

Content and uptake of micronutrients by spring barley grain as exposed to the sulphur fertilization

Zawartość i pobranie mikroelementów z ziarnem jęczmienia jarego w warunkach nawożenia siarką

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In recent 20 years a deficit of sulphur is observed in Polish soils, as a result of considerable limitation of industrial emissions and change in assortment of fertilizers. Estimated fall of SO₂ in Poland in 1980 amounted to about 5 million tons, and until 2005 it decreased five times. Growing number of studies indicate that in plants growing in conditions of sulphur deficit occur metabolism disturbances which impair the plant growth and development, which in consequence leads to reduction in yield quality. In this conditions, it was necessary not only to take into consideration this element in plant fertilization, but also to carry out research over its effect on the chemical composition of yields, including the content of microelements, which compose the majority of plant enzymes or play a role of their activators.

Previous studies of the role of sulphur in shaping yield quality markers were conducted mostly on plants from the family *Brassicaceae*, which show large quantitative demand for this element. However, there are reports showing that also cereals and grasses – species taking up much less sulphur than *Brassicaceae*, positively respond to the presence of this element in fertilizers.

In view of growing sulphur deficit and a crucial physiological role of this element, research was undertaken on spring barley, aimed at the assessment of the effect of different fertilizers containing sulphur used, in different forms and rates, on the grain yield quantity and the content and uptake of microelements with the grain of this species.

The study was based on the three-year field experiment conducted in Wierzychucinek at the Research Station of the University of Technology and Life Sciences (53°26' N, 17°79' E). The strict field experiment was established with the randomized split-plot design in the typical lessive soil (*Luvisols* acc. to WRB) with low abundance in sulphur. The studied factor was the type of mineral fertilization containing sulphur in ionic form (ammonium sulphate (VI), potassium sulphate (VI) or elemental form (Wigor S). Fertilizers were applied at rates of 20 or 40 kg S·ha⁻¹. The experiment was conducted based on a uniform level of fertilization with phosphorus (20 kg P·ha⁻¹) and potassium (90 kg K·ha⁻¹).

The present study indicated that the use of sulphur usually significantly increased the grain yield of spring barley – on average by 8.0%, irrespective of the type of rate of the fertilizer. At the same time no significant differences were found in yield-forming effect of the studied fertilizers and no differences between the rates 20 and 40 kg·ha⁻¹ were proven. The highest content of iron (on average – 69.5 mg·kg⁻¹) and zinc (69.4 mg·kg⁻¹), lower – of manganese (11.1 mg·kg⁻¹) and the lowest – of copper (4.71 mg·kg⁻¹) was indicated in spring barley grain. The applied fertilization with sulphur had a significant effect on contents of manganese, iron and copper. For those microelements, under the influence of applied fertilizers, in each of the study years, irrespective of the form and rate of sulphur, usually a small increase in content was found as compared with the unfertilized treatment. Ammonium sulphate (VI), compared with the other studied fertilizers, affected the content of microelements to the greatest degree, except for zinc. Significant differences affected by this fertilizer in relation to the control were, irrespective of the rate, on average for the study years, for manganese – 19.2%, and for iron – 19.5%. Application of 20 and 40 kg S·ha⁻¹ in the form of ammonium sulphate (VI) caused a significant differentiation in the content

of manganese (difference – 8.0%), iron (15.9%) and copper (13.4%). Uptake of all the studied microelements with spring barley grain was significantly higher on treatment fertilized with sulphate than on the control treatment. For Mn, Fe and Cu a significantly higher uptake was found after the application of ammonium sulphate (VI) than as a result of the application of Wigor S.