EFFECTS OF CADMIUM ON THE ROOT GROWTH OF THE ELITE WHITE POPLAR CLONE ‘VILLAFRANCA’


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Cadmium is one of the most toxic heavy metal pollutants in nature. Extensive studies have been carried out to explain the cellular effects of Cd in animal cells both in vivo and in vitro whereas some aspects of its effect on plants are still under discussion (Lakimova et al., 2005; Vassilev et al., 2002). Poplars and willows have an high potential to clean-up sites contaminated by heavy metals (Vassilev et al., 2002). For this reason we transformed an elite white poplar clone ‘Villafranca’ with a gene (trx) encoding an artificial metallothionein to evaluate his tolerance to cadmium by in-vitro and in-vivo experimental trials. We tested several Cd concentrations and determined the Cd-content in roots, leaves and stems by ICP–MS. When the plants were grown in vitro, no statistically significant differences were observed between the root dry weight of the plants cultivated on medium treated with 180 µM Cadmium Sulfate and the root dry weight of the controls. The plants grown on 120 µM Cadmium sulfate showed, on average, a root dry weight significantly higher than the plants of the other treatments. The Cd-content was higher in the roots than in the leaves and stems for each treatment and the highest content of all was found at 120 µM. A significant increase of the dry weight of the roots at 120 µM Cadmium Sulfate had also been observed in a previous Cd-tolerance test on the P. alba clone ‘Villafranca’. At increasing Cd concentrations (0, 20, 50 and 100 ppm) no statistically significant differences were observed among the dry weight of the roots after six months of growth in pots containing soil enriched with cadmium nitrate. However for two of the lines tested, the dry root weight was higher at 50 and 100 ppm Cd. The Cd-content in roots increased significantly with the growing level of Cd.. The sub-cellular localization of cadmium, carried out using EELS connected to the TEM, on the root cells of a transgenic and a control line grown on 100 ppm Cd, showed the presence of Cd in the nucleus. No cellular apoptosis phenomenon was observed. Schützendübel et al. showed that a low concentration of Cd (5 µM) stimulates root growth in poplar but higher concentrations lead to a drastic reduction of root growth (Cosio et al., 2006) .At cellular level, Cd induces oxidative stress and apoptosis in both plant and animal cells ( Hamada et al., 1997; Lakimova et al., 2005). Hamada et al. demonstrated that apoptosis following Cd exposure in mammalian cells is associated with intracellular movement of Cd and metallothioneins. On the basis of our results we speculate about the role of metallothioneins in the mechanisms of Cd-tolerance in poplar roots. Further studies are currently in progress to investigate the role of metallothioneins in Cd translocation into the nucleus and Cd-induced dose-dependant apoptosis.