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EVALUATION OF THE FODDER VALUE OF THE OVER GROUND PARTS OF SEDGES FROM THE SECTION *MUEHLENBERGIANAE* (L.H. BAILEY) KÜK.

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ABSTRACT. This paper contains the results of research of concentrations of macroelements (P, K, Ca, Mg, Na), microelements (Cu, Zn, Mn, Fe), SiO_2 and elementary composition in over-ground parts of the selected species of the genus *Carex* (*Carex spicata*, *C. muricata* and *C. divulsa*).

Key words: *Carex*, elementary composition, macroelements, microelements, crude ash

Introduction

Genus *Carex* L. belongs to the less accurately described taxa of the Polish vascular plants. This group is difficult due to several questions, concerning taxonomical problems and their economic utility. It is commonly believed, that sedges are unnecessary components of meadows and pastures, which decreases fodder quality, digestibility and its palatability, because some species of *Carex* contain high amount of sclerenchyma (**Grynia** et **al.** 1987).

Despite this opinion, there are several species of *Carex*, which have soft leafs, practically without silica bodies, and are characterized by low content of sclerenchyma. To such group belongs representatives of section *Muehlenbergianae* (L.H. Bailey) Kük. – *Carex spicata* Huds., *C. muricata* L. and *C. divulsa* Stokes (**Szczepanik-Janyszek** and **Woźnica** 2001).

The representatives of investigated section grow in several meadows, pastures communities and other grasslands and are very morphologically similar to the grasses, particularly at the vegetative stages.

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Plants of this section have big and weighty seeds and are often being unintentionally spread by farmers, becoming one of the components of meadows and pastures. **Janyszek** (unpublished data) observed pastures, where *C. spicata* and *C. muricata* were dominants, and their tufts were often and willingly grazed. *Carex divulsa* is much more rare species, because of its specific ecological preferences. This species is related to the termophilous skirt communities and usually avoids places intensively mowed or grazed. (**Szczepanik-Janyszek** 2001). Due to its rarity, the taxon is protected by Polish law.

The aim of the performed experiments was to determine the fodder value of the over-ground parts of sedges from the *Muehlenbergianae* section (L.H. Bailey) Kük, using selected chemical analysis.

Research methods

The material for the analyses was collected in July at flowering and earlier fruiting phases. Those phases were chosen, because described species are very similar to each other and are practically undistinguishable at the vegetative stages.

On the other hand, mowing of meadows is usually realized during the phases in which sedges are blooming or have mature sacks. This moment is optimal to gain the crop with maximum content of proteins and best quality fodder.

Every samples were collected from the same site – the patch of fertile meadow belonging to the association *Arrhenatherretum elatioris* Br.-Bl. 1919 ex Scherrer 1925.

The performed investigations included entire over-ground plant parts, i.e. leaves, as well as stems together with inflorescences or fruits, which were ground after drying.

The analyses of concentrations of organic carbon (C) and sulfur (S) were made by using method of the elementary analysis.

The content of crude nitrogen (N) was determined using the Kjeldahl method. Crude ash was calculated after burning samples in a muffle furnace at the temperature of 550°C (**Lityński** et **al.** 1976). Concentrations of macroelements: P, K, Ca, Mg, Na as well as silica SiO_2 in % DM and microelements Cu, Zn, Mn, Fe, Co, Ni and Cr in mg/kg DM were determined according to the methodology of **Ostrowska** et **al.** (1991).

Results

Elementary composition

There were no significant differences of percentage concentration of nitrogen (N) in the studied species (Table 1). Higher content of nitrogen was found in *C. muricata* (mean 2.26% in DM), lowest in *C. divulsa* (mean 1.85% in DM). Such a high concentration of this element shows the high amount proteins in fodder. Relatively large is also the C:N proportion. Concentration of sulfur (S) in the analyzed samples was lower than average contents of sulfur in the grasses, (**Falkowski** et **al.** 2000) and amounted from 0.2 to 0.8% in DM. *Carex spicata* had the lowest content of crude ash (7.86% in DM) from analyzed group, while the other species had: *C. divulsa* 9.04%, and *C. muricata* 9.13% in DM.

Table 1

Elementary composition in the studied samples (% DM)
Skład elementarny części nadziemnych badanych gatunków turzyc (% s.m.)

Species Gatunek	Sample number Numer próbki	Crude ash Popiół surowy	Chemical composition Skład chemiczny		
			N	C	S
C. divulsa	1	9.02	1.85	41.64	0.09
	2	8.99	1.74	39.98	0.07
	3	9.12	1.97	40.99	0.03
Mean Średnia		9.04	1.85	40.87	0.06
C. spicata	1	7.79	1.99	42.97	0.06
	2	7.78	1.99	46.11	0.09
	3	8.01	2.01	37.75	0.04
Mean Średnia		7.86	2.00	42.28	0.06
C. muricata	1	9.09	2.29	42.93	0.05
	2	9.17	2.19	40.76	0.12
	3	9.12	2.29	47.21	0.05
Mean Średnia		9.13	2.26	43.63	0.07

Concentrations of macroelements and silica

In the case of concentrations of macroelements: potassium (K), calcium (Ca), magnesium (Mg) and sodium (Na) slight differences between the species and analyzed samples were observed. However, those contents were a little lower than those recommended by standards optimal for fodder, and only content of potassium was relatively high (Table 2).

The mean silica concentration (SiO_2) in *C. spicata* amounted 1.21% in DM and was almost 1% lower than that of *Festuca arundinacea* (2.25% in DM), which is characterized by a high concentration of silica (**Falkowski** 1983). Other species of genus *Festuca* – *F. pratensis*, considered as a very valuable component of fodder, contains 2% SiO_2 in DM (**Falkowski** l983). The silica concentrations in *C. divulsa* amounted to 1.71% in DM and in *C. muricata* – 1.74% in DM.

Especially interesting is the comparison of average contents of the analyzed macroelements in representatives of section *Muehlenbergianae* and in selected species from the genus *Carex* growing on peat bogs in the valley of the Rurzyca River (**Rogalski** et **al.** 2004) (Table 3). The concentration of P, K, Ca and Na in the species studied in this paper was two to three times higher.

Table 2

Concentration of macroelements in the studied samples (% DM)
Zawartość makroelementów w częściach nadziemnych badanych gatunków turzyc (% s.m.)

Species Gatunek	Sample number Numer próbki	Macroelements – Makroelementy					
		P	K	Ca	Mg	Na	SiO_2*
C. divulsa	1	0.46	2.94	0.76	0.15	0.16	1.71
	2	0.45	2.56	0.77	0.21	0.15	1.69
	3	0.67	3.02	0.67	0.13	0.17	1.73
Mean Średnia		0.53	2.84	0.73	0.16	0.16	1.71
C. spicata	1	0.32	2.67	0.43	0.11	0.16	1.21
	2	0.51	2.84	0.42	0.11	0.42	1.14
	3	0.32	2.76	0.50	0.12	0.06	1.26
Mean Średnia		0.38	2.76	0.45	0.11	0.21	1.20
C. muricata	1	0.22	2.89	0.51	0.10	0.29	1.72
	2	0.32	2.18	0.71	0.15	0.54	1.68
	3	0.34	2.98	0.62	0.31	0.41	1.81
Mean Średnia		0.29	2.68	0.61	0.19	0.41	1.74

*Concentration of SiO_2 according to **Falkowski** (1983) – 2% in DM (0.9% Si in DM).
*Zawartość SiO_2 wg **Falkowskiego** (1983) – 2% w s.m. (0,9% Si w s.m.)

Table 3

Average contents of macroelements in the analyzed species in comparison to sedges growing on peat bogs (% DM)
Zawartość makroelementów w częściach nadziemnych badanych gatunków turzyc w porównaniu z turzycami torfowiskowymi (% s.m.)

Species – Gatunek	Macroelements – Makroelementy			
	P	K	Ca	Na
C. divulsa, *C. spicata*, *C. muricata* – mean – średnia	0.40	2.76	0.60	0.26
C. gracilis	0.13	1.51	0.33	0.07
C. acutiformis	0.18	1.94	0.32	0.10
C. riparia	0.15	2.19	0.35	0.17

Concentrations of microelements

Average concentration of cuprum (Cu) and zinc (Zn) constituted half of average amounts recommended by standards for natural fodders (Table 4). The manganese (Mn) content was higher than its average concentrations in grasses (38 mg kg/DM), legumes (39 mg kg/DM) and meadows herbs (7 mg kg/DM) (**Falkowski** et **al.** 2000). The studied sedges had also high content of iron (Fe) – a few times more than proposed by the feeding norms (30 mg kg/DM), and its average amount changes from 129.24 (*C. divulsa*) up to 228.43 mg kg/DM (*C. muricata*).

Table 4

Concentration of microelements of the studied samples (mg/kg DM)*
Zawartość mikroelementów w badanych gatunkach (mg/kg s.m.)*

Species Gatunek	Sample number Numer próbki	Microelements – Mikroelementy			
		Cu	Zn	Mn	Fe
C. divulsa	1	4.15	17.55	133.09	118.90
	2	3.67	14.99	131.96	134.06
	3	4.86	17.45	140.89	134.75
Mean Średnia		4.23	16.66	135.31	129.24
C. spicata	1	5.75	32.70	140.00	155.30
	2	5.45	35.55	139.10	163.60
	3	6.09	21.08	160.42	148.88
Mean Średnia		5.76	29.78	146.51	155.93
C. muricata	1	5.85	30.11	166.65	232.60
	2	5.90	28.55	159.40	230.35
	3	5.01	31.77	162.78	222.34
Mean Średnia		5.59	30.14	162.94	228.43

*mg/kg DM = ppm.
*mg/kg s.m. = ppm.

Comparison of concentration of microelements in the analyzed species and sedges growing on the meadows in the Noteć Valley (**Kociałkowski** et **al.** 1967) shows insignificant the differences between both groups (Table 5).

Table 5
Comparison of concentration of microelements in studied species and other sedges growing on the meadows of the Noteć Valley (mg/kg DM)
Porównanie zawartości mikroelementów w badanych gatunkach i w innych turzycach rosnących na łąkach Dolnej Noteci (mg/kg s.m.)

Species – Gatunek	Microelements – Mikroelementy			
	Cu	Zn	Mn	Fe
C. divulsa, *C. spicata*, *C. muricata* – mean – średnia	5.19	25.53	148.25	171.20
Others meadows sedges – mean Inne gatunki turzyc łąkowych – średnia	8.50	19.61	181.9	167.87

Summary and conclusions

1. Basing on chemical analyses, fodder value was evaluated of over-ground parts of sedges from section *Muehlenbergianae* (L.H. Bailey) Kük – *Carex spicata* Huds., *C. muricata* L., *C. divulsa* Stokes, collected at flowering and earlier fruiting phases in the same plant community – *Arrhenatherretum elatioris.*

2. Results show, that overground parts of representatives of section *Muehlenbergianae* have a very valuable chemical composition and are a valuable fodder, similar to numerous species of grasses.

3. The most remarkable features are: high concentration of proteins (10.88 to 14.37% of DM) and especially high proportion of C:N, and the phytochemical composition suitable for the values optimal for the fodder.

4. Average content of silica, an element significant for the digestibility of carbohydrates and nutrition value, was varying in the studied species from 1.21% to 1.74% kg DM and was lower than in the case of many species of grasses, This feature confirms the relatively high nutrition value of the over-ground parts of the studied sedges.

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OCENA WARTOŚCI PASZOWEJ RUNI GATUNKÓW Z RODZAJU *CAREX* L. Z SEKCJI *MUEHLENBERGIANAE* (L.H. BAILEY) KÜK.

S t r e s z c z e n i e

W pracy zaprezentowano wyniki badań wartości odżywczej runi (liści, łodyg i owoców) turzyc z sekcji *Muehlenbergianae* (L.H. Bailey) Kük. – *Carex spicata* Huds., *Carex muricata* L. i *Carex divulsa* Stokes. Używając wybranych metod, analizowano skład elementarny i zawartość niektórych mikro- i makroelementów. Aby zminimalizować wpływ siedliska na zawartość badanych elementów, rośliny zbierano z tego samego stanowiska w obrębie płatu *Arrhenatherretum elatioris.*

Analizowano zawartość węgla organicznego, azotu i siarki, a także popiołu surowego oraz makroelementów (P, K, Ca, Mg, Na), krzemionki i mikroelementów (Cu, Zn, Mn, Fe).

Wyniki badań wskazują, że turzyce z sekcji *Muehlenbergianae* mają bardzo korzystny skład chemiczny i są bardziej wartościową paszą od runi wielu gatunków traw. Świadczy o tym duża zawartość białka ogólnego we wszystkich badanych gatunkach turzyc, utrzymująca się na poziomie od 10,88 do 14,37% w s.m., oraz stosunkowo szeroki stosunek C:N, a także skład fitochemiczny porównywalny z zawartościami optymalnymi dla paszy.

Zawartość krzemionki, elementu wpływającego w dużym stopniu na strawność i wartość pokarmową, wynosi u badanych gatunków od 1,21 do 1,74% w s.m. Ilość ta nie przekracza wartości granicznej, dopuszczalnej w skarmianej paszy, i jest o wiele mniejsza niż u wielu traw, co potwierdza dużą wartość paszową badanych gatunków.

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