Summary

Effect of silicon fertilisation of wheat on the reduction of stress caused by heavy metal content in the soil

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The literature abounds with studies on the mitigating role of silicon in situations of excess metals for plants, but almost all studies have been conducted under water culture conditions where metals and Si were added to the nutrient solution. Such results cannot be directly transferred to agricultural practice, hence research is needed in which plants grow in soil and Si is applied in a way that can be used in agricultural practice. The objective of my study was to test the response of wheat plants growing in zinc and copper contaminated soil to soil and foliar silicon application.

In this study, 2 series of experiments were conducted, one with soil contamination of Zn (600 mg kg-1), and second with Cu (200 mg kg-1). Metals were applied in the form of sulfate. In experiments with Zn, the effect of foliar and soil application of Si on the response of wheat cultivar Lindbergh was studied. In experiments with Cu, the effect of soil application of Si on the response of two wheat cultivars, Lindbergh and Kandela, was studied. All experiments were conducted in 2.3 kg pots filled with soil brought from the field. Silicon was applied topically at rates of 200 and 400 mg kg-1 Si before sowing the crops. Foliar application consisted of spraying the plants with silicon three times at weekly intervals. The spray concentrations used were 2 and 6 mM L -1 Si. In both series of experiments, soil contamination with metals caused a significant increase in Zn and Cu concentration in shoots and roots of the tested wheat, which resulted in a decrease in plant biomass yield. In experiments with an excess of zinc in the soil, a soil application of Si reduced the decrease in shoot and root biomass of Lindbergh wheat caused by Zn toxicity, while a three-fold foliar spray had no such effect. In addition, foliar application of Si had a less favorable effect on reducing Zn concentration in shoots and roots than soil application. At the same time, both methods of Si application increased Zn uptake by plants, but only the soil application reduced Zn transfer from roots to shoots.

In experiments with an excess of Cu in soil, both soil application of Si reduced the negative effect of Cu on the biomass of the Lindbergh cultivar, while it did not show such an effect for the Kandela cultivar. In addition, Si application reduced Cu concentration in wheat shoots, but this reduction was bigger for Lindbergh than for Kandela. The reason for the lack of a beneficial effect of Si on the biomass of Kandela was probably the fact that the reduction in Cu concentration in its shoots was too small. As in the experiments with Zn, the soil application of Si caused a significant increase in the concentration of this element in the shoots of both cultivars.

In both Zn and Cu experiments, the applied metal rates caused a slight decrease in soil pH, and the soil application of sodium silicate counteracted the decrease in pH. The beneficial effect of reduced metal toxicity in the sites with soil application of Si may have been due not only to the effect of silicon taken up by the plants, but also to the slight increase in soil pH.