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GENETIC ANALYSIS OF YIELD AND ITS ATTRIBUTES IN BREAD WHEAT UNDER THREE SOWING DATES CONDITIONS

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ABSTRACT

This study was conducted at the Agricultural Extension Field, El-Gemmeiza, El-Gharbiah Governorate, Egypt during the two successive growing seasons 2014/15 and 2015/16. The eight common wheat cultivars (Triticum aestivum L. em Thell), Line 1, Sids 1, Sids 13, Shandweel 1, Misr 1, Sakha 61, Sakha 94 and Gemmeiza 12 were crossed in a half dilele cross design to estimate combining ability associated with grain yield and its component in three expirements under the three sowing dates, i.e. of 25 October (D_1 sowing date), 15th November (D_2 sowing date), 5th December (D_3 sowing date) and to determined the most stable parents and crosses with high grain yield. Also, to determine the pest method of selection will be used in the segregation generations. The results showed that mean squares due to sowing dates were highly significant for all traits studied, indicating as expected that the differences between the three sowing dates were markedly differed. Mean squares due to genotypes, parents, crosses, parent vs. crosses and interactions between parents or crosses with sowing dates were highly significant for all yield, and some of its components at the three sowing dates as well as their combined analysis. Mean squares due to GCA, SCA, GCA x sowing date and SCA x sowing date were highly significant and/or significant for grain yield and some of its components in the three sowing dates and combined analysis. The ratios of GCA / SCA that exceeded the unity were detected for yield and yield components traits at the three sowing dates and their combined analysis, indicating that the largest part of the total genetic variability associated with these traits is a result of additive and additive x additive gene action. While, for other traits, the non-additive gene effects seemed to be responsible for their inheritance. It could be concluded that the breeder can be used the four parents P_5 (Misr 1), P_6 (Sakha 94), P_7 (Sakha 61) and P_8 (Gemmeiza 12) to improve yield and earliness including them in breeding programs. The breeder could include the five crosses (Gemmeiza 12 x Line 1), (Sakha 94 x Sids 1), (Gemmeiza 12 x Shandaweel 1), (Sakha 94 x Misr 1) and (Sakha 61 x Sakha 94) in breeding programs to segregate lines with high grain and straw yield, since they shwoed significant and positive ($\hat{S}_{ij}$) effects for grain and straw yield and some of its components in the three sowing dates and their combined analysis. Finally, pedigree method of selection will be an excellent method for breeders to select good lines with high yield and stability under a wide range of sowing dates based on yield and yield component traits.

Key words**:** ***Wheat, Sowing date, Yield, Yield components, Genetic analysis.***

INTRODUCTION

Wheat is the most important food crop in the worled on the basis of area harvested and production. In 2016 the worled total area harvested was 220.07 million hectares which gave about 749.46 million tonnes, of total produce (FAOSTAT, 2016). Wheat is an annual cereal crop. It is a self-pollinated crop and serves as the primary food for almost one third of the world's population. Wheat is a unique gift of ALLAH to mankind as it can be moulded into innumerable products like chapatis, breads, cakes, biscuits, pasta and many hot and ready-to-eat breakfast foods. Wheat grain contains

starch (60-68%), protein (6-21%), fat (1.5-2.0%), cellulose (2.0-2.5%), minerals (1.8%) and vitamins. The uniqueness of wheat in contrast to other cereals is that wheat contains gluten protein which enables leavened dough to rise by forming minute gas cells and this property enables bakers to produce light breads (Padhar (2005). In Egypt, wheat is the major winter cereal crop; the Egyptian capita obtain more than 30 % of their carbohydrate needs from wheat. In 2016 the Egyptian total area harvested was 1.37 million hectares which gave about 9 million tonnes of total produce. Still there is a big gap between production and consumption, that's due to the high consumption which reaches 15 million ton/year (about 46% of the total need), revealing the increase of Egyptian population which reached about 84% in the last two decades (FAOSTAT, 2016). In Egypt wheat is almost sown in the last half of November, in some case Egyptian farmers resort to sow wheat in the beginning of November; so they harvest it early especially if the next crop is cotton, and this reduces the total grain production because of the unsuitable weather condition such as rainfall and temperature at seedling stage. So the breeders must help the cultivators to solve this problem by breed new high yielding varieties with high stability to a wide range of sowing dates. Understanding genetic phenomena for the expression of yield and its related traits and use of suitable breeding schemes is imperative for the development of desirable superior genotypes (Saleem *et al* 2010). For estimation of the GCA (general combining ability) and SCA (specific combining ability) effects, combining ábility analysis is one of the commonly used tools. This method is very much helpfull in identification of the potential parents and outstanding cross combintations for exploitation in future wheat improvement programs. Superior parental genotypes are identified through GCA whereas SCA identifies potential commercial hybrids for the desired traits. Selection of desirable parental genotypes on the basis of GCA effects could result in producing superior recombinants through crossing/hybridizing with other matching parental genotype (Malíni *et al* 2006, El-Hosary and Nour El Deen 2015 and AL Saadoown et al. 2017 and 2018).

Therefore, the present study was conducted at three different sowing dates using a 8 x 8 half diallel set, among 8 diverse parents with using the following objectives: (1) Estimating the combining ability variances and their effects for grain yield and its associated traits in wheat under the three sowing dates and their combined analysis. (2) Identifying the promising parents and cross combinations for improvement of grain yield under the three sowing dates and combined analysis. (3) Suggesting a suitable selection method for developing high yielding wheat in a wide range of sowing dates.

MATERIALS AND METHODS

This study was conducted at the Agricultural Extension Field, El-Gemmeiza, El-Gharbiah Governorate, Egypt during the two successive growing seasons 2014/15 and 2015/16. Eight common wheat lines and cultivars, (*Triticum aestivum* L. em Thell), i.e. Line 1, Sids 1, Sids 13, Shandaweel 1, Misr 1, Sakha 94, Sakha 61 and Gemmeiza 12 representing a wide range of diversity for several agronomic characters were selected for this study. The commercial names, source and pedigree of the parents used in this study are presented in Table (1).

Table 1. The code number, names and pedigree of the parental cultivars.

No.	Variety or Line	Pedigree
1	Line 1	OUASSOU-20 ICW01-00114-0AP-3AP-0AP-0AP-6AP/MOR-0AP/MOR-0AP
2	Sids 1	HD2172/Pavon"S" 1158.57/Maya74"S"Sd46-4Sd-2Sd-1Sd-0Sd.
3	Sids 13	KAUZ"S"//TSI//TSI//SNB"S". IWC94-0375-4AP-2AP-030AP-0APS-3AP-0APS-050AP-0AP-0SD.
4	Shandaweel 1	SITE//MO/4/NAC/TH.AC//3*PVN/3/MIRLO/BUC. CMSS93-BOOS675-72Y-010M-010Y-010M-3Y-0M-0THY-0SH.
5	Misr 1	OASIS/KAUZ//4*BCN/3/2*PASTOR. CMSS00Y01881T-050M-030Y-030M-030WGY-33M-0Y-0S.
6	Sakha 94	INIA/RL4220//7C/YR"S".CM-14530-2S-5S-0S.
7	Sakha 61	Opata/Rayon//Kauz-CMBW90Y3180-OTOPM-3Y-010M-010Y-10M-015Y-0Y-OPA-0S.
8	Gemmeiza 12	OTUS/3/SARA/THB//VEE. CMSS97Y002275-5Y-010M-010Y-010M-2Y-1M-0Y-0GM.

Grains from each of the parental lines and varieties were sown at various sowing dates in order to overcome the differences in time of heading in 2014/15 growing season. During this season, all possible parental combinations without reciprocals were made among eight parents giving a total of twenty-eight crosses.

In 2015/16 season, the parental genotypes and their respective 28 hybrids were divided into three equal parts and sown in three sowing dates, i.e. 25th October (D_1 sowing date), 15th November (D_2 sowing date), 5th December (D_3 sowing date), in three separate experiments, each experiment was designed in a randomized complete blocks design with three replications. Each of parental genotypes and their F_1's were sown in plots, each plot consisted of two rows. Each row was three meters long and 30 cm apart. Plants within row were sown in 20 cm plant space. Dry method of planting was used in this concern. The other cultural practices of growing wheat were properly practiced.

Data for all traits studied were recorded on 10 individual guarded plants, chosen at random from each plot for perants and their F_1 crosses and

the collected data were on days to heading (DH), days to maturity (DM), No. of spikes per plant, No. of grains per spike, 1000-grain weight, grain yield per plant, straw yield/plant and harvest index. Monthly average temperature and amount of rainfall are shown in Table (2).

Table 2. Monthly average temperature, relative humidity (RH) and amount of rainfall (2015/2016 season).

Months	Temperature C		R.H. (%)	Rain fall mm/month
	Max.	Min.		
Oct.2015	32.34	19.87	55.66	0.33
Nov.2015	26.36	15.73	63.42	0.66
Dec.2015	21.49	11.21	64.61	0.27
Jan.2016	18.72	7.91	63.15	0.61
Feb.2016	24.45	9.79	56.53	0.08
Mar.2016	26.57	11.58	48.47	0.26
Apr.2016	33.79	14.96	39.26	0.07
May.2016	34.75	17.66	39.10	0.00

Statistical analysis

An ordinary analysis of variance was firstly performed for each experiment separately for a diallel cross set including parents. The effects of both blocks and genotypes were assumed to be fixed. Combined analysis of the three sowing dates experiments was carried out whenever the homogeneity test as outlined by Snedecor and Cochran (1982). General and specific combining ability variances and effects caculated were obtained by using Griffing's (1956) diallel cross analysis designated as method (2) model (1).

RESULTS AND DISCUSSION

The analysis of variance for all sources of variation in 1st, 2nd and 3rd sowing date and their combined analysis in F1 for the traits studied, i.e. days to heading, days to maturity, No. of spikes/plant, , no. of grains/spike, 1000-grain weight (g), straw yield/plant (g), grain yield/plant (g) and harvest index are presented in Table 3.

Mean squares due to sowing dates were highly significant for all traits studied indicating as expected that the differences between the three sowing dates were markedly differed. Mean squares due to genotypes, parents, crosses, parents vs. crosses were highly significant for all studied traits at the three sowing dates as well as their combined analysis, except for No. of spikes/plant and 1000-grains weight in the combined analysis due to parents. This suggests a clear evidence of the true differences among these genotypes in most traits and the parental lines and cultivars differed in their mean performances for most studied traits. Also, mean squares due to parent vs. crosses were insignificant under the combined analysis for most studied traits. Mean square due to genotypes, parents and crosses interactions with sowing date were also highly significant for all studies traits.

Table 3. Mean squares for all traits studied at the three sowing dates and their combined analysis (comb.) in the F_1.

SOV	df		Days to heading				Days to maturity			
	S	C	D_1	D_2	D_3	C	D_1	D_2	D_3	C
Rep	2	2	0.84	0.75	0.68		3.82	3.46	3.12	
Sowing dates		2				2465.63**				5459.70**
Rep./S. dates		6				0.76				3.47
Genotypes	35	35	154.73**	132.87**	119.92**	44.60**	202.52**	169.89**	153.32**	56.98**
parents	7	7	210.97**	146.79**	132.48**	51.60**	283.85**	180.21**	162.64**	63.42**
Crosses	27	27	144.67**	130.10**	117.42**	43.50**	188.66**	169.67**	153.12**	56.72**
P vs cross	1	1	32.82**	110.32**	99.57**	25.45**	7.47	103.60**	93.50**	18.89**
Geno x S. dates		70				181.46**				234.38**
Parents x S.		14				219.32**				281.64**
Crosses x S.		54				174.35**				227.36**
P vs F1 x S.		2				108.63**				92.85**
Error	70	210	1.82	1.66	1.49	1.66	2.14	1.94	1.75	1.94
SOV	df		No. of spikes/plant				No. of grains/spike			
	S	C	D_1	D_2	D_3	C	D_1	D_2	D_3	C
Rep	2	2	25.30**	0.47	5.24*					902.81**
Sowing dates		2				154.16**				25.33
Rep./S. dates		6				10.34**	293.68**	511.85**	674.51**	45.31**
Genotypes	35	35	14.18**	55.54**	44.32**	7.50**				717.36**
parents	7	7	8.27**	34.58**	17.44**	2.92				389.75**
Crosses	27	27	15.71**	62.00**	52.74**	8.89**				765.87**
P vs cross	1	1	14.17**	27.89**	4.97	1.72				1700.92**
Geno x S. dates		70				53.27**	403.47**	275.39**	130.43**	29.80*
Parents x S.		14				28.68**	248.30**	568.79**	762.46**	47.83**
Crosses x S.		54				60.78**	750.15**	629.62**	2108.15**	86.09**
P vs F1 x S.		2				22.65**	9.54	11.80	16.16	12.50
Error	70	210	1.45	1.47	1.60	1.51				902.81**
SOV	df		1000-grains weight				Straw yield/plant			
	S	C	D_1	D_2	D_3	C	D_1	D_2	D_3	C.
Rep	2	2				430.52**				106967.48**
Sowing dates		2				6.52				20.18
Rep./S. dates		6	111.24**	65.89**	120.29**	9.96**	4136.44**	2638.95**	1528.42**	232.70**
Genotypes	35	35				143.73**				4035.55**
parents	7	7				75.11**				6873.36**
Crosses	27	27				152.74**				3351.52**
P vs cross	1	1				380.62**				2639.85**
Geno x S. dates		70	75.60**	26.99**	53.76**	6.12	8956.99**	2831.93**	2387.05**	429.24**
Parents x S.		14	104.49**	78.20**	132.24**	9.44**	3026.72**	2610.83**	1255.70**	190.21**
Crosses x S.		54	542.88**	5.97	263.33**	50.93**	354.94**	2047.28**	2881.50**	4.01
P vs F1 x S.		2	3.41	2.79	4.77	3.66	18.44	17.46	26.94	20.95
Error	70	210				430.52**				106967.48**

Table 3. Cont.

SOV	df		Grain yield/plan				Harvest index			
	S	C	D_1	D_2	D_3	C	D_1	D_2	D_3	C
Rep	2	2	1.00	5.01	4.86		2.70	8.16	0.48	1.00
Sowing		2				2278.02**				
Rep./S.		6				27.96**				
Genotype	35	35	1264.67**	1041.71**	1137.54**	212.32**	518.29**	479.88**	869.06**	1264.67**
parents	7	7	738.90**	686.79**	849.74**	145.33**	1057.26**	559.94**	850.46**	57.59**
Crosses	27	27	1443.71**	1166.7**	1252.37**	237.50**	389.36**	452.68**	883.91**	76.06**
P vs cross	1	1	110.87**	149.60**	51.59**	1.11	226.69**	653.62**	598.29**	9.67
Geno x S.		70				1615.80**				898.38**
Parents x		14				1065.04**				1205.03**
Crosses x		54				1812.67**				824.95**
P vs F1 x		2				155.47**				734.47**
Error	70	210	6.07	4.09	4.41	4.86	4.69	5.52	7.16	5.79

***and ** significant at 0.05 and 0.01 respectively D_1 =1st Sowing date). D_2= 2nd Sowing Date D_3 =3rd Sowing.date C= combind data.**

The significance of genotypes and genotypes interaction with sowing dates indicated that the behavior of different studied genotypes, parents and crosses was markedly differed from each sowing date to another.

Mean squares due to genotypes were significant, indicating the significant differences among the studied wheat genotypes in the majority of traits. In this concern, mean squares due to parents and crosses were highly significant, indicating that the parental genotypes and their F_1 hybrids exhibit reasonable degrees of variability for all studied traits in the three sowing dates. The significant mean squares of sowing dates, genotypes, parents, crosses and their interactions with sowing dates has bean studied by many investigators, e.g. Abdel-Nour (2011), who determined the genetic behaviour of earliness components as well as yield and its components in the F_1 and F_2 diallel cross of bread wheat under optimum and late sowing dates conditions. (optimum sowing date on November 20th and the second one was planted in late sowing dates Jan D1) and found that genotypes mean squares were significant for most studied characters in both sowing dates. El-Ashmouny *et al* (2016), who studied the genetic behavior of some bread wheat genotypes (*Triticum asetivum* L.) under different sowing dates using half diallel crosses analysis among eight parents. The first experiment was planted in recommended sowing date (30 November D1) and the second was planted in late sowing (30 December D2) in 2014/2015 and they found that the analysis of variance revealed highly significant differences among genotypes for all studied traits in F_1 and F_2 under D1 and D2. Morgan *et al* (2018), studied the genetic components of variation and identified the best combination under two sowing dates. A half-diallel cross

of eight parents and their F_1 crosses were grown under two sowing dates, i.e. normal sowing date (15th November) (N) and late sowing date (15th December) (H) and they reported that analysis of variance indicated significant mean squares due to the sowing date for all studied characters.

Mean performances

The mean performances of all genotypes (eight parents and their twenty-eight crosses) at the three sowing dates as well as their combined data are presented in Table (4). For earliness (heading and maturity date (days) the parental variety Sakha 61 followed by Sakha 94 and Gemmeiza 12 showed the earliest desirable mean values at the three sowing dates and their combined data. On the other hand, the parental variety Sids 13 showed the latest undesirable mean for earliness (heading and maturity date at the three sowing dates and combined data. Also, the two cross combinations (Sakha 94 x Misr 1) and (Sakha 61 x Sakha 94) gave the lowest values for the same traits.

For No. of spikes/plant, Sids 13 followed by Sids 1 in the D_1 sowing date, Sids 13 followed by Sakha 94 in the D_2 sowing date, Sakha 94 followed by Gemmeiza 12 in the D_3 sowing date and Sakha 94 followed by Sids 13 then Gemmeiza 12 in the combined data have the longest spike. As for crosses, the crosses (Shandaweel 1 x Sids 13) , (Sakha 61 x Sakha 94), (Gemmeiza 12 x Sakha 94) and (Gemmeiza 12 x Sakha 61) showed the highest mean values for this trait in the three sowing dates and their combined. With respect to No. of grains/spike, the parents Sakha 94, Sids 13 and Sids 1 in the three sowing dates and their combined data and Misr 1 in D_2 sowing date, D_3 sowing date and the combined data were the best in this trait; they showed the highest mean values for No. of grains/spike. While, the cross (Sakha 61 x Misr 1) followed by (Shandaweel 1 x Sids 13) and (Sakha 94 x Shandaweel 1) were the best in this trait; they showed the highest mean values for No. grains/spike in the combined analysis and one or more of the three sowing dates. Regarding to 1000-grains weight (g), the highest mean values were scored by the parent Sids 1 in D_2, D_3 and combined data followed by Shandweel 1 in D_1, D_2 and combined data and Misr 1 in D_3 sowing date. In the same line, the highest mean values were scored by the cross (Sids 13 x Sids 1) followed by (Gemmeiza 12 x Sakha 94) in the combined analysis and one or more of the three sowing dates. For straw yield/plant (g), the highest mean values were scored by the parental Line 1 in D_2 and combined data and Misr 1 in D_2 and D_3. Also, the highest mean values were scored by the cross combinations of Sakha 61 with the three parents Line 1, Sakha 94 and Gemmeiza 12 in the combined analysis and one or more of the three sowing dates.

Table 4. The genotypes mean performance in the three sowing dates and their combined data for all studied traits in F_1 diallel crosses among 8 parents.

Genotypes	Days to heading				Days to maturity			
	D_1	D_2	D_3	Comb.	D_1	D_2	D_3	Comb.
Line 1	113.59	107.72	102.33	107.88	158.36	150.18	142.67	150.40
Sids 1	105.08	99.65	94.67	99.80	155.40	147.37	140.00	147.59
Sids 13	107.30	101.75	96.67	101.91	153.18	145.26	138.00	145.48
Shandaweel 1	99.53	94.39	89.67	94.53	157.25	149.12	141.67	149.35
Misr 1	99.90	94.74	90.00	94.88	141.71	134.39	127.67	134.59
Sakha 94	93.61	88.77	84.33	88.91	146.15	138.60	131.67	138.80
Sakha 61	90.65	85.96	81.67	86.09	135.05	128.07	121.67	128.26
Gemmeza 12	90.00	94.74	90.00	91.58	134.67	141.75	134.67	137.03
Parents mean	99.96	95.96	91.17	95.70	147.72	141.84	134.75	141.44
Sids 1 X Line 1	106.93	101.40	96.33	101.56	155.03	147.02	139.67	147.24
Sids 13 X Line 1	115.81	109.82	104.33	109.99	157.99	149.82	142.33	150.05
Shandaweel 1 X Line 1	104.71	99.30	94.33	99.45	153.18	145.26	138.00	145.48
Misr 1 X Line 1	103.97	98.60	93.67	98.74	146.52	138.95	132.00	139.16
Sakha 94 X Line 1	96.57	91.58	87.00	91.72	149.85	142.11	135.00	142.32
Sakha 61 X Line 1	89.17	84.56	80.33	84.69	137.64	130.53	124.00	130.72
Gemmeza 12 X Line 1	102.86	97.54	92.67	97.69	151.33	143.51	136.33	143.72
Sids 13 X Sids 1	102.12	96.84	92.00	96.99	151.33	143.51	136.33	143.72
Shandaweel 1 X Sids 1	98.79	93.68	89.00	93.82	150.96	143.16	136.00	143.37
Misr 1 X Sids 1	106.56	101.05	96.00	101.20	156.51	148.42	141.00	148.64
Sakha 94 X Sids 1	96.94	91.93	87.33	92.07	149.48	141.75	134.67	141.97
Sakha 61 X Sids 1	89.91	85.26	81.00	85.39	134.31	127.37	121.00	127.56
Gemmeza 12 X Sids 1	103.60	98.25	93.33	98.39	151.70	143.86	136.67	144.08
Shandaweel 1 X Sids 13	105.82	100.35	95.33	100.50	158.73	150.53	143.00	150.75
Misr 1X Sids 13	97.31	92.28	87.67	92.42	138.75	131.58	125.00	131.78
Sakha 94 X Sids 13	101.75	96.49	91.67	96.64	149.11	141.40	134.33	141.62
Sakha 61 X Sids 13	90.28	85.61	81.33	85.74	133.57	126.67	120.33	126.86
Gemmeza 12 X Sids 13	105.08	99.65	94.67	99.80	152.07	144.21	137.00	144.43
Misr 1 X Shandaweel 1	97.31	92.28	87.67	92.42	148.74	141.05	134.00	141.26
Sakha 94 X Shandaweel	103.23	97.89	93.00	98.04	152.44	144.56	137.33	144.78
Sakha 61X Shandaweel	90.28	85.61	81.33	85.74	137.64	130.53	124.00	130.72
Gemmeza 12 X	97.31	92.28	87.67	92.42	157.99	149.82	142.33	150.05
Sakha 94 X Misr 1	99.16	94.04	89.33	94.18	146.15	138.60	131.67	138.80
Sakha 94 X Misr 1	86.95	82.46	78.33	82.58	133.57	126.67	120.33	126.86
Sakha 61 X Misr 1	92.87	88.07	83.67	88.20	145.78	138.25	131.33	138.45
Sakha 61 X Sakha 94	88.80	84.21	80.00	84.34	137.27	130.18	123.67	130.37
Gemmeza 12 X Sakha 94	93.98	89.12	84.67	89.26	143.93	136.49	129.67	136.70
Gemmeza 12 X Sakha 61	93.61	88.77	84.33	88.91	136.90	129.82	123.33	130.02
Crosses mean	98.63	93.53	88.86	93.67	147.09	139.49	132.51	139.70
LSD 5%	1.83	1.75	1.66	1.73	1.99	1.89	1.80	1.87
LSD 1%	2.62	2.50	2.38	2.45	2.84	2.71	2.57	2.65

D_1 =1st Sowing date D_2= 2nd Sowing Date D_3 =3rd Sowing.date Com = combind data.

Table 4. Cont.

Genotypes	No. of spikles/plant				No. of grains/spike			
	D_1	D_2	D_3	Comb.	D_1	D_2	D_3	Comb.
Line 1	12.52	17.92	12.76	14.40	90.33	76.47	89.47	85.43
Sids 1	14.73	10.99	13.48	13.06	97.33	73.54	93.72	88.20
Sids 13	16.67	19.71	9.75	15.38	108.67	72.47	85.76	88.97
Shandaweel 1	13.90	14.67	14.32	14.30	85.67	61.44	84.27	77.12
Misr 1	12.98	18.03	14.61	15.21	83.67	85.76	89.93	86.45
Sakha 94	13.52	19.55	16.46	16.51	94.00	86.33	91.00	90.44
Sakha 61	11.03	11.65	10.11	10.93	83.33	71.97	72.15	75.82
Gemmeza 12	13.01	16.96	15.51	15.16	69.33	90.39	86.77	82.16
Parents mean	13.54	16.19	13.37	14.37	89.04	77.30	86.63	84.32
Sids 1 X Line 1	9.05	11.04	14.31	11.47	75.00	75.08	75.06	75.05
Sids 13 X Line 1	13.67	18.92	16.73	16.44	79.00	90.77	80.39	83.39
Shandaweel 1 X Line 1	11.37	10.98	14.01	12.12	97.33	69.03	54.36	73.58
Misr 1 X Line 1	10.92	9.98	21.00	13.97	76.00	94.20	45.28	71.83
Sakha 94 X Line 1	13.36	12.71	9.99	12.02	90.00	58.41	78.48	75.63
Sakha 61 X Line 1	13.66	15.05	11.33	13.35	81.67	76.68	91.92	83.42
Gemmeza 12 X Line 1	14.76	17.64	17.36	16.59	97.00	76.40	53.08	75.50
Sids 13 X Sids 1	12.21	14.31	11.31	12.61	95.67	53.72	55.14	68.17
Shandaweel 1 X Sids 1	6.58	8.51	3.04	6.04	68.67	84.67	94.92	82.75
Misr 1 X Sids 1	13.34	8.27	6.06	9.22	95.33	76.34	89.00	86.89
Sakha 94 X Sids 1	13.26	17.67	17.83	16.25	89.00	101.07	63.85	84.64
Sakha 61 X Sids 1	9.43	11.00	14.22	11.55	81.67	82.78	75.00	79.82
Gemmeza 12 X Sids 1	8.44	12.11	14.27	11.61	85.67	99.96	49.68	78.44
Shandaweel 1 X Sids	14.25	21.03	22.95	19.41	83.00	95.33	89.03	89.12
Misr 1X Sids 13	10.84	17.09	14.59	14.17	63.00	69.03	94.14	75.39
Sakha 94 X Sids 13	14.09	16.50	10.83	13.81	86.33	90.19	64.79	80.44
Sakha 61 X Sids 13	15.78	15.38	12.69	14.62	83.33	107.20	66.38	85.64
Gemmeza 12 X Sids 13	14.19	9.47	6.90	10.19	88.67	99.27	72.62	86.85
Misr 1 X Shandaweel 1	11.43	13.99	13.26	12.89	66.00	69.79	61.69	65.83
Sakha 94 X	13.51	9.14	12.19	11.61	79.33	101.47	86.39	89.07
Sakha 61X	11.62	10.98	14.41	12.33	75.67	100.36	82.49	86.17
Gemmeza 12 X	12.76	17.35	15.80	15.30	80.33	76.02	75.70	77.35
Sakha 94 X Misr 1	13.23	15.09	17.50	15.27	75.33	76.02	79.33	76.89
Sakha 94 X Misr 1	15.09	19.95	14.80	16.61	91.67	77.14	99.19	89.33
Sakha 61 X Misr 1	12.37	18.39	13.50	14.76	82.33	95.39	100.75	92.83
Sakha 61 X Sakha 94	15.10	26.00	14.40	18.50	84.00	78.34	94.00	85.45
Gemmeza 12 X Sakha	14.52	22.63	16.67	17.94	73.67	77.17	66.18	72.34
Gemmeza 12 X Sakha	16.05	17.80	16.93	16.93	91.00	75.13	89.30	85.14
Crosses mean	12.67	14.96	13.89	13.84	82.70	83.11	76.01	80.60
LSD 5%	1.64	1.65	1.72	1.65	4.20	4.67	5.47	4.75
LSD 1%	2.34	2.36	2.46	2.34	6.00	6.68	7.81	6.73

Table 4. Cont.

Genotypes	1000-grains weight (g)				Straw yield/plant (g)			
	D_1	D_2	D_3	Comb.	D_1	D_2	D_3	Comb.
Line 1	34.00	39.67	33.33	35.67	68.49	118.67	84.60	90.58
Sids 1	32.67	43.00	43.67	39.78	100.79	81.17	81.00	87.65
Sids 13	35.33	41.00	35.00	37.11	15.94	73.00	73.00	53.98
Shandaweel 1	42.33	41.33	34.33	39.33	60.84	21.33	19.73	33.97
Misr 1	33.00	36.33	44.67	38.00	194.80	60.17	31.33	95.43
Sakha 94	34.00	35.67	39.33	36.33	145.24	36.90	44.03	75.39
Sakha 61	30.33	37.00	39.33	35.56	79.67	90.67	19.67	63.33
Gemmeza 12	24.33	35.00	36.67	32.00	100.72	80.90	22.93	68.19
Parents mean	33.25	38.63	38.29	36.72	95.81	70.35	47.04	71.07
Sids 1 X Line 1	36.00	40.67	41.67	39.44	69.98	131.57	19.23	73.59
Sids 13 X Line 1	36.00	43.67	50.00	43.22	20.19	90.17	55.67	55.34
Shandaweel 1 X Line 1	40.00	36.33	53.33	43.22	97.23	102.93	56.10	85.42
Misr 1 X Line 1	29.67	31.33	45.67	35.56	115.36	46.73	87.33	83.14
Sakha 94 X Line 1	41.67	42.33	42.00	42.00	103.53	97.47	22.50	74.50
Sakha 61 X Line 1	36.67	38.67	31.33	35.56	108.23	170.27	30.83	103.11
Gemmeza 12 X Line 1	33.67	38.67	57.00	43.11	98.96	75.50	22.67	65.71
Sids 13 X Sids 1	40.67	52.67	45.67	46.33	110.82	61.03	33.00	68.29
Shandaweel 1 X Sids 1	47.00	44.67	29.67	40.44	96.04	87.43	76.93	86.80
Misr 1 X Sids 1	37.33	39.00	31.33	35.89	90.83	52.27	33.60	58.90
Sakha 94 X Sids 1	36.00	30.33	47.00	37.78	98.56	31.80	72.67	67.67
Sakha 61 X Sids 1	41.00	36.33	39.00	38.78	123.49	85.00	43.00	83.83
Gemmeza 12 X Sids 1	33.33	41.67	41.33	38.78	63.75	108.67	63.37	78.59
Shandaweel 1 X Sids	35.67	37.67	34.33	35.89	123.62	65.33	21.00	69.98
Misr 1X Sids 13	32.33	36.33	36.00	34.89	104.11	71.40	15.97	63.82
Sakha 94 X Sids 13	36.00	34.33	46.33	38.89	77.38	71.33	40.67	63.13
Sakha 61 X Sids 13	55.67	28.33	43.67	42.56	111.79	101.33	18.57	77.23
Gemmeza 12 X Sids 13	38.67	40.33	41.33	40.11	90.55	96.63	43.40	76.86
Misr 1 X Shandaweel 1	38.67	43.00	41.67	41.11	89.58	97.37	23.00	69.98
Sakha 94 X	32.00	37.00	46.33	38.44	98.56	55.07	21.37	58.33
Sakha 61X	38.33	29.33	52.67	40.11	78.53	101.10	14.00	64.54
Gemmeza 12 X	34.67	37.33	39.33	37.11	51.21	44.03	29.47	41.57
Sakha 94 X Misr 1	41.67	39.00	38.67	39.78	111.98	62.30	17.83	64.04
Sakha 94 X Misr 1	47.00	38.33	40.33	41.89	153.39	58.37	20.33	77.36
Sakha 61 X Misr 1	34.00	31.67	37.00	34.22	75.56	49.13	28.67	51.12
Sakha 61 X Sakha 94	45.33	38.33	37.00	40.22	159.11	80.33	23.00	87.48
Gemmeza 12 X Sakha	49.33	38.33	45.33	44.33	103.77	64.67	21.33	63.26
Gemmeza 12 X Sakha	33.67	40.00	42.33	38.67	178.71	103.80	13.67	98.72
Crosses mean	38.64	38.06	42.05	39.58	100.17	80.82	34.61	71.87
LSD 5%	2.51	2.27	2.97	2.57	5.84	5.68	7.06	6.15
LSD 1%	3.59	3.25	4.25	3.64	8.34	8.12	10.09	8.71

Table 4.Cont.

Genotypes	Grain yield/plant (g)				Harvest index (%)			
	D_1	D_2	D_3	Comb.	D_1	D_2	D_3	Comb.
Line 1	54.18	78.67	49.40	60.75	44.18	39.88	36.90	40.32
Sids 1	62.21	45.63	71.33	59.73	38.24	42.80	46.92	42.66
Sids 13	72.72	75.33	39.00	62.35	82.10	50.80	34.81	55.90
Shandaweel 1	36.16	53.67	57.27	49.03	37.25	71.60	75.10	61.32
Misr 1	58.87	74.83	77.33	70.35	23.21	55.45	71.17	49.94
Sakha 94	66.09	78.43	82.30	75.61	31.28	68.05	65.15	54.82
Sakha 61	28.66	42.67	38.67	36.67	26.46	32.00	66.31	41.59
Gemmeza 12	39.94	70.43	66.40	58.93	28.40	46.54	75.31	50.09
Parents mean	52.35	64.96	60.21	59.18	38.89	50.89	58.96	49.58
Sids 1 X Line 1	17.02	47.43	54.77	39.74	19.55	26.51	73.99	40.02
Sids 13 X Line 1	45.48	82.50	71.67	66.55	69.31	47.77	56.30	57.79
Shandaweel 1 X Line 1	37.44	42.73	54.57	44.91	27.81	29.34	49.32	35.49
Misr 1 X Line 1	32.98	42.93	82.67	52.86	22.24	47.89	48.63	39.59
Sakha 94 X Line 1	61.14	52.53	52.17	55.28	37.13	35.12	69.89	47.38
Sakha 61 X Line 1	46.77	64.40	67.17	59.45	30.24	27.45	68.55	42.08
Gemmeza 12 X Line 1	66.37	75.50	66.33	69.40	40.14	48.19	74.55	54.29
Sids 13 X Sids 1	41.51	54.57	41.33	45.80	27.23	38.45	60.69	42.12
Shandaweel 1 X Sids 1	30.62	30.40	12.73	24.59	24.17	36.83	14.20	25.07
Misr 1 X Sids 1	80.50	33.87	23.07	45.81	46.99	51.63	40.76	46.46
Sakha 94 X Sids 1	70.44	70.67	71.33	70.81	41.68	45.40	49.70	45.59
Sakha 61 X Sids 1	25.51	44.00	85.33	51.62	17.12	28.82	66.51	37.48
Gemmeza 12 X Sids 1	18.92	60.57	46.97	42.15	22.84	74.21	41.89	46.32
Shandaweel 1 X Sids 13	64.05	89.00	95.33	82.79	34.14	57.67	81.95	57.92
Misr 1X Sids 13	35.23	66.60	63.70	55.18	25.27	48.27	80.01	51.18
Sakha 94 X Sids 13	65.29	70.67	43.33	59.76	45.75	49.78	51.60	49.04
Sakha 61 X Sids 13	89.54	66.00	49.43	68.32	44.50	39.44	72.70	52.21
Gemmeza 12 X Sids 13	62.78	47.37	27.60	45.92	40.95	32.90	39.10	37.65
Misr 1 X Shandaweel 1	42.42	55.97	45.67	48.02	32.11	36.50	66.50	45.04
Sakha 94 X Shandaweel	54.11	40.27	60.97	51.78	35.47	42.24	74.06	50.59
Sakha 61X Shandaweel 1	42.48	41.90	81.00	55.13	35.16	29.32	85.27	49.92
Gemmeza 12 X	69.45	66.30	71.20	68.98	57.56	60.11	70.74	62.80
Sakha 94 X Misr 1	76.35	57.70	75.17	69.74	40.54	48.12	80.81	56.49
Sakha 94 X Misr 1	103.28	76.30	74.00	84.53	40.24	56.71	78.45	58.47
Sakha 61 X Misr 1	34.44	72.87	76.00	61.10	31.30	60.19	72.61	54.70
Sakha 61 X Sakha 94	73.55	104.00	81.00	86.18	31.62	56.43	77.89	55.31
Gemmeza 12 X Sakha 94	70.23	111.33	66.67	82.74	40.36	63.28	75.76	59.80
Gemmeza 12 X Sakha 61	76.29	71.20	91.33	79.61	29.93	40.69	86.99	52.53
Crosses mean	54.79	62.13	61.88	59.60	35.41	44.97	64.62	48.33
LSD 5%	3.35	2.75	2.85	2.96	2.94	3.19	3.64	3.23
LSD 1%	4.79	3.93	4.08	4.19	4.21	4.57	5.20	4.58

D_1 =1st Sowing date). D_2= 2nd Sowing Date D_3 =3rd Sowing.date Com= Combind data.

For grain yield/plant (g), the highest mean values were scored by the parent Sakha 94 in the three sowing dates and combined data and Misr 1 in D_2, D_3 and combined data in addition to Sids 13 in D_1 sowing date and Line 1 in the D_2 sowing date. While, the highest mean values were scored by the cross combinations of Sakha 94 with the three parents Misr 1, Sakha 61 and

Gemmeiza 12 in the combined analysis and one or more of the three sowing dates. With respect to harvest index, the highest harvest index was scored by the parent Sids 13 in D_1, Shandweel 1 in the D_2 sowing date and combined data and Gemmeiza 12 in the D_3 sowing date. While, the highest mean values scored by the crosses (Gemmeiza 12 x Shandaweel 1), (Gemmeiza 12 x Sakha 94) and (Sakha 94 x Misr 1) in the combined analysis and one or more of the three sowing dates.

In this study, the highest yield was obtained on the second sowing date of (15 Novamber), (Figure (1). The greater yield in this date could be explained by the recommended sowing date, where plants were able to receive an additional benefit of soil moisture, precipitation (as shown in Table 2), have a faster grain filling period, ripen quick, heavy grain weight, good tillering and reducing the risk of heat stress during grain fill.

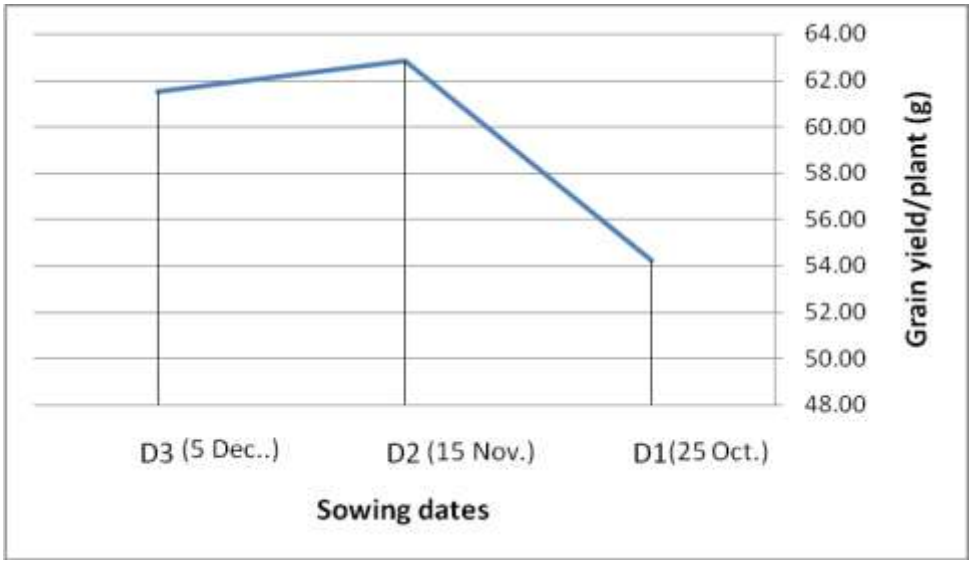

Fig. 1. Mean grain yield/plant (g) under three sowing dates

The effect of sowing date on the mean performance of grain yield and some agronomic traits has been reported by many workers, e.g. Abdel-Nour (2011) who indicated that the recommended sowing date produced the highest number of spikes/m^2, number of kernels/spike, 1000- kernel weight, biological yield and grain yield. Seleiman *et al* (2011). determined the effect of different sowing dates (i.e., 1st November, 15th November, 1st December and 15th December) on yield and it components as well as grain quality and the results revealed that sowing date on 15th November surpassed the other sowing dates in all of yield studied parameters, grain filling rate and flour percentage. Ali *et al* (2016). studied the response of two durum (Sohag 3 and Karim) and two bread (Misr1 and Casino) wheat varieties to three sowing dates (November 1st, November 15th and December 1st) and they

found that November 15th sowing date was the most suitable sowing date which gave the highest values for phenological characters, grain yield and its components.

Combining abilities

The analysis of variance for general and specific combining ability in the three sowing dates and their combined analysis are presented in Table 5.

The mean squares due to GCA and SCA were highly significant and/or significant at the three sowing dates and their combined analysis for all studied traits, except for 1000-grain weight in the combined analysis. The significant GCA and SCA mean square is evident that additive and non-additive types of gene action were important for the inheritance of these traits.

The ratio GCA/SCA exceeded the unity was detected for all stutied traits at the three sowing dates and their combined analysis, except for No. of spike/plant in the D_3 sowing date, No. of grains/spike and 1000-grain weight in the three sowing dates and their combined analysis. The ratio GCA/SCA which largely exceeded the unity may indicate that the largest part of the total genetic variance associated with these traits is a result of additive and additive x additive gene action. While for the other traits, the non-additive gene effects seamed to be responsible to inheritance. similar results for significant general and specific combining ability variances were obtained by Samier (2015), who reported that mean squares due to general (GCA) and specific (SCA) combining ability, were generally significant for all studied characters, reflecting the importance of both additive and non-additive gene effects in the inheritance of these characters. General combining ability variances were higher than those of specific combining ability, consequently the GCA/SCA ratios were more than unity, indicating the prevailing of additive gene effect which have considerable roles in the inheritance of these characters. El-Ashmouny *et al* (2016). Studied the genetic behavior of some bread wheat genotypes (*Triticum asetivum* L.) under different sowing dates using half diallel crosses analysis among eight parents and they reported that highly significant effects for either GCA or SCA in F_1 and F_2 under D1 and D2. Kandil *et al* (2016) revealed that mean squares due to general and specific combining ability were significant for all studied characters, indicating that additive and dominance genetic variance were significant for all studied characters except for 1000- grain weight. Obtained results are of great interest for bread wheat breeder to improve grain yield through its components. Similar results were reported before by Kumar *et al* (2011), Singh *et al* (2012), Brahim and Mohamed (2014), Kumar and Kerkhi (2015), and Rajput and Kandalkar (2018).

Table 5. Mean squares estimates of combining ability analysis for all traits studied in the three sowing dates and their combined data in F_1 diallel cross.

SOV	df		Days to heading				Days to maturity			
	S	C	D_1	D_2	D_3	C	D_1	D_2	D_3	C
Sowing date	2	2				2465.63*				5459.70*
Rep./ Sowing		6				0.76				3.47
Genotypes	35	35				44.60**				56.98**
GCA	7	7	186.92**	161.81**	146.03*	81.75**	254.18**	226.25**	204.19**	112.75**
SCA	28	28	17.74**	14.91**	13.46**	7.44**	20.84**	14.22**	12.84**	7.43**
GCA/SCA			10.57	10.85	10.85	10.99	12.20	15.91	15.91	15.18
Geno. x		70				181.46**				234.38**
GCA x		14				206.51**				285.94**
SCA x		56				19.34**				20.24**
Error	70	21	0.61	0.55	0.50	0.55	0.71	0.65	0.58	0.65
SOV	df		No. of spikes/plant				No. of grains/spike			
	S	C	D_1	D_2	D_3	C	D_1	D_2	D_3	C
Sowing date	2	2				154.16**				902.8
Rep./ Sowing		6				10.34**				25.33
Genotypes	35	35				7.50**				45.31**
GCA	7	7	7.27**	30.98**	8.12**	5.40**	86.68**	70.17**	95.96**	9.43*
SCA	28	28	4.09**	15.40**	16.44**	3.33**	100.69**	195.73**	257.05**	25.96**
GCA/SCA			1.78	2.01	0.49	1.62	0.86	0.36	0.37	0.36
Geno. x		70				53.27**				717.3**
GCA x		14				20.48**				121.7**
SCA x		56				16.29**				263.7**
Error	70	21	0.48	0.49	0.53	0.50	3.18	3.93	5.39	4.17
SOV	df		1000-grains weight				Straw yield/plant			
	S	C	D_1	D_2	D_3	C	D_1	D_2	D_3	C
Sowing date	2	2				430.52**				106967.4
Rep./ Sowing		6				6.52				20.18
Genotypes	35	35				9.96**				232.70**
GCA	7	7	31.40**	24.75**	9.71**	2.47	2886.35*	2202.97*	1059.80**	208.59**
SCA	28	28	38.50**	21.27**	47.69**	5.61**	1001.93*	548.82**	371.89**	93.29**
GCA/SCA			0.82	1.16	0.20	0.44	2.88	4.01	2.85	2.24
Geno. x		70				143.73**				4035.55*
GCA x		14				31.69**				2970.27*
SCA x		56				50.93**				914.67**
Error	70	21	1.14	0.93	1.59	1.22	6.15	5.82	8.98	6.98

Table 5. Cont.

S.O.V	df		Grain yield/plant				Harvest index			
	S	C	D_1	D_2	D_3	C	D_1	D_2	D_3	C
Sowing date	2	2				2278.02**				20387.02**
Rep./ Sowing dates		6				27.96**				7.11
Genotypes	35	35				212.32**				70.47**
GCA	7	7	517.45**	660.95**	312.90**	173.21**	315.18**	297.49**	545.25**	68.19**
SCA	28	28	397.58**	268.81**	395.75**	89.39**	137.16**	125.58**	225.80**	26.99**
GCA/SCA			1.30	2.46	0.79	1.94	2.30	2.37	2.41	2.53
Geno. x sowing dates		70				1615.80**				898.38**
GCA x sowing dates		14				659.05**				544.86**
SCA x sowing dates		56				486.37**				230.77**
Error	70	210	2.02	1.36	1.47	1.62	1.56	1.84	2.39	1.93

***and ** significant at 0.05 and 0.01 respectively D_1 =1st Sowing date). D_2= 2nd Sowing Date D_3 =3rd Sowing.date C = combind data.**

General combining ability effects (ĝi)

Estimates of general combining ability effects (ĝi) for individual parental genotype for each trait at the three sowing dates as well as their combined data are presented in Table 6. General combining ability effects computed herein were found to differ significantly from zero in most cases. High positive values would be of interest under all traits studied in question.

The parental cultivar, Line 1 showed highly significant and positive desirable (ĝi) effects for No. of grains/spike in D_1 sowing date, 1000-grain weight in D_2, and D_3, straw yield/plant at D_2 and D_3 and combined data and harvest index at the D_1 sowing date.

It could be concluded that the traits days to heading and days to maturity traits which showed negative GCA effects are favorable, the parents cultivar P_5 (Misr 1), P_6 (Sakha 94) and P_8 were the best combiners for earliness under D_1, D_2, D_3 environments as well as the combined analysis.

With respect to other studied traits, positive GCA effects are favorable, the parent P_1 (Line 1) exhibited highly significant positive desirable ($\hat{g}_i$) effects for No. of grains/spike in the D_1 sowing date, 1000-grain weight in the D_2 sowing date and straw yield/plant in D_3 sowing. Similarly, the parent P_3 (Sids 13) for No. of spikes/plant, No. of grains/spike and grain yield/plant in D_1, D_2 and the combined data.

Table 6. Estimates of general combining ability effects for the parental lines and varieties evaluated under the three sowing dates and their combined data in the F_1 diallel cross.

Parent	Days to heading				Days to maturity			
	D_1	D_2	D_3	Comb.	D_1	D_2	D_3	Comb.
Line 1	5.69**	5.16**	4.90**	1.75**	4.32**	3.75**	3.56**	1.29**
Sids 1	2.47**	2.11**	2.00**	0.73**	3.51**	2.97**	2.83**	1.03**
Sids 13	4.24**	3.79**	3.60**	1.29**	2.29**	1.82**	1.73**	0.65**
Shandaweel 1	0.62**	0.35	0.33	0.14	4.91**	4.31**	4.09**	1.48**
Misr 1	-0.64**	-0.84**	-0.80**	-0.25**	-2.56**	-2.78**	-2.64**	-0.89**
Sakha 94	-2.27**	-2.39**	-2.27**	-0.77**	-0.45	-0.78**	-0.74**	-0.22*
Sakha 61	-8.00**	-7.82**	-7.43**	-2.58**	-10.41**	-10.22**	-9.71**	-3.37**
Gemmeiza 12	-2.10**	-0.35	-0.33	-0.31**	-1.60**	0.94**	0.89**	0.03
LSD gi 5%	0.46	0.44	0.42	0.17	0.50	0.47	0.45	0.19
LSD gi 1%	0.61	0.58	0.55	0.23	0.66	0.63	0.60	0.25
LSD gi-gj 5%	1.41	1.34	1.28	0.27	1.53	1.45	1.38	0.29
LSD gi-gj 1%	1.87	1.78	1.69	0.35	2.03	1.93	1.83	0.38
Parent	No. of spikes/spike				No. of grains/spike			
	D_1	D_2	D_3	C	D_1	D_2	D_3	C
Line 1	0.00	-0.40	-0.50*	0.63**	1.97**	-4.28**	-4.78**	-0.79**
Sids 1	-0.40	-1.40**	-3.22**	-1.60**	2.87**	-1.56**	-1.52*	-0.02
Sids 13	0.33	1.26**	1.50**	-0.85**	3.93**	1.41*	-1.13	0.47*
Shandaweel 1	0.40	-0.65**	-1.58**	0.03	-3.53**	-1.68**	0.78	-0.49*
Misr 1	-1.00**	-0.26	0.17	0.60**	-4.00**	-0.69	4.39**	-0.03
Sakha 94	-0.20	0.83**	2.17**	0.84**	0.87	1.90**	0.97	0.42
Sakha 61	0.20	0.30	0.24	-0.50*	-0.13	0.52	3.73**	0.46
Gemmeiza 12	0.67*	0.33	1.22**	0.85**	-1.97**	4.38**	-2.44**	0.00
LSD gi 5%	0.51	0.41	0.41	0.43	1.05	1.17	1.37	0.47
LSD gi 1%	0.55	0.55	0.57	0.22	1.40	1.55	1.82	0.63
LSD gi-gj 5%	1.55	1.26	1.27	1.32	3.22	3.59	4.20	0.73
LSD gi-gj 1%	1.67	1.68	1.75	0.34	4.28	4.76	5.57	0.97
Parent	1000-grains weight				Straw yield/plant			
	D_1	D_2	D_3	C	D_1	D_2	D_3	C
Line 1	-1.53**	0.73*	1.68**	0.10	-14.24**	24.55**	12.72**	2.56**
Sids 1	-0.03	2.77**	-0.79*	0.22	-3.78**	1.36	16.74**	1.59**
Sids 13	0.87**	1.17**	-0.36	0.19	-22.25**	-0.32	3.79**	-2.09**
Shandaweel 1	1.40**	0.43	-0.49	0.15	-13.64**	-11.05**	-5.50**	-3.35**
Misr 1	-1.03**	-1.23**	-1.09**	-0.37**	23.76**	-14.86**	-4.70**	0.47
Sakha 94	1.30**	-1.27**	1.04**	0.12	15.05**	-16.97**	-2.89**	-0.53
Sakha 61	2.13**	-2.03**	-0.59	-0.05	17.98**	17.51**	-13.36**	2.46**
Gemmeiza 12	-3.10**	-0.57	0.61	-0.34**	-2.89**	-0.22	-6.79**	-1.10**
LSD gi 5%	0.63	0.57	0.74	0.63	1.46	1.42	1.77	0.61
LSD gi 1%	0.83	0.76	0.99	0.83	1.94	1.89	2.35	0.81
LSD gi-gj 5%	1.93	1.75	2.28	1.93	4.48	4.36	5.42	0.95
LSD gi-gj 1%	2.56	2.32	3.03	2.56	5.95	5.79	7.20	1.25

Table 6. Cont.

Parent	Grain yield/plan				Harvest index			
	D_1	D_2	D_3	C	D_1	D_2	D_3	C
Line 1	-7.27**	0.06	-0.54	-0.86**	0.92*	-7.46**	-5.52**	-1.34**
Sids 1	-7.93**	-13.20**	-7.54**	-3.19**	-4.95**	-2.91**	-12.87**	-2.30**
Sids 13	6.11**	6.26**	-8.32**	0.45**	12.57**	-0.07	-5.83**	0.74**
Shandaweel 1	-7.54**	-9.09**	-1.76**	-2.04**	-0.47	1.86**	2.20**	0.40*
Misr 1	3.47**	-0.89*	4.14**	0.75**	-4.05**	4.36**	3.99**	0.48**
Sakha 94	11.50**	9.92**	6.17**	3.07**	0.95*	5.99**	3.97**	1.21**
Sakha 61	2.65**	-1.17**	5.31**	0.75**	-4.39**	-7.37**	9.87**	-0.21
Gemmeiza 12	-0.99*	8.12**	2.54**	1.07**	-0.57	5.61**	4.20**	1.03**
LSD gi 5%	0.84	0.69	0.71	0.30	0.74	0.80	0.91	0.32
LSD gi 1%	1.11	0.92	0.95	0.39	0.98	1.06	1.21	0.43
LSD gi-gj 5%	2.57	2.11	2.19	0.46	2.26	2.45	2.79	0.50
LSD gi-gj 1%	3.42	2.80	2.91	0.60	3.00	3.26	3.71	0.66

***and ** significant at 0.05 and 0.01 respectively D_1 =1st Sowing date). D_2= 2nd Sowing Date D_3 =3rd Sowing.date C= combind data.**

Moreover, it showed positive ($\hat{g}_i$) effects for straw yield/plant in the D_3 sowing date, 1000-grain weight in D_1 and D_2, and harvest index in D_1 sowing date and combined data. Parent P_4 (Shandweel 1) exhibited highly significant and positive ($\hat{g}_i$) effects for harvest index in D_2, D_3 and the combined data, parent P_5 (Misr 1) expressed highly significant positive desirable ($\hat{g}_i$) effects for No. of spikes/plant and No. of grains/spike in the D_3 sowing date, straw yield/plant in the D_1 sowing date, grain yield/plant in D_1, D_3 and combined data and harvest index in the D_2, D_3 and combined data. Parent P_6 (Sakha 94) showed positive and significant $\hat{g}_i$ effects for grain weight/plant and harvest index in the three sowing dates and combined data. Also, it showed positive desirable (ĝi) effects for 1000-grain weight in D1 and D3 sowing date.

The parent P_7 (Sakha 61) showed highly significant and positive desirable ($\hat{g}_i$) effects for No. of grain /spike and harvest index in the D_3 sowing date. Also, it showed positive desirable ($\hat{g}_i$) effects for 1000-grain weight in D_1 sowing date and straw yield/plant in the D_1, D_2 and combined analysis. Parent P_8 (Gemmeiza 12) showed positive desirable ($\hat{g}_i$) effects for grain yield/plant and harvest index in the D_2, D_3 sowing date, and combined data and for No. of spikes/plant in the three sowing dates and combined data, No. of grains/spike and grain weight/spike in the D_2 sowing date.

Generally, it could be concluded that the breeder can use the three parents P_6 (Sakha 94), P_7 (Sakha 61) and P_8 (Gemmeiza 12) to improve yield and earliness by including them in breeding programs.

The positive and significant ($\hat{g}_i$) effects for yield and yield components and the negative ($\hat{g}_i$) effects for heading date (days) and maturity date (days) in the Egyptian wheat cultivars were obtained by many workers before, e.g. Samier (2015), who revealed that the cultivar Sids 4 was a good combiner for early heading and maturity, long spike and great No. of kernels/spike, Giza 168 was good combiner for high grain yield/plant and Gemmiza 10 for heavy1000-kernel weight, and Sakha 94 was a good combiner for tall plant. These results seem to be useful for wheat breeding program in making the proper decision when initiating a crossing plan. El-Ashmouny *et al* (2016), found that the parental genotypes, Shandaweel-1 (P1) and Line-26 (P8) were good combiners for No. of spikes/plant under (D2), Sids-4 (P5) under (D1, D2) and Sids-12 (P2) under (D2) for days to maturity and Line-26 (P8) for grain yield/plant under (D2). Kandil *et al* (2016), revealed that wheat cultivars Sids12 was the best general combiner for all studied characters, except number of spikes/plant; Gemmiza 11 for all studied characters except 1000– grain weight; Miser 1 for spike length and 1000- grain weight. Morgan *et al* (2018), reported that the best general combiners for grain filling period under both sowing dates were Giza 168 and Gemmeiza 11, whereas, for grain filling rate and grain yield/plant the best combiners under the two sowing dates were Shandaweel 1 and Sids 12.

Specific combining ability effects

Specific combining ability ($\hat{S}_{ij}$) effects of the hybrid combinations were computed for all studied traits in F_1 in the three sowing dates and their combined analysis are presented in Table 7.

For earliness traits (days to heading and days to maturity), thirteen, fourteen, fourteen and ten crosses expressed significant desirable negative ($\hat{S}_{ij}$) effects at D_1 D_2, D_3 and the combined analysis, respectively. The four crosses (Sakha 61 x Line 1), (Shandaweel 1 x Sids 1), (Misr 1 x Sids 13) and (Sakha 61 x Sids 13) gave the best ($\hat{S}_{ij}$) effects in the combined analysis and four crosses for days to heading only and two crosses for days to maturity only under all environments as well as the combind analysis, respectively.

With respect to No. of spikes/ plant, four, ten, eleven and four crosses expressed significant and desirable positive ($\hat{S}_{ij}$) effects at D_1 D_2, D_3 and the combined analysis, respectively. The four crosses (Sakha 94 x Sids 1), (Shandaweel 1 x Sids 13), (Sakha 61 x Sakha 94) and (Sakha 94 x Misr 1) gave the best ($\hat{S}_{ij}$) effects in the combined analysis and one or more of the three sowing dates. For No. of grains/ spike, eight, ten, thirteen and four crosses expressed significant desirable positive ($\hat{S}_{ij}$) effects at D_1 D_2, D_3 and the combined analysis, respectively. Only the cross (Sakha 61 x Misr 1) showed significant ($\hat{S}_{ij}$) effects in the three sowing dates and their combined analysis.

Table 7. Estimates of specific combining ability effects for twenty-eight crosses evaluated in the three sowing dates and their combined data in the F1 diallel cross.

Cross	Days to heading				Days to maturity			
	D_1	D_2	D_3	C	D_1	D_2	D_3	C
Sids 1 X Line 1	-0.15	0.07	0.06	0.001	-0.02	0.29	0.27	0.06
Sids 13 X Line 1	6.95**	6.80**	6.46**	2.25**	4.16**	4.25**	4.04**	1.38**
Shandaweel 1 X Line 1	-0.52	-0.28	-0.27	-0.12	-3.28**	-2.80**	-2.66**	-0.97*
Misr 1 X Line 1	0.00	0.21	0.20	0.04	-2.47**	-2.03**	-1.93**	-0.71
Sakha 94 X Line 1	-5.77**	-5.27**	-5.00**	-1.78**	-1.25	-0.87	-0.83	-0.33
Sakha 61 X Line 1	-7.44**	-6.85**	-6.50**	-2.31**	-3.50**	-3.01**	-2.86**	-1.04*
Gemmeza 12 X Line 1	0.35	-1.34*	-1.27*	-0.25	1.38*	-1.19	-1.13	-0.10
Sids 13 X Sids 1	-3.52**	-3.13**	-2.97**	-1.07**	-1.69*	-1.29*	-1.23*	-0.47
Shandaweel 1 X Sids 1	-3.22**	-2.85**	-2.70**	-0.97*	-4.69**	-4.13**	-3.93**	-1.42**
Misr 1 X Sids 1	5.81**	5.72**	5.43**	1.88**	8.34**	8.22**	7.81**	2.71**
Sakha 94 X Sids 1	-2.19**	-1.86**	-1.77**	-1.94**	-0.80	-0.45	-0.43	-0.56
Sakha 61 X Sids 1	-3.48**	-3.09**	-2.94**	-1.06**	-6.02**	-5.40**	-5.13**	-1.84**
Gemmeza 12 X Sids 1	4.31**	2.42**	2.30**	1.00*	2.57**	-0.06	-0.06	0.27
Shandaweel 1 X Sids 13	2.03**	2.14**	2.03**	0.69	4.30**	4.39**	4.17**	1.43**
Misr 1X Sids 13	-5.22**	-4.74**	-4.50**	-1.61**	-8.20**	-7.47**	-7.09**	-2.53**
Sakha 94 X Sids 13	0.85	1.01	0.96	0.31	0.05	0.36	0.34	0.08
Sakha 61 X Sids 13	-4.89**	-4.42**	-4.20**	-1.50**	-5.54**	-4.94**	-4.69**	-1.69**
Gemmeza 12 X Sids 13	4.01**	2.14**	2.03**	0.91*	4.16**	1.45*	1.37*	0.78
Misr 1 X Shandaweel 1	-1.59*	-1.30*	-1.24*	-0.46	-0.84	-0.48	-0.46	-0.20
Sakha 94 X Shandaweel 1	5.95**	5.86**	5.56**	1.93**	0.75	1.03	0.97	0.31
Sakha 61X Shandaweel 1	-1.26*	-0.99	-0.94	-0.35	-4.09**	-3.57**	-3.39**	-1.23**
Gemmeza 12 X Shandaweel 1	-0.13	-1.79**	-1.70**	-0.40	7.45**	4.57**	4.34**	1.82**
Sakha 94 X Misr 1	3.14**	3.19**	3.03**	1.04**	1.94**	2.15**	2.04**	0.68
Sakha 94 X Misr 1	-3.33**	-2.95**	-2.80**	-1.01*	-0.69	-0.34	-0.33	-0.15
Sakha 61 X Misr 1	-3.31**	-4.81**	-4.57**	-1.41**	2.72**	0.08	0.07	0.32
Sakha 61 X Sakha 94	0.15	0.35	0.33	0.09	0.90	1.17	1.11	0.35
Gemmeza 12 X Sakha 94	-0.58	-2.21**	-2.10**	-0.54	-1.24	-3.68**	-3.49**	-0.93*
Gemmeza 12 X Sakha 61	4.79**	2.87**	2.73**	1.15**	1.68*	-0.90	-0.86	-0.01
LSD Sij 5%	1.22	1.17	1.11	0.77	1.33	1.26	1.20	0.83
LSD Sij 1%	1.62	1.55	1.47	1.01	1.76	1.68	1.59	1.09
LSD sij-sik 5%	2.08	1.99	1.89	1.13	2.26	2.15	2.04	1.23
LSD sij-sik 1%	2.76	2.64	2.51	1.50	3.00	2.86	2.71	1.62
LSD sij-skl 5%	1.96	1.87	1.78	0.38	2.13	2.03	1.93	0.41
LSD sij-skl 1%	2.61	2.49	2.36	0.50	2.83	2.69	2.56	0.54

Table 7. Cont.

Cross	No. of spikes/spike				No. of grains/spike			
	D_1	D_2	D_3	C	D_1	D_2	D_3	C
Sids 1 X Line 1	-2.02**	-0.48	1.50*	-0.11	-13.94**	-0.89	2.99	-1.32
Sids 13 X Line 1	-0.06	2.68**	3.18**	0.64	-11.01**	11.83**	7.93**	0.97
Shandaweel 1 X Line 1	-0.45	-2.18**	-0.42	-0.34	14.79**	-6.82**	-20.01**	-1.34
Misr 1 X Line 1	-1.29*	-4.93**	6.00**	-0.02	-6.08**	17.35**	-32.70**	-2.38*
Sakha 94 X Line 1	0.06	-4.20**	-5.25**	-1.04**	3.06*	-21.02**	3.92*	-1.56
Sakha 61 X Line 1	0.90	0.08	-2.57**	-0.18	-4.28**	-1.38	14.60**	0.99
Gemmeza 12 X Line 1	1.96**	1.68**	2.11**	0.64	12.89**	-5.51**	-18.06**	-1.19
Sids 13 X Sids 1	-0.51	0.80	-0.02	0.03	4.76**	-27.95**	-20.58**	-4.86**
Shandaweel 1 X Sids 1	-4.24**	-1.92**	-9.17**	-1.70**	-14.78**	6.09**	17.30**	0.96
Misr 1 X Sids 1	2.14**	-3.92**	-6.71**	-0.94*	12.36**	-3.22*	7.76**	1.88
Sakha 94 X Sids 1	0.96	3.48**	4.82**	3.09**	1.16	18.91**	-13.97**	2.03
Sakha 61 X Sids 1	-2.33**	-1.25*	2.54**	-0.12	-5.18**	2.01	-5.57**	-0.97
Gemmeza 12 X Sids 1	-3.35**	-1.12*	1.24*	-0.36	0.66	15.33**	-24.72**	-0.97
Shandaweel 1 X Sids 13	0.78	5.87**	9.99**	1.85**	-1.51	13.79**	11.01**	2.59*
Misr 1X Sids 13	-3.02**	0.18	1.07	-0.20	-21.04**	-13.50**	12.50**	-2.45*
Sakha 94 X Sids 13	-0.87	-2.41**	-2.93**	-0.69	-2.58	5.07**	-13.42**	-1.21
Sakha 61 X Sids 13	1.36*	-1.59**	0.26	0.00	-4.58**	23.45**	-14.59**	0.48
Gemmeza 12 X Sids 13	-0.27	-8.48**	-6.87**	-1.74**	2.59	11.66**	-2.17	1.34
Misr 1 X Shandaweel 1	-0.52	0.17	-1.15	-0.17	-10.58**	-9.65**	-21.85**	-4.68**
Sakha 94 X Shandaweel 1	0.46	-6.69**	-2.45**	-0.96*	-2.11	19.44**	6.27**	2.62*
Sakha 61X Shandaweel 1	-0.90	-2.91**	1.10	-0.30	-4.78**	19.70**	-0.39	1.61
Gemmeza 12 X	0.21	2.47**	1.15	0.43	1.72	-8.49**	-1.01	-0.86
Sakha 94 X Misr 1	-0.21	-2.49**	2.29**	-0.04	-5.64**	-7.01**	-4.40*	-1.89
Sakha 94 X Misr 1	2.18**	4.31**	0.93	0.82*	11.69**	-4.51**	12.70**	2.21*
Sakha 61 X Misr 1	-0.56	1.76**	-1.71**	-0.06	4.19**	9.89**	20.44**	3.83**
Sakha 61 X Sakha 94	1.11*	8.36**	0.29	1.08**	-0.84	-5.90**	10.93**	0.47
Gemmeza 12 X Sakha 94	0.50	4.00**	1.21*	0.63	-9.34**	-10.92**	-10.71**	-3.44**
Gemmeza 12 X Sakha 61	2.56**	1.11*	2.81**	0.72	8.99**	-11.59**	9.65**	0.78
LSD Sij 5%	1.10	1.10	1.15	0.73	2.81	3.12	3.65	2.11
LSD Sij 1%	1.45	1.46	1.53	0.97	3.72	4.14	4.85	2.78
LSD sij-sik 5%	1.86	1.87	1.95	1.08	4.77	5.31	6.21	3.12
LSD sij-sik 1%	2.47	2.49	2.60	1.43	6.33	7.05	8.25	4.11
LSD sij-skl 5%	1.76	1.77	1.84	0.36	4.50	5.00	5.86	1.04
LSD sij-skl 1%	2.33	2.35	2.45	0.48	5.97	6.64	7.77	1.37

Table 7. Cont.

Cross	1000-grains weight				Straw yield/plant			
	D_1	D_2	D_3	C	D_1	D_2	D_3	C
Sids 1 X Line 1	0.12	-1.02	-0.43	-0.15	-11.20**	27.16**	-47.60**	-3.52*
Sids 13 X Line 1	-0.78	3.58**	7.47**	1.14*	-42.53**	-12.56**	1.79	-5.92**
Shandaweel 1 X Line 1	2.69**	-3.02**	10.94**	1.18*	25.90**	10.94**	11.51**	5.37**
Misr 1 X Line 1	-5.21**	-6.35**	3.87**	-0.85	6.63**	-41.46**	41.94**	0.79
Sakha 94 X Line 1	4.46**	4.68**	-1.93	0.80	3.51	11.39**	-24.70**	-1.09
Sakha 61 X Line 1	-1.38	1.78*	-10.96**	-1.17*	5.29**	49.71**	-5.89*	5.46**
Gemmeza 12 X Line 1	0.86	0.31	13.50**	1.63**	16.88**	-27.32**	-20.63**	-3.45*
Sids 13 X Sids 1	2.39**	10.55**	5.60**	2.06**	37.65**	-18.50**	-24.91**	-0.64
Shandaweel 1 X Sids 1	8.19**	3.28**	-10.26**	0.13	14.25**	18.63**	28.32**	6.80**
Misr 1 X Sids 1	0.96	-0.72	-8.00**	-0.86	-28.35**	-12.74**	-15.82**	-6.32**
Sakha 94 X Sids 1	-2.71**	-9.35**	5.54**	-2.18**	-11.92**	-31.09**	21.44**	-7.19**
Sakha 61 X Sids 1	1.46	-2.59**	-0.83	-0.22	10.09**	-12.37**	2.25	0.00
Gemmeza 12 X Sids 1	-0.98	1.28	0.30	0.07	-28.79**	29.03**	16.04**	1.81
Shandaweel 1 X Sids 13	-4.04**	-2.12**	-6.03**	-1.35*	60.30**	-1.79	-14.66**	4.87**
Misr 1X Sids 13	-4.94**	-1.79*	-3.76**	-1.17*	3.39	8.08**	-20.50**	-1.00
Sakha 94 X Sids 13	-3.61**	-3.75**	4.44**	-0.33	-14.63**	10.13**	2.40	-0.23
Sakha 61 X Sids 13	15.22**	-8.99**	3.40**	1.07	16.86**	5.65**	-9.23**	1.48
Gemmeza 12 X Sids 13	3.46**	1.55*	-0.13	0.54	16.48**	18.68**	9.03**	4.91**
Misr 1 X Shandaweel 1	0.86	5.61**	2.04*	0.95	-19.74**	44.78**	-4.17	2.32
Sakha 94 X Shandaweel 1	-8.14**	-0.35	4.57**	-0.44	-2.06	4.59*	-7.61**	-0.56
Sakha 61X Shandaweel 1	-2.64**	-7.25**	12.54**	0.29	-25.02**	16.15**	-4.51	-1.49
Gemmeza 12 X	-1.08	-0.72	-2.00*	-0.42	-31.47**	-23.19**	4.39	-5.58**
Sakha 94 X Misr 1	3.96**	3.31**	-2.50*	0.53	-26.03**	15.63**	-11.95**	-2.48
Sakha 94 X Misr 1	8.46**	3.41**	0.80	1.41*	12.45**	-22.78**	1.02	-1.03
Sakha 61 X Misr 1	0.69	-4.72**	-3.73**	-0.86	-44.51**	-14.28**	2.78	-6.22**
Sakha 61 X Sakha 94	4.46**	3.45**	-4.66**	0.36	26.88**	1.30	1.88	3.34*
Gemmeza 12 X Sakha 94	13.69**	1.98*	2.47*	2.02**	-7.60**	3.36	-6.35**	-1.18
Gemmeza 12 X Sakha 61	-2.81**	4.41**	1.10	0.30	64.41**	8.02**	-3.55	7.65**
LSD Sij 5%	1.68	1.52	1.98	1.14	3.90	3.79	4.71	2.73
LSD Sij 1%	2.23	2.02	2.63	1.50	5.18	5.04	6.26	3.60
LSD sij-sik 5%	2.85	2.58	3.38	1.69	6.63	6.45	8.02	4.03
LSD sij-sik 1%	3.79	3.43	4.48	2.22	8.81	8.57	10.65	5.32
LSD sij-skl 5%	2.69	2.43	3.18	0.56	6.25	6.09	7.56	1.34
LSD sij-skl 1%	3.57	3.23	4.22	0.74	8.30	8.08	10.04	1.77

Table 7. Cont.

Cross	Grain yield/plan				Harvest index			
	D_1	D_2	D_3	C	D_1	D_2	D_3	C
Sids 1 X Line 1	-22.03**	-2.17*	1.34	-2.54**	-12.59**	-9.40**	29.02**	0.78
Sids 13 X Line 1	-7.61**	13.43**	19.02**	2.76**	19.64**	9.01**	4.30**	3.66**
Shandaweel 1 X Line 1	-2.01	-10.99**	-4.64**	-1.96**	-8.82**	-11.35**	-10.72**	-3.43**
Misr 1 X Line 1	-17.47**	-18.99**	17.56**	-2.10**	-10.80**	4.70**	-13.19**	-2.14**
Sakha 94 X Line 1	2.65*	-20.20**	-14.97**	-3.61**	-0.91	-9.70**	8.08**	-0.28
Sakha 61 X Line 1	-2.86*	2.76**	0.90	0.09	-2.46*	-4.01**	0.84	-0.63
Gemmeza 12 X Line 1	20.38**	4.57**	2.83**	3.09**	3.61**	3.75**	12.51**	2.21**
Sids 13 X Sids 1	-10.92**	-1.24	-4.32**	-1.83**	-16.57**	-4.85**	16.02**	-0.60
Shandaweel 1 X Sids 1	-8.16**	-10.06**	-39.48**	-6.41**	-6.58**	-8.41**	-38.49**	-5.94**
Misr 1 X Sids 1	30.71**	-14.79**	-35.04**	-2.12**	19.81**	3.89**	-13.72**	1.11
Sakha 94 X Sids 1	12.62**	11.19**	11.19**	11.67**	9.51**	-3.96**	-4.77**	0.26
Sakha 61 X Sids 1	-23.46**	-4.38**	26.06**	-0.20	-9.71**	-7.18**	6.14**	-1.19
Gemmeza 12 X Sids 1	-26.42**	2.90**	-9.54**	-3.67**	-7.81**	25.23**	-12.80**	0.51
Shandaweel 1 X Sids 13	11.23**	29.08**	43.90**	9.36**	-14.14**	9.59**	22.22**	1.96**
Misr 1X Sids 13	-28.60**	-1.52	6.37**	-2.64**	-19.43**	-2.31*	18.49**	-0.36
Sakha 94 X Sids 13	-6.57**	-8.27**	-16.03**	-3.43**	-3.96**	-2.42*	-9.91**	-1.81*
Sakha 61 X Sids 13	26.54**	-1.84*	-9.06**	1.74**	0.13	0.60	5.29**	0.67
Gemmeza 12 X Sids 13	3.41**	-29.76**	-28.13**	-6.05**	-7.23**	-18.92**	-22.63**	-5.42**
Misr 1 X Shandaweel 1	-7.76**	3.19**	-18.22**	-2.53**	0.45	-16.01**	-3.04*	-2.07**
Sakha 94 X Shandaweel 1	-4.11**	-23.32**	-4.95**	-3.60**	-1.19	-11.90**	4.52**	-0.95
Sakha 61X Shandaweel 1	-6.89**	-10.60**	15.94**	-0.17	3.84**	-11.46**	9.84**	0.25
Gemmeza 12 X Shandaweel 1	23.73**	4.52**	8.91**	4.13**	22.42**	6.35**	0.98	3.31**
Sakha 94 X Misr 1	7.13**	-14.09**	3.35**	-0.40	7.47**	-8.52**	9.49**	0.94
Sakha 94 X Misr 1	42.91**	15.60**	3.05**	6.84**	12.50**	13.44**	1.23	3.02**
Sakha 61 X Misr 1	-22.29**	2.88**	7.82**	-1.29	-0.25	3.94**	1.06	0.53
Sakha 61 X Sakha 94	5.15**	32.49**	8.02**	5.07**	-1.12	11.53**	0.68	1.23
Gemmeza 12 X Sakha 94	5.47**	30.54**	-3.54**	3.61**	3.81**	5.40**	4.22**	1.49*
Gemmeza 12 X Sakha 61	20.38**	1.49	21.99**	4.87**	-1.29	-3.84**	9.55**	0.49
LSD Sij 5%	2.24	1.84	1.91	1.31	1.97	2.13	2.43	1.43
LSD Sij 1%	2.97	2.44	2.53	1.73	2.61	2.83	3.23	1.89
LSD sij-sik 5%	3.81	3.13	3.24	1.94	3.34	3.63	4.13	2.12
LSD sij-sik 1%	5.06	4.15	4.31	2.56	4.44	4.82	5.49	2.80
LSD sij-skl 5%	3.59	2.95	3.06	0.65	3.15	3.42	3.90	0.71
LSD sij-skl 1%	4.77	3.91	4.06	0.85	4.19	4.54	5.17	0.93

***and ** significant at 0.05 and 0.01 respectively D_1 =1st Sowing date). D_2= 2nd Sowing Date D_3 =3rd Sowing date C= combind data.**

With regard to 1000-grain weight, ten, twelve, eleven and six crosses expressed significant desirable positive ($\hat{S}_{ij}$) effects at D_1 D_2, D_3 and the combined analysis, respectively. Only the two crosses (Sids 13 x Sids 1) and (Gemmeiza 12 x Sakha 94) showed significant ($\hat{S}_{ij}$) effects in the three sowing dates and their combined analysis. For straw yield/ plant (g), twelve, fourteen, seven and seven crosses expressed significant desirable positive ($\hat{S}_{ij}$) effects at D_1 D_2, D_3 and the combined analysis, respectively. Only, the three crosses (Shandaweel 1 x Line 1), (Shandaweel 1 x Sids 1) and (Gemmeiza 12 x Sids 13) showed significant and positive ($\hat{S}_{ij}$) effects in the three sowing dates and their combined analysis.

For grain yield/ plant (g), thirteen, twelve, fourteen and nine crosses expressed significant and desirable positive ($\hat{S}_{ij}$) effects at D_1 D_2, D_3 and the combined analysis, respectively. Only, the five crosses (Gemmeiza 12 x Line 1), (Sakha 94 x Sids 1), (Gemmeiza 12 x Shandaweel 1), (Sakha 94 x Misr 1) and (Sakha 61 x Sakha 94) showed significant and positive ($\hat{S}_{ij}$) effects in the three sowing dates and their combined analysis. Regarding to harvest index, eight, eleven, fourteen and six crosses expressed significant desirable positive ($\hat{S}_{ij}$) effects at D_1 D_2, D_3 and the combined analysis, respectively. Only, the two crosses (Sids 13 x Line 1) and (Gemmeiza 12 x Line 1) showed significant and positive ($\hat{S}_{ij}$) effects in the three sowing dates and their combined analysis.

These results are in harmony with the results were obtained by Ahmad (2010), El-Ashmouny *et al* (2016 and Kandil *et al* (2016).

Generally, the breeder could use the three parents P_6 (Sakha 94), P_7 (Sakha 61) and P_8 (Gemmeiza 12) to improve yield and earliness. Also, he could use the five crosses (Gemmeiza 12 x Line 1), (Sakha 94 x Sids 1), (Gemmeiza 12 x Shandaweel 1), (Sakha 94 x Misr 1) and (Sakha 61 x Sakha 94) in breeding programs to segregate lines with high grain and straw yield, since they had significant and positive ($\hat{S}_{ij}$) effects for grain and straw yield and some of grain yield components in the three sowing dates and their combined analysis. Pedigree method of selection will be an excellent choice for breeders to select good lines with high yield and stability under a wide range of sowing dates based on yield and yield component traits.

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التحليل الوراثى للمحصول ومكوناته فى قمح الخبز تحت ظروف ثلاث مواعيد للزراعة

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تم اجراء هذه الدراسة في محطة البحوث الزراعية بالجميزة بمحافظة الغربية بمصر خلال موسمي ٢٠١٤/٢٠١٥ و ٢٠١٥/٢٠١٦. تم اختيار ثمانية أصناف وسلالات من القمح ، Triticum aestivum L. em Thell، في هذه الدراسة ، حيث تم تهجينها في نظام التهجين النصف تبادلى لتقدير القدرة على التألف لمحصول الحبوب ومكوناته في تواريخ الزراعة الثلاثة في ٢٥ أكتوبر (تاريخ الزراعة الأول)، ١٥ نوفمبر (تاريخ الزراعة الثاني، ٥ ديسمبر (تاريخ الزراعة الثالث) و إجراء التحليل المشترك لتحديد أكثر الأباء و الهجن ذات الإنتاجية العالية من الحبوب ، وكذلك لتحديد طريقة الإنتخاب المثلى التي سيتم استخدامها في الأجيال الإنعزالية. يمكن تلخيص النتائج التي تم الحصول عليها من هذه الدراسة على النحو التالي: كان التباين الراجع الى مواعيد الزراعة معنويا لجميع الصفات المدروسة مما يشير إلى وجود اختلافات ملحوظة بين مواعيد الزراعة. وجد أن التباين الراجع الى التراكيب الوراثية عالى المعنوية لكل الصفات المدروسة في مواعيد الزراعة الثلاثة بالإضافة إلى التحليل المشترك. كما وجد أن تباين التفاعل بين التراكيب الوراثية مع مواعيد الزراعة عالى المعنوية لجميع الصفات موضع الدراسة. كما كان التباين الراجع للأباء عالى المعنوية لجميع الصفات المدروسة في مواعيد الزراعة الثلاثة بالإضافة إلى التحليل المشترك فيما عدا عدد السنابل / النبات ووزن ١٠٠٠ حبة في التحليل المشترك. على نفس الخط ، كانت التباينات الناتجة عن التفاعل بين الأباء و مواعيد الزراعة عالى المعنوية لجميع الصفات المدروسة. أيضا أظهرت النتائج أن التباين الراجع للهجن عالى المعنوية لجميع الصفات المدروسة في مواعيد الزراعة الثلاثة بالإضافة إلى التحليل المشترك فيما. بنفس الطريقة وجد أن التباين الناتج عن التفاعل بين الهجن ومواعيد الزراعة عالى المعنوية لكل الصفات المدروسة. أظهرت النتائج أن الأباء السلالة ١ , سخا ٩٤ و مصر ١ كانت الأفضل فى صفات محصول الحبوب و القش و معظم مكونات المحصول تحت مواعيد الزراعة

الثلاثة و التحليل المشترك. بالنسبة لدليل الحصاد أعطت الاباء سدس ١٣ فى الميعاد الأول, شندويل ١ فى الميعاد الثانى و التحليل المشترك و جميزة ١٢ فى الميعاد الثالث أعلى دليل حصاد مقارنة بباقى الأباء. كان التباين الراجع للقدرة العامة على التألف معنويا أو عالى المعنوية في مواعيد الزراعة الثلاثة والتحليل المشترك لكل الصفات المدروسة فيما عدا وزن ١٠٠٠ حبة في التحليل المشترك. كانت التباينات الناتجة عن القدرة الخاصة على التألف معنوية أو عالية المعنوية لجميع الصفات في مواعيد الزراعة الثلاثة وتحليلها المشترك. تجاوزت النسبة بين GCA/SCA الوحدة لجميع الصفات في مواعيد الزراعة الثلاثة وتحليلها المشترك، ما عدا عدد السنابل/النبات في ميعاد الزراعة الثالث ، وعدد الحبوب/السنبلة ووزن ١٠٠٠ حبة في مواعيد الزراعة الثلاثة وتحليلها المشترك. مما يدل على ان فعل الجين المضيف هو الاهم فى توارث هذه الصفات. يمكن لمربى القمح الإستفادة من الأ باء مصر ١, سخا ٩٤ , سخا ٦١ و جميزة ١٢ فى الحصول على هجن عالية المحصول تحت مدى واسع من مواعيد الزراعة من خلال إدراجها فى برامج التهجين و التربية. يستطيع مربى القمح إدراج الهجن (جميزة ١٢ X جيزة ١٧١), (سخا ٩٤ X سدس ١), (جميزة ١٢ X شندويل ١), (سخا ٩٤ X مصر)١ و (سخا ٦١ X سخا ٩٤) فى برامج الإنتخاب لعزل سلالات عالية المحصول و القش حيث انها أعطت أعلى القيم لتاثير القدرة الخاصة على التألف فى هذه الصفات فى مواعيد الزراعة الثلاثة و التحليل المشترك.ايضا تعتبر طريقة الإنتخاب بإستخدام سجلات النسب هى الطريقة المثلى للإنتخاب لصفات المحصول فى الهجن الناتجة من هذه الدراسة.