

Short rotation coppice on metal contaminated land

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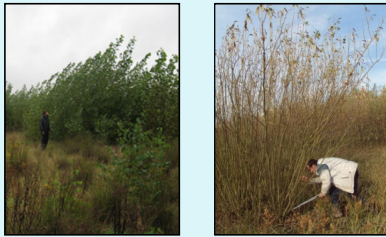
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Introduction

- Diffusely contaminated land is a problem all over Europe. Heavy metals in the soil render the land useless for agricultural practices since the crops will be contaminated too, making them unfit for food or feed purposes.
- The Campine region in North-Eastern Flanders is a textbook example of this issue. Due to historical contamination, an area of 700 km² in the Belgian and Dutch Campine region has a problematically elevated heavy metal content.
- Various efforts have been made to find an appropriate technique to remediate contaminated soil. Chemical and physical cleaning protocols have proven to be very invasive, sometimes leaving the soil infertile after treatment. These techniques are also very energy-demanding and expensive.
- Phytoremediation is a technique where plants are used to absorb the contaminants from the soil. When the above-ground biomass is harvested, the pollution is removed from the land with it. It is a non-energy-demanding process which keeps the soil structure and composition in good shape for agriculture.
- The drawback of phytoremediation is the long sanitation time. This problem can be overcome by valorization of the produced biomass through other channels than food and feed production to ensure an income for the farmer. Bio-energy production with energy crops is a promising strategy in this context.
- **The aim of this project is to investigate the potential of short rotation coppice as an energy crop grown on contaminated land.**

Short rotation coppice (SRC)

- Short rotation coppice entails the use of tree species (for example willow and poplar) for the production of woody biomass in growth cycles with harvest every 3-4 years.
- This wood can be used for papermaking, chipboard production, energy generation...



Experimental setup and results

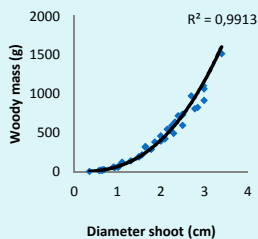
- A heavy metal contaminated test site in Lommel (Belgium) that contained mainly Cd and Zn was planted with 5 poplar clones and 8 willow clones.
- Total **biomass production** of the viable plants in the 6th growth year (2nd year after harvest) was estimated with four allometric scales, from which the best was chosen:

$$M = a \cdot D^b$$

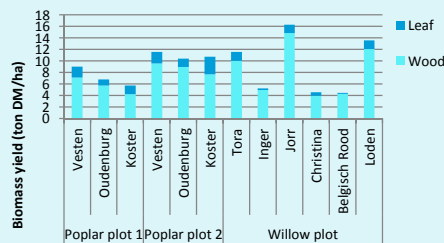
M is the woody biomass of the shoot

D is the diameter of the shoot at 20 cm height

a and b are specific coefficients

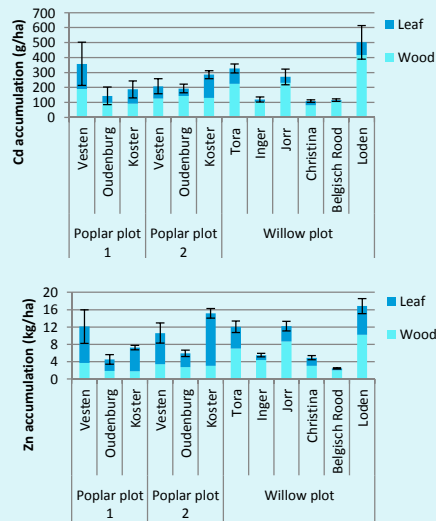


Example of allometric scale, fit to the datapoints



Estimation of biomass production of the different clones

- **Metal uptake** of the plants:

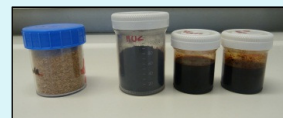


Metal accumulation of the different clones

- More metals accumulate in leaf as compared to wood biomass.
- Great variability between clones.
- Willow clone Jorr has the highest biomass yield.
- Based on biomass production and yearly metal accumulation, phytoremediation time can be estimated.
- Remediation of the soil with Jorr will be a side effect of energy crop production and will take 271 to 418 years.

Future perspectives

- The long phytoremediation time can be shortened by usage of **soil amendments**. Thoughtful use of these amendments is commanded since leaching of the metals can be an undesired side effect.
- The next step in this promising project is the investigation of the **valorization** possibilities of the contaminated wood.
- An example is **pyrolysis**. This is a process in which the biomass is heated in the absence of oxygen to produce char and bio-oils.



Wood, char, pyrolysis oils

Conclusions

- Short rotation coppice is suitable for growth on metal contaminated land with satisfying biomass production. Metal accumulation is relatively low, making the crop unsuitable for quick sanitation of the soil.
- Willow and poplar biomass can be valorized through several pathways. A good example is bio-energy production which can generate an income for the farmer, so that phytoremediation time is no longer a restricting factor.
- The strategy of **bio-energy production** out of **biomass on contaminated land** will tackle two problems at once, namely **constituting to a bio-based society** and **remediation of contaminated soils** as a long term effect.