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HABITAT OCCURRENCE AND NUTRITION VALUE OF *ACHILLEA MILLEFOLIUM* L. IN GRASSLANDS

Jacek Alberski, Stefan Grzegorczyk, Adam Kozikowski, Marzena Olszewska

Chair of Grassland
University of Warmia and Mazury

Abstract

In 1998-2000, in the area of Olsztyn Lake District, 33 plant communities on semi-natural grasslands with a high percentage of *Achillea millefolium* L. were analyzed. The analyzed objects were located on very light, light, medium and heavy mineral soils. The species composition was evaluated with Braun-Blanquet method. Soil samples were collected for chemicals analyses. In dry matter of *Achillea millefolium* L. the content of crude protein, crude fibre, crude ash and macroelements was determined. Meadow-pasture communities with high percentage of *Achillea millefolium* L. in sward are floristically very valuable, particularly those located on light and medium soils. Irrespective of soil type, *Achillea millefolium* L. was accompanied by *Poa pratensis, Dactylis glomerata, Festuca rubra, Trifolium repens, Vicia cracca, Heracleum sibiricum and Taraxacum officinale*. The heavy soils had a higher content of P, K, Mg, Ca and Na, whereas very light soils contained more humus. *Achillea millefolium* L. contained 110-121 $g \cdot kg^{-1}$ crude protein, 249--309 $g \cdot kg^{-1}$ crude fibre and 97-123 $g \cdot kg^{-1}$ crude ash, much P, K and Ca irrespective of soil type and much Mg (3.1 $g \cdot kg^{-1}$) on very light soils.

Key words: habitat, soil category, nutrition value, *Achillea millefolium*.

dr inż. Jacek Alberski, Chair of Grassland, University of Warmia and Mazury, Poland, pl. Łódzki 1, 10-718 Olsztyn, e-mail: alberj@uwm.edu.pl

WARUNKI SIEDLISKOWE I WARTOŚĆ POKARMOWA
ACHILLEA MILLEFOLIUM L. NA UŻYTKACH ZIELONYCH

Abstrakt

W latach 1998-2000, na terenie Pojezierza Olsztyńskiego, objęto badaniami 33 zbiorowiska roślinne na półnaturalnych użytkach zielonych ze znacznym udziałem *Achillea millefolium*. Badane obiekty były zlokalizowane na bardzo lekkich, lekkich, średnich i ciężkich glebach mineralnych. Skład gatunkowy runi wyceniono metodą Braun-Blanqueta. Pobrano próbki glebowe do analiz chemicznych. W materiale roślinnym *Achillea millefolium* określono zawartość białka ogólnego, włókna surowego, popiołu surowego oraz makro- i mikroelementów. Zbiorowiska łąkowo-pastwiskowe ze znacznym udziałem *Achillea millefolium* w runi są bardzo cenne florystycznie, szczególnie te zlokalizowane na glebach lekkich i średnich. Niezależnie od kategorii agronomicznej gleby, *Achillea millefolium* towarzyszyły: *Poa pratensis*, *Dactylis glomerata*, *Festuca rubra*, *Trifolium repens*, *Vicia cracca*, *Heracleum sibiricum* i *Taraxacum officinale*. Gleby ciężkie zawierały więcej P, K, Mg, Ca i Na, natomiast lekkie więcej próchnicy glebowej. *Achillea millefolium* L. zawierał: 110-121 g·kg^{-1} białka ogólnego, 249-309 g·kg^{-1} włókna surowego, 97-123 g·kg^{-1} popiołu surowego, duże ilości P, K i Ca niezależnie od kategorii agronomicznej gleby oraz więcej Mg (3,1 g·kg^{-1}) na glebach bardzo lekkich.

Słowa kluczowe: siedlisko, kategoria gleby, wartość pokarmowa, *Achillea millefolium*.

INTRODUCTION

High fertility of soils, optimum moisture and rational utilization are conducive to the formation of communities which are floristically rich and at the same time stabilized in terms of the species (KOSTUCH 1995). Taking into account the economical, floristic and feed aspects, it is justifiable to use grasslands extensively, hence it is then possible to maintain communities in which meadow-pasture herbs have a significant share in the vegetation, becomes justifiable (ALBERSKI 2004, BUTKUVIENE, BUTKUTE 2004, LUNNAN 2004).

It is still an open question whether feed from extensive meadows, which is characterized by a lower content of protein and phosphorus but a higher level of fibre and lower digestibility, is of good feeding value (FALKOWSKI 1996). In natural meadow-pasture communities, *Achillea millefolium* L. is the plant belonging to the group of the herbs and weeds which affects the biological value of feed (KOZŁOWSKI, SWĘDRZYŃSKI 1996, TRZASKOŚ et al. 2006).

The aim of this investigation was to monitor the occurrence of *Achillea millefolium* L. in grass communities and to indicate availability of this species for nutritional purposes through analyses of the nutrient content.

MATERIALS AND METHODS

The investigation was carried out on grasslands of Olsztyn Lake District in the years 1998-2000. In total, 33 meadow objects with a high percentage

(above 5%) of *Achillea millefolium* in the vegetation, located on mineral soils, were selected. The species composition of the vegetation was estimated using Braun-Blanquet phytosociological method.

Soil samples were collected from every object. The structure of the soil was analyzed. In addition, the soil's pH, organic substance content and abundance in some macro- and microelements were determined. The content of crude protein, crude fibre, crude ash as well as macro- and microelements was examined in the plant material of *Achillea millefolium*.

The results of the experiment were assessed using the analysis of variations based on Tukey's test.

RESULTS

Achillea millefolium is a characteristic species of the *Molinio-Arrhenatheretea* class, which has a rich species diversity. According to many authors (Trzaskoś et al. 2006, Gudaityte, Venskutonis 2007) milfoil appears in different habitats, such meadows, roadsides, forest meadows and abandoned fields. In 33 meadow objects covered by the study, in which *Achillea millefolium* was recorded, there were 117 plant species in total, most on light soils, similar to Demolder (2007). Irrespective of the type of soil, feed-valuable species occurred most frequently. Among grasses, they were *Dactylis glomerata* L.*, Festuca pratensis* L.*, Festuca rubra* L.s.s.*, Poa pratensis*, papilionaceus – *Trifolium repens, Vicia cracca,* herbs and weeds – *Heracleum sibiricum, Plantago lanceolata and Taraxacum officinale* (Table 1).

The analysed objects were located on soils belonging to different soil categories: 7 were on very light soils, 11 on light, 9 on medium and 6 on heavy soils. Gudaityte and Venskutonis (2007) qualified *Achillea millefolium* as a species of wide ecological amplitude. Irrespective of the agronomic category, all soils can be regarded as abundant in Mg and Zn, moderately abundant in K, Cu, Mn and Fe and low in P (*Border numbers for content estimation...* 1990).

Both a higher pH and higher abundance in the studied macro- and microelements were recorded in heavy soils. On the other hand, very light soils were characterized by a higher content of humus (4.25 g·kg^{-1}) – Table 2. Grzegorczyk et al. (2004) ascertained higher abundance in humus on high moisture habitats.

The evaluation of *Achillea millefolium* dry matter demonstrated that this species accumulates similar contents of nutrients irrespective of the type of soil. The following mean values were determined in the analysed material: crude protein (116 g·kg^{-1}), crude fibre (114 g·kg^{-1}), Ca (14.1 g·kg^{-1}), Na (0.8 g·kg^{-1}), Cu (9.9 mg·kg^{-1}), Fe (163.3 mg·kg^{-1}) and Zn (33.4 mg·kg^{-1}) – Table 3. *Achillea millefolium* in the sward of meadows improves the fodder value of the sward (Trzaskoś et al. 2006).

Table 1

The most frequent plant species in meadow with *Achillea millefolium*

Species	Soil category							
	very light		light		medium		heavy	
	C*	Cc**	C*	Cc**	C*	Cc**	C*	Cc**
1	2	3	4	5	6	7	8	9
Grasses								
Festuca pratensis Huds.	V	1680.0	III	410.0	III	85.6	III	85.0
Dactylis glomerata L.	V	1214.3	V	1455.5	V	2140.0	III	1251.7
Poa pratensis L.	VI	144.3	V	1778.2	V	2528.9	V	791.7
Festuca rubra L. s. s.	III	74.3	III	729.1	VI	114.4	VI	750.0
Phleum pratense L.	III	607.1	III	410.9	III	112.2	VI	86.7
Lolium perenne L.	III	72.9	II	47.3	II	56.7		
Deschampsia caespitosa (L.) P.Beauv.	III	38.6	I	23.6	II	28.9	V	631.7
Arrhenatherum elatius (L.) P. Beauv.	II	1071.4	I	341.8	I	1.1		
Holcus lanatus L.	II	71.4	III	432.7	I	27.8	V	128.3
Alopecurus pratensis L.	II	71.4	III	706.4	VI	891.1	VI	710.0
Anthoxanthum odoratum L.	I	535.7	III	410.0	II	83.3	VI	126.7
Avenula pubescens (Huds.) Dumort.	I	35.7	I	0.9	II	417.8		
Poa trivialis L.			II	364.5	I	1.1	I	1.7
Poa annua L.	I	35.7			I	1.1		
Festuca arundinacea Schreb.	I	1.4	I	22.7			I	1.7
Legumes								
Trifolium pratense L.	VI	750.0	I	204.5	III	750.0	II	126.7
Lotus corniculatus L.	III	1071.4	I	409.1	II	2.2	I	1041.7
Trifolium repens L.	III	752.9	III	615.5	VI	668.9	III	128.3
Vicia cracca L.	III	217.1	III	977.3	III	334.4	III	500.0

cont. Table 1

1	2	3	4	5	6	7	8	9
Medicago lupulina L.	III	217.1	I	0.9	I	83.3		
Vicia sepium L.	II	214.3	I	68.2	I	83.3	I	625.0
Trifolium dubium Sibth.	II	108.6	I	69.1	II	84.4		
Lathyrus pratensis L.	I	535.7	II	478.2	III	416.7	I	250.0
Lotus uliginosus Schk.			I	204.5	I	83.3	II	375.0
Trifolium hybridum L.			I	0.9	I	166.7	I	1.7
Herbs and weeds								
Achillea millefolium L.	V	928.6	V	1727.3	V	1333.3	V	1958.3
Taraxacum officinale F. H. Wigg.	V	1107.1	VI	840.9	V	807.8	VI	500.0
Heracleum sibiricum L.	III	1250.0	III	139.1	III	918.9	VI	251.7
Equisetum arvense L.	III	145.7	II	2.7	I	55.6		
Cirsium arvense (L.) Scop.	III	144.3	VI	435.5	III	113.3	II	333.3
Plantago lanceolata L.	II	72.9	VI	457.3	III	280.0	VI	251.7
Ranunculus repens L.	II	72.9	I	46.4	II	111.1	V	338.3
Alchemill vulgaris L. s.l.	II	72.9	II	137.3	II	56.7	III	791.7
Rumex acetosa L.	II	72.9	II	92.7	III	113.3	III	335.0
Stellaria graminea L.	II	2.9	II	91.8	III	58.9	I	1.7
Leontodon autumnalis L.	I	71.4	III	49.1	II	56.7		
Glechoma hederacea L.	I	1.4	I	0.9	I	55.6	I	1.7
Prunella vulgaris L.	I	1.4	I	45.5			I	1.7
Ranunculus acris L. s. s.	I	1.4	II	137.3	II	3.3	II	3.3
Cirsium oleraceum (L.) Scop.			I	0.9	II	222.2	I	250.0
Lychnis flos-cuculi L.			I	0.9	I	1.1	I	1.7

C – Constancy, **Cc – Cover coefficient

Table 2

Chemical properties of different soils

Specification	Soil category							
	very light		light		medium		heavy	
	Mv	min-max	Mv	min-max	Mv	min-max	Mv	min-max
pH_{KCl}	5.3	4.1-6.3	5.4	4.1-6.1	5.1	4.1-6.1	6.2	4.4-6.8
$g \cdot kg^{-1}$								
Humus	4.25	2.63-8.62	3.42	1.77-6.46	2.83	1.53-5.42	3.07	1.53-6.22
N	2.72	1.10-3.64	2.10	0.94-3.64	1.40	0.70-2.63	1.70	0.80-2.82
P	0.04	0.02-0.13	0.05	0.02-0.16	0.08	0.03-0.22	0.11	0.04-0.35
K	0.05	0.03-0.26	0.09	0.04-0.28	0.08	0.04-0.28	0.22	0.05-0.38
Mg	0.06	0.02-0.14	0.06	0.02-0.14	0.08	0.02-0.18	0.13	0.04-0.19
Ca	0.53	0.22-1.28	0.88	0.33-3.18	0.62	0.22-1.48	1.69	0.33-3.80
Na	0.02	0.01-0.05	0.02	0.01-0.05	0.02	0.01-0.05	0.03	0.01-0.05
$mg \cdot kg^{-1}$								
Cu	2.1	1.3-4.7	3.2	1.6-6.1	3.4	1.6-8.4	8.7	2.7-16.6
Mn	100.6	66.3-183.5	164.3	76.5-231.2	121.7	69.2-203.4	246.3	99.1-430.2
Zn	10.5	7.2-23.9	17.6	9.6-35.5	13.9	8.2-25.7	20.5	13.2-56.4
Fe	1673	988-2320	1689	1012-2340	1739	1043-2336	3096	1037-9034

Mv – mean value; min-max – minimum-maximum

Table 3

Content of the nutrients in *Achillea millefolium* (in DM)

Specification	Soil category							
	very light		light		medium		heavy	
	Mv	min-max	Mv	min-max	Mv	min-max	Mv	min-max
$g \cdot kg^{-1}$								
Total protein	110 a	89-121	121 a	106-131	118 a	102-128	111 a	102-121
Crude fibre	302 a	245-344	276 a	224-332	249 a	218-311	293 a	244-340
P	3.5 a	2.2-4.8	5.0 b	3.1-6.8	5.1 b	3.1-6.8	5.1 b	3.2-6.8
K	28.4 a	18.7-33.4	42.5 b	23.4-52.4	44.8 b	33.4-52.8	42.5 b	28.4-48.2
Mg	3.1 b	1.9-3.8	2.1 a	1.6-2.8	2.1 a	1.8-2.6	2.1 a	1.6-2.6
Ca	15.0 a	12.1-18.4	13.0 a	11.5-16.4	14.2 a	11.8-16.7	14.9 a	12.1-16.7
Na	0.7 a	0.2-0-1.3	0.9 a	0.3-1.5	0.9 a	0.2-1.6	0.8 a	0.3-1.6
$mg \cdot kg^{-1}$								
Cu	8.8 a	6.8-12.4	10.2 a	7.8-12.8	10.5 a	8.8-12.4	9.6 a	6.8-12.8
Mn	102.3 ab	48.3-178.2	150.8 b	65.1-244.8	165.3 b	91.5-362.1	50.4 a	31.4-206.1
Zn	36.7 a	28.3-58.1	36.3 a	26.4-56.3	32.5 a	24.1-56.8	25.5 a	21.1-43.7
Fe	169.2 a	83.2-231.4	151.1 a	98.5-214.2	141.3 a	46.6-221.6	211.5 b	96.4-387.1

a, ab, b – homogenous groups
Mv – mean value; min-max – minimum-maximum

Table 4

Significant coefficients of correlation between *Achillea millefolium* chemical composition and chemical properties of soil

Soil proper-ties	Elements content in plant									
	N	P	K	Mg	Ca	Na	Cu	Mn	Zn	Fe
pH								-0.633**		0.333*
Humus	0.325*	-0.380*		0.497**					0.345*	
N		-0.453**		0.538**						
P			0.327*			-0.387*				
K		0.311*						-0.372*		0.395*
Mg								-0.433**		
Ca								-0.480**		0.465**
Na								-0.354*		0.356*
Mn		0.399*						-0.334*		
Cu								-0.344*		
Zn		0.329*				0.326*				
Fe										

*significant at $p=0.05$
**significant at $p=0.01$

Achillea millefolium, irrespective of soil type, contained a lot of phosphorus and potassium as well as calcium, and little sodium and zinc. According to MARINAS, GARCIA-GONZALEZ (2006) *Achillea millefolium* shows a high P and K content, especially in June. In plants from very light soils, significantly more Mg and significantly less P and K were determined, whereas significantly less Mn was observed in plants growing on heavy soils. Interesting data were obtained from the correlation between the influence of some chemical properties of soil and the content of nutrients in plants. In the examined species, a lower content of Mn with a higher pH and a higher abundance of soil in Ca and Mg was recorded. It was also found out that the growth of N content in the soil is followed by a decrease in the content of P and an increase in the content of Mg in plants (Table 4).

According to MICHLER, ARNOLD (1999) a high frequency of *Achillea millefolium* per site was positively correlated with phosphate, magnesium and manganese and negatively with carbonate and hydrogen ion concentration in soil.

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CONCLUSION

1. Valuable species of grasses, *Papilionaceae* plants and other herbs occurred in large numbers and at high intensity in meadow-pasture communities with a high percentage of *Achillea millefolium* L. in vegetation.

2. Irrespective of the type of soil, the habitat of this species can be regarded as abundant in Mg ad Zn, moderately abundant in K, Cu, Mn and Fe and low in P.

3. In terms of nutritive value, *Achillea millefolium* is characterised by a high concentration of P, K and Ca.

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