# THE EFFECT OF SOIL NUTRIENTS AND ANIMAL EXCRETA ON GRASSLAND BIODIVERSITY IMPROVEMENT

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**Abstract:**

The topsoil is one of the most important components in grassland and sustains the sward physically, chemically and biologically. Farmers often refer to the soil-sward-animal complex or interrelations to underline the fact that the proper functionings of all three are inextricably linked. Grazing has a favourable effect on animals – however, grazing also has a major effect on the plant stock of pastured grasslands. Sheep do not feed plants from urine patches, which may result in a change in the diversity of plants on the pasture.
One of the aims of our research was to examine the effect of animal excreta coverage on grassland biodiversity improvement. The research took place on nature conservation grassland areas, pasturing ewes. We analyzed the effect of urine induced lush patches on sustaining the diversity of plant species. Results showed that lush patches were grazed unevenly. The outer circle, app. 15% of the patches has been grazed, a further 15-20% has been somewhat grazed, while the middle of the patch, 60-70% remained ungrazed.
In the first growth, grass species in the middle of the lush patch seed heads (40-150 patch$^{-1}$) while on the outer edge of the patch, rhizomatous plants advanced.
The diversity of species on grasslands can be sustained by grazing. Nongrazed area and generative tiller number indicate that grazed nature conservation pastures are able to renew themselves through a generative way, as an indirect effect of grazing.

**Keywords:** grassland, biodiversity improvement, soil, animal excreta, sheep, urine patch

## Introduction

The analysis of grazing is important to maintain the plant diversity of pastures on nature conservation areas. (Malatinszki *et.al.*, 2004, Penksza *et.al.*,2005, Centeri *et.al.* 2007, Szabó *et.al.*,2007,Tasi 2005, 2007,) Between 75 and 90 per cent of the N in the herbage consumed by cattle and sheep is excreted, the proportion depending upon the type and class of animal. (Herczeg *et.al.*,206, Várallyay 2006a,2006b. Ligetvári *et.al.*2006)
According to Frame (1992), dump excretion is about 1-1.5 kg/sheep, as a total of 0.1-0.2 kg of dump defecated 6-8 times/day. This amount, when added up for the whole grazing period, is app. 300-700 kg (app. 200 - 400 kg dry matter). The expected dump coverage of the pasture is about 0.05-0.07 $m^2$/animal. The amount of urine is 1-2 litre/sheep/day as a total of 15-20 excretions. A sheep's urination covers an area of 0.03-0.05$m^2$ (Haynes and Williams 1993). According to Bristow *et.al* (2006) in the sheep urine, total N ranged from 3.0 to 13.7 g litre$^{-1}$ of which an average of 83% was present as urea. Herbage species vary in their tolerance to or recovery from urine scorch or dung smother.(Nagy,J.2006) Clovers are more susceptible to urine scorch than grasses. Herbage growth rates in and around the patch are stimulated. Herbage response to urine has been attributed to its N concentration and can last for 2 to 3 months (Ledgard *et. al.*, 1982., Magyar *et al.*, 2005, Németh 2006. Jolánkai *et.al.*2006).

## Materials and methods

Our grazing experiment was conducted with ewes on alkaline soil nature conservation grassland in 2005/2006, using a pastoral grazing method. The aim of the experiment was to analyse the effects of ewe's dump on the change of the diversity of plant species on the pasture after a spring grazing period. We also examined the effects of urine patches on yield growth, and the feeding behaviour of ewes, by analysing the yields of grazed and partially grazed parts of urine patches. We monitored the number of generative tillers on the non-grazed parts, in order to sustain biodiversity and nature conservation effect. We monitored the change of the ratio of plant species, and examined the effect of grazing on the change of botanical cover of different species. (Szemán, 2007, Szemán *et.al* 2007., Opitz von Boberfeld *et.al.*, 2006)

Grazing was started in early spring to ensure that sheep graze a large area due to the small amount of grass available. Urine scorch patches were marked. The effect of dump on the decay and regeneration of plants, on the grazing of the next growth, and on the generative phase of grasses were monitored.

While grazing the primary growth, sheep consumed only parts of the urine induced lush patches. Plants not grazed could reach generative phase, which supports grassland biodiversity. We also measured the area of urine induced lush patches and the weight of grazed and un-grazed herbage.

The grasses turned dark green on dumped patches therefore they were easy to separate. Based on the grazing effect, patches were divided into three parts: the grazed outer border, where both the shoots and the stems of the grass were grazed; the mildly grazed area, where only the top of the shoots were grazed, resulting in the prevention of flowering; and the un-grazed inner circle, where grasses and other species generated reproductive structures and seed. Generative shoots of the ungrazed plants were collected and counted by species. Each time an analysis of the botanical composition was conducted. Plant coverage and the change of size of uncovered area was also determined.

## Results and discussion

In grazed pasture systems, grazing animals deposit urine and dung causing high nutrient loading to relatively small proportion of the total grazed area.

Grazing was started in early spring. Urine scorch patches were marked. The height of grass enabled the sheep to graze on a certain area only for one day; grazing was repeated on the same area 30 days later. Grazed grasses started flowering. Sheep fully grazed grasses on areas not dumped, while urine patches were only partially grazed.

We analyzed the effect of urine induced lush patches on the diversity of plant species. Results showed that lush patches were unevenly grazed. The outer circle, app. 15% of the patches has been grazed, a further 15-20% has been somewhat grazed, while the middle of the patch, 60-70% remained ungrazed.

Based on the darker green colour of grass, we measured the size of patches and the weight of the ungrazed herbage after grazing. Urine induced lush patches were divided into four groups based of their size. We assumed that the smaller the patch, the greater the ungrazed yield is. We found that this assumption was true only for the biggest areas,

while there was no significant difference between the remaining yields. That can be explained by the heterogenity of grass species' coverage. The grazing of leguminous plants showed that sheep left more plants on smaller size patches. Plants grazed on the borders of the patches could have grown outside the urine covered area, with only their roots reaching into richer soil, therefore the lack of odour enabled their intense grazing similar to not dumped areas.
The generative tiller number was determined at grasses flowering on the lush patches. Only the species *Alopecurus pratensis*, *Festuca pseudovina* and *Poa pratensis* have grown flowering stems. Flowering *Festuca pseudovina* was found only in some of the lush patches. We assumed that generative stems were eaten by the early grazing, which may have resulted in a lack of flowering.

*Table 1* Mean herbage biomass (DM g patch$^{-1}$) and flowering tiller number after urine patch (area cm$^{-2}$) grazing

| Different size urine patch area of grasses | *Alopecurus pratensis* | *Festuca pseudovina* | *Poa pratensis* | Legumes fresh weight | Herbage Dry matter |
|---|---|---|---|---|---|
| | flowering tiller number | | | | |
| cm$^2$ | head patch$^{-1}$ | | | g patch$^{-1}$ | |
| 2826 | 32 | - | 12 | 1,4 g | 38,2 |
| 1923 | 82 | - | 9 | 5,9 g | 67,1 |
| 1425 | 49 | 91 | 7 | 4,8 g | 54,6 |
| 1374 | 54 | - | 13 | 30,4 g | 42,4 |
| Patch/head | NS | | NS | | |
| Patch/yield | | | | ** | NS |

**:P<0.01 and NS non significant

## Conclusions

Grazing has an effect on the diversity of plants - not only through the pasturing itself, but also through the dumping of sheep. Sheep do not eat plants from urine patches, which may affect the diversity of plants on the pasture.
Sheep fully grazed grasses on areas not dumped, while urine patches were only partially grazed. The outer circle, app. 15% of the patches has been grazed, a further 15-20% has been somewhat grazed, while the middle of the patch, 60-70% remained ungrazed.
We assumed that the smaller the patch, the greater the ungrazed yield is. We found that this assumption was true only for the biggest areas, while there was no significant difference between the remaining yields. That can be explained by the heterogenity of grass species' coverage. The grazing of leguminous plants showed that sheep left more plants on smaller size patches.
Plants not grazed could reach generative phase, which supports grassland biodiversity. There is no explainable difference between the number of shoots and the size of lush patches. *Alopecurus pratensis* had the least (32) shoots on the biggest area, outnumbered by the number of shoots (82) on a smaller area. In the first growth, grass species in the middle of the lush patch seed heads (40-150 patch$^{-1}$ ) while on the outer edge of the patch, rhizomatous plants advanced.

Nongrazed area and generative tiller number indicate that grazed nature conservation pastures are able to renew themselves through a generative way, as an indirect effect of grazing.

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**References**

Bristow A.W. Whitehead C.D. Soskburn E.J (2206) Nitrogenous constituents in the urine of cattle, sheep and goats. *Journal of the Science of Food and Agriculture*, 59. 3 387-397

Centeri, Cs. , Á. Malatinszky, M. Vona, Á. Bodnár, K. Penksza (2007) State and sustainability of grasslands and their soils established in the Atlantic-Montane zone of Hungary. Cereal Research Communications 35(2): 309-312.

Frame J. (1992) Improved Grassland Management. *Farming Press* 181-185

Haynes R. J. Williams P.H (1993) Nutrient cycling and soil fertility in the grazed pasture ecosystem *Advances in Agronomy*, 49 119-199

Herczeg, E., Á. Malatinszky, T. Kiss, Á. Balogh, K. Penksza (2006) Biomonitoring studies on salty pastures and meadows in South-East Hungary. Tájökológiai Lapok 4(1): 211-220.

Jolánkai M., Szempétery. Zs. , Hegedüs, Z.: 2006. Pesticide Residue dischange dynamics in wheat grain. Cereal Research Communications, Vol. 34 No 1 pp. 505-509

Ledgard S.F , Steele K.W , Saunders W.M H. (1982) Effect of urine and its major constituents on pasture properties. *New Zeland Journal of Agricultural Research*, 25 61-68

Ligetvári F., Várallyay Gy., Schweitzer, F , 2006. Sivatagok és az elsivatagosodás nemzetközi éve, UNESCO 2006. Agrokémia és Talajtan. 55. (2) 487-498.

Magyar I. E , - W. Opitz von Boberfeld, - L. Szemán und - H. Laser (2005): Keimungsverhalten von Kräutersaatgut unter variierten Umweltbedingungen. (Germination features of herbs among lab conditions). Die Bodenkultur. Austrian Journal of Agricultural Research Produktion und Verarbeitung. (Production and Processing). WUV-Universitätsverlag. 55. (1) 2004 p 13-19.

Malatinszky, Á , K. Penksza (2004) Traditional sustainable land use towards preserving botanical values in the Putnok Hills (South Gömör, Hungary) Ekológia (Bratislava) 23(1 Suppl ) 205-212.

Nagy, J ,. 2006 Adatok a tiszántúli öntözetlen réti talajú gyepek főbb gyepalkotó fűfajainak optimális kémiai talajjavításához és tápanyagellátásához. Növénytermelés Vol 55 Nos 3-4

Németh, T ,: 2006 Nitrogen in the soil-plant system, nitrogen balances Cereal Research Communications, Vol 34 No 1 pp 61-65

Opitz von Boberfeld, W , K. Banzhaf, F. Hrabe, J Skladanka, S Kozlowski, P Golinski, L Szeman, J Tasi, (2006): Effect of different agronomical measures on yield and quality of autumn saved herbage during winter grazing – 1st communication Yield and digestibility of organic matter . Czech Journal of Animal Science, 2006 (5): 205 - 213 p.

Penksza K., Benyovszky B. M , Malatinszky Á. (2005) Legeltetés okozta fajösszetételbeli változások a bükki nagymezői gyepben Növénytermelés 54(1-2): 53-64.

Szabó, M., A. Kenéz, D. Saláta, L. Szemán, Á. Malatinszky (2007) Studies on botany and environmental management relations on a wooded pasture between Pénzesgyör and Hárskút villages Cereal Research Communications 35(2) 1133-1136.

Szemán L. (2007). Environmental conseqvences of sustainability on grassland Cereal Research communikation 35 (2): 1157 – 1160 Part II

Szemán, L. –Kádár, I - Kovács, P. (2007). The effect of „gyimesi racka" sheep grazing on permanent grassland biodiversity. In A. De Vliegher, - L. Carlier (edited by) Permanent and temporary grassland. Proceedings of the 14th Symposium of the European Grassland Federation. Ghent, Belgium. 153-157p

*Tasi J.* (2007). Diverse impacts of nature conservation grassland management. Cereal Research Communications Vol.35. No. 2 1205-1209. p

Tasi, J. (2005) Heavy metal, macro- and microelement content of grass species and dicotyledons Acta Agronomica Hungarica. Tom 53 No 3 349-352 p

Várallyay, Gy , 2006a Life quality - soil - food chain Cereal Research Communications 34 (1) 335-339

Várallyay, Gy , 2006b Soil degradation processes and extreme soil moisture regime as environmental problems in the Carpathian Basin Agrokémia es Talajtan. 55 (1-2) 9-18