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GENETIC ANALYSIS OF EARLINESS COMPONENTS IN SOME BREAD WHEAT GENOTYPES

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ABSTRACT

The main objectives of this investigation were to study the inheritance of earliness traits in wheat, (*Triticum aestivum* L.) also to evaluate and study some early and late mature parents and their resulted crosses. This investigation included eight bread wheat parental genotypes differed in their earliness components. Half diallel cross was made between these genotypes. The eight parents and their 28 F1 crosses were planted in two sowing dates, early and normal. The collected data were analyzed using Griffing 1956 procedure, Method 2, model 1.The collected data of this experiment were days to first node emergence, days to booting, days to heading, days to anthesis, days to maturity, grain filling period and grain filling rate. Mean performance of most earliness components was low at early sowing date comparing with those at normal one for most genotypes. The parental genotypes Line 1 and Line 2 and most of their crosses gave the most desirable values in most earliness traits. The crosses Line 1 × line 2, Line 1× Sonalica, Giza 163 × Gemmeiza 9 and Sakha 61 × Giza 163 gave the lowest mean values of earliness traits in early sowing date. Meanwhile, the crosses Line 1 × Line 2, Line 2 × Sonalica and Line 1 × Line 3 gave the best values toward earliness at normal sowing date. The cross between Line 1 and Line 2 was the most superior one in its earliness traits at the two sowing dates. Genotypes mean squares for all earliness traits were highly significant at the two sowing dates. The highest and desirable values of heterosis percentage relative to the mid parent for days to first node, to booting and days to heading were obtained from cross Giza 163 × Sids 1 at the two sowing dates, for days to anthesis from cross Giza 163 × Sids 1 under early sowing date and from cross Line 1 × Giza 163 at normal sowing one and, for days to maturity from cross Line 1 × Giza 163 at the two sowing dates. The best crosses over better parent for grain filling period was cross Giza 163 × Sids 1 under the two sowing dates, for grain filling rate was crosses Sakha 61× Giza 163 and Line 2 × Line 3 at the two sowing dates, respectively. General and Specific combining ability mean squares were highly significant for all traits under study at early and normal sowing dates. The GCA/SCA ratios were more than unity for all earliness traits at both sowing dates except for grain filling rate under normal sowing date. Based on general combining ability estimates, the best combiners at early and normal sowing dates for days to first node, to booting, to heading, to anthesis and for days to maturity were Line 1 and Line 2; and for grain filling period and grain filling rate were Giza 163 and Gemmeiza 9. Based on the estimates of specific combining ability estimates, the best cross for days to first node, to booting, and days to heading was cross Giza 163 × Sids 1 at both sowing dates, for days to anthesis was Giza 163 × Sids 1 at early sowing date and Sonalika × Giza 163 at normal sowing date; for days to maturity was Line 1× Giza 163 at early sowing date and Sakha 61 × Sonalika at normal sowing date, for grain filling period were Sakha 61× Giza 163 and Sakha 61× Sonalika at both sowing dates, respectively. For grain filling rate, the best crosses were Sakha 61 × Giza 163 and Line 2 × Line 3 under the two sowing dates, respectively.

INTRODUCTION

Developing new early maturing cultivars of bread wheat without losses in grain yield ability is the major objective of many wheat breeding programs. Yield losses due to biotic and abiotic stresses may be minimized in early maturing genotypes. These genotypes usually reach maturity before the development of many diseases and escape several harsh abiotic stress conditions during the 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.

Earliness in maturity is considered as a composed trait, because it depends on periods of growth stages; i.e. emergence, tillering, elongation, spikelet initiation, anthesis and grain filling to maturity. Moreover, these periods differed from genotype to another. It means that earliness seems to be a super-trait affected by many sub-traits, particularly those related to the physiological development of wheat plants. For instance, growth and its components have major influences on heading and maturity dates of wheat plants, which are eventually reflected on the final grain yield.

To exploit different types of gene action involved in inheritance of earliness traits of some Egyptian bread wheat genotypes, information regarding their relative magnitude and estimates of combining ability are essential. Combining ability studies are frequently used by plant breeders to evaluate newly developed genotypes for their parental usefulness and to assess the gene action involved in various traits, so as to design an efficient plan for further genetic upgrading of the existing materials. However, the combining ability and genetic variance components studies in a single environment may not provide precise information as environmental effects play an important role and greatly influence the genetic variance component estimates. Such information on combining ability analysis and /or genetic variance components of wheat under varying environmental conditions is scanty. It is, therefore, necessary to assess combining ability and components of genetic variance for earliness components to ensure better production and gain under selection. Such information will help wheat breeders in their identification of parents and selection strategies. The differences in the duration of vegetative growth phase, in some cultivars, seem to be related to their differences in earliness. Likewise, understanding the relationship between earliness components and yield potential will lead to an improved grain yield (Konings, 1989; 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 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 from some biotic and abiotic stresses such as rusts, hot winds and terminal heat in upper Egypt. The possibility of double cropping wheat and cotton in Egypt in the present time has new trends and considerable attentions among wheat breeders (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 main objectives of the present investigation were to:

1-Investigate the genotypic differences in earliness component traits to identify some early maturing and high yielding genotypes.

2-Determine the mode of inheritance, heterosis and combining ability for earliness components in some Egyptian bread wheat genotypes and their crosses tested under two sowing dates.

MATERIALS AND METHODS

The fieldwork of this study was conducted at the Experimental Farm of Sakha Agricultural Research Station (ARC), Kafer-Elsheikh, Egypt. The experiment was carried out during the two wheat growing seasons. 2003/2004 and 2004/2005. Eight genetically diverse bread wheat parental genotypes representing a wide range of several earliness traits were used in this investigation. However, the names, abbreviations, and pedigrees of these genotypes are given in Table 1. In 2003/2004 season, grains from each of the parental genotypes were sown at three various dates to overcome the differences in time of flowering during this season. All possible cross combinations excluding reciprocals were made among the eight parental genotypes. In 2004/2005, the materials comprising 36 genotypes (8 parents and 28 F_1 crosses) were evaluated in two separate experiments under two different sowing dates, i.e. 26/10/2004 and 24/11/2004. Each experiment was laid out in a randomized complete block design with four replications. Each genotype was sown in a single row 4m long, 25cm distance between rows and with plants 20cm apart within the row. The recommended package of cultural practices was followed. The collected data were, days to first node emergence, to booting, to heading, to anthesis, to maturity, grain filling period and grain filling rate.

Statistical procedures:

For the two sowing dates, the collected data were analyzed based on plot mean. All obtained data were subjected to the statistical analysis of the RCBD in four replications to test the differences among various genotypes under the two sowing dates. Combined analysis was not performed between the two sowing dates, where the homogeneity test indicated highly significant differences among them. MSTAT–C computer program was used in this concern. Moreover, for each sowing date, data were analyzed using Griffing (1956) procedure method 2 model 1 to estimate general and specific combining ability (GCA and SCA) estimates. In addition, heterosis was determined for individual cross as the percentage deviation of F_1 means from mid-parent (MP) and better-parent (BP) means and expressed as percentages for each sowing date.

Table 1: Names, abbreviations and pedigrees of eight bread wheat genotypes.

Genotype name	Abbr.	Earliness	Cross Name & Pedigree
Sakha 61	SKH 61	early	Inia / RL 4220 // 7c / Yr "S" CM15430 -2S-5S-0S-0S
Line 1	L1	early	BB /CC/2* CNO /3/ TOB/ 8156 /4/ SUN / PSN'S' /5/ BCH /4/ 7C/PATO (B) /3/ LR 64 / INIA// INIA /BB /6/ K 134 (60) / VEE S. 12544-5S-3S-3S-2S
Line 2	L2	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
Sonalika	SKA	early	II53.388/AN//YT54/N10B/3/LR/4/ 4649.A.4.18.2. 1Y / Y53 // 3*Y50 II18427 – 4R – 1M – 0IND
Giza 163	GZ 163	late	T. aestivun / Bon // Cno / 7c CM33009 –F-15M-4Y-2M-1M-1M-1Y-0M
Gemmeiza 9	GEM 9	late	Ald "S" / Huac"s" // Cmh 74 A. 630 / Sx GM 4583-5GM-1GM-0GM
Sids 1	SD 1	late	Hd 2172 / Pavon "S" // 1158.57/ Maya 74 S" Sd 46-4Sd-2Sd-1Sd-0Sd
Line 3	L3	late	SERI /3/ R37 /GHL 121 // KAL / BB /4/ MN 72253 / ALD /5/SITTA /6/ ESDA / KAUZ CMSS 92Y01642T -35Y-010M-010Y-010Y-1M-0Y-0AP

RESULTS AND DISCUSSION

Analysis of variance:

Analysis of variance for each sowing date for earliness traits are presented in Table 2. In each sowing date, analyses of variance for earliness traits were highly significant for all genotypes, reflecting the presence of sufficient genetic variability among these genotypes and the behavior of each genotype is markedly different from sowing date to another. Similar results were found by Moghaddam *et al.* (1997), Sharma and Tandon (1997), Hamada (2003) and Menshawy (2005). From the previous results, it could be concluded that most sources of variations were higher at early sowing date than those obtained from normal sowing date.

Table (2): Analysis of variance for earliness traits for early (E) and normal (N) sowing dates.

S.O.V	Reps		Genotypes		Error	
d.f	3		35		105	
Trait	M.S					
	E	N	E	N	E	N
Days to first node	2.71*	2.30**	228.54**	189.46**	0.91	0.48
Days to booting	8.45*	15.51**	1284.32**	394.11**	2.69	1.99
Days to heading	8.04*	14.19**	1252.88**	258.60**	2.28	0.95
Days to anthesis	2.14	8.10**	1154.09**	212.02**	1.83	1.17
Days to maturity	7.58**	15.86**	112.40**	60.27**	1.30	3.72
Grain filling period	5.60**	34.51**	721.63**	90.17**	2.84	4.73
Grain filling rate	0.06**	0.15**	0.13**	0.08*	0.02	0.03

*,** Significant at 0.05 and 0.01, probability levels , respectively.

Mean performance:

Mean performance estimates of the parents and their resulted hybrids for all earliness traits are given in Table 3. As known, the low mean performances of earliness component traits are preferred. Generally, mean performance of most studied traits of the involving parents were markedly decreased at early sowing date except for the late parent, Giza 163, where its mean value was higher at early sowing date. It may be due the genotypes differentiation responses and sensitivity to temperature and light changes when plants are exposing to different degrees of temperature and day light requirements through early sowing date which will be reflected on phases of development and the transformation from vegetative phase to reproductive one.

The results presented in Table 3 showed that, genotypes which had long heading date and short grain filling periods had the highest mean values of grain filling rate. These results are in accordance with the findings of Menshawy (2005). These results suggest that genotypes having long heading periods usually require short time to reach physiological maturity due to their short filling period. In general, the parental genotypes Line 1 and Line 2 and most of their resulted crosses gave the most superior and desirable values toward earliness. Such genotypes may be used in wheat breeding programs to improve and produce early mature genotypes useful in entering new agricultural rotations including also some early mature crops.

The resulted crosses could be classified to three groups based on the mating system or crossing type as follows: at normal sowing date, mating system early × early gave early mature crosses by percentage of 100% or all F_1 progenies were early. Meanwhile, mating system early × late gave some of early mature crosses percentage of 25%. On the other side, mating system late × late did not give any early mature crosses either at early or normal sowing dates. This means that, to produce early mature crosses, it is necessary to use at least one early mature parent in mating process. In addition, all mean performances at early sowing date were low when compared with their corresponding ones at normal sowing date. This reflected that the environmental conditions existing in each sowing date were markedly different. In other word, the behavior of each genotype was markedly changed at the two sowing dates. Doubtless, the upnormal or non expected changes due to high temperature degrees existing at early sowing date seem to be the main causes to decreasing mean performances of some earliness traits.

Combining ability analysis:

Variances of combining ability for all earliness traits at the two sowing dates are presented in Table 4. Both general combining ability and specific combining ability (GCA and SCA) variances were highly significant for all traits under the two sowing dates, indicating the importance role of additive and non-additive effects in determining the performance of these traits. However, GCA variance values were higher than those of SCA were for all traits under the study at the two sowing dates. The obtained findings proved that, selection for improve earliness traits would be more effective by using some of the present parents and crosses. Moreover, the results revealed that the ratios of GCA/SCA under the two sowing dates were more than unity for all traits except for grain filling rate at normal sowing date only. This means that these traits are predominantly controlled by additive gene effect. Therefore, it could be concluded that selection procedure based on the accumulation of additive effect would be more effective in early segregated generations. On the other hand, grain filling rate at normal sowing date was mainly controlled by non-additive gene action. These results are agreement with those obtained by many researches, Hamada (2003), Nazeer *et al.* (2004)and Menshawy (2005).

Table (3): Mean performance of the eight parents and their crosses for earliness characters under early (E) and normal (N) sowing dates.

Trait***	FN		DB		DH		DA		DM		GFP		GFR	
Date	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.
Parents														
SKH 61	40.50	54.3	58.0	83.3	77.8	94.3	91.3	103.5	159	149	81.5	54.5	0.46	0.80
L. 1	37.00	46.3	42.3	68.5	57.5	83.5	72.8	96.5	152	144	94.3	60.5	0.32	0.61
L. 2	37.25	44.8	42.3	64.5	59.8	81.5	72.5	94.0	154	144	94.5	62.0	0.28	0.56
SKA	38.5	47.5	49.3	68.3	66.0	86.5	80.8	97.5	158	147	92.0	60.0	0.41	0.62
GZ 163	68.3	73.5	117.0	103.5	129.5	115.8	139.0	125.3	174	157	44.3	41.3	0.85	1.00
GEM 9	47.0	62.3	84.3	95.3	99.0	104.3	115.5	113.8	169	156	69.8	51.3	0.63	0.73
SD 1	41.5	52.5	74.0	89.5	97.8	103.0	116.0	113.5	170	156	71.8	52.0	0.81	0.95
L. 3	51.8	65.3	84.3	94.3	104.0	105.6	117.8	114.3	167	156	63.3	50.0	0.56	0.88
Hybrids														
SKH 61 × L. 1	38.5	52.5	46.5	72.5	63.6	88.3	78.3	99.8	155	145	91.5	57.0	0.44	0.74
SKH 61 × L. 2	39.5	52.5	50.3	73.5	66.8	88.6	80.5	99.3	158	146	90.8	57.5	0.35	0.69
SKH 61 × SKA	40.5	54.0	53.0	74.5	70.0	89.5	88.3	101.8	159	144	89.3	54.3	0.59	1.01
SKH 61 × GZ 163	59.8	65.8	93.0	92.5	107.5	103.3	118.8	112.8	166	153	58.0	49.3	0.96	0.97
SKH 61 × GEM 9	44.8	63.0	68.3	88.5	86.5	99.5	99.3	108.3	164	152	77.8	52.8	0.74	0.87
SKH 61 × SD 1	42.0	54.5	61.0	85.3	81.3	97.3	96.8	106.3	165	151	83.3	53.5	0.59	0.90
SKH 61 × L. 3	46.0	60.8	67.5	87.0	85.5	98.8	98.8	106.3	165	153	79.3	53.8	0.67	0.98
L. 1 × L. 2	37.8	47.0	44.0	67.8	59.0	83.0	72.8	96.0	155	145	95.5	61.5	0.26	0.56
L. 1 × SKA	38.3	48.3	47.8	68.8	62.8	85.6	77.8	97.8	154	145	91.5	59.5	0.34	0.70
L. 1 × GZ 163	41.8	53.8	60.3	82.0	76.3	94.3	90.8	103.5	155	146	79.0	51.5	0.69	0.97
L. 1 × GEM 9	40.8	54.8	59.3	82.0	73.5	93.3	88.8	103.5	162	149	68.8	55.3	0.55	0.73
L. 1 × SD 1	40.0	52.5	53.5	77.8	71.8	92.3	90.5	103.0	163	147	91.0	54.3	0.52	0.79
L. 1 × L. 3	40.5	52.0	69.3	78.8	74.3	93.0	89.3	103.3	161	147	87.0	53.8	0.43	0.82
L. 2 × SKA	38.3	48.3	47.5	68.3	63.8	85.3	77.0	97.0	155	145	91.0	59.8	0.44	0.70
L. 2 × GZ 163	45.3	55.5	67.3	83.5	83.3	95.5	97.8	104.2	162	147	78.3	51.0	0.61	0.89
L. 2 × GEM 9	43.3	54.3	65.3	85.3	79.5	95.0	92.5	104.3	164	148	84.3	52.5	0.51	0.72
L. 2 × SD 1	40.5	52.3	54.3	78.0	73.3	92.5	88.5	102.5	164	147	90.3	54.3	0.50	0.82
L. 2 × L. 3	40.8	53.5	58.5	80.3	74.3	94.0	88.5	103.8	164	149	89.3	54.8	0.47	1.17
SKA × GZ 163	46.3	59.8	69.0	85.5	87.0	96.8	101.3	105.5	162	151	74.8	54.3	0.71	0.98
SKA × GEM 9	41.8	54.3	61.8	83.5	78.3	95.3	94.5	104.5	164	150	85.5	54.8	0.51	0.95
SKA × SD 1	39.0	52.3	51.8	76.3	70.0	92.8	88.3	103.3	163	152	92.5	59.0	0.53	0.77
SKA × L. 3	42.0	51.5	60.8	78.8	76.3	94.0	91.0	103.0	164	150	88.0	56.3	0.54	0.85
GZ 163 × GEM 9	60.5	67.3	103.3	98.2	118.3	109.8	131.0	118.3	169	154	50.8	43.8	0.87	0.92
GZ 163 × SD 1	41.3	55.0	66.5	90.5	87.5	101.8	99.5	113.5	166	153	78.0	50.8	0.86	1.05
GZ 163 × L. 3	63.0	67.3	101.3	96.3	116.8	107.5	129.3	116.8	168	153	51.0	45.3	0.86	0.81
GEM 9 × SD 1	41.5	60.3	67.0	89.5	83.0	101.5	99.0	112.3	168	153	85.0	51.3	0.52	0.93
GEM 9 × L. 3	48.5	65.8	85.3	95.5	103.0	105.3	117.3	116.0	168	153	64.8	48.0	0.78	0.85
SD 1 × L. 3	43.3	62.8	69.8	90.5	90.0	102.5	104.8	113.3	168	154	77.5	51.0	0.63	0.97
Means	44.1	56.1	65.1	82.7	82.1	95.8	96.6	106.	162	149	80.4	53.7	0.58	0.84
LSD 0.05	1.37	1.00	2.53	2.03	2.17	1.39	1.94	1.55	1.64	2.77	5.82	4.21	0.18	.24
0.01	1.84	1.34	3.17	2.73	2.92	1.88	2.61	2.09	2.20	3.72	7.83	5.66	0.24	0.33

*,**Significant at 0.05 and 0.01, probability levels respectively.

*** FN: Days to first node DB: Days to booting DH: Days to heading DA: Days to anthesis DM: Days to maturity GFP: Grain filling period GFR: Grain filling rate

However, additive gene effect was the major part of the genetic variability. Degree of dominance was less than unity for all earliness components under the three sowing dates, indicating the presence of partial dominance controlling earliness traits. Abd-El-Nour, Nadia (2006), Darwish (2007) and Singh *et al.* (2007) obtained similar results.

Table (4): Mean squares of general combining ability (GCA) and specific combining ability (SCA) of 8-parent wheat diallel cross for earliness traits under early (E) and normal (N) sowing dates.

S.O.V	GCA		SCA		Error		GCA/SCA	
d.f	7		35		105			
	M.S							
Trait	E	N	E	N	E	N	E	N
Days to first node	917.26**	838.28**	56.48**	27.25**	0.91	0.48	1.65	3.13
Days to booting	5702.05**	1923.91**	179.89**	11.66**	2.69	1.99	3.22	19.88
Days to heading	5619.11**	1251.08**	161.32**	10.48**	2.28	0.94	3.53	13.10
Days to anthesis	5126.03**	999.16**	161.11**	15.24**	1.82	1.17	3.22	7.09
Days to maturity	505.53**	263.36**	14.12**	9.50**	1.30	3.72	3.93	4.49
Grainfilling period	3087.94**	407.82**	130.06**	10.76**	2.84	4.73	2.43	6.68
Grain filling rate	0.54**	0.22**	0.03*	0.05**	0.02	0.03	5.20	0.95

*,**Significant at 0.05 and 0.01, probability levels respectively.

General combining ability (GCA) estimates:

Estimates of general combining ability (GCA) effects of all parental genotypes for earliness traits under the two sowing dates are presented in Table 5. These estimates were fluctuated and had no stable trends between the two sowing dates. It seems that due to the sharply changes in degrees of temperature existing during the growing season caused some of non expected fluctuated results in most studied traits particularly earliness components.

Based on general combining ability estimates, it could be concluded that the best combiners for days to first node, to booting, to heading, to anthesis and days to maturity were Sakha 61, Line 1, Line 2 and Sonalika at both sowing dates, and Sids 1 for days to first node under the two sowing dates and days to booting at early sowing date. These parents had desirable and significant negative GCA estimates for these traits. These results are in general agreement with those reported by Sharma and Tandon (1997). Also, these results were completely agreed with those reported by Menshawy *et al.* (2004) and El-Hawary (2006). For grain filling period the best combiners were Giza 163, Gemmeiza 9 and Line 3 under the two sowing dates, in addition, for grain filling rate the best combiners were Giza 163, Gemmeiza 9, Sids 1and Line 3 under the two sowing dates, except for Gemmeiza 9 at normal sowing date. These results indicated that these genotypes could be considered as good combiners for developing these traits. Lastly, it was interested to notice that, the strong relationship between GCA estimates and their corresponding mean performances, where early mature parents had the lowest mean performances and negative sign of GCA estimates for most earliness components.

Table (5): Estimates of general combining ability estimates of 8 spring wheat parents for earliness traits under early (E) and normal (N) sowing dates.

Trait***	FN		DB		DH		DA		DM		GFP		GFR	
Date	E	N	E	N	E	N	E	N	E	N	E	N	E	N
Geno.														
SKH 61	-0.47**	0.71**	-3.06**	-0.41*	-2.21**	-0.89**	-2.61**	-1.31**	-1.29**	-0.49	0.91**	0.41	0.01	0.02
L. 1	-4.52**	-5.12**	-13.06**	-7.79**	-14.26**	-6.59**	-13.56**	-5.46**	-5.34**	-3.51**	8.91**	3.08**	-13.**	-0.11**
L. 2	-3.69**	-5.12**	-11.46**	-7.89**	-11.88**	-6.57**	-12.61**	-5.94**	-3.42**	-3.34**	8.46**	3.23**	-0.15**	-0.09**
SKA	-3.37**	-4.12**	-9.61**	-7.24**	-9.86**	-5.04**	-8.96**	-4.66**	-2.57**	-1.56**	7.22**	3.48**	-0.07**	-0.04
GZ 163	9.76**	6.68**	20.84**	9.11**	19.69**	7.78**	17.72**	7.06**	3.16**	2.31**	-16.54**	-5.47**	0.20**	0.10**
GEM 9	1.83**	3.96**	9.24**	6.86**	8.14**	4.56**	8.44**	4.01**	3.14**	2.34**	-4.74**	-2.22**	0.05**	-0.01
SD 1	-2.62**	-0.94**	-1.43**	2.24**	1.37**	2.41**	3.02**	2.66**	3.11**	1.91**	1.74**	-0.49	0.06**	0.06*
L. 3	3.08**	3.96**	8.52**	5.11**	8.99**	4.36**	8.54**	3.64**	2.96**	2.34**	-6.04**	-2.02**	0.03	0.06*
LSD(gi)														
0.05	0.28	0.20	0.48	0.40	0.44	0.28	0.40	0.34	0.33	0.56	0.49	0.63	0.03	0.06
0.01	0.37	0.26	0.64	0.52	0.59	0.37	0.53	0.45	0.44	0.74	0.65	0.83	0.05	0.08
LSD gi-gj														
0.05	0.42	0.28	0.73	0.63	0.67	0.44	0.60	0.49	0.51	0.86	0.75	0.97	0.06	0.06
0.01	0.56	0.37	0.96	0.83	0.88	0.59	0.79	0.64	0.67	1.14	0.99	1.28	0.07	0.08

***,**Significant at 0.05 and 0.01, probability levels respectively.**

***** FN: Days to first node DB: Days to booting DH: Days to heading DA: Days to anthesis**
DM: Days to maturity GFP: Grain filling period GFR: Grain filling rate

Specific combining ability (SCA) estimates:

The estimates of specific combining ability (SCA) estimates under the two sowing dates are presented in Table 6. For days to first node, nine and eight crosses considered as the best crosses under early and normal sowing dates. The most desirable crosses were Line 1 × Giza 163 and Giza 163×Sids 1.

Regarding to days to booting, fourteen and seven crosses had significant negative SCA under the two sowing dates, respectively. The most superior crosses were Line 1 × Giza 163 and Giza 163 × Sids 1 at early sowing date, while, for normal sowing date the best crosses were Giza 163 × Sids 1and Gemmeiza 9 × Sids 1. With respect to days to heading, data showed fourteen and six crosses possess desirable significant negative SCA estimates under the two sowing dates. The most superior crosses were Line 1 × Giza 163 and Giza 163 × Sids 1 under early and normal sowing dates, respectively. For days to anthesis there were fourteen and eight crosses had significant negative SCA estimates under early and normal sowing dates, respectively. The most desirable crosses were Line 1 × Giza 163 and Giza 163 × Sids 1 at early sowing date, while, for normal sowing date the best crosses were Line 2 × Giza 163 and Sonalika × Giza 163. For days to maturity, six and three crosses under the two sowing dates had significantly negative values. The best crosses of them were Line 1 × Giza 163 and Giza 163 × Sids 1 at early sowing date and Sakha 61 × Sonalika and Line 1 × Giza 163 at normal sowing date. For grain filling period, there were seven and five crosses possessed desirably significant SCA estimates under early and normal sowing dates, respectively. The most superior crosses were Giza 163 × Gemmeiza 9 and Giza 163 × Line 3 at early sowing date and Sakha 61 × Sonalika and Giza 163 × Gemmeiza 9 at normal sowing date. Concerning grain filling rate, the best cross was Sakha 61 × Giza 163 at early sowing date and Line 2 × Line 3 at normal sowing date. Generally, the most superior and diserable crosses for for most ealiness traits at early sowing date were Line 1 × Giza 163, Giza 163 × Sids 1, Giza 163 × Gemmeiza 9 and Giza 163 × Line 3. For normal sowing date the best crosses were Sakha 61 × Sonlika, Line 1 × Giza 163, Giza 163 × Sids 1 and Giza 163 × Gemmeiza 9. For both sowing dates the most superior crosses were Line 1 × Giza 163, Giza 163 × Sids 1 and Giza 163 × Gemmeiza 9.

These results clarified the most previously defined and valuable crosses possessed non-additive gene effects in different earliness traits. Also, it suggested that above mentioned crosses could be useful in wheat breeding programs for improving these traits. More and broad extensive experiments will be needed to screen these valuable genetic materials before using in the wheat breeding programs to devlop and improve early mture genotypes.

Heterosis percentages:

The estimations of heterosis over mid and better parents for earliness traits under the two sowing dates are presented in Table 7. For days to first node, there were thirteen and ten crosses had highly significant negative heterosis effects for mid-parent under the two sowing dates, respectively.

Table (6): Estimates of specific combining ability estimates for earliness traits of F_1 diallel crosses tested under early (E) and normal (N) sowing dates.

Trait	FN		DB		DH		DA		DM		GFP		GFR	
Date	E	N	E	N	E	N	E	N	E	N	E	N	E	N
Geno.														
SKH61/L1	-0.59	0.86**	-2.51**	-2.01**	-2.11**	-0.09	-2.15**	0.48	-0.83	-0.24	1.27	-0.15	-0.01	-0.02
SKH61/L2	-0.41	0.86**	-0.36	-0.91	-1.23	0.14	-0.85	0.46	-*0.25	0.34	0.97	0.20	0.08	-0.08
SKH61/SKA	0.26	1.36**	0.54	-0.56	0.00	-0.39	3.25**	1.68**	0.65	-3.69**	0.65	-3.30**	0.08	0.19
SKH61/GZ163	6.39**	2.31**	10.09**	1.09	7.95**	0.54	7.71**	0.96	1.17*	1.19	-6.78**	0.65	0.17**	0.01
SKH61/GEM9	-0.69	2.29**	-3.06**	-0.66	-1.50*	0.01	-3.15**	-0.49	-0.33	0.91	1.17	0.90	0.10	0.02
SKH61/SD1	1.01*	-1.31**	0.37	0.72	0.03	-0.09	-0.23	-1.14*	0.22	-0.16	0.20	-0.07	-0.05	-0.01
SKH61/L3	1.89**	0.04	-3.08**	-0.41	-3.35**	-0.54	-3.75**	-2.12**	0.62	1.16	3.97**	1.70	0.05	0.05
L1/L2	-0.69	1.19**	3.39**	0.72	3.08**	0.34	2.35**	1.36**	0.80	1.86*	-2.28*	1.53	-0.03	-0.09
L1/SKA	2.06**	1.44**	5.29**	1.07	4.80**	1.31**	3.70**	1.83**	-0.30	0.59	-5.10**	-0.72	-0.06	0.00
L1/GZ163	-7.56**	-3.86**	-12.66**	-2.03**	-11.25**	-2.76**	-9.98**	-4.14**	-5.03**	-2.54**	6.22**	0.23	0.04	0.13
L1/GEM9	-0.64	-0.14	-2.06**	0.22	-2.45**	-0.54	-2.70**	-1.09*	1.72**	0.19	4.17**	0.73	0.05	0.01
L1/SD1	3.06**	2.51**	2.87**	0.59	2.58**	0.61	4.48**	-0.24	2.52**	-1.39	-0.05	-2.00**	0.02	-0.01
L1/L3	-2.14**	-2.89**	-0.83	-1.28**	-2.55**	-0.59	-2.30**	-0.97*	1.17*	-1.65	3.72**	-0.97	-0.05	0.02
L2/SKA	1.24**	1.44**	3.44**	0.67	3.43**	1.04*	2.00**	1.56**	-1.73**	0.41	-5.15**	-0.62	0.09	-0.02
L2/GZ163	-4.89**	-2.11**	-7.26**	-0.43	-6.63**	-1.54**	-3.93**	-2.92**	-0.70	-1.96*	5.92**	-0.42	-0.03	0.04
L2/GEM9	1.04*	-0.64	2.34**	3.57**	1.18	1.19**	0.35	0.13	1.30*	-0.99	0.12	-2.17*	0.03	-0.02
L2/SD1	2.74**	2.76**	2.02**	0.94	1.70*	0.84	1.53*	-0.27	1.35*	-1.31	-0.35	-2.15*	0.01	0.01
L2/L3	-2.71**	-1.39**	-3.68**	0.32	-4.43**	0.39	-3.75**	0.01	2.00**	0.26	6.42**	-0.12	0.01	0.36**
SKA/GZ163	-4.21**	1.14**	-7.26**	0.92	-4.90**	-1.81**	-4.08**	-2.94**	-1.30*	0.76	3.60**	2.58**	0.00	0.07
SKA/GEM9	-0.79	-1.64**	-3.01**	1.17	-2.10**	-0.09	-1.55*	-0.89	0.45	-0.26	2.55**	-0.17	-0.05	0.17
SKA/SD1	0.91*	1.26**	-2.33**	-1.46*	-3.58**	-0.44	-2.38**	-0.79	-0.50	1.91*	3.07**	2.35*	-0.03	-0.19
SKA/L3	-1.79**	-4.39**	-3.68**	-1.83**	-4.95**	-1.14**	-5.15**	-2.02	1.40**	-0.01	6.35**	1.13	0.00	-0.02
GZ163/GEM9	4.84**	0.56	8.04**	-0.43	8.35**	1.59**	8.28**	1.13*	-0.03	-0.64	-8.38**	-2.22*	0.03	0.00
GZ163/SD1	-9.96**	-6.79**	-18.03**	-3.56**	-15.63**	-4.26**	-17.80**	-2.27**	-3.23**	-1.21	12.40**	3.05**	0.02	0.05
GZ163/L3	6.09**	0.56	6.77**	-0.68	6.00**	-0.46	6.43**	0.01	-0.83	-1.39	-6.83**	-0.92	0.04	-0.20*
GEM9/SD1	-1.79**	1.19**	-5.93**	-2.31**	-8.58**	-1.29**	-9.03**	-0.47	-0.98	-0.99	7.60**	0.30	-0.17**	0.05
GEM9/L3	-0.49	1.79**	2.37**	0.82	3.80**	0.51	3.70**	2.31**	-1.08*	-0.91	-4.88**	-1.42	0.12*	-0.05
SD1/L3	-1.29**	3.69**	-2.46**	0.44	-2.43**	-0.09	-3.38**	0.91	-1.03*	-0.24	1.40	-0.15	-0.03	0.00
LSD Sij														
0.05	0.86	0.63	1.47	1.27	1.36	0.86	1.21	0.97	1.03	1.74	1.51	1.95	0.11	0.20
0.01	1.13	0.83	1.95	1.68	1.79	1.14	1.60	1.28	1.36	2.30	2.00	2.58	0.15	0.26
LSD Sij-Skl														
0.05	1.27	0.93	2.18	1.88	2.01	1.30	1.80	1.44	1.52	2.57	2.24	2.89	0.16	0.20
0.01	1.68	1.23	2.88	2.48	2.65	1.72	2.37	1.91	2.01	3.39	2.96	3.82	0.22	0.26

***,**Significant at 0.05 and 0.01, probability levels respectively.**
***** FN: Days to first node DB: Days to booting DH: Days to heading DA: Days to anthesis**
DM: Days to maturity GFP: Grain filling period GFR: Grain filling rate

Table (7): Percentages of heterosis over mid-parent (M.P) and better- parent (B.P) for F_1 crosses for earliness characters under early (E) and normal (N) sowing dates.

Character***	FN				D.B				D.H				D.A			
Date	E.		N.		E.		N.		E.		N.		E.		N.	
Genotype	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P
SKH.61/L.1	-0.65	4.05**	4.48**	13.51**	-7.23**	10.06**	-4.45**	5.84**	-6.10**	10.43**	-0.70	5.69**	-4.57**	7.56**	-0.25	3.37**
SKH.61/L.2	1.61**	6.04**	6.06**	17.32**	0.25	18.93**	-0.51	13.95**	-2.91**	11.72**	0.71	8.59**	-1.68*	11.03**	0.51	5.59**
SKH.61/SKA.	2.53**	5.19**	6.14**	13.68**	-1.17	7.61**	-1.65	9.16**	-2.61**	6.06**	-0.97	3.47**	2.62**	9.29**	1.24	4.36**
SKH.61/GZ.163	9.89**	47.53**	2.94**	21.20**	6.29**	60.34**	-0.94	11.11**	3.74**	38.26**	-1.67**	9.55**	3.15**	30.14**	-1.42*	8.94**
SKH.61/GEM.9	2.29**	10.49**	8.15**	16.13**	-4.04**	17.67**	-0.84	6.31**	-2.12*	11.25**	0.25	5.57**	-3.99**	8.77**	-0.35	4.59**
SKH.61/SD.1	2.44**	3.70**	2.11**	3.81**	-7.58**	5.17**	-1.30	2.40*	-7.41**	4.50**	-1.39*	3.18**	-6.63**	6.03**	-2.07**	2.66**
SKH.61/L.3	-0.27	13.58**	1.67**	11.98**	-5.10**	16.38**	-1.97*	4.50**	-5.91**	9.97**	-1.13	4.77**	-5.50**	8.22**	-2.41**	2.66*
L.1 / L.2	1.68**	2.03**	3.30**	5.03**	4.14**	4.14**	1.88*	5.04**	0.64	2.61*	0.61	1.84**	0.17	0.34	0.79	2.13**
L.1 / SKA.	1.32*	3.38**	2.93**	4.32**	4.37**	13.02**	0.55	0.73	1.62	9.13**	0.59	2.40**	1.30	6.87**	0.77	1.30
L.1 / GZ.163	-20.67**	12.84**	-10.23**	16.22**	-24.33**	42.60**	-4.65**	19.71**	-18.45**	32.61**	-5.40**	12.87**	-14.29**	24.74**	-6.65**	7.25**
L.1 / GEM.9	-2.98**	10.14**	0.92*	18.38**	-6.32**	40.24**	0.15	19.71**	-6.07**	27.83**	-0.67	11.68**	-5.71**	21.99**	-1.55*	7.25**
L.1 / SD.1	1.91**	8.11**	6.33**	13.51**	-7.96**	26.63**	-1.58	13.50**	-7.57**	24.78**	-1.07	10.48**	-4.11**	24.40**	-1.90**	6.74**
L.1 / L.3	-8.73**	9.46**	-6.73**	12.43**	-5.53**	41.42**	-3.23**	14.96**	-8.05**	29.13**	-1.59**	11.38**	-6.30**	22.68**	-2.02**	6.99**
L.2 / SKA.	0.99	2.68**	4.61**	7.82**	3.83**	12.43**	2.82**	5.81**	1.39	6.69**	1.49*	4.60**	0.49	6.21**	1.31*	3.19**
L.2 GZ.163	-14.22**	21.48**	-6.13**	24.02**	-15.54**	59.17**	-0.60	29.46**	-12.02**	39.33**	-3.17**	17.18**	-7.57**	34.83**	-4.90**	10.90**
L.2 / GEM.9	2.67**	16.11**	1.40**	21.23**	3.16**	54.44**	6.73**	32.17**	0.16	33.05**	2.29**	16.56**	-1.33	27.93**	0.36	10.90**
L.2 / SD.1	2.86**	8.72**	8.48**	17.88**	-6.67**	28.40**	1.30	20.93**	-6.98**	22.59**	0.27	13.50**	-6.10**	22.07**	-1.20	9.04**
L.2 / L.3	-8.43**	9.40**	-2.73**	19.55**	-7.51**	38.46**	1.10	24.42**	-8.70**	25.10**	0.53	15.34**	-6.70**	22.41**	-0.36	10.37**
SKA./GZ.163	-13.35**	20.13**	-1.24**	25.79**	-16.99**	40.10**	-0.44	25.27**	-11.00**	31.82**	-4.33**	11.85**	-7.85**	25.39**	-5.27**	8.21**
SKA./GEM.9	-2.34**	8.44**	-1.14**	14.21**	-7.49**	25.38**	2.14*	22.34**	-5.15**	18.56**	-0.13	10.12**	-3.69**	17.03**	-1.07	7.18**
SKA./SD.1	-2.50**	1.30	4.50**	10.00**	-16.02**	5.08**	-3.33**	11.72**	-14.50**	6.06**	-2.11**	7.23**	-10.29**	9.29**	-2.13**	5.90**
SKA./L.3	-6.93**	9.09**	-8.65**	8.42**	-8.99**	23.35**	-3.08**	15.38**	-10.29**	15.53**	-2.08**	8.67**	-8.31**	12.69**	-2.72**	5.64**
GZ.163/GEM.9	4.99**	28.72**	-0.92*	8.03**	2.61*	22.55**	-1.13	3.15**	3.50**	19.44**	-0.23	5.28**	2.95**	13.42**	-1.05	3.96**
GZ.163/SD.1	-24.83**	-0.60	-12.70**	4.76**	-30.37**	-10.14**	-6.22**	1.12	-22.99**	-10.49**	-6.97**	-1.21	-21.96**	-14.22**	-4.92**	0.00
GZ.163/L.3	5.00**	21.74**	-3.06**	3.07**	0.62	20.18**	-2.65**	2.12*	0.00	12.26**	-2.82**	1.90**	0.68	9.77**	-2.51**	2.19**
GEM.9/SD.1	-6.21**	0.00	5.01**	14.76**	-15.32**	-9.46**	-3.11**	0.00	-15.63**	-15.09**	-2.05**	-1.46*	-14.47**	-14.29**	-1.21	-1.10
GEM.9/L.3	-1.77**	3.19**	3.14**	0.77	1.19	1.19	0.79	1.33	1.48	4.04**	0.36	0.96	0.54	1.52	1.75**	1.98*
SD.1/L.3	-7.24**	4.22**	6.58**	19.52**	-11.85**	-5.74**	-1.50	1.12	-10.78**	-7.93**	-1.68**	-0.49	-10.37**	-9.70**	-0.55	-0.22
LSD 0.05	1.16	1.34	0.84	0.97	1.99	2.30	1.71	1.98	1.83	2.11	1.18	1.36	1.64	1.89	1.31	1.51
0.01	1.53	1.77	1.12	1.29	2.63	3.03	2.26	2.61	2.42	2.80	1.56	1.80	2.17	2.50	1.73	2.00

*,**Significant at 0.05 and 0.01, probability levels respectively.

*** FN: Days to first node DB: Days to booting DH: Days to heading DA: Days to anthesis

Table (7) Contd.

Character***	DM				GFP				GFR			
Date	E.		N.		E.		N.		E.		N.	
Genotype	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P
SKH.61 X L.1	-0.32	2.14**	-0.77	0.87	4.13	12.27**	-0.87	4.59*	12.82**	-4.35**	4.96**	-7.50**
SKH.61 X L.2	0.48	2.11**	-0.09	1.74	3.13	11.35**	-1.29	5.50**	-5.41**	-23.91**	1.47	-13.75**
SKH.61 X SKA.	0.39	0.79	-2.62*	-1.88	2.88	9.51**	-5.24**	-0.46	35.63**	28.26**	42.25**	26.25**
SKH.61 X GZ.163	-0.60	3.92**	-0.25	2.52	-7.75**	31.07**	2.87	19.39**	46.56**	12.94**	7.78**	-3.00
SKH.61 X GEM.9	0.15	3.14**	0.08	2.35	2.81	11.47**	-0.24	2.93	35.78**	17.46**	13.73**	8.75**
SKH.61 X SD.1	0.08	3.30**	-0.74	1.34	8.65**	16.03**	0.47	2.88	-7.09**	-27.16**	2.86*	-5.26**
SKH.61 X L.3	0.92	3.45**	0.25	2.52	9.50**	25.30**	2.87	7.50**	31.37**	19.64**	16.67**	11.36**
L.1 X L.2	0.98	1.81*	0.52	0.70	1.19	1.33	0.41	1.65	-13.33**	-7.14**	-4.27**	-8.20**
L.1 X SKA.	-0.40	1.65*	-0.17	0.69	-1.74	-0.54	-1.24	-0.83	-6.85**	-17.07**	13.82**	12.90**
L.1 X GZ.163	-4.61**	2.31**	-3.16**	1.22	14.08**	78.53***	1.23	24.85**	17.95**	-18.82**	20.50**	-3.00
L.1 X GEM.9	1.25	6.92**	-0.83	3.13*	8.23**	27.24**	-1.12	7.80**	15.79**	-12.70**	8.96**	0.00
L.1 X SD.1	1.32	7.25**	-2.01	1.74	9.64**	26.83**	-3.56*	4.33*	-7.96**	-35.80**	1.28	-16.84**
L.1 X L.3	1.10	6.26**	-2.00	1.91	10.48**	37.55**	-2.71	7.50**	-2.27*	-23.21**	10.07**	-6.82**
L.2 X SKA.	-0.88	0.32**	0.00	1.05	-2.41	-1.09	-2.05	-0.42	27.54**	7.32**	18.64**	12.90**
L.2 X GZ.163	-1.52*	4.70**	-2.50*	2.09	12.79**	76.84**	-1.21	23.64**	7.96**	-28.24**	14.10**	-11.00**
L.2 X GEM.9	1.39*	6.16**	-1.34	2.79*	2.59	20.79**	-7.28**	2.44	12.09**	-19.05**	11.63**	-1.37
L.2 X SD.1	1.00	6.00**	-1.68	2.26	8.57**	25.78**	-4.82**	4.33*	-8.26**	-38.27**	8.61**	-13.68**
L.2 X L.3	2.02**	6.32**	-0.50	3.66**	13.15**	41.11**	-2.23	9.50**	11.90**	-16.07**	62.50**	32.95**
SKA. X GZ.163	-2.49**	2.37**	-0.49	3.07*	9.72**	68.93**	7.16**	31.52**	12.70**	-16.47**	20.99**	-2.00
SKA. X GEM.9	0.23	3.64**	-0.66	2.39	5.72*	22.58**	-1.57	6.83**	-1.92	-19.05**	40.74**	30.14**
SKA. X SD.1	-0.76	2.85**	0.66	3.58**	12.98**	28.92**	5.36**	13.46**	-13.11**	-34.57**	-1.91	-18.95**
SKA. X L.3	1.00	3.96**	-0.50	2.56	13.37**	39.13**	2.27	12.50**	11.34**	-3.57**	13.33**	-3.41*
GZ.163 X GEM.9	-1.31	0.15	-1.76	-1.29	-10.96**	14.69**	-5.41**	6.06**	17.57**	2.35**	6.36**	-8.00**
GZ.163 X SD 1	-3.57**	-2.36**	-2.24	-1.61	34.48**	76.27**	8.85**	23.03**	3.61**	1.18	7.69**	5.00**
GZ.163 X L.3	-1.61*	0.30	-2.24	-1.77	-5.12*	15.25**	-0.82	9.70**	21.99**	1.18	-13.83**	-19.00**
GEM.9 X SD.1	-0.67	-0.44	-1.61	-1.45	20.14**	18.47**	-0.73	0.00	-27.78**	-35.80**	10.71**	-2.11
GEM.9 X L.3	-0.15	0.30	-1.45	-1.45	-2.63	-7.17*	-5.19***	-4.00	31.09**	23.81**	5.59**	-3.41*
SD.1 X L.3	-0.52	0.15	-1.13	-0.97	14.81**	8.01**	0.00	2.00	-8.03**	-22.22**	6.01**	2.11
LSD 0.05	1.38	1.60	2.34	2.70	4.92	5.68	3.55	4.10	2.04	2.36	2.64	3.05
0.01	1.83	2.11	3.09	3.57	6.50	7.50	4.70	5.42	2.70	3.12	3.49	4.02

*,**Significant at 0.05 and 0.01, probability levels respectively.
***DM: Days to maturity GFP: Grain filling period GFR: Grain filling rate

On the other hand, heterosis caused significantly lateness for the remain crosses. Better parent heterosis effects were positively significant for most crosses under the two sowing dates. These results showed that the genotypes derived from Sonalika, Giza 163 and Sids 1 had the most desirable amount of heterosis. In general, the most desirable heterotic effect under the two sowing dates were detected in the crosses Line 1 × Giza 163 , Line 2 × Giza 163 and Giza 163 × Sids 1, relative to mid parent. Heterotic effects for days to booting were detected for eighteen and nine crosses, which had highly significant negative heterosis effects for mid-parent under the two sowing dates, respectively. Only three desirable heterosis estimates were significantly negative relatively to the better parent at early sowing date and that were detected in crosses Giza 163 × Sids 1 Gemmeiza 9 × Sids 1 and Sids 1 × Line 3. On the other hand, all crosses had significant positive heterotic effects for better parent at normal sowing date. In general, the most desirable heterotic effects under the two sowing dates were obvious in the crosses Giza 163 × Sids1, Line 1 × Giza 163 and Gemmeiza 9 × Sids 1 relatively to mid parent. The best crosses relatively to mid and better parents at early sowing date were Giza 163 × Sids 1 and Gemmeiza 9 × Sids 1. With regard to days to heading, significant negative heterosis effect relatively to mid-parent were detected in most crosses at early sowing date, whereas, twelve crosses had the most desirable effects at normal sowing date. Relatively to better parent, in early sowing date, high and desirable negative heterotic effect were detected only in the three crosses Giza 163 × Sids 1, Gemmeiza 9 × Sids 1 and Sids 1 × Line 3. Meanwhile, in normal sowing date, only one cross Gemmeiza 9 × Sids 1 gave considerable heterotic effects. These results showed of that these crosses seems to be promising in improvement of this trait. Abdel-Hafez *et al.* (2003) recorded similar findings. In general, the crosses, Giza 163 × Sids 1, Gemmeiza 9 × Sids 1 and Sids 1 × Line 3 gave the most desirable heterotic effects relative to mid and better parents under the two sowing dates, respectively. Regarding to days to anthesis, significant negative heterosis effect relative to mid-parent were obtained from the two sowing date for most studied crosses. Meanwhile, considerable heterosis effects relative to better parent in early sowing date were detected in three crosses, Giza 163 × Sids 1 Gemmeiza 9 × Sids 1 and Sids 1 × Line 3. On the other side, at the normal sowing date there were no cross-exhibited considerable or desirable heterotic effects.

In general, the crosses Giza 163 × Sids 1, Gemmeiza 9 × Sids 1 and Sids 1 × Line 3 gave the most desirable values of heterosis effects relatively to mid and better parent.

With respect to days to maturity, only five and three crosses had significant negative heterosis effects for mid-parent under the two sowing dates, respectively. These crosses were Line 1 × Giza 163, Line 2 × Giza 163, Sonalika × Giza 163, Giza 163 × Sids 1 and Giza 163 × Line 3 and Meanwhile, at normal sowing date the crosses Sakha 61 × Sonalika, Line 1 × Giza 163 and Line 2 × Giza 163 gave the most desirable values of heterosis effects relatively to mid-parent. Whereas, for better-parent there was only one cross Giza 163 × Sids 1 had significant negative heterosis effect at early sowing date. Hence, it could be concluded that this cross is valuable in breeding for earliness. On the other hand, no crosses possessed significant negative heterotic effects relatively to better parent at normal sowing date. In general, the cross Giza 163 × Sids 1 was the most superior one which gave high and desirable heterotic effects relatively to mid and better parents at the early sowing date. For grain filling period, the estimates of heterosis indicating that there were three crosses, i.e. Sakha 61 × Giza 163, Giza 163 × Gemmeiza 9 and Giza 163 × Line 3, as well as six crosses i.e., Sakha 61 × Sonalika, Line 1 × Sids 1, Line 2 × Gemmeiza 9, Line 2 × Sids 1, Giza 163 × Gemmeiza 9 and Gemmeiza 9 × Line 3 showed significant negative heterosis effects relatively to mid-parent under the two sowing dates, respectively. Whereas, most remaining crosses showed significant positive heterotic effects at early sowing date and non-significant heterosis effects at normal sowing date. Better parent heterotic effects were significant positive for most crosses under the two sowing dates, but the most considerable or desirable value was recorded for cross Gemmeiza 9 × Line 3 (-7.17%) at early sowing date. As known, significantly positive heterotic effect for grain filling rate are favorable for wheat breeders. Hence, there were seventeen and twenty-three crosses had significant positive heterosis effect relatively to mid-parent under early and normal sowing dates, respectively. For better parent heterosis, there were six and eight crosses showed significant positive heterotic effect obtained from the two sowing dates, respectively. The most desirable values of heterosis effects in the two dates of planting were obtained from the two crosses, Line 2 × Line 3 and Giza 163 × Sids 1.

From the previous results, it could be concluded that early sowing date gave the highest values of heterotic effect. At the same time, most desirable heterotic effect relatively to mid and better parents for earliness traits were detected in the crosses, Sakha 61 × Giza 163, Line 1 × Giza 163, Giza 163 × Sids 1 and Giza 163 × Gemmeiza 9 at early sowing date, and were Line 1 × Giza 163, Giza 163 × Sids 1, Line 2 × Gemmeiza 9 and Line 2 × Line 3 at normal sowing date. These results were completely agreed with those obtained by Hamada (2003), Jan *et al.* (2005), El-Hawary (2006).

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التحليل الوراثي لصفات التبكير في بعض التراكيب الوراثية لقمح الخبز

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أجريت هذه الدراسة لفهم طبيعة توارث مكونات التبكير فى النضج و تقيم ودراسة مجموعة من الآباء المتباينة فى مكونات التبكير فى النضج. وقد نفذت الدراسة في المزرعة البحثية بمحطة البحوث الزراعية بسخا في المواسم الزراعية ٢٠٠٣/٢٠٠٤ و ٢٠٠٤/٢٠٠٥. وقد تم تحليل بيانات التجربة بطريقة Griffing 1956 الطريقة الثانية النموذج الأول مستخدمين ثمانية أصناف وسلالات من قمح الخبز (*Triticum aestivum* L.) .وقد تم عمل كل الهجن الممكنة مع استبعاد الهجن العكسية بين هذه التراكيب الوراثية وتم الحصول منها علي ٢٨ هجيناً. تمت زراعة التراكيب الوراثية الأبوية والهجن الناتجة منها تحت ميعادين للزراعة أحدهما مبكر ٢٦/١٠/٢٠٠٤ و الأخر في الميعاد المناسب ٢٤/١١/٢٠٠٤. كانت البيانات المدروسة في هذه التجربة هي عدد الأيام حتي ظهور العقدة الأولى، و حتي الوصول لطور الحمل، و حتى طرد السنابل، وحتى التزهير وعدد الأيام حتى النضج، فترة امتلاء الحبوب و معدل امتلاء الحبوب. كانت جميع متوسطات مكونات التبكير منخفضة فى ميعاد الزراعة المبكر لأغلب الآباء والهجن الناتجة منها. أعطت الآباء سلالة ١وسلالة ٢ واغلب الهجن الناتجة منها اقل المتوسطات لمكونات التبكير في النضج. كما أعطت الهجن سلالة ١× سلالة ٢، سلالة ١ × سوناليكا، جيزة ١٦٣ × جميزة ٩ ، سخا٦١ ×جيزة ١٦٣ اقل المتوسطات لمكونات التبكير فى النضج فى ميعاد الزراعة المبكر ، بينما أعطت الهجن سلالة١ × سلالة ٢، سلالة ١ × سوناليكا، سلالة ١ ×سلالة ٣ أفضل القيم لمعظم مكونات التبكير فى ميعاد الزراعة العادي.

واظهر الهجين سلالة ١ × سلالة ٢ قيما مرغوبة فى كلا ميعادي الزراعة.كانت جميع قيم مجموع متوسطات مربعات الانحرافات للتراكيب الوراثية عالية المعنوية لكل مكونات التبكير في كلا الموعدين. وكان أفضل الهجن الأعلى من متوسطي الأبوين لصفات عدد الأيام حتي ظهور العقدة الأولى وحتي الوصول لطور الحمل و حتى طرد السنابل الهجين جيزة ١٦٣ × سدس١ في كلا الموعدين ونفس الهجين لصفة عدد الأيام حتى التزهير في الموعد الأول والهجين سلالة ١× جيزة ١٦٣ في الموعد الثاني.بينما كان أفضل الهجن لصفة عدد الأيام حتى النضج في كلا الموعدين هو سلالة ١× جيزة ١٦٣. أما بالنسبة لصفة فترة امتلاء الحبوب كان الهجين جيزة ١٦٣ × سدس١ هو أفضل الهجن في كلا الموعدين . وبالنسبة لصفة معدل امتلاء الحبوب كان الهجينان سخا ٦١ × جيزة ١٦٣ و سلالة ٢× سلالة ٣ هما أفضل الهجن في كلا الموعدين، علي الترتيب. كانت جميع قيم متوسطات مجموع مربعات الانحرافات للقدرة العامة والخاصة علي التآلف عالية المعنوية لكل الصفات في كلا الميعادين. وكانت النسبة GCA/SCA أكبر من الواحد في كل الصفات تحت كلا الميعادين فيما ماعدا لصفات معدل امتلاء الحبوب و عدد حبوب السنبلة في الموعد المناسب في كلا الميعادين، مما يبين أهمية التباينات المضيفة وغير المضيفة و المتحكمة في توارث هذه الصفة. وقد أظهرت النتائج أن المكون المضيف هو المكون الرئيسي في وراثة معظم صفات التبكير. من ناحية أخرى كانت أفضل التراكيب الوراثية الأبوية التي لها قدرة عامة عالية على التآلف لصفات عدد الأيام حتي ظهور العقدة الأولى، عدد الأيام حتي الوصول لطور الحمل، عدد الأيام حتى طرد السنابل، عدد الأيام حتى التزهير و عدد الأيام حتى النضج هي السلالة ١ والسلالة ٢، أما صفات فترة امتلاء الحبوب و معدل امتلاء الحبوب فكان أفضل التراكيب هما جيزة ١٦٣ و جميزة ٩. بناءا على تقديرات القدرة الخاصة على الائتلاف كان أفضل الهجن لصفات عدد الأيام حتي ظهور العقدة الأولى وحتي الوصول لطور الحمل وحتى طرد السنابل هو الهجين جيزة ١٦٣ × سدس ١ في كلا الموعدين، و لصفة عدد الأيام حتى التزهير هو الهجين في الموعد الأول جيزة ١٦٣ × سدس١ و سوناليكا × جيزة ١٦٣ في الموعد الثاني، بينما كان أفضل الهجن لصفة عدد الأيام حتى النضج سلالة ١× جيزة ١٦٣ و سخا ٦١ × سوناليكا في كلا الموعدين علي الترتيب .وبالنسبة لصفة فترة امتلاء الحبوب كان الهجينان سخا ٦١ × جيزة ١٦٣ و سخا ٦١ × سوناليكا هما أفضل الهجن في كلا الموعدين علي الترتيب وفى صفة معدل امتلاء الحبوب كان أفضل الهجن في الموعد الأول هو سخا ٦١ × جيزة ١٦٣.