Zagazig J. Agric. Res., Vol. 47 No. (1) 2020 1-12

Plant Production Science

http:/www.journals.zu.edu.eg/journalDisplay.aspx?Journalld=1&queryType=Master

EFFECT OF SOWING DATE ON YIELD AND ITS COMPONENTS FOR SOME BREAD WHEAT GENOTYPES

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Received: 25/12/2019; Accepted: 08/01/2019

ABSTRACT: Two field experiments were conducted at the experimental farm of Sakha Agricultural Research Station ARC, Kafr El-Sheikh, Egypt, during two winter successive seasons 2016/17 and 2017/18 to determine the effect of two planting dates (23 November and 23 December) on yield and its components of 14 bread wheat genotypes. The experimental design was randomize complete bloke with three replications. Each sowing date is sown in separated experiment, the first experiment was planted on 23 Nov.(recommended sowing date), while late one were on 23 Dec. in both seasons, Results indicdated that , heading and, maturity dates, grain filling period and rate, plant height, grain weight, number of grains/spike, number of spikes/m^2, grain and straw yields and harvest index were significantly affected by sowing dates. Recommended sowing date (23 Nov.) recorded the highest value for each of character in both growing seasons. Sids 4 and Line 10 were the earlier genotypes for days to heading and maturity. Misr 2 and Line 8 were the best genotypes for grain filling rate, grain and straw yield in both seasons. Whereas, Misr 2 recorded the highest value for each of plant height and No. of spikes/m^2. Line 7 recorded the highest value for each of grain weight and harvest index. For tolerance index (TOL), the lowest values were recorded for Lines 9, 11 and 10, respectively. With regard for yield reduction, the lowest values were obtained by Misr 2 and line 9. Therefore, Misr2 and line 9 recommended to sowing in both recommended and late sowing date in North Delta region.

Key words: *Triticum aestivum*, tolerance index, sowing dates, genotypes.

INTRODUCTION

Wheat (*Triticum aestivum* L.) the most important cereal crop in international commerce of the world. The total production of wheat in Egypt is still far below the consumption and annual demand. The local production is about 55% of the local requirement. This gap can be filled by increasing the planting area in the reclaimed lands, increasing the productivity for the planted area and decreasing the losses in production and consumption (**Abd EL-Hamid 2006).** The most factors that lead to increase wheat yield is breeding, producing new genotypes with high yielding ability, planting in recommended time and using all other ways such as fertilization, irrigation, weed control, pest control, the best storage and *etc*.

Sowing date is one of the most important agronomic factors involved in producing high yielding in small grain cereal crops, which affects the timing and duration of vegetative and reproductive stages. Several researchers **(Nasim *et al.,* 2006; Rahman *et al.,* 2009; Ali *et al.,* 2010; Alisial *et al.,* 2010; Mostafa *et al.,* 2010; El-Sarag and Ismaeil, 2015; Menshawey *et al.,* 2015)** studied the effect of planting date on wheat grain yield and its related variables which increased with normal sowing comparing to late sowing date. Higher grain yield in recommended sowing date was due to higher number of spikes m^{-2} and mean grain weight than late sowing. **Abdel Nour and Hayam (2011)** found that days to heading and maturity, plant height, number of spikes m-², number of grains $spike^{-1}$, 1000-grain weight, biological yield and grain yield were significantly the highest in the recommended date compared to the late and early dates of planting.

The fluctuation in environmental conditions such as day length, temperature, humidity and precipitation may alter plant functions and productivity (**Muhammad *et al.,* 2013)**.

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In Egypt the grain yield was reduced under heat stress in late sowing, in the range of 30-46% comparing with optimal sowing date (**Abd El-Shafi and Ageb, 1994**). One among the strategies that farmers can use to stabilize and increase crop yields in the face of a changing climate is to adjust sowing dates. **Singh and Uttam (1999)** estimated yield loss as 39 kg/ha/ day for each day delay in sowing from recommended sowing date. **Wajid *et al.* (2004)** reported that recommended sowing on 10 Nov. gave higher grain yield over late sowing (10 Dec.) by 60.6%.

The objectives of this study were to determine the effect of late sowing on the productivity of fourteen bread wheat genotypes, to determine the most suitable wheat cultivar for farmers in Kafr El-Sheikh Governorate and other surrounding areas with similar environmental conditions and to determine the losses in grain yield due to late sowing.

MATERIALS AND METHODS

Two field experiments were conducted at Sakha Agricultural Research Station, ARC, Egypt, during two winter growing successive seasons 2016/17 and 2017/18. The site is located at 30.94 North Latitude, 30.11 East Longitude with an elevation of about 6 m above sea level. Fourteen bread wheat genotypes (Table 1) were evaluated under recommended and late sowing dates. The first experiment was planted on 23 November (recommended sowing date), while late one was on 23 Dec., in both growing seasons. The experimental design was a randomize complete block with three replications. Each plot was consisted of 6 rows, 3.5 m length and 20 cm apart between them (4.2m^2 =1/1000 faddan). Seeding rate was 60 kg/faddan . Monthly mean air temperature (C^o), and rainfall (mm/month) during the two growing seasons at the experimental site are shown in (Table 2). The growing degree dayes (GDD) were calaulated from mean daily temperature (C^o), and base temperature (C^o), as:

$$GDD = \frac{T_{max.} + T_{min.}}{2} - T_{base}$$

Where:

T_{base} = 4.5^{o}C in wheat (**Parthasarathi and Jeuakumar, 2014**).

Superphosphate (15.5/P_2O_5) was band placed at the time of sowing. Also, N fertilizer at level of 90 kg/faddan, was applied twice before the first and the second irrigations as ammonium nitrate (33.5% N). The other culture practicics where applied as recommended in the experimental area.

Studied Characters

Days to heading (DH), Days to maturity (DM), grain filling period (GFP), grain filling rate (GFR), plant height in cm (PH), number of spikes/m^2, number of grains/spike, 1000 grain weight (g), grain yield (ardab/fad.) straw yield (ton/fad.), harvest index (%) (HI) (One ardab= 150 kg).

The susceptibility index for grain yield was calculated using the following formulas:

1- Tolerance index (TOL) = YP-YS **(Rosielle and Hambling, 1981**).

2- Yield reduction ratio (Yr). Yr= 1-YS/Yp **(Gollestani and Assad, 1998)**.

Yield potential (YP) and stress yield (YS)

Statistical Analysis

Data collected in the two seasons were statistically analyzed according to the technique of analysis of variance (ANOVA) according to **Gomez and Gomez (1984)**. The combined analysis was conducted for the two experiments in the two years. The recorded data were statistically analyzed using statistical software package Genstat version12. The least significant differences (LSD) at the level of 0.05 probability was employed to compare the differences among the treatment means according to **Steel *et al.* (1997)**.

RESULTS AND DISCUSSION

Analysis of Variance

The analysis of variance for the collected data (Table 3) indicated that mean squares due to years, sowing dates, genotypes and all interaction combinations were significant or highly significant for all studied characters except for days to maturity, harvest index and interaction between years and sowing dates. These results indicated that all genotypes

Table 1. Name and pedigree of 14 bread wheat (*Triticum aestivum* L.) genotypes used in the study*

Genotype	Pedigree and selection history	Origin
Sids 4	MAYA "S"/MON "S"//CMH 74A. 2/3/Giza157*2 SD 10001-2SD-3SD-2SD-0SD.	Egypt
Misr2	SKAUZ/BAN92 CMSS96M03611S-1M-010SY-010M-010SY-8M-0Y-0S)	Egypt
Line 1	SIDS 12 // WBLL1*2/BRAMBLING S. 16965 -018S -011S-1S -0S	Egypt
Line 2	WBLL1*2/BRAMBLING // HUBARA-21 S. 17017 -056S -019S-1S -0S	Egypt
Line 3	GIZA 168/5/MAI "S"/PJ//ENU "S"/3/KITO/POTO.19//MO/JUP/4/K134 (60)/ VEE/8/KAUZ/ATTILA /7/ KVZ /4/ CC / INIA /3/ CNO // ELGAU / SON 64 /5/ SPARROW "S" / BROCHIS "S" /6/ BAYA "S" / IM S. 16959 -030S -010S-1S -0S	Egypt
Line 4	SHANDWEEL 1 /8/KAUZ / ATTILA /7/ KVZ /4/ CC / INIA /3/ CNO // ELGAU / SON 64 /5/ SPARROW "S" / BROCHIS "S" /6/ BAYA "S" / IMU S. 16969-030S-024S-1S-0S	Egypt
Line 5	CHEN/AEGILOPS SQUARROSDA (TAUS)//BCN/3/2*KAUZ/6/GIZA 168 /5/ MAI "S" / PJ // ENU "S" /3/ KITO / POTO. 19 // MO / JUP /4/ K 134 (60) / VEE S. 16862 -035S -06S-3S-2S -0S	Egypt
Line 6	MINO /6/ SAKHA 12 /5/ KVZ // CNO 67 / PJ 62 /3/ YD "S" / BLO "S" /4/ K 134 (60) / VEE S. 16869 -010S -07S-1S-1S -0S	Egypt
Line 7	MINO /6/ SAKHA 12 /5/ KVZ // CNO 67 / PJ 62 /3/ YD "S" / BLO "S" /4/ K 134 (60) / VEE S. 16869 -010S -07S-1S-2S -0S	Egypt
Line 8	MINO /6/ SAKHA 12/5/KVZ//CNO 67/PJ 62/3/YD "S"/BLO "S"/4/K 134 (60) / VEE S. 16869 -010S -07S-4S-1S -0S	Egypt
Line 9	GIZA 168 /5/ MAI "S" / PJ // ENU "S" /3/ KITO / POTO. 19 // MO / JUP /4/ K 134 (60) / VEE /8/ KAUZ / ATTILA /7/ KVZ /4/ CC / INIA /3/ CNO // ELGAU / SON 64 /5/ SPARROW "S" / BROCHIS "S" /6/ BAYA "S" / IMU S. 16959 -030S-014S-1S -0S	Egypt
Line 10	GIZA 168/5/MAI "S"/PJ//ENU "S"/3/KITO/POTO. 19 // MO / JUP /4/ K 134 (60) /VEE/8/KAUZ/ATTILA/7/KVZ/4/CC/INIA/3/CNO//ELGAU/SON64/5/SPARROW "S" / BROCHIS "S" /6/ BAYA "S" / IMU S. 16959 -030S-014S-2S -0S	Egypt
Line 11	GEMMEIZA 9 // ATTILA *2 / GIZA 168 S. 16947-08S-2S-5S-0S	Egypt
Line 12	GEMMEIZA 9 // ATTILA *2 / GIZA 168 S. 16947-08S-2S-7S-0S	Egypt

*** Source:** Wheat Research Department, ARC , **Egypt**

Table 2. Monthly mean air temperature (C^o), and rainfall (mm/month) during the growing seasons 2016/17 and 2017/18 at the experimental site

Month	Temperature (C^o)				Rainfall (mm)	
	2016/17		2017/18			
	*Max.	Min.	Max.	Min.	2016/17	2017/18
Nov.	24.9	17.9	27.65	23.01	0.0	0
Dec.	19.3	10.8	21.50	18.40	32.94	0
Jan.	18.2	5.7	18.85	14.03	9.6	36.4
Feb.	19.7	10.2	21.53	14.50	25.2	16.6
Mar.	21.7	17.9	25.51	16.59	0	0
Apr.	26.5	21.6	27.80	19.94	10.6	0
Total					78.34	53.0

* Max= maximum, Min = minimum

Table 3. Mean squares of all studied characters over the two seasons

Character		DH	DM	GFP	GFR	PH	S/M^2	GY	G/S	1000GW	SY	HI
SOV	d.f	MS										
Years (Y)	1	4746.72**	8120.38**	450.15**	6257.10**	9226.34**	164000**	1193.60**	223.10*	205.39**	83.44**	53.94**
Sowing dates (S)	1	1157.63**	5976.21**	1873.34**	19768.04**	2958.48**	2062165**	4111.80**	3565.93**	4843.24**	22.17**	3240.26**
Y*S	1	108.48**	9.52 ns	53.72*	474.80**	162.05*	99134**	58.97**	314.88**	92.39**	0.42**	8.21n.s
Error	8	2.85	7.95	5.16	10.52	19.35	5843	2.91	23.06	3.99	0.02	2.57
Genotypes (G)	13	245.15**	123.34**	42.46**	450.37**	209.35**	15498**	39.23**	352.09**	39.65**	1.91**	22.88**
Y*G	13	25.05**	28.96**	34.98**	83.09**	76.02**	6498**	6.49**	202.26**	14.29**	0.57**	11.20**
S*G	13	22.55**	7.46**	20.04**	121.70**	45.98**	6239**	16.84**	62.23**	23.12**	0.16*	10.12**
Y*S*G	13	12.00**	17.41**	5.35**	84.44**	24.55**	6796**	7.42**	50.26*	14.33**	0.28**	17.24**
Error	104	1.19	1.90	1.76	13.03	8.45	1074	1.47	26.81	3.03	0.07	2.73
CV%		1.3	1	2.6	6.1	2.8	8.7	6	10.3	4.3	5.8	4.3

Ns, *, ** = not significant, significant at P≤ 0.05 and ≤ 0.01 level of probability, respectively.
DH: Days to heading, DM: days to maturity, GFP: grain filling period, GFR: grain filling rate, PH : plant height (cm), S/M^2: No. of spikes/m^2, GY: grain yield,(ardab/fad.), G/S: No. of grains / spike, 1000GW: weight of 1000 grains (g), SY: straw yield (ton/fad.) and HI: harvest index (%).

Differently responded to the different environmental conditions suggesting the importance of the assessment of genotypes under different environments in order to identify the best genetic make up for a particular environment. Similar findings were obtained by **Menshawy (2007) and Hamam and Khaled (2009)**.

Mean Performance

The results in Table 4 show the mean performance for all studied characters under the two sowing dates in the two years. Sids 4 and line 10 were the earliest genotypes in days to heading and days to maturity and Sids 4 was the highest genotypes for No. of grains/spike. Line 5 has the lowest value for grain filling period. On the other hand, Misr 2 was the best genotype for grain filling rate (short filling period), plant height, No. of spikes/m^2, grain and straw yields. Regarding the harvest index, the best genotype was Line 7. Genotypes Sids 4, Misr 2, Line 5 and Line 7 can be used for improve studied characters.

Effect of Years

The results in Tables 5 and 6 illustrates the effect of years on all studied genotypes and characters. For all studied characters, values were significantly decreased in the second season compared to the first season except for No. of grains/spike, 1000 grain weight and harvest index which had higher values in the second season compared to the first one for most genotypes. These decreases, in the values for studied characters, were due to the increase in temperature in the second season comparing with the first one (Table 2). No. of grains/spike did not effected by years, this result may be due to non-sensitivity of this character to the variation in environment conditions. **Menshawy (2007)** imported that 1000 grains weight and harvest index reported high values in the second season compared to the first season. Similar findings were reported by **Seleiman *et al.* (2011) and Wahid *et al.* (2017)**. The reduction in No. of spikes/m^2 might be a reason in increase these characters in the second season.

Effect of Sowing Date

The effect of sowing date on all characters are presented in Tables 7 and 8. All studied characteristics were significantly affected by sowing date and recorded the highest values in recommended sowing date compared with those resulted from late one. Generally, the weather conditions during the last 10 days of Nov., were favorable for wheat germination. GDD in recommended sowing were 2046.6 and 2488.1 while, in late sowing they were 1679.4 and

Table 4. Mean performance for all studied characters over the two seasons

Character	DH	DM	GFP	GFR	PH	S/M^2	G/S	1000GW	GY	SY	HI
Genotype											
Sids 4	77	129	51	48.7	106	269	66	41.8	16.8	3.6	39.6
Misr2	94	142	48	73.4	115	417	50	37.2	23.6	5.3	40.1
Line 1	85	133	48	63.2	102	381	52	41.0	20.3	4.6	39.2
Line 2	81	132	51	59.0	108	381	48	41.7	20.5	4.8	38.6
Line 3	80	132	52	55.0	102	378	53	38.3	19.3	4.8	37.2
Line 4	83	132	49	61.9	105	395	49	42.2	20.5	5	37.8
Line 5	85	132	47	59.1	100	404	50	40.0	18.7	4.6	37.8
Line 6	78	129	51	58.0	105	372	50	40.1	20.1	4.4	39.2
Line 7	78	130	52	61.8	104	348	53	42.6	21.9	4.5	41.1
Line 8	79	131	52	65.4	104	402	51	44.0	23.1	5.1	39.6
Line 9	80	131	52	51.8	108	377	46	41.1	18.2	4.7	35.9
Line 10	77	129	52	55.6	106	383	43	39.4	19.6	4.8	37.3
Line 11	80	130	51	56.0	101	372	45	40.9	19.1	4.3	39.7
Line 12	78	131	53	56.0	99	407	46	38.9	20.5	4.5	38.5
LSD (0.05)	0.9	1.1	1.1	2.9	2.4	26.5	4.2	1.41	0.98	0.22	1.04

Where, DH: days to heading, DM: days to maturity, GFP: grain filling period, GFR: grain filling rate, PH : plant height (cm), S/M^2: No. of spikes/m^2, G/S: No. of grains/spike, 1000GW: weight of 1000 grains (g), GY: grain yield,(ardab/fad.), SY: straw yield (ton/fad.) and HI: harvest index (%).

Table 5. Effect of the interaction between years and genotypes on days to heading, days to maturity, grain filling period, grain filling rate, plant height and No. of spikes/m^2 during two seasons

Character	DH		DM		GFP		GFR		PH		S/M^2	
Year	**2016/17**	**2017/18**	**2016/17**	**2017/18**	**2016/17**	**2017/18**	**2016/17**	**2017/18**	**2016/17**	**2017/18**	**2016/17**	**2017/18**
Genotype												
Sids 4	81	72	136	122	54	49	52.5	45.0	112	101	259	279
Misr2	98	91	145	139	49	47	79.8	67.1	117	113	509	324
Line 1	90	77	139	126	48	48	73.1	53.3	112	92	420	342
Line 2	86	73	140	125	52	51	66.0	52.0	115	100	411	351
Line 3	83	75	140	123	56	48	57.8	52.3	113	91	407	348
Line 4	86	78	139	124	52	46	66.2	57.7	113	96	440	351
Line 5	91	75	138	126	46	49	68.1	50.2	109	91	447	361
Line 6	82	72	135	123	52	50	63.5	52.4	112	98	396	348
Line 7	83	72	138	123	54	50	71.9	51.8	111	98	386	310
Line 8	84	71	139	122	54	50	70.5	60.4	110	98	436	368
Line 9	84	73	139	124	54	50	57.9	45.7	113	103	395	359
Line 10	81	72	139	120	57	48	58.2	53.0	112	101	388	378
Line 11	84	74	136	125	51	50	59.6	52.3	112	91	387	357
Line 12	81	72	138	124	55	51	65.6	46.5	107	90	442	372
LSD (0.05)	1.3		1.8		1.6		4.1		3.5		43.4	

Where, DH: days to heading, DM: days to maturity, GFP: grain filling period, GFR: grain filling rate, PH : plant height (cm), S/M^2: No. of spikes/m^2.

Table 6. Effect of the interaction between years and genotypes on No. of grains/spike, weight of 1000 grains, grain yield, straw yield and harvest index

Character	G/S		1000GW		GY		SY		HI	
Year	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18
Genotype										
Sids 4	58	74	41.3	42.3	18.8	14.9	3.8	3.5	40.6	38.5
Misr2	40	59	36.0	38.5	25.9	21.2	6.4	4.2	37.8	42.5
Line 1	50	54	41.5	40.5	23.4	17.3	5.4	3.9	39.0	39.5
Line 2	46	50	41.3	42.1	23.0	17.9	5.7	3.9	37.0	40.2
Line 3	57	50	36.3	40.4	21.7	16.9	5.6	4.0	36.3	38.0
Line 4	50	47	41.0	43.4	23.3	17.8	5.7	4.2	37.4	38.2
Line 5	51	49	39.9	40.1	20.8	16.6	5.2	3.9	37.2	38.3
Line 6	47	52	36.5	43.7	22.5	17.7	5.1	3.8	38.1	40.4
Line 7	49	57	39.6	45.5	26.0	17.7	5.4	3.7	40.9	41.4
Line 8	54	49	43.2	44.8	25.8	20.4	5.7	4.6	39.6	39.6
Line 9	50	42	40.7	41.6	21.0	15.3	5.4	4.0	36.4	35.5
Line 10	41	45	38.1	40.6	22.2	17.0	5.7	3.9	35.6	39.0
Line 11	44	46	40.1	41.8	20.5	17.7	4.8	3.8	38.7	40.7
Line 12	49	44	38.2	39.5	24.6	16.4	5.2	3.9	39.2	37.7
LSD (0.05)	5.9		2.01		1.44		0.3		1.89	

Where, G/S: No. of grains/spike, 1000GW: weight of 1000 grains (g), GY: grain yield (ardab/fad.), SY: straw yield (ton/fad.) and HI: harvest index (%).

Table 7. Effect of the interaction between sowing dates and genotypes on days to heading and maturity, grain filling period, and rate, plant height and No. of spikes/m^2

Character	DH		DM		GFP		GFR		PH		SM^2	
Sowing date	RS	LS	RS	LS	RS	LS	RS	LS	RS	LS	RS	LS
Genotype												
Sids 4	80	75	134	123	55	48	54.0	43.5	108	104	315	223
Misr2	100	88	149	134	49	47	86.4	60.5	122	108	513	320
Line 1	88	81	139	126	51	45	74.1	52.3	103	100	486	276
Line 2	83	79	138	127	55	48	70.6	47.5	113	102	477	285
Line 3	82	77	138	126	55	49	64.4	45.7	103	101	485	270
Line 4	85	80	137	126	52	46	72.8	51.1	110	99	515	276
Line 5	88	81	138	127	49	46	70.2	48.1	102	98	524	284
Line 6	80	76	134	123	54	48	76.7	39.3	112	98	484	260
Line 7	80	77	136	125	56	48	75.4	48.2	107	102	478	218
Line 8	82	76	138	124	56	48	76.8	54.1	109	99	523	282
Line 9	82	76	136	126	54	50	62.9	40.8	113	103	505	250
Line 10	78	76	134	124	56	49	63.5	47.7	112	101	510	256
Line 11	82	78	137	124	55	46	63.1	48.8	107	96	474	271
Line 12	79	76	138	123	60	47	66.2	45.8	102	96	547	267
LSD (0.05)	1.3		1.8		1.6		4.1		3.5		43.4	

Where, RS: recommended sowing date, LS: late sowing date, DH: days to heading, DM: days to maturity, GFP: grain filling period, GFR: grain filling rate, PH: plant height (cm), S/M^2: No. of spikes/m^2.

Table 8. Effect of the interaction between sowing dates and genotypes on No. of grains/spike, 1000-grain weight (g), grain yield (ardab/fad.), straw yield (ton/fas.) and harvest index (%)

Character	GS		1000GW		GY		SY		HI	
Sowing dates	**RS**	**LS**	**RS**	**LS**	**RS**	**LS**	**RS**	**LS**	**RS**	**LS**
Genotype										
Sids 4	72	59	48.2	35.4	19.7	13.9	3.8	3.5	44.9	34.2
Misr2	54	45	39.8	34.7	28.2	18.9	5.7	4.9	43.5	36.8
Line 1	57	47	44.7	37.3	24.8	15.8	5.0	4.3	42.8	35.6
Line 2	49	47	47.7	35.8	25.9	15.1	5.1	4.4	43.9	33.3
Line 3	60	46	44.6	32.0	23.7	14.9	5.1	4.5	41.1	33.3
Line 4	53	44	47.1	37.4	25.5	15.6	5.3	4.6	42.1	33.5
Line 5	58	42	45.7	34.3	22.8	14.6	4.8	4.3	41.6	33.9
Line 6	56	44	47.7	32.5	27.8	12.5	5.1	3.8	44.9	33.6
Line 7	60	46	48.9	36.2	28.2	15.5	5.0	4.1	45.8	36.5
Line 8	57	45	49.7	38.3	28.7	17.4	5.6	4.7	43.3	35.9
Line 9	47	45	47.1	35.2	22.7	13.7	5.0	4.5	40.6	31.3
Line 10	47	39	42.8	35.9	23.7	15.4	5.1	4.5	41.6	33.0
Line 11	47	43	45.3	36.6	23.2	15.0	4.7	3.9	42.6	36.8
Line 12	49	44	45.2	32.5	26.5	14.5	4.9	4.1	44.4	32.5
LSD (0.05)	5.9		2.01		1.44		0.3		1.89	

Where, RS: recommended sowing date, LS: late sowing date, G/S: No. of grains/spike, 1000GW: weight of 1000 grains (g), GY: grain yield,(ardab/fad.), SY: straw yield (ton/fad.) and HI: harvest index (%).

1981.7 in both seasons, respectively. Other stages would have the suitable condition starting from Dec., up to the end of the season (usually to late Apr., or to the first week of May). Moreover, it is well known that weather almost plays important roles with all the characteristics especially on yield and yield components.

These results were in good agreement with those reported by **Tawfelis *et al.* (2006), Talukder (2014), Menshawy *et al.* (2015) and Yadav *et al.* (2018). Menshawy *et al.* (2015)** recorded that timing of initiation of vegetative and reproductive organs depends upon temperature and photoperiod, but the survival and subsequent size of such organs is dependent upon the supply of assimilates. The choice of sowing date is, therefore, vital to ensure both sufficient grain sitting initiated and sufficient assimilates. **Amal *et al.* (2016)** indicated that late sowing of wheat subjected the grains to low soil temperatures causing poor emergence, and high temperatures at the end of season, which might adversely affect reproductive growth stage.

The Interaction Effect

The effect of interaction among seasons, sowing dates and genotypes on all studied characters are shown in Tables 9, 10 and 11. The late sowing date in the two growing seasons showed a reduction in the means of all studied characters. In this respect, **Menshawy (2007)**, reported that environmental factors, *viz.*, temperature and day length were distinct at the time of sowing and during crop growth under different natural photothermal environments. The all studied genotypes had shortened duration of pre-heading and maturing under the late sowing in the seasons. Under the recommended sowing date (OS), the studied genotypes were earlier in 2017/2018 comparing to the first season. These results reflected the differences in climatic conditions during the two growing seasons (Table 2). Similar results were obtained by **Rahmani *et al.* (2013) and Talukder *et al.* (2014)**.

The Relationship between Recommended and Late Sowing Date on Grain Yield

The results presented in Table 12 show the grain yield for all genotypes as a mean of the

Table 9. Mean values of days to heading and maturity, grain filling period and rate for 14 wheat genotypes under sowing dates during 2016/2017 and 2017/2018 seasons

Character	DH				DM				GFP				GFR			
Years	2016/2017		2017/2018		2016/2017		2017/2018		2016/2017		2017/2018		2016/2017		2017/2018	
Sowing date	RS	LS	RS	LS	RS	LS	RS	LS	RS	LS	RS	LS	RS	LS	RS	LS
Genotype																
Sids 4	85	79	74	71	143	128	126	117	58	49	52	47	54.4	50.5	53.5	36.5
Misr 2	106	86	95	89	156	134	143	135	50	48	48	46	93.1	66.5	79.7	54.5
Line 1	97	86	80	76	146	132	132	121	49	46	52	45	87.5	58.8	60.6	45.9
Line 2	90	86	76	72	145	134	131	119	55	48	55	47	79.6	52.3	61.5	42.6
Line 3	88	80	77	74	146	134	129	118	58	54	52	44	68.7	46.9	60.1	44.5
Line 4	90	84	80	77	144	134	130	118	54	50	50	41	78.1	54.2	67.6	47.9
Line 5	98	88	79	74	144	133	131	121	47	45	52	47	80.6	55.5	59.8	40.7
Line 6	86	80	74	72	140	130	129	117	54	50	54	45	90.0	37.1	63.4	41.4
Line 7	87	82	73	71	143	132	128	117	57	50	55	46	90.0	53.7	60.9	42.8
Line 8	88	82	75	70	146	132	129	116	58	50	54	46	83.7	57.4	69.9	50.8
Line 9	88	81	77	72	143	134	130	119	55	53	53	46	68.2	47.6	57.5	34.0
Line 10	84	81	73	71	143	135	126	114	59	54	52	43	68.9	47.5	58.0	47.9
Line 11	87	83	76	73	142	130	132	118	55	47	55	45	68.8	50.5	57.4	47.2
Line 12	83	82	74	71	145	131	132	116	62	49	58	45	74.3	56.8	58.2	34.8
LSD (0.05)	1.8				2.5				2.3				5.8			

Where, RS: recommended sowing date, LS: late sowing date, DH: days to heading, DM: days to maturity, GFP: grain filling period, GFR: grain filling rate,

Table 10. Mean values of plant height, No. of spikes/m^2, No. of grains/spik and, 1000-grain weight (g) during 2016/2017 and 2017/2018 seasons

Character	PH				S/M^2				GS				1000 GW			
Year	2016/2017		2017/2018		2016/2017		2017/2018		2016/2017		2017/2018		2016/2017		2017/2018	
Sowing dates	RS	LS	RS	LS	RS	LS	RS	LS	RS	LS	RS	LS	RS	LS	RS	LS
Genotype																
Sids 4	113	110	103	98	282	236	348	209	67	49	78	70	47.0	35.6	49.4	35.1
Misr2	128	107	117	110	600	418	427	221	45	34	63	56	37.8	34.2	41.8	35.1
Line 1	113	110	93	90	553	288	419	264	53	47	61	47	45.3	37.6	44.1	36.9
Line 2	123	107	103	97	543	278	410	291	51	42	47	52	48.0	34.7	47.3	37.0
Line 3	115	112	92	90	513	302	457	239	68	46	53	47	42.5	30.0	46.7	34.0
Line 4	120	107	100	92	585	294	445	258	55	45	51	44	46.4	35.6	47.7	39.2
Line 5	110	108	95	87	601	293	447	275	63	39	52	45	46.7	33.1	44.7	35.5
Line 6	122	103	102	93	531	262	437	258	55	40	57	48	47.4	25.7	47.9	39.4
Line 7	115	107	98	97	549	222	408	213	58	39	61	52	47.6	31.6	50.2	40.9
Line 8	115	105	103	93	611	262	435	301	60	47	54	43	48.8	37.7	50.6	38.9
Line 9	120	107	107	100	535	255	475	244	48	51	45	38	47.7	33.7	46.5	36.7
Line 10	118	105	105	97	579	197	442	314	47	35	48	43	42.3	34.0	43.3	37.8
Line 11	118	105	95	87	504	271	444	271	45	43	48	44	45.2	34.9	45.4	38.2
Line 12	110	105	93	87	629	254	465	280	52	45	45	42	46.6	29.8	43.9	35.1
LSD (0.05)	4.9				61.4				8.3				2.85			

Where, RS: recommended sowing date, LS: late sowing date, PH: plant height, S/M^2,: No. of spikes /m^2,

G/S: No. of grains / spike, 1000 GW: weight of 1000 grains (g).

Table 11. Mean values of the grain and straw yields and harvest index for 14 wheat genotypes under sowing dates during 2016/2017 and 2017/2018 seasons

Character	GY				SY				HI			
Year	2016/2017		2017/2018		2016/2017		2017/2018		2016/2017		2017/2018	
Sowing dates	RS	LS	RS	LS	RS	LS	RS	LS	RS	LS	RS	LS
Genotype												
Sids 4	21.0	16.5	18.4	11.4	4.0	3.6	3.6	3.4	46.4	34.8	43.4	33.6
Misr2	30.8	21.1	25.5	16.8	7.3	5.5	4.1	4.3	38.9	36.6	48.0	37.0
Line 1	28.8	18.0	20.9	13.7	5.8	5.0	4.2	3.6	42.9	35.1	42.7	36.2
Line 2	29.2	16.8	22.5	13.3	6.0	5.4	4.3	3.5	43.6	30.4	44.3	36.2
Line 3	26.7	16.8	20.8	12.9	5.9	5.2	4.3	3.7	40.3	32.3	41.8	34.3
Line 4	28.3	18.2	22.7	13.0	6.4	5.1	4.3	4.1	40.0	34.7	44.2	32.3
Line 5	25.1	16.5	20.6	12.7	5.4	5.0	4.2	3.6	41.1	33.3	42.1	34.5
Line 6	32.6	12.5	23.0	12.4	5.7	4.4	4.4	3.2	46.0	30.1	43.8	37.0
Line 7	34.0	18.0	22.4	13.0	5.9	4.9	4.1	3.2	46.4	35.3	45.3	37.6
Line 8	32.4	19.2	25.0	15.7	6.2	5.3	5.1	4.1	44.0	35.2	42.6	36.6
Line 9	25.1	16.9	20.2	10.5	5.7	5.2	4.3	3.8	39.7	33.0	41.5	29.5
Line 10	27.2	17.1	20.2	13.7	5.9	5.4	4.2	3.7	41.1	30.1	42.1	35.8
Line 11	25.2	15.8	21.2	14.3	5.2	4.4	4.2	3.4	42.3	35.2	42.9	38.4
Line 12	30.6	18.6	22.4	10.4	5.5	5.0	4.4	3.3	45.6	32.9	43.2	32.2
LSD (0.05)	2.03				0.42				2.67			

Where, RS: recommended sowing date, LS: late sowing date, GY: grain yield (ardab/fad.), SY: straw yield (ton/fad.) and HI: harvest index (%).

Table 12. Mean of grain yield in the recommended (RS) and late sowing date (LS) over the two growing seasons and tolerance index (TOL) and yield reduction ratio (YR%)

Genotype	RS	LS	TOL	YR%
Sids 4	22.92	12.78	10.14	0.44
Misr2	29.21	19.59	9.62	0.33
Line 1	25.96	16.10	9.86	0.38
Line 2	26.58	14.73	11.85	0.45
Line 3	23.11	13.33	9.78	0.42
Line 4	24.46	14.57	9.89	0.40
Line 5	23.63	14.41	9.22	0.39
Line 6	28.81	13.34	15.47	0.54
Line 7	29.71	15.94	13.77	0.46
Line 8	29.15	17.38	11.78	0.40
Line 9	23.10	15.46	7.64	0.33
Line 10	24.10	15.53	8.57	0.36
Line 11	23.22	15.00	8.23	0.35
Line 12	26.88	14.74	12.14	0.45

two seasons and values of tolerance index(TOL) and yield reduction under late sowing date compared to the grain yield in recommended sowing date .From the results in Table 12, high tolerance index values were recorded for Lines 6, 7 and 12, whereas the lowest values were recorded for Lines 9, 11 and 10.

With regard to yield reduction, the lowest values were obtained by Misr 2 and line 9 and the highest values were recorded for lines 6 and 7. From this results Misr 2 the best genotype and tolerante to late sowing because its high yield potential in recommended sowing date. It has moderate value for tolerance index (9.62) and the lowest value in yield reduction (0.33) under late sowing compared to other bread wheat genotypes

Conclusion

The best sowing date to gives high grain and straw yields was 23th of November. The bread wheat cultivar Misr 2 is recommended to be growing in North Delta region in case of recommended and late sowing because his stability in the two sowing dates and low yield reduction when sowing at late sowing.

Acknowledgement

Our sincere thanks goes to wheat research department for proving necessary facility to accomplish this search. We would like to thank all staff of Sakha research station for their suggesting, moral support and necessary help during experimentation

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تأثير مواعيد الزراعة على المحصول ومكوناته في بعض التراكيب الوراثية من قمح الخبز

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أجريت تجربتين حقليتين بالمزرعة البحثية بمحطةِ البحوث الزراعية بسخا مركز البحوث الزراعية، كفر الشيخ، مصر خلال موسمي ٢٠١٧/٢٠١٦ و٢٠١٨/٢٠١٧ لتقيم أربعة عشر تركيباً وراثياً تحت ميعادين للزراعة، الميعاد الأول هو الموصى به والميعاد الثاني تحت ظروف الزراعة المتأخرة وكانت الزراعة في ٢٣ نوفمبر و٢٣ ديسمبر في كلا الموسمين. استخدم في تنفيذ التجربة تصميم قطاعات كاملة العشوائية حيث تم زراعة كل ميعاد في تجربة مستقلة كانت الصفات المدروسة هي (عدد الأيام من الزراعة و حتى طرد السنابل وحتى النضخ الفسيولوجي، فترة ومعدل امتلاء الحبوب، ارتفاع النبات ووزن الألف حبة، عدد السنابل في المتر المربع، عدد حبوب السنبلة، محصول الحبوب والقش للفدان ودليل الحصاد) وأظهرت النتائج أن الزراعة في الميعاد الموصي به (٢٣ نوفمبر) أعطت أفضل النتائج في كلا الموسمين، الصنف سدس ٤ والسلالة رقم ١٠ أكثر التراكيب تبكيرا في صفتي عدد الأيام حتي الطرد والنضخ الفسيولوجي، بينما حقق الصنف مصر ٢ والسلالة رقم ٨ أعلى القيم بالنسبة لصفات معدل امتلاء الحبوب وارتفاع النبات ومحصول الحبوب والقش، في حين كان الصنف مصر أطول التراكيب وأكثرهم عددا في صفة عدد السنابل في المتر المربع، بينما كانت السلالة ٧ كانت الأعلى في وزن الألف حبة ودليل الحصاد، وأظهرت نتائج دليل التحمل قدرة السلالات ٩,١١ و ١٠ على الترتيب علي تحمل الظروف غير الملائمة، بينما كان الصنف مصر ٢ والسلالة رقم ٩ أقل التراكيب الوراثية انخفاضًا في المحصول نتيجة الزراعة المتأخرة مقارنة بباقي التراكيب الوراثية تحت الدراسة وبناء علي ما تحصل عليه من نتائج يمكن ان يوصي بزراعة الصنف مصر٢ والسلالة ٩وذلك في حالة الزراعة في الميعاد الموصي به وكذا الميعاد المتأخر بمنطقة شمال الدلتا.

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