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RELATION BETWEEN SOIL AND FOLIAR FERTILIZATION OF PERMANENT MEADOW

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A b s t r a c t. The aim of the study was to estimate the influence of changing mineral content in the soil on the meadow yield in the permanent meadow experiment. The following treatments were applied: control; PK+220 kg N/ha; PK+110 N; PK+110 N+ foliar fertilization; PK+55 N; and PK+55 kg N + foliar fertilization. The studies have revealed that the investigated fertiliser combinations gave similar results of the total content of macro- and microelements in the soil. Using lower nitrogen doses to soil together with foliar fertilization positively affected yielding of a permanent meadow which can be important for soil protection. Efficiency of foliar fertilization was higher with the lowest nitrogen dose supplied to the soil which suggests its ecological safety.

K e y w o r d s: permanent meadow, soil and foliar fertilization, soil properties, hay yield.

INTRODUCTION

Mineral fertilization of grassland is a very important cultivation method as it affects yield. However, numerous researchers [4-6,9] showed its negative influence on the soil environment. An alternative technique can be foliar fertilisation [10,11]. Some field investigations [1,3,6] showed a positive influence of this last method of nutrient supply on the yield level and quality in the case many of cultivated plants.

The present research aims to estimate the influence of changing mineral content in the soil on the meadow yield that has not been investigated so far.

Those researches are the proof of estimation of foliar fertilization (by nitrogen with microelements) on efficiency of mineral fertilization a specially with nitrogen, by less doses of nitrogen dose treated to soil.

METHODS

The experiment was carried out in 1994-1996 on a permanent meadow in the Agricultural Research Station (ARS) Zawady by method of randomised blocks. The following treatments were established:

1. Control - "O"
2. PK + 220 kg N/ha
3. PK + 110 kg N/ha
4. PK + 110 kg N/ha + foliar fertilization
5. PK + 55 kg N/ha
6. PK + 55 kg N/ha + foliar fertilisation.

Phosphorus fertilization (80 kg P_2O_5/ha) was used once each year in spring, but potassium (120 kg K_2O/ha) and nitrogen (220, 110, 55 kg N/ha) three times in a vegetation season. Foliar fertilization in the form of Agrosol was used three times under each mowing.

Each year three harvests were gathered. The soil samples were taken before the experiment and each autumn from the level of 0-15 cm. The values of pH were estimated in 1 N KCl, nitrogen by the Kjeldahl's method, and the mean content of macro and microelements by the AAS method.

RESULTS

The experiment was located (Table 1) on ground gley soil derived from light clay on the heavy clayey sand. In the deeper level there was medium silty clay and sandy gravel. It originated from a bedrock rich in calcium carbonate.

The soil had a neutral reaction and high nutrient content (Table 2). The results showed that the neutral reaction before the experiment was the same only in the

Table 1. Grain size distribution of the soils

Genetic horizon	Depth (cm)	Grain size distribution (%)									
		Fractions, mm									
		>1	<1	1-0.5	0.5-0.15	0.25-0.1	0.1-0.05	0.05-0.02	0.02-0.005	0.005-0.002	<0.002
A	0-19	9.5	90.5	18.2	15.8	13.0	4.0	20	13	7.0	9.0
BG	19-32	32.2	67.8	38.3	21.3	5.4	9.0	10	7.0	3.0	6.0
G1	32-65	31.1	68.9	8.1	10.6	6.3	9.0	30	20	6.0	10
G2	65-91	52.2	47.8	Sandy gravel							

Table 2. pH and total content of some chemical elements (in % of d.m.) in soil before and after three years of investigations in studied objects

Estimated factor	Before investigation	Investigated objects*					
		1	2	3	4	5	6
pH of soil	7.0	7.0	6.2	6.7	6.5	6.6	6.4
N	0.65	0.45	0.63	0.45	0.51	0.56	0.46
K	2.2	2.4	1.7	1.9	1.8	2.2	1.9
P	0.047	0.051	0.055	0.043	0.051	0.053	0.053
Ca	1.3	1.6	0.7	1.5	1.4	2.1	1.4
Mg	0.10	0.11	0.09	0.09	0.10	0.10	0.09
Na	0.01	0.04	0.06	0.04	0.04	0.07	0.05
Cu	13.8	14.3	16.2	14.8	11.7	12.8	13.4
Zn	130	84	100	129	113	78	121
Mn	115	115	111	66	130	131	145

*For explanation see "Methods".

control plots. It changed significantly in the soil fertilised with nitrogen given to soil or in the foliar form. Similar results were also reported by Kopeć *et al.* [8] and Czuba *et al.* [2]. Nitrogen content decreased in the soil especially after foliar fertilization. Similar situation was also observed for the content of total nitrogen, potassium and calcium. Foliar fertilization not related to nitrogen fertilization to soil, did not cause any changes in phosphorus, magnesium and sodium content but increased manganese content. Very interesting results were obtained for copper and zinc content as foliar fertilization with the lowest levels of nitrogen fertilization to soil caused an increase of both elements content similarly as in the case of higher dose of nitrogen fertilization.

Different contents of the analysed elements was related to different botanical sward composition from various objects with foliar fertilization. It is well known that various groups of meadow plants uptake different quantities of mineral elements [5].

Co-operation of soil and foliar fertilization positively affected hay yield of a permanent meadow (Table 3). The highest mean yield of hay obtained during the investigation period was correlated with standard soil fertilization (220 kg N/ha). It was a little lower but comparable to the plots where fertilization was applied to the soil and to leaves. It is important from the point of view of both profitability of foliar fertilization and soil protection.

Also the analysis of yield increase (Table 4) showed that foliar fertilization gave the best effects with the lowest levels of nitrogen fertilizers used to soil (55 kg N/ha). It amounted to 1.91 t/ha of dry matter. In the same combination, the highest production

Table 3. Changes of dry matter yield (t/ha) in regard to fertilizer combinations

Treatments	Years			$\bar{x}$ for combination
	1994	1995	1996	
Control	5.70	4.65	5.05	5.1
PK+220 kg N/ha	9.74	9.66	10.46	9.9
PK+110 kg N/ha	7.70	8.27	9.72	8.56
PK+55 kg N/ha	6.58	7.72	8.78	7.69
PK+110 kg N/ha+foliar fertilization (1 spray)	9.16	9.21	10.22	9.5
PK+110 kg N/ha+foliar fertilization (2 spray)	9.60	9.59	10.25	9.8
PK+55 kg N/ha+foliar fertilization (1 spray)	8.42	9.10	9.82	9.1
PK+55 kg N/ha+foliar fertilization (2 spray)	9.28	9.58	9.95	9.6
$\bar{x}$ for years	8.08	8.19	9.02	

$LSD_{0.05}$ for years - 0.19; for fertilizer combination - 0.41; for interaction: years x fertilizer combination - 0.67.

Table 4. Effect of foliar fertilization on yields and efficiency of nitrogen fertilization

Specification	Treatments	
	PK+55 kg N/ha	PK + 110 kg N/ha
Yield of d.m. (t/ha), mean for 3 years		
No foliar fertilization	9.11	9.53
Foliar 1 spray	9.60	9.81
Foliar 2 spray	7.69	8.57
$LSD_{0.05}$	0.22	0.23
Yield increase (t/ha) of d.m. under influence of foliar fertilization:		
Foliar 1 spray	1.42	0.96
Foliar 2 spray	1.91	1.24
Effect of 1 kg N used in foliar form (kg d.m.):		
Foliar 1 spray	14.7	4.97
Foliar 2 spray	19.8	6.43

effect of 1 kg of nitrogen used in foliar fertilization was observed. It amounted to 19.8 kg of dry matter. Reaction of foliar fertilization at the lowest nitrogen dose used to soil, suggested that this form of nutrient supply positively affected yielding and was ecologically safe.

CONCLUSIONS

1. The investigated fertiliser combinations gave similar results of the total content of macro- and microelements in the soil.

2. Using lower nitrogen doses to soil together with foliar fertilization positively affected yielding of a permanent meadow which can be important for soil protection.

3. Efficiency of foliar fertilization was higher with the lowest nitrogen dose supplied to the soil which suggests its ecological safety.

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