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Jacek SOSNOWSKI[1]

EFFECT OF DIFFERENT FACTORS ON THE QUALITY OF FEED COMPONENTS

WPŁYW RÓŻNYCH CZYNNIKÓW NA JAKOŚĆ MIESZANEK PASZOWYCH

Abstract: The aim of this study was to determine the effect of different doses of nitrogen and soil's fertilizers on the feed value of *Festulolium braunii* mixture with red clover and alfalfa. The experience with cultivation of *Festulolium braunii* (Felopa variety) in mixture with red clover (Tenia variety) and alfalfa (Tula variety), was established in April 2007. Full period, three – cuts of experimental objects using, were in 2008–2010. The first study factor was the following levels of nitrogen fertilization: N0 – control^{o} (without nitrogen fertilization), N1 – 60 kgN · ha^{-1}, N2 – 120 kgN · ha^{-1}. The second factor was the tested soil's fertilizer. The studies included total protein content, crude fiber and organic or dry matter digestibility [%].The best nutritional value (concentration of protein, fiber and digestibility of dry matter) were characterized the crops on the objects supplied with a lower dose of nitrogen (60 kgN · ha^{-1}). The study showed lack of efficacy for increasing nitrogen doses to improve the feed quality of *Festulolium braunii* in a mixture with red clover and alfalfa. Application of soil's fertilizer to nutrition of tested mixtures not caused significant differences in protein and fiber content in the feed. Its significant impact was noted only on the objects supplied with 60 kgN · ha^{-1}, where it caused a decrease in dry matter digestibility (an average about 2 %) of *Festulolium braunii* mixture with red clover and alfalfa.

Keywords: soil's fertilizer, nitrogen dose, mixture, *Festulolium braunii*, red clover, alfalfa

The basic of grassland functioning in the rural economy, is the production of full value forage for ruminants. For this purpose, especially useful are convertible grasslands [1]. The fodder from grass – legumes mixtures belongs to one of the most valuable and cheapest feed used in animal nutrition [2]. The main advantages of this crop is a higher yield level and more favorable nutritional value compared with monocultures, the ability to extend the utilization period, better health of the individual components of the mixture, reducing the sward infestation, easier feed conservation (hay, silage) and reduction of losses during the storage [3, 4]. Some authors [5] underlined the importance of soil conditions in the yield formation of cultivated mixtures. In the time of simplified rotations, more often we meet with a progressive

[1] Institute of Agronomy, University of Natural Sciences and Humantities in Siedlce, ul. B. Prusa 14, 08–110 Siedlce, Poland, phone: +48 25 643 13 20, email: laki@uph.edu.pl

degradation of soils, and as a result, with the reduction of crop yields and with the increase of expenditure on plant production. In addition, soil without the structure is difficult to tillering, and it clumping and acidified. Are also disrupted air-water relations, and hence, there is inhibition of decomposition processes of organic matter and humus formation [6]. According to many authors [7, 8], to improve of this state can be use a soil's fertilizer, which increases the biological activity of soil and restoration of humus cavities, thereby improving soil fertility.

In addition, some studies [9], have shown that the use of microbial preparations to feed the grass – legumes mixtures, caused a significant increase in dry matter yield of plants and preferably effected on the floristic composition of the sward. Therefore, the aim of this study was to determine the effect of different doses of nitrogen and soil's fertilizers on the feed value of *Festulolium braunii* mixture with red clover and alfalfa.

Materials and method

The experience with cultivation of *Festulolium braunii* (Felopa variety) in mixture with red clover (Tenia variety) and alfalfa (Tula variety), was established in April 2007, in randomized blocks in 3 replicants on the experimental object of Grassland Department and Green Areas Creation in Siedlce (geographic coordinates: 52.169^{o} N, 22.280^{o} E). Share of individual components of mixtures and standard of seeds sowing were as follows:

– *Festulolium braunii* 50 % (40 kg · ha^{-1}),
– *Trifolium pratense* 25 % (21 kg · ha^{-1}),
– *Medicago sativa* ssp. *media*, 25 % (26 kg · ha^{-1}).

Surface plot was 6 m^2. In the year of sowing only infestation cuts was carried out. Full period, when three – cuts of experimental objects were used, were in 2008–2010. The first experience factor was the following levels of nitrogen fertilization: N0 – control^{o} (without nitrogen fertilization), N1 – 60 kgN · ha^{-1}, N2 – 120 kgN · ha^{-1}.

Nitrogen (34 % ammonium nitrate) was used in three divided doses, subsequently sown into each regrowth.

The substrate of experience belongs to soil with hortisole type formed from medium sand. Granulometric composition of the soil shows Table 1.

Table 1

Granulometric composition of soil material existing as subsoil in experiment

Percentage share of soil fractions [diameter in mm]								
1–0.1	0.1–0.05	0.05–0.02	0.02–0.06	0.06–0.002	< 0.002	Sum of fraction 0.1–0.02	Sum of fraction < 0.02	Grain group
76	9	5	4	4	2	14	10	psg

On the basis of soil chemical analysis performed at the Station Chemical Agriculture in Wesola was found that soil under cultivation was characterized by neutral reaction and medium high humus content (Table 2). In addition, it was characterized by a very

high content of phosphorus, high magnesium and an average of available forms of potassium, total nitrogen, nitrate and ammonium. Soil's fertilizer was used once for watering plants in a phase of *Festulolium* shooting in the first regrowth, as a solution at a dose 0.9 $dm^3 \cdot ha^{-1}$ diluted in 350 dm^3 of water. Combinations of soil's fertilizer labeled as UG, and without fertilizer as BUG. According to Trawczynski [7], in soil's fertilizer are yeast, lactic acid bacteria, photosynthetic bacteria and *Azotobacter*, *Pseudomonas* and *Actinomycetes*. In addition, it contains the following macro- and micronutrients: potassium (3500 mg $\cdot$ dm^{-3}), nitrogen (1200 mg $\cdot$ dm^{-3}), sulfur (1000 mg $\cdot$ dm^{-3}), phosphorus (500 mg $\cdot$ dm^{-3}), sodium (200 mg $\cdot$ dm^{-3}), magnesium (100 mg $\cdot$ dm^{-3}), zinc (20 mg $\cdot$ dm^{-3}) and manganese (0.3 mg $\cdot$ dm^{-3}).

Table 2

Chemical composition of soil as a subsoil in experiment

pH in KCl	Content of assimilated components [mg $\cdot$ 100 g^{-1} of soil]			Content [%]		Content [mg $\cdot$ kg^{-1} d.m.]	
	P_2O_5	K_2O	Mg	N_{tot}	Humus	$N\text{-}NO_3$	$N\text{-}NH_4$
6.99	90.0	19.0	8.4	0.18	3.78	10.10	7.47
Results uncertainty*							
± 3 %	± 20 %	± 20 %	± 20 %	± 20 %	± 17 %	± 22 %	± 25 %

* Widened uncertainty calculated with using of widen index 2, what gives the level 95 %.

In addition, on all the plots potassium fertilization (60 % potassium salt) were used in an amount of 120 $kgK_2O \cdot ha^{-1}$. But phosphorus (46 % superphosphate) at a dose 80 $kgP_2O_5 \cdot ha^{-1}$, was sown once in early spring.

The chemical analysis of plant material included total protein content, crude fiber and dry matter digestibility [%]. The plant material in terms of those characteristics, were collected from all the cuts in the last two years of the experiment. It was done at the Institute of Technology and Life Sciences in Falenty, PL.

The study results were evaluated statistically by using analysis of variance for multivariate experiments. Differentiation of means was verified by Tukey's test at significance level $p \leq 0.05$.

The climatic conditions of research area were typical for IX – eastern of agriculture and climatic district of Poland. Average annual air temperature varied within 6.7–6.9 ^oC, and in the summer, the average daily temperature was 15 ^oC. Annual precipitation levels amounted to 550–650 mm, while they are not belong to frequent, but to heavy. Growing season starts in the first decade of April and ends in the third of October, and so takes from 200 to 220 days. Meteorological data from the research years were obtained from the Meteorology and Hydrology Station in Siedlce. However, in order to determine the temporal and spatial variability of meteorological elements and their effects on plants vegetation, was calculated the hydrometrical ratio of Sielianinow.

From the data presented in Table 3 resulted, that the most preferred and size distribution of precipitation, optimal air temperatures per growing season of plants, was

in 2009. This year were not the months with drought but in the other years were the months with strong and week drought.

Table 3

Value of hydrometrical index of Sielianinow (K) in individual months of vegetation period

Study years	Month						
	IV	V	VI	VII	VIII	IX	X
R1 – 2008	0.82	1.34	1.08	1.23	0.54	0.69	1.72
R2 – 2009	1.03	2.24	1.03	1.26	1.36	1.01	1.73
R3 – 2010	0.40	2.21	1.19	1.18	1.79	2.81	0.53

K < 0.5 – high drought; 0.51–0.69 – drought; 0.70–0.99 – week drought, K > 1.0 – not drought.

Results and discussion

In the first year of full using of the experiment, nitrogen fertilization did not differentiate the protein content within the tested combinations (Table 4).

Table 4

Protein content [% d.m.] of the *Festulolium braunii* mixture with red clover and alfalfa (average from cuts)

Combination of fertilization		Study years		Mean
		2009	2010	
N0	UG	18.90	18.64	18.77
	BUG	17.24	18.08	17.66
N1	UG	18.54	19.26	18.90
	BUG	18.21	20.62	19.41
N2	UG	18.39	19.34	18.86
	BUG	18.26	18.07	18.16
Mean for soil's fertilizer				
UG		18.61	19.08	18.84
BUG		17.90	18.80	18.35
Mean for nitrogen dose				
N0		18.07	18.36	18.21
N1		18.37	19.94	19.16
N2		18.32	18.70	18.51
Mean		18.25	19.00	18.62
$LSD_{0.05}$ for: study year (A) – n.s. soil's fertilizer (B) – n.s. nitrogen dose (C) – 0.90		interaction: (A×B) – 0.88 (A×C) – 1.52 (B×C) – n.s. (A×B×C) – n.s.		

Nitrogen dose: N0 – no nitrogen, N1 – 60 kgN · ha^{-1}, N2 – 120 kgN · ha^{-1}. UG – soil's fertilizer, BUG – no soil's fertilizer.

In the second year of the study, the highest protein content occurred in the plants from the plots fertilized with 60 kgN · ha^{-1} (19.94 % d.m.). It should also be noted that regardless of study years and applied soil's fertilizer, the statistical analysis showed significantly higher protein content in dry matter of the mixture cultivated on the objects supplied with a lower dose of nitrogen (60 kgN · ha^{-1}).

A similar relationship was noted in other study [10]. This author analyzed the average yield of *Festulolium* mixtures with red clover for objects fertilized with different doses of nitrogen, generally showed, that increasing amounts of this factor not caused a significant increase in the yield of protein. The other authors [11] showed, that in the first two years of cultivation, significantly higher yield of protein for mixtures of meadow fescue with red clover were obtained after fertilization with dose of 60 kgN · ha^{-1}, compared with control dose. But increasing the amount of nitrogen applied to 120 kg · ha^{-1} did not result a significant increase in the yield of protein. Microbiological preparation used in the experiment did not differentiate significantly these characteristics, however, other studies [9], have shown, that it caused the increase in dry matter yield of the tested mixture, what in consequences caused an increase in the yield of protein in feed.

Table 5

The crude fiber content [% d.m.] of the *Festulolium braunii* mixture with red clover and alfalfa (average from cuts)

Combination of fertilization		Study years		Mean
		2009	2010	
N0	UG	25.52	23.45	24.48
	BUG	24.18	23.65	23.91
N1	UG	22.08	24.91	23.49
	BUG	22.81	23.85	23.33
N2	UG	25.53	26.90	26.21
	BUG	26.11	24.95	25.53
Mean for soil's fertilizer				
UG		24.27	25.08	24.67
BUG		24.36	24.15	24.25
Mean for nitrogen dose				
N0		24.85	23.55	24.20
N1		22.44	24.38	23.41
N2		25.82	24.40	25.10
Mean		24.37	24.11	24.23
$LSD_{0.05}$ for: study year (A) – n.s. soil's fertilizer (B) – n.s. nitrogen dose (C) – 0.78		interaction: (A×B) – n.s. (A×C) – 1.82 (B×C) – n.s. (A×B×C) – 1.27		

Nitrogen dose: N0 – no nitrogen, N1 – 60 kgN · ha^{-1}, N2 – 120 kgN · ha^{-1}. UG – soil's fertilizer, BUG – no soil's fertilizer.

Conversely to the protein content in dry matter yield of plants, has developed the crude fiber content. It was confirmed by other studies [12, 13]. The largest amount of fiber (Table 5) occurred at the objects supplied with the highest dose of nitrogen (N2 – 120 kg N · ha^{-1}) and amounted an average 25 %. The using of soil's fertilizer, similar as in the case of proteins, not differenced significantly of received values.

The tested mixture regardless of the fertilizer combination characterized by a low dry matter digestibility, on the level an average 57 % (Table 6).

Table 6

Digestibility of dry matter [%] of *Festulolium braunii* mixture with red clover and alfalfa (average from cuts)

Combination of fertilization		Study years		Mean
		2009	2010	
N0	UG	56.10	56.04	56.07
	BUG	56.14	57.05	56.59
N1	UG	58.17	57.94	58.05
	BUG	59.84	60.22	60.03
N2	UG	55.19	57.34	56.26
	BUG	55.08	56.22	55.65
Mean for soil's fertilizer				
UG		56.48	57.10	56.79
BUG		57.02	57.03	57.02
Mean for nitrogen dose				
N0		56.12	56.54	56.33
N1		59.00	59.08	59.04
N2		55.13	56.78	55.95
Mean		56.75	57.46	57.10
$LSD_{0,05}$ for:		interaction:		
study year (A)	– n.s.	(A×B)	– n.s.	
soil's fertilizer (B)	– n.s.	(A×C)	– n.s.	
nitrogen dose (C)	– 2.27	(B×C)	– 1.89	
		(A×B×C)	– n.s.	

Nitrogen dose: N0 – no nitrogen, N1 – 60 kgN · ha^{-1}, N2 – 120 kgN · ha^{-1}. UG – soil's fertilizer, BUG – no soil's fertilizer.

This fact is a consequence of three – cuts using of plots [14–17]. However it should be noted, that the highest digestibility were characterized the cultivations reached with 60 kgN · ha^{-1} (average 59 %). Significant influence of soil's fertilizer on this feature, regardless of study years, it has been noted only on the objects supplied with a lower dose of nitrogen (N1). In this case, the supply with soil's fertilizer to *Festulolium braunii* cultivation with red clover and alfalfa caused a decrease in digestibility on average about 2 %. Analyzing the means for soil's fertilizer in the whole study cycle, it

should be noted that it had no significant effect on the digestibility of dry matter of investigated plants. Similar tendency was also for organic matter digestibility (Table 7).

Table 7

Digestibility of organic matter [%] for *Festulolium braunii* mixture with red clover and alfalfa (average from cuts)

Combination of fertilization		Study years		Mean
		2009	2010	
N0	UG	57.78	57.72	57.75
	BUG	57.82	58.76	58.30
N1	UG	59.91	59.67	59.79
	BUG	61.64	62.02	61.83
N2	UG	56.84	59.06	57.95
	BUG	56.73	57.90	57.32
Mean for soil's fertilizer				
UG		58.17	58.81	58.49
BUG		58.73	58.74	58.73
Mean for nitrogen dose				
N0		57.80	58.23	58.02
N1		60.77	60.85	60.81
N2		56.78	58.48	57.63
Mean		58.45	59.18	58.81
$LSD_{0.05}$ for: study year (A) – n.s.; soil's fertilizer (B) – n.s.; nitrogen dose (C) – 2.17		interaction: (A×B) – n.s.; (A×C) – n.s.; (B×C) – 1.95; (A×B×C) – n.s.		

Nitrogen dose: N0 – no nitrogen, N1 – 60 kgN · ha^{-1}, N2 – 120 kgN · ha^{-1}. UG – soil's fertilizer, BUG – no soil's fertilizer.

According to other author [18], a mixture of *Festulolium* with red clover and alfalfa gets very good scores in a scale of Fliege-Zimmer, and as a maize silage can be a primary feed in the feeding of cattle, especially cows with a capacity about 8000 liters of milk. Higher fiber content and thus lower the digestibility of dry matter, indicates the need of earlier harvest of the first cut and greater frequency of mowing. However, it should be noted, that the tested mixture, covered the basic feed criteria for ruminants [19, 20].

Conclusion

The best nutritional value (concentration of protein, fiber and digestibility of dry matter) were characterized the crops on the objects supplied with a lower dose of nitrogen (60 kgN · ha^{-1}).

The study showed lack of efficacy for increasing nitrogen doses to improve the feed quality of *Festulolium braunii* in a mixture with red clover and alfalfa.

Application of soil's fertilizer to nutrition of tested mixtures not caused significant differences in protein and fiber content in the feed. Its significant impact was noted only on the objects supplied with 60 kgN · ha^{-1}, where it caused a decrease in dry matter digestibility (an average about 2 %) of *Festulolium braunii* mixture with red clover and alfalfa.

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WPŁYW RÓŻNYCH CZYNNIKÓW NA JAKOŚĆ MIESZANEK PASZOWYCH

Instytut Agronomii
Uniwersytet Przyrodniczo-Humanistyczny w Siedlcach

Abstrakt: Doświadczenie z uprawą *Festulolium braunii* (odmiana Felopa) w mieszance z koniczyną łąkową (odmiana Tenia) i lucerna mieszańcową (odmiana Tula) założono w kwietniu 2007 r. Udział poszczególnych komponentów mieszanki były następujące: *Festulolium braunii* 50 %, koniczyna łąkowa 25 %, lucerna mieszańcowa 25 %. Okres pełnego, trzykośnego użytkowania obiektów doświadczalnych przypadał na lata 2008–2010. Pierwszym czynnikiem doświadczalnym były następujące poziomy nawożenia azotem: N0 – obiekt kontrolny (bez nawożenia azotem), N1 – 60 kgN · ha^{-1}, N2 – 120 kgN · ha^{-1}. Azot (34 % saletra amonowa) zastosowano w trzech dzielonych dawkach, wysiewanych kolejno na każdy odrost. Drugi czynnik to użyźniacz glebowy: BUG – bez użyźniacza, UG – użyźniacz glebowy. Ponadto na wszystkich poletkach zastosowano nawożenie potasem (60 % sól potasowa) w ilości 120 kgK_2O · ha^{-1} – użyto na odrosty. Natomiast fosfor (46 % superfosfat) w dawce 80 kgP_2O_5 · ha^{-1}, wysiano jednorazowo wczesną wiosną. Szczegółowymi badaniami objęto zawartość białka ogólnego, włókna surowego oraz strawność organicznej i suchej masy (%). Przeprowadzone badania wykazały, że najlepszą wartością pokarmową (koncentracją białka, włókna i strawnością suchej masy) odznaczały się uprawy prowadzone na obiektach zasilanych niższą dawka azotu (60 kgN · ha^{-1}). Zastosowanie użyźniacza glebowego do zasilania badanych mieszanek nie przyczyniło się do istotnego zróżnicowania omawianych parametrów jakościowych surowca paszowego.

Słowa kluczowe: użyźniacz glebowy, dawka azotu, mieszanka, *Festulolium braunii*, koniczyna łąkowa, lucerna