THE EFFECT OF LOW-INPUT UPON SEMI-NATURAL GRASSLANDS OF APUSENI MOUNTAINS

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Abstract

The floristic composition of permanent grasslands is the results of the interaction between all the ecological factors and the controlled conditions. The most significant influence upon the species diversity is owned by the intensity of fertilization and the used mineral fertilizers. The nitrogen fertilization, especially in high doses, influences quickly and considerably the site's floristic composition. The aim of our study was to identify the effect of mulching with different frequencies combined with mineral fertilization on floristic composition and the production of permanent grasslands in Apuseni Mountains, Romania. The technological inputs' performance generates a considerable decrease of the plant diversity, especially in case of the variants treated with large quantities of fertilizers. Because we presented results in the second years testing the effects of mineral fertilizer is lower regarding changes at canopy level.

Key words: plant diversity, mineral fertilization, grassland, mulching, dry matter

Extensive grasslands contribute a great deal to both biodiversity and landscape quality [Schupbach et al., 2004, cited by Sevcikova, 2009] and for maximum benefit requires environmentally friendly vegetation management that utilizes the interaction between grasses and dicotyledonous species, without dependence on herbicides or chemical fertilizers.

Over a long period of time no elementary management measures were applied to permanent meadows in Romania, and it was assumed that they could provide efficient yields without technological inputs, even if grazing began early in spring and continued to late autumn (Samuil et al., 2011). In the last time the importance of semi-natural grasslands for forage production diminished as result of the cattle population decrease in marginal areas of Apuseni Mountains, Romania (Brinkmann et al., 2009). Mulching is a simple and low-cost procedure that can help maintain many grassland locations and fallow farm land (Prochnow, 2000, cited by Gaiser and Pavlu, 2009). On the other hand, the mineral fertilization affects the flora and the results are relatively low abundance and low diversity of species (Rotar et al., 2010).

MATERIAL AND METHOD

Experimental field is located in Poienile Ursului the Gârda de Sus village, Alba county, Apuseni Mountains at 1380 m elevation, with southern slope of 5 % angle and a districambosol type of soil. The experience has 7 experimental variants in 5 repetitions, placed according to random blocks method. The size of experimental parcel is 6 m^2. The experimental variants are the following: V1 = witness, mown once per year without technological input, V2 = mulching once per year, V3 = mulching twice per year, V4 = mulching once per year and 25 N 25 P 25 K every year, V5 = mulching once per year and 25 N 25 P 25 K once at two years, V6 = mulching plus 25 P 25 K every year, V7 = mulching plus 25 P 25 K once at two years.

Mineral fertilizers had been applied in early spring (on the 16th of April 2010). The floristic studies have been performed before the harvest (beginning of July) according to Braun-Blanquet method. The harvest and mulching were carried out during the phase of *Poaceaes*' blooming, with a rotational mowing machine, at 5 cm mowing height. For floristic data, the mean abundance-dominance (ADm) and constancy (K) were calculated (table 2). Data regarding the share of economic groups (*Poaceae, Cyperaceae-Juncaceae, Fabaceae* and diverse), species number and Shannon Index (SI) were processed by analysis of variance. Five classes of constancy were used, and data processing of DM yield was made by analysis of variance.

RESULTS AND DISCUSSIONS

The influence of mineral fertilizers upon the dry matter is rather low (table 1). For some experimental variants an increase of DM yield in comparison to the unfertilized witness is noticed, and for others a DM decrease toward the witness is noticed. Either we refer to the increase or the

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decrease the yield differences do not show statistic insurance (ns).

The control's plant community was represented by *Agrostis capillaris-Festuca rubra* type. In average for all five replication this type of grassland had the next floristic composition: 49.9% *Poaceae*, 0.32% *Cyperaceae* and *Juncaeae*, 6.15 % *Fabaceae* and 41.9 % plants from other botanical families -OBF (table 2). Among *Poaceaes,* beside the dominant species is noticed the presence of *Anthoxantum odoratum*. *Cyperaceaes* and *Juncaceaes* are represented by *Luzula campestris* species (0.32%). Among *Fabaceaes*, the highest share is owned by *Trifolium repens* (3.65%), followed by *Trifolium pratense* and *Lotus corniculatus*. The plants of OBF are represented by many species, among them a few having a more considerable presence: *Arnica montana* (5.8%), *Hypericum maculatum* (2.2%), *Knautia dipsacifolia* (1.85%), *Thymus pulegioides* (7.05%), *Trollius europaeus* (7,75 %) etc. The control's plant community shows, in average per 5 repetitions, 31 species. The number of species grew in comparison to the control and the SI slightly decreased compared to the control, but these variations were not totally due to experimental factors. The floristic nucleus of control's plant community is represented by species having V constancy (built-up species) and the ones having IV constancy (frequent species). Among the built-up species the following are distinguished: *Agrostis capillaris, Anthoxantum odoratum, Festuca rubra, Arnica montana, Knautia dipsacifolia, Leucanthemum vulgare, Plantago lanceolata, Rhinantus minor, Rumex acetosa, Thymus pulegioides, Trollius europaeus* and *Viola tricolor*. The frequent species are: *Luzula campestris, Trifolium pretense, Anthyllis vulneraria, Centaurea mollis, Cerastium holostoides, Gentianella lutescens, Hieracium aurantiacum, Hypericum maculatum, Silene nutans* and *Stellaria graminea*. After introducing technological inputs, certain minor changes are being noticed at the sward level within the same type's limits as in the control. *Poaceaes*' share slightly increases in case of all treatments, in comparison to the untreated witness, up to 58.35% at variant with mulching once per year plus PK 25:25 kg ha^{-1}. The smallest share is recorded in case of the variant with mulching once per year plus NPK 25:25:25 kg ha^{-1} applied once at two years. *Agrostis capillaris* increases its share in case of all treatments from the witness except variant 5, where it has the same participation as the witness. The highest share is reached in case of the second variant (mulching once per year). *Anthoxantum odoratum* species faces minimum changes, except for V5, where it reaches up to 5.35%. *Festuca rubra* maintains itself almost to the same level in case of all experimental variants, except for V2, where reaches up to 12.5%. *Cyperaceaes* and *Juncaceaes* are maintained almost to the same level in all experimental variants. In some variants, *Fabaceaes* modify their amount depending on the applied treatments, but in others they maintain themselves almost to the witness level (V3, V4 and V5). The largest amount of *Fabaceae* is recorded in V7 (9.95%), followed by the one in V2 (8.05%) and the one in V6 (7.4%). Out of this family, the most remarkable share is owned by *Trifolium repens* (3. 65% in witness). The plants in OBF reduce their participation in case of all treatments in comparison to the untreated control. The share changes are minimum in case of V4 and V5. In case of the other treatments, the OBF plants increase their share up to 32.7% (V6). As consequence of input application, certain species slightly decrease their participation, such as: *Achillea distans, Arnica montana, Thymus pulegioides, Trollius europaeus* etc. As result of treatments, some species increase their participation, like: *Ajuga genevensis, Centaurea pseudophrygia, Colchicum autumnale, Hypericum maculatum, Pimpinella major* etc. The applied treatments have determined changes of the plant diversity, which is slightly reduced from the witness.

Table 1

The influence of mineral fertilizers upon the dry matter (DM) yield

	Experimental variants	Dry Matter		Difference	Significance
		t ha^{-1}	%		
2010	Witness- mown once/year	2.01	100.0	+0.00	-
	Mulching once/year	2.12	105.1	+0.10	-
	Mulching twice/year	1.98	98.3	-0.03	-
	Mulching once/year + NPK 25:25:25 (every year)	2.57	127.6	+0.56	-
	Mulching once/year + NPK 25:25:25 (once at two years)	1.82	90.3	-0.20	-
	Mulching + PK 25:25 (every year)	2.07	102.9	+0.06	-
	Mulching+ PK 25:25 (once at two years)	2.07	102.7	+0.05	-

DL(p 5%) +0.51 DL(p 1%) +0.70 DL(p 0,1%) +0.94

Table 2

The influence of mineral fertilizers upon floristic composition

Experimental variants	V1		V2		V3		V4		V5		V6		V7	
	Witness-mown once/year		Mulching once/year		Mulching twice/year		Mulching once/year + NPK 25:25:25 (every year)		Mulching once/year + NPK 25:25:25 (once at two years)		Mulching + PK 25:25 (every year)		Mulching+ PK 25:25 (once at two years)	
	ADm	K	ADm	K	ADm	K	ADm	K	ADm	K	ADm	K	ADm	K
Cover (%)	94.6		96.2		94.6		96.4		94.8		95.4		95.8	V
Species														
Poaceae	49.9		55.15		57.75		55.85		54.45		58.35		56.2	
Agrostis capillaris	29.5	V	40.5	V	33.5	V	33.5	V	29.5	V	36	V	33.5	V
Anthoxanthum odoratum	1.4	V	1.85	V	2.65	IV	2.75	V	5.35	V	4.1	V	3.2	V
Festuca rubra	19	V	12.5	V	21.5	V	19.5	V	19.5	V	18.25	V	19.5	V
Phleum montanum	0		0.3	III	0.1	I	0.1	I	0.1	I	0		0	
Cyperaceae si *Juncaceae*	0.32		0.3		0.3		0.4		0.4		0.5		0.5	
Carex leporina	0		0		0		0		0		0.1	I	0.1	I
Luzula campestris	0.32	IV	0.3	III	0.3	III	0.4	IV	0.4	IV	0.4	IV	0.4	IV
Fabaceae	6.15		8.05		6.05		5.8		5.8		7.4		9.95	
Lotus corniculatus	1.2	III	0.85	IV	1.1	II	1.3	IV	1.2	III	0.2	II	1.85	V
Trifolium pratense	1.3	IV	1.4	V	1.3	IV	0.85	IV	1.4	V	2.3	V	2.3	V
Trifolium repens	3.65	V	5.8	V	3.65	V	3.65	V	3.2	V	4.9	V	5.8	V
OBF	41.9		35.5		34.82		39.55		38.29		32.7		34.02	
Achillea distans	1.2	III	2.2	IV	0.75	III	1.2	III	1.3	IV	0.75	III	0.1	I
Ajuga genevensis	0.1	I	0.1	I	0.3	III	0		0.2	II	0		0.2	II
Alchemilla vulgaris	0.1	I	0.75	III	0.65	II	0.1	I	0		0.1	I	0.2	II
Anthyllis vulneraria	1.3	IV	0.4	IV	0.3	III	0.65	II	1.2	III	0.65	II	1.2	III
Arnica montana	5.8	V	1.65	III	3.45	IV	1.85	V	3.55	IV	4.1	V	1.75	IV
Astrantia major	0.1	I	0.1	I	0		0.1	I	0.4	IV	0		0	
Campanula abietina	0.2	II	0.1	I	0		0		0		0		0	
Centaurea mollis	1.75	IV	1.75	IV	0.85	IV	1.2	III	1.85	V	1.65	III	1.85	V
Centaurea pseudophrygia	0.1	I	0.85	IV	0.65	II	0.2	II	0.1	I	0		0.65	II
Cerastium holosteoides	0.4	IV	0		0.2	II	0.1	I	0.3	III	0.2	II	0.4	IV
Cirsium erisithales	1.1	II	0.1	I	1.2	III	0.65	II	0.1	I	0.1	I	0.3	III
Colchicum autumnale	0.2	II	0		0.4	IV	0.2	II	0.4	IV	0.1	I	0.3	III
Euphrasia roskoviana	0.12	II	0.1	I	0		0.1	I	0.1	I	0.1	I	0.2	II
Galium mollugo	1.2	III	0.2	II	0.2	II	0.3	III	0.2	II	0.3	III	1.3	IV
Gentianella lutescens	0.24	IV	0.1	I	0.1	I	0.1	I	0		0.1	I	0	
Gnaphalium sylvaticum	0		0		0		0		0		0		0.1	I
Gymnadenia conopsea	0.02	I	0		0.02	I	0		0.02	I	0		0	
Hieracium aurantiacum	1.75	IV	5	V	3.2	V	3.2	V	2.75	V	2.1	III	0.85	IV
Hypericum maculatum	2.2	IV	8.5	V	4.7	IV	6.05	V	0.95	V	4.35	IV	0.5	V
Knautia dipsacifolia	1.85	V	1.85	V	0.75	III	1.75	IV	2.3	V	1.75	IV	1.3	IV
Laserpitium latifolium	0.1	I	0		0		0		0		0		0	
Leucanthemum vulgare	0.5	V	0.5	V	0.95	V	0.95	V	0.5	V	0.5	V	0.95	V
Linum catharticum	0.1	I	0.2	II	0		0.1	I	0.1	I	0		0.3	III
Pimpinella major	0.85	IV	1.4	V	1.3	IV	1.75	IV	0.95	V	0.85	IV	0.85	IV
Plantago lanceolata	0.95	V	0.3	III	0.5	V	0.5	V	0.5	V	0.4	IV	0.95	V
Plantago media	0.12	II	0		0.1	I	0.2	II	0.2	II	0		0.2	II
Polygala comosa	0.3	III	0.1	I	0.3	III	0.1	I	0		0.1	I	0.3	III
Polygala vulgaris	0.2	II	0.1	I	0.2	II	0		0.2	II	0.1	I	0.1	I
Primula veris	0.3	III	0.2	II	0.1	I	0		0.1	I	0		0	

	V1		V2		V3		V4		V5		V6		V7	
Experimental variants	Witness-mown once/year		Mulching once/year		Mulching twice/year		Mulching once/year + NPK 25:25:25 (every year)		Mulching once/year + NPK 25:25:25 (once at two years)		Mulching + PK 25:25 (every year)		Mulching+ PK 25:25 (once at two years)	
	ADm	K	ADm	K	ADm	K	ADm	K	ADm	K	ADm	K	ADm	K
Ranunculus acris	0.4	IV	0.2	II	0.4	IV	0.4	IV	0.5	V	0.5	V	0.5	V
Ranunculus bulbosus	0		0		0		0		0		0.1	I	0	
Rhinanthus minor	0.95	V	0.85	IV	0.95	V	1.3	IV	0.4	IV	0.95	V	0.95	V
Rumex acetosa	0.5	V	0.4	IV	0.5	V	0.4	IV	0.4	IV	0.4	IV	0.4	IV
Scabiosa columbaria	0.2	II	0		0		0.1	I	0.2	II	0.2	II	0	
Silene nutans	0.4	IV	0.3	III	0.3	III	0.3	III	0.4	IV	0.4	IV	0.5	V
Stellaria graminea	0.4	IV	0.5	V	0.4	IV	0.5	V	0.5	V	0.5	V	0.5	V
Thalictrum aquilegiifolium	0		0		0.1	I	0		0		0.1	I	0.2	II
Thymus pulegioides	7.05	V	3.2	V	6.6	V	7.85	V	8.3	V	5.35	V	7.05	V
Trollius europaeus	7.75	V	2.2	IV	2.75	V	6.15	V	8.1	IV	4.9	V	7.85	V
Vaccinium myrtillus	0		0		0		0		0.02	I	0		0.02	I
Veratrum album	0.2	II	0.4	IV	0.3	III	0.2	II	0.3	III	0.2	II	0.4	IV
Veronica chamaedrys	0.3	III	0.4	IV	0.85	IV	0.5	V	0.4	IV	0.3	III	0.3	III
Veronica serpilifolia	0.1	I	0		0		0		0		0		0	
Viola tricolor	0.5	V	0.5	V	0.5	V	0.5	V	0.5	V	0.5	V	0.5	V
No of species	31		27.8		28		27		30		25.6		31.2	
Shannon Index	2.56		2.35		2.43		2.48		2.49		2.36		2.48	

CONCLUSIONS

As result of applying treatments of mulching and mulching combined with mineral fertilizers changes occur regarding the DM yield comparative to witness, but they do not have statistic insurance. Witness's plant community is represented by *Agrostis capillaris- Festuca rubra* type, and by applying mulching combined with mineral fertilization the same grassland type is being maintained. The ratio among the economic groups of plants slightly changes through an increase of Poaceaes in detriment on OBF plants.

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