TWO CUCURBITACEAN SPECIES CONTAIN TETRACHLORODIBENZO-P-DIOXIN-BINDING MOLECULES THAT WOULD BE HELPFUL FOR SOIL PHYTOREMEDIATION

B. CAMPANELLA and R. PAUL

Laboratoire de Toxicologie environnementale, Faculté universitaire des Sciences agronomiques, Gembloux, Belgium

In the wake of the observation by Hülster and Marschner (1993) that zucchini (*Cucurbita pepo* L. var. Diamant) absorbs large quantities of polychlorodibenzo-*p*-dioxins and polychlorodibenzofuranes (PCDD/Fs) through its roots, our research aimed at contributing to the description of the mechanism involved in this process, using 14C-labelled TetraCDD. PCDD/Fs are very hydrophobic (log Kow = 5 to 8) and therefore have low bioavailability. These molecules are adsorbed straight and stoped on the root surface. The authors found no other species showing such an absorption capacity. According to the current hypothesis, a molecule produced by zucchini and released into its root exudates complexes with the pollutant. These complexes then become hydrophilic enough to be absorbed by the roots and translocated to all plant parts. Our trials confirmed both root absorption and further translocation, using 14C-TetraCDD. We also attempted to isolate one or several binding molecules in other members of the Cucurbitaceae family. These trials showed that such a molecule exists in melon. However, it is necessary to ensure that a molecule synthesised by the plant and likely to be involved in the mechanism under investigation is actually exuded by its roots. The exudation of a complexing substance by zucchini became detectable from the 2nd week onwards. The exudation of the complexing substance in melon occurred later, from the 5th week; this might be attributable to slower plant growth. The numerous attempts to form a complex using leaf blade extracts have shown that TetraCDD concentration could reach 0.486 to 0.647 µg/l in the aqueous phase. This is significantly higher than that which would correspond to the sole aqueous solubility of 2,3,7,8-TCDD, i.e. 0.02 µg/l (Shiu *et al.*, 1988). Neumann obtained a concentration of 3.21 10-2 µg/l in the root exudates of zucchini (Neumann, Hülster and Marschner, 1997). The complexing substances and the complex can be precipitated by TCA in both melon and zucchini extracts. The step-wise precipitation trials suggested that there are at least two groups of molecules with a different molecular weight in these extracts. Separation on Sephadex G-25 showed that the complexing substances contained in melon leaves have a molecular weight above 5 kD. All this information is important to complete and clarify the hypothesis about the absorption and transport mechanisms. We are currently attempting to identify one of these binding molecules. Basic research on the complexing substance and the description of the mechanism involved will undoubtedly result in the development of applications for soil depollution. Many investigations in the field of soil phytoremediation have shown that one of the main constraints to removing hydrophobic pollutants is their low bioavailability. Some authors use chelating agents to enhance the phytoextraction of heavy metals from the soil. It would be possible to use binding molecules produced by melon and zucchini to remediate sites contaminated by dioxins and perhaps other hydrophobic pollutants.

This research is being supported financially by an *FNRS* mandate (B.C.).

References:

Hülster A. and Marschner H. (1993). Chemosphere 27(1-3), 439-446.

Neumann G., Hülster A. and Marschner H. (1997). Rhizosphärenprozesse, umweltstress und ökosystemstabilität. M. W., 167-175.

Shiu W.Y., Doucette W., Gobas F., Andren A. and Mackay D. (1988). Environ. Sci. Technol. 22(6), 651-658.