Zagazig J. Agric. Res., Vol. 45 No. (1) 2018 1-21

Plant Production Science

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

INFLUENCE OF SOWING DATE, VARIETAL DIFFERENCES AND PLANTING DENSITY ON PRODUCTIVITY OF WHEAT CROP (*Triticum aestivum* L.)

Safaa M.H. Abd El-Hadi*, A.A-G. Ali, A.E.A. Omar and E.E.A. El-Sobky

Agron. Dept., Fac. Agric., Zagazig Univ., Egypt

Received: 06/12/2017 ; Accepted: 20/12/2017

ABSTRACT: The present study was conducted at field experiment in Mit Ghamer District, Dakahlia Governorate, Egypt, during 2014/2015 and 2015/2016 seasons. The study aimed to find out the effect of sowing dates (November 15th, November 30th and December 15th), cultivars (Giza 171, Sids 12 and Gemmiza 11) and planting densities (300, 400 and 500 grains/m^2) on yield and yield attributes of wheat. The early wheat sowing on 15th Nov. appeared to be produced the highest plant height, spike length, number of grains/spike, weight of grains/spike, 1000-grain weight and grain yield/fad. Varietal differences effected significantly on yield and yield attributes where, Gemmiza 11 cultivar appeared to be produced the highest plant height, spike length, grain weight/spike, 1000-grain weight and grain yield per fad. While Giza 171cultivar tended to produce the highest number of spikes/m^2. On other hand, dense planting of 500 grains/m^2 obtained the highest number of spikes per m^2, as well as, grain yield/fad., as compared with the other two planting densities. While, light density (300 grains/ m^2) gave the highest grain number/spike and grain weight /spike. Regarding the significant interaction between the studied factors on almost yield and yield attributes, showed that early sowing on 15th Nov. obtained the highest grain yield/fad., with Gemmiza 11 and Sids 12 cultivars when dense planting of 500 grains/m^2 were applied.

Key words: Wheat, sowing date, planting densities, yield attributes.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is an important and strategic cereal crop in the world. In Egypt, the total cultivated area of wheat reached 3.39 million faddans and the total production overtake 9.28 million tons (**FAOSTAT, 2017**). This production, however, does not meet consumption where about 5 million tons are imported. The changes in climate factors are being felt globally in the form of changes in temperature and rainfall pattern. An increase in ambient CO_2 is usually considered beneficial as it results in increased photosynthesis in crops, especially those with C_3 mechanism of photosynthesis as wheat crop. Adaptation options such as growing improved varieties, change in sowing date can reduce the impacts of climate change on wheat crops. Sowing date is one of the most important agricultural factors that determine crop productivity especially wheat crop, which affects the duration of the vegetative and reproductive stages. **Randhawa *et al.* (1977)** showed that, delay wheat sowing exposed crop plants to higher temperature during heading, resulting in reduced yield and its attributes. Similar trends were reported by **Refay (2011), Costa *et al.* (2013) and Amal *et al.* (2016)**. On other hand, **Hozayn and Abd El-Monem (2010)** found that the high values of vegetative characters of wheat were occurred when wheat was planted earlier due to exposure plants to high temperature. Also, the highest value of each of yield attributes and grain yield as well as biological yield were occurred when wheat was sown earlier. Moreover, **Aftab *et al.* (2004)** reported that biomass accumulation, wheat grain yield and its components were increased with early seeding

* **Corresponding author: Tel. :** +20128339127
E-mail address: safaaabdelhady@yahoo.com

on the beginning of November. On other side, several authors reported significant increase of grain yield and yield attributes due to wheat varietal differences (**Abd El-Hameed, 2012; Abd El-Razek and El-Sheshtawy, 2013; Radwan *et al*., 2014; Fayed *et al*., 2015; Fadel *et al*., 2016**). Wheat plants are one of dense growing crops which having a high compensatory capacity, so, plant density is a very important agronomic practices that determine the productivity of wheat and are particularly affected by both the varieties and sowing date. Increasing planting density significantly increased plant height, number of spikes/m^2; grain, straw and biological yields/fad., but significantly decreased grain weight/spike and 1000 grain weight (**Ali *et al*., 2004**). Similar trends were reported by **Ghorbani and Basiri (2013), Kenarsari *et al*. (2014) and Isabelle *et al*. (2015)**. While, **Stephen *et al*. (2005)** showed that increasing seed rates produced more dense wheat populations and hence, reduced both grain yield and yield components. Therefore, the present study aimed to investigate the effect of sowing dates, cultivars and planting densities on yield and its attributes of wheat.

MATERIALS AND METHODS

The present study was conducted at field experiment in Mit Ghamer District, Dakahlia Governorate, Egypt under Agronomy Department supervision, Faculty of Agriculture, Zagazig University, during 2014/2015 and 2015/2016 seasons. The study aimed to find out the effect of sowing dates, cultivars and planting densities on yield and yield attributes of bread wheat. The experimental site was clay in texture (21.2% sand, 35.7% and 43.1% clay). The soil had an average pH of 8.11and organic matter of 1.0% as well as available N of 79 ppm, available P of 15 ppm and available K of 270 ppm. A split-split plot of the rendomized complete block design with three replications was used, where three sowing dates (November 15th, November 30th and December 15th) were allocated in the main plots. Three cultivars (Giza 171, Sids 12 and Gemmiza 11 cvs.) were allocated in the sub-plots .While, the sub-sub plots were assigned to three planting densities *i.e.* 300, 400 and 500 grains/m^2. The sub-sub plot area was 7 m^2 (3.5 × 2 m) included 10 rows of 3.5 m length and 20 cm apart. Wheat sowing was made after rice (*Oryza sativa* L.) as a preceding crop in both seasons. Superphosphate (15.5% P_2O_5) was band placed at the time of sowing. Also, N fertilizer at level of 90 kg N/fad., was applied twice before the first and the second irrigations as ammonium nitrate (33.5%).The other culture practices were applied as recommended in the experimental area. At harvest, ten guarded plants were taken at random from each plot to record the following yield and yield attributes: Plant height (cm), spike length (cm), number of grains/spike, grain weight/ spike (g) and 1000-grain weight (g). Number of spikes/ m^2 was recorded from 1 m^2 using a wooden square for each experimental plot. Grain yield/ fad., were recorded from 2 m^2 in each sub-sub plot. Data were statistically analyzed according to **Gomez and Gomez (1984)** by using **MSTAT-C (1991)** where statistical program Version 2.1 was used for analysis of variance (ANOVA). A combined analysis was undertaken for the data of the two seasons after testing the homogeneity of the experimental errors by Bartellets test (**Steel *et al*., 1997**). Treatment means were compared using least significant differences (LSD) test at 0.05 level of probability (**Waller and Duncan, 1969**). In interaction Tables, capital and small letters were used to denote significant differences among rows and columns means, respectively.

RESULTS AND DISCUSSION

Plant Height (cm)

Results in Table 1 show the effect of sowing dates, cultivars and planting densities on plant height in the both seasons and their combined. It is evident from Table 1 that plant height was significantly affected by sowing dates in both seasons and their combined. Wheat sowing on mid of November produced longer plants compared with sowing on November 30th and December 15th in both seasons and their combined. These results are in accordance with those reported by **Abdel Nour *et al.* (2011), Alam *et al.* (2013), Amal *et al.* (2016) and Fadel *et al.* (2016)**. Whereas, **Geith *et al.* (2013)** found that sowing wheat on 25th November significantly increased plant height. With respecting to varietal differences, the results revealed that, varietal differences were significantly affected on plant height in both seasons and their combined. It is clear that Sids 12 cv gave the shortest plants compared with

Table 1. Plant height (cm) of wheat plant as affected by sowing dates, wheat cultivars and planting densities and their interactions in the two seasons and their combined

Main effects and interactions	Plant height (cm)		Combined
	2015/2016	2016/2017	
Sowing date (S)			
S_1-November 15th	113.03 a	109.38 a	111.20 a
S_2-November 30th	105.85 b	105.25 b	105.55 b
S_3-December 15th	97.74 c	102.98 c	100.36 c
F. test	**	**	**
Cultivar (C)			
C_1-Giza 171	107.10 b	108.55 a	107.82 b
C_2-Sids 12	97.648 c	101.67 c	99.659 c
C_3-Gemmiza 11	111.87 a	107.39 b	109.63 a
F. test	**	**	**
Planting density(D)			
D_1-300 grains/m^2	106.45 a	105.60 b	106.03
D_2-400 grains/m^2	105.60 a	105.83 ab	105.71
D_3-500 grains/m^2	104.56 b	106.17 a	105.37
F. test	*	*	NS
Interaction			
S × C	**	**	**
S × D	**	**	**
C × D	**	**	**

*, ** and NS indicate significant at 0.05, 0.01 and not significant, respectively.

Giza 171 and Gemmiza 11 cvs in both seasons and their combined. The results are in accordance with those reported by **Abdel-Nour *et al*. (2011) and Fadel *et al*. (2016)**. Likely, plant height was significantly decreased with dense planting (500 grains/m^2) during the first season. While, in the second season, plant height took reverse direction where light density gave the shortest plants compared with dense planting. However, others got significant increase in plant height due to dense planting **(Ali *et al*., 2004; Yasin and Omar, 2013; Amal *et al*., 2016)**. According to the combined analysis, interaction between sowing dates and cultivars, cultivars and planting density, as well as sowing dates and planting densities affected significantly on plant height of wheat. But, no additional information could be obtained other than the main effects. Therefore, interaction tables were not discussed.

Spike Length (cm)

The length of spike plays a vital role in wheat towards the grains spike and finally the yield (**Shahzad *et al*., 2007**). Thus, the results in Table 2 expose spike length of wheat cultivars as influenced by sowing dates, varietal differences and planting density. Meanwhile, sowing dates revealed highly significant differences during the second season, whereas

Table 2. Spike length (cm) of wheat as affected by sowing dates, cultivars and planting densities and their interactions in the two seasons and their combined

Main effects and interactions	Spike length (cm)		
	2015/2016	2016/2017	Combined
Sowing date(S)			
S_1-November 15th	11.926	12.97 a	12.452
S_2-November 30th	11.937	12.79 b	12.367
S_3-December 15th	12.767	12.27 c	12.522
F. test	N.S	**	N.S
Cultivar (C)			
C_1-Giza 171	11.707 b	11.64 c	11.678 b
C_2-Sids 12	11.163 c	12.53 b	11.850 b
C_3-Gemmiza 11	13.759 a	13.86 a	13.813 a
F. test	**	**	**
Planting density(D)			
D_1-300 grains/m^2	12.244 a	13.00 a	12.622 a
D_2-400 grains/m^2	12.530 a	12.78 b	12.656 a
D_3-500 grains/m^2	11.856 b	12.27 c	12.063 b
F. test	**	**	**
Interaction			
S × C	**	**	**
S × D	*	**	NS
C × D	*	**	NS

Where *, ** and NS indicate significant at 0.05, 0.01 and not significant, respectively.

Table 2-a. Spike length of wheat plants as affected by the interaction between sowing dates and cultivars (combined data)

Cultivars / Sowing dates	Giza 171	Sids 12	Gemmiza 11
	B	B	A
November, 15th	12.02 a	11.97 a	13.35 b
	B	B	A
November, 30th	11.45a	11.87a	13.78 ab
	B	B	A
December, 15th	11.56a	11.70 a	14.31a

the early sowing on 15th Nov. gave the longest spike followed by mid- sowing on 30 th Nov. while the shortest spike was recorded by the late sowing date. Otherwise, the differences among first season and the combined did not reach the level of significance. Generally the early sowing tended to produce longer spike as compered by the late sowing. This may be due to the heat units and metabolites stored in early sowing caused to vigorous growth and longer spikes. These results are in agreement with those reported by **Kandil *et al.* (2011), Geith *et al.* (2013), Tomar *et al.* (2014) and Farooq *et al.* (2016)**.

With respect to varietal differences, the results revealed highly significant differences, where Gemmiza 11cv. appeared to be produced the longest spikes during both growing seasons as well as their combined which followed by Sids 12 and Giza 171cvs. Such differences in spike length almost due to genetical variation and their interaction with environmental condition. These results are in a good accordance with those reported by **Abd El-Hameed (2012) and El-Lethy *et al.* (2013)**. However, **El-Gizawy (2005)** indicated that spike length of wheat cultivars did not different significantly. Likely, planting density results indicated highly significant differences throughout the two growing seasons and their combined whereas the light planting density of 300 grains/m^2 tended to produce the longest spikes which followed by middle density of 400 grains/m^2, while the shortest spikes were achieved by dense planting of 500 grains/m^2 through the two growing seasons and the combined. The negative effect of the highest planting density on spike length could be attributes to the increase in population as a result of dense planting and consequently low penetration of light within wheat canopy, hence, high competition between plants for water, minerals and other edaphic factors. In this connection, **Ali *et al.* (2011) and Yasin and Omar (2013).** However, **Saleh (2000) and Hussain *et al.* (2003)** reported that plant density and/or seeding rate had no significant effect on spike length of wheat. Furthermore, the significant interaction between sowing dates and wheat cultivars (Table 2-a) concerning the combined results, showed that Gemmiza 11 cv. produced the longest spikes under different sowing dates used. Thus, the longest spike (14.31 cm) was achieved by Gemmiza 11 cv. on late sowing of 15th December. On the contrary, the shortest spike (11.45 cm) was recorded by Giza 171 cultivar under middle sowing date of 30th November.

Number of Spikes/m^2

Number of spikes/m^2 results as one of the major yield components are present in Table 3. The influence of sowing date results revealed highly significant differences through both growing seasons and their combined analysis, where late sowing achieved the highest number of spikes/m^2 during the first season and the combined as compared with other two sowing dates. However, the reverse direction was observed during the second growing season whereas the early sowing on 15th Nov. was obtained the highest number of spikes/m^2 which followed by late sowing (15th Dec.) then, the lowest number of spikes/m^2 was recorded by the middle sowing date on 30th Nov. The reverse direction noticed between the two growing seasons may be attributed to effect of climatic factor especially temperature and light through both seasons, which might adversely affect reproductive growth stages. In this connections, several investigators reported significant differences between sowing differences from season to season and from sowing date to another included **Gul *et al.* (2012), El-Nakhlawy *et al.* (2015) and Farooq *et al.* (2016)**. However, **Geith *et al.* (2013)** reported that sowing dates had no significant effect on number of spikes/m^2. Respecting varietal differences results, highly significant differences were observed during both growing seasons and their combined. Mean through, Giza 171 cv. gave the highest number of spikes /m^2 during the first season and the combined which followed by Sids 12 cv., while in the second season Sids 12 cv. achieved the highest number of spikes/m^2 (358.81) followed by Giza 171 cv. (352.63). At contrary, Gemmiza 11 cv. recorded the lowest through both growing seasons and their combined. Concerning the combined results Giza 171 cultivar achieved the highest number of spikes /m^2 (369.00) followed by Sids 12 one (363.51) then, Gemmiza 11 cv. which recorded the lowest number of spikes/m^2 (324.92). Several investigators showed the varietal differences

Table 3. Number of spikes/m^2 of wheat plant as affected by sowing dates, wheat cultivars and planting densities and their interactions in the two seasons as well as the combined

Main effects and interactions	Number of spikes /m^2		
	2015/2016	2016/2017	Combined
Sowing date(S)			
S_1-November 15th	320.85 c	362.04 a	341.44 b
S_2-November 30th	357.44 b	318.33 c	337.88 b
S_3-December 15th	413.70 a	342.52 b	378.11 a
F. test	**	**	**
Cultivar (C)			
c_1Giza 171	385.37 a	352.63 b	369.00 a
c_2Sids 12	368.22 b	358.81 a	363.51 b
c_3 Gemmiza 11	338.40 c	311.44 c	324.92 c
F. test	**	**	**
Planting density(D)			
D_1-300 grains/m^2	341.81 c	330.52 c	336.16 c
D_2-400 grains/m^2	357.03 b	344.59 b	350.81 b
D_3-500 grains/m^2	393.148 a	347.78 a	370.46 a
F.test	**	**	**
Interaction			
S × C	**	**	**
S × D	**	**	**
C × D	**	**	**

Where: *, ** and NS indicate significant at 0.05, 0.01 and not significant, respectively.

among wheat cultivars regarding number of spikes/m^2 included **Ali *et al.* (2004), Abdel-Nour *et al.* (2011), Abd El-Razek and El-Sheshtawy (2013) and Abd El-Khalek *et al.* (2015)**. Likely, planting density results indicated highly significant differences throughout the two growing seasons and their combined. Mean-through, number of spikes/m^2 appeared to be significant increase as planting density increased from 300 to 400 and up to 500 grains/m^2. Then, the highest number of spikes/m^2 (370.46) was obtained by dense planting of 500 grains/m^2 which followed by middle density of 400 grains/ m^2 (350.81), while the lowest number of spikes/ m^2 (336.16) was given by the light density of 300 grain/m^2, concerning the combined results. The superiority of dense planting over light and middle densities reached around 9.26 and 5.30%, respectively concerning the combined results. Such increase in number of spikes/m^2 achieved by dense planting is mainly due to the increase in number of plants. These results are in agreement with those found by **Yasin and Omar (2013), Kenarsari *et al.* (2014) and Isebelle *et al.* (2015)**. Otherwise, **Ghorbani and Basiri (2013)** reported that number of spikes/m^2 reduced by increasing number of grains/m^2 (500 /m^2) compared to lower number of grains/m^2 (250/m^2). On the other hand, **Ashmawy *et al.* (2002)** showed that either planting density or seeding rate had no significant effect on number of spikes/m^2. Regarding the significant interaction between the studied factors (combined results), the interaction between sowing dates and wheat cultivars (Table 3-a) indicated that the highest number of grains/m^2 (423.27), obtained by Sids 12 cv. under late sowing on 15th Dec., while the lowest number (301.11 spikes/m^2) was recorded by the same cultivar (Sids 12) when sown on 15th Dec. Furthermore, the significant interaction between sowing dates and planting densities (Table 3-b) showed that late sowing on 15th Dec. achieved the highest number of spikes/m^2 when dense planting of 500 grains/m^2 was applied. At contrary, the lowest number (318.55) was given by early sowing (15th Nov.) with light density of 300 grains/m^2. Finally, the significant interaction effect between cultivars and planting densities (Table 3-c) indicate that Giza 171 cultivar gave the highest number of spikes/m^2 (402.00) when dens planting of 500 grain/ m^2 was applied. On the other direction, Gemmiza 11 cultivar recorded the lowest number of spikes/ m^2 (316.00) when light density of 300 grains/m^2 was used.

Number of Grains/spike

Number of grains/spike is an important yield contributing parameter and has direct effect on the final grain yield of wheat. Table 4 shows the influence of sowing dates, varietal differences and planting density on number of grains/spike during both growing seasons and their combined. Concerning the influence of sowing dates on number of grains/spike, the results revealed highly significant differences during the second season and the combined, while it could not reach the level of significant in the first season whereas the early sowing on 15 th Nov. produced the highest number of grains/ spike which followed by the mid sowing date on 30th Nov., while the lowest number of grains/ spike was recorded by the late sowing of 15th Dec. The early sowing resulted in better development of the grains due to longer growing period which produce more assimilates as well as suitable climate factor. These results were strongly supported by those of **Tomar *et al.* (2014), El- Nakhlawy *et al.* (2015), Farooq *et al.* (2016)**. However, **Tahir *et al.* (2009)** reported that sowing date had did not significantly affect on number of grains/ spike.

Respecting varietal differences influence on number of grains/spike, the results indicated highly significant differences through both growing seasons and their combined, where Sids 12 cv. was the superior in number of grains /spike followed by Gemmiza 11 cv., however Giza 171 cv. gave the lowest number of grains/spike. Differences among cultivars might be attributed to genetic variability. Several investigators stated the significant difference between wheat cultivars regarding number of grains/spike among them **Abd El-Iattief (2014) and Ahmed *et al.* (2017)**. Regarding the influence of planting density on number of grains /spike, the results revealed significant and highly significant difference during both seasons and their combined, wherein the high density appeared to produce higher number of grains/spike as compared with middle and dense planting. These results almost followed the same patterns of spike length (Table 2). In other words, increasing planting density from 300 to 400 and up to500 grains /m^2 tended to decrease number of grains /spike. Such reduction in number of grains /spike resulted from dens planting may be due to the competition between individual plants and struggling for the viable nutrients in surrounding media. In this connection, **Ghorbani and Basiri (2013), Yasin and Omar (2013) and Isabelle *et al.* (2015)** stated that number of grains /spike was significantly decreased as planting density or seeding rate was increased. Regarding the significant interaction between the studied factors (combined results), the significant interaction between sowing dates and wheat cultivars (Table 4-a) indicated that Sids 12 cultivar gave the highest number of grains/spike (70.70), when early sown on 15th Nov., was applied, while the lowest one was recorded by Giza 171 cultivar (53.76) under the late sowing on 15th Dec. Furthermore, the significant interaction between sowing dates and planting densities (Table 4-b) showed that the highest number of grains/spike (65.28) was obtained by early sowing on 15th Nov. when middle-planting density of 400 grains/m^2 was applied. Otherwise, the lowest number of grains/spike (53.73) was given by late sowing (15th Dec.) with middle planting density (400 grains/m^2). Finally, the significant interaction between cultivars and planting densities (Table 4-c) revealed that. Sids 12 cultivar achieved the highest number of grains/spike (66.04) when light planting density of 300 grain/m^2 was used. However, the lowest

Table 3-a. Number of spikes/m^2 of wheat plant as affected by the interaction between sowing dates and cultivars (combined data)

Cultivar / Sowing date	Giza 171	Sids 12	Gemmiza 11
	A	C	B
November, 15th	381.94 a	301.11 c	341.27 a
	B	A	C
November, 30th	334.94 b	366.11 b	312.55 c
	B	A	C
December, 15th	390.11 a	423.27 a	320.94 b

Table 3-b. Number of spikes/m^2 of wheat plant as effected by the interaction between sowing dates and planting densities (combined data)

Planting density / Sowing date	300 grains/m^2	400 grains/m^2	500 grains/m^2
	B	B	A
November, 15th	318.55 c	330.05 c	375.72 b
	B	A	B
November, 30th	325.72 b	352.05 b	335.88 c
	B	B	A
December, 15th	364.22 a	370.33 a	399.70 a

Table 3-c. Number of spikes/m^2 of wheat plant as affected by the interaction between cultivars and planting densities (combined data)

Cultivar / Planting density	300 grains/m^2	400 grains/m^2	500 grains/m^2
	C	B	A
Giza 171	340.77 a	364.22 a	402.00 a
	B	AB	A
Sids 12	351.72 a	364.27 a	374.55 b
	B	AB	A
Gemmiza 11	316.00 b	323.94 b	334.83 c

Table 4. Number of grains /spike of wheat plants as affected by sowing dates, wheat cultivars and planting densities and their interactions in the two seasons as well as the combined

Main effects and interactions	Number of grains/spike		
	2015/2016	2016/2017	Combined
Sowing date(S)			
S_1-November 15th	62.411	66.841 a	64.626 a
S_2-November 30th	62.157	62.585 b	62.361 b
S_3-December 15th	58.733	53.296 c	56.015 c
F. test	N.S	**	**
Cultivar (C)			
c_1-Giza 171	57.726 c	57.559 b	57.643 c
c_2-Sids 12	63.741 a	62.630 a	63.185 a
c_3-Gemmiza 11	61.815 b	62.533 a	62.174 b
F. test	**	**	**
Planting density(D)			
D_1-300 grains/m^2	62.882 a	61.759 a	62.321 a
D_2-400 grain/m^2	60.481 a	60.833 ab	60.657 b
D_3-500 grains/m^2	59.978 b	60.100 b	60. 039 b
F.test	**	*	**
Interaction			
S×C	**	**	**
S×D	**	**	**
C×D	**	**	**

Where *, ** and NS indicate significant at 0.05, 0.01 and not significant, respectively.

Table 4-a. Number of grains/spike of wheat plants as affected by the interaction between sowing dates and cultivars (combined data)

Cultivar / Sowing date	Giza 171	Sids 12	Gemmiza 11
	C	A	B
November, 15th	58.13b	70.70 a	65.04 a
	B	A	AB
November, 30th	61.03a	63.81 b	62.23 a
	B	AB	A
December, 15th	53.76c	55.03 c	59.24 b

Table 4-b. Number of grains/spike as of wheat plants affected by the interaction between sowing dates and planting densities (combined data)

Planting density / Sowing date	300 grains/m^2	400 grains/m^2	500 grains/m^2
	A	A	A
November, 15th	64.817 a	65.28 a	63.77 a
	A	B	B
November, 30th	65.07 a	61.85 b	60.16 b
	A	B	A
December, 15th	56.89 b	53.73 c	57.32 c

Table 4-c. Number of grains/spike of wheat plants as affected by the interaction between cultivars and planting densities (combined data)

Planting density / Cultivar	300 grains/m^2	400 grains/m^2	500 grains/m^2
	A	A	A
Giza 171	56.47 b	58.47 b	57.53 b
	A	B	AB
Sids 12	66.04 a	59.22 b	64.28 a
	A	AB	B
Gemmiza 11	63.91 a	63.17 a	59.43 b

one (56.47) was recorded by Giza 171 cultivar when light planting density of 300 grain/m^2 was applied.

Weight of Grains/spike (g)

Results present in Table 5 show the influence of sowing date, varietal differences and planting density on weight of grains/spike during both growing seasons and their combined analysis. Respecting to the influence of sowing dates, the results revealed highly significant differences throughout the two seasons and the combined, where the early sowing on 15th Nov. appeared to produce the highest weight of grains/spike which followed by the mid -sowing on 30th Nov., then the lowest weight of grains/spike was recorded by the late sowing of 15th Dec. In other words, weight of grains/spike tended to be gradually decreased as sowing date delayed from 15th Nov., to 30th Nov. and up to 15th Dec. These results almost followed the same patterns of number of gains/spike (Table 4) the grain weight significantly decreased with each day delay in sowing. This indicate that late sowing shorted the development phases of wheat and adversely affect the grain development and result in low weight of grains/spike. These results are in agreement with those reported by **Tomar *et al.* (2014) and Fadel *et al.* (2016)**.

Varietal differences results in Table 5 showed highly significant differences during both growing seasons and their combined analysis, where Gemmiza 11 cv. achieved the highest grains weight /spike which followed by Sids 12 cv. , while Giza 171 cv. gave the lowest grains weight/spike. These results almost followed the same patterns of spike length (Table 2). In other words, the superiority of Gemmiza 11 cv. may be attribute to its ability to produce higher dry matter/plant, higher number of spikeletes/spike and longer spike which in turn resulted in heaviest grains/spike as compared with the other

Table 5. Weight of grains/spike (g) of wheat as affected by sowing dates, wheat cultivars and planting densities and their interactions in the two seasons as well as the combined

Main effects and interactions	Weight of grains/ spike (g)		
	2015/2016	2016/2017	Combined
Sowing date(S)			
S_1-November 15th	3.422 a	3.951 a	3.687 a
S_2-November 30th	3.241 b	2.566 b	2.904 b
S_3-December 15th	2.542 c	2.103 c	2.326 c
F. test	**	**	**
Cultivar (C)			
c_1-Giza 171	2.837 c	2.629 c	2.733 c
c_2-Sids 12	3.048 b	2.911 b	2.980 b
c_3-Gemmiza 11	3.326 a	3.081 a	3.204 a
F. test	**	**	**
Planting density(D)			
D_1-300 grains/m^2	3.152	2.966 a	3.059 a
D_2-400 grains/m^2	3.085	2.863 b	2.974 b
D_3-500 grains/m^2	2.974	2.792 c	2.883 c
F. test	N.S	**	**
Interaction			
S×C	**	**	**
S×D	**	**	**
C×D	*	*	**

Where: *, ** and NS indicate significant at 0.05, 0.01 and not significant, respectively.

two cultivars. The varietal differences among wheat cultivars concerning the weight of grains/ spike were reported by several investigators, from them **Wally (2008), Amin (2010), Hafez *et al.* (2012) and Abd El-Lattief (2014)**. Planting density results indicated highly significant differences during the second season and the combined when weight of grains/spike appeared to be significant decreased as planting density was increased from 300 to 400 and up to 500 grains/m^2. In other words, light planting of 300 grains/m^2 achieved the highest weight of grains/spike followed by middle density of 400 grains/m^2, while dense planting of 500 grains/m^2 recorded the lightest grains/spike. However, the differences did not reach the level of significance in the first season. These results almost followed the same patterns of spike length (Table 2) and number of grains /spike (Table 3). In this connection, **Raheim *et al.* (2012), Yasin and Omar (2013), and Isebelle *et al.* (2015)** reported that light planting density or low seeding rate tended to produce heavier grains/spike, However the reverse effect was observed by **Amin *et al.* (2010) and Ali *et al.* (2011)**. Concerning the significant interaction between the studied factors regarding the combined results, the interaction between sowing dates and wheat cultivars (Table 5a) indicated that the highest grain weight/spike

Table 5-a. Grains spike weight of wheat plants as affected by the interaction between sowing dates and cultivars (combined data)

Cultivar / Sowing date	Giza 171	Sids 12	Gemmiza 11
	B	A	AB
November, 15th	3.32 a	3.90 a	3.84 a
	B	B	A
November, 30th	2.79 b	2.83 b	3.09 b
	B	B	A
December, 15th	2.09c	2.21c	2.68 c

Table 5-b. Grains spike weight of wheat plants as affected by the interaction between sowing dates and planting densities (combined data)

Planting density / Sowing date	300 grains/m^2	400 grains/m^2	500 grains/m^2
	A	B	B
November, 15th	3.95 a	3.617 a	3.494 a
	AB	A	B
November, 30th	2.94 b	3.022 b	2.744 b
	B	B	A
December, 15th	2.28c	2.28c	2.44 c

Table 5-c. Grains spike weight of wheat plants as affected by the interaction between planting densities and cultivars (combined data)

Planting density / Cultivar	300 grains/m^2	400 grains/m^2	500 grains/m^2
	A	A	A
Giza 171	2.828 c	2.711 b	2.661 b
	A	A	A
Sids 12	3.022 b	2.922 b	3.006 a
	A	AB	B
Gemmiza 11	3.328 a	3.300 a	2.983 a

(3.9 g) was obtained by Sids 12 cv. under the early sowing date on 15th Nov., while the lowest one (2.089 g) was recorded by Giza 171cv., when planted late on 15th Dec. Furthermore, the significant interaction effect between sowing dates and planting densities (Table 5-b) showed that the heaviest grains/spike (3.950 g) was achieved by early sowing on 15th Nov. when light planting density of 300 grains/m^2 was applied. On the other hand, late sowing on 15th Dec recorded lighter grains/spike compared with light and middle planting densities. Finally, the significant interaction between cultivars and planting densities (Table 5-c) indicated that the heaviest grains/spike (3.328 g) was given by Gemmiza 11 cv. when light planting density of 300 grain/m^2 was applied. At contrast, the lightest grains/spike (2.661 g) was recorded by Giza 171 cv. when dense planting of 500 grain/ m^2 was used.

Thousand-Grain Weight (g)

Table 6 expose the influence of sowing date, varietal differences and planting density on 1000- grain weight during both growing seasons and their combined. Regarding the influence of sowing dates, the results revealed highly significant differences throughout both seasons and the combined, whereas the early sowing on 15th Nov. appeared to obtain the heaviest 1000-grain weight which followed by the middle sowing on 30th Nov. while the lightest 1000-grains was recorded by late sowing on 15th Dec. In other words, 1000-grain weight tended to be gradually decreased as sowing date was delayed from early sowing to middle sowing and late sowing. These results almost followed the same patterns of number of grains/spike (Table 3) and weight of grains /spike (Table 5) while it was taken reverse direction with those of number of spikes/m^2 (Table 4). It is evident that late sowing of wheat subject the grains to low soil temperature causing poor plant growth (plant height Table 1), and high temperature at the end of the season, which might be adversely affect the reproductive growth stage. The obtained result are in accordance with those reported by **Fayed *et al.* (2015), Fadel *et al.* (2016) and Farooq *et al.* (2016)**. Likely varietal differences revealed highly significant differences during both growing seasons and their combined, where Gemmiza 11 Cv. appeared to produce heaviest 1000- grain which followed by Giza 171 cv., while Sids 12 cv. gave the lightest 1000- grains. Then, Gemmiza 11, Giza 171 and Sids 12 cultivars recorded 46.759, 42.148 and 41.685 g, respectively regarding 1000-grain weight (combined results). These results almost followed the same patterns of plant height, spike length and grains spike weight (Tables 1, 2 and 5 for the same following order). Several investigators reported that wheat cultivars differed significantly in 1000- grain weight included, **El-Lethy *et al.* (2013), Radwan *et al.* (2014) and Ahmed *et al.* (2017).**

With respect to the influence of planting density on 1000- grain weight “g”, the results showed highly significant difference during both growing seasons and their combined analysis where light and middle planting densities of 300 and 400 grains/m^2 obtained higher 1000- grain weight as compared with dense planting density of 500 grains/m^2, regarding the combined results. These results almost followed the same patterns of spike length, number of grains/spike and grains spike weight (Tables 2, 3 and 5, respectively). Others wise, the results showed reverse direction with number of spikes /m^2 (Table 3). In other words, dense planting tended to produce higher number of spikes /m^2 and lower grain weight/spike and 1000- grain weight. Such result might be attributed to occurrence of inter and/or intra-competition among dense plants of wheat. These results are in good line with those reported by **Ali *et al.* (2004) Ghorbani and Basiri (2013) and Yasin and Omar (2013)**. On the contrary, **Amin *et al.* (2010)** showed that 1000-grain weight of wheat appeared to be increased as planting density increased from 400 to 500 and up to 600 grains/m^2. However, **Isabelle *et al.* (2015)** reported that planting density from 250 up to 450 grains/m^2 had no significant effect on 1000-grain weight of wheat. The significant interaction effect between the studied factors regarding the combined results showed that the interaction effect between sowing dates and wheat cultivars (Table 6-a) indicated that the highest 1000- grain weight (56.72 gm) was obtained by Gemmiza 11 cv. under the early sowing date on 15th Nov., while the lowest one (31.88 g) was recorded by Giza 171 cv. when

Table 6. 1000 grain weight (g) of wheat as affected by sowing dates, wheat cultivars and planting densities and their interactions in the two seasons as well as the combined

Main effects and interactions	1000- grain weight (g)		
	2015/2016	2016/2017	Combined
Sowing date (S)			
S_1-November 15th	54.074 a	50.963 a	52.519 a
S_2-November 30th	49.963 b	38.259 b	44.111 b
S_3-December 15th	34.481 c	33.444 c	33.963 c
F. test	**	**	**
Cultivar (C)			
c_1-Giza 171	44.259 b	40.034 b	42.148 b
c_2-Sids 12	43.481 c	39.889 b	41.685 c
c_3-Gemmiza 11	50.778 a	42.741 a	46.759 a
F. test	**	**	**
Planting density(D)			
D_1-300 grains/m^2	47.407 a	40.111 b	43.759 a
D_2-400 grains/m^2	46.037 b	41.519 a	43.778 a
D_3-500 grains/m^2	45.074 c	41.037 a	43.056 b
F.test	**	**	**
Interactions			
S×C	**	**	**
S×D	**	*	**
C×D	**	**	**

Where; *, ** and NS indicate significant at 0.05, 0.01 and not significant, respectively.

Table 6-a. Thousand grain weight of wheat plants as affected by the interaction between sowing dates and cultivars (combined data)

Cultivar / Sowing date	Giza 171	Sids 12	Gemmiza 11
	B	B	A
November, 15th	50.00 a	50.83 a	56.72 a
	B	C	A
November, 30th	44.55 b	40.94 b	46.83 b
	C	B	A
December, 15th	31.88 c	33.27 c	36.72 c

planted late on 15th Dec. Concerning the significant interaction effect between sowing dates and planting densities (Table 6-b), the results showed that early sowing on 15th Nov., appeared to produce high 1000-grain weight under the different planting densities as compared with the other two sowing dates. On the other hand, the lowest 1000-grain weight (32.00 g) was achieved by late sowing on 15th Dec. when dense planting of 500 grains/m^2 was applied. In addition, the significant interaction effect between cultivars and planting densities respecting 1000-grain weight (Table 6-c) indicated that the highest 1000- grain weight (49.16 g) was given by Gemmiza 11 cv., when middle planting density of 400 grains/$m^2$was used. However, the lowest 1000- grain weight (40.38 g) was recorded by Sids 12 cv. with middle planting density of 400 grains/m^2.

Grain Yield (ton/fad.)

Grain yield of wheat crop is the result of combined effect of various yield contributing components. Results in Table 7 expose the influence of sowing date, varietal differences and planting density on grain yield on wheat during both growing seasons and their combined. Meanwhile, sowing date results revealed highly significant differences throughout both seasons and the combined, whereas the early sowing on 15th Nov. appeared to obtain the highest grain yield/fad., during the two growing seasons and their combined analysis which followed by the middle sowing of 30th Nov. while the lowest grain yield/fad., was recorded by late sowing on 15th Dec., In other words, grain yield/fad., tended to be gradually decreased as sowing date was delayed from early sowing on 15th Nov. to middle sowing on 30th Nov., and late sowing on 15th Dec. The superiority of grain yield/fad., achieved by early sowing relatively to middle and late sowings amount to around 21.31 % and 32.77% for the same following order concerning the combined result. These results almost followed the same patterns of the yield components include number of grains/spike (Table 4) weight of grains/spike (Table 5) and 1000- grain weight (Table 6). Such result indicated that delaying of wheat planting led to shorting of vegetative stages as well as the climatic condition were less suitable for growth duration especially temperature degree with the delay in sowing date. So, weather conditions prevailing during wheat growth may be the reason for the detected such variations between sowing dates. These results are in accordance with those reported by **Qasim *et al.* (2008), El-Gizawy (2009), Abbas *et al.* (2010), Hozayn and Abd El-Monem (2010)** who indicated that the reduction in weight grain yield and its attributes with delaying sowing date was a result of expose plants to high temperature, which reduced season length. Also, the obtained results are in agreement with those reported by **Gul *et al.* (2012), Jat *et al.* (2013) , Fayed *et al.* (2015) and Farooq *et al.* (2016)**. Likely, the wheat varietal differences revealed highly significant differences during both growing seasons and their combined analysis, where Gemmiza 11 cv. out-yielded the other two cultivars during both growing seasons and combined which achieved the highest grain yield/fad., through the two seasons and their combined recording 3.781, 3.189 and 3.485 ton/ fad., for the same following order. These results almost followed the same patterns of yield attributes included, spike length, grains spike weight and 1000-grain weight (Tables 1, 5 and 6, respectively). The varietal differences among wheat cultivars were reported by several investigator included **Radwan *et al.* (2014) Fayed *et al.* (2015), Amal *et al.* (2016) and Ahmed *et al.* (2017)**.

Concerning the influence of planting density on grain yield/fad., the results revealed highly significant differences during both growing seasons and their combined analysis where dense planting density of 500 grains/m^2 appeared to produce the highest grain yield/fad., as compared with the other two planting densities during the second season and the combined, however in the first season the results followed the reverse direction where the light planting density of 300 grains/m^2 obtained the highest grain yield/fad. Thus, the combined results showed that dense planting of 500 grains /m^2 gave the highest grain yield/fad., (3.388 ton), then the lowest grain yield/fad., (3.259 ton) was given by middle –density of 400 grains/m^2. The superiority of dense planting of 500 grains /m^2 over lighter density of 300 and 400 grains/m^2 amounted to about 2.30% and 3.81% for the same following order. These results almost followed the same patterns of number of spikes/m^2 (Tabie 3). The obtained results are in accordance with those reported by **Costa *et al.* (2013), Yasin and Omar (2013), Kenarsari *et al.* (2014) and Eslami *et al.* (2014).** Otherwise,

Table 6-b. Thousand grain weight of wheat plants as affected by the interaction between sowing dates and planting densities (combined data)

Planting density Sowing date	300 grains/m^2	400 grains/m^2	500 grains/m^2
	A	A	A
November, 15th	52.27 a	52.11 a	53.16 a
	A	A	A
November, 30th	44.44 b	43.88 b	44.00 b
	AB	A	B
December, 15th	34.55 c	35.33 c	32.00 c

Table 6-c. Thousand grain weight of wheat plants as affected by the interaction between cultivars and planting densities (combined data)

Planting density Cultivar	300 grains/m^2	400 grains/m^2	500 grains/m^2
	A	A	A
Giza 171	41.88 c	41.77 b	42.77 b
	A	B	B
Sids 12	43.22 b	40.38 c	41.44 c
	B	A	C
Gemmiza 11	46.16 a	49.16 a	44.94 a

Table 7. Grain yield (ton/fad.) of wheat as affected by sowing dates, wheat cultivars and planting densities and their interactions in the two seasons as well as the combined

Main effects and interactions	Grain yield (ton/fed.)		
	2015/2016	2016/2017	Combined
Sowing date(S)			
S_1-November 15th			
S_2-November 30th	3.791 a	4.306 a	4.049 a
S_3-December 15th	3.799 a	2.574 b	3.186 b
F. test	3.256 b	2.187 c	2.722 c
Cultivar (C)	**	**	**
c_1-Giza 171	3.494 c	2.996 b	3.245 b
c_2-Sids 12	3.571 b	2.881 c	3.226 b
c_3-Gemmiza 11	3.781 a	3.189 a	3.485 a
F. test	**	**	**
Planting density(D)			
D_1-300 grains/m^2	3.687 a	2.933 b	3.310 b
D_2-400 grain/m^2	3.579 b	2.938 b	3.259 c
D_3-500 grains/m^2	3.580 b	3.19 a	3.388 a
F.test	**	**	**
Interactions			
S×C	**	**	**
S×D	**	**	**
C×D	**	**	**

Where: *,** and NS indicate significant at 0.05, 0.01 and not significant, respectively.

Stephen *et al.* (2005) Ali *et al.* (2011) and Awoke *et al.* (2017) reported that the light planting density or low seeding rate gave the highest grain yield/unit area as compared with dense planting and high seeding rate. Respecting the significant interaction effects between the studied factors regarding the combined results, the interaction effect between sowing dates and wheat cultivars (Table 7-a) indicated that Gemmiza 11 and Sids 12 cv. appeared to produce the highest grain yield/fad., (4.201 and 4.115 ton, respectively) when were sown early on 15th Nov., while the lowest grain yield/ fad., (2.559 ton) was recorded by Giza 171 cv. when planted late on 15th Dec. The significant interaction effect between sowing dates and planting densities (Table 7-b), the results showed that early sowing on 15th Nov., was obtained the highest grain yield/fad., (4.125 ton) when dense planting of 500 grains/ m^2 was applied, while the lowest one (2.648 ton) was recorded by late sowing on 15th Dec., when middle planting density of 400 grains/m^2 was applied. Finally, the significant interaction effect between wheat cultivars and planting densities (Table 7-c) indicated that Sids 12 and Gemmiza 11 cultivars give the highest grain yield /fad. (3.472 and 3.472 ton, respectively) when dense planting of 500 grain/m^2 was applied. While Giza 171 cv. obtained higher grain yield/fad., (3.363 ton) when light planting density of 300 grain/m^2 was applied. On the other direction, Sids 12 cv. recorded lower grain yield/fad., when either light or middle planting densities were used.

Table 7-a. Grain yield (ton/fad.) of wheat plants as affected by the interaction between sowing dates and cultivars (combined data)

Sowing date \ Cultivar	Giza 171	Sids 12	Gemmiza 11
	A	A	A
November, 15th	3.830 a	4.115 a	4.201 a
	A	B	AB
November, 30th	3.347 b	2.918 b	3.294 b
	B	AB	A
December, 15th	2.559 c	2.647 c	2.961 c

Table 7-b. Grain yield (ton/fad.) of wheat plants as affected by the interaction between sowing dates and planting densities (combined data)

Sowing date \ Planting density	300 grains/m^2	400 grains/m^2	500 grains/m^2
	B	B	A
November, 15th	4.003 a	4.018 a	4.125 a
	B	B	A
November, 30th	3.158 b	3.110 b	3.292 b
	A	B	A
December, 15th	2.769 c	2.648 c	2.748 c

Table 7-c. Grain yield (ton/fad.) of wheat plants as affected by the interaction between cultivars and planting densities (combined data)

Cultivar / Planting density	300 grains/m^2	400 grains/m^2	500 grains/m^2
	A	B	B
Giza 171	3.363 b	3.152 b	3.222 b
	B	B	A
Sids 12	3.116 c	3.092 b	3.472 a
	A	A	A
Gemmiza 11	3.452 a	3.533 a	3.472 a

REFERENCES

Abbas, R.N., A. Tanveer, A. Ali and Z.A. Zaheer (2010). Simulating the effect of emex australis densities and sowing dates on agronomic traits of wheat. Pak. J. Agric. Sci., 47 (2): 104-110.

Abd El-Hameed, I.M. (2012). Response of four new bread wheat (*Triticum aestivum* L.) cultivars to nitrogen fertilizer levels under sprinkler irrigation system in sandy soils. Egypt. J. Gron., 3-4 (1): 1-17.

Abd El-Khalek, A.A., R.Kh. Darwesh, M.A.M. El-Mansoury (2015) .Response of some wheat varieties to irrigation and nitrogen fertilization using ammonia gas in North Nile Delta regionl. Ann. Agric. Sci., 60 (2): 245-256 .

Abd El-Lattief, E.A. (2014). Determining the optimization seeding rate for improved productivity of wheat under Southern Egypt conditions. Int. J. Agron. and Agric. Res., 4 (1): 47-57 .

Abd El-Razek, U.A. and A.A. El-Sheshtawy (2013). Response of some wheat varieties to bio and mineral nitrogen fertilizers. Asian J. Crop Sci., 5: 200-208.

Abdel Nour, N.A.R. and H.S.A. Fateh (2011). Influence of sowing date and nitrogen fertilization on yield and its components in some bread wheat genotypes. Egypt. J. Agric. Res., 89 (4) 1413-1434.

Aftab, W., H.N. Abid, A. Ahmad, M. Rafiq, A.R. Goheer and M. Ibrahim (2004). Effect of sowing date and plant density on growth, light interception and yield of wheat under semi arid conditions. Int. J. Agric. and Bio., 6 (6): 1119–1123.

Ahmed, B.E.A.M., A.I. Adam, M.K. Hassan and M.O. Ahmed (2017). Response of two wheat cultivars (*Triticum aestivum* L.) to amended nitrogen fertilizer on yield and grain quality in halfa elgadidah area. MOJ Biol. Med., 1 (5): 00029.

Alam, Md.P., S. Kumar, N. Ali, R.P. Manjhi (2013). Performance of wheat varieties under different sowing dates in Jharkhand. J. Wheat Res., 5 (2): 61-64.

Ali, A.G.A., O.E. Zeiton, A.H. Bassiauny and A.R.Y.A. El-Banna (2004). Productivity of wheat cultivars grown at El khattara and El aarish under different levels of planting densities and N-fertilization. Zagazig J. Agric. Res., 31 (4A):.1225-1256.

Ali, A.G., M. Laghar, F.C. Oad, T. Shamasuddin, Q. Chachar, A. Gandahi, M.S. Hussain and W.U. Syed (2011). Growth and yield attributes of wheat at different seed rate. Sarhad J. Agric., 27 (2): 177-184.

Amal, G.M.A., A.O. Mohsen, I.N. Ali and Sh.E. Sami (2016). Effect of sowing date and nitrogen fertilization level on growth and productivity of some durum and bread wheat varieties . Alex. Sci. E. J., 37 (4): 541-549.

Amin, E.H.M. (2010). Agronomic practices affecting growth and productivity of certain wheat cultivars in the new cultivated soils. Ph. D. Thesis, Fac. Agric, Zagazig Univ., Egypt.

Ashmawy, F. and A.M.A. Abo-Warda (2002). Response of some wheat cultivars to different seeding rates and nitrogen fertilization levels in sandy soil. Egypt. J. App. Sci., 17 (10) :136-157.

Awoke, T., T. Yoseph and M. Mitiku (2017). Effect of sowing methods and seed rate on yield of bread wheat (*Triticum aestivum* L.) at South aric district, South omo zone, Snnpr, Ethiopia. Int. J. Res. G., 5 (6): 175-181.

Costa, R., N. Pinheiro, A.S. Ameida, C. Gomes, J. Coutinho, J. Coco, A Costa and B. Nacas (2013). Effect of sowing date and seeding rate on bread wheat yield and test weight under Mediterranean conditions. Emir. J. Food Agric., 25: 951-961 .

El-Gizawy, N.K.B. (2005). Yield and nitrogen efficiency as influenced by rates and sources of nitrogen fertilization of some wheat varieties. Proc. 11th Conf. Agron., Agric. Dept., Fac. Agric., Assiut Univ., Egypt.

El-Gizawy, N. (2009). Effect of planting date and fertilizer application on yield of wheat under no till system. World J. Agric. Sci., 5: 777-783.

El-Lethy, S.R., M.T. Abd El-Amid and F. Reda (2013). Effect of potassium application on wheat (*Triticum aestivum* L,) Cultivars crown under salinity stress. World App1. Sci. J., 26 (7): 840-850.

El-Nakhlawy, F.S., A. Fahad and Z.I. Muhammad (2015). Response of wheat genotypes to planting dates in the arid region. Sci. Agric., 10 (2) : 59-63 .

Eslami, H., H. Najafi Navae, A.R. Alazmani and A.N. Shojaei (2014). Effect of sowing dates and seeding density on yield of wheat (*Triticumm aestivum* L.). Int. Res. J. Appl. Basic. Sci., 8 (7): 836-838.

Fadel, A.A.H., A.Y.A. El-Bana, A.E.A. Omar and M.E.I. Abdul Hamid (2016). Response of some wheat cultivars to varying sowing dates and nitrogen fertilization levels under sandy soil conditions. Zagazig J. Agric Res., 43 (1): 29-48.

Farooq, U., E.A. Kan, A.B. Khakwani1, S. Ahmed, N. Ahmed and G. Zaman (2016). Impact of sowing time and seeding density on grain yield of wheat variety gomal. Asian J.Agri. Biol., 4(2): 38-44 .

FAOSTAT (2017). Food and Agricultural Organization of the United Nations (FAO), FAO Statistical Database, http:// faostat3. fao.org/ download/Q/QC/E.

Fayed, T.B., I. Eman, M.K. Hassanein and A. Magdy (2015). Evaluation and prediction of some wheat cultivars productivity in relation to different sowing dates under North Sinai region conditions. Ann. Agric. Sci., 60 (1): 11-20.

Geith, E.M.S., O.Z. El-Badry and S.A. Wahid (2013). Response of growth and straw yield of some wheat genotypes to sowing dates and nitrogen levels. Zagazig J. Agric. Res., 40 (5): 176-181 .

Ghorbani, M.H. and M. Basiri (2013). Plant density effect on growth and seed yield of wheat in saline soils and rain fed condition. Electronic J. Crop Prod., 6 (2): 57 - 72.

Gomez, K.N. and A.A. Gomez (1984). Statistical Procedures for Agricultural Res., John Wiley and Sons, New York, 2nd Wd. 68.

Gul, H., B. Saeed, A.Z. Kan, U. Latif, K. Ali, J. Rehman, S. -ur-Rehman (2012). Yield and yield contributing traits of wheat cultivars in relation with planting dates and nitrogen fertilization. ARPN J. Agric. and Bio. Sci., 7 (6): 386-396.

Hafez, E.M., S.H. AbouKhadrah, S. Gh, R. Sorour and A.R. Yousef (2012). Comparison of agronomic and physiological nitrogen use efficiency in three cultivars of wheat as affected by different levels of N-sources. Proceedings of the 13th Int. Econ. Conf., Fac. Agric., Benha Univ., Egypt.

Hozayn, M. and A.A. Abd El-Monem (2010). Alleviation of the potential impact of climate change on wheat productivity using arginine under irrigated Egyptian agriculture Options MØditerranØennes, A., 95-100.

Hussain ,I.; M.A. Kan and K. Ahmed (2003) .Effect of row spacing on the grain yield and the yield components of wheat (*Triticum aestivum*). Pak. J. Agron., 2 (3) :153-159.

Isabelle, D., A. Vanasse, D. Pageau and Y. Dion (2015). Seeding rate and cultivar effects on yield, yield components and grain quality of spring spelt in eastern Canada Canadian. J. Plant Sci., 95(5): 841-849.

Jat, L.K., S.K. Singh, A.M. Latare, R.S. Singh and C.B. Patel (2013). Effect of dates of sowing and fertilizer on growth and yield of wheat (*Triticum aestivum*) in an Inceptisol of Varanasi Indian. J. Agron., 58 (4): 611-614.

Kandil, A.A., M.H. El-Hindi, M.A. Badawi, S.A. El-Morarsy and F.A.H. Kalboush (2011). Response of wheat to rates of nitrogen, biofertilizers and land leveling. Crop Environ., 2: 46-51 .

Kenarsari, J., S. Ali and A. Ali (2014). Influence of sowing density, nitrogen fertilizer level and splitting on yield and yield components of wheat., 5 (3): 25-35.

MSTAT-C. (1991). A microcomputer program for the design, management and analysis of agronomic research experiment. MSTAT Dev. Team, Michign State Univ.

Qasim, M., M. Qamer and M. Alam (2008). Sowing dates effect on yield and yield components of different wheat varieties. J. Agric. Res., 46(2): 135-140.

Radwan, F.I., M.A. Gomaa, M.A.A. Naser and I.F. Mussa (2014). Response of some wheat varieties to humic acid, mineral and biofertilization on productivity and quality. Middle East J. Agric. Res., 3(3): 631-637.

Raheim, N., H.A. Khoshkhabar, A. Mirzaei and K. Nazaralizadeh (2012). Effect of planting density on grain yield, yield components and associated traits of three durum wheat cultivars in Western Iran. Int. J. Agric. and Crop Sci., 4(2): 79-85.

Randhawa, A.S., R.S. Jolly and S.S. Dhillon (1977). Response of wheat and barley to nitrogen and different dates of sowing. Crop Improv., 41 (1):49-64.

Refay, Y.A (2011). Yield and yield component parameters of bread wheat genotypes as affected by sowing dates. Middle-East J. Sci. Res., 7 (4): 484-489.

Saleh, M.E. (2000). Effect of sowing rate and nitrogen level on the productivity of Mexipak -65 wheat cultivar. J. Agric. Sci. Mansoura Univ., 25 (3) :1475-1483 .

Shahzad, M.A., W.U. Din, S.T. Sahi, M.M.K. Ehsanullah and M. Ahmad (2007). Effect of sowing dates and seed treatment on grain yield and quality of wheat. Pak. J. Agric. Sci., 44 (4): 581-583.

Steel, R.G-D., J.H. Torrie and D.A. Dickey (1997). Principles and Procedures of Statistics. Abiometrical Approach. 3rd ED., M, Graw Hill Book Co., New York, USA.

Stephen, R.C., D.J. Saville and E.G. Drewit (2005). Effects of wheat seed rate and fertiliser nitrogen application practices on populations, grain yield components and grain yields of wheat (*Triticum aestivum* L.). New Zealand J. Crop and Hort. Sci., 33: 125-130.

Tahir, M., A. Ali, M.A. Nadeem, A. Hussain and F. Khalid (2009). Effect of different sowing dates on growth and yield of wheat (*Triticum aestivum* L.) varieties in district Jhang, Pak. J. Life Soil Sci., 7: 66-69.

Tomar, S., S. Tomar and S.C.S. Astav (2014). Yield and yield component response of wheat (*Triticum aestivum* L.) genotypes to different sowing dates in Gird region of Madhya Pradesh. Int. J. Farm Sci. 4(2): 1-6.

Waller, R.A. and D.B. Duncan (1969). Abays rule for symmetric multiple comparison problem. J. AM. Stat. Assoc., 64: 1484-1503.

Wally, A.A.E. (2008). Effect of some agronomic practices on growth and yield of some wheat cultivars under nawely reclaimed soil. Ph. D. Thesis, Fac. Agric., Zagazig Univ., Egypt.

Yasin, M.A.T. and A.E.A. Omar (2013). Effect of sowing methods, seeding rate and chemical herbicides on wheat under sandy soil condition. Zagazig J. Agric. Res., 40 (6): 1045-1057.

تأثير ميعاد الزراعة والإختلافات الصنفية والكثافة النباتية على إنتاجية محصول القمح

صفاء محمد حسانين عبد الهادي - أحمد عبد الغني علي
عبد الرحمن السيد أحمد عمر - السيد السيد أحمد السبكي

قسم المحاصيل - كلية الزراعة - جامعة الزقازيق – مصر

أجريت هذه الدراسة في تربة طينية تابعة لمركز ميت غمر محافظة الدقهلية خلال الموسمين الشتويين ٢٠١٦/٢٠١٥ و ٢٠١٧/٢٠١٦، بهدف دراسة تأثير مواعيد الزراعة (١٥ نوفمبر، ٣٠ نوفمبر و١٥ ديسمبر) والأصناف (جيزة ١٧١، سدس ١٢ وجميزة ١١) والكثافة النباتية (٣٠٠، ٤٠٠ و٥٠٠ حبة/م^{٢}) علي محصول القمح ومساهماته، ويمكن تلخيص النتائج المتحصل عليها علي النحو التالي: أدت الزراعة المبكرة في ١٥ نوفمبر إلى زيادة معنوية في كل من ارتفاع النبات، طول السنبلة، عدد حبوب/السنبلة، وزن حبوب السنبلة، وزن الألف حبة وكذلك محصول الحبوب للفدان، لوحظ وجود فروق معنوية لتأثير الإختلافات الصنفية على المحصول ومؤشراته حيث أدى زراعة الصنف جميزة ١١ إلي زيادة ارتفاع النبات، طول السنبلة، وزن حبوب السنبلة، وزن ١٠٠٠ حبة ومحصول الحبوب/فدان، بينما تفوق الصنف جيزة ١٧١ في كل من صفات عدد السنابل/م^{٢} والمحصول الكلي/ فدان، أدى زيادة الكثافة النباتية إلى ٥٠٠ حبة/م^{٢} إلي زيادة معنوية لكل من عدد السنابل/م^{٢} ومحصول الحبوب/ فدان مقارنة بالكثافات الأخرى، حيث حققت الكثافة المنخفضة (٣٠٠ حبة/م^{٢}) أعلي القيم لكل من عدد حبوب السنبلة، وزن حبوب السنبلة، كان هناك تفاعل بين عوامل الدراسة في أغلب الصفات تحت الدراسة، والتي تشير إلى إمكانية معظمة إنتاجية محصول القمح من خلال التبكير في الزراعة خلال منتصف نوفمبر واستخدام الصنف سدس ١٢ أو جميزة ١١ مع زيادة الكثافة النباتية إلي ٥٠٠ حبة/م^{٢}.

المحكمون :
١- أ.د. على عبدالعظيم سرحان أستاذ المحاصيل – كلية التكنولوجيا والتنمية – جامعة الزقازيق.
٢- أ.د. اسمـــاعيـل عبدالحميـد أستاذ المحاصيل – كليــة الـزراعــة – جــامعـــة الــزقــازيـق.