THE EVALUATION OF PERENNIAL GRASS CULTIVARS IN LATVIA CONDITION

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Abstract. *In order to evaluate the species and breeds of perennial grasses from the neighbouring countries and to determine more persistent and productive cultivars suitable for growing in Latvia conditions 29 cultivars from 4 countries (LT, LV, EE, SE): 6 cultivars of Lolium perenne (Lp), 3 Festulolium (FxL), 7 Phleum pratense (Pp), 7 Festuca pratensis (Fp), and 6 Dactylis glomerata (Dg) were studied by using randomized complete block design with three replications. Such characteristics as forage dry matter yield (DMY), winter hardiness, regrowth intensity of all cultivars were measured during the 5 years of use and fodder quality of Lp, FxL and Fp cultivars was determined in the 1st and 2nd cut. The results indicated that Pp, Fp and Dg cultivars were characterized by long and more stable persistence in sward in Latvia conditions. In the 5th year of use Lp cultivars disappeared greatly from the sward after black frost. Higher and more stable yields over the 5 years of use accounted for Pp cultivars; the best ones: 'Switch' (SE), 'Varis' (LV), 'Teicis' (LV) provided more than 7 t ha^{-1} DMY on average. During the 4 year period FxL cultivars provided good average DMY with high forage quality.*

Key words: *perennial grasses, cultivars, dry matter yield, forage quality, winter hardiness.*

INTRODUCTION

Perennial grasses (*Phleum pratense L.*, *Festuca pratensis Huds.*, *Dactylis glomerata L.*, *Lolium perenne L.*, *Festulolium)* are the main components of permanent grasslands in sustainable grassland ecosystems throughout the temperate climate zones. In many countries an active breeding work is carried out with the aim to create new cultivars with prolonged existence in sward, increased productivity and improved fodder quality. A very important property of perennial grasses is their ability to give stable and high dry matter yields under different environmental conditions [13]. The level of the productivity and stability depends on the genetic potential of the forage grass species [4].

The most important forage grass species in the Nordic region to the north of 60^0 N is timothy. In Norway, Sweden and Finland, timothy is the only grass species that can be grown successfully almost anywhere because of its superior persistence [11],[15]. It constitutes the main species in most seed mixtures [12]. A hardy perennial bunchgrass, adapted to cool climates and frequently used in timothy based mixtures for combined cutting and grazing in Northern countries is Meadow fescue (*Festuca pratensis Huds*.). It is widely adapted to lowlands of central and northern Europe and appropriate for intensive management system [1].

Perennial ryegrass (*Lolium perenne L*.) (*Lp*) is the dominant forage grass species in Europe due to its high regrowth capacity, rapid establishment, tolerance to frequent cutting and high nutritive value for ruminant livestock [19]. *Lp* plays an important role in the more maritime regions southward the 60^0 N. In the southern parts of Sweden it is grown successfully, but there always in mixtures with other grasses as it is still too unreliable to be grown in monoculture [14]. With its superior properties *Lp* will undoubtedly become a promising option at higher latitudes with prolonged growing season and milder winters. Fescues (*Festuca* spp.) and ryegrasses (*Lolium* spp.) can be hybridized fairly easily [9], which makes it possible to combine the superior forage quality of ryegrass species with the high persistency and stress tolerance of fescues in interspecific *Lolium*×*Festuca* hybrids *(*×*Festulolium*) [15]. Festulolium hybrids have a great recombination potential, which is being successfully used in plant breeding [2],[17].

Orchardgrass (*Dactylis glomerata* L.) (*Dg*) starts growth early in spring, develops rapidly, and flowers during May under Latvia conditions. It is more tolerant of shade, drought, and heat than the timothy. *Dg* can be grown in poor and shallow soils [16] and to produce high yields within proper management.

In general grasslands are not only a relatively cheap source of feed for ruminants, but are also increasingly being recognized for their contribution to the conservation of biodiversity, to the regulation of physical and chemical fluxes in ecosystems, to the mitigation pollution and to production of landscape amenity [6].

The aim of our study was to compare various species and breeds of perennial grasses from the neighbouring countries and to determine more persistent and productive cultivars suitable for growing in Latvia conditions for qualitative fodder production.

MATERIALS AND METHODS

The comparison of varieties included 29 cultivars from 4 countries (*LT*, *LV*, *EE*, *SE*): 6 cultivars of *Lolium perenne* (*Lp*), 3 Festulolium (*FxL*), 7 *Phleum pratense (Pp), 7 Festuca pratensis (Fp),* and 6 *Dactylis glomerata (Dg).* The trial was conducted at the experimental field of the Research Institute of Agriculture in Skriveri (56°37 N and 25°07 E) in a randomized block design with three replications. The number of standard was raised to the 12th in order to enhance the accuracy of the test. Accounting plot area 10 m^2. The trial was established in May 2009 without cover crop in a sod-podzolic loam soil, pH KCl 6.0, plant available $P_2O_5$132 mg kg^{-1}, K_2O 86.0 mg kg^{-1}, organic matter content 1.8 g kg^{-1}. Seeding rates: *Lp* 20; *Pp* 12; *Fp* 25; *Dg* 15 kg ha^{-1}. Basic fertilisation before sowing was not used; in the production years ammonium nitrate (60 N) was used 3 times per year: in early spring just after the beginning of vegetation and after the 1st and 2nd cut (in total 180 N per year). The first cut was done at heading; the aftermaths harvest times (2) were decided depending on the weather conditions in the growing season. The research was done until 2014, thereby for 5 years the dry matter yield (DMY), regrowth intensity comparing aftermath yield with total yield and winter hardiness of each breed were evaluated. For *Fp*, *Lp* and *FxL* forage quality was determined: N (Kjeldal method); ADF, NDF and ash (gravimetrical method and calculation). Crude protein (%) was calculated using coefficient (N,%*6.25_{coef}). Relative feed value (RFV) was calculated using formulas RFV = DDM*DMI/1.29_{coef}; DDM% =88.9_{coef} – (0.779_{coef}*ADF%); DMI% = 120_{coef}/NDF%.

Climatic conditions during the 2009-2014 in Latvia were very various both in winter and summer period, and they also differed sharply over the month. Lots of rainfall fell during the 1st growing season in 2010 (569 mm). Very different climatic conditions prevailed in 2011, when the growing season was dry and relatively warm, the plants lacked moisture from the early summer. Altogether in growing season there was 431 mm rainfall. In June and July there was hot weather with an average air temperature 17.8^0 and 20.2^0 respectively. The spring and beginning of summer 2012 was very cool and rainy, during the growing season there was 655 mm rainfall. The growing season of 2013 was characterized by very favourable growing conditions – long, warm, with sufficient precipitation. Especially extreme wintering conditions developed in winter 2013/2014, when in December the mean air temperature was +6…8^0 C over the long lasting average, therefore vegetation continued. On January 12 it began to freeze and frost increased in force every night reaching –24^0 in the 3rd decade. There was black frost with strong North-East winds until February 10. For all overwintering crops, including grasses, it was a big challenge. The following spring was early, but very cool and wet, while during the summer months – July and August there was a prolonged drought and heat.

Statistical analysis. 1. Significance of the differences ($P < 0.05$) among the cultivars was detected by data processing with Microsoft Excel program data subprogram using mathematical and statistical functions.

RESULTS AND DISCUSSION

The climate change and new types of stresses will have various implications for adapting forage cultivars to the changing conditions both through breeding and different management schemes [7]. Grassland productivity is affected by several factors: soil characteristic, climatic conditions – particularly total and seasonal distribution of rainfall and temperature – altitude, latitude and management [6]. Different climatic conditions during testing years influenced growing and development as well as dry matter yield (DMY) of cultivars, therefore the yield varies considerably for all grass species over the years. It is especially expressed in 2011 when DMY are significantly lower due to cool and dry condition.

Productivity varies both between the species and cultivars. In Latvia agro-climatic conditions higher and more stable yields have been produced by *Phleum pratense* (*Pp*), *Dactylis glomerata* (*Dg*) and *Festulolium* (*FxL*) for several years (Table 1). The favourable growing season of 2010 contributed the development of grass, therefore despite rather low fertilisation level (without using of P and K) in the 1st year of use high DMY was obtained: over 9.0 t ha^{-1} for *FxL*; 7.74-9.43 t ha^{-1} for *Pp*; 5.83-6.49 t ha^{-1} for *Festuca pratensis* (*Fp*) and 5.83-6.49 t ha^{-1} for *Dg*.

Table 1

The evaluation of productivity (DMY) and winter hardiness (WH) of cultivars

Variety (origin)	DMY, t ha^{-1} (per year and on average 2010-2014)						Aftermath of DMY$_{tot}$ 2010-2014, %	WH (1-9 p.) 2014
	2010	2011	2012	2013	2014	on average		
Dg Priekuļu 30 (LV) (a)	6.19	5.88	5.16	7.21	6.57	6.20^{bcd}	50.5^{D}	7.2^{Cd}
Dg Jõgeva 242 (EE) (b)	5.66	5.37	4.97	6.90	6.06	5.79^{A}	50.7^{D}	7.0^{Cd}
Dg Jõgeva 220 (EE) (c)	5.48	4.98-	5.29	6.22-	6.36	5.67^{A}	50.2^{D}	8.3^{abdef}
Dg SW Luxor (SE) (d)	5.33	4.48-	4.90	5.99-	6.19	5.37^{AEF}	57.3^{abcef}	6.0^{ABCEF}
Dg Regenta (LT) (e)	6.30	5.76	5.13	6.89	5.79	5.97^{d}	51.5^{D}	7.0^{Cd}
Dg Aukštuolė (LT) (f)	6.13	6.15	4.94	6.72	6.13	6.01^{d}	48.3^{D}	7.0^{Cd}
$LSD1_{0.05}$	*1.02*	*0.82*	*0.70*	*0.96*	*0.87*	*0.37*	*2.79*	*0.66*
$LSD2_{0.05}$	*1.25*	*1.00*	*0.86*	*1.24*	*0.78*	*0.46*	*3.42*	*0.81*
Fp Silva (LV) (a)	6.49	4.63	5.00	6.18	3.11	5.08^{bcefg}	40.4^{De}	6.9
Fp SW Minto (SE) (b)	5.83-	3.66-	4.07-	5.10-	2.53-	4.42^{AD}	43.0^{Defg}	7.0
Fp Patra (LV) (c) 4n	5.71-	4.13	4.76	5.32-	2.51-	4.49^{AD}	40.5^{De}	6.7
Fp Kaita DS (LT) (d)	5.98	4.81	4.99	5.94	2.71-	4.89^{bce}	57.3^{abcefg}	6.7
Fp Raskila (LT) (e) 4n	6.02	4.58	4.42	4.93-	2.30-	4.45^{AD}	35.8^{ABCD}	7.0
Fp Arni (EE) (f)	6.29	4.52	4.14-	5.37-	2.95	4.65^{A}	37.8^{BD}	7.0
Fp Vaira (LV) (g)	6.27	4.16	4.56	6.28	2.58-	4.77^{A}	38.4^{BD}	6.7
$LSD1_{0.05}$	*0.61*	*0.59*	*0.67*	*0.55*	*0.32*	*0.25*	*3.29*	*0.85*
$LSD2_{0.05}$	*0.79*	*0.76*	*0.86*	*0.71*	*0.41*	*0.33*	*4.25*	*1.10*
Pp Teicis (LV) (a)	8.20	6.68	7.81	8.28	4.77	7.15^{BE}	33.4^{BCDE}	6.7^{B}
Pp Switch (SE) (b)	9.43+	6.66	8.90+	7.66	5.21	7.57^{adfg}	41.1^{acdfg}	7.7^{aef}
Pp Varis (LV) (c)	7.82	6.59	7.98	8.30	5.43	7.22^{E}	37.1^{aBEfg}	7.0^{e}
Pp Jauniai (LT) (d)	7.74	6.55	7.11	7.02-	5.18	6.72^{BE}	35.6^{aBEfg}	7.0^{e}
Pp 2690 (LT) (e)	8.78	5.92	9.38+	9.33+	6.92+	8.07^{acdfg}	41.1^{acdfg}	6.0^{BCDG}
Pp Jõgeva 54 (EE) (f)	8.18	6.82	7.72	7.24-	4.33	6.86^{BE}	32.5^{BCDE}	6.7^{B}
Pp Tika (EE) (g)	8.23	6.31	7.72	7.48	4.69	6.89^{BE}	33.5^{BCDE}	7.0^{e}
$LSD1_{0.05}$	*0.90*	*0.87*	*1.01*	*0.85*	*0.94*	*0.40*	*1.67*	*0.65*
$LSD2_{0.05}$	*1.14*	*1.10*	*1.28*	*1.08*	*1.19*	*0.50*	*2.11*	*0.82*
Lp Spīdola (LV) (a) 4n	7.90	4.63	6.02	5.37	X	5.98^{f}	34.5^{CGHI}	2.0
Lp SW Birger (SE) (b) 4n	7.94	5.08	5.26	5.39	X	5.92^{f}	37.5^{C}	3.0
Lp Elena DS (LT) (c)	7.66	4.82	6.46	4.01-	X	5.74^{f}	45.9^{abdef}	1.0^{DEF}
Lp Raminta (LT) (d)	7.09	4.78	6.24	4.79	X	5.73^{f}	37.4^{C}	4.7 c
Lp Raite (EE) (e)	7.11	4.49	5.97	6.03	X	5.92^{f}	38.7^{C}	5.0 c
Lp Raidi (EE) (f)	6.32-	4.11-	4.88-	4.11-	X	4.86^{ABCDE}	32.4^{CGHI}	5.0 c
$LSD1_{0.05}$	*0.92*	*0.50*	*0.77*	*0.79*	*X*	0.38	*4.91*	*2.68*
$LSD2_{0.05}$	*1.13*	*0.61*	*0.94*	*0.97*	*X*	0.47	*6.01*	*3.28*
FxL Saikava (LV) (a) 4n	9.79	5.00	7.24	6.73	X	7.19	40.8^{af}	3.7
FxL Punia (LT) (b) 4n	10.20	5.67	6.62	6.84	X	7.33	40.3^{af}	4.0
FxL Vizule (LV) (c) 4n	9.40	5.27	6.22	6.33	X	6.81	42.2^{af}	3.7
$LSD1_{0.05}$	*1.66*	*0.90*	*1.11*	*1.02*	*X*	*0.60*	*6.01*	*3.05*

*$LSD1_{0.05}$ – variants have been compared with standard
**$LSD2_{0.05}$ – variants have been compared between themselves
(+);(-) – deviations from the standard
Letters: capital – indicate to the variant with significantly lower DMY;
lower-case – to significantly higher DMY(both compared with standard).

Very different growing conditions developed in 2011, from the beginning of vegetation up to July it was very dry, grasses lacked moisture, nitrogen fertiliser was not used effectively. Under such circumstances the highest DMY (over 6 t ha^{-1}) was developed by *Pp* varieties, whereas this species is less demanding in terms of soil and climatic conditions. Lower yield (less than 5 t ha^{-1}) accounted for more demanding species: *Lp* and *Fp* breeds, as *Lp* is demanding in nutrients, but *Fp* has an advantage in damp areas, therefore meadow fescue is commonly used in pasture mixtures in cool, moist environments [3].

The growing season of 2012 was different from the previous one with very rainy and cold spring and summertime. This affected grass growth and development regime, time of harvesting and DMY. The second half of summer was warm and dry, the resulting DMY of *Pp*, *FxL* and *Lp* in the 3rd year of use in general was satisfactory. The highest DMY (7.11-9.38 t ha^{-1}) was produced by *Pp* varieties: the best results accounted for No '2690' (LT) and 'Switch' (SE) – 9.38 t ha^{-1} and 8.90 t ha^{-1}, respectively. The lowest DMY in this condition accounted for *Dg* and *Fp* cultivars – on average it was within 4 to 5 t ha^{-1}.

In 2013 there developed favourable conditions for grass growth, it was warm and moist. Since it was the 4th year of sward use, the total DMY was considered to be good, more stable and higher DMY was provided by *Pp* (7.02-9.33 t ha^{-1}), *FxL* (6.33-6.73 t ha^{-1}) and *Dg* (above 6.0 t ha^{-1}) cultivars.

In the 5th year of use after black frost during winter 2013/2014 a lot of plants disappeared from *Lp* and *FxL* swards, therefore it was decided not to account the DMY for these species. However, such atypical wintering conditions didn't affect the sward quality of *Pp* and *Dg* cultivars, which provided the highest DMY: the best results was 6.57 t ha^{-1} for *Dg* 'Priekuļu 30' (LV) and 6.92 t ha^{-1} for *Pp* No '2690' (LT).

A significant role in the formation of high and stable DMY of perennial grasses is played by the availability of K and P nutrients. As the analysis of soil in trial field showed low K and medium P content and these plant nutrients were not provided with any fertiliser, it was a limiting factor, therefore DMY in general for all species were not very high, although harvest levels varied significantly between species and cultivars.

The trial data show that on average the lowest DMY in 5 years of use (< 5.0 t ha^{-1}) accounted for *Fp* under these circumstances, the most productive cultivar was 'Silva' (LV) – 5.08 t ha^{-1}. The data indicate that all *Fp* cultivars included in testing are of intensive type, especially 4n varieties are very demanding on fertiliser. The percentage of aftermath from total DMY for *Fp* cultivars ranged within 20% – from 37.8% 'Arni' (EE) to 57.3% 'Kaita' (LT), noting that the first one regrow more slowly compared with the second mentioned (Table 1). Assessing the winter hardiness (WH) of *Fp* cultivars in the spring of 2014 (5th year of use), it was found that all varieties have shown good WH, it ranged slightly – from 6.7 to 7.0 points (Table 1).

More productive of *Dg* varieties was standard 'Priekuļu 30' (LV) – providing 6.2 t ha^{-1} on average during the 5 years of use. This cultivar showed good WH, to (7.2 points). The greatest percentage of aftermath of total DMY was for cultivar 'Luxor' (SE) – 57.3%, which shows good regrowth capacity. In our trials 'Luxor' was evaluated as the latest-type cultivar in comparison with other included, while the earliest one was 'Jõgeva 220' (EE), which stood out with very good winter hardiness (8.3 points).

More stable and high yields under certain circumstances and management were provided by *Pp* breeds, most productive was perspective No '2690' (LT) – 8.06 t ha^{-1} on average in 5 year of use. The standard 'Teicis' (LV), which is early-type cultivar, produced 7.15 t ha^{-1}. The highest percentage of aftermath yield (41.1%) accounted for breeds: No '2690' (LT) and 'Switch' (SW). Timothy usually distinguished with good WH. In our trial after the 5th year wintering ratings for *Pp* varieties were satisfactory, ranging from 6.0 No '2690' (LT) to 7.7 points 'Switch' (SW).

Evaluating the DMY of *Lp* cultivars during 4-year period is seen that the results are quite similar (from 4.86 t ha^{-1} for 'Raidi' (EE) to 5.98 t ha^{-1} for 'Spīdola' (LV). A larger proportion of the grass aftermath (46%) and hence better regrowth ability were detected for cultivar 'Elena' (LT). WH in the period of 2010-2013 for all *Lp* varieties was good. A lot of *Lp* plants disappeared from sward after black frost during the winter of 2013/2014, but the results differed between cultivars. Lower WH was noticed for 'Elena' (LT), but Estonian cultivars 'Raite' and 'Raidi' stood out with better overwintering.

All three *FxL* cultivars were evaluated as quite similar, on average DMY in 4 years a slightly lower (6.81 t ha^{-1}) accounted for 'Vizule' (LV), higher (7.33 t ha^{-1}) for 'Punia' (LT), which stood out with better WH, too. Whereas the highest aftermath percentage (42.3%) of the total DMY and therefore the best regrowth abilities were shown by cultivar 'Vizule' (LV).

Forage quality. Harvesting and grazing management have to be dealt with the trade – off between forage quantity and quality to maximize net energy and protein harvested per ha. Feeding value of pasture is the product of voluntary feed consumption and the digestibility of nutrients consumed [10]. Nitrogen is a key factor in grassland farming and in ruminant nutrition [18].

Protein is often a limited resource on farms with high yielding dairy cows. The highest protein content of *Fp* cultivars in the 1st mowing are for: 'Arni' (EE) – 12.50% and 'Kaita' (LT) – 12.31%; in the 2nd mowing for: 'Patra' (LV) – 17.13% and 'Minto' (SE) – 17.12% (Table 2). The 2nd mowing forage quality is better, what can be explained by the fact that there in the sward are very few culms. A biomass is accumulating with plant growth, sward quality in terms of net energy, protein content and potential voluntary intake in decreasing as a result of plant maturation. A less mature plant contains a lower proportion of true stem and dead material and a greater proportion of leaf which is lower in fibre and highly digestible [5].

Table 2

Forage quality during period 2010- 2011 (in average)

Variety	Crude protein, %		Relative feed value RFV		Ash, %	
	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut
Fp Silva (LV) (a)	11.74	15.45	100.16^{H}	109.43	6.31	7.31
Fp SW Minto (SE) (b)	10.66	17.12^{i}	101.50^{dH}	108.13	6.12	7.14^{K}
Fp Patra (LV) (c) 4n	11.06	17.13^{i}	102.66^{dH}	114.41	5.79^{F}	7.49
Fp Kaita DS (LT) (d)	12.31	16.01	$89.49^{BCEFGHIK}$	109.69	5.46^{FK}	7.51
Fp Raskila (LT) (e) 4n	11.76	16.25	104.53^{dH}	113.93	5.73^{F}	6.97^{K}
Fp Arni (EE) (f)	12.50^{j}	15.39	104.49^{dH}	104.52	6.79^{cdeh}	7.00^{K}
Fp Vaira (LV) (g)	11.65	15.27	101.34^{dH}	101.28	6.00	7.19^{K}
Lp Spīdola (LV) (h) 4n	10.14	14.20	$121.42^{abcdefgijk}$	114.11	5.70^{F}	8.00
FxL Saikava (LV) (i) 4n	9.71	10.35^{BC}	104.14^{dH}	104.27	6.22	7.79
FxL Punia (LT) (j) 4n	8.56^{F}	13.35	99.37^{H}	103.05	6.14	8.08
FxL Vizule (LV) (k) 4n	8.96	12.58	107.6^{dH}	101.76	6.48^{d}	8.50^{befg}
$LSD1_{0.05}$	*3.44*	*6.00*	*10.40*	*15.24*	*0.86*	*1.12*

When comparing the forage quality of *FxL* with *Lp*, which is recognized as the most valuable perennial grass species in the world, we can see that no *FxL* cultivar exceeds *Lp* 'Spīdola' (LV) in protein content of the 1st mowing; in the 2nd mowing good performance in protein content is for *LxP* 'Punia' (LT) and 'Vizule' (LV).

Relative feed value (RFV) characterize the forage quality. If the index is above 100, the feed is assessed as good; above 124 – as very good; but if the index is less than 100 then feed is not enough quality. For our evaluated cultivars RFV ranged from 99.37 *FxL* 'Punia' (LT) to 121.42 *Lp* 'Spīdola' (LV) in the 1st cut and from 101.28 *FxL* 'Vizule' (LV) to 114.41 *Fp* 'Patra' (LV) in the 2nd cut. Both tetraploid (4n) *Fp* cultivars 'Patra' and 'Raskila' are distinguished by higher RFV, what is a characteristic feature of tetraploid *Fp* cultivars in general due to the chemical content of its swards.

The ash indicates the total mineral substances content in forage. Too much ash in forages can distort ration levels leading to incorrect nutrient levels that can harm a dairy nutrition program's performance. The typical ash content for perennial grasses is 7-12% on a dry matter basis. Ash does not contribute any calories (energy) to the diet [8]. In our trial the content of ash ranged from 5.46% *Fp* 'Kaita' (LT) to 6.79% *Fp* 'Arni' (EE) in the 1st cut and from 6.97% *Fp* 'Raskila' (LT) to 8.50 % *FxL* 'Vizule' (LV) in the 2nd cut.

CONCLUSIONS

All the species and cultivars under research are well suitable for forage production in Latvia, although the productivity depends on agro-climatic condition during the growing season and wintering. *Pp*, *Fp* and *Dg* cultivars are characterized by long and more stable persistence in sward. In the 5th year of use *Lp* cultivars disappeared greatly from the sward after black frost.

Higher and more stable yields over the 5 years of use accounted for *Pp* cultivars: 'Switch' (SE), 'Varis' (LV), 'Teicis' (LV) and perspective No '2690' (LT), which provided more than 7 t ha^{-1} DMY on average. Good average DMY with high forage quality during the 4 year period was provided by *FxL* cultivars 'Punia' (LT) and 'Saikava' (LV) – 7.33 and 7.19 t ha^{-1}, respectively.

In general the forage quality of all cultivars of *Lp*, *Fp* and *FxL* was satisfactory providing RFV over 100 for both mowings.

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