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Dry mass yield from sainfoin in binary mixtures with ryegrass and cocksfoot

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SUMMARY – A field trial under non-irrigated conditions was carried out in Central North Bulgaria. Two sainfoin populations, cultivar 'Jubilejna' and the new selected No. 239 were tested in pure stands, and in binary mixtures with perennial ryegrass and cocksfoot under cutting regime of utilization. Sainfoin had a bigger portion in mixtures with ryegrass in second and third cut as compared to the mixture with cocksfoot. The mixtures were less infested than pure sainfoin, but the mixtures with ryegrass were more infested than those with cocksfoot. On average for three years the dry mass yield from sainfoin No. 239 was 20% higher than that from sainfoin 'Jubilejna' in pure stands, and 19% higher on average for mixtures with grasses. There was no difference in the average annual dry mass yield from pure sainfoin stands as compared to those from mixtures, but considering weed proportion, the mixtures showed advantages.

Keywords: Sainfoin, perennial ryegrass, cocksfoot, mixtures.

RESUME – *"Rendement en matière sèche du sainfoin en association binaire avec du ray-grass et du dactyle". Un essai en champ a été fait dans des conditions non irriguées en Bulgarie Centrale du Nord. Deux populations de sainfoin, la variété "Jubilejna" et le N° 239 nouvellement sélectionné, ont été etudiées dans des semis purs et dans des associations binaires avec ray-grass anglais et dactyle au régime de coupes pour foin. Le sainfoin représentait une portion plus grande dans les associations avec le ray-grass pour les première et troisième coupes en comparaison à l'association avec le dactyle. Les associations étaient moins envahies par les mauvaises herbes que le sainfoin pur, mais les associations avec le ray-grass étaient plus envahies par les mauvaises herbes que celles avec le dactyle. En moyenne pour trois ans, le rendement en matière sèche du sainfoin n° 239 était plus élevée de 20% en comparaison au sainfoin "Jubilejna" dans des semis purs et de 19% en moyenne pour les associations avec les céréales. Il n'y avait pas de différence dans le rendement moyen annuel en matière sèche des semis purs de sainfoin en comparaison à ceux des associations, mais en vue de la portion des mauvaises herbes, les associations ont des avantages.*

Mots-clés : *Sainfoin, ray-grass anglais, dactyle, associations.*

Introduction

Sainfoin is a suitable component of perennial grass-legume mixtures under nonirrigated conditions (Chakarov, 1998). It cohabits very well with other perennial grass and legume species, weed infestation is twice lower, and dry mass is higher as compared to pure stand (Chakarov and Dimitrova, 2003; Vasilev, 2004). According to the authors, in a mixed stand of smooth bromegrass and sainfoin cultivar "Jubilejna", the crude protein yield was 49% higher than that from a pure stand. Cocksfoot cultivar "Dabrava" and perennial ryegrass cultivar "Meretti" have not been studied as components of binary mixtures with sainfoin. The objective of this study was to determine the botanical composition of sward and dry mass yield from two sainfoin synthetic populations (cultivar "Jubilejna" and the new selected No. 239) in binary mixtures with cocksfoot and perennial ryegrass under cutting regime of utilization.

Materials and methods

A field trial was carried out under nonirrigated conditions during the 2003-2006 periods. Long plot method was used with four replications and record plot size of 10 m^2. Soil subtype was slightly leached chernozem, poorly supplied with nitrogen and phosphorus, and well supplied with potassium. Soil solution pH was 6.4. Two sainfoin populations, cultivar "Jubilejna" and the new selected No. 239 were tested in pure stands and in binary mixtures with perennial ryegrass (cultivar "Meretti") and with

cocksfoot (cultivar Dabrava). Before basic cultivation 300 kg ha^{-1} P_2O_5 and 150 kg ka^{-1} K_2O were applied as reserve fertilizing depending on soil supply. Nitrogen was applied at the time of sowing (50 kg ha^{-1}). Chemical weed control was not conducted. Sainfoin was sown at a sowing rate of 120 kg ha^{-1} nonpodded seed, and perennial ryegrass and cocksfoot at 25 kg ha^{-1}. The legume:grass ratio was 1:1 in the mixed stands. The first cut of swards was done at early flowering stage of sainfoin, but the others at the herbage height of 30 cm. Two cuts were obtained in the year of trial establishment, three cuts in 2004 and 2006, and four in 2005. Data on botanical composition and dry mass yield on average for the period after trial establishment is shown in this article. Experimental data on dry mass yield was submitted to analysis of variance and means were compared to those obtained from pure sainfoin stand using LSD.

Results and discussion

Biological characteristics of sainfoin and grasses in the different cuts, formed under respective meteorological conditions, determined dynamics in botanical composition of the sward. Under a hay-cutting regime of utilization, sainfoin and grasses formed reproductive stems mainly in first cut, and represented 65% of annual yield. In the next cuts they formed stems and leaves only (Chakarov, 1998; Katova 2005; Vasilev, 2006).

Sainfoin as a component of the swards dominated in all stands and cuts (Fig. 1). Its participation was lower in the fourth cut for mixtures. On the contrary, grasses took a bigger portion in the fourth cut. Cocksfoot as more drought resistant, took a bigger portion in mixtures during the summer (second and third cut) than ryegrass. It was found that sainfoin No. 239 had a bigger portion in mixture with cocksfoot than cultivar "Jubilejna". The mixtures give more flexible swards (more efficient use of biotic and abiotic factors) were less infested than pure stands. The mixtures with ryegrass were more infested than those with cocksfoot except for the fourth cut.

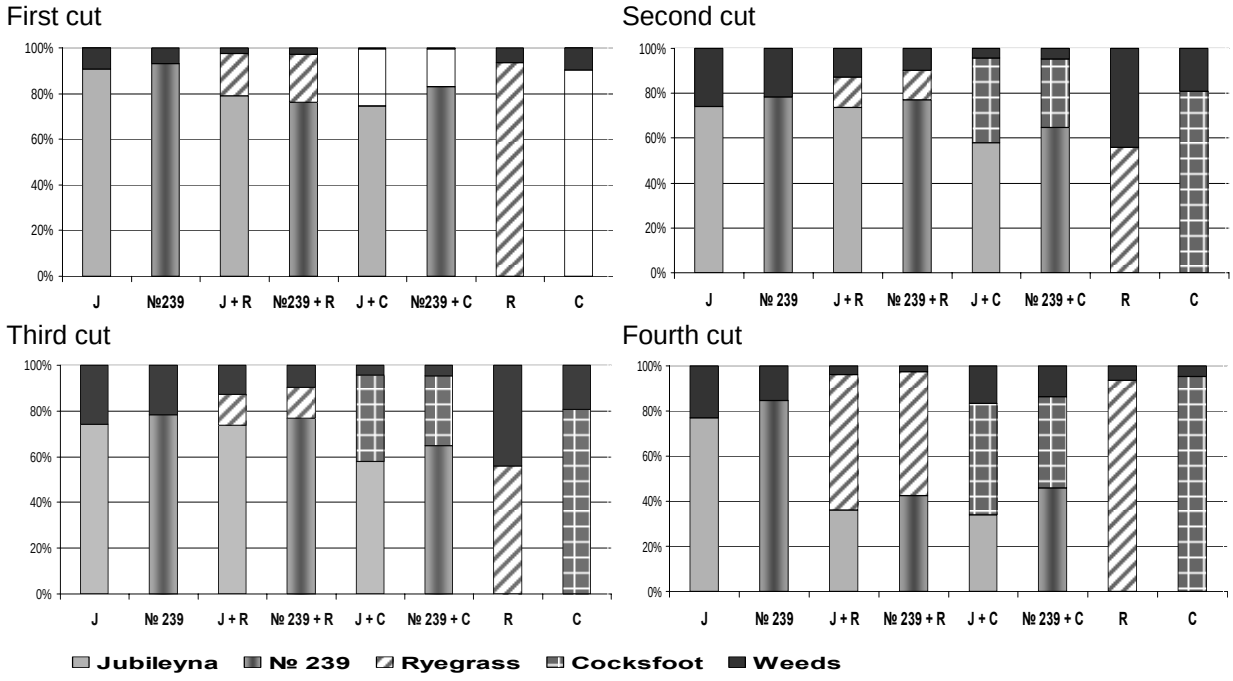

Fig. 1. Botanical composition on average for the 2004-2006 period.

On average for the 2004 - 2006 period, the most productive species was sainfoin, followed by cocksfoot and ryegrass (Table 1). In the first cut mixtures were higher productive than pure stands, but only the dry mass yield of the mixtures with cultivar "Jubilejna" exceeded the pure stand of "Jubilejna". In the second cut the dry mass yield of the pure sainfoin stands exceeded those of the mixtures except for the mixture "Jubilejna" with cocksfoot. In the third and fourth cuts no differences

were found between pure sainfoin stands and respective mixtures. The average annual yield obtained from the mixture „Jubilejna" and cocksfoot exceeded significantly the yield obtained from pure stand of "Jubilejna".

Table1. Dry mass yield on average for the 2004 - 2006 period (kg ha^{-1})

	Treatments \ Cuts	I	II	III	IV	Total	%
1	Jubilejna	5693 ^{b}	2632 ^{b}	1583 ^{b}	240 ^{ab}	10147 ^{b}	100.0
2	No. 239	6840 ^{ab}	3289 ^{a}	1845 ^{b}	256 ^{a}	12229 ^{a}	120.5
3	Jubilejna + Ryegrass	6647 ^{ab}	2194 ^{bc}	1430 ^{bc}	238 ^{ab}	10509 ^{b}	103.6
4	No. 239 + Ryegrass	7347 ^{a}	2672 ^{b}	1625 ^{b}	255 ^{a}	11899 ^{ab}	117.3
5	Jubilejna+ Cocksfoot	6887 ^{ab}	2533 ^{bc}	1811 ^{b}	242 ^{ab}	11473 ^{ab}	113.1
6	No. 239 + Cocksfoot	7222 ^{a}	2624 ^{b}	2069 ^{a}	238 ^{ab}	12152 ^{a}	119.8
7	Ryegrass	2090 ^{c}	722 ^{d}	993 ^{d}	218 ^{b}	4023 ^{c}	39.6
8	Cocksfoot	2275 ^{c}	909 ^{d}	1516 ^{bc}	213 ^{ab}	4914 ^{c}	48.4
	LSD 5%	676	310	306	61	856	

$^{a, b\ c, d}$ Different letters in the same column denote significant difference (P< 0.05) between means.

Depending on sainfoin population average for the tested swards, it was found that No. 239 was more productive than "Jubilejna" in the first, second and annual yield (Table 2).

Table 2. Average dry mass yield of tested swards depending on sainfoin population, on average for the 2004 - 2006 period (kg ha^{-1})

Sainfoin populations \ CUTS	I	II	III	IV	Total	%
Sainfoin cultivar „Jubilejna"	6409 ^{ab}	2453 ^{b}	1608 ^{b}	240 ^{a}	10710^{b}	100.0
Sainfoin No. 239	7136 ^{a}	2861 ^{a}	1846 ^{a}	250 ^{a}	12093 ^{a}	112.9
LSD 5%	336	257	212	53	573	

$^{a, b}$ Different letters in the same column denote significant difference (P< 0.05) between means.

The dry mass yield of both mixtures exceeded that of the pure stand in the first cut, but they were less productive in the second (Table 3). In the third cut the highest yield was obtained in the mixture with cocksfoot, followed by the pure stand, and by the mixture with ryegrass. There was no difference in the forth cut as well as in the average annual yield.

Table 3. Dry mass yield depending on the type of stand, average for the period 2004 – 2006 (kg ha^{-1})

Type of stand \ CUTS	I	II	III	IV	Total	%
1. Pure stand of sainfoin	6266 ^{ab}	2960 ^{a}	1714 ^{ab}	248 ^{a}	11188 ^{ab}	100.0
2. Mixture with ryegrass	6997 ^{a}	2433 ^{b}	1527 ^{ab}	246 ^{a}	11204 ^{ab}	100.1
3. Mixture with cocksfoot	7054 ^{a}	2578 ^{b}	1940 ^{a}	240 ^{a}	11813 ^{a}	105.6
LSD 5%	878	296	194	58	1238	

$^{a, b}$ Different letters in the same column denote significant difference (P< 0.05) between means.

Conclusions

Sainfoin had a bigger portion in mixtures with ryegrass in second and third cut as compared to the mixture with cocksfoot. The mixtures were less infested than pure sainfoin, but the mixtures with ryegrass were more infested than those with cocksfoot. On average for three years the dry mass yield from sainfoin No. 239 was higher by 20% than sainfoin "Jubilejna" in pure stands, and by 19% on average for mixtures with grasses. There was no difference in the average annual dry mass yield from pure sainfoin stands as compared to those from mixtures, but considering the weed portion, the mixtures had advances.

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