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Effects of Harvesting Dates on Qualitative Characteristics of Bread Wheat Cultivars

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In the agricultural season of 2022/2023, wheat crop samples were collected from farmers' fields in Al-Muthana Governorate to investigate the impact of different harvesting dates on the qualities and qualitative characteristics of bread wheat varieties. The study utilized a factorial experimental design, incorporating two factors: harvesting dates (18.04, 28.04, and 08.05) and wheat bread varieties (Ibaa 99, Babylon, Wafia), each with three replications. Key findings included significant differences among harvesting dates, with the first harvest date yielding the highest averages for 1000 grain weight, grain moisture, and specific weight. In contrast, the third harvest date recorded the highest protein percentage in grains. Additionally, significant variations were observed among wheat cultivars, with Ibaa 99 having the highest protein percentage, Babylon having the highest 1000 grain weight, grain moisture, and specific weight, and Wafia having the highest wet gluten content. The interaction between these factors showed significant differences in most qualitative traits studied. This study highlights the importance of selecting optimal harvesting dates to maximize wheat quality attributes.
Keywords: Wheat, qualitative characteristics, harvesting dates.

INTRODUCTION

Wheat (*Triticum aestivum* L.) plays a crucial role in ensuring food security by providing a significant portion of energy, protein, and essential nutrients for human consumption (Jamali *et al.*, 2000).
Understanding the qualitative characteristics of wheat is essential for ensuring that wheat-based products meet the desired taste, aroma, size, and nutritional attributes (Al-Hulaitan *et al.*, 2018). Additionally, climate change poses challenges, particularly in arid and semi-dry regions, impacting wheat crops' physiological processes and overall quality (Mohammed *et al.*, 2018). Consequently, identifying optimal harvest dates becomes vital in enhancing qualitative characteristics (Jiyad and Gum, 2014). Genetic factors also play a significant role in influencing grain qualities, and their interaction with environmental conditions, such as planting and harvesting dates, can further affect wheat varieties' performance and quality (Fadl *et al.*, 2010).
This study aims to investigate the effects of different harvest dates on the qualitative characteristics of bread wheat varieties, emphasizing the importance of selecting appropriate harvest dates to maximize wheat quality.

MATERIALS AND METHODS

Samples of the wheat crop grown in the agricultural season 2022/2023 were collected from farmers' fields in Governorate of Al-Muthanna. To now effect of difference in harvest dates on the qualities and qualitative characteristics of varieties of wheat crops. The study applied according factorial experiments design, with two factors. The first one was different harvest dates and included three dates (18.04, 28.04,05.08), which were symbolized by the symbol (H1, H2, H3) respectively; the second factor has three cultivars of bread wheat (Ibaa 99, Babylon, Wafia), they are designated by the symbol (V1, V2, V3) with three replications.
An agricultural area was identified in Al-Muthanna Governorate, in which three varieties were cultivated, samples were collected for the cultivated varieties according to the harvest dates referred to in the second factor, and three replicates were taken from each variety, and for each planting date, the qualitative characteristics were studied below:

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***1- 1000 grains weight (g)*:** 1000 grains weight was calculated after being randomly taken samples were taken from each individual experimental unit and weighed on a precision balance.

***2- Percentage of moisture (%)*:** Wheat grain samples were analyzed in the Quality Control Laboratory of the Ministry of Commerce - Grain Division to determine their relative humidity using a Grain Moisture Tester, Processing Department - Al-Muthanna Branch.

3- Specific weight (kg/hec): In the quality control laboratory associated with the Ministry of Trade's Grain Processing Department's Muthanna Branch, the specific weight was measured using a Hectoliter weight type mld-100, the size of a quarter of a litre, and the results were converted to kg per hec.

***4- Measuring protein percentage in grains (%)*:** In the quality control laboratory of the Ministry of Commerce - Grain Division, the protein content and ash content of wheat grain samples were estimated using the standard method outlined by AACCI Method 39-10.01 employing NIR infrared technology to estimate protein content in tiny grains, Processing Department - Muthanna Branch.

***5 - Content of wet gluten (%)*:** Wet gluten percentage was calculated for the flour of wheat samples using the Glutomatic gluten index device equipped by the Swedish company Perten in laboratory of quality control of grain manufacturing company. The examination was carried out by weighing 10 grams of flour for each sample separately, and it was placed in the device container automatically for five minutes. After the end of the washing process, the piece of gluten was transferred and weighed on a sensitive scale, ensuring that no part of it remained inside the container, and the results were recorded in grams and converted to percentages.

GenStat's statistical analysis followed the study's protocol, with means compared using the L.S.D test at the 0.05 significance level (Al-Rawi and Khalaf Allah, 2000).

RESULTS AND DISCUSSION

***1000 grains weight (g)*:** Table (1) showed that delay in harvest date harms grain weight, as the first of harvest date (H1) recorded a highest mean for this trait, amounting to 39.11 g, while the second harvest date (H2) gave 34.75 g, having a big difference from harvest date. The third (H3), It resulted in a 1000-grain average weight that was 33.33 g, it can note delay in harvesting dates that the averages began to decrease for the weight of 1000 grains. This may be due to a coincidence of the third harvest date with high temperatures, and thus less material accumulated in an estuary, which decreased grain weight. This result was in line with what Alam *et al.* (2013) found.

According to Table 1's results, there were significant differences between cultivars in terms of the weight of 1000 grains. The Babylon (V2) variety provided the highest average for this trait, which came to 39.20 g, followed by the Wafia cultivar (V3) and the Ibaa 99 (V1) cultivar, whose average came to 31.45 g. The cause may be ascribed to the fact that grain weight is a measure of how well photosynthetic products are transferred from source to sink; this is connected to the cultivar's genetic composition. This conclusion was in line with Noaema *et al.* (2020a).

Table 1's findings revealed a significant interaction for this feature between harvest dates and cultivars. In terms of average 1000 grain weight, the combination of the Babylon cultivar and the first harvest date produced the best result (42.21 g), whereas the combination of the Ibaa 99 cultivar and the third harvest date produced the lowest result (28.57 g***).***

Table 1. Effect of harvest dates, cultivars, and their interaction on 1000 grains weight (g)

Varieties (V)	Harvest dates (H)			Average (V)
	H1	H2	H3	
V1	36.97	28.64	28.57	31.45
V2	42.21	39.00	36.40	39.20
V3	38.13	36.69	34.84	36.56
Average (H)	39.11	34.78	33.33	
L.S.D 0.05	V	H	V×H	
	1.25	1.25	2.16	

Grain moisture (%): Table (2) shows that the harvest dates had a significant effect on this trait, as it gave the highest average moisture percentage in the first date (H1) reached 10.00%, while (H2) gave an average of 8.67%, also differed significantly from other dates. The third harvest (H3), gave a lowest average, amounted to 8.33%. The decrease in grain moisture at the time of the third harvest may be attributed to high temperatures during ripening period of crop at this date due to delay in harvesting, which led to rapid loss of moisture from grain. The result agreed with Ismail et al. (2017).

Table (2)'s findings showed that the wheat cultivars varied greatly in terms of grain moisture, with Babylon (V2) cultivar producing the highest average of 9.56% for this feature, which was comparable to Wafia cultivar (V3)'s average of 9.38%, it differed significantly with Ibaa 99 cultivar (V1), which gave the lowest percentage of grain moisture amounted to 8.11%. The difference of varieties in the percentage of moisture in grain may be attributed to the chemical composition of grain and the degree of its hardness, in addition to genetic factors and extent of their effect on the moisture content of grain. Alternately, the cause could be related to the hygroscopic properties of wheat grain and the fact that, during harvest, environmental factors like humidity and temperature have a significant impact on moisture content. These findings supported the information provided by Ali *et al.* (2018).

Regarding the interaction, Table 2's findings revealed that there were significant differences in the percentage of grain moisture, with the combination of the Babylon cultivar and

first date producing the highest average moisture content of 10.53% (without significantly differing from the combination of the Wafia cultivar and first date, which produced an average of 10.13%), and the combination of the Ibaa 99 cultivar and second date producing the lowest average for this trait of 7.43%.

Table 2. Effect of harvest dates, cultivars, and their interaction on grain moisture (%)

Varieties	Harvest dates (H)			Average
(V)	H1	H2	H3	(V)
V1	9.33	7.43	7.66	8.11
V2	10.53	9.43	8.73	9.56
V3	10.13	9.43	8.60	9.38
Average (H)	10.00	8.67	8.33	
L.S.D 0.05	V	H	V×H	
	0.30	0.30	0.52	

Specific weight (kg hec^{-1}): The results showed in Table 3 that the specific weight of grain will decrease if the harvest date is postponed, as the first harvest date (H1) gave the highest specific weight of 81.42 kg hec-1, While it was noted that the third harvest date (H3) gave this trait an average of 80.02 kg hec-1, the second harvest date (H2) gave the trait the lowest average of 79.91 kg hec-1. Decrease specific weight in late dates may be because moisture loss rates from grains are rapid due to high temperatures. This is what late date suffered from, which produces small grains, which reflected in specific weight of grains, or perhaps this was due to the exposure of the plant to inappropriate environmental conditions during the grain filling period, which affected late date. The result was in line with what Babiker et al. mentioned (2017).

Table 3. Effect of harvest dates, cultivars, and their interaction on Specific weight (kg hec^{-1}).

Varieties	Harvest dates (H)			Average
(V)	H1	H2	H3	(V)
V1	83.27	75.53	78.07	79.96
V2	83.43	82.83	81.20	82.49
V3	77.57	78.37	80.80	78.91
Average (H)	81.42	79.91	80.02	
L.S.D 0.05	V	H	V×H	
	0.64	0.64	1.11	

The results showed in Table 3 the cultivars significantly differed among in the specific weight of grains, as the highest specific weight was given in Babylon cultivar (V2), which amounted to 82.49 kg hec-1, Ibaa 99 (V1) was a cultivar that produced an average of 79.96 kg hec-1. Compared to cultivar Wafia (V3), which produced the lowest average of 78.91 kg hec-1, it was significantly different. Different proportions of the chemical makeup of wheat grains could be the cause of cultivar-specific weight discrepancies, and this result was in line with what was indicated by Aydin and Ozturk (2004). According to the results, the combination of the two factors (Babylon cultivar and first harvest date) produced the trait's highest average specific weight of 83.43 kg hec-1, while the combination of the two factors (Babylon cultivar and first date) produced the trait's lowest average specific weight of 77.57 kg hec^{-1}.

Protein content in grains (%): The results indicated in Table 4 that delaying harvest date led to significant increase grain protein, The third harvest date (H3) provided the highest average protein content in grains, at 12.58%, whereas the first harvest day (H1) was recorded, gave the lowest average protein percentage, it reached 9.85%. The third harvest date, which has the lowest weight per grain (Table 1), may be responsible for the high protein content. This can be explained by the fact that there are two sources of protein in grains: the vegetative and fruiting sections, and accordingly, the high temperatures in harvest period of the third date and decrease in humidity (Table 2) lead to stress on fruiting parts, and then their contribution to making food decreases, which encourages the plant to rely on materials most of them are protein substances, which are transferred from the vegetative part, which leads to increase protein sedimentation in grain. This result was agreed with Shakir et al. mentioned (2019).

Table 4 showed varieties of wheat differed significantly in this characteristic, as cultivar Ibaa 99 (V1) excelled and gave the highest average protein percentage amounted to 12.62%, while the lowest protein percentage in grains was given by wafia variety, (V3) amounted to 9.75%. The difference in percentage of protein between cultivars depends on nature of cultivar and its genetic makeup. The results agreed with indicated by Noaema *et al.* (2020b).

The combination (Ibaa 99 cultivar x the third harvest date) excelled and gave the highest average protein percentage of 15.46%, while combination (Wafia cultivar x the first harvest date) showed the lowest average of these characteristics reached 9.20%. The interaction in Table (4) between two factors showed a significant effect on the percentage of grain protein.

Table 4. Effect of harvest dates, cultivars, and their interaction on Protein content in grains (%).

Varieties	Harvest dates (H)			Average
(V)	H1	H2	H3	(V)
V1	10.83	11.56	15.46	12.62
V2	9.53	10.26	11.96	10.58
V3	9.20	9.73	10.33	9.75
Average (H)	9.85	10.52	12.58	
L.S.D 0.05	V	H	V×H	
	0.17	0.17	0.29	

Content of wet gluten (%): Table (5) show varieties of wheat differed significantly in the content of wet gluten, as cultivar

Wafia (V3) gave a highest rate for this trait, amounting to 30.11%, while the lowest average wet gluten was for Babylon cultivar (V2) amounted to 29.30%. Wet gluten concentration varies between cultivars due to differences in their genetic make-up and the amount of protein in grains (Table 4). This outcome was in line with Al-Azzawi's (2017) conclusions. There were no discernible changes in the wet gluten content between the harvest dates and the interaction between cultivars and dates (Table 5).

Table 5. Effect of harvest dates, cultivars, and their interaction on Wet gluten content (%).

Varieties	Harvest dates (H)			Average
(V)	H1	H2	H3	(V)
V1	29.43	30.10	29.63	29.72
V2	29.06	29.30	29.53	29.30
V3	30.10	30.17	30.06	30.11
Average (H)	29.53	29.85	29.74	
L.S.D 0.05	V	H	V×H	
	0.42	N.S	N.S	

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