Egypt. J. Plant Breed. 23(4):701– 713(2019)

GENETIC ANALYSIS FOR YIELD, ITS COMPONENTS AND RUSTS RESISTANCE IN FOUR BREAD WHEAT CROSSES

Thanaa H. A. Abd El-Kreem

Wheat Research Dep., Field Crops Research Institute, ARC, Egypt

ABSTRACT

The present study was executed at Nubaria Agricultural Research Station during the three growing seasons from 2014/2015 to 2016/2017 to estimate the type of gene action using the six populations (P_1, P_2, F_1, F_2, BC_1 and BC_2) of four wheat crosses cross #1 (Sakha 93×Giza 171); cross #2 (Shandaweel 1× Giza 171); cross #3 (Shandaweel 1×Gemmeiza 11) and cross #4 (Shandaweel 1×Gemmeiza 12). The studied characters were grain yield and its components, resistance to yellow rust and leaf rust diseases. Results indicated significant positive heterotic effects relative to better and mid parents for number of spikes/plant, number of kernels/spike, 100-kernel weight in cross 1 and grain yield/plant in cross #3. Results indicated the presence of non-allelic interaction for most studied characters in all crosses under the study. Meanwhile, the relative importance of additive, dominance and epistatic effects varied among characters and crosses, the relative importance of dominance and epistatic effects were shown for number of spikes/plant and number of kernels/spike. The additive and epistatic effects were important for 100-kernels weight and grain yield/plant characters. Average degree of dominance was less than unity for all characters in all crosses, indicating the presence of partial dominance except for number of spikes/plant and grain yield in cross #3 which indicated the presence of over dominance. Significant positive values of inbreeding depression were detected for yield and its components in all crosses, except for grain yield in crosses # 2 and 3 which were not significant. Heritability estimates in broad sense were high to medium for all studied characters in all crosses, but in narrow sense, estimates were high to low for all characters in all crosses. The expected genetic advance as a percent of F_2 ranged from high to low in all crosses for all characters. Based on these results, cross # 4 (Shandweel 1 x Gemmeiza 12) showed high genetic advance associated with high heritability and thus could be promising in breeding programs of wheat and selection for obtaining high grain yield plants and resistance to rusts.

Key words: ***Gene effects, Heritability, Genetic advance, Heterosis, Wheat.***

INTRODUCTION

Bread wheat (*Triticum aestivum* L.) is the most important cereal crop in Egypt. The productivity of wheat is influenced by various biotic or a biotic stresses (Abdelaal *et al* 2017). Wheat yellow rust (*Puccinia striiformis* f. sp. *Tritici,*) is one of the most important diseases in the world; it causes high losses in the production of most Egyptian wheat cultivars. Leaf rust (*Puccinia recondita)* is considered the most common and widely distributed of the three wheat rusts and become a more serious problem on wheat. Draz *et al* (2015) found yield losses up to 50% due to leaf rust. Development of new high yielding cultivars and resistant to rust diseases is the main objectives of wheat breeders. The success of any breeding program depends on the genetic variability and gene action included in the inheritance of different characters in the used materials.

Heritability determined in broad and narrow senses are very useful for breeding programs, while high heritability is not always associated with high genetic advance, but in order to make effective selection, high heritability should be associated with high genetic gain (Mahgoub 2006). Gene effects have been examined in wheat by several researchers (Menshawy 2004, Abd El-Rahman 2013 and Kumar *et al* 2017) who found that additive, dominance and epistatic gene effects were involved in the expression of yield and its component. The present work aims to estimate the genetic parameters: heterosis, genetic variance, type of gene action, heritability and the predicted genetic gain from selection for grain yield and its components as well as resistance to yellow and leaf rusts for four crosses of wheat. These genetic parameters would be used in the approval of efficient breeding strategies in wheat breeding to develop high yielding wheat genotypes resistant to rusts.

MATERIALS AND METHODS

The present work was carried out at the newly reclaimed land research experimental farm of Nubaria Agricultural Research Station, (ARC), and Egypt during the three successive seasons from 2014/2015 to 2016/2017. The plant materials of this study were five parental cultivars of bread wheat and the in crosses, namely cross #1 (Sakha 93 × Giza 171); cross #2 (Shandaweel1 × Giza 171); cross #3 (Shandaweel 1 × Gemmeiza 11) and cross #4 (Shandaweel 1 × Gemmeiza 12). Names and pedigree of parental cultivas are given in Table (1).

Table 1. Names and pedigree of the five bread wheat cultivars.

No.	Cultivars	Pedigree and selection history
1	Sakha 93	Sakha 92/TR 810328. S 8871-1S-2S-1S-0S
2	Shandaweel 1	SITE//MO/4/NAC/TH.AC//3*PVN/3/MIRLO/BUC. CMSS93B00567S-72Y-010M-010Y-010M-3Y-0THY-0SH.
3	Gemmeiza 11	B0W"S"/KVZ"S"//7C/SERI82/3/GIZA168/SAKHA61. CGM7892-2GM—1GM-2GM-1GM0GM
4	Gemmeiza 12	OTUS/3/SARA/THB//VEE. CCMSS97Y00227S-5Y-010M-010Y-010M-2Y-1M-0Y-0GM
5	Giza 171	Sakha 93 / Gemmeiza 9. GZ2003-101-1GZ- 4GZ-1GZ-2GZ-0GZ

In the first season 2014/2015 the parental cultivars were crossed to obtain F_1 seeds. In 2015/2016 season the hybrid seeds of the four crosses were sown to give F_1 plants, after that, these plants were selfed to produce F_2, while some of the F_1 plants of each cross were backcrossed to each of the two parents to give the backcrosses (BC_1 and BC_2). In 2016/2017 season the six populations P_1, P_2, F_1, F_2, BC_1 and BC_2 of the four crosses were sown in a randomized complete block design with three replications to represent the final experiment. Each plot consisted of two rows for two parents, one row for F_1, three rows for each of the two backcrosses and 8 rows for the F_2 population. Length the row was 3 m, 30 cm apart and 15 cm between seeds within a row. The recommended cultural practices were applied during the growing season. Data were recorded on 30, 30, 180 and 60 plants taken at random for both parents, F_1, F_2 and backcrosses of each cross, respectively. The characters studied were number of spikes per plant, number of kernels per spike, 100-kernel weight, kernels weight per spike, grain yield per plant and response to yellow and leaf rust diseases which was estimated as infection severity multiplied by assigned constant values ranging from 0, 0.2, 0.4, 0.6, 0.8 and 1 according to Stakman *et al* (1962).

Statistical and genetic analysis

Heterosis was determined as the percentage of the deviation of F_1 hybrid over mid and better parent values. Inbreeding depression was calculated as the difference between the F_1 and F_2 means expressed as a percentage of the F_1 mean. Average degree of dominance were estimated according to Mather and Jinks (1982).

The population means and the variances were used to calculate scaling test as outlined by Mather (1949) and Hayman and Mather (1955) to estimate the presence of non-allelic interactions. The six populations means in each cross were used to calculate the six parameters of gene effects, according to Gamble (1962).The standard error of additive (a), dominance (d), additive x additive (aa), additive x dominance (ad) and dominance x dominance (dd) were obtained by calculating the square root of their respective variance. T–test values were calculated by dividing the effects of a, d, aa, ad and dd on their respective standard errors.

Heritability estimates were computed in both broad (h^2b) and narrow senses (h^2n) for F_2 generation according to Allard (1960) and Mather (1949). The expected genetic advance under selection (Δg) was computed according to Johnson *et al* (1955). Also, this expected gain was expressed as a percentage of F_2 mean ($\Delta g\%$) according to Miller *et al* (1958) and genotypic variance and environmental variance according to Falconer (1989).

RESULTS AND DISCUSSION

Mean performance

Mean and variance of the studied characters in the four crosses for the six populations P_1, P_2, F_1, F_2, BC_1 and BC_2 are presented in Table (2).

Table 2. Mean ($\bar{X}$) and variance (S^2) of the P_1, P_2, F_1, F_2, BC_1 and BC_2 populations of four wheat crosses for characters.

Characters	Crosses	Statistical Parameter	P_1	P_2	F_1	F_2	BC_1	BC_2
No. of spikes/ plant	#1	$\bar{X}$	12.40	15.20	16.10	13.69	15.95	13.30
		S^2	9.60	7.50	12.49	18.99	13.60	16.69
	#2	$\bar{X}$	15.80	14.40	15.00	18.98	14.22	14.41
		S^2	4.84	9.02	08.91	18.98	13.29	14.41
	#3	$\bar{X}$	16.31	16.67	14.93	14.54	16.85	18.42
		S^2	19.81	13.10	09.92	32.06	28.44	27.11
	#4	$\bar{X}$	14.83	14.51	18.63	13.78	13.26	13.97
		S^2	5.24	4.81	06.65	27.43	13.93	23.64
No. of kernels/ spike	#1	$\bar{X}$	81.70	79.50	89.67	77.77	69.10	76.78
		S^2	34.24	38.29	41.47	176.60	89.36	187.00
	#2	$\bar{X}$	83.20	84.40	87.80	75.00	68.55	76.95
		S^2	46.70	17.77	22.70	146.75	89.33	90.58
	#3	$\bar{X}$	87.94	82.42	86.45	80.62	78.00	78.12
		S^2	68.87	86.95	75.47	193.00	121.80	149.11
	#4	$\bar{X}$	76.40	72.40	80.78	85.62	83.00	77.63
		S^2	63.70	96.80	88.49	335.40	275.00	188.20
100-kernel weight (g)	#1	$\bar{X}$	3.76	4.18	4.26	4.00	3.59	3.99
		S^2	0.52	0.55	0.65	1.20	0.98	0.85
	#2	$\bar{X}$	4.55	4.82	4.19	4.42	4.07	4.30
		S^2	0.72	0.54	0.38	1.19	1.11	0.94
	#3	$\bar{X}$	4.59	4.04	3.90	4.00	4.11	4.00
		S^2	0.17	0.98	0.43	1.00	0.96	0.78
	#4	$\bar{X}$	4.09	4.89	4.25	3.76	4.03	4.25
		S^2	0.35	0.37	0.60	0.60	0.42	0.63
Kernels weight/spike (g)	#1	$\bar{X}$	3.27	3.80	3.67	3.56	2.69	3.19
		S^2	0.64	0.83	0.66	1.23	1.10	1.23
	#2	$\bar{X}$	3.66	4.00	3.53	3.66	2.93	3.40
		S^2	0.65	0.90	1.10	1.56	1.20	1.56
	#3	$\bar{X}$	4.48	3.43	3.00	3.62	3.63	3.74
		S^2	0.72	1.33	1.32	1.75	1.58	1.75
	#4	$\bar{X}$	3.02	3.27	3.30	3.31	3.84	3.59
		S^2	0.70	0.79	1.31	1.25	1.253	1.25
Grain yield/ plant (g)	#1	$\bar{X}$	26.44	34.43	34.11	32.34	30.30	31.14
		S^2	58.47	37.10	51.55	118.55	84.72	98.10
	#2	$\bar{X}$	32.40	34.83	35.87	36.10	29.03	33.80
		S^2	37.00	20.56	23.11	178.00	99.15	108.50
	#3	$\bar{X}$	33.30	30.53	36.21	34.27	36.64	39.63
		S^2	43.00	43.70	126.97	306.94	276.27	244.99
	#4	$\bar{X}$	32.54	37.96	37.04	31.00	28.04	38.31
		S^2	37.46	34.64	55.41	323.40	150.00	273.00

Table 2. contd.

Characters	Crosses	Statistical parameter	P_1	P_2	F_1	F_2	BC_1	BC_2
Resistance to yellow rust disease	#1	$\bar{X}$	3.42	5.44	4.60	4.24	4.49	6.75
		S^2	0.34	0.56	0.48	3.65	1.82	2.56
	#2	$\bar{X}$	1.86	5.48	2.26	4.63	5.86	6.81
		S^2	0.01	0.01	0.34	6.91	4.45	3.88
	#3	$\bar{X}$	1.00	7.75	7.87	4.51	5.02	5.09
		S^2	0.01	0.01	0.08	5.51	5.00	3.81
	#4	$\bar{X}$	1.49	0.63	1.77	5.0	4.00	1.39
		S^2	0.45	0.01	0.10	5.5	3.59	2.30
Resistance to leaf rust disease	#1	$\bar{X}$	4.52	1.00	1.00	1.70	3.02	0.96
		S^2	0.01	0.01	0.01	4.98	5.48	0.40
	#2	$\bar{X}$	0.08	1.00	0.57	2.00	0.81	0.45
		S^2	0.01	0.01	0.24	1.00	0.70	0.37
	#3	$\bar{X}$	0.10	0.10	0.46	1.00	0.81	0.49
		S^2	0.01	0.01	0.24	0.86	0.58	0.74
	#4	$\bar{X}$	0.10	0.79	1.00	1.70	0.45	0.50
		S^2	0.01	0.02	0.01	0.62	0.38	0.29

The F_1 mean values exceeded the mid values of the two parental means for most of the studied characters in the four crosses. The F_2 population mean values were intermediate between the two parents and less than F_1 mean values for most of yield and its components, indicating the importance of non-additive components of genetic variance for the studied characters; such results as in harmony with these Darwish *et al* (2018). While, the two backcrosses (BC_1 and BC_2) mean performance values varied in each trait towards the mean of its recurrent parent. Similar results were obtained by Abd El-Rahman and Hammad (2009).

Heterosis, inbreeding depression and potence ratio

Heterosis was determined as the percentage deviation of F_1 mean performance from the better and mid parents for all charcters. In this concern, percentages of heterosis over better and mid parent values are presented in Table (3).

Table 3. Heterosis, inbreeding depression and potence ratio in four crosses for all characters.

Characters	Crosses	Heterosis%		Inbreeding depression%	Potence ratio% H/D
		$\overline{M}$P	BP		
No. of spikes/ plant	#1	16.67**	5.92**	14.97**	0.43
	#2	-0.66	-5.06	4.67**	0.33
	#3	-9.43	-10.40	2.65**	1.04
	#4	28.57**	25.62**	26.00**	0.51
No. of kernels/ spike	#1	11.25**	9.74*	13.27**	0.90
	#2	4.77	1.58	14.58**	0.91
	#3	1.49	-1.69	7.16*	0.08
	#4	8.58**	5.73	5.99*	0.46
100-kernel weight (g)	#1	7.35**	1.94**	6.10**	0.31
	#2	-10.52	-12.98	5.49**	0.98
	#3	-38.57	-45.67	11.65**	0.91
	#4	-5.35	13.09	11.55**	0.28
Kernels weight /spike (g)	#1	3.82**	-3.42	3.00**	1.39
	#2	-7.94	--11.85	3.80**	0.30
	#3	-24.15	-33.00	20.67**	0.98
	#4	22.13**	17.46**	13.82**	1.72
Grain yield/ plant (g)	#1	4.33**	-0.93	2.13*	0.53
	#2	6.71*	2.99	0.64	0.14
	#3	13.47**	8.75*	5.37	1.24
	#4	5.08	-2.42	17.32**	0.42
Resistance to yellow rust disease	#1	3.87**	-15.36	7.83**	0.30
	#2	-38.56	-58.83	22.88**	-
	#3	-	-1.60**	42.69**	1.21
	#4	66.35**	18.46**	141.70**	0.20
Resistance to leaf rust disease	#1	-63.79	-77.86	70.00**	0.47
	#2	5.82**	-42.70	-	-
	#3	-	36.00**	49.57	0.96
	#4	124.97**	26.74**	29.0**	0.21

(*) and (**) significant at 0.05 and 0.01 levels of probability, respectively.

Positive and significant or highly significant heterosis over mid and better parent values were obtained for number of spikes/plant in cross 1 and cross 4; number of kernels/spike and 100-kernele weight in cross 1, grain yield/plant in cross 3 and kernels weight/spike and resistance to the two rusts in cross 4. Also, heterosis relative to mid parent was highly significant for number of kernels/spike in cross 4, grain yield/plant in all crosses except for cross 4 and kernels weight/spike in the first cross might be due to the dominance and/or dominance x dominance effects. Similar results were obtained by Zaazaa *et al* (2012), Abd El-Rahman (2013) and Kumar *et al* (2017).

Inbreeding depression recorded as reduction in performance of F_2 generation relative to F_1 is shown in Table (3). Results showed highly significant and positive values for all traits in all studied crosses, except for grain yield/plant in cross 2 and cross 3 and leaf rust in cross 3. Potence ratio values were less than unity in most crosses for all characters, indicating partial dominance in these crosses. While, it was more than unity for number of spikes/plant, grain yield/plant and yellow rust resistance in cross 3 and kernels weight/spike in cross 1 and 4. These results indicated the presence of over dominance, suggesting early selection might improve these characters in these crosses. Similar results were obtained by Sultan *et al* (2011) and El-Shaarawy (2012).

Genetic effects for studied characters

Types of gene action for the studied characters are presented in Table (4).The mean effects (m) were highly significant in the four crosses for all characters, except for number of spikes/plant and grain yield in cross 3, yellow and leaf rusts resistance in crosses 1 and 3. The additive gene effect (a) was quite small in magnitude relative to the dominance gene effects. Additive gene effect was positive and significant or highly significant for 100-kernel weight and kernel weight/spike in cross 3 and leaf rust resistance in cross1. These results indicated that selection could be effective for traits in early segregating generations. On the other hand, significant or highly significant and negative additive effects were obtained for; 100-kernel weight in cross 4, grain yield/plant in cross 1 and 4, yellow rust resistance in all crosses, except for cross 4 as well as for leaf rust resistance in cross 2 and 4, indicating that the additive effects were less important in the inheritance of these characters. Similar results were obtained by Abd El-Rahaman (2013).

Table 4. Type of gene action estimated by generation means in four crosses for all studied characters.

Characters	Crosses	Gene action					
		(m)	(a)	(d)	(aa)	(ad)	(dd)
No. of spikes/plant	#1	10.06**	-1.40	8.48	3.74	8.10**	-2.44
	#2	16.10**	0.70	-6.10	-1.00	-0.72	5.00
	#3	4.46	-0.18	29.84**	12.03**	-2.42	-19.37**
	#4	15.14**	0.34	-8.94	-0.65	-2.09	12.43**
No. of kernels/Spike	#1	99.93**	1.11	-78.37**	-19.32**	-17.57**	68.11**
	#2	92.80**	-0.6	-66.20**	-9.00	-15.60*	61.20**
	#3	93.98**	2.76	-47.35*	-8.80	-5.76	39.82**
	#4	95.62**	2.00	-25.16	21.22*	6.74	10.32
100-kernel weight (g)	#1	04.81**	-0.21	-2.69	-0.84	-0.38	2.14*
	#2	05.62**	-0.13	-3.38	-0.94	-0.19	1.95
	#3	04.09**	0.28*	-0.18	0.22	-0.33	-0.01
	#4	02.97**	-0.40**	1.87	1.52**	0.36	-0.60
Kernel weight/spike (g)	#1	06.02**	-0.27	-7.48**	-2.48**	-0.47	5.13**
	#2	05.81**	-0.17	-6.32**	-1.98**	-0.60	4.03**
	#3	03.70**	0.53**	0.39	0.26	-1.27	-1.09
	#4	02.40**	-0.13	2.21	0.75	-0.10	-0.76
Grain yield/plant (g)	#1	36.92**	-4.00*	-15.50	-6.48	6.31	12.69
	#2	52.36**	-1.22	-48.54*	-18.74*	-7.11	32.05*
	#3	16.45	1.39	51.53	15.47	-8.75	-31.76
	#4	24.82**	-2.71*	11.00	10.43	-14.88	1.22
Resistance to yellow rust disease	#1	-01.08	-1.01**	15.60**	5.51**	-2.51*	-9.92**
	#2	-14.71**	-1.81**	48.84**	18.38**	1.71	-31.87**
	#3	02.18	-3.37**	3.62	2.19	6.6**	2.07
	#4	07.35**	0.43	-6.74	-6.28**	4.36**	1.16
Resistance to leaf rust disease	#1	01.60	1.76**	1.01	1.16	0.61	-1.61
	#2	16.53**	-0.46**	-31.67**	-15.99**	1.65*	15.71**
	#3	00.25	0.00	1.55	-0.15	0.64	-1.34
	#4	03.70**	-0.34**	-6.94**	-3.25**	0.59	4.24**

(*) and (**) significant at 0.05 and 0.01 levels of probability, respectively.

The dominance gene (d) effects are presented (Table 4). They were significant or highly significant and positive for number of spikes/plant in cross 3 and yellow rust resistance in cross 1 and cross 2, indicating the importance of the role of the dominance gene effects in the inheritance of these characters and the selection could be effective in late segregating generations. Meanwhile, significant or highly significant and negative dominance effects were obtained for number of kernels/spike in crosses 1, 2 and 3, kernels weight /spike in cross 1 and 2, grain yield/plant in crosses 2 and leaf rust resistance in crosses 2 and 3. These results are in harmony with those obtained by Abd El-Rahaman and Hammad (2009) and Khattab *et al* (2010).

Additive × additive (aa) type of gene action (Table 4) was significant to highly significant and positive for number of spikes/plants in cross 3, number of kernels/spike in the cross 4, 100-kernel weight in cross 4 and yellow rust resistance in the crosses 1 and 2. So, early generation selection for these traits might be effective for wheat breeding program. On the other hand, significant or highly significant and negative additive × additive (aa) type of gene effects were detected for number of kernels/spike in cross 1, kernels weight /spike in crosses 1 and 2, grain yield/spike in cross 2, yellow rust resistance in cross 4 and leaf rust resistance in crosses 1 and 4. Similar results were obtained by koumber and El-Gammal (2012) and Darwish *et al* (2018).

Additive × dominance (ad) types of epistasis were positive and significant or highly significant for number of spikes/plant in the cross 4, yellow rust resistance in crosses 3 and 4 also and were positive and significant for leaf rust resistance in cross 2. Meanwhile, the other crosses showed negative significant or highly significant and insignificant values. The dominance × dominance (dd) epistasis gene effect were positive and significant or highly significant for number of spikes/plant in cross 4, number of kernels/spike in all crosses, except for cross 4, 100-kernel weight in cross 1, kernels weight/spike in crosses 1 and 2, grain yield/plant in cross 2 and leaf rust resistance in crosses 2 and 4. While, the other crosses showed negative and highly significant or insignificant values. These results indicated the importance of dominance x dominance gene action in the genetic system which control these characters. Similar results were reported by Tonk *et al* (2011), Zaazaa *et al* (2012) and Darwish *et al* (2018).

Phenotypic and genotypic coefficient of variation

Data of phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) for studied traits in the four crosses are presented in Table (5). The results indicated that PCV values were larger than GCV for all characters in all crosses. These results indicated that the environment had an important role in the expression of these characters. These results are in harmony with those obtained by Kotal *et al* (2010) and Darwish *et al* (2018).

Table 5. Heritability percentage in broad (h^2b) and narrow (h^2n) senses and expected genetic advance from selection (Δg) in four crosses for all the studied characters.

Characters	Crosses	GCV	PCV	Heritability percentage		Expected genetic advance	
				H^2(b)	H^2(n)	Δg	Δg %
No. Of spikes/ plant	#1	18.99	9.13	48.06	40.49	3.630	26.55
	#2	18.98	11.39	60.01	54.06	4.850	33.93
	#3	32.06	17.78	55.47	26.75	3.120	21.46
	#4	27.43	21.86	79.71	63.04	6.800	49.35
No. Of kernels/ spike	#1	176.60	138.60	78.48	43.51	11.910	15.32
	#2	146.75	117.69	80.20	77.40	19.310	25.75
	#3	193.00	115.90	60.05	59.63	17.060	21.26
	#4	335.40	252.90	75.25	61.90	23.350	27.27
100-kernel weight (g)	#1	1.20	0.62	51.94	47.50	1.070	26.80
	#2	1.19	0.65	54.34	27.73	0.623	14.10
	#3	1.00	0.48	47.57	26.00	0.535	13.39
	#4	0.60	0.16	26.22	24.37	0.387	10.30
Kernel weight /spike (g)	#1	1.23	0.52	58.63	45.79	10.260	31.76
	#2	1.56	0.68	84.89	83.34	22.900	63.45
	#3	1.75	0.63	76.80	30.17	10.880	31.78
	#4	1.25	0.32	86.86	69.20	25.630	82.71
Grain yield/ plant (g)	#1	118.55	69.51	42.28	14.48	0.330	9.29
	#2	178.00	151.11	43.38	39.74	1.022	27.94
	#3	306.94	235.71	35.81	18.29	0.418	13.77
	#4	323.40	280.90	25.36	6.40	0.147	4.45
Resistance to yellow rust disease	#1	3.65	3.19	87.34	80.11	3.150	74.36
	#2	1.00	0.88	98.26	79.41	1.630	75.43
	#3	5.51	5.48	99.10	40.61	1.940	43.06
	#4	5.50	5.31	96.50	92.89	4.480	89.74
Resistance to leaf rust disease	#1	4.98	4.97	99.20	50.84	2.330	86.57
	#2	6.91	6.82	98.26	93.70	3.530	76.42
	#3	0.86	0.78	89.84	46.70	0.893	89.3
	#4	0.62	0.61	97.82	87.10	1.410	83.1

Heritability and expected genetic advance from selection

Heritability in both broad and narrow sense and expected genetic advance from selection for studied characters are presented in Table (5).

Heritability estimates in broad sense were relatively high for all studied characters in all crosses. Except for 100-kernel weight and weight kernels/spike in cross 4, but they were medium according to Ali (2017). While, heritability estimates in narrow sense were low to high for all studied characters in all crosses, ranging from 6.4% in cross 4 for kernels weight/spike to 93.7 % in cross 2 for leaf rust resistance, indicating that these traits were affected by additive and non-additive effects. Similar results were obtained by Menshawy and Najeeb (2004), Khattab *et al* (2010) and Farshadfar *et al* (2013).

The expected genetic advance as percent of F_2 ranged from 4.45% for kernels weight/spike in cross 4 to 89.74% for yellow rust resistance in cross 4. The highest values of narrow sense heritability were associated with highest genetic advance for most of the studied characters in most crosses indicating sufficient improvement of different traits. So it is possible to practicing selection in early segregating generations for these traits. Generally, the results indicated that cross # 4 could be used for selecting plants with high grain yield and resistance to yellow and leaf rusts.

REFERENCES

Abdelaal, A.A., Kh., R. I. Omara, M.Y. Hafez, Samar, M. Esmail and A. EL Sabagh (2017). Anatomical biochemical and physiological changes in some Egyptian wheat cultivars inoculated with *Puccinia gramini* f. *tritici* f. sp. *tritici* Fresen.Environ.Bull. 27 (1): 296-305.

Abd El-Rahman, E. Magda (2013). Estimation of some genetic parameters through generation mean analysis in three bread wheat crosses. Alex. J. Agric. Res. 58(3):183-195.

Abd El-Rahman, Magda E. and S.M. Hammad (2009). Estimation of some genetic parameters for some agronomic characteristics in three crosses of bread wheat. J. Agric. Sci., Mansoura Univ. 34(2): 1091-1100.

Ali, O.I.M. (2017). Durable resistance to leaf rust in some Egyptian wheat cultivars. Ph.D., Faculty of Agric.,Cairo Univ., Egypt.

Allard, A. M. (1960). Principles of Plant Breeding. John Wiley and Sons. Inc. NY, U. S. A.

Darwish, M.A.H., W. Z. E. Farhat and A. EL Sabagh (2018). Inheritance of some agronomic characters and rusts resistance in fifteen F2 wheat populations. Cercetări Agronomice în Moldova LI, 1 (173): 5-28.

Draz, I. S. Abou-El Seoud, M. S. Kamara, A. E.M. Alaa-Eldein and A. F. El-Bebany(2015). Screening of wheat genotypes for leaf rust resistance along with grain yield. AOAS 60(1) 29-39.

El-Shaarawy, G.A. (2012). Gene effects for yield and yield components in some bread wheat crosses. Egypt. J. Plant Breed. 16 (4): 75-87.

Falconer, D. S. (1989). Introduction to Quantitative Genetics .3rd Ed., John Wiley&Sons, Inc., New York.

Farshadfar, E., F. Rafiee and H. Hasheminasab (2013). Evaluation of genetic parameters of agronomic and morpho-physiological indicators of drought tolerance in bread wheat (*Triticum aestivum* L.) using diallel mating design. AJCS 7(2):268-275.

Gamble, E. E. (1962). Gene effects in corn (*Zea mays* L.). I-Separtion and relative importance of gene effects for yield. Can. J. Plant Sci., 42:339-348.

Hayman, B. I. and K. Mather (1955). The description of genetic interaction in continuous variation. Biometrics 11: 69-82.

Johnson, H. W., H. F. Robinson and R. E. Comstock. (1955). Estimation of genetic and environmental variability in soybeans. Agron. J.47:314-322.

Khattab, S.A.M., R.M. Esmail and A.M.F. ALAnsary (2010). Genetical analysis of some quantitative traits in bread wheat (*Triticum aestivum* L.). New York Science Journal 3(11) 152-157.

Kotal, B.D., A. R. Das and B. K. Choudhury (2010). Genetic variability and association of characters in wheat (*Triticum aestivum* L.). Asian J. Crop Sci. 2: 155-160.

Koumber, R.M. and A.A. El-Gammaal (2012). Inheritance and gene action for yield and its attributes in three bread wheat crosses (*Triticum aestivum* L.). World Journal of Agricultural Sciences 8(2):156-162.

Kumar, S., K. Anuj and K. Jaydaev (2017). Genetic analysis for heterotic traits in bread wheat using six parameters modle. Electronic. Journal of plant Breeding 8(1):206-215.

Mahgoub, S. Hayam (2006). Genetic studies on grain yield and other agronomic traits in three crosses of bread wheat, Egypt. J.Agric.Res.10(2):299-315.

Mather, K. (1949). Biometrical Genetics. Dover Publications, Inc., London.

Mather, K. and J.K. Jinks (1982). Biometrical Genetics. Great Br. Univ. Press. 3rd ed.

Menshawy, A.M.M. (2004). **Genetical analysis of grain yield and some related traits in bread wheat. Egypt. J. Agric. Res.82 (1):203-214.**

Menshawy, A M., and M. Najeeb (2004). Genetical and pathological studies on certain Egyptian wheat genotypes as affected by both leaf and stripe rust. J. Agric. Sc. Mansoura Univ. 29:2041-2051.

Miller, P. A., J. C. Williams, H. F. Robinson, and R. E. Comstock. (1958). Estimates of genotypic and environmental variances and covariance in Upland cotton and their implications in selection. Agron. J. 50:126 -131.

Stakman, E. C., D. M. Stewart and W. Q. Loegering (1962). Identification of physiologic races of *Puccinia graminis* var. *tritici.* ARS, USDA., Agr. Res. Serv. Bull. E6/7. 53pp.

Sultan, M.S., A.H. Abd Elatif, M.A. Abdel Moneam and M.N.A. El-Hawary (2011). Genetic parameters for some yield and yield components characters in four crosses bread wheat under two water regime treatments. J. Plant Prod., Mansoura Univ. 2(2): 351-366.

Tonk, F.A., E. Ilker and M. Tosun (2011). Quantitative inheritance of some wheat agronomic traits. Bulgarian J. Agric. Sci. 17(6): 783-788.

Zaazaa, El. M.A.H. M.A. Hager and E.F. El-Hashash (2012). Genetical analysis of some quantitative traits in wheat using six parameters genetic model. American – Eurasian J. Agric. & Environ. Sci. 12(4):456-462.

التحليل الوراثى للمحصول ومكوناته والمقاومة للأصداء

فى أربعة هجن من قمح الخبز

ثناء حمد عبد السلام عبد الكريم

قسم بحوث القمح – معهد بحوث المحاصيل الحقلية– مركز البحوث الزراعية– مصر

أجريت هذه الدراسة بمزرعة محطة البحوث الزراعية بالنوبارية خلال ثلاثة مواسم زراعية متتالية من ٢٠١٤/٢٠١٥ وحتى ٢٠١٦/٢٠١٧ لدراسة تأثير الفعل الجيني باستخدام نظام العشائر الست (الأب الأول, الأب الثانى, الجيل الأول, الجيل الثاني, الهجين الرجعى الأول و الهجين الرجعى الثاني) لأربعة هجن من القمح هي: الهجين الأول (سخا ٩٣ x جيزة ١٧١), الهجين الثاني (شندويل ١x جيزة ١٧١), الهجين الثالث (شندويل ١x جميزة ١١) و الهجين الرابع (شندويل ١x جميزة ١٢). تم دراسة محصول الحبوب ومكوناته وصفة المقاومة لمرضى الصدأ الأصفر وصدأ الأوراق وقد أظهرت معظم الصفات المدروسة تباينا وراثياً معنوياً فى الهجن الأربعة ،أوضحت النتائج وجود قوة هجين موجبة ومعنوية لكل من متوسط الأبوين والأب الأفضل فى صفات عدد السنابل للنبات ، عدد حبوب السنبلة، وزن ال١٠٠ حبة فى الهجين الأول ومحصول الحبوب للنبات فى الهجين الثالث، أكدت النتائج وجود تفاعل بين العوامل غير الأليلية بالنسبة لمعظم الصفات في معظم الهجن, كما أشارت النتائج إلى أهمية تأثيرات كل من الفعل الوراثي المضيف والسيادي و التفوقى التي اختلفت تبعا للصفات والهجن. أظهرت النتائج اهمية التأثير الجينى السيادى و التفوقى فى توارث عدد السنابل للنبات و صفة عدد حبوب السنبلة و الفعل الوراثي المضيف و التفوقي في صفتى وزن ال١٠٠حبة ومحصول الحبوب للنبات. بالنسبة لدرجة السيادة كانت أقل من الواحد فى معظم الصفات لكل الهجن مشيرا لوجود سيادة جزئية فيما عدا صفتى عدد السنابل للنبات ومحصول الحبوب للنبات فى الهجين الثالث كانت أكبر من الواحد مشيرا الى وجود سيادة فائقة ،أظهرت النتائج ان التدهور الناتج عن التربية الداخلية معنوى وموجب للمحصول ومكوناته فى جميع الهجن ما عدا محصول الحبوب للنبات فى الهجين الثانى والثالث كان غير معنوى. بالنسبة للتقديرات الخاصة بكفاءة التوريث فإن كفاءة التوريث بالمعنى الواسع كانت متوسطة الى مرتفعة في كل الصفات في جميع الهجن أما كفاءة التوريث بالمعنى الضيق فتراوحت مابين منخفضة إلى مرتفعة فى كل الصفات فى جميع الهجن. كما أن التقدم الوراثي المتوقع نتيجة الانتخاب تراوح مابين منخفض إلى مرتفع بالنسبة لمعظم الصفات موضع الدراسة ، كان أفضل الهجن المبشرة الهجين الرابع (شندويل ١ x جميزة ١٢) حيث أعطي قيما عالية للتقدم الوراثى المتوقع نتيجة للانتخاب وكذلك كفاءة التوريث لصفة محصول الحبوب للنبات والمقاومة لصدأ الأصفر والأوراق حيث يمكن الاستفادة منه فى انتخاب نباتات عالية المحصول ومقاومة للأصداء.

المجلة المصرية لتربية النبات ٢٣(٤) : ٧٠١- ٧١٣ (٢٠١٩)