Influence of Mineral and Organic Fertilization on Grassland from Transilvanian Plateau

Ioan ROTAR, Roxana VIDICAN, Gheorghe TOTH, Anca PLEȘA*, Ioana VAIDA, Vasile IUGA, Adriana MOREA

Faculty of Agriculture, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca
Cluj-Napoca, Manăştur street, 3-5, 400372, Romania.
* corresponding author, e-mail: anca.plesa@usamvcluj.ro

Bulletin USAMV series Agriculture 75(2)/2018
Print ISSN 1843-5246; Electronic ISSN 1843-5386
DOI 10.15835/buasvmcn-agr: 2018.0016

Abstract

Mineral and organic fertilization have a huge effect on natural grasslands. The purpose of this research is to assess the state of the biodiversity and pastoral value for grasslands from the Transylvanian Plateau area. In this area has been analyzed the floristic composition and a series of ecological indexes, respectively humidity, soil reaction, temperature and nitrogen. Other aspects taken in account were the agronomical and anthropogenic specters. The analyzed grasslands are placed in the perimeter of Gheorgheni village, from Cluj County. Experience includes 20 experimental variants with organic fertilization with combined with mineral fertilization, 5 variants in 4 rehearsals. Each experimental variant is 2 m long X 5 m wide. In most hill meadows the economic efficiency is relatively low, and in order to be increased, it is necessary to apply the whole complex of measures for their improvement, care and exploitation, of which a special role is the application of appropriate treatments that stimulate the development of valuable species. Several researches show that applying fertilizers on grasslands is economically justified since, generally, 1 kg of active element results in an increase of 80-100 kg of green matter.

Keywords: combined fertilization, *Festuca rupicola*, diversity, Transylvania Plateau

INTRODUCTION

On dairy farms, green fodder is the most valuable and cheapest source of animal feed. Mineral and organic fertilization has a great effect on natural grasslands. The combination of these types leads to changes in both the floral composition and the productivity of these grasslands. The grasslands in the studied area are predominantly in the Transylvanian Plateau, on slopes slightly inclined, especially slopes exposed to the south and southwest. The purpose of this research is to assess the state of biodiversity and the pastoral value for the grasslands in the Transylvanian Plateau area, influencing the mineral inputs or combined with the organic ones. New products developed from wastes from industries could be used as amendments and fertilisers. This could reduce the use of inorganic fertilisers at the same time as residues are recycled. Several studies have shown that the use of wastes from industries as amendments and fertilisers can increase crop yields and quality and result in signifcant economic returns for producers (Hue, 1992).

MATERIALS AND METHODS

Study site

The analyzed grasslands are located within the perimeter of the village of Gheorgheni, in Cluj County. The experience includes 20 experimental variants with organic fertilization combined with mineral fertilization, 5 variants in 4 rehearsals. Each experimental variant is 2 m long x 5 m wide. The experimental variants are V1-witness, unfertilized, V2-10 t/ha manure, V3-10 t/ha manure + 50N25P25K, V4-100N50P50K, V5-10 t/ha manure +100N50P25K.

The area shows a typical plain until hillside climate and the landscape is undulating. It is

Table. 1. Floristic composition of the type of grassland *Festuca rupicola-Bromus erectus* and specific requirement on ecological, agronomic and anthropogenic (B - BioForm, T - temperature, U - humidity, R - soil reaction, N – nutrition, C - tolerance of mowing, P - tolerance of grazing, S - tolerance of crushed, VF- fodder value, H - hemerobie, UR - urbanophile, SO - sozological category, -Average, ADm- mean abundance – dominance)

B	T	U	R	N	C	P	S	VF	SO	H	UR	Specii	ADm
												Poaceae	**53.5**
HS	x	6	x	5	9	9	9	7	n	2 - 5	3	*Agrostis capillaris*	8
HT	x	x	5	x	7	5	5	4	n	2 - 4	2	*Anthoxantum odoratum*	0.5
HT	5	3	8	3	5	4	4	6	n	2 - 3	2	*Bromus erectus*	12.5
GRs	5	4	7	4	3	6	6	5	n	2 - 3	2	*Brachipodium pinatum*	2.5
HT	x	x	x	3	4	4	4	5	n	2 - 3	2	*Briza media*	2.5
HT	x	5	x	6	8	4	6	9	n	3 - 4	3	*Dactylis glomerata*	2.5
												Elymus elongatus	5
HT	x	6	x	6	6	4	6	9	n	2 - 4	2	*Festuca pratensis*	2.5
H	7	3	8	2	7	7	7	4	n	2 - 3	2	*Festuca rupicola*	17.5
												Fabaceae	**18.5**
Phn	6	3	5	2	1	5	4	4	n	2 - 3	1	*Cytisus albus*	2.5
H	5	4	9	3	3	7	-	1	n	2 - 4	2	*Coronilla varia*	0.5
HT	x	4	7	4	6	4	4	7	n	2 - 4	3	*Lotus corniculatus*	2.5
HT	7	3	8	x	6	2	2	8	n	3 - 4	1	*Onobrychis viciifolia*	0.5
HT	x	3	8	2	5	4	4	6	n	2 - 3	1	*Trifolium montanum*	2.5
												Trifolium panonicum	8
HT	x	x	x	6	7	4	4	8	n	3 - 4	2	*Trifolium pratense*	0.5
ChRs	x	x	x	6	8	8	8	8	n	3 - 5	3	*Trifolium repens*	0.5
TT	5	4	x	6	6	4	4	7	n	3 - 4	2	*Trifolium campestre*	0.5
HA	x	5	x	6	6	1	2	6	n	3 - 4	2	*Vicia cracca*	0.5
												AFB	**48.5**
ChRs	x	4	x	5	7	4	5	6	n	2 - 4	3	*Achillea milefolium*	0.5
H	7	3	8	3	3	3	3	6	n	2 - 3	1	*Asperula cynanchica*	0.5
HRs	6	4	x	4	4	2	4	4	n	2 - 3	1	*Betonica officinalis*	5
HRs	x	x	x	2	4	4	4	4	n	2 - 3	2	*Campanula rotundifolia*	0.5
HRs	6	4	6	6	4	2	2	4	n	2 - 4	1	*Centaurea nigrescens*	2.5
-	-	-	-	-	-	-	-	-	-	-	-	*Centaurea stoebe*	2.5
HT	x	5	x	5	8	4	4	4	n	3 - 5	3	*Cerastium holosteoides*	0.5
HRs	5	5	6	5	6	2	2	4	n	3 - 4	3	*Crepis bienis*	2.5
GRs	5	6	7	x	5	9	3	1	n	2 - 3	1	*Colchicum autumnale*	0.5
GA	6	x	7	x	4	4	4	5	n	3 - 6	3	*Convolvurus arvensis*	0.5
HRs	5	4	7	2	3	4	4	4	n	2 - 3	2	*Dianthus carthusianorum*	0.5
-	-	-	-	-	-	-	-	-	-	-	-	*Dipsacum fullolum*	0.5
HRs	7	4	x	3	4	2	2	5	n	2 - 3	1	*Filipendula hexapetala*	8
HT	5	4	7	3	5	4	4	5	n	2 - 3	2	*Galium verum*	5
HRs	5	4	x	4	5	3	2	4	n	3 - 5	3	*Knautia arvensis*	0.5
-	-	-	-	-	-	-	-	-	-	-	-	*Laserpitium latifolium*	0.5
HR	x	4	8	3	4	8	8	5	n	2 - 4	2	*Plantago media*	2.5
HR	x	x	x	x	7	6	6	6	n	2 - 4	3	*Plantago lanceolata*	2.5
HS	x	x	4	x	9	8	8	4	n	3 - 4	2	*Prunella vulgaris*	0.5

TRs	x	x	x	3	5	8	3	3	n	2 - 3	1	*Rhinanthus minor*	5
HT	5	4	2	2	7	4	4	2	n	2 - 5	2	*Rumex accetosela*	2.5
HRs	6	4	8	4	5	3	3	4	n	2 - 3	2	*Salvia pratensis*	2.5
HRs	5	4	7	6	6	9	4	1	n	2 - 3	2	*Senecio jacobea*	0.5
-	-	-	-	-	-	-	-	-	-	-	-	*Stelaria graminea*	0.5
-	-	-	-	-	-	-	-	-	-	-	-	*Scabioza ochroleuca*	0.5
-	-	-	-	-	-	-	-	-	-	-	-	*Teucrium chamaedris*	0.5
-	-	-	-	-	-	-	-	-	-	-	-	*Tragopogon pratensis*	0.5

characterized by a high variation of land use and topoclimatic conditions in the area and fine-grained mosaic of different land uses, including substantial amounts of semi natural vegetation with 7.2°C average temperature. The vegetation observations were made on 20 plots.

Data analysis

The floristic composition was interpreted using an improved Braun-Blanquet scale with subdivisions (Păcurar and Rotar, 2014, Ţucra *et al.* 1987). Sward fodder value was calculated based on species quality score on a scale from 1 (poor) to 9 (excellent), after Dierschke and Briemle (2002), as modified by Păcurar and Rotar (2014). Sward fodder value was performed on a scale from 1 (poor sward, quality dominated by toxic species) to 9 (excellent) after Păcurar and Rotar, 2014. Data regarding the share of economic groups (Poaceae, Cyperaceae-Juncaceae, Fabaceae and other botanical families- AFB), species number were processed by analysis of variance. Plant resistance against interference mechanical, such as mowing, grazing and crushed materialized by value indicator (from 1-9) after Dierschke and Briemle (2002), and the names of appropriate species depending on the category disturbance were taken after Păcurar and Rotar (2014, Cristea *et al*, 2004). Based on data from spectrum it can be calculate the average indicator of a phytocenosis. This may be unweighted or weighted. Assigning a phytocenosis feed is achieved at the expense calculated weighted average indicator value.

RESULTS AND DISCUSSIONS

The result shows that Poaceae have the largest share in the canopy, followed by plants from other botanical families (AFB) and Fabaceae. Significant crop yields were obtained at maximum fertilization of 10 t/ha of manure (100N50P2O525K2O), all of which were not statistically assured. Manure application without mineral fertilization reached the highest CP content in the forage 248 g kg^{-1} DM (Hakl J *et al,* 2016). The influence of mineral fertilization on organic fertilization during the second year of experience also determines major changes in the floristic composition.

In the floristic composition, Poaceae family have the largest share in the canopy with an average participation of 53.5%, followed by plants in other botanical families (AFB) at 48.5%, and Fabaceaele are present with only 18.5 % coverage. Among the Poaceae, besides the dominant species (*Festuca rupicola-Bromus erectus*), *Agrostis capillaris* with an 8% coverage and then the other species with a smaller coverage (Table 1) are also noted. The Fabaceae family are represented by species like: *Trifolium intermedium* 8%, *Cytisus albus*, *Lotus corniculatus* and *Trifolium montanum*, each with a 2.5% coverage. Among the plants in other botanical families, the following species with more significant cover are found: 8%, *Betonica officinalis, Galium verum* and *Rhinanthus minor* with a 5% coverage (Tab. 1).

Following the ecological spectrum, *Festuca rupicola-Bromus erectus* phytococenosis has a meso-xerophilic carater (Up = 3.91), neutrophil (Rp = 7.23) and oligomezotroph (Np = 3.41).

From the agronomic point of view, phytocenosis of the type *Festuca rupicola-Bromus erectus* is tolerant to mowing (Cp = 5.61), grazing tolerance (Pp = 5.02) and moderately tolerant to crushed (Sp = 4.89). From the analysis of these factors, we can say that the grassland has a maximum of two grazing cycles per year, in which the plants are partially consumed in a semi-extensive system. In fact, the appreciation of the consumption level supports the assertions (Tab. 2).

In the phytocoenosis of the *Festuca rupicola-Bromus erectus* type there are 3 toxic species

Table 2. Ecological indexes

Eclg. indexes	Ecological spectrum										VIMnp
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**x**	**VIMp**
Unp	0	0	6	15	4	3	0	0	0	9	4.14
Up	0	0	36	36	6	11	0	0	0	13	3.91
Rnp	0	1	0	1	2	2	7	7	1	16	6.76
Rp	0	2.5	0	0.5	3	5	12	38.5	0.5	40	7.23
Nnp	0	6	8	5	4	8	0	0	0	6	4.00
Np	0	26	36.5	13	11.5	10	0	0	0	5	3.41
Agron. indexes	Agronomic spectrum										VIMnp
	1	2	3	4	5	6	7	8	9	x	VIMp
Cnp	1	0	4	7	7	7	6	3	2	0	5.46
Cp	2.5	0	4	21.5	28.5	9.5	24	3.5	8.5	0	5.61
Pnp	1	5	3	15	2	2	2	4	3	0	4.73
Pp	0.5	18.5	3.5	36	3	5	18	8.5	9	0	5.02
Snp	0	6	4	15	2	4	1	3	1	0	4.39
Sp	0	14.5	8.5	38.5	1	10	17.5	3.5	8	0	4.89
VFnp	3	1	1	12	6	6	3	3	2	0	5.00
VFp	1.5	2.5	5	35.5	21	19	11	1.5	5	0	5.06

Legend

U humidity
C mowing
VF fodder value
R soil reaction
P grazing
np unweighted (depending on the number of species)
N nutrition
S crushed
p weighted (depending on species coverage)

Table 3. Influence of fertilization on dry matter yield (t/ha)

Graduation of fertilization	Production t/ha	Percentage%	Differences t/ ha	Significances
V1 (witness)	17.59	100.0	0.0	Mt.
V2 -10 t/ha manure	19.10	108.6	1.51	-
V3 -10 t/ha manure + 50N25P25K	20.15	114.5	2.56	-
V4 V4-100N50P50K	19.17	109.0	1.58	-
V5 -10 t/ha manure +100N50P25K.	22.23	126.4	4.64	*
DL (5%)			4.08	
DL (1%)			5.72	
DL (0.1%)			8.08	

(*Coronilla varia, Colchicum autumnale* and *Senecio jacobea*), each with a 0.5% participation, a species harmful to animal products (*Rumex accetosela*) with a weight of 2.5 %. There is only one species that damages the vegetation and it is *Rhinanthus minor*, which has a 5% participation in the canopy. There are also a ballast species with a participation of 35.5%, medium forage species having 40% coverage. There are 6 good fodder species with coverage of 12.5% and excellent fodder species are only 5% coverage.

The type of *Festuca rupicola-Bromus erectus* has a pastoral value of 5.06, so this meadow falls in the 6th grade, the meadow category is medium and supports 1.01-1.20 UVM/ha.

The production of dry substance in fertilized fertilizer experience recorded values between 17.59 t/ha SU in the control variant and 22.23 t/ha SU in the most fertilized variant. Production spores are not statistically assured, as can be seen in Tab. 3. These results are also confirmed by other researchers such as Rotar (1993), Deak (2012). Pleşa et al, 2015 shows that the intensification of *Festuca rubra* grassland management is justified in the Apuseni Mountains up to application levels of 10 Mg ha^{-1} manure. This treatment leads to an increase in sward quality and also to a wide phytodiversity of the grassland. However, it is once again confirmed that the application of high doses of organic fertilizers leads to the tripling of productions. Levels of mineral and organic fertilization in combination with agro-ecological conditions and type of permanent grassland have strong influences on DM yield. Increasing nitrogen fertilization rate also reduces the weed proportion and increases the appearance of high quality grass species (Tab. 3). These research results confirm the necessity of the use of mineral fertilizers, especially nitrogen, on permanent grassland (Vučković *et al*, 2016).

CONCLUSION

The *Festuca rupicola-Bromus erectus* grassland is in a climax of equilibrium only the massive fertilizer doses cause changes in the floristic composition and production level.

REFERENCES

1. Cristea V, Gafta D, Pedrotti F (2004). Fitosociologie, Publisher Presa Universitară Clujeană.
2. Hakl J, Kunzová E, Konečná J (2016). Impact of long-term fertilization on crude protein fractions of lucerne forage in the first cut, Grassland Science in Europe, Vol. 21 – The multiple roles of grassland in the European bioeconomy.
3. Hue NV (1992) Correcting soil acidity of a highly weathered ultisol with chicken manure and sewage-sludge. Communications in Soil Science and Plant Analysis 23: 241-264.
4. Păcurar F, Rotar I (2014). Metode de studiu şi interpretare a vegetaţiei pajiştilor. Risoprint Publisher, Cluj-Napoca, Romania.
5. Pleşa A, Rotar I, Păcurar F, Vidican R, Balázsi A, Stoian V (2015). Organic fertilization on mountain grassland. Grassland Science in Europe. Grassland and forages in high output dairy farming systems, 20: 289.
6. Ţucra I, Kovacs AJ, Roşu C, Ciubotaru C, Chifu T, Neacşu M, Bărbulescu C, Cardaşol V, Popovici D, Simtea N, Motcă G, Dragu I, Spirescu M (1987). Principalele tipuri de pajişti din R.S. România, Centrul de Material Didactic şi Propagandă Agricolă,Bucureşti.
7. Vučković S, Prodanović S, Simić A, Savić M, Pajčin Đ. (2016). Effect of fertilization on yield on permanent grasslands in Serbia. Grassland Science in Europe, Vol. 21 – The multiple roles of grassland in the European bioeconomy.