EFFECT OF FERTILIZATION ON GRASSLAND QUALITY

HLOUCALOVA PAVLINA, NOVOTNA MONIKA, HORKY PAVEL, SKLADANKA JIRI, KNOT PAVEL
Department of Animal Nutrition and Forage Production
Mendel University in Brno
Zemedelska 1, 613 00 Brno
CZECH REPUBLIC

pavlina.hloucalova@mendelu.cz

Abstract: The aim of this work was evaluate the effect of different intensity fertilization on grassland quality and basic nutrition characteristics (dry matter, fiber, nitrogenous substances, carbohydrates, ash and NEL). The monitored grass stands are situated in the BohemianMoravian Highlands. The fertilization with degree unfertilization is the test factor, PK fertilized, fertilized N90+PK and fertilized N180+PK. There was monitored the grassland quality and basic NIRS parameters. The grassland quality increased with the level of fertilization. The grassland quality was lowest in unfertilized variants (average 22.50), nitrogen fertilization proven its value increases (average 59.65). As a feed crop was the best PK, with regard to the content of NEL (5.5 MJ · kg^{-1}), fiber (204.9 g · kg^{-1}), carbohydrates (53.4 g · kg^{-1}) and NL (149.3 g · kg^{-1}).

Key Words: Permanent grassland, grassland quality, NIRS, fertilization

INTRODUCTION

The grassland is defined as a multispecies community, which consists of three basic components – grass *Poaceae, Viciaceae* and herbal. The grassland is the second most widespread vegetation cover on the planet. The grassland is characterized production and non-production functions. The grassland are stable due long – term inserting additional energy as moving and grazing. The permanent grassland are on the absolute sites. They are the sites, on which adverse environmental conditions don´t allow cultivation field crops (Hrabě, Buchgraber 2004, Urban, Šarapatka 2003).

Deterioration of management and use grasslands has been with the decline in castle in 2006. Green forage from grasslands is relatively cheap feed from an economic viewpoint. The meadows and pastures provide the best protection before erosion and leaching in terms of ecological. Grassland management also has got effect on the number of species in the growth (Kohoutek et al. 2007, Gaisler et al. 2004). Grasslands are able to effectively use high doses of nutrients. The grasslands are very valued in the area protection of water resources. The low content acceptable phosphorus and conversely higher content potassium (Urban, Šarapatka 2003, Havelka 1984).

N, P, K, Ca and Mg are the most important nutrients for the formation and quality of the fodder. The nitrogen is critical yield sequestering nutrient. The unfertilized permanent grasslands reach yield hay 3–4.5 ha · t^{-1}. The fertilizer NPK can increase yield dry matter forage until 2–3 times. Permanent grasslands react on the treatment fertilizers better than field left fallow (Hrabě, Buchgraber 2004, Laieş, Moisuc 2009).

The nitrogen is present in the organic form in the soil from 98–99%. Symbiotic bacteria can store until 3 kg · ha^{-1} N fixation of atmospheric nitrogen. Nitrogen is deliveres 10 kg · ha^{-1} per year deductions from the air. Nitrogen fertilization changing the qualitative composition forage. Content and digestibility nitrogenous substances in dry matter increase with a balanced fertilizer P and K. Content dry matter and soluble decreases with excessive doses nitrogen (Hrabě, Buchgraber 2004, Urban, Šarapatka 2003). Fertilization phosphorus affects content P in forage, improves the taste and quality of forage. The importance of potassium is the transfer of energy – ADP, ATP. Phosphorus is bound mostly in the form of organic compounds in grasslands. Usefulness phosphorus is dependent on soil pH. The mutual ratio Ca:P is more important than content phosphorus in forages. The mutual ratio Ca:P for milk cow should be 1.5–2:1 (Urban, Šarapatka 2003, Havelka 1984, Hrabě, Buchgraber 2004).

Collected samples use to determine the quality of the phytomass. Samples were determined dry matter at 60°C, then were determined laboratory content fiber, nitrogenous substances, fat, ash and minerals (Ca, P, Na, K, Mg, Fe, Cu, Zn). The nitrogen – free substances process colors is determined by calculating, BE, ME, NEL, NEV, PDIN a PDIE is calculating using regression equations. Organic matter digestibility was determined using methods TILLEY and TERRY or is derived based on the NIRS method. The determination of concentrations NEL in forage permanent grassland replaces earlier used starch unit. The aging process fodder characterizes increasing content fiber in relation to the phenological. Fertilization NPK is reflected to the content nitrogen substances. Concentration nitrogen substances decreases aging stand opposite than the fiber. Content nitrate nitrogen in the crop increase with high doses nitrogen fertilization – 0.3 % N-NO_3 is considered for toxic border (Hrabě, Buchgraber 2004, Veselý et al. 2011, Urban, Šarapatka 2003, Havelka 1984).

MATERIAL AND METHODS

The experimental area

The experimental area of the Department of Animal Nutrition and Forage Mendel University is located in the BohemianMoravian Highlands, in the land Kameničky. Station lies at an altitude of 650 m, on the south-facing slope with an inclination of 3°. Soil type is classified as pseudogley, soil is sandy to loamy. Average annual precipitation was 785 mm, average annual temperature in the samee period was 6.7°C (Nawrath et al. 2013).

The experimental arrangement

The small – plot experiment was established in 1992 with four replications. The size of each parcel is 1.5x10 m. The fertilization with degree unfertilization is the test factor, PK (30 kg · ha^{-1} P and 60 kg · ha^{-1} K), N90+PK (90 kg · ha^{-1} N, 30 kg · ha^{-1} P, 60 kg · ha^{-1} K) and N 180+PK (180 kg · ha^{-1} N, 30 kg · ha^{-1} P, 60 kg · ha^{-1} K). Nitrogen was applied in two doses – 2/3 and 1/3 of the spring after the first mowing. Potassium and phosphoric fertilizers were applied in the spring. The harvesting took place in three deadlines in early June, early August and early October (Nawrath et al. 2013).

Quality grassland EGQ

The water content, chemical composition (fat, carbohydrates, lipids), the content of toxic substances and essential oils, vitamins, odor, morphological structure, digestibility, palatability and other effects decides the feeding value of each species. Feed indexes of individual species include in the fresh state and may vary depending on the excess or deficiency of nutrients, humidity, etc. EGQ reaches values of -50 to 100 – toxic to highly valuable (Novák 2004, Jurko 1990).

The average basic nutrition characteristics (dry matter, fiber, nitrogenous substances, carbohydrate, ash and NEL) were determined method NIRS.

Statistical evaluation

Microsoft Office Excel 2007 was used for processing and evaluation of the results. The data was entered into the tables from which they were subsequently created graphs of average values. Statistical evaluation was performed in Statistica CZ 10 method multi-factor analysis of variance ANOVA followed by Tukey test testing.

RESULTS AND DISCUSSION

Grassland quality EGQ

The values quality grasslands moved in variants of fertilizations from 18.40 to 64.61 (Table 1). This corresponds vegetation worthless and very little valuable to less valued and valuable. Novák (2004) reached similar results, which in his work shows that the average value EGQ meadow vegetation was 59.8 with representation 35 species. ECQ decreased variants PK, N90+PK and N 180+PK between year 3 and 4. Slight increase is possible to observe in variant unfertilizied. The reduce quality is caused development of species with low or negative value feed-bulrush, buttercup yellow – gold and sedge. The quality unfertilized grassland ranges from 18.4 to 25.5, that is worthless to less valuable crop. The

very few valuable to less valuable vegetation prevails the variant PK in recent years. The change quality vegetation less valuable tu valuable was observed in year 1and 3. The growth fertilization N90+PK was classified as less valuable up valuable in each years. The reducing the quality of the grasslands there up to EGQ = 48.17 in year 4. Mrkvička, Veselá (2001) states that although nitrogen fertilizer demonstrable increases quality forage. Incorrect application can result in reduces quality and falatibility of forage. Low values EGQ in variants unfertilized and PK is attributable to a higher proportion of buttercups in rapid growth.

Novák (2004) in his work shows that grass and clover, which represent a major component of vegetation with a high feed values, accounted for only 52% of the total share. The reducing the representation of other herbs in the stand can significantly affect the quality of the grass.

Table 1 The grassland quality (EGQ) of individual variants of fertilization (Kameničky)

Year	Unfertilized	PK	N90+PK	N180+PK
1.	23.96	56.92	64.61	57.91
2.	18.40	37.73	63.10	45.41
3.	20.94	50.54	58.55	55.34
4.	23.71	39.66	48.17	45.49
5.	25.50	38.85	63.82	47.20

The nutritional characteristics

The values of fiber indicated in Table 2 ranged from 204.9–223.2 g · kg^{-1}. According Hrabě, Buchgraber (2004) is high fiber typical for vegetation heavily fertilization. The fiber reached in our experiment the highest (P<0.05) values in variant N180+PK. This confirms their claims. Kohoutek et al. (2007) say, that the fiber of the forage decreases with increasing proportion of legumes in the vegetation. The clover in crop PK reached the highest proportion. This is confirmed by our results.

The content nitrogenous substances in the forage value reached 133.7–149.3 g.kg^{-1}. Hrabě, Buchgraber (2004) say that fertilization nitrogen fertilizes increases content nitrogen substances in the forage. Unfertilized growth and growth N180+PK reached similar values (Table 2). It doesn´t match previous statements. Those results are statistically insignificant.

Table 2 Effect of fertilization on basic nutrition characteristics growth – NIRS (Kameničky)

Treatment	Fiber [g · kg^{-1}]	NL [g · kg^{-1}]	Carbohydrates [g · kg^{-1}]	Ash [g · kg^{-1}]	NEL [MJ · kg^{-1}]
Unfertilized	209.4 ^{a}	137.2 ^{a}	53.1 ^{a}	114.9 ^{ab}	5.6 ^{a}
PK	204.9 ^{a}	149.3 ^{b}	53.4 ^{a}	120.2 ^{b}	5.5 ^{a}
N90+PK	214.6 ^{ab}	133.7 ^{a}	57.5 ^{a}	118.2 ^{ab}	5.5 ^{a}
N180+PK	223.2 ^{b}	135.7 ^{a}	63.3 ^{b}	114.1 ^{a}	5.3 ^{b}

Different letters in the columns indicate statistically significant differences at a level of P<0.05

Concentration NEL in forage was ranged of values from 5.3 to 5.6 MJ · kg^{-1}, when lowest values (P<0.05) reached vegetation N180+PK. Pozdíšek et al. (2008) reported, that optimum function rumen can be use dat a ratio of 130 g nitrogenous substances and 5.9 MJ NEL. Unfertilized vegetations is much closer this ratio according to Table 2. Their feeding is useful only in areas where there is an emphasis on quality (Table 1).

CONCLUSION

The quality grasslands with the increasing intensity of fertilization also increased. The growth N90+PK (61.57 – less valuable to valuable growth), reached the highest value. The unfertilized growth reached the lowest value (24.76 – worthless and very little valuable growth). The content fiber of the forage increase with increasing intensity of fertilization, conversely concentration NEL decreases. With regard to the fiber content, NL and NEL Kameničky station to appear as the most valuable fodder crops fertilized only phosphorus and potassium.

Fertilizing grassland is needed to ensure the production of high-quality forage. Unfertilized vegetation are indeed richer, but in terms of the feed are not suitable for nutrition high productive animals. They can be recommended in areas with higher requirements for non – production functions, and extensive use such as grazing cattle breeds less demanding.

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