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Effect of Sowing Date on Growth, Accumulated Heat, Yield and Its Components of Some Bread Wheat Genotypes

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Abstract

Field experiment was carried out at Etay El –Baroud Agricultural Research Station during the two successive seasons 2016/ 2017 and 2017/ 2018 to study the effect of four different sowing dates i. e., 1st, 15th, 30th November and 15th December on growth, phenology, growing degree days, yield and its components of eight wheat genotypes i. e., Giza 171, Shandaweel 1, Gemmieza 10, Gemmieza 11, Sids 12, Sids 13, Line 3 and Line 4. Significant differences were detected among the studied sowing dates, where; the first sowing date gave the heaviest shoot dry weight and the highest leaf area index at 50, 65 and 80 days in the two studied seasons. The highest value of CGR at 50-65 days at the first sowing date in the first season, also CGR and NAR achieved the highest values at 65-80 days from sowing at 30 November in the second season and at 15 December in the first season. Number of days taken to emergence, tillering and jointing were gradually reduced with wheat planting from 15 December to 1 November, however, number of days to maturity was gradually increased. Moreover life cycle of wheat gradually decreased with delayed planting. Sowing date at 1st of November achieved the highest values of GDD in tillering, jointing, booting, heading and maturity, while sowing date at 15th December achieved lowest values of GDD in both studied seasons. The highest chlorophyll content, heat use efficiency, harvest index and heaviest biological and grain yield/ fed were obtained at sowing date 30 November in the two studied seasons. Tested wheat genotypes significantly difference, where Gemmieza 11 cultivar and Line 4 had the heaviest shoot dry weight and highest leaf area index at 50, 65 and 90 days in both seasons. Moreover, at 80-95 days Giza 171 gave the superiority for net assimilation rate in both seasons and for crop growth rate in the second season only, also at 50-65 days Line 3 and 65- 80 days Line 4 gave the highest value of CGR in the first season. Moreover, maximum days and accumulated GDD detected for Giza 171 at jointing stage and Line 4 at maturity in the two seasons. Giza 171 gave the highest value for chlorophyll content and 1000- kernel weight in both seasons and HUE, plant height and harvest index in the first season, while biological yield in the second season. The highest number of tillers/m^2 was recorded in Sids 13 cultivar and spike length for Gemmieza 11 in both studied seasons. Also, Line 3 had the highest biological yield in the first season and Line 4 for HI in the second season. The interaction between sowing dates and genotypes had significant, where; in most cases, delayed sowing (15 December) had adverse effects on shoot dry weight, leaf area index, crop growth rate, net assimilation rate, phenological stages and growing degree days but the intensity varied among wheat genotypes. Sustaining the growth in late sown conditions of Shandaweel 1, Giza 171, Line 3 and Line 4 was clear indication of its adaptability measures to terminal heat stress. Planting of Giza 171, Gemmieza 11 and Line 4 on 15 or 30 November seemed the most productive combination. The finding of this investigation may help both physiologists and breeders in determining the sowing dates and genotypes could be selected for good growth and high yield.

Key words: Crop growth rate, Genotypes, Growing degree days, Net assimilation rate, Phenology, Sowing date, Wheat, Yield.

Introduction

Wheat (*Triticum aestivum* L.) is considered an important cereal crop in the world. It used as human food and animal feed. Accounting for a fifth of humanity's food, wheat is second after rice as a source of calories in the diets of consumers in developing countries and is first as a source of protein **(Braun *et al*., 2010)**. The nutritional value of wheat is extremely important and it supplies more calories, protein, dietary fiber, B- group vitamins and minerals to the diet of world's population than any other cereal crop **(Hussain *et al*., 2015)**. Plant growth and development of cereals can be divided into three major phases **(Snape *et al*., 2001 and Gonzalez *et al*., 2002)**, the first being the vegetative period from germination to intensive stem elongation, the second the generative period from intensive stem elongation to heading and the third the grain filling period from heading to physiological maturity.

Sowing dates is one of the most important agronomic factors involved in producing high yielding grain cereal crops, which affects the timing and duration of vegetative and reproductive stages **(El-Sarag and Ismaeil, 2015)**. At optimum sowing date positively impacts the grain yield and baking quality of wheat, causing better adjustment to the physiology, phenology and environmental conditions **(Ribeiro *et al*., 2009)**. In addition, the optimum sowing date also affects the water, temperature and solar radiation available for the crop **(Silva *et al*., 2014)**. Also, **Abdel Nour and Fateh (2011)** found that days to heading and maturity, plant height, number of spikes/m^2, number of kernels/spike, 1000-

kernel weight, biological yield and grain yield were significantly highest in the optimum date compared to the late and early dates of planting.

Under optimal conditions, 80 to 90% of the carbohydrates translocate to the wheat grain are assimilates from current photosynthesis and 10 to 20% from the plant's reserve **(Spiertz and Vos, 1985).** However, under stress conditions such as drought and high temperature, crops do not translocate carbohydrates to grain because in this situation the crop basically survives without production **(Hall, 2001)** and resource allocation **(Martiniello and Teixeira da Silva, 2011).**

Temperatures more than optimum accelerates developmental processes in wheat and further reduction in yield may occur due to increasing photorespiration in C3 plant species **(Polley, 2002)**. Temperature is a modifying factor in all stages of wheat development including germination, tillering, booting, ear emergence, anthesis and maturity since it can influence the rate of water supply and other substrates necessary for growth, but varies with plant species, variety and phonological stages **(Wahid *et al*., 2007).** Reproductive phases like booting, fertilization and gametogenesis (8-9 days before anthesis) are most sensitive to high temperature in various plants **(Tarchoun *et al*., 2012).** Accordingly, further increase in grain yield should be achieved by developing new cultivars with higher dry matter at anthesis and maturity, while maintaining high values of the harvest index **(Zhou *et al*., 2014).**

Too early sowing produces weak wheat plants with poor root system. In addition, during too early sowing the temperature is above the optimum, which deals to irregular germination caused by frequent death of embryos and decomposition of endosperm due to bacteria or fungi **(Abdel Nour and Fateh, 2011)** and chance of running out from moisture stress at later growth stages **(Ahmed and Farooq, 2013).** In most cases, delaying sowing date after the optimal period can result in changed environmental conditions during grain filling, exposing grain growth and filling to water deficit and high air temperatures **(Ferrise *et al*., 2010).** Delayed sowing often leads to the shortening the period until anthesis and plants enter the reproductive stage earlier and face a shortage of photosynthetic resources **(Foulkes *et al*., 2004).** Wheat required 68 to 90 days for grain formation, but late planted wheat manifested severe reduction in number of days to complete grain formation due to short life cycle and high temperature at reproductive stage **(Slafer and Whitechurch, 2001 and Sial *et al*., 2005).**

Due to an increasing trend of rising temperatures around the world, wheat may be exposed to greater thermal stress in the near future. Therefore, the identification and development of suitable wheat genotypes is an important step to resolve this threat to production and to achieve high yield, even under high temperature stress. Therefore, the aim of the study is determining optimum sowing date according to environmental conditions and wheat genotypes to increase growth, yield and quality traits of grains.

Materials and Methods

Field experiment was carried out at Etay El-Baroud Agricultural Research Station, El- Behera governorate (30º 89'E, 30º 65' N) during 2016/2017 and 2017/2018 seasons to study the effect of four different sowing dates i. e., 1st ,15th and 30th of November as well as 15th of December on eight of wheat genotypes i.e. , Giza 171, Shandaweel 1 , Gemmieza 10 , Gemmieza 11 Sids 12 , Sids 13 , Line 3 and Line 4 and their interactions on growth, phenology, growing degree days, yield and its components.

Table 1. The Code number, name, pedigree and selection history of the studied parental bread wheat cultivars and lines.

Code No.	Name	Pedigree and selection history
P1	Giza 171	Sakha 93 /Gemmieza 9. GZ2003 –101-1GZ - 4GZ –1GZ - 2GZ - 0GZ.
P2	Shandweel 1	Site / MO/4 /Nac/th.Ac.//3*pvn/3/Mir L0/Buc. Cmss93Boos 67s-72Y-010M-010Y-010M-3Y-0M-0THY-0SH.
P3	Gemmeiza10	MAYA74"S"/ON//1160-147/3/BB/GLL/4/CHAT"S"/5/CROW"S"
P4	Gemmeiza11	BOW"S"/KVS"S"//7C/SERI82/3/GIZA168/SAKHA61 GM-7892-2GM-1GM2GM-1GM-0GM
P5	Sids12	BUC//7C/ALD/5/MAYA74/ON//1160-147/3/BB/GLL/4/CHAT"S"/6/MAYA/VUL//CMH74A.630/4*SX. SD7096-4SD-1SD-0SD
P6	Sids13	ALMAZ.19=KAUZ"S"//TSI/SNB"S" IICSBW1-0375-4AP-2AP-030AP-0APS-3AP-0APS-050AP-0AP-0SD
P7	Line 3	BABAX/LR42//BABAX*2/4/SNI/TRAP#1/3/KA//I*2/TRAP//KAAUZ.
P8	Line 4	CGSS0/B00045T-099Y-099M-099Y-099M-40Y-0B-0ET.

A split plot design with three replications was used. Sowing dates were randomly allotted in main plot, while wheat genotypes in sub plot. Plot size was 2 x 3.5 m. Ploughing two times and leveling were practiced before sowing dates. All wheat genotypes were sown on well prepared seedbed as aforementioned sowing dates. Sowing was done by hand drill keeping. Seed rate was 60 kg / fed. Phosphorus fertilizer in form of superphosphate (15.5 %) applied at 31 kg P_2O_5 during soil preparation. Nitrogen fertilizers in form of urea (46.5 %) applied in two doses, one half after 21 days from sowing and the rest after 21 days later. All practices were done as recommended during the two investigated seasons.

Growth parameters

Estimation of shoot dry weight and leaf area index from 20 x 20 cm in each plot samples were collected randomly at 50, 65, 80 and 95 days after sowing. Samples were oven dried at 70 C to constant weight. Leaf area index (LAI), crop growth rate (CGR) and net assimilation rate (NAR) was estimated according to **Hunt (1990)** formulas.

Chlorophyll content

About 0.5 g fresh weight of mixed leaves was homogenized in 5 ml of 85% cold acetone and centrifuged. The extract was diluted to the appropriate volume before the optical density was measured at 663 and 647 nm **(Metzener *et al.*, 1965)**. The following equations were applied to calculate chlorophyll content of the samples as mg/g fresh weight at 80 days old.

Chlorophyll a= 11.79 E_{663} – 2.29 E_{647}

Chlorophyll b= 20.05 E_{647} – 4.77 E_{663}

Phenological stages, growing degree days and heat use efficiency

When the first seedling got emerged, it was recorded as days to start emergence. The days on which 50 % seedling switched into tillering, jointing and booting stage were recorded as days to start tillering, jointing and booting stages. Calculate number of days to maturity. The growing degree days (GDD) were calculated from mean daily temperature (^{0}C) and base temperature as:

GDD = (Tmax +Tmin)/ 2 – Tb (Where Tb= 4.5 ^{0}C)

Where Tmax and Tmin represented the maximum and minimum temperature and Tb denotes the base temperature **(Ahmed and Farooq, 2013).** Weather data from planting to harvest were collected from meteorological Station at Etay El- Baroud Agricultural Research Station (Table 2).

Table 2. Temperature (^{0}C) and rainfall (mm) during the wheat growing period in 2016/2017 and 2017/2018 seasons.

Month	2016 /2017				2017 /2018			
	Max. T	Min. T	Mean	Total rainfall	Max. T	Min. T	Mean	Total rainfall
Nov.	20.23	12.97	16.60	89	23.57	13.87	18.72	18
Dec.	18.77	10.74	14.76	73	21.26	13.36	17.31	67
Jan.	17.22	8.42	12.82	36	18.77	10.74	14.76	73
Feb.	18.75	9.79	14.27	8	21.14	11.59	16.37	26
Mar.	21.07	13.65	17.36	4	24.39	13.81	19.10	4
Apr.	25.93	14.87	20.40	-	27.37	15.80	21.59	4
May	28.63	19.93	24.28	-	30.97	20.42	25.70	-

Accumulated GDD for different phenophases were calculated by summation of daily GDD of each developmental stage. Heat use efficiency (HUE) was computed using the below given formulae:

HUE= Grain yield/Accumulated GDD (^{0}C day)

Yield and yield components

At harvest five plants were randomly taken from each sub- plot to estimate plant height, number of tillers, spike length, number of kernels/spike and 1000 - kernel weight. Also, grain and biological yield were determined. The harvest index (HI) was calculated as a ratio between grain yield and biological yield.

Statistical analysis

The collected data were statistically analyzed using Fisher's analysis of variance technique and LSD test at 5 % probability level was used to compare the differences among treatments means (**Steel *et al.*, 1997**).

Results and Discussion

Growth parameters

Data present in Table (3a) revealed that, shoot dry weight was significantly affected by sowing dates during the two growing seasons at 50, 65, 80 and 95 days after sowing (DAS). The first sowing date gave the heaviest shoot dry weight at 50, 65 and 80 days in the two studied seasons. These results were in agreement with those of **Andarzian *et al*. (2014),** who reported that, plants from earlier sowing produced more aboveground dry matter. Similar trend observed for shoot dry weight at 30 November (34.41 g) in the second season and 15 December (45.50 g) in the first season where the highest value achieved at 95 days from sowing. **Mirosavljevic *et al.* (2015)** fond that delayed sowing dates reduced dry matter remobilization and contribution of vegetative dry matter to grain yield.

The obtained results indicated that, shoot dry weight was significantly affected by different genotypes in the two studied seasons, where Gemmieza 11had the heaviest shoot dry weight (4.75 and 4.10 g) at 50 (DAS) in the two seasons, respectively, also it the first (17.20 g) in the second season, besides Line 4 (24.44 g) in the first season at 80 (DAS). It's important to clear that Line 4 achieved superiority at 65 and 95 days in the two seasons.

Table 3a. Effect of sowing dates and wheat genotypes on shoot dry weight during 2016/2017 and 2017/2018 seasons.

Treatment	Shoot dry weight (g)							
	2016/2017				2017/2018			
	50 days	65 days	80 days	95 days	50 days	65 days	80 days	95 days
Sowing dates								
1/11	6.71^{a}	12.92^{a}	22.68^{a}	40.42^{b}	5.81^{a}	11.42^{a}	19.19^{a}	33.04^{a}
15/11	2.81^{b}	5.47^{c}	11.92^{b}	28.36^{c}	2.50^{d}	4.95^{b}	11.33^{c}	26.0^{b}
30/11	3.43^{d}	8.62^{b}	20.63^{a}	39.67^{b}	3.45^{b}	5.11^{b}	17.10^{b}	34.41^{a}
15/12	3.11^{c}	8.40^{b}	22.48^{a}	45.50^{a}	2.97^{c}	4.86^{b}	10.68^{c}	31.48^{a}
$LSD_{0.05}$	0.28	1.15	1.89	3.14	0.33	0.30	1.0	3.05
Genotypes								
Giza 171	3.74^{b}	7.56^{b}	17.48^{bc}	39.19^{b}	3.18^{b}	5.66^{c}	11.55^{d}	32.09^{ab}
Shandaweel 1	3.88^{b}	8.66^{b}	19.74^{b}	40.72^{b}	3.25^{b}	6.15b^{c}	13.38^{c}	27.22^{b}
Gemmieza 10	4.07^{b}	7.49^{b}	15.36^{c}	35.04^{b}	4.05^{a}	6.10b^{c}	13.60b^{c}	31.41^{ab}
Gemmieza 11	4.75^{a}	9.40^{a}	19.09^{b}	37.83^{b}	4.10^{a}	7.28^{a}	17.20^{a}	35.12^{a}
Sids 12	3.70^{b}	8.72^{ab}	19.45^{b}	36.33^{b}	3.66^{ab}	6.81^{ab}	16.68^{ab}	31.16^{ab}
Sids 13	4.15^{b}	8.84^{ab}	20.66^{b}	35.53^{b}	3.83^{a}	6.44^{b}	13.26^{cd}	28.68^{b}
Line 3	4.09^{b}	9.72^{a}	19.23^{b}	36.58^{b}	3.56^{ab}	6.91^{ab}	15.27^{b}	28.81^{b}
Line 4	3.74^{b}	10.41^{a}	24.44^{a}	46.65^{a}	3.83^{a}	7.32^{a}	15.66^{ab}	35.36^{a}
$LSD_{0.05}$	0.48	1.26	2.50	5.39	0.40	0.63	1.78	3.77

Means in the same column followed by the same letter (s) were not significantly different according to $LSD_{0.05}$ values.

As for the interaction between sowing dates and wheat genotypes, data in Table (3b) showed that, significantly effect on shoot dry weight (7.35,15.53 and 21.58 g) at 50 and 65 days in the first season and at 80 days from sowing in the second season resulted from Sids 12 at the first sowing date. At 15 December, the superiority for Line 4 (34.96 and 66.86 g) at 80 and 95 days in the first season and Line 3 (12.39 g) at 65 days from sowing in the second season only at the first sowing date, however **Mirosavljevic *et al*. (2018)** reported that dry matter production is one of the best indicators of crop response to the influence of genotypic and environmental factors.

Data presented in Table (4a) pointed out that leaf area index (LAI) was significantly affected by sowing dates during the two investigated seasons at 50, 65, 80, and 95 days (DAS) whereas, the highest value achieved from the earliest sowing date (1/11). Similar results are in agreement with **(Dalirie *et al*., 2010)** who reported that, the maximum value of total dry matter was obtained for the maximum value of leaf area index of wheat at the first sowing date. The increasing in leaf area index is one of the ways of increasing the capture of solar radiation within the canopy and production of dry matter.

Data cleared that, genotypes had significant effect on leaf area index, where Gemmieza 11 cultivar achieved maximum LAI at 50 days (1.99 and 1.68) after sowing in the 1st and 2nd seasons and at 65 and 95 (2.57 and 8.77) in the second season, while Line 4 and Sids 13 (4.16 and 6.72) significantly surpassed at 65 and 80 days after sowing in the 1st season, whereas Sids 12 (4.63) at 80 days after sowing and Gemmieza 11 (8.77) at 95 days after sowing in the second season. Wheat genotypes had different responses to leaf area index **(Dalirie *et al*., 2010).** Concerning the interaction effect, data presented in Table (4b) cleared that LAI was significantly affected by the interaction between sowing dates and wheat genotypes in the two studied seasons. Gemmieza 11, Shandaweel 1 and Gemmieza 10 gave highest value (2.79) of LAI at 1st November at 50 days' after sowing date in the first season, while Shandaweel 1 (5.44 and 13.39) and Line 4 at 95 (DAS) surpassed at 15 December in the first season at 65 and 95 days and at 1 November at 65 days (5.26) after sowing in the second season. In this respect Line 3 and Giza 171 significantly surpassed in the 1st November at 80 and G. 171 at 95 days in the second season. It's important to clear that Sids 13 (8.30) and Line 4 (13.11) achieved superiority in 30 November and 15th December at 80 and 95 days, respectively, in the 1st season. The results, on the other hand agreed with the findings of **Ahmed and Farooq (2013)** who reported that delayed sowing puts adverse effects with respect to leaf area index but the intensity varied among varieties.

Table 3b. Effect of sowing dates and wheat genotypes interactions on shoot dry weight in 2016/2017 and 2017/2018 seasons.

Sowing dates	Genotypes	Shoot dry weight (g)					
		2016/2017				2017/2018	
		50 days	65 days	80 days	95 days	65 days	80 days
1/11	Giza 171	6.62^{c-e}	13.02^{b-d}	25.70^{cd}	42.75^{di}	10.91^{cd}	20.97^{ab}
	Shandaweel 1	5.96^{f}	13.36^{b}	22.63^{e-h}	44.37^{cq}	11.90^{ab}	18.83^{cd}
	Gemmieza 10	7.22^{ab}	10.69^{fg}	16.65^{l-n}	49.30^{cd}	10.49^{d}	15.40^{fg}
	Gemmieza 11	7.11^{a-c}	11.40^{ef}	23.39^{d-q}	36.74^{qn}	11.07^{cd}	18.72^{cd}
	Sids 12	7.35^{a}	15.53^{a}	24.49^{c-f}	34.36^{jp}	12.14^{ab}	21.58^{a}
	Sids 13	6.82^{b-d}	13.22^{bc}	22.59^{e-h}	34.94^{lp}	11.46^{bc}	17.72^{de}
	Line 3	6.38^{d-f}	13.68^{b}	22.01^{f-i}	32.67^{kq}	12.39^{a}	21.00^{ab}
	Line 4	6.25^{ef}	12.52^{b-e}	23.98^{d-f}	48.25^{ce}	11.00^{cd}	19.40^{bd}
15/11	Giza 171	1.96^{o}	3.96^{o}	8.47^{r}	24.46^{q}	3.61^{l}	7.70^{lm}
	Shandaweel 1	2.57^{l-o}	4.38^{no}	9.28^{qr}	24.60^{q}	3.87^{kl}	9.04^{kl}
	Gemmieza 10	3.41^{ik}	5.87^{l-o}	13.38^{n-q}	28.31^{n-q}	5.08^{gi}	11.37^{hk}
	Gemmieza 11	2.93^{j-n}	7.77^{i-l}	14.41^{m-o}	30.84^{m-q}	6.62^{ef}	13.35^{gh}
	Sids 12	2.38^{m-o}	4.64^{n-o}	13.49^{n-q}	31.79^{lq}	4.40^{il}	13.02^{hi}
	Sids 13	2.73^{k-o}	5.17^{m-o}	12.83^{o-r}	27.94^{oq}	4.97^{hk}	12.61^{hi}
	Line 3	3.23^{j-m}	5.54^{m-o}	9.88^{p-r}	27.17^{pq}	5.21^{gi}	10.34^{jl}
	Line 4	3.28^{j-l}	6.45^{k-n}	13.66^{n-p}	31.77^{lq}	5.85^{fg}	13.16^{gh}
30/11	Giza 171	3.65^{ij}	5.06^{m-o}	16.63^{l-n}	41.71^{ei}	4.16^{il}	11.95^{hi}
	Shandaweel 1	2.40^{l-o}	6.45^{k-n}	17.82^{j-m}	36.52^{ho}	3.65^{l}	17.58^{de}
	Gemmieza 10	3.18^{j-n}	8.65^{il}	16.79^{k-n}	32.38^{kq}	4.51^{il}	17.48^{df}
	Gemmieza 11	4.53^{g-h}	11.60^{d-f}	20.19^{h-j}	47.89^{cf}	7.02^{c}	20.13^{ac}
	Sids 12	2.31^{no}	8.12^{j-k}	19.38^{i-k}	40.48^{fk}	6.40^{ef}	21.60^{a}
	Sids 13	4.91^{q}	9.06^{hi}	27.19^{bc}	43.60^{dh}	4.53^{il}	11.51^{hk}
	Line 3	4.22^{hi}	9.26^{gi}	21.93^{f-i}	35.02^{ip}	4.31^{il}	16.63^{ef}
	Line 4	2.31^{no}	10.78^{fk}	25.17^{c-e}	39.76^{gl}	6.31^{ef}	19.98^{ac}
15/12	Giza 171	2.73^{k-o}	8.23^{i-k}	19.12^{i-l}	47.85^{cf}	3.98^{jl}	5.54^{m}
	Shandaweel 1	4.62^{gh}	10.47^{f-h}	29.24^{b}	57.42^{b}	5.19^{gi}	8.10^{lm}
	Gemmieza 10	2.51^{l-0}	4.75^{m-o}	14.61^{m-o}	30.16^{nq}	4.33^{il}	10.16^{jm}
	Gemmieza 11	4.44^{gh}	6.85^{j-m}	18.39^{j-l}	35.86^{hp}	4.42^{il}	16.63b^{il}
	Sids 12	2.79^{k-o}	6.62^{k-n}	20.46^{g-i}	38.72^{gm}	4.31^{il}	10.54^{ef}
	Sids 13	2.81^{k-o}	7.94^{i-k}	20.04^{h-k}	35.66^{ip}	4.81^{hl}	11.24^{il}
	Line 3	2.53^{l-o}	10.43^{f-h}	23.10^{d-h}	51.48b^{bc}	5.76^{fg}	13.16^{hk}
	Line 4	3.12^{j-n}	11.92^{c-f}	34.96^{a}	66.86^{a}	6.12^{eg}	10.12^{gh}
$LSD_{0.05}$		0.97	2.53	5.02	10.80	1.27	3.57

Means in the same column followed by the same letter (s) were not significantly different according to $LSD_{0.05}$ values.

Table 4a. Effect of sowing dates and wheat genotypes on leaf area index (LAI) during 2016/2017 and 2017/2018 seasons.

Treatment	Leaf area index (LAI)							
	2016/2017				2017/2018			
	50 days	65 days	80 days	95 days	50 days	65 days	80 days	95 days
Sowing dates								
1/11	2.44^{a}	4.51^{a}	6.79^{a}	9.69^{a}	2.38^{a}	4.34^{a}	6.20^{a}	9.17^{a}
15/11	1.14^{b}	2.06^{c}	4.24^{c}	6.88^{c}	0.95^{c}	1.83^{b}	3.62^{b}	6.56^{c}
30/11	1.27^{b}	2.72^{b}	6.15^{b}	8.33^{b}	1.19^{b}	1.54^{c}	3.78^{b}	5.69^{d}
15/12	1.32^{b}	4.01^{b}	6.55^{ab}	10.12^{a}	1.27^{b}	1.82^{b}	3.17^{c}	7.88^{b}
$LSD_{0.05}$	0.16	0.38	0.41	0.55	0.10	0.13	0.31	0.48
Genotypes								
Giza 171	1.38^{b}	3.09^{c}	5.52^{bc}	8.65^{ab}	1.20^{c}	2.10^{b}	3.64^{b}	7.54^{b}
Shandaweel 1	1.67^{b}	3.79^{ab}	6.0^{b}	9.20^{ab}	1.42^{b}	2.52^{a}	4.0^{ab}	6.27^{c}
Gemmieza 10	1.59^{b}	2.94^{c}	5.25^{c}	7.43^{c}	1.15^{ab}	2.15^{b}	3.95^{ab}	7.70^{b}
Gemmieza 11	1.99^{a}	3.57^{b}	5.04^{c}	8.40^{b}	1.68^{a}	2.57^{a}	4.52^{a}	8.77^{a}
Sids 12	1.33^{b}	3.41b^{c}	6.51^{ab}	8.79^{ab}	1.34b^{c}	2.30^{ab}	4.63^{a}	6.32^{c}
Sids 13	1.35^{b}	3.85^{ab}	6.72^{a}	9.21^{ab}	1.43^{b}	2.35^{ab}	3.73^{b}	7.08^{bc}
Line 3	1.50^{b}	3.79^{ab}	5.96^{b}	8.75^{ab}	1.51^{ab}	2.52^{a}	4.58^{a}	7.10^{bc}
Line 4	1.51^{b}	4.16^{a}	6.42^{ab}	9.77^{a}	1.48^{ab}	2.55^{a}	4.51^{a}	7.80^{b}
$LSD_{0.05}$	0.22	0.47	0.58	0.84	0.15	0.21	0.47	0.86

Means in the same column followed by the same letter (s) were not significantly different according to $LSD_{0.05}$ values.

Table 4b. Effect of sowing dates and wheat genotypes interactions on leaf area index (LAI) in 2016/2017 and 2017/2018 seasons.

Sowing dates	Genotypes	Leaf area index (LAI)							
		2016/2017				2017/2018			
		50 days	65 days	80 days	95 days	50 days	65 days	80 days	95 day
1/11	Giza 171	1.78^{b}	4.82^{ab}	7.96^{ab}	10.37^{be}	1.67^{d}	4.18^{cd}	6.81^{ab}	9.69^{ab}
	Shandaweel 1	2.69^{a}	5.40^{a}	7.39^{ab}	10.36^{be}	2.49^{b}	5.26^{a}	6.65^{b}	8.84^{cd}
	Gemmieza 10	2.75^{a}	4.09^{b}	5.52^{hm}	9.34^{fg}	2.79^{a}	4.09^{cd}	5.49^{ce}	8.57^{cd}
	Gemmieza 11	2.79^{a}	4.26^{b}	5.87^{fk}	9.78^{df}	2.75^{a}	4.12^{cd}	5.67^{cd}	9.65^{ab}
	Sids 12	2.18^{b}	4.71^{ab}	8.22^{a}	9.16^{bc}	2.32^{b}	4.49^{b}	6.63^{cb}	8.76^{cd}
	Sids 13	2.44^{ab}	4.37^{b}	5.80^{hk}	9.33^{fg}	2.24^{c}	4.26^{cd}	5.24^{de}	9.26^{ad}
	Line 3	2.47^{ab}	4.27^{b}	7.25^{bd}	9.42^{eg}	2.44^{bc}	4.29^{bc}	7.16^{a}	8.97^{bcd}
	Line 4	2.46^{ab}	4.15^{b}	6.30^{eh}	9.74^{ef}	2.38^{bc}	4.05^{d}	5.95^{c}	9.59^{ad}
15/11	Giza 171	1.01^{hk}	1.66^{n}	2.86^{r}	6.34^{hi}	0.82^{ij}	1.35^{m}	2.98^{jn}	6.22^{fi}
	Shandaweel 1	0.96^{ik}	1.60^{n}	3.42^{qr}	7.03^{hi}	0.77^{j}	1.41^{im}	3.23^{in}	6.77^{fgh}
	Gemmieza 10	1.25^{hj}	1.81^{mn}	5.07^{jn}	6.94^{hi}	1.01^{gi}	1.70^{jm}	3.72^{hk}	6.56^{fi}
	Gemmieza 11	1.32^{hj}	2.63^{jm}	4.05^{oq}	6.98^{hi}	1.19^{eg}	2.32^{ef}	3.62^{il}	6.91^{fg}
	Sids 12	0.77^{k}	2.06^{ln}	5.32^{in}	7.40^{ij}	0.81^{ij}	1.65^{km}	4.63^{f}	6.39^{fi}
	Sids 13	1.16^{hk}	1.81^{mn}	4.53^{np}	6.93^{hj}	0.86^{hj}	1.76^{ji}	3.67^{hi}	6.74^{fgh}
	Line 3	1.35^{hi}	2.31^{ln}	3.84^{pr}	6.40^{eh}	1.13^{eh}	2.06^{fi}	3.29^{in}	6.29^{fi}
	Line 4	1.26^{hj}	2.61^{jm}	4.87^{lo}	7.05^{fj}	1.05^{fj}	2.41^{ef}	3.85^{gj}	6.62^{fgh}
30/11	Giza 171	1.45^{jh}	2.36^{kn}	5.41^{in}	7.19^{fj}	1.05^{fj}	1.34^{m}	2.67^{no}	5.45^{hk}
	Shandaweel 1	1.06^{hk}	2.73^{jl}	5.27^{in}	6.03^{eg}	1.22^{eg}	1.44^{km}	3.34^{in}	4.03^{k}
	Gemmieza 10	1.33^{hj}	3.31^{ij}	5.69^{hl}	6.91^{gi}	0.97^{gj}	1.36^{m}	3.15^{jn}	5.50^{hk}
	Gemmieza 11	1.92^{b}	4.12^{gh}	5.03^{kn}	10.08^{e}	1.39^{e}	1.78^{ik}	4.92^{ef}	8.49^{de}
	Sids 12	1.21^{hk}	3.67^{gi}	6.62^{dg}	9.94^{ei}	1.11^{ei}	1.58^{km}	4.51^{f}	5.67^{gj}
	Sids 13	0.89^{jk}	4.68^{ab}	8.30^{a}	9.94^{ef}	1.34^{ef}	1.57^{km}	2.89^{mo}	5.18^{ijk}
	Line 3	1.19^{hk}	4.15^{b}	6.10^{ei}	3.36^{eg}	1.24^{eg}	1.58^{km}	4.31^{fh}	5.67^{gj}
	Line 4	1.09^{hk}	4.76^{ab}	6.80^{ce}	9.18^{eg}	1.18^{eg}	1.68^{km}	4.44^{fg}	5.52^{hk}
15/12	Giza 171	1.29^{hj}	3.53^{hi}	5.85^{jk}	10.71^{eg}	1.26^{eg}	1.54^{km}	2.11^{o}	8.79^{cd}
	Shandaweel 1	1.97^{ef}	5.44^{a}	7.93^{ab}	13.39^{ef}	1.32^{ef}	1.99^{gj}	2.76^{no}	5.45^{hk}
	Gemmieza 10	1.03^{hk}	2.57^{jn}	4.71^{mp}	6.55^{eg}	1.22^{eg}	1.46^{km}	3.43^{in}	10.17^{a}
	Gemmieza 11	1.95^{ef}	3.28^{ij}	5.23^{jn}	6.78^{e}	1.40^{e}	2.08^{fh}	3.87^{gi}	10.04^{abc}
	Sids 12	1.16^{hk}	3.21^{ik}	5.90^{fj}	8.68^{ei}	1.11^{ei}	1.48^{km}	2.75^{no}	4.48^{jk}
	Sids 13	0.92^{ik}	4.53^{cf}	8.24^{a}	10.67^{eg}	1.27^{eg}	1.80^{hk}	3.13^{kn}	7.15^{f}
	Line 3	1.00^{ik}	4.43^{df}	6.65^{cf}	11.10^{eg}	1.23^{eg}	2.15^{eg}	3.55^{im}	7.46^{ef}
	Line 4	1.24^{hj}	5.12^{ac}	7.85^{ab}	13.11^{ef}	1.32^{ef}	2.08^{fh}	3.80^{gk}	9.47^{ad}
$LSD_{0.05}$		0.45	0.94	1.17	1.69	0.30	0.42	0.94	1.72

Means in the same column followed by the same letter (s) were not significantly different according to $LSD_{0.05}$ values.

Data listed in Table (5a) detected that CGR was significantly affected by sowing dates at three periods in the two studied seasons, except for 80 - 95 days after sowing in the first season only. Data also indicated that earliest sowing date achieved the highest values of crop growth rate at 50- 65 days (0.414 and 0.373 g/day) in the 1st and 2nd season. While, planting in 15th December achieved highest value of CGR (0.939 g/day) in the 1st season at 65 – 80 days after sowing and at 30th November (0.803 g/day) in the 2nd season. It's important to clear that CGR was significantly affected by sowing dates at 80 - 95 days after sowing in the 2nd season only. **Lee and Heuvelink (2003)** reported that leaf area index increased with crop growth, reaching a maximum value in which the maximal capability of intercepting solar energy was reached, when CGR is also maximum. The lowest CGR values were recorded during early vegetative growth; similar results are in agreement with **(Valero *et al*., 2005 and Ahmed and Farooq, 2013).** NAR was significantly influenced by sowing dates in the season and at 65 - 80 days after sowing in the first season and the highest NAR was obtained at 30th November (0.370 mg/cm^2/day) at 65-80 DAS in the 2nd season. It's important to clear that sowing wheat in 1st and 15th November achieved maximum numbers of NAR at 50 - 65 days after sowing (0.134 and 0.131 mg/cm^2/day) in the 2nd season. **Silva *et al*. (2018)** found that, the second planting date was superior in physiological index compared to the first one, achieving maximum dry matter, crop growth rate and net assimilation rate and this planting date generated higher grain yield. The latest sowing date and 30th November achieved highest values of NAR (0.300 and 0.282 mg/cm^2/day) at 80 - 95 days after sowing in the 2nd season.

Table 5a. Effect of sowing dates and wheat genotypes on crop growth rate (CGR) and net assimilation rate (NAR) during 2016/2017 and 2017/2018 seasons.

Treatment	Crop growth rate (CGR) (g /day)						Net assimilation rate (NAR) ($mg/cm^2/day$)					
	2016/2017			2017/2018			2016/2017			2017/2018		
	50-65 days	65-80 days	80-95 days	50-65 days	65-80 days	80-95 days	50-65 days	65-80 days	80-95 days	50-65 days	65-80 days	80-95 days
Sowing dates												
1/11	0.414^{a}	0.650^{b}	1.153^{a}	0.373^{a}	0.519^{b}	0.922^{b}	0.130^{a}	0.140^{b}	0.160^{a}	0.131^{a}	0.108^{b}	0.122^{c}
15/11	0.192^{b}	0.430^{c}	1.105^{a}	0.164^{b}	0.426^{bc}	0.978^{b}	0.137^{a}	0.156^{b}	0.223^{a}	0.134^{a}	0.171^{b}	0.222^{b}
30/11	0.348^{a}	0.800^{a}	1.312^{a}	0.120^{c}	0.803^{a}	1.128^{b}	0.168^{a}	0.187^{ab}	0.203^{a}	0.089^{b}	0.370^{a}	0.282^{a}
15/12	0.352^{a}	0.939^{a}	1.534^{a}	0.126^{c}	0.387^{c}	1.386^{a}	0.159^{a}	0.199^{a}	0.204^{a}	0.090^{b}	0.167^{b}	0.300^{a}
$LSD_{0.05}$	0.082	0.141	NS	0.031	0.093	0.209	NS	0.038	NS	0.020	0.068	0.051
Genotypes												
Giza 171	0.260^{b}	0.60^{b}	1.447^{a}	0.165^{b}	0.392^{b}	1.319^{a}	0.126^{b}	0.178^{a}	0.238^{a}	0.101^{a}	0.149^{b}	0.324^{a}
Shandaweel 1	0.318^{ab}	0.738^{ab}	1.398^{a}	0.193^{ab}	0.482^{b}	0.922^{b}	0.133^{b}	0.165^{a}	0.210^{ab}	0.104^{a}	0.200^{ab}	0.226^{b}
Gemmieza 10	0.227^{b}	0.534^{b}	1.313^{a}	0.156^{b}	0.500^{ab}	1.187^{ab}	0.122^{b}	0.167^{a}	0.222^{ab}	0.096^{a}	0.225^{ab}	0.241^{b}
Gemmieza 11	0.310^{ab}	0.646^{b}	1.242^{a}	0.211^{ab}	0.661^{a}	1.194^{ab}	0.136^{b}	0.164^{a}	0.209^{ab}	0.115^{a}	0.222^{ab}	0.213^{b}
Sids 12	0.334^{ab}	0.715^{ab}	1.151^{a}	0.209^{ab}	0.666^{a}	0.965^{ab}	0.156^{ab}	0.175^{a}	0.168^{ab}	0.125^{a}	0.251^{a}	0.217^{b}
Sids 13	0.312^{ab}	0.788^{ab}	1.026^{a}	0.173^{b}	0.455^{b}	1.027^{ab}	0.145^{b}	0.180^{a}	0.147^{b}	0.099^{a}	0.207^{ab}	0.199^{b}
Line 3	0.445^{a}	0.633^{b}	1.135^{a}	0.223^{a}	0.557^{ab}	0.901^{b}	0.186^{a}	0.142^{a}	0.178^{ab}	0.114^{a}	0.191^{ab}	0.186^{b}
Line 4	0.405^{a}	0.935^{a}	1.489^{a}	0.235^{a}	0.556^{ab}	1.313^{a}	0.184^{ab}	0.192^{a}	0.207^{ab}	0.135^{a}	0.187^{ab}	0.224^{b}
$LSD_{0.05}$	0.092	0.176	NS	0.050	0.121	0.255	0.041	NS	0.053	NS	0.057	0.054

Means in the same column followed by the same letter (s) were not significantly different according to $LSD_{0.05}$ values.

Considering wheat genotypes, obtained results revealed that CGR and NAR were significantly varied at all genotypes except at 80 - 95 days after sowing relative to CGR in the 1st season only and NAR at 65 - 80 days after sowing in the first season and 50 - 65 days after sowing in the second season. Data listed in the same Table detected that line 3 (0.445 and 0.186) significantly surpassed CGR and NAR at 50 - 65 days after sowing during the 1st season, while line 4 (0.935) showed superiority CGR at 65 - 80 days after sowing in the 1st season and (0.235) at 50-65 days in the second season for CGR and NAR. Giza 171 cultivar came in the first rank in the two studied seasons for CGR and NAR at 80 – 95 days after sowing. It's important to clear that sides 12 gave the highest values of CGR and NAR at 65 - 80 days after sowing in the second season.

As for interaction between sowing dates and genotypes data in Table (5b) showed that, at the first of November Gemmieza 10 surpassed significantly for CGR and NAR (2.176 and 0.332) at 80-95 days in the first season, while Line 3 showed superiority for CGR (0.462) at 50-65 days from sowing in the second season only. Also, at 15 November Gemmieza 11 showed the highest NAR (0.179) at 50-65 days in the second season. However, at 30 November Sids 12 and Gemmieza 10 produced the highest CGR (1.045) and NAR (0.456) at 65-80 days and Giza 171 for NAR (0.504) at 80-95 days in the second season only. At 15 December, Line 4 came in the first rank for CGR (0.587 and 1.536) at 50-65 and 65-80 days from sowing in the first season. **Ahmed and Farooq (2013)** found that, sustaining the growth in late sown conditions of Wafaq-2001 cultivar was clear indication of its adaptability measures to terminal heat stress.

Chlorophyll content

Data listed in Table (6a) pointed out that sowing dates had significant effect on chlorophyll a, chlorophyll b and chlorophyll a + b in both seasons. Chlorophyll a + b was equaled at 15 and 30 November (1.693 mg/g f. wt) in the first rank in the first season, while 30th November came (1.426) in the first rank followed by 15 November (1.399) in the second season, the lowest value of chlorophyll a + b was observed at 15 December (1.273 and 1.240) during the two successive seasons. The results were similar to those of **Spano *et al*. (2003)** who reported that at late sown wheat due to accelerated leaf senescence the assimilates that were supplied to the grain decreased.

It's important to remember that the highest values of chlorophyll a (1.17 and 0.94 mg/g f. wt) in the first and 2nd season respectively at sowing date 30 November and chlorophyll b content (0.529 and 0.494 mg/g f. wt) in the 1st and 2nd seasons, respectively at sowing date 15 November. Similarly, the suitable time of wheat planting was the 15th November with respect to high chlorophyll contents might also contribute to higher photosynthetic rate was reported by **(Thomas *et al*., 2005 and Ahmed and Farooq, 2013)**.

Data also in Table (6a) pointed out that chlorophyll a, b and a + b were significantly affected by wheat genotypes in the 1st and 2nd seasons. It's important to say that Giza 171 cultivar gave the highest chlorophyll a , b and a + b contents in the two studied seasons except Gemmieza 11 came in the first rank in chlorophyll b (0.513 and 0.488) in the first and second seasons. **Xu and Huang (2009)** found that in cool-season cereal species, heat stress decreased chlorophyll contents leading to a lot of physiological damage and leaf senescence suffered the most.

With regard to interaction between sowing dates and genotypes results in Table (6b) indicated that significantly the highest values of chlorophyll a (1.283 and 1.040 mg/g f. wt) and a + b (1.862 and 1.580 mg/ g f. wt) resulted from sowing Giza 171 cultivar at 30 November, while Gemmieza 11 cultivars for chlorophyll b at 15 November in both studied seasons. **Pande and Verma (2011)** have documented the adverse effects of delayed sowing and wide variation among genotypes for chlorophyll contents.

Table 5b. Effect of sowing dates and wheat genotypes interactions on crop growth rate (CGR) and net assimilation rate (NAR) in 2016/2017 and 2017/2018 seasons.

Sowing dates	Genotypes	Crop growth rate (CGR)					Net assimilation rate (NAR)				
		2016/2017			2017/2018		2016/2017		2017/2018		
		50-65 days	65-80 days	80-95 days	50-65 days	65-80 days	50-65 days	80-95 days	50-65 days	65-80 days	80-95 days
1/11	Giza 171	0.427^{af}	0.845^{ce}	1.136^{di}	0.393^{ac}	0.671^{cf}	0.155^{bd}	0.139^{ei}	0.160^{ab}	0.136^{hm}	0.104^{i}
	Shandaweel 1	0.493^{ad}	0.616^{dj}	1.449^{ah}	0.437^{ab}	0.462^{fk}	0.1122^{cf}	0.179^{ci}	0.128^{ae}	0.085^{km}	0.105^{ki}
	Gemmieza 10	0.232^{gk}	0.397^{hj}	2.176^{a}	0.249^{de}	0.327^{im}	0.072^{ef}	0.332^{a}	0.134^{ae}	0.075^{lm}	0.170^{gi}
	Gemmieza 11	0.286^{ej}	0.799^{cf}	0.890^{gi}	0.302^{cd}	0.510^{fj}	0.100^{df}	0.121^{gi}	0.097^{cg}	0.114^{hm}	0.160^{hi}
	Sids 12	0.545^{ab}	0.598^{dj}	0.658^{i}	0.433^{ab}	0.629^{dg}	0.178^{ac}	0.083^{i}	0.144^{ad}	0.125^{jm}	0.115^{ji}
	Sids 13	0.427^{af}	0.625^{cj}	0.823^{hi}	0.367^{ac}	0.417^{gl}	0.140^{be}	0.118^{gi}	0.132^{ae}	0.100^{im}	0.143^{il}
	Line 3	0.486^{ad}	0.556^{ej}	0.717^{hi}	0.462^{a}	0.576^{eh}	0.153^{bd}	0.106^{hi}	0.154^{ac}	0.111^{hm}	0.083^{l}
	Line 4	0.418^{af}	0.764^{cg}	1.618^{ag}	0.345^{bc}	0.560^{fi}	0.129^{b}f	0.222^{bg}	0.119^{bf}	0.124^{hm}	0.142^{il}
15/11	Giza 171	0.133^{jk}	0.301^{j}	1.066^{fi}	0.121^{gj}	0.277^{jm}	0.115^{bf}	0.276^{ac}	0.124^{bf}	0.117^{hm}	0.211^{ek}
	Shandaweel 1	0.120^{jk}	0.327^{ij}	1.021^{fi}	0.117^{gj}	0.344^{im}	0.107^{cf}	0.220^{bg}	0.132^{ae}	0.167^{jl}	0.208^{ek}
	Gemmieza 10	0.164^{hk}	0.500^{fj}	0.996^{fi}	0.147^{fj}	0.420^{jl}	0.133^{bf}	0.184^{ci}	0.120^{bf}	0.177^{j}	0.208^{ek}
	Gemmieza 11	0.323^{di}	0.443^{gj}	1.096^{ei}	0.251^{de}	0.449^{fk}	0.185^{ab}	0.225^{af}	0.179^{a}	0.167^{hm}	0.227^{di}
	Sids 12	0.151^{ik}	0.590^{dj}	1.220^{ci}	0.138^{fj}	0.575^{eh}	0.129^{bf}	0.213^{bh}	0.127^{ae}	0.220^{ei}	0.161^{hl}
	Sids 13	0.163^{hk}	0.517^{ej}	1.008^{fi}	0.157^{ej}	0.509^{fj}	0.123^{bf}	0.194^{bh}	0.131^{ae}	0.211^{ei}	0.212^{ek}
	Line 3	0.272^{fk}	0.289^{j}	1.153^{di}	0.164^{ej}	0.342^{im}	0.185^{ab}	0.240^{ae}	0.117^{bf}	0.137^{hm}	0.271^{cg}
	Line 4	0.211^{gk}	0.481^{fj}	1.207^{ci}	0.219^{df}	0.487^{fk}	0.117^{bf}	0.235^{ae}	$0.146a^{ac}$	0.174^{hm}	0.250^{ch}
30/11	Giza 171	0.094^{k}	0.772^{cg}	1.672^{af}	0.061^{j}	0.519^{fi}	0.059^{f}	0.286^{ab}	0.056^{g}	0.285^{cg}	0.504^{a}
	Shandaweel 1	0.270^{fk}	0.758^{cg}	1.247^{ci}	0.059^{j}	0.928^{ab}	0.181^{ac}	0.247^{ad}	0.047^{g}	0.449^{ab}	0.310^{ce}
	Gemmieza 10	0.364^{cg}	0.543^{ej}	1.040^{fi}	0.148^{fj}	0.865^{ac}	0.182^{ac}	0.171^{di}	0.065^{fg}	0.456^{ab}	0.266^{ce}
	Gemmieza 11	0.471^{ae}	0.573^{ej}	1.846^{ae}	0.201^{eg}	0.874^{ac}	0.193^{ab}	0.277^{ac}	0.142^{ad}	0.302^{cf}	0.236^{di}
	Sids 12	0.387^{bg}	0.751^{cj}	1.407^{bi}	0.157^{ei}	1.045^{a}	0.188^{ab}	0.192^{bh}	0.136^{ad}	0.429^{ab}	0.242^{di}
	Sids 13	0.377^{bg}	1.206^{b}	1.443^{ah}	0.070^{ij}	0.465^{fk}	0.129^{bf}	0.178^{ci}	0.054^{g}	0.361^{ac}	0.216^{dj}
	Line 3	0.336^{bg}	0.845^{ce}	0.873^{gi}	0.085^{hj}	0.821^{ad}	0.157^{bd}	0.143^{ei}	0.068^{fg}	0.335^{bd}	0.215^{dj}
	Line 4	0.565^{a}	0.959^{bc}	0.972^{fi}	0.182^{eh}	0.911^{ab}	0.254^{a}	0.133^{fi}	0.150^{ac}	0.350^{ac}	0.268^{cg}
15/12	Giza 171	0.367^{cg}	0.726^{ch}	1.916^{ac}	0.085^{hj}	0.104^{gl}	0.176^{ac}	0.253^{ad}	0.066^{fg}	0.060^{m}	0.449^{ab}
	Shandaweel 1	0.390^{bg}	1.252^{ci}	1.879^{ad}	0.162^{ei}	0.193^{gl}	0.132^{bf}	0.194^{bh}	0.130^{fg}	0.100^{gm}	0.282^{cf}
	Gemmieza 10	0.150^{ik}	0.657^{cg}	1.041^{fi}	0.062^{j}	0.389^{m}	0.101^{df}	0.203^{bh}	0.065^{g}	0.196^{ik}	0.323^{cd}
	Gemmieza 11	0.160^{hk}	0.770^{bd}	1.164^{b}i	0.092^{hj}	0.814^{lm}	0.067^{ef}	0.213^{bh}	0.045^{dg}	0.305^{ce}	0.232^{di}
	Sids 12	0.255^{fk}	0.923^{cf}	1.217^{ci}	0.111^{fj}	0.415^{ghl}	0.128^{df}	0.186^{bh}	0.095^{eg}	0.233^{dh}	0.351^{bc}
	Sids 13	0.384^{bg}	0.807^{ce}	1.041^{fi}	0.101^{hj}	0.429^{be}	0.189^{ab}	0.121^{gi}	0.080^{b}f	0.187^{fl}	0.271^{cg}
	Line 3	0.527^{ac}	0.845^{a}	1.892^{ad}	0.182^{eh}	0.493^{fk}	0.249^{a}	0.223^{bj}	0.119^{ae}	0.183^{gl}	0.177^{fl}
	Line 4	0.587^{a}	1.536^{ab}	2.127^{ab}	0.195^{eg}	0.267^{km}	0.235^{a}	0.239^{ae}	0.126^{ae}	0.102^{jm}	0.316^{cd}
$L.S.D_{0.05}$		0.181	0.352	0.773	0.097	0.241	0.079	0.104	0.056	0.112	0.104

Means in the same column followed by the same letter (s) were not significantly different according to $LSD_{0.05}$ values.

Table 6a. Effect of sowing dates and wheat genotypes on chlorophyll content during 2016/2017 and 2017/2018 seasons.

Treatment	Chl a		Chl b		Chl a + b	
	2016/2017	2017/2018	2016/2017	2017/2018	2016/2017	2017/2018
Sowing dates						
1/11	1.07^{b}	0.87^{c}	0.478^{c}	0.455^{c}	1.555^{b}	1.333^{c}
15/11	1.16^{a}	0.90^{b}	0.529^{a}	0.494^{a}	1.693^{a}	1.399^{b}
30/11	1.17^{a}	0.94^{a}	0.515^{b}	0.483^{b}	1.693^{a}	1.426^{a}
15/12	0.87^{c}	0.84^{d}	0.401^{d}	0.396^{d}	1.273^{c}	1.240^{d}
$LSD_{0.05}$	0.02	0.01	0.007	0.003	0.019	0.009
Genotypes						
Giza 171	1.14^{a}	0.94^{a}	0.517^{a}	0.485^{a}	1.659^{a}	1.429^{a}
Shandaweel 1	1.03^{c}	0.88^{c}	0.468^{b}	0.441^{d}	1.498^{d}	1.324c
Gemmieza 10	0.97^{d}	0.86^{cd}	0.469^{b}	0.435^{e}	1.450^{e}	1.299^{d}
Gemmieza 11	1.09^{b}	0.91^{b}	0.513^{a}	0.488^{a}	1.609^{b}	1.404^{b}
Sids 12	1.13^{a}	0.93^{ab}	0.514^{a}	0.477^{b}	1.650^{a}	1.409^{b}
Sids 13	1.03^{c}	0.85^{d}	0.455^{c}	0.426^{f}	1.495^{d}	1.277^{e}
Line 3	1.06^{b}	0.87^{cd}	0.445^{d}	0.447^{d}	1.514^{d}	1.322^{c}
Line 4	1.08^{b}	0.87^{cd}	0.468^{b}	0.457^{c}	1.555^{c}	1.333^{c}
$LSD_{0.05}$	0.02	0.02	0.009	0.005	0.025	0.017

Means in the same column followed by the same letter (s) were not significantly different according to $LSD_{0.05}$ values.

Table 6b. Effect of sowing dates and wheat genotypes interactions on chlorophyll content in 2016/2017 and 2017/2018 seasons.

Sowing dates	Genotypes	Chl a		Chl b		Chl a + b	
		2016/2017	2017/2018	2016/2017	2017/2018	2016/2017	2017/2018
1/11	Giza 171	1.150^{cf}	0.923^{de}	0.500^{ce}	0.478^{gh}	1.650^{eg}	1.400^{ce}
	Shandaweel 1	1.053^{i}	0.896^{eh}	0.480^{f}	0.430^{k}	1.532^{kl}	1.328^{hg}
	Gemmieza 10	0.923^{k}	0.853^{jn}	0.480^{f}	0.432^{k}	1.402^{m}	1.288^{km}
	Gemmieza 11	1.116^{fh}	0.866^{hm}	0.510^{c}	0.490^{ef}	1.628^{fh}	1.358^{fh}
	Sids 12	1.143^{cf}	0.906^{dg}	0.503^{cd}	0.500^{de}	1.640^{eh}	1.408^{cd}
	Sids 13	1.003^{j}	0.860^{hn}	0.423^{h}	0.410^{lm}	1.428^{m}	1.270^{ln}
	Line 3	1.100^{gh}	0.873^{gl}	0.446^{g}	0.438^{k}	1.548^{jk}	1.310^{ik}
	Line 4	1.130^{eg}	0.840^{ko}	0.486^{ef}	0.462^{ij}	1.618^{gh}	1.302^{jl}
15/11	Giza 171	1.236^{b}	0.973^{bc}	0.423^{h}	0.522^{b}	1.802^{bc}	1.498^{b}
	Shandaweel 1	1.116^{fh}	0.870^{gm}	0.503^{cd}	0.462^{ij}	1.620^{fh}	1.312^{ik}
	Gemmieza 10	1.013^{h}	0.873^{gl}	0.490^{df}	0.470^{hi}	1.502^{l}	1.342^{gi}
	Gemmieza 11	1.143^{cf}	0.926^{de}	0.583^{a}	0.542^{a}	1.728^{d}	1.470^{b}
	Sids 12	1.246^{ab}	0.983^{b}	0.593^{a}	0.508^{cd}	1.840^{ab}	1.490^{b}
	Sids 13	1.156^{ce}	0.880^{fj}	0.593^{a}	0.472^{gi}	1.668^{e}	1.352^{gh}
	Line 3	1.173^{cd}	0.860^{hn}	0.510^{c}	0.500^{de}	1.658^{ef}	1.360^{fh}
	Line 4	1.220^{b}	0.893^{ei}	0.506^{cd}	0.478^{gh}	1.728^{d}	1.370^{eg}
30/11	Giza 171	1.283^{ab}	1.040^{a}	0.580^{a}	0.540^{a}	1.862^{ab}	1.580^{a}
	Shandaweel 1	1.083^{hi}	0.943^{cd}	0.490^{df}	0.482^{fg}	1.572^{ij}	1.428^{c}
	Gemmieza 10	1.133^{eg}	0.913^{df}	0.483^{f}	0.452^{j}	1.618^{gh}	1.358^{fh}
	Gemmieza 11	1.223^{b}	0.986^{b}	0.550^{b}	0.512^{bc}	1.772^{c}	1.500^{b}
	Sids 12	1.233^{b}	0.996^{b}	0.560^{b}	0.482^{fg}	1.792^{c}	1.480^{b}
	Sids 13	1.176^{c}	0.853^{jn}	0.500^{ce}	0.452^{j}	1.678^{e}	1.308^{jk}
	Line 3	1.136^{dg}	0.893^{ei}	0.473^{f}	0.472^{gi}	1.610^{hi}	1.368^{eg}
	Line 4	1.156^{ce}	0.913^{df}	0.486^{ef}	0.478^{gh}	1.642^{eh}	1.390^{df}
15/12	Giza 171	0.906^{kl}	0.836^{io}	0.416^{hi}	0.400^{mn}	1.322^{n}	1.238^{np}
	Shandaweel 1	0.870^{ln}	0.833^{mo}	0.400^{ij}	0.392^{no}	1.270^{oq}	1.228^{op}
	Gemmieza 10	0.853^{no}	0.823^{no}	0.423^{h}	0.388^{op}	1.278^{ap}	1.210^{pq}
	Gemmieza 11	0.893^{km}	0.876^{fk}	0.413^{hi}	0.410^{lm}	1.308^{no}	1.288^{km}
	Sids 12	0.923^{k}	0.843^{jo}	0.403^{ij}	0.418^{l}	1.328^{n}	1.260^{mo}
	Sids 13	0.816^{o}	0.806^{o}	0.393^{jk}	0.370^{q}	1.208^{r}	1.178^{q}
	Line 3	0.860^{mn}	0.873^{jl}	0.380^{k}	0.378^{pq}	1.240^{pr}	1.250^{no}
	Line 4	0.843^{no}	0.856^{in}	0.390^{ijk}	0.412^{l}	1.232^{qr}	1.270^{ln}
$LSD_{0.05}$		0.040	0.040	0.017	0.012	0.040	0.033

Means in the same column followed by the same letter (s) were not significantly different according to $LSD_{0.05}$ values.

Phenological stages, growing degree days and heat use efficiency

Data presented in Table (7a) showed that different sowing dates had significantly effect on all phonological traits in both studied seasons. The days from sowing to emergence, tillering and jointing increased with late planting. The required days for germination was earlier when temperature was higher in early sowing dates but germination was later in late sowing date due to low temperatures **(Hossain and Teixeira da Silva., 2012).**

On the other side, sowing in 15th November recorded the longest periods to booting (81.59 and 80.68 days) and heading (93.19 and 92.87days) in both studied seasons respectively. While the lowest values were recorded at 15th December for booting (76.90 and 76.21 days) and heading (87.35 and 86.90 days) during the two successive seasons. These results in harmony with those obtained by (**Amrawat *et al*., 2013).** Also, **Abdel Nour and Fateh (2011)** found that sowing dates had significant effect on days to heading. They demonstrated that sowing dates in 25 November showed maximum days to heading.

It's important to clear that number of days to physiological maturity were decreased by late planting in the two studied seasons. These variations in days to maturity may be due to the change in temperature and light intensity. The longest periods were observed at 1 November (166.50 and 165.93 days) in the two investigated seasons, respectively, while the lowest values at 15th December (145.53 and 144.90 days) in the two studied seasons. Similar findings are in agreement with **(Hameed *et al*., 2004).** The early sown wheat has availed the longest period for completion of phonological stages and thus attained maximum values for GDD **(Ahmed and Farooq, 2013).**

Table 7a. Effect of sowing dates and wheat genotypes on days required to attain different phonological stages of wheat during 2017/2018 and 2018/ 2019 seasons.

Treatment	Emergence		Tillering		Jointing		Booting		Heading		Maturity	
	2016/ 2017	2017/ 2018	2016/ 2017	2017/ 2018	2016/ 2017	2017/ 2018	2016/ 2017	2017/ 2018	2016/ 2017	2017/ 2018	2016/ 2017	2017/ 2018
Sowing dates												
1/11	6.21d	5.53d	39.80c	39.02d	50.86b	49.46b	81.04b	80.09a	92.62b	92.12b	166.50a	165.93a
15/11	6.84c	6.28c	40.25c	39.65c	51.09ab	50.16ab	81.59a	80.68a	93.19a	92.87a	161.78b	161.00b
30/11	7.18b	6.75b	41.25b	40.90b	51.17ab	50.71a	78.80c	76.81b	91.35c	90.78c	159.46c	158.46c
15/12	8.12a	7.56a	43.65a	43.18a	51.68a	51.03a	76.90d	76.21b	87.35d	86.90d	145.53d	144.90d
$LSD_{0.05}$	0.1	0.36	0.49	0.26	0.58	0.75	0.38	1.02	0.51	0.32	0.32	0.32
Genotypes												
Giza 171	7.06ab	6.68ab	41.62a	41.18a	52.27a	51.37a	79.77a	77.13a	91.61a	90.68b	157.50c	156.81d
Shandaweel 1	7.25ab	6.62ab	40.87a	40.31b	51.12b	49.62c	79.81a	78.93a	91.05ab	90.75b	158.31b	158.12b
Gemmieza 10	6.87b	6.07c	41.37a	40.81ab	50.68b	50.31bc	79.62ab	79.00a	90.91ab	90.50b	157.87c	157.12d
Gemmieza 11	7.37a	6.81a	41.12a	40.56b	51.12b	50.00c	80.0a	78.93a	91.06ab	90.62b	157.75c	156.87d
Sids 12	7.12b	6.37bc	41.31a	40.73ab	51.46b	50.68b	79.61ab	78.56a	90.31b	89.75c	158.87ab	157.62c
Sids 13	7.37a	6.87a	41.20a	40.62ab	50.81b	50.31bc	79.56ab	78.68a	91.62a	91.31a	158.68ab	158.0b
Line 3	6.81b	6.50b	41.37a	40.87ab	51.43b	50.56b	79.31ab	78.18a	91.46a	91.31a	158.62ab	157.62c
Line 4	6.87b	6.31bc	41.05a	40.43b	50.72b	49.88c	79.0b	78.18a	91.0ab	90.43b	158.93a	158.43a
$LSD_{0.05}$	0.3	0.31	NS	0.42	0.55	0.41	0.51	NS	0.58	0.33	0.42	0.34

Means in the same column followed by the same letter (s) were not significantly different according to $LSD_{0.05}$ values.

Data listed in Table (7a) pointed out that, there were significant differences between the studied genotypes for days required to attain different phonological stages of wheat. Sids 13 and Gemmieza 11 cultivars were surpassed and equaled in number of days from sowing to emergence (7.37 days) in the 1st season, while Sids 13 (6.87 days) observed superiority in the second season, however Line 3 gave the lowest number (6.81 days) in the 1st season and Gemmieza 10 (6.07days) in the 2nd season only. Data found in the same Table also, showed that Giza 171 achieved superiority in both of tillering and jointing during the two studied seasons, while Shandaweel 1 recorded the lowest values of tillering and jointing in the 2nd season only. Regarding Gemmieza 11 cultivar showed superiority in booting in the 1st and 2nd season. while Sids 13 cultivar gave superiority in heading date in the 1st and 2nd seasons in heading date and equaled with line 3 in the second while the line 4 came in the final relative to booting in the 1st and 2nd seasons and equaled with Line 3 in the 2nd season. On the other side, Sids 12 gave the lowest values (90.31 and 89.75 days) in heading date in the 1st and 2nd seasons, respectively.

It's important to clear that, Line 4 was latest in maturity date (158.93 and 158.43 days) in the 1st and 2nd seasons. While, Giza 171 (157.50 and 156.81 days) and Gemmieza 11 (157.75 and 156.87 days) cultivars were the earliest in maturity date during the two investigated seasons. Environmental effect on the number of days required for occurrence of different growth stages of wheat varied with genotypes **(Araus *et al*., 2007).**

Data presented in Table (7b) showed that the interaction between sowing dates and wheat genotypes significantly affected on emergence, tillering, jointing, heading and maturity in the two investigated seasons and booting stage in the first season only.

Table 7b. Effect of sowing dates and wheat genotypes interactions on days required to attain different phonological stages of wheat in 2016/2017 and 2017/2018 seasons.

Sowing dates	Genotypes	Days from sowing to … 1^{st} season						Days from sowing to … 2^{nd} season				
		Emergence	Tillering	Jointing	Booting	Heading	Maturity	Emergence	Tillering	Jointing	Heading	Maturity
1/11	Giza 171	6.25^{ik}	40.75^{gj}	51.25^{cg}	80.75^{dh}	92.50^{ei}	164.50^{d}	6.0^{g}	40.0^{il}	49.75^{gj}	91.75^{gi}	164.0^{e}
	Shandaweel 1	6.0^{jk}	39.75^{km}	51.0^{dh}	80.50^{dh}	91.75^{hk}	166.25^{c}	5.0^{h}	38.75^{np}	48.75^{k}	91.0^{jl}	166.0^{bd}
	Gemmieza 10	6.50^{hj}	40.50^{hk}	50.50^{fi}	80.25^{fi}	92.75^{dh}	166.50^{bc}	6.0^{g}	39.75^{im}	49.50^{hk}	92.25^{fg}	165.50^{d}
	Gemmieza 11	6.25^{ik}	39.50^{ln}	50.75^{eh}	81.50^{ae}	92.25^{fj}	166.0^{c}	5.0^{h}	38.25^{p}	49.0^{jk}	91.50^{hj}	165.75^{cd}
	Sids 12	5.75^{k}	39.25^{nm}	50.0^{hi}	81.0^{cg}	92.0^{gk}	167.25^{ab}	5.0^{h}	38.75^{np}	49.75^{gj}	91.25^{ik}	166.50^{ab}
	Sids 13	6.75^{gi}	39.75^{kn}	49.50^{i}	82.0^{ac}	93.50^{ae}	167.50^{ab}	6.25^{fg}	39.0^{mp}	49.25^{ik}	93.0^{de}	167.0^{ab}
	Line 3	6.25^{jk}	40.0^{jm}	51.50^{bf}	81.25^{bf}	93.25^{bf}	166.50^{bc}	6.0^{g}	39.25^{lo}	50.0^{fi}	93.75^{c}	166.25^{bc}
	Line 4	6.0^{jk}	38.75^{n}	51.25^{cg}	80.50^{eh}	93.0^{cg}	167.50^{ab}	5.20^{h}	38.25^{p}	49.75^{gj}	97.50^{a}	166.50^{ab}
15/11	Giza 171	6.75^{gi}	41.0^{fi}	52.50^{ab}	81.25^{bf}	92.50^{ei}	161.0^{ch}	6.50^{eg}	40.75^{fi}	51.50^{bc}	91.50^{hj}	160.50^{ij}
	Shandaweel 1	7.0^{fh}	40.0^{jm}	51.25^{cg}	81.0^{cg}	93.75^{ad}	161.50^{fg}	6.50^{eg}	39.25^{lo}	50.0^{fi}	93.50^{cd}	161.0^{hi}
	Gemmieza 10	6.25^{ik}	41.25^{fh}	51.0^{dh}	82.50^{a}	93.0^{cg}	161.75^{fg}	5.25^{h}	40.25^{hk}	50.25^{eh}	92.50^{ef}	161.25^{gh}
	Gemmieza 11	7.0^{fh}	40.25^{il}	50.75^{eh}	81.75^{ad}	92.50^{ei}	161.0^{gh}	6.75^{df}	40.0^{il}	49.25^{ik}	92.0^{fh}	160.50^{ij}
	Sids 12	7.25^{eg}	40.0^{jm}	51.50^{bf}	81.50^{ae}	92.25^{fj}	163.50^{e}	6.25^{fg}	39.25^{lo}	50.25^{eh}	91.50^{hj}	162.0^{f}
	Sids 13	7.50^{df}	39.75^{km}	50.50^{fi}	80.75^{dh}	94.24^{ab}	161.5^{fg}	7.0^{ce}	39.50^{kn}	50.0^{fi}	94.50^{b}	160.75^{hj}
	Line 3	6.25^{ik}	40.50^{hk}	51.0^{dh}	82.25^{ab}	94.50^{a}	161.75^{fg}	6.0^{g}	39.75^{jm}	50.50^{dg}	94.0^{bc}	160.25^{j}
	Line 4	6.75^{gi}	39.25^{mn}	50.25^{gi}	81.75^{ad}	94.0^{ac}	162.25^{f}	6.0^{g}	38.50^{op}	49.75^{gj}	93.50^{cd}	161.75^{fg}
30/11	Giza 171	7.25^{eg}	41.25^{fh}	51.50^{bf}	79.25^{il}	91.25^{jl}	159.50^{ik}	6.75^{df}	41.0^{fh}	51.75^{ab}	91.00^{jl}	159.00^{kl}
	Shandaweel 1	7.75^{ce}	41.0^{fi}	50.75^{eh}	79.75^{hk}	91.75^{hk}	159.0^{k}	7.50^{bc}	40.75^{fi}	49.50^{hk}	91.25^{ik}	159.25^{k}
	Gemmieza 10	7.25^{eg}	41.50^{eg}	50.25^{gi}	78.75^{kn}	91.50^{il}	159.25^{jk}	6.50^{eg}	41.25^{eg}	50.50^{dg}	90.50^{ln}	158.25^{m}
	Gemmieza 11	7.50^{df}	40.75^{gj}	51.25^{cg}	80.0^{gj}	91.25^{jl}	159.50^{ik}	7.00^{ce}	40.50^{gj}	50.75^{cf}	90.75^{km}	158.00^{mn}
	Sids 12	7.0^{fh}	42.25^{de}	51.75^{be}	78.25^{lo}	91.0^{kn}	160.0^{ij}	6.50^{eg}	41.50^{ef}	51.25^{bd}	90.25^{mn}	157.50^{n}
	Sids 13	7.50^{df}	41.25^{fh}	51.o^{dh}	79.0^{jm}	92.0^{gk}	159.0^{k}	7.00^{ce}	40.25^{hk}	50.75^{cf}	91.50^{hj}	158.25^{m}
	Line 3	6.75^{gi}	40.50^{hk}	52.0^{bd}	77.50^{or}	91.75^{hk}	160.25^{hi}	6.50^{eg}	40.50^{gj}	51.00^{be}	91.00^{jl}	158.50^{lm}
	Line 4	6.50^{hj}	41.75^{ef}	50.50^{fi}	77.75^{nq}	90.50^{lm}	159.25^{jk}	6.25^{fg}	41.50^{ef}	50.25^{eh}	90.00^{n}	159.00^{kl}
15/12	Giza 171	8.0^{bd}	43.50^{bc}	53.25^{a}	77.25^{os}	90.0^{m}	145.0^{m}	7.50^{bc}	43.0^{bc}	52.50^{a}	88.50^{o}	143.75^{r}
	Shandaweel 1	8.25^{ac}	42.75^{cd}	51.50^{bf}	78.0^{mp}	87.75^{no}	146.50^{l}	7.50^{bc}	42.50^{cd}	50.25^{eh}	87.25^{p}	146.25^{o}
	Gemmieza 10	7.50^{df}	42.25^{de}	51.0^{dh}	77.0^{pt}	87.00^{op}	144.0^{n}	6.75^{df}	42.00^{de}	51.00^{be}	86.75^{pq}	143.50^{r}
	Gemmieza 11	8.75^{a}	44.0^{b}	51.75^{be}	76.75^{pt}	88.25^{no}	144.50^{mn}	8.50^{a}	43.50^{ab}	51.00^{be}	88.25^{o}	143.25^{r}
	Sids 12	8.50^{ab}	43.75^{b}	52.0^{bd}	77.50^{or}	86.00^{p}	144.75^{mn}	7.75^{bc}	43.25^{ac}	51.50^{bc}	86.00^{rs}	144.50^{q}
	Sids 13	7.75^{ce}	44.25^{b}	52.25^{ac}	76.50^{rt}	86.75^{op}	146.75^{i}	7.25^{bd}	43.75^{ab}	51.25^{bd}	86.25^{qs}	146.00^{op}
	Line 3	8.0^{bd}	4450^{a}	51.25^{cg}	76.25st	86.75^{op}	146.0^{i}	7.50^{bc}	44.00^{a}	50.75^{cf}	86.50^{qr}	145.50^{p}
	Line 4	8.25^{ac}	44.25^{b}	50.50^{fi}	76.0^{t}	86.50^{p}	146.75^{i}	7.75^{b}	43.50^{ab}	50.00^{fi}	85.75^{s}	146.50^{o}
$LSD_{0.05}$		0.61	0.98	1.10	1.02	1.17	0.85	0.63	0.84	0.82	0.67	0.68

Means in the same column followed by the same letter (s) were not significantly different according to $LSD_{0.05}$ values.

Gemmieza 11 cultivar had the highest values of days from sowing to emergence (8.75 and 8.50 days) at 15^{th} December in both seasons, the 1^{st} and 2^{nd} respectively. On the other side, Sids 12 was the lowest (5.75 and 5.00 days) at 1^{st} November in the 1^{st} and 2^{nd} seasons. Data cleared that periods from sowing to tillering were (44.50 and 44.00 days) obtained from line 3 at 15^{th} December in the first and second seasons, while the lowest values were obtained from line 4 (38.75 and 38.25 days) at 1^{st} November in the two studied seasons. On the other hand, Giza 171 showed the longest period from sowing to jointing stage (53.25 and 52.50 days) when sowing date delayed to 15 December in the 1^{st} and 2^{nd} seasons, while Sids 13 achieved the lowest value (49.50 days) at 1^{st} November in the 1^{st} season, while Shandaweel 1 (48.75 days) in the 2^{nd} season. Gemmieza 10 had the highest values (82.50 days) at 15 November and Line 4 had the lowest (76.00 days) from sowing date to booting stage at 15 December in the 1^{st} season only.

Concerning line 3 achieved highest value (94.50 days) from sowing date to heading at 15 November in the 1^{st} season and line 4 (97.50 days) at 1^{st} November in the 2^{nd} season, whereas Sids 12 had the lowest days (86.00 days) in the first season and Line 4 (85.75 days) in the second season at 15 December. Sids 13 cultivar x 1^{st} November achieved highest values (167.50 and 167.00 days) from sowing to maturity in the 1^{st} and 2^{nd} seasons, respectively, while at 15 December Gemmieza 10 had the lowest days (144.00 days) in the first season and Gemmieza 11 (143.25 days) in the second season. From our results, life cycle of wheat gradually decreased with delayed planting and cultivars behaved differently. These differences among the genotypes are due to their different genetic makeup. These results are in agreement with those obtained by **(Hussain *et al*., 2012 and Wahid *et al*., 2017).** Data presented in Table (8a) pointed out that, growing degree days (GDD) strongly significant correlated with sowing date in the 1^{st} and 2^{nd} seasons except maturity stage in the first season. Sowing date at 1^{st} of November achieved the highest values of GDD in tillering, jointing, booting, heading and maturity, while sowing date at 15^{th} December achieved lowest values of GDD in both studied seasons. Similar findings are in harmony with **Amrawat *et al*. (2013)** who obtained that, the GDD was decreased with the successive delay in sowing.

Table 8a. Effect of sowing dates and wheat genotypes on the growing degree days (GDD) during 2016/2017 and 2017/2018 seasons.

Treatment	Growing degree days (GDD)											
	2016/2017						2017/2018					
	Emergence	Tillering	Jointing	Booting	Heading	Maturity	Emergence	Tillering	Jointing	Booting	Heading	Maturity
Sowing dates												
1/11	72.95^{c}	454.53^{a}	574.78^{a}	826.54^{a}	927.78^{a}	1797.31^{a}	84.04^{c}	542.68^{a}	692.42^{a}	988.59^{a}	1130.04^{a}	2096.87^{a}
15/11	90.64^{a}	427.50^{b}	523.59^{b}	781.59^{b}	883.83^{b}	1760.32^{a}	89.01^{c}	538.26^{a}	646.62^{b}	934.81^{b}	1096.78^{b}	2020.51^{b}
30/11	74.75^{c}	388.82^{c}	470.37^{c}	733.20^{c}	848.51^{c}	1793.81^{a}	93.09^{b}	510.64^{b}	612.18^{c}	896.43^{c}	1045.81^{c}	1994.48^{c}
15/12	82.31^{b}	391.51^{c}	460.86^{d}	710.50^{d}	830.17^{d}	1658.04^{a}	109.98^{a}	486.53^{c}	566.77^{d}	850.96^{d}	997.54^{d}	1815.48^{d}
$L.S.D_{0.05}$	3.51	8.27	5.13	7.99	15.8	NS	5.72	5.23	14.43	35.12	6.33	8.71
Genotyps												
Giza 171	79.90^{ab}	421.50^{a}	516.03^{a}	765.90^{a}	862.96^{a}	1737.56^{cd}	96.31^{a}	525.68^{a}	641.68^{a}	924.59^{a}	1069.53^{a}	1971.34^{b}
Shandaweel 1	81.81^{ab}	413.90^{a}	506.18^{ab}	766.34^{a}	876.31^{a}	1750.59^{cd}	95.61^{a}	515.75^{b}	621.15^{b}	930.15^{a}	1068.90^{a}	1990.06^{a}
Gemmieza 10	77.96^{b}	417.72^{a}	503.65^{b}	762.90^{a}	878.87^{a}	1741.96^{d}	88.43^{a}	521.31^{ab}	629.18^{b}	931.13^{a}	1065.31^{ab}	1975.90^{b}
Gemmieza 11	83.21^{a}	416.62^{a}	506.56^{ab}	766.71^{a}	871.68^{a}	1906.15^{b}	98.31^{a}	517.40^{ab}	625.09^{b}	929.37^{a}	1068.59^{a}	1972.11^{b}
Sids 12	80.15^{ab}	417.34^{a}	509.28^{ab}	763.34^{a}	864.28^{a}	1759.68^{c}	92.21^{a}	519.93^{ab}	633.18^{ab}	926.50^{a}	1057.31^{b}	1983.03^{ab}
Sids 13	83.56^{a}	417.37^{a}	503.43^{b}	762.56^{a}	877.78^{a}	1756.31^{c}	94.21^{a}	518.78^{ab}	629.01^{b}	926.15^{a}	1073.46^{a}	1987.53^{ab}
Line 3	77.12^{b}	419.71^{a}	509.78^{ab}	759.59^{a}	877.81^{a}	1756.0^{cd}	95.68^{a}	521.75^{ab}	631.93^{ab}	850.75^{b}	1073.62^{a}	1981.46^{ab}
Line 4	77.56^{b}	400.56^{b}	504.28^{b}	756.31^{a}	870.87^{a}	2210.71^{a}	91.46^{a}	516.12^{b}	624.75^{b}	922.96^{a}	1063.62^{ab}	1993.25^{a}
$LSD_{0.05}$	4.68	9.12	7.27	NS	NS	14.74	NS	6.24	8.69	52.36	7.55	12.32

Means in the same column followed by the same letter (s) were not significantly different according to $LSD_{0.05}$ values.

Early sowing resulted in absorbing sufficient GDD in relatively more time, while late sown crop experienced higher temperature during late stage in less time. Data also cleared that 15 November had the highest values of GDD in emergence stage (90.64 ^{0}C) in the 1st season and 15 December (109.98 ^{0}C) in the 2nd season, but the lowest values (72.95 and 84.04 ^{0}C) at the first sowing date in the 1st and 2nd seasons, respectively.

With regard to wheat genotypes significantly effect on GDD for growth stages in both seasons , except for booting and heading in the first season and emergence in the second season. It is important to clear that Giza 171 cultivar recorded highest values of tillering growing degree days (421.5 and 525.68 ^{0}C) during the 1st and 2nd seasons, whereas the highest value of GDD in heading stage was noticed with Gemmieza 10 (878.87 ^{0}C) in the 1st season and Line 3 (1073.62 ^{0}C) in the 2nd season. Results also indicated that Line 4 (2210.71 and 1993.25 ^{0}C) achieved maximum number in maturity GDD in both studied seasons. The differences in the genetic constitution among the genotypes are behind their GDD requirement differences. These results are on line with those showed by **Wahid *et al.* (2017)** who reported that the differences in the genetic constitution among the cultivars are behind their GDD requirement differences.

Data presented in Table (8b) pointed out that GDD for tillering and heading were significantly affected by the interaction between sowing dates x wheat genotypes in the two studied seasons, whereas GDD for maturity was significantly affected in the 1st season and emergence in the second season. The highest value of GDD (124.75 ^{0}C) from sowing date to emergence was taken at 15th December x Gemmieza 11 in the 2nd season. The maximum number of GDD at tillering achieved from Giza 171 at 1st of November was (471. 5 and 555.50 ^{0}C) in the 1st and 2nd season respectively.

It's important to clear that at 1st November the highest value of GDD at heading and maturity stages were (935.13 and 1812.50 ^{0}C) taken from Sids 13 in the first season and Line 3 (1146.25 ^{0}C) at heading stage in the second season. Similar results are in agreement with **(Amrawat *et al*., 2013).**

Table 8b. Effect of sowing dates and wheat genotypes interactions on the growing degree days in 2016/2017 and 2017/2018 seasons.

Sowing dates	Genotypes	Growing degree days (GDD)					
		Emergence	Tillering		Heading		Maturity
		2017/2018	2016/2017	2017/2018	2016/2017	2017/2018	2016/2017
1/11	Giza 171	90.00^{fh}	471.50^{a}	555.50^{a}	926.63^{ac}	1126.00^{be}	1767.50^{ce}
	Shandaweel	90.00^{fh}	461.25^{a}	538.88^{ce}	920.25^{ad}	1119.00^{df}	1793.50^{ac}
	Gemmieza	90.00^{fh}	468.75^{a}	552.25^{ab}	928.88^{ab}	1131.50^{bd}	1797.25^{a}
	Gemmieza	75.75^{i}	458.38^{a}	532.25^{ef}	924.63^{ac}	1123.88^{ce}	1789.75^{ac}
	Sids 12	75.50^{i}	456.13^{a}	542.13^{be}	922.25^{ad}	1121.25^{cf}	1808.38^{a}
	Sids 13	93.50^{eg}	461.25^{a}	542.75^{be}	935.13^{a}	1139.00^{ab}	1812.50^{a}
	Line 3	90.00^{fh}	464.00^{a}	545.50^{ad}	933.13^{a}	1146.25^{a}	1797.38^{a}
	Line 4	79.00^{hi}	395.00^{de}	532.25^{ef}	931.38^{ab}	1133.50^{ac}	1812.25^{a}
15/11	Giza 171	93.13^{eg}	435.63^{b}	550.25^{ac}	879.88^{ef}	1084.00^{i}	1748.25^{e}
	Shandaweel	93.13^{eg}	425.38^{be}	534.00^{df}	891.25^{de}	1102.88^{gh}	1755.88^{e}
	Gemmieza	76.00^{i}	436.25^{b}	544.63^{ad}	909.50^{ae}	1091.50^{hi}	1759.63^{de}
	Gemmieza	96.63^{dg}	327.38^{g}	542.00^{be}	879.13^{ef}	1088.25^{i}	1748.88^{e}
	Sids 12	90.00^{fh}	425.38^{be}	533.88^{df}	877.50^{ef}	1084.00^{i}	1786.75^{ad}
	Sids 13	100.13^{cf}	422.75^{be}	536.63^{df}	895.25^{ce}	1112.50^{eg}	1755.50^{e}
	Line 3	86.50^{gi}	430.13^{be}	539.38^{ce}	899.25^{be}	1107.50^{fg}	1759.75^{de}
	Line 4	86.50^{gi}	418.75^{c}	525.38^{fg}	895.25^{ce}	1103.63^{gh}	1768.00^{be}
30/11	Giza 171	93.13^{eg}	388.63^{df}	512.13^{hi}	850.25^{fh}	1048.50^{ji}	1793.88^{ac}
	Shandaweel	101.75^{ce}	386.88^{df}	509.38^{hi}	853.63^{fh}	1051.38^{jk}	1784.63^{ad}
	Gemmieza	90.50^{fg}	390.00^{df}	514.50^{gi}	850.25^{fh}	1042.50^{ji}	1788.88^{ac}
	Gemmieza	96.13^{dg}	385.88^{df}	506.38^{hi}	846.88^{fi}	1045.50^{ji}	1795.75^{ab}
	Sids 12	90.50^{fg}	395.13^{df}	516.75^{gh}	843.25^{gi}	1039.25^{kl}	1805.00^{a}
	Sids 13	96.13^{dg}	388.50^{df}	504.00^{ij}	857.13^{fg}	1054.38^{j}	1784.63^{ad}
	Line 3	89.13^{gh}	384.50^{df}	506.38^{hi}	850.25^{fh}	1048.50^{ji}	1807.75^{a}
	Line 4	87.50^{gh}	391.13^{df}	517.25^{gh}	836.50^{gi}	1036.50^{l}	1790.00^{ac}
15/12	Giza 171	109.0^{bc}	390.25^{df}	484.88^{km}	855.13^{fg}	1019.63^{m}	1640.63^{gi}
	Shandaweel	109.0^{bc}	382.13^{ef}	480.75^{lm}	836.50^{gi}	1002.38^{no}	1668.38^{fg}
	Gemmieza	97.23^{dg}	377.50^{f}	475.50^{m}	826.88^{gi}	995.75^{op}	1622.13^{i}
	Gemmieza	124.75^{a}	394.88^{de}	489.00^{kl}	836.13^{gi}	1016.75^{mn}	1630.25^{hi}
	Sids 12	112.88^{b}	392.75^{df}	487.00^{km}	814.13^{i}	984.75^{p}	1638.63^{hi}
	Sids 13	105.13^{bd}	397.00^{de}	491.75^{jl}	823.63^{gi}	988.00^{op}	1672.63^{f}
	Line 3	109.0^{bc}	400.25^{d}	493.75^{jk}	848.63^{fi}	992.25^{op}	1659.13^{fh}
	Line 4	112.88^{b}	397.38^{de}	489.63^{kl}	820.38^{hi}	980.88^{p}	1672.63f
$LSD_{0.05}$		14.83	18.22	12.51	34.93	15.13	29.49

Means in the same column followed by the same letter (s) were not significantly different according to $LSD_{0.05}$ values.

Data listed in Table (9) pointed out that all sowing dates significantly affected in Heat Use Efficiency (HUE) during the two investigated seasons. The best sowing date achieved highest number of HUE was at 30th November (1.47 and 1.31) in the two investigated seasons could be attributed to the highest grain yield obtained under the third sowing date. Whereas, least HUE observed at the first sowing date (0.82 and 0.67) was primarily associated with reduction in grain yield and the mother reason is varying temperature at different growth stages of wheat **(Hussain *et al.*, 2012)**. Also, the highest heat use efficiency for grain yield was recorded under normal sown wheat crop **(Kumari *et al.*, 2009 and Solanki *et al.*, (2017).**

With regard to wheat genotypes were significantly in HUE in the first season only. Giza 171 had the highest value (1.24) and Sid13 cultivar had the poorest grain yield as well as higher GDD which resulted in the lowest HUE (1.10).

Yield and yield components

Data listed in Table (10a) revealed that both of plant height, number of tillers/m^2, spike length and number of kernels / spike were significantly affected by sowing dates in the two seasons of study. The tallest plants were noticed at 15th and 30th November in the 1st season and at 15th November in the 2nd season. Similar results were obtained by **(Abdel Nour and Fateh, 2011).** Whereas, the shortest plants were observed in the earliest sowing date 1st November. Number of tillers recorded highest values at 15 November (259.81 and 227.06) in the 1st and 2nd seasons, respectively. While the minimum number of tillers/ m^2 were (177.18 and 100 .21) resulted in the earliest sowing date in the 1st and 2nd seasons, respectively. The longest spike was recorded at 30 November in the first season and 15 November in the second season, while the shortest at 1st November in the two seasons. Data cleared that number of kernels/ spike was surpassed at 30 November and the lowest at 15th December and 1st November in the two studied seasons. Similar results are in agreement with **(Wahid *et al*., 2017). Bashir *et al*. (2014)** found that wheat planting in 10th November showed superior performance in plant height, number of tillers/plant, spike length and number of spikelet/spike. Also, optimum sowing date was favorable to more formation tiller and effective spike number, thus increasing the yield **(Anwar *et al*., 2019).** On the other hand, **Rahman *et al*. (2009)** reported that higher temperature enhances leaf senescence causing reduction in green leaf area during reproductive stages, ultimately resulted in less productive tillers/ plant, which is one of the major causes of yield loss of wheat

Table 9. Effect of sowing dates and wheat genotypes on heat use efficiency (HUE) during 2016/2017 and 2017/2018 seasons.

Treatment	Heat use efficiency (HUE)	
	2016/2017	**2017/2018**
Sowing dates		
1/11	0.82^{d}	0.67^{d}
15/11	1.39^{b}	1.17^{b}
30/11	1.47^{a}	1.31^{a}
15/12	0.96^{c}	0.85^{c}
$LSD_{0.05}$	0.07	0.04
Genotypes		
Giza 171	1.24^{a}	1.02^{a}
Shandaweel 1	1.17^{ab}	1.02^{a}
Gemmieza 10	1.17^{ab}	1.03^{a}
Gemmieza 11	1.16^{ab}	0.95^{a}
Sids 12	1.10^{3b}	0.97^{a}
Sids 13	1.10^{3b}	1.01^{a}
Line 3	1.14^{ab}	0.99^{a}
Line 4	1.16^{ab}	1.00^{a}
$LSD_{0.05}$	0.06	NS

Means in the same column followed by the same letter (s) were not significantly different according to $LSD_{0.05}$ values.

Table 10a. Effect of sowing dates and wheat genotypes on yield and yield components during 2016/2017 and 20017/2018 seasons.

Treatment	Plant height (cm)		No. of tillers /m^2		Spike length (cm)		No. of kernels/spike	
	2016/ 2017	**2017/ 2018**	**2016/ 2017**	**2017/ 2018**	**2016/ 2017**	**2017/ 2018**	**2016/ 2017**	**2017/ 2018**
Sowing dates								
1/11	88.92^{c}	86.75^{c}	177.18^{c}	100.21^{c}	9.62^{c}	9.35^{c}	47.76^{c}	47.15^{c}
15/11	102.0^{a}	100.33^{a}	259.81^{a}	227.06^{a}	11.84^{ab}	11.52^{a}	56.91^{b}	59.38^{b}
30/11	102.28^{a}	98.95^{a}	233.93^{b}	206.62^{b}	12.01^{a}	10.50^{b}	59.77^{a}	61.65^{a}
15/12	98.46^{b}	95.06^{b}	231.50^{b}	202.56^{b}	11.45^{b}	10.39^{b}	46.80^{c}	46.68^{c}
$LSD_{0.05}$	1.88	2.70	19.69	11.67	0.41	0.29	1.32	2.06
Genotypes								
Giza 171	103.93^{a}	99.31^{a}	210.81^{ab}	176.62^{b}	11.39^{bc}	10.56^{bc}	53.80^{ab}	55.56^{a}
Shandaweel 1	98.47^{c}	96.23b^{c}	238.81^{a}	198.07^{a}	11.60^{b}	9.96^{d}	52.96^{ab}	54.27^{ab}
Gemmieza 10	92.68^{d}	91.46^{cd}	219.75^{ab}	181.43^{b}	10.68^{d}	9.82^{de}	51.71^{ab}	53.46^{ab}
Gemmieza 11	102.50^{ab}	99.45^{cd}	200.56^{b}	169.75^{b}	12.83^{a}	12.02^{a}	54.40^{a}	53.84^{ab}
Sids 12	94.56^{d}	93.20^{c}	222.18^{ab}	176.62^{b}	10.85^{cd}	10.51^{c}	53.33^{ab}	54.23^{ab}
Sids 13	90.18^{f}	88.06^{d}	239.12^{a}	203.50^{a}	10.07^{e}	9.47^{e}	51.73^{ab}	52.88^{ab}
Line 3	100.06^{bc}	96.90^{bc}	237.18^{a}	181.87^{b}	11.15^{c}	10.28^{cd}	49.83^{b}	51.43^{b}
Line 4	100.93^{b}	97.56^{b}	236.43^{a}	185.06^{b}	11.27^{bc}	10.91^{b}	54.75^{a}	54.05^{ab}
$LSD_{0.05}$	1.86	4.07	21.97	12.43	0.36	0.38	2.87	2.20

Means in the same column followed by the same letter (s) were not significantly different according to $LSD_{0.05}$ values.

On the other side plant height was significantly affected by genotypes in the two studied seasons. Giza 171 was the tallest (103.93 and 99.31 cm) and Sids 13 was the shortest (90.18 and 88.06 cm) in the first and second seasons, respectively. Data also cleared that, number of tillers/m^2 was significantly differed with different wheat genotypes. The maximum number of tillers/m^2 was given from Sids 13 and minimum number of Gemmieza 11. Data also, obviously showed that the longest spike was taken from Gemmieza 11 in the 1st and 2nd seasons while, the shortest spikes were taken from Sids 13 during the two studied seasons. Obtained results also, pointed out that, number of kernels/spike was significantly affected by wheat genotypes in the 1st and 2nd season. The highest value was (54.40) taken from Gemmieza 11 in the 1st season and Giza 171 (55.56) in the 2nd season. While the lowest value were (49.83 and 51.43) taken from line 3 in the 1st and 2nd seasons, respectively.

Data presented in Table (10b) pointed out that 1000- kernel weight was significantly affected by sowing date and the heaviest was observed at 15 November (46.39 and 48.01 g) in the first and second seasons, respectively. Meanwhile, at the optimum planting date, the plants had suitable and longer environmental conditions for vegetative growth, which resulted in the active photosynthesis and maximum translocation of assimilates to grains and thus had heaviest grains **(Abdel Nour and Fateh, 2011).** Also, 1000- kernel weight was significantly affected by wheat genotypes. Giza 171 cultivar had the heaviest 1000 - kernel weight (44.45) while, the lowest value was in Sids 13 cultivar (40.75 g). **Sadek (2001)** cleared that the reason behind the variation in 1000-grain weight for wheat cultivars might be due to their different genetic constitutions as well as their response to the prevailing environmental conditions. It̓s important to clear that the highest grain yield (2645.57 and 2613.45 Kg/ fed) and biological yield (6977.50 and 6702.5 Kg/ fed) were observed at 30 November in both seasons. These results due to high number of kernels/ spike and chlorophyll content. While the lowest grain yield (1484.45 and 1409.55 Kg/ fed) and biological yield (4395.00 and 3872.50 Kg/ fed) were recorded at 1st November in the 1st and 2nd seasons. **Wahid *et al.* (2017)** found that the decrease in grain yield when wheat sown early is attributed to the low temperatures during anthesis stage , which affected the viability of pollen grains and consequently reduced the pollination by these unviable pollen grains.

Also planting wheat at 15 December had adverse effect on grain yield. These results are in agreement by **Hossain *et al.* (2012a)** reported that early planting wheat faces high temperature stress at the vegetative stage and late sowing is affected at two stages: germination by low temperature stress and at the reproductive stage by high temperature, which ultimately affects grain yield. Also, delaying sowing tended to late on coming of heading and flowering stages and shortening the duration of grain filling stage which causes less dry matter mobilization efficiency and reduced biomass and grain yield **(Anwar *et al.*, 2019).** It̓s important to clear that, wheat sown in 30 November had lower HI values than wheat sown in 15 November; lower HI was not a result of decreased grain yield but of higher plant biomass. Harvest Index surpassed at 15th November (42.06 and 42.17)) in the two studied seasons due to the increasing in 1000- kernel weight and number of tillers /m^2. **Seleiman *et al.* (2011)** fond that sowing wheat on 15th November gave the highest values for all growth, yield and its components as well as grain quality characters in comparison with other sowing dates.

Table (10b): Effect of sowing dates and wheat genotypes on yield and yield components during 2016/2017 and 20017/2018 seasons.

Treatment	1000-kernel weight (g)		Grain yield (Kg/fed)		Biological yield (Kg/fed)		Harvest Index (%)	
	2016/2017	2017/2018	2016/2017	2017/2018	2016/2017	2017/2018	2016/2017	2017/2018
Sowing dates								
1/11	39.70^c	41.24^c	1484.45^c	1409.55^d	4395.00^d	3872.50^c	33.93^c	36.75^c
15/11	46.39^a	48.01^a	2458.82^b	2372.90^b	5900.00^b	5655.00^b	42.06^a	42.17^a
30/11	43.24^b	44.97^b	2645.57^a	2613.45^a	6977.50^a	6702.50^a	38.26^b	39.25^b
15/12	39.44^c	39.50^c	1597.72^c	1546.05^c	5558.77^c	5232.50^b	29.45^d	29.65^d
$LSD_{0.05}$	1.47	0.74	146.83	91.31	328.41	517.43	3.64	2.47
Genotypes								
Giza 171	44.45^a	44.44^a	2167.80^a	2021.65^{ab}	5892.50^{ab}	5572.50^a	38.28^a	36.02^{ab}
Shandaweel 1	43.86^a	43.52^{ab}	2067.45^a	2032.95^a	5805.00^{ab}	5332.50^{ab}	35.48^{ab}	38.12^{ab}
Gemmieza 10	41.32^b	43.99^a	2042.10^a	2044.25^a	5677.50^{ab}	5572.50^a	35.72^{ab}	36.96^{ab}
Gemmieza 11	43.15^{ab}	44.33^a	2032.10^a	1880.45^b	5702.50^{ab}	5397.50^{ab}	35.47^{ab}	34.78^b
Sids 12	41.34^b	43.99^a	2004.70^a	1914.05^b	5610.00^{ab}	5197.50^b	35.33^{ab}	36.86^{ab}
Sids 13	40.75^b	42.67^b	1989.35^a	2002.80^{ab}	5482.50^b	5242.50^b	35.78^{ab}	37.82^{ab}
Line 3	41.33^b	42.50^b	2020.35^a	1976.40^{ab}	6037.50^a	5457.50^{ab}	33.55^b	36.29^{ab}
Line 4	41.33^b	42.01^b	2049.30^a	2011.80^{ab}	5455.05^b	5152.50^b	37.49^{ab}	38.78^a
$LSD_{0.05}$	1.83	1.10	NS	112.09	298.72	289.76	2.60	2.21

Means in the same column followed by the same letter (s) were not significantly different according to $LSD_{0.05}$ values.

Obtained results, also revealed that, grain yield was significantly affected by different wheat genotypes in the second season only, whereas biological yield and harvest index were significantly influenced by different wheat genotypes in the two studied seasons. Line 3 gave highest value of biological yield (6037.50 Kg/ fed), however the highest values of grain yield and harvest index % resulted from Giza 171 (2167.80 Kg/ fed and 38.28 %) in the first season and harvest index for Line 4 (38.78%) in the second season. Similar results are in agreement with (**Bashir *et al*., 2014)**. The grain yield is the sum total of different yield contributing factors controlled by both genetically and environmentally **(Shirpukar *et al*., 2008).** Since wheat yield formation is a complex character and governed by the complimentary interaction between source (photosynthesis and availability of assimilates) and sink component (storage organs) **(Amrawat *et al*., 2013)**.

In this experiment, data in Table (11) pointed out that, both of spike length and number of kernels/ spike significantly affected by the interaction between sowing dates x wheat genotypes in the two studied seasons, while plant height, biological yield/ fed and harvest index in the first season and number of tillers/m^2 and 1000 – kernel weight in the second season, only.

Table 11. Effect of sowing dates and wheat genotypes interactions on yield and yield components in 2016/2017 and 2017/2018 seasons.

Sowing dates	**Genotypes**	**2016/2017**					**2017/2018**			
		Plant height (cm)	**Spike length (cm)**	**No. of kernels/ spike**	**Bio. yield (Kg/fed)**	**Harvest index**	**No. of tillers/ m^2**	**Spike length (cm)**	**No. of Kernels /spike**	**1000-kernel weight (g)**
1/11	Giza 171	96.50^{il}	9.62^{ij}	47.20^{k-n}	4080^{k}	38.50^{eg}	109.25^{kl}	9.27^{i-m}	47.97^{g-j}	42.21^{d-f}
	Shandaweel 1	85.75^{p}	9.54^{ij}	47.80^{k-n}	4390^{k}	35.35^{f-i}	125.75^{k}	9.25^{j-n}	49.97^{g-j}	39.12^{g-j}
	Gemmieza 10	83.00^{p}	9.29^{ij}	48.00^{jn}	4470^{k}	32.94^{h-k}	91.25^{lm}	9.02^{lm}	48.23^{g-j}	40.73^{f-h}
	Gemmieza 11	93.00^{mo}	11.08^{fg}	52.13^{gk}	4630^{k}	31.55^{i-l}	83.00^{m}	10.66^{ef}	47.73^{g-j}	40.47^{f-i}
	Sids 12	84.00^{p}	9.13^{j}	46.20^{in}	4450^{k}	31.12^{i-l}	101.00^{lm}	9.12^{k-m}	46.47^{ij}	41.96^{d-f}
	Sids 13	83.50^{p}	8.92^{j}	43.47^{n}	4550^{k}	32.00^{i-l}	109.00^{kl}	8.66^{m}	45.50^{j}	41.31^{ef}
	Line 3	90.25^{no}	9.96^{hi}	49.47^{jm}	4410^{k}	34.37^{g-i}	96.75^{lm}	9.50^{i-l}	44.57^{j}	41.90^{d-f}
	Line 4	95.00^{km}	9.46^{ij}	47.87^{jn}	4180^{k}	35.62^{g-i}	85.75^{m}	9.36^{i-m}	46.77^{h-j}	42.27^{d-f}
15/11	Giza 171	107.0^{ab}	12.08^{de}	63.67^{ab}	6580^{ed}	37.86^{d-g}	198.75^{hi}	11.87^{c}	66.73^{a}	49.47^{a}
	Shandaweel 1	106.25^{ac}	12.63^{cd}	55.40^{eh}	5860^{f-h}	41.30^{b-e}	247.50^{b}	11.00^{de}	55.63^{f}	47.40^{bc}
	Gemmieza 10	98.50^{gj}	11.13^{fg}	51.47^{hi}	5630^{g-i}	43.64^{ab}	218.00^{e-g}	10.78^{ef}	56.80^{ef}	48.85^{ab}
	Gemmieza 11	106.0^{bc}	13.00^{bc}	53.87^{fi}	5880^{e-h}	42.40^{ac}	208.25^{gh}	12.90^{a}	57.30^{ef}	48.75^{ab}
	Sids 12	98.75^{gj}	11.58^{ef}	56.80^{dg}	5910^{e-g}	41.75^{bd}	217.00^{fg}	11.55^{cd}	59.70^{de}	48.82^{ab}
	Sids 13	93.75^{in}	10.00^{hi}	58.73^{cf}	5910^{e-g}	42.45^{ac}	282.25^{a}	10.62^{e-g}	60.50^{c-e}	47.51^{a-c}
	Line 3	104.00^{bf}	12.21^{de}	53.80^{fi}	5910^{e-g}	40.88^{b-e}	205.50^{gh}	11.87^{c}	58.03^{ef}	46.97^{bc}
	Line 4	101.75^{dg}	12.13^{de}	61.60^{ad}	5520^{g-i}	46.21^{a}	239.25^{b-d}	11.62^{cd}	60.40^{de}	46.38^{c}
30/11	Giza 171	109.50^{a}	12.17^{de}	56.60^{eh}	7320^{b}	39.07^{c-f}	212.75^{f-h}	10.79^{e}	59.87^{de}	45.65^{c}
	Shandaweel 1	103.25^{cf}	12.46^{de}	58.93^{be}	7350^{b}	38.17^{c-g}	186.25^{ij}	9.71^{h-l}	60.10^{de}	46.38^{c}
	Gemmieza 10	96.00^{jm}	11.71^{ef}	62.20^{ac}	6900^{bc}	37.09^{e-h}	209.25^{gh}	9.75^{h-l}	63.07^{b-d}	45.95^{c}
	Gemmieza 11	106.75^{ab}	13.88^{a}	65.27^{a}	6800^{cd}	38.36^{c-g}	188.50^{ij}	12.54^{ab}	64.17^{a-c}	47.33^{bc}
	Sids 12	99.75^{gi}	11.62^{ef}	64.13^{a}	6350^{d-f}	41.39^{b-e}	180.25^{j}	11.00^{de}	66.40^{ab}	46.49^{c}
	Sids 13	93.75^{ln}	10.88^{g}	55.67^{eh}	6360de	40.44^{b-e}	243.25^{be}	9.21^{j-m}	50.73^{gh}	43.44^{d-f}
	Line 3	105.25^{bc}	11.63^{ef}	53.13^{gj}	8000^{a}	32.11^{i-k}	206.50^{gh}	10.00^{f-i}	58.00^{ef}	43.30^{de}
	Line 4	106.00^{bc}	11.79^{e}	62.27^{ac}	5740^{gh}	39.45^{b-f}	226.25^{d-f}	11.08^{de}	62.87^{b-d}	41.24^{e-g}
15/12	Giza 171	104.75^{bd}	11.71^{ef}	45.72^{mn}	5590^{gi}	37.71^{d-g}	185.75^{ij}	10.54^{e-g}	47.70^{g-j}	40.45^{f-i}
	Shandaweel 1	98.25^{hk}	11.79^{e}	49.73^{i-n}	5620^{gi}	27.09^{l}	232.75^{c-e}	9.91^{g-j}	51.37^{g}	41.20^{e-g}
	Gemmieza 10	93.25^{lo}	10.63^{gh}	45.20^{mn}	5710^{gh}	29.19^{kl}	207.25^{gh}	9.75^{h-i}	45.77^{ij}	40.45^{f-i}
	Gemmieza 11	104.25^{be}	13.38^{ab}	46.33^{l-n}	5500^{g-i}	29.58^{j-l}	199.25^{hi}	12.00^{bc}	46.17^{ij}	40.77^{f-h}
	Sids 12	95.75^{j-m}	11.09^{fg}	46.20^{l-n}	5750^{gh}	27.06^{l}	208.25^{gh}	10.41^{e-h}	44.37^{j}	38.70^{h-j}
	Sids 13	89.75^{o}	10.50^{gh}	49.07^{i-n}	5110^{ij}	28.24^{kl}	179.50^{j}	9.41^{i-m}	44.80^{j}	38.42^{ij}
	Line 3	100.75^{jh}	10.83^{g}	42.93^{n}	5830^{gh}	28.04^{kl}	218.75^{e-g}	9.79^{h-k}	45.13^{j}	37.85^{j}
	Line 4	101.00^{eh}	11.71^{ef}	47.27^{k-n}	5380^{hi}	28.70^{kl}	189.00^{ij}	11.58^{ed}	46.20^{ij}	38.16^{j}
$LSD_{0.05}$		3.73	0.73	5.75	598.2	5.22	24.90	0.77	4.40	2.20

Means in the same column followed by the same letter (s) were not significantly different according to $LSD_{0.05}$ values.

Data pointed out that Giza 171cultivar was the tallest (109.50 cm) at 30th November in the first season and the highest number of kernels/ spike (66.73) and the heaviest of 1000-kernel weight (49.47 g) at 15 November in the second season only. Similar trend observed for spike length, where Gemmieza 11 had the tallest spike length (13.88 and 12.90 cm) at 30 November and 15 November in the 1st and 2nd seasons, respectively, also at 30 November Gemmieza 11 cultivar had the highest number of kernels/ spike (65.27) in the first season only. Obtained results, also revealed that Line 3 gave the heaviest biological yield (8000 Kg/ fed) at 30 November and Line 4 had the highest harvest index (46.21%) at 15 November in the first season. Variation in dry matter accumulation and remobilization can be attributed to differences in environmental conditions during the pre and post-anthesis periods **(Ehdale *et al*., 2006)** and genotypes **(Przulj and Momcilovic, 2001).**

Conclusion

Most of the wheat growth, phonological stages, growing degree days and yield components were reduced by delaying the planting date. The sowing date at 15 or 30 November resulted in better performance of all genotypes than late sowing (15 December). From overall performance (growth, Phenology and yield) Shandaweel 1, Giza 171, Line 3 and Line 4 were considered to be the best performing genotypes under late planting wheat.

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تاثير ميعاد الزراعة على النمو و الحرارة المتجمعه و المحصول و مكوناته لبعض التراكيب الوراثيه فى قمح الخبز

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اجريت تجربة حقليه بمحطة البحوث الزراعية بايتاى البارود خلال موسمى الزراعة 2017/2016 و2018/2017 وذلك لدراسة تاثير مواعيد الزراعة (1و15و30 نوفمبر و15 ديسمبر) على بعض صفات النمو وعدد الايام للوصول لمرا حل النمو المختلفة ودرجات الحرارة المتجمعه لكل مرحله و الانتاجية لثمانية تراكيب وراثية للقمح و هى جيزة 171 و شندويل 1 و جميزة 10 و جميزة 11 و سدس 12 و سدس 13 و سلالة 3 و سلالة 4 . وقد سجلت اختلافات معنوية بين مواعيد الزراعة الاربعة حيث كانت نباتات ميعاد الزراعة الاول الاثقل للوزن الجاف و الاعلى لدليل المساحة الورقية عند عمر 50 و65 و80 يوم من الزراعة. وكذلك الاعلى فى معدل نمو المحصول عند 50–65 يوم فى موسم الزراعة الاول. وكانت الزراعة فى 15 ديسمبر فى الموسم الاول وكذلك الزراعة فى 30 نوفمبر فى الموسم الثانى الاعلى فى معدل نمو المحصول و صافى معدل التمثيل الضوئى عند 65–80 يوم. اما عدد الايام للوصول لمراحل البزوغ و التفريع و الاستطالة نقص تدريجيا عند الزراعة فى 15 ديسمبر وحتى 1 نوفمبر و على العكس منها فى مرحلة النضج حيث تزداد عدد الايام تدريجيا للوصول لمرحلة النضج. اى ان دورة حياة النبات تستغرق مدة زمنية اقل فى الزراعة المتاخرة. وكانت كمية الحرارة المتجمعه فى جميع مراحل النمو من مرحلة التفريع حتى مرحلة النضج اعلى فى ميعاد الزراعة الاول و الاقل فى ميعاد الزراعة الاخير. و كانت الزراعة عند 30 نوفمبر الاعلى فى كمية الكلوروفيل و كفاءة استخدام الحرارة و دليل الحصاد و الاثقل للوزن البيولوجى و محصول الحبوب للفدان. و قد اظهرت التراكيب الوراثية المختبرة فروق معنوية و كان الصنف جميزة 11 و السلالة 4 الاثقل فى الوزن الجاف و كذلك دليل المساحة الورقية عند عمر 50 و 60 , 90 يوم و كذلك جيزة 171 الاعلى فى صافى معدل التمثيل الضوئى وكذلك فى معدل نمو المحصول مع السلالتين 3 و 4. و قد سجلت اطول فتره للوصول لمرحلة الاستطالة و اعلى كمية حرارة متجمعه مع الصنف جيزة 171 و لمرحلة النضج مع السلالة 4. و كذلك الصنف جيزة 171 الاعلى فى كمية الكلوروفيل و اغلبية صفات المحصول و مكوناته مع سدس 13 وجميزة 11 و السلالتين 3 و 4. اما التفاعل ببين ميعاد الزراعة والتراكيب الوراثية كان معنويا حيث كانت الزراعة المتاخرة (15 ديسمبر) لها تاثير سلبى على صفات النمو تحت الدراسة وكذلك عدد الايام لمراحل النمو المختلفة وكمية الحرارة المتجمعه و لكن هذا التاثير السلبى يختلف باختلاف التراكيب الوراثية. و كانت الاصناف شندويل 1 و جيزة 171 و السلالتين 3 و 4 مميزة فى النمو فى ميعاد الزراعة الاخير (15 ديسمبر) و هذا يدل على مقدرتها على تحمل التاثير السلبى للزراعة المتاخرة. اما زراعة الاصناف جيزة 171 و جميزة 11 و السلالة 4 فى ميعاد الزراعة الثانى (15 نوفمبر) او ميعاد الزراعة الثالث (30 نوفمبر) حيث كانت الاعلى فى صفات المحصول و مكوناته. و نتائج هذه الدراسة تساعد فى تحديد الميعاد الافضل للزراعة و كذلك افضل هذه التراكيب الوراثية المختبرة لاعطاء اعلى نمو و انتاجية.