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THE INFLUENCE OF SOWING DATE ON YIELD AND QUALITY OF WINTER BARLEY AND TWO-ROW BARLEY

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Abstract: *The study aimed to evaluate the influence of sowing date on grain yield and the main quality parameters of two autumn-sown cereals, barley, cultivar Iulian, and two-row barley, cultivar Diana. The research was carried out during two growing seasons, 2024-2025 and 2025-2026, under field conditions, using five sowing dates established at approximately two-week intervals. In the first growing season, sowing was performed on September 20, October 5, October 15, October 30, and November 15, while in the second growing season, sowing dates were September 24, October 7, October 21, November 5, and November 19. Grain yield and quality parameters, namely thousand-grain weight (TKW) and hectoliter weight (HLW), were determined. For barley, in the 2024–2025 growing season, yield increased up to the third sowing date, reaching 6383 kg/ha, after which it declined, reaching 5388 kg/ha at the latest sowing date. In 2025-2026, the highest yield was recorded at the first sowing date 7127 kg/ha, while delayed sowing resulted in a significant decrease in yield, down to 5176 kg/ha. TKW and HLW showed moderate variations, with maximum values of 43.9 g and 62.7 kg/hl, respectively. For two-row barley, the maximum yield was 7727 kg/ha at the second sowing date in the first year and 6355 kg/ha at the second sowing date in the second year, after which yield progressively decreased at the later sowing dates. In general, delayed sowing resulted in lower yield, as well as reductions in TKW and HLW. It is recommended to plant barley between September 20 and October 15, and two-row barley between October 5 and October 21, to attain higher grain yield and favorable grain quality.*

Keywords: *barley; two-row barley; sowing date; grain yield; grain quality*

INTRODUCTION

Achieving high yields and good grain quality depends on the interaction between environmental factors and cultivation practices. Among the agronomic measures with a significant influence is sowing date, which determines the conditions for emergence, vegetative development, tillering capacity, and plant resistance to unfavorable winter conditions. The appropriate selection of sowing date contributes to maximizing the productive potential of cultivars and to the development of yield components (GREEN et al., 1985).

Sowing too early or too late can affect plant development and final yield, with the effects depending on climatic conditions and the genetic characteristics of the cultivar. Research has shown that sowing date and genotype can influence grain yield and other agronomic traits, highlighting the importance of adapting cultivation practices to specific growing conditions (MOUSTAFA et al., 2021).

In addition to yield, grain quality is an important criterion for assessing barley crop performance. The main indicators include thousand-grain weight (TGW) and hectoliter weight (HLW). Thousand-grain weight reflects grain development and filling, while hectoliter weight provides information about the physical characteristics and commercial value of the harvested grain. These parameters can be influenced by genotype, environmental conditions, and cultivation practices (GRIFFEY et al., 2010).

In this context, evaluating the influence of sowing date on barley, cultivar Iulian, and two-row barley, cultivar Diana, is important for identifying effective cultivation practices. Analyzing the results obtained over two growing seasons allows variations in grain yield and quality to be assessed under different climatic conditions.

The aim of this study is to evaluate the influence of sowing date on grain yield, thousand-grain weight, and hectoliter weight in barley, cultivar Iulian, and two-row barley, cultivar Diana, in order to identify the sowing periods that provide favorable results in terms of both yield and grain quality.

MATERIAL AND METHODS

The research was conducted under field conditions at the National Agricultural Research and Development Institute (NARDI) Fundulea, Romania, during the 2024–2025 and 2025–2026 growing seasons. The experimental site is characterized by cambic chernozem soil.

The study aimed to evaluate the influence of sowing date on grain yield and quality parameters in autumn-sown barley and two-row barley, using the cultivars Iulian and Diana, respectively. The Iulian variety is a typical winter barley variety (with six rows of grains per year), medium-late maturing, and has good tillering capacity. It exhibits good resistance to winter conditions and lodging, as well as to foliar diseases (moderately resistant to net blotch of barley leaves - *Pyrenophora teres f. teres*).

The Diana variety has a two-row ear, making it a true two-row barley (distichous). The ear is long, well-developed, yellow at maturity, and bears long awns.

Five sowing dates were evaluated in each growing season, at approximately two-week intervals. In the 2024–2025 growing season, sowing was performed on September 20, October 5, October 15, October 30, and November 15. In the 2025–2026 growing season, sowing dates were September 24, October 7, October 21, November 5, and November 19.

The parameters analyzed were grain yield, thousand-grain weight (TGW), and hectoliter weight (HLW). Grain yield was expressed in kg ha^{-1}, TGW in grams (g), and HLW in kg hL^{-1}. The crop was continuously monitored, ensuring that all necessary factors for achieving the proposed objectives were taken into account. This was achieved by applying the specific cultivation technology for barley and carrying out maintenance operations and harvesting at the optimal moisture level. All measurements were performed in the laboratory.

Table 1

Temperatures during the experimental period

Year	Months										Average
	IX	X	XI	XII	I	II	III	IV	V	VI	
2024-2025	20.0	12.7	4.9	4.0	4.2	-1.9	9.4	11.7	16.0	24.3	10.13
2025-2026	19.8	11.5	8.7	3.4	-0.6	1.4	7.2	11.5	17.2	23.3	10.34

The thermal differences between the two growing seasons had distinct effects on barley and two-row barley, owing to their genetic and physiological characteristics. In the 2024–2025 agricultural year, the excessively warm autumn in September (20.0°C) and October (12.7°C) had a more pronounced effect on barley sown during the earliest sowing periods. Barley, having a greater tillering capacity and a more vigorous initial growth rate than two-row barley, developed

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excessive biomass before winter. This made it particularly vulnerable to the frost in February (-1.9°C). Two-row barley, with a slower initial growth rate and shorter stature, tolerated this stress better; however, both crops were affected when vegetation resumed. During the final growth stage in June, the high temperature of 24.3°C severely affected both crops, but two-row barley experienced a more critical decline in the MH index, as industrial brewing standards require uniform grains and the heat induced forced ripening.

Table 2

Precipitation during the experimental period

Year	Months										Total (mm)
	IX	X	XI	XII	I	II	III	IV	V	VI	
2024-2025	62.0	7.8	49.0	85.0	10.8	22.8	25.6	29.6	89.0	9.2	390.8
2025-2026	10.8	89.6	101.8	14.4	31.4	85.5	38.2	31.6	83.4	31.6	518.3

In the 2024–2025 agricultural year, the total precipitation of 390.8 mm provided a basic water supply for crop development, but its monthly distribution created different conditions during crop establishment and harvesting. Precipitation in September (62.0 mm) provided very favorable moisture conditions for the germination of crops sown during the first sowing period. However, the sharp decrease in rainfall in October (7.8 mm) slowed emergence in the subsequent sowing periods, affecting two-row barley more severely because of its comparatively moderate initial germination vigor. In spring, the moderate temperatures in March and April supported normal tillering, but the marked reduction in precipitation during the final growth stage in June (9.2 mm) accelerated grain maturation. Under these conditions, barley was able to make better use of its six-row spike architecture to maintain yield, although the grains did not reach their maximum filling potential, resulting in a lower thousand-kernel weight (TKW). Meanwhile, two-row barley recorded a decrease in the hectoliter weight (HLW) index.

In the 2025–2026 agricultural year, the more abundant precipitation of 518.3 mm provided a superior water supply during critical periods of crop demand. Although the beginning of the season was drier in September (10.8 mm), substantial rainfall in October (89.6 mm) and November (101.8 mm) ensured rapid, vigorous, and highly uniform emergence across all sowing periods. The soil moisture accumulated during winter and maintained by spring rainfall stimulated strong tillering in both cereal crops. The decisive factor was the precipitation recorded in May (83.4 mm) and June (31.6 mm), which supplied the water required during flowering and grain-filling stages. This prolonged period of favorable water availability enabled the full development of all grains within the spike in barley and promoted the formation of large, heavy grains with excellent bulk density in two-row barley, resulting in outstanding values for the thousand-kernel weight (TKW) and hectoliter weight (HLW) indices.

RESULTS AND DISCUSSIONS

Regarding productivity, the highest grain yield value of 7127 kg/ha was recorded in the 2025–2026 agricultural year within the first sowing date, while the lowest level of 5176 kg/ha was obtained in the 2024–2025 experimental year in sowing date V, highlighting a clear decline as sowing was delayed.

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Analyzing the yield evolution in the 2024–2025 agricultural year, it is observed that the maximum potential was reached in sowing date III, with a value of 6383 kg/ha, closely followed by sowing date II (6321 kg/ha) and sowing date I (6299 kg/ha). Postponing the sowing to later dates led to a gradual decrease in harvest, with production falling to 5888 kg/ha in sowing date IV and reaching the

minimum threshold for this year in sowing date V (5388 kg/ha).

In the 2025–2026 agricultural year, the downward trend in yield with the calendar advance of sowing was much more pronounced. After the production peak recorded in sowing date I (7127 kg/ha), the harvest suffered a sharp reduction in sowing date II, dropping to 6061 kg/ha. This downward trajectory continued steadily in the subsequent windows, with recorded values of 5922 kg/ha in sowing date III, 5683 kg/ha in sowing date IV, finally reaching the lowest productive performance in sowing date V (5176 kg/ha).

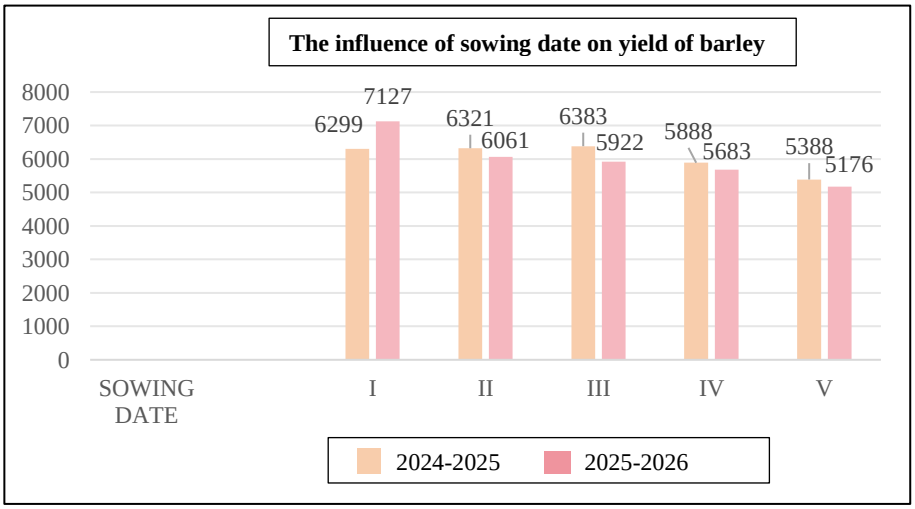


Figure 1. The influence of sowing date on yield of barley

Regarding the productivity of the two-row form, the maximum grain yield level of 7727 kg/ha was achieved in the 2024–2025 agricultural year within sowing date II, while the lowest value of 5384 kg/ha was recorded in the 2025–2026 experimental year in sowing date V, confirming the general trend of harvest reduction in late-sown variants.

Analyzing the evolution in the 2024–2025 agricultural year, it is noted that production starts at 6310 kg/ha in the first date and reaches the experimental peak in sowing date II (7727 kg/ha). Starting from sowing date III, the harvest follows a continuous downward curve, dropping to 7060 kg/ha, then registering a sharper decrease in sowing date IV (6311 kg/ha) and establishing the minimum threshold of this year within sowing date V, with a value of 5932 kg/ha.

In the 2025–2026 agricultural year, the productive behavior was similar in terms of dynamics, but the quantitative levels were lower in most sowing dates compared to the previous year. Thus, after an initial value of 5866 kg/ha in sowing date I, production reaches the season's maximum in sowing date II, with 6355 kg/ha. Subsequently, the calendar delay of sowing

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constantly penalized the harvest level, with values dropping successively to 6066 kg/ha in sowing date III, 5716 kg/ha in sowing date IV, down to the absolute minimum of 5384 kg/ha recorded in sowing date V.

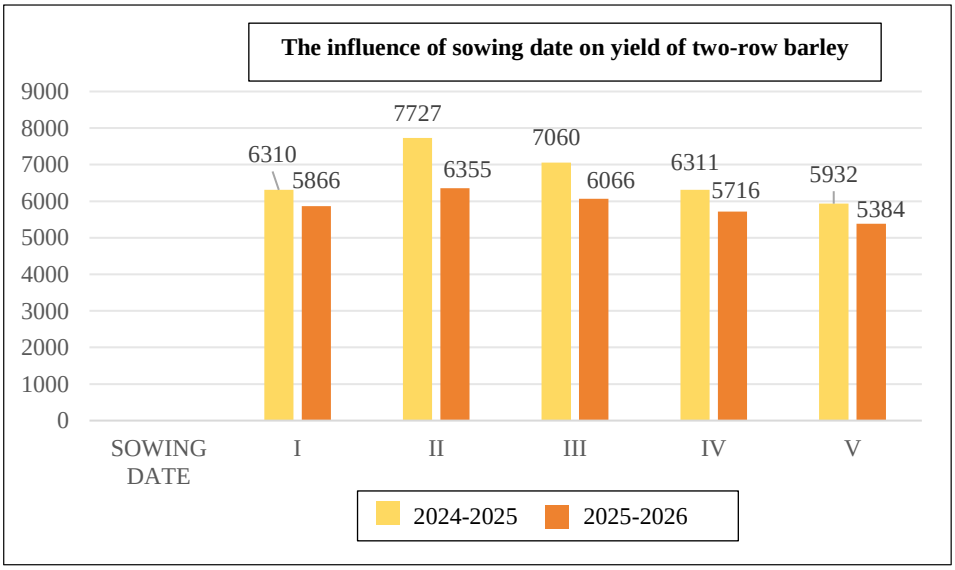


Figure 2. The influence of sowing date on yield of two-row barley

The highest TKW value of 43.90 g was recorded in sowing date III (2024–2025), while the lowest value of 40.70 g was obtained in sowing date V of the same growing season.

Compared to the control (Sowing Date II), the 2024–2025 season showed very significant decreases in sowing date I (-1.30 g) and sowing date V (-2.40 g), whereas sowing date III induced a very significant increase (0.80 g). In the 2025–2026 season, sowing dates I and III led to very significant increases (1.30 g and 1.70 g, respectively), while the remaining sowing dates showed statistically insignificant variations.

he maximum HLW value of 62.70 kg/hl was reached in sowing date III (2025–2026), and the minimum value of 58.60 kg/hl was observed in sowing date V (2024–2025).

Compared to the control, the first season showed significant increases only in sowing dates III and IV, both achieving an identical gain of 0.40 kg/hl. In the second year (2025–2026), sowing date I caused a distinctly significant decrease (-1.20 kg/hl), while sowing date III brought a very significant increase of 2.40 kg/hl. Late sowing dates remained statistically insignificant.

Table 3

The influence of sowing date on thousand-grain weight (TKW) and hectoliter weight (HLW) of autumn barley

SOWING DATE	YEAR	TKW (g)	TKW %	DIFFERENCE (g)	SIGNIFICANCE	HLW (KG/HL)	HLW %	DIFFERENCE (kg/hl)	SIGNIFICANCE
I	2024 - 2025	41.8	96.98	−1,3	000	58,7	99.66	-0.2	-
II		43,1	100.00	0.0	CONTROL	58.9	100.00	0.0	CONTROL

III		43,9	101.86	0.8	***	59.3	100.68	0.4	*
IV		43,1	100.00	0.0	-	59,3	100.68	0.4	*
V		40,7	94.43	-2.4	000	58.6	99.49	-0.3	-
		DL 5% 0.309	DL 1% 0.450	DL 0.1 % 0,676		DL 5% 0.320	DL 1% 0.470	DL 0.1% 0.700	
I	2025 - 2026	43,3	103.10	1.3	***	59,1	98.01	-1.2	**
II		42,0	100.00	0.0	CONTROL	60,3	100.00	0.0	CONTROL
III		43.7	104.05	1.7	***	62,7	103.98	2.4	***
IV		42.0	100.00	0.0	-	60.1	99.67	-0.2	-
V		41,9	99.76	-0.1	-	59.6	98.84	-0.7	0
		DL 5% 0.184	DL 1% 0.267	DL 0.1% 0.401		DL 5% 0.580	DL 1% 0.840	DL 0.1% 1.260	

The maximum TGW level was 52.40 g (Sowing Date I, 2025–2026), while the minimum was 49.20 g (Sowing Dates IV and V, 2024–2025).

Compared to the control, the first three sowing dates in 2024–2025 were statistically insignificant, but sowing dates IV and V caused a distinctly significant reduction of -2.40 g. In the 2025–2026 season, very significant gains were recorded in sowing dates I (4.40 g) and III (3.60 g), while the later dates remained statistically insignificant.

The highest value of 62.40 kg/hl was obtained in sowing date III (2025–2026), and the lowest value of 60.10 kg/hl was found in sowing date V (2024–2025).

Compared to the control, the 2024–2025 season showed a distinctly significant decrease in sowing date I (-1.90 kg/hl) and a very significant decrease in sowing date V (-2.20 kg/hl). In the 2025–2026 season, sowing date III was the only one that brought a significant increase (1.30 kg/hl), with all other treatments being insignificant.

Table 4.

The influence of sowing date on thousand-grain weight (TGW) and hectoliter weight (HLW) of two-row barley

SOWING DATE	YEAR	TKW (g)	TKW %	DIFFERENCE (g)	SIGNIFICANCE	HLW (KG/HL)	HLW%	DIFFERENCE (kg/hl)	SIGNIFICANCE
I	2024-2025	51,2	99.20	-0.4	-	60.4	96.9	-1.9	00
II		51,6	100.00	0.0	CONTROL	62,3	100.00	0.0	CONTROL
III		51,4	99.60	-0.2	-	62,3	100.00	0.0	-
IV		49,2	95.30	-2.4	00	61.8	9.2	-0.5	-
V		49,2	95.30	-2.4	00	60.1	96.5	-2.2	000
		DL 5% 1.250	DL 1% 1.830	DL 0.1% 2.750		DL 5% 0.950	DL 1% 1.390	DL 0.1% 2.750	
I	2025-2026	52,4	109.20	4.4	***	61,8	101.10	0.7	-
II		48,0	100.00	0.0	CONTROL	61,1	100.00	0.0	CONTROL
III		51,6	107.50	3.6	***	62,4	102.10	1.3	*
IV		47,6	99.20	-0.4	-	60.8	99.50	-0.3	-
V		47,7	99.40	-0.3	-	60,8	99.50	-0.3	-
		DL 5% 1.310	DL 1% 1.920	DL 0.1% 2.880		DL 5% 0.890	DL 1% 1.300	DL 0.1% 1.950	

CONCLUSIONS

In conclusion, temperature and precipitation conditions significantly influenced the development of barley and two-row barley, resulting in variations in quality indices across the two agricultural years. The 2025–2026 agricultural year, characterized by a more favorable rainfall regime, supported better crop development and higher thousand-kernel weight (TKW)

and hectoliter weight (HLW) values. In contrast, high temperatures and precipitation deficits during the 2024–2025 agricultural year accelerated ripening and negatively affected grain filling and quality.

Sowing date significantly affects both yield and physical quality traits of autumn barley and two-row barley, with delayed sowing leading to a systematic decline in performance across both experimental seasons.

For autumn barley (cv. Iulian), the optimal window covers the first three sowing dates. Sowing date III provided the best balance in the 2024–2025 agricultural year, maximizing both thousand-kernel weight (43.90 g) and yield (6383 kg/ha). Conversely, postponing sowing until date V severely penalized the crop, reducing the harvest to the minimum threshold of 5176 kg/ha.

For autumn two-row barley (cv. Diana), sowing date II represents the absolute optimum in terms of productivity, reaching a peak of 7727 kg/ha in the first year and 6355 kg/ha in the second experimental year.

Physical quality indicators (TKW and HLW) are strongly affected by the interaction between climatic conditions and sowing date. While early sowing (dates I–III) maintained stable values or very significant increases, late windows (dates IV–V) caused distinctly significant decreases in TKW (up to -2.40 g) and very significant reductions in hectoliter weight.

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