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ORIGINAL RESEARCH PAPER

BRIDGING PROTEIN GAP IN CHANGING CLIMATIC CONDITION IN SERBIA OR IN NORTHERN KOSOVO

Daniel KLEE[1] , Aleksandar ĐIKIĆ[2] and Jelena ĐOKIĆ[3]

1 International Business College Mitrovica, Kralja Petra b.b. Kosovska Mitrovica, daniel.klee@veb.de
2 Poljoprivredni fakultet Univerziteta u Prištini sa sedištem u Kosovskoj Mitrovici, amerika@vektor.net
3 Fakultet Tehničkih nauka Univerziteta u Prištini sa sedištem u Kosovskoj Mitrovici,
E-mail: jeladjokic7@gmail.com

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SYNOPSIS

In this paper there are presented results of the trials, which have considered content of raw proteins in red clover of the cultivar Kolubara, in the second year, in the agro-ecological conditions of west Serbia, on the soil type Eutric Cambisol, depending on mineral nutrition.

Content of proteins in leaves after the first mowing in the control variant without added N, in the first, second and in the third swath were measured. Content of proteins after added 30 kgs/ha of N raised up to 18,68%, but after adding 30kgs/ha of N after second mowing raised up to 19,34%, which was significantly higher compared to the control (17,24%).

. The vegetation period is monitored, and according to the findings showing wind direction shift, and the trends in air relative humidity, temperature and the ratio of precipitation/ evapotranspiration (ET), the strategy for climate change impact mitigation and protein production adaptation to the actual conditions was proposed.

INTRODUCTION

Livestock production is growing rapidly as a result of the increasing demand for animal products. FAO projections suggest that global meat production and consumption will rise from 233 million tons (2000) to 300 million t (2020), and milk from 568 to 700 million t over the same period. The big increase in animal protein demand over the last few decades has been largely met by the worldwide growth in intensive livestock production, particularly poultry and pigs. This is expected to continue as real income grows in the emerging economies (FAO, 2002)

Rehder and *Loeser* state that cultivating legumes has a positive effect on the carbon balance and on soil fertility (Rehder and Loeser,2002,) Greenhouse gas emission and the use of nitrogen fertilizers can be reduced significantly and, thus,

contribute to biodiversity in agriculture. Furthermore, cultivating legumes could provide an imputes for developing innovative food products (Markovic at al., 2012).

Red clover (*Trifolium pratense L.)* is among the most important perennial forage legume. As fodder, red clover is being used as green-fresh pasture or prepared (hay, haylage, flour, silage).

It is characterized by a high yield of biomass, fast regeneration after mowing, high biological values and high quality forage. According to the content of essential amino acids (cysteine, tryptophan, leucine) exceeds the maize and oats grains. Proteins are particularly abundant foliage, the content do not exceed 25% in the budding stage, which corelates with the specific value of red clover leaves in making quality forage. Content of vitamins and minerals make it one of the best forage species.

It is characterized by large amounts of vitamin A, vitamin C, D, E, K, B1, B2, B3 and trace elements Mo, Co, B, Cu, Mn (Taylor and Quesenberry, 1996). It contains a high content of carbohydrates, which makes it a good energy food, even better than alfalfa and Italian ryegrass. Quality of red clover forage depends primarily on the phase of development, level cuts, content of leaves and environmental conditions. Also, the stress caused by the adverse effects of environmental and seasonal changes can have a significant impact on the decline in forage quality of red clover, due to disturbance of the ratio between stalk and leaves which influence on accelerated aging, decreasing the proteins content, and increasing the content of polysaccharides (Vasiljevic at al., 2005).

In order to maintain biological value of red clover fertilizing, as well as climate conditions are the key factors. The duration and frequency in dry and hot periods will have an influence in protein content of Red Clover, so some other species with better tolerance on climatic changes will be taken into consideration.

MATERIALS AND METHODS

The trials have been done on a soil type Eutric cambisol at the Agriculture School farm in Lesak. Eutric cambisol is being considered as a typical soil type for the most of legumes, and particularly for red clover and alfalfa. Sampling has been done on each 20 cm, up to the depth of 120 cm. Agrochemical properties of the soil have been analyzed by standard methods, and the results are presented in the table 1. Irrigation of the soil has been done regularly.

Red clover used in the experiment was Kolubara cultivar, as the typical cultivar for the region (Vasiljevic at al., 2005). Fertilizing has been provided with 30 kgs of Nitrogen after the first mowing (Y_1) and with additional 30 kgs after second mowing (Y_2). Results have been compared to the control (without N- fertilizing) (Y_0).

Analyze of protein content has been done in the leaves by appropriate standard methods. Results have been analyzed and presented in the table 2.

The changing climatic conditions are also important for the total balance of protein in some region. As the climate is rapidly changing, for this research the meteorological data are taken from the neighboring stations, and the process of interpolation is applied. The average values are obtained for the last twenty years, and compared to the 2012, that is extremely dry period in Serbia. The vegetation period is calculated and applied on Red Clover vegetation.

RESULTS AND DISCUSSION

Soil used in the trial belongs to the Distric cambisol soil type. Analyses have been done by standard methods for this kind of research, and the results are presented in the table 1.

Table 1: Agrochemical properties of the Distric cambisol in the experiment.

Depth (cm)	Humus (%)	Y^1 (ccm)	N (%)	T	S	T-S	pH		P_2O_5	K_2O
				($cmol^+ kg^{-1}$)			H_2O	KCl	(mg 100 g^{-1})	
0-20	5.18	5.47	0.14	43,71	38.08	5.63	7.24	6.48	8.0	13.8
20-40	3.84	3.98	0.13	45.69	39.79	5.90	7.55	6.58	7.0	13.6
40-60	1.66	2.45	0.09	45.24	40.02	5.22	7.46	6.42	1.3	8.5
60-80	0.71	2.97	0.07	46.29	41.31	4.98	7.64	6.52	1.0	7.6
80-100	0.63	3.35	0.02	45.62	42.02	3.60	8.04	6.80	0.8	4.3

As it is presented in the table, soil has neutral to slightly alkaline reaction, with high content of humus. In the adsorptive complex there is high content of adsorbed alkaline cations, which is typical for this type of soil. Content of essential nutrients has been analyzed too. Considering phosphorus it can be concluded that its content is low, and content of potassium can be considered as in the values of median content. The most important for increasing the proteins in the plants is Nitrogen, and its content can be considered as median too, which should be corrected by fertilizing.

Table 2: Content of Nitrogen in the red clover leaves of Kolubara cultivar.

Variant			
	Content of Proteins % (1st mowing)	Content of Proteins % (2nd mowing)	Content of Proteins % (3rd mowing)
V_0	19,76	17,,42	17,24
V_1	19,76	18,72	18,42
V_2	19,76	18,68	19,34

Out of the results presented in the table 2, it can be concluded as follows: Content of proteins in red clover without application of N fertilizers is the highest in the first mowing and it is decreasing in each following mowing. There are two reasons for this phenomenon. First one is quantity of Nitrogen accumulated by nodular microorganisms and second one is increased soil moisture in the spring time, which increases mobility of Nitrogen. Afterwards Nitrogen quantity decreases as a result of its consumption and its rinsing over time, which influents on protein content. This decrease of raw proteins exceeds 2,5% after the third mowing.

The climatic change impact on vegetation period is analyzed by comparing the meteorological data: precipitation, evapotranspiration and temperature (PET), in the period from 1990-2010 (fig. 1), and during the last year (fig.2).

The conditions for vegetation show significant difference in the observed period, and the last year showed some characteristics of dry and hot semi-arid climate. This can influence the yield of Red Clover in total, but also the protein concentration, as the protein is accumulated in the leaves.

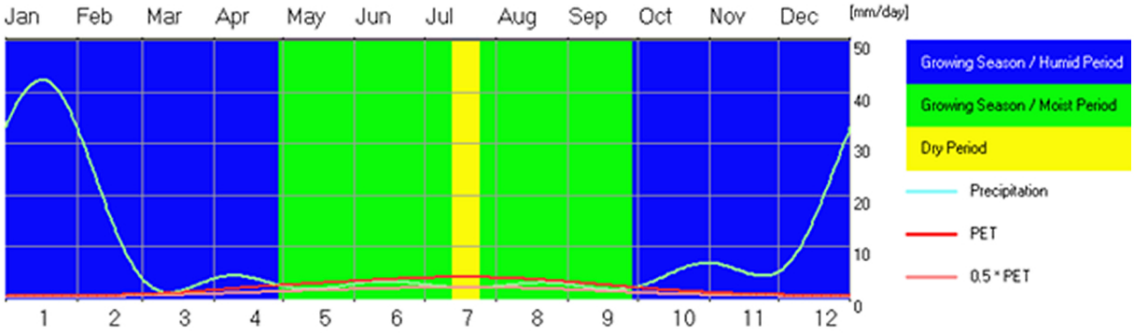

Figure 1: Vegetation period in Northern Kosovo, average in the interval 1992-2012.

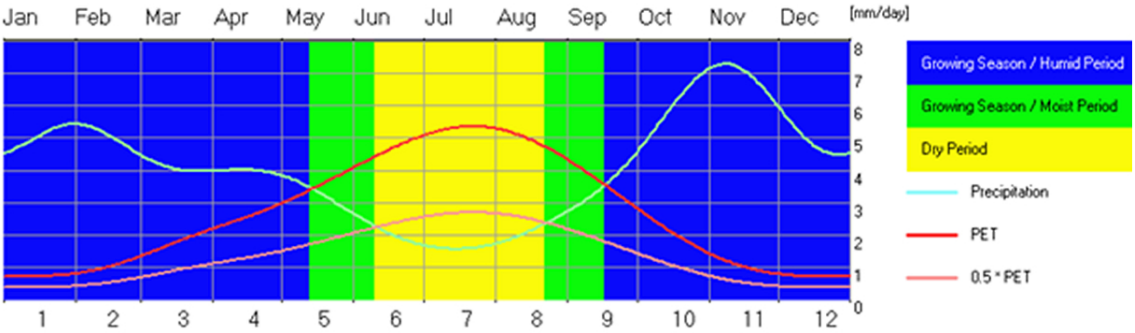

Figure 2: Vegetation period in Northern Kosovo, in 2012.

CONCLUSION

In order to prevent decrease of raw proteins, additional fertilizing with Nitrogen has been undertaken. This measure has cushioned decrease of raw proteins in red clover leaves. Thus with application with additional 30kgs/ha nitrogen after the first mowing, protein gap has been halved. With application of additional 30kgs/ha nitrogen, after the second mowing content of proteins has been increased and compared to the control without statistical significance.

Finally it can be concluded that continuously application of nitrogen fertilizers after each mowing enables equal production of raw proteins in a red clover leaves during the vegetation. As the vegetation period is significantly shortened by the climate change, we propose involvement of some other plants, such as old species (chickpea and okra, which are rich in protein), in the feeding mixture. This will also support the biodiversity conservation, by introducing the old species into modern agricultural production.

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