Phytotoxicity of Sodium Fluoride and Uptake of Fluoride in Willow Trees

The willow tree (Salix viminalis) toxicity test and a cress seed germination test (Lepidium sativum) were used to determine uptake and phytotoxicity of NaF. Concentrations in hydroponic solutions were 0-1000 mg F/L and 0-400 mg F/L in the preliminary and definitive test. A third test was done with soils collected from a fluoride-contaminated site at Fredericia, Denmark. The EC_{10}, EC_{20} and EC_{50} values for inhibition of transpiration were determined to 38.0, 59.6 and 128.7 mg F/L, respectively. The toxicity test with soil showed strong inhibition for the sample with the highest fluoride concentration (405 mg free F per kg soil, 75 mg F per L soil solution). The seed germination and root elongation test with cress gave EC_{10}, EC_{20} and EC_{50} values of 61.4, 105.0 and 262.8 mg F/L, respectively. At low external concentrations, fluoride was taken up more slowly than water and at high external concentrations at the same velocity. This indicates that an efflux pump becomes overloaded at concentrations above 210 mg F/L. Uptake kinetics were simulated with a non-linear mathematical model, and the Michaelis-Menten parameters were determined to half-saturation constant $K_M$ near 2 g F/L and maximum enzymatic removal rate $v_{max}$ at 9 g/(kg d).