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Yield potential and persistency of cocksfoot and tall fescue in mixtures with lucerne at different levels of nitrogen fertilization

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SUMMARY – In order to determine the suitability of cocksfoot and tall fescue with lucerne in mixture at a certain level of N fertilization, a mixture of lucerne, cocksfoot and tall fescue was seeded and four different N fertilization levels (0, 70, 140, 210) were applied. The results were monitored in the second year of investigation. Cocksfoot has proven to be more persistent and with higher yields of grass for cultivation in mixture with lucerne compared to tall fescue. Control treatments had a better effect on lucerne, whereas in treatments with N, especially N 210, grasses improve their competitive abilities and increase productivity. Considering individual cuts, cocksfoot was present more frequently than tall fescue during the whole vegetation season and uniformity of yields per cuts for certain fertilization treatments diminished in the N210→N0 direction. Competitive ability is a very important characteristic of species that make up grass-leguminous mixtures.

Keywords: Orchard grass, tall fescue, mixture, yield.

RESUME – *"Potentiel de rendement et persistance du dactyle vulgaire et de la fétuque roseau en mélange avec la luzerne et selon différents niveaux de fertilisation azotée". Pour déterminer les bonnes conditions de la culture de dactyle vulgaire et de fétuque roseau mélangés avec de la luzerne en fonction de différents niveaux de fertilisation azotée, on a semé un mélange de luzerne et de dactyle vulgaire et de luzerne, de dactyle vulgaire et de fétuque roseau, avec quatre niveaux de fertilisation azotée (0, 70, 140, 210). Les résultats ont été observés deux ans après la plantation, c'est-à-dire dans la première année de production. Il s'est avéré que le dactyle vulgaire est plus constant et que son rendement est plus grand que celui de la fétuque roseau à condition d'être mélangé avec de la luzerne. Les traitements de contrôle ont eu le meilleur effet sur la luzerne, alors qu'un traitement avec N, et surtout avec N210, fait augmenter les capacités de concurrence aux herbes en augmentant leur productivité. En examinant certains andains, on a pu constater que le dactyle vulgaire est plus abondant que la fétuque roseau, durant toute la période de végétation, alors que l'équilibre de rendement par andains diminuait en fonction des traitements particuliers de fertilisation de N210 à N0. La compétitivité est une caractéristique très importante des espèces qui entrent dans la composition des mélanges de plantes fourragères et légumineuses.*

Mots-clés : *Dactyle vulgaire, fétuque roseau, mélange, rendement*.

Introduction

The introduction of lucerne into grasslands improves the quality of forage as well as its nutritive value, while reducing the cost of N fertilization due to the biological N fixation of lucerne. Lucerne, as other legumes, satisfies over 80% of their N requirements through nitrogen fixation (Danso *et al*., 1995). If grown together with grasses, than N utilization from nitrogen fixation is considerably higher, from 92-95% of their requirements (Brophy *et al*., 1987).

When growing, cultivating mixtures we must consider the choice of species included into mixture, i.e. their competitive traits (Vučković, 2004). Grasses used for livestock feed differ in regard to their abilities to be grown in mixture (Casler, 1988). Compatibility of grasses and legumes depends on morphological and physiological characteristics of species as well as characteristics of given association, its interaction with applied agro-technical measures, climatic edaphic and biological conditions in which an association is developing (Frame and Laidlaw, 1998).

The objective of this research was to determine the compatibility and persistence of cocksfoot (*Dactylis glomerata*) and tall fescue (*Festuca arundinaceae*) cultivated in mixture with lucerne (*Medicago sativa*) with the application of certain levels of N fertilization.

Materials and methods

The investigation was carried out in the period 2003-2004, on an experimental field of the Institute for Animal Husbandry, Belgrade-Zemun, on soil type poor carbonate chernozem (pH = 7.3, N = 2000 ppm, P = 90 mg/100g, K = 16mg/100g) and in the conditions of moderate continental climate (T = 12,1 °C, P = 645 mm).

Two grass species were used: cocksfoot (cv. K-40) and tall fescue (cv. K-20). For preparation of mixture lucerne cultivar K-28 was used. The ratio of species in the mixture during sowing was 1:1:1 (10 kg ha^{-1} of seed of each species).

Four fertilization levels were applied: N0, N70, N140, N210. Fertilization was carried out using split method. Half of the fertilizer was applied in early spring, at the beginning of vegetation season, and the other half after the first cut. All fertilization treatments were repeated four times. The size of the main plot was 10 m^2.

The trial data was collected in a year marked by a very low amount of precipitation compared to usual quantities for this climatic region. This condition affected considerably the investigated traits of species contained in mixture. In three studied cuts the botanical composition was determined and weight of each species in mixture measured.

For statistical interpretation of data variance analysis was used.

Results and discussion

In Table 1 yield of cocksfoot and tall fescue according to treatments and cuts are presented.

Table1. Yields of cocksfoot and tall fescue according to treatments and cuts

Species/Cut	Yield of green mass t ha^{-1}				
	Treatments with N (kg ha^{-1})				Average
	0	70	140	210	
Cocksfoot					
I cut	5.72	6.39	2.57	5.46	5.03
II	4.52	1.53	0.72	1.4	2.04
III	2.66	2.84	1.5	1.51	2.13
Average	4.3	3.6	1.6	2.8	3.068
	F=3.660*; LSD 0.05 = 2.0964; LSD 0.01 = 3.1755				
Tall fescue					
I cut	0.2	1.1	1.48	1.38	1.05
II	0.12	0.38	0.073	1.36	0.48
III	0.43	0.46	0.31	0.83	0.51
Average	0.25	0.65	0.62	1.19	0.678
	F= 2.925*; LSD 0.05 = 0.7826; LSD 0.01 = 1.1856				

Based on the presented results it can be concluded that cocksfoot produced the highest yield on fertilization level N0 in all cuts in average of 4.3 t ha^{-1}, a slightly lower yield in treatments with N70 of 3.6 t ha^{-1}, and significantly lower yields, with probability of P = 0.95, in treatments with N140, 1.6 t ha^{-1}. It is obvious that cocksfoot is higher yielding and more competitive in mixture with lucerne and tall fescue in treatments without N and with the lowest tested amount of N of 70 kg ha^{-1}. In regard to cuts, cocksfoot produced the highest yields in mixture in the first cut in treatments with N70 6.39 t ha^{-1}, which is by 3.82 t ha^{-1} more than in treatments with N140. In the second cut, cocksfoot produced the lowest yields. According to treatments, N140 of 0.72 t ha^{-1} or by 3.8 less compared to treatments without N fertilization.

Compared to cocksfoot, tall fescue produced considerably lower yields in mixture with lucerne, which indicates its lower competitive ability for growing in mixture (Vassilev, 2004). It was most competitive in treatments with the highest level of nitrogen where it produced the yield of 1,19 t ha^{-1} confirming the research of Berdahl *et al* (2001). Treatments without N reflected very negatively on its yielding capacity and competitive ability. Yields in N0 treatments were by 0.94 t ha lower compared to N210. The highest yields were produced in the first and the lowest in the third cut, same as cocksfoot.

Conclusion

The yield of cocksfoot in mixture with lucerne and tall fescue was highest in treatments without fertilization whereas the yield of tall fescue, although considerably lower than that of cocksfoot, increased with increased amounts of N fertilizer, being the highest in treatments with 210 kg N ha.

In order for tall fescue to survive in mixture it is necessary to add N in amounts higher than 210 kg ha. This indicates great competitive ability of cocksfoot in relation to tall fescue and lower suitability of their combination in mixture with lucerne.

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