References

JANÍK, M. 1971. Pastva na holiach Krivánskej Malej Fatry a jej negatívny vplyv na krajinu. In: Životné prostredie, Bratislava, 1971, no.5, p. 69 – 74
JIŘIŠTE, L.- MLÁDKOVÁ, A. 1999. Likvidace invazních druhů rostlin na území KRNAP a ochranného pásma. Správa KRNAP, Vrchlabí, 1999, ISBN 80 – 902489 – 85, p.125
MEARNS, R. 1997. Livestock and environment: potential for complementarity.In: World animal rewiew, vol. 88, 1997, no.1, p. 2-14
NOVÁK, J. 1992. Obnova degradovaného trávneho ekosystému s dominanciou Rumex obtusifolius. In: Aktuálne otázky krmovinárstva v teórii a praxi. Nitra, SPU, 1992, p..175-178
STEINFELD, H. 1997. Options to address livestockenvironment interactions. In: World animal rewiew, vol. 88, 1997, no.1, p.15-20
ŠÚR, D. 1994. Vplyv pasenia jalovíc a jahničiek na extenzívny pasienkový porast. Rostl. Výr., no.11, 1994, p.1077 – 1085

FLORISTIC CHANGES IN PRATOCENOSIS AFTER CESSATION OF FERTILIZING

Ján JANČOVIČ, Ľuboš VOZÁR, Mária BABEĽOVÁ
Slovak Agricultural University in Nitra

Summary

Field experiments were conducted to study the effect of fertilizing and its absence on floristic composition of semi-natural grasslands. Diversified grass community is changed during eight years of fertilization by gradated nitrogen rates into grassland with 71 to 84 % share of grasses. Phosphorus-potassium fertilization supports the development of dicotyledonous species and share of grasses is falling. After three-year cessation of fertilization unfertilized stand is typical by almost 50 % share of dicotyledonous species, grass species (*Festuca pratensis* Huds., *Festuca rubra* L.) are disappearing and moss (20 %) is spread in the stand. In the stand fertilized before cessation with PK-fertilizers the share of leguminous crops is significantly falling (by 24 %), and the representation of the other meadow herbs and grasses is increasing. Absence of fertilization affected minimally the stand with 240 kg $N.ha^{-1}$, though the stand was thinned due to a reduction in the representation of grasses (by 8 %) and the other herbs (by 2.5 %). Absence of fertilization affected negatively the development of floristic composition of grass pratocenosis. Minimum utilization of grassland starts as late as in the second year after cessation of the process of secondary succession.

***Key words*:** semi-natural grassland, floristic composition, cessation of fertilization

Introduction

Fertilization increases production capacity of seminatural grasslands, but on the other side its biodiversity is falling. One of the potential assumptions of regeneration of biodiversity is absence of mineral fertilization (Jeangros, Bertola, 1997) with minimising of the other anthropogenic factors, but with such a possibility of cultivation of grasslands which will preserve their species variability (Jančovič, 1996). In conditions of Slovakia an attention was paid to the problem of absence of mineral fertilization and effect of its composition on floristic structure and productivity at the end of the 1960s (Lichner, et al., 1966) at increase of the utilization of mineral fertilizers and recently when their application fell significantly (Olff, Bakker, 1991; Jančovič, Holúbek, 1993; Gáborčík et al., 1997).

Material and methods

Experimental field trials with fertilization of grasslands (1986 – 1993) and after its absence (1994 – 1996) were performed on seminatural grasslands in the region Stražov Hills (Central Slovakia, locality Chvojnica). The territory of the trial site is situated at an altitude of 600 m above sea level, with geographic altitude 48° 53' and 18° 34' of longitude. Slope character of the terrain ranges between 17° to 20°.
The site belongs to the slightly warm region, into subregion slightly arid with dominantly cold winter. According to long-term measurements average annual temperature reaches here 6.5 °C and 11.1 °C in the growing season. The long-term average of the whole-year sum of precipitation is 848 mm, while it is 431 mm during the growing season. Soil-forming substrate of the site is geest of Jurassic schists with inserts of marls, on which acid cambisol was formed. Semi-natural grassland has been identified as an association of *Lolio-Cynosuretum R. Tx* 1937 in view of phytocenology.
Original treatments of fertilization and rates of nitrogen are presented in Table 1. Phosphorus and potassium fertilization was constant and determinated at 30 kg $P.ha^{-1}$ and 70 kg $K.ha^{-1}$ annually.

Table 1 Treatments and rates of nitrogen (kg.ha^{-1})

Treatments	Nitrogen rates in year			
	1st	2nd	3rd	4th
1	–	–	–	–
2	PK	PK	PK	PK
3	PK + 60 N	PK + 60 N	PK + 60 N	PK + 60 N
4	PK + 120 N	PK + 120 N	PK + 120 N	PK + 120 N
5	PK + 240 N	PK + 240 N	PK + 240 N	PK + 240 N

The trial was established in four replications, an area of harvest plot was 10 m^2. In the years 1986 to 1989 all treatments were utilized in four cuts and in the years 1990 to 1993 differentially according to fertilization treatments (2 – 3 cuts). During the years 1994 to 1996 fertilization was omitted and only one cut was used based on the methodology after Rychnovská et al. (1987) in the time of maximum biomass production (end of June). Floristical analysis was performed by the method of projective dominance before each cut to find the changes in floristic composition of the stand in different treatments (Regal, 1956). Agrochemical properties of the experimental site prior for stand establishment are given in Table 2.

Table 2 Agrochemical soil properties of experimental site

Depth of soil sampling (mm)	0 – 100	101 – 200
pH / KCl	4.6	4.6
C_{ox} (g.kg^{-1})	36.0	24.0
N_t (g.kg^{-1})	4.0	2.8
P (mg.kg^{-1})	15.7	4.3
K (mg.kg^{-1})	66.0	120.0
Mg (mg.kg^{-1})	113.7	91.9
Ca (mg.kg^{-1})	850	750
Sum of exchangeable basis cations mmol.kg^{-1})	48.1	44.8
Sorptive capacity (mmol.kg^{-1})	138.0	133.0
Degree of sorptive saturation (%)	34.1	33.7

Results and discussion

The studied grass community before fertilization was floristically varied, with dominance of grass species (73 %) where the other meadow herbs formed 25 % share and leguminous crops were presented by 2 %. Already in the first year of fertilization and utilization representation of different floristic groups changed (Table 3), mainly in treatments with gradated nitrogen nutrition. Phosphorus-potassium fertilization applied in the initial year of the trial without nitrogen emphasised herbal character of the stand with distribution of dicotyledonous herbs (*Leontodon autumnalis* L., *Taraxacum officinale* Webb., *Alchemilla vulgaris* L., *Trifolium repens* L., *Lotus corniculatus* L. and *Vicia cracca* L.)
After eight years of mineral nutrition (Table 3) the share of grasses increased, except treatments 1 and 2, what is known from studies of many authors (Krajčovič et al., 1968; Lichner, 1972; Folkman, 1985; Holúbek, 1991 and others). Only in the treatment with 60 kg N.ha^{-1} even after this period floristic composition similar to the first year of fertilization is preserved, but with slightly higher representation of leguminous plants (by 2.5 %) and decrease of other herbs (by 4 %).
After three-year elimination (1994 to 1996) of fertilization representation of floristic groups in all studied treatments (Table 3). Unfertilized stand is after absence of fertilization characteristic by almost 50 % representation of dicotyledonous species with dominance of *Leontodon autumnalis* L. (25 %), *Alchemilla vulgaris* L. (7 %) and *Achillea millefolium* L. (2.25 %). Recess of *Festuca rubra* L. (from 26 to 9 %) and particularly *Festuca pratensis* Huds. (from 17 to 2.5 %) is reported. The share of *Anthoxanthum odoratum* L. (7 %) and *Nardus stricta* L. (9 %) is increasing. More than 30 % decrease of grass species reflected in relatively high proportion of blank places (20 %) with distribution of moss (*Polytrichum commune* Hdw.), which modifies the moisture regime and suppresses mainly grasses by its aggression. In the treatment with phosphorus-potassium nutrition the proportion of leguminous plants fell significantly (by 24 %), previously affected by mineral nutrition, but according to Rabotnov (1974) also by periodicity of their occurrence. Such anthropogenically increased proportion of leguminous plants on originally oligotrophic sites is not a stable cha-racter, because their higher presence after elimination of fertilization is dependent on gradual withdrawal of applied nutrients (PK) and competitive relationships about these nutrients with wide-leaved herbs and aggressive grasses in the stand. In treatments fertilized before with gradated nitrogen rate (treatments 3 and 4) the proportion of grass species fell by 12 % during three years of elimination and representation of leguminous plants and other meadow herbs increased. The cessation of fertilization affected at least the floristic composition in the treatment with 240 kg N.ha^{-1}, though also here the proportion of grasses fell by 8 % and proportion of other herbs by 2.5 % and totally the stand was thinned (13.5 % of blank places). In grass phytocenosis priority belongs to low grass species less demanding

for nitrogen (*Festuca rubra* L., *Agrostis tenuis* Sibth., *Anthoxanthum odoratum* L., *Poa pratensis* L.). The proportion of the other meadow herbs is low and occurs according to different species from 0.25 % to 2.5 %.

Table 3 Dominance and grassland composition

Treatment	Dominance (%)	Floristic groups			
		grasses	legumes	other herbs	blank places
1	dominance after one year of fertilization (1986)	70.0	0.8	28.5	0.7
2		68.0	4.0	28.0	–
3		70.0	1.5	28.5	0.5
4		62.0	2.6	34.5	0.8
5		71.5	1.0	26.9	0.6
1	dominance after long-term fertilization (1986 – 1993)	63.0	2.0	33.0	2.0
2		52.0	30.0	18.0	–
3		71.0	4.0	24.0	1.0
4		73.0	1.0	24.0	2.0
5		84.0	–	13.0	3.0
1	dominance after cessation of fertilization (1996)	31.5	2.0	46.5	20.0
2		54.0	6.0	36.5	3.5
3		59.0	3.0	34.0	4.0
4		61.0	3.0	31.0	5.0
5		79.0	–	10.5	13.5

References

FOLKMAN, I.: Changes in grass ecosystem at long-term utilization of nutrients and different frequency of utilization: Final report, Nitra: VŠP, 1985, 52 p.
GÁBORČÍK, N. et al.: Interruption of mineral fertilization and successive changes of grassland. In: Management for grassland biodiversity. Proc. Int. Symp. Warszawa – Lomža, 1997, p. 295-300.
HOLÚBEK, R.: Production capacity and quality of semi-natural grasslands in moderate warm and moderate arid region. Bratislava: Veda, 1991, 132 p.
JANČOVIČ, J.: Floristic changes of long-term fertilized grassland after cessation of fertilization. In: Proc. Int. Conf., SPU Nitra, 1996, p. 174-177.
JANČOVIČ, J. – HOLÚBEK, R.: Application of gradated and alternate nitrogen rates in semi-natural grasslands: Final report, SPU Nitra, 1993, 50 p.
JEANGROS, B. – BERTOLA, C.: Changes during six years in botanical composition, species diversity and productivity of a permanent meadow after cessation of fertilizer application and reduction of cutting frequency. In: Management for grassland biodiversity. Proc. Int. Symp. Warszawa – Lomža, 1997, p. 75-79.
KRAJČOVIČ, V. et al.: Forage production. Bratislava: SVPL, 1968, 564 p.
LICHNER, S.: Study of biology of bird's foot-trefoil (*Lotus corniculatus* L.), tufted vetch (*Vicia cracca* L.) and meadow pea (*Lathyrus pratensis* L.) in natural grassland. Poľnohospodárstvo, 18, 1972, no.4, p. 285-286.
LICHNER, S. – FOLKMAN, I. – HOLÚBEK, R.: Contribution to the study of the effect of high NPK rates of nutrients applied in different ratios on natural grassland. Poľnohospodárstvo, 12, 1966 no.6, p. 411-420.
OLFF, H. – BAKKER, J. P.: Long-term dynamics of standing crop and species composition after the cessation of fertilizer application mown grassland. Journal of Ecology, 28, 1991 no.3, p. 1040-1052.
RABOTNOV, T. A.: Lugovedenije. Moskva, Izd. Moskov. Universiteta, 1974, 384 p.
REGAL, V.: Microscopic method of evaluation of fodder quality. Sbor. ČSAZV, 1956 no.6, 19-25.
RYCHNOVSKÁ, M. et al.: Methods of the study of grass ecosystems. Praha, Academia, 1987, 272 p.