

IWASAKI, K., MAIER, P., FECHT, M., HORST, W.J. (2001): Effects of silicon supply on apoplastic manganese concentrations in leaves and their relation to manganese tolerance in cowpea (*Vigna unguiculata* (L.) Walp.). Plant Soil (accepted)

## **Effects of silicon supply on apoplastic manganese concentrations in leaves and their relation to manganese tolerance in cowpea (*Vigna unguiculata* (L.) Walp.)**

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### **Abstract**

The effects of Silicon (Si) supply on manganese (Mn) toxicity symptoms and Mn and Si concentrations in the leaf apoplast in a Mn-sensitive cowpea cultivar (*Vigna unguiculata* (L.) Walp. cv. TVu 91) were investigated by solution culture experiments. When 1.44 mM Si was supplied concurrently with 50  $\mu$ M Mn, the Mn toxicity symptoms were clearly avoided without decreasing the bulk-leaf Mn concentration. On the other hand, the symptoms were not completely alleviated when the plants were pretreated with 1.44 mM Si and then exposed to 50  $\mu$ M Mn without concurrent Si supply. Plants of both of these treatments exhibited lower Mn concentrations in the apoplastic washing fluids and higher amounts of adsorbed Mn on the cell walls than the plants treated with 50  $\mu$ M Mn without Si supply. However, the difference between plants with continuous and interrupted Si supply was not significant. Moreover, the Mn concentration in the apoplastic washing fluids of the plants with continuous supply of 1.44 mM Si and 50  $\mu$ M Mn was higher than that of the plants without Si supply at 10  $\mu$ M Mn which showed distinct Mn toxicity symptoms. These results suggest that Si supply alleviates Mn toxicity symptoms not only by decreasing the concentration of soluble apoplastic Mn by enhanced adsorption of Mn on the cell walls but also by detoxification of apoplastic Al through the soluble Si in the apoplast.