

## INFLUENCE OF SOIL CONDITIONS ON THE HAY FODDER VALUE AND CONTENT OF PAPILIONACEOUS PLANTS IN THE MEADOW GREENNESS GROWTH

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**A b s t r a c t.** Due to the short life of valuable Papilionaceous plants in the grassland greenness growth, the effect of soil conditions on these species was investigated. The research was carried out in 1993-1995 on the wane meadows of the Lublin Upland. Relations of pH and soil nutrient content on the Papilionaceous content in the greenness growth and the content of macro- and microelements in fodder was analysed. The research showed that Papilionaceous occurrence was clearly related to the soil kind, reaction, and phosphorus and magnesium content. The collected greenness growth contained too little P, Mg, Cu, and Zn. Only the pH and Mg, out of the investigated soil components, affected the content of some individual elements in the plants.

**K e y w o r d s:** grassland, Papilionaceous plants, soils, pH, elements.

### INTRODUCTION

Papilionaceous plants in the greenness growth of meadows and pastures are very important elements that positively affect fodder quality, environment, and enhance economic results in agriculture [2,3,5,8]. There are, however, some difficulties in preserving these species in the greenness growth of the permanent grassland. One of the reasons is definitely the fact that they are less competitive to grass fertilised with high nitrogen doses. However, proper soil conditions and the cultivation systems used are also very important. An example of the above could be grassland, where the Papilionaceous stay for several dozen years [9,11].

Hence, the aim of this paper is to estimate relations between Papilionaceous occurrence in the meadow greenness growth and nutrient content in fodder, and soil reaction and content of macro- and microelements.

## MATERIAL AND METHODS

The research was carried out in 1993-1995 on properly moisturised meadows located in the valleys of the following rivers: the Bystra, the Bystrzyca, the Ciemięga, and the Czerniejówka. All the objects were situated in the area of the Lublin Upland close to the eastern border of Poland. Representative soil samples (0-25 cm) and samples of meadow greenness growth were taken from the selected meadows with high Papilionaceous plants share. The content of the Papilionaceous was measured using the method of botanical-weight analysis after drying the greenness growth sample until air dried. Then, the samples were ground and the following parameters were analysed: absolutely dry mass; P, K, Ca, Mg, Cu, Fe, Mn, and Zn content. The following parameters were measured in the soil samples: pH in 1 n KCl, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O, Mg, B, and Cu. All the chemical measurements were performed at the Regional Agrochemical Station in Lublin, according to the recognised methods. In total, 33 soil samples and 33 plant samples including 18 samples from mineral soil meadows and 15 samples from organic soil meadows were subjected to analysis. In the experimental years, average temperatures and precipitation levels were as follows: 1993 - 8.1 °C and 421.3 mm; 1994 - 7.8 °C and 560 mm; 1995 - 9.2 °C and 674 mm.

The results were analysed statistically at the Computer Centre of the University of Agriculture in Lublin. Coefficients of variation, correlations, and significance of differences between individual features were analysed.

## RESULTS AND DISCUSSION

The mineral soils of the investigated meadows had higher pH and nutrients content than the organic soils, which were practically highly rotten peat. Only in the case of K<sub>2</sub>O and Mg content, no significant differences were observed (Table 1). There was more Papilionaceous plants in the meadows with mineral soils (29.87 %) than in those with organic soils (16.77 %). A similar phenomenon was observed in other habitats [4,6]. Variation coefficients were usually high (over 50 %). Only in the case of pH and Cu, the average variation coefficient was 12.02 and 36.76%, respectively. The biggest difference between variation coefficients calculated for pH was significant. Papilionaceous content in the greenness growth depended on the soil kind. Regardless of the soil origin, a significant positive influence of

**Table 1.** Characteristics of the chemical composition of the soil samples and Papilionaceous content in the meadow greenness growth

Soil kind	pH in KCl	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	Mg	B	Cu	Content of the Papilionaceous (%)	
		(mg 100 g <sup>-1</sup> )			(mg kg <sup>-1</sup> )			
Mineral	a	6.88	20.78	11.35	6.75	2.72	3.98	29.87
Organic	b	5.58	8.05	10.97	5.37	1.26	2.80	16.77
Average	c	6.23	14.42	11.16	6.06	1.99	3.39	23.32
Variation range	c	5.0-7.6	4.0-56.4	3.7-27.3	1.2-15.3	0.17-7.65	1.2-6.8	2.5-60.6
Variation coefficient (%)	a	4.36	62.93	56.90	50.30	73.73	34.11	41.54
	b	8.53	52.46	60.04	72.26	72.86	35.07	66.41
Correlations with content of the Papilionaceous	c	12.02	58.73	57.57	60.55	88.59	36.76	54.15
LSD ( $\alpha \leq 0.05$ )	a	0.5126*	0.4264*	0.2135	0.4655*	0.2371	0.2785	-
	b	0.4318*	0.3876*	0.3040	0.6029*	0.1783	0.2362	-
	c	0.4037*	0.3851*	0.2151	0.5875*	0.2541	0.2412	-
between soil kinds		0.20	7.43	n.i.	n.i.	1.12	0.82	8.77

\*significant at  $\alpha \leq 0.05$ .

phosphorus and magnesium and pH on the Papilionaceous development (significant correlations) was observed.

Except for nitrogen, greenness growth of the meadows with mineral soils was richer in the investigated nutrients. No significant differences were observed only in the case of Mg, Cu, Fe, and Zn (Table 2). Following nutritional directives by Underwood [12], it can be stated that fodder had too little phosphorus, magnesium, copper, and zinc. Similar results were also given by Borowiec [1] and Gajda [4], who studied fodder parameters of the greenness growth in the meadows of the Lublin district.

The highest variation coefficient is the coefficient of Mn content in the greenness growth (61.47 %), and the lowest, of total N (19.03%) and P (20.89%). The values of the remaining coefficients ranged from 30 to 40%. They were not strongly affected by the kind of soil.

On the basis of the significance of the calculated correlations, a positive influence of pH increase on the Mg content in the greenness growth was observed, together with a negative influence on the Mn accumulation. Magnesium significantly decreased the Mn content in plants. The observed relations were confirmed in other papers [7,10].

It is worth emphasising that meadows with high a content of Papilionaceous plants were usually pastured after the second cut. White clover and meadow clover were the most numerous Papilionaceous species.

**Table 2.** Characteristics of the chemical composition of the meadow greenness growth in the samples with high Papilionaceous content

		N-total	P	K	Ca	Mg	Cu	Fe	Mn	Zn	
		(% d.m.)					(mg kg <sup>-1</sup> d.m.)				
Mineral	a	1.84	0.31	2.30	1.61	0.18	4.48	108.1	162.8	33.8	
Organic	b	2.22	0.26	1.68	1.07	0.16	4.56	104.9	81.8	33.8	
Average	c	2.03	0.29	1.99	1.34	0.17	4.72	106.5	123.3	33.8	
Variation range	c	1.14- 3.08	0.18- 0.44	0.89- 3.83	0.58- 2.31	0.1- 1.35	1.7- 7.6	58.0- 206.0	34.0- 327.0	10.0- 49.0	
Variation coefficient (%)	a	19.06	21.55	43.79	30.54	31.39	31.13	36.08	56.79	25.07	
	b	20.17	20.82	36.65	29.35	29.19	34.07	40.04	51.37	35.93	
	c	19.03	20.89	40.17	32.69	31.41	30.26	38.53	61.47	30.01	
LSD ( $\alpha \leq 0.05$ ) between soil kinds		0.23	0.04	0.43	0.20	n.i.	n.i.	n.i.	15.8	n.i.	

**Table 3.** Correlation between nutrient content in the meadow greenness growth, Papilionaceous content and some soil features

Soil property	N-total	P	K	Ca	Mg	Cu	Fe	Mn	Zn
	(% d.m.)					(mg kg <sup>-1</sup> d.m.)			
pH <sub>KCl</sub>	0.1873	73	73	0.10.0380	0.0380	0.0380	-0.3126	-0.6586*	-0.2297
P <sub>2</sub> O <sub>5</sub>	0.2521	0.2324	0.2674	0.0756	0.1142	0.0927	0.0308	-0.2626	-0.1314
K <sub>2</sub> O	0.1499	0.2401	0.3383	0.1677	0.2034	0.0335	0.0571	-0.1376	0.0559
Mg	0.1871	0.0390	0.0152	0.1373	0.2987	0.2284	0.0993	-0.3447*	0.0327
B	0.0278	0.1346	0.0861	-0.2577	0.2691	0.0171	0.2041	-0.0516	0.1562
Cu	0.0007	0.1783	0.1757	0.2170	0.1973	0.1124	-0.1606	-0.2520	0.0455

## CONCLUSIONS

1. Mineral soils contained higher amounts of the investigated elements and had a significantly higher pH than organic soils. Greenness growth from the meadows situated on mineral soils contained 13.1% more Papilionaceous plants on the average than the greenness growth of organic meadows.

2. Except for nitrogen, greenness growth from the meadows located on mineral soils usually contained more nutrients, especially phosphorus, potassium, calcium, and manganese. Content of P, K, and Mg in the greenness growth had significantly lower variation coefficients than in the soil.

3. High Papilionaceous share in the greenness growth was affected by high pH and sufficient amounts of phosphorus and magnesium in the soil.

4. Low pH of the soil solution had an important effect on the manganese accumulation in the greenness growth, whereas high pH favours magnesium uptake by

plants. High Mg content in the soil significantly limited Mn absorption by the meadow greenness growth.

## REFERENCES

1. **Borowiec J., Urban D.:** Kondycja geochemiczna siedlisk łąkowych lubelszczyzny. Łąki. LTN, Lublin, 1997.
2. **Davies A., Morgan C.T., Fothergill M.:** Effect of extensification on sheep production from an upland permanent pasture. Proc. 15th General Meeting of the EGF, Wageningen, 290-301, 1994.
3. **Fagerberg B.:** Estimation of proportion of Legumes and its influence on nitrogen fixation in sustainable grassland production. Proc. 15th General Meeting of the EGF, Wageningen, 159-161, 1994.
4. **Gajda J.:** Łąki łąkowe w dolinach rzecznych na przykładzie Bugu i Wieprza. Zesz. Probl. Post. Nauk Roln., 308, 53-73, 1987.
5. **Goliński P.:** Ekonomiczne aspekty wykorzystania motylkowatych na użytkach zielonych. Biul. Nauk., 1, ART Olsztyn, 9-74, 1998.
6. **Jargiello J., Miazga S., Mosek B., Sawicki B., Czarnecki Z.:** Ocena niektórych czynników wpływających na występowanie roślin motylkowatych w runi łąk i pastwisk dolinowych Wyżyny Lubelskiej. Zesz. Probl. Post. Nauk Roln., 442, 193-203, 1996.
7. **Mengel K., Kirkby E.A.:** Podstawy żywienia roślin. PWRiL, Warszawa, 1983.
8. **O'Neill P.:** Environmental Chemistry. Chapman & Hall, UK, 1993.
9. **Opitz von Boberfeld W.:** Grünlandlehre. Verl. Eugen Ulmer, Stuttgart, 336, 1994.
10. **Sawicki B.:** Przydatność wybranych gatunków i odmian traw pastewnych do mieszanek na łąki trwałe w różnych warunkach siedliskowych. Wyd. AR Lublin, 35-38, 1997.
11. **Sawicki B., Miazga S., Mosek B., Jargiello J.:** Udział roślin motylkowatych w runi łąk dolinowych. Biul. Nauk., 1, ART Olsztyn, 335-342, 1998.
12. **Underwood S.J.:** Żywienie mineralne zwierząt. PWRiL, Warszawa, 1971.