Effect of Planting Dates on Growth and Yield of Four Cultivars of Wheat

Mahmood T. Al-Jayashi¹, Ali A.S. Hawal² and Alyaa Muayad Adham³

¹,³Agriculture College, Al-Muthanna University, Al-Muthanna, Iraq.
²Directorate of Agriculture of Al-Muthanna, Iraq.

¹Email: mohmoodth999@mu.edu.iq

Abstract

A field experiment was applied at the research station in Al-Najmi district, Al-Muthanna governorate during the agricultural season 2020-2021, to determine evaluating several cultivars of wheat by changing the date of their cultivation. The experiment was applied using the split plot using the Randomized complete Block Design (RCBD) with three replicates experiment method, where the planting dates were occupied (1/11, 15/11, 1/12 and 12/15) the main plots, while the cultivars (Baghdad, Furat, Rashid, and Wafia) occupied the secondary plots and with three replicates. The results showed that the planting date (1/12) was superior to the number of days up to 75% of flowering, the number of spikes.m², and the grain yield ton.ha⁻¹, which amounted to 109 days, 409.9 spikes and 5.77 tons, respectively. While the planting date (15/11) exceeded in both characteristics the leaf area and the number of grains in the spike, as it reached 46.18 cm and 49.78 grains. As for the cultivaries, the Baghdad cultivar surpassed in the characteristics of the area of the flag leaf, the number of fertile spikes, the number of grains per spike, and the grain yield, which reached 44.70 cm, 395.7 spikes.m⁻², 48.38 grains, spike⁻¹ and 6.16 tons.ha⁻¹, respectively.

Keywords: Growth, Cultivars, Wheat, Poaceae.

1. Introduction

Cereal crops are among the most important and oldest crops known to man because they were the basic material in his food, and the source of energy he needs because it contains a high percentage of carbohydrates necessary to provide his body with calories [1]. Wheat (Triticum aestivum L.), belonging to the family Poaceae, was at the forefront of strategic grain crops in the world and Iraq, and the efforts of specialists are concerted to raise its productivity and improve the quality of the resulting grain, which is positively reflected on the final products manufactured from it, and its importance comes because it contains the protein gluten, the basis for the bread industry, and a staple food for the world's population [2]. Where the grain consists of 63-71% starch, 8-17% protein, 8-17% water, 2-2.5% cellulose, 1.5-2% fat, -23% sugar, and 1.5-2% mineral elements [3]. The global cultivated area has reached 736.5 thousand hectares, and its productivity is expected to be about 739.9 million tons [4]. The phenomenon of climate change is one of the most important challenges facing humanity at the present time, and one of the most important scenarios witnessed by the regions of the world, especially the arid and semi-arid regions, is the increase in the concentration of atmospheric CO₂, the high rate of temperatures and the low and fluctuation of precipitation, which led to the emergence of disturbances in some physiological functions. The phenology of agricultural crops in general and wheat in particular, such as an increase in photosynthesis and respiration and a reduction in the life cycle [5].

Therefore, all environmental conditions and their variables are closely related to the date of planting and the appropriate requirements of temperature and photoperiod for the different stages of the plant. Understanding the crop’s performance under different environmental conditions (planting date) will inevitably lead us to know its behavior through its response to this change, and enable us to discover its genetic capabilities by ensuring the synchronization of the growth and formation of its various organs with the appropriate climatic conditions whose impact is reflected in increasing productivity and improving its quality characteristics. Lead us to choose the appropriate genotype for the most appropriate dates through early or late planting, reconsidering some agricultural practices, including re-examining agricultural dates and their suitability with the current climatic changes, which may be a feasible agricultural practice to face climate changes.
2. Materials and Methods

2.1 Experience site

A field experiment was carried out at the research station in Al-Najmi district (35 km north of the city of Samawa, which was used by the Agricultural Research Department, the National Program for Wheat Development during the agricultural season 2020-2021.

2.2 Experience factors

The experiment included a study of two factors:

The first: four planting dates, which were 1/11, 15/11, 1/12, and 15/12.

The second: It includes four cultivars of wheat (Baghdad, Wafia, Furat, Rashid).

2.3 Experience design

Based on the data and the nature of the factors included in the study, the treatments were distributed in a split-plots using the Randomized Complete Block Design (RCBD) with three replicates, and each replicate contains 16 experimental units.

2.4 Agricultural operations

The experimental land was plowed by two orthogonal plows with the inverter plow, after conducting the (watering) process for it, and it was divided according to the design used into panels with an area of (2 m x 2 m = 4 m²). 20 cm between one line and another, and the secondary panels were separated from each other by a distance of (0.5 m). Wheat seeds were sown according to the dates mentioned above, with a seed quantity (120 kg ha⁻¹) [6], the nitrogen fertilization process was 200 kg H⁻¹ by four equal batches of urea fertilizer (46% N) first in the emergence stage, the second is at the branching stage, the third is at the elongation stage, and the fourth is at the booting stage [7]. Phosphate fertilizer was added at the rate of 80 kg ha⁻¹ of P₂O₅ fertilizer before planting.

2.5 studied traits

2.5.1 Number of days from planting to 75% flowering

It was calculated based on the number of days from planting up to 75% of flowering for the experimental units by field observation.

2.5.2 Flag Leaf area (cm². plant⁻¹)

It was measured using a ruler for ten plants taken randomly from each experimental unit at the end of the flowering stage when the leaf area reaches its maximum limits and according to the law:

The leaf area = the length of the flag leaf * its width in the widest area * 0.95 [8].

2.5.3 Number of spikes m⁻²

The number of spikes after reaching full maturity for all harvested plants was calculated from two middle lines from each experimental unit and converted on the basis of square meter.

2.5.4 The number of grains. spike⁻¹

It was calculated from the average number of grains for ten spike after severing these ears manually and the number of grains spike⁻¹.

2.5.5 Weight of 1000 grains (g)

1000 grains were counted taken randomly from each experimental unit and then each sample was weighed using the sensitive scale.
2.5.6 Grain yield (tons ha\(^{-1}\))

The grain yield of the group of harvested plants was estimated from the two middle lines (40 x 200 cm) after manual threshing of the plants from each experimental unit, and after isolating the straw from the grain, it was weighed and the grain yield was extracted, ton ha\(^{-1}\).

3. Results and Discussion

3.1 Number of days from planting to 75% flowering

Table (1) showed that the planting dates affected the duration of the period from flowering to physiological maturity, as it gave the plants of the third date (1/12) the longest possible period to reach 75% flowering, which amounted to 110.75 days, while the plants of the first date gave (1/11) The shortest period was 93.58 days. The reason for the short flowering period at the first planting date is due to the increase in climatic changes rates from high temperatures and an increase in light intensity, which led to the accumulation of heat units needed for flowering. This result agreed with what was reached by the mechanism of Aglan et al. [9] who found a significant difference between planting dates in this trait. The results also showed in Table (1) that there was a significant difference between the cultivars in the number of days to reach 75% of flowering, where the plants of the faithful row took the longest period of 109.00 days with a significant difference from all cultivars, while the Baghdad row recorded the lowest period of 92.42 days and this is varieties of response to environmental conditions temperature and photoperiod requirements. As for the effect of the interaction in this trait, the results showed a significant difference between the planting dates and the cultivated cultivars, as the combination (faithful cultivar x fourth date) gave the longest period of 117.67 days, while the combination (Furat cultivar x first date) recorded the shortest period of 86.00 days.

Table 1. Effect of planting dates and cultivars and the interaction on the number of days from planting up to 75%.

| Cultivars | Planting date | average |
|-----------|---------------|---------|
|           | First (1/11)  | Second (15/11) | Third(1/12) | Forth (15/12) |
| Baghdad   | 81.33         | 87.67   | 107.00      | 98.33         | 93.58       |
| Rashid    | 105.33        | 107.67  | 111.67      | 112.33        | 109.25      |
| Wafia     | 97.00         | 114.33  | 114.00      | 117.67        | 110.75      |
| Furat     | 86.00         | 92.67   | 103.33      | 100.33        | 95.58       |
| Means     | 92.42         | 100.58  | 109.00      | 107.17        |             |
| L.S.D\(_{0.05}\) | 1.91 | 1.71 | 3.34 |  |

3.2 The leaf area (cm\(^2\))

Table (2) showed that the early planting date had a significant effect on the leaf area, as the plants of the first date (1/11) gave the highest leaf area amounted to 44.70 cm\(^2\), while the plants of the fourth date (15/12) gave the lowest average for this trait. It reached 33.65 m\(^2\) and the reason for this superiority is attributed to the appropriate climatic conditions at the first planting date, from the intensity of lighting and temperatures, which was reflected positively on the products of photosynthesis and thus increasing the supply of the flag leaf with everything it needed as it was the last parts of the plant [10].

The results also showed that the cultivars differed among themselves in this trait, as the Baghdad cultivar outperformed by giving it the highest average of 44.70 cm\(^2\), while the Furat cultivar gave the lowest average of 33.65 cm\(^2\), and this result was in agreement with Al-Kafaai [1], which attributed the reason for this to the influence of the science paper on the genetic structure of the cultivaries This is due to the difference in the period from planting until the expulsion of the ears.

The results also showed a significant interaction between the cultivars and planting dates, as the combination (Rashid cultivar x second date) gave the highest average of 53.54 cm\(^2\) while the combination (Furat cultivar x third date) gave the lowest average of 31.15 cm\(^2\).
Table 2. The effect of planting dates and cultivars and the interaction on leaf area (cm²).

| Cultivars | Planting date | average |
|-----------|---------------|---------|
|           | First (1/11)  | Second (15/11) | Third (1/12) | Forth (15/12) |
| Baghdad   | 42.23         | 50.13    | 41.74       | 44.72         | 44.70         |
| Rashid    | 45.06         | 53.54    | 38.51       | 40.37         | 44.37         |
| Wafia     | 39.98         | 42.15    | 34.04       | 37.34         | 38.38         |
| Furat     | 31.19         | 38.89    | 31.15       | 33.38         | 33.65         |
| Means     | 39.62         | 46.18    | 36.36       | 38.95         |               |

L.S.D_{0.05} = 1.09

Table 3. The effect of planting dates and cultivars and the interaction on Number of spikes m².

| Cultivars | Planting date | average |
|-----------|---------------|---------|
|           | First (1/11)  | Second (15/11) | Third (1/12) | Forth (15/12) |
| Baghdad   | 358.7         | 364.2    | 465.6       | 394.4         | 395.7         |
| Rashid    | 354.5         | 338.8    | 450.3       | 385.6         | 382.3         |
| Wafia     | 332.3         | 303.2    | 383.7       | 372.5         | 347.9         |
| Furat     | 316.4         | 283.9    | 339.8       | 335.1         | 318.8         |
| Means     | 340.5         | 322.5    | 409.9       | 371.9         |               |

L.S.D_{0.05} = 13.22

3.3 Number of spikes m²

Table (3) showed that the planting dates had a significant impact on the number of spikes, as the plants of the first date (1/11) gave the highest average of 395.7 spikes m², while the plants of the fourth date recorded the lowest average of 318.8 spikes m², the reason for this is due to the late planting date, which affected the growth of the vegetative total, especially the number of straws, which mainly affects the number of spikes.

The table also showed that there were significant differences between the cultivars in this trait, as the cultivar Wafia was superior by giving it the highest average of 409.9 spikes m² while the cultivar Rashid recorded the lowest average of 322.5 spikes m². This result agreed with Al-Salem [12], who pointed out the different types of wheat among them. The results also showed a significant interaction, as it was noted that the combination (Baghdad cultivar × the third date) gave the highest average of 465.5 spikes m² while the combination (faithful cultivar × the second date) gave the lowest average of 303.2 spikes m² and the reason for this can be attributed to what was discussed for the factors was single.

Table 4. The effect of planting dates and cultivars and the interaction on Number of grains spike⁻¹.

| Cultivars | Planting date | average |
|-----------|---------------|---------|
|           | First (1/11)  | Second (15/11) | Third (1/12) | Forth (15/12) |
| Baghdad   | 49.78         | 47.12    | 50.03       | 49.78         |
| Rashid    | 47.12         | 49.78    | 50.03       | 47.12         |
| Wafia     | 49.78         | 47.12    | 50.03       | 47.12         |
| Furat     | 49.78         | 47.12    | 50.03       | 47.12         |
| Means     | 49.78         | 47.12    | 50.03       | 47.12         |

L.S.D_{0.05} = 13.22

3.4 The number of grains spike⁻¹

Table (4) showed that the sowing dates affected the number of grains, as the second sowing date (11/15) gave the highest average of 49.78 grains⁻¹, while the third sowing dates (1/12) recorded the lowest average of 40.07 grains spike⁻¹. The reason for the decrease in the number of grains in the late dates is due to the high temperature during that period, which negatively affected the number of grains in the spike. This result agreed with Al-Rashi [10] and Jassim et al. [13] who found a significant difference in the different sowing dates for the number of grains characteristic.

The results also showed a significant difference between the cultivars of the experiment in the trait of the number of grains, as the Baghdad cultivar significantly outperformed it by giving it the highest average of 48.38, while the Euphrates cultivar recorded the lowest average of 40.46. During the period of its formation and this result agreed with Farooq et. al. [14].

The results also showed a significant interaction between planting dates and cultivars, as the combination (Baghdad cultivar × second date) gave the highest average of 58.03, while the combination (Furat cultivar × third date) recorded the lowest average of 37.23 grains.
3.5 Weight of 1000 grains (g)

The results in Table (5) showed that the planting dates affected the trait of the weight of a thousand grains, as the plants of the first date (1/11) gave the highest average of 42.21 g, while the plants of the fourth date recorded the lowest average of 34.24 g. The reason for the decrease in the weight of the grains with the delay in planting dates was due to the short duration of the grain’s filling period due to its coincidence with high temperatures and consequently the lack of accumulated materials and its low weight. This result agreed with Al-Jaishi [10] and Alam et al. [15].

It was also noted from the table that there was a significant difference between the cultivars included in the experiment, where the plants of the cultivar Rashid gave the highest average of 44.36 g without a significant difference with the Baghdad cultivar, which recorded an average of 44.27 g, while the cultivar recorded the lowest average of 37.32 g. The discrepancy between the cultivaries in this trait may be due to the difference in the number of grains in the spike, which led to a greater opportunity for the accumulation of nutrients in the grain due to the lack of competition, agreed with Al-Amiri and Al-Obaidi [16] and Al-Hamdawi [17]. The results also showed a significant interaction between planting dates and cultivars, as the combination (Rasheed cultivar × the third date) gave the highest average of 47.00 g without significant drooping with some combinations, while the combination (Furat cultivar × the second date) recorded the lowest average of 30.77 g.

3.6 Grain yield (tons. ha⁻¹)

The results of Table (6) showed that the planting dates affected the yield, as the plants of the first date (1/11) gave the highest average of 6.16 tons.ha⁻¹ with no significant difference with the second date (15/11) which recorded an average of 6.14 tons. ha⁻¹, while the fourth planting date (12/15) gave the lowest average of 4.12 tons. ha⁻¹. The reason for the superiority of the planting date for the first may be due to the formation of a sufficient number of fertile ears (table 3.) and the number of grains (table 4.), which was positively reflected on the weight of one thousand grains (table 5.), which led to an increase in yield, agreed with Shaker et al. [18].

It was also shown from the results of table (6) that the cultivars differed significantly in the trait of grain yield, as the cultivar Wafia gave the highest average of 5.77 tons ha⁻¹ without significant difference with the Baghdad cultivar, while the cultivar Rashid recorded the lowest average of 5.28 tons ha⁻¹. The reason for the superiority of the cultivar Wafia in the grain yield is due to its superiority in the characteristic of the number of fertile spike. Table (3) These results agreed with Al-Aseel et al. [19], who showed that the wheat cultivars differ among themselves in the grain yield. It was noted that there was a significant interaction between the cultivars and planting dates, as the combination (Rasheed cultivar × the third date) gave the highest average of 6.74 tons.ha⁻¹, while the combination (Furat cultivar ×the second date) gave the lowest average of 3.65 tons.ha⁻¹.
Table 6. The effect of planting dates and cultivars and the interaction on grain yield (tons. ha⁻¹).

| Cultivars     | Planting date |                   |                   |                   |                   |                   |
|---------------|---------------|-------------------|-------------------|-------------------|-------------------|-------------------|
|               | First (1/11)  | Second (1/15/11) | Third, (1/12)     | Forth, (1/15/12)  | Average           |                   |
| Baghdad       | 5.93          | 6.00             | 6.60              | 6.12              | 6.167             |                   |
| Rashad        | 5.93          | 5.99             | 6.74              | 5.90              | 6.142             |                   |
| Wafia         | 5.88          | 5.50             | 5.68              | 5.28              | 5.588             |                   |
| Furat         | 4.89          | 3.65             | 4.07              | 3.90              | 4.129             |                   |
| Means         | 5.661         | 5.288            | 5.776             | 5.302             |                   |                   |

L.S.D₀.₀₅        | Planting date | Cultivars | Planting date* Cultivars |
|----------------|---------------|-----------|-------------------------|
| 0.17           | 0.21          | 0.40      |

References

[1] Al-Anbari, Muhammad Ahmad Abrihi (2004) Reciprocal genetic analysis and path factor for genotypes of bread wheat. Triticum aestivum L. Ph.D. thesis. College of Agriculture, University of Baghdad.
[2] Jamali, K D.; M. A. Arain and M. Mhamd (2000) Comparative performance of semi-dwarf wheat (Triticum aestivum L.) genotypes. Wheat Information Service, (90): 45-46.
[3] Al-Shammari, Ibrahim Abdullah Hamza (2007) Stimulation and evaluation of genetic variation for drought tolerance in some cultivars of wheat (Triticum aestivum L.) ex vitro. PhD thesis. faculty of Agriculture. Baghdad University.
[4] FAO (2017) World Wheat market at a glance Food outlook, Economic Social Dept. (1): 1-7.
[5] Al Hosani. Ahmed Sheikha (2017) Climate change . Report on the state of the environment in the Emirate of Abu Dhabi. 11-page publications. Environment Agency Abu Dhabi.
[6] Indicative Bulletin (2012) Agricultural Extension Department. p. 36 Baghdad, Iraq.
[7] Jadoua, Khudair Abbas and Haider Abdel Razzaq Baqer (2012) Effect of seed depth on yield characteristics and components for six cultivars of wheat. Iraqi Journal of Agricultural Sciences, 43(1):25-37.
[8] Thomas, H. (1975) The growth response to weather of simulator vegetative swards of a single genotype of Lolium perenne . J. Agric. Sci. Camb., 84 : 333-343.
[9] Aglan M.A., E.A.Abd EL- Hamid and A.M.Morsy (2020) Effect of Sowidng date on yield and its components for some breads wheat genotypes Zagazig . Agric. Res., 47: 117-122.
[10] Al-Jiashi, Ali Abdel-Sada about (2020) Effect of planting dates on the growth, yield and quality of local cultivars and newly introduced genotypes of fine wheat. PhD thesis. Faculty of Agriculture, Al-Muthanna University.
[11] Al-Kaefai, Maryam Hamed Abdel-Kazim (2017) Response of newly introduced wheat cultivars, Triticum aestivum L., to different planting dates. Master's thesis. College of Agriculture, Al-Muthanna University.
[12] Al-Salem, Saleh Hadi Farhoud (2018) Evaluation of genotypes of bread wheat (Triticum aestivum) using biochemical and molecular techniques compared to morphological characterization. PhD thesis, College of Agriculture, Al-Muthanna University.
[13] Jassim, Shaker Rahma, Tariq Kazem Maya, and Adnan Jassim Thabet (2016) Effect of planting dates on growth, yield and components of wheat (Triticum aestivum L.). Maysan Journal of Academic Studies, (29): 176-185.
[14] Farooq, M., I. Khan., S. Ahamed., N. Tlyas., A.Saboors., M. Bakhtiar., S. Khan., I. Khan. and N. Ilyas (2018) Agronomical efficiency of two Wheat (Triticum aestivum L.) Cultivaries against different level of Nitrogen fertilizer in Subtropical region of Pakistan. International Journal of Environmental & Agriculture Research., 4(4): 227-233.
[15] Alam Md. P., S. Kumar, N. Ali, R. P. Manjhi, N. Kumari, R. K. Lakva and T. Zharih (2013) Performance of Wheat Cultivaries under Different Sowing Dates in Jharkland. J. Wheat Res., 5 (2): 61-64.
[16] Al-Amiri, Muhammad Mahmoud Abd al-Illah and Muhammad Awaad Al-Obaidi (2016) Evaluation of Several Genetic Structures of Wheat and Tartikel Crops under Desperm Agriculture Conditions in Sulaymaniyah Governorate.. Anbar Journal of Agricultural Sciences 163(4): 141-171.
[17] Al-Hamdawi, Esraa Rahi Sayhod (2017) Contribution of flag leaf, rest of plant leaves and inflorescence parts to growth and grain yield of three cultivars of wheat and oats. Master's thesis, College of Agriculture, Al-Muthanna University.
[18] Shaker A. M., M. M. Salih ., AL-Salim . S. H. F. (2019) Study of certified wheat (Triticum aestivum L) cultivars response to different planting date to evaluate the active products and yield . Plant Archives, 19(1): 142-145.
[19] Al-Aseel, Ali Salim Mahdi, Dawood Salman Madab Al-Obaidi and Muhammad Hamdi Mahmoud Al-Qadi. (2018) Response of Bread Wheat Cultivaries Triticum aestivum L. to Four Sowing Dates. Journal of Tikrit University of Agricultural Sciences., 18(2): 77-86.