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Effect of Planting Dates on Qualitative Traits of Wheat (*Triticum aestivum* L.) Varieties

Iqtdar Khudair Al-mafraji[1], Salah Hameed Jumaa[2] and Abdullah Hassn Mohammed[3]

[1]Department of Field Crops, Tikrit University, College of Agriculture, IRAQ.

[2]Department of Field Crops, Tikrit University, College of Agriculture, IRAQ.

[3]Department of Field Crops, Tikrit University, College of Agriculture, IRAQ.

[3]Corresponding Author: abdullah@tu.edu.iq

ORCID

https://orcid.org/0000-0002-7761-2713

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ABSTRACT

A field experiment was carried out during the winter season 2022-2023 at the research station of the Field Crops Department, College of Agriculture, Tikrit University to study the effect of planting dates on the qualitative characteristics of each of the cultivated varieties to determine the best planting date for each variety and to find the best combination between (varieties x planting dates). The experiment was applied using the Split Plot Design method using a Randomized Complete Block Design (R.C.B.D) with three replications. Main plots included planting dates (Oct. 5, Oct. 25, Nov. 15, Dec. 5, Dec. 25) while sub-plots included wheat varieties (Ibaa99, Al-Rashid, Al-Baraka, Sham6, Tammuz2, Al-Hashimiyah, Al-Nour and Al-Adnaniyah). The results showed a significant effect of the variety treatments on all studied qualitative traits. Tammuz 2 variety was superior in the protein percentage and sedimentation volume (12.32% and 30.03 ml), respectively, Sham6 variety was superior in the wet and dry gluten percentage (36.64 and 12.30%, respectively), while Ibaa99 variety was superior in the ash and flour moisture percentage (1.91 and 9.60%, respectively). Planting date treatments had a significant effect on the qualitative characteristics of wheat varieties. Planting date treatment of Dec. 25 was superior by giving the best results for the protein percentage (12.05%), wet and dry gluten percentage (35.85 and 11.97%, respectively), ash percentage (1.76%), and sedimentation volume (28.92 ml). Also, the interaction between (varieties x planting dates) had a significant impact on the qualitative traits studied, the interaction treatment of (Tammuz2 x Dec. 25) was superior by giving the best results for the protein percentage (12.76%), the interaction of (Sham6 x Dec. 25) was superior in wet and dry gluten percentages (38.96 and 12.93%, respectively), and the interaction of (Ibaa99 x Nov. 15, Dec. 5 and Dec. 25) gave the highest values of ash percentage (1.96%), sedimentation volume (35.53ml) and flour moisture percentage (9.96%), respectively.

Keywords- Ash, Gluten, Moisture, Planting dates, Protein, Sedimentation, Wheat varieties.

I. INTRODUCTION

Wheat (*Triticum aestivum* L.) belongs to Poaceae family. It is considered one of the most important and most productive grain crops in the world. During 2021-2022, the total global wheat grain production reached 778.6 million tons, compared to 697.0 million tons in the 2011-2012, and 756.5 million tons in the period of 2016-2017, which led to an annual increase of only 1.24% in the past ten years and 0.83% during the past five years. These results show a decline in the annual rate of increase versus the desired rate of 1.5-2% to meet the growing demand of the world population [1]. In Iraq, the cultivated area of the wheat reached (1.87 million

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hectares) in 2022, except for the Kurdistan region, where this area decreased by (20.9%) from the previous season, which was (2.37 million hectares). Wheat production also reached (2.77 million tons), with an estimated decrease about (34.7%) of last season's productivity, which was estimated at (4.23 million tons) with average yield (1.48 tons ha^{-1}) compared to (1.79 tons ha^{-1}) for the year 2021 [2]. More than two-thirds of the world's population depends on the wheat crop for their livelihood. It provides human food with more than 25% of calories and proteins. In addition, it contains fats, some mineral salts, thiamine (B1) and riboflavin (B2) vitamins [3]. Grains are used in the manufacture of bread, as well as pasta, biscuits, and a wide range of sweets because due to their components of starch and protein compounds. It is also a good source of dietary fiber, resistant starch, phenolic acids, lignans, and various antioxidant compounds such as carotenoids, tocopherols, and tocotrienols. These components provide a wide range of medicinal properties, including anti-cancer, anti-microbial, anti-diabetic, antioxidant, laxative and moisturizing effects. Residues of wheat such as hay and straw are also used as dry animal feed [4]. The low productivity of wheat per unit area is one of the most important problems facing increasing production and achieving self-sufficiency of this crop. Therefore, work must be done to raise its production efficiency through the use of resistant varieties with high production efficiency. Varieties vary in the nature of their growth due to their genetic variabilities. Therefore, the growth of the crop, its arrival at the vegetative growth stage, and the yield differ depending on the variety, which is reflected in its growth and productivity. The total crop yield is affected by multiple genetic and environmental factors, most notably planting dates, and developing genotypes that are

compatible with early and late planting is considered one of the best solutions to obtain a resistant variety and to reduce the effect of low or high temperatures on plants [5]. Planting dates are considered one of the essential inputs for field crops. The optimal sowing date is affected by climate changes, so it is assumed that the best planting date is determined to obtain the best plant yield. The characteristics of crop production are directly correlated to the temperature and relative humidity of the atmosphere during a growing season. Therefore, it is necessary to provide the thermal requirements of the wheat varieties to get high production [6]. Hence, this study aimed to demonstrate the genetic susceptibility of wheat varieties and the extent of adaptation to the appropriate planting date and the impact of this on the qualitative characteristics, also to evaluate different planting dates, which may be a feasible agricultural practice to face climate changes.

II. METHODOLOGY

A field experiment was carried out during the winter season 2022-2023 at the research station of the Field Crops Department, College of Agriculture, Tikrit University, located at longitude 34.35 east and latitude 34.27 north, in order to study the effect of five planting dates (Oct. 5, Oct. 25, Nov. 15, Dec. 5, Dec. 25) and the accompanying effects and changes of environmental factors on the growth requirements and qualitative characteristics of eight different wheat varieties (Ibaa99, Al-Rashid, Al-Baraka, Sham6, Tammuz2, Al-Hashimiyya, Al-Nour and Al-Adnaniyah). Soil samples were taken from the experimental land randomly from five locations, with a size of 1 kg and a depth of (0-30 cm). The soil samples were mixed and sent to the laboratory of the Soil and Water Resources Department at the College of Agriculture, Tikrit University to analyze the soil sample and know its physical and chemical characteristics (Table 1). The experiment was carried out using a Randomized Complete Block Design (R.C.B.D.), according to a split-plot arrangement, with three replications. Each replicate includes five main plots (planting dates), and each main plot is divided into eight sub-plot (wheat varieties). The area of the sub-plot is (2 x 0.6m), and five lines with dimensions (10 x 10cm) were planted. The soil service process was carried out by tiling the land with disc harrows, because the soil is gypsum. Then the field was leveled and amended. After that, the field was divided into three replications, where each replicate included 40 experimental units (five main plots and eight sub-plots). The field was fertilized with phosphate fertilizer at a rate of 100 kg ha^{-1} of P2O5 before planting. Nitrogen fertilizer (urea) 46% N was added in an amount of 200 kg ha-1in three batches, first was in the emergence stage, the second was in branching stage and the third in the booting stage [7]. The planting process was carried out manually according to the five planting dates. The water used for irrigation was well water, and weed was removed manually whenever necessary.

Table 1: Physical and Chemical Characteristics of the Experimental Soil.

No.	Characteristics	Value	Unit
1	EC	3.43	MS
2	pH	7.6	-
3	Ca	120	PPM
4	K	110	PPM
5	Na	867	PPM
6	N	25	PPM
7	P	8.4	PPM
8	Mg	15	PPM
9	Lime	19	%
10	Gypsum	16	%
11	Organic matter	1.1	%
12	Sand	41.5	%
13	Silt	48	%
14	Clay	10.5	%
15	Soil texture	Loam	-

2.1 The qualitative characteristics studied:

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The qualitative characteristics of wheat flour samples were estimated using the Informatic device, equipped by Perten Company, located at the General Company for Grain Processing, according to the method of [8], it is Near Infrared Reflectance (NIR) [9].

***2.2 Protein percentage* (%):**

This is done by taking 10 grams of the previously prepared flour sample and placing it in a small, cubic-shaped container located within the device. The device is turned on and results are given within a few minutes. The small container is cleaned with a special brush when preparing for the next sample.

2.3 Wet gluten percentage (%):

The flour was mixed, then (10) g of flour sample was weighed on the sensitive scale, then a fine sieve with a size of (88) microns was placed in the plastic washing container of the device, and the sample of flour was emptied into the container, and then the plastic container was placed in the place designated for it in the device. After that, the device is turned on. In the first stage, the sample was washed and the starch and dissolved protein were removed through rotating blades that mix the sample with the continuous drip of the saline solution on the sample, when the device stops automatically, the first stage of washing ended. In the second stage, the washed sample was extracted, then transferred to another vessel containing a coarse sieve, and the device was restarted to wash the bran. After the specified period has finished, the device was stopped, the washed sample was extracted and placed on a sensitive scale, a reading of the scale was taken, and the weight was calculated according to the following equation:

Wet gluten% = total weight (weak + strong) x 100

2.4 Dry gluten percentage (%):

After calculating the percentage of wet gluten, the sample was dried in an oven at a temperature of 105°C for four minutes in the GlutorK 2020 device, then the sample was weighed in a sensitive scale, the result was recorded and converted to a percentage.

Dry gluten Percentage (%) = Dry gluten weight/ Weight of flour sample × 100

2.5 Ash percentage (%) :

The ash content in flour was estimated by following the standard method No. (0.8-0.1) [8] by burning (5) g of flour at a temperature of 6000°C for 5 hours. A Muffle Furnace oven type Gallenhamp Tactical 308 was used for this purpose until the grayish white color appears or until the weight stabilizes .Ash can be calculated from the following equation:

Ash percentage (%)= The weight of ash calculated above/ Sample weight=100 – 14/100 - the percentage of sample moisture x 100

Sedimentation volume (ml)

The method of extracting the sedimentation volume was developed by [10] as a useful method in estimating the strength of the mixture. The sedimentation volume was estimated using the Informatic device, which was manufactured by the Swiss company Perten. The wheat sample was roughly ground and sieved to separate most of the bran, and (15) g of the previously prepared flour sample was taken. Then it was placed in a small cubic-shaped container that placed in the device. The device was turned on and the results can be obtained after a short period of no more than 5 minutes .

2.6 Moisture percentage of flour (%):

The moisture content of flour of the studied varieties was measured using a 50-PFEUFFR HE moisture test device approved by the Ministry of Trade, General Grain Processing Company, Tikrit branch.

The data were analyzed statistically as a factorial experiment using the split-plot method according to a Randomized Complete Block Design (R.C.B.D.) using the statistical program SAS (2003), and the means of the studied characteristics were compared using the Duncan multiple range test at $\alpha = 0.05$.

III. RESULTS AND DISCUSSION

Analysis of variance showed high significant difference among planting dates for all studied traits except flour moisture percentage, high significant difference among varieties for all studied traits, and high significant interaction for protein percentage, wet and dry gluten percentage. These results indicated that there were high variation among planting dates and high genetic variation among varieties (Table 2).

3.1 Protein percentage (%)

The protein content of wheat grains is an important characteristic in the grain manufacturing process because of its major role in determining the type and quality of the flour produced. Wheat proteins are among the best types of proteins used in the bread industry and depend mainly on genetic factors and environmental and agricultural conditions during the growth stage. Table (3) showed the effect of wheat varieties, planting dates, and the interaction of (varieties x planting dates) on the trait of protein percentage (%) in grains. It was noted that there were significant differences among wheat varieties for protein percentage. Tammuz2 variety gave the highest value of protein (%), which was reached (12.32%), while Ibaa99 variety had the lowest value, which was recorded (10.80%). The reason for these differences among the varieties is attributed to their genetic nature and the extent of their response to physiological processes that affect the formation of the products of the photosynthesis process. These results are consistent with the results of [11] [12] who stated that wheat varieties significantly affect the protein percentage.

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Table 2: Analysis of Variance of Wheat Varieties, Planting Dates, and Their Interaction of Qualitative Traits

S.O.V	d.f	Protein (%)	Wet Gluten (%)	Dry Gluten (%)	Ash (%)	Sedimentation Volume (Ml)	Flour Moisture (%)
Block (B)	2	0.063	1.420	0.189	0.007	2.404	1.028
Planting Dates (A)	4	6.069 **	83.172 **	9.256 **	0.065 **	113.409 **	0.654
Error (a)	8	0.080	0.358	0.031	0.002	7.614	0.565
Varieties (B)	7	4.166 **	39.033 **	4.334 **	0.103 **	51.710 **	1.618 *
Planting Dates × Varieties	28	0.504 **	3.571 **	0.443 **	0.006	9.286	0.455
Error(b)	70	0.066	0.165	0.029	0.003	7.957	0.420

*Significant at the 0.05 probability level.
**Significant at the 0.01 probability level.

Table 3: The effect of varieties, planting date, and their interaction on the protein percentage (%) in grains of wheat crop

Varieties	Planting dates					varieties Averages
	Oct. 5	Oct. 25	Nov. 15	Dec. 5	Dec. 25	
Ibaa99	10.53 mn	10.63 lmn	10.50 mno	10.80 k-n	11.56 fgh	10.80 f
Al-Rashid	10.90 klm	11.40 g-j	11.20 Ijk	11.33 hij	11.86 def	11.34 c
Al-Baraka	11.40 g-j	11.63 fgh	11.90 c-f	11.33 h-j	12.90 a	11.83 b
Sham 6	10.50 no	10.90 klm	11.70 e-h	11.00 jkl	11.63 fgh	11.14 cd
Tammuz 2	11.76 d-g	12.16 cd	12.60 ab	12.30 bc	12.76 a	12.32 a
Al-Hashimiyah	9.33 q	11.36 g-j	10.90 Klm	11.10 Jk	11.76 d-g	10.89 ef
Al-Nour	10.86 k-n	11.33 hij	10.10 op	11.00 jkl	12.06 cde	11.07 de
Al-Adnaniyah	9.83 p	10.46 no	10.90 Klm	11.60 f-i	11.86 def	10.93 de
Averages Planting dates	10.64 c	11.23 b	11.22 B	11.30 b	12.05 a	

*Means followed by the same letter for each factor and the interaction between factors are not significantly different ($P \leq 0.05$) according to Duncan's test

For planting dates, the fifth planting date (Dec. 25) was significantly superior to all planting dates for protein percentage (12.05%) while the first planting date (Oct. 5) gave the lowest value (10.64%). This increase in protein percentage may be due to the delay in the planting date leading to the grain filling period being exposed to high temperatures, which leads to the conversion of nitrogen into protein. In addition, the decrease of grain yield at this date (Dec. 25) led to an increase in the protein percentage, as there is a negative correlation between the grain yield and the nitrogen percentage. This correlation resulted from a decrease in the nitrogen percentage in grains when the grain yield increase. These results are consistent with the findings of [13] [14] who found that environmental conditions that lead to decrease the grain yield are expected to lead to an increase the percentage of protein.

For the interaction, the two varieties Al-Baraka and Tammuz2 gave the highest values of protein percentage at the fifth date planting (Dec. 25), reached (12.90 and 12.76%) respectively, and they differed significantly from the rest of the studied varieties at all planting dates. While the combination of (Al-Hashimiyah x Oct. 5) had the lowest value of protein percentage (9.33%). This difference may be due to the variation of grain yield and protein percentage as a result of the effect of the variation in the response of varieties to environmental variations occurring with the different of the planting date [13]. This result agreed with [14] [15].

3.2 Wet gluten percentage(%)

Table (4) showed the effect of the varieties, planting dates, and the interaction (varieties x planting dates) on the trait of wet gluten percentage (%). It was noted that the varieties differed from each other significantly. Sham6 variety gave the highest wet gluten percentage, amounted to (36.64%), and this superiority was significant over the rest of the varieties, while the lowest percentage of wet gluten was in the Al-Nour variety, which was (31.12%). The reason of these differences among varieties is due to their genetic nature and the percentage of protein present in the grain., as [16] stated that the percentage of wet gluten is considered a reflection of the percentage of protein in the flour and is also considered a good indicator of the quality of the variety. This result is consistent with the results of [11] [12] [17] [18] who they found a significant difference between wheat varieties in the percentage of wet gluten.
For planting dates, the fifth planting date (Dec. 25) was significantly superior to all planting dates in wet gluten percentage trait, which amounted (35.85%) while the first planting date (Oct. 5) had the lowest mean of this trait (31.09%). The reason for this superiority may be due to the decrease of grain yield in this planting date and the increase of protein percentage .

For the interaction, the interaction of (Sham6 x Dec. 25) gave the highest mean of wet gluten percentage, which reached to (38.96%), and it was differed significantly from the rest of the studied varieties at all planting dates. while the lowest mean of this trait was recorded in the interaction of (Al-Baraka x Oct. 5), which was reached (29.73%). The reason of this results may be due to a reflection of the protein percentage.

Table 4: The effect of varieties, planting dates, and their interaction on the percentage of wet gluten (%) in the wheat crop

Varieties	Planting dates					varieties Averages
	Oct. 5	Oct. 25	Nov. 15	Dec. 5	Dec. 25	
Ibaa99	32.93 lmn	33.40 jkl	32.20 op	33.20 jkl	35.83 efg	33.55 b
Al-Rashid	30.70 tu	32.36 m-p	32.30 nop	36.16 de	37.73 B	33.85 b
Al-Baraka	29.73 w	31.36 rs	30.80 stu	36.16 ijk	35.13 H	32.14 e

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Sham 6	34.10 i	36.80 cd	36.10 ef	37.23 bc	38.96 A	36.64 a
Tammuz2	31.03 rst	32.80 l-o	34.00 ij	33.30 kl	33.80 Ijk	32.98 cd
Al-Hashimiyah	29.93 vw	30.93 r-u	30.46 tuv	35.50 fgh	36.13 Ef	32.59 de
Al-Nour	29.96 vw	30.30 uvw	31.50 qr	30.90 r-u	32.96 Lm	31.12 f
Al-Adnaniyah	29.96 uvw	32.10 pq	33.20 kl	35.36 gh	36.26 De	33.45 bc
Averages Planting dates	31.09 d	32.50 c	32.57 c	34.44 b	35.85 A	

*Means followed by the same letter for each factor and the interaction between factors are not significantly different (P ≤ 0.05) according to Duncan's test

3.3 Dry gluten percentage (%)

The percentage of dry gluten is highly correlated with the percentage of wet gluten, which is obtained after drying the wet gluten at a high temperature. Calculating the percentage of dry gluten is important to determine the percentage of moisture absorbed by the gluten of different varieties of wheat when water is added. Table (5) showed the effect of wheat varieties, planting dates, and the interaction of (varieties x planting dates) on the trait of dry gluten percentage. It was noted that there were significant differences among wheat varieties for the percentage of dry gluten. Sham6 variety gave the highest value of dry gluten percentage, which amounted to (12.30)%, and it was significantly higher than the rest of the varieties, while Al-Nour variety had the lowest value, which was recorded (10.41%). The reason for these differences among the varieties may be attributed to their genetic nature and the extent of their response to physiological processes that affect the formation of the products of the photosynthesis process. This is consistent with the results of [11] [12] who found a significant difference between wheat varieties in the percentage of dry gluten.

As for planting dates, the fifth planting date (Dec. 25) was significantly superior to the rest of the planting dates and gave the highest mean of dry gluten percentage, amounted to (11.97)%, while the first planting date had the lowest value of this trait, which amounted to (10.38)%.

Table 5: The effect of varieties, planting date, and their interaction on the percentage of dry gluten (%) in the wheat crop

Varieties	Planting dates					varieties Averages
	Oct. 5	Oct. 25	Nov. 15	Dec. 5	Dec. 25	
Ibaa99	10.93 i-l	10.93 i-l	10.90 jkl	11.33 efg	11.96 d	11.21 bc
Al-Rashid	10.16 opq	10.83 Kl	10.70 lm	11.96 d	12.56 b	11.24 b
Al-Baraka	10.03 q	11.13 e-i	10.06 pq	11.20 e-i	11.90 D	10.86 e
Sham 6	11.46 e	12.30 Bc	12.33 bc	11.20 b	12.93 a	12.30 a
Tammuz2	10.46 mn	11.03 h-k	11.40 ef	11.16 e-i	11.30 e-h	11.07 cd
Al-Hashimiyah	10.00 q	10.36 No	10.33 nop	11.93 d	12.13 cd	10.95 de
Al-Nour	10.00 q	10.13 Opq	10.46 mn	10.50 mn	10.96 i-l	10.41 f
Al-Adnaniyah	10.03 q	10.46 Mn	11.06 g-k	11.86 d	12.00 d	11.08 cd
Averages Planting dates	10.38 d	10.90 C	10.90 c	11.55 b	11.97 a	

*Means followed by the same letter for each factor and the interaction between factors are not significantly different (P ≤ 0.05) according to Duncan's test

The reason for the superiority of fifth planting date is due to the superiority of this planting date in the percentage of wet gluten, as the amount of dry gluten is highly correlated with the amount of wet gluten, which is obtained after drying wet gluten at a high temperature.

As for the interaction, the interaction of (Sham6 x Dec. 25) gave the highest mean of dry gluten percentage, which amounted (12.93%), and it was differed significantly from the rest of the studied varieties at all planting dates. The reason for this superiority is due to the superiority of this combination in the percentage of wet gluten. While the lowest mean of this trait was recorded in the interactions of (Al-Hashimiyah x Oct. 5) and (Al-Nour x Oct. 5), which was (10.00%).

3.4 Ash percentage (%)

Table (6) showed the effect of the varieties, planting dates, and the interaction of (varieties x planting dates) on the trait of ash percentage (%). This table shoed that were significant differences among the varieties. Ibaa99 variety gave the highest value of ash percentage, amounted to (1.91)%, while the lowest value of this trait was in Al-Rashid and Sham6 varieties, which was amounted (1.65 and 1.66%), respectively. The reason for this difference may be attributed to the difference in genetic composition of the studied varieties.

For the planting dates, planting dates of Dec. 25, Dec. 5, and Nov. 15 were significantly superior to the rest of the dates, and they gave ash percentage reached to (1.76, 1.75, and 174%), respectively, compared to the first (Oct. 5) and second (Oct. 25) dates, which amounted to (1.64, 1.67%), respectively. The reason of this superiority may be attributed to the adaptation of the studied wheat varieties to environmental conditions as well as optimum and late planting dates, which led to optimum growth and thus gave a higher ash percentage.

For the interaction, the interaction of (Ibaa99 x Nov. 15) gave the highest mean of ash percentage, which reached to (1.96%), and it was differed significantly from the rest of the studied varieties at all planting dates. While the lowest mean of this trait was recorded in the interaction of (Sham6 x Oct. 25), which was reached (1.50%).

Table 6: The effect of varieties, planting dates, and their interaction on the ash percentage (%) of the wheat crop

Varieties	Planting dates	

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	Oct. 5	Oct. 25	Nov. 15	Dec. 5	Dec. 25	varieties Averages
Ibaa99	1.90 ab	1.93 ab	1.96 A	1.90 ab	1.86 bc	1. 91 a
Al-Rashid	1.56 ij	1.63 ghi	1.70 Efg	1.70 Efg	1.66 fgh	1.65 d
Al-Baraka	1.60 hi	1.66 fgh	1.73 Def	1.73 def	1.80 cd	1.70 bc
Sham 6	1.63 ghi	1.50 j	1.70 Efg	1.70 Efg	1.76 de	1.66 d
Tammuz2	1.63 ghi	1.66 fgh	1.70 Efg	1.80 cd	1.73 def	1.70 bc
Al-Hashimiyah	1.60 hi	1.66 fgh	1.66 Fgh	1.73 def	1.70 efg	1.67 cd
Al-Nour	1.60 hi	1.63 ghi	1.73 Def	1.73 def	1.76 de	1.69 bcd
Al-Adnaniyah	1.63 ghi	1.70 efg	1.73 Def	1.73 def	1.80 cd	1.72 b
Averages Planting dates	1.64 b	1.67 b	1.74 A	1.75 a	1.76 a	

*Means followed by the same letter for each factor and the interaction between factors are not significantly different (P ≤ 0.05) according to Duncan's test

3.5 Sedimentation volume (ml)

The sedimentation test is an indirect method to determine the quality of grains and their ability to make bread and to estimate the quality and strength of flour. Also, the sedimentation value is an indicator of the quality of the protein and evidence of the strength of the gluten. Table (7) showed the effect of varieties, planting dates, and the interaction of (varieties x planting dates) on the sedimentation volume trait. It is noted from the table that the varieties differed significantly, and the Tammuz2 variety achieved the highest value of the sedimentation volume, which reached (30.03 ml) and was significantly superior to the rest of the varieties. The reason of this superiority may be due to the superiority of Tammuz2 variety in protein percentage. While the lowest mean of this trait was in the Al-Adnaniyah variety, which amounted (24.18 ml).

For the planting dates, the fifth planting date (Dec. 25) was significantly superior to the rest of the planting dates, which gave the highest sedimentation volume (28.92 ml) followed by the fourth planting date (28.50 ml), while the first planting date (Oct. 5) had the lowest value of this trait, which amounted (24.07 ml). These results are consistent with findings of [12] [14] [15].

For the interaction, the interaction of (Ibaa99 x Dec. 5) gave the highest mean of sedimentation volume, which reached to (35.53 ml), and it was differed significantly from the rest of the studied varieties at all planting dates. while the lowest mean of this trait was recorded in the interaction of (Al-Adnaniyah x Oct. 5), which was reached (22.10 ml).

Table 7: The effect of varieties, planting dates, and their interaction on sedimentation volume (ml) of the wheat crop

Varieties	Planting dates	

	Oct. 5	Oct. 25	Nov. 15	Dec. 5	Dec. 25	varieties Averages
Ibaa99	23.20 klm	24.23 h-m	26.50 e-m	35.53 a	27.06 d-l	27.30 a
Al-Rashid	25.36 f-m	25.50 e-m	26.36 e-m	26.40 e-m	27.90 c-j	26.30 abc
Al-Baraka	22.30 m	23.43 j-m	27.13 c-l	28.73 b-h	29.56 b-f	26.23 bc
Sham 6	26.23 e-m	26.66 d-m	27.43 c-l	28.70 b-i	30.00 b-e	27.80 b
Tammuz2	27.06 d-l	27.20 c-l	31.16 a-d	31.70 abc	33.03 ab	30.03 a
Al-Hashimiyah	24.13 i-m	24.76 g-m	25.40 f-m	27.33 c-l	27.56 c-k	25.84 bc
Al-Nour	22.16 m	22.90 Lm	25.06 f-m	26.00 e-m	27.13 c-l	24.65 c
Al-Adnaniyah	22.10 m	23.10 Klm	23.03 klm	23.60 j-m	29.10 b-g	24.18 c
Averages Planting dates	24.07 c	24.72 Bc	26.51 B	28.50 a	28.92 a	

*Means followed by the same letter for each factor and the interaction between factors are not significantly different (P ≤ 0.05) according to Duncan's test

3.6 Moisture percentage of flour (%)

Grain moisture is one of the most important factors and features that affect the quality of flour. Variation of grain moisture levels is due to differences in weather conditions during harvesting or storage] 19]. Table (8) showed the effect of varieties, planting dates, and the interaction of (varieties x planting dates) on the moisture percentage of flour trait. It was noted that there were significant differences among wheat varieties for flour moisture percentage. Ibaa 99 variety had the highest of flour moisture percentage, which was (9.60%) followed by Al-Nour variety (9.59%), while Al-Hashimiyah variety gave the lowest value, which was recorded (8.77%). The reason for this increase may be attributed to genetic differences among varieties and their response to environmental conditions. These results are consistent with the findings of [16] [20] [21].

For the planting dates, there were no significant differences among planting dates, and the fifth date (Dec. 25) was statistically superior and gave the highest value of the flour moisture percentage trait, amounted to (9.44%), while the fourth date gave the lowest value, which was (9.01.%).

For the interaction, the interaction of (Ibaa99 x Dec. 25) gave the highest mean of the flour moisture percentage trait, which reached to (9.96%), and it was differed significantly from the rest of the studied varieties at all planting dates. While the lowest mean of this trait was recorded in the interaction of (Tammuz2 x Dec. 5), which was reached (7.06%).

Table 8: The effect of varieties, planting dates, and their interaction on the Moisture percentage of flour (%) of the wheat crop

Varieties	Planting dates					varieties Averages
	Oct. 5	Oct. 25	Nov. 15	Dec. 5	Dec. 25	

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Ibaa99	9.26 a-d	9.50 abc	9.86 ab	9.43 abc	9.96 a	9.60 A
Al-Rashid	9.10 a-d	9.30 a-d	9.10 a-d	8.93 a-d	9.13 a-d	9.11 abc
Al-Baraka	9.00 a-d	9.30 a-d	9.66 abc	9.70 abc	9.60 abc	9.45 ab
Sham 6	9.40 a-d	9.60 abc	9.33 a-d	9.36 a-d	9.50 abc	9.44 ab
Tammuz2	9.10 a-d	9.16 a-d	9.43 abc	7.06 cd	9.33 a-d	8.82 bc
Al-Hashimiyah	9.10 a-d	8.83 bcd	8.36 d	8.73 d	8.83 bcd	8.77 C
Al-Nour	9.50 abc	9.60 abc	9.60 abc	9.53 abc	9.73 abc	9.59 A
Al-Adnaniyah	9.10 a-d	9.40 a-d	9.266 a-d	9.33 a-d	9.43 abc	9.30 abc
Averages Planting dates	9.19 a	9.33 a	9.32 a	9.01 a	9.44 a	

*Means followed by the same letter for each factor and the interaction between factors are not significantly different ($P \leq 0.05$) according to Duncan's test

IV. CONCLUSION

The results obtained from this study showed significant differences among varieties, planting dates, and the interaction between (varieties x planting dates) of all studied traits. These results confirm the existence of genetic variations among varieties, as well as their differences in response to planting dates and thus their impact on the studied qualitative traits. Consequently, Tammuz 2 variety was superior in the protein percentage and sedimentation volume while Sham6 variety was superior in the wet and dry gluten percentage, and baa99 variety was superior in the ash and flour moisture percentage. Planting date treatment of Dec. 25 was superior by giving the best results for all studied traits.

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