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Management of *Festuca valesiaca* L. grasslands from North Eastern of Romania

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Abstract: Romania ranks fifth in Europe, after France, Great Britain, Spain and Germany, in terms of the total natural grassland area. The total area in Romania is 4.9 million ha, of which 3.4 million ha grassland and 1.5 million ha hayfield, which is an important source of livestock fodder. This paper shows the influence of sustainable management, applied on the *Festuca valesiaca* L. grasslands found at 107 m a.s.l., in the forest-steppe zone of Ezareni, Iasi County. In this experience, we have studied the effect of organic fertilizers, applied at rates of 10-30 t ha^{-1}, with N_{50-100} P_{36-72}, on fodder content, yield, flower and chemical composition.

Keywords: *Festuca valesiaca*, permanent grassland, fertilization, canopy structure, yield

Introduction

Meadow degradation it is determined by changes in plant living conditions and vegetation structure. When these changes are accompanied by yield declines or quality deterioration, meadow does not correspond any more from the economic viewpoint.

Permanent meadows are an important source of animal feed, provided improvement measures involving rational use are employed. For a long-term period, no basic management measures were applied on permanent meadows in Romania, due to the estimate that efficient yields could be achieved without technological inputs even if grazing began early in the spring and continued late in the autumn.

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Insufficient material and financial resources and declining interest in permanent meadows improvement resulted in the diminishment and eventual abandonment of some technological actions that began and ended until 1989.

The reduction in the productive potential of permanent grasslands in North-Eastern Romania, found on slope fields, covering over 65-70% of land, is caused by erosion, along with unfavourable climatic conditions and wrong management practices (Samuil *et al.,* 2007). The low efficiency of these pasturelands is due to irrational exploitation, overgrazing and the absence of any improvement measures.

The increase in the productive potential of these grasslands can be achieved by fertilization with different rates and types of organic and mineral fertilizers (Cardaşol, 1994). The investigations carried out so far shown the positive effects of manure, combined with moderate rates of mineral fertilizers, applied on grasslands.

In terms of rational use, they can completely replace chemical fertilizers (Hopkins *et el.,* 1999, Ryser *et al.,* 2001, Jeangros *et al.,* 2003, Peeters *et al.,* 2004, Zimkova *et al.,* 2007). Manure has a positive action on plant nutrition regime, it can improve the thermic and aeration regime of soil, intensify the activity of soil microorganisms and act favourably on vegetation development (Carlen *et al.,* 1998, Britaňák *et al.,* 2008). The investigations carried so far have demonstrated the positive effects of reasonably applied manure on grasslands (Tonn and Briemle, 2010).

The *Festuca valesiaca* L. pasturelands from the Romania's forest steppe respond positively to medium organic and mineral fertilization, through improvement of botanical composition and structure and through an increase in raw protein content of fodder.

This paper presents the results obtained during 2006-2009, on *Festuca valesiaca* L. permanent grassland, improved by fertilization with different rates and combinations of organic and mineral fertilizers.

Materials and Methods

The trial was carried out on *Festuca valesiaca* L permanent grassland with a low plant composition, situated at 107 m a.s.l., on a 10% slope. The soil was cambic chernozem, weakly leached, with a clayey texture, a pH of 6.5-6.7, and a content in mobile phosphorus of 25-30 mg kg^{-1} and in mobile potassium of 300-350 mg kg^{-1}, at the depth of 0-30 cm.

The climatic conditions during the testing period were characterized by mean temperatures of 9.5 ^{0}C and mean total rainfalls of 552.4 mm. At Ezareni – Iasi, the year 2007 was extremely dry, with climatic conditions being unfavourable to the good development of vegetation on grasslands. The fertilization treatments are presented in the Table 1.

Tab. 1 Fertilization treatments

Fertilization treatments	Manure (t ha^{-1})	P_2O_5 (kg ha^{-1})	K_2O (kg ha^{-1})
T_1 – control	0	0	0
T_2	10 every year	50	36
T_3	10 every year	50+50	72
T_4	20 every 2 years	50	36
T_5	20 every 2 years	50+50	72
T_6	30 every 3 years	50	36
T_7	30 every 3 years	50+50	72

Manure, phosphorus and potassium were applied in autumn, while the nitrogen was applied in spring, before the beginning of the growing season (first decade of April), at a rate of 1000 kg manure, 5 kg N, 3 kg P_2O_5 and 7 kg K_2O.

Harvesting was carried out at the stage of ear formation of dominant grasses, and yield was expressed in dry matter (DM). Changes in the structure of canopy were determined using the gravimetrical method.

In order to establish the nutrition relations, we have calculated the quantity of nitrogen obtained from grassland and the nitrogen use efficiency from organic fertilizers, based on the direct relation between them and the yield amount. Data were analyzed using ANOVA and differences between averages were shown by the LSD test.

Results and Discussion

The data presented in Table 2 show the positive effect of fertilization on DM production, with differences related to the applied rates and fertilizer types and to the climatic conditions during the experimental period.

The analysis of the production data shows that in 2006, dry matter yield ranged between 2.3 t ha^{-1} DM in the control and 4.1 t ha^{-1} DM in T_7 fertilization treatment (Table 2). The highest yields were recorded at the fertilization rate of 30 Mg ha^{-1} cattle manure, applied every 3 years, combined with mineral fertilizers of 3.9 t ha^{-1} DM and 4.1 Mg ha^{-1} DM, respectively.

In 2007, the vegetation of permanent grasslands was highly affected by long-term drought that dominated the testing area of Ezareni, from September 2006 until august 2007. Therefore, the productivity was diminished, resulting in a very low effect of fertilization on production. In that year, yields ranged between 1.5 t ha^{-1} DM in the unfertilized control and 2.7 t ha^{-1} DM in T_7 fertilization treatment. Yield uniformity may be noticed, irrespective of the used fertilization level used.

The yields obtained in 2008 were higher than those in the previous years, ranging between 6.2 t ha^{-1} DM in the unfertilized control and 10.3 t ha^{-1} DM in the T_7 fertilization treatment. The yields obtained in 2009 varied between 2.0 t

ha^{-1} DM in the unfertilized control and 3.1 t ha^{-1} DM in the T_7 fertilization treatment.

Tab. 2 Influence of fertilization on dry matter production (t ha^{-1})

Fertilization treatments	2006	2007	2008	2009	Average
T_1 – control	2.3	1.5	6.2	2.0	3.3
T_2	3.4	2.2	8.7	2.6	4.2*
T_3	3.7	2.4	9.4	2.7	4.6**
T_4	3.5	2.3	9.0	2.4	4.3*
T_5	3.9	2.5	10.3	2.9	4.9**
T_6	3.9	2.6	8.4	2.8	4.4*
T_7	4.1	2.7	10.3	3.1	5.1**
Average	3.5	2.3	8.9	2.6	4.3
					*=LSD 5%; **= LSD 1% ; ***= LSD 0.1%

The mean average yields obtained during 2006-2009 ranged between 3.3 t ha^{-1} DM in the control and 5.1 t ha^{-1} DM in the T_7 fertilization treatment. The analysis of the mean yields suggest that their increase was due to the increase in manure application rate and, especially, mineral fertilizers rate.

Tab.3 Influence of fertilization on canopy structure (%)

Fertilization treatments	Grasses		Legumes		Others	
	2006	2009	2006	2009	2006	2009
T_1 – control	69	49	10	20	21	31
T_2	76	36	13	22	11	42
T_3	69	38	15	23	16	39
T_4	70	37	11	25	19	38
T_5	67	38	15	27	18	35
T_6	67	37	11	26	22	37
T_7	68	38	16	28	16	34
Average	69	39	13	24	18	37

In 2006, the analysis of the canopy structure showed that the mean recorded values were 67% for grasses, 13% for legumes and 18% for other species (Table 3). In 2009, the mean recorded values were 39% for grasses, 24% for legumes and 37% for other species

The most important changes were found in plants belonging to the "various" group, which showed significant increases with increasing manure application rate. In *Festuca valesiaca* grassland of Ezăreni, a total of 40 species was recorded, of which six species belonged to grasses, 10 species to fabaceae and 24 species to other species. Positive changes were observed in the sward composition, including an increase in the percentage of some valuable fodder

species: *Poa pratensis L, Festuca pratensis Huds, Arrhenatherum elatius (L) Presl., Medicago falcata L.*

Tab. 4 Influence of fertilization on chemical composition

Fertilization treatments	CP (g kg^{-1})	CF (g kg^{-1})	Mean yield of RP (kg ha^{-1})
T_1 – control	90.1	242.2	297
T_2	90.6	241.2	380
T_3	92.2	240.1	424
T_4	95.1	239.8	409
T_5	99.4	238.9	487
T_6	102.5	238.8	451
T_7	103.4	237.8	527

Table 4 shows the values of crude protein (CP), crude fibre (CF) and protein yield ha^{-1}. The changes in canopy structure induced by fertilization also affected the quality of the fodder, inducing a slight increase in raw protein percentage. The yield of crude protein was influenced by raw protein procentage and DM yield, ranging between 297 kg ha^{-1} DM in the control and 527 kg ha^{-1} DM in the T_7 fertilization treatment with 30 Mg ha^{-1} cattle manure, applied every 3 years+N50+50 kg ha^{-1}+P72 kg ha^{1}.

Tab. 5. Nitrogen export and nitrogen use efficiency

Fertilization treatments	Applied N (kg ha^{-1})	Exported nitrogen by yield		Nitrogen use efficiency (%)
		Total N (kg ha^{-1})	Difference to the control (kg ha^{-1})	
T_1 – control	0	48	-	-
T_2	100	61	13	13
T_3	150	68	20	13
T_4	100	65	17	17
T_5	150	78	30	20
T_6	100	72	24	24
T_7	150	84	36	24

The nitrogen extracted from soil by grassland yield and the nitrogen use efficiency of fertilizers were influenced by rates and combinations of spread fertilizers (Table 5). The highest nitrogen use efficiency was 24% in T_6 and T_7 treatments and the lowest coefficient i.e. 13% was obtained in the T_2 and T_3 treatments.

Conclusions

The permanent grasslands of *Festuca valesiaca* L. from Romania respond very well to the fertilization, which may be used as an important measure in permanent grasslands.

The DM yields obtained were influenced by climatic conditions, and type and level of organic and mineral fertilization.

Throughout the experiment, the highest yields were obtained at the fertilization with 30 t ha^{-1} cattle manure, applied every 3 years+ N50+50 kg ha^{-1}+P72 kg ha^{-1}.

The results obtained have shown positive effects of fertilization on productivity, biodiversity and canopy structure of the studied permanent grassland. Crude protein yield was influenced by crude protein percentage and DM production.

The management of permanent grasslands, through method of use, type and intensity of fertilization, and control method, has a high influence on phytocoenotic biodiversity, rate of species in the vegetation structure and dominant species in the canopy.

Fertilization also contributed to the improvement of botanical structure by increasing the grass percentage in the detriment of the legumes and other species.

For practical use, we recommend T_7 and T_5 treatments, which gave the highest yields and canopy structures, and very good nitrogen use efficiency.

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MENADZMENT PAŠNJAKA FESTUCA VALESIACA L. IZ SEVERNO-ISTOCNOG PODRUCJA RUMUNIJE.

- originalni naučni rad -

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Rezime

Rumunija je na petom mestu u Evropi, po ukupnim površinama prirodnih travnjaka,, posle Francuske, Velike Britanije, Španije i Nemačke. Ukupna površina travnjaka u Rumuniji obuhvata 4.9 miliona ha, od kojih 3.4 miliona hektara pašnjaka i 1.5 miliona hektra livada, što predstavlja značajan izvor hrane za životinje.

Ovaj rad je pokazao uticaj održivog menedžmenta, primenjen na *Festuca valesiaca* L. travnjaka pronađenog na 107 metera visine, u šumsko stepskoj zoni iz Ezareni, Županiija Iaši. U tom cilju utvrđen je uticaj organskih đubriva, u količini od 10-30 t ha^{-1}, unošenjem u količinma N_{50-100} P_{36-72}, na prinos i hemijski sastav stočne hrane.