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ASSESSMENT OF THE HERBACEOUS CANOPY RADIATION PROFILES AND FORAGE QUALITY IN THE MOUNTAIN GRASSLANDS FROM FUNDATA AREA, ROMANIA

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Abstract

This work presents the mapping of the herbaceous canopy radiation profiles and forage quality in the mountain grasslands from the Fundata area, Romania. The dominant species is Agrostis capillaris and many other valuable grasses and legumes grow in the area. The measurements considered floristic composition, LAI, canopy height, and forage quality i.e., ash, protein, total fiber, nitrates, and phosphorus, respectively. The altitude influences the floristic composition and forage quality. The pastoral value was assessed as 67 which is considered as good value with a grazing capacity of 1-2 livestock units/ha. For sustainable grassland management in mountain areas, the role of perennial canopy amplifies, acquiring the valences of multifunctional utilization and requiring reliable methods for environmental protection and enhancing the natural specific landscape.

Key words*: floristic composition, LAI, canopy radiation, forage quality, altitudinal gradient.*

INTRODUCTION

Romania has large mountainous areas that have been recently considered as a territory of special, strategic national interest, economic, social, and environmental following Law No. 197/2018 (Official Monitor no.659, July 20, 2018).

Consequently, the mountain area is considered disadvantaged, because of the restrictions related to the limited use of agricultural land, due to the altitude and climate conditions, the slopes, the geological substrate and the high costs of its works, living conditions, poor infrastructure, limited business environment, access to education and medical services (Păcurar et al., 2023). Regarding the grasslands distribution, there are approximately 23% in the mountains and 3% in the alpine floor from the total area of grasslands from Romania according to Mocanu et al. (2021). One way to maintain and improve the quality of life in these areas is to keep the ecological attributes of the mountain grasslands (Onete et al., 2023).

Hence, the Romanian state may grant differentiated payment for animal breeders in the mountain area, depending on the severity of the natural restrictions and the altitudinal gradient, to maintain farmers in the grasslands, raising livestock, as well as to keep or to improve the productivity of grasslands. It is important to establish efficient pastoral arrangements in compliance with the management objectives of the grasslands to maintain the high natural value in the mountain area.

It is important to develop projects for sustainable management of agricultural and forest lands in the mountain area. Furthermore, the protection of pastures from degradation, and the transformation of some poorly productive arable lands into extensive grasslands maintain the existing biodiversity also preventing the negative impact on the environment and landscape.

Valahia University of Targovişte has implemented several projects that aimed to improve the students' perception and awareness of the biodiversity of grasslands in Fundata Village, (https://fimsa.valahia.ro/acasa/proiecte-fdi/). In this regard, a series of experiments were carried out to improve the knowledge related to the floristic composition, herbaceous canopy characteristics, including radiation interception and absorption, and forage quality within grasslands from Fundata area (Dincă et al., 2014).

Within grasslands, plants establish phytosociological associations in complex functional groups through which they imprint specific features of grasslands regarding the relationships between the species that are in the association, as well as between them and the biotope in which they live (Samuil et al., 2011). At the same time, the plants in the composition of the association provide the utilization value, as well as the ways of grassland exploitation and improvement. The systematic grouping of plant species allows their study regarding different characteristics (Onete et al., 2021) such as botanical traits, biological efficiency for bioconversion, vivacity, the value of utilization, the rate of growth and development, requirements for ecological factors, using type, etc. The number of species in grasslands' vegetation depends on several factors. Among the most important ones are: pedoclimatic conditions, using type and applied technology (Marușca et al., 2020). Thus, the main groups of plants that are found in the mountain grasslands are divided into: grasses, legumes, sedges and bulrushes, and finally those with less importance as forage named "species from other botanical families" or miscellaneous.

The ability of grasses to permanently form shoots (multiple stems - tillers) allows them to intercept a larger amount of solar energy and to use more nutrients from the soil. That is why the grasses have a bigger capacity to fight for space, thus reaching a larger dominance in the grassland. By tillering, the grasses form a larger vegetative mass than other plants, thus being the main plants that participate in ensuring high and constant productions on the grasslands, more significantly at higher altitudes. At the same time, the tillering process is also a way of vegetative reproduction, which is very high in the grasses on the grasslands (Stanciu et al., 2016).

The tillering efficiency is also related to the photosynthetically active radiation (PAR) and the ability of the species to deploy efficiently the leaf area (Dincă and Dunea, 2018). In this sense, the current paper aims to obtain more information related to the herbaceous canopy radiation profiles and forage quality in a representative mountain grassland located on the spruce altitudinal stratum from Fundata village. The methodological approach included the utilization of the SunScan plant canopy analyzer for extracting relevant elements regarding the sward architecture and PAR distribution within the heterogeneous canopy on a transect following the slope.

MATERIALS AND METHODS

Study area description

The experiments were performed in a typical *Agrostis capillaris* grassland near the Didactic base of Valahia University for mountain studies located in Fundata Village (45°, 42424N; 25°, 29272E; altitude 1190 m - Fundățica.

The administrative territory of the Fundata village overlaps the central sector of the Bran - Rucăr - Dragoslavele tectonic Corridor, having a transversal development to it, between the Piatra Craiului and Bucegi - Leaota mountain units, components of the Bucegi mountain group, in the eastern Carpathians Southerners (Dunea et al., 2018).

From the total area of the village (32.6 km^2), the largest share is held by the Bran - Rucăr - Dragoslavele Corridor (92.65%), which gives the locality a unitary character through its relief, which has a particularly important role in increasing tourist attractiveness, through the excellent landscapes and views it offers. Administratively, Fundata village belongs to Brașov county, being bordered to the northeast by Moieciu from Brașov county, and to the south and west by Dragoslavele and Dâmbovicioara, both from Argeș county. It is considered one of the highest permanent settlements in Romania, being the locality with the town hall located at the highest height in our country (Figure 1. *a* and *b*).

The soil type is an important factor for species growth and spatial distribution (Dușa et al., 2023). The general soil distribution in Fundata village is provided by the presence of districambosol type in large areas, interrupted locally by small areas covered with rendzina and rendzina lithosols. Where the relief allowed the accumulation of a substantial deposit of parent material, districambosols have developed (Ilie and Mihalache, 2019). Where the massive limestones are close to the surface or even outreach, local rendzinas with lower or higher skeletal content occur. The profiles made near the vegetation sampling transect highlighted this, with two profiles of districambosol and one of rendzina lithosol (Photo 1 a and b).

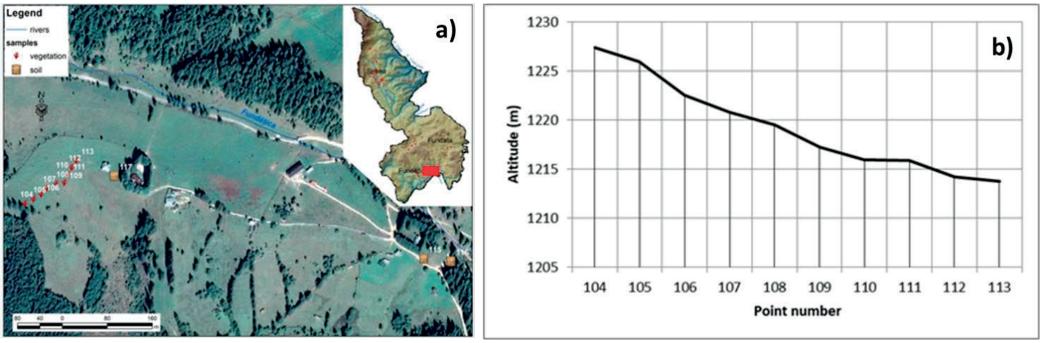

Figure 1. The transect of the vegetation samplings (Points 104-113) performed in a representative mountain grassland located in Fundata village, Romania (the red rectangle is the area highlighted in the picture) (a); Elevation profile (b)

Samplings and PAR/LAI measurements

The sections from which the plants were harvested were carried out on a NE-facing slope between 1213 m and 1227 m altitude, on 5 July 2023.

Aboveground parts of the plants were collected by cutting using a 50 × 50 cm quadrat resulting in 6 representative samples coded P1-P6.

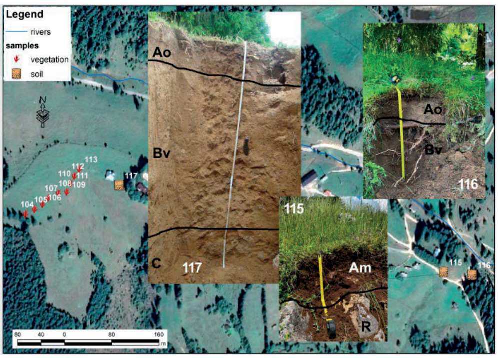

Photo 1. Soil profile locations (Points 115-117) from the study area, in Fundata village - near the Fundăţica Students' Practice Base of Valahia University of Târgovişte, Romania

All species were identified and the participation was expressed in % Dry Matter (DM). Concomitantly with the vegetation sampling, the PAR profile was assessed before cutting using a performant canopy analyzer system (SunScan Canopy Analysis System, Delta-T Devices Ltd., Cambridge, UK), which allowed the non-destructive assessment of the leaf area index (LAI). The 1-m probe was introduced in the canopy near the ground. A BF5 beam fraction sensor which is the reference PAR sunshine sensor was placed outside the canopy in direct light. Another, BF sensor measured continuously the PAR flux from 11.30 a.m. to 12.30 p.m. (Photo 2). More information regarding the PAR measurements can be found in Dunea et al. (2019).

Forage quality analysis

The nutritive value and feed safety of the collected samples were determined to characterize the specific chemical parameters. The chemical assays were performed in triplicate for each sample and the results were expressed on a *dry matter* (DM) basis.

The DM content was determined by drying the samples at 105°C for 3-h up to the constant mass and the results were expressed in percentages. The *ash content*, expressed in g/kg DM, was measured by calcination at 550°C in a lab furnace (STC 411.06, Sweden). The *nitrogen content* (N) was determined according to the Kjeldahl method (AOAC, 1999) and the *crude protein* (CP) content was calculated as N × 6.25. The *total dietary fiber* (TDF) content was determined based on AACC method 32-05.01 and AOAC method 985.29, using the Megazyme Total Dietary Fiber Assay Kit. TDF was expressed in g/kg DM.

The *phosphorus (P) content* was determined spectrophotometrically, based on the formation of a colored complex with the ammonium molybdate. The amount of the phosphoric anhydride was multiplied by 0.436 and the results were expressed in g/kg DM. The *nitrates content* (mg/kg DM) was determined spectrophotometrically at a wavelength of 470 nm, based on the reaction of NO_3^- with phenol 2.4-disulfonic acid.

The obtained dataset has been statistically processed using the SPSS 26.0 (SPSS, USA) software and reported as the mean ± standard deviation and coefficient of variation (C.V.).

Photo 2. Measurements performed with the Sunscan Canopy Analysis System and the PAR sensors.

RESULTS AND DISCUSSIONS

Field measurements and observations showed that the dominant species was *Agrostis capillaris* with a ground cover of more than 50% (Table 1). Other accompanying valuable grasses were *Arrhenatherum elatius* (11%), *Festuca rubra* (10.8%), *Phleum pratense* (9.2%), *Cynosurus cristatus* (5%), *Alopecurus pratensis* (3.3%) and *Trisetum flavescens* (2.5%). In association with these grass species, several valuable legumes were found with lower participation (Table 1).

Better site ecological conditions, such as soil fertility and moisture, may favor legumes' establishment and the development of valuable grassland subtypes.

Table 1. Leaf Area Index (LAI) and participation of species in the canopy for each sampling point

Floristic composition	Leaf Area Index (LAI)	Participation in canopy - PC (%)
P1 - Point 104	2.47	-
Arrhenatherum elatius	-	66
Festuca rubra	-	30
Medicago lupulina	-	4
P2 - Point 105	2.57	-
Phleum pratense	-	55
Festuca rubra	-	35
Lotus corniculatus	-	10
P3 - Points 106, 107, 108, 109	2.96	-
Agrostis capillaris	-	100
P4 - Points 110, 111	1.97	-
Agrostis capillaris	-	80
Cynosurus cristatus	-	20
P5 - Point 112	3.03	-
Agrostis capillaris	-	100
P6 - Point 113	3.52	-
Agrostis capillaris	-	40
Alopecurus pratensis	-	20
Cynosurus cristatus	-	10
Trisetum flavescens	-	15
Trifolium montanum	-	15

Radiative conditions were characterized by an average Diffuse/Total PAR regime with a total PAR of 1665.02, and diffuse PAR of 528.4 µmol m^{-2} s^{-1}, respectively. Figure 2 highlights the

PAR time series recorded during the field assessments by the separate BF sensor on 5 July 2023 between 11.30 a.m. to 12.30 p.m.

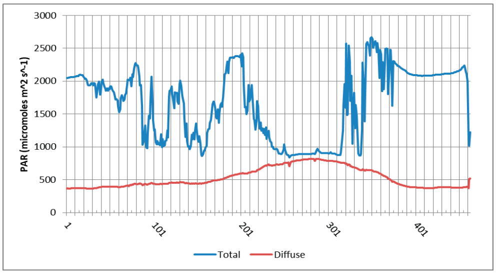

Figure 2. PAR measurements (μmol m^{-2} s^{-1}) recorded on 5 July 2023 between 11.30 a.m. to 12.30 p.m. (total and diffuse PAR)

The average values and CVs for the radiative parameters measured in the canopy of each sampling point were as follows: transmitted radiation 98.3 (60.2%), spread 1.1 (44.7%), incident 1096.2 (55.8%), beam fraction - the fraction of Total incident radiation in the Direct beam 0.3 (111.5%), zenith angle105.9 (0.9%).

LAI ranged from 1.97 to 3.52 m^2 leaves m^{-2} ground (mean = 2.9; C.V. = 28.7%) showing that the parameter was higher in the complex association formed with more grass species (P6) - Table 1.

The pastoral value was assessed as 67 which is considered a good value with a grazing capacity of 1-2 livestock units/ha (Table 2).

The dry matter content is an important indicator of the forage quality both in terms of nutritional value and energy potential. Evaluation of the dry matter content in a relationship with the chemical indicators such as crude protein content and fiber content is purposeful to establish if the nutritive components of forage meet the requirements of grazing animals.

Table 2. Pastoral value of the studied grassland based on the floristic composition

Floristic composition (Species)	Participation in grassland (%)	Specific Quality Index (I_s)	PC ×I_s
Agrostis capillaris	53.3	3	160
Festuca rubra	10.8	3	33
Phleum pratense	9.2	5	46
Alopecurus pratensis	3.3	4	13
Cynosurus cristatus	5.0	3	15
Trisetum flavescens	2.5	4	10
Arrhenatherum elatius	11.0	4	44
Medicago lupulina	0.7	4	3
Lotus corniculatus	1.7	3	5
Trifolium montanum	2.5	2	5
SUM	100	-	333
Pastoral Value (=SUM/5)	-	-	**67**
Grassland quality (50-75)	***Good***		

The dry matter content of the samples analyzed in dried form (Figure 3) ranged between 91.26 ± 0.17% (P5 - *Agrostis capillaris*) and 93.26 ± 0.18% (P4 - *Agrostis capillaris* and *Cynosurus cristatus*). The P3 sample containing *Agrostis capillaris* stood out based on a dry matter content that was higher with 1.14% than the sample P5. Numerous factors such as altitudinal zone, growing season, and phenology influence the dry matter content of the forage.

Relative high differences were determined concerning the ash content of the samples (Figure 4), which is known as a negative factor that influences animal nutrition. Despite its high content of dry matter, the P4 sample was characterized by the lowest ash content, i.e., 47.71 ± 0.91g/kg DM. The P3 sample was located at the opposite limit of the determined interval within the group of the herbaceous mass (72.04 ± 1.00 g ash/kg DM), emphasizing the potential contribution of the *Cynosurus cristatus* in decreasing the mineral content of the mountain grasslands. An average value of the ash content, i.e., 59.5 ± 0.98 g/kg DM, was determined in the P6 sample containing legumes and grasses. The floristic composition and the stage of plant development influence the total mineral content of forage.

The crude protein content varied in large limits (Figure 5), between 63.09 ± 0.66 g/kg DM (P4) and 122.08 ± 1.25 g/kg DM (P6). A close value to the superior limit of the interval was also determined in the case of the P3 sample, its protein content being of 119.81 ± 0.75 g/kg DM which correlates with the dry matter content of *Agrostis capillaris* from this sample. Usually, the CP, one of the key elements of forage quality, declines with the stage of development (Dunea et al., 2019).

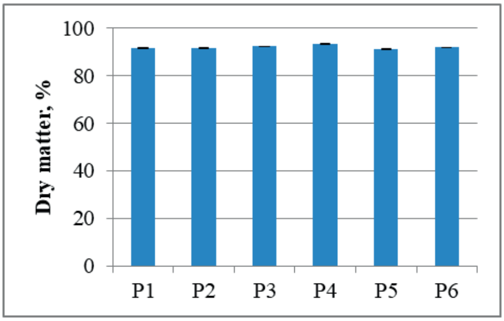

Figure 3. Dry matter content of the analyzed samples

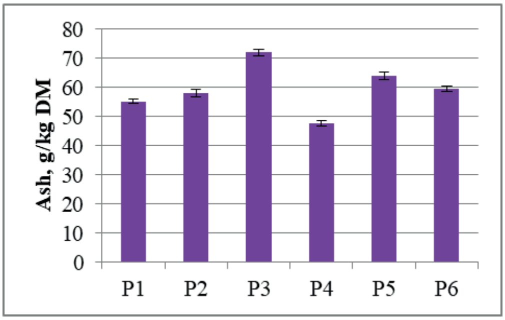

Figure 4. The mineral content (ash) of the samples

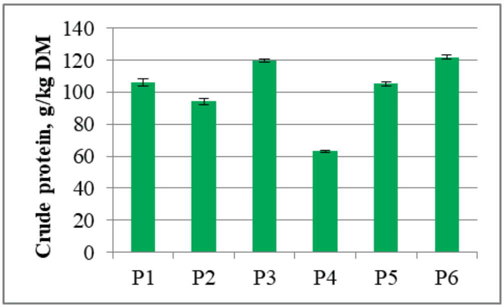

Figure 5. The crude protein content of the samples

Roukos et al. (2011) evaluated the nutritional quality of the grasses, legumes, and forbs in the Preveza Prefecture grasslands in North-Western Greece. The experimental plots were located in three altitudinal zones (i.e., lower, middle, and upper). The authors pointed out that the altitudinal zone strongly affected the nutritive value of the fodder. The CP of the three botanical components ranged between 115 and 167 g/kg DM. For all botanical components, protein and fiber contents were highest and lowest, respectively, in the upper altitudinal zone.

Compared to our results, higher values of CP content of two legumes were determined by Peiretti et al. (2016) in a survey conducted in Alpine pastures located in NW Italy. The authors reported values of 156 g CP/kg for *Lotus corniculatus* and 152 g CP/kg for *Trifolium repens*. For *Medicago lupulina* grown in Central Northern Bulgaria, a content of 22.94% crude protein was determined by Naydenova et al. (2022).

In another mountainous area of Romania, the highest values of crude protein content (19.50%) and total mineral content (12.75%) were reported in the legume species *Trifolium repens* compared to most species in the grass canopy in a study conducted on an improved subalpine grassland in the Bucegi Mountains (Andreoiu et al., 2021).

The fiber concentration increases as plants advance to the mature stage, affecting the dry matter digestibility. Although the protein content of the sample composed of *Agrostis capillaris* and *Cynosurus cristatus* (P4) was the smallest within the group of the analyzed samples, its dietary fiber content was 322.29 ± 0.95 g/kg DM. Comparatively, the fiber concentration was 16.44% smaller in the P5 sample than in P4. The fiber content of the sample containing *Festuca rubra* was in the middle part of the interval determined for the entire group of samples, as follows: 279.09 ± 2.25 g/kg DM in the sample P1 and 286.87 ± 0.66 g/kg DM in the sample P2 (Figure 6).

Compared to our dataset, higher values of the fiber content were determined by Roukos et al. (2011) and Peiretti et al. (2016). Thus, the acid detergent fiber (ADF) of the grasses, legumes, and forbs in the Preveza Prefecture grasslands ranged between 311 and 337 g/kg DM (Roukos et al., 2011), while values of 418 g/kg and 357 g/kg were reported by Peiretti et al. (2016) for *Lotus corniculatus* and *Trifolium repens* respectively.

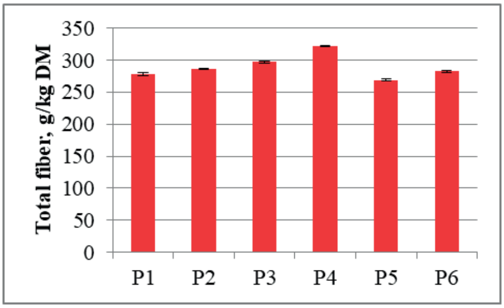

Figure 6. The total dietary fiber content of the samples

In subalpine grassland in the Bucegi Mountains, *T. repens* had the lowest ADF value (22.40%), with significant differences from the other species, while the higher dry matter content was determined in grasses (Andreoiu et al., 2021).
Referring to species of plants included in our study, *Arrhenatherum elatius* forage was reported as having the highest content of crude fiber, i.e., 30.2%, compared to *Festulolium* and *Dactylis glomerata* (Skládanka et al., 2008). Also, this species was characterized by the highest NDF (neutral detergent fiber) content (60.5%).
Phosphorus is an important part of the ash that contributes to the animal nutrition. A significant amount of P 4.99 ± 0.3 g/kg DM, was determined in the P6 sample (Figure 7) which could be explained by the presence of numerous legumes and grasses in this sample. The phosphorus content of the other samples was relatively close, ranging from 3.43 ± 0.18 g/kg DM (P3) to 3.99 ± 0.22 g/kg DM (P5).
The phosphorus content of the grasses, legumes, and forbs in the Preveza Prefecture grasslands in North-Western Greece was reported as follows: 1.95 g/kg DM, 2.45 g/kg DM, and 2.73 g/kg DM respectively (Roukos et al., 2011). The basic chemical composition of *Medicago lupulina* in Central Northern Bulgaria was also reported as follows: 0.21% phosphorus, 31.34% crude fiber, and 10.45% crude ash (Naydenova et al., 2022).
The nitrogen cycle in nature includes many forms of N coming from organic and mineral fertilizers used in agriculture but also from different processes that take place in soil and water. The nitrates content of the samples (Figure 8) varied widely, between 2.33 ± 0.15 mg/kg DM (P3) and 28.93 ± 1.08 mg/kg DM (P6). For the other samples, this parameter decreased as follows: 23.67 ± 0.6 mg/kg DM (P5) > 13.24 ± 0.35 mg/kg DM (P1) > 8.91 ± 0.4 mg/kg DM (P2) > 4.88 ± 0.41 mg/kg DM (P4).

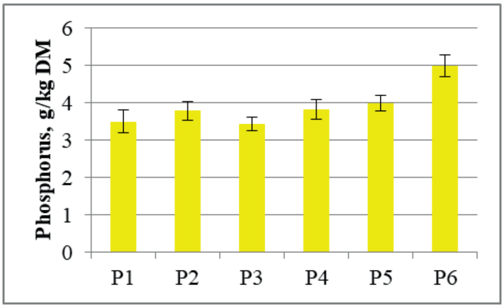

Figure 7. The phosphorus content of the samples

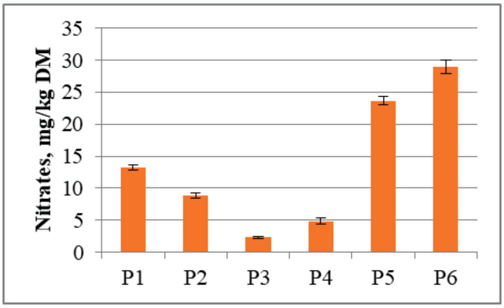

Figure 8. The nitrates content of the samples

Other results showed that a large variation in nutrient contents (protein and fiber) of the flora of Mount Varnoudas pastures in NW Greece was determined not only between seasons but also, between altitudinal zones (Mountousis et al., 2011). The authors reported a mean content of CP of 83.02 g/kg DM in the lower altitudinal zone, respectively 96.55 g/kg DM in the upper altitudinal zone. The lower contents of neutral detergent fiber (aNDF) and acid detergent fiber (ADF) found in grasslands of the middle altitudinal zone were explained in relationship with the presence of more broadleaved species in those grasslands.
Our study added new information regarding the chemical composition of the forage to the presented reports underlining the valuable elements related to the forage obtained in the mountain grasslands, and the importance of complex studies to maintain their multifunctional potential and the forage quality (Samuil et al., 2018).
The data referring to dry matter, ash, and nitrates content, have a normal, positive, and platykurtic distribution (Table 3). For the crude protein

content, a normal, negative, and leptokurtic distribution was observed. On the contrary, the data distribution referring to TDF and phosphorus content was asymmetrical, positive, and leptokurtic, respectively.

The correlation analysis (Table 4) shows strong direct correlations between the dry matter content and total dietary fiber content ($r = 0.953$, $p < 0.01$), protein content and leaf area index ($r = 0.876$, $p < 0.01$), phosphorus content and nitrates content ($r = 0.785$, $p < 0.01$). The positive correlation between dry matter and fiber content sustains the important role of fiber on dry matter digestibility, with an impact on animal nutrition. With the late stages of development (seed formation and ripening), the forage cell wall contents increase, having as a result the increase of the fiber content.

An average positive correlation ($r = 0.67$, $p < 0.01$) was also observed between the DM content and the fiber content of a clover collection consisting of species such as *Trifolium montanum*, *T. repens* and *T. pratense* (Vilčinskas and Dabkevičienė, 2010). The authors reported a very high correlation between the chemical composition characteristics of the clover collection.

The correlation between CP and leaf area index was present due to the synthesis of this nutritional component in the expanding leaf surfaces of plants. Effects of P on nitrate accumulation are dependent on plant species and sampling time respectively. According to our data, the forage response to P significantly influences the nitrate concentration.

Table 3. Descriptive statistics of the explanatory variables used in the chemical analysis and composition of the six relevant samples in the studied mountain grassland located in Fundata village, Romania

Indicator	Dry matter, %	Ash, g/kg DM	Crude protein, g/kg DM	Total dietary fibers, g/kg DM	Phosphorus, g/kg DM	Nitrates, mg/kg DM
Mean	91.99	5.47	9.35	26.66	3.61	1.25
Median	91.84	5.40	9.66	26.17	3.52	1.02
Mode	91.10	4.35	9.50	24.53	3.11	0.20
Std. Deviation	0.69	0.71	1.84	1.79	0.49	0.91
Skewness	0.88	0.34	-0.97	1.004	1.33	0.48
Kurtosis	-0.102	-0.37	0.018	0.13	0.85	-1.33
Minimum	91.10	4.35	5.81	24.53	3.11	0.20
Maximum	93.45	6.75	11.35	30.09	4.68	2.75

Table 4. Pearson correlation coefficient values and type of association for the analyzed parameters - *correlation is significant at the 0.05 level (2-tailed); **correlation is significant at the 0.01 level (2-tailed)

	DM	Ash	CP	TDF	Phosphorus	Nitrates	LAI
DM	1	-0.350	-0.555*	0.953**	-0.013	-0.529*	-0.491*
Ash	-	1	0.767**	-0.393	-0.150	0.006	0.643**
CP	-	-	1	-0.656**	0.224	0.436	0.876**
TDF	-	-	-	1	-0.134	-0.656**	-0.622**
Phosphorus	-	-	-	-	1	0.785**	0.599**
Nitrates	-	-	-	-	-	1	0.704**
LAI	-	-	-	-	-	-	1

Moderate and positive correlations were determined between the mineral content (ash) of the forage and crude protein ($r = 0.767$, $p < 0.01$), ash and leaf surface ($r = 0.643$, $p < 0.01$), phosphorus content and the leaf surface ($r = 0.599$, $p < 0.01$), and nitrates content and leaf surface respectively ($r = 0.704$, $p < 0.01$). The first case would be possible due to the need for a certain mineral in protein synthesis. Our result is in agreement with the correlation coefficients between ash and CP reported by Türk et al. (2015) for the quality of forage in grazing and non-grazing areas of pastures.

Moderate and indirect correlations were established in the frame of our study between dry matter and crude protein ($r = 0.555$, $p < 0.05$), dry matter and nitrates ($r = 0.529$, $p < 0.05$), and total fiber and nitrate content ($r = 0.656$, $p < 0.01$).

An inverse correlation was determined between total fiber and crude protein of the analyzed samples ($r = 0.656$, $p < 0.01$), in agreement with the data reported by Waramit et al. (2012) between CP and aNDF. The negative correlation between DM and CP might be affected by the analysis of the forage in dried conditions, so the values reported in this paper refer to the corresponding DM.

These results pointed out that the floristic composition and the forage quality are key elements for characterizing the perennial canopy efficiency through grazing ensuring proper animal production and economic success (Motca, 2010). The efficiency of the leaf area of the heterogeneous canopy to capture light has an important role in dry matter production and its composition.

CONCLUSIONS

The mountain area occupied by permanent grasslands harbors the most numerous plant species compared to other relief forms, being characterized by larger biodiversity. The number of species differs from one altitudinal vegetation layer to another, the maximum number being recorded on the lower altitude grasslands, in the transition layer of the beech and common spruce. Regarding the studied area, an increase in the presence of valuable grass species and a decrease in other botanical species were observed compared to the previous assessments. This could be the result of the installation of fences by the owners of the grasslands that stopped the overgrazing. The sward has recovered due to the beneficial cooperation between valuable forage species.

Regarding the slope effect on the qualitative parameters of the forage, lower to medium values of all determined parameters were recorded in the upper sampling points (P1 and P2).

In the middle of the transect on a space occupied mainly by *Agrostis capillaris,* the samples contained high amounts of dry matter, proteins, fibers, and ash. On the contrary, the phosphorus and nitrates content were the lowest compared to the other five main samples. The highest fiber content was determined in sample P4, composed of *Agrostis capillaris* and *Cynosurus cristatus*.

The smallest DM and TDF were determined in the lower part of the transect, in the P5 sample (*Agrostis capillaris*), characterized also by high amounts of ash, phosphorus, and nitrates.

The presence of more valuable legumes and grasses at the base of the transect (sample P6) seemed to be correlated to an increased content of proteins.

From our knowledge, this is the first report of using such an approach for assessing the herbaceous vegetation in the Romanian mountain grasslands. The results are useful for pastoral value assessment, forecasting of biomass, and floristic composition considering the influence of climate variability.

Future work should consider more comparative studies regarding the influence of slope considering all the versant expositions and altitudinal gradients on the floristic composition and chemical composition of the plants. Another aspect that will be considered is to establish the elemental composition of the ash and its contribution to the forage quality.

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