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Productive longevity of fodder galega-grass swards

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Introduction

Red clover, alfalfa and white clover are traditional forage crops in Latvia. In Latvian agricultural practice, fodder galega (*Galega orientalis* Lam.) is grown for a relatively short period. Recently introduced into Latvia, it is rousing ever-growing interest due to its persistency and high yielding ability. Experiments on fodder galega show that this longlived legume survives in pure stands for 25 and more years and provides annual DM yields from 9.56 to 11.0 t ha⁻¹ (Adamovics and Auzins, 2006; Slepetyšs, 2000; Slepetyšs and Adamovics, 2011). Pure fodder galega stands, compared to other legumes, are not thinning out during harvest years providing stable yields of green feed and seeds. The use of the symbiotic potential of fodder galega grown in mixtures with grass contributes to the production of ecologically safe forage and animal products.

The main aim of this study was to examine the optimum productivity of fodder galega/grass swards and determine the implications of the cutting regime for the quality of forage

Materials and Methods

In 1978, cultivation and research on fodder galega was started at Latvia University of Agriculture. Multilateral field experiments were conducted during a 34 years period (1980-2014). They were carried out with the aim to study continuous green forage production from fodder galega-grass swards in the stage of intensive growth.

The 35 mixed (13 binary and 22 multi – species) swards were developed on sod calcareous soil (pH_{KCl} was 6.7, mobile P 52 and K 128 mg kg⁻¹, organic matter content 21 - 25 g kg⁻¹ of soil). Pure swards, binary- and multi-species seed mixtures were composed of fodder galega cv. 'Gale' and 13 grass species: *Alopecurus pratensis* L., *Arrhenatherum elatius* L., *Bromus inermis* Leyss, *Dactylis glomerata* L., *Festuca pratensis* Huds, *Festuca rubra* L., *Festuca arundinacea* Scheb., *Phleum pratense* L., *Lolium perenne* L., *Phalaris arundinacea* L., *Agrostis gigantea* Roth, *Poa pratensis* L. and *Poa palustris* L.. Stands were sown in early May in 1980, 1986, 1990 and 1997. The total seeding rate was 1000 germinating seeds m⁻². The ratio of fodder galega-grass seeds in 13 binary mixtures (1986) was 50:50. In all experiment series (1990 and 1997) the mixture contained 40% fodder galega and 60% grass seeds: 7 binary mixtures 40:60, 14 three – component mixtures 40:30:30, 5 four – component mixture 40:20:20:20, 1 five – component mixtures 40:15:15:15:15 and 2 six - component mixtures 40:12:12:12:12:12. The plots were fertilised with 40 kg P₂O₅ ha⁻¹ and 150 kg K₂O ha⁻¹ and without or with N90 kg ha⁻¹ in 2 equal dressings. Swards were cut two to four times during the growing season. The plot size was 14 to 20 m². Meteorological conditions greatly differed during the experimental period.

The botanical composition of the sward was determined at each cut for all treatments. The chemical composition of plants was determined only for the first cut by the following methods: dry matter (DM) – drying; crude protein (CP) – modified Kjeldahl; crude fibre (CF), neutral detergent fibre (NDF), acid detergent fibre (ADF) and net energy of lactation (NEL)

Results and Discussion

Without reseeding, in 34 production years of pure galega, the following average yields of DM and CP were obtained at early flowering: 8.36 t ha⁻¹ DM and 1.78 t ha⁻¹ CP on sod calcareous soil in a two-cutting management.

Fodder galega significantly surpassed other forage legumes in respect to productive longevity, and fluctuations in DM yield were insignificant between years of use. Inclusion of a grass species in a mixture resulted in yield increase by 28 to 36% already in the first production year. Split application of the 90 kg N fertiliser negatively affected the proportion of galega in a sward resulting in the decrease of DM yields by 1.04 t ha⁻¹ at two cutting management, compared to unfertilized plots. Frequently cutting (four times) had a declining effect on the productivity of galega-grass mixtures. The

total yield of DM decreased by 3.34 t ha⁻¹ or 35.2% in all experimental plots at a four-cutting management. Significant (P>95%) changes were observed in the productivity of galega-grass swards in all treatments, depending on N-fertilizer and frequency of cutting (Table 1).

In 9 production years average yields of dry matter and crude protein of pure galega stands obtained in the bud stage amounted to 9.50 t ha⁻¹ DM and 1.84 t ha⁻¹ CP at a two-cutting management and 6.16 t ha⁻¹ DM and 1.31 t ha⁻¹ CP at a four-cutting management respectively. Receiving no fertilizer N, highly productive binary and three species galega-grass swards were developed providing the following average yields of DM and CP - 9.80 t ha⁻¹ DM and 1.82 t ha⁻¹ CP at two-fold cutting treatments, and 6.56 t ha⁻¹ DM and 1.47 t ha⁻¹ CP at four- fold cutting regime.

Table 1. Dry matter yields of fodder galega/grass swards, t ha⁻¹ (1998-2006, nine production years on average)

Cutting frequency (F _A)	Nitrogen fertilizer, kg ha ⁻¹ (F _B)	Composition of swards (F _C)						Average	Average (F _A) LSD _{0,05} = 0.32	Average (F _B) LSD _{0,05} = 0.21
		fodder galega	number of components in mixtures							
			two	three	four	five	six			
Two - fold	N 0	9.70	9.92	11.07	10.26	9.80	10.12	10.14	9.50	8.35
	N 90	8.74	8.86	9.27	9.14	8.67	8.46	8.86		7.31
Four - fold	N 0	6.48	6.82	7.24	6.63	6.26	5.96	6.56	6.16	
	N 90	6.35	5.45	6.81	5.77	5.02	5.14	5.76		
Average (F _C)		7.82	7.76	8.60	7.95	7.74	7.42	7.83		
LSD _{0,05} = 0.19										
Trial LSD _{0,05} =0.43										

The productivity of binary fodder galega-grass swards was the following: the average yield 9.92 t ha⁻¹ DM in swards receiving no fertiliser N, and 8.86 t ha⁻¹ DM in swards splitting the fertiliser into two applications at the beginning of the growing season and after cut 1. Fodder galega-grass swards contributed to the crop yield and made N available to the companion grasses.

Depending on the cutting regime, highly productive binary swards were developed when growing fodder galega in association with *Arrhenatherum elatius*, *Dactylis glomerata*, *Festuca arundinacea*, *Phleum pratense* and *Lolium perenne*. In the first production years the companion grass, such as *Dactylis glomerata*, *Festuca arundinacea*, *Lolium perenne*, contributed to the total yield of the sward. The proportion of creeping grass, such as *Alopecurus pratensis*, *Bromus inermis*, *Phalaris arundinacea*, *Agrostis alba*, *Festuca rubra*, *Poa pratensis*, increased in 3rd, 4th and 5th production years.

Most productive fodder galega-grass mixtures were composed of three species providing the following average yields: 10.75-12.36 t ha⁻¹ DM and 1.98 - 2.34 t ha⁻¹ CP. At three-fold cutting regime, three-component mixed swards excelled with CP and DM yields providing 1.86 and 10.01 t ha⁻¹, respectively.

The crop yield level in a sward was not significantly affected by the increase of the number of the species from 4 to 6 in a sward, compared to binary and three species mixed swards, but it ensured, stability of yields between production years.

The chemical composition and nutritive value dynamic of fodder galega were studied. In branching and bud stages fodder galega excelled with high crude protein contents, 279 g kg⁻¹ DM. In mixed swards the CP content decreased to 253 g kg⁻¹ DM in the bud stage; at early flowering the average CP content was 226 g kg⁻¹ DM. Literature findings (Moller and Hostrup, 1996) indicate that there is a rapid increase of the CF content, including NDF and ADF fractions when cutting fodder galega in early bloom and later. Our studies showed that in mixtures with grasses the average NDF content did not exceed 488 g kg⁻¹ DM, compared to NDF content 512 g kg⁻¹ DM in pure galega stands in early bloom.

Conclusion

Fodder galega in pure stands or in mixtures with grass of various growth patterns is productive, of high quality and persists for long periods. Three species mixtures proved to be most productive. Competitive grasses in the mixtures reduce productive longevity of swards compared to pure galega stands. Dry matter of fodder galega has a high content of crude protein with a high concentration of non-replacable amino acids.

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