Acta fytotechn zootechn, 22, 2019(1): 13–16
http://www.acta.fapz.uniag.sk

Original Paper

Selected qualitative parameters above-ground phytomass of the Lenor-first Slovak cultivar of *Festulolium* A. et Gr.

Peter Hric*, Ľuboš Vozár, Peter Kovár
Slovak University of Agriculture in Nitra, Slovak Republic

Article Details: Received: 2018-10-04 | Accepted: 2018-11-06 | Available online: 2019-01-31

https://doi.org/10.15414/afz.2019.22.01.13-16

The aim of this experiment was to compare selected qualitative parameters in above-ground phytomass of the first Slovak cultivar of *Festulolium* A et. Gr. cv. Lenor in comparison to earlier registered cultivars Felina and Hykor. The pot experiment was conducted at the Demonstrating and Research base of the Department of Grassland Ecosystems and Forage Crops, Slovak Agricultural University in Nitra (Slovak Republic) with controlled moisture conditions (shelter) in 2017. Content of nitrogen, phosphorus, potassium, calcium, magnesium, crude fibre and water soluble carbohydrates were determined from dry above-ground phytomass of grasses. The significantly highest (P <0.05) nitrogen content in average of cuts was in above-ground phytomass of Felina (30.3 g kg^{-1}) compared to Hykor (25.4 g kg^{-1}) and new intergeneric hybrid Lenor (25.0 g kg^{-1}). The lowest phosphorus content was found out in hybrid Lenor (3.4 g kg^{-1}). In average of three cuts, the lowest concentration of potassium was in new intergeneric hybrid Lenor (5.8 g kg^{-1}). The lowest content of calcium was found out in hybrid Lenor (7.0 g kg^{-1}). Magnesium concentration ranged from 5.0 g kg^{-1} (Hykor) to 6.1 g kg^{-1} (Felina). Higher (P <0.05) fiber content in average of cuts was in above-ground phytomass of Lenor (27.0%) and Hykor (26.5%) than Felina (24.0%). The highest concentration of water soluble carbohydrates was found in Hykor and Lenor (3.5%).

Keywords: grass hybrids, festulolium, quality

1 Introduction

Festulolium A et Gr. is a natural or synthetic intergeneric hybrid between species of the genus *Festuca* L. and *Lolium* L. Breeding aim is a cumulating the positive, agriculturally important, parents properties in the newly created genome (Casler et al., 2002; Humphreys et al., 2003; Černoch and Groenbaek, 2015). Hybrids are divided into two groups. The first group consists of so called ryegrass type (*Lolium* L.) for example cv. Perun, Bečva and Lofa. Another group consists of so called fescue type (*Festuca* L.) for example cv. Felina, Fojtan and Hykor (Kováč, 2002; Humphreys et al., 2003).

x *Festulolium* had a broad spectrum uses. They are used in animal nutrition in the form of fresh phytomass, or as conserved fodder in the form of hay and silage. Among other things, they can also be used like a biogas plants. *Lolium* x *Festuca* grass hybrids have a good agronomical potential especially in adverse environments (Nesheim and Bronstad, 2000; Prochnow et al., 2009; Herkeľ et al., 2015; Hric et al., 2018).

Quality hay is a natural and irreplaceable feed for ruminants and horses (Bíro et al., 2014). Nutrient content in feeds from grasslands varies and their concentration, depending on several factors (Čunderlík and Martincová, 2013). Chemical composition and yield value of forage mainly depends on species, levels of soil fertilization, agro-technology, phenological phase, collection technology, conservation and storage (Gálik et al., 2016).

The aim of this experiment was to compare selected qualitative parameters of above-ground phytomass of the first Slovak cultivar of *Festulolium* A. et Gr. with different cultivars.

2 Material and methods

The experiment was established (sowed the seeds) on 21st March 2017. It was realized in the Demonstrating and Research Base of Department of Grassland Ecosystems and Forage Crops, Slovak Agricultural University in Nitra (Slovak Republic) with controlled moisture conditions in 2017.

***Corresponding Author:** Peter Hric, Slovak University of Agriculture in Nitra, Faculty of Agrobiology and Food Resources, Department of Grassland Ecosytems and Forage Crops, Tr. Andreja Hlinku 2, 979 76 Nitra, Slovak Republic, e-mail.peter.hric@uniag.sk

We watched out 3 cultivars of *Festulolium* A. et Gr.:

1. *Festulolium* A. et Gr. cv. Felina
2. *Festulolium* A. et Gr. cv. Hykor
3. *Festulolium* A. et Gr. cv. Lenor

Felina (registered in 1988) (*Lolium multiflorum* LAM. × *Festuca arundinacea* Schreb). was created by crossing *Lolium multiflorum* LAM. cv. Rožňovský and Tiara with *Festuca arundinacea* Schreb. ecotypes from the neighbourhood Hladké Životice (Czech republic) and backcrossing with selected varieties of the world assortment. Hybrid Felina is the first Czech variety of *Festulolium* A. et Gr. Felina is taller, persistent, resistant to frost and drought. It has a winter character. It is *Festulolium pabulare* and fescue type (Kováč et al., 2002).

Hykor (registered in 1991) (*Lolium multiflorum* LAM. x *Festuca arundinacea* Schreb.) was created by crossing *Lolium multiflorum* LAM. cv. Rožňovský and Tiara with *Festuca arundinacea* Schreb. ecotypes from the neighbourhood Hladké Životice (Czech republic) and backcrossing with selected varieties of the world assortment. Hykor is resistant to freezes, drought and lie down. It is *Festulolium pabulare* and fescue type (Kováč et al., 2002).

Lenor (registered in 2015) (*Lolium multiflorum* LAM. × *Festuca arundinacea* Schreb.) was created by crossing *Lolium multiflorum* LAM. cv. Jamaoba with *Festuca arundinacea* Schreb. cv. Sopline and backcrossing with selected varieties of the world assortment. Lenor is the first Slovak variety of *Festulolium* A. et Gr. It has a rapid growth in the spring. Lenor is resistant to frost and drought. It has fine leaves and it is suitable for grazing. The breeder is Graminex s.r.o. Levoča (Slovak Republic). It is *Festulolium pabulare* and fescue type (Bašta, 2017). In Slovak State Varieties Tests was Lenor was compared with Felina and Hykor.

Experiment was conducted in containers with volume 2 dm^3 in 3 replicates. Each container contained four individual seedlings. Chemical characteristics of applied substrate are documented in Table 1.

Grass plants were fertilized at a dose of 100 kg ha^{-1} N (1.44 g per a container) with NPK fertilizer (14-9-10). The whole dose of fertilizer was divided into two equal doses (2 × 50 kg ha^{-1} N). First fertilization was applied 21st April 2017 (month after sowing) and second fertilization was done after the first mowing. The plants were irrigated at the first signs of water scarcity. Irrigation dose was 200 ml water for each container.

Grasses were cut to 50 mm. There 3 mowing were realized in terms 23rd June, 14th August and 27th September 2017. Moved aboveground phytomass was drying at 105 °C to constant weight. Then were determined:

- N – by Kjeldahl,
- P – spectrophotometrically by phosphomolybdic method after wet mineralization with HNO_3 and $HClO_4$,
- K and Ca – flame photometry after wet mineralization with s HNO_3 and $HClO_4$,
- Mg – spectrophotometrically with titanium yellow after wet mineralization with HNO_3 and $HClO_4$,
- WSC – (water soluble carbohydrates) by method Luff-Schoorl,
- CF – (crude fiber) by two-stage hydrolysis in weakly acidic and weakly alkaline medium by Hennberg-Stohmann.

The results were evaluated by software STATISTICA 7.1 complete CZ analysis of variance (Fisher LSD test, $\alpha = 0.05$).

3 Results and discussion

Mineral content play a number of important roles in the animal organism. The content of mineral content is about 1.6% in plants. Their contents vary widely and their concentration depends on several factors (Bíro et al., 2016). *Poaceae* L. is characterized by different values of nutritional value Gibson (2009). According to Gibson (2009), the suitable range of mineral content in the grassland is as follows: N 10.0–53.0 g kg^{-1}, P 0.5–9.8 g kg^{-1}, K 2.1–49.3 g kg^{-1}, Ca 0.3–27.3 g kg^{-1}, Mg 0.3–7.9 g kg^{-1}.

Selected qualitative parameters in above-ground phytomass of *Festulolium* A. et Gr. cultivars are presented in table 2. The nitrogen (N) content decreased in all cultivars from 1st cut to 2nd cut. Only in hybrid Felina was the N content higher in the second cut (32.0 g kg^{-1}) compared to first cut (31.6 g kg^{-1}). The higher (P <0.05) nitrogen content in average of cuts was in above-ground phytomass on Felina (30.3 g kg^{-1}) than Hykor (25.4 g kg^{-1}) and Lenor (25.0 g kg^{-1}). Similar trend of the decrease of the nitrogen content in above-ground phytomass of *Festulolium* A. et Gr. with increased cut found Skládanka et al. (2010).

Also, the phosphorus (P) content gradually declined from 1st cut to 3rd cut. Only in hybrid Hykor was the P content higher in the third cut (3.5 g kg^{-1}) compared

Table 1 Substrate agrochemical properties

Nt	P	K	Ca	Na	Mg	Fe	C_{ox}	pH
mg kg^{-1}							g kg^{-1}	
4,067.07	71.53	538.78	6,720.00	556.52	716.29	39.43	4.41	6.70

to second cut (3.0 g kg^{-1}). In the total evaluation was not finding significant difference of P content between the evaluated cultivars. At the least content of phosphorus was found out in hybrid Lenor (3.4 g kg^{-1}). Jančovič et al. (2013) considers P content in the dry matter of grassland 2.8 g kg^{-1} and more.

Another element of assessment was potassium (K). Jančovič et al. (2013) considered the potassium content in the grassland dry phytomass from 20 to 22 g kg^{-1}. It is lower concentration than the physiological need for plants, but it is higher than the need for animals. The potassium concentration in above-ground phytomass had a decreasing tendency with other cuts. The exception was only the third cut of Felina In average of three cuts was the least concentration of potassium in new intergeneric hybrid Lenor (5.8 g kg^{-1}).

In first cut the calcium (Ca) content of above-ground phytomass was from 4.6 g kg^{-1} (Lenor) to 6.4 g kg^{-1} (Felina). In the next cut, the Ca concentration increased by almost twice compared to the first cut. In the last, the cut calcium content declined in all cultivars. In the average Ca concentration of above-ground phytomass was 7.0 g kg^{-1} and higher. The qualitative grassland feed should contain at least 7.0 g kg^{-1} calcium (Jančovič et al., 2013).

Magnesium (Mg) content in above-ground phytomass cultivars had similar development as calcium. In the total evaluation significant difference of Mg concentration between the evaluated cultivars was not found. Magnesium content was from 5.0 g kg^{-1} (Hykor) to 6.1 g kg^{-1} (Felina).

In ruminant nutrition the fibre has irreplaceable place. It participates in the proper digestion of feed, encourage chewing, rumen and intestinal peristalsis and ensures the mechanical saturation of the animal (Gálik et al., 2016). Štýbnarová et al. (2013) state that the minimum fibre content in feed intended for the proper functioning of the ruminant digestive system should be 18.0–20.0%. The authors further point out that the fibre content above 30%, declined the digestibility of the feed and therefore the energy value of the grasses. In the first cut was concentration of crude fiber (CF) as follows: 24.0% (Lenor), 23.1% (Hykor) and 21.3% (Felina). In the first cut Houdek (2010) found the 29.6% and 29.0% CF content of the hybrid Felina and Hykor, respectively. In the following cut the crude fiber concentration in Felina was 24.16%, in Hykor 27.02% and in Lenor 27.04%. Similar results in the second cut was measured by Houdek (2010). Also in the last cut new intergeneric hybrid Lenor reached the highest CF content (30.1%). The higher (P <0.05) fiber content of average of cuts was in above-ground phytomass in Lenor (27.0%) and Hykor (26.5%) as Felina (24.0%). Černoch et al. (2004) found the total fiber content of the cultivar Felina 26.4% and Hykor 25.3%. Skládanka et al. (2014) presented content of CF in Felina 27.9% and Hykor 27.0%.

Water soluble carbohydrates (WSC) are an important source of energy for the animals and for the rumen microflora. Digestibility is almost 100%. The plants accumulate sugars during the day and during the night they spend them. This suggests that the WSC content is the lowest in the morning and the highest at the end of the day (Hakl and Fuksa, 2011). Water soluble carbohydrates have a positive effect on animal production parameters. In work Miller et al. (2001) has proven effect of WSC from

Table 2 Selected qualitative parameters above-ground phytomass of *Festulolium* A. et Gr. cultivars

Order of cut and cultivar	N	P	K	Ca	Mg	CF	WSC
	g kg^{-1}					%	
1st cut Felina	31.6	4.6	8.8	6.4	5.0	21.3	4.0
2nd cut Felina	32.0	3.9	5.3	12.5	7.2	24.2	2.4
3rd cut Felina	27.3	3.1	5.7	8.9	6.0	26.6	1.2
Average of cuts	30.3[a]	3.9[a]	6.6[a]	9.3[a]	6.1[a]	24.0[a]	2.5[a]
1st cut Hykor	30.4	4.6	7.8	5.9	4.2	23.1	4.2
2nd cut Hykor	23.7	3.0	5.7	11.7	6.2	27.0	1.9
3rd cut Hykor	22.1	3.5	5.3	6.3	4.6	29.5	4.2
Average of cuts	25.4[b]	3.7[a]	6.3[a]	8.0[a]	5.0[a]	26.5[b]	3.5[a]
1st cut Lenor	30.1	4.5	7.4	4.6	3.9	24.0	4.2
2nd cut Lenor	24.4	3.0	5.5	8.6	6.6	27.0	2.7
3rd cut Lenor	20.5	2.8	4.4	7.8	6.4	30.1	3.5
Average of cuts	25.0[b]	3.4[a]	5.8[a]	7.0[a]	5.6[a]	27.0[b]	3.5[a]

a, b statistically significant differences (Fisher LSD test, $\alpha = 0.05$), N – nitrogen, P – phosphorus, K – potassium, Ca – calcium, Mg – magnesium, CF – crude fiber, WSC – water soluble carbohydrates

grasses on improve milk production. In the first cut was concentration of water soluble carbohydrates in Felina 4.0% and 4.2% in Hykor and new hybrid Lenor. In the first cut Houdek and Jambor (2010) found the WSC content of the hybrid Felina 12.2% and 11.9% Hykor. In the second cut declined WSC content on all cultivars (1.9–2.7%). In the second cut Houdek and Jambor (2010) found the 9.82% and 14.0% of water soluble carbohydrates concentration of the hybrid Felina and Hykor, respectively. In the last cut was reached the highest content of water soluble carbohydrates in Hykor (4.2%). In the total evaluation was not finding significant difference of WSC content between the evaluated cultivars. The highest concentration of water soluble carbohydrates has in Hykor and Lenor (3.5%). Skládanka et al. (2014) presented content of WSC in Felina 11.0% and Hykor 12.9%. Černoch et al. (2004) found the water soluble carbohydrates concentration of the cultivar Felina 7.2% and Hykor 10.3%.

4 Conclusions

On the basis of the results, it can be stated that new Slovak cultivar of *Festulolium* A. et Gr. Lenor had comparable values of qualitative parameters fabove-ground phytomass in comparison with earlier registered cultivars Felina and Hykor. Consisdering the evaluation of the content of nitrogen, phosphorus, potassium, calcium, magnesium, crude fiber and water soluble carbohydrates. Lenor was found suitable for animal nutrition.

Acknowledgements

We would like to thank Zuzana Podolinská and Ján Pečko for assistance in collecting the data.

References

BAŠTA, Ľ. (2017) New varieties of red clover and grasses. *Our field*, vol. 21, no. 7, pp. 26–27 (in Slovak).

BÍRO, D. et al. (2014) *Conservation and adjustment of feeds.* 1st ed., Nitra: Slovak University of Agriculture in Nitra (in Slovak).

BÍRO, D. et al. (2016) *Animal nutrition.* Nitra: Slovak University of Agriculture in Nitra (in Slovak).

CASLER, M.D. et al. (2002) Natural selection for survival improves freezing tolerance, forage yield and persistence of *Festulolium*. *Crop Science*, vol. 42, no. 5, pp. 1421–1426. doi: https://doi.org/10.2135/cropsci2002.1421

ČERNOCH, V., HOUDEK, I. and CAPKA R. (2004) *Festulolium* – grass for future. In *Bericht über die 55. Tagung 2004 der Vereinigung der Pflanzenzüchter und Saatgutkaufleute Österreichs* HBLFA Raumberg – Gumpenstein, 23.–25. November 2004, pp. 87–89.

ČERNOCH, V. and GROENBAEK, O. (2015) Benefits of × *Festulolium* varieties in European agriculture. In *Proceedings of the 18th Symposium of the European Grassland Federation Wageningen 15–17 June 2015*. Wageningen Academic Publishers: Wageningen, pp. 386–388.

ČUNDERLÍK, J. and MARTINCOVÁ, J. (2013) Monitoring the pruduction and qualitative parameters of semi-natural grassland in differentiated nutrition. In *Ecology of grassland: Proceedings of scientific works.* Piešťany : Plant Production Research Center, pp. 38–42. (in Slovak)

GÁLIK, B. et al. (2016) *Nutritional characteristics of feeds.* Nitra: Slovak University of agriculture in Nitra (in Slovak).

GIBSON, D. J. (2009) *Grasses & Grassland Ecology.* New York: Osford University Press.

HAKL, J. and FUKSA, P. (2011) *Production and dietetic effects roughhages.* Praha: CZU v Prahe (in Czech).

HERKEĽ, R. et al. (2015) The effect of biological additive on nutrient composition of grass silage. *Acta fytotechnica et zootechnica*, vol. 18, no. 4, pp. 106–109. doi: https://doi.org/10.15414/afz.2015.18.04.106–109

HRIC, P. et al. (2018) Growth-production parameters of the first Slovak cultivar of *Festulolium* A. et Gr. *Acta Universatis Agriculturae et Silviculturae Mendelianae Brunensis*, vol. 66, no. 3, pp. 825–828. doi: https://doi.org/10.11118/actaun201866030825

HOUDEK, I. (2010) Perspective species and varieties of grasses and clovers from ŠS Hladké Životice, s.r.o. *In Forage quality of herbaceous and cattle in changing economic conditions:* Proceedings from a national scientific conference with international participation. Praha: VÚRV, pp. 61–67.

HOUDEK, I. and JAMBOR. V. (2010) *Festulolium* Hybrids from Breeding Station Hladké Životice and their Quality. In *14th International Symposium Forage Conservation.* March 17–19, Brno : NutriVet Ltd., pp. 22–24.

HUMPHREYS, M.W., CANTER, P.J. and THOMAS, H.M. (2003) Advances in introgression technologies for precision breeding within the *Lolium-Festuca* complex. *Annals of Applied Biology*, vol. 143, no. 1, pp. 1–10. doi:https://doi.org/10.1111/j.1744-7348.2003.tb00263.x

JANČOVIČ, J. et al. (2013) The effect of nitrogen fertilization on the grass phytomass quality. *Agrochémia – Agrochemistry*, vol. 53, no. 2, pp. 3–5 (in Slovak).

KOVÁČ, L., HOUDEK, I. and GEJGUŠ, J. (2002) *The use of grass intergeneric hybrids in specific conditions of East Slovak Lowland.* Michalovce: Grafex (in Slovak).

MILLER, L. A. et al. (2001) Increasd concentration of water-soluble carbohydrate in perennial reygrass (*Lolium perenne* L.): milk production from late-lactation dairy cows. *Grass and Forage Science*, vol. 56, no. 4, pp. 383–384. doi: https://doi.org/10.1046/j.1365-2494.2001.00288.x

NESHEIM, L. and BRONSTAD, I. (2000) Yield and winter hardiness of *Festulolium* (*Festuca* x *Lolium*) in Norway. *Grassland Science in Europe*, 5, pp. 238–240.

PROCHNOW, A. et al. (2009) Bioenergy from permanent grassland – a review: 1. Biogas. *Bioresource Technolgy*, vol. 100, no. 21, pp. 4931–4944.

SKLÁDANKA, J. et al. (2010) Can *Festulolium*, *Dactylis glomerata* and *Arrhenatherum elatius* be used for extension of the autumn grazing season in Central Europe? *Plant, Soil and Environment*, vol. 56, no. 10, pp. 488–498. doi: https://doi.org/10.17221/91/2010-PSE

SKLÁDANKA, J. et al. (2014) *Crop production*. Brno: MU (in Czech).

ŠTÝBNAROVÁ, M., PUKYŠOVÁ, V. and MIČOVÁ, P. (2013) Changes in crude fibre and ADF concentration in fodder of orchard grass (*Dactylis glomerata* L.) under different permanent gassland´s intensity of utilisation. *Research in cattle breeding*, vol. 55, no. 2, pp. 10–17 (in Czech).

