

EVALUATION OF FORAGE PRODUCTION AND QUALITY OF TIMOTHY (*Phleum pratense* L.) IN THE PEDOCLIMATIC CONDITIONS OF BRASOV

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Abstract

The species *Phleum pratense* (timothy) presents high variability, especially due to its wide distribution and ecological adaptability. It tolerates cold temperate climates and soils with a neutral to slightly acidic reaction. This paper presents the results regarding the evaluation of the production capacity (t/ha DM) and forage quality of 5 Romanian genotypes (Tirom, Carpatica, Rarău, Syn 1.5 and Syn 1.14) and 2 foreign genotypes (Bobr and Liskra) of the species *Phleum pratense*, studied in comparative crops during 2022-2024, within the Breeding and Genetic Resources Laboratory of the Research and Development Institute for Grassland Brasov. The Romanian varieties respond effectively to the current requirements: high production, good quality of forage, suitability to various type of use, competitiveness and good resistance to disease and pests. The varieties Bobr and Liskra proved to be earlier and more productive in the first years of cropping, but they showed a lower perennality. Regarding the quality, there were differences depending on the genotype and the phenophase of harvesting.

Key words: forage quality, forage production, genotype, *Phleum pratense* L.

INTRODUCTION

Phleum pratense (commonly known as timothy grass) is a perennial, tuft-forming species belonging to the family Poaceae and the genus *Phleum* (Moreno et al., 2023; Pang et al., 2026). *Phleum pratense* grass is native to Europe, temperate Asia and North Africa, and has become naturalized in many cool or temperate regions (Lacefield et al., 1980; Bélanger et al., 2001; Havstad et al., 2013). This is an important forage grass that is used for pasture, hay and silage, which is a widely cultivated in cold, humid regions of the world, including northeastern and northwestern US and Canada, and the Nordic countries in Europe (Bernes et al., 2008; Bélanger et al., 2001; Nissinen et al., 2010).

Timothy is a leafy and tall-growing grass with high biomass production, as well as high nutritive value and digestibility compared to many other forage grasses (Helgadóttir et al., 2014). The forage quality of *Phleum pratense* is regulated by the developmental stage of the plant and is usually highest during the early growth of the crop when most of the tillers are in the vegetative stage (Bélanger et al., 2001; Gustavsson et al., 2004). It is highly palatable for cattle and horses, having a high nutritive

value and digestibility (Becker et al., 2020; Radkowski et al., 2020).

According to Bertrand et al. (2008), the higher dry matter digestibility of *Phleum pratense* species grown under cool temperatures was caused by an increase in cell wall digestibility, in part due to the delay in reaching a given stage of development under cooler temperature. The nutritive value of timothy decreases with time, phenological development and increasing forage yield, and harvesting conditions could reduce its nutritive value, particularly with extended wilting periods (Belanger et al., 2001; Ould-Ahmed et al., 2014). To enhance both dry matter yield and nutritional quality, it is essential to distinguish genotypes that exhibit a reduced trade-off between these two traits.

There are many research studies confirming an inverse relationship between dry matter yield and nutritive value (Bélanger and McQueen, 1996; Bélanger and McQueen, 1998; Casler and Vogel, 1999).

The aim of this research was to evaluate the dry matter production and forage quality of 5 Romanian genotypes of *Phleum pratense* (Tirom, Carpatica, Rarău, Syn 1.5 and Syn 1.14) and 2 foreign genotypes (Bobr from Poland, and Lischka from Germany) which have been

studied in comparative crops during 3 years (2022-2024) and 3 harvesting periods.

MATERIALS AND METHODS

The investigation was based on field trials carried out at Research and Development Institute for Grasslands, Braşov, Romania in the period 2022-2024. The study consisted of determining the dry matter production and forage quality obtained from timothy grass (*Phleum pratense* L.), the experiment being located starting with 2021.

The experimental plot (area of 210 m²) consisted of sowing the 7 varieties of *Phleum pratense*, randomized in three replications. Each block extended over an area of 70 m². Each variety was sown in three replications on an area of 10 m² (2 m width and 5 m length), and the rows were sown at a distance of 12.5 cm. The experiment was conducted by applying a seeding rate of 2000 seeds/m² (10 kg/ha). Each replication was fertilized with an amount of 52.5 kg of active ingredient per hectare of NPK, twice a year.

The soil was a preluvosol soil types with the following characteristics: humus content of 3.02%, available phosphorus 35.8 ppm, and available potassium 131 ppm, with a pH of 6.2. The climatic conditions during the study (2022-2024) indicate a warmer period compared to the multiannual average (Table 1), and generally they allowed for optimal plant growth and development. Regarding the thermal regime, all study years were warmer than the 59-year multiannual average of 7.72°C. In 2022, the annual average temperature exceeded the baseline by 1.41°C. The warming trend continued in 2023 with a deviation of +2.40°C, reaching a peak in 2024. In 2024, the annual average temperature exceeded the multiannual average by 3.73°C, while during the vegetation period (April-September), the thermal deviation reached 3.45°C above the reference value.

In terms of precipitation, the study period was characterized by a general water deficit compared to the multiannual average of 753.2 mm. The year 2023 was particularly dry, recording a total annual deficit of 182.8 mm. During the vegetation period of the same year, a negative deviation of 121.3 mm was observed, significantly affecting the growing conditions. In 2024, although the annual precipitation

(730.6 mm) was closer to the multiannual average with a minor deficit of 22.6 mm, the vegetation period remained dry, recording 43.2 mm less rainfall than the historical average.

Table1. Climatic conditions from Braşov stationary 2022-2024

Years	Annual average I-XII	Dev.*	Vegetatio n period IV-IX	Dev.
Temperature (°C)				
2022	9.13	+1.41	15.92	+1.68
2023	10.12	+2.40	15.98	+1.75
2024	11.45	+3.73	17.68	+3.45
Average 59 years	7,72	0	14.23	0
Precipitation (mm)				
2022	574.2	-179.0	376.6	-152.5
2023	570.4	-182.8	407.8	-121.3
2024	730.6	-22.6	485.9	-43.2
Average 59 years	753.2	0	529.1	0

*Dev.- Deviation

During the three-year study, comparative observations were conducted on *Phleum pratense* to evaluate dry matter production and nutritional indicators, including crude protein (CP), crude fiber (CF), dry matter digestibility (DMD), and organic matter digestibility (OMD). For the analysis, samples were dried at 60 °C and ground using a Grindomix GM 200 mill. The chemical parameters were determined by Near Infrared Spectroscopy (NIRS) using a Perten DA 7200 analyzer. Forage quality was determined by a range of characteristics with nutrient content influenced by factors such as grass species or cultivars, growth stage, and soil conditions (Guţu et al., 2025). All the data was statistically analysed using analysis of variance (ANOVA). The relationships between the observed traits were assessed on the basis of the Pearson’s correlation coefficients, using CORRELATION procedure in the STATISTICA software.

RESULTS AND DISCUSSIONS

The 7 genotypes studied were evaluated from a productive and qualitative point of view. Regarding dry matter production, we present the results from the 3 years studied. The analysis of the variety and year interaction (Table 2) highlights variations in production determined

mainly by annual environmental conditions. In 2022, the production had high values for all varieties, ranging between 9.70 t/ha (Syn 1.5) and 11.03 t/ha (Syn 1.14). Dry matter yield is about 2-9 t/ha depending on the stage of maturity and other factors (Grant and Burgess, 1978; Bélanger et al., 2001; Brégard et al., 2001).

Table 2. Dry matter production (average), obtained in the 3 years studied

Variety x year*		Mean DM t/ha	Std. Err. *	-95.0 %	+95.00 %
Tirom	1	10.90	0.7505	7.6706	14.129
	2	10.83	0.2403	9.7991	11.867
	3	5.50	0.4041	3.7611	7.2389
Carpatica	1	10.90	0.6245	8.2129	13.587
	2	10.73	0.7965	7.3061	14.160
	3	6.37	0.8987	2.4995	10.233
Rarău	1	10.90	0.1527	10.242	11.557
	2	10.90	0.5567	8.5043	13.295
	3	6.57	0.5811	4.0660	9.0673
Syn1.14	1	11.03	0.7859	7.6515	14.415
	2	9.50	0.5567	7.1043	11.895
	3	6.63	0.5364	4.3251	8.9414
Syn 1.5	1	9.70	0.2886	8.4579	10.942
	2	10.77	1.0806	6.1170	15.416
	3	6.13	0.6489	3.3412	8.9254
Bobr	1	10.87	0.405	9.1218	12.611
	2	10.70	0.3785	9.0710	12.328
	3	6.03	0.417	4.2362	7.8304
Lischka	1	10.77	0.5696	8.3158	13.217
	2	10.67	0.7796	7.3123	14.021
	3	6.27	0.6984	3.2616	9.2716
DL 5% = 1.77 t/ha, DL 1% = 2.36% t/ha, DL 0.1% = 3.09 t/ha.					

*Std.Err. – Standard error; Year: 1 - 2022, 2 - 2023, 3 - 2024.

In 2023, the production level was comparable, with values between 9.50 and 10.90 t/ha. In contrast, in 2024, there was a sharp decrease in production for all varieties, the values being between 5.50 and 6.63 t/ha. The differences between 2022 and 2024, respectively between 2023 and 2024, significantly exceed the DL threshold of 0.1% (3.09 t/ha) for all analysed varieties, which indicates a very significant influence of the climatic conditions specific to 2024 on the production level. The decrease of production in 2024 was relatively uniform across all genotypes, the amplitude of the reduction being between approximately 4.3 and 5.4 t/ha. Comparison of varieties within the same year shows that the differences between the average values do not exceed the DL 5%

threshold (1.77 t/ha). Thus, in no experimental year were statistically significant differences recorded between varieties, which indicates a relatively close productive potential of them under the experimental conditions studied.

The variation in production was predominantly determined by the year factor, while the differences between varieties and the interaction between variety and year did not have a statistically significant influence.

The results highlight the relative stability of the tested varieties under the conditions of the preluvosol at the experimental site. Although this soil type has a good water-holding capacity, it could not fully compensate for the severe precipitation deficits recorded in 2022 and 2023, confirming the crop's high sensitivity to extreme climatic fluctuations. The specific climatic conditions of each study year significantly influenced production, with thermal and hydric stress being the primary drivers of yield variability.

The lack of a significant interaction between the varieties and the specific climatic conditions of each study year indicates that the tested varieties maintain stable performance across different environmental contexts (Figure 1).

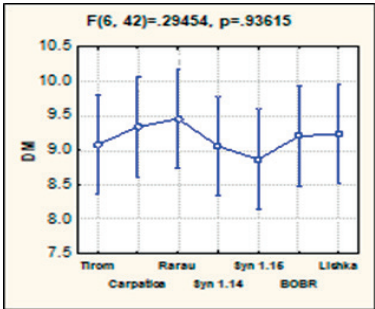


Figure 1. DM variation t/ha, F test

Therefore, the variation in production is predominantly determined by annual environmental conditions, and the productive potential of the analyzed varieties is relatively close under the experimental conditions studied. There are no statistically significant differences between the 7 varieties, according to the p value (0.93615) > 0.05, which indicates that the differences are insignificant. The total highest value of DM t/ha was recorded in the first and the second year, approximately 11 t/ha (Figure 2). The highest value of DM t/ha (9.5 t/ha) was

recorded for the Rarău variety, and the lowest yield, approximately 8.9 t/ha, was obtained for the Syn 1.5 variety (Figure 3).

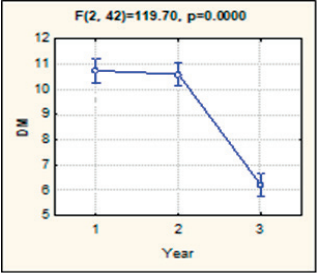


Figure 2. DM variation t/ha, in 2022, 2023 and 2024

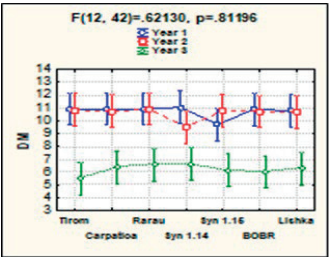


Figure 3. DM variation t/ha, in 2022, 2023 and 2024 for the 7 varieties of *Phleum pratense* L.

The difference in dry matter production between the 3 years factor grades is very significant, according to the value of p ($0.0000 < 0.001$), which show that the differences are very significant. The highest dry matter production was recorded at Syn 1.14, in 2022, approximately 11.03 t/ha, respectively 10.6 t/ha, and the lowest in 2024, approximately 5.5 t/ha, the Tirom variety (Figure 3).

Numerous studies have evaluated the forage quality of *Phleum pratense*, highlighting considerable variability in their biochemical composition depending on growth conditions, cultivar, and harvest stage (Guțu et al., 2025). The crude protein (CP) content is a fundamental indicator of forage quality in perennial grasses, reflecting the plant's capacity for nitrogen uptake and metabolism. In general, perennial grasses exhibit a wide range of CP levels, typically declining as the plant matures. For *Phleum pratense* L. (timothy), literature indicates that CP content is highly sensitive to environmental factors and management, with values often ranging from 12% to 16% in the early stages of growth in Romanian conditions

(Moga and Schitea, 2005). Globally, research shows that while timothy is highly palatable, its protein accumulation is strongly conditioned by the interaction between genotype and thermal or hydric stress (Bélanger et al., 2001; Wang et al., 2014). The analysis of CP content in our study (Table 3) highlights significant differences driven by the specific climatic factors of each experimental period rather than the mere chronological passage of years.

Table 3. Crude protein (%) (average), obtained in the 3 years studied

Variety	Year	Mean CP %	Std. Err. *	-95.00 %	+95.00 %
Tirom	1	16.42	0.4261	14.588	18.255
	2	13.07	0.4073	11.314	14.819
	3	12.82	0.7084	9.7683	15.865
Carpatica	1	16.81	0.4415	14.911	18.710
	2	13.66	0.2328	12.653	14.657
	3	12.68	0.1452	12.058	13.308
Rarău	1	16.98	0.2436	15.929	18.026
	2	12.73	0.2834	11.513	13.953
	3	12.75	0.2500	11.674	13.825
Syn 1.14	1	17.22	0.5690	14.773	19.670
	2	13.52	0.2128	12.606	14.438
	3	13.57	0.5019	11.406	15.726
Syn 1.5	1	17.64	0.7902	14.244	21.044
	2	14.26	0.3087	12.927	15.583
	3	14.00	0.6557	11.178	16.821
Bobr	1	16.26	0.6375	13.512	18.998
	2	12.80	0.1924	11.971	13.628
	3	12.52	0.1740	11.767	13.265
Lischka	1	16.54	0.5938	13.989	19.099
	2	12.92	0.1365	12.334	13.509
	3	11.12	0.4419	9.21	13.018
DL 5%=1,27 %, DL 1%= 1,69 %, DL 0.1%= 2,21 %					

*Std.Err. – Standard error; Year: 1 - 2022, 2 - 2023, 3 - 2024.

In the first experimental period (2022), characterized by a moderate thermal deviation (+1.68°C during vegetation) and a manageable water deficit (Table 1), the CP content reached its peak across all varieties. Values varied between 16.26% (Bobr) and 17.64% (Syn 1.5). The maximum difference of 1.38% exceeded the DL 5% threshold (1.27%), indicating that under favorable conditions, the genetic potential of the Syn 1.5 variety for nitrogen accumulation is significantly superior. These high levels are consistent with the findings of Wang et al. (2014), who documented an upper limit of 17.4% CP for timothy under optimal management. During 2023, a general decline in

CP content was observed (12.73% to 14.26%), primarily due to the severe water deficit recorded during the vegetation period (-121.3 mm, as shown in Table 1). This drought stress limits the mobility of nitrogen in the soil and its subsequent mineralization, a mechanism that directly impacts protein synthesis. Despite this environmental pressure, Syn 1.5 maintained its qualitative lead (14.26%), standing out significantly (DL 5%) from the lower values recorded by the Rarău variety (12.73%). These results align with Tomić et al. (2007), who noted that abiotic stress can significantly compress the qualitative range of timothy forage.

In the 2024 period, the impact of extreme thermal stress became the dominant factor. With a thermal deviation of +3.45°C above the multiannual average during the vegetation season (Table 1), CP content showed the most pronounced differentiation between genotypes. Values varied between 11.12% (Lischka) and 14.00% (Syn 1.5). The very significant difference of 2.88% (exceeding DL 0.1%) reveals a clear contrast in metabolic stability. The Lischka variety showed a sharp qualitative decline, likely due to heat-induced accelerated leaf senescence, whereas the Romanian synthetic lines Syn 1.5 and Syn 1.14 demonstrated a robust resilience, maintaining relatively high CP levels. Our results confirm that under the specific conditions of Brasov, the Romanian genotypes remain in the upper half of this qualitative spectrum, even when faced with significant thermal pressure. Comparing the experimental periods, there is a clear reduction in the crude protein content from 2022 to 2023 and 2024, with the differences exceeding in most cases the DL 0.1% threshold. This highlights a very significant influence of the specific environmental drivers - primarily the thermal acceleration and the precipitation deficit - on the forage quality. Consequently, the environmental context of 2022, characterized by a more balanced thermal regime, was the most favorable for crude protein accumulation. In contrast, the conditions of 2024, marked by the highest thermal deviation (+3.45°C during vegetation, Table 1), proved to be the most restrictive for maintaining high protein levels across all studied varieties.

Comparing the years, there is a clear reduction in the crude protein content from 2022 to 2023

and 2024, with the differences exceeding in most cases the DL 0.1%, which highlights a very significant influence of the annual conditions on the quality of the feed. Thus, the year 2022 was the most favorable for the accumulation of crude protein, and the year 2024 the least favorable. The variation in crude protein content highlights the specific response of the studied varieties to the restrictive environmental factors defined in the experimental methodology. Rather than a mere annual fluctuation, the decline observed in the latter periods is a direct consequence of the thermal stress (+3.45°C deviation) and hydric deficit (-121.3 mm) (Table 1), which limited nitrogen mineralization and uptake. From a scientific perspective, the superiority of the Syn 1.5 variety is not accidental; it reflects its genetic plasticity and ability to maintain metabolic stability under heat stress. While varieties like Lischka showed a higher sensitivity to the complex of factors characterizing the 2024 season, the synthetic lines demonstrated a more robust biological characteristic in translocating nitrogen to the aerial biomass. This differentiated behavior, supported by specialized literature (Wang et al., 2014; Tomić et al., 2007), confirms that under controlled experimental conditions, the genetic factor remains essential in mitigating the negative impact of abiotic stress. To better visualize and synthesize the complex interaction between the studied genotypes and the experimental years, a Two-Way Joining cluster analysis (Heatmap) was performed (Figure 4).

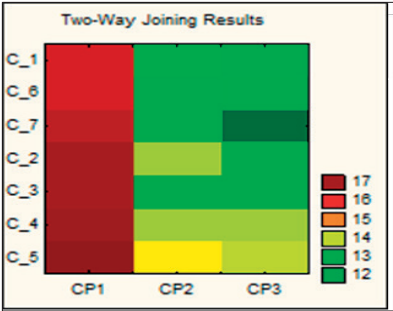


Figure 4. Two-way joining cluster analysis (heatmap) of crude protein (CP) content in the studied *Phleum pratense* varieties across the three experimental periods (Periods: CP1 - 2022, CP2 - 2023, CP3 - 2024; Varietal codes: C_1 - Tirom, C_2 - Carpatica, C_3 - Rarău, C_4 - Syn 1.14, C_5 - Syn 1.5, C_6 - BOBR, C_7 - Lischka)

It is important to know the amount of crude fiber in *Phleum pratense* hay because it can have a negative effect on the relative food value and energy concentration (Țiței et al., 2022). In terms on the crude fiber content %, the results obtained highlight a pronounced influence of annual conditions on the recorded values, as well as differences between varieties within the same year (Table 4).

In 2022, the crude fiber contents were the lowest, ranging between 27.18% (Syn 1.14) and 28.69% (Lischka). The maximum difference between varieties was 1.51%, the lower value, DL 5% (1.69%), which indicates the absence of statistically significant differences between varieties this year.

In 2023, there was an obvious increase in the crude fiber content for all varieties, the range being between 31.26% (Carpatica) and 33.27% (Rarău). The maximum difference was 2.01%, exceeding the DL 5% (1.69%), but being below the DL 1% (2.26%), which indicates significant differences at the 5% level. The Rarău, Lischka and Bobr varieties presented the highest values this year.

Table 4. Crude fiber (%) (average), obtained in the 3 years studied

Variety	Year	Mean CF %	Std. Err. *	-95.00 %	+95.00 %
Tirom	1	27.54	0.098	27.119	27.969
	2	32.41	0.313	31.062	33.759
	3	30.95	1.625	23.954	37.945
Carpatica	1	27.56	0.392	25.865	29.245
	2	31.26	0.481	29.183	33.327
	3	30.65	0.208	29.754	31.545
Rarău	1	27.90	0.157	27.222	28.577
	2	33.27	0.409	31.504	35.029
	3	31.02	0.437	29.135	32.897
Syn 1.14	1	27.18	0.581	24.673	29.681
	2	32.22	1.081	27.568	36.875
	3	29.63	0.142	29.020	30.246
Syn 1.5	1	27.54	0.529	25.267	29.821
	2	31.63	0.101	31.195	32.07
	3	30.15	0.680	27.221	33.078
Bobr	1	28.31	0.298	27.027	29.594
	2	33.08	0.473	31.042	35.113
	3	31.72	0.066	31.429	32.003
Lischka	1	28.69	0.728	25.555	31.822
	2	33.16	0.502	30.994	35.316
	3	32.68	0.693	29.701	35.665
DL 5%=1,69%, DL 1%= 2,26%, DL 0.1% = 2,96%					

*Std.Err. – Standard error; Year: 1 - 2022, 2 - 2023, 3 - 2024.

In 2024, the values remained at a higher level compared to 2022, ranging between 29.63% (Syn 1.14) and 32.68% (Lischka). The maximum difference between the varieties was 3.05%, a value exceeding the DL 0.1% (2.96%), indicating very statistically significant differences. The Lischka variety stood out with the highest value, while Syn 1.14 recorded the lowest level.

Comparing the years with each other, a clear increase in the values is observed from 2022 to 2023, the differences exceeding the DL threshold of 0.1% in most cases, which demonstrates a very significant influence of the annual climatic variations. In 2024, the values decreased slightly compared to 2023, but they were higher than those registered in 2022.

Crude fiber (%) was significantly influenced by the annual conditions, with 2023 being the most favorable. The differences between the varieties were insignificant in 2022, significant at the level of 5% in 2023 and very significant in 2024, which suggests a more pronounced differentiation of the behavior of the genotypes under more variable environmental conditions. Figure 5, illustrates the two-way joining cluster analysis (heatmap), which simultaneously groups both the *Phleum pratense* varieties and the experimental periods based on crude fiber (CF) content.

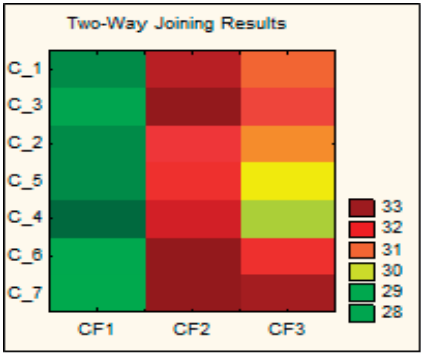


Figure 5. Two-way joining cluster analysis (heatmap) of crude fiber (CF) content in the studied *Phleum pratense* varieties across the three experimental periods. (Periods: CF1 - 2022, CF2 - 2023, CF3 - 2024; Varietal codes: C_1 - Tirom, C_2 - Carpatica, C_3 - Rarău, C_4 - Syn 1.14, C_5 - Syn 1.5, C_6 - BOBR, C_7 - Lischka)

The initial experimental period (2022) is uniformly defined by green hues, confirming that the baseline environmental conditions of

that year systematically restricted crude fiber biosynthesis to its lowest levels (28-29%) across the entire germplasm collection. The second experimental period (2023) marks a radical physiological shift, appearing as a homogenous dark red cluster where synergistic annual factors stimulated maximum fiber deposition, driving values to their absolute peaks (32-33%) in nearly all investigated varieties. The final experimental period (2024) acts as a heterogeneous transitional zone depicted in orange and yellow; unlike the previous years, this phase induced a diversified, variety-

dependent response. The analysis of all cellular constituents shows moderate variability for crude protein (CP) (14.2%) and dry matter (DM) (25.3%), while crude fiber (CF), dry matter digestibility (DMD) and organic matter digestibility (OMD) showed greater stability (7-7.6%).

The overall mean values were: CP = 14.30%, CF = 30.41%, DMD = 63.28%, OMD = 59.36%, DMD = 9.17%. These indices confirm the greater variability of protein and soluble dry matter compared to fiber and DMD (Table 5).

Table 5. Statistical index of cellular constituents

Statistical index of cellular constituents	Mean	Minimum	Maximum	Variance	Std.Dev.	Standard	Cv [%]
CP	14.30	10.6500	18.9667	4.1195	2.0297	0.2557	14.2
CF	30.41	26.0667	34.1500	5.0380	2.2446	0.2828	7.4
DMD	63.28	55.2500	73.5333	23.3489	4.8321	0.6088	7.6
OMD	59.36	51.6000	68.7667	19.2498	4.3875	0.5528	7.4
DM	9.17	4.7000	12.9000	5.4090	2.3257	0.2930	25.3

The correlation between CP and CF is strongly negative ($r = -0.86$), suggesting that an increase in CP is associated with a decrease in CF. In contrast, CP shows very strong positive correlations with DMD ($r = 0.93$) and OMD ($r = 0.90$), indicating a direct relationship between these variables. The correlation between CP and DM is moderately positive ($r = 0.47$) (Figure 6).

The CF shows strong negative correlations with DMD ($r = -0.85$) and OMD ($r = -0.84$), but has a weak correlation with DM ($r = -0.17$), suggesting that the influence of CF on DM is insignificant.

DMD and OMD show an extremely strong correlation ($r = 0.99$), indicating a possible redundancy or collinearity between these two variables. Regarding DM, it is moderately correlated with CP ($r = 0.47$), DMD ($r = 0.44$) and OMD ($r = 0.40$), suggesting a moderate influence of these variables on DM.

CONCLUSIONS

The research highlights that, in the context of current climate changes in the Braşov area, the qualitative stability of the *Phleum pratense* crop is determined more by the genetic resilience of the genotype than by the gross productive potential. The Romanian synthetic lines (Syn 1.5 and Syn 1.14) have a superior capacity for nitrogen translocation to the aerial biomass even under extreme thermal stress conditions (+3.45°C above the average), in contrast to foreign varieties which exhibit accelerated leaf senescence.

Although annual climatic variations (hydryc and thermal stress) unified the dry matter production

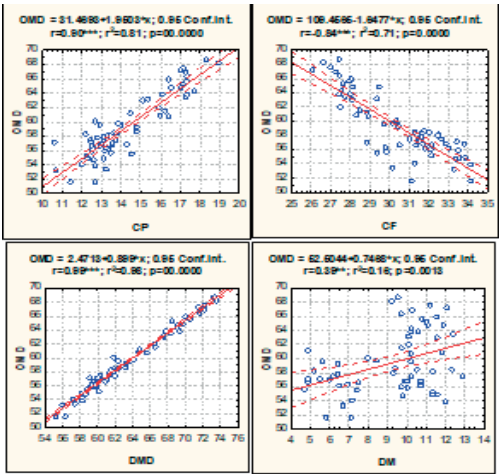


Figure 6. Linear regression plots between OMD and quality parameters

- OMD vs. CP: $y = 31.4693 + 1.9503x$, $r = 0.90***$, $p < 0.0001$;
- OMD vs. CF: $y = 109.4585 - 1.6477x$, $r = -0.84***$, $p < 0.0001$;
- OMD vs. DMD: $y = 2.4713 + 0.889x$, $r = 0.99***$, $p < 0.0001$;
- OMD vs. DM: $y = 52.5044 + 0.7486x$, $r = 0.39**$, $p = 0.0013$.

Dashed red lines represent the 95% confidence intervals.

across all genotypes, the research reveals that metabolic differentiation between varieties becomes critical under abiotic pressure, directly influencing the nutritional value (crude protein and fiber).

The paper provides new arguments for using protein stability and the limitation of cellulose biosynthesis during drought periods as primary indicators in the selection of genetic material intended for grasslands.

Our results confirm that, on preluvosol soil types, using Romanian synthetic genotypes represents an efficient adaptation strategy for farmers, guaranteeing high-quality forage even in years with severe precipitation deficits, partially offsetting the inevitable quantitative losses.

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MISCELLANEOUS

