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**INFLUENCE OF DEVELOPMENT PHASE ON PRODUCTION
CHARACTERISTICS OF LUCERNE IN ZETSKO-BJELOPAVLICKA
VALLEY'S AGRO-ENVIRONMENTAL CONDITIONS**

SUMMARY

The paper presents the results of a two-year research on influence of development phase on production characteristics of lucerne, with a view to determining the optimal harvest time. The research was conducted in the Zetsko-Bjelopavlicka Valley's agro-environmental conditions (Ljeskopoljski Lug) using irrigation (irrigation norm 250 – 300 l/m² and irrigation rate 50 l/m²) and three variants of mowing (four-cut, five-cut and six-cut mowing system).

Mowing was done at the following phenological phases: boot phase, beginning of flowering and full flowering (seeding pods), while observing the occurrence and development of buds on the crown roots.

Based on these results we can conclude that the intensity of exploitation, that is, the number of cuts and phenological phases in which mowing is conducted has a very significant influence on production properties, primarily on the yield and nutritive value of the lucerne fodder.

Keywords: Lucerne, mowing, phenological phase, yield, quality.

INTRODUCTION

Lucerne is the most important fodder plant, characterized by high potential for yield of dry matter and high crude protein content. Its production properties depend on several factors, but lucerne's yield and nutritive value depend to a large extent also from the plant age, i.e. from the development phase at the mowing. It is known that earlier mowing results in a high nutritive value, but lower yield of dry matter, while as plants mature, they produce higher yield of a poorer quality. Results of research conducted by many authors (Bošnjak *et al.* 1983, Katić *et al.* 2004(a), 2007; Maksimović *et al.* 2007) point to the need to identify the optimal period for the use of lucerne with the objective of harmonizing its main production properties.

The yield and the quality of the fodder as well as period of exploitation depends, among others, to a large extent on mowing frequency, i.e. on the number of cuts during the vegetation period (Kallenbach *et al.* 2002; Nagy, 2003; Veronesi *et al.* 2006; Katić *et al.* 2004 and 2007). Đukić *et al.* (2004) underline that in average growing conditions and appropriate exploitation system, an

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average lifetime of a lucerne plant is three to five years, reaching high yields of dry matter and crude proteins.

The purpose of this research was to analyse the effects of lucerne mowing in different plant development phases and number of cuts during vegetation period on production properties, first of all, the yield of dry matter and yield and content of crude proteins.

MATERIALS AND METHOD

The research was conducted in the vicinity of Podgorica, on the trial plot of the Biotechnical Faculty, in the period 2004-2006. The soil of the trial plot is a deeper variety of brown Mediterranean soil, developed on powerful gravely fluvio-glacial deposits - (Fuštić *et al.* 1987). This soil is characterized by a mild acid reaction (pH in H₂O 5.81-6.05), low phosphorous content (6.78 mg/100g of soil), and a higher potassium content (22.50mg/100g of soil). Average humus content is 3.95%.

The region of the Zetsko-Bjelopavlička Valley is under the influence of a modified Mediterranean climate, characterized by mild and rainy winters and long, hot and dry summers. The major influence of the Mediterranean climate is in the coastal zone of the Lake of Skadar and the broader area of Podgorica, gradually falling towards the northern brinks of the valley and further along the valleys of the rivers Morača, Zeta and Cijevna. The climatic conditions in the years of research did not vary significantly from the multi-annual average (mean annual temperature 16.2⁰C, during vegetation 21.1⁰C and annual sum of precipitation 1530 l/m² and during vegetation 597 l/m²). However, a detailed analysis of the data leads to a conclusion that climatic conditions in 2006 were less favourable compared to the year before, which particularly applies to the rainfall distribution during the vegetation period.

The trial was set up in early September 2004 using the randomized block design with three repetitions. The plot area was 10m², hand-sown with seed rate of 15 kg/ha. Two varieties were included in this trial (Banat ZMS II and Legend) and autochthonous population Šas.

Mowing was done in three crop development phases, as follows: boot, beginning of blooming and full bloom. Six cuts were done in the first variant, five in the second and four in the third.

Spray irrigation was used in the trial plot, with irrigation norms of 250 l/m² in the first and 300 l/m² in the second year of the research, with irrigation rates of 50 l/m² each. The share of digestible proteins was done on the basis of tabular values of the nutrient contents of the fodder (Opačić, 1990).

The research programme included monitoring of the following parameters:

- green mass yield, measured immediately after mowing
- yield of dry matter, by drying at 60⁰ C
- content (by Kjeldahl) and yield of crude proteins (calculation based on the CP content and yield of dry matter)
- plant density

The results obtained were processed by variance analysis and significance of differences between mean values was established with the LSD test.

RESULTS AND DISCUSSION

Results of yield of fresh fodder, dry matter and crude proteins by variants, presented as mean values of biannual research (2005 – 2006) are presented in the Table 1 below.

Green Mass Yield

The highest average green mass yield of 68.65 t ha⁻¹ was in the case of the variety NS – Balkan, slightly higher than the Legend variety (68.12 t ha⁻¹) and significantly higher than the Šas population (60.04 t ha⁻¹).

Development phase at the cutting had a significant effect on the green mass yield. The highest yield was achieved at the beginning of the blooming in five-cut system and the lowest in the full bloom phase in the four-cut system. In all the varieties the differences were highly significant, while differences compared to yields in boot phase in the six-cut system were significant. The differences in yields between the boot and full bloom phases were not statistically significant.

Tab. 1. Average yields for cutting phases of examined lucerne varieties

Varieties	Cutting phases	No. of cuts	Yields (t ha ⁻¹)		
			Green mass	Dry matter	Crude protein
NS-Banat	Buton./Boot	6	67.61	13.52	3.20
	Poč.cvj./Beg.bl.	5	73.25	16.18	3.45
	Puno cvj./Bloom	4	65.10	15.62	2.99
	Prosječno/Aver.	-	68.65	15.11	3.23
Legend	Buton./Boot	6	65.31	12.51	3.12
	Poč.cvj./Beg.bl.	5	70.55	15.03	3.26
	Puno cvj./Bloom	4	63.28	13.93	2.74
	Prosječno/Aver.	-	68.12	13.82	3.06
Šas	Buton./Boot	6	59.66	12.65	2.68
	Poč.cvj./Beg.bl.	5	64.12	14.64	2.97
	Puno cvj./Bloom	4	56.35	13.71	2.57
	Prosječno/Aver.	-	60.04	13.67	2.83
LSD 005			5.34	1.12	0.22
001			7.16	1.66	0.39

Dry Matter Yield

The analysis of results of average yields of dry matter shows that the highest yield was achieved by the variety NS- Banat, 15.11 t ha⁻¹, highly significantly higher compared to the variety Legend (13.82 t ha⁻¹) and the population Šas (13.67 t ha⁻¹), which gave very close yields. The Legend variety is characterised by a somewhat higher share of leaves in the yield structure, which is why the dry matter yield is lower than expected on the basis of the green mass yield.

The highest average dry matter yields were at the beginning of bloom phase and the lowest at the boot phase. The differences in yields were highly significant, while compared to the yields in the full bloom phase, the differences were not statistically significant (tab.1).

Crude Protein Yield

Varieties NS - Balkan and Legend had close average crude protein yields (3.23 and 3.06 t ha⁻¹ respectively), highly significantly higher and significantly higher, respectively, compared to the population Šas (2.83 t ha⁻¹). The differences in yields among varieties were not significant.

The crude protein yield varied, depending on the development phase at cutting. All varieties had the highest yield at the beginning of bloom phase (five-cut system) very significantly higher compared to the full bloom stage (four-cut system) and significantly higher compared to the boot phase yield (six-cut system). The Legend variety in the boot phase had very significantly higher yield compared to the yield in the full bloom phase.

Dry Matter Quality (Composition)

All varieties under research had quite balanced average results of the chemical composition of the dry matter (tab. 2).

The dry matter share varied from 21.89 % with the Legend variety to 22.93 % with the Šas population. On average, the Legend variety had the highest share of crude proteins (22.11%), and the lowest of crude fibre (30.01%), while the Šas population had the lowest protein content (20.74%), and the highest fibre content (31.04%). The content of ash and digestible proteins was close among all varieties and populations under research.

Tab.2. Nutrients in % of examined lucerne varieties

<i>Varieties</i>	<i>Cutting phases</i>	<i>Dry matter</i>	<i>Crude protein</i>	<i>Fibres</i>	<i>Ash</i>	<i>Digestible protein</i>
NS-Banat	Buton./Boot	20.61	23.70	28.22	9.36	19.91
	Poč.cvj./Beg.bl.	22.10	21.33	30.18	8.81	16.00
	Puno cvj/Bloom	24.03	19.15	32.63	8.24	13.41
	Prosječno/Aver.	22.25	21.39	30.34	8.80	16.44
Legend	Buton./Boot	20.74	24.95	28.07	9.42	20.26
	Poč.cvj./Beg.bl.	21.30	21.70	29.86	8.81	16.28
	Puno cvj/Bloom	23.65	19.68	32.10	8.15	13.78
	Prosječno/Aver.	21.89	22.11	30.01	8.79	16.77
Šas	Buton./Boot	21.15	23.52	28.60	8.90	19.76
	Poč.cvj./Beg.bl.	22.80	20.35	31.24	8.51	15.26
	Puno cvj/Bloom	24.10	18.74	33.28	8.10	13.12
	Prosječno/Aver.	22.93	20.74	31.04	8.50	16.05

Significant differences in the dry matter composition were noted in different plant development phases at cutting. The most favourable chemical composition and the highest nutritive value of the fodder (dry matter) were in the

boot phase and the lowest in the full bloom phase. The share of crude and digestible proteins and minerals decreases as plants mature, while fibre content rises, which indubitably points to the decrease of the fodder's nutritive value.

The results obtained in this research are in line with the conclusions of most of the authors studying this problem (Bošnjak *et al.* 1983, Maksimović *et al.* and Katić *et al.* 2007); the difference being that the six-cut system had not been included in their research.

CONCLUSION

Based on results of the two-year research of the influence of development phase on cutting of lucerne it can be concluded that the highest average yields of green mass dry matter and crude proteins were achieved in the beginning of bloom phase and the lowest in the full bloom phase.

The differences in average yields among varieties under research were significantly lower than the differences among the development phases at cutting the Lucerne.

The varieties under research had a quite balanced chemical composition, while more significant differences were established in the share of nutrients in dry matter in different development phases.

The best production properties of the varieties under research were in five-cut system (beginning of bloom phase) and the lowest with four-cut system in full bloom phase. The six-cut system resulted in somewhat lower yields (compared to five-cut system) in fodder of high nutritive value.

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**UTICAJ FAZE RAZVOJA NA PROIZVODNE OSOBINE
LUCERKE U AGROEKOLOŠKIM USLOVIMA
ZETSKO-BJELOPAVLIĆKE RAVNICE**

SAŽETAK

U radu su prikazani rezultati dvogodišnjih ispitivanja uticaja faze razvoja na važnije proizvodne osobine lucerke, sa ciljem utvrđivanja optimalnog vremena kosidbe. Ispitivanja su sprovedena u agroekološkim uslovima Zetsko-Bjelopavličke ravnice (Leškopoljski lug), uz primjenu navodnjavanja kišenjem (norma navodnjavanja $250 - 300 \text{ l/m}^2$ i zalivna norma 50 l/m^2) i tri varijante kosidbe (četvoro, peto i šestootkosni sistem).

Ogled je košen u sljedećim fenološkim fazama: butonizacija, početak cvjetanja i puno cvjetanje (zametanje mahuna), uz praćenje pojave i razvijenosti pupoljaka na kruni korijena.

Na osnovu dobijenih rezultata može se zaključiti da intenzitet iskorišćavanja, odnosno broj okosa i fenološke faze u kojima se kosidba obavlja vrlo značajno utiče na proizvodne osobine, prvenstveno na visinu prinosa i hranljivu vrijednost krme lucerke.

Ključne riječi: lucerka, kosidba, fenološka faza, prinos, kvalitet.