

N-CONTAINING COPPER COMPLEXES IN WHEAT PRODUCTION

P. SZAKÁL¹ – R. SCHMIDT¹ – M. BARKÓCZI¹ – R. KALOCSAI² – D. BEKE¹ – O. CSATAI

¹ University of West Hungary Faculty of Agricultural and Food Sciences

9200. Mosonmagyaróvár Vár 2. E-mail: szakalp@mtk.nyme.hu

² UIS Ungarn Laboranalytical LTD Mosonmagyaróvár, Terv Str. 92.

Introduction

A significant proportion of Hungarian soils show copper deficiency (Kádár 1984). FAO studies also underlined that soluble copper content (extracted by ammonium-acetate-EDTA) is low in Hungary compared to international data (Sillanpää 1982). The average copper content of the upper cultivated layer varies between 12-120 mgkg⁻¹. The amount of available forms of copper is around 1-2% of this value and takes up about 0.2-2.0 kg ha⁻¹ (Györi 1962, Szabó et al. 1987). In calcareous soils (Kádár and Németh 2003) or after liming of soils (Szakál et al. 1997a, Reisinger et al. 1996) the solubility of copper is decreasing. Numerous studies refer to the fact that due to the hindered transport processes deficiency can occur in the plants even in cases when the soil is relatively well supplied with certain nutrients. This underlines the importance of foliar application and top dressing Szentpéteri et al. (2005). Copper plays an important role in plant metabolism. It is the component or activator of numerous enzymes that take part in transpiration processes and electron transport. Copper is indispensable for carbohydrate-, protein- and fat- metabolism (Shkolnyik 1984). Copper also catalyses the redox reactions of flavonoids. In recent times more and more studies deal with the relationship between trace element nutrition and the yield and quality of wheat. Unfortunately in a part of these experiments sulphate and chloride compounds are used which are often depressive to a certain extent and for this reason the effect of the cation itself can be proved unquestionably.

Materials and Methods

The preparation of copper complexes of amine and saccharose ligand:

The preparation of amin complexes: The amine complexes were prepared from copper-chloride containing microelectronic waste. The copper-chloride containing waste was reacted with KOH. The copper-hydroxide precipitation was filtered with a vacuum filter until it became chloride-free. After filtering the copper hydroxide was reacted with ammonium-hydroxide in a membrane reactor. After cooling we set the pH of complex between 8.5-9.2 values. It is suitable for spraying in this pH range; if the pH is higher it may cause burning on the plants.

The preparation of copper-saccharose complex: In the preparation process concentrated sugar solution – made from granulated sugar – was given to acidic copper-sulphate with continuous mixing and simultaneous KOH administration for pH reduction. Since the process is highly exotherm, the compounds need to be cooled in a duplicator. For stabilising the complex the administration of other complexes is necessary.

The produced complexes were administered in the form of foliar application at two phenological phases at booting and at flowering. The experiments were carried out in Komárom in the years 1998-2000 on calcareous Danube alluvial soil.

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

pH		K _A	CaCO ₃ %	Humus %	AL-soluble			nKCl	EDTA-soluble			
H ₂ O	KCl				P ₂ O ₅	K ₂ O	Na	Mg	Zn	Cu	Mn	Fe
mgkg ⁻¹												
7.93	7.50	39.0	8.5	2.1	183	165	39	57.4	1.1	0.85	33.2	24.7

The following copper doses were applied in all three years: 0.1; 0.3; 0.5; 1.0; 2.0 kg ha⁻¹. The application of the copper complexes was done with a 2.5 l high- pressure sprayer; the amount administered to 1 plot was 0.6 l. The spraying at the flowering treatments was done in the afternoon.

The size of the plots was 10 m²; the arrangement of the experiment was a randomised block design; the wheat variety used was GK Kincső. The harvest was done with a plot harvester, after harvest we measured the yield and from the samples we made the chemical analysis and determined the quality parameters.

The data were evaluated by analysis of variance and regression analysis.

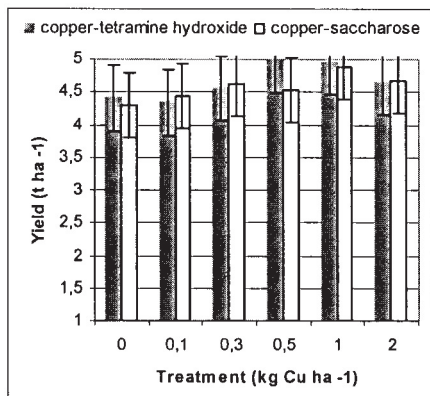
Results and discussion

Foliar fertilisation experiments were carried out in Komárom at two phenological phases, at booting and at flowering in 2000.

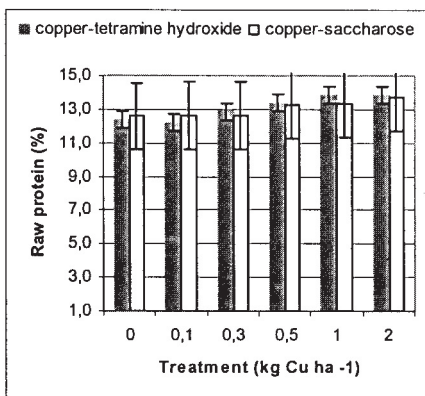
In this experiment we studied the effect of the copper compounds on the yield and on the quality of flour.

The yield of wheat increased if copper doses higher than 0.1 kg ha⁻¹ were applied.

Though the results are not significant we can establish that in the case of copper-tetramine treatments the maximum yield (4.98 and 4.95 t ha⁻¹) was obtained at the doses of 0.5 and 1.0 kg ha⁻¹ respectively. Regarding the copper-saccharose treatments the 1 kg ha⁻¹ dose proved to be the more effective and resulted in 4.88 t ha⁻¹ yield. Due to the copper-saccharose doses higher than 1.0 kg ha⁻¹ the yield decreased. On the basis of the results obtained we can establish that copper-tetramine-hydroxide had more favourable effect on the yield than copper-saccharose. The yield changed in a different way due to the application of the copper complexes. (Figure 1)



(1)



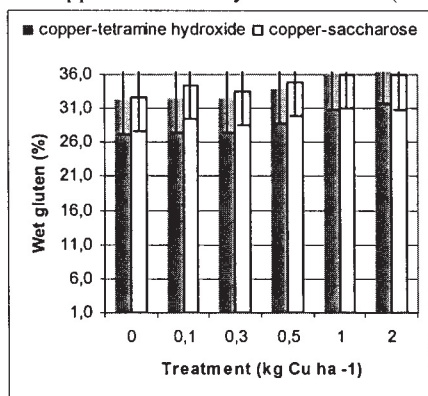
(2)

Figure 1. Yield of wheat due to the application of copper complexes at booting in 2000.

Figure 2. Raw protein content of wheat due to the application of copper complexes at booting in 2000.

The effect of the treatments on the raw-protein content:

The analysis of the results revealed that there were significant differences in the raw protein content achieved due to the copper-tetramine-hydroxide doses ($P=1.0\%$).



(3)

Figure 3. Wet gluten content of winter wheat due to the application of copper complexes at booting in 2000.

On the basis of the results we can establish that the raw protein content of winter wheat increased with increasing copper doses. In some cases the raw protein content expanded by 15% the respecting value of the control. Among the compounds applied copper-tetramine-hydroxide was the most effective in increasing raw protein content. Compared to the control even the highest copper dose (2.0 kg ha^{-1}) increased the raw protein content. Regarding the yield this dose had already a depressive effect and the yield decreased.

The effect of treatments on the wet gluten content:

Changing of wet gluten content is displayed in Figure 3. The results prove that the wet gluten content increased in all of the cases due to the treatments and the changes are significant at the 10% probability level. The highest wet gluten content was measured in the case of both complexes at the 1.0 and 2.0 kg ha^{-1} copper dose and the values were 36.65 and 36.10% respectively. Except the 2.0 kg ha^{-1} copper dose the copper-saccharose treatments were more effective in increasing the wet gluten content.

Conclusions

The yield of wheat increased due to the treatments with copper complexes at booting. The highest yield was achieved when copper-tetramine-hydroxide treatments were applied.

The two types of complexes (tetramine and saccharose) increased the raw protein content to about the same extent. The highest increase was measured at the 1.0 kg ha^{-1} copper dose.

The wet gluten content increased as a result of the application of the complexes at booting. In increasing the wet gluten content the copper-saccharose treatment was more effective than copper-tetramine-hydroxide.

References

- Győri, D. 1962 A Mg, Zn, Cu, Mo, Co mikroelemek eloszlása és vegyületformái néhány talajtípusban. MTA Agrártud. Oszt. Közl. 21: 1-2.
- Kádár, I. Németh, T. 2003 Mikroelemek kilúgozása meszes csernozjom talajon. Konferencia kötet Prof. Dr. Pais István 80. születésnapja tiszteletére. Bessenyei György Könyvkiadó, Nyíregyháza.
- Kádár, I. Shalaby, M. 1984 A N és a Cu trágyázás hatása a talaj és a növény tápelemtartalmára. Növénytermelés. 34. 2. 119-127.
- Reisinger, P. Schmidt, R. Szakál, P. 1996 A talajmeszezés helyzete és a lehetséges megoldások hazánkban. Integrált Növénytermesztés 12, p.100-108.
- Shkolnyik, N.Y.A. 1984 Trace elements in plants. Elsevier, Amsterdam.
- Sillanpää, M. 1982 Micronutrients and the nutrient status of soils. A global study. FAO Soils Bulletin, Róma, 48.
- Szabó, A. Regusné Möcsényi, Á. Győri, D. Szentmihályi, S. 1987 Mikroelemek a mezőgazdaságban. Mezőgazdasági Kiadó, Budapest.
- Szakál, P. Schmidt, R. 1997 Copper fertilization of wheat with copper complex and changes in flour quality. 17. Arbeitstagung Die Bedeutung der Mengen- und Spurelemente. Jena. p. 53-64.
- Szentpéteri Zs., Jolánkai M., Kleinheincs, Cs., Szöllősi, G. 2005 Effect of Nitrogen Topdressing on Winter Wheat. Cereal Research Communications 2-3 619-627
- Péli, E.R., Peeva, V., Georgieva, K., Tuba, Z. (2005): Some Responses of the homoiochlorophyllous desiccation-tolerant dicot *Haberlea rhodopensis* Friv. to dessication and rehydration, Cer. Res. Com. 33: 293-295.
- Kádár, I. (2004): Szennyvíziszap-adagok hatása a növény (*Triticum vulgare* L.)-talaj rendszer néhány mikrobiológiai és biokémiai tulajdonságára (Impact of sludge treatments on some microbiological and biochemical properties of plant (*Triticum vulgare* L.)-soil system. – in *Hungarian*). Agrokémia és Talajtan. 53. 3-4. 331-342 pp
- Svetková, K.; Henselová, M.; Morvová, M. (2005): Effects of a carbonization product as additive on the germination, growth and yield parameters of agricultural crops. Acta Agron. Hun. 53. (3). 241-250 pp
- Tanács, L., Matuz, J., Gerő, L., Petróczi, I.M. (2005): Effect of NPK Fertilizers and Fungicides on the Quality of Bread Wheat in Different Years. Cereal Res. Commun. 33 (2-3): 627-634 pp