

Accumulation of trace elements in fast growing woody bioenergy crops

Werner Hentschel

Freiberg, Germany (werner.hentschel@student.tu-freiberg.de)

There is quite limited knowledge about Ge and Rare Earth Elements (REE) in the plant-soil-path in woody plant species. But since these elements occur widely dispersed in the earth crust with concentrations of several $\text{mg}\cdot\text{kg}^{-1}$ (Ge $1.6\text{ mg}\cdot\text{kg}^{-1}$, Nd $25\text{ mg}\cdot\text{kg}^{-1}$) phytomining could be promising approach as a tertiary use of bioenergy crops that uses plants to extract elements from soils via their roots. Thus we conducted research on the concentrations of strategic elements (with focus on Ge and REE) in wood and leaves of fast growing tree species (*Salix spec.*, *Populus spec.*, *Betula pendula*, *Alnus glutinosa*, *Fraxinus excelsior*, *Acer pseudoplatanus*).

In total 30 study sites were selected in the mining affected area around Freiberg (Saxony, Germany), differing in their species composition and degree of contamination with toxic trace metals (Pb, As, Cd). There are the same number of study sites which represent forestry agriculture (short rotation coppice) as sites with naturally grown groves.

On each site plant tissues (wood and leaves, respectively) of different species were sampled. In addition soil samples were taken from a soil depth of 0 - 30 cm.

Concentrations of elements in soil extracts and plant tissues were measured with ICP-MS in order to investigate for correlations between the amounts of the target elements in plant tissues and soil characteristics like pH, texture, nutrients and target element concentrations in six operationally defined soil fractions (mobile, acid soluble, oxidizable, amorphous oxides, crystalline oxides, residual or siliceous). The element Nd was selected as representative for the group of REEs, since this element showed a high correlation with the concentrations of the other REE.

We found that the concentration of Nd in the leaves ($0.31\text{ mg}\cdot\text{kg}^{-1}\text{Nd}$) were several times higher than in herbaceous species ($0.05\text{ mg}\cdot\text{kg}^{-1}\text{Nd}$). The concentration of Ge in leaves were fifteen times lower than that of Nd.

Considering the Nd concentrations in leaves *Fraxinus excelsior* ($0.10\text{ mg}\cdot\text{kg}^{-1}$) and *Betula pendula* ($0.06\text{ mg}\cdot\text{kg}^{-1}$) feature the lowest, while *Populus spec.* ($0.77\text{ mg}\cdot\text{kg}^{-1}$) and *Salix spec.* ($0.36\text{ mg}\cdot\text{kg}^{-1}$) showed by far the highest ones in a comparison between the different tree species.

We found significant correlations between the concentration of the target elements in the plant tissue and the concentration of these elements in the first steps of the sequential extraction of the soil samples.

Especially the fact that the concentrations of the target elements in the leaves are two to eight times higher than the concentrations in the wood should be noticed. This kept in mind, changes in the harvest management of short rotation coppices should be considered for phytomining with woody crops.

These studies have been carried out in the framework of the PhytoGerm project financed by the Federal Ministry of Education and Research, Germany.