Name ANNICK GOMMERS
Subject RADIOCAESIUM UPTAKE AND CYCLING IN WILLOW SHORT ROTATION COPPICE

Abstract

Large territories were contaminated with varying radionuclides after the accident in the nuclear power plant in Chernobyl in 1986. Non-edible industrial crops may provide an alternative for traditional agricultural crops when the activity levels in the food crops are too high and mechanical or chemical countermeasures are not effective or economically not feasible. Willow short rotation coppice (SRC) aims at producing wood in short rotations for heat or electricity production.

Radiocaesium uptake and cycling in willow SRC was investigated. Different factors were studied that influence radiocaesium uptake in the wood. It was found that differences in radiocaesium uptake between willow clones were small. The potassium concentrations in the solution, however, affected to a large extent the uptake process of radiocaesium *in se*. Radiocaesium concentrations in stems of willows grown hydroponically at 0.05 m*M* were 11 times larger than the radiocaesium concentrations of willows grown at 0.4 m*M*. Apart from a higher uptake due to a decreased competition at the root surface, radiocaesium may be mobilised from the soil minerals in conditions of potassium depletion. The radiocaesium mobilisation depended, however, strongly on the type of minerals (e.g. trioctahedral vs. dioctahedral minerals) and of the potassium supply. It was shown that the test mineral (phlogopite) weathered from an external potassium concentration of 0.06 m*M* downwards and that radiocaesium mobilisation increased with an increased weathering of the mineral.

The radiocaesium concentration in willow wood (3 years old stems) grown in field conditions on a loamy soil was 53 times smaller than in willow wood on a sandy soil, but on both soils the concentration remained below the exemption limit of 740 Bq kg^{-1}. A depletion of the potassium concentration in the soil solution of the sandy soil during the last year of the cutting cycle resulted, however, in an increased radiocaesium concentration in the wood. Adequate potassium fertilisation thus remains important, especially in poorly buffered soils. Radiocaesium export with the harvested wood was very small compared to the total soil inventory (< 0.02 %). The radiocaesium immobilisation in the wood, accounted for only 21 % of the maximal net uptake in the shoots over the three growing seasons. Between 19 and 50 % of the plant radiocaesium returned to the soil by litter and throughfall and between 23 and 64 % was retranslocated in autumn to the root system.

The potassium status of the soil also determined to a large extent the final radiocaesium concentration in the wood in willow SRC in commercial fields on radiocaesium contaminated soils in Sweden . However, the ammonium concentration in the soil solution and the mineral type were also important to predict the radiocaesium concentration in the soil solution and thus the soil-to-wood transfer.

University
KATHOLIEKE UNIVERSITEIT LEUVEN
Faculty
LANDBOUWKUNDE EN TOEGEPASTE BIOLOGISCHE WETENSCHAPPEN
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PROF. R. MERCKX AND PROF. E. SMOLDERS, KULEUVEN