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EFFECTS OF UTILISATION INTENSITY AND FERTILIZATION LEVEL ON FORAGE PRODUCTION AND QUALITY OF PERMANENT GRASSLAND ON A FLUVISOIL

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Abstract

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In 2003–2007 the issue of the forage production and quality on the permanent grassland was researched by the Crop Research Institute Prague, Research Station Jevíčko. The long-term small plot trials with tall oatgrass stand type (*Arrhenatherion*) were established in 2003 on a fluvisoil. Four types of utilisation were used in the trial: 1. Intensive (I_1) – 4 cuts per year (1st cut on 15th May, every next after 45 days); 2. Medium intensive (I_2) – 3 cuts per year (1st cut on 30th May, every next after 60 days); 3. Low intensive (I_3) – 2 cuts per year (1st cut on 15th June, 2nd after 90 days); 4. Extensive (I_4) – 2 cuts per year (1st cut on 30th June, 2nd after 90 days) and four levels of fertilizer application: F_0 = no fertilization; $F_{PK} = P_{30}K_{60}N_0$; $F_{PKN90} = P_{30}K_{60}+N_{90}$; $F_{PKN180} = P_{30}K_{60}+N_{180}$. The overall average DM production of grasslands over five years was 7.19 $t.ha^{-1}$. The lowest annual DM production is 6.77 $t.ha^{-1}$ during the intensive utilisation (I_1) and it increases towards the extensive (I_4) utilisation to 7.62 $t.ha^{-1}$, at all levels of fertilization. Application of phosphorus and potash fertilizers did not have significant effects on grassland DM yield. Application of N-fertilizer increased DM production ($P_{0.01}$) already on the level F_{PKN90} to 8.49 $t.ha^{-1}$, on the level F_{PKN180} DM matter still increased up to 9.51 $t.ha^{-1}$. Forage quality was highest during the intensive (I_1) utilisation and relatively lowest during the extensive (I_4) utilisation. The intensive (I_1) utilisation of permanent grassland improves OMD ($P_{0.01}$), concentration of CP and NEL and decreases fiber concentration ($P_{0.01}$) when compared with the extensive (I_4) utilisation. Fertilizing did not affect quality significantly except for CP concentration which increases with N-fertilization while NEL concentration decreases. Optimal utilisation intensity for dairy cows with annual production of 7–8 thousand kg of milk seems to be the intensive (I_1) utilisation with the level of fertilization F_{PKN180} for given grass stand (plant society *Arrhenatheretum*). The forage from the medium intensively (I_2) utilized grassland meets quality parameters for suckler cows at the end of lactation period, the forage from less intensively and extensively (I_3, I_4) utilized grassland is suitable for cows only in the dry period in the form of hay.

permanent grassland, utilisation intensity, fertilization level, forage production and quality

In the countries of Central and Eastern Europe the reforms from the 1990s brought considerable transformation of agriculture connected with the decrease of cattle numbers by more than 50 % which deteriorates management and utilisation of existing permanent grasslands. Agroenvironmental measures in the Czech Republic (CR) support extensive management of grasslands aimed at the increase of grassland diversity, which is not sufficiently experimentally based. The proportion of extensively utilised permanent grassland in the CR has recently increased due to agroenvironmental measures (decree of government No. 242/2004 Coll., on implementation of agroenvironmental measures (AEM), as amended by the decree of government No. 542/2004 Coll. and No. 119/2005 Coll. and 79/2007 Coll.) up to 60–80 %, which leads to surplus of unfeedable forage (data by Ministry of Agriculture; Kohoutek, Pozdíšek; 2007).

In Switzerland the law requires as a part of proper agricultural practice minimal area of species diverse meadows and pastures of 7 % (so-called ecological compensation areas) with delayed first cut until 15th June in lowlands and 15th July in mountaineous areas (Gujer, 2005), with the aim to reach about 10 % of interconnected ecological compensation areas. The research conducted in the CR indicates that optimal area of extensively managed permanent grassland harvested in mid-June and utilizable in the cattle feeding ration (dairy and beef cattle) in the dry period should not exceed 15 % of managed area (Kohoutek, Pozdíšek; 2006). For utilisation of every other 1 % of so-called "biodiversity" extra in the area of grassland in the CR would be necessary to increase cow numbers by 4 thousand heads, which is unrealistic at the moment. The numbers of cows decreased from 1256 thousand heads in 1989 to 564 thousand heads (151 thousand heads of beef cattle and 417 thousand heads of dairy cows) in 2006 (data from the Czech Statistical Bureau) as a result of lower demand for dairy products and significantly higher productivity of dairy cows from 3980 to 6542 kg of milk per a cow a year (in 2006) and the cattle numbers are still falling. To reach 65 % "biodiversity" 260 thousand cows would be necessary, which cannot be absorbed by the dairy and beef market in the CR.

MATERIAL AND METHODS

In 2003–2007 a small-plot trial established on permanent grassland on fluvisoil was observed in Jevíčko. The Jevíčko site is situated a mild climatic region with average annual temperature 7.9 °C, annual rainfall 572 mm, altitude 343 m (Tab. I). Permanent grassland belongs to the plant society of *Arrhenatherion*. The precise small plot trials were set in the form of split blocks in four replications, the plot area is 10 m^2. Dominant plant species at the time of trial establishment were *Arrhenatherum elatius* (L.) – 19 %, *Festuca arundinacea* Schreb. (11 %), *Dactylis glomerata* L. (7 %), *Plantago lanceolata* L. (13 %) and *Crepis biennis* L. (9 %). Subdominant were *Trisetum flavescens* (6 %) and *Poa pratensis* (3 %). Representation of species present in vegetation was made by the method of reduced projective dominance. The intensity of permanent grassland utilisation: 1. Intensive (I_1) – 4 cuts per year (1st cut on 15th May, every next after 45 days); 2. Medium intensive (I_2) – 3 cuts per year (1st cut on 30th May, every next after 60 days); 3. Low intensive (I_3) – 2 cuts per year (1st cut on 15th June, 2nd after 90 days); 4. Extensive (I_4) – 2 cuts per year (1st cut on 30th June, 2nd after 90 days). Fertilization levels: F_0 = no fertilization; $F_{PK} = P_{30}K_{60}N_0$; $F_{PKN90} = P_{30}K_{60}+N_{90}$; $F_{PKN180} = P_{30}K_{60}+N_{180}$. Phosphorus was applied in the form of Fosmag MK (25 % P_2O_5), potassium as potash (60 % K_2O) and nitrogen as saltpeter with limestone (27 % N). In the system of sustainable management, a considered cattle load of 1, resp. 2 $LU.ha^{-1}$ in less favoured areas was taken into account to determine nitrogen and PK rates.

The contribution evaluates dry matter (DM) production and forage quality in the parameters of organic matter digestibility (OMD), crude protein (CP), fibre and net energy of lactation (NEL) in the average of five experimental years. The parameters of forage quality were set with FOSS NIRSystems 6500 instrument (Company NIRSystems, Inc., Silver Spring, USA), by measuring dried and ground samples in small ring cups in two parallel replications. Sample scanning was made in the reflectance mood in the area of 400–2500 nm (25 000–4 000 cm^{-1}), that is in visible and near infra red region of spectrum, a step of scanning 2 nm. The forage quality was predicted with WinISI II software (Infrasoft International, Inc., USA), version 1.50. NIR calibration equations for all determinations were developped by Partial Least Squares (PLS) regression of reference values on the 1st derivative of SNV and detrended spectra. The attained results were statistically processed with the variance analysis, the differences between averages were tested with Tukey test for the levels of significance $P_{0.05}$ and $P_{0.01}$.

RESULTS AND DISCUSSION

The first two harvest years were deficient in rainfall: when compared with a 30-year average of annual rainfall (544.7 mm), the deficit was 130.4 mm in 2003, and in vegetative season the deficit was 90.9 mm. In 2004 the annual rainfall deficit was 55.8 mm, the deficit in vegetative season was however 85.4 mm, which means that the deficit was partly compensated for in off-vegetative season (e.g. in October and November) – Tab. I. In the following years the annual average rainfall was slightly above long-term average, in 2007 distinctively (the increase was 142.5 mm, in vegetative season 60.4 mm). That year the rainfall was above average in March, May and September. A summer spell of drought (usually at the beginning of July) in 2004 and 2006 did not have dramatic effect at this site, although the data presented in Tab. I could signal that. The temperatures during the whole five year period were above average.

Dry matter production in the five-year average reached 7.19 $t.ha^{-1}$ in the average of utilisation intensities and levels of fertilization and it was statistically significantly influenced by two factors: intensity of utilisation and level of fertilization (Tab. II). During the intensive (I_1) utilisation dry matter production is the lowest (6.77 $t.ha^{-1}$) and it increases highly significantly ($P_{0.01}$) towards the two-cut (I_4) utilisation up to 7.62 $t.ha^{-1}$ (Tab. II, Fig. 1). During the medium intensive (I_2) utilisation lower yield was reached in the average of years and fertilization than during the two-cut (I_3, resp. I_4) utilisation ($P_{0.05}$). During the four-cut (I_1) utilisation the yield was even lower [compared with three-cut (I_2) utilisation insignificantly, compared with two-cut (I_3, resp. I_4) utilisation significantly – $P_{0.01}$]. Fertilization effect can be generally assessed as significant (Tab. II, Fig. 1). Whereas the fertilization level F_{PK} (5.64 t.ha^{-1}) increases dry matter production compared with F_0 (5.14 t.ha^{-1}) insignificantly, in combination with nitrogen significantly ($P_{0.01}$) to 8.49 t.ha^{-1} on the fertilization level F_{PKN90}, resp. to 9.51 t.ha^{-1} on the fertilization level F_{PKN180}.

Meadow vegetation at the mesohygrophyte stand in Jevíčko with a plant society of *Arrhenatheretum* was very valuable from the viewpoint of yield and even forage quality and it responsed well to fertilization (similarly Klimeš, 2004; Holúbek *et al.*, 2007). In agreement with these authors the results of our work demonstrated that the vegetation did not react to the summer spell of drought by the significant decrease of dry matter yield, not even in the years that suffered from the rainfall deficit (2003, 2004). Simultaneously there was a positive reaction to nitrogen fertilization that almost doubled the yield compared with non-fertilized control. High variability of yield depending on pratotechnique was confirmed, as presented by Šantrůček (2007). The yield at the Jevíčko site was two or three times higher than the average yield on permanent grassland in CR and it is on the yield level of hihgly developed EU countries.

OMD in the five-year average reached 64.9 % (Tab. II) in the average of utilisation intensities and levels of fertilization. When we consider intensity of utilisation, the organic matter digestibility (in the average of fertilization levels) is the lowest during the extensive (I_4) utilisation (61.3 %) and it increases towards the intensive (I_1) utilisation up to 69.5 %, which statistically highly significant increase ($P_{0.01}$). The forage from the two-cut (I_4) utilisation demonstrated lower digestibility than the forage from less intensive (I_3) utilisation ($P_{0.05}$) – Tab. II, Fig. 2. The effect of PK and NPK fertilization on OMD was in the years average of utilisation intensities below the level of significance ($P_{0.05}$) – Tab. II, Fig. 2.

Similarly Míka *et al.* (1997); Kudrna *et al.* (1998) and Zeman *et al.* (2006) claim that fertilization does not affect OMD significantly, but OMD is significantly affected by the intensity of utilisation: higher number of cuts improves OMD, dry matter yield generally decreases. Extensive management of grassland, i.e. late harvest, requires higher cattle numbers for conversion of low quality forage because OMD and voluntary intake decreases (Gruber *et al.*, 2002). More concentrates have to be used to sustain necessary productivity, which means that the amount of discharged nitrogen by cattle and in this way up to 150 kg.ha^{-1} N has to utilized on grassland. This leads to the increase of the amount of produced forage and higher ecological burden (Gruber *et al.*, 2000; Kohoutek, Pozdíšek; 2006).

CP concentration in forage in the average of five harvest years reached 127.5 g.kg^{-1} DM (Tab. II) in the average of utilisation intensities and levels of fertilization. When we consider intensity of utilisation, CP concentration (in the average of levels of fertilization) was the lowest during the two-cut utilisation (I_4 – 114.8 g.kg^{-1} DM, resp. I_3 – 113.9 g.kg^{-1} DM) and it increases towards the four-cut utilisation (I_1) up to 151.7 g.kg^{-1} DM, which is statistically highly significant ($P_{0.01}$) – Tab. II, Fig. 3.

Fertilization compared with non-fertilized control (F_0) increases (in the average of utilisation intensities) CP concentration statistically highly significantly ($P_{0.01}$) only on the fertilization level F_{PKN180} because applied nitrogen at highly productive site at Jevíčko increases firstly DM production linearly and only on the fertilization level F_{PKN180} increase CP concentration, which was in the case of fertilization level F_{PKN90} „diluted“ into the yield (Tab. II, Fig. 3). Legumes, which have low proportion in the meadow stand at the given site, had minimal influence on the CP concentration. Other forb species could have higher influence, especially in the first harvest, on the CP concentration since their proportion is much higher. The attained results of the CP concentration are in agreement with the results of Míka *et al.* (1997) they proved that meadow stand with high proportion of grasses usually has only medium CP concentration in forage.

Fibre concentration in forage in the average of five harvest years reached 264.2 g.kg^{-1} DM (Tab. II) in the average of utilisation intensities and levels of fertilization. The lowest fibre concentration in the average levels of fertilization was during intensive (I_1) utilisation and reached 223.1 g.kg^{-1} DM (Tab. II, Fig. 4). The fibre concentration increases statistically highly significantly ($P_{0.01}$) with the decreasing number of harvests. The attained results confirm that the fibre concentration in forage quickly increases during delayed first harvest and lower number of harvests as a result of intensive lignification of plant tissues, and also a result of changing proportions of main botanical groups. Grasses in flowering stage, sometimes at the beginning of seed maturity, prevail in the grassland which is managed extensively. The level of fertilization (in the average of utilisation intensities) does not affect the fibre concentration as much as the intensity of utilisation (Tab. II, Fig. 4). Compared with non-fertilized control (the fibre concentration 250.4 g.kg^{-1} DM), PK fertilization and both levels of NPK fertilization increased the fibre concentration highly significantly ($P_{0.01}$) in the forage from permanent grassland to 261.8 g.kg^{-1} DM, resp. to 275.6 g.kg^{-1} and 269.0 g.kg^{-1}.

The decrease of the fibre concentration from the two-cut towards the four-cut utilisation is in agreement with the results of Kühbauch, 1987; Minson, 1990; van Soest, 1994 and others who quote the folowing fibre concentration: 331, 291, 246 g.kg^{-1} DM. OMD and fibre digestibility increases when the fibre concentration decreases (Míka *et al.*, 1997; Zeman *et al.*, 2006; Pozdíšek, 1997), although some types of secondary metabolites can decrease digestibility in some plants (Míka *et al.*, 2001). The growing number of harvests in the experiment of Gruber *et al.* (2002) increased very clearly voluntary intake of voluminous forage (10.4; 13.0; 15.2 kg DM) and overall feedstuff intake. Higher number of harvests is not usually recommended because the costs for four cuts are higher than the quality increase when compared with three cuts (Holúbek *et al.*, 2007). The most profitable seems to be the two-cut management on most kinds of grassland, only at the mesophyte and mesogryphyte stands the three-cut management can be considered (Hrabě, Buchgraber; 2004) understanding that such forage in only suitable for the cattle with average productivity. Higher intensity of utilisation of permanent grassland significantly decreases forgae production per ha, but the forage is of better quality. This is characterized by higher voluntary intake and also higher concentration of nutrients and energy, which allows to feed cattle with diet based on forage of high quality all year round and supplemented with concentrates only in restricted amount to meet actual demands of animal production. On the contrary the extensive management of permanent grassland leads to surpluses of non-feedable forage and increses the demands for concentrates consumption (Kohoutek, Pozdíšek; 2007).

The NEL concentration (Tab. II) in the average of five harvest years reached 5.50 MJ.kg^{-1} DM in the average of utilisation intensities and levels of fertilization. The NEL concentration is more affected by the intensity of utilisation than the level of fertilization. The highest NEL concentration in the average of fertilization levels was reached during intensive (I_1) utilisation (5.85 MJ.kg^{-1} DM), during medium intensive (I_2) utilisation the NEL concentration decreases to 5.55 MJ.kg^{-1} DM and during the two-cut utilisation falls to 5.29 (I_3), resp. 5.32 (I_4) MJ.kg^{-1} DM (Tab. II, Fig. 5). Statistics show that every decrease in the number of harvests results in highly significant ($P_{0.01}$) decrease of the NEL concentration in forage. These results are in agreement with findings of Kühbauch, 1987; Minson, 1990; van Soest, 1994 and others who also found that the digestibility (OMD) and energy concentration was clearly lower with lower number of harvests. This is connected with morphological changes of plants when the proportion of stalks increases and their lignification continues. PK fertilization and PK fertilization combined with N fertilization decrease the NEL concentration in forage as presents Tab. II and Fig. 5, where the highest NEL concentration in forage in the average of utilisation intensities (5.60 MJ.kg^{-1} DM) was at non-fertilized control (F_0), whereas on the fertilization levels F_{PK} and F_{PKN90} the NEL concentration fell highly significantly ($P_{0.01}$) to 5.49 MJ.kg^{-1} DM, resp. 5.42 MJ.kg^{-1}; on the fertilization F_{PKN90} it fell statistically significantly ($P_{0.05}$) to 5.50 MJ.kg^{-1} DM. The reason lies in botanical composition of the stand when nitrogen application increases grasses proportion. As presented by Weissbach (2003), in optimal harvest maturity in the spring growth for silage the forage had ~6.0 MJ.kg^{-1} DM NEL, hay fodder for dairy cows of medium productivity (6500 kg milk.year^{-1}) ~5.4 MJ.kg^{-1} DM NEL. Early and quality cut and quality conservation of this forage is very important for animal voluntare intake (VI). The findings of Schwarz, Gruber (1999), who calculated the increase of voluminous fodder voluntary intake by up to 2.2 kg DM per MJ NEL, demonstrate how significant it is to increase this value.

CONCLUSION

The annual total of DM production in the five-year average (2003–2007) was 7.19 t.ha^{-1}. DM production is the lowest during the intensive (I_1) utilisation of permanent grassland (6.77 t.ha^{-1}) and it increases towards the extensive (I_4) utilisation (7.62 t.ha^{-1}) at all levels of fertilization. When considering the level of fertilization, the lowest DM production was at non-fertilized control (5.14 t.ha^{-1}). Fertilization with phosphorus and potassium fertilizers did not affect the DM production significantly. N-fertilization highly significantly ($P_{0.01}$) increases DM production already on the level of fertilization F_{PKN90} to 8.49 t.ha^{-1}, on the fertilization level F_{PKN180} DM production still increased to 9.51 t.ha^{-1}.

The forage quality was the highest during the intensive (I_1) utilisation and relatively lowest during the extensive (I_4) utlisation. The intensive (I_1) utilisation of permanent grassland compared with extensive (I_4) utilisation highly significantly ($P_{0.01}$) increases OMD, CP and NEL concentrations and highly significantly ($P_{0.01}$) decreases the fibre concentration. Fertilization did not affect the quality significantly except for CP concentration which increases with N-fertilization whereas NEL concentration decreases. Optimal intensity of utilisation of the given meadow stand (plant society of *Arrhenatheretum*) from the viewpoint of the forage quality for highly productive dairy cows (7–8 thousand kg milk) is the intensive (I_1) utilisation on the fertilization level F_{PKN180}. The forage from medium intensively (I_2) utilized grassland meets the quality requirements for suckler cows towards the end of lactation, the forage from less intensively and extensively (I_3, I_4) utilized grassland is only suitable for dry period in the form of hay.

The intensive utilisation of permanent grassland significantly decreases forage production and increases the quality o forage which is characterized by higher concentration of nutrients and energy. This alows to feed reduced cattle herd contemporary occuring in the CR with diet based substantially on forage of high quality all year round and supplemented with concentrates only in restricted amount to meet actual demands of animal production. The reason of it is (1) to involve more area grassland into the herbage production, and (2) to higher the efficiency of animal production as the price of concentrates has recently increased a lot also in this country. The extensive management of permanent grassland leads to the surpluses of non-feedable fodder and increases the demands for concentrates consumption by cattle herd. Although agroenvironmental measures in the CR support extensive forms of management, the attained results demonstrate that it is possible to reach necessary production decrease and forage quality increase by the expert and proper method of pratotechnique. This is especially significant for the enterprises focused on husbandry of cattle with above average productivity, resp. in enterprises which cannot afford high consumption of concentrates to compensate low quality forage to reach expected productivity.

I: *Monthly rainfall (mm) and average daily air temperature (°C) at the Jevíčko site in 2003–2007*

Precipitation [mm]

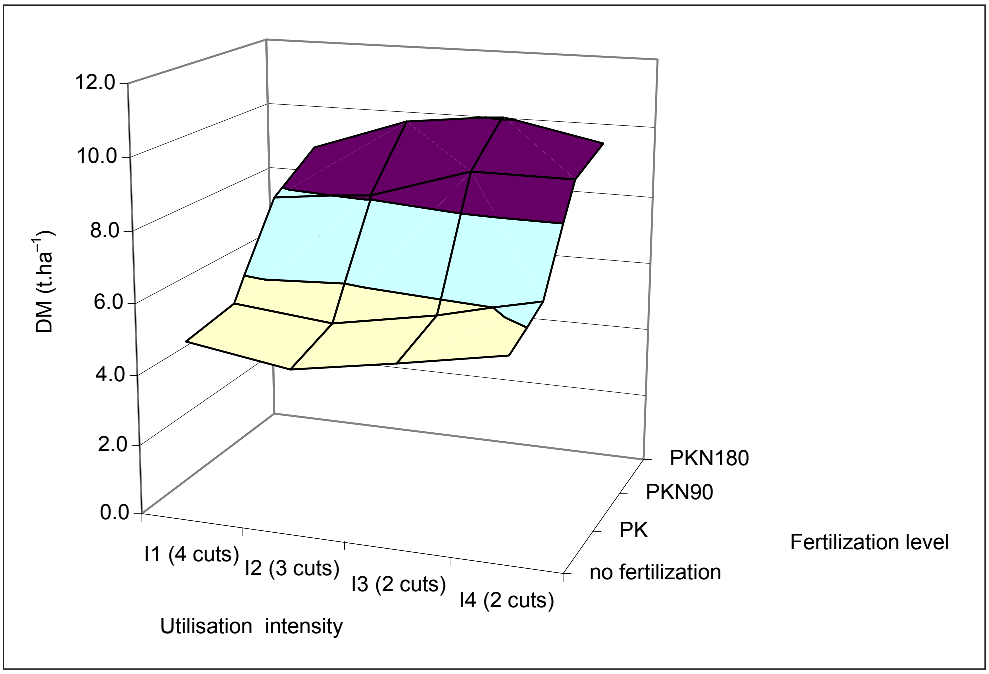
Year	Month												Annual avg.	Vegetative season avg.	Difference from 30-year average	
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.			Annual	Veg. season
2003	–2.1	–4.4	2.7	6.9	14.8	18.3	17.6	19.0	12.2	5.4	5.4	–0.9	7.9	14.8	+0.5	+1.4
2004	–5.4	0.0	2.2	8.9	11.1	15.0	16.7	17.2	11.9	9.2	3.4	–0.5	7.5	13.5	+0.1	+0.1
2005	–0.4	–4.6	0.3	8.7	12.4	15.8	17.8	15.5	13.5	8.0	2.1	–1.1	7.3	13.9	–0.1	+0.5
2006	–7.9	–4.1	–0.5	8.3	12.5	16.5	20.2	15.1	14.3	9.0	5.8	2.2	7.6	14.5	+0.2	+1.1
2007	3.1	3.0	4.5	9.1	14.3	18.0	18.1	17.5	10.8	6.9	1.7	–0.9	8.8	14.6	+1.4	+1.2
30-year average	–2.8	–0.8	2.7	7.0	12.6	15.1	16.8	16.4	12.3	7.6	2.3	–0.8	7.4	13.4		

Temperature [°C]

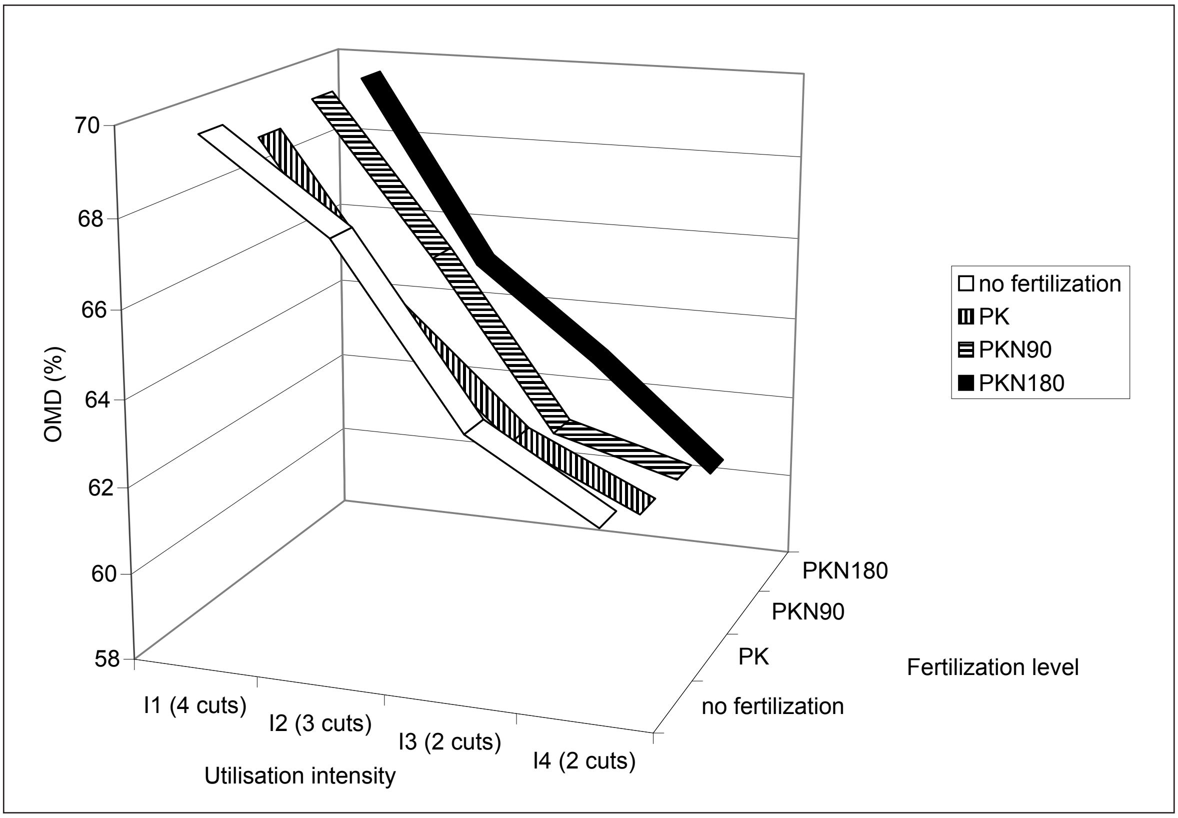
Year	Month												Annual rainfall	Vegetative season rainfall	Difference from 30-year average	
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.			Annual	Veg. season
2003	29.4	2.0	5.1	29.2	74.2	49.3	50.5	23.9	29.4	50.0	16.9	54.4	414.3	256.5	–130.4	–90.9
2004	34.3	28.6	35.1	39.9	26.4	93.4	25.5	37.3	39.5	50.7	61.9	16.3	488.9	262.0	–55.8	–85.4
2005	50.2	35.4	20.4	39.7	61.3	46.5	117.5	98.0	22.4	6.1	20.8	51.4	569.7	385.4	+25.0	+38.0
2006	27.1	27.7	49.4	80.8	79.6	51.6	17.3	156.5	4.8	27.0	38.4	12.8	573.0	390.6	+28.3	+43.2
2007	53.5	39.4	70.5	1.4	99.2	72.7	76.0	66.4	92.1	45.4	53.9	16.7	687.2	407.8	+142.5	+60.4
30-year average	32.3	28.8	28.3	34.9	58.3	74.3	67.0	66.5	46.4	30.8	39.3	37.8	544.7	347.4		

II: *Dry matter production and forage quality of grassland in relation to: (A) utilisation intensity and (B) fertilization level – the average five years utilisation (2003–2007)*

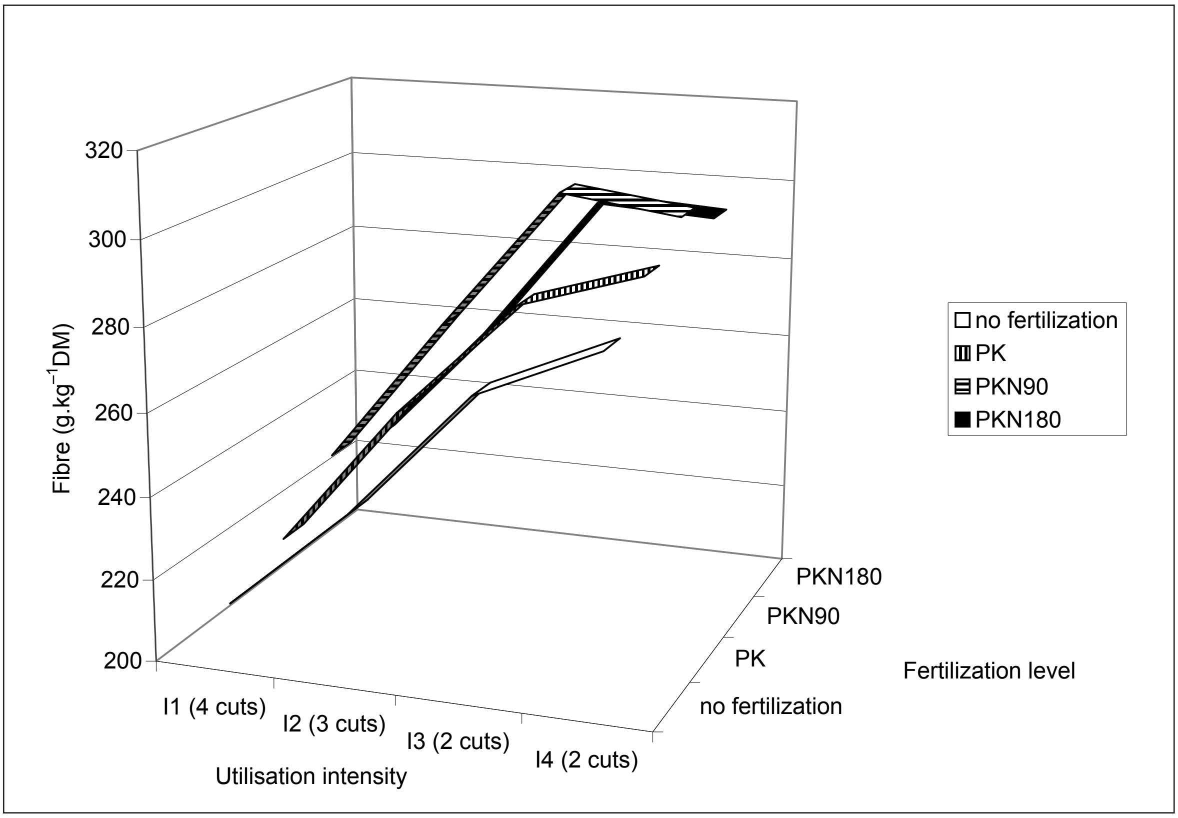
	DM	OMD	CP	Fibre	NEL
	($t.ha^{-1}$ DM)	(%)	($g.kg^{-1}$ DM)	($g.kg^{-1}$ DM)	($MJ.kg^{-1}$ DM)
A (Utilisation)					
I_1	6.77	69.5	151.7	223.1	5.85
I_2	6.91	66.1	129.4	254.8	5.55
I_3	7.45	62.9	113.9	287.3	5.29
I_4	7.62	61.3	114.8	291.4	5.32
Average	7.19	64.9	127.5	264.2	5.50
$D_{T0.05}$	0.52	1.2	5.1	7.9	0.08
$D_{T0.01}$	0.63	1.5	6.2	9.7	0.10
B (Fertilization)					
F_0	5.14	65.8	122.4	250.4	5.60
F_{PK}	5.61	64.6	121.5	261.8	5.49
F_{PKN90}	8.49	64.7	123.4	275.6	5.42
F_{PKN180}	9.51	64.6	142.5	269.0	5.50
Average	7.19	64.9	127.5	264.2	5.50
$D_{T0.05}$	0.52	1.2	5.1	7.9	0.08
$D_{T0.01}$	0.63	1.5	6.2	9.7	0.10



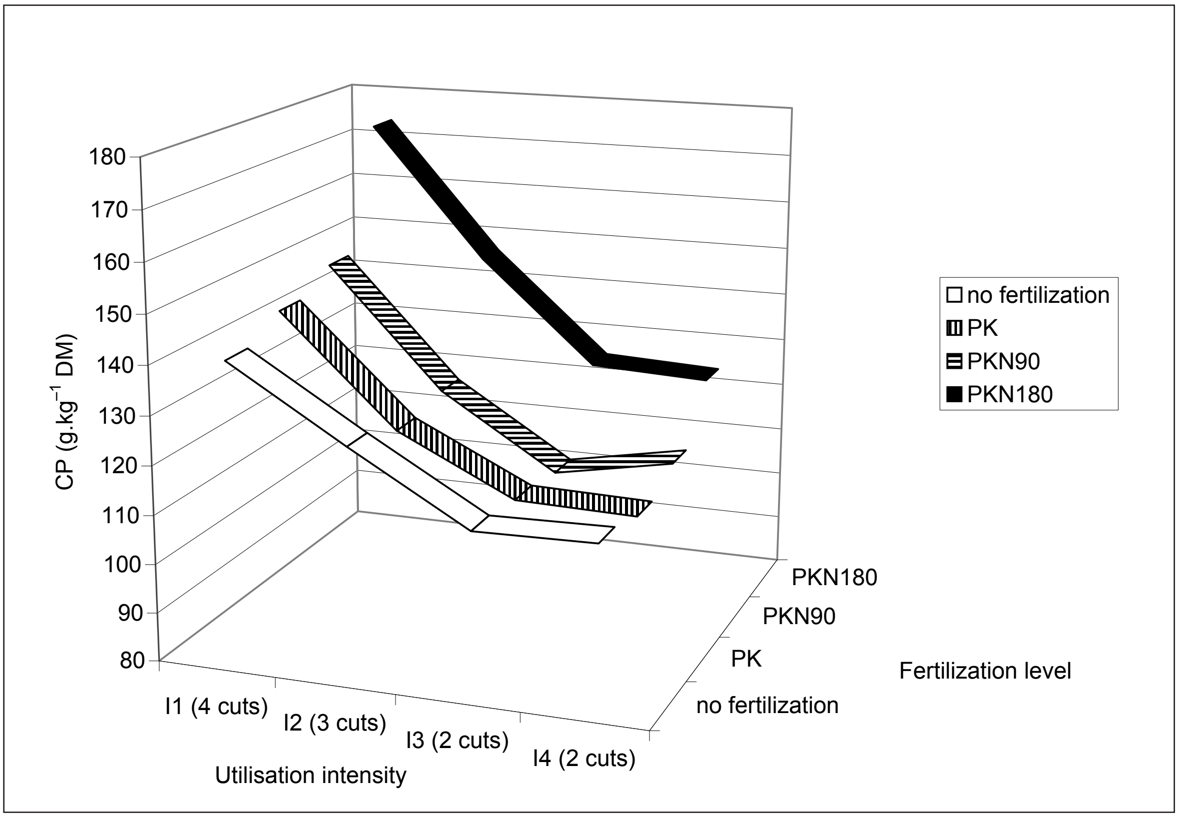
1: *The effect of utilisation intensity and fertilization level on forage production of grassland (average of 2003–2007)*



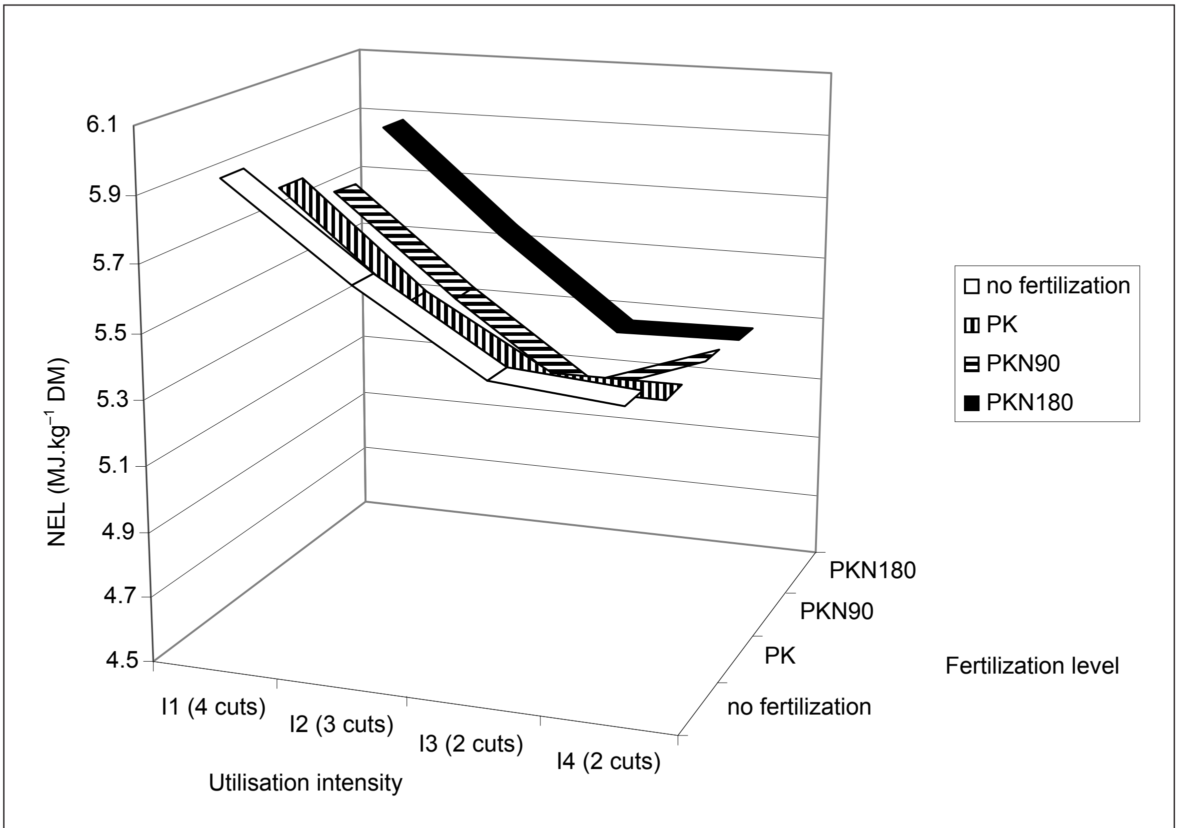
2: *The effect of utilisation intensity and fertilization level on the organic matter digestibility (OMD) of grassland forage (average of 2003–2007)*



3: *The effect of utilisation intensity and fertilization level on crude protein (CP) concentration in grassland forage (average of 2003–2007)*



4: *The effect of utilisation intensity and fertilization level on fibre concentration in grassland forage (average of 2003–2007)*



5: *The effect of utilisation intensity and fertilization level on NEL concentration in grassland forage (average of 2003–2007)*

SOUHRN

Vliv intenzity využívání a úrovně hnojení na produkci a kvalitu píce trvalého travního porostu na fluvizemi glejové

V letech 2003–2007 byla ve Výzkumném ústavu rostlinné výroby, v.v.i. Praha, Výzkumné stanici Jevíčko, řešena problematika produkce a kvality píce trvalého travního porostu (TTP). Dlouhodobý maloparcelový pokus byl založen v roce 2003 na louce s rostlinným společenstvem *Arrhenatherion*, půdní typ fluvizem glejová. V pokusu byly zařazeny čtyři varianty intenzity využití TTP: 1. intenzivní (I_1) – 4 seče ročně (1. seč 15. května, další seče po 45 dnech); 2. středně intenzivní (I_2) – 3 seče ročně (1. seč 30. května, další seče po 60 dnech); 3. málo intenzivní (I_3) – 2 seče ročně (1. seč 15. června, další seče po 90 dnech); 4. extenzivní (I_4) – 2 seče ročně (1. seč 30. června, další seče po 90 dnech) a čtyři úrovně hnojení: F_0 = bez hnojení; $F_{PK} = P_{30}K_{60}N_0$; $F_{PKN90} = P_{30}K_{60}+N_{90}$; $F_{PKN180} = P_{30}K_{60}+N_{180}$. Roční úhrn produkce sušiny TTP v průměru pěti sklizňových let činil 7,19 t.ha^{-1}. Nejnižší produkce sušiny je při intenzivním (I_1) využívání (6,77 t.ha^{-1}) a zvyšuje se směrem k extenzivnímu (I_4) využívání na 7,62 t.ha^{-1}, a to při všech úrovních hnojení. Hnojení fosforečnými a draselnými hnojivy výnosovou hladinu travního porostu významně neovlivnilo. Aplikací dusíkatého hnojiva došlo ke zvýšení ($P_{0,01}$) ročního úhrnu produkce sušiny už při úrovni hnojení F_{PKN90} na 8,49 t.ha^{-1}, při úrovni hnojení F_{PKN180} se produkce sušiny dále zvyšovala až na 9,51 t.ha^{-1}. Kvalita píce byla nejvyšší při intenzivním (I_1) využití a relativně nejnižší při extenzivním (I_4) využití. Intenzivní (I_1) využití TTP v porovnání s extenzivním (I_4) zvyšuje stravitelnost organické hmoty ($P_{0,01}$), koncentraci NL, NEL a snižuje koncentraci vlákniny ($P_{0,01}$). Hnojení nemělo na kvalitu významný vliv, s výjimkou koncentrace NL, které s úrovní N-hnojení narůstají, zatímco koncentrace NEL klesá. Jako optimální intenzita obhospodařování pro daný luční porost (rostlinné společenstvo *Arrhenatheretum*) z hlediska kvality píce pro vysoce užitkové dojnice s užitkovostí 7–8 tis. kg mléka je intenzivní (I_1) využití při úrovni hnojení F_{PKN180}. Píce středně intenzivně (I_2) využívaného porostu kvalitativními parametry splňuje požadavky pro chov skotu bez tržní produkce mléka ke konci laktace, píce z málo intezivního a extenzivního (I_3,I_4) využití je z krmivářského hlediska využitelná pouze pro období stání na sucho ve formě sena.

trvalý travní porost, intenzita využívání, úroveň hnojení, produkce a kvalita píce

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