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Water regime of metal-contaminated soil under juvenile forest vegetation

M. Menon (1), K.C. Abbaspour (2), and R. Schulin (1)

(1) Institute of Terrestrial Ecology, Swiss Federal Institute of Technology Zürich (ETHZ), Switzerland. (2) Swiss Federal Institute for Environmental Science and Technology (EAWAG), Dübendorf, Switzerland. (manoj.menon@env.ethz.ch / Fax: +41 44 633 1123)

In a three-year factorial lysimeter study in Open Top Chambers (OTCs), we investigated the effect of topsoil pollution by the heavy metals Zn, Cu, and Cd on the water regime of newly established forest ecosystems. Furthermore, we studied the influence of two types of uncontaminated subsoils (acidic vs. calcareous) and two types of irrigation water acidity (ambient rainfall chemistry vs. acidified chemistry) on the response of the vegetation. Each of the 8 treatment combinations was replicated 4 times. The contamination (2700 mg.kg^{-1} Zn, 385 mg.kg^{-1} Cu and 10 mg.kg^{-1} Cd) was applied by mixing filter dust from a non-ferrous metal smelter into the upper 15 cm of the soil profile, consisting of silty loam (pH 6.5). The same vegetation was established in all 32 lysimeters. The model forest ecosystem consisted of seedlings of Norway spruce (*Picea abies*), willow (*Salix viminalis*), poplar (*Populus tremula*) and birch (*Betula pendula*) trees and a variety of herbaceous understorey plants. Systematic and significant effects showed up in the second and third growing season after canopies had closed. Evapotranspiration was reduced in metal contaminated treatments, independent of the subsoil type and acidity of the irrigation water. This effect corresponded to an even stronger reduction in root growth in the metal treatments. In the first two growing seasons, evapotranspiration was higher on the calcareous than on the acidic subsoil. In the third year the difference disappeared. Acidification of the irrigation water had no significant effect on water consumption, although a tendency to enhance evapotranspiration became increasingly manifest in the second and third year. Soil water potentials indicated that the increasing water consumption over the years was fed primarily by intensified extraction of water from the topsoil in the lysimeters with acidic subsoil, whereas also lower depths became strongly exploited in the lysimeters

with calcareous subsoil. These patterns agreed well with the vertical profiles of fine root density related with the two types of subsoil.