RESEARCH REGARDING THE IMPROVEMENT OF MOUNTAIN MEADOWS IN RANCA AREA, GORJ COUNTY

Călin SALCEANU[1], Liviu Aurel OLARU[1], Cătălin Viorel POPESCU[1], Marian DOBRE[1], Alina Marilena PRIOTEASA[1], Alex Emanuel PRIVANTU[1], Leontina Monica SUNĂ[2]

University of Craiova, Faculty of Agronomy, Craiova, Libertății Street, no. 19, 200421, Romania[1]
Inspectoratul Școlar Județean Dolj[2]
author email: calin.salceanu@yahoo.com

Corresponding author email: liviu.olaru.dtas@gmail.com

Abstract

Our country has 4.82 million hecare of meadows, of which 3.34 million are used by grazing. Gorj County is occupied by meadows on almost half of the surface, the meadows in the mountain area being the most intensely exploited. The Rânca area is positioned at altitudes of 1350-1680 m, in the upper part of the boreal floor. The average annual temperature is about 5°C, and the rainfall exceeds 1,000 mm annually. Under these conditions, on these surfaces were installed meadows ecosystems with limited potential of production and quality of feed, such as those of Nardus stricta L.*. The research carried out in the agricultural year 2024-2025, within the Research base of the mountain meadows belonging the University of Craiova, Faculty of Agronomy, aimed at quantification of the effect of different types of fertilizers on the biodiversity, productivity and quality of the feed on a Nardus stricta* L. *meadow. Ferilization with complex solids mineral fertilizers, NPK type, led to an increase in the percentage of grasses species and a decrease in the varous species and to an increase in the production and feed quality of Nardus stricta* L.*, meadow. Also, fertilization efficiency had the maximum value in thys case..*

Key words**: **inputs, biodiversity, production, quality

INTRODUCTION

Grass-land species remain ones of the most economically significant forage crops worldwide due to their high biomass yield, superior protein content, and critical role in sustainable livestock production (**Acatrinei et al., 2024, Sălceanu et al., 2023a, Sălceanu et al., 2023b Sărățeanu et al., 2023**). However, increasing environmental variability and evolving biotic pressures continue to challenge traditional cultivars, underscoring the need for improved genetic resources (**Paraschivu et al., 2023**).

In Romania, since the year 2000, sheep and goat herds had an increase of almost 50%, reaching 11,869,500 heads at the end of the year 2024. (**www.insse.ro, 2025**. In these conditions, the need for feed to support these herds also increased.

Our country has 4.82 million hecare of meadows, of which 3.34 million are used by grazing. Gorj County is occupied by meadows on almost half of the surface, the meadows in the mountain area being the most intensely exploited (**Stavarache M. and Naie Margareta, 2024**).

The Rânca area is positioned at altitudes of 1350-1680 m, in the upper part of the boreal floor. The average annual temperature is about 5°C, and the rainfall exceeds 1,000 mm annually. Under these conditions, on these surfaces were installed meadows ecosystems with limited potential of production and quality of feed, such as those of *Nardus stricta* L.

The potential of these grasslands is limited by poor pedoclimatic conditions, such as soil with insufficient nutrient content, acidic pH, a short vegetation period, precipitation in large quantities and a small amount of biologically active temperatures.

One of the fastest ways to increase the productive potential of these types of meadows is fertilization. The effect of

fertilization is visible, first of all, in terms of biodiversity and vegetation structure, but also in terms of feed quality (**Samuil C. et al, 2018**; **Yasemin K. Et al, 2019**, **Dragomir N. et al, 2020**; **Karbivska Y. Et al, 2020**; **Bita-Nicolae Claudia et al, 2023; Palaj A. et al, 2024**).

The research was carried out in the agricultural year 2024-2025, within the Research base of the mountain meadows belonging the University of Craiova, Faculty of Agronomy (45°17'52"N, 23°40'32"E, 1540 m altitude).

The aim of the research was to quantify the effect of different types of fertilizers on the biodiversity, productivity and quality of the feed on a *Nardus stricta* L. meadow in Ranca area, Gorj County.

MATERIALS AND METHODS

The research was carried out in the agricultural year 2024-2025, within the Research base of the mountain meadows belonging the University of Craiova, Faculty of Agronomy. The aim of the research was to quantify the effect of three types of fertilizers on the biodiversity, productivity and quality of the feed on a *Nardus stricta* L. meadow in Ranca area, Gorj County.

Studied factor was fertilization with four graduations:

F_1 - Unfertilized (control variant);

F_2 - Fertilized with complex mineral fertilizers ($N_{20}P_{20}K_{20}$) (figure 1);

F_3 - Fertilized with 5 litres per hectare complex mineral foliar fertilizers ($N_{20}P_{20}K_{20}$ + Bo, Cu, Fe, Mn, Mo, Zn) (figure 1);

F_4 - Fertilization with 10 tons (Mg) per hectare semi-fermented sheep manure (N: 0,82 %; P: 0,24 %; K: 0,65 %).

The experience was set, the year 2024, in randomized blocks, in three replications, with the area of a plot of 30 m^2 (6 m × 5 m).

Figure 1 Fertilization and harvesting of *Nardus stricta* L. meadow (own foto)

The floristic study on the vegetation was carried out using the geobotanical method, by identifying in each experimental variant the presence and classification of existing species in the vegetation by economic groups and determining quantitative phytocenological indices, including abundance and dominance. Harvested was done with the help of the rider, and the determination of the production on each experimental variant was performed by weighing the resulting green mass and reported per hectare (figure 1).
After determining the dry matter (DM) forage content, production was expressed in tonnes per hectare DM.
The dry matter content was determined by drying in an oven at 103 °C for 3 hours; work device: Heat-adjustable oven - Venticell 111 l; standard - SR ISO 6496/2001;
The pastoral value (Vp) was calculated with the formula:

$$Vp = (\Sigma A \times Is)/100$$, where:

A - the average coverage of each species in the floristic structure;
Is - specific forage value index, with values between -2 and 5 (**Csűrös Ş., 1970**).
With the help of the pastoral value, the grazing capacity or the load with animals was determined (Cp) (**Motcă G. et al, 1994**):

$Cp = Vp \times c$ ($UVM \cdot ha^{-1}$), where:

UVM - 500 kg adult cattle;
Vp - pastoral value;
c (coefficient, depending on the degree of intensification of the meadow) - 0.4-0.6 (**Vîntu V. et al, 2017**).
Crude protein content (CP) was calculated by multiplying the total nitrogen content by the conversion factor 6,25 using the relationship:

$CP = Nt \times 6.25$, where:

Nt - total nitrogen content.
Total nitrogen content (Nt), in order to establish the crude protein content, was determined using the Kjeldahl method, which involved three successive stages of work: mineralization of organic matter in the presence of sulfuric acid, nitrogen being transformed into ammoniacal nitrogen, ammonia distillation and its titration. In this case, the Kjeldahl-Digestor - InKjel P system was used, using the standard method - SR ISO 13325/1995.
The results were interpreted statistically by analysis of variance and calculation of Least Significant Difference (LSD). Differences with statistical signification were highlighted as follows:
* - significant positive difference (p = 5 %);
** - distinctly significant positive difference (p = 1 %);
*** - very significant positive difference (p = 0.1 %);
° - significant negative difference (p = 5 %);
°° - distinctly significant negative difference (p = 1 %);
°°° - very significant negative difference (p = 0.1 %).

RESULTS AND DISCUSSIONS

Meadow biodiversity

In year 2025, the average number of identified species was 26 at variant F_1, 25 at variant F_2, 27 at variant F_3 and 29 at variant F_4.
Among the species with a higher coverage degree were highlighted: *Nardus stricta* L., *Festuca nigrescens* Lam., *Deschampsia flexuosa* (L.) Trin., *Anthoxanthum odoratum* L., *Poa media Schur*, from the grasses (74.6-90.4 % total coverage); *Trifolium repens* L., *Trifolium pratense* L. from the legumes (1.5-10.4 % total coverage); *Luzula sudetica* (Willd.) Schult., *Carex pallescens* L. from the *Cyperaceae* and *Juncaceae* (1.8-3.6 % total coverage); *Scorzonera rosea* Waldst. & Kit., *Viola declinata* Waldst. & Kit., *Geum montanum* L., *Potentilla erecta* (L.) Raeusch., *Thymus balcanus* Borbás, *Veronica officinalis* L. from the various (3.4-13.8 % total coverage); briophytes and lichens, with a coverage level below 1% (table 1).
The implemented imputes have generated the following changes, regarding biodiversity (table 1):

Table 1. The influence of fertilization on the biodiversity characteristics of the *Nardus stricta* L meadow

Variant		Grasses %	Legumes %	*Cyperaceae* and *Juncaceae* %	Various %	Pastoral value (Vp)	Grazing capacity (Cp) UVM·ha^{-1}	Grassland Quality
						Motcă G. et al, 1994		
F_1[C]		82,6[C]	1,5[C]	2,1[C]	13,8[C]	1,48[C]	0,74[C]	Mid to weak
F_2		90,4**	2,6	3,6*	3,4[ooo]	2,95*	1,77**	Good to very good
F_3		85,3	2,8	2,3	9,6[oo]	1,96	1,18	Good
F_4		74,6[oo]	10,4**	1,8	13,2	3,07*	1,84**	Good to very good
LSD	*0.5*	*5,0*	*4,3*	*1,4*	*2,0*	*1,35*	*0,67*	-
	0.1	*7,5*	*6,6*	*2,2*	*3,1*	*2,04*	*1,01*	-
	0.01	*12,1*	*10,5*	*3,5*	*5,0*	*3,28*	*1,62*	-

Source: Own data ([C] - control)

In the F_2 variant, fertilized with $N_{20}P_{20}K_{20}$, the percentage of gramine species increased distinctly significantly, from 82.6 % to 90.4% and in the F_4 variant, fertilized with 10 Mg·ha^{-1} manure, the percentage of gramine species decreased distinctly significantly, from 82.6% to 74.6 %.

In the F_4 variant, fertilized with 10 Mg·ha^{-1} manure, the percentage of gramine species decreased distinctly significantly, from 82.6% to 74.6 %.

In the F_4 variant, fertilized with 10 Mg·ha^{-1} manure, the percentage of legumes species increased distinctly significantly, from 1.5 % to 10.4 %, by the development of *Trifolium pratense* L.

In the F_2 variant, fertilized with $N_{20}P_{20}K_{20}$, the percentage of *Cyperaceae* and *Juncaceae* species increased significantly, from 2.1 % to 3.6 %.

In the F_2 variant, fertilized with $N_{20}P_{20}K_{20}$, the percentage of various species decreased significantly, from 13.8 % to 3.44 and in the F_3 variant, fertilized with complex mineral foliar fertilizers, the percentage of various species decreased distinctly significantly, from 13.8% to 9.6 %.

The other changes in the biodiversity parameters studied were insignificant.

In the literature were developed methods of classification of the productivity and quality of the grasslands, only on the basis of the floristic composition, without determination of production and without quality analysis, such as the method elaborated by **Motcă G. et al, 1994**. Thus, in the case of the researches carried out, by applying complex solids mineral fertilizers, $N_{20}P_{20}K_{20}$ type and 10 Mg·ha^{-1} manure, increased the value of the meadow from a medium to weak one, to a good to very good one (Vp increased significantly and Cp increased distinctly significantly).

Meadow productivity

The implemented imputes have generated the following changes, regarding productivity (table 2):

In the F_2 variant, fertilized with $N_{20}P_{20}K_{20}$, the green mass production increased distinctly significantly, from 6.86 Mg·ha^{-1} to 10.96 Mg·ha^{-1} and in the F_4 variant, fertilized with 10 Mg·ha^{-1} manure, the green mass production increased very significantly, from from 6.86 Mg·ha^{-1} to 11.87 Mg·ha^{-1}.

In the F_2 variant, fertilized with $N_{20}P_{20}K_{20}$, the dry matter production increased distinctly significantly, from 1.97 Mg·ha^{-1} to 3.19 Mg·ha^{-1} and in the F_4 variant, fertilized with 10 Mg·ha^{-1} manure, the dry matter production increased distinctly significantly, from from 1.97 Mg·ha^{-1} to 3.11 Mg·ha^{-1}. Production at the F_4 variant had a water content higher by 2.9% than at the F_2 variant.

The other changes in the productivity parameters were insignificant.

Meadow quality

The implemented imputes have generated the following changes, regarding the feed quality (table 2):

In the F_2 variant, fertilized with $N_{20}P_{20}K_{20}$, the total nitrogen content (Nt) increased significantly, from 1.467 % to 1.669 %.

Table 2. The influence of fertilization on the productivity and feed quality on the *Nardus stricta* L. meadow

Variant		Green mass production Mg·ha^{-1}	Dry matter %	Dry matter production (DM) Mg·ha^{-1}	Total nitrogen content (Nt) %	Crude protein content (CP) %	Crude protein production kg·ha^{-1}	Fertilization efficiency (kg CP per kg of N applied)
F_1[C]		6,86[C]	28,7	1,97[C]	1,467[C]	9,17[C]	180,6[C]	Control
F_2		10,96**	29,1	3,19**	1,669*	10,43*	332,7*	7,6
F_3		7,41	27,4	2,03	1,450	9,06	183,9	3,3
F_4		11,87***	26,2	3,11**	2,002**	12,51***	389,1**	2,5
LSD	*0.5*	*1,72*	-	*0,78*	*0,167*	*1,09*	*135,1*	-
	0.1	*2,60*	-	*1,18*	*0,253*	*1,65*	*204,6*	-
	0.01	*4,17*	-	*1,89*	*0,406*	*2,67*	*328,6*	-

Source: Own data ([C] - control)

In the F_4 variant, fertilized with 10 Mg·ha^{-1} manure, total nitrogen content (Nt) increased distinctly significantly, from 1.467 % to 2.002 %. This change was due to the increase in the percentage of legumes species group.

In the F_2 variant, fertilized with $N_{20}P_{20}K_{20}$, the crude protein content (CP) increased significantly, from 9.17 % to 10.42 % and in the F_4 variant, fertilized with 10 Mg·ha^{-1} manure, the crude protein content (CP) increased very significantly, from 9.17 % to 12.51 %.

The protein content increased from 180.6 kg·ha^{-1} to F_1 variant, control variant, to 332.7 kg·ha^{-1} at F_2 variant and 389.1 kg·ha^{-1} on variant F_4.

CONCLUSIONS

Ferilization with complex solids mineral fertilizers, $N_{20}P_{20}K_{20}$ type, led to an increase in the percentage of grasses species and a decrease in the varous species and to an increase in the production and feed quality of *Nardus stricta* L., meadow.

Ferilization with complex foliar mineral fertilizers, $N_{20}P_{20}K_{20}$ + microelements (5 l·ha^{-1}), led to the increase of the percentage of species in the various group and the insignificant increase of production and quality of *Nardus stricta* L., meadow.

Ferilization with 10 Mg·ha^{-1} manure, led to an decrease in the percentage of grasses species and a increase in the legumes species and to an increase in the production and feed quality of *Nardus stricta* L., meadow.

The protein content increased from 180.6 kg·ha^{-1} to F_1, unfertilized (control variant), control variant, to 332.7 kg·ha^{-1} at F_2 variant (ferilized with complex solids mineral fertilizers, $N_{20}P_{20}K_{20}$ type) and 389.1 kg·ha^{-1} on variant F_4 (ferilized with 10 Mg·ha^{-1} manure).

Fertilization efficiency had the maximum value in case of fertilization with solid mineral fertilizers, of NPK type with 7.6 kg CP per 1 kg of N applied, followed by the fertilization with foliar mineral fertilizers, of NPK + microelements type with 3.3 kg CP per 1 kg of N applied and by the manure one with 2.5 kg CP per 1 kg of N applied.

REFERENCES

Acatrinei (Dumitriu), S., Mihai Stavarache, Cristian-Sorin Gavrilă, Elena-Manuela Vacarciuc, Ana-Maria Dudău, Daniela Bouruc, Elena Stavarache, Mirela Paraschivu, Călin Sălceanu, Stejărel Brezuleanu **-2024.** Improving economic efficiency on degraded permanent meadows by various management systems. Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development Vol. 24, Issue 1, p.17-23.

Bita-Nicolae Claudia, Yildiz F., Kaya O., 2023 - Exploring the Biodiversity and Conservation Value of Alpine Grasslands in the Bucegi Massif, Romanian Carpathians. Sustainability, 15:2-21, doi.org/ 10.3390/su151612643

Csűrös Ş., 1970 - Despre vegetaţia ierboasă a luncilor din Transilvania. Contribuţii Botanice,. Cluj-Napoca, pp.

123-143.

Dragomir N., Sauer M., Sauer I., Dragoş M., Rechiţean D., 2020 - Floristic diversity and pastoral value of permanent grassland fertilized in coventional and organic system. Bulletin UASVM, series Agriculture, 77(1):13-16

Karbivska Y., Martyshchuk V., Kyrhak V, Voloshchuk M., 2020 - The effectiveness of surface improvement of sloping mountain meadows of the Carpathians, Bulletin of Agricultural Science 98(7):25-30, doi.org/10.31073/agrovisnyk202007-05

Motcă G., Oancea I., Geamăn Lidia-Ivona, 1994 - Pajiştile României, tipologie şi tehnologie. Editura Tehnică şi Agricolă, Bucureşti

Palaj A., Kollár J., Michalová M., 2024 - Changes in the *Nardus* grasslands in the (Sub)Alpine Zone of Western Carpathians over the last decades. Biologia, 79:1081-1090, doi.org/10.1007/s11756-023-01458-8.

Paraschivu, Mirela, Elena Partal, Călin Sălceanu, 2023. Assessment of the application effects of the derogation covering gaec 7 and 8 standards on agricultural and environmental condition, food security, environmental preservation and climate change. Analele Universităţii din Craiova, seria Agricultură – Montanologie – Cadastru (Annals of the University of Craiova - Agriculture, Montanology, Cadastre Series) Vol. 53 (2)/2023, p. 139-143.

Samuil C., Stavarache M., Sîrbu C., Vîntu V., 2018 - Influence of sustainable fertilization on yield and quality food of Mountain Grassland. Notulae Botanici Horti Agrobotanici, 46(2):410-417.

Sălceanu,C., Mirela Paraschivu, Aurel Liviu Olaru, 2023a. The perfomance and economic efficiency of new genotypes of Alfalfa (Medicago sativa). Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development Vol. 23, Issue 4, p.747-754.

Sălceanu,C., Mirela Paraschivu, Aurel Liviu Olaru, Cătălin Aurelian Roșculete, Leontina Monica Gonța (Sună), 2023b. *The performans of new Romanian alfalafa (Medicago sativa) genotypes.* Analele Universităţii din Craiova, seria Agricultură – Montanologie – Cadastru (Annals of the University of Craiova - Agriculture, Montanology, Cadastre Series) Vol. 53 (1)/2023, p.265-271.

Sărățeanu,V., Otilia Cotuna, Mirela Paraschivu, Luminița L. Cojocariu, Marinel Nicolae Horablaga, Dorin Rechițean, Vlad Dragoslav Mircov, Călin Sălceanu, Alina Andreea Urlică, Loredana Copăcean– 2023. Features of natural succession of ex-arable forest-steppe grass-land (from western Romania) under the influence of climate. Plants, 12(6):1204.

Stavarache M., Naie Margareta, 2024 - Gestionarea durabilă a pajiștilor permanente, Editura PIM, Iaşi, 306 pag. 978-606-13-8143-2

Vîntu V., Samuil C., Stavarache M., 2017 - Cultura pajiştilor şi a plantelor furajere - Îndrumător de lucrări practice. Editura „Ion Ionescu de la Brad", Iaşi, ISBN: 978-973-147-265-2

Yasemin K., Nora S.R., Arlettaz R., Humbert J.Y., 2019 - Conservation and restoration of *Nardus* grasslands in the Swiss northern Alps. Applied Vegetation Science, 23:26-38, doi: 10.1111/avsc.12462

www.insse.ro, 2025 - Efectivele de animale existente la 1 decembrie 2024, available on-line at: https://insse.ro/cms/sites/default/files/com_presa/com_pdf/ef.animale_r2024.pdf