



Characterization of some grain quality traits of winter wheat (*Triticum aestivum* L.) cultivars grown in the Ilfov area

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Abstract. Grain technological quality in winter wheat is influenced by cultivar and growing season conditions. This study characterised selected grain quality traits of four winter wheat cultivars — Glosa, FDL Abund, Python and Promitor — grown at Moara Domneasca, Ilfov County, Romania, during the 2022–2023 and 2023–2024 growing seasons. Protein content, wet gluten content and gluten deformation index were determined in composite milled grain samples and expressed on a 14% moisture basis. The two seasons differed in precipitation, with 445.0 mm recorded in 2022–2023 and 623.2 mm in 2023–2024, compared with the multiannual average of 640.6 mm. In 2022–2023, protein content ranged from 12.10% in Promitor to 13.45% in FDL Abund, while wet gluten content ranged from 30.05% in FDL Abund to 40.70% in Promitor. In 2023–2024, protein content increased in all cultivars, reaching the highest value in Python at 15.00%, while Promitor again recorded the highest wet gluten content at 40.85%. Across both seasons, Python recorded the highest mean protein content, Promitor showed the highest wet gluten content and gluten deformation index, while FDL Abund combined above-control protein levels with the lowest gluten-related values. The results suggest that protein content and gluten-related parameters may follow different cultivar-dependent patterns, indicating that the combined evaluation of multiple grain quality indicators may provide a more comprehensive assessment of the technological quality potential of winter wheat.

Keywords: winter wheat, grain quality, protein content, wet gluten, gluten deformation index.

Introduction. Winter wheat (*Triticum aestivum* L.) has a central role in food systems, not only through its contribution to grain production, but also through the technological potential of its grain for milling and bread-making.

The value of wheat grain depends on a complex combination of physical, biochemical and functional traits, among which protein content, gluten characteristics and gluten behaviour are particularly important. Wheat differs from other cereals by the ability of its gluten proteins to form a viscoelastic dough, a property that explains its extensive use in bread and other wheat-based products (Shewry, 2009; Khan & Shewry, 2009). In winter bread wheat, technological suitability is described through both physical traits and biochemical or technological traits such as protein content, wet gluten content, gluten quality and rheological potential (Demydov et al., 2022; Marinciu et al., 2021; Manda et al., 2022). Previous studies have shown that wheat quality is influenced by genotype, environment, genotype × environment interaction, soil type, fertilisation, crop protection and technological management (Alda et al., 2011; Szekely et al., 2010; Mut et al., 2010; Păunescu et al., 2023). Research conducted on wheat grains cultivated in Romania showed that protein content, test weight and other physicochemical traits may vary according to the biological material analysed, highlighting the complexity of wheat grain quality assessment (Golea et al., 2023). Comparative studies under Romanian conditions also showed that protein and wet gluten content differ among cultivars, confirming the important role of the biological factor (Alda et al., 2011; Szekely et al., 2010; Dunăreanu & Bonea, 2020). Grain quality is not determined by cultivar alone, but also by crop nutrition and agronomic management. Nitrogen nutrition and balanced fertilisation are important for grain protein accumulation and gluten-related quality traits, while sowing time, sowing density, preceding crop and crop protection may influence both yield and quality-related traits (Sala et al., 2009; Chețan, 2019; Pîntea, 2007; Starodub & Tabacari, 2018; Partal & Contescu, 2025; Prioteasa et al., 2025). Recent

multi-environment research on Romanian winter wheat cultivars showed that cultivar and environment significantly influence both grain yield and protein concentration, while the response to reduced nitrogen availability depends on genotype and environmental conditions (Şerban et al., 2025). These findings support evaluating cultivars not only through productivity, but also through qualitative traits across agricultural years. The expression of wheat quality traits is also strongly dependent on climatic conditions. Temperature and rainfall distribution may influence crop development, grain filling and protein accumulation, thereby affecting the balance between productivity and technological value. Under Romanian conditions, winter wheat cultivars have been shown to respond differently to hydric and thermal stress, with consequences for yield and grain characteristics (Mustăţea et al., 2008; Melucă et al., 2011; Marinciu et al., 2013; Voinea, 2019; Berca et al., 2021). Changes in air temperature may modify wheat phenology, including anthesis and maturity, altering the period available for grain filling and quality formation (Croitoru et al., 2012). Drought stress may reduce yield-related traits while increasing protein content, indicating that quality results should be interpreted in relation to the climatic background of each agricultural year (Javed et al., 2025).

The objective of this study was to evaluate selected grain quality traits, namely protein content, wet gluten content and gluten deformation index, in four winter wheat cultivars grown under the pedoclimatic conditions of Moara Domneasă, Ilfov County, Romania, and to compare their technological profiles across two consecutive growing seasons.

Material and Method. The study was carried out over two consecutive growing seasons, 2022–2023 and 2023–2024, at the Moara Domneasă Agricultural Research-Development Didactic Station, Ilfov County, Romania, within the experimental field of the University of Agronomic Sciences and Veterinary Medicine of Bucharest. The experimental site is located on reddish preluvosol, the zonal soil type characteristic of the Moara Domneasă area, characterized by moderate fertility and several physical and chemical constraints that may influence crop establishment, water availability and nutrient dynamics. Previous research described reddish preluvosol as having a clay-loamy texture, low to moderate humus content, an acidic to moderately acidic reaction, reduced water permeability and susceptibility to compaction (Mihalache et al., 2010; Petcu & Mihalache, 2022). Temperature and precipitation differed between the two seasons, with 2023–2024 recording higher rainfall amounts than 2022–2023, a contrast that may have influenced grain filling conditions (Table 1).

Grain quality parameters were assessed in four winter wheat cultivars: Glosa, FDL Abund, Python and Promitor, all sown using basic seed, category B. The study was based on a bifactorial field experiment involving four cultivars and five sowing densities; however, the present paper focuses exclusively on cultivar-related grain quality traits. A common crop management protocol was applied in both growing seasons. Seedbed preparation consisted of ploughing and disking, and fertilisation included 60 kg active ingredient ha⁻¹ nitrogen and 60 kg active ingredient ha⁻¹ phosphorus at crop establishment, followed by 60 kg active ingredient ha⁻¹ nitrogen at spring vegetation resumption. Sowing was performed in October of each growing season, and the crops were harvested at full maturity in early July 2023 and late June 2024.

For each cultivar and growing season, composite grain samples were prepared by combining equal quantities of grain collected from all five sowing density variants, so as to obtain a representative bulk sample at cultivar level. Before laboratory determinations, samples were homogenised and milled under standard laboratory conditions. Moisture content was determined for each sample and all results were expressed on a 14% moisture basis, allowing comparison among cultivars and growing seasons under the same reference moisture level.

Protein content was determined by the Kjeldahl method and corrected to a 14% moisture basis. Wet gluten content was determined according to SR ISO 5531:2002 and SR 90:2007, while the gluten deformation index was determined according to SR 90:2007 and expressed in millimetres. All determinations were performed in triplicate and mean values were used for data presentation. Results are discussed descriptively,

with cultivar Glosa serving as the control; differences between each cultivar and the control are expressed as absolute arithmetic differences (Δ values).

Table 1

Climatic background at Moara Domnească during the 2022–2023 and 2023–2024 growing seasons, compared with the 1991–2020 multiannual average

Month	<i>Monthly mean temperature (°C)</i>			<i>Precipitation (mm)</i>		
	2023-2024	2022-2023	1991-2020	2023-2024	2022-2023	1991-2020
October	15.6	14.0	12.3	21.1	10.3	50.4
November	7.9	8.9	6.3	124.7	32.9	45.2
December	3.8	2.8	0.7	32.6	25.8	45.1
January	0.6	4.4	-1.0	37.8	81.1	38.7
February	7.4	2.8	1.4	19.7	6.0	33.1
March	8.2	7.9	6.1	54.3	30.5	45.8
April	14.9	10.4	11.9	81.2	79.6	53.1
May	16.4	16.5	17.4	36.3	43.9	67.8
June	25.4	21.7	21.5	29.4	46.9	82.7
July	27.4	25.5	23.7	42.2	47.3	73.3
August	26.4	25.3	23.7	39.0	24.1	44.7
September	20.1	21.1	18.4	104.9	16.6	60.8
Mean/Total	14.5	13.4	11.9	623.2	445.0	640.6

Source: <https://open-meteo.com/>

Results and Discussion. Results for the 2022–2023 growing season are presented in Table 2. The grain quality parameters showed differences among cultivars relative to the control cultivar Glosa, both in terms of protein content and gluten characteristics.

Protein content ranged from 12.10% in Promitor to 13.45% in FDL Abund. Compared with Glosa, which recorded 12.50%, FDL Abund exceeded the control by +0.95 percentage points, while Python showed a positive difference of +0.60 percentage points. Promitor was the only cultivar with a value below the control, recording a negative difference of -0.40 percentage points.

Wet gluten content showed a different distribution. Glosa recorded 38.35%, while FDL Abund and Python registered lower values, of 30.05% and 33.50%, corresponding to negative differences of -8.30 and -4.85 percentage points, respectively. Promitor, despite having the lowest protein content among the analysed cultivars, showed the highest wet gluten content, of 40.70%, exceeding Glosa by +2.35 percentage points. This pattern suggests that protein content and wet gluten content did not follow the same ranking across cultivars.

The gluten deformation index ranged from 5.00 mm in FDL Abund to 8.50 mm in Promitor. Glosa and Python recorded identical values of 7.00 mm. FDL Abund had the lowest deformation index, with a negative difference of -2.00 mm relative to the control, indicating a firmer gluten structure, while Promitor exceeded the control by +1.50 mm, suggesting a more deformable gluten mass. The distribution of this parameter broadly followed the same direction as wet gluten content.

Overall, each cultivar displayed a distinct technological profile. FDL Abund combined the highest protein content with the lowest wet gluten content and gluten deformation index, suggesting a divergent relationship between protein content and the two gluten-related indicators. Python showed protein content above the control, accompanied by a moderate reduction in wet gluten content and an unchanged gluten deformation index. Promitor presented a contrasting profile, with the lowest protein content but the highest values for both wet gluten content and gluten deformation index, suggesting that gluten quantity and deformability in this cultivar were not driven primarily by total protein level. Glosa maintained an intermediate position across all three parameters, consistent with its role as control cultivar.

Table 2

Technological quality parameters of winter wheat grains —
Growing season 2022–2023

<i>Parameter</i>	<i>Glosa*</i>	<i>FDL Abund</i>	<i>Python</i>	<i>Promitor</i>	Δ <i>FDL Abund</i>	Δ <i>Python</i>	Δ <i>Promitor</i>
Protein content, %	12.50	13.45	13.10	12.10	+0.95	+0.60	-0.40
Wet gluten content, %	38.35	30.05	33.50	40.70	-8.30	-4.85	+2.35
Gluten deformation index, mm	7.00	5.00	7.00	8.50	-2.00	0.00	+1.50

Δ values represent the difference between each cultivar and the control cultivar Glosa (*). Positive values indicate higher values than the control, whereas negative values indicate lower values than the control.

For the 2023–2024 growing season, the results are presented in Table 3. The grain quality parameters showed differences among cultivars relative to the control cultivar Glosa, with protein content, wet gluten content and gluten deformation index following different patterns of variation.

Protein content ranged from 13.00% in Glosa to 15.00% in Python. Python showed the highest value, exceeding Glosa by +2.00 percentage points, followed by FDL Abund with a positive difference of +0.90 percentage points and Promitor with a marginal increase of +0.20 percentage points. Compared with 2022–2023, protein content increased in all cultivars, with the most pronounced inter-annual increase recorded in Python.

Wet gluten content ranged from 31.70% in FDL Abund to 40.85% in Promitor, while Glosa recorded 38.50%. As in the previous season, FDL Abund and Python registered lower values than the control, with negative differences of -6.80 and -3.25 percentage points, respectively, whereas Promitor again exceeded Glosa by +2.35 percentage points. These results suggest that the increase in protein content was not accompanied by a proportional increase in wet gluten content, since both FDL Abund and Python had higher protein levels than Glosa but lower wet gluten values. Compared with 2022–2023, wet gluten content increased slightly in all cultivars, while the relative ranking among cultivars remained unchanged.

The gluten deformation index ranged from 5.50 mm in FDL Abund to 9.00 mm in Promitor, with control cultivar Glosa recording 7.75 mm. Promitor exceeded the control by +1.25 mm, Python showed a slight positive difference of +0.25 mm, while FDL Abund recorded the lowest value, with a negative difference of -2.25 mm, indicating a firmer gluten structure. Compared with the previous season, the index increased in all cultivars, suggesting a tendency towards slightly more deformable gluten in the second growing season.

Overall, the cultivar-specific technological profiles observed in 2022–2023 were generally confirmed in the 2023–2024 growing season, although some inter-annual differences were evident. FDL Abund again combined protein content above the control with the lowest wet gluten content and gluten deformation index, supporting the hypothesis of a divergent relationship between protein accumulation and gluten-related traits. Python stood out more clearly in the second season, recording the highest protein content and the most pronounced inter-annual increase, while wet gluten content remained below the control and the gluten deformation index stayed close to Glosa. Promitor again showed the highest wet gluten content and gluten deformation index; however, unlike in 2022–2023, its protein content slightly exceeded the control in 2023–2024, suggesting a minor shift in protein accumulation without altering its overall technological profile. Glosa continued to provide a balanced reference point for the comparison of the three quality parameters.

Table 3

Technological quality parameters of winter wheat grains —
Growing season 2023–2024

<i>Parameter</i>	<i>Glosa*</i>	<i>FDL Abund</i>	<i>Python</i>	<i>Promitor</i>	Δ <i>FDL Abund</i>	Δ <i>Python</i>	Δ <i>Promitor</i>
Protein content, %	13.00	13.90	15.00	13.20	+0.90	+2.00	+0.20
Wet gluten content, %	38.50	31.70	35.25	40.85	-6.80	-3.25	+2.35
Gluten deformation index, mm	7.75	5.50	8.00	9.00	-2.25	+0.25	+1.25

Δ values represent the difference between each cultivar and the control cultivar Glosa (*). Positive values indicate higher values than the control, whereas negative values indicate lower values than the control.

Results for the two-year experimental mean are presented in Table 4 and Figure 1. When the two growing seasons were considered together, the mean values suggested the cultivar-dependent differentiation of grain quality traits and highlighted the stability of the technological profiles observed in the individual years.

Table 4

Technological quality parameters of winter wheat grains —
Two-year experimental mean (2022–2023 and 2023–2024)

<i>Parameter</i>	<i>Glosa*</i>	<i>FDL Abund</i>	<i>Python</i>	<i>Promitor</i>	Δ <i>FDL Abund</i>	Δ <i>Python</i>	Δ <i>Promitor</i>
Protein content, %	12.75	13.68	14.05	12.65	+0.93	+1.30	-0.10
Wet gluten content, %	38.43	30.88	34.38	40.78	-7.55	-4.05	+2.35
Gluten deformation index, mm	7.38	5.25	7.50	8.75	-2.13	+0.13	+1.38

Δ values represent the difference between each cultivar and the control cultivar Glosa (*). Positive values indicate higher values than the control, whereas negative values indicate lower values than the control.

Protein content averaged across the two seasons ranged from 12.65% in Promitor to 14.05% in Python. Compared with Glosa, which recorded a two-year mean of 12.75%, Python showed the highest positive difference, of +1.30 percentage points, followed by FDL Abund with +0.93 percentage points, while Promitor remained slightly below the control, with a negative difference of -0.10 percentage points.

Wet gluten content showed a different distribution. Promitor recorded the highest two-year mean, of 40.78%, exceeding Glosa by +2.35 percentage points, while FDL Abund and Python remained below the control, with negative differences of -7.55 and -4.05 percentage points, respectively. This further suggests that wet gluten content did not follow the same cultivar ranking as protein content.

The gluten deformation index ranged from 5.25 mm in FDL Abund to 8.75 mm in Promitor, while Glosa recorded 7.38 mm. Promitor exceeded the control by +1.38 mm and Python showed only a marginal positive difference of +0.13 mm, whereas FDL Abund recorded the lowest value, with a negative difference of -2.13 mm. The distribution of this parameter remained broadly aligned with wet gluten content rather than with total protein content.

The two-year mean therefore supported the cultivar-specific patterns observed in the individual seasons. FDL Abund maintained the contrast between high protein content and low gluten-related values, suggesting that protein accumulation was not directly reflected in gluten quantity or deformability. Python was characterized by the highest mean protein content, but this advantage was not accompanied by above-control wet

gluten content, while its gluten deformation index remained close to the control. Promitor showed the opposite tendency, with the highest wet gluten content and gluten deformation index despite having the lowest mean protein content. Glosa provided a stable reference level for the comparison of the analysed quality parameters.

Overall, the two-year mean suggests that protein content and gluten-related parameters may follow different cultivar-dependent patterns, indicating that the combined evaluation of these indicators can provide a more complete assessment of the technological quality potential of winter wheat grains.

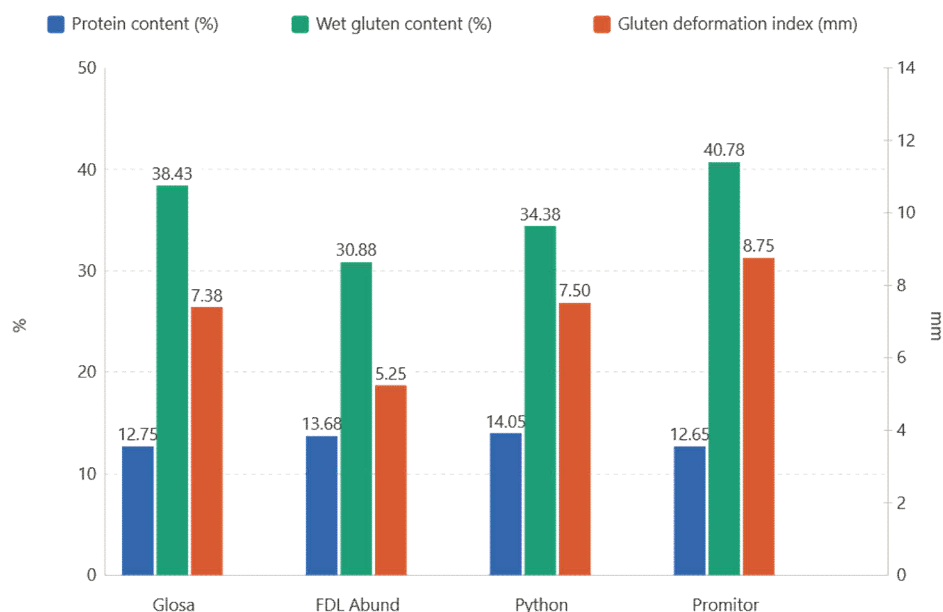


Figure 1. Variation of grain quality indicators by cultivar — two-year mean (2022–2023 and 2023–2024).

Conclusions. The results obtained under the pedoclimatic conditions of the Ilfov area showed that the four winter wheat cultivars expressed distinct grain quality profiles, with differences among protein content, wet gluten content and gluten deformation index.

In the 2022–2023 growing season, FDL Abund recorded the highest protein content, but the lowest wet gluten content and gluten deformation index, while Promitor showed the opposite pattern, with the lowest protein content and the highest gluten-related values. Python exceeded the control cultivar Glosa in protein content, while maintaining lower wet gluten values and a gluten deformation index similar to the control.

In the 2023–2024 growing season, protein content increased in all cultivars, with Python showing the most pronounced inter-annual increase. However, this increase was not accompanied by a similar rise in wet gluten content or gluten deformation index, suggesting that protein content and gluten-related parameters did not follow the same ranking across cultivars.

Across the two growing seasons, Python recorded the highest mean protein content, Promitor showed the highest wet gluten content and gluten deformation index, while FDL Abund combined above-control protein levels with the lowest gluten-related values. Glosa maintained an intermediate and balanced position across the three quality parameters.

Overall, the results suggest that the technological quality potential of winter wheat grains should not be assessed through a single indicator alone. A combined evaluation of protein content, wet gluten content and gluten deformation index may provide a more accurate characterization of cultivar quality under the specific conditions of the Ilfov area.

Acknowledgements. This study formed part of the doctoral research programme of the first author. The authors acknowledge the University of Agronomic Sciences and Veterinary Medicine of Bucharest and the Moara Domnească Agricultural Research-Development Didactic Station for providing financial and logistical support for the experimental work.

Authors Contributions. AMP wrote the manuscript; DIM read and revised the manuscript.

Conflicts of Interest. The authors declare that there is no conflict of interest.

Data Availability. The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Funding. This research received no external funding.

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Received: 17 May 2026. Accepted: 16 June 2026. Published online: 17 June 2026.

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How to cite this article:

Petre, A. M., Marin, D. I. (2026). Characterization of some grain quality traits of winter wheat (*Triticum aestivum* L.) cultivars grown in the Ilfov area. *AAB Bioflux, 18(1)*, 51-58.