

Dubljević, R., Radonjić, D., Marković, M. (2020): Production traits of major types of grasslands in the Durmitor area. *Agriculture and Forestry*, 66 (2): 229-236.

DOI: 10.17707/AgricultForest.66.2.20

Radisav DUBLJEVIĆ, Dušica RADONJIĆ, Milan MARKOVIĆ¹

PRODUCTION TRAITS OF MAJOR TYPES OF GRASSLANDS IN THE DURMITOR AREA

SUMMARY

Research was done on three localities in the area of Durmitor mountain with the aim to determine the production potential, primarily floristic composition and yield of important types of mountain grasslands (*Nardetum strictae*, *Agrostidetum vulgaris* and *Poetum viollacea*). Natural grasslands in this area are of special importance, because their share in the total agricultural area is above 90% and they are often the only source of fodder for ruminants.

Although Durmitor is a habitat of many plant species, including some endemic, these grasslands have a simple to semi-complex floristic composition, mostly due to the competitiveness of leading plants. The share of grasses and herbaceous plants in the fresh biomass of fodder is over 61-68%, legumes 3-6%, and plants of other families 29-33%. The highest yield at all localities was obtained on grassland of the *Agrostidetum vulgaris* type (7.74 - 9.81 t/ha⁻¹), and the lowest on *Nardetum strictae* 5.72 - 6.94 t/ha⁻¹ of fresh fodder. Although most of these grasslands are significantly degraded, their production characteristics can be significantly improved by applying appropriate agricultural techniques and if they are regularly used.

Keywords: Durmitor, grassland, floristic composition, grasses, legumes, yield.

INTRODUCTION

Improving the production of animal feed in the mountainous area of Montenegro is a constant aspiration and goal, but without sufficient commitment to achieve the expected results. The production resource of natural grasslands is one of the most important potentials for development of livestock production in rural areas, where grasslands share in the total agricultural area are above 90% (Dubljević, 2009). Hay and pasture are the basic, and often the only fodder with a smaller share of grain and concentrated feed. Bearing in mind that the grasslands potential is a base for ruminant nutrition, a very significant reduction of the livestock population directly affected the condition and degree of use of meadows, and especially pastures in the wider area of Durmitor mountain.

¹Radisav Dubljević (corresponding author: ratod@ac.me), Dušica Radonjić, Milan Marković University of Montenegro, Biotechnical Faculty, Mihaila Lalica 1, 81000, Podgorica, MONTENEGRO.

Notes: The authors declare that they have no conflicts of interest. Authorship Form signed online.

Received: 10/04/2020

Accepted: 20/06/2020

In an effort to reactivate these areas by returning to the countryside, some measures of agricultural policy are trying to stimulate production, primarily livestock. To meet such efforts, this research was conducted with the aim to contribute the determination of the production potential of mountain natural meadows, which have already been significantly degraded due to poor use and the absence of the care of swards.

In the earlier period, with a much larger number of heads of ruminants, the meadows were fertilized with manure, what resulted in good yields and positive changes in the floristic composition. Bearing in mind that there is almost no manure in this area nowadays, it would be necessary to apply mineral fertilizers, especially on swards that will not be in the system of organic livestock production. Rational fertilization improves the production characteristics of swards, primarily yield, nutritional value and floristic composition (Dubljević, 2005, 2007, 2010; Vučković *et al.*, 2007; Grubišić *et al.*, 2011; Stoycheva *et al.*, 2016). The authors emphasized the high degree of degradation of mountain grasslands in other areas of similar natural conditions, but also the relation to that resource. There is a real need to work on improvement of the characteristics of mountain grasslands, especially meadows, in the coming period, but also the obligation to apply the measures to preserve the state of the environment.

Durmitor mountain plateau (Jezersko-sinjajevinska and Planinsko Pivska area) is an area that abounds in meadows and pastures of very different potential and accessibility. In the recent time, most of these areas have not been used due to the drastic reduction of livestock in mainly abandoned rural areas or villages.

MATERIAL AND METHODS

Study of production characteristics of more important types of natural meadows in the Durmitor area was performed on the territory of the municipalities of Žabljak (Kovčica, locality B-1), Plužine (Pišće locality B-2) and Šavnik (Donja Bukovica locality B-3). These localities are at the altitude as follow: B-1 1500 m; B-2 1650 m and B-3 1250 m.

The study of vegetation and classification of grasslands was performed using the Braun - Blanquet method. The selected types of grasslands that are the subject of these studies were determined on the basis of previous research (Kovačević, 1969; Dubljević, 2005, 2007; Stešević and Caković, 2013; *etc.*), their distribution and overall importance for livestock production in this area.

Sward productivity was determined by mowing and measuring fresh fodder from 1m² plots (4 x 1 plots for each grassland variant) (3 localities x 3 grassland types). Dry matter content was determined by the gravimetric method according to AOAC (2000). Yield analysis was performed on the basis of weight participation of grasses, legumes and herbaceous plants or herbs (plants of other families - Ranunculaceae, Apiaceae, Scrophulariaceae, Asteraceae, Lamiaceae, Rubiaceae) in the total yield of fodder.

In the whole area, which is under the influence of a harsh mountain climate, specific orographic and edaphic factors, (very dynamic relief), several

plant communities have been formed on different lands, with similar and sometimes quite different properties.

Kovačević (1969), examining the grassland communities of the wider area of Durmitor mountain, identified the following groups:

- A - Mountain grasslands: (Goleti and Rudine in the local language)
- B - Hilly - mountain grasslands
- C - Mountain heaths
- D - Hilly grasslands
- E - Wetlands

Three main grassland communities or types: *Nardetum strictae* (A-1), *Agrostietum vulgaris* (A-2) and *Poetum violacea* (A-3) were identified as the variants of the most represented meadow communities in this area. However, the other grassland communities (*Festucetum vallesiaca*, *Brometum erecti*, *Plantagietum carinata*, *Festucetum rubra* – fallax) are also important but not considered in this research due to the fact that they have a rather complex floristic composition.

Statistical analysis encompassed the calculation of basic statistical parameters. The statistical significance of the results for grassland biomass and DM in different grassland communities (factor A) and at different location (factor B) was tested by ANOVA using LSD test. In statistical analysis of data program Statistica 10 was used.

RESULTS AND DISCUSSION

Meadow types and their botanical features

The wider area of Durmitor mountain is characterized by quite complex meadow-pasture vegetation, but the larger meadow complexes closer to the settlements (villages or 'katuns' - mountain settlements) are dominated by types of *Nardetum strictae*, *Agrostietum vulgarisi*, *Poetum violacea*, but their transitional forms created by human influence (fertilization, organized exploitation, etc.) are also significant.

The *Nardetum strictae* type

Grasslands of the *Nardetum strictae* type are dominant in the study area (table 1), where they consist almost half of the total grassland. They have a simple floristic composition, changed very slowly, and considered the most difficult for land reclamation. The leading species *Nardus strictae* is a plant with very modest production characteristics (composition, yield and nutritional value), but due to its good cover and firm and compacted sod, it protects the soil well from erosion, even on higher slopes.

The formation and spread of this type of grassland was mostly influenced by unfavorable natural conditions, which limited the development of better species and their communities, but also man, by poor management.

Table 1. Plant composition of grassland type *Nardetum strictae* by the localities*

Plant species	B-1	B-2	B-3	Plant species	B-1	B-2	B-3
<u>Poaceae</u>							
<i>Nardus strictae</i>	3	4	3	<i>Festuca rubra</i> –	2	1	1
<i>Bromus erectus</i>	1	1	+	<i>fallax</i>			
<i>Phleum pratense</i>	1	2	2	<i>Festuca vallesiaca</i>	2	1	1
<i>Poa pratensis</i>	+	1	1	<i>Poa violacea</i>	1	1	+
<i>Anthoxanthum</i>	-	+	+	<i>Agrostis vulgaris</i>	1	2	1
<i>odoratum</i>				<i>Briza media</i>	+	+	+
<u>Fabaceae</u>							
<i>Trifolium repens</i>	1	1	+	<i>Trifolium montanum</i>	+	+	-
<i>Lotus corniculatus</i>	+	1	1	<i>Vicia cracca</i>	+	+	+
<i>Genista sagitalis</i>	1	1	+	<i>Trifolium alpestre</i>	+	-	+
<i>Trifolium pratense</i>	-	+	+				
<u>Plants from other</u>							
<u>families</u>				<i>Taraxacum officinale</i>	1	1	1
<i>Galium verum</i>	1	+	1	<i>Veratrum album</i>	1	1	+
<i>Verbascum nigrum</i>	+	+	+	<i>Ranunculus repens</i>	2	1	1
<i>Rumex acetosela</i>	+	1	1	<i>Plantago lanceolata</i>	1	1	1
<i>Achilea millefolium</i>	1	1	+	<i>Carex sp</i>	+	-	-
<i>Veratrum album</i>	+	+	-	<i>Euphorbia sp</i>	+	+	+
<i>Hipericum perforatum</i>	-	+	-				

* B-1 Kovčica; B-2 Pišće; and B-3 Donja Bukovica.

Vegetation of non-fertilized grassland type *Nardetum strictae* is high of about 20 cm in average, achieves low yields and poor nutritional value of forage. The condition is better on periodically and constantly fertilized surfaces, where desirable changes in the floristic composition present. In the earlier period, a good part of these grasslands was used for grazing, while in recent times they have been almost completely abandoned due to the reduction of livestock.

The *Agrostidetum vulgaris* type

Agrostis vulgaris is one of the most widespread plant species on grasslands of various areas and habitats, especially in mountainous but also in lower areas (Mijatović, 1972). This plant is part of several associations, but also builds its own, which is one of the best for livestock production in the less favorable natural conditions of the Durmitor area.

The community *Agrostidetum vulgaris* in the area of Durmitor (table 2) is most often of anthropogenic origin, because it was formed by changes in the floristic composition of more dominant grasslands (*Nardetum strictae*) caused by regular fertilization and exploitation. For a long time, due to the situation in livestock sector, these grasslands have been exposed to a strong process of degradation, because there are no measures of their improvement. Less valuable grasses and vegetables are increasingly present in the plant cover, with an increasing share of worthless and harmful species.

Table 2. Plant composition of *Agrostidetum vulgaris* meadows by localities*

Plant species	B-1	B-2	B-3	Plant species	B-1	B-2	B-3
<u>Poaceae</u>							
<i>Agrostis vulgaris</i>	3	4	4	<i>Poa pratensis</i>	1	1	1
<i>Cynosurus cristatus</i>	1	+	1	<i>Festuca rubra</i> –	1	1	+
<i>Phleum pratense</i>	+	1	1	<i>fallax</i>			
<i>Danthonia calicynia</i>	-	+	+	<i>Festuca vallesiaca</i>	+	1	+
<i>Dactylis glomerata</i>	+	1	1	<i>Poa violacea</i>	+	+	-
<i>Nardus strictae</i>	1	1	+	<i>Briza media</i>	+	+	+
<u>Fabaceae</u>							
<i>Trifolium repens</i>	1	2	2				
<i>Trifolium pratense</i>	+	1	1	<i>Trifolium alpestre</i>	1	+	1
<i>Lotus corniculatus</i>	+	1	+	<i>Trifolium montanum</i>	+	+	+
<i>Trifolium campestre</i>	+	-	+	<i>Vicia cracca</i>	1	-	+
<u>Plants from other families</u>							
<i>Achillea millefolium</i>	2	1	2	<i>Taraxacum officinale</i>	+	-	-
<i>Galium verum</i>	+	1	+	<i>Veratrum album</i>	+	1	1
<i>Verbascum nigrum</i>	+	+	-	<i>Ranunculus</i>	1	1	1
<i>Rumex acetosela</i>	-	+	+	<i>montanum</i>			
<i>Hipericum perforatum</i>	+	+	-	<i>Plantago lanceolata</i>	1	+	1
<i>Plantago carinata</i>	+	+	1	<i>Carex sp</i>	+	+	+
				<i>Euphorbia sp</i>	+	+	+

* B-1 Kovčica; B-2 Pišče; and B-3 Donja Bukovica.

Meadows of the type *Agrostidetum vulgaris* are characterized by a more complex plant cover, average height of about 30-40 cm, of very good cover (95 - 100%). In competition with other swards in this area, it gives the highest yields of hay of satisfactory quality.

The *Poetum violacea* type

Meadows of the *Poetum violacea* type (table 3) cover slightly lower flat terrains with a smaller slope, where the soils are slightly deeper and wetter. They are more of a climatogenic than anthropogenic origin, which can be seen in their maintenance, despite the unfavorable environmental conditions and complete

neglect. Belongs to the better meadows of this area, especially on unfertilized areas, thanks to the higher fertility of the land it covers.

These grasslands have a slightly more complex plant cover than the *Nardetum strictae* type, with an average height of about 30-40 cm. They give medium yields of satisfactory quality, especially with earlier mowing. They are characterized by a very high degree of cover, so since they cover terrains with a smaller slope, there is almost no soil erosion on them.

Table 3. Plant composition of *Poetum violacea* meadow by localities*

Plant species	B-1	B-2	B-3	Plant species	B-1	B-2	B-3
<u>Poaceae</u>							
<i>Poa violacea</i>	3	4	3	<i>Festuca vallesiaca</i>	2	1	1
<i>Festuca rubra – fallax</i>	1	1	1	<i>Anthoxanthum</i>	+	+	+
<i>Agrostis vulgaris</i>	+	+	1	<i>odoratum</i>			
<i>Cynosurus cristatus</i>	-	+	+	<i>Poa pratensis</i>	+	-	+
<i>Phleum pratense</i>	1	1	1	<i>Briza media</i>	+	+	-
<i>Nardus strictae</i>	1	1	+	<i>Dactylis glomerata</i>	+	+	+
<u>Fabaceae</u>							
<i>Trifolium repens</i>	1	+	1	<i>Trifolium montanum</i>	+	+	+
<i>Trifolium pratense</i>	+	-	+	<i>Vicia cracca</i>	+	+	+
<i>Lotus corniculatus</i>	+	1	1	<i>Anthyllis vulneraria</i>	1	1	+
<u>Plants from other</u>							
<u>families</u>				<i>Timus montanus</i>	2	1	1
<i>Achillea millefolium</i>	1	2	1	<i>Taraxacum officinale</i>	+	+	1
<i>Galium verum</i>	+	+	-	<i>Veratrum album</i>	+	1	1
<i>Verbascum nigrum</i>	+	1	+	<i>Ranunculus montanum</i>	1	+	1
<i>Rumex acetosela</i>	-	+	+	<i>Plantago lanceolata</i>	1	1	1
<i>Euphorbia sp</i>	+	+	+	<i>Carex sp</i>	+	-	+
<i>Plantago carinata</i>	+	-	+				
<i>Ranunculus repens</i>	1	+	+				

* B-1 Kovčica; B-2 Pišće; and B-3 Donja Bukovica.

Yields of grass biomass and dry matter

The results of measuring the yield of fresh grass and dry matter of the examined types of grassland by localities are given in Table 4. The highest average yields at all localities were in meadow type *Agrostidetum vulgaris*, namely 7.74 t/ha⁻¹ (B-1), 8.86 t/ha⁻¹ (B-3) and 9.81 t/ha⁻¹ (B-2), and the least one in type of *Nardetum strictae*, 5.72 t/ha⁻¹ (B-1), 6.47 t/ha⁻¹ (B-3) and 6.94 t/ha⁻¹ (B-2). The average yield of variants A-2 was significantly higher compared to variants A-1 and A-3.

Apart from the variants (types of grasslands), differences in yield were also achieved by localities. At sites B-2 and B-3, the yields of fresh fodder of all variants were significantly higher than the yields at site B-1.

Similar yields of fresh forages were obtained by Mijatović (1972), Dubljević (2003, 2009, 2010), Vučković *et al.* (2007), on non-fertilized grasslands of the type *Nardetum striktae*, *Agrostidetum vulgaris* and *Poetum*

violacea. In addition to the yield, Radonjić et al. (2019) in their research emphasized the influence of pasture feed composition on the quality of dairy products. Table 5 shows the share of grasses, legumes and plants from other families (PFOF) in the total yield of green fodder by variants and localities.

Tab. 4 Yields of fresh grass biomass and dry matter (t / ha⁻¹)

Type of grassland (A)	Localities (B)*							
	B - 1		B - 2		B - 3		Average	
	Grass biomass	DM	Grass biomass	DM	Grass biomass	DM	Grass biomass	DM
<i>Nardetum strictae</i> A - 1	5,72 ^{ak}	1,65 ^{ap}	6,75 ^{al}	2,09 ^{ap}	6,94 ^{al}	2,03 ^{ap}	6,47 ^a	1,92 ^a
<i>Agrostidet. vulgaris</i> A - 2	7,74 ^{bk}	2,34 ^{bp}	9,27 ^{bl}	2,63 ^{bp}	9,81 ^{bl}	2,71 ^{bp}	8,85 ^b	2,56 ^b
<i>Poetum violacea</i> A - 3	7,10 ^{ck}	2,11 ^{bp}	7,92 ^{cl}	2,25 ^{abp}	8,68 ^{cm}	2,42 ^{abp}	7,90 ^c	2,26 ^{ab}

* B-1 Kovčica; B-2 Pišče; and B-3 Donja Bukovica.

The values in the same column marked by different letters (a, b, c) differ significantly, according to LSD test ($p < 0.05$)

The corresponding values for the Grass biomass (k, l, m) and for the DM (p, q r) in the same raw marked by different letters differ significantly, according to LSD test ($p < 0.05$)

Table 5. Structure of grass biomass (in %)

Type of grassland (A)	Localities (B)*											
	B - 1			B - 2			B - 3			Average		
	Grass	Legum.	PFOF	Grass	Legum.	PFOF	Grass	Legum.	PFOF	Grass	Legum.	PFOF
<i>Nardetum strictae</i> A - 1	71	3	26	68	3	29	66	4	30	68	3	29
<i>Agrostidet. vulg.</i> A - 2	65	5	30	60	6	34	58	7	35	61	6	33
<i>Poetum violacea</i> A - 3	67	4	29	64	5	31	61	6	33	64	5	31

* B-1 Kovčica; B-2 Pišče; and B-3 Donja Bukovica.

In all types of grasslands, in all localities, the average share of the grasses in the grass biomass was the highest in type A-1(68%), followed by type A-3 with 64% and 61% in type A-2, while the least was in legumes, 4-7%. The share of plants from other families was 29 - 33%.

CONCLUSIONS

Based on the results of the research of the production potential of important types of grasslands in the area of Durmitor mountain, the following conclusions can be drawn:

- The wider area of the slopes and foothills of Durmitor represents a large, but insufficiently used potential for the development of livestock production.

- Meadow types *Nardetum strictae*, *Agrostidetum vulgaris* and *Poetum violacea* are dominant in this area, but *Festucetum vallesiaca*, *Brometum erecti*, *Festucetum rubra-falax* and others are significantly present.

- The highest average fresh grass yields were in the meadow type of *Agrostidetum vulgaris* 8.85 t/ha-1, and the lowest in *Nardetum strictae* 6.47 t/ha-1 of green fodder.

- The average share in the total yield of fresh biomass was 61 - 68% of grasses, 3 - 6% of legumes and 31 - 33% of the other plant families.

REFERENCES

- AOAC 2000. Official methods of analysis of AOAC International. 17th ed. Gaithersburg, Maryland, USA (method number 991.20; 33.2.11).
- Dubljević, R.; Mitrović, D. 2010. Fertilizing results of high montain grasslands *Poetumviolace*. Biotechnology in Animal Husbandry, p 417 – 422, 2010. Institute for Animal Husbandry, Belgrade - Zemun.
- Dubljević, R. ; Mitrović, D. 2009. Productive Featurer of Mountain Lawn Type *Agrostidetum vulgaris*, Fertilizadwzh Differet Nitrogen Doses. Agroznanje, Vol. 10. Br. 2, ISSN. 1512, Banja Luka
- Dubljević, R. 2003. Uticaj đubrenja azotom na proizvodne osobine travnjaka *Nardetum strictae*. Poljoprivreda i šumarstvo, Vol 49 (1-2) 39-46. Podgorica.
- Dubljević, R. 2007. Uticaj đubrenja azotom na proizvodne osobine livade tipa *Agrostietum vulgaris* u brdskom području Polimlja. Institut za ratarstvo i povrtarstvo, Novi Sad, Zbornik radova-Vol. 44, No. I, Novi Sad.
- Dubljević, R. 2009. Country Pasture Forage Resource Profiles. FAO.
- Đuričković, M. 1978. Ispitivanje agrotehničkih i agromelioracionih mjera za povećanje proizvodnje na prirodnim livadama. Poljoprivreda i šumarstvo, XXIV, 1, 85-90. Titograd.
- Mijatović, M. 1972. Tipovi prirodnih livada i pašnjaka na planini Stolovi i njihove proizvodne osobine. Univerzitet u Beogradu, Zbornik radova Poljoprivrednog fakulteta. God XX, sv. 549, 1 – 17. Beograd.
- Grubišić, M.; Vuković, Z.; Savić, N.; Stojanović, S. 2011. Nove mere i tehnologije u biološkoj rekultivaciji zemljišta na odlagalištu Drmno. Zbornik radova II Simpozijuma, Vrnjačka Banja PKS Str. 700-705. Beograd.
- Kovačević, J. 1969. Travnjačke biljne zajednice Durmitorsko – Sinjajevinske i centralne oblasti Crne Gore u odnosu na faktore staništa. Poljoprivredna znanstvena smotra. Sv. 26. br 10. Zagreb.
- Radonjić, D. 2019. Uticaj ispaše na travnjacima različitih područja Crne Gore na sadržaj masnih kisjelina u kravljem mlijeku. Univerzitet u Beogradu, Poljoprivredni fakultet Zemun.
- Stat-Soft Inc. 2010. STATISTICA (Data Analyses Software System), v.10.0. 2010., USA. www.statsoft.com.
- Stešević, D.; Caković, D. 2013. Katalog vaskularne flore Crne Gore, Tom I CAN-u Podgorica.
- Stoycheva, I.; Kirilov, A.; Naydenova, Y; Katova, A. 2016. Yield and composition changes of temporary and permanent pasture. Grassland Science in Evrope 21: 317-320.
- Vučković, S.; Simić, A.; Đorđević, N.; Živković, D.; Erić, P., Ćupina, B.; Stojanović, I.; Petrović-Tošković, S. 2007. Uticaj đubrenja na prinos livade tipa *Agrostietum vulgaris* u zapadnoj Srbiji. Zbornik radova Instituta za ratarstvo i povrtarstvo, 44, 1, 355-360.