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NUTRITIVE VALUE OF THE OVER GROUND PARTS OF SEDGES FROM THE SECTION *VULPINAE* (CAREY) CHRIST. AT DIFFERENT PLANT DEVELOPMENTAL STAGES

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ABSTRACTS. This paper contains the results of the research of selected macroelements, microelements and elementary composition in over-ground parts of sectio *Vulpinae* (*Carex vulpina* L., *C. otrubae* Podp.) in two developmental stages.

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

Introduction

The chemical composition of plants from grasslands is one of significant factors affecting fodder quality, its palatability and digestibility and, consequently, the production results of farm animals, mainly ruminants (**Trąba** 1996). The fodder value also depends on sward species composition because the content of many macro- and microelements is associated with species characters of a given plant (**Kociałkowski** et **al.** 1967, **Oświt** and **Sapek** 1976). Still another important factor influencing the above-mentioned value is the plant developmental phase because, as the vegetation season progresses, the shoots of the majority of species alter their chemical composition (**Falkowski** et **al.** 2000, **Grzelak** 2004).

In the course of the investigations described in this study, representatives of the *Carex* genus, which belong to the *Vulpinae* (Carey) Christ. section, were analysed. This section comprises two taxons which occur in Poland (**Egorova** 1999): *Carex vulpina* L. and *C. otrubae* Podp. (= *C. nemorosa* Rebent.). The two species are very similar to each other morphologically and, practically speaking, are indistinguishable at the vegetative stage. Their main differences involve only the way of nervation of the sac and the extent

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of its sheen at the stage of full maturity. However, apart from typical specimens which can be easily allocated to one of the species and which meet the appropriate taxonomic criteria, there are many individuals which can be treated as intermediate forms between two types (**Szczepanik-Janyszek** and **Woźnica** 2001). The only vegetative trait quoted in literature which differentiates these species and which refers to the winged stem is not reliable because it is not closely correlated with a definite morphological type of the sac which is characteristic for a given species.

Both species grow on the same sites and in identical plant communities, most frequently side by side. In this study, the authors decided to abandon the common practice of determining the fodder value of individual taxons separately and, therefore, the *Vulpinae* section was treated as a complex of two species.

The aim of the performed experiments was to determine the fodder value of the over-ground parts of sedges from the *Vulpinae* section and to compare the content of the examined minerals in relation to the plant developmental phase. It appears from numerous observations (**Janyszek**, unpublished data) that animals prefer to graze young tussocks, although a lot of older stems together with fruits are harvested with forage.

Research methods

The material for analyses was collected in the course of two developmental phases of plants; earlier, in May (in Table 1 designated as I) – at the beginning of flowering as well as in July (II) – at the stage of fruiting. Every time, samples were collected from the same site and the same tufts growing in semi-natural communities within confines of the *Polygono-Cirsietum oleracei* R. Tx. 1951 patch.

The performed investigations included the entire over ground plant parts, i.e. leaves as well as stems together with inflorescences or fruits which were ground after drying. 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 i Cr in mg/kg DM were determined according to the methodology of **Ostrowska** et **al.** (1991).

Results

Ash, nitrogen phosphorus and potassium content

The content of crude and pure ash in samples collected in May is relatively small and, on average, amounts to 8.6 and 5.8% in DM. Similar values were obtained when analysing the experimental material collected in July, during the phase of full flowering – 7.8 and 6.6%, respectively.

When analysing the percentage concentration of major constituents, it was found that sedges from the *Vulpinae* section which were harvested at the earlier phase of development deposited more crude nitrogen (1.64% in DM) than those collected later

(1.24% in DM) (Table 1). According to **Falkowski** et **al.** (1982), the content of nitrogen in grasses ranges from 1.9 to 3.6% in DM. The content of phosphorus determined in the material harvested in May was 0. 07% in DM and its level was significantly higher than that determined in the material collected in July – 0.04% in DM. However, this content was by over 0.2% lower than that recommended by English standards optimal for fodder. The content of potassium was relatively high and differences in its concentration determined in the samples harvested at the two dates were slight and amounted to 0.28% in DM: 2.77 in May and 2.49 (% in DM) – in June.

Table 1

Concentration of crude ash and pure ash, nitrogen, phosphorus and potassium in the studied samples (% DM)
Zawartość popiołu surowego i czystego oraz azotu, fosforu i potasu w badanych próbach (% s.m.)

Taxa Takson	Sample number Numer próbki	Crude ash Popiół surowy	Pure ash Popiół czysty	Chemical composition Skład chemiczny		
				N	P	K
Sectio – Sekcja	1	8.60	5.81	1.64	0.07	2.78
Vulpinae	2	8.16	5.74	1.66	0.11	2.73
(I)	3	8.95	5.87	1.62	0.07	2.79
Mean – Średnia	–	8.59	5.81	1.64	0.08	2.77
Sectio – Sekcja	1	7.88	6.59	1.35	0.04	2.37
Vulpinae	2	7. 86	6.67	1.14	0.05	2.58
(II)	3	7.79	6.64	1.24	0.03	2.52
Mean – Średnia	–	7.85	6.63	1.24	0.04	2.49

Concentrations of macroelements

Calcium, magnesium and sodium play an important role in the processes of fodder digestion and have some influence on nutrient availability as well as on the health condition of animals. Their concentrations in the examined samples derived from the earlier date are contained within the standard limits in comparison with the optimal concentrations recommended for forage, although in the case of samples harvested later, they deviate slightly from these standards (Table 2).

The content of silica (SiO_2) is also very important, primarily because of its effect on the digestibility of carbohydrates found in cell walls. The content of this compound is a species characteristic but it also depends on ecological and site factors as well as the plant developmental phase (**Grynia** et **al.** 1987).

In the case of the examined plant material, low silica content was observed primarily in young specimens collected in May and it is significantly lower than in the average content found in grasses or other sedge species, for example in the *Muehlenbergianae* (L.H. Bailey) Kük section (**Grzelak** et **al.** 2005). The amount of silica in the examined plants increased rapidly with their development. This is confirmed by other studies (**Grynia** et **al.** 1987) on the silica content in the domestic ecotypes of tall fescue.

Table 2

Concentration of macroelements of the studied samples (% DM)
Zawartość makroelementów w badanych próbach (% s.m.)

Taxa Takson	Sample number Numer próbki	Macroelements – Makroelementy			
		Ca	Mg	Na	SiO_2*
Sectio – Sekcja	1	0.59	0.18	0.06	1.28
Vulpinae	2	0.63	0.19	0.08	1.38
(I)	3	0.59	0.19	0.07	1.25
Mean – Średnia	–	0.61	0.19	0.07	1.31
Sectio – Sekcja	1	0.48	0.16	0.03	2.84
Vulpinae	2	0.54	0.17	0.03	2.76
(II)	3	0.43	0.19	0.02	2.97
Mean – Średnia	–	0.49	0.17	0.03	2.86

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

Concentrations of microelements

Concentrations of all the examined microelements were higher in samples collected earlier, i.e. in plants which were collected at their younger developmental phases (Table 3).

Table 3

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

Taxa Takson	Sample number Numer próbki	Microelements – Mikroelementy						
		Cu	Zn	Mn	Co	Fe	Ni	Cr
Sectio – Sekcja	1	5.92	19.95	180.39	0.23	378.17	1.05	1.95
Vulpinae	2	5.99	19.56	187.34	0.24	399.79	1.19	1.96
(I)	3	5.87	19.78	178.87	0.19	379.78	1.02	1.67
Mean – Średnia	–	5.93	19.76	182.20	0.22	385.91	1.09	1.86
Sectio – Sekcja	1	5.46	17.43	85.64	0.12	80.12	0.21	0.77
Vulpinae	2	5.32	16.89	86.77	0.19	83.45	0.11	0.76
(II)	3	5.49	17.77	86.11	0.12	81.11	0.33	0.86
Mean – Średnia	–	5.42	17.36	86.17	0.14	81.56	0.22	0.80

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

These differences are slight in the case of copper and zinc whose content was somewhat smaller than the recommended standards for forage. On the other hand, differences in the contents of manganese and iron were very big in samples harvested in May and July but they were sufficient in the case of both harvest data and exceeded the required standards for forage. Similar differences between the harvest dates and phases were observed in the case of cobalt (Co), nickel (Ni) and chromium (Cr) contents, i.e. elements whose seasonal variations, accumulation potentials and the role they play in the forage digestion processes are still little known and not sufficiently elucidated.

Microelements in sedges from the *Vulpinae* section and in other meadow plants

The content of microelements in sedges from the *Vulpinae* section and in meadow plants (**Kociałkowski** 1967) is shown in Table 4.

Table 4

Mean concentrations of microelements in sedges from the *Vulpinae* section and in other meadow plants (mg/kg DM)
Średnie zawartości mikroelementów w turzycach z sekcji *Vulpinae* oraz w innych roślinach łąkowych (mg/kg s.m.)

Plants Rośliny	Cu	Zn	Mn	Co	Pure ash Popiół czysty
Sedges of *Vulpinae* Sekcja *Vulpinae*	5.7	18.6	134.2	0.18	6.22
Grasses – Trawy	8.1	18.4	122.2	0.15	6.73
Other sedges Inne turzyce	8.5	19.6	181.9	0.14	5.60
Papilionaceous Motylkowate	13.5	36.3	87.5	0.36	10.07
Weeds – Chwasty	18.8	46.0	57.3	0.61	10.46
Horsetails – Skrzypy	5.6	37.4	133.0	0.11	16.08
Thistles – Osty	16.6	29.9	103.0	0.06	17.42

The mean copper concentration in sedges of the examined section amounts to 5.7 mg kg/DM and this represents the lowest quantity of this element from among the analysed group of plants with the exception of horsetail (5.6) and it constitutes only half of that recommended by English standards with regard to the level of microelements in forages.

On the other hand, the content of zinc calculated from the sample means of the examined sedges is 18.6 mg kg/DM and is comparable with the concentration of this element in grasses and other sedge species, although it is slightly lower than in legumes and horsetails.

The manganese content of 134.2 mg kg/DM is high but similar to that found in horsetails and higher than in grasses and thistles.

The performed analyses revealed high concentrations of cobalt (0.18 mg kg/DM). Only legumes and some weeds are richer in this element.

Relatively little clear ash is found to occur in sedges and other grasses in relation to the remaining groups of plants, especially thistles and horsetails.

Conclusions

1. The content of nitrogen in the sward of sedges from the *Vulpinae* section amounted to 1.64% in DM when harvested in May and to 1.24% in DM when collected in June. This is comparable with some grass species but differs from the optimal content standards of this component in forages.

2. The amount of silica in samples derived from the same tufts increases with the passage of time and with the progressing maturity of plants.

3. The performed chemical analyses of macroelements (P, K, Ca, Mg and Na) showed that they occurred within standard limits in comparison with the optimal concentrations for forages in the case of the early harvest and slightly lower, when the plant material was collected later.

4. Both sedges and grasses exhibit a slightly lower ash content in comparison with legumes, weeds and thistles which is in agreement, to some extent, with the content of microelements in the above-mentioned plant groups.

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WARTOŚĆ ODŻYWCZA CZĘŚCI NADZIEMNYCH TURZYC Z SEKCJI *VULPINAE* (CAREY) CHRIST. W RÓŻNYCH FAZACH ROZWOJOWYCH ROŚLIN

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

Celem przeprowadzonych badań była ocena wartości paszowej runi (liści, łodyg i owoców) turzyc z sekcji *Vulpineae* (Carey) Christ. – *Carex vulpinae* L. i *C. otrubae* Podp. – i porównanie tych wartości w dwóch fazach rozwojowych roślin, wiosną i późnym latem. Ze względu na duże podobieństwo morfologiczne obu gatunków sekcja została potraktowana jako kompleks obu gatunków.

Zawartość azotu w runi turzyc z sekcji *Vulpinae* wynosi w I terminie zbioru 1,64% w s.m., a w II terminie 1,24% w s.m. Jest to porównywalne z niektórymi gatunkami traw, lecz odbiega od optymalnych norm zawartości tego składnika w paszy. W kolejnych terminach zbioru oraz w miarę postępującej dojrzałości roślin wzrasta ilość krzemionki w próbach pochodzących z tych samych kęp. Zawartość makroelementów P, K, Ca, Mg i Na mieści się w granicach normy w porównaniu z ich optymalnymi zawartościami w paszy w przypadku zbioru runi w pierwszym terminie i jest nieco mniejsza od normy w przypadku zbioru w terminie późniejszym. Turzyce i trawy charakteryzują się mniejszą zawartością popiołu niż motylkowate, chwasty i osty, co jest w pewnym stopniu zgodne z zawartością mikroelementów w wymienionych grupach roślin.

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