Conclusions

Grasses composed 71, legumes 13, Forbs 16 % of a natural unfertilized extensive sward. Nitrogen fertilizers increased the share of grasses in the total yield of green matter by 6-12 %; N120-240 diminished the part of legumes. Decrease of legumes ranged even by 10 % in the 3rd yr.

Phosphorus fertilizers increased the share of legumes, whereas botanical composition of the sward varied insignificantly in combination with N and K.

Botanical composition of a sward improved by surface means (spraying with Glyphosate and sowing in) varied and depended on the amount of nutritious matters in the soil.

The most effective means for maintaining a suitable composition of a sowed sward is balanced fertilization with NPK.

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PERSPEKTIVE MANAGEMENT AND UTILISATION OF GRASSLAND IN THE CZECH REPUBLIC

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Abstract

Permanent grasslands in the Czech Republic (CR) cover the area of 950 000 ha, that is 22.2 % of agricultural land (4280 000 ha). In our paper we evaluate the influence of three cut frequencies performed at four sites of permanent grassland in CR at the standard level of fertilizing PKN_{90} on yield, quality and utilisation of fodder by cattle measured in terms of milk production. We carried out a model calculation of cattle herd size needed for farming utilisation of grasslands on the basis of exact results completed with accessible literary sources on fodder intake by cattle at the stated intensity. Dry matter production in the average of evaluated sites and treatments decreases from a two-cut to four-cut utilisation from 8.05 $t.ha^{-1}$ to 6.42 $t.ha^{-1}$ and calculated dry matter production for the model area of 500 000 ha of grasslands is 4025 000 t at the two-cut system, 3665 000 ha at the three-cut system and 3210 000 ha at the four-cut system. Hence, the cow herd size necessary for the conversion of feedable dry matter is 382 000 cows in the treatment without grain supplementation and extensive utilisation in form of a two-cut system, 306 000 in a

three-cut system and 231 000 in a four-cut system, the difference between two and four cut frequencies is then 151 000 dairy cows. By this given number of suckler cows it is possible CR to manage 300 000 hectares of grassland at the all-year need of 4.5 t productive solid on 1 LU, providing that the forage from the grassland at the average long-time yield will be exclusive an all-year feed.

Key words
Grasslands, botanical composition, fodder quality, cattle, moulding of farming system

Introduction

Permanent grasslands cover an area of 950 000 ha which make up 22.2% of the total agricultural land (4280 000 ha) in the Czech Republic. However, a decrease in the number of livestock from 1236 000 cows in 1990 to 570 000 cows in 2004 has resulted in the deterioration of grassland management and utilization. Czech agrarian policy accepted a European agricultural model with multi-functionality features based on research results. A complicated situation arises especially in less favoured areas, where the substitution of ruminant farming by other agrarian activity is impossible in practice (Harvieu, 2002). However, a decrease in the importance of forage dry matter yield and an improvement in the utilisation of forage production can produce an increase in grassland forage quality. For example, Gruber *et al*. (2000) reported that two, three and four cuts per year resulted in forage intakes of 10.4, 13.0 and 15.2 kg of dry matter (DM) cow^{-1} day^{-1}, respectively, and an increase in the intake of total feedstuffs. Production of the feedstuff in terms of milk production was 11.4, 17.2 and 23.0 kg of milk per cow^{-1} day^{-1} after 2, 3 and 4 cuts, respectively.

The situation in the CR is highly unfavourable in comparison with countries of the EU-15 where dairy cows numbers reach 20 580 000 head and the number of suckler cows 11 950 000, that is 36.7 % of the total cattle stock (Pflimlin, Todorov, 2003), whereas in the CR the number of suckler cows was about 100 000 heads in 2002 and the number of dairy cows 477 000 head, that is only 17.3 % (Kvapilík *et al*., 2003). In Switzerland the law requires a minimum area of 7 % of species diverse meadows and pastures (so-called ecological compensation areas) of the total area with postponed first cut until June 15 in the lowlands and July 15 in mountainous areas (Gujer, 2005), the goal is to reach about 10 % of interconnected ecological compensation areas.

Our contribution evaluates the effect of frequency of grassland utilisation on production and quality of forage and by calculation to determine the necessary size of dairy cows herds with young cattle for utilisation in an area of 500 thousand ha of grasslands.

Nowadays, about 300 thousand ha are utilised for suckler production, and 150 thousand ha are not utilized, out of the total area of 800 thousand ha of harvested grassland (Pozdíšek, Kohoutek *et al*., 2004).

Materials and Methods

The experiment was established in 2003 on permanent grassland at the four sites of Jevíčko, Liberec, Rapotín and Zubří. The grassland vegetation at each site was classified as *Arrhenatherion*. At each site there was a factorial design of four levels of grassland utilisation intensity (I) and four levels of fertilisation (F) laid out in four replications of 10 m^2 plots.

The intensity of utilisation: I_1 (1^{st} cut until May 15^{th}, 4 cuts per year – cuts at 45 days interval), I_2=(1^{st} cut between 16^{th} and 31^{st} May, 3 cuts per year at 60 days interval), I_3= (1^{st} cut between 1^{st} and 15^{th} June, 2 cuts per year at 90 days interval) and I_4= (1^{st} cut between 16^{th} and 30^{th} June, 1 or 2 cuts per year, second cut after 90 days). Four levels of fertiliser 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}. From the observed treatments were selected two cuts (I_3), three cuts (I_2) and four cuts (I_1) treatments fertilised with N_{90}+$P_{30}K_{60}$, which corresponds to the load of about one $LU.ha^{-1}$. For the calculation of livestock size necessary for forage conversion were used two-year averages [from 2003 and 2004 from four sites in the CR (Jevíčko, Liberec, Rapotín, Zubří)] of dry matter production and forage quality (concentration of NEL, CP and fibre) (Kohoutek *et al*., 2005). Voluntary intake of dry matter by dairy cows at 2, 3 and 4 cut of grassland annually in the feed ration with and without grain

determined in feeding and balance trials was taken from research results by Gruber *et al*. (2000). Simulation calculation derived from the nutrient need of 600 kg dairy cow according to stock-feeding charts of nutrient needs (Sommer *et al*., 1994).

Simulation calculation is carried out with the treatment of feeding rations without grain and with added grain with daily milk yield of 20 kg of milk, that is about 6100 kg of FCM milk, that is on the level of the present average efficiency of dairy cows in the CR. Selected treatments were by calculation determined daily and annual milk production, annual forage dry matter intake, total consumption of grain, necessary dairy cows herd size for particular methods of grassland utilisation and livestock size. Potential dry matter production of crop yield from the trials was reduced to the so called „feedable dry matter" by deducting 30 % for losses during the harvest, conservation and feeding.

Over all sites the botanical composition of vegetation was recorded in proportion to agrobotanical groups (grasses, legumes, forbs) and the number of vascular plant species. The contribution evaluates the total number of detected plant species per treatment in all sites over a period of four years, and the effect of experimental interventions on the representation of botanical groups in the average of sites and evaluated years. The acquired results were statistically evaluated with analysis of variance, the differences between the averages were tested with the Tuckey test on the level of significance of 95 % ($D_{T0.05}$), resp. 99 % ($D_{T0.01}$).

Results and Discussions

Dry matter yields and forage quality are presented in Table 1. The simulated total annual intakes of forage from two, three and four cuts per year when fed without grain were 4.21, 4.79 and 5.56 t DM cow^{-1} year^{-1}, respectively. Forage intake decreased when grain was added to the diet, possibly due to substitution, but the trend was similar at 3.26, 3.99 and 4.48 t DM cow^{-1} year^{-1}, respectively.

The size of a dairy cow herd, which includes young cattle, that is necessary to efficiently utilise the forage harvested from 500 000 ha of grasslands under the three cutting regimes was estimated based on the forage yield and intake results (Table 1).

The production of feedable DM was 2 818 000 t in a two-cut system, 2 566 000 t in a three-cut system and 2 247 000 t in a four-cut system, which was 20% less than the two-cut system. Therefore, the intensive level of utilisation decreased the total forage production from the grassland, which is a major issue of grassland management in the Czech Republic and Slovakia.

The size of a dairy cow herd necessary to utilise the feedable DM without grain ranged between 382 000 cows in the extensive two-cut system and 231 000 cows in the four-cut system (Table 1).

On this basis, potential milk production per cow and per lactation ranged between 2340 and 5637 kg of FCM milk. Therefore, the milk production from dairy cow herds that utilise grassland forage from two, three and four cuts per year would be 894, 1212 and 1302 000 t of milk per year, respectively.

The addition of grain into the diet, in order to reach a mean milk yield of 20 kg FCM head^{-1} day^{-1}, led to an increase of 55-112 000 the cows necessary to convert of the amount forage given. The consumption of grain required to reach a target yield of 6100 kg of FCM milk year^{-1} was 1 045 000 t in a two-cut system, 525 000 t in a three-cut system and 283 000 t in a four-cut system. The milk production from these modelled herds was 3 013 000, 2 245 000 and 1 745 000 t of FCM milk per year, respectively.

The relation between forage conversion by dairy cows and young cattle is about 4:3. It is possible that an extensive system of grassland utilisation can require more cattle management while an intensive system of grassland management can support a good level of milk production without a large quantity of imported feedstuffs. Based on the simulations a four-cuts system seemed to be optimal for the agricultural utilisation of 0.5 million ha of grasslands in the Czech Republic. This will require the development of a dairy cow herd of 250 – 300 000 which produces about 6000 kg of FCM milk per year, together with young cattle, to utilise the forage produced.

Table 1 The effect of intensity of utilisation of grassland on yield, quality, voluntary intake (VI) of forage, milk and farmyard manure production. A model calculation of cattle herd size for utilisation of 500 thousand ha of grasslands harvested under different intensities

Parameter	Unit	Utilisation intensity (number of cuts a year)					
		2	3	4	2	3	4
		Without grain			With grain (to the level of 20 kg of FCM milk)		
Dry matter yield	t ha^{-1}	8.05	7.33	6.42	8.05	7.33	6.42
NEL concentration in forage dry matter	MJ kg^{-1}	5.28	5.70	5.85	5.28	5.70	5.85
Crude protein concentration in forage dry matter	g kg^{-1}	127	164	181	127	164	181
Crude fiber concentration in forage dry matter	g kg^{-1}	281	231	214	281	231	214
Voluntary intake (VI) of dry matter by a dair cow (recalculated from Gruber, 2000)	kg 100 kg^{-1} l.w.	1.99	2.33	2.76	1.47	1.89	2.17
Calculation of dry matter intake by a dairy cow weighing 600 kg	kg $head^{-1}$	11.94	13.98	16.56	8.82	11.34	13.02
NEL intake through forage (dairy cow weighing 600 kg)	MJ $head^{-1}$ day^{-1}	63.04	79.69	96.88	46.57	64.64	76.17
Grain dry matter intake (energy concentration 8 MJ NEL.kg^{-1} DM)	kg $head^{-1}$ day^{-1}	-	-	-	6.94	4.68	3.24
NEL intake through grain	MJ $head^{-1}$ day^{-1}	-	-	-	55.48	37.41	25.88
Daily NEL intake by a dairy cow weighing 600 kg	MJ $head^{-1}$ day^{-1}	63.04	79.69	96.88	102.05	102.05	102.05
Calculation of daily milk production from forage (NEL)	kg FCM $head^{-1}$ day^{-1}	7.7	13.0	18.5	2.4	8.2	11.9
Daily milk production	kg FCM.$head^{-1}$ day^{-1}	7.7	13.0	18.5	20	20	20
Dairy cow efficiency per lactation	kg FCM	2340	3962	5637	6100	6100	6100
Annual dry matter forage intake	t $head^{-1}$	4.21	4.79	5.56	3.26	3.99	4.48
Potential dry matter production of crop yield from 500 thousand ha of grasslands	thousand t	4025	3665	3210	4025	3665	3210
Feedable dry matter production of crop yield after deducting 30 % losses	thousand t	2818	2566	2247	2818	2566	2247
Cow herd	Thousand heads	382	306	231	494	368	286
Cattle load per ha of grassland	LU ha^{-1}	1.61	1.28	0.97	2.08	1.54	1.20
Slurry production	thousand m^3	15545	11992	9897	20071	14407	12276
N production in cattle slurry per ha of grassland	kg ha^{-1} N	90.8	88.0	103.1	126.9	109.7	122.1

The area of 0.3 mil ha of grasslands is utilised by suckler cows. From the ecological viewpoint a smaller herd is more favourable because less farmyard manure is produced and thus also less nitrogen (Table 1).

Table 2. The effect of utilisation intensity and fertilization level on the total number of plant species as well as the proportion of grasses, legumes and forbs, % (in the average of 2003 – 2006)

Utilisation intensity	Evaluated feature				Fertilization level	Evaluated feature			
	Number of plant species	Grasses %	Forbs %	Legumes %		Number of plant species	Grasses %	Forbs %	Legumes %
I1	82.1	54.8	36.0	9.2	F_0	81.6	53.8	36.3	9.8
I2	81.1	59.7	33.6	6.6	F_{PK}	80.8	56.4	33.0	10.6
I3	75.8	65.4	28.5	6.1	F_{PKN90}	75.6	66.6	28.9	4.5
I4	74.0	68.1	26.7	5.2	F_{PKN180}	75.1	71.2	26.6	2.3
$D_{T0,05}$	3.7	1.5	1.6	0.9	$D_{T0,05}$	3.7	1.5	1.6	0.9
$D_{T0,01}$	4.5	1.9	1.9	1.1	$D_{T0,01}$	4.5	1.9	1.9	1.1

From the attained results in table 2 it is obvious that the intensity of statistically highly significantly utilization decrease sthe number of species in the vegetation from 82.1 in a four-cut system to 74.0 in an extensive two-cut system (Odstrcilova *et al*., 2007). This is related to a higher proportion of grasses in the vegetation, which is the lowest in a four-cut system (54.8 %) and increases up to 68.1 % in a two-cut system and is the same at all levels of fertilization. The increased proportion of grasses reduces the proportion of legumes and native species. The level of fertilization towards higher rates of nitrogen statistically significantly decreases the total number of species in the vegetation, similarly to extensive management, from 81.6 to 75.1 species. It statistically significantly increases the proportion of grasses in the vegetation 53.8 to 71.2 % and decreases the proportion of forbs (from 36.3 to 26.6 %) and legumes (from 9.8 to 2.3 %).

The system where grassland is cut four times per year is also the most favourable practice from an ecological perspective. It decreases the annual amount of grain used on the 500 000 ha of grassland by 762 000 t. This decreases the nutrient load of the agricultural system through the reduction of imported nutrients in the purchased feedstuff. Under such a system a stocking rate of 0.5 cow ha^{-1} of grassland was reached and about 1 LU ha^{-1} when young cattle were included, which is the herd size quota in the present agricultural situation.

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