Acta agriculturae Slovenica, suplement 2 (september 2008), 143–148.

http://aas.bf.uni-lj.si

Agris category codes: L02 COBISS Code 1.08

COMPARISON OF YIELDS AND NUTRITIVE VALUE OF DIFFERENT SPRING GREEN FORAGE MIXTURES

Richárd HOFFMANN, Tamás FÁBIÁN and Ferenc DÉR

University of Kaposvár, Faculty of Animal Science, Department of Botany and Plant Production, Guba S. 40, H-7400 Kaposvár, Hungary, e-mail: hoffmann.richard@ke.hu

ABSTRACT

To achieve a more efficient system of green feeding it is necessary to introduce new field cropping species in ruminant nutrition as green forage is which nutritional value has not been exactly evaluated yet. In our researches we analysed the yields and nutritive value of different spring green forage mixtures. We concluded that green forage mixtures gave more green and crude protein yield than the average of the components, and the nutritive value of the mixtures was better than the components' nutritive value. In the average of three years, the dry matter content in the mixtures was similar to each other at the start of flowering. In our research the measured dry matter content in mixtures was higher than pea mixed with sunflower from literature and pea mixed with oat. The difference between vetch mixed with oat and the analyzed pea and barley mixture was 29 g/kg. Pea can give almost the same crude protein yield level than pea with oat and pea with spring barley. Based on achieved results it can be concluded that pea was a reliable component with barley and oat even in extreme weather conditions and in spring mixtures with barley or oat, the vegetative types of pea are recommended as leguminous component instead of using the "traditional" vetches, with special regard to the crude protein content.

Key words: cattle / animal nutrition / green forage / forage mixtures / nutrition value

PRIMERJAVA PRIDELKA IN HRANILNE VREDNOSTI RAZLIČNIH SPOMLADANSKIH MEŠANIC VOLUMINOZNE KRME

IZVLEČEK

V prehrano prežvekovalcev bi morali zaradi bolj učinkovitega krmljenja z voluminozno krmo uvesti nove vrste krmnih rastlin, vendar njihove hranilne vrednosti še sploh nismo natančno določili. V naših raziskavah smo analizirali pridelke in hranilno vrednost različnih spomladanskih krmnih mešanic. Ugotovili smo, da dajo zelene krmne mešanice več zelenih in surovih beljakovin, kot je povprečje za posamezne sestavine in da je hranilna vrednost mešanic boljša, kot je hranilna vrednost posameznih sestavin. V povprečju treh let je bila vsebnost suhe snovi v vseh sestavinah mešanic podobna na začetku cvetenja. V naši raziskavi je bila izmerjena vsebnost suhe snovi mešanic višja, kot je bila v grahu v mešanici s sončničnimi semeni po podatkih iz literature, in v mešanici graha in ovsa. Razlika med grašico v mešanici z ovsom in analiziranim grahom v mešanici z ječmenom je bila 29 g/kg. Grah da lahko skoraj enako količino beljakovin kot grah z ovsom in grah z jarim ječmenom. Iz dobljenih rezultatov lahko zaključimo, da je bil grah zanesljiva sestavina z ječmenom ali ovsom tudi v izjemnih vremenskih pogojih, v spomladanskih mešanicah z ječmenom in ovsom pa so zeleni deli graha priporočljivi kot stročnični delež namesto običajnih graščic, predvsem zaradi vsebnosti beljakovin.

Ključne besede: govedo / prehrana živali / zelena krma / krmne mešanice / prehranska vrednost

INTRODUCTION

Roughage produced either on crop fields or grasslands is basic source in ruminants' nutrition. If we do not have enough grassland or meadow, than we have to find alternative field croppings in the vegetation period which are able to give cheap and natural roughage. The green forage mixtures were natural and abound in minerals and vitamins. Good energy-protein relation is important for ruminant nutrition as well. Many farms used the "green chain", especially the well-known "Iregszemcsei forage growing System" (Kurnik, 1966). Nowadays under economic pressure, the majority of middle and small sized farms need to reduce their costs of animal feeding. In case of semi-intensive milk and beef production, as well as heifer rearing on these small or medium size farms, there is a demand for green forage based diet during the vegetation period instead of monodietical feeding. The monodietical nutrition can be changed for seasonal nutrition or the system of combined nutrition at some farms. We expect to improve the importance of the green forage mixtures production even if there aren't enough grasslands or its quality isn't adequate.

To achieve a more efficient system of green feeding is need to introduce new forage species in ruminant nutrition as green forage, which nutritional value has not been exactly determined yet.

Our aims were to compare the different spring green forage mixtures and their pure stands by the following aspects:

- the nutrient content and the potential fresh mass, dry matter and crude protein yields of species in pure stands and in green forage mixtures, in small plot experiments of different species and types of roughage;
- the green forage which can be used nowadays and its nutrient contents are different or not from green forage which were used from 1960's to 1970's;

MATERIALS AND METHODS

The field experiments were carried out on forage species of green forage mixtures used in ruminant nutrition at the Experimental and Educational Facility of the Faculty of Animal Sciences, University of Kaposvár, between 2002 and 2004. The type of the soil is brown forest soil with clay illuvitation. The properties of the level A (0–30 cm) are the following: pH (H_2O): 6.28; K_A: 37, Humus %: 1.5. During the vegetation period the temperature and rainfall were also recorded. The treatments were designed in four repetitions in randomized complete block design in small plots of 1.4 m × 9.2 m. The treatments of the experiments were the different forage species and mixtures. Table 1 shows the species and varieties mixtures and the seed density.

Table 1. Species, types and germ count of pure green forages and mixtures, 2002–2004

Nomination	Germ count pcs/ha	
	Component 1	Component 2
pea with barley; Annabell-Rubin	1 000	500
pea with oat; Bakonyalja-Rubin	1 000	500
spring barley; Annabell	3 000	-
oat; Bakonyalja	3 000	-
pea; Rubin	1 200	-

The seeding was made by WINTERSTEIGER (seeder) for 12 cm row-distance and in 2–4 cm deep. Harvesting was made by HALDRUP (reaper) at the beginning of flovering of the crop components. During the vegetation period, the growth status of the plants and the date of change in the phenological phases were recorded.

Difference was not found in the growth of the mixtures, harvesting was always done at the same time, ensuring similar environmental conditions. The harvesting time was before the flowering of the cereal. After harvesting, the green yields of the plots were measured and the yields per hectare were calculated.

Average samples of 4 to 5 kilograms of the second and third repetitions were analyzed to learn the details of the nutrient content of the different treatments. After determination of the dry matter and nutritive content, the percentage of crude protein, crude fat, crude fibre, crude ash and nitrogen-free extract in the dry matter was calculated. The fresh mass yields per hectare, the dry matter yield and the crude protein yield per hectare were calculated too.

The statistical analysis was done with SPSS 10.0 at 5% significance level ($P \leq 0.05$). One-way analysis of variances was used to test the yields of the experiments and the averages of the three years of the different treatments.

RESULTS AND DISCUSSIONS

In many cases the weather of the experimental years caused higher difference in the yields and nutrient contents than between the treatments within a year. According to the phenological results, the crop components of mixtures come into harvestable phase at the same time.

Green yields of spring mixtures

In the average of the three years analyzed, pea with oat gave 3.5 tons more green yield per hectare than pea with barley (Table 2).

Table 2. Green yield of spring mixtures forages and its components, 2002–2004

Nomination	Green yield t/ha			
	2002	2003	2004	Average
pea with barley; Annabell-Rubin	27.2[a]	12.2[a]	14.9[a]	18.1[ab]
pea with oat; Bakonyalja-Rubin	32.3[b]	10.9[a]	21.7[b]	21.6[ab]
spring barley; Annabell	30.7[b]	10.3[a]	9.3[c]	16.7[b]
oat; Bakonyalja	36.8[c]	15.0[b]	19.3[d]	23.7[a]
pea; Rubin	26.4[a]	11.1[a]	24.0[e]	20.5[ab]
$Sz.D_{5\%}$	2.8	2.5	2.09	6.88

This difference was not significant despite of that pea with oat gave significantly higher yields in 2002 and 2004 than the mixture with barley. In the average of the three years analyzed, the highest yield was given by oat and the lowest by barley. The difference was significant both in

average of the three year and annually. Pea, with higher yield than barley and lower than oat, was found different from neither the crop components nor the mixtures. The green yields of mixtures were between their components' in 2002, 2004 and in average of the three years. Pea with oat gave higher yields per hectare than pure pea, while pea with barley was like barley. Mixtures, were not different from each other or their components. Similarly with our results Székely and Tótth (1961) wrote that pea with oat mixture green production was 17–24 t/ha. Instead of the vetch with oat mixtures was given lower green yield (13–20 t/ha) than in our experimental pea mixed with oat (Székely and Tótth, 1961; Janata *et al*., 1973; Antal, 2001). According to Székely and Tótth (1961) and Janata *et al*. (1973) pea with sunflower mixture sowed early in the spring are able to give 18–25 t/ha green yield. That is more measured green produce than pea with barley mixtures and similar to the pea mixed with oat, but the problem is that the mixtures have to chop before feeding.

Nutrient content, dry matter and crude protein yield of spring mixtures

In the average of three years, the dry matter content of the mixtures was similar to each other (Table 3) at the start of flowering. Contrary, in 2002–2003, pea with barley had 12–13 g/kg higher dry matter; while in 2004 pea with oat had 24 g/kg higher dry matter content. Mixtures' dry matter content were lower than oat's and barley's, and higher than pea's. In our research measured dry matter content of mixtures was higher than pea mixed with sunflower by literature (128–174 g/kg) and pea mixed with oat (145–154 g/kg) (Székely and Tótth, 1961; Kurnik, 1966; TKI, 1975; Herold, 1977; Schmidt, 1996). Despite of these, dry matter yields were significantly different in 2002 and 2004. In the average of three years, pea with oat was better with 0.6 t/ha, which was not significant. Looking at the components, the dry matter content of barley was higher than oat, although the difference of the three years was not significant. Contrary, barley produced almost 1 t/ha lower dry matter yield than oat, which was due to the significantly higher figures in 2002 and 2004 in case of oat. In the average of three years, pea gave significantly less dry matter yield than oat; the difference is 1 t/ha compared to spring barley; which was due to the low dry matter content of pea. The dry matter content of the mixtures was between the components'. The difference was significant between spring barley and pea with spring barley. The dry matter yield of the mixtures was lower than the grain components and higher than pure pea. The differences were not significant. In literature has not written dry matter yield yet, but it is countable from green yield and dry matter content. Based on Székely and Tótth (1961), Tótth *et al*. (1962) and TKI (1975) dates the means counted value was 3.4–4.6 t/ha pea mixed with oat and 2.7–3.6 t/ha vetch mixed with oat, which were similar to our results of the mixtures.

In the average of the three years, the crude protein contents of the mixtures and the components were different from each other. Pea with spring barley had significantly higher (+16 g/kg) crude protein content than pea with oat. Contrary, the crude protein yields of these mixtures were similar in 2002. Pea with spring barley in 2003, in 2004 and pea with oat gave significantly higher crude protein yield. Spring barley and oat on their own had almost the same level of crude protein, while pea had significantly higher (with more than 80 g/kg) crude protein content, in the average of the three years. Crude protein contain of pea with barley mixture was similar to pea mixed with sunflower by literature with a gradient of one in one and the pea with oat mixture was similar too pea mixed with sunflower with a gradient of one in three mixtures (Herold, 1977; Schmidt, 1996). Crude protein contain of pea mixed with oat were less with 15 g/kg than Herold (1977) presented (170 g/kg), but it was the same as the studied pea with barley mixture. Instead of the literature, crude protein content of vetch mixed with oat (142 g/kg) was lower than measured value of our mixtures (Schmidt, 1996). The difference between vetch mixed with oat and the analyzed pea and barley mixture was 29 g/kg. Pea gave more crude protein yield (30 kg/ha and 65 kg/ha more) than pea with oat and pea with spring barley,

respectively, although, there was not significant difference found. Almost similar crude protein yield per hectare can be achieved with these mixtures compared to pure pea. Further, mixtures gave higher crude protein yield than the grain components. The difference was only 37 kg/ha between oat and pea with oat, due to the relatively high green yield and dry matter content of oat. Between pea with spring barley and spring barley, the difference was much higher: 121 kg/ha; however it was not significant, due to the large difference within the experimental years. Concluding, during the three years analyzed, pea proved to be a good component in spring barley or oat mixtures – even in extreme whether conditions. It contributed to ensuring the success of production and yield security. Crude protein yield of vetch with oat mixture was counted 420–460 kg/ha based on literature (DMKI, 1965; TKI, 1973, 1974, 1975; Herold, 1977; Harangozó, 1988; Antal, 2000). Those values are similar with measured value of our two mixtures. On the contrary crude protein produce of pea mixed with sunflower (550–600 kg/ha) was lower than yield of our trial mixtures (Tótth *et al*., 1962; Janata *et al*., 1973).

Table 3. Dry matter and crude protein content and yield of spring mixtures, 2002–2004

Nomination	Dry matter content g/kg feed				Dry matter yield t/ha			
	2002	2003	2004	Average	2002	2003	2004	Average
pea with spring barley; Annabell-Rubin	201	238	169	203^{ac}	5.46^{a}	2.90^{a}	2.52^{a}	3.6^{a}
pea with oat; Bakonyalja-Rubin	189	225	193	202^{ac}	6.10^{b}	2.44^{ac}	4.18^{b}	4.2^{ab}
spring barley; Annabell	240	275	259	258^{b}	7.36^{c}	2.83^{a}	2.40^{a}	4.3^{ab}
oat; Bakonyalja	204	241	229	225^{ab}	7.50^{c}	3.62^{b}	4.41^{b}	5.2^{b}
pea; Rubin	161	197	145	168^{c}	4.24^{d}	2.18^{c}	3.47^{c}	3.3^{a}
Sz.D$_{5\%}$	-	-	-	39.7	0.56	0.59	0.29	1.37
Nomination	Crude protein content g/kg feed				Crude protein yield t/ha			
	2002	2003	2004	Average	2002	2003	2004	Average
pea with spring barley; Annabell-Rubin	161	176	175	171^{a}	879^{a}	510^{a}	441^{a}	610^{ab}
pea with oat; Bakonyalja-Rubin	147	167	150	155^{b}	897^{a}	407^{b}	627^{b}	644^{a}
spring barley; Annabell	107	132	127	122^{c}	787^{b}	374^{b}	305^{c}	489^{b}
oat; Bakonyalja	111	128	119	119^{c}	832^{ab}	463^{ab}	525^{d}	607^{ab}
pea; Rubin	199	215	205	206^{d}	844^{ab}	469^{ab}	712^{e}	675^{a}
Sz.D$_{5\%}$	-	-	-	15.9	79	92	61	153.8

CONCLUSIONS

- The individual components of mixtures have comparative advantage when they are produced in mixtures, in case of both the grain and legumes components. Pea with barley and pea with oat gave at least the same or higher green yield and crude protein yield than the pure population of the components. The reason of it – agreeing with Kurnik (1966), Láng (1966) and Herold (1977) – is that the water and nutrient contents of soil are better used by mixtures, the cropping field can be better used, while competitive inhibition does not emerge or only in extreme conditions.
- During the three years of the trial, pea was a reliable component with barley and oat even in extreme weather conditions. Pea improved the success of production and the yield reliability. In spring mixtures with barley or oat, the vegetative types of pea are recommended as leguminous component instead of using the "traditional" vetches, with special regard to the crude protein content. Using this mixture, the variety available at spring time widens; and with a periodic cropping, these can be fed even till the second decade of July.
- Based on the yield and nutritive content of green forages analyzed in the experiments, these can be alternative feed for not only dual purpose cattle. Where not sufficient quantity of pasture is available for heifer rearing, the possibility for using green forage mixtures produced on crop fields arises. Similarly to heifers, dry milking type cows also can be fed with green forage mixtures. By feeding green forage, the costs of fermentation and storing can be reduced. If we can not feed up the entire amount, the remaining of the cropped nutrition can be used for making good quality hay or fermented feed if it was harvested at appropriate time.
- In our opinion, a greater emphasis should be laid on the production of further alternative green forages in the future, such as spring triticale with pea, to ensure a continuous feed supply in summertime.

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