GROWTH AND YIELD COMPONENTS OF SOME BREAD WHEAT CULTIVARS AS AFFECTED BY DIFFERENT SOWING DATES

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ABSTRACT

An experiment was conducted at Research Station, State Board for Seeds Testing and Certification, Baghdad, Iraq during 2015-2016 and 2016-2017 seasons to determine the effect of four sowing dates (20th October, 10th November, 30th November and 20th December) on grain yield and it's components of three wheat cultivars (Bohooth 22, Bohooth 158 and Rasheed). The experiment was laid out in Randomized Complete Blocks Design (RCBD) within split plot arrangement. Sowing dates distributed in main plots and cultivars in sub plots with three replications. Sowing date 10th November was superior in grain yield (4.96 and 5.21 t ha^{-1}) and most of its components (number of spikes 403.3 and 408.6 spike m^{-2} and number of spikelets per spike 22.08 and 22.26 spikelet spike^{-1} and number of grains per spike 56.37 and 58.63 grain spike^{-1}), and some other traits (number of tillers 448.6 and 442.0 tiller m^{-2} and spike length 15.84 and 14.39 cm) for both seasons, respectively, whereas sowing in 20th October was superior in 1000 grain weight (42.94 and 43.72 g) for both seasons, respectively. Cultivar Rasheed was superior in grain yield (4.50 and 4.71 t ha^{-1}) and most of yield components (number of spikes 389.5 and 397.3 spike m^{-2} and number of spikelets per spike 22.52 and 22.59 spikelet spike^{-1} and 1000 grain weight 41.61 and 43.02 g) and in some other traits (number of tillers 428.7 and 432.4 tiller m^{-2} and spike length 17.27 and 16.69 cm) for both seasons, respectively. It's clear from the results that 10th November is the best sowing date at central Iraq to get highest grain yield, and the early or late sowing could be decrease the grain yield, although the effect of early sowing is greater than the effect of late sowing on this trait in wheat.

Keywords: wheat, sowing dates, spike length, 1000 grain yield, grain yield.
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تأثر مكونات النمو والحاصل لبعض أصناف حنطة الخبز بمواعيد الزراعة المختلفة

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المستخلص

نفذت تجربة حقلية خلال الموسمين 2015–2016 و 2016–2017 في محطة أبحاث دائرة فحص وتصديق البذور التابعة لوزارة الزراعة في ابو غريب، بهدف دراسة تأثير أربعة مواعيد للزراعة (20 تشرين الأول و10 و30 تشرين الثاني و20 كانون الأول) في حاصل الحبوب ومكوناته لثلاثة أصناف من حنطة الخبز (بحوث 22 وبحوث 158 ورشيد). صممت التجربة وفق تصميم القطاعات الكاملة المعشاة بثلاثة مكررات وبترتيب الألواح المنشقة. وضعت مواعيد الزراعة في الألواح الرئيسة والأصناف في الألواح الثانوية عشوائيا. تفوق موعد الزراعة 10 تشرين الثاني بإعطاء أعلى حاصل حبوب بلغ 4.96 و5.21 طن هـ$^{-1}$ ومعظم مكوناته (عدد السنابل 403.3 و408.6 سنبلة م$^{-2}$ وعدد السنيبلات في السنبلة 22.08 و22.26 سنيبلة سنبلة$^{-1}$ وعدد الحبوب في السنبلة 56.37 و58.63 حبة سنبلة$^{-1}$)، وفي بعض الصفات (عدد الفروع الكلية 448.6 و442.0 فرع م$^{-2}$ وطول السنبلة 15.84 و14.39 سم) لكلا موسمي الدراسة بالتتابع، في حين تفوق موعد الزراعة 20 تشرين الأول بإعطائه أعلى وزن 1000 حبة بلغ 42.94 و43.72 غم للموسمين بالتتابع. تفوق الصنف رشيد بإعطائه أعلى حاصل حبوب بلغ 4.50 و4.71 طن هـ$^{-1}$ ومعظم مكوناته (عدد السنابل 389.5 و397.3 سنبلة م$^{-2}$ وعدد السنيبلات في السنبلة 22.52 و22.59 سنيبلة سنبلة$^{-1}$ ووزن 1000 حبة 41.61 و43.02 غم)، وفي بعض الصفات (عدد الفروع الكلية 428.7 و432.4 فرع م$^{-2}$ وطول السنبلة 17.27 و16.69 سم) للموسمين بالتتابع. يستنتج من هذه الدراسة أن الزراعة في 10 تشرين الأول هو أفضل موعد للمنطقة الوسطى من العراق للحصول على أعلى حاصل من الحبوب للحنطة وان الزراعة المبكرة أو المتأخرة عن هذا الموعد تسبب انخفاض حاصل الحبوب، بالرغم من أن تأثير الزراعة المبكرة كان اكبر من تأثير الزراعة المتأخرة في هذه الصفة.

كلمات مفتاحية: الحنطة، مواعيد الزراعة، طول السنبلة، وزن 1000 حبة، حاصل الحبوب

***البحث مستل من أطروحة دكتوراه للباحث الأول.**

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INTRODUCTION

Wheat (*Triticum aestivum* L.) is considered to be one of the most important cereal crops and staple food for approximately two billion people all over the world and cultivated on areas more than 240 million hectares which is larger than any other crop (19). Wheat is widely adapted and grown in most regions across the globe; from almost 60° N in Northern Europe (Norway) to 40° S in South America (Chile) (8). The final yield of wheat is an outcome of the interaction of genetic, environmental conditions such as, temperature and light, G×E interaction and agronomic factors (14). The most factors that lead to the increase of wheat yield is breeding and development of new cultivars with high grain yield, seeding during optimum time and using all other managements such as fertilization, irrigation, pests control and etc. that increase the yield. Planting date is one of the most critical considerations and agronomic factors involved in producing high yield of small grain cereal crops like wheat. Planting date is one of the most important agronomic factors involved in producing high yielding small grain cereal crops (23). Early or late sowing dates increases the risk of wheat yield losses (1, 10, 12). Late sowing reduces chance of survival, generally delays maturity, increases disease chances and reduces yield potential (7). Most researchers documented that the number of spikes m^{-2} (2, 15), Number of spikelets $spike^{-1}$ (16, 24), Spike length (4, 18) and 1000 grain weight (3, 21) were affected significantly by sowing dates. Due to global warming, temperature increases are probable to decrease wheat production in developing countries (where almost 66% of all wheat is produced) by 20-30%. According to the estimates a rise in temperature of 1°C in the wheat growing season could reduce the wheat yields by about 3-10% (27). Global production of wheat is predicted to decrease by 6% for each °C of further increase in temperature and become more variable over space and time (5). Several researchers showed that wheat cultivars differed in growth, yield and its components (6, 11, 20, 24). So, because of the global warming, the present study was designed to determine the effect of different sowing dates on some growth and yield traits of three bread wheat cultivars.

MATERIALS AND METHODS

An experiment was conducted at Research Station, State Board for Seeds Testing and Certification, Baghdad, Iraq, located at latitude of $33^{o}.32'$N and longitude of $44^{o}.23'$E. during the winter seasons 2015-2016 and 2016-2017. Split plot design in the arrangement of Randomized Complete Block Design (RCBD) with three replicates was used. Sowing dates (20^{th} October, 10^{th} November, 30^{th} November and 20^{th} December) occupied the main plots, whereas the cultivars (Bohooth 22, Bohooth 158 and Rasheed) were in sub plots. The net of sub plot area was 6 m^2 (nine rows, three meters long, 20 cm apart and 5 cm depth). Recommended land preparations to facilitate uniform distribution of seeds, fertilizers, and irrigation water were performed. Wheat grains (120 kg ha^{-1}) were sown manually with single row hand drilling. The soil was irrigated after the sowing immediately. Before sowing, soil was analyzed for its mechanical and chemical properties. The nitrogen fertilizer in the form of urea (46% N) was applied as per treatment in four splits; one at the time of sowing, second at growth stage ZGS:13, third at ZGS:32 and forth at ZGS:40 according to Zadoks scale (28), whereas phosphorus was added at the time of planting in a form of tri super phosphate (P_2O_5 46%) . All plots received uniform cultural practices. The obtained data were statistically analyzed through analysis of variance (ANOVA) by using statistical software package Genstat version (12). The least significant differences (L.S.D) at the level of 0.05 probability was employed to compare the differences among the treatment means (22). The traits below were studied:

1- Number of tillers m^{-2}: Total number of tillers per one meter row length was counted and converted to one meter square.

2- Spike length (cm): At harvest, ten random spikes were taken and their length was measured then the average of ten spikes was recorded.

3- Number of spikes m^{-2}: At harvest, total number of spikes per one square meter was recorded.

4- No. of grains spike^{-1}: Were counted from ten randomly selected spikes in each replicate at harvest.

5- Number of spikelets spike^{-1}: At harvest, ten random plants were taken from each plot and number of grains was counted then divided by ten

6- 1000-grain weight (g): 1000 grain were counted after harvest from each plot and then weighted by using a digital balance with two digits at moisture of 12%..

7- Grain yield (t ha^{-1}): Was estimated from a meter square and adjusted to 12% moisture content.

RESULTS AND DISCUSSION

Number of tillers : It is evident from the results in Table 1 that the number of tillers m^{-2} was affected significantly by sowing dates. Generally, results showed that the highest number of tillers m^{-2} (448.6 and 442.0 tiller m^{-2}) was obtained when wheat was sown on 10th November, while the lowest number of tillers m^{-2} (339.0 and 350.9 tiller m^{-2}) was obtained when wheat was sown on 20th December for both seasons, respectively. These results may be due to the effect of environmental conditions. Similar results were reported by RakesKumar Sharma (18), who found that delay in sowing from 15 November to end of December reduced this trait. The results in Table 1 shows clearly that the differences in number of tillers m^{-2} due to wheat cultivars were significant. Rasheed c.v. gave the highest number of tillers m^{-2} (428.7 and 432.4 tiller m^{-2}) followed by Bohooth 158 (376.1 and 383.2 tiller m^{-2}) than Bohooth 22 (361.2 and 377.6 tiller m^{-2}) during both seasons, respectively. The effect of interaction was non-significant during both seasons (Table 1), this reveals that the response of the cultivars to the sowing dates are identical.

Table 1. Effect of sowing dates, cultivars and their interaction on number of tillers m^{-2} for both seasons.

Sowing dates	First season Cultivars			means	Second season Cultivars			means
	Bohooth 22	Bohooth 158	Rasheed		Bohooth 22	Bohooth 158	Rasheed	
20th Oct.	362.3	397.3	440.3	400.0	400.7	409.7	429.0	413.1
10th Nov.	390.7	484.7	470.3	448.6	409.0	448.7	468.3	442.0
30th Nov.	364.3	312.3	424.3	367.0	357.3	340.0	457.3	384.9
20th Dec.	327.3	310.0	379.7	339.0	343.3	334.3	375.0	350.9
L.S.D 5%		NS		66.43		NS		46.29
Means	361.2	376.1	428.7		377.6	383.2	432.4	
L.S.D 5%		47.82				37.51		

Number of spikes

Sowing dates had a significant effect on the number of spikes m^{-2} in both seasons (Table 2). Highest number of spikes m^{-2} (403.3 and 408.6 spike m^{-2}) was recorded when wheat was sown in November 10, while the lowest number of spikes m^{-2} (300.4 and 333.2 spike m^{-2}) were produced at sowing in December 20 in both seasons, respectively. These differences may be due to increasing in number of tiller m^{-2} when wheat was sown in November 10 as compared with the late sowing in December 20 (Table 1). These results are in harmony with those obtained by Alisial et al. (2) who found that the delay in sowing significantly reduced number of spikes m^{-2}. Regarding cultivars, Rasheed produced highest number of spikes m^{-2} (389.5 and 397.3 spike m^{-2}), whereas Bohooth 22 gave the lowest number (315.9 and 359.4 spike m^{-2}) for both seasons, respectively (Table 2). These results might be due to that Rasheed cultivar produced more number of tillers m^{-2} as compared with other two cultivars (Table 1). Table 2 shows that the effect of interaction on this trait was non-significant during both seasons, this indicates the similarity response of cultivars to sowing dates.

Table 2. Effect of sowing dates, cultivars and their interaction on number of spikes m^{-2} for both seasons.

Sowing dates	First season Cultivars			means	Second season Cultivars			means
	Bohooth 22	Bohooth 158	Rasheed		Bohooth 22	Bohooth 158	Rasheed	
20th Oct.	333.0	380.3	418.3	377.2	386.0	396.0	413.0	398.3
10th Nov.	309.0	449.0	452.0	403.3	388.0	414.7	423.0	408.6
30th Nov.	329.7	307.0	381.3	339.3	335.7	320.7	397.3	351.2
20th Dec.	292.0	303.0	306.3	300.4	328.0	315.7	356.0	333.2
L.S.D 5%		NS		44.42		NS		55.48
Means	315.9	359.8	389.5		359.4	361.8	397.3	
L.S.D 5%		46.12				29.13		

Spike length : Sowing dates, wheat cultivars and their interaction significantly affected spike length in both seasons (Table 3). Sowing in 10th November produced taller spikes (15.84 cm) during first season, while 20th October gave the tallest spikes during second season (14.51 cm). The shortest spikes (14.03 and 12.55 cm) were produced at the late sowing in 20th December in both seasons, respectively. This may be due to the climatic effect and metabolites stored in early sowing caused to taller plants, vigorous growth and taller spikes. Similar results were obtained by other authors (1, 17). They found that delay in sowing decreased significantly this trait. Rasheed c.v. produced the tallest spikes (17.28 and 16.69 cm) followed by Bohooth 158 (14.16 and 12.65 cm), whereas shortest spikes were obtained from plants of Bohooth 22 cultivar (13.23 and 11.80 cm), for both seasons, respectively. Table 3 shows significant interaction between two variables in both seasons, this indicates different response of wheat cultivars, which used in this experiment to seeding dates. Rasheed c.v. gave tallest spikes when sown in 10th November (18.50 cm) for first season, and (17.78 cm) when sown in 20th October in second season. The lowest means of this trait were recorded with Bohooth 22 plants sown in 20th December (12.45 and 11.22 cm) for both seasons, respectively.

Table 3. Effect of sowing dates, cultivars and their interaction on spike length (cm) for both seasons

Sowing dates	First season Cultivars			means	Second season Cultivars			means
	Bohooth 22	Bohooth 158	Rasheed		Bohooth 22	Bohooth 158	Rasheed	
20th Oct.	13.40	13.81	18.36	15.19	12.20	13.54	17.78	14.51
10th Nov.	13.83	15.19	18.50	15.84	11.95	13.50	17.71	14.39
30th Nov.	13.22	14.04	16.24	14.50	11.84	12.01	16.38	13.41
20th Dec.	12.45	13.61	16.02	14.03	11.22	11.53	14.91	12.55
L.S.D 5%		0.972		0.692		0.995		0.760
Means	13.23	14.16	17.28		11.80	12.65	16.69	
L.S.D 5%		0.483				0.469		

Number of spikelets spike^{-1}

It is evident from the results shows in Table 4 that sowing dates, cultivars and their interaction affected significantly to the number of spikelets spike^{-1} in both seasons. Maximum number of spikelets spike^{-1} (22.08 and 22.26 spikelet spike^{-1}) was observed from sowing date 10th November, while the minimum number of spikelets spike^{-1} (19.35 and 19.50 spikelet spike^{-1}) were produced when plants were sown later in 20th December in both seasons, respectively. This means that number of spikelets spike^{-1} decreased by 14.11% and 14.15% with delaying sowing from 10th November to 20th December for both seasons, respectively. This finding might be attributed to the increased fertility with the taller spikes at the early sowing date. Similar results were reported by AnureetKaurPannu and Buttar (4) who concluded that the highest values for number of spikelets spike^{-1} were produced when wheat was sown early in 15th November. Highest number of spikelets spike^{-1} were recorded with Rasheed plants (22.52 and 22.59 spikelet spike^{-1}) followed by Bohooth 22 plants (21.01 and 21.15 spikelet spike^{-1}), whereas lowest number of the same trait were recorded from plants of Bohooth 158 (19.37 and 19.58 spikelet spike^{-1}) for both seasons, respectively. This observation indicated that significant variation among the cultivars could be due to differences in genetic materials. A significant interaction between cultivars and sowing dates due to differences in response of cultivars to seeding dates. Rasheed plants gave the highest number of spikelets spike^{-1} (23.22 and 23.60 spikelet spike^{-1}) when sown in 10th November, while the lowest number were obtained with Bohooth 158 plant (17.45 and 18.12 spikelet spike^{-1}) when sown in 20th December for both seasons, respectively.

Table 4. Effect of sowing dates, cultivars and their interaction on number of spikelets spike^{-1} for both seasons.

Sowing dates	First season Cultivars			means	Second season Cultivars			means
	Bohooth 22	Bohooth 158	Rasheed		Bohooth 22	Bohooth 158	Rasheed	
20th Oct.	22.25	20.65	22.82	21.91	22.29	20.22	23.37	21.96
10th Nov.	22.29	20.72	23.22	22.08	22.57	20.60	23.60	22.26
30th Nov.	20.79	18.65	22.15	20.53	20.60	19.35	22.16	20.71
20th Dec.	18.69	17.45	21.90	19.35	19.13	18.12	21.25	19.50
L.S.D 5%		1.119		0.900		0.491		0.366
Means	21.01	19.37	22.52		21.15	19.58	22.59	
L.S.D 5%		0.501				0.236		

Number of grains spike^{-1}

Results in Table 5 indicate that sowing dates had a significant effect on number of grains spike^{-1}. Sowing wheat cultivars in 10th November attained the highest number of grains spike^{-1} (56.37 and 58.63 grain spike^{-1}), compared with those obtained when wheat was sown at 20th October, 30th November and 20th December which produced 30.19, 51.71 and 46.19 grain spike^{-1} for fist season, and 31.07, 52.25 and 44.87 grain spike^{-1} for second season, respectively. The increase in this trait with sowing wheat on 10th November could be due to the climatic conditions during plant cycle that helped rapid growth and formation of good canopy able to make good photosynthesis which produced tallest spikes (Table 3) and highest number of spikelets spike^{-1} (Table 4). These results are in agreement with those obtained by other authors (16, 18). They found that sowing dates affected significantly the number of grains spike^{-1} which increased when wheat was sown on optimum date compared with early or late sowing dates. Regarding the cultivars, results in Table 5 shows a significant difference among the tested cultivars. Generally, the highest cultivar in number of grains spike^{-1} was Bohooth 22 followed by Rasheed and Bohooth158 which produced 51.23, 45.84 and 41.28 grain spike^{-1} during the first season, and 50.18, 47.69 and 42.24 grain spike^{-1} during second season, respectively. The effect of interaction between sowing dates and cultivars on this trait was significant during both seasons (Table 5). This difference due to differences among cultivars to sowing dates. Cultivar Bohooth 22 gave highest number of grains per spike (63.10 and 62.55 grain spike^{-1}) when sown in 10th November, whereas the lowest number of the same trait were obtained from Bohooth 158 plants when sown in 20th October (18.40 and 19.64 grain spike^{-1}) for both seasons, respectively.

Table 5. Effect of sowing dates, cultivars and their interaction on grains spike^{-1} for both seasons.

Sowing dates	First season Cultivars			means	Second season Cultivars			means
	Bohooth 22	Bohooth 158	Rasheed		Bohooth 22	Bohooth 158	Rasheed	
20th Oct.	32.00	18.40	40.16	30.19	33.28	19.64	40.29	31.07
10th Nov.	63.10	51.70	54.30	56.37	62.55	55.53	57.82	58.63
30th Nov.	56.50	50.90	47.73	51.71	55.64	50.82	50.31	52.25
20th Dec.	53.30	44.10	41.17	46.19	49.27	42.99	42.36	44.87
L.S.D 5%		5.622		3.752		8.749		7.618
Means	51.23	41.28	45.84		50.18	42.24	47.69	
L.S.D 5%		2.899				3.476		

1000-grain weight

Results in Table 6 show that there were significant differences in 1000-grain weight regarding sowing dates. The highest 1000 grain weight was recorded with plants sown on 20th October (42.94 and 43.72 g), while the lowest value was with plants sown on 20th December (33.04 and 34.22 g). The means of 10th November and 30th November were 40.09 and 38.11 g for first season, and 41.27 and 40.20 g for second season, respectively. It is obvious from the results that 1000-grain weight decreased as the sowing date delayed from 20th October till 20th December. The highest value for 1000-grain weight on 20th October might be due to the favorable environmental conditions for vegetative growth, which resulted in the active photosynthesis and maximum translocation of the assimilates to the grains and thus had heaviest grains. These results are in agreement with those obtained by Menshawy (13), he reported that under late sowing, a reduction in 1000-grain weight could be attributed to the reduction in grain filling period. Results clearly show significant variations among the tested cultivars. Rasheed c.v. had the heaviest 1000-grain weight (41.61 and 43.02 g), followed by Bohooth 22 (38.20 and 38.72 g) then Bohooth 158 (35.83 and 37.82 g) for both seasons, respectively. The reason behind the variation in 1000-grain weight for wheat cultivars could be due to their different genetic constitutions as well as their response to the prevailing environmental conditions. The effect of interaction on this trait was significant during both seasons (Table 6). This difference is due to differences among cultivars to seeding dates. Rasheed plants produced heaviest 1000 grain (47.16 and 48.76 g) when sown in 20th October, whereas the same cultivar produced the lightest 1000 grain (32.24 and 33.12 g) when sown in 20th December for both seasons, respectively.

Table 6. Effect of sowing dates, cultivars and their interaction on 1000-grain weight (gm) for both seasons.

Sowing dates	First season Cultivars			means	Second season Cultivars			means
	Bohooth 22	Bohooth 158	Rasheed		Bohooth 22	Bohooth 158	Rasheed	
20th Oct.	42.45	39.22	47.16	42.94	41.31	41.08	48.76	43.72
10th Nov.	39.74	34.82	45.70	40.09	39.70	38.32	45.78	41.27
30th Nov.	36.85	36.17	41.32	38.11	38.93	37.27	44.40	40.20
20th Dec.	33.76	33.11	32.24	33.04	34.96	34.58	33.12	34.22
L.S.D 5%		3.219		2.400		3.807		3.252
Means	38.20	35.83	41.61		38.72	37.82	43.02	
L.S.D 5%		1.549				1.566		

Grain yield

Grain yield is an important trait in evaluating the adaptability of cereal crops to environmental variations. Data in Table 7 shows that grain yield was significantly influenced by sowing dates. The highest value for this trait (4.96 and 5.21 t ha^{-1}) was obtained when wheat was sown on 10th November, and the lowest value was obtained at sowing date on 20th October (3.52 and 3.54 t ha^{-1}). The value of grain yield when wheat was sown on 30th November and 20th December was 4.21 and 3.70 t ha^{-1} for the first season and 4.49 and 3.71 t ha^{-1} for the second season, respectively. Delaying sowing to 20th December decreased grain yield about 34.05% and 40.43% compared with the sowing on 10th November, while the reduction in grain yield when wheat was sown on 20th October was 40.91% and 47.18% compared with wheat sown on 10th November for both seasons, respectively. The sowing on 10th and 30th November was more beneficial than the late sowings on 20th December as far as in arid regions the growing season for the winter crops is short, therefore, the growth period is complicated by high temperature at the end of the growing season. Furthermore, data reveal that sowing at optimum time favored the maximum partitioning of photosynthesis when compared to the late sowing and gave maximum grain yield. While, the decrease in grain yield when wheat was sown early (20th October) is attributed to the low temperatures during anthesis stage, which affected the pollen shedding, viability of pollen grains and consequently reduced the pollination by these unviable pollen grains. Similar results were reported by some other authors (9, 25). The reduction in wheat grain yield under heat stress could be caused by accelerated senescence, increased respiration, reduced photosynthesis and accelerated phasic development. On the contrary, other researchers (16) showed that sowing wheat on 15th December gave the highest grain yield per unit area. The effect of cultivars on grain yield was significant as shows in Table 7. The cultivar Rasheed gave the highest yield (4.50 and 4.71 t ha^{-1}) followed by Bohooth 22 (4.13 and 4.27 t ha^{-1}) and Bohooth 158 (3.66 and 3.73 t ha^{-1}) for both seasons, respectively. Rasheed ranked 1st, Bohooth 22 ranked 2nd and Bohooth 158 ranked 3rd. This variation among the three cultivars could be attributed to their different adaptation to wide differences in climatic conditions, and this difference could be due to their different genetic constitution. The effect of interaction between sowing dates and cultivars was significant for both seasons (Table 7). This difference is due to differences among cultivars to seeding dates. Rasheed produced the highest grain yield (5.30 and 5.53 t ha^{-1}) when sown in 10th November, whereas Cultivar Bohooth 158 gave the lowest yield (2.63 and 2.59 t ha^{-1}) when sown in 20th October during both seasons, respectively.

Table 7. Effect of sowing dates, cultivars and their interaction on grain yield (t ha^{-1}) for both seasons.

Sowing dates	First season Cultivars			means	Second season Cultivars			means
	Bohooth 22	Bohooth 158	Rasheed		Bohooth 22	Bohooth 158	Rasheed	
20th Oct.	3.66	2.63	4.25	3.52	3.67	2.59	4.36	3.54
10th Nov.	5.08	4.51	5.30	4.96	5.48	4.62	5.53	5.21
30th Nov.	4.30	3.83	4.49	4.21	4.55	4.06	4.85	4.49
20th Dec.	3.49	3.65	3.97	3.70	3.38	3.65	4.11	3.71
L.S.D 5%		0.7082		0.6363		0.8057		0.7651
Means	4.13	3.66	4.50		4.27	3.73	4.71	
L.S.D 5%		0.2620				0.2421		

It may be concluded from the results of this research that sowing in 10th November is the optimum sowing date to attain high grain yield in wheat under Iraqi environmental conditions.

REFERENCES

1. Ali, M. A., M. Ali, M. Sattar and L. Ali. 2010. Sowing date effect on yield of different wheat varieties. J. Agric. Res., 48 (2):157-162

2. Alisial, M., M. A. Arain, M. U. Dahot, G. S. Markhand, K. A. Laghari, S. M. Mangrio, A. A. Mirbahar and M. H. Naqvi. 2010. Effect of sowing dates on yield and yield components on mutant – cum – Hybrid Lines of bread wheat. Pak. J. Bot., 42(1): 269-277

3. Al-Otayk, S. M. 2010. Performance of yield and stability of wheat genotypes under high stress environments of the central region of Saudi Arabia. Met. Env. & Arid Land Agric. Sci., 21(1): 81-92

4. AnureeKaurPannu, R. K. and G. S. Buttar. 2010. Splitting of nitrogen dose affects yield and net returns in wheat sown on different dates. Indian Journal of Ecology, 37(1): 18-22

5. Asseng, S., F. Ewert, P. Martre, R. P. Rötter, D. B. Lobell, D. Cammarano, B. A. Kimball. 2015. Rising temperatures reduce global wheat production. Nature Climate Change, 5(2): 143-147

6. Baloch, M. S., I. T. H. Shah, M. A. Nadim, M. I. Khan and A. A. Khakwani. 2010. Effect of seeding density and planting time on growth and yield attributes of wheat. J. Animal & Plant Sci., 20(4): 239-242

7. El-Gizawy, N. Kh. B. 2009. Effect of planting date and fertilizer application on yield of wheat under no till system. World J. of Agric. Sci., 5(6): 777-783

8. El-Nakhlawy, F. S., F. Alghabari and M. Z. Ihsan. 2015. Response of wheat genotypes to planting dates in the Arid Region. Sci. Agric., 10 (2): 59-63

9. Hameed, E., A. S. Wajid, A. A. Shad, B. B. Jehan and M. Tilah. 2004. Effect of different planting dates, seed rate and nitrogen levels on wheat. Asian J. plant Sci., 2(6): 467-474.

10. Hasina, G., B. Saeed, A. Z. Khan, U. Latif, K. Ali, J. Rehman and S. Rehman. 2012. Yield and yield contributing triats of wheat cultivars in relation with planting dates and nitrogen fertilization. ARPN J. of Agric. & Biol. Sci., 7(6): 386-395

11. Javaid I., K. Hayat and S. Hussain. 2012. Effect of sowing dates and nitrogen levels on yield and yield components of wheat (*Triticum aestivum* L.). Pakistan J. Nutri., 11(7): 531-536

12. Madani, A., A. Shirani-Rad, A. Pazoki, G. Nourmohammadi, R. Zarghami and A. Mokhtassi-Bidgoli. 2010. The impact of source or sink limitations on yield formation of winter wheat (*Triticum aestivum* L.) due to post-anthesis water and nitrogen deficiencies. Plant Soil Environ. 56 (5): 218–227

13. Menshawy, A. M. M. 2007. Evaluation of some early bread wheat genotypes under different sowing dates. Earliness character. Fifth Plant Breeding Conference (May). Egypt J. Plant Breed., 11(1): 25-40. Special Issue

14. Moustafa, A. T. H. and S. A. El-Sawi. 2014. Influence of sowing date on development, harvest index and yield components for bread wheat cultivars having different thermal responses in middle Egypt. J. Plant Prod., Mansoura Univ., 5 (2): 211 – 226

15. Nasim, G., S. Ashraf and A. Javaid, 2006. Effect of sowing time on mycorrhizal development in wheat. Mycopath., 4(1): 13-19

16. Nohe, T. A., M. M. Abd-Alla, and T. F. Hussein. 2009. Effect of sowing dates and seeding rates on yield, yield components and quality of durum wheat (*Triticum durum* L.) under AL-Gabal AL-Akdar conditions, Libya J. Agric. Res. Kafer EL-Shekh Univ., Egypt, 35(3): 841-857

17. Rahman, M. M., A. Hossain., M. A. Hakim and M. M. R. Shah., 2009. Performance of wheat genotypes under optimum and late sowing condition. Ind. J. Sustain. Crop Prod., 4(6): 34-39

18-RakeshKumar Sharma, S. N. 2003. Effect of nitrogen on wheat as influenced by dates of sowing. Annals of Agricultural Research, 24(4): 104-110

19. Safdar, M. A., K. Naseem, M. A. Siddiqi, T. Hameed, and S. Khalil. 2009. Quality evaluation of different wheat varieties for the production of unleavened flat bread (Chapatti). *Pakistan J. Nutri.,* 8(**11**): 1773- 1778

20-Sial, M. A., M. A. Arain, S. K. Mazhar, H. Naqvi, M. U. Dahot and N. A. Nizamani. 2005. Yield and quality parameters of wheat genotypes as affected by sowing dates and

high temperature stress. Pak. J. Bot., 37(3): 575-584

21. Singh, P., and P. Dwivedi. 2015. Morpho-physiological responses of wheat (*Triticum aestivum* L.) genotypes under late sown condition. Soc. Plant Res., 28(1): 16-25

22. Steel, R. G. D., J. H. Torrie and D. A. Dickey. 1997. Principles and Procedures of Statistics: a Biometric Approach, 3rd Ed. McGraw Hill Book Co. Inc., New York. USA, pp: 484

23-Subedi, K. D, B. L. Ma and A. G. Xue. 2007. Planting date and nitrogen effects on grain yield and protein content of spring wheat. Crop Sci., 47: 36–44

24-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, Pakistan. Pak. J. Soc. Sci., 7(1): 66-69

25. Tammam, A. M. and M. B. Tawfelis. 2004. Effect of sowing date and nitrogen fertilizer levels in relation to yield and yield components of durum wheat (*Triticum turgidum* var,durum) under upper Egypt environments. J. Agric. Sci. Mansoura Univ., 29(10): 5431-5442

26. VirenderSardana Sharma, S. K. and A. S. Randhawa. 2002. Performance of wheat (*Triticum aestivum*) varieties under different sowing dates and nitrogen levels in the sub-mountain region of Punjab. Indian Journal of Agronomy, 47(3): 372-377

27. You, L., M.W. Rosegrant, S. Wood and D. Sun. 2009. Impact of growing season temperature on wheat productivity in China. Agricultural and Forest Meteorology, 149(6): 1009-1014

28. Zadoks, J. C., T. T. Change and C. F. Knozak. 1974. Adecimal code for growth stages of cereals. Weed Res., 14: 415-421.