POSSIBILITIES OF COVER OF MINERALS FROM GRASSLANDS IN NUTRITION OF DAIRY COWS

R. Holúbek, I. Holúbek

Slovak University of Agriculture, Nitra, Slovak Republic

The problem of the contents of minerals and their comparison with standardised need by dairy cows were studied in semi-natural grassland (TTP), tillage-recovered grassland (DTP) and additionally sown grassland (PTP). Stands had identical nutrition level and utilization. Contents of minerals (K, P, Ca and Mg) were determined in hay dry matter by chemical analyses. Based on the contents of minerals in fodder dry matter of TTP, PTP, DTP and standardised need, it was found that quality of feed ration at mono-dietary feeding is not optimal (Table II). It is presented above all by high content of potassium. Feed ration provides an optimum need of P for dairy cows, but surplus of Ca in results in unbalanced ratio Ca : P (Fig. 1). Amount of Mg in feed ration is optimum. Tetanic index is unfavourable and reaches several times higher values than required by the standard. Differences in the quality of feed from TTP, PTP and DTP are not significant in view of their mineral composition from which follows that additional sowing and radical regeneration of some grass species and legumes does not solve the situation, only it is slightly improved. Mg and Ca contents in hay dry matter create prerequisites for cover of the need of minerals in feed ration for maintenance and 10–12 l milk production. Different level of fertilization of grasslands does not optimize contents of minerals in fodder dry matter as to the needs and requirements of animals.

permanent grassland; temporal grassland; additionally sown grassland; dry matter; minerals; feed ration; dairy cow

INTRODUCTION

There are disproportion in dry matter of herbage and hay following from different demands of plants and animals for mineral nutrition. The mentioned differences can be diminished to a certain degree through nutrition and fertilization of grasslands (K l e č k a et al., 1938; K l a p p , 1971; L i c h n e r et al., 1983; H o l ú b e k , 1991; K r a j č o v i č et al., 1995).

Except absolute values of the contents of minerals, their ratio has been emphasised in recent years. The relationship soil-plant-animal-quality of animal production is solved more complex. These are particularly relationships of minerals P : Ca, K : Na, K : (Ca + Mg) and others (Holúbek, 1991; Krajčovič et al., 1995; Slamka, 1998). It followed from the results of the research of VÚTPHP and importance of the effect of agents for P that types of stands are in the first place, of which the highest values are reached on permanent grasslands (TTP). The importance of cuts in the second place was always unambiguous. Mainly the sites decide upon the contents of K, Ca and Mg (Krajčovič et al., 1995). Based on long-term trials the combinations of different minerals or groups of elements were determined, in confrontation with the requirements for nutrition of polygastric animals (Lichner et al., 1993; Holúbek, 1991). If minerals are not supplied to animals in feed in required amounts and ratios, it is recommended to supplement them in concentrated or industrially prepared feedstuffs (Sommer et al., 1994; Holúbek et al., 1997).

This study has been aimed at evaluating the quality of hay dry matter in eutrophised grassland (after long-term undirected folding) after radical regeneration, additional sowing and nitrogen fertilization in view of the contents of selected minerals in relationship to requirements of dairy cows.

MATERIAL AND METHOD

The contribution evaluates six-year results of pratotechnic research devoted to the issues if technology of cultivation, nutrition, fertilization and utilization of grasslands.

In the aspect of methodology and organization the study is a part of the state research project, originally denoted as E-V-2 "Ecologically favour management in the region on the basis of grasslands", co-ordinated by Prof. V. Krajčovič.

This task has been materialised through the network of 10 experimental sites under different ecological conditions of CR and SR. One of co-operating workers within the above project is the Department of Feedstuff Management of AF SPU Nitra. Three-task trial was established in three parallel blocks: first block represents a permanent grassland (TTP), the second one is temporary grassland (DTP) and the third one is additionally sown grassland (PTP).

TTP represented an original semi-natural grassland from typological standpoint identified as a union *Cynosurion* R.Tx. 1973, association *Lolio-Cynosuretum typicum* (Jurko, 1974). Radical regeneration of natural stand through deep autumn tillage (1991) by plough with plough skim. In the spring of the following year preplanting soil treatment (dragging, harrowing, use of cultivator) was done and subsequent seeding of clover-grass mixture of the following composition:

Lolium multiflorum x *Festuca arundinacea*	hybrid Felina	12 kg.ha^{-1}
Lolium perenne	variety Metropol	8 kg.ha^{-1}
Dactylis glomerata	variety Rela	4 kg.ha^{-1}
Trifolium pratense	variety Sigord	3 kg.ha^{-1}
Trifolium repens	variety Huia	2 kg.ha^{-1}
	Total	29 kg.ha^{-1}

In the third block (PTP) additional sowing of clover-grass mixtures was performed in identical composition like in the second block (DTP).

All three blocks had identical variants of mineral nutrition (randomly arranged in four replications), identical way of nitrogen split to different cuts and identical forms of fertilizers were applied.

Variant	Number of utilizations	Rate of nutrients (12 kg.ha^{-1})		Date of nitrogen application		
		P	N	in spring	after first cut	after second cut
1	3	–	–	–	–	–
2	3	30	–	–	–	–
3	3	30	90	30	30	30
4	3	30	180	60	60	60

Phosphorus was applied in the form of superphosphate and nitrogen in the form of ammonium nitrate with limestone. The first application of nitrogen and phosphorus fertilizers was performed on both sites in spring in the time of greening of stands. Further nitrogen rates were applied at last 10 days after cut.

Stands were cut three times during the growing season:
1st cut – at the growth stage of heading of prevailing grass species
2nd cut – approximately 4–5 weeks after the first cut
3rd cut – approximately 6–8 weeks after the second cut.

Determination of concentration of minerals in TP dry matter:
- phosphorus after mineralization by wet way photometrically by phosphomolybdenum method
- potassium by flame photometry after mineralization by wet way
- calcium and manganese complexometrically titrimetrically.

The effect of cultivation technology, radical regeneration and fertilization on changes in concentration of minerals in TP dry matter was evaluated in view of standardised daily need of nutrients for dairy cows (Sommer et al., 1994). Based on this standard a dairy cow of live weight 500 kg at production

8 kg FCM of milk daily needs to provide maintenance metabolism and this production the following amounts of minerals: Na – 16.6 g, K – 54 g, P – 39 g, Ca – 46 g, Mg – 28.6 g.

Provided that a dairy cow of the above efficiency needs to consume 11.5 kg of dry matter daily (Sommer et al., 1994), assurance (offer) of minerals in daily feed ration was calculated as follows:

Assurance (offer) of minerals = concentrated minerals in dry matter x intake of dry matter per animal and day. Calculated values were compared with standardised demand of animals for different mineral elements. Results of experimental studies were statistically evaluated by the method of multi-factorial analysis of variance and LSD test.

RESULTS AND DISCUSSION

The content of minerals in TP dry matter is presented in Table I. Significant differences in the contents of minerals (K, Ca, P, Mg) among stands, variants and cuts result from statistical evaluation.

Provided that dairy cows of live weight 500 kg at production 8 kg of FCM of milk need to consume 11.5 kg of dry matter (S o m m e r et al., 1994) the following assurance of minerals in feed ration composed of grass mass was calculated (Table II). As it follows from Table II, in potassium many fold higher content (8–10 times) of this element as is the daily need of dairy cows was recorded in all variants and all cuts and types of grasslands. This situation is conditioned by high potassium concentration in soil which did not fall below 400 $g.ha^{-1}$ even after three years of utilization of TP. In the case of heifers, as found by S l a m k a (1997) K surplus is more significant.

Situation in assurance of demands of livestock for manganese it can be said it is in optimum or excesses standardised demand in hay dry matter of TTP and PTP. The mentioned finding follows from soil reserves of manganese as well as floristic composition of dicotyledonous species of meadow plants. Temporary grassland gives in feed ration optimum saturation of Mg except the second and third variant in the first cut (27.8 $g.ha^{-1}.day^{-1}$).

The content of phosphorus in forage TTP except variant 1 and additionally sown grassland (TP) is in optimum and practically fulfills daily cows. Other situation is in the phosphorus content in DTP where except the first cut (variants 2, 3, 4 and variant 1 in the second cut) its deficit was found. Explanation can be seen in floristic changes. Radical regeneration of original stand caused a significant and fast reduction of the number of species what was manifested as soon as after the first cut after regeneration when the number of species in DTP fell to 19 (variant 1) compared with original stands

I. Content of minerals in hay dry matter ($g.kg^{-1}$) – average values for the years 1992 to 1997

Variant	K			Mg			P			Ca		
Permanent grassland (TTP)												
	1 K	2 K	3 K	1 K	2 K	3 K	1 K	2 K	3 K	1 K	2 K	3 K
I	31.30	30.50	28.76	2.97	3.87	3.74	3.48	3.42	3.30	9.38	11.80	12.54
II	34.08	31.61	29.56	3.20	3.60	3.74	4.14	3.58	3.78	8.48	10.86	11.06
III	34.85	32.49	28.80	2.67	3.56	3.91	3.97	3.63	3.66	9.13	10.20	11.35
IV	31.02	28.90	26.12	2.61	3.66	3.75	4.19	3.93	3.83	7.45	8.76	10.62
Additionally sown grassland (PTP)												
Variant	K			Mg			P			Ca		
	1 K	2 K	3 K	1 K	2 K	3 K	1 K	2 K	3 K	1 K	2 K	3 K
I	34.38	34.71	32.23	3.00	4.34	4.02	4.24	3.62	3.71	8.32	9.20	10.17
II	34.82	35.25	32.22	2.67	4.03	4.11	4.14	3.65	4.10	7.96	8.71	10.26
III	34.24	36.45	27.65	2.77	3.08	3.58	4.56	3.55	3.68	7.32	8.79	8.74
IV	33.98	35.71	28.96	2.51	3.32	3.23	4.56	3.69	3.64	7.05	9.22	8.73
Temporary grassland (DTP)												
Variant	K			Mg			P			Ca		
	1 K	2 K	3 K	1 K	2 K	3 K	1 K	2 K	3 K	1 K	2 K	3 K
I	36.13	33.23	29.61	3.39	4.04	4.59	3.42	3.30	3.12	5.64	7.52	7.94
II	36.90	33.42	28.06	3.24	3.69	4.73	3.66	3.55	3.21	6.00	8.10	6.88
III	36.83	34.81	26.57	3.44	3.88	3.56	3.81	3.22	3.13	4.75	6.17	6.54
IV	33.16	30.86	26.7	3.35	3.83	3.54	3.87	3.88	3.21	4.34	7.59	6.40

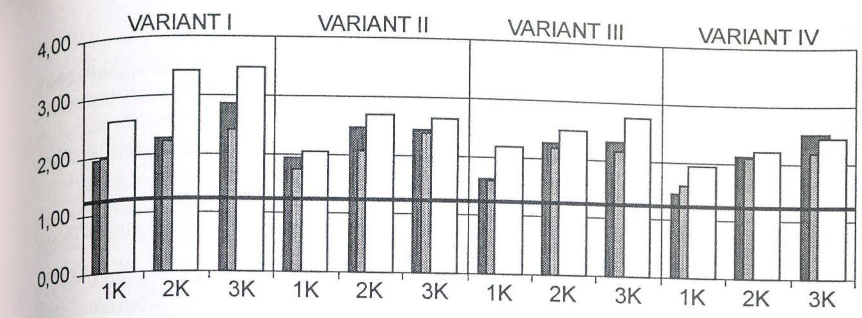
Explanations:
Variant 1 – unfertilized control
Variant 2 – 30 kg $P.ha^{-1}$
Variant 3 – 30 kg $P.ha^{-1}$ + 90 kg $N.ha^{-1}$
Variant 4 – 30 kg $P.ha^{-1}$ + 180 kg $N.ha^{-1}$
1 K – first cut, 2 K – second cut, 3 K – third cut

(37 species, variant 1). There was a similar tendency in the other variants (S l a m k a, 1998). The effect of regeneration acted during the whole period of lasting of the trial, though the number of species was increasing with the years. In the first cut of the final year abundance on TTP was 35–37 species, while on DTP it was 20–25 species on nitrogen unfertilized variants and 5–6 species on nitrogen fertilized variants (H o l ú b e k et al., 1997).

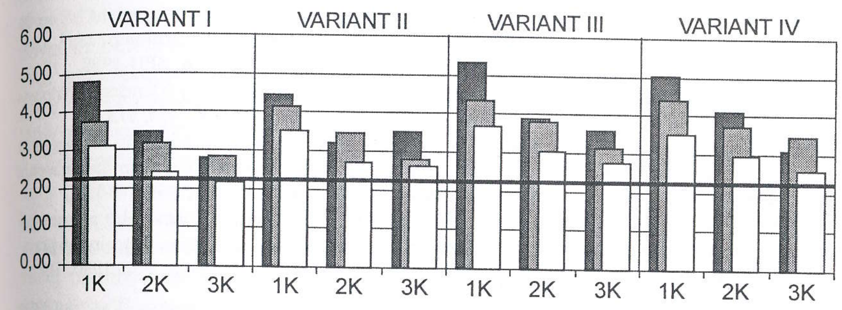
II. Assurance of minerals for dairy cows (g per animal and day) – average values for the years 1992 to 1997

Element	K			Mg			P			Ca		
Permanent grassland (TTP)												
Opt.	54.0			28.6			39.0			46.0		
Variant	1 K	2 K	3 K	1 K	2 K	3 K	1 K	2 K	3 K	1 K	2 K	3 K
I	360.0	350.8	330.7	34.2	44.5	43.0	40.0	39.3	38.0	107.9	135.7	144.2
II	391.9	363.6	340.0	36.8	41.4	43.0	47.6	41.2	43.5	97.5	124.9	127.2
III	400.8	373.7	331.2	30.7	40.9	45.0	45.7	41.7	42.1	105.0	117.3	130.5
IV	356.7	332.4	300.4	30.0	42.1	43.1	48.2	45.2	44.1	85.7	100.7	122.1
Additionally sown grassland (PTP)												
Element	K			Mg			P			Ca		
Opt.	54.0			28.6			39.0			46.0		
Variant	1 K	2 K	3 K	1 K	2 K	3 K	1 K	2 K	3 K	1 K	2 K	3 K
I	395.4	399.1	370.6	34.5	49.9	46.2	48.7	41.6	42.7	95.7	105.8	117.0
II	400.5	405.4	370.5	30.7	46.3	47.2	47.6	42.0	47.2	91.6	100.2	118.0
III	393.8	419.2	318.0	31.8	35.5	41.2	52.5	40.8	42.3	84.2	101.1	100.5
IV	390.8	410.7	333.0	28.8	38.2	37.1	52.4	42.4	41.8	81.0	106.0	100.4
Temporary grassland (DTP)												
Element	K			Mg			P			Ca		
Opt.	54.0			28.6			39.0			46.0		
Variant	1 K	2 K	3 K	1 K	2 K	3 K	1 K	2 K	3 K	1 K	2 K	3 K
I	415.5	382.1	340.5	39.0	46.5	52.8	39.3	38.0	35.9	64.9	86.5	91.3
II	424.4	384.3	322.7	37.3	42.4	54.4	42.1	40.8	36.9	69.0	93.2	79.1
III	423.5	400.3	305.6	39.6	44.6	40.9	43.8	37.0	36.0	54.6	71.0	75.2
IV	381.3	354.9	307.1	38.5	44.0	40.7	44.5	44.6	36.9	49.9	87.3	73.6

Saturation of livestock by calcium is higher in the feed ration in four types of grasslands than required demand what results in unfavourable ratio Ca : P, which should achieve optimally the values 1.2 (Lichner et al., 1983; Sommer et al., 1994). Since there is a surplus of Ca in TP forage this ratio is wider and reaches the values in an interval 1.46 to 3.47 (Fig. 1), whereas it is more favourable on DTP due to meadow plants which are richer in the content of Ca compared with cotyledonous grass species in phytocenosis (Klapp, 1971; Holúbek et al., 1997).



1. Ca : P ratio



2. Tetanic index

For Figs. 1 and 2:
- ■ temporary grassland
- ▨ additionally sown grassland
- □ permanent grassland
- – optimum

Certain indicator of balance of mineral nutrition of polygastric animals is the ratio between K and bivalent cations Ca + Mg (the so-called tetanic index) whose optimum value for dairy cows in 0.72 (Sommer et al., 1994). Results of tetanic index are documented in Fig. 2. It follows from them that the values of tetanic index in all three technologies of cultivation of grasslands (except variant 1 in the third cut of TTP) highly exceed an optimum value for animals while more favourable values of tetanic index were reached in forage of TTP and PTP in which greater share of legumes and other herbs was increasing by the content Ca + Mg.

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Received for publication on May 19, 1999

HOLÚBEK, R. – HOLÚBEK, I. (Slovenská poľnohospodárska univerzita, Nitra, Slovenská republika):

Možnosti krytia minerálnych látok z trávnych porastov vo výžive dojníc.

Scientia Agric. Bohem., *30*, 1999: 171–179.

Cieľom experimentálnych prác bolo posúdiť vplyv rôznych technológií obhospodarovania trávnych porastov na obsah minerálnych prvkov (P, K, Ca, Mg) a ich porovnanie s normovanou potrebou dojníc.

Pre splnenie uvedeného cieľa bol založený dvojfaktorový pokus v troch paralelných blokoch. Prvý blok predstavuje trvalý trávny porast (TTP), z fytocenologického hľadiska identifikovaný ako zväz *Cynosurion* R.Tx. 1973, asociácia *Lolio-Cynosuretum typicum* (Jurko, 1974). Druhý blok prezentuje dočasný trávny porast (DTP), ktorý vznikol orbou pluhom s predplúžkom a následnou sejbou ďatelinotrávnej miešanky. Tretí blok bol trávny porast (PTP) prisiaty ďatelinotrávnou miešankou rovnakého zloženia ako na DTP.

Porasty mali jednotnú úroveň hnojenia priemyselnými hnojivami: variant 1 – nehnojená kontrola, variant 2 – 30 kg P.ha^{-1}, variant 3 – 30 kg P.ha^{-1} + 90 kg N.ha^{-1}, variant 4 – 30 kg P.ha^{-1} + 180 kg N.ha^{-1}. Využívanie TP bolo troma kosbami v senokosnej zrelosti. V sušine sena bola v experimentálnych rokoch a kosbách stanovená koncentrácia minerálnych látok:

- P po mineralizácii mokrou cestou fotometricky fosfomolybdénovou metódou,
- K plameňovou fotometriou po mineralizácii mokrou cestou,
- Ca a Mg komplexometricky titračne.

Výsledky obsahu minerálnych prvkov (tab. I) sme štatisticky vyhodnotili viacfaktorovou analýzou rozptylu. Rozdiely v kvalite krmu z aspektu ich minerálneho zloženia nie sú vždy štatisticky preukazné. V zdrojoch premenlivosti sme zistili preukaznosť medzi kosbami a variantmi hnojenia. Z uvedeného vyplýva, že prísev kultúrnych druhov tráv a ďatelinovín situáciu nerieši, iba mierne zlepšuje. Vplyv technológií obhospodarovania TP na zmeny koncentrácie minerálnych prvkov v sušine sena sme posúdili z hľadiska normatívnej potreby živín pre dojnice (Sommer et al., 1994). Na základe tejto normy dojnica o živej hmotnosti 500 kg pri produkcii 8 kg FCM mlieka denne potrebuje na zabezpečenie záchovného metabolizmu nasledovné množstvá minerálnych látok: Na – 16,6 g, K – 54 g, P – 39 g, Ca – 46 g a Mg – 28,6 g. Za predpokladu, že dojnica o vyššie uvedenej úžitkovosti potrebuje denne prijať 11,5 kg sušiny (Sommer et al., 1994), vypočítali sme ponuku minerálnych látok v kŕmnej dávke nasledovne:

Zabezpečenie (ponuka) minerálnych látok = koncentrácia minerálnej látky v sušine x príjem sušiny na kus a deň. Vypočítané hodnoty (priemer za 6 rokov) sme porovnali s normatívnou požiadavkou zvierat na jednotlivé minerálne látky (tab. II).

Sledovaním obsahu minerálnych látok v sušine sena trávnych porastov a normovanej potreby sme zistili, že kvalita kŕmnej dávky pri monodiétnom kŕmení nie je optimálna. Prezentuje sa predovšetkým vysokým obsahom draslíka, podmieneného vysokou zásobou v pôde (500–600 g.kg^{-1}) v dôsledku dlhodobého neusmerneného košarovania mladým dobytkom.

Kŕmna dávka zabezpečuje optimálnu potrebu fosforu pre dojnice, avšak prebytok Ca v nej spôsobuje nevyvážený pomer Ca : P. Množstvo horčíka v kŕmnej dávke je v optime.

Tetanický index (obr. 2) je nepriaznivý a dosahuje niekoľkonásobne vyššie hodnoty, ako požaduje norma. V hodnotenom ukazovateli sme zistili štatisticky významný rozdiel medzi typmi porastov. Najpriaznivejšie hodnoty tetanického indexu sme dosiahli na TTP – 2,91, potom nasleduje PTP – 3,58 a nakoniec DTP s hodnotou 3,93.

Obsahom Mg a Ca v sušine sena TP sú vytvorené predpoklady pre krytie potreby minerálnych látok na 12 až 13 l mlieka.

trvalý trávny porast; dočasný trávny porast; prisiaty trávny porast; sušina; minerálne látky; kŕmna dávka; dojnica

Contact Address:

Prof. Ing. Rudolf Holúbek, DrSc., Slovenská poľnohospodárska univerzita, Agronomická fakulta, Katedra krmovinárstva, Tr. A. Hlinku 2, 949 76 Nitra, Slovenská republika