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YIELD AND CHEMICAL COMPOSITION OF ORCHARD GRASS HARVEST REMAINS-STRAW (*Dactylis glomerata* L.) DEPENDING ON THE VEGETATION SPACE AND APPLICATION OF MINERAL FERTILIZERS

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Abstract: In the process of forage-blade perennial grass seed production, a certain amount of harvest remains-straw is gained. Orchard grass is the most prominent species of the forage plants, due to seed requirements and the amount of straw per harvest and the leaf ratio in the yield. The proper choice of vegetation spacing and the application of mineral fertilizers are the key factors for high yield of both seed and harvest remains. There are several opinions about the quality of harvest remains. According to some authors this straw is worthless and should not be used for livestock nutrition. Another opinion is that this feed has poor nutritive value, but may be significant bulk feed for livestock, such as calves, with lower nutrient requirements. Therefore, the aim of this paper is to determine the yield and the composition of harvest remains of orchard grass. The gained harvest remains of orchard grass is of poor quality. However it can be used as the bulk feed where the concentrated feed is dominant, such is the calf fattening. The vegetation space has the significant influence on the content of ADF and NDF in leaf and on the content of NDF in the stem. The application of mineral fertilizers, also, has the significant influence on the yield of harvest remains, on the content of ADF and NDF in leaf and on the content of crude protein and NDF in the stem. So, the proper using of mineral fertilizers can affect the seed yield and, also, the yield and quality of harvest remains.

Key words: orchard grass, harvest remains, yield, chemical composition

Introduction

Orchard grass is the most prominent species of the forage plants, due to seed requirements and the amount of straw per harvest and the leaf ratio in the yield. There are several opinions about the quality of harvest remains. Some authors suggest that this straw is worthless and should not be used for livestock nutrition. Other opinion is that this feed has poor nutritive value but it can be significant as bulk feed for livestock with lower nutrient requirements, such as calves. In some years with long dry periods there are lack of bulk livestock feed with high nutrient value made of perennial forage legumes, clover-grass mixtures or blade grasses. *Dinić et al. (2003)* state that the orchard grass forage has a high protein content, which in the phase of earing is 195.5 g kg^{-1} DM (dry matter), while in the phase of blossoming is 176.4 g kg^{-1} DM. *Dinić et al. (1999)* also indicate that orchard grass cut in the later stages, usually the case in practice, contains 115.3 g kg^{-1} DM. According to *Waldo (1984)* the amount of the NDF (neutral detergent fiber) in the feed is the best single indicator of consumption potential for ruminants. *Jorgenson (1984)* indicates that the ADF (acid detergent fiber) consists of high amount of insoluble cellulose components (cellulose, lignin, insoluble ashes) and is a good indicator of digestibility of that feed.

Materials and Methods

The study was conducted during two year period in four repetitions. It was done in the agro-ecological conditions of eastern Serbia on the soil of vertisol type. Next parameters were studied:

- Interrow spacing of 12.5 cm, amount of seeds in the sowing 30 kg ha^{-1} - the first way of sowing (A_1);

- Interrow spacing 25 cm, amount of seeds in the sowing 15 kg ha^{-1} - the second way of sowing (A_2).

A is a factor of the amount and time of mineral fertilizer application:

- B_0-control-without mineral fertilizers;

- B_1-400 kg ha^{-1}, N15: P15: K: 15, or pure fertilizers N60: P60: K60 kg ha^{-1} applied in the fall;

- B_2-400 kg ha^{-1}, N15: P15: K: 15 +110 kg ha^{-1} KAN 27%, or pure fertilizers N90: P60: K60 kg ha^{-1}, applied in the fall;

- B_3-400 kg ha^{-1}, N15: P15: K: 15, that is pure fertilizers N60: P60: K60 kg ha^{-1} applied in early spring;

- B_4-400 kg ha^{-1}, N15: P15: K: 15 +110 kg ha^{-1} Khan 27%, or pure fertilizers N90: P60: K60 kg ha^{-1} applied in early spring, (factor B, treatments B0 to B4).

After the seed harvest, the yield of harvest remains was determined (t ha^{-1}), and so was the leaf ratio (%) and the stem with panicle ratio (%). On the air-dry forage following chemical analyses were conducted:

- Crude protein content (CP-DM g kg^{-1}) by Kjeldahl method on the Kjeltec Auto System;

- NDF content by methods of *Van Soest and Wine (1967)*,

- ADF content by methods of *Van Soest (1963)*.

The results of yield and chemical analysis of the forage were analyzed using two-factor analysis of variance (ANOVA). Significant difference between treatments was determined by LSD test.

Results and Discussion

In the seed production, many measures are taken in order to achieve as greater seed yield as possible. The harvest remains are a by-product and are part of the reason for such low yields, (Table 1). Crop from the first treatment (A_1) achieved higher yield of 0.16 t ha^{-1}, which is negligible. The yield of harvest remains varied depending on the application of mineral fertilizers up to 1.71 t ha^{-1} in the first way of establishment. In the second way of establishment (A_2) it was varied up to 1.75 t ha^{-1}. The goal in voluminous animal feed production is to achieve a higher content of leaf in the total weight of which causes a better forage quality. Depending on the share of vegetation space, the share of leafs varies to 0.93%. Application of mineral fertilizers in the first way of establishment demonstrated the impact on the leaf share for 2.39%, and the second way of establishment was lessened for 0.46% (Table 1). In the orchard grass seed production the higher number of stem mainly affects the achievement of higher seed yield, so the goal of raising technology is to increase the number of stems. The average ratio of stems with panicles in the first way of sowing was 77.08% and 78.03% in the second. Treatment with the application of mineral fertilizers affected the ratio of stems with panicle to 2.3% in the first way of establishment and to 1.7% in second way. In addition to a slightly larger share of leaf and greater seed yield on the crops established at the narrower interrow spacing with the A_1 treatment, a higher content of crude protein was found (Table 1 and 2)

Table 1. Total yield (t ha^{-1}), the leaf ratio (%) and stem ratio (%), depending on the vegetation space, average for 2007 – 2008

A / B	A_1			A_2		
	Total yield (t ha^{-1})	Leaf (%)	Stem and panicle (%)	Total yield (t ha^{-1})	Leaf (%)	Stem and panicle (%)
B_0	1.38	23.68	76.32	1.24	22.98	77.02
B_1	2.65	21.29	78.71	2.46	21.07	78.93
B_2	2.91	23.65	76.35	2.81	22.09	77.91
B_3	2.78	22.87	77.13	2.51	21.21	78.79
B_4	3.09	23.02	76.90	2.99	22.52	77.48
$\overline{X}$	2.56	22.90	77.08	2.40	21.97	78.03

			Yield	Leaf	Stem and panicle
	A	0,05	0.271	2.916	5.777
LSD 0.05	B	0.05	0.050	2.071	4.976

In the A_2 treatment, 0.4% lower content of crude protein was found, compared to the A_1. At the same treatment, leafs had higher crude protein content of 17.7 g kg^{-1} DM, and for the treatment of A_1, row protein content was greater of 20.7 g kg^{-1} DM.

Table 2. The average content of crude protein, ADF and NDF in leaf depending on the vegetation space and the application of mineral fertilizers

A \ B	A_1			A_2		
	CP (g kg^{-1} SM)	ADF (g kg^{-1} SM)	NDF (g kg^{-1} SM)	CP (g kg^{-1} SM)	ADF (g kg^{-1} SM)	NDF (g kg^{-1} SM)
B_0	48.4	500.2	892.1	39.6	528.3	870.4
B_1	40.7	473.0	839.4	43.5	475.4	846.2
B_2	50.6	467.3	817.3	52.2	449.4	926.6
B_3	40.2	439.7	815.8	42.9	454.1	927.7
B_4	52.7	453.6	819.9	52.1	484.5	893.8
$\overline{X}$	46.5	466.9	836.9	46.1	478.5	892.9

			SP	ADF	NDF
	A	0.05	0.043	1.173	0.799
LSD 0.05	B	0.05	0.067	2.956	1.265

Application of the mineral fertilizers in the first way of sowing demonstrated impact of 12.0 g kg^{-1} DM of crude protein, and 12.6 g kg^{-1} DM in the second way of the sowing. Examining the content of crude protein after 10 days from the end of blossoming, *Dinić (1999)* found the value of 126.4 g kg^{-1} DM in the leaf. In the first way of sowing the harvest remains of orchard grass leaf contained an average ADF of 466.9g kg^{-1} DM. Leaf contained 43.6 g kg^{-1} DM of ADF less compared to the stem with panicle. Application of mineral fertilizers had influence on the ADF of 60.5 g kg^{-1} DM. In the second way of sowing, the average ADF content determined was 11.6 g kg^{-1} DM lower than in the first way. Leaf had ADF for 42.8 g kg^{-1} DM lower in this way of establishment compared to stems with panicle. ADF was varied under the influence of mineral fertilizers for 36.6g kg^{-1} DM. Orchard grass leaf contained 836.9 g kg^{-1} DM NDF after seed harvesting in first way of sowing, and stem contained for 89.2 g kg^{-1} DM more. The second way of the sowing achieved 56 g kg^{-1} DM higher NDF content compared to the first. Also, leaf achieved lower NDF content for 39.2 g kg^{-1} DM compared to stem. Application of mineral fertilizers showed influence on NDF varying for 76.3 g kg^{-1} DM in the first way of sowing and for 81.5 g kg^{-1} DM in the second (Table 2 and 3).

Table 3. The average crude protein content, ADF and NDF in the stem and panicle depending on the vegetation space and the mineral fertilizers applied

A / B	A$_1$			A$_2$		
	CP (g kg^{-1} SM)	ADF (g kg SM)	NDF (g kg^{-1} SM)	CP (g kg^{-1} SM)	ADF (g kg^{-1} SM)	NDF (g kg^{-1} SM)
B$_0$	18.1	544.7	935.9	20.5	514.4	916.6
B$_1$	29.1	552.9	912.9	33.5	544.2	934.7
B$_2$	24.9	508.6	948.6	26.9	529.2	924.5
B$_3$	29.4	492.7	932.7	27.7	507.4	944.1
B$_4$	27.6	453.6	900.2	33.5	511.3	940.8
$\overline{x}$	25.8	510.5	926.1	28.4	521.3	932.1

	SP	ADF	NDF
A	0.083	1.869	0.799
LSD 0.05 B	0.052	2.956	1.265

According to *Dinić (1999)* orchard grass forage contains 67.5 g kg^{-1} DM crude protein in the stem. However, it is about the exploitation phase (10 days after the end of blossoming). From the aspect of animal feed quality, the one which is obtained from the stem is of much lower quality in relation to that provided by leafs, or where leafs participated in a higher percentage. It was determined by chemical analysis that the average content of crude protein in stem is 25.8 g kg^{-1} DM in the first way of sowing, and slightly more in the second (Table 3). Influence of vegetation space on the content of ADF, was negligible. The influence of the application of mineral fertilizers showed significantly greater impact (in A$_1$ = 552.9 g kg^{-1} DM-B$_2$, and 453.6 g kg^{-1} DM-B4. Also, the NDF in a different vegetation space showed minor differences. Under the influence of mineral fertilizers NDF was varied to 48.4 g kg^{-1} DM in the first vegetation space, and 27.5 g kg^{-1} DM in the second vegetation space (Table 3).

Conclusion

Based on the complete testing of yield and chemical composition of harvest remains of orchard grass (*Dactylis glomerata* L.) depending on the vegetation space and application of mineral fertilizers, it can be concluded that:

- Production of orchard grass seed spurs a certain amount of harvest remains as the by-product;

- The vegetation space has had a significant influence on the content of ADF and NDF in the leaf and the NDF in the stem;

- The application of mineral fertilizers have had a significant influence on the yield of harvest remains, on the crude protein content, ADF and NDF content in the leaf, as well as on the NDF content in the stem. Thus, the proper mineral nutrition can affect the yield and quality of harvest remains, in addition to seed yield. Harvest remains can be successfully used to satisfy the needs for bulk feed of certain livestock categories, especially when the concentrated feed is dominant.

Prinos i hemijski sastav žetvenih ostataka ježevice (*Dactylis glomerata* L.) u zavisnosti od primene mineralnih hraniva i vegetacionog prostora

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Rezime

Prilikom proizvodnje semena krmnih trava ostaje izvesna količina žetvenih ostataka. Ježevica je vodeća krmna trava, kako po potrebama za semenom, tako i po količini i udelu lista u žetvenim ostacima, odnosno po kvalitetu žetvenih ostataka. Pravilan izbor vegetacionog prostora i primena mineralnih đubriva su ključni faktori za visok prinos i semena i žetvenih ostataka.

U praksi vlada mišljenje da su ovi žetveni ostaci veoma lošeg kvaliteta, odnosno u hranljivom pogledu bezvredni, druga mišljenja su da mogu biti značajna kabasta hrana za ishranu junadi, ovaca i koza, odnosno kategorija životinja gde su zahtevi za kvalitetom hraniva niži.

U radu je prikazan prinos žetvenih ostataka (t ha^{-1}) i procentualni udeo lista u odnosu na druge delove biljke. Hemijske analize lista (SP, NDF, ADF, hemiceluloze, lignin) i drugih delova biljke pokazuju da su ovo solidna hraniva za kategorije životinja sa nižim zahtevom kvaliteta.

Primena različitih mineralnih hraniva kao i vegetacioni prostori su značajno uticali na prinos žetvenih ostataka i procentualni udeo lista. Na ostale praćene pokazatelje kvaliteta uticaj primene mineralnih hraniva i vegetacionih prostora nisu pokazali statistički značajne razlike.

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