

THE EFFECT OF N- AND TRACE ELEMENT- FERTILISATION ON THE ZN CONTENT OF MEADOW GRASS

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Introduction

Zn is an indispensable element for plants, animals and humans alike. Zn in the soil can be found in the form of bivalent ion, the absorption complex of the soil binds it strongly. Its solubility increases with rising H^+ ion concentration; its complex forming ability is similar to that of copper. The solubility of different zinc compounds decreases with the increasing pH (Kádár 2004).

The essentiality of Zn was proved around the 30ies of the 20th century. From animal health point of view this knowledge became practically important when the parakeratosis disease of swine was identified as Zn-deficiency (Szabó et al. 1987). Zn first of all plays important role in the function of enzymes of the intermediary metabolism (Horváth and Nacsev 1972). According to the survey of Régiusné (1988) the proportion of Zn-deficient animals in cattle herds is 20-30% in saline and diluvial soils and 12% in loess soils. This problem occurs not only in Hungary but all over the world. Bonomi et al. (1988) proved that in 10 Italian dairy farms there was a direct relationship between Zn-deficiency and the occurrence of foot diseases. In a study of Wunsch et al. (2005) the authors describe that in natural range pastures in Brazil the Mn and Fe content of grasses were higher than the requirement of beef cattle, copper content was deficient in some months, but Zn content was always lower than required for cattle.

The Zn-requirement of ruminant animals feeding on mostly roughages is about 40 mgkg⁻¹ according to Kakuk and Schmidt (1988) and 50 mgkg⁻¹ according to Kozma and Tölgyesi (1979). Even if this value is influenced by numerous factors, such as the fitin-, and Ca-content or the Ca/P proportion of the fodder we can agree that approximately this Zn level has to be safeguarded in order to avoid the primary or secondary Zn-deficiency. Zn is a permanent component of swine and poultry premixes in recent times, but the task of solving the proper Zn supply of ruminants is still ahead of us.

Methods

For studying the effect of nitrogen and trace element fertilisation on the chemical composition of grasses we set a large plot experiment among other places in Oroszlány, Hungary. For nitrogen supply we used three different types of nitrogen fertilisers, ammonium-nitrate, ammonium-sulphate and urea. By using these three fertilisers we wanted to utilise the different acidity factor of them. We set two nitrogen levels in the experiment, 200 and 400 kg ha⁻¹. We also added trace elements – 25 kg ha⁻¹ copper and zinc respectively – at both N levels. The size of the plots was 50 m². The application of the N fertilisers was done by hand. The copper and zinc sulphate was dissolved in water and sprayed to the plots.

The arrangement of the experiment was a randomised block design with four repetitions.

The soil type of the experimental site is alluvial meadow soil (humic gley) with medium nutrient supply. The Zn content of the soil is quite low, even if we consider the relatively loose structure of the soil (A_K cohesion number <38).

The average soil composition is displayed in Table 1.

Table 1. Average soil composition of the experimental site in Oroszlány

pH		K _A	CaCO ₃ %	Humus %	AL-soluble			nKCl Mg	EDTA-soluble			
H ₂ O	KCl				P ₂ O ₅	K ₂ O	Na		Zn	Cu	Mn	Fe
mgkg ⁻¹												
7.15	7.52	33	2.9	2.09	165	251	68	330	1.9	1.6	99.5	86.5

Grass was cut with a mower commonly used on farms. After cutting the grass was collected, measured, and after measuring a 1 kg sample was taken for chemical analysis. The Zn content of the grass was determined with atomic absorption spectrophotometer. For the evaluation of the data we used analysis of variance.

Results and discussion

According to the feed and blood tests carried out at the farm we can establish that the Zn content of the fodder is not enough to meet the Zn requirement of cattle, which is about 40-50 mgkg⁻¹ calculated on dry matter basis.

In accordance with the soil test results the fodder does not contain enough zinc even if we take into consideration that the average zinc content of grasses is between 25 and 35 mgkg⁻¹. The Zn-content of the control plants was 16.37 mgkg⁻¹ at the first mowing and 18.22 mgkg⁻¹ at the second mowing, which is far behind the 50 mgkg⁻¹ Zn-requirement of cattle.

In our experiment the average zinc content of the fertilised grass was 20.69 mgkg⁻¹ at the first mowing and it was somewhat higher (25.53 mgkg⁻¹) at the occasion of the second mowing.

The zinc content of the plants of the control plots was lower at both harvest time, so we can conclude that the treatments increased the Zn-content of the grass.

Table 1 Zn-content of grass in Oroszlány, 1st cut

Fertiliser	N-dose		Average (B)
	200 kgha ⁻¹	400 kgha ⁻¹	
Ammonium nitrate			
<i>Without trace elements</i>	18.05	19.15	18.60
Cu	18.85	20.52	19.68
Zn	21.62	16.90	19.26
Cu+Zn	19.42	19.70	19.56
	19.48	19.06	
Ammonium sulphate			
<i>Without trace elements</i>	22.17	23.55	22.86
Cu	16.40	22.65	19.52
Zn	22.47	19.95	21.21
Cu+Zn	21.60	22.70	22.15
	20.66	22.21	
Urea			
<i>Without trace elements</i>	17.75	21.35	19.55
Cu	20.75	18.85	19.80

Zn	22.47	20.47	21.47
Cu+Zn	25.20	24.07	24.63
	21.54	21.18	

Control: 16.37, LSD 1.985 (A); 1.62 (B); 2.29 (C)

Table 1 Zn-content of grass in Oroszlány, 2nd cut

Fertiliser	N-dose		Average (B)
	200 kgha ⁻¹	400 kgha ⁻¹	
Ammonium nitrate			
<i>Without trace elements</i>	20.55	22.05	21.30
Cu	20.37	23.50	21.93
Zn	29.10	25.40	27.25
Cu+Zn	24.60	39.97	32.28
	23.65	27.73	
Ammonium sulphate			
<i>Without trace elements</i>	19.47	27.80	23.63
Cu	23.10	34.52	28.81
Zn	24.65	22.35	23.50
Cu+Zn	22.57	28.37	25.47
<i>Without trace elements</i>	22.45	28.26	
Urea			
<i>Without trace element</i>	23.12	21.97	22.55
Cu	38.77	23.40	31.08
Zn	28.85	24.27	26.56
Cu+Zn	20.92	23.10	22.01
	27.91	23.18	

Control: 18.22, LSD 4.53 (A); 3.70 (B)

Between the grand average of N-fertilisers

Between the trace element treatments in the average of N-fertilisers

The difference between the Zn-content of the control and fertilised plants was significant at the probability level of 5% at the first mowing, but it could not be proved statistically regarding the second harvest.

The administration of zinc-sulphate increased the zinc content of the grass that could be detected especially at the second mowing. The zinc-content of the zinc-fertilised plants was 17% higher on the average than that of the plants treated only with nitrogen fertiliser without zinc supplementation. The highest increase was detected at the second harvest in the case of 400 kgha⁻¹ nitrogen fertiliser treatments. In some cases the combined application of copper and zinc was also effective in increasing the zinc content.

Conclusions

The average Zn-content of grasses is between 15-30 mgkg⁻¹. This amount is not enough to meet the requirement of grazing animals. That was the reason why we tried to increase the Zn-content in our fertilisation experiments.

On the basis of the results we can conclude that the original grass grown in the experimental site is severely deficient comparing to the needs of cattle. The fertilisation increased the zinc content of the plants. Regarding the three kinds of fertilisers the highest zinc content was detected at the 400 kg ha⁻¹ dose of ammonium sulphate. Copper and zinc supplementation also increased the zinc content, but even this grass of higher zinc level was still deficient from animal nutritional point of view.

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