Production Capacity of a Mountain Meadow in Slovakia

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The XXII International Grassland Congress (Revitalising Grasslands to Sustain Our Communities) took place in Sydney, Australia from September 15 through September 19, 2013.

Proceedings Editors: David L. Michalk, Geoffrey D. Millar, Warwick B. Badgery, and Kim M. Broadfoot

Publisher: New South Wales Department of Primary Industry, Kite St., Orange New South Wales, Australia

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Keywords: Semi-natural grassland, fertilisation, dry matter production, plant species

Introduction

Slovakia is rich in grassland ecosystem diversity due to its geological, geomorphologic and climatic conditions (Seffer *et al*. 2002). Grasslands make up to 81% of total agricultural land in the upland and mountain regions. They are regarded as basic sources of forage for cattle and sheep. During the last century, the utilisation of mineral fertilisers increased dramatically not only on arable land, but even on grassland in Europe (Hejcman *et al*. 2007). The objective of our 11-year trial was to compare the dry matter production of permanent grasslands at two levels of mineral nutrition under extreme climatic conditions of northern Slovakia.

Methods

The experiment took place in a mountain region of Slovakia. Its site characteristics are: longitude 48°55´ N, latitude 20°06´E, altitude 960 m, total rainfall during growing period 500 mm, temperature over the same period 9.5°C. The semi-natural grassland belongs to the *Festuco-Cynosuretum* association, and in 1992, at the beginning of the experiment it comprised of 32 plant species. Two nutrition levels applied to this sward (P30 (kg/ha) K60 and N90 + PK) were compared with an unfertilised control (N0) between 1992 and 2002. The total yield of the dry matter was established by three cuts a year. The experimental design (10 × 32 m) had four randomised replicates with each plot being 2.5 × 8 m. Measurements of botanical composition were always carried out before the first cut of each year.

Results

Above-ground dry matter production differed significantly between treatments and years (Table 1). The mineral fertiliser applied had a more significant impact on the dry matter production (F=34.6, P=0.0001) than the year (F=4.1, P=0.0002). Production at the first cut repeatedly decided the total dry matter production; they correlated positively (r= 0.87, P=0.0001). Based on the 11 years of the experiment, we established that increased mineral fertilisation had a negative impact on the proportion of the first cut in the total production. This proportion gradually decreased from 62% of unfertilised control to 59% observed in the P30K60 treatment and to 55% with N90+PK fertilisation. The proportion of the second cuts was as high as 25%. The third cuts varied from 13% to 18%.

The above-ground dry matter production was not related to total rainfall and average daily temperatures during the growing period. However, higher average daily temperatures between the beginning of April and the end of June were associated with lower dry matter yield (r=-0.41, P=0.0001). The amount of rainfall during this period did not influence the production (P=0.8).

The above-ground dry matter production was significantly influenced by the botanical composition of the grassland. The average proportion of grasses on the control and the PK treatments were identical (46%). Applied nitrogen supported the presence of grasses which averaged 67%. The proportion of legumes differed between the treatments applied, averaging 20%, 31% and 11% on the control,

Table 1. Dry matter production (t/ha) of the semi-natural grassland under different levels of mineral fertilisation, and total of rainfall and temperatures during growing period. Square root transformed data are in parentheses.

Year	Control	P30K60	N90+PK	Rainfall (mm)	Temperature (°C)
1992	2.85	3.75	4.73	399.9	10.35
1993	1.91	3.75	4.93	440.1	9.74
1994	2.30	4.61	6.44	425.0	10.82
1995	2.98	4.43	6.91	600.5	9.63
1996	1.67	2.63	5.26	403.7	10.67
1997	2.30	3.59	6.23	483.0	9.14
1998	1.77	3.83	5.57	445.2	11.13
1999	1.89	4.16	5.44	536.1	10.72
2000	0.89	1.35	3.31	504.0	10.50
2001	1.26	1.68	3.79	764.9	10.08
2002	1.80	2.39	2.02	582.5	10.76
Mean	1.79 (1,36) a	2.95 (1,75) ab	4.52 (2,18) b	507.7	10.32

Table 2. Foliage cover of the most frequent species (grasses, legumes and herbs) during period 1992-2002 and average number of plant species (np = not present).

Plant species	Treatments		
	N0	P30K60	N90+PK
Alopecurus pratensis	8.1	9.6	19.7
Dactylis glomerata	5.9	5.4	6.7
Poa pratensis	8.7	9.7	11.9
Trisetum flavescens	5.2	4.8	9.5
Trifolium repens	7.8	15.7	np
Vicia cracca	5.0	6.4	np
Alchemilla xanthochlora	5.5	3.3	2.9
Ranunculus acris	2.2	0.6	1.1
Taraxacum officinale	7.0	5.7	5.4
Veronica chamaedrys	5.5	4.3	3.5
Sum of the most frequent species	60.9	65.5	60.7
Number of plant species	26.5b	25.5b	23.2a

P30K60 and N90+PK treatments, respectively. The presence of herbs varied, however in the course of the experiment they declined from 34% (control) to 23 and 22% on the P30K60 and N90+PK treatments.

Only eight plant species were present in all treatments and years; in addition, *Trifolium repens* and *Vicia cracca* were not recorded on the plots treated with nitrogen (Table 2). These eight (or ten respectively) plant species amounted to almost two-thirds of the vegetation cover. There was a strong trend evident in which the more intensive fertilisation resulted in a slightly decreased number of plant species. On average, the lowest number of plant species was recorded when nitrogen fertilisation was applied (23.2 species). This number was significantly lower when compared with the control and P30K60 treatments; the latter treatments did not differ from each other. Jancovic *et al*. (2004) reported a positive effect of PK fertilization on the herbal character of the stand and spread of the dicotyledonous plants.

Conclusion

The mineral fertiliser applied had more impact on the dry matter production than the year. The first cut had significant impact on the total dry matter production. Eight plant species amounted for almost two-thirds of the total vegetation cover of the treatments applied.

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