EFFECT OF HARVEST FREQUENCY AND FERTILIZATION ON YIELDS AND QUALITY OF FORAGE

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ABSTRACT

The effect of fertilization and the harvest frequency on production and floristic characteristics of a meadow stand were assessed in a small plot trial established in 2003 in Vatín, Vysočina Region, the Czech Republic. Four levels of fertilization (none; N0 + P30 + K60 kg·ha^{-1}; N90 + P30 + K60 kg·ha^{-1}; N180 + P30 + K60 kg·ha^{-1}) were combined with four treatments of exploitation intensity (4 cuts per year, first cut on 15th May, every next after 45 days; 3 cuts per year, first cut on 30th May, every next after 60 days; 2 cuts per year, first cut on 15th June, next after 90 days; 2 cuts per year, first cut on 30th June, next after 90 days). Production of dry matter and forage quality was evaluated. Data from 2009–2011 were used in this paper. Yields of the dry matter increased along with increasing amounts of nutrients supplied and ranged from 3.8 t·ha^{-1} (non-fertilized) to 9.1 t·ha^{-1} (N180PK). With respect to the exploitation intensity, highest yields were attained under two-cut management (6.8 t·ha^{-1} in extensive and 6.3 t·ha^{-1} in low-intensive variant) compared to three- and four-cut variants (both 6.1 t·ha^{-1}). Concerning qualitative parameters of forage, exploitation intensity affected significantly concentration of NEL, crude protein and fibre. The highest concentration of NEL was in 4-cut (5.44 MJ·kg^{-1}), crude protein in 4-cut (155.7 g·kg^{-1}) and fibre in 2-cut late (269.8 g·kg^{-1}). The results showed significant differences among all the levels of fertilization. The highest concentration was observed in N180PK fertilization: crude protein 144.77 g·kg-1 and fibre 258.6 g·kg^{-1}.

Key words: permanent meadow, fertilization, harvest frequency

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INTRODUCTION

In the Czech Republic, grasslands are mostly secondary communities developed in habitats originally occupied by forests, which represent a climax vegetation. Natural grasslands occur only in the areas with extreme conditions, where growth of woody vegetation is impossible. Thus most of the Czech grasslands developed as a result of human activities (Rychnovská et al., 1985). In the course of time different types of management resulted into different types of grassland such as meadows and pastures. The maintenance of all these anthropogenic (or secondary, semi-natural) grasslands depends on management disabling progress of trees and shrubs (Klimek et al., 2007). At the largest scale, the distribution of grasslands and their species diversity depends on climate. Particular grassland is affected by bedrock, soil, water regime, altitude, nutrient status, local climate, disturbance etc (Gibson, 2009). Then it follows that semi-natural permanent meadows, as a result of the concurrence of many factors, represent a great reservoir of biodiversity. Among anthropogenic activities, the fertilization appears to be the most important factor affecting floristic composition and yields, whilst the intensity of exploitation influences mainly quality of forage (Mrkvička and Veselá, 2002; Hrabě and Knot, 2011). Especially nitrogen fertilization causes rapid shifts in the sward composition supporting growth of tufted grasses at the expense of legumes and other forbs (Silvertown et al., 2006). Hrevušová et al. (2009) summarize, that the effect of nitrogen fertilization is apparent even 16 years after cessation of a long-term fertilization.

MATERIAL AND METHODS

A small plot trial was established in 2003 within the permanent meadow, which set up in the 1990s. Site is located near Vatín, Vysočina region, the Czech Republic, in the floodplain of the Oslava River, at 535 m above sea level. Annual rainfall averages 618 mm; mean annual temperature is 6.9 °C. Soil is stagnosol on the quaternary fluvial deposits, bedrock is biotitic paragneiss. The trial was designed in the form of split blocks with four replications. Area of the plot was 10 m^2. There were four treatments of nutrition level combined with four treatments of exploitation intensity. Nutrition levels were: no fertilization; N0 + P30 + K60 kg·ha^{-1} (PK); N90 + P30 + K60 kg·ha^{-1} (N90PK); N180 + P30 + K60 kg·ha^{-1} (N180PK). Total amount of nitrogen was dosed in a ratio of 1:1:1:0, 1:1:1 and 1:1 in four-cut, three-cut and two-cut treatments, respectively. Yields of dry matter were calculated through using the weight difference of fresh and dry forage samples (after drying at 60 °C). Concentrations of crude protein and fibre were analysed by NIRS method. Results from yeaars 2009 – 2011 are presented in this paper. Results were processed by ANOVA and subsequent Tukey's HSD test in the STATISTICA software.

RESULT AND DISCUSSION

Average production of dry matter was 6.3 t·ha^{-1}. It was significantly affected by level of fertilization (Fig. 1), while year and exploitation intensity had no significant effect (Fig. 2). Yields of DM increased along with increasing amounts of nutrients supplied and ranged from 3.8 t·ha^{-1} in non-fertilized treatment to 9.1 t·ha^{-1} under doses of 180 kg of nitrogen per hectare. The results showed significant differences among all the levels of fertilization (Fig. 3 and 4). With respect to the exploitation intensity, highest yields were attained under two-cut management (6.8 t·ha^{-1} in extensive and 6.3 t·ha^{-1} in low-intensive variant) compared to three- and four-cut variants (both 6.1 t·ha^{-1}). The results of exploitation intensity are showed in Fig. 4 and 5. These results correspond to those obtained by Nerušil et al. (2008) in similar experiment from another site. They also refer to dominant effect of nutrition level and rather lower effect of exploitation intensity on the production of biomass. Hrabě and Knot (2011) also state that management with four cuts per year is unfavourable in terms of yields of dry matter, yet forage quality is higher due to younger

developmental stage of harvested forage. Especially concentration of N-substances is higher and thus total yield of crude protein is higher by more than 20 % in comparison to two-cut variants.

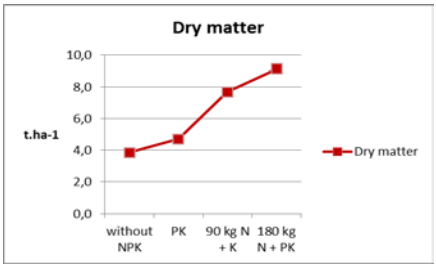

Fig. 1: Yields of dry mass in relation to level of fertilization (average of all years and fertilization levels)

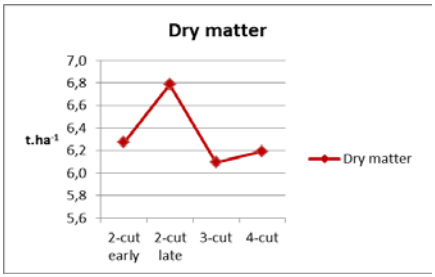

Fig. 2: Yields of dry mass to exploitation intensity (average of all years and exploitation intensities)

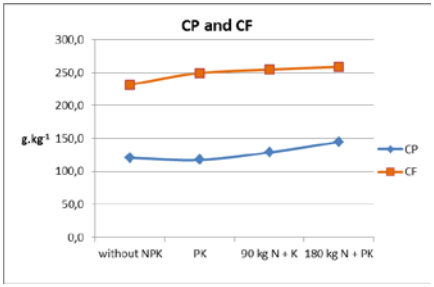

Fig. 3: Concentration of fibre and crude protein in relation to level of fertilization (average of all years and fertilization levels)

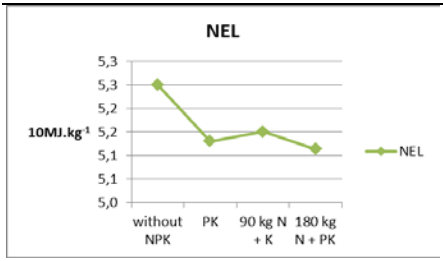

Fig. 4: Concentration of NEL in relation to level of fertilization (average of all years and fertilization levels)

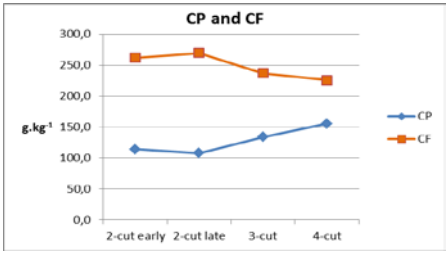

Fig. 5: Concentration of fibre and crude protein in relation to exploitation intensity (average of all years and exploitation intensities)

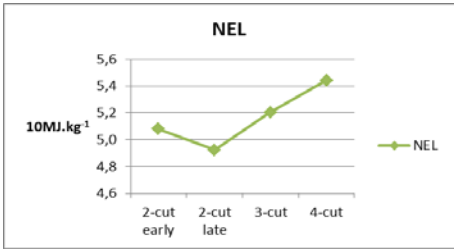

Fig. 6: Concentration of NEL in relation to exploitation intensity (average of all years and exploitation intensities)

CONCLUSIONS

Nutrients supply caused significant differences in production of dry matter between all levels of fertilization. Highest production was reached on plots receiving N180PK (9.1 t·ha^{-1} on average in all years and exploitation intensities). The effect of year and exploitation intensity on yield of the dry matter was not proved. Concerning qualitative parameters of forage, exploitation intensity affected significantly concentration of NEL, crude protein and fibre. In relation to level of fertilization affected significantly concentration crude protein and fibre.

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