Study on Productivity of some Legume Crops in Pure Cultivation and Mixtures

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Summary

In the conditions of pot trial the productivity of birdsfoot trefoil (*Lotus corniculatus* L.) cv. 'Targovishte' 1"; sainfoin (*Onobrychis Adans.*) breeding N26, white clover (*Trifolium repens* L.) cv. 'Milka', and subclover (*Trifolim subterraneum ssp. brachycalicinum*) cv. 'Clear', in pure cultivation and in mixtures was studied. The treatments were as follows: 1. birdsfoot trefoil 100%; 2. sainfoin 100%; 3. white clover 100%; 4. subclover 100%; 5. cocksfoot 100%; 6. birdsfoot trefoil+cocksfoot; 7. sainfoin+cocksfoot 8. white clover+cocksfoot; 9. subclover+cocksfoot; 10. birdsfoot trefoil+ subclover; 11. sainfoin+subclover; 12. white clover+subclover. The ratio between components in the mixtures was 50:50. Cocksfoot (*Dactylis glomerata* L.) cv. 'Dabrava' as a grass component was used. It was found, that aboveground dry matter yield of white clover, birdsfoot trefoil, sainfoin and subclover in mixture with cocksfoot was higher as compared to these in pure cultivation. Subclover in mixture with birdsfoot trefoil increased aboveground dry matter yield, but in mixture with sainfoin and white clover did not contribute to increase of their productivity.

Key words

birdsfoot trefoil, sainfoin, white clover, subclover, mixtures, aboveground dry matter yield, root dry matter yield

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Introduction

The interest in systems based on legumes increased significantly over recent years due to their importance for sustainable and ecological farming (Porqueddu et al., 2003; Frame, 2005; Frame and Laidlaw, 2005; Vasilev et al., 2005; Nyfeler et al., 2006). Legumes are often grown in mixtures with grasses. Grass-legume mixtures are more sustainable and better overcome unfavourable conditions as compared to their pure cultivation (Vassilev, 2004; Peeters et al., 2006; Mannetje, 2006). Mixtures have an important environmental aspect, reducing the need to use pesticides (Dimitrova, 1995). They are more productive than pure stands and each species contributes the productivity in varying degrees (Frame, 2005; Porqueddu and Gonzales, 2006). To ensure sustainable and balanced mixture the choice of suitable grass component is important (Peeters et al., 2006).

Cocksfoot is medium to long-term highly productive grass crop. It grows quickly in the spring, but due to the deeper root system grows intensive equally in a dry summer months and autumn (Jacobs and Siddoway, 2007).

Birdsfoot trefoil, sainfoin and white clover are valuable forage crops and suitable components of perennial mixtures (Chakarov and Vasilev, 1995).

Subclover is a relatively new crop for Bulgaria. It is an annual legume; drought resistant species with winter-spring type of development and selfsowing ability (Frame et al., 1998). It's importance as a component of perennial mixtures is based on the ability to overcome successfully the difficult winter period (Vasilev, 2006, 2009).

The aim of this work is to study the productivity of birdsfoot trefoil, sainfoin, white clover and subclover in grass-legume and legume mixtures.

Materials and methods

A pot trial was carried out in green house of Institute of Forage Crops, Pleven, Bulgaria, with 12 treatments in 4 replications (2009-2010). Sainfoin (*Onobrychis Adans.*) breeding N26; birdsfoot trefoil (*Lotus corniculatus* L.) cv. 'Targovishte' 1; white clover (*Trifolium repens* L.) cv. 'Milka', subclover (*Trifolim subterraneum ssp. brachycalicinum*) cv. 'Clear' and cocksfoot (*Dactylis glomerata* L.) cv. 'Dabrava' were tested. Depth of sowing was 1- 1.5 cm for white clover, subclover and birdsfoot trefoil; 0.5-1 cm for cocksfoot, and 3 cm for sainfoin. Leached chernozem soil subtype was used. The treatments were as follows: 1. birdsfoot trefoil (C1); 2. sainfoin 100% (C2); 3. white clover 100% (C3); 4. subclover 100% (C4); 5. cocksfoot 100% (C5); 6. birdsfoot trefoil+cocksfoot (50:50); 7. sainfoin+cocksfoot (50:50); 8. white clover+cocksfoot (50:50); 9. subclover+cocksfoot (50:50); 10. birdsfoot trefoil+subclover (50:50); 11. sainfoin+subclover (50:50); 12. white clover+subclover (50:50).

Two cuts for forage (cutting height of 18-20 cm) were harvested. In the laboratory conditions the aboveground fresh matter yield (g/pot) (data not shown), and the aboveground dry matter yield (g/pot) (dried at 60°C) were recorded. Root system of the plants was washed and root fresh matter yield root (g/pot) (data not shown), dry matter yield (g/pot), (dried at 60°C) were recorded. Total productivity (aboveground dry matter yield+root dry matter yield), (g/pot) was calculated. The values were compared to these of pure legume crops. The data were statistically processed by the LSD using SPSS 10.0 computer program.

Results and discussion

Dry matter yield in grass-legume mixtures is higher due to more efficient use of nature resources. Legumes are stimulated for fixing more nitrogen, which increased the possibility to

Table 1. Aboveground dry matter yield and root dry matter yield of birdsfoot trefoil, sainfoin, white clover and subclover in grass-legume and legume mixtures

Treatments	Aboveground dry matter yield g/pot	To C1,C2,C3,C4 %	Root dry matter yield g/pot	To C1,C2,C3,C4 %
Birdsfoot trefoil (100%)- C1	3.53	-	1.47	-
Birdsfoot trefoil+Cocksfoot (50:50)	5.06	+43	1.11	-25
Birdsfoot trefoil +Subclover (50:50)	4.31	+22	2.13	+45
LSD at P< 0.05	0.67		0.29	
Sainfoin- C2	3.99	-	4.78	-
Sainfoin + Cocksfoot (50:50)	5.74	+44	1.64	-66
Sainfoin + Subclover (50:50)	4.06	+2	3.15	-34
LSD at P< 0.05	0.35		0.15	
White clover (100%)- C3	3.84	-	2.86	-
White clover + Cocksfoot (50:50)	5.30	+38	0.50	-83
White clover + Subclover (50:50)	3.99	+4	1.64	-43
LSD at P< 0.05	0.68		0.08	
Subclover 100% - C4	2.27		1.24	-
Subclover+ Cocksfoot (50:50)	3.90	+72	1.21	-2
Subclover + White clover (50:50)	2.87	+27	1.07	-14
LSD at P< 0.05	0.35		0.43	
Average for pure stands	3.41	-	2.59	-
Average for legume-grass mixtures	5.00	+47	1.12	-57
Average for legume mixtures	3.81	+12	2.04	-21
LSD at P< 0.05	0.48		0.84	

supply grasses with nitrogen (Zapata and Baert, 1989). Nitrogen assimilation from grasses in mixtures is much greater than that in pure swards and resulted in higher yield of biomass (Nyfeler et al., 2006).

In the conditions of our study the aboveground dry matter yield was higher when grass was a component of the mixture (Table 1). The aboveground mass of cocksfoot is very good leaved, grows as fast in summer as in spring and contributes the productivity (Walton, 1983). When cocksfoot was a component of birdsfoot trefoil, the aboveground dry matter yield was by 43% higher compared to productivity of pure birdsfoot trefoil; by 44% for sainfoin; by 38% for white clover, and by 72% for subclover.

Subclover as a component of birdsfoot trefoil increased aboveground dry matter yield by 22%, but cocksfoot as a component of birdsfoot trefoil increased twice more. Subclover in mixtures with sainfoin and white clover does not contribute to increased productivity.

Despite the increased aboveground dry matter yield, the root dry matter yield decreased when cocksfoot was a component of the mixtures. Cocksfoot has highly developed and deep root system, which competes with the development of roots of other components. The decrease was by 25% for birdsfoot trefoil; by 66% for sainfoin, and by 83% for white clover. Cocksfoot had no depressive effect on dry root matter yield in subclover. Subclover suppressed the root dry matter yield by 34% in mixture with sainfoin, and by 43% in mixture with white clover. We assume that this was due to the slower development of sainfoin after the emergency and shallow root system of white clover. Root dry matter yield in mixture of birdsfoot trefoil and subclover was by 45% higher as compared to pure cultivation of birdsfoot trefoil.

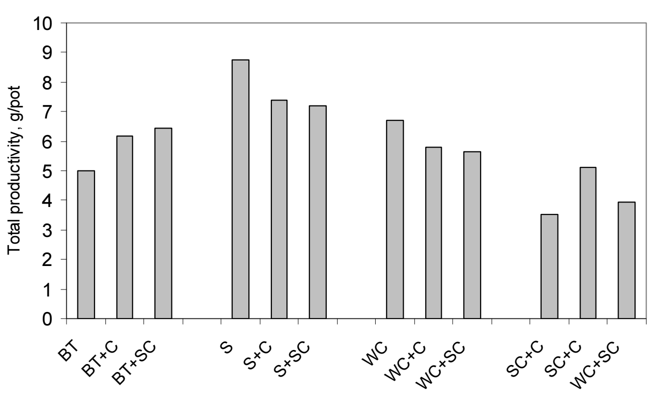

Figure 1. Total productivity of birdsfoot trefoil, sainfoin, white clover and subclover in grass-legume and legume mixtures (g/pot) (BT- Birdsfoot trefoil; C- Cocksfoot; SC-Subclover; S- Sainfoin; WC- White clover)

Total productivity of mixtures of birdsfoot trefoil with cocksfoot and birdsfoot trefoil with subclover, was by 23 and 29% higher as compared to that in pure cultivation (Figure 1). In the mixture of subclover with cocksfoot, the increase was by 45%.

Conclusions

Aboveground dry matter yield of white clover, birdsfoot trefoil, sainfoin and subclover in mixture with cocksfoot was higher as compared to those in pure cultivation. Subclover in mixture with birdsfoot trefoil increased aboveground dry matter yield, but in mixture with sainfoin and white clover did not contribute to increase of their productivity.

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