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INFLUENCE OF DIFFERENT FORMS OF NITROGEN FERTILIZATION ON THE CONTENT OF MACROLEMENTS (Ca, Mg) IN MEADOW SWARD Part II

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Abstract

Foliar fertilization is not a new application method, especially with respect to field crops. However, little information is available regarding foliar fertilization of grasses.

This paper contains a presentation of guidelines for rational fertilization of permanent meadow through delivery of nitrogen doses applied in various forms. The study was conducted near Siedlce in 1999-2001. Basic fertilization was applied once in the growing period, in the spring, introducing to the soil the following quantities of nutrients: N–60 kg·ha^{-1}, P–60 kg·ha^{-1}, K–60 kg·ha^{-1}. The fertilizers were used in two forms: multiple (Polifoska 15) [P] and a mix of fertilizers (ammonium nitrate, superphosfate, potasic salt) [M]. Under the second and third cut of grass, additional nitrogen nutrition was applied on the experiment plots, as foliar or soil fertilization treatments. The following nitrogen doses were used (in kg·ha^{-1}): 27.6 (N_1), 41.4 (N_2), 55.2 (N_3). Every year, three cuts were collected for determination of the content of calcium and magnesium.

The fertilization variants modified the content of calcium in sward. The concentration of calcium increased from 8.4 to 9.0 g kg^{-1} d.m. only under the influence of increasing doses of nitrogen applied in the liquid form against the background of the multiple fertilizer.

While analysing the content of calcium in plants in dependence of the applied doses and method of supplementary nitrogen fertilization, it was found out that most calcium was in plants from plots foliar fertilized with a nitrogen dose of 55.2 kg·ha^{-1} (N_3). The lowest calcium level was in grass fertilized with 41.4 kg N·ha^{-1} (N_2) applied to soil.

The content of magnesium in sward was high: on average 3.0 g·kg^{-1} d.m. in grass fertilized with the multiple fertilizer and 3.1 g·kg^{-1} d.m. in grass receiving a mixture of single-component fertilizers.

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Key words: meadow sward, nitrogen dose, mineral fertilization, foliar fertilization, calcium, magnesium.

WPŁYW FORMY NAWOŻENIA AZOTEM NA ZAWARTOŚĆ MAKROELEMENTÓW (Ca, Mg) W RUNI Z ŁĄKI TRWAŁEJ

Abstrakt

Obecnie intensyfikacja produkcji roślinnej wymusza konieczność szukania rozwiązań ograniczających m.in. zanieczyszczenie środowiska. Są nimi np. nowe technologie nawożeniowe umożliwiające łączenie stosowanych składników, co wpływa na lepsze wykorzystanie azotu przez rośliny.

Celem pracy było porównanie wpływu nawożenia użytków zielonych azotem na zawartość makroelementów w runi łąkowej. Badania prowadzono w latach 1999-2001 na łące trwałej. Każdego roku po ruszeniu wegetacji stosowano nawożenie podstawowe pogłównie, wnosząc do gleby odpowiednio: N–60 $kg \cdot ha^{-1}$, P–60 $kg \cdot ha^{-1}$, K–60 $kg \cdot ha^{-1}$. Zastosowano dwie formy nawozów: wieloskładnikowy (Polifoska 15) [P] i mieszaninę nawozów jednoskładnikowych [M] (saletra amonowa, superfosfat pojedynczy, sól potasowa). W drugim i trzecim odroście stosowano nawożenie azotem w formie dolistnej (20%, 30%, 40% roztwór mocznika) i dokorzeniowej (saletra amonowa). Dawki azotu wynosiły: 27,6 $kg \cdot ha^{-1}$ (N_1); 41,4 $kg \cdot ha^{-1}$ (N_2); 55,2 $kg \cdot ha^{-1}$ (N_3). W każdym roku badań zebrano po trzy pokosy. W runi łąkowej określono zawartość wapnia i magnezu.

Analizując zawartość wapnia w roślinach w zależności od zastosowanych dawek i rodzaju nawożenia uzupełniającego azotem, stwierdzono, że najwięcej tego składnika było w roślinach z poletek nawożonych dolistnie dawką 55,2 $kg \cdot ha^{-1}$ azotu (N_3), natomiast najmniej po zastosowaniu dokorzeniowo dawki 41,4 $kg \cdot ha^{-1}$ (N_2).

Zawartość magnezu w badanej runi była wysoka i wynosiła średnio 3,0 $g \cdot kg^{-1}$ s.m. w przypadku nawożenia nawozem wieloskładnikowym i 3,1 $g \cdot kg^{-1}$ s.m. w przypadku nawozów jednoskładnikowych.

Słowa kluczowe: ruń łąkowa, dawka azotu, forma azotu, dokarmianie dolistne, nawożenie mineralne, wapń, magnez.

INTRODUCTION

High fertilization of grasslands often has negative consequences, such as a worse chemical composition of the fodder produced from grass, disappearance of some bird or insect species, or unfavourable changes in the content of macroelements in soil (Czuba 1996, Doboszynski 1994, Winnicka, Bobrecka-Jamro 1996). Currently, less fertilizers are being used on meadows or pastures. Limiting fertilization can help to maintain the ecological equilibrium of natural grasslands by improving their biodiversity (Spatz, Buchgraber 2003, Wasilewski-Sutkowska 2001). It is, however, necessary to look for other solutions which would, for example, reduce environmental contamination. Foliar fertilization could be an answer, as it can deliver small amounts of nutrients very effectively (Jankowski et al. 1999, Jodełka et al.

2001). Empirically tested profitability of foliar fertilization of meadow sward (JANKOWSKI et. al. 1999, JODEŁKA et. al. 1999, 2000, JODEŁKA, JANKOWSKI 2001) has encouraged us to test the reaction of fodder grasses to this fertilization method in relation to the content of mineral compounds in grasses. Foliar fertilization is not a new application method, especially with respect to field crops. However, little information is available regarding foliar fertilization of grasses.

The present study is part of an attempt to formulate guidelines for fertilization of grasslands by testing supplementary nitrogen fertilization in two forms (soil and foliar).

Thus, the aim of this work has been to evaluate the influence of nitrogen fertilization applied in the two forms on the content of calcium and magnesium in meadow sward.

MATERIAL AND METHODS

A detailed description of the soil and meteorological conditions prevailing during the trials can be found in part one of this paper (KOLCZAREK et al. 2008).

Chemical analyses of the plant material for determination of Ca and Mg were performed by the method of absorption atomic spectrophotometry.

RESULTS AND DISCUSION

The content of calcium in plants ranged from 8.2 $g \cdot kg^{-1}$ d.m. to 9.2 $g \cdot kg^{-1}$ d.m. A comparison of the influence of the type of basic fertilization (Table 1) showed that the plants from objects fertilized with the mixture of single-component fertilizers contained more calcium (9.0 $g \cdot kg^{-1}$ d.m.). FALKOWSKI et. al. (1990) as well as TRĄBA and WOLAŃSKI (1999) suggested that such levels of calcium in sward was sufficient to satisfy animals' alimentary needs. Our results proved that the fertilization variants modified the content of calcium in sward. The content of calcium rose from 8.4 to 9.0 $g \cdot kg^{-1}$ d.m. only under the influence of an increasing doses of nitrogen applied in the liquid form in conjunction with the multiple fertilizer. Moreover, plants from plots fertilized with the mixture of single-component fertilizers contained more calcium irrespective of the method of supplementary nitrogen fertilization.

With regard to the influence of basic and supplementary fertilization methods on the cuts (Figure 1), a decrease of the calcium content was demonstrated in the successive re-growths when nitrogen was applied in the solid form, independently of the type of basic fertilization. While analysing

Table 1

Content of Mg and Ca in plants ($g \cdot kg^{-1}$ d.m.) depending on fertilization method (soil and foliar) and nitrogen dose (mean for the years)

Basic fertilization	Nitrogen dose	Magnesium		$\bar{x}$	Calcium		$\bar{x}$
		Additional fertilization			Additional fertilization		
		foliar	soil		foliar	soil	
Polifoska [P]	N_1	2.9	2.9	2.9	8.4	8.4	8.4
	N_2	3.0	2.8	2.9	8.6	8.3	8.5
	N_3	3.0	3.0	3.0	9.0	8.2	8.6
	$\bar{x}$	3.0	2.9	3.0	8.7	8.3	8.5
Mix of fertilizers [M]	N_1	3.1	3.0	3.1	8.8	8.9	8.9
	N_2	3.1	3.1	3.1	9.2	8.7	9.0
	N_3	3.0	3.0	3.0	9.1	9.2	9.2
	$\bar{x}$	3.1	3.0	3.1	9.0	8.9	9.0
$\bar{x}$ Mean [PM]	N_1	3.0	3.0	3.0	8.6	8.7	8.7
	N_2	3.1	3.0	3.0	8.9	8.5	8.8
	N_3	3.0	3.0	3.0	9.1	8.7	8.9
	$\bar{x}$	3.1	3.0	3.1	8.9	8.6	8.8
n.s. non-significant		$LSD_{0.05}$ additional fertilization (A) – n.s. nitrogen dose (B) – n.s. basic fertilization (C) – n.s. interaction: A x B – n.s. A x C – n.s. B x C – n.s. A x B x C – n.s.			$LSD_{0.05}$ additional fertilization (A) – n.s. nitrogen dose (B) – n.s. basic fertilization (C) – 0.5 interaction: A x B – 0.6 A x C – 0.6 B x C – 0.6 A x B x C – 0.8		

the content of calcium in plants in dependence of the applied doses and method of supplementary nitrogen fertilization, it was found out that most calcium was in plants from plots foliar fertilized with a nitrogen dose of 55 $kg \cdot ha^{-1}$ (N_3). The lowest calcium level was in grass fertilized with 41.4 kg $N \cdot ha^{-1}$ (N_2) applied to soil.

Moreover, the highest content of calcium in the whole period of investigations was found in the sward taken from plots receiving foliar fertilization with nitrogen (8.9 $g \cdot kg^{-1}$ d.m.).

Magnesium is another important element in animals nourishment (Baryła 1992, Nowak 1992, Preś 1984) and its threshold level in grasses should be 2 $g \cdot kg^{-1}$ d.m. (Falkowski et. al. 1990). The content of magnesium in the

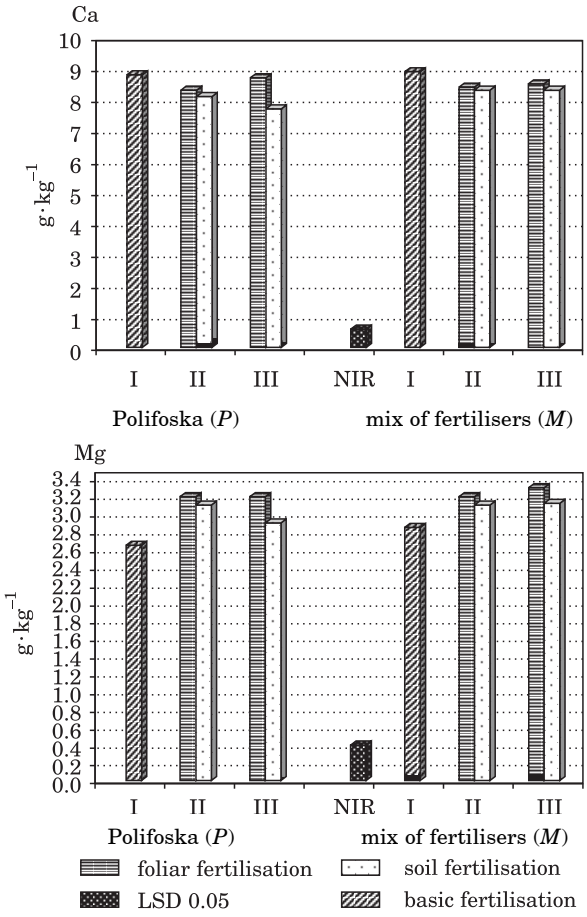

Fig. 1. Content of Ca and Mg in plants (g□kg^{-1}) depending on basic fertilization type, additional soil or foliar fertilization, nitrogen dose and cuts (means for the years)

sward we studied was high (Table 1): an average 3.0 g·kg^{-1} d.m. in grass fertilized with the multiple fertilizer and 3.1 g·kg^{-1} d.m. in sward receiving the mixture of single-component fertilizers. A comparison of the influence of the interaction between the basic and supplementary fertilization as well as individual nitrogen doses on the content of magnesium in plants (Table 1) showed this effect was not statistically significant as the values obtained ranged 2.8 to 3.1 g·kg^{-1} d.m.

However, our analysis of the influence of the type of basic fertilization and the method of introducing supplementary nitrogen fertilization to successive cuts (Figure 1) showed that the content of magnesium in meadow sward increased together with the increasing nitrogen dose applied in the foliar form, independently of the type of basic fertilization. Similar results have been presented by CIEPIELA (2004) and JODEŁKA et al. (2000).

Besides, the analysis of the magnesium content in plants in dependence of the doses and method of supplementary nitrogen fertilization (Table 1) showed that most magnesium appeared in plants from plots receiving 41.4 kg $N \cdot ha^{-1}$ in foliar fertilization (N_2). The other doses in conjunction with either way of supplementary fertilization did not differentiate significantly the content of magnesium.

CONCLUSIONS

1. The form of fertilizers significantly differentiated the content of mineral components in meadow sward.

2. Meadow fertilization with a mixture of single-component fertilizers resulted in an larger increase in the quantity of calcium and magnesium than a multiple fertilizer.

3. The content of magnesium in meadow sward increased together with an increase in the does of nitrogen dose applied in the foliar form, independently of the type of basic fertilization.

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