Festulolium - grass for future

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The main goal for Festulolium is connection of suitable traits from different species into one plant. Advantage of Lolium species is their quality (digestibility, palatability), quick establishment and earliness in spring growth. From Festuca species we would like to combine their stress tolerance (winter hardiness, drought tolerance and persistency). There is a different approach to Festulolium in West and Central Europe. While breeders of West Europe are concentrating on improvement of stress tolerance of ryegrasses, main goal for Central Europe breeders is improvement of fescue quality (see *Table 1*).

We used two ways for forming of Festulolium varieties. Amphiploids are coming from direct crossing of two species on the same ploidy level. Rate of both parents in such material should be 50:50 according to theoretical assumption. The second way is crossing of the species on different ploidy level (Lolium 2x x Festuca 6x) with improvement of hybrid fertility by backcross with the parental species. Rate of backcrossed species in Festulolium is much higher then DNA rate of the second parent. In such case we are speaking about introgression.

For forage purposes both ways is possible to use for forming of Festulolium varieties. For turf the main goal is introgression of stress tolerance from fescue into perennial ryegrass.

Tall fescue type of Festulolium like Hykor and Felina has flexible using from temporary grass-clover silage mixtures to permanent grasslands for hay production and grazing. They stand out by high yield and persistency. Due to the deeper root system they are growing very well in both dry and wet conditions. In the mixtures can substitute pure meadow and tall fescue.

Followed Festulolium varieties are listed in different countries at present day:

Germany	L.multiflorum 4x x F.pratensis 4x	Paulita, Paulena	
Poland	L.multiflorum 4x x F.pratensis 4x	Felopa, Rakopan Sulino, Agula	
UK	L.multiflorum 4x x F.pratensis 4x L.perenne 4x x F.pratensis 4x	Emrys, Elmet Prior	
Czech Rep.	L.multiflorum 4x x F.pratensis 4x L.multiflorum 2x x F.arundinacea 6x	Perun, Perseus Beèva Lofa Felina Hykor Korina Lesana	loloid type type Lm 4x type Lh 4x type Fa 6x type Fa 6x type Fa 6x type Fa 6x
Lithuanian	L.multiflorum 4x x F.pratensis 4x	Punia	
USA	L.perenne 4x x F.pratensis 4x	Spring Green Duo	
New Zealand	L.perenne 2x x F.pratensis 2x	Matrix	

Table 1: **Complementary traits in the Festuca-Lolium complex - SAGES table adapted for Central Europe climatic conditions**

Trait	Festuca pratensis	Festuca arundinacea	Festuca glaucescens	Festuca rubra	Lolium multiflorum	Lolium perenne
Quality						
Speed of establishment	++	++	+	++	++++	+++
Earliness of spring growth	+++	++++	++	++++	++++	+++
Summer growth potential	+++	+++	+	+++	++++	+++
Digestibility	+++	++	+	+	++++	+++
Stress resistance						
Winter hardiness	++++	+++	+++	+++	+	++
Drought resistance	++	++++	++++	++++	+	++
Persistency	++	++++	+++	+++	+	++

Table 2: **Yield production of Festulolium braunii varieties compared with meadow fescue Norway 1999-2002 dry matter yield (%) from 3 harvest years**

	Variety	Year 1	Year 2	Year 3
Festulolium	Perun	100	100	100
	Punia	93	99	88
	Paulita	91	92	89
Meadow fescue	Skra	80	72	83
	Fure	80	71	83

Table 3: **Experiment established 1991, harvest of 1992, 1993 and 1994: dry matter yield comparison (%)**

		1992	1993	1994	sum
Festulolium	Lofa	108	106	94	103
	Prior	97	107	85	95
Perennial ryegrass	Mustang	104	107	84	98
	Tarpan	100	100	100	100

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Table 4: **Hay yield in 2nd harvest year Hladke Zivotice est. 1996, harvest 1998**

species	variety	1st cut t/ha	*DM %*	2nd cut t/ha	*DM %*	3rd + 4th cut t/ha	*DM** %*	Total t/ha
Cocksfoot	NIVA	**4,76**	*23,30*	**2,96**	*25,00*	*** 4,68**	*25,5/31,4*	**12,40**
Tall fescue	KORA	**6,08**	*24,60*	**3,19**	*25,60*	*** 5,89**	*25,1/34,8*	**15,16**
Festulolium	FELINA	**6,50**	*25,00*	**3,23**	*26,90*	*** 6,42**	*25,1/35,3*	**16,15**
Festulolium	HYKOR	**6,73**	*25,00*	**3,39**	*27,20*	*** 6,09**	*25,1/31,5*	**16,21**
Festulolium	PERUN	**6,42**	*24,60*	**1,91**	*25,60*	**1,44**	*28,50*	**9,77**
P. ryegrass	MUSTANG	**5,88**	*25,20*	**1,69**	*28,00*	**1,33**	*31,60*	**8,90**

* sum 3rd cut and 4th cut, ** DM first figure is % DM 3rd cut, second figure is % DM 4th cut

Italian ryegrass type Becva can substitute pure Italian ryegrass in the silage mixture with improvement of their persistency on two harvest years. Quality and quantity of dry matter remain on the same level.

Amphiploids of Italian ryegrass type like Perun and Perseus are combining high and quality dry matter yield with 4 years persistency. They can substitute Italian and perennial ryegrass in short-term silage mixtures and meadow fescue in temporary meadows and pastures. Comparison of dry matter yield of that Festulolium type you can see in *Table 2*.

Lofa is specific Festulolium similar to hybrid ryegrass what was found in the progeny of Lolium multiflorum x Festuca arundinacea after backcross with Lolium multiflorum. This variety combine high yield potential with outstanding quality (high WSC content, excellent digestibility and palatability). Persistency is 3-4 years. In temporary silage mixtures, meadows and pastures can substitute hybrid ryegrass or pure perennial ryegrass. Comparison of Lofa dry matter yield with older Festulolium Prior and tetraploid perennial ryegrass is in *Table 3.*

Practical using of new Festulolium varieties were tested in agronomy value trials as pure species and in the mixtures.

Comparison of the yield and quality traits of different species with tall fescue type of Festulolium (Hykor, Felina) and loloid type of Festulolium braunii (Perun) you can see in *Tables 4* and *5*. Varieties were harvested in different time according to their development stage in similar DM content. Perun and Mustang are later than other varieties and in dry summer conditions both stopped their

Table 5: **Quality traits of the same trial**

species	variety	WSC %	CP %	Fibre %	DOM %	NEL MJ/kg
Cocksfot	NIVA	6,2	14,7	25,9	79,9	6,03
Tall fescue	KORA	8,4	13,4	25,4	76,7	5,45
Festulolium	FELINA	7,2	13,5	26,4	76,9	5,53
Festulolium	HYKOR	10,3	12,2	25,3	77,1	5,30
Festulolium	PERUN	21,4	8,1	24,7	78,8	5,64
P. ryegrass	MUSTANG	19,4	8,2	22,1	80,2	5,75

Table 6: **Hay yield in 2nd harvest year - mixtures Hladke Zivotice est. 1996, harvest 1998**

species	variety	1st cut t/ha	*DM %*	2nd cut t/ha	*DM %*	3rd + 4th cut t/ha	*DM ** %*	SUM t/ha
Alfalfa	ZUZANA	**5,09**	*18,20*	**3,25**	*21,20*	*** 5,94**	*22,80*	**14,28**
Red clover	VESNA	**4,99**	*16,20*	**3,71**	*15,50*	*** 4,82**	*20/19,3*	**13,52**
Alfalfa Festulolium	ZUZANA PERUN	**4,56**	*18,90*	**2,64**	*21,00*	***5,96**	*23,4/21,9*	**13,16**
Clover Alfalfa Festulolium	VESNA ZUZANA PERUN	**6,58**	*17,60*	**3,91**	*18,10*	***5,63**	*20,3/24,6*	**16,12**
Clover Alfalfa Festulolium	VESNA ZUZANA FELINA	**5,83**	*16,90*	**3,56**	*17,00*	***5,85**	*22,1/27,6*	**15,24**
Clover Festulolium	VESNA HYKOR	**5,83**	*17,60*	**5,02**	*21,40*	***7,15**	*22,8/22,1*	**18,00**
Clover Festulolium	BESKYD PERUN	**7,37**	*17,90*	**4,86**	*17,10*	***5,69**	*23,2/20,2*	**17,92**

* sum 3rd cut and 4th cut ** DM first figure is % DM 3rd cut, second figure is % DM 4th cut

Table 7: **Quality of clover-grass mixtures - 1st cut**

species	variety	WSC %	CP %	Fibre %	DOM %	NEL MJ/kg
Alfalfa Festulolium	ZUZANA PERUN	4,4	16	22,6	78,6	5,99
Clover Alfalfa Festulolium	VESNA ZUZANA PERUN	12,5	13,9	23,6	80,6	5,29
Clover Alfalfa Festulolium	VESNA ZUZANA FELINA	11,8	18	20,5	83	5,89
Clover Festulolium	VESNA HYKOR	15,3	11,1	27,1	80,5	/
Clover Festulolium	BESKYD PERUN	17,3	13,3	22,9	90,8	/

growth. Both varieties were harvested in three cuts only and third cut was reduced by drought (see high DM content). All trial was fertilised by 60 kg N per ha for each cut.

Perun and Mustang as Lolium and loloid type of Festulolium mark out by higher WSC and lower crude protein and fibre content in comparison with other species. Lower crude protein content can be caused by shortage of N by its loosing in winter and spring and its inaccessibility in dry summer.

Using of Festulolium varieties in temporary grass-clover silage mixtures is presented in *Tables 6* and *7*.

Single mixtures were harvested in different time according to suitable development stage of the earliest component. No N fertilisation was used in trials excluding 30 kg N per ha after last cut in the autumn for support of grass shooting.

Yield production of grasses was covered by legume fixed N only. Combination of alfalfa with red clover and Festulolium was used for stabilisation of the yield in changeable dry and wet climatic conditions. From those trials is possible to find yield improvement of grass legume mixtures in comparison with pure legumes.

On the base of the 15 years of experiences from practical exploitation of Festulolium we can successfully substitute pure Festuca and Lolium species in different mixtures for agricultural purposes. Using of suitable Festulolium types can improve yield and quality potential of grasslands and temporary swards for silage production.