Miscanthus cultivation and remediation potential on heavy metal contaminated soil in Poland

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1. Introduction

Arable soils contaminated with heavy metals have a negative influence on regional economies, by restricting sustainable agricultural development and the trade of goods [1]. Recognising the importance of management options for sustainable and safe use of heavy metal contaminated soils, investigations have looked at combining the production of energy crops on contaminated areas with phytoremediation of the soil. Whereas heavy metal contaminated soils are unsuitable for food production, dedicated energy crops can allow a sustainable commercial exploitation of these soils by establishing biomass feedstock production systems [2,3]. The challenge of the MISCOMAR project was to combine the remediation potential of seedbased *Miscanthus* hybrids with biomass production. Testing of different *Miscanthus* hybrids and the standard *Miscanthus* x *giganteus* as a control should give a clear indication if this energy crop could be used for phytoremediation of soils contaminated with heavy metals.

2. Experimental

Randomized experimental plots ($25m^2$) were established on arable land contaminated with heavy metals, due to the nearby smelting activities in the past. Before planting, soil samples were taken to determine basic soil parameters, including total (*aqua regia*) and bioavailable ($CaCl_2$ extraction) lead, cadmium and zinc concentration. Each genotype was tested in three replicates at a plant density of 2 plants per m^2 (50 plants per plot). After each of the growing seasons plant material was sampled during autumn (in October, green harvest) and winter (in March, brown harvest) to determine among others biomass yield and differences in heavy metal uptake.

3. Results and Discussion

Total soil heavy metals concentration exceed the maximum threshold values described by Polish government regulations, excluding this area from food production. Field test results over three years on *Miscanthus* biomass production showed that yield potential of seed-based hybrids was often comparable to the highly productive *Miscanthus* x *giganteus*, with next generation hybrids giving high yields in both green (autumn) and brown (spring) harvests. *Miscanthus* seed-based hybrids and standard *M.* x *giganteus* showed heavy metal phytostabilisation potential due to low uptakes of lead, cadmium and zinc to aboveground biomass resulting in low bioaccumulation. Moreover, a lower content of heavy metals was found in all seed-based *Miscanthus* hybrids in comparison to the standard clone.

4. Conclusions

Cultivation of energy crops in heavy metal contaminated soil may provide an opportunity for site restoration and contribute to development of biobased value chains for energy and material supply. It is crucial to select the correct hybrids which are able both to survive in the contaminated environment as well as climatic conditions.

5. References

[1] G. Tóth et al., *Environ Int*, 88, (2016) pp. 299-309.
[2] M. Pogrzeba et al., *Int J Phytoremediation*, 20, (2018) pp. 1194-1204.
[3] A. Mahar et al., *Ecotox Environ Safe*, 126, (2016) pp. 111-121.

Additional information

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