THE USE OF BIO-ENERGY CROPS FOR PHYTOREMEDIATION OF METAL ENRICHED SOILS IN THE CAMPINE REGION

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Heavy metal contamination

• 19th century-mid 1970
  – Zn and Pb refineries in “the Campine” (Kempen)
  – Pyrometallurgical process

• Through the years
  – Atmospheric deposition
  – Enrichment of trace elements in top soil layer

• Now
  – 700 km² (BE + NL), 280 km² (BE)
  – Cd, Zn and Pb contamination
Heavy metal contamination

• Soil characteristics in the Campine
  – Sandy
  – Acidic
  → High availability of trace elements

• Consequences
  – Accumulation of metals in crops
  – Exceeding legal threshold values of food and fodder crops
  → Action is needed
Methods for sanitation

• Conventional methods
  – Expensive
  – Not feasible on a large scale

• Phytoremediation
  – Sustainable
  – Feasible on a large scale
Phytoremediation is a technique that involves the use of plants for the removal of pollutants from the environment or to render them harmless (Garbisu & Alkorta, 2001)
Phytoremediation: which plants?

• Hyperaccumulating plants
  – High concentration
  – Low biomass
  → Good extraction

• New approach: annual or perennial plants
  – Lower concentration
  – High biomass
  → Also good extraction!
  – Use in non-food
    • Energy
    • Fibre
    • Paper
Experimental site
Results: Energy maize (1)

- **Biomass**
  - $20 \pm 3$ ton DM
  - No great differences between cultivars
  - No great differences with maize on non-contaminated soils
Results:
Energy maize (2)

- Extraction
  - $18 \pm 3 \text{ g Cd ha}^{-1}$
  - No significant differences between cultivars
  - Long remediation period
    2 to 1.2 mg Cd kg$^{-1}$ dry soil $\sim \pm 200$ years
Short Rotation Coppice

- Cyclic yielding of woody biomass
  Period: 2-3-4 to max. 8 years
- High biomass producing species
- Mainly willow or poplar
• After 2 years of growth
  – Willow
    • Zwarte Driebast, Loden, Belders high biomass
    • Loden and Zwarte Driebast high extraction
  – Poplar
    • Grimminge and Koster high biomass
    • Grimminge and Koster high extraction
Results: Short Rotation Coppice (2)

- Extraction
  - Removal of the leaves can shorten extraction period with ± 45 %
  - Remediation is shorter than with energy maize
  - Calculation
    - Assume biomass 6 ton DM ha\(^{-1}\) per year
    - Cd concentration of shoots 25 mg kg\(^{-1}\) DM
    - 2 to 1.2 mg kg\(^{-1}\) dry soil ~± 25 years, only shoots
Conclusions: Energy maize

- Long remediation period
- Good productivity
- Low concentration of metals in plant material

Considered for use in non-food industry
  - Batch test for anaerobic digestion
    No influence of heavy metals on biogas potential
  - Continuous test for anaerobic digestion
    Possible influence of heavy metals on biogas potential?
    Metals in digestate?
Conclusions: Short Rotation Coppice

• Very promising
  – Good extraction potential

• Real conclusions after further research of
  – Full rotation
  – Re-growth
  – Harvest period
  – Treatment of biomass

• To be continued…
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Thank you for your attention