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PRODUCTION CAPABILITIES AND NUTRITIVE VALUE OF FODDER FOR ANIMAL NUTRITION IN MOUNTAINOUS AREA OF REPUBLIC OF SRPSKA

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Abstract

There is lack of feed in the mountainous region of the Republic of Srpska despite the large agricultural area. The main source of feed is natural grasslands of low productivity and low energy value. In this paper we determined the yield and nutritional value of the natural grasslands using agricultural practices of fertilization and sowing. Also, a number of production technologies on plowed land with annual legumes and grass-legumes mixture were designed. The aim of this work was to increase the yield and quality of forage on natural grassland and on plowed land. It was determined the forage yields per unit area as well as the nutritional value of the air-dry hay. According to the results of chemical analysis, low protein content in natural grasslands was found (8.96 to 9.59%), regardless of the agro-technical measures application. It was identified a high protein content sowing grass-legume mixtures, especially in the second cut (from 17.31 to 21.77%). The digestibility of nutrients from green feed depends on the plant growing stage and species of animal consuming such feed. The digestibility of this feed for ruminants is 75-80%, for horses 60%, and 50% for pigs. Applied agro-technical measures show that the production of high-quality nutrients can be increased in this region.

Key words: *mountainous area, natural grasslands, plowed land, yield, nutritional value.*

Introduction

Of the total agricultural area 350 000 ha land are under natural meadows and pastures in Republika Srpska. Arable land cover an average of 586 000 ha, fallow and uncultivated land 240 000 ha. Accorfing to a multi-year average, forage crops on arable land is planted on 75 000 ha. Most of this area is located in the hilly-mountainous region. The characteristic of production in these areas are low yields and poor quality. The reason for the low and unstable yields and poor quality of forage is the lack of agro technical measures (*Dubljević*, 2007). Natural grasslands belong to the most widespread meadow-pasture communities in the mountainous region of Serbia (*Lazarević et al*., 2009). Several authors (*Stevanović et al.*, 2004; *Nešić et al*., 2004; *Vučković et al*., 2004; *Alibegović et al.*, 2004) found that the proper fertilization of meadows and pastures with mineral and organic fertilizers, the rational exploitation, under the same conditions can provide of several times increasing of hay yield (up to 20 t ha-1), and at the same time improving the quality of forage. One of the most important nutrients for achieving high yields of natural grassland is nitrogen. *Vitousek and Howarth (1991), Frink et al. (1999), LeBauer and Treseder (2008)* point out that the nitrogen is usually the limiting factor for high production of natural grasslands. Different species of perennial grasses and legumes can be combined into the mixtures that are suitable for a specific production area, the purpose of use and duration of exploitation *(Lazarevic et al., 2006). Kessler and Lehman (1998)* concluded that sown grasslands had a higher yield and quality of the biomass as compared to natural grasslands. Increasing of legumes in the mixtures reduces the need for nitrogen fertilizer and in that way reduces the cost of fodder production per unit area (*Vučković*, 2004). The number of species that can be breeded for

fodder production is limited because of short growth season in the mountainous region. In the research of Gatarić et al., (2009) it was concluded that excellent results can be achieved by breeding fast growing perennial legume of forage pea and vetch.
The aim of this study was to determine forage yield and its quality, and based on these results to obtain the proposed measures for the repair of natural meadows and recommendations for planting species that will increase the production of good quality forage.

Materials and Methods

The research was conducted on agricultural land in the village Mrkalji, in the municipality of Han Pijesak, during the growing season in 2013 (44 ° 01 ’30 "N, 18 ° 56 ’10" E, 1111 altitude). Arable land has a shallow layer on dolomite. It has acid reaction and very poor content of available P_2O_5, medium content of humus and rich content of K_2O. Meteorological parameters of the study area during the vegetation period in 2013 are shown in Table 1

Table 1. The average monthly temperature and the amount of monthly precipitation in the growing season

Month	III	IV	V	VI	VII	VIII	IX	X
Temperature°*C*	0.6	8.2	11.4	14.4	17.0	17.6	11.3	9.6
Precipitation *lm*$^{-1}$	94.1	53.0	201.3	75.3	69.6	75.7	105.5	93.3

The experiment on a natural meadow, type Agrostietum vulgaris, was placed in four variants: 1.control, 2.fertilization with 200 kg ha^{-1} NPK (15:15:15), 3.fertilization with 300 kg ha^{-1} NPK (15:15:15) and 4. sowing off 20 kg ha^{-1} of red clover + 20 kg ha^{-1} + Italian ryegrass fertilization with 200 kg ha^{-1} NPK (15:15:15). Agro technical measures were not used in the control group. All variants are mowed at the same time.
The experiment on arable land included planting legume-grass mixtures and planting perennial fast-growing legumes. Three variations were used in legume-grass mixtures: red clover + Italian ryegrass, white clover + ryegrass and red fescue + Birdsfoot trefoil. Sowing was manually from sowing rate 20 kg ha^{-1} legumes +20 kg ha^{-1}grass. The joint crops were used from the fast-growing legume: field pea (120 kg ha-1) + oats (40 kg ha-1) and vetch (80 kg ha-1) + oats (40 kg ha-1). Before sowing the soil was fertilized with 300 kg ha^{-1} NPK (15:15:15). After sowing the soil was rolled. The experimental unit was 0.1 ha. Samples were collected at an optimal growth phase, i.e. the flowering phenophase. Four samples per 10m^2 were taken from each experimental unit, and thereafter the green mass was weighed. Samples were taken from the diagonal of the four variants of each. The green mass was determined, dried, prepared and analyzed in the Laboratory of feed quality control. The chemical composition was determined and calculated protein production for all variants. Quality of dry matter was determined after analyzing the chemical composition. Chemical analyzes were performed according to the following methodology: protein micro-Kjeldahl method, modification by Bremner (1960) and crude protein by multiplying by a factor of 6.25; crude fat in plant material, using the Soxhlet; crude fiber content of the plant material, the method by Henneberg - Stohman; crude ash content in the plant material, burning at 550^{o}C until constant weight. The share of nitrogen-free extracts (NFE) was calculated based on the chemical composition of the dry matter. Forage measurement was performed on the experimental plot and the analysis was performed in the Laboratory of feed quality control of Banja Luka Faculty of Agriculture. Biometric measurements were processed by PC applications for Windows: Statistical Package for Social Sciences and Excel.

Results and Discussion

Results of testing forage yield in natural meadows and arable land are presented in Figure 1. Based on the data it can be concluded that the treatment application on the natural meadows was an increase yield compared to the control group. On the arable land forage production was significantly higher than in the natural grasslands. The lowest yield of 5.53 t ha $^{-1}$ was achieved on the natural meadows, on the control plot, with no argo technical measures. The yield was significantly increased on the natural meadow with applied treatments as compared to control; for a variant of fertilization 200 kg ha $^{-1}$ of 27.1%, for the variant of fertilization 300 kg ha $^{-1}$ of 37.4%, and sowing off of 43.8%.

Vuckovic et al., (2004) reported that application of 160 kg N ha^{-1} showed an increase of biomass yield of grassland for 153% compared to control. According to Dubljevic (2007), natural grassland fertilization with nitrogen is very important because its application increased forage yield and crude protein, potentiates growth and tillering grass, increasing the density of grass cover, extending the vegetation and slows down aging plants. Djuric et al. (2007) noted that the fertilizing natural grasslands increasing the proportion of high-quality plants on the lawn, which results in greater production of proteins. The highest biomass production was achieved in the arable land of vetch + oat (27.30 t ha $^{-1}$) and a mixture of white clover + ryegrass in two cuts (26.38 t ha $^{-1}$). The production of biomass in a growing season is 2-5 times higher than the natural grasslands. For perennial mixture since it was the first year of establishing the crop can be expected that in the coming year's production will be even greater.

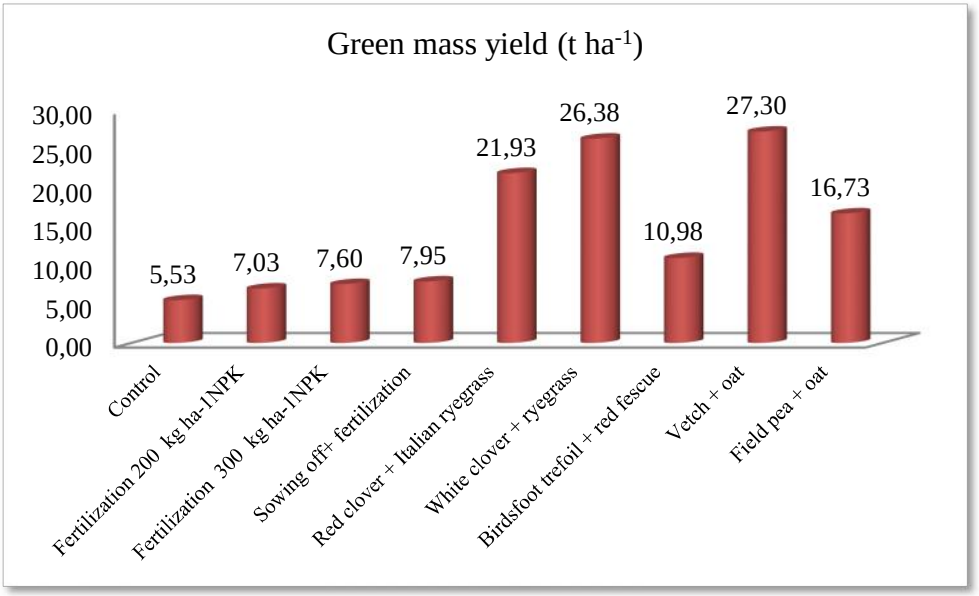

Figure 1. Green mass yield

Green feed, produced on grasslands or arable land, has a high water content, which may range from 60 and even more than 80%, and primarily depends on the stage of the plant maturity. The results of the chemical composition of plant dry matter are shown in Table 2. The percentage of protein from natural grasslands ranged from 7.10 to 10.14%, while the fiber content was 29.6 to 32.60%. The differences in the chemical composition on natural grasslands were created largely because of differences in the floristic composition on micro-locations, and due to the heterogeneity of the land, rather than as a result of the applied treatment.

A higher content of nutrients was observed in all tested variants on arable land compared to natural grasslands. Variant of white clover and perennial ryegrass in the second cut had the

highest crude protein content (21.87%) and crude fat (2.91%) and the lowest content of crude fiber (20.96%). By analyzing the chemical composition of first cut of this mixture was found high nutritional value. Higher protein content was determined in the second cut compared to the first cut in all tested legume-grass mixtures. One year fast-growing legumes with supporting crops (oats) had a high nutritional value. The crop of vetch and oats in addition to high yield of green mass showed a favorable ratio of crude protein and crude fiber. Of the total amount of crude protein, true protein is represented 45-85% and the rest are amides. However, ruminants can use amide well due to microorganisms which are found in the rumen. (Grubić and Adamovic, 2003).

Table 2. Chemical composition of feed dry matter

		Variant	Crude protein (%)	Crude fat (%)	Crude fiber (%)	Crude ash (%)	Nitrogen-free extracts (NFE) (%)
Natural grassland		Control	8.14	1.81	31.33	6.88	51.84
		Fertilization 200 *kg ha*$^{-1}$NPK	10.14	2.13	29.60	7.35	50.78
		Fertilization 300 *kg ha*$^{-1}$NPK	8.13	1.92	31.10	6.08	52.77
		Sowing off+fertilization	7.10	1.84	32.60	6.29	52.17
Legume-grass mixtures	First cut	Red clover + Italian ryegrass	13.34	2.10	29.90	8.34	46.32
		White clover + ryegrass	18.96	2.39	22.80	9.07	46.78
		Birdsfoot trefoil + red fescue	17.47	1.96	23.30	8.18	49.09
	Second cut	Red clover + Italian ryegrass	17.31	2.43	27.20	8.66	44.40
		White clover + ryegrass	21.87	2.91	20.96	11.25	43.01
		Birdsfoot trefoil + red fescue	21.77	2.01	21.47	11.64	41.01
Legumes		Vetch + oat	20.55	2.05	21.80	13.03	42.57
		Field pea + oat	16.46	1.92	25.96	6.34	49.32

Economic significance of natural grasslands is determined by two main factors, vegetation cover quality and yield of fodder *(Kojic et al., 2001).* The chemical composition of dry matter of natural grasslands is of crucial significant for the quality of animal feed, and is highly dependent on environmental factors, floristic composition and developmental stages of plants *(Ivanovski et al., 2004).* The digestibility of the organic matter of green plants depends on the plant growing stage and animal species consuming such feed. The digestibility of this feed for ruminants is 75-80%, for horses 60%, and 50% for pigs.

Conclusions

Based on a survey of forage yield and quality in agricultural areas in the mountainous region of the Han Pijesak municipality can be drawn the following conclusions:

Forage production on natural grassland with agro technical measures: fertilization and sowing off + fertilization can be increased from 5.53 t ha^{-1} on 7-8 t ha^{-1}.

There were no significant differences in the level of protein, but it can be expected in the coming period due to changes in the floristic composition.

However, the total production of protein per unit area was significantly greater with agro technical measures.

Very good production results and quality of feed were obtained by sowing the joint crops of vetch and oat, on arable land in the mountainous area, in a very short growing season of 80 days.

The yield was 27.30 t ha^{-1}. This feed had high nutritional value, with 20.55% crude protein, 2.05% crude fat and 21.80% crude fiber.

Production and quality of perennial legume-grass mixtures in a growing season is 2-5 times higher than the natural grasslands.

Out of all tested feed the best quality showed legume-grass mixtures, white clover + ryegrass with a high content of crude protein in the first cut (18.96%) and second (21.87%) and total production of green mass of 26.38 t ha^{-1}.

The digestibility of the organic matter of green plants depends on the plant growing stage and animal species consuming such feed. The digestibility of this feed for ruminants is 75-80%, for horses 60%, and 50% for pigs.

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