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Effect of sowing date on grain yield and quality of some Egyptian bread wheat genotypes

Nagwa E. Shalaby[1*], *Sedhom A.M. Abdelkhalik*[2], *Khaled I. Gad*[2] *and Basma E. Elsamahy*[1]
Address:
[1]*Seed Technology Research Department, Field Crops Research Institute, Agriculture Research Center, Egypt.*
[2]*Wheat Research. Department, Field Crops Research Institute, Agriculture Research Center, Egypt.*
Corresponding author: **Nagwa E. Shalaby, e-mail: nagwashalaby@yahoo.com*
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ABSTRACT
There are many factors responsible for the decline in average wheat yield. One of these determining factors is the sowing date, which greatly affects the grain yield and other quality characteristics. The main objective of this study was to investigate the performance of various wheat genotypes when sown at various dates, including how these sowing dates affected the yield and its components as well as seed quality. Therefore, during the 2018–2019 and 2019–2020 growing seasons, two field experiments were carried out at the Sakha Agricultural Research Station in Egypt using a Randomized Complete Block Design with three replications. There were a total of 30 treatments, including three dates of sowing*i.e.*5th November, 5th December and 5th January and 10 wheat genotypes *i.e.*Misr1, Misr2,Misr3, Sakha94, Sakha95, Line1, Giza171, Gemmiza12, Sids14 and Shandaweel1.The results showed that the early sowing date on the 5th of November gave the highest values for 1000 grain weight, seedling length, dry seedling weight, electrical conductivity, and hectoliter weight. In addition, the December 5th sowing was placed first and produced the highest number of spikes/m^2, grain yield and germination %. While, sowing of wheat on 5th of January, gave the lowest values for all characteristics, except protein % and gluten wet and dry %. In addition, Misr3 cultivar outperformed the other examined genotypes and recorded the highest number of spikes/m^{2}and grain yield/fed. The highest values for germination, seedling dry weight, protein content, hectoliter weight, and wet and dry gluten percent were also observed in Line1 genotype. A correlation study of all the assessed characteristics revealed that electrical conductivity test and number of spikes/m^2 were negatively correlated with all the examined quality parameters. It can be concluded that, sowing on 5thof November is advised for wheat crop to obtain higher yield in five cultivars (Misr3, Sakha94, Gemmiza12, Sids14, and Shandaweel1), but sowing on 5thof December is advised to maximize wheat productivity and obtain good quality of grains in the other five genotypes. Due to late seeding, Misr3 and Sakha 95, two of the 10 genotypes employed, produced more grain yield than the other genotypes but Line1 genotype was superior for most of grain quality parameters so, this study recommended use Misr 3 & Sakha 95 cultivars and the promissing wheat genotype (Line1) to develop bread wheat genotypes in breeding programs under the environmental conditions of Kafr Elsheikh governorate.
Keywords: Wheat, Sowing dates, Grain yield, Quality.

INTRODUCTION

Worldwide, wheat (*Triticum aestivum* L.) is regarded as a strategic cereal crop. It offers sustenance for both domestic animals and people. Additionally, it is regarded as a crucial source of protein and carbohydrates for people, but particularly in underdeveloped nations**.** Wheat is a crop that is valued for its ability to make bread. It contains the unique ingredient "gluten," which provides the cellular structure of bread's spongy interior with a structural foundation. The primary winter grain crop and the significant source of nutrition in Egypt is wheat. Due to ongoing population growth and a small amount of arable land, the gap between wheat production and consumption in Egypt keeps growing. To fill this gap in wheat production, it is crucial to use optimum sowing dates and promising genotypes (Ouda *et al.*, 2017).

One of the most significant agronomic procedures that affects growth, production, and seed quality is the sowing of dates. It is also seen as a non-monetary input. Thus, choosing a genotype with high acclimation and seeding wheat at the right time based on local environmental conditions are the best ways to maximize yields and grain quality characteristics (Badawi *et al.,* 2014). Productivity will grow under any suitable circumstance that lengthens the vegetative and reproductive stages (Egliet *et al.,* 1987). Reproductive growth is typically shifted into less favorable conditions with fewer days, lower radiation, and colder temperatures when planting is delayed (Bayisa *et al.,* 2000). A considerable decrease in wheat yield results from delayed seeding, which exposes crops to unfavorable conditions such as low temperatures during vegetative growth and low germination rates, as well as delayed flowering and hot temperatures during the reproductive period. In addition, it was shown that wheat plants exposed to heat stress by delaying the planting date had a high grain protein content (Yan *et al.,* 2008). Seeds exposed to unfavorable environmental conditions experienced a quick decline in germination and vigor. The quality of seed is significantly impacted when parental plants are exposed to high temperatures during growth and development. As a result, less vigorous and viable grains that are smaller and shriveled are generated; when utilized as seed for the following crop, they perform poorly (Waheeba *et al.,* 2017). As a result, a variety of adaptation techniques are immediately needed to address the effects of climate change on agriculture (Dubey *et al.,* 2019). Developing heat stress-tolerant genotypes and alter sowing dates to avoid terminal heat stress are two adaptations for the wheat crop. The sensitivity of yield to a delayed planting date and the climate differed by genotype (Abdelkhalik and Hagras, 2021). To increase yield advantage and maximum wheat output per unit area, choosing the right genotype is essential. However, most researchers have focused their study on growth and yield rather than grain quality. (Badawi *et al.*, 2014).

For this reason, the target of the present study was to evaluate the performance of ten wheat genotypes under different sowing dates and their interactions on yield and its components as well as seed quality parameters under the environmental conditions of Sakha, Kafr El-Sheikh Governorate.

MATERIALS AND METHODS

This experiment was conducted at Sakha agricultural Research Station Farm, Kafr El-Sheikh Governorate, where the geographical location is 31° 5' N latitude, 30° 56' E longitude and 7 m above sea level, in North Delta, Egypt during the two winter growing seasons of 2018/2019 and 2019/2020. Ten wheat genotypes under three sowing dates, namely 5th of November (early sowing), 5th of December (close to normal sowing) and 5th of January (late sowing) were applied. Name and pedigree of all genotypes are presented in Table 1.Some physicochemical properties of the soil used had the following characteristics: pH, 7.81 and 7.16; EC, 5.22 and 5.16 dSm^{-1}; organic matter, 1.58 and 1.67 %; available N, P and K (mg kg^{-1}), 7.95 and 8.11, 6.10 and 6.36, 361.9and 342.1, during the two growing seasons, respectively.

Every sowing date was treated as a distinct experiment. Three replications for each sowing date were used in the RCPD (Randomized Complete Block Design) layout of the experiment. Each plot had a 2 m^2 area and 5 rows that were 20 cm apart and 2 m long. A sowing rate of 350 seeds per square meter was used for planting. We used all the wheat suggestion packages. Figure 1 shows the weather information for the researched site during the two growing seasons.

Table 1. Name, pedigree, and selection history of the ten tested bread wheat genotypes

Name	Pedigree	Selection history
Misr 1	OASIS/SKAUZ//4*BCN/3/2*PASTOR	CMSS00Y01881T-050M-030Y-030M-030WGY-33M-0Y-0S
Misr 2	SKAUZ/BAV92	CMSS96M03611S-1M-010SY-010M-010SY-8M-0Y-0S
Misr 3	ATTILA*2/PBW65*2/KACHU	CMSS06Y00582T-099TOPM-099Y-099ZTM-099Y-099M-10WGY-0B-0EGY
Sakha 94	OPATA/RAYON//KAUZ	CMBW90Y3180-0TOPM-3Y-010M-010M-010Y-I0M-0I5Y-0Y-0AP-0S.
Sakha 95	PASTOR//SITE/MO/3/CHEN/ AEGILOPS SQUARROSA(TAUS)//BCN/4/WBLL1	CMSA01Y00158S-040POY-040M-030ZTM-040SY-26M-0Y-0SY-0S.
Line1	SIDS1/ATTILA//GOUMRIA-17	S. 16498-042S-013S-21S -0S
Giza 171	SAKHA 93/GEMMEIZA 9	S.6-IGZ-4GZ-IGZ-2GZ-0S
Gemmiza 12	OTUS/3/SARA/THB//VEE	CMSS97Y00227S-5Y-010M-010Y-010M-2Y-1M-0Y-0GM
Sids 14	BOW "S"/VEE"S"//BOW"S"/TSI/3/BANI SEWEF 1	SD293-1SD-2SD-4SD-0SD
Shandaweel 1	SITE/MO/4/NAC/TH.AC//3*PVN/3/MIRLO/BUC	CMSS93B00567S-72Y-0I0M-010Y-010M-3Y-0M-0HTY-0SH

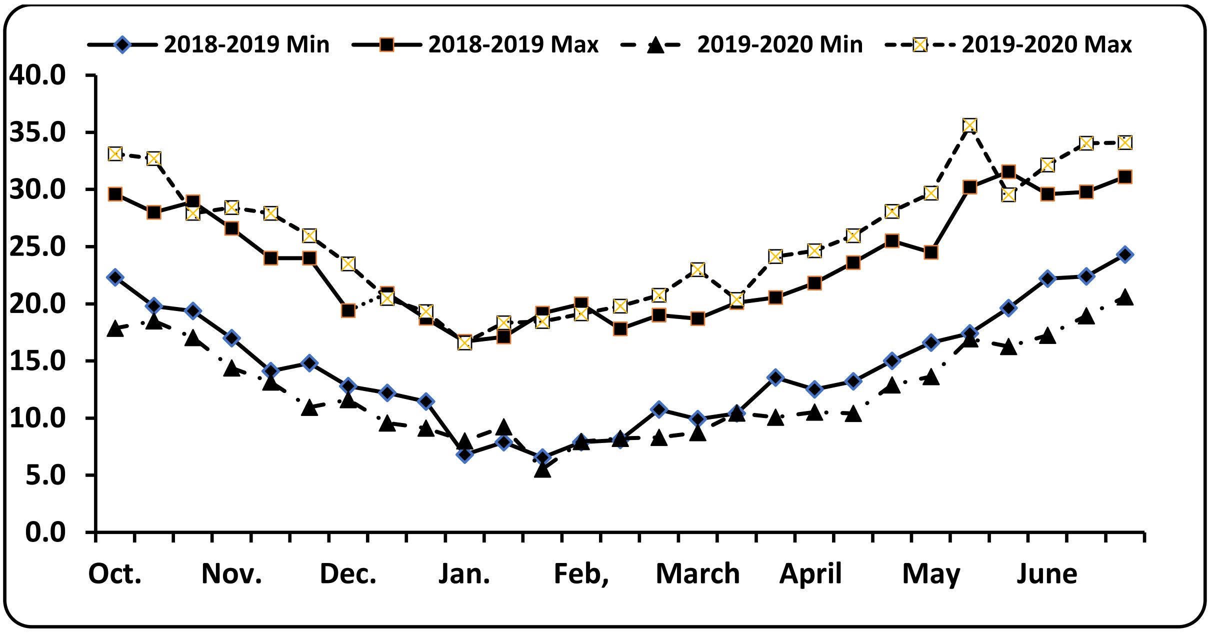

Fig. 1. Average 10 days minimum (Min) and maximum (Max) temperature from October to June 2018/2019 and 2019/2020 at Sakha Agricultural Research Station

At harvesting, the following characters were estimated:

- Number of spikes/m^2
- Number of grains/spike
- 1000 – grain weight (g).
- Grain yield (ton ha.$^{-1}$)

- AOAC's improved Kjeldahl method was used to determine the amount of crude protein in cereals (I.S.T.A 1990).
- A dockage-free grain sample's hectoliter weight (ghL-1) was calculated using an electronic balance and the Seed Buro Hectoliter Mass Device.
- The conventional procedure (AACC, 2000) of handwashing the meal until starch was found in the washing water was used to calculate the percentages of wet and dry gluten. The meal was then dried and weighed.
- % of germination. The International Seed Testing Association's ISTA regulations were followed in its calculation (I.S.T.A 1999).
- According to the guidelines of the International Seed Testing Association ISTA, seedling length (cm) and seedling dry weight (g) were calculated (I.S.T.A 1999).
- Test for electrical conductivity (E.C): In a 250 ml flask with 200 ml of distal water at 20°C, three replicates of 50 weighed seeds from each treatment were incubated for 24 hours. Following this time, the conductivity of the solution was immediately measured using the conductivity meter CMD 830 WPA and expressed as mohs per centimeter per gram of seed (Anonymous, 2002).

Statistical analysis:

Using the MSTAT-C computer and the analysis of variance (ANOVA) technique for the randomized complete block design for wheat genotypes in each experiment (sowing dates), collected data were statistically analyzed. A combined analysis across sowing dates was then performed in accordance with Gomez and Gomez (1984). Prior to doing the combined analysis, the Levene test was conducted as a standard statistical procedure to verify the homogeneity of each individual error term (Levene, 1960). According to Snedecor and Cochran (1967), the least significant difference (LSD) approach was employed to examine the differences between means at a 5% level of probability.

RESULTS

Effect of sowing dates:

The combined analysis exhibited significant differences among sowing dates on number of spikes/m^2, thousand grain weight and grain yield but, no significant difference was found in number of grains/spike (Table 2). The intermediate sowing date (5th December) gave the highest value in number of spikes/m^2 and grain yield (536.72- and 11.21-ton ha.$^{-1}$), respectively. Early sowing date (5th November) markedly resulted in the highest value of thousand grain weight (45.85g). On the other hand, late sowing date (5th January) showed the lowest value of thousand grain weight and grain yield (42.35g and 10.04-ton ha. $^{-1}$), respectively. On the other hand, there were significant differences among the three sowing dates on wheat quality traits in combined analysis as shown from data presented in Table 3. Early sowing date (5th November) produced the highest values of seedling length, seedlings dry weight, electrical conductivity and hectoliter weight (26.87cm, 0.21g, 20.57µS.cm^{-1} and 65.44 g), respectively. Whereas, intermediate sowing date (5th December) resulted in the highest value of germination percentage (97.05 %). Regarding the effect of sowing date on protein content and wet and dry gluten percentage, data presented in Table (3) revealed that protein and wet and dry gluten % were significantly and gradually increased with delaying sowing date. Delay sowing wheat up to 5th January (late sowing date) resulted in the highest values of protein content and wet and dry gluten percentage (12.33, 31.44 and 10.96%), respectively. Whereas the lowest values of the same traits (11.84, 31.44 and 10.96%) were recorded with sowing on early sowing date (5th November), respectively.

Table 2. Mean performance of studied wheat genotypes for some yield characters under different sowing dates

Variable	SM$^{-2†}$	KS^{-1}	TKW (g)	**Grain yield** (ton ha. $^{-1}$)
Cultivars				
Misr 1	564.08	56.79	44.88	10.85
Misr 2	556.02	64.14	40.45	10.50
Misr 3	564.13	53.16	46.21	11.75
Sakha 94	500.08	59.61	42.42	10.55
Sakha 95	541.03	56.54	47.43	11.56
Line1	506.53	53.54	46.88	10.52
Giza 171	452.37	63.4	44.56	11.28
Gemmiza 12	468.51	61.12	43.85	9.60
Sids 14	517.83	62.31	45.83	11.26
Shandaweel 1	535.42	63.47	38.29	9.65
F. test	**	**	**	**
LSD 0.05	53.83	4.591	2.85	0.769
Sowing dates				
05-Nov	501.49	59.97	45.85	11.03
05-Dec	536.72	59.77	45.54	11.21
05-Jan	523.56	58.47	42.35	10.04
F. test	*	NS	**	**
LSD 0.05	29.88	4.12	1.56	0.56

SM^{-2}: number of spikes per square meter, KS^{-1}: number of kernels per spike, TKW: one thousand kernel weight.
*, ** and NS indicated P< 0.05, 0.01 and not significant, respectively.

Table 3. Mean performance of studied wheat genotypes for technological characters under different sowing dates

Variable	G (%)	SL (cm)	SDW (g)	E.CµS.cm^{-1}	Protein (%)	Wet gluten (%)	Dry gluten (%)	Hectoliter (g)
Cultivars								
Misr 1	88.3	23.84	0.19	16.78	12.28	26.06	8.98	60.06
Misr 2	87.22	27.55	0.17	18.94	11.9	24.58	8.75	60.38
Misr3	93.92	24.2	0.19	15.15	12.3	29.16	9.71	62.75
Sakha 94	91.11	22.86	0.2	19.77	12.08	24.41	8.82	60.34
Sakha 95	93.17	32.9	0.19	16.96	12.21	25.11	8.93	62.76
Line1	95.91	26.56	0.21	16.28	12.59	31.81	9.83	63.62
Giza 171	90.78	22.82	0.14	17.92	11.48	28.75	9.61	62.55
Gemmiza 12	89.14	22.37	0.18	18.04	12.47	28.98	9.43	62.03
Sids 14	89.78	24.23	0.19	15.28	12.22	26.31	9.17	62.61
Shandaweel 1	85.9	23.69	0.16	15.69	11.35	23.17	8.64	62.22
F. test	**	**	**	**	**	**	**	**
LSD 0.05	0.82	0.39	0.03	0.4	0.07	0.47	0.11	1.35
Sowing dates								
05-Nov	86.31	26.87	0.21	20.57	11.84	22.74	7.95	65.44
05-Dec	97.05	23.92	0.19	17.09	12.06	26.31	8.64	63.52
05-Jan	88.2	21.03	0.15	13.58	12.33	31.44	10.96	56.83
F. test	**	**	**	**	**	**	**	**
LSD 0.05	0.45	0.21	0.014	0.22	0.04	0.26	0.06	0.74

G: Germination; SL: Seedling length; SDW: Seedling dry weight.

*, ** and NS indicated P< 0.05, 0.01 and not significant, respectively.

Genotypes performance:

Significant differences among the ten studied wheat genotypes were detected in all studied traits (Table2). Misr3 cultivar resulted in the highest values of number of spikes/m² and grain yield (654.13 and 11.75ton ha. $^{-1}$), respectively and the lowest values in number of grains/spike and electrical conductivity (53.16 and 15.15 µS.cm^{-1}), respectively. While, Sakha 95 cultivar was the heaviest in thousand grain weight and the longest in seedling length (47.43g and 32.9 cm), respectively. Also, Line1 genotype surpassed other studied cultivars in germination percentage (95.91 %), seedling dry weight (0.21 g), protein percentage (12.59 %), wet and dry gluten (%31.81 %, 9.83 %) and hectoliter weight (63.62 g). On the other hand, the lowest values in number of spikes/m^2 and seedling dry weight (452.37 and 0.14g) were obtained from Giza171 cultivar, respectively. However, the shortest seedling (22.37cm) and the lowest grain yield (9.6 t ton ha. $^{-1}$) were observed in Gemmiza12 cultivar. Shandaweel1 cultivar produced the lowest values of thousand grain weight (38.29 g) as well as germination percentage (85.9 %), protein content (11.35 %) and wet and dry gluten percentage (23.17 and 8.64 %), respectively.

Effect of genotype × sowing date:

The combined analysis exhibited significant differences due to the interaction between sowing date and genotype in all studied traits except for grain yield (Table4). Data presented in this table show that the highest number of spikes/m^2 (611.43) was resulted from sowing on 5th December. On the other hand, the lowest number of spikes/m^2 (396.12) was obtained under early sowing date (5th November). Number of grains/spike and one thousand grain weight were significantly affected by the interaction between sowing date and genotype. Data listed in Table 4 indicates that the highest value of number of grains/spike and thousand-grain weight (68.07 and 53.21 g) was obtained from Giza 171 as a result of delaying sowing up to 5th December, respectively. On the other hand, the lowest values of these traits (47.67 and 36 g) were resulted from Misr3 under sowing date (5th December) and Shandaweel1 under the early sowing date (5th November), respectively. For germination percentage Line1 recorded the highest percent (99.07 %) with sowing on 5th December but, the lowest percent (73.08 %) was found in Shandaweel1 with sowing in 5th January. Also, for seedling length and dry weight, Gemmiza12 produced the tallest seedling (29.30 cm) and the heaviest seedling (0.26 g) with sowing on 5th November, while Giza171 recorded the shortest seedling (19.18 cm) and the lightest seedling (0.12 g) under Sowing on 5th January. Sakha 94 with sowing on 5th November gave the highest value in electrical conductivity (24.33 µS.cm^{-1}) but, the lowest one (12.28 µS.cm^{-1}) was obtained from Misr3 as a result of delaying sowing up to 5th December. Delay sowing date up to 5 December was accompanied with increase of protein content and wet and dry gluten percentage. It was noticed that Line1 and Gemmiza12 are characterized by higher wet and dry gluten percent (36.45 and 35.9 %) by late sowing on 5 January, while Gemmiza12 was characterized by higher wet gluten % by sowing on 5 December, respectively, whereas the lowest values of these traits (17.62 and 7.17%) were observed in Shandaweel1 with sowing on 5th November, respectively. Giza171 and Sakha 95 recorded the highest values (67.55 and 66.9 g) in hectoliter weight by sowing on 5th November, respectively. Otherwise, Sakha 94 gave the lowest one (50.72 g) with sowing on 5th December.

Agronomy and seed quality relationships:

Correlation analysis among all studied characteristics were illustrated in Figure (2). The correlation analysis showed that number of spikes/m^2 was significantly and positively correlated with thousand grain weight, germination percentage, seedling dry weight, protein percentage and grain yield but, it was negatively correlated with the rest of traits (electrical conductivity test, number of kernels/spikes, wet and dry gluten, hectoliter weight and seedling length). The relationship of grain yield with thousand grain weight was positive and significant and was positive but not significant with germination percentage, wet and dry gluten, seedling dry weight, protein percentage and hectoliter weight and showed a negative correlation with electrical conductivity test, number of kernels/spike and seedling length. Protein content showed a positive and significant correlation with seedling length and seedling dry weight while, showed negative correlation with seedling length, electrical conductivity test and number of kernels/spikes. Also, only positive but not significant correlation was obtained between protein content and the rest of traits. The relationship of gluten dry weight with 1000-grain weight, germination percentage, hectoliter weight and seedling length was positive while, number of kernels/spike and electrical conductivity test was negative. Seedling length showed a significant and a positive correlation with hectoliter weight and positive correlation with 1000-grain weight, wet and dry gluten, and germination %, negative correlation was observed between seedling length and both electrical conductivity test and number of kernels/spikes. Hectoliter weight exhibited significant and positive correlation with dry gluten and positive but not significant correlation with 1000-grain weight, wet gluten, and germination percentage. However, it expressed a negative relationship with electrical conductivity test and number of kernels/spikes. The relationship of germination percentage with 1000-grain weight and wet and dry gluten was significantly positive and positive, respectively but, it was negative with electrical conductivity test and number of kernels/spikes. The correlation of dry gluten with wet gluten and 1000-grain weight was highly significant positive and electrical conductivity test and number of kernels/spikes was negative. Wet gluten showed a highly significant positive correlation with 1000-grain weight and a negative correlation with electrical conductivity test and number of kernels/spikes. Thousand grain yield exhibited a negative correlation with electrical conductivity test and number of kernels/spikes. The number of kernels/spikes was negatively correlated with electrical conductivity test.

Table 4. Interaction effect of sowing date and wheat genotype on some yield and technological characters

Sowing date	Genotype	SM^{-2}†	KS^{-1}	TKW (g)	Grain yield (ton ha.$^{-1}$)	Germination (%)	Seedling length (cm)	Seedling dry weight (g)	E.C µS.cm^{-1}	Protein (%)	Wet gluten (%)	Dry gluten (%)	Hectoliter (g)
05- November	V1	584.88	60.88	44.93	11.30	80.75	26.80	0.21	18.55	12.15	22.33	8.12	63.90
	V2	545.98	62.82	42.53	9.75	76.48	25.20	0.19	23.20	11.64	18.97	7.58	64.32
	V3	539.50	54.08	49.24	12.58	90.00	26.92	0.22	21.37	12.10	22.97	8.27	66.32
	V4	487.80	64.30	41.93	10.90	84.83	24.57	0.19	24.33	11.91	18.70	7.35	65.62
	V5	544.98	57.73	47.01	11.58	88.67	26.33	0.21	19.58	12.05	21.07	7.63	66.90
	V6	396.12	48.88	51.32	10.65	92.17	28.62	0.22	18.42	12.24	25.77	8.48	65.52
	V7	403.72	60.62	51.48	11.50	82.67	25.93	0.16	21.25	10.90	30.82	8.65	67.55
	V8	441.03	60.47	45.67	10.13	93.00	29.30	0.26	22.68	12.24	25.03	8.53	64.20
	V9	461.75	65.92	48.37	11.68	85.72	28.07	0.23	17.68	11.99	24.17	7.70	65.70
	V10	609.18	64.00	36.00	10.33	88.78	27.02	0.21	18.70	11.21	17.62	7.17	64.40
05- December	V1	572.18	57.42	47.38	11.83	97.33	23.65	0.19	14.63	12.24	25.32	8.48	61.30
	V2	610.12	62.85	39.64	11.97	93.83	22.50	0.17	18.38	11.92	24.53	8.53	61.47
	V3	607.28	47.67	46.01	11.49	97.78	23.93	0.19	16.13	12.29	27.08	8.72	63.18
	V4	493.82	57.52	43.42	10.65	97.00	21.87	0.23	19.62	12.12	24.78	8.60	64.70
	V5	510.98	58.32	52.07	12.07	97.33	22.82	0.19	17.37	12.18	26.08	8.55	63.58
	V6	611.43	54.30	45.83	11.39	99.07	25.80	0.21	16.92	12.39	30.92	8.95	64.19
	V7	404.50	68.07	53.21	11.69	96.67	23.33	0.14	18.57	11.34	27.98	8.97	63.80
	V8	495.95	64.60	43.61	10.04	97.75	26.15	0.18	18.08	12.49	29.00	8.78	64.08
	V9	524.17	64.60	45.77	11.42	97.92	25.17	0.19	15.55	12.24	24.25	8.40	65.23
	V10	536.75	62.35	38.45	9.55	95.83	24.02	0.16	15.67	11.38	23.13	8.40	63.67
05- January	V1	535.17	52.08	42.32	9.44	86.82	21.08	0.17	12.85	12.46	30.52	10.33	54.97
	V2	511.95	66.75	39.17	10.00	91.33	19.97	0.16	15.25	12.15	30.25	10.57	55.37
	V3	545.60	57.72	43.38	11.19	93.97	21.75	0.18	12.28	12.52	34.42	11.18	58.75
	V4	518.62	57.00	41.93	10.11	91.50	20.35	0.16	15.35	12.20	29.73	10.50	50.72
	V5	567.12	53.57	43.21	11.05	93.50	22.55	0.18	13.95	12.41	28.17	10.60	57.78
	V6	512.03	57.45	43.50	9.53	96.47	25.25	0.19	13.50	12.62	32.75	11.42	61.15
	V7	548.90	61.52	43.99	10.66	93.00	19.18	0.12	13.95	11.98	36.45	11.88	56.30
	V8	468.55	58.30	42.25	8.65	76.67	20.67	0.13	13.37	12.68	35.90	11.78	59.53
	V9	567.58	56.42	43.36	10.66	85.72	19.45	0.15	12.63	12.43	30.50	11.42	55.15
	V10	460.33	63.90	40.42	9.08	73.08	20.05	0.12	12.72	11.86	28.75	9.93	58.58
F. test		**	*	**	NS	**	**	*	**	**	**	**	**
LSD 0.05		93.23	7.952a	4.94	1.333	1.42	0.67	0.04	0.70	0.11	0.82	0.17	2.34

SM^{-2}: number of spikes per square meter, KS^{-1}: number of kernels per spike, TKW: one thousand kernel weight.; G: Germination; SL: Seedling length; SDW: Seedling dry; G1: Misr 1, G2: Misr 2, G3: Misr 3, G4: Sakha 94, G5: Sakha 95, G6: Line1, G7: Giza171, G8: Gemmiza12, G9: Sids 14 and G10: Shandaweel 1

*, ** and NS indicated P< 0.05, 0.01 and not significant, respectively

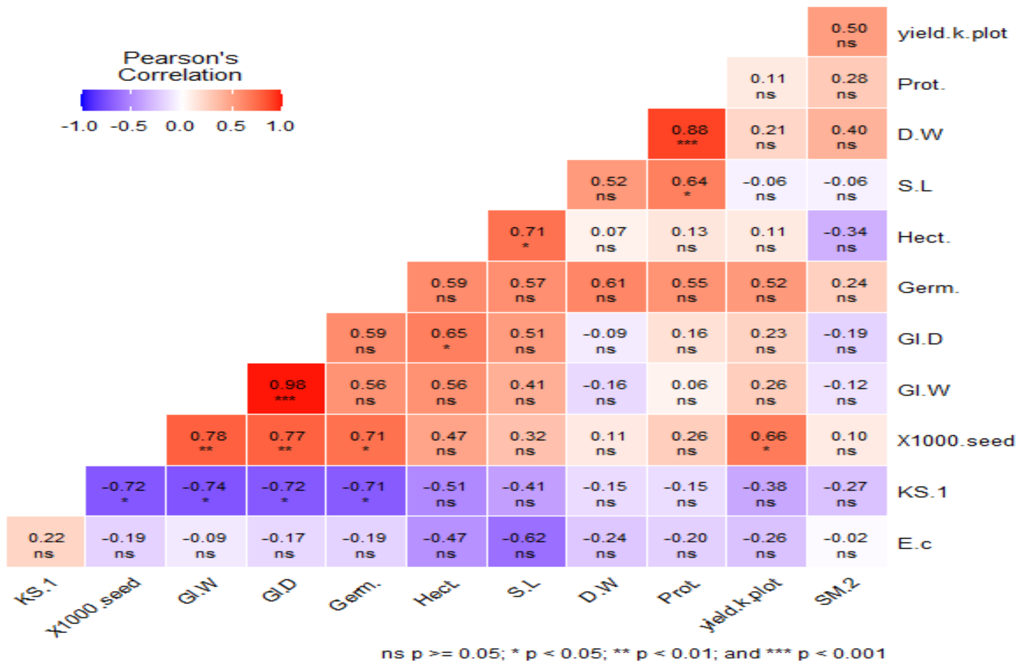

Fig. 2. Simple correlation coefficients (r) among yield and quality characteristics for the studied bread wheat genotypes.

DISCUSSION

Early sowing date (5th November) markedly resulted in the highest value of thousand grain weight. This could be due to that long plant duration gave a maximum vegetative growth when planting was carried out earlier. Delaying sowing date decreased number of grains/spikes, thousand grain weight and grain yield. This could be due to the fluctuation in climatic conditions such as day length, temperature, humidity, and precipitation. The results on yield and yield components presented here are in harmony with the results of Haroun *et al.* (2012), Mumtaz *et al.* (2015), Acharya *et al.* (2017), Swami *et al.* (2019) and Bachhao *et al.* (2018) who cleared that late sowing decreased the duration of phenology as compared to normal sowing due to fluctuated un-favorable high temperature during the growth period. The size of sink components like thousand-grain weight was dramatically lowered by higher temperatures during the vegetative stage, demonstrating a significant inverse link to mean seasonal ambient temperatures. Additionally, this reduces the time needed for the grain to mature, resulting in smaller grains and a decrease in thousand-grain weight (Sial *et al.,* 2005; Singh et al., 2018). The maximum value of germination percentage was obtained at the intermediate sowing date (5th December). While delaying the sowing date until January 5 (a late sowing date) reduced electrical conductivity values, which is good for seed quality, it also produced the highest protein content and wet and dry gluten percentage values. According to (Abdullah *et al.,* 2007; Motzo *et al.,*2007; Yan *et al.,*2008; Badawi *et al.,* 2014; Eslami *et al.,*2014; Yusuf *et al.,*2019), the effect of planting date on grain quality. The favorable effect of sowing wheat on December 5 may be attributed to the seasonable environmental conditions during this period, such as temperature, relative humidity, day length, and light intensity, which allow for rapid and high germination and increase yield components as well as grain yield per unit area (Seleiman et al. 2011; Gul *et al.,* 2012; Kaur, 2017).

Differences between genotypes in the studied traits might be attributed to the differences in the genetical constitution and genetic factors makeup of these genotypes which seriously affected by environmental conditions. Such results agree with Pan *et al.,* (2005); Fergany *et al.,* (2014); El-Nakhlawy *et al.,* (2015); Munsif *et al.* (2015); Babiker *et al., (*2017); Hussain *et al.,* (2018). Desta *et al.,* (2020) who reported that selection of suitable crop genotypes according to the agroclimatic conditions may play crucial role in realizing the optimum production of any crop commodity. The differences due to the interaction between sowing date and genotype in all studied traits except for grain yield were like those observed by Sial *et al.* (2005), Hasina *et al.,* (2012), Munsif *et al.* (2015), Yusuf *et al.* (2019) and Ahmed (2021).

The relationship of grain yield with thousand grain weight was positive and significant and was positive but not significant with germination percentage, wet and dry gluten, seedling dry weight, protein percentage and hectoliter weight and showed a negative correlation with electrical conductivity test, number of kernels/spikes. The relationship of germination percentage with 1000-grain weight and wet and dry gluten was significantly positive and positive, respectively but, it was negative with electrical conductivity test and number of kernels/spikes. These results are in accordance with those reported by Gul *et al.* (2012), Mahajan *et al.,* (2018) and Yusuf *et al.* (2019).

CONCLUSION

In general, sowing on the 5th of November is advised for wheat crop to obtain higher yield in five genotypes (Misr 3, Sakha 94, Gemmiza 12, Sids 14, and Shandaweel1), but sowing on the 5th of December is advised to maximize wheat productivity and obtain good quality of grains in the other five genotypes. Grain yield is an important criterion in evaluating the adaptability of a crop to an environmental variation. The results of this study may aid breeders in identifying features that might be chosen for wheat genotypes sown at various times for high yield and quality. Due to late seeding, Misr 3 and Sakha 95, two of the 10 genotypes employed, produced more grain yield than the other ten genotypes but Line1 genotype was superior for most of grain quality parameters so, this study recommended use Misr 3 and Sakha 95 cultivars and the promissing wheat genotype (Line1) to develop bread wheat genotypes in breeding programs under the environmental conditions of Kafr Elsheikh governorate.

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تأثير ميعاد الزراعة على إنتاجية وجودة الحبوب لبعض التراكيب الوراثية لقمح الخبزالمصري

نجوي إبراهيم شلبي[1]* ، سيدهم عبدالخالق محمدعبدالخالق[2] ، خالد ابراهيم جاد[2]،بسمه السيد السماحي[1]

1. قسم بحوث تكنولوجيا البذور، معهد بحوث المحاصيل الحقلية ، مركز البحوث الزراعية ، مصر.
2. قسم بحوث القمح ، معهد بحوث المحاصيل الحقلية ، مركز البحوث الزراعية ، مصر.

*بريد المؤلف المراسل: nagwashalaby@yahoo.com

هناك العديد من العوامل المسئولة عن إنخفاض متوسط إنتاجية القمح، أحد هذه العوامل المحددة هو ميعاد الزراعة، لأنه يؤثر بشكل كبير على المحصول وخصائص الجودة. لذا كان الهدف الرئيسي من هذه الدراسة هو التحقق من أداء التراكيب الوراثية للقمح عند زراعتها في مواعيد مختلفة، بما في ذلك كيفية تأثير مواعيد الزراعة على المحصول ومكوناته وكذلك جودة البذور.لذلك، خلال موسمي النمو 2018-2019 و2019-2020 ، تم إجراء تجربتين حقليتينفى محطة البحوث الزراعية في سخا في مصر باستخدام تصميم القطاعات العشوائية الكاملة في ثلاث مكررات. تكونت المعاملات من 30 معاملة ، عبارة عن ثلاثة مواعيد زراعه وهي؛ 5 نوفمبر ، 5 ديسمبر و 5 يناير و 10 تراكيب وراثية للقمح وهي؛ مصر 1 ، مصر 2 ، مصر 3 ، سخا 94 ، سخا 95 ، السلالة1 ، جيزة 171 ، جميزة 12 ، سدس 14 وشندويل 1.

أظهرت النتائج أن ميعاد الزراعه المبكر في الخامس من نوفمبر أعطى أعلى قيم لوزن 1000 حبة ، طول البادرة ، الوزن الجاف للبادرة ، التوصيل الكهربائي ، ووزن الهكتولتر. بالإضافة إلى ذلك ، أظهر ميعاد الزراعه في 5 ديسمبر أكبر قيم في عدد السنابل / م 2 ، محصول الحبوب ونسبة الإنبات. بينما سجل ميعاد زراعه القمح في الخامس من يناير قيم أقل لجميع الصفات ماعدا البروتين٪ والجلوتين الرطب والجاف٪. بالإضافة إلى ذلك ، تفوق التركيب الوراثي مصر 3 على الطرز الوراثية الأخرى التي تمتدراستها وسجلت أعلى عدد للسنابل / م 2 وإنتاجية الحبوب / فدان. كما لوحظت أعلى القيم للإنبات والوزن الجاف للبادرة ومحتوى البروتين ووزن الهكتوليتر ونسبة الجلوتين الرطب والجاف في السلالة1. ومن حيث الارتباط، أظهرتالدراسة وجود إرتباط إيجابي معنوي لجميع الصفات تحت الدراسة في حين أن اختبار التوصيل الكهربائي وعدد السنابل / م 2 ارتبطا سلبيا مع جميع الصفات التي تم فحصها.

يمكن الاستنتاج أن الزراعة في الخامس من نوفمبر لمحصول القمح للحصول تعطي أعلى في خمسة أصناف وهى (مصر 3 ، سخا 94 ، الجميزة 12 ، سدس 14 ، شندويل 1) ، ولكن يُنصح بالزراعة في الخامس من ديسمبر لزيادة إنتاجية وجودة القمح في الخمسة أصناف الأخرى وبالنسبة لميعاد الزراعة المتأخر فان الصنفين (مصر3،سخا95) أعطو أعلى محصول بينما تفوقت السلالة1 في معظم الصفات التكنولوجية. لذلك توصي الدراسة باستخدام الصنفين (مصر3 ، سخا 95) والسلالة البشرة (سلالة1) في برامج التربية لتحسين قمح الخبز المصري تحت الظروف البيئية الخاصة بمحافظة كفرالشيخ.

الكلمات المفتاحية : القمح ، مواعيد الزراعة ، محصول الحبوب ، الجودة.