THE IMPORTANCE OF SOWN GRASSLANDS AND SHARE OF LEGUME SPECIES IN THE MIXTURES FOR THE LIVESTOCK PRODUCTION

D. Lazarević, M. Stošić, Z. Lugić, D. Terzić

Abstract: The production of quality forage has a significant role in a rational production of meat and milk, especially when we take into account that animal feeds make the largest portion in livestock production expenses. A suitable choice of grass-leguminous mixture is a prerequisite for the production of quality animal feeds and thus for greater production of meat and milk. One of the major prerequisites for a grass-legume mixture to provide a high production level and quality of animal feeds is an adequate share of leguminous components therein during a whole cycle of grasslands exploitation. With that aim, in the Centre for Forage Crops in Kruševac, many trials have been conducted from various aspects, so that this paper describes an analysis of the results of the influence of leguminous component in mixtures on production and qualitative characteristics of mixtures in lowland and hilly-mountainous regions. As a rule, grass-leguminous mixtures are more productive than pure legume in the same way as grass species fertilized by 100 kg N. Thus the mixture of alfalfa and orchard grass obtained a dry matter yield of 14.2; pure alfalfa 13.7; orchardgrass 8.7 and orchardgrass fertilized by 100 kg N 11.7, tha1. Similar results have also been obtained for other mixtures (red clover and Italian ryegrass, bird’s foot trefoil and meadow fescue, white clover and perennial ryegrass). Leguminous component in mixtures effects a reduced reaction of fertilizer on the increasing of grassland yield and content of proteins and minerals in relation to grass species. The share of legumes in the amount of 30% provides a good balance between a high production and grassland quality.

Key words: grasses, legumes, mixtures, production, chemical composition

Introduction

Livestock production, especially cattle breeding as its integral part, is a pivot of development of every agricultural production. Livestock production is the only branch in which a relatively rough farm products are being turned into fine ones, namely meat and milk. Transformation of a whole economy, that is, a functioning of market mechanisms is imposed as a necessity to increase the volume of production with the lowest possible inputs making it as more rational as possible. Animal feeds have the largest share in the expenses structure of the production of milk and meat which according to the results of Koljačić et al. (1995) amount to 50%, i.e., over 60%, so that in this production and preparation thereof lies a great opportunity for finding out the ways of making an overall livestock production a more economical one. A key role in all this has a production, conserving and utilization of quality forage animal feeds which ought to replace expensive concentrated feeds. The results of numerous domestic and foreign authors (Radojević and Stošić, 1975; Stošić and Jeremić, 1981; Orr et al., 1990; Stošić and Lazarević., 1997) are pointing to the possibility of the production of high quality forage animal feeds which if adequately conserved (Dinić et al., 1997; Dinić et al., 2002) can guarantee a high and economically justified livestock production.

A major acicde of forage animal feeds are natural and sown grasslands which in Serbia occupy about 31% of agricultural surface, especially in hilly-mountainous region, where they represent almost the only acicde of animal feed. In a numerous trials it has been confirmed that by an adequate fertilizing (Stošić and Radojević, 1980; Lazarević et al., 1999/3) and utilization, besides a high production, a high quality of plant mass from grasslands could also be realized. There is no doubt that sown grasslands are in advantage over natural ones because they have better yield, production and quality.

In Serbia, the production of livestock feeds on sown grasslands started more largely in the ‘60s of the last century when it quickly reached its peak. They are particularly important on slopes and lighter soils, what is a common feature of higher terrains. They spread and occupied the surfaces formerly used for growing of

1 Review paper supported by the Ministry of Science and Environment Protection, Project no. TR6872B - Revijalni rad je finansiran od strane Ministarstva za nauku i zaštitu životne sredine Projektom broj: TR6872B
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cereals eliminating in that way the need for frequent cultivation of soil and playing a crucial role in protecting the soil from the erosion. In lowland area sown grasslands occupied margin types of soil such as pseudogley, marshy terrains, strong podzolic soils and smonica or terrains with a high level of underground waters. More rarely they are formed within farm systems as an intensive type of production. It is estimated that in the time of spreading of sown grasslands they occupied about 150,000 ha, but today those surfaces are reduced significantly primarily due to a dramatic downfall in livestock fund.

Considering the fact that the grasslands are sown on less fertile soils in most cases unfavourable for growing of leguminous species there is a problem of their maintenance in mixtures what affects adversely the reduction of quality plant mass. The aim of this paper was to summarize some long lasting experiences and results in livestock feed production from sown grasslands with special emphasis being given to the importance of preserving leguminous species in mixtures and corresponding measures.

Production of grass-leguminous mixtures

Grass-leguminous mixtures have a high production potential (over 20 t\,ha\(^{-1}\) DM), but the level of their utilization depends on the conditions of growing and use of suitable agricultural measures. A great variety of species, especially when grasses are in question, enables making compositions of grass-leguminous mixtures adapted to various climate and soil conditions and the mode of utilization. Far greater problem occurs during the choice of leguminous components, because of, for example, sensibility of alfalfa to acid soils, a brief life of red clover, bad competitive ability of bird's foot trefoil and white clover in cutting conditions of utilization. No matter the fact that the mixtures can be made to endure better some habitats or the level of culture operations it is quite normal to have a greater production of grasslands on more fertile soils than on less fertile ones. For example, we shall compare the results obtained in the vicinity of Kruševac on alluvial soil (Fig.1) and on mountain Kopaonik on brown-ore soil (Fig.2), where it can be observed that the same mixtures realized much greater productivity on more fertile soil, that is on smaller altitudes. On lower altitudes the most productive were the mixtures of red clover and Italian ryegrass, and alfalfa and orchardgrass, whereas on higher altitudes in acid reaction soils the most productive was the mixture of meadow fescue and bird's foot trefoil, then the mixture of meadow fescue, Italian ryegrass and perennial ryegrass, and red and white clover and bird's foot trefoil.

Among agriculture measures a system of fertilization and utilization of grassland (Lazarević et al., 1998, 1999/3, 2001/1, 2001/2) has the greatest effect on the production of mixtures. The grasslands are most frequently established outside crop rotation, on poorer, acid, more shallow and skeletal soils. For that reason the production of livestock feed cannot be organized there without fertilizing because it would be rather a negligent one. It can be best illustrated by the results of Stošić and Radovević (1980) where average nine-year production of mixtures depending on applied quantity of fertilizer is shown.

Figure 1. The yield of single grasses and legumes and their mixtures (150 m a.s.l.) 1. Italian ryegrass+red clover, 2. Orchardgrass+alfalfa, 3. Perennial ryegrass+white clover, 4. Meadow fescue+yellow bird's foot trefoil
The Importance Of Sown Grasslands And Share Of Legume Species In The Mixtures For The Livestock Production

Figure 2. The yield of grass-leguminous mixtures on Kopaonik mount. (1200 m a.s.l.) 1. Italian ryegrass+red clover, 2. Perennial ryegrass+white clover, 3. Meadow fescue+yellow bird's foot trefoil, 4. All grasses and legumes

Table 1. Effects of NPK fertilizers on the average 9 year yield of the mixtures (Stošić and Radojević, 1980)

<table>
<thead>
<tr>
<th>Fertilization</th>
<th>tha⁻¹</th>
<th>%</th>
</tr>
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<tbody>
<tr>
<td>Control</td>
<td>1.96</td>
<td>100.0</td>
</tr>
<tr>
<td>N₁₅₀P₆₀K₅₀</td>
<td>7.08</td>
<td>361.2</td>
</tr>
<tr>
<td>N₁₅₀P₆₀K₇₀</td>
<td>7.18</td>
<td>366.3</td>
</tr>
<tr>
<td>N₁₅₀P₆₀K₉₀</td>
<td>6.45</td>
<td>329.1</td>
</tr>
<tr>
<td>N₁₅₀P₆₀K₁₁₀</td>
<td>6.83</td>
<td>348.5</td>
</tr>
<tr>
<td>N₁₅₀P₆₀K₁₂₀</td>
<td>7.04</td>
<td>359.2</td>
</tr>
<tr>
<td>N₁₅₀P₇₀K₅₀</td>
<td>7.19</td>
<td>366.8</td>
</tr>
<tr>
<td>N₁₅₀P₇₀K₇₀</td>
<td>6.46</td>
<td>329.6</td>
</tr>
<tr>
<td>N₁₅₀P₇₀K₉₀</td>
<td>7.30</td>
<td>372.4</td>
</tr>
<tr>
<td>N₁₅₀P₇₀K₁₁₀</td>
<td>7.72</td>
<td>393.8</td>
</tr>
<tr>
<td>N₁₅₀P₇₀K₁₂₀</td>
<td>4.11</td>
<td>209.2</td>
</tr>
</tbody>
</table>

The results clearly show that sown grasslands require a complete fertilization by NPK fertilizers increasing the production 3 or 4 times. The application of single nutrients seems to be unjustifiable since very rapidly it leads to some other elements which restrict the production. Although the N is a bearer of productivity the application of N₁₅₀P₇₀ without K leads to decrease in yield of 7.72 tha⁻¹ and on the treatment with N₁₅₀P₆₀K₁₂₀ to 4.1 tha⁻¹. The same is also with singular use of some other fertilizers. The results show that the greatest production was obtained on the treatment with N₁₅₀P₆₀K₁₂₀, greater even than with N₁₅₀P₆₀K₉₀, what indicates optimal fertilizing of grasslands in hilly-mountainous region.

Dynamics of forming of biomass on sown grasslands and its distribution during a vegetation period depends on many factors. Among them the most important are ecological conditions with altitude as a deciding effect, biological properties of leading components, fertilization, quantities and distribution of precipitations, the time of the first utilization, etc.. It is a lawful property of all grasslands regardless differences between them that the accumulation of organic matter flows constantly from the beginning to the end of vegetation period. However, that process is not equalized; in the beginning it is quite voluminous, then falls to the minimum in drought period (late July, August) and again it grows by the beginning of September. It has been established that the most intensive forming of biomass is in the second decade of May (Stošić, 1988). Study of the dynamics of daily production is a prerequisite of organizing continuous production of livestock feed on grasslands where the goal is to obtain more equalized distribution possible during a vegetation period. That equalization could be partly realized by combining various species and cultivars which differ in early maturity, and therefore in the time of maximum accumulation, what is extremely important for pasture system of utilization. As an example we can present the results from Kopaonik mount (obtained at 1200 altitude) where the use of first cut began on 20th May (red fescue), and finished on 25th June (thinothy), what means that in the period lasting 35 days vegetative mass was continuously maturing (Tomić et al., 1989). On the other hand, the system of grasslands utilization effects, in the first place, the
height of daily production, while the curve itself has a relatively uniform trend. It can be illustrated by the results of daily production of sown grasslands (alfalfa, orchard grass and perennial ryegrass) obtained in the conditions of alternate grazing and continual grazing of sheep in comparison with cutting utilization (Fig. 3).

![Figure 3: Daily production of sown lawn in different systems of utilization (Lazarević et al., 1999/1, 2001/1)](image)

The importance and maintenance of leguminous species in mixtures

In order to obtain high production of grasslands and quality of plant mass it is necessary to make a good balance between grasses and legumes in mixtures to be maintained during longest possible period of exploitation. In lowland region and on more quality types of soil it is not so great a problem, but it is more strongly expressed on acid soils and in mountainous regions. Leguminous species, due to the ability of nitrogen fixation, decrease the need for application of N fertilizers. Frame and Newbould (1986) reported out that white clover could fix from 80-280 kg N ha\(^{-1}\), so that the application of N fertilizers could be significantly reduced or even eliminated. Holiday (1992) pointed out that the mixtures realized the same yield as grasses fertilized by 180-200 kg N ha\(^{-1}\), that is, that the production of milk per 1 ha on mixtures was the same as on grasses fertilized by 250-300 kg N ha\(^{-1}\). It can also be confirmed by our results (Fig.1) that mixtures always give greater production of grasslands in relation to pure legumes, as well as grasses fertilized by 100 kg N ha\(^{-1}\) (Lazarević et al., 1998). Similar results were obtained by Stošić and Jeremić (1981). In western Europe it is thought that mixtures should realize 80% production in relation to grasses on which 300-400 kg N ha\(^{-1}\) has been applied (Soegard, 1988; Morrison, 1988; Orr et al., 1990; Holliday, 1992, etc.).

The question is which is the optimal share of legumes from the aspect of maintaining a high productivity of grasslands and high quality of vegetative mass. Increasing the share of legumes leads to improving of quality of vegetative mass, and also, as by rule, to increasing productivity. Stošić and Jeremić (1981) obtained greater production of vegetative mass when the ratio of legumes and grasses was 70:30 than reversely. Phtlin and Journet (1983), are of the opinion that share of white clover in the mixture in the amount of 30% provides a balance between a high production and quality of vegetative mass. Similar data were displayed by Murphy (1987) who thinks that 35% of white clover seems to be necessary. The share of leguminous component cannot be the same in all species. In higher species (alfalfa, red clover) it can be greater than in lower ones (white clover, bird's foot trefoil), what is suggested by the results of Stošić and Jeremić (1981).

The preserving of leguminous component in mixtures is hindered and highly influenced by ecological conditions, regime of plants nutrition and utilization. Determination of the relation of major nutrients and their quantities is a delicate task; more difficult than in any other crops. Since the composition of mixture is being changed in each following year of utilization, the kinds and quantities of fertilizer must be constantly adapted to a new situation. A decisive role in maintenance of leguminous species in the mixtures has a system of fertilizing and utilizing of grasslands. Nitrogen, as an upholder of productivity by imposing grass species leads to pushing out the leguminous species, while on the other hand phosphorus and potassium strengthen their development, but only in cases when smaller quantities of nitrogen are applied (Lazarević, 1994; Stošić et al. 2004). The problems are more expressed on acid soils where the activity of symbiotic microorganisms is decreased and where the need for nitrogen is more emphasized. By calcification these problems can be significantly alleviated and simultaneously retained a greater share of legumes in mixtures.
By application of 2 tha-l lime on humic-silicate soil in Kopaonik mount a greater yield of vegetative mass by 22.5% was obtained along with the share of Sweden clover (Trifolium hybridum) of 38.7-49.5%, while in treatments where lime had not been used there was observed their complete withdrawal. Søegard (1998) obtained greater share of white clover in mixture with top dressing on the 11th day post harvest in relation to top dressing on the first day. After defoliation N fixation is considerably reduced in a few hours and resumes its normal level in 2 weeks only (Gordon et al., 1990), so that by the addition of nitrogen immediately after defoliation it stimulates the development of grass species and reduces nitrogen fixation decreasing in this way the yield of legumes in mixture. Urea has a smaller influence on the decrease of nitrogen fixation (15%) in relation to KAN (27%) (Murphy, 1987).

A system of utilization plays a significant role in floristic composition. By trials conducted in the around of Kruševac (Lazarević et al., 1999) it was established that the projected ratio of alfalfa, orchard grass and perennial ryegrass of 40:30:30% was in the second year of utilization 29:10:50% in alternate grazing, 0:4:73% in continuous grazing, 11:19:52% in frequent cutting and 16:59:20 in non-frequent cutting. In continuous grazing alfalfa completely withdrew and its place was refilled by white clover (21%) from spontaneous flora.

Quality of vegetative mass from sown grasslands

Sown grasslands, besides pure legume crops, represent the surfaces where highest quality forage livestock feed can be provided. Quality of vegetative mass from sown grasslands depends on numerous factors such as the share of species in mixtures, especially on the share of leguminous plants in biomass, the phasis of the plant development, fertilization, way of conserving and utilization, etc., (Scehovic, 1981; Dinić et al., 1994a; Lazarević, 1996).

A special significance, when the quality of vegetative mass on the grasslands is in question, have leguminous plants. By their high content of protein, minerals and carotene (Sredanović et al., 1991; Dinić et al., 1994b) they are excellent supplement to grass species, which have lower content of proteins, but are richer in carbohydrates. Regularly balanced relationship of grasses and legumes in mixture supplies the animals with quality feed both from the aspect of energy and protein. By investigations carried out in the vicinity of Kruševac (Lazarević et al., 1999/2) it was found that the mixture of red clover and Italian ryegrass had a greater content of proteins than pure Italian ryegrass by 36%, and by 8.3% less than red clover. The similar was found in mixture of alfalfa and orchard grass which had greater content of protein by 33.7% than orchard grass and less by 4% in relation to pure alfalfa. It is identical also with the mixtures of white clover and Perennial ryegrass, that is, meadow fescue and bird's foot trefoil. Similar results were obtained by Jeremić and Stolić (1981) with mixtures of alfalfa and orchard grass, that is, red clover and Italian ryegrass.

On the other hand, leguminous components effect also in a positive way greater consuming of vegetative mass by increasing its flavour, increasing in the same time the livestock production. Holliday (1992) pointed out that 25% legumes in mixture increased consuming by 10%. Newton et al. (1985) confirmed that lambs had greater live body weight gain (328 g) when grazing mixture in comparison with perennial ryegrass fertilized by 200 kg Nha⁻¹ (269 g). Also a dressing percentage of meat in the same lambs was 49.7% and the production of meat 553 kg ha⁻¹ on mixtures, while by the grazing of grasses the dressing percentage was 47.5% and meat production 507 kg ha⁻¹.

Conclusion

On the basis of the results obtained it can be concluded that sown grasslands represent a significant potential for the production of quality livestock feed improving a livestock production as a whole. Numerous research results suggest that by a suitable choice of mixtures, in the first place by making a good balance between grasses and legumes and suitable culture operations a high production of quality livestock feed can be realized. By a share of legume in the mixtures in the amount of 30-35% a balance among high productivity, reduced application of mineral fertilizers and high quality of vegetative mass is being realized. As by rule, the mixtures are more productive in relation to pure legumes in the same way as grasses fertilized by 150-200 kg Nha⁻¹.
A maintenance of leguminous component in mixtures is in the greatest part influenced by fertilization, especially by a level of N nutrition and utilization. A larger application of N fertilizer leads to removing of leguminous species. By calcification of acid soils the prerequisites are being created for maintaining legumes in mixtures particularly in hilly-mountainous region.

A distribution of production throughout a year is unequalized, being intensive in spring and less intensive in the second half of year but a maximum daily production could change by using the mixtures of different time of maturing.

By use of mixtures 5-10% lower protein content is obtained in relation to pure legumes but significantly higher in relation to grasses. Also, a higher daily live weight gain and production of milk per ha is obtained in relation to grass species.

ZNAČAJ SEJANIH TRAVNJAKA I UDELA LEGUMINOZNIH VRSTA U SMEŠAMA U PROIZVODNJI KABASTE STOČNE HRANE

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Rezime

Proizvodnja kvalitetne kabaste stočne hrane ima značajnu ulogu u nacionalizaciji proizvodnje mesa i mleka, posebno kada se ima u vidu da stočna hrana ima najveći udeo u tržkovima stočarske proizvodnje. Pravilan izbor travno-leguminoznih smeša stvara preduslove za proizvodnju kvalitetne stočne hrane, a time i povećanje proizvodnje mesa i mleka. Jedan od osnovnih preduslova da bi jedna travno-leguminozna smeša obezbedila visoku proizvodnju i kvalitet stočne hrane je adekvatno učešće leguminozne komponente u smešama tokom celog ciklusa eksploatacije travnjaka. U tom cilju su vršena brojna istraživanja u Centru za krmno bilje u Krusevcu sa različitih aspekata, a u ovom radu je prikazana jedna analiza rezultata uticaja leguminozne komponente u smešama na njene proizvodne i kvalitetne karakteristike u ravničarskom i brdsko-planinskom području. Po pravilu, travno-leguminozne smeše su produktivnije od pojedinčenih leguminoznih, kao i travnih vrsta koje su dubrene sa 100 kg N dubrava. Tako je smeša lucerke i ježevica ostvarila prinos suve materije 14,2; čista lucerka 13,7; ježevica 8,7 i ježevica dubrena sa 100 kg N 11,7 ha-1. Slični rezultati su dobijeni i kod drugih smeša (crvena detelina i italijanski ljulj, žuti zvezdan i livadski vijk, bela detelina i engleski ljulj). Leguminozna komponenta u smeši utiče na smanjeno reagovanje dubrava na povećanje prinosa travnjaka, a takođe i na povećanje sadržaja proteina i minerala u odnosu na travne vrste. Učešće leguminosa od 30% obezbeđuje balans između visoke produkcije i kvaliteta travnjaka.

Literature