GENETIC BEHAVIOR OF EARLINESS, YIELD AND YIELD COMPONENTS IN THREE BREAD WHEAT CROSSES UNDER TWO SOWING DATES

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Abstract

The main objective of this investigation was to study the inheritance of earliness and some agronomic traits in bread wheat. The experiment was conducted at Sakha Experimental Research Station during 2003/2004 to 2005/2006 seasons. Three crosses were made used four parents differ in their maturity. Those crosses were Sakha 61/Line 2 (early × early), Line 2/Giza 163 (early × late) and Giza 163/Gemmeiza 9 (late × late). Data indicated that the two involved parents in each cross were significantly different for most traits at the two sowing dates. F- test for the F_2 variance showed that F_2 plants were genetically different in the three crosses for all studied traits under the two sowing dates. Mean values for number of spikes/plant, number of kernels /spike and grain yield/plant under the normal sowing date were higher than the corresponding ones at early sowing date. Meanwhile, mean value for kernel weight was higher at early sowing date than that of the normal one. Additive and dominance genetic effects played together a great role in the inheritance of all studied traits under the two sowing dates. However, the additive genetic effect was more important. Moreover, additive × additive and dominance × dominance epistatic effects were important in all studied traits under the two sowing dates. Heritability estimates were high for most studied traits under the two sowing dates in both broad and narrow senses. Therefore, the expected genetic advance was moderate or high for most studied traits under the two sowing dates.

Key words: bread wheat, earliness, yield, gene action, heritability, genetic advance.

INRODUCTION

Bread wheat (*Triticum aestivum* L.) is the most important cereal crop in Egypt as well as in the world. The annual consumption of wheat grains in Egypt is about 12 million tons, while the annual local production is about 8 million tons in 2006. Efforts of scientists to minimize the gab between local consumption and local production are directed towards two approaches, i.e. expanding the cultivated wheat area and increasing wheat productivity.

Earliness plays a significant role in adapting crop species to moisture stress condition. Developing new early-maturing cultivars of bread wheat without losses in grain yield ability is a major objective of many wheat breeding programs. Early maturing genotypes usually reach maturity before the development of many diseases and also escape several harsh abiotic stress conditions during wheat grain filling stage. Some wheat cultivars, differing in maturity date, can produce similar grain yield, suggesting the effectiveness of yield enhancement by manipulating earliness potentiality.

To exploit different types of gene action involved in inheritance of earliness and agronomic traits of some Egyptian bread wheat genotypes, information regarding their relative magnitude is essential. The negative correlation between vegetative growth period and grain filling period obtained by Knott and Gebeyehou (1987) suggested that selection for long filling period would also result in early heading. These results indicate that a combination of short vegetative growth period and long grain filling period may produce higher grain yield in wheat. Likewise, understanding the relationship between earliness components and yield potential will lead to an improved grain yield (Lambers *et. al.*, 1989 and Simane et al., 1993).

In Egypt, success of wheat cultivars to be cultivated in the rain-fed area of the northern coast may depend entirely on the earliness of these genotypes, which can enable them to escape from drought that may occur later. Also, early genotypes can be useful to intensive agriculture in the old cultivated lands. In addition, they are useful in escaping some biotic and abiotic stresses such as rusts, hot winds and terminal heat prevailing at late wheat growing season in upper Egypt. The possibility of double cropping wheat and cotton in Egypt has also heightened interest in high-yielding early-maturing wheats (Menshawy, 2007). Early harvest of wheat crop is critical to allow cotton crop sufficient time to develop and to produce an adequate yield. Therefore, the objectives of the present investigation were to:

1. Investigate the genotypic differences in earliness component traits and to identify some early maturing and high yielding genotypes.
2. Determine the mode of inheritance, type of gene action and heritability estimates for earliness and agronomic traits in some parental Egyptian bread wheat and their crosses under two sowing dates.

MATERIALS AND METHODS

The field work of this investigation was conducted at the Experimental Farm of Sakha Agricultural Research Station (ARC), KafrEl-Sheikh, Egypt during the three wheat growing seasons i.e., 2003/2004, 2004/2005 and 2005/2006. Three different crosses were made using four wheat genotypes i.e. Sakha 61, Line 2, Giza 163 and

Gemmeiza 9. The established crosses were selected to represent all possible combinations among early and late mature parents as follows:

Cross - 1	(Skh.61 x L2)	Early x early
Cross - 2	(L2 x G.163)	Early x late
Cross - 3	(G.163 x Gem.9)	Late x late

In 2004/2005, the F_1 of each of the previous crosses was backcrossed to its parents to produce BC_1 (F_1 x P_1) and BC_2 (F_1 x P_2). The F_1 plants were selfed to produce F_2 seeds. In 2005/2006, the six populations of the three wheat crosses (P_1, P_2, F_1, BC_1, BC_2 and F_2) were evaluated in two separate experiments under two different sowing dates, 26/10/2005 (early sowing date) and 23/11/2005 (normal sowing date). The two separate experiments were laid out in a randomized complete block design with three replications. For each experiment, the recommended package of cultural practices was followed.

Table 1. Name, earliness and pedigree of the studied bread wheat genotypes.

Genotype	Name	Earliness	Cross Name & Pedigree
P_1	Sakha 61	Early	Inia / RL 4220 // 7c / Yr "S" CM15430 -2S-5S-0S-0S
P_2	Line 2	Early	SAKHA 12 /5/ KVZ // CNO 67 / PJ 62 /3/ YD "S" / BLO "S" /4/ K 134 (60) / VEE S.14665-2S -2S -0SY-0S
P_3	Giza 163	Late	T. aestivun / Bon // Cno / 7c CM33009 -F-15M-4Y-2M-1M-1M-1Y-0M
P_4	Gemmeiza 9	Late	Ald "S" / Huac"s" // Cmh 74 A. 630 / Sx GM 4583-5GM-1GM-0GM

At harvest, data were obtained from 30; 30; 30; 300; 100 and 100 individual guarded plants for P_1, P_2, F_1, F_2, BC_1 and BC_2 of each cross, respectively. Days to heading (DH), Days to maturity (DM), Grain filling period (GFP),Grain filling rate (GFR), Number of spikes/plant (S/P), Number of kernels/spike(K/S), Kernels weight (100-KW) and Grain yield per plant (GY) were recorded.

Various biometrical parameters in the study were calculated because F_2 genetic variance was significant for all studied traits. The gene action, i.e. additive (a), dominance (d), additive × additive (aa), additive × dominance (ad) and dominance × dominance (dd) were obtained using the method illustrated by Gamble (1962).

Heritability was calculated in both broad and narrow senses according to Mather's (1949) procedure. The predicted genetic advance (Δg) was computed according to Johanson *et. al.* (1955). The expected gain represented as a percentage of F_2 mean (Δg %) was estimated according to Miller *et. al.* (1958).

RESULTS AND DISCUSSION

a- Genetic differences between parents

The data in Table (2) indicate that the two parents of each cross were significantly different for most traits in all crosses under the two sowing dates, revealing the diverse of genetic background for each studied parent.

As F_2 plants are genetically different in the three crosses for all studied traits under the two sowing dates; the different biometric parameters used in this investigation were estimated. This existence of significant genetic variability in spite of the significant differences between parents obtained herein in most traits may suggest that genes of such effects were not completely associated in the parents, i.e., these genes are dispersed.

b- Mean and variances

The data in Table (3) showed the means and variances for the six populations of the three crosses under the two sowing dates for all studied traits. Also, from the pervious data it was interested to note that the earliest parent was Line 2 and the latest one was Giza 163 for all traits, except for grain filling rate. In addition, partial dominance gene effects seems to control all earliness traits. In addition, data also showed that number of spikes/plant, number of kernels/spike and grain yield/plant were governed by partial dominance for most cases under the two sowing dates, whereas kernel weight was controlled by over dominance for most cases.

Table 2. The t-test of differences between parents and the F- test for significance of the genetic variances among F_2 plants in the three crosses of spring wheat for earliness traits under early and normal sowing dates.

Cross	Cross 1				Cross 2				Cross 3			
Sowing date	Early		Normal		Early		Normal		Early		Normal	
Character	P_1 vs P_2	F_2	P_1 vs P_2	F_2	P_2 vs P_3	F_2	P_2 vs P_3	F_2	P_3 vs P_4	F_2	P_3 vs P_4	F_2
Days to heading	**	**	**	**	**	**	**	**	**	**	**	**
Days to maturity	N.S	**	**	**	**	**	**	**	**	**	**	**
Grain filling period	**	**	**	**	**	**	**	**	**	**	**	**
Grain filling rate	**	**	**	**	**	**	**	**	**	**	N.S	**
No. spikes / plant	**	**	**	**	**	**	**	**	**	**	N.S	**
No. kernels / spike	**	**	**	**	**	**	*	**	*	**	**	**
100 kernels weight	**	**	N.S	**	**	**	**	**	*	**	N.S	**
Grain yield / plant	**	**	**	**	**	**	N.S	**	**	**	**	**

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

Cross 1: Sakha 61 /Line 2 Cross 2: Line 2 / Giza 163 Cross 3: Giza 163 / Gemmeiza 9

c- Types of gene action

Data were subjected to genetic analysis using Gamble (1962), procedure to estimate generation mean components i.e. mean effect (m), additive(a), dominance (d), additive × additive (aa) additive × dominance (ad) and dominance × dominance (dd) gene effects. However, types of gene action for all studied traits in the three crosses under the two sowing dates are shown in Table (4). The estimated mean effect parameter (m), which reflects the contribution due to overall mean plus the loci effects and interactions of the fixed loci, were highly significant for all studied traits in all crosses under the two sowing dates.

Additive genetic effect was significant and/or highly significant for most studied traits under the two sowing dates. These results indicated that the potentiality of improving the performance of these traits by using pedigree selection method might be more effective. In addition, the major contribution of dominance gene effects for most traits is indicated by the relative magnitude of dominance to (m) parameter. In addition, the dominance genetic effects were significant or highly significant for all traits in most crosses under the two sowing dates. These results are pointing out the importance of dominance gene effects in the inheritance of all traits. Significant additive and dominance components indicate that both additive and dominance gene effects were important in the inheritance of earliness traits. The presence of both additive and non-additive gene action for earliness traits indicate that selection procedures based on the accumulation of additive effect could be very successful in improving these traits. These results are infull agreement with those obtained by Hamada (2003b), Hammad and Abd El-Aty (2007) and Abd El-Rahman (2008).

Significant or highly significant additive × additive epistatic type of gene action was also detected for most studied traits. On the other hand, additive × dominance type of digenic epistsis was non-significant for most crosses under early sowing dates for most studied traits. However, it was significant for most crosses under normal sowing date for most studied traits. Dominance × dominance type of gene action was also significant for most crosses under early sowing date for most studied traits. The presence of both additive and non-additive gene actions in most studied traits would indicate that selection procedures based on the accumulation of additive effects might be successful in improving all traits under investigation. However, to maximize selection advance procedures, which are known to be effective in shifting genes frequency when both additive and non-additive genetic variations are involved would be preferred. These results were in agreement with those reported by Aglan (2003), Hendawy (2003), Abd El-Nour and Mosherf (2006) and El-Sayed and El-Shaarawy (2006).

Table 3. Means ($\bar{x}$) and variances (S^2) of P_1, P_2, F_1, F_2, BC_1 and BC_2 populations of all traits for three crosses of spring wheat under early and normal sowing dates.

Trait	Cross	Statistical parameter	Genotype											
			P_1		P_2		F_1		F_2		BC_1		BC_2	
			Early	Normal	Early	Normal	Early	Normal	Early	Normal	Early	Normal	Early	Normal
Days to heading	1	$\bar{x}$	75.80	92.23	63.40	75.57	71.77	89.97	71.53	86.41	75.23	89.97	68.52	82.02
		S^2	7.13	3.63	1.77	3.98	7.56	14.37	33.26	26.30	15.87	14.37	25.85	16.90
	2	$\bar{x}$	63.40	75.57	125.20	120.77	81.33	88.31	83.38	94.22	75.56	88.31	104.14	104.72
		S^2	1.77	3.98	14.37	1.70	10.37	25.14	225.65	86.25	57.87	25.14	184.57	64.85
	3	$\bar{x}$	125.20	120.77	99.17	106.53	113.27	118.96	119.62	115.29	123.17	118.96	112.96	114.82
		S^2	12.86	1.70	7.73	2.74	14.55	33.75	209.86	69.97	104.99	33.75	116.78	38.98
Days to maturity	1	$\bar{x}$	152.17	146.80	151.20	141.13	151.00	147.89	154.95	145.63	153.50	147.89	153.52	145.62
		S^2	5.94	1.82	4.10	5.77	6.62	5.94	18.71	10.53	12.57	5.94	12.01	6.22
	2	$\bar{x}$	151.20	141.13	171.53	157.60	153.00	147.17	156.44	146.75	158.13	147.17	165.84	150.88
		S^2	6.44	5.77	5.91	2.39	9.17	10.19	62.20	25.39	26.66	10.19	43.82	19.14
	3	$\bar{x}$	171.53	157.60	167.27	154.70	167.93	157.82	172.95	156.08	172.76	157.82	171.27	157.01
		S^2	5.91	2.39	7.17	3.04	4.75	16.69	50.53	31.92	28.88	16.69	27.79	18.60
Grain filling period	1	$\bar{x}$	76.37	54.57	87.80	65.57	79.23	57.92	83.42	59.22	78.27	57.92	85.00	63.60
		S^2	7.21	4.67	6.51	8.32	9.36	13.08	24.10	18.79	18.00	13.08	15.44	13.57
	2	$\bar{x}$	87.80	65.57	46.33	36.83	71.67	58.86	73.05	52.53	82.58	58.86	61.70	46.16
		S^2	8.99	8.32	12.02	1.32	16.64	17.92	85.38	40.96	35.28	17.92	73.27	27.57
	3	$\bar{x}$	46.33	36.83	68.10	48.17	54.67	38.87	53.34	40.79	49.59	38.87	58.31	42.19
		S^2	12.02	1.32	2.85	1.32	6.99	15.80	77.48	22.06	35.12	15.80	50.94	16.27
Grain filling rate	1	$\bar{x}$	0.70	1.06	0.29	0.66	0.44	1.01	0.52	0.85	0.53	1.01	0.35	0.80
		S^2	0.01	0.02	0.00	0.02	0.01	0.07	0.04	0.15	0.03	0.07	0.02	0.08
	2	$\bar{x}$	0.29	0.56	1.09	1.09	0.61	0.79	0.57	0.79	0.39	0.79	1.04	1.14
		S^2	0.01	0.02	0.07	0.03	0.04	0.09	0.11	0.16	0.03	0.09	0.12	0.13
	3	$\bar{x}$	1.09	1.09	0.60	1.03	0.86	1.12	0.78	0.83	0.95	1.12	0.82	0.86
		S^2	0.07	0.03	0.07	0.06	0.09	0.17	0.20	0.20	0.11	0.17	0.17	0.12

Cross 1: Sakha 61 /Line 2 Cross 2: Line 2 / Giza 163 Cross 3: Giza 163 / Gemmeiza 9

Table 3. Contd.

Trait	Cross	Genotype												
		Statistical parameter	P_1		P_2		F_1		F_2		BC_1		BC_2	
			Early	Normal	Early	Normal	Early	Normal	Early	Normal	Early	Normal	Early	Normal
No. spikes /plant	1	$\bar{x}$	19.7	22.77	10.43	14.5	10.93	20	14.96	18.06	13.6	22.26	11.03	16.89
		S^2	9.6	20.94	4.19	7.91	8.13	9.79	29.27	43.25	20.62	28.35	14.62	29.2
	2	$\bar{x}$	10.43	14.5	18	16.9	11.9	19.13	13.43	16.88	12.2	18.14	18.02	20.26
		S^2	4.19	7.91	9.66	8.58	12.3	8.33	25.39	30.16	17.62	20.75	18.67	24.89
	3	$\bar{x}$	18	16.9	11.47	18.53	14.27	15.47	15.78	16.56	17.49	19.51	13.73	17.1
		S^2	9.66	8.58	17.77	16.6	9.44	12.05	46.16	35.89	30.12	28.48	32.56	23.33
No. kernels / spike	1	$\bar{x}$	60.77	73.4	54.67	64.1	58.37	75.4	59.62	66.66	61.57	67.24	60.6	68.78
		S^2	34.46	27.7	25.54	25.54	66.31	18.73	126.17	108.7	69.19	71.98	99.93	66.35
	2	$\bar{x}$	54.67	64.1	74.37	67.53	67.73	77.07	63.61	63.59	55.98	63.92	69.11	69.7
		S^2	25.54	25.54	69.55	46.19	76	37.72	186.17	142.36	134.79	69.44	152.84	109.99
	3	$\bar{x}$	74.37	67.53	79.13	78.37	68.5	67.43	68.44	62.79	70.29	68.76	63.51	61.44
		S^2	69.55	46.19	77.43	210.24	83.36	75.84	487.77	301.12	205.04	222.5	461.04	237.26
100 kernel-weight	1	$\bar{x}$	5.56	5.36	6.91	5.49	6.57	5.78	5.83	5.24	5.73	5.24	6.42	5.76
		S^2	0.15	0.16	0.45	0.08	0.32	0.27	0.65	0.36	0.4	0.3	0.47	0.24
	2	$\bar{x}$	6.91	5.49	5.3	5.09	6.63	5.49	5.59	5.24	5.95	5.5	5.52	5.1
		S^2	0.45	0.29	0.16	0.1	0.3	0.08	0.69	0.55	0.55	0.41	0.44	0.34
	3	$\bar{x}$	5.3	5.09	5.53	5.25	5.88	5.68	5.17	4.92	5.12	5.23	5.65	5.24
		S^2	0.16	0.1	0.18	0.12	0.2	0.06	0.39	0.56	0.19	0.34	0.44	0.34
Grain yield/ Plant	1	$\bar{x}$	53.19	57.8	25.57	42.92	35.13	67.24	43.4	50.23	41.43	58.46	30.18	51.03
		S^2	54.46	76.12	22.88	65.96	46.58	70.72	326.1	546.3	189.1	270.77	180.18	351.88
	2	$\bar{x}$	25.57	42.92	50.29	39.91	43.45	68.84	40.31	40.79	32.21	46.37	62.42	52.43
		S^2	40.2	65.96	152	42.69	190.1	38.79	397.14	403.73	205.88	294.38	332.57	291.04
	3	$\bar{x}$	50.29	39.91	40.92	49.41	47.51	38.07	40.64	33.8.5	46.81	42.94	46.54	36.11
		S^2	152	42.69	86.05	153.82	72.56	86.65	526.4	317.21	277.85	236.39	425.71	227.75

Cross 1: Sakha 61 /Line 2 Cross 2: Line 2 / Giza 163 Cross 3: Giza 163 / Gemmeiza 9

Table 4. Types of gene action using generation means for all studied traits in three crosses of spring wheat under early and normal sowing dates.

		(m)		(a)		(d)		(aa)		(ad)		(dd)	
Trait	Cross	Early	Normal	Early	Normal	Early	Normal	Early	Normal	Early	Normal	Early	Normal
Days to heading	1	71.53**	86.41**	6.71**	7.94**	3.54	0.004	1.38	-1.66	0.51	-0.39	-6.16	-3.38
	2	83.38**	94.22**	-28.59**	-16.41**	12.90**	4.67	25.87**	9.17**	2.31	6.19**	-34.00**	-11.57*
	3	119.62*	115.29*	10.21**	4.13**	-5.14	6.05*	-6.22	6.40*	-2.81	-2.98**	-15.12*	-20.05**
Days to maturity	1	154.95*	145.63*	-0.02	2.27**	-6.44**	6.96**	-5.76**	4.49**	-0.51	-0.57	-2.92	-10.71**
	2	156.44*	146.75*	-7.71**	-3.71**	13.84**	6.09**	22.21**	9.09**	2.46**	4.52**	-41.43**	-13.71**
	3	172.95*	156.08*	1.49	0.81	-5.24*	2.78	-3.77	5.33**	-0.64	-0.64	-9.61**	-15.50**
Grain filling period	1	83.42**	59.22**	-6.73**	-5.68**	-9.98**	6.95**	-7.13**	6.15**	-1.02	-0.18	3.23	-7.33**
	2	73.05**	52.53**	20.88**	12.70**	0.94	1.42	-3.66	-0.08	0.14	-1.67*	-7.43	-2.14
	3	53.34**	40.79**	-8.72**	-3.32**	-0.10	-3.26*	2.45	-1.06	2.16*	2.34**	5.51	4.55
Grain filling Rate	1	0.52**	0.85**	0.17**	0.21**	-0.36**	0.48**	-0.31**	0.23	-0.03	0.01	0.42**	0.09
	2	0.57**	0.79**	-0.65**	-0.35**	0.48**	-1.80**	0.56**	0.72**	-0.25**	-3.09**	-0.82**	5.68**
	3	0.78**	0.83**	0.13*	0.26**	0.43**	0.51**	0.41**	0.62**	-0.11	0.23**	-0.53	-0.56*
No. spikes/ plant	1	14.96**	18.06**	2.57**	5.37**	-14.72**	7.42**	-10.59**	6.05**	-2.07*	1.23	13.32**	-7.07
	2	13.43**	16.88**	-5.82**	-2.11**	4.39*	12.70**	6.71**	9.27**	-2.04**	-0.91	-14.92**	-16.40**
	3	15.78**	16.56**	3.76**	2.41**	-1.16	4.75*	-0.69	7.00**	0.49	3.23**	-3.76	-13.85**
No. kernels/ spike	1	59.62**	66.66**	0.97	-1.53	6.52	12.04**	5.87	5.39	-2.08	-6.18**	-18.03*	10.86
	2	63.61**	63.59**	-13.13**	-5.78**	-1.06	24.13**	-4.28	12.88**	-3.28	-4.06*	18.60*	5.64
	3	68.44**	62.79**	6.78*	7.31**	-14.4	3.72	-6.15	9.24	9.16**	12.73**	29.05*	11.13
100-kernel weight	1	5.83**	5.24**	-0.69**	-0.52**	1.33**	1.37**	0.99**	1.01**	-0.01	-0.45**	0.33	-0.59
	2	5.59**	5.24**	0.43**	0.40**	1.10**	0.44	0.58*	0.25	-0.38**	0.20	1.94**	0.12
	3	5.17**	4.92**	-0.53**	-0.01	1.33**	1.75**	0.86**	1.25**	-0.41**	0.07	0.20	-0.48
Grain yield/ plant	1	43.40**	50.23**	11.25**	7.43**	-34.59**	34.94**	-30.34**	18.06*	-2.56	-0.01	36.13**	-1.85
	2	40.31**	40.79**	-30.21**	-6.06*	33.53**	61.87**	28.02**	34.44**	-17.85**	-7.57**	-54.53**	-11.53
	3	40.64**	33.85**	0.27	6.83**	26.05**	16.11*	24.15**	22.69**	-4.42	11.58**	-24.61	-15.33

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

Cross 1: Sakha 61 /Line 2 Cross 2: Line 2 / Giza 163 Cross 3: Giza 163 / Gemmeiza 9

d- Heritability and expected genetic advance from selection

Heritability estimates in broad and narrow senses and expected genetic advanced for all earliness traits are presented in Table (5). Generally, heritability values in broad sense under the two sowing dates as expected, were slightly higher than the corresponding ones in narrow sense in the three studied crosses for all studied traits except for few cases under the two sowing dates. In these cases, the same estimates in broad and narrow senses were detected. This could be due to the negative estimates of the dominance genetic variance. These results are in general agreement with those obtained by Hagras (1999) and Hammad (2003). On the other side, heritability estimates in narrow sense were moderate to high for all studied traits in the three studied crosses under the two sowing dates. These results revealed that the genetic variance was mostly attributed to additive effects for all studied traits. This confirmed the previous results found by means of gene action estimates of additive genetic portion, which was mostly predominant. Similar results were obtained by Chowdary and Kashif (2003), Hendawy (2003), Ismail *et. al.* (2006), and Abd El-Rahman (2008).

Data in Table (5) showed that the expected genetic advance for most studied traits under the two sowing dates were moderate to high. This indicate that heritability was due to additive gene effects and selection for these traits could be possible in early generations; however, it would be better if it was delayed to later generations.

For grain filling rate and kernel weight, the expected genetic advance estimates were low for all crosses under the two sowing dates, indicating that selection for these traits would be effective in late generations. This suggests that these traits are controlled by non-additive gene effects, and that the inheritance of such traits is influenced by environment rather than genotype. These results are in agreement with those of Hamada (2003a), Chandra *et. al.* (2004), Sharon *et. al.* (2005), Abd El-Nour and Mosherf (2006) and Abo Elala (2006).

Generally, In the present work, moderate to high genetic advance from selection as percentage (Δg %) was associated with moderate to high heritability estimates, therefore, selection in these particular populations could be effective and satisfactory for successful breeding purpose.

Table 5. Heritability percentage in broad and narrow senses and expected genetic advance from selection for earliness traits in three crosses of spring wheat under early and normal sowing dates.

		Heritability				Expected genetic advance			
		(h^2_b)		(h^2_n)		(Δ g)		(Δ g %)	
Trait	Cross	Early	Normal	Early	Normal	Early	Normal	Early	Normal
Days to heading	1	83.50	82.25	74.58	81.09	8.86	8.57	12.39	9.91
	2	96.08	97.40	92.56	95.97	28.64	18.36	34.35	19.49
	3	94.42	96.07	94.32	96.05	28.15	16.55	23.53	14.36
Days to maturity	1	70.33	62.04	68.67	62.04	6.12	5.65	3.95	3.88
	2	88.46	85.53	86.70	84.47	14.09	8.77	9.00	5.97
	3	88.23	91.77	87.83	89.48	12.86	10.41	7.44	6.67
Grain filling period	1	68.08	58.39	61.25	58.15	6.19	5.19	7.43	8.77
	2	85.30	89.51	72.87	88.93	13.87	11.72	18.99	22.32
	3	90.59	93.51	88.93	50.41	16.13	5.28	0.30	12.95
Grain filling rate	1	85.72	86.56	80.49	86.56	0.35	0.78	67.43	91.68
	2	63.42	86.74	58.62	69.37	0.40	0.58	69.01	73.62
	3	60.57	74.24	58.98	50.41	0.54	0.13	69.09	55.71
No. spikes/plant	1	75.04	70.21	75.04	66.93	8.87	9.07	59.27	50.2
	2	65.68	72.58	57.05	48.68	5.92	5.51	44.08	32.62
	3	73.37	65.43	64.23	55.67	8.99	6.87	56.96	41.5
No. kernels/spike	1	66.63	77.93	65.96	72.73	15.26	15.62	25.6	23.43
	2	69.37	74.37	45.5	73.96	12.79	18.18	20.11	28.59
	3	84.26	63.22	63.44	47.31	28.86	16.91	42.18	26.94
100-kernel weight	1	53.33	53.24	53.33	51.61	1.12	0.64	19.31	12.21
	2	55.7	72.07	54.93	65.83	0.94	1.01	16.76	19.26
	3	54	83.08	38.05	79.01	0.49	1.21	9.46	24.65
Grain yield/plant	1	87.33	87.02	86.75	86.02	32.27	41.42	74.37	82.45
	2	67.91	87.83	64.42	55	26.45	22.76	65.6	55.81
	3	80.33	70.25	66.34	53.68	31.36	19.7	77.16	58.18

Cross 1: Sakha 61 /Line 2 Cross 2: Line 2 / Giza 163 Cross 3: Giza 163 / Gemmeiza 9

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السلوك الوراثي للتبكير والمحصول ومكوناته في ثلاثة هجن من قمح الخبز في موعدين للزراعة

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أجريت هذه التجربة لدراسة توارث مكونات التبكير في النضج والصفات المحصولية الأخرى في قمح الخبز. وقد نفذت هذه التجربة بمحطة البحوث الزراعية بسخا في المواسم الزراعية من ٢٠٠٣/٢٠٠٤ وحتى ٢٠٠٥/٢٠٠٦. تم عمل ثلاثة هجن بين أربعة تراكيب وراثية مختلفة في موعد النضج وهذه الهجن هي سخا ٦١ × سلالة ٢ (مبكر × مبكر)، سلالة ٢× جيزة ١٦٣(مبكر × متأخر) و جيزة ١٦٣× جميزة ٩ (متأخر × متأخر). وقد قيمت الآباء والهجن في موعدين للزراعة أحدهما مبكر والأخر في الموعد المناسب. وتم تحليل البيانات تبعا لطريقة Gamble 1962. أوضحت نتائج اختبارات (t) أن جميع التراكيب الوراثية الداخلة في تكوين كل هجين كانت مختلفة معنويا عن بعضها لمعظم الصفات تحت الدراسة لكلا الموعدين. واظهر اختبار (F) لتقدير تباين الجيل الثاني وجود اختلافات عاليه المعنوية لكل الهجن لجميع الصفات تحت الدراسة في كلا الموعدين. كانت معظم قيم متوسطات مكونات التبكير في الهجن الثلاثة المستخدمة أقل في الموعد المناسب عن مثيلتها في الموعد المبكر.كانت قيم المتوسط العام لكل من صفات عدد سنابل النبات, عدد حبوب السنبلة و محصول النبات أعلى في الموعد المناسب عن مثيلتها في الموعد المبكر . بينما كانت قيم متوسطات صفة وزن الحبوب أعلي في الموعد المبكر عن مثيلتها في الموعد المناسب. كان للفعل الجيني المضيف والسيادي دورا كبيرا في وراثة كل الصفات المدروسة في كلا موعدي الزراعة. و أظهرت النتائج أن الفعل الجيني المضيف هو الأكثر أهمية في وراثة معظم الصفات. وكان للفعل الجيني التفوقي من نوعى المضيف × المضيف و السيادي × السيادي دورا مهما في وراثة الصفات المدروسة في موعدي الزراعة.كما كانت قيم درجة التوريث بمفهوميها العام والدقيق عالية في معظم الصفات المدروسة في الموعدين.وكانت قيم التحسين الوراثي متوسطة إلي عالية لمعظم الصفات في كل الهجن في الموعدين ولهذا ينصح بإجراء الانتخاب في الأجيال المبكرة ولكن سيكون من الأفضل تأخيره للأجيال المتأخرة.