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Relative Feed Value of Different Varieties of *Dactylis glomerata* and *Festuca pratensis*

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Abstract: The aim of this paper is to analyze fluctuation in nutritional value of *Dactylis glomerata* and *Festuca pratensis* varieties grown on mineral and organic soil. Moreover, the paper deals with analysis of their nutritional value in terms of animal feeding. This paper has drawn on two field experiments set up and carried out between 2010 and 2013 by the Research Centre for Cultivar Testing in Słupia Wielka. The experiment was conducted in two experimental stations: one in the Research Centre for Cultivar Testing in Krzyżewo and the other in the Experimental Stations for Variety Testing in Uhinin, being a branch of the Research Centre for Cultivar Testing in Cicibor Duży. The experiment was arranged and conducted according to COBORU guidelines. The experimental plots were sown with varieties of *Dactylis glomerata*: Niva, Tukan, Amila, Crown Royale and with varieties of *Festuca pratensis*: Limosa, Pasja, Anturka, Amelka (d. AND 1009). In the experimental plots with the varieties of *Dactylis glomerata* the grass was harvested six times a year and chemical analysis of the biomass was done taking dry matter only from five cuts. The varieties of *Festuca pratensis* were harvested four times. The RFV (relative feed value) was determined using the Linn and Martin method. Linn and Martin's test proved that *Festuca pratensis* had better nutritional value than *Dactylis glomerata*. For *Dactylis glomerata*, no matter what the variety and location was, the relative feed value ranged from 125 to 151, which puts that grass species in II quality class, good enough to feed high production dairy cows and heirs selected for replacements. The analysis of the relative feed value proved that no matter from which cut, the biomass of *Dactylis glomerata* belonged in III quality class, (RFV between 103 and 124) and it can be used to feed good beef cattle, older heifers and, in small quantities, dairy cows.

Key words: Dry matter intake, dry matter digestability, relative feed value.

1. Introduction

According to Jankowska-Huflejt and Wróbel [1], roughages should cover all nutritional requirements of animals to maintain biological functions and production. Research done by the authors proved that relative feed value (RFV) of dry matter of the grasses ranged from 103 to 124 (III class of forage quality). According to Linn and Martin [2] classification, those species can be used as good quality feed for fattening cattle, for older heifers and only in a limited amount for milking cows. This fodder is not adequate at all to feed young heifers selected for breeding, for intensive fattening of beef cattle and for intensive dairy cattle. However, because of good value of this fodder it is not used to feed nonlactating cows or non-intensive cattle for fattening. For those animals the fodder of relative feed value between 87 and 102 can be used.

Sosnowski [3] says that the best quality animal feed (with the optimum value of *neutral detergent* fiber—NDF and acid detergent fiber—ADF, optimum digestibility and dry matter intake) is perennial ryegrass and *Festuca pratensis*. The feed with the lowest nutritional value is dry matter coming from *Dactylis glomerata*.

The aim of this paper is to analyze fluctuation in nutritional value of *Dactylis glomerata* and *Festuca pratensis* varieties grown on mineral and organic soil. Moreover, the paper deals with analysis of their nutritional value in terms of animal feeding.

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2. Methods

This paper has drawn on two field experiments set up and carried out between 2010 and 2013 by the Research Centre for Cultivar Testing in Słupia Wielka. The experiment was conducted in two experimental stations: one in the Research Centre for Cultivar Testing in Krzyżewo and the other in the Experimental Stations for Variety Testing in Uhinin, being a branch of the Research Centre for Cultivar Testing in Cicibor Duży. The stations are located in the Podlaskie Woivodeship, the Wysokie Mazowiekie county, in the commune of Sokoły. Uhnin is located in the Lublin Vovodeship, the Parczew county and the Dębowa Kłoda commune.

The experiment was arranged and conducted according to COBORU guidelines [4]. The experimental plots were sown with varieties of *Dactylis glomerata*: Niva, Tukan, Amila, Crown Royale and with varieties of *Festuca pratensis*: Limosa, Pasja, Anturka, Amelka (d. AND 1009).

The plots were randomly selected, 1.5 m wide and 6.67 m long, with an area of 10 m^2, grouped in blocks with four replications. They were separated by 1 m pathways between blocks and with 0.5 m pathways between sub-blocks. The pathways lay fallow. The experiment in Krzyżewo was set up on ploughed soil, with spring barley as the forecrop. In Uhnin the experimental plots were located on peat meadow. Table 1 and 2 present soil characteristics and mineral fertilizers used.

In the research the amount of seeds of the grass sown varies depending on the variety and the location of the experiment. It was as follows (in kg/ha):

- *Dactylis glomerata*—Tukan: 16.3; Amila: 17.5; CR: 18.8 (Krzyżewo) and 17.6 (Uhnin); Niva: 18.3,
- *Festuca pratensis*—Pasja: 28.7; Limosa: 29.8 (Krzyżewo) and 27.1 (Uhnin); Anturka: 26.6; Amelka: 27.8 (Krzyżewo) and 27.9 (Uhnin).

The sowing dates for *Dactylis glomerata* were 22 April 2011 (Krzyżewo), 6 May 2011 (Uhnin) and for *Festuca pratensis* 22 May 2011 (Krzyżewo) and 29 April 2011 (Uhnin).

In the year when the experiment was set up the grass was not harvested and only weeds were mowed. According to the guidelines of COBORU, the full exploitation of *Dactylis glomerata* varieties was due between 2012 and 2013, whereas for *Festuca pratensis* it was due between 2011 and 2012. In the experimental plots with the varieties of *Dactylis glomerata* the grass was harvested six times a year and chemical analysis

Table 1 Soil conditions.

Grass	*Dactylis glomerata*		*Festuca pratensis*	
Location	Krzyżewo	Uhnin	Krzyżewo	Uhnin
Soil conditions				
The value of soil according to IUNG	52	50	52	70
Agricultural value	5	1p	5	1z
Type	P	PS	P	PS
Texture	ls	-	ls	-
pH	6.7	5.5	6.7	5.5

Symbols: 1p—good and very good permanent meadow, 5—good quality rye soil; P—podsolic soil, PS—peaty soil, ls—loamy sand.

Table 2 Mineral fertilizers used in the experiment with varieties of *Dactylis glomerata* and *Festuca pratensis*.

Fertilizers in $kg \cdot ha^{-1}$				
Nitrogen—N: before sowing, in consecutive years	270 245	80 192	80	80
Phosphorus—P_2O_5: before sowing, in consecutive years	90 80	100 100	80	80
Potassium—K_2O: before sowing, in consecutive years	90 130	100 110	100	100

of the biomass was done taking dry matter only from five cuts. The varieties of *Festuca pratensis* were harvested four times. Each year in the course of the experiment fresh and dry matter of each cut were weighed. Research Centre for Cultivar Testing made those measurements available to be used in this paper.

Climatic conditions of the area where the experiment was carried out are typical for the 9th agricultural and climatic eastern part of Poland. The average annual air temperature varies from 6.7 to 6.9 °C and in the summer season the average 24 h temperature is 15 °C. The growing season usually starts on 28 March, lasts till 30 October and is 200 to 220 days long. The average climatic water balance during the time of the experiment varied considerably according to the period and location. Annual rainfall ranges from 550 to 650 mm, with not frequent but recurrent rain. Water stress was mainly observed in spring while water deficit occurred in July [5]. During the time of the experiment weather data were provided by the Meteorological and Hydrological Stations in Krzyżew and Uhnin. To determine temporal variation of meteorological parameters and their impact on plant growth Sielianinov's hydrothermal index was used with the month's classification according to Skowera and Puła [6]. As it can be seen from Table 3 space-time distribution of annual rainfall varied. April was a month of water stress only in 2011 in Krzyżewo (K = 0.86), whereas in May water deficit was noted in Uhnin in 2012 (K = 0.84). Every year in June there was enough rain both in Krzyżewo and Uhnin (K between 1.06 and 2.12). July was either extremely wet (Krzyżewo 2011 K = 3.9, Uhnin K = 3.03) or dry (Krzyżewo and Uhnin 2013). However, on the whole both July and August were rather dry whereas September and October happened to be extremely dry one year each with Sielianinov's hydrothermal index more than 4 (Krzyżewo 2013 and Uhnin 2012).

The RFV was determined using the Linn and Martin [2] method. The formula is as follows:

$$RFV = (DMD \times DMI): 1.29$$

RFV—relative feed value,

DMI—dry matter intake (DMI = 120: NDF in % of body weight).

DMD—digestibility of dry matter (DMD = 88.9 – 0.779 × ADF in %).

3. Results and Discussion

According to Hintz and Albrecht [7] and Linn and Martin [2] feed quality depends on the plant development stage at the time what it is harvested. The older a harvested plant is the lower its nutritional value because it contains more fiber in its biomass, which has an impact on digestibility and the value of the intake of the dry matter [8-11].

The data in Table 5 indicate that using neutral detergent fiber content, NDF, the calculated dry matter intake, DMI, of *Dactylis glomerata* and *Festuca*

Table 3 Sielianinov's hydrothermal index (K) during the growing season in the years of the experiment in Krzyżewo and Uhnin.

Month	Krzyżewo			Uhnin		
	Year of experiment					
	2011	2012	2013	2011	2012	2013
IV	0.86 (s)	1.63 (dw)	2.50 (w)	1.39 (o)	1.06 (ds)	2.79 (bw)
V	1.64 (dw)	1.09 (ds)	1.80 (dw)	1.09 (ds)	0.84 (s)	2.87 (bw)
VI	1.06 (ds)	1.83 (dw)	1.53 (o)	2.12 (w)	1.92 (dw)	1.74 (dw)
VII	3.90 (sw)	1.55 (o)	1.08 (ds)	3.03 (sw)	0.81 (s)	0.92 (s)
VIII	1.15 (ds)	3.18 (sw)	0.89 (s)	0.79 (s)	1.25 (ds)	0.12 (ss)
IX	0.41 (bs)	0.40 (ss)	4.84 (sw)	0.21 (ss)	0.79 (s)	2.46 (w)
X	0.81 (s)	2.27 (w)	0.48 (bs)	1.27 (ds)	4.90 (sw)	0.46 (bs)

Note: (ss)—extremely dry, (bs)—very dry, (s)—dry, (ds)—quite dry, (o)—optymal, (dw)—quite wet, (w)—wet, (bw)—very wet, (sw)—extremely wet.

Table 4 Evaluation of forage from pastures and meadows using relative feed value—RFV [1, 2].

Quality class	RFV	Animals
I	> 150	high production dairy cows
II	125-149	good dairy cows, young heifers selected as replacements
III	103-124	good beef cattle, older heifers, dairy cows, in small quantities
IV	87-102	beef cattle, nonlactating cows
V	75-86	cull cows for fattening (as low quality feed) together with high energy

Table 5 Dry matter intake (DMI) and of *Dactylis glomerata* and *Festuca pratensis* based on the grass variety, cut and location.

Objects	*Dactylis glomerata*		Objects	*Festuca pratensis*	
	Dry matter intake DMI [% of body weight]	Dry matter digestability DMD [%]		Dry matter intake DMI [% of body weight]	Dry matter digestability DMD [%]
Variety					
CR	2.31	64.8	Amelka	2.40	68.3
Amila	2.35	64.8	Anturka	2.37	67.9
Tukan	2.37	65.0	Pasja	2.38	70.0
Niva	2.32	64.3	Limosa	2.32	67.2
Location (typ of soil)					
Uchnin	2.30	64.4	Uchnin	2.34	67.8
Krzyżewo	2.37	64.9	Krzyżewo	2.40	67.8
Cut					
PI	2.41	65.9	PI	2.43	68.3
PII	2.47	65.9	PII	2.48	68.2
PIII	2.32	64.3	PIII	2.33	68.1
PIV	2.24	63.0	PIV	2.20	67.2
PV	2.27	64.1	-	-	-

Pratensis was on average 2.35%. The highest dry matter intake DMI (2.47% of *Dactylis glomerata* and 2.48% *Festuca pratensis*) was from second cut and the lowest (about 2.20%) from the fourth cut.

The dry matter intake for both species of grass differed by as little as 0.01% and such a difference was negligible in the experiment. In the case of the observed dried matter digestibility, DMD (Table 5), calculated using the content of acid detergent fiber, ADF. It is worth noting that the value of this parameter is higher for *Festuca pratensis* than for *Dactylis glomerata*. This tendency is confirmed when digestibility is determined with the NIRS (Near Infrared Spectroscopy) method, the non-destructive screening method. Besides, it is worth noting that the variety of Pasja has an exceptionally high value of digestibility. Dry matter digestibility of the grass determined with the NIRS method was 61%, whereas observed value of digestibility was 70%.

Linn and Martin's test [2] proved that *Festuca pratensis* had better nutritional value than *Dactylis glomerata* (Fig. 1 and 2). For *Dactylis glomerata*, no matter what the variety and location was, the relative feed value ranged from 125 to 151 [2], which puts that grass species in II quality class, good enough to feed high production dairy cows and heirs selected for replacements (Tab. 4). The analysis of the relative feed value proved that no matter from which cut, the biomass of *Dactylis glomerata* belonged in III quality class, (RFV between 103 and 124) and it can be used to feed good beef cattle, older heifers and, in small quantities, dairy cows. Out of *Festuca pratensis* varieties Limosa and Anturka were of III quality class. All varieties from cuts 3 and 4 grown in Uhnin on organic soil also belonged to III quality class.

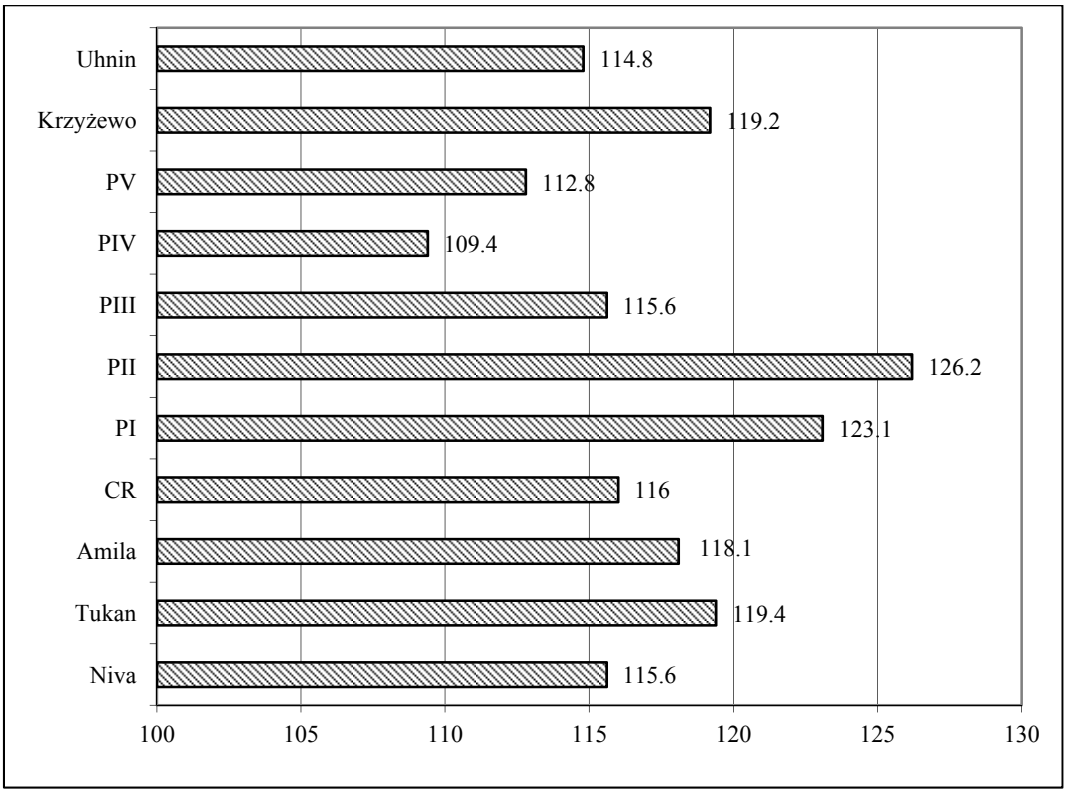

Fig. 1 Relative feed value—RFV of the *Dactylis glomerata* dry matter based on the grass variety, cut and location.

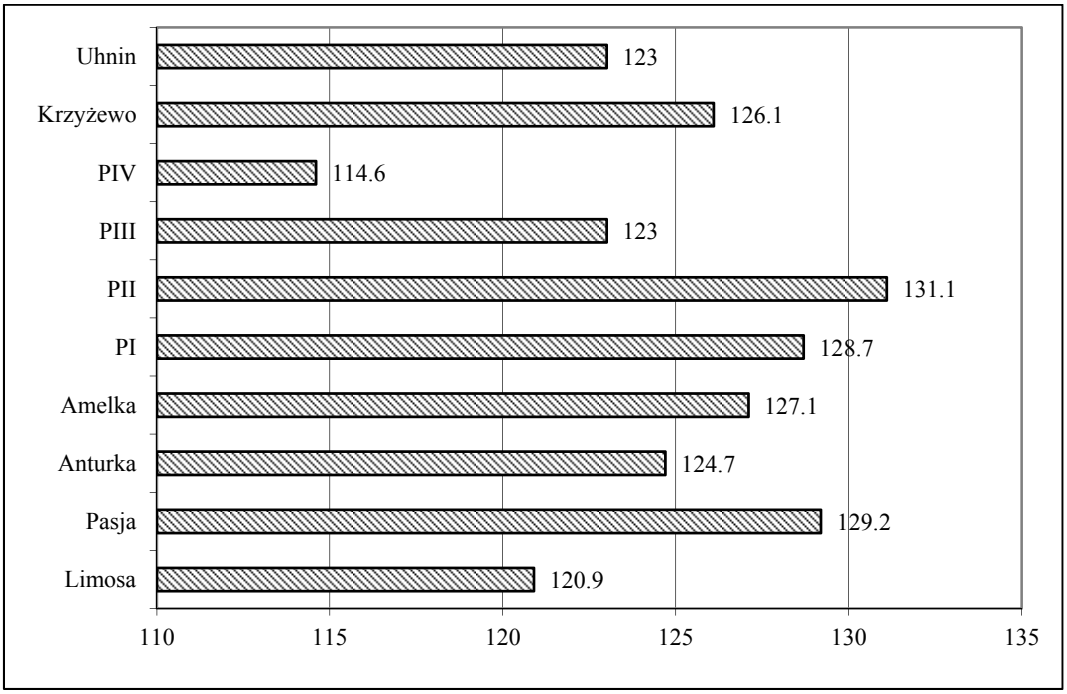

Fig. 2 Relative feed value—RFV of the *Festuca pratensis* dry matter based on the grass variety, cut and location.

4. Conclusions

Analyzing different cuts of *Dactylis glomerata* and *Festuca pratensis* varieties it was observed that the best nutritional value with the high relative feed value had the second cut. For both species of grass the varieties growing on mineral soil had a better nutritional value than those growing on organic soil. Nutritional values of *Dactylis glomerata* and *Festuca pratensis* varieties differ considerably, with the Tukan variety of *Dactylis glomerata* being the best one. In the case of *Festuca pratensis* the best varieties are Pasja and Amelka.

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