Effect of different management on the yields, forage quality and botanical composition of permanent grassland

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Introduction

Grassland management has a crucial effect on the production and quality of forage and, at the same time, animal performance. However, it is essential to use different approaches in order to be able to select the most appropriate method of grassland management and to observe all relevant aspects and consequences. The aim of this contribution is to evaluate how different strategies affect dry matter yield and forage quality in permanent grasslands on the basis of the grassland trials established under the conditions of the Czech Republic by simultaneous observation of species composition.

Materials and methods

Pratotechnical trial describing:

Locality:

- Rapotín (Czech Republic); altitude: 390–402 m a. s. l.
- long-term temperature and precipitation during vegetation: 9.1 °C; 481 mm

Treatments:

Intensity of utilisation:

1 = intensive (1st cut by May 15th, 4 cuts per year at 45-day interval)
2 = medium intensive (1st cut between 16th and 31st May, 3 cuts per year at 60-day interval)
3 = low intensive (1st cut between 1st and 15th June, 2 cuts per year at 90-day interval)
4 = extensive (1st cut between 16th and 30th June, 1 or 2 cuts per year, second cut after 90 days)

Fertilisation:

A = no fertilisation
B = $P_{30}K_{60}$
C = $N_{90}P_{30}K_{60}$
D = $N_{180}P_{30}K_{60}$ (pure nutrients)

Evaluated parameters:

- annual dry matter yield (DM)
- forage quality (total of 264 samples):
  - » Weende analysis (crude protein – CP, ether extract – EE, crude fibre – CF, ash – A)
  - » organic matter digestibility – OMD (*in vitro* method Tilley and Terry, 1968)
  - » energy value: ME (metabolisable energy), NEL (net energy of lactation)
- botanical composition - projective dominance method

Statistical analysis:

- full factorial model for a two-way ANOVA (interactions for all parameters under investigation)
- two-way ANOVA (effects of intensity of utilisation, fertilisation and their interaction) followed by the LSD test
- redundancy analyses (CANOCO for Windows v. 4.5)

Results and discussion

Dry matter yield and forage quality:

- The highest dry matter yield was achieved in treatment fertilised with the highest dose of nitrogen. Intensity of utilisation decreased the yield up to 4.68 t ha^{-1}, especially when four cuts were taken.
- The content of crude protein significantly decreased with extensive utilisation up to 99.4 g kg^{-1} DM. It was positively influenced by nitrogen fertilisation at all treatments of intensity of utilisation.
- Organic matter digestibility negatively correlated with the amount of crude fibre in the fodder. The intensity of utilisation had especially significant effects on OMD, with decreasing intensity of utilisation reducing the OMD up to 59.1 %.
- The highest content of energy (5.50 MJ kg^{-1} DM) was found in the intensive utilisation by the fertilisation $N_{180}P_{30}K_{60}$; however influence of the fertilization was not significant.

Botanical composition:

- The inclusion of environmental variables (time, fertilisation, cutting regime) explained ca 22 % of the variability in species composition. Species composition under our conditions was the most significantly influenced by intensity of utilisation (9.5 %) and time (8.5 %).
- The higher rates of nitrogen decreased the total number of species in vegetation. The effect of the intensity of utilisation on the species diversity was significant only in unfertilised grasslands where the highest number of species was achieved for the extensively utilised treatment (20 species in mean of 2003–2008).
- The nitrogen fertilisation in combination with the extensive utilisation increased the proportion of grasses (mainly *Elytrigia repens* and *Dactylis glomerata*) (dominance of 86.3 %; mean of 2003–2008).
- The highest mean proportion of legumes, mainly *Trifolium repens* (dominance of 14.3 %; mean of 2003–2008), was found in the intensively utilised treatment with $P_{30}K_{60}$.

Conclusion

We can conclude that dry matter yield, forage quality and botanical composition of permanent grassland was significantly influenced by management (fertilisation, exploitation) and also by time. These findings are related to the conditions in the Czech Republic and they are important for the nutrition of cattle and for efficient grassland management.

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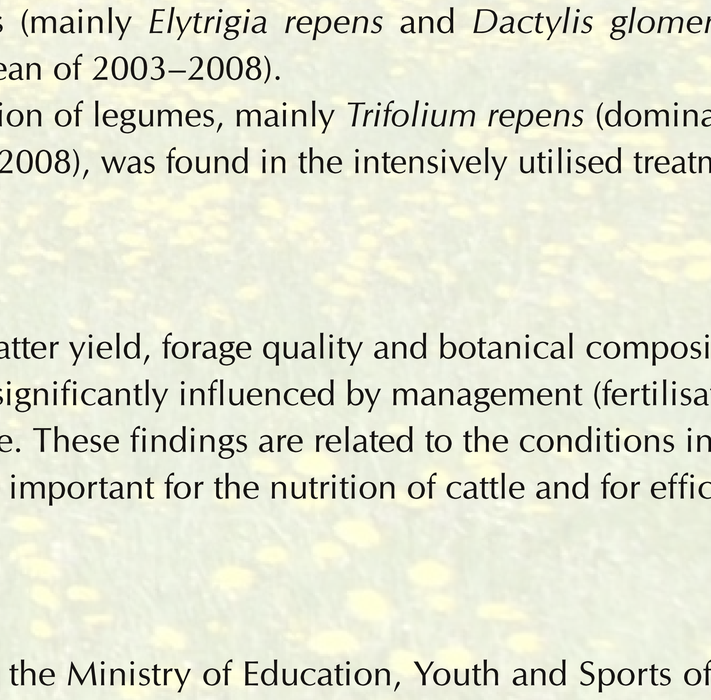
Table 1 Dry matter yield and forage quality at different grassland management (2003–2008)

Treatment	DM [t ha^{-1}]	CP [g kg^{-1} DM]	CF [g kg^{-1} DM]	EE [g kg^{-1} DM]	A [g kg^{-1} DM]	OMD [%]	ME [MJ kg^{-1} DM]	NEL [MJ kg^{-1} DM]
1A	4.68	146.8	240.0	32.8	109.2	67.7	9.31	5.46
1B	4.75	143.3	243.9	33.7	112.5	67.3	9.22	5.39
1C	6.93	157.8	236.8	33.4	110.1	67.2	9.22	5.39
1D	8.05	178.7	237.8	34.0	107.6	68.1	9.37	5.50
2A	4.85	127.0	257.6	31.4	109.3	65.8	8.96	5.22
2B	4.99	127.8	259.3	33.2	116.4	64.6	8.70	5.03
2C	6.87	140.7	258.9	33.1	118.4	66.2	8.94	5.20
2D	8.09	160.0	261.6	32.8	115.5	65.9	8.96	5.21
3A	5.00	106.7	286.0	27.7	93.1	61.5	8.44	4.85
3B	5.45	105.4	288.1	28.4	95.6	61.8	8.47	4.87
3C	7.69	120.7	298.9	27.6	93.9	61.3	8.42	4.83
3D	8.31	144.6	295.7	28.8	86.5	63.3	8.80	5.10
4A	5.15	99.4	304.3	26.4	93.4	60.1	8.24	4.70
4B	5.42	102.2	300.2	27.7	97.3	61.0	8.32	4.76
4C	7.76	115.8	308.4	28.2	96.2	59.1	7.98	4.52
4D	7.94	127.2	303.9	27.9	93.1	59.8	8.15	4.64
Mean	6.37	131.5	273.8	30.4	103.0	63.8	8.72	5.04
$LSD_{0.05}$	0.68	10.9	12.7	1.3	4.9	1.5	0.21	0.15

Figure 1 Ordination plot from RDA summarising the effect of grassland management and time



Cutting regime: **4** – four cuts /yr; **3** – three cuts /yr; **2i** – two cuts /yr; **2e** – two or one cut /yr; Fertilisation: **0** – no fertilisation; **PK** – $P_{30}K_{60}$; **N90PK** – $N_{90}P_{30}K_{60}$; **N180PK** – $N_{180}P_{30}K_{60}$ (pure nutrients)