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NOTA DE INVESTIGACIÓN

EFFECT OF MINERAL AND ORGANIC FERTILIZATION ON MOUNTAIN MEADOWS YIELD

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SUMMARY

Fertilization is the main factor influencing meadow yield. Permanent utilization of meadows results in sward degradation depending on the level and type of fertilization, what is shown up by a lower yield level. Therefore, the aim of this work was to estimate the effect of the method and level of fertilization on the yield of mountain meadows. The research was carried out in 2001-2003 on the permanent grassland in Czarny Potok, near Krynica (650 m above sea level). Six fertilizer treatments were applied: mineral fertilization with $P_{20}K_{58}$, $N_{100}P_{20}K_{58}$, organic fertilization in the form of loose penning, loose penning supplemented with mineral fertilizers (NPK), tight penning, and a control (not fertilized). Herbage yield ranged between 4.83-9.47 t ha⁻¹ depending on treatment and year. The meadow treated with a PKN mineral fertilizer had the highest average yield (8.35 t ha⁻¹) during the study period, followed by the loose pen supplemented with mineral fertilization NPK. However, the respective value found for the control was 39% lower. It is obvious that fertilization results in the yield growth when compared to non fertilized meadows. In mountain meadows good results can be achieved using loose penning supplemented with mineral fertilization.

Keywords: sheep penning.

INTRODUCTION

Agricultural production of the mountain permanent grasslands in Poland was usually related to extensive or semi-intensive utilization. It resulted from taking into consideration economic aspects of production and adjusting of its intensification to the actual economic and productive needs verified – as usually in the private activity – based on economics. Therefore, for many decades the utilization of these areas by farmers was rather based on the traditionally former models than on the short-term and changeable economic trends. This particularly concerns those higher altitude grasslands usually utilized as extensive pastures (Kopeć, 1993). It was not taken into consideration the use of large quantities of mineral fertilizers on mountain pastures because of high costs. It was a wide practice

to focus usually on the utilization of the natural fertilizing value of fresh animal faeces, and their careful and rational management on the pasture was very important. The concentration of sheep in the night penning as well as supplying frequency of the pasture is also of a great importance (Twardy, 1991).

MATERIALS AND METHODS

Research was conducted on the permanent grassland in Czarny Potok, near Krynica (altitude of 650 m) during the years 2001–2003. Experiments were located on a brown, acid soil derived from the Magurski sandstone. It has a light clay texture and chemical characteristics as follows: pH_{KCl} 4.3, organic matter content 44.2 g kg⁻¹ and total nitrogen 3.2 g kg⁻¹. Level of available macro elements was: P 11 g kg⁻¹, K 58 g kg⁻¹ and Mg 55 g kg⁻¹.

The experiment on the comparison of sheep penning fertilization and fertilization with mineral fertilizers started in the autumn 2001. Six treatments were applied in a split-plot design with four replicates:

1. control
2. $\text{P}_{18}\text{K}_{50}$ mineral fertilization,
3. $\text{N}_{100}\text{P}_{18}\text{K}_{50}$ mineral fertilization,
4. loose penning,
5. loose penning + PKN fertilization,
6. tight penning.

In the treatments with mineral fertilizers, phosphorous was applied once in the spring at 18 kg P ha⁻¹; and nitrogen and potassium in two equal doses after the first and second regrowth. To achieve the animal faces treatments as it comes to loose or tight penning each sheep was being kept on an area of 3 and 1 m², respectively. Doses of nutrients provided by loose penning amounted: N, 33 kg ha⁻¹, P, 16 kg ha⁻¹ and K 26 kg ha⁻¹ and 100, 46 and 70 kg ha⁻¹ for the tight penning, respectively. To provide equal amount of nutrients taking as the basis the tight penning, the field with loose penning was supplemented with mineral fertilizer.

Sward yields were calculated from four plots of 1 m² from each field after mowing and weighing, and expressed as tons of herbage dry matter (DM) per hectare.

RESULTS AND DISCUSSION

Herbage yields varied significantly depending on the method of fertilization and the year (Table 1). The highest yield during the first year was recorded at the tight penning treatment (1 animal per m²), followed by the mineral fertilizer treatment. In the second and third years, mineral fertilizer treatments and loose penning with mineral supplementation reached the highest yields. Herbage yields at the tight penning treatment decreased along the study period. In the second year this loss in relative numbers amounted to 7.3% and in the third year to 10.7%. The highest average yield was recorded at the N₁₀₀P₁₈K₅₀ treatment, followed by the loose penning supplemented with mineral fertilization and the tight penning treatments. On the contrary, poor yields were recorded, besides the control, at the loose penning and the P₁₈K₅₀ fertilization treatments. Nutrients applied were not enough to satisfy plant requirements.

TABLE 1

Herbage dry matter yields along the study period (t DMha⁻¹).

Producciones de materia seca durante el período de estudio (t MS ha⁻¹).

Variant	Dry matter yield (t·ha ⁻¹)				Index of yield growth
	2001	2002	2003	Average	
Control	5.31	5.17	4.83	5.10	1.00
P ₁₈ K ₅₀	6.98	7.16	7.06	7.07	1.39
N ₁₀₀ P ₁₈ K ₅₀	7.70	9.49	7.85	8.35	1.64
Loose penning	5.95	6.23	5.65	5.94	1.16
Loose penning +NPK	6.66	9.47	8.19	8.11	1.59
Tight penning	8.10	7.51	7.23	7.61	1.49
NRI (p=0.05)	0.58	0.88	0.61	0.58	0.23

Animal manure is a valuable organic fertilizer, playing an important role not only in plant nutrition but also in the forming of soil fertility (Gašiorek *et al.*, 2000, Kasperczyk *et al.*, 2001). Country new economic conditions are pushing up the application of higher rates of fertilizers. The main factors were the relationship between production costs and prizes of agricultural products as well as the thought of a negative influence of the mineral fertilizers on the flora, soil, water environment and animals. A high level of nitrogen fertilization contributes toward soil acidification and leads to impoverishment of the number of legume species in the pasture. Moreover, sward becomes looser, and synantropic flora, like *Rumex crispus* (curly dock) and *Cirsium* sp. (plume thistle), appears (Mazur, 1988). The use of inadequate amounts of mineral fertilizers causes

losses of the nutritive value of forages as well as lixiviation of nutrients to the water table (Wesołowski, 1991).

CONCLUSIONS

Mountain grassland yields respond widely to the level and type of fertilization. The highest yields were obtained with the treatments in which mineral fertilizers were applied, followed by the application of nutrients with loose penning supplemented with mineral fertilization and tight penning. In fact, these last two fertilization strategies should be recommended (i.e. loose penning with mineral fertilization and tight penning) according to the present study results. Simultaneously, economic aspects as well as social conditions of the farmers have to be taken into account (cannot be omitted) before the full implementation of such recommendations.

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EFFECTO DE LA FERTILIZACION MINERAL Y ORGÁNICA SOBRA LA PRODUCCIÓN DE PRADOS DE MONTAÑA

RESUMEN

La fertilización es el factor más influye en la producción de los prados. El objetivo de este trabajo fue estimar el efecto del modo y nivel de fertilización en la producción de prados de montaña. La investigación se realizó entre 2001 y 2003 en los prados de Czarny Potok, cerca de Krynica a 650 m de altitud. Se aplicaron seis tratamientos de fertilización: control sin fertilizantes, dos niveles de fertilización mineral: $P_{20}K_{58}$ y $N_{100}P_{20}K_{58}$, y tres niveles de fertilización orgánica mediante redileo con dos densidades de ovejas: baja, baja suplementada con fertilizante mineral NPK, y alta. La producción de hierba osciló entre 4,83 y 9,47 t ha⁻¹, en función del tratamiento y del año. El tratamiento con NPK fue el más productivo, alcanzando una producción media de 8,35 t ha⁻¹, seguida por la del tratamiento con baja densidad de ovejas suplementada con NPK. El control dio una producción 39% menor. En todo caso, se obtuvieron buenos resultados mediante la fertilización a través del redileo con baja densidad, suplementada con NPK.

Palabras clave: redileo con ovino.