant and harvest index in the first cross and number of kernels/spike in the three crosses.

Heritability in narrow sense was high in magnitude and nearly equal its corresponding in the broad for maturity date in the three crosses. High estimates for heritability in the broad sense was accompanied by moderate value of the narrow sense were obtained for plant height in the first and second cross, number of spikes/plant in the first and third cross, number of kernels/spike, biological yield and grain yield/plant in the first cross and harvest index in the third cross. For other cases, high estimates for heritability in the broad sense was accompanied by low values for the narrow sense.

Genetic gain was rather higher for number of spikes plant in the first and third cross, number of kernels/spike in the second cross. Moderate gain was found for grain yield/plant in the three crosses, number of kernels/spike in the first and third cross, harvest index in the first and second cross, 1000-kernel weight in the second cross and biological yield/plant in the first cross. Relatively low gain was found for remaining cases.

INTRODUCTION

Wheat (*Triticum aestivum*, L) is the most important crop all over the world and in Egypt. National wheat production is insufficient to meet the local consumption according to the higher increase of population especially in the recent years. The domestic wheat production is about six million tons from 2.5 million fed., while the imports totaled about six million tons of wheat.

Wheat breeders are always looking for means and sources of genetic improvement for gain yield, its components and other agronomic characters. Genetic diversity is the main tool for the breeders to have better recombinants by creating heritable variability upon which selection can be practiced.

Information the genetics and gene effect of breeding materials could ensure long-term selection and better genetic improvements. The maximum progress in improving any character would be expected in a selection program when the additive gene action was the main component of the genetic variance, whereas, the presence of non-additive gene action might suggest the use of hybridization program for achieving this goal, many genetic models were reported by Mather (1949) Gamble (1962) and Mather and Jinkes (1971).

The present investigation was planned to study the behavior of gene action and some genetic parameters i.e. heterosis, heritability and genetic advance in the three wheat crosses using the six populations of each cross.

MATERIALS AND METHODS

The present study was carried at Etay-Baraud Agriculture Research Station during three winter successive growing seasons i.e. 2002/2003, 2003/2004 and 2004/ 2005.

The six wheat genotypes i.e. sids 1, sids 6 and Sakha 93 (Locale varieties) and introduced lines and or varieties Yacora RCB143 RCB122 were used to generate the experimental material for this study.

Table (1): Name pedigree and origin of wheat genotypes.

Entry	Cultivar or lines	Pedigree	Origin
1	Sids 1	HD2172/Pavon "S" // 158-57 Maya 74 "S" Sd 46-45d-2Sd-1Sd-0Sd	Egypt
2	Sids 6	Maya "S" / Mon "S" / CMH74-A592131 Sakha 8* 25D 10002-4Sd-3Sd-1Sd-0Sd	Egypt
3	Sakha 93	Sakha 92/TR810328 S8871-1S-2S-1S-0S	Egypt
4	Yacora	1123584-26Y-2M-1Y-OM-89Y-OMEX	CIMMYT
5	RCN 143	Sx / cardinal	ICARDA
6	RCB 122	Star "S" SWM 7215-2Y-2Y-0Y-2Y-0Y-41m-0y	CIMMYT

The experimental population used in this study were derived form three crosses among parental material. The original crosses, namely sids 1X Yacora (I), RCB 143 X Sakha 93 (II) and RCB 122X sids 6 (III) were developed in 2002/2003 growing season. In 2003/2004 season, F1 plants were selfed and back crossed to each parent. In 2004/2005 season, three experiments arranged in randomized complete block design with three replications were carried out. Each experiments included the six populations. Normal recommended agricultural practices were followed. Data were recorded for all guarded plants for the yield, yield components.

The genetic variance within F_2 population was firstly evaluated. If that variance is significant, various genetical parameters were than derived.

Heterosis (H%) was expressed as percent increase of the F_1 performance above the mid-parent value. Inbreeding depression (ID%) was estimated as the average part decrease of F_2 from the average of F_1-deviation (E_1) and backcross deviation (E_2) were estimated as suggested by Mather and Jinks (1971).

In addition the six-parameters model proposed by Gamble (1962) was followed. Both broad and narrow sense heritability (h^2b and h^2n) respectively were calculated according Mether's procedure (1949). The expected genetic advance (ΔG) and genetic coefficient of variation (G.C.V%) were calculated according to Johanson *et al.* (1955). Also, potance ratio (p) was calculated according to smith (1962).

RESULTS AND DISCUSSION

The present investigation was carried out to estimate; heterosis, inbreeding depression, potence ratio, epistatic deviation, gene action, genetic coefficient of variation, heritability and genetic advance under selection for maturity date, plant height, number of spikes/ plant, number of kernels/spike, 1000-kernel weight, biological yield/plant, grain yield/ plant, straw yield/plant and harvest index.

The six population P_1, P_2, F_1, F_2, BC_1 and BC_2 of each the three cross, i.e. sids 1X Yacora (I) RCB143X Sakha 93 (II) and RCB122X sids 6 (III). The six populations of each particular cross were evaluated in a separate experiment. Means ($\bar{X}$), variance (S^2) and mean variance ($S^2\bar{X}$) of all traits in the three crosses for parents, F_1, F_2, BC_1 and BC_2 presented in (Table 2). The differences between the two parents were significant in each of the three crosses for all the studied characters. Significant genetic variance was detected for all traits in the three crosses and therefore, other genetic parameters were estimated.

Significant positive heterotic effects were obtained for plant height, number of spikes/plant, number of kernels/spike, 1000-kernel weight, biological yield/plant, grain yield/plant and harvest index in the three cross, straw yield in the first and third cross and maturity date in the second cross.

However, significant negative heterotic effects were found for maturity date in the first and third cross, and straw yield/plant in the third cross (Table 3). Earliness, if found in wheat is favorable for escaping destructive injuries caused by stress conditions. The first and third cross as previously mentioned expressed significant negative heterosis for maturity date. Hence, it could be concluded that both populations are valuable in breeding for earliness, as maturing date is a good indicator of earliness. Similar results were obtained by Hassan and Abd El-Monieum (1991), Bayoumi (2004). Significant positive heterotic effects for plant height were obtained by Ketata *et al.* (1976) Shamarka (1980), Mahdy (1988), Kaddoussi and Hassan (1991), Afiah *et al.* (2000), El-Hosary *et al.* (2000) and Darwish and Ashoush (2003). On the contrary, significant negative heterotic effects for plant height were reported by Bayoumi (2004). In significant heterotic effects for plant height were reached by El-Rassas and Mitkes (1985) and A.M. Moussa (2005). Significant positive heterotic effect for number of spikes/plant were reported by Hendawy (1990), Hendawy (1994-b), Hewezi (1996) and Bayoumi (2004). Significant positive heterotic effects for number of kernels/spike reached by Add El-Monieum (1991), Hendawy (1994-b), El-Hosary *et al.* (2000).

Hence, heterotic increase in grain yield/plant if found in one or more of the three components (number of spikes/plant, number of kernel, spike and 1000-kernel weight) may lead to favorable yield increase in hybrids. It is note worth that heterotic effect fro grain yield was larger in magnitude than that for any one of its components which is logically expected. The results indicated that the number of spikes/plant was the major contributing factor to heterosis in the first and third cross followed by number of kernels/spike and their 1000-kernel weight. However in the second cross the 1000-kernel weight followed by number of spike/plant and then number of kernels/spike were nearly similar contributing to heterosis of grain yield.

Inbreeding depression

Significant negative inbreeding depression values were found for maturity date in the first and third cross. Insignificant inbreeding depression values were shown for biological yield, plant and straw yield/plant in the third cross-significant positive inbreeding depression values were obtained in the other cases. Except for biological and straw yields/ plant in the third cross, significant heterosis and inbreeding depression associated in all traits (Table 3). This is logical since the expression of heterosis in F_1 will be followed by considerable reduction in F_2 performance. Similar results were in harmony with what have been previously observed by Hendawy (2003), Darwish and Ashoush (2003). Significant heterosis and insignificant inbreeding depression were obtained for biological and straw yields/plant in the third cross. El-Hosary (1983) in field bean, reported that a major portion of the genetic effect was of additive nature. In addition, conflicting estimated of heterosis and inbreeding depression reported here in may be due to the presence of linkage disequilibria between genes in the parental stock van der veen (1959), Chowdry *et al.*, (2001) and Esmail and Katiab (2002).

Table (2): Means ($\bar{X}$), variance (S^2) and mean variance ($S^2\bar{X}$) of six populations for three wheat crosses I (Sids 1 x Ycora), II (RCB 143 x Sakha 93) and III (RCB 122 x Sids 6) for the all studied traits.

Character	Cross	Statistical parameter	P_1	P_2	F_1	F_2	BC_1	BC_2
Maturity date	I	$\bar{X}$	148.29	134.92	140.63	142.53	145.42	138.06
		S^2	5.11	7.21	5.91	21.23	15.86	12.63
		$S^2\bar{X}$	0.102	0.144	0.118	0.085	0.106	0.084
	II	$\bar{X}$	153.71	144.33	150.15	146.11	149.18	145.65
		S^2	7.57	9.82	5.92	36.89	23.62	27.11
		$S^2\bar{X}$	0.151	0.196	0.118	0.147	0.157	0.181
	III	$\bar{X}$	157.43	141.65	147.96	150.23	152.61	146.25
		S^2	8.28	5.83	7.33	50.56	31.84	34.67
		$S^2\bar{X}$	0.166	0.117	0.147	0.202	0.212	0.231
Plant height	I	$\bar{X}$	123.84	86.53	114.31	111.42	120.44	100.96
		S^2	18.19	16.38	14.36	53.79	45.78	39.28
		$S^2\bar{X}$	0.364	0.328	0.287	0.215	0.305	0.262
	II	$\bar{X}$	140.51	97.84	128.31	125.41	137.11	112.27
		S^2	11.43	10.95	14.79	42.59	36.34	34.91
		$S^2\bar{X}$	0.227	0.219	0.296	0.170	0.242	0.233
	III	$\bar{X}$	101.53	116.18	116.37	114.61	109.79	117.46
		S^2	6.62	8.35	12.32	35.56	29.63	25.49
		$S^2\bar{X}$	0.132	0.167	0.246	0.142	0.197	0.170
No. of spikes / plant	I	$\bar{X}$	13.21	16.53	17.26	14.53	14.99	16.98
		S^2	3.97	7.55	5.74	22.54	20.18	14.98
		$S^2\bar{X}$	0.079	0.151	0.115	0.09	0.134	0.099
	II	$\bar{X}$	14.96	12.81	15.71	14.43	14.67	13.52
		S^2	7.75	5.36	9.21	21.59	18.27	17.16
		$S^2\bar{X}$	0.155	0.107	0.184	0.086	0.122	0.114
	III	$\bar{X}$	11.14	3.63	9.63	7.98	10.21	6.51
		S^2	9.91	8.14	11.46	25.33	16.63	22.34
		$S^2\bar{X}$	0.198	0.163	0.229	0.101	0.111	0.149
No. of kernels / spike	I	$\bar{X}$	67.26	42.91	63.35	59.42	65.87	53.86
		S^2	18.89	16.44	11.57	33.29	26.22	24.86
		$S^2\bar{X}$	0.378	0.329	0.231	0.133	0.175	0.166
	II	$\bar{X}$	46.96	59.46	58.19	55.62	52.63	60.15
		S^2	46.71	47.17	32.53	112.62	72.98	88.38
		$S^2\bar{X}$	0.934	0.943	0.651	0.450	0.486	0.589
	III	$\bar{X}$	71.89	102.25	99.92	92.56	84.63	101.11
		S^2	23.58	21.35	18.26	61.94	52.47	46.86
		$S^2\bar{X}$	0.472	0.427	0.365	0.248	0.350	0.312

Table (2): Cont.

Character	Cross	Statistical parameter	P1	P2	F1	F2	BC1	BC2
1000-kernel weight	I	$\bar{X}$	47.76	40.91	50.47	47.79	49.98	46.69
		S^2	11.72	10.39	9.22	22.61	20.63	18.54
		$S^2\bar{X}$	0.234	0.208	0.184	0.09	0.137	0.124
	II	$\bar{X}$	44.38	49.52	53.55	47.85	47.88	51.42
		S^2	10.78	9.56	14.77	36.65	27.49	31.98
		$S^2\bar{X}$	0.216	0.191	0.295	0.147	0.183	0.213
	III	$\bar{X}$	52.24	57.36	55.45	53.37	54.65	57.61
		S^2	12.40	10.73	10.19	31.46	27.15	25.08
		$S^2\bar{X}$	0.248	0.214	0.204	0.126	0.181	0.167
Biological yield / plant	I	$\bar{X}$	103.63	71.48	105.25	95.44	105.48	89.24
		S^2	50.93	75.56	65.79	135.85	101.46	116.14
		$S^2\bar{X}$	1.018	1.512	1.316	0.543	0.676	0.774
	II	$\bar{X}$	116.55	96.74	115.84	112.65	122.43	105.23
		S^2	69.68	73.27	50.66	174.42	141.20	153.89
		$S^2\bar{X}$	1.394	1.466	1.014	0.698	0.941	1.026
	III	$\bar{X}$	100.65	69.97	88.64	86.17	96.89	81.09
		S^2	88.34	66.81	92.54	198.82	185.06	173.23
		$S^2\bar{X}$	1.766	1.336	1.850	0.795	1.237	1.115
Grain yield / plant	I	$\bar{X}$	33.02	16.72	35.84	29.72	35.62	25.62
		S^2	10.38	14.76	19.66	34.28	29.95	25.18
		$S^2\bar{X}$	0.208	0.296	0.394	0.137	0.199	0.168
	II	$\bar{X}$	29.41	36.24	37.57	31.93	32.66	38.46
		S^2	12.46	11.14	15.39	30.49	27.79	23.44
		$S^2\bar{X}$	0.249	0.223	0.308	0.122	0.185	0.156
	III	$\bar{X}$	33.14	27.00	34.96	32.54	35.38	32.56
		S^2	15.51	14.73	13.61	41.66	38.21	31.59
		$S^2\bar{X}$	0.310	0.294	0.272	0.167	0.268	0.231
Straw yield / plant	I	$\bar{X}$	70.61	54.76	69.41	65.72	69.86	63.62
		S^2	17.42	18.82	22.53	50.53	40.25	46.35
		$S^2\bar{X}$	0.348	0.376	0.451	0.203	0.268	0.309
	II	$\bar{X}$	87.14	60.50	78.27	80.27	89.77	66.77
		S^2	19.79	25.22	27.12	71.57	66.74	60.87
		$S^2\bar{X}$	0.396	0.504	0.542	0.286	0.445	0.406
	III	$\bar{X}$	67.51	42.97	53.68	53.63	61.51	48.53
		S^2	23.92	21.55	24.58	56.18	49.41	51.98
		$S^2\bar{X}$	0.478	0.430	0.492	0.225	0.326	0.346
Harvest index	I	$\bar{X}$	31.86	23.39	34.05	31.14	33.77	28.71
		S^2	15.49	17.40	18.41	39.35	38.27	30.55
		$S^2\bar{X}$	0.310	0.348	0.368	0.157	0.255	0.204
	II	$\bar{X}$	25.23	37.46	32.43	28.34	26.68	36.55
		S^2	13.69	14.62	16.73	36.68	33.98	28.61
		$S^2\bar{X}$	0.274	0.292	0.334	0.147	0.226	0.191
	III	$\bar{X}$	32.93	38.59	39.44	37.76	36.52	40.15
		S^2	15.67	14.85	13.74	42.07	40.43	34.93
		$S^2\bar{X}$	0.314	0.296	0.274	0.168	0.269	0.233

Potence ratio

Potence ratio (P) was calculated to study the nature and degree of dominance for the studied traits (Table 3) the values were exceeding the unity for cross III (RCB122 × Sids 6) for plant height this indicating over dominance in this cases. Similar results were recorded by El-Haddad and Ali (1979), Hagras (1999) and El-Sayed *et al.*, (2000). Potence ratio exceeding unity in cross I (Sids 1 × Yacora) for plant height, number of spikes/plant, 1000-kernel weight, biological yield/plant, grain yield/ plant and harvest index. Potence ratio exceeding unity in cross (II) (RCB 143 × Sakha 93) for number of spikes/plant, 1000-kernel weight and grain yield/plant. Whereas potence ratio values were less than unity for maturity date and number of kernels/spike indicating partial dominance. Similar results obtained by Menon and Sharma (1995), Tsenov (1996), El-Sayed *et al.*, (2000) and Tammam (2005).

The epistatic deviation

Significant positive F_2 deviation were detected for plant height in the three crosses, maturity date in the first and third cross and straw yield/plant in the second cross. While significant negative values wer obtained for 1000-kernel weight in the second and third cross and number of spikes/plant in the first cross, maturity date and grain yield/plant in the second cross, (Table 3). These results may refer to the contribution of epistatic gene effects in the performance of these traits. On the other hand, insignificant F_2 deviation were detected for other cases. This may indicate that the epistatic gene effects have minor contribution in the inheritance of these cases.

Also, when no epistasis is assumed, backcross performance would be expected to be near the average of F_1 and recurrent parent performance. Appreciable deviation from this expected value, however, will be observed if epistasis is found.

A rather large backcross deviation were obtained for maturity date in the first and second cross, plant height and biological yield, plant in the second and third cross, 1000-kernel weight in the first and third cross, number of spikes/plant and straw yield/plant in the second cross and grain yield/plant in the third cross, revealing that the epistatic gene effects has major contribution in the inheritance of these traits. Similar results were recorded by Darwish and Ashoush (2003) and Tammam (2005).

Gene action

Nature of gene action was also studied according to relationship illustrated by Gamble (1962). The estimate of the various types of gene effects contributing to the genetic variability are presented in (Table 3). For estimating the various parameters of gene effects, the larger mean performing parent in each trait was usually considered as P_1. in all traits, the mean effects parameter (m) which reflects the contribution due to the over all mean plus the locus effects and interactions of the fixed loci, was highly significant. With the exception of 1000-kernel weight in the second cross, the additive genetic estimates were either significant positive or negative. These results indicate the potentiality of improving the performance of these traits by using pedigree selection program. Similar results were obtained by Hamada (2003), Hendawy (2003) and Tammam (2005).

In addition, the additive type of gene action was higher in magnitude than dominance type in plant height in the three crosses, maturity date and number of kernels/spike in the first and third cross, and number of spikes/plant, biological and straw yields/plant in the second and third cross, the additive parameter (a) was much more in magnitude than dominance effects.

On the other hand, the major contribution by dominance gene effects to variation in these crosses for other cases is indicated by the elative magnitude of parameter (d) to additive gene effects (a). in addition, the estimates of dominance effects were significant either positive or negative for all traits except plant height and straw yield/plant in third cross and number of spikes/plant in the second cross, indicating the importance of dominance gene effects in the inheritance of all traits. Significant (a) and (d) components in most traits indicated that both additive and dominance effects were important for these traits. This results agree with El-Hennawy (1992), Mahdy (1988) and Seleem and El-Sawi (2006).

Table (3): Heterosis, indreeding depression and gene action parameters in the three crosses I (sides 1 X yacora), II (RCB143×Sakha93) and III (RCB122 ×sides 6) for all studied traits.

Character	Cross	Heterosis %	Inbreeding depression %	F2 Deviation E1	Backcrooss deviation E2	Gene action parameters					
						m	a	d	aa	ad	dd
Maturity	I	-0.69*	-1.53**	1.42**	1.25*	142.53**	7.36**	-4.13*	-3.16*	0.68	0.67
	II	0.76*	2.69*	-3.47**	4.33**	146.11	3.53**	6.36**	5.22*	-1.16	3.46
	III	-1.06**	-1.53**	1.48*	1.36	150.23**	6.36**	-4.77*	-3.20	-1.53	0.48
Plant height	I	8.68**	2.53**	1.68*	1.91	111.42**	19.48**	6.24*	-2.88	0.82	-0.93
	II	7.67**	2.26*	1.67*	1.90*	125.41**	24.84**	6.26*	-2.88	3.51**	-0.91
	III	6.90**	1.51**	2.00**	2.03*	114.61**	-7.67**	3.58	-3.94*	-0.34	-0.11
No . of spikes/ plant	I	16.07**	15.82**	-1.53**	-0.16	14.53**	-1.99	8.21**	5.82**	-0.33	-5.50*
	II	13.14**	8.15**	-0.36	-1.40*	14.43**	1.15*	0.48	-1.34	0.07	4.15**
	III	30.39**	17.13**	-0.53	-0.29	7.98**	3.70**	3.76*	1.52	0.05	-0.93
No . of kernels / spike	I	15.00**	6.20**	0.21	1.30	59.42**	12.01**	10.04**	1.78	-0.16	-4.37
	II	9.36**	4.42**	-0.08	1.38	55.62**	-7.52**	8.06**	3.08	-1.27	-5.84
	III	14.76**	7.36**	-0.93	-1.25	92.56**	16.48**	14.09**	1.24	-1.30	1.26
1000 – kernel weight	I	13.84**	5.31**	0.39	1.86*	47.79**	3.29**	8.31**	2.18	-0.13	-5.91*
	II	14.06**	10.64**	-2.39**	-1.20	47.85**	-3.54	13.80**	7.20**	-0.97	-4.80*
	III	1.19*	3.75**	-1.75**	2.01*	53.37**	-2.96*	11.69**	11.04**	-0.40	-15.06**
Biological yield / plant	I	20.21**	9.32**	-0.96	1.91	95.44**	16.24**	25-37**	7.68*	0.16	*-11.51
	II	8.62**	2.75*	1.41	5.18**	112.65**	17.20**	13.92**	4.72	7.30**	-15.07**
	III	3.90*	2.79	-0.81	4.03*	86.17**	15.80**	14.61**	11.28*	0.46	**-19.34****
Grain yield / plant	I	44.11**	17.07**	-0.63	0.53	29.72**	10.00**	14.57**	3.60	1.85	-4.66*
	II	14.45**	15.01**	-3.26**	0.73	31.93**	-5.80**	19.27**	14.52**	-2.38	-15.97**
	III	16.26**	6.92**	0.02	2.91**	32.54**	2.82**	10.61**	5.72*	-0.25	-11.54**
Straw yield / plant	I	10.73**	5.32**	-0.33	1.38	65.72**	6.24**	10.81**	4.08*	-1.68	-6.85*
	II	6.03**	-3.13*	4.68**	4.45**	80.72**	23.00**	-5.35*	-9.80**	9.68**	0.90
	III	-2.82**	0.09	-0.83	1.12	53.63**	12.98**	4.00	5.56*	0.71	-7.80*
Harvest index	I	23.26**	8.55**	0.30	0.80	31.14**	5.06**	6.82**	0.40	0.82	-2.01
	II	3.46*	12.61**	-3.54*	-0.54	28.34**	-9.87**	14.19**	13.10**	-3.75*	-12.01**
	III	10.29**	4.25**	0.16	1.47	37.76**	-3.63**	5.98*	2.30	-0.80	-5.24*

Insignificant F_2 deviation (E_1), backeross deviation (E_2) and the various estimates for epistatic gene action (aa, ad, dd) were detected for number of spikes/plant in the third cross, grain yield/plant and harvest index in the first cross and number of kernels/spike in the three crosses, revealing the minor role of epistasis in these cases, and that the strong heterotic effect previously obtained was mainly due to dominance.

On the other hand, significant for epistatic gene effects for one or more of the three types of epistasis were exhibited in the other cases.

Additive × additive (aa) gene effects were significant for maturity date and straw yield/plant in the three crosses, number of spikes, plant in the first cross, plant height in the third cross, 1000-kernel weight and grain yield/plant in the second and third cross, biological yield/plant in the first and third cross and harvest index in the second cross.

Additive × dominance (ad) gene effects were significant for plant height, biological yield/plant, straw yield/plant and harvest index in the second cross.

Dominance × dominance (dd) type of gene action was significant for harvest index in the second and third cross, number of spikes/plant in the first and second cross, harvest index in the second and third cross, 1000-kernel weight, biological and grain yield in the three crosses and straw yield/plant in the first and third cross.

The absolute relative magnitude of the epistatic gene effects to the mean effects were some what variable depending on the cross and trait studied. Generally, the absolute magnitude of the epistatic effects were lower than the mean effects. Similar results were recorded by Abo-El- Enein and Gomma (1977), Shamarka (1980), Seleem (1993), Hendawy (1994-a), El-Sayed (1997), Esmail and Kattab (2002) and Tammam (2005).

Heritability

Heritability in broad sense for the studied traits was computed and the obtained estimates are presented in (Table). High heritability values in broad sense detected for all the studied traits in the three crosses. Heritability in narrow sense was computed on F_2 and backcross basis, and the obtained results are present in (Table).

For maturity date in the three crosses, heritability in narrow sense was high in magnitude and nearly equals its corresponding in the broad sense. His revealed that the genetic variance for these cases was mostly attributed to additive effects of genes. This finding is in line with that previously obtained by means of gene action studies were estimates of additive genetic portion was mostly predominant, similarity in magnitude between values for both broad and narrow means was also reached before by Ozkan *et al.* (1997), Shehab El-Din (1997), Hagras (1999) and Darwish and Ashoush (2003).

For plant height in the first and second cross, number of spikes, plant in the first and third cross, number of kernels/spike, biological yield, plant and grain yield/plant in the first cross, and harvest index in the third cross, high estimates for heritability in the broad sense was accompanied by moderate value for the narrow sense. This result ascertained that both additive and non-additive genetic variance were important in the existence of variabilities in these cases. This finding agreed with that of gene action stuties.

For other cases, high estimate for heritability in the broad sense was accompanied by low values for the narrow ones. This result ascertained that the non-additive variance having a great role in the existence of variabilities in these cases. This results agreement with those obtained by Yadav *et al.* (2003) and Tammam (2005).

Table (4): Heritability, genetic advance, potence ratio and genetic coeffient of variation for all characters studied in the three wheat crosses.

Characters	Cross	Heritability %		tic advance		G.C.V%	Potency Ratio%
		Broad Sense	Narrow Sense	Δ g	Δ g%		
Maturity Date	1	71.36	65.80	6.80	4.38	2.73	-0.14
	11	78.94	62.48	7.82	5.35	3.69	0.24
	111	85.68	68.45	10.03	6.67	4.38	-0.20
Plant Height	1	69.68	41.87	6.87	6.32	5.68	5.49
	II	70.91	37.91	5.03	4.01	4.38	0.43
	III	74.44	44.99	5.53	4.82	23.09	1.03
No. of Spikes/ Plant	I	74.47	44.01	4.30	29.62	28.19	1.44
	11	65.54	35.89	3.43	23.81	26.07	1.69
	111	61.16	46.15	4.78	59.96	49.32	0.60
No. Of kernels / spike	1	53.04	46.56	5.53	9.31	7.07	0.68
	11	62.58	56.72	12.40	22.29	15.09	0.80
	111	65.99	39.63	6.42	6.94	6.91	0.85
1000- kernel – weight	1	53.81	26.76	2.62	5.48	7.30	1.79
	11	68.07	37.73	4.70	9.83	10.44	2.57
	111	64.69	33.98	3.93	7.36	8.45	0.25
Biological yield / plant	1	52.82	39.82	9.56	10.02	8.87	1.10
	11	62.99	30.82	8.38	7.44	9.31	0.93
	111	58.47	19.79	5.75	6.67	12.51	0.22
Grain yield / plant	1	56.44	39.18	4.72	15.90	14.80	1.33
	11	57.37	31.98	3.64	11.39	13.09	1.39
	111	64.91	32.45	4.31	13.26	15.98	1.59
Straw yield / plant	1	61.38	29.29	4.30	6.54	8.49	0.85
	11	66.40	21.70	3.78	26.24	8.34	0.33
	111	58.44	19.53	3.01	5.62	10.68	0.13
Harvest index	1	56.54	25.11	3.24	10.40	15.15	1.52
	11	59.07	29.36	3.66	12.93	16.14	0.18
	111	64.93	20.87	2.79	7.38	13.84	1.30

Genetic advance under selection

The values of expected genetic advance (Δg) reported in (Table) show the possible gain from selection as percent increase in the F_3 over the F_2 plants are selected.

Genetic gain was rather high for number of spikes/plant in the first and third cross, number of kernels/spike in the second cross. Moderate gain was found for grain yield/plant in the three crosses, number of kernels, spike in the first and third cross, harvest index in the first and second cross, 1000-kernel weight in the second cross and biological yield/plant in the first cross. Relatively low gain was found for remaining cases. Similar results were obtained by Ozkan *et al.* (1997), Ghimiray and Sarkar (2000), Darwish and Ashoush (2003) and Said (2003).

Quantitative characters having high heritability values may be of great help for selection on the basis of phenotypic performance. paradoxically, Johnson *et al.*, (1955), in their studies in soybean reported that heritabiligy estimates along with genetic gain are usually more useful than heritability values alone in predicting the resultant effect for selecting the best individuals. On the other hand, Dixit *et al.* (1970) 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. In the present work high genetic gain was found to be associated with rather moderate heritability estimates for number of spikes/plant in the three crosses. Therefore, selection for this trait in this particular population should be effective and satisfactory for successful breeding purposes. High or moderate heritability estimate and moderate genetic advance were obtained for grain yield/plant in the three crosses and number of kernel/spike in the first and third cross. Hence, it could be concluded that selection for these traits in these populations will be effective but probably of less success than in the former two traits.

Relatively low genetic gain was associated with low heritability values in most reminder cases. Hence, selection for these may be less effective. As it well know, expected improvement of selection is directly proportional to the heritability values. Also, the expected response to selection, varies with the measure of total variability in the traits, and therefore reflects the total response that could be realized by breeding techniques.

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التحليل الوراثى لبعض الصفات المحصولية فى القمح

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أجرى هذا البحث بفرض تقييم ثلاث هجين من القمح وهى سدس X1 ياكورا (I)، XRCB143 سخا ٩٣ (II)، XRCB122 سدس ٦ (III) بالإضافة إلى العشائر الستة لكل هجين لبعض الصفات المحصولية الهامة. وفيما يلى بعض النتائج المتحصل عليها:

- أظهرت النتائج معنوية موجبة لقوة الهجين لصفة ارتفاع النبات، عدد السنابل/ نبات وعدد الحبوب/ سنبلة، ووزن الألف حبة،محصول بيولوجى، محصول الحبوب/ نبات ودليل الحصاد فى الهجن الثلاث ومحصول القش/ نبات فى الهيجين الأول والثالث وتاريخ النضج الفسيولوجى فى الهجين الثانى. كما وجدت معنوية سالبة لقوة الهجين لبعض الصفات والبعض الآخر لم يظهر معنوية.
- أوضحت النتائج وجود معنوية سالبة التأثير التربية الداخلية لصفة تاريخ النضج الفسيولوجى فى الهجين الأول، كما أن صفة المحصول البيولوجى ومحصول القش/ نبات فى الهجين الثلاث أظهرت عدم المعنوية أمام باقى الصفات أظهرت معنوية موجبة.
- دراسة طبيعة الفعل الجينى أوضحت أهمية الفعل الأضافى عن الفعل الجينى السيادى لصفة ارتفاع النبات فى الثلاث هجين وتاريخ النضج الفسيولوجى وعدد الحبوب/سنابل فى الهجين الأول والثالث وعدد السنابل/نبات والمحصول البيولوجى ومحصول القش/نبات فى الهجين الثانى والثالث كما وجد تأثير معنوى للتفوق لصفة عدد السنابل/ نبات فى الهجين الثالث ومحصول الحبوب/نبات ودليل الحصاد فى الهجين الأول وعدد الحبوب/ سنابل فى الهجين الثلاث.
- وجد أن درجة التوريث بالمعنى الواسع لصفة تاريخ النضج الفسيولوجى فى الهجين الثلاث تقترب من قيم درجة التوريث بالمعنى الضيق وهذا يؤدى إلى فاعلية عملية الانتخاب المظهرى خلال الأجيال الإنعزالية أما بالنسبة للقيم المرتفعة لدرجة التوريث بالمعنى الواسع مع قيم متوسطة لدرجة التوريث بالمعنى الضيق وجد فى الصفات الآتية: ارتفاع النبات فى الهجين الأول والثانى وعدد السنابل/ نبات فى الهجين الأول ودليل الحصاد فى الهجين الثالث أما بالنسبة لباقى الصفات أظهرت قيم أقل لدرجة التوريث بالمعنى الواسع مع قيم أقل درجة التوريث بالمعنى الضيق.

العائد الانتخابى المتوقع كان مرتفع لصفة عدد السنابل/ نبات فى الهجين الأول والثالث وعدد الحبوب/ سنبلة فى الهجين الثانى بينما كان العائد الانتخابى المتوقع متوسط فى لصفة محصول الحبوب/ نبات فى الثلاث هجين وعدد الحبوب/ سنبلة فى الهجين الأول والثالث ودليل الحصاد فى الهجين الأول والثانى ووزنه ١٠٠٠ حبة فى الهجين الثانى والمحصول البيولوجى/ نبات فى الهجين الأول. بينما كان العائد الأنتخابى المتوقع منخفض نسبياً فى باقى الحالات