Using *Salix* spp. in phytostabilization of metal pollution in soils : an example of phytoremediation appropriate to the brownfields of Wallonia

Aricia Evlard[1], Philippe Druart[2], Gilles Colinet[1]

[1]University of Liege – Gembloux Agro-Bio Tech – "Soil & Water Systems " Unit
Passage des Déportés, 2. B-5030 Gembloux - Aricia.Evlard@ulg.ac.be
[2]Centre wallon de Recherches Agronomiques, Bioingeneering Unit

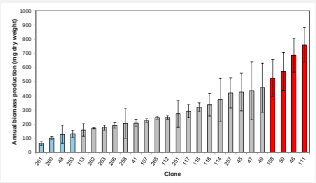
1 WHAT DO WE WANT TO KNOW ? The metal tolerance of *Salix* spp. clones originating from Wallonia (Belgium)*



Rooted cuttings of 26 *Salix* clones, originating from different areas in Wallonia (Belgium), were planted outdoor in 10 L containers filled with **metal-contaminated dredging sludge from March to September 2010.**

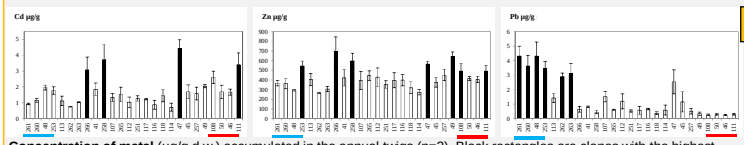
2 WHAT DID WE DO ?*

➢ Biomass measurement



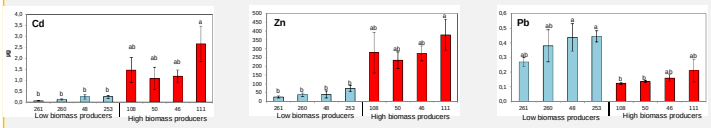
Annual twig biomass production mean of the clones (n=3) in mg d.w. Bars represent standard error of mean. The low and high biomass producers were selected following Gupta's multiple mean comparison results.

➢ Metal concentrations in the annual twigs



Concentration of metal (µg/g d.w.) accumulated in the annual twigs (n=3). Black rectangles are clones with the highest metal concentration (Gupta's multiple mean comparison). Bars represent standard error of mean.

What happens when we compare metal extraction between high and low biomass producers ?



Total amount of metal (µg) accumulated in the annual twigs of the low and high biomass producers (n=3). Letters represent the Tukey test results to compare clones. Means that do not share a letter are significantly different. Bars represent standard error of mean.

What about their health ? Are the biomass producers more tolerant than the low ones ?

To answer these questions we used **complementary physiological measurements i.e.**
✔ **Carbohydrate concentrations** ✔ **Chlorophyll fluorescence** ✔ **Proteins accumulation (2D-Dige)**

3 WHAT DO WE KNOW ?

- These clones have an ability to grow in presence of metals. This reflects a **metal tolerance**
- Biomass production **varies among the clones** in presence of metals
- We distinguish **2 groups** : **Low biomass producers group** / **High biomass producers group**

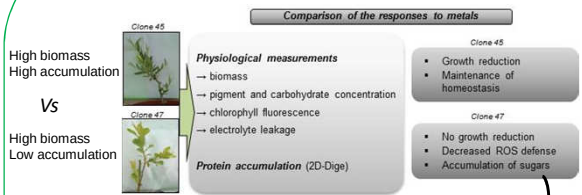
- Metal concentrations don't follow the biomass production
- 1 **High biomass ≠ High metal concentration**
- The **highest [Pb] are found in the low biomass producers**
- **Focus on the interesting clone 47 : a complementary experiment.** See box 4

- 2 **Elevated biomass production can increase** the total Cd, Zn, Ni and Mn **uptake** by plants although the metal concentrations in the annual twigs remain low. This is explained as an effect of **dilution**.
- On the **opposite**, **Pb concentration** in twig tissues is so high in the **low biomass producers** that the effect of dilution is not seen and the **uptake** of this metal **remains high**
- 3 **High biomass ≠ High metal uptake**

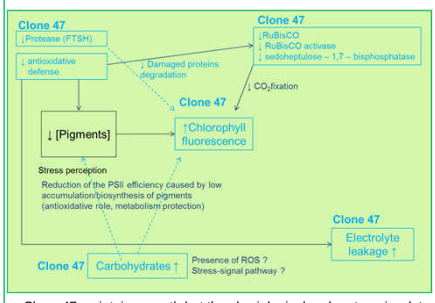
- The light absorbed by the PSII is **equally efficient used in the photochemistry** between the two groups and so, they have a same photochemical capacity of PSII.
- The **leaf carbohydrate** content **does not differ significantly** between the two groups.
- Induction of **antioxidative defense proteins** in the both groups
- 4 **The low biomass producers could be able to cope with stress due to Pb which, as a result, reduced their growth**.

4 FOCUS ON THE CLONE 47*

Do high biomass and high accumulation mean a better tolerance ?



GLOBAL VIEW OF THE RESULTS



5
- Clone 47 maintains growth but the physiological and proteomics data suggests that this can only be done at the cost of cellular deregulation.
- Growth reduction and proteomic changes in clone 45 indicate that this clone adjusts its metabolism to maintain cellular homeostasis. **Growth reduction = tolerance strategy**

What about its use in phytoremediation ?

High biomass is not always linked with a good tolerance strategy.
In a long-term study, the survival of the clone 47 might be compromised making it a poorer candidate for phytoremediation efforts.

*These works have been conducted in association with EVA-CRP Gabriel Lippmann (Luxembourg)

INPUTS

into our KNOWLEDGE to APPLY *in situ* the techniques of phytoremediation




Phytoremediation field trial in Wallonia with the previously studied local clones of *Salix* spp.

WHAT DO WE THINK ? We make the hypothesis that these *Salix* clones are more appropriate in phytostabilization than phytoextraction