

The effect of different grass species and fertilization level in fodder galega mixtures

Meripõld H., Tamm U., Tamm S. and Võsa T.

Estonian Crop Research Institute, 48309 Jõgeva, Estonia; heli.meripold@etki.ee

Abstract

Fodder galega (*Galega orientalis* Lam.) is a forage legume that has been grown in Estonia for approximately 43 years. Pure galega is known to be a persistent and high-yielding crop rich in nutrients, in particular crude protein (CP). Galega is usually grown in a mixture with grass in order to optimize its nutrient concentration, increase dry matter (DM) yield and improve fermentation properties. There are certain grass species suitable for the mixture. In this study galega mixtures with reed canarygrass (*Phalaris arundinacea* L.) cv. Marathon, timothy (*Phleum pratense* L.) cv. Tika, red fescue (*Festuca rubra* L.) cv. Kauni and festulolium cv. Hykor were investigated in two successive years (2013-2014). Three cuts were carried out during in both years. Nitrogen (N) fertilization (rate of N50) was applied in spring before the first and second cuts. Early-season N applications to galega-grass swards can prevent N-deficiency in the spring. The total dry matter yield varied from 7.6 to 13.7 Mg ha⁻¹. The CP concentration in the DM varied from 123-188 g kg⁻¹. Both DM-yield and CP were dependent on the year, mixture and fertilization. High N fertilization favoured grass growth and reduced the role of galega in the sward.

Keywords: fodder galega, goat's rue, galega-grass mixtures, forage yield, fertilization

Introduction

Along with other legume fodder crops like lucerne and clovers, goat's rue (fodder galega) has been grown in Estonia for almost 43 years. Galega (*Galega orientalis* Lam.) is very persistent with a high-yielding ability. Results have shown that the yields can possibly be as high as 8.5 to 10.5 Mg of dry matter and 1.7 to 1.8 Mg of crude protein per hectare, with a crude protein (CP) concentration of 200-220 g kg⁻¹ dry matter (DM) (Raig *et al.*, 2001). The nutritive value is highest when the 1st cut is taken at budding or at the beginning of flowering. In order to connect the need for nitrogen (N) fertilizer with biologically fixed N, it is favourable to grow galega in a mixture with grass. Of plant nutrients, nitrogen has the highest effect on yield and quality of forage crops. When choosing grasses for mixtures, the rate of species development, duration, and the effect on nutritive value should all be considered. Earlier results have shown that growing galega in mixtures with grasses improves the nutritive value and ensiling properties of forage crops (Lättemäe *et al.*, 2005; Meripõld *et al.*, 2014).

Materials and methods

The experimental field was established in 2012 in Saku Estonia (latitude 57° 25'). The study includes two years' data (2013-2014). The trial plots were established on a typical soddy-calcareous soil where the agrochemical indicators were as follows: pH_{KCl} 6.3 (ISO 10390); humus concentration C_{org} 3.3% and concentration of lactate soluble P and K being 114 and 161 mg kg⁻¹, respectively. Four galega-grass mixtures were used. The galega variety Gale was sown in binary mixtures with reed canarygrass (*Phalaris arundinacea* L.) cv. Marathon (7 kg ha⁻¹), red fescue (*Festuca rubra* L.) cv. Kauni (10 kg seed ha⁻¹), timothy (*Phleum pratense* L.) cv. Tika (8 kg ha⁻¹) and festulolium cv. Hykor (15 kg ha⁻¹), respectively. The sowing rate of the seed of Gale was 15 kg ha⁻¹ in all mixtures. Pure fodder galega and festulolium plots were included in the trials as a control.

In order to increase competitiveness of grasses and DM yield at the first cut, two N fertilization levels were used: 0 and 50 kg ha⁻¹ (April or May). The crop was cut with a scythe, then weighed, and samples

taken for analyses. The botanical composition of the crop was determined prior to sampling. A three-cut harvesting system was used and there were three replicated plots for each treatment. The data determined in this experiment were: DM yield, crude protein (CP), neutral detergent fibre (NDF), acid detergent fibre (ADF) and metabolisable energy (ME) contents. Accumulated effective temperatures over 5 °C for first cut in 2014 and 2013 were 241 and 291 °C, respectively. The trial results were processed statistically by the method of dispersion analysis (Excel for Windows 2003).

Results and discussion

The results indicate that galega-grass mixtures provided high DM yield in the two years after establishment. Over the two years, the yields from mixture-treatments varied from 7.6 to 13.7 Mg ha⁻¹ year⁻¹, with significant differences between the average yields for the different N levels and mixtures (Table 1). The yields were higher in 2014 and ranged from 9.4 to 13.7 Mg ha⁻¹. Application of N fertilizer changed the botanical composition of the sward. N fertilizer increased the proportion of grasses and reduced the galega proportion in the galega-reed canarygrass and galega-timothy treatments.

In 2013 the average galega cv. Gale proportion in all mixture treatments was 27%, but in the second year it was 46%. At fertilization level N0 and N50 the red fescue cv. Kauni was less competitive (Figure 1).

Table 1. The dry matter yield (Mg ha⁻¹) of fodder galega-grass mixtures in 2013-2014 under 0 or 50 kg ha⁻¹ N fertilization levels.¹

Species	2013		2014	
	N0	N50	N0	N50
Galega	10.5	8.2	12.0	10.7
Galega/reed canarygrass	7.6	11.1	9.5	11.1
Galega/timothy	8.7	10.3	9.4	13.2
Galega/red fescue	7.9	10.3	11.4	11.4
Galega/festucolium	8.2	12.1	10.0	13.7
Festucolium	5.5	10.2	6.2	10.7

¹ Least significant difference ($P < 0.05$) = 0.80.

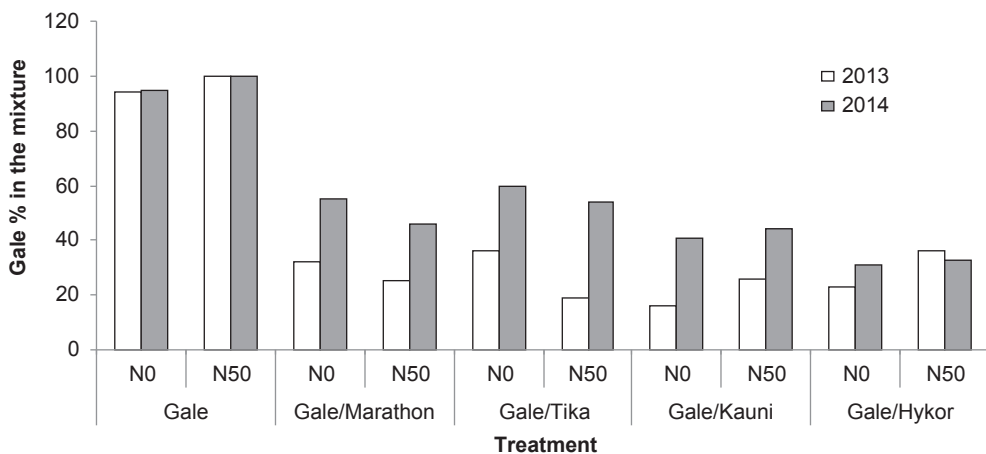


Figure 1. The botanical composition of galega-grass mixture of first cut in 2013-2014.

Table 2. The nutritive value of the fodder galega-grass mixtures of first cut in 2013-2014.¹

Mixture	N-fertilizer	2013				2014			
		CP g kg ⁻¹	NDF g kg ⁻¹	ADF g kg ⁻¹	ME MJ kg ⁻¹	CP g kg ⁻¹	NDF g kg ⁻¹	ADF g kg ⁻¹	ME MJ kg ⁻¹
Galega	N0	188	416	355	9.5	254	406	373	9.3
	N50	187	378	331	9.9	241	358	327	9.9
Galega/reed canarygrass	N0	142	581	387	9.1	197	479	365	9.3
	N50	142	547	375	9.3	204	404	298	10.2
Galega/timothy	N0	123	594	393	8.9	182	492	368	9.3
	N50	137	564	379	9.2	212	460	318	9.9
Galega/red fescue	N0	126	568	395	8.9	187	488	340	9.6
	N50	143	531	367	9.4	217	424	311	10
Galega/festulolium	N0	110	616	399	8.9	176	489	345	9.6
	N50	163	506	349	9.6	206	463	330	9.8
Festulolium	N0	82	613	375	9.3	86	536	308	9.7
	N50	146	560	369	9.3	155	506	320	9.9

¹ CP = crude protein; NDF = neutral detergent fibre; ADF = acid detergent fibre; ME = metabolisable energy.

The highest competitiveness was shown by the timothy cv. Tika and the reed canarygrass cv. Marathon at N50 fertilization in 2013.

The nutritive value of mixtures is presented in Table 2. In general, the nutritive value of mixtures was mainly dependent on the fertilization level. When fertilization level increased, CP concentration and ME increased but NDF and ADF decreased. Lower CP in mixtures (110-197 g kg⁻¹ DM) and ME (8.9-9.6 MJ kg⁻¹ DM) concentrations were found in the N0 treatments. At the N50 fertilization level, the CP (137-217 g kg⁻¹ DM) concentration and ME (9.2-10.2 MJ kg⁻¹ DM) both increased. The NDF and ADF concentrations in mixtures were lower in 2014 than in 2013, as plant development in 2014 was less advanced because of the weather (i.e. a lower accumulated effective temperatures for the first cut in 2014 compared to 2013).

Conclusions

The galega-grass mixtures maintained high yielding ability and nutritive value over two years. The nutritive value of mixtures was mainly dependent on fertilization. The N50 fertilization rate favoured grass growth, but reduced the role of galega in the sward. Similar high ME values were obtained in galega-festulolium and galega-reed canarygrass mixtures. The ME concentration was lower in galega-timothy mixture due to higher fibre concentration compared with other grasses. On the basis of these results, fertilization rate of N50 should be recommended in order to avoid grasses being lost from the sward and to prevent N deficiency in the spring.

References

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