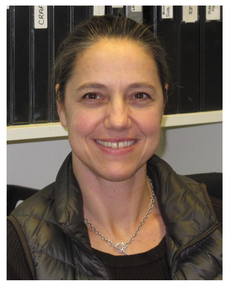
Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada



Method for screening Cu, Zn, or Pb phytotoxicity on switchgrass and reed canarygrass

Annie Claessens*, François Langevin, Isabelle Royer, Athyna Cambouris, Denis Angers, and Noura Ziadi

Agriculture and Agri-Food Canada, Québec, QC

*Annie.Claessens@agr.gc.ca

Introduction

- In Canada, there is a large number of trace metal (TM) contaminated sites, which cannot be used for human or animal food production (Government of Canada, 2011).
- Selection of species or cultivars with low capacity to accumulate TM has been identified as a strategy to develop cropping systems on contaminated soils (Tang et al., 2012).
- Switchgrass (*Panicum virgatum* L.) and reed canarygrass (*Phalaris arundinacea* L.) are increasingly studied as energy crops in eastern Canada and many studies have reported that both species have the capacity to establish and grow on contaminated soils (Evanylo et al. 2005; Gleeson 2007; Chen et al. 2011).

The objective was to develop a new screening method to identify more tolerant TM genotypes in switchgrass and reed canarygrass.

Materials & methods

Plant material

- ✓ 5 switchgrass cv.: Alamo, Cave-in-Rock, Kanlow, Summer, and Sunburst
- ✓ 2 reed canarygrass cv.: Bellevue and Venture
- ✓ 512 plants per cultivar were seeded in multi-cells under 16 h photoperiod and 25/22°C Day/Night temperature in April 2016
- ✓ After 4-wk, 198 plants (6 plants/cv./rep) were selected based on their vigor uniformity and transplanted in a sandy mix substrate spiked with either Cu, Zn, or Pb
- ✓ After 8-wk, each plant was harvested and shoot dry matter (DM) yield was determined

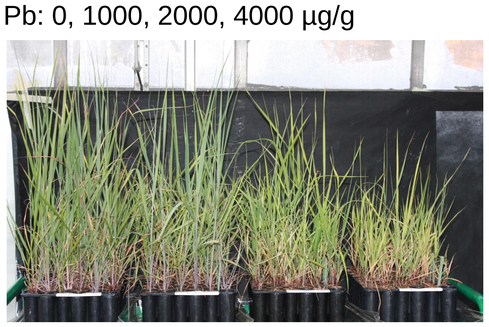
Experimental design

- ✓ Completely randomized design with 3 replicates:
  - 3 trace metals added as: $CuSO_4$, $ZnSO_4$, $Pb(NO_3)_2$
  - 4 TM concentrations (adjusted pH ≈ 6.8)

    Cu: 0, 150, 275, 525 µg/g

    Zn: 0, 300, 550, 1050 µg/g

    Pb: 0, 1000, 2000, 4000 µg/g



A multiple regression analysis was performed to determine for each TM and species the concentration at which plant growth is reduced by 50% (LD50).

Results & Discussion

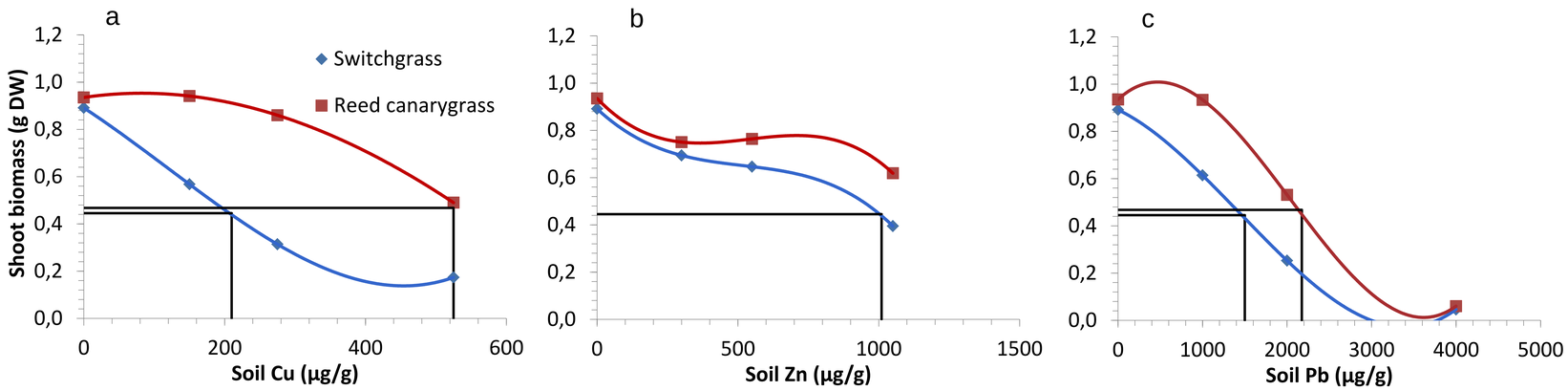


Figure 1. Shoot biomass for switchgrass and reed canarygrass after 56 days of growth in substrate spiked with Cu (a), Zn (b), or Pb (c).

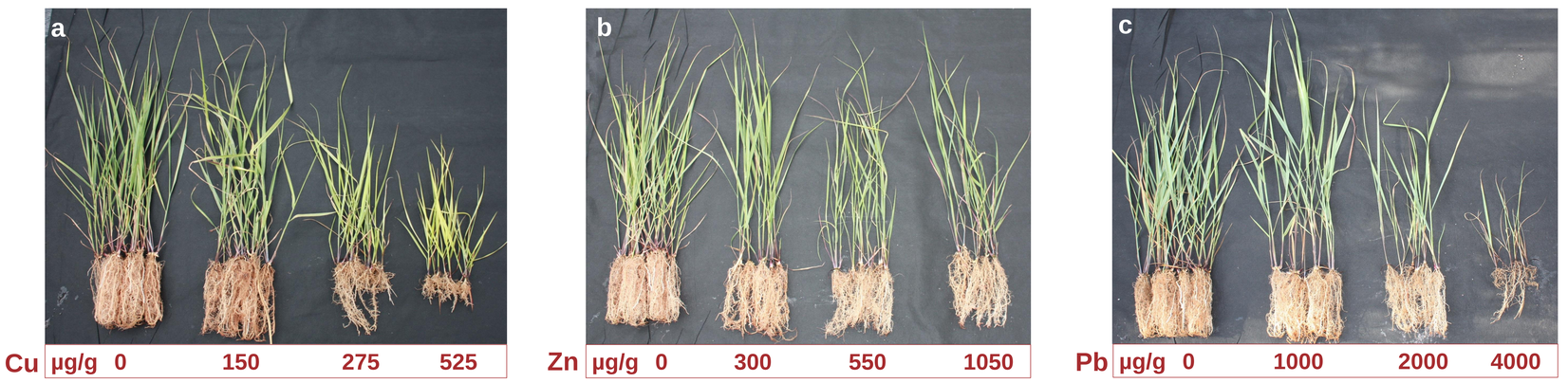


Figure 2. Shoot and root biomass of switchgrass cv. Cave-in-Rock plants after 56 days of growth in substrate spiked with Cu (a), Zn (b), or Pb (c).

- ✓ For switchgrass, the biomass was reduced by 50% when 210 µg of Cu, 1010 µg of Zn, or 1500 µg of Pb was added to the substrate.
- ✓ For reed canarygrass, the biomass was reduced by 50% when 525 µg of Cu, >1050 µg of Zn, or 2175 µg of Pb was added to the substrate.
- ✓ Based on these results reed canarygrass seems to be more tolerant to TM contamination at the early stage of development than switchgrass.

Conclusions

These LD50 will be particularly useful to identify more tolerant TM genotypes within switchgrass and reed canarygrass breeding material. This is required to develop breeding populations and to accelerate the development of cultivars adapted to sites with contaminated soils.

References

- Chen et al. 2011. Ecotox. 20:409-418.
- Evanylo et al. 2005. J. Environ. Qual. 34: 1811-1819.
- Gleeson 2007. M.S. thesis. Queen's University, Kingston, Ontario, Canada.
- Gouvernement du Canada 2011. http://www.tbs-sct.gc.ca/fcsi-rscf/home-accueil-fra.aspx
- Tang et al. 2012. Pedosphere. 22: 470-488.

Acknowledgements

This research was funded by the Science and Technology Branch of Agriculture and Agri-Food Canada

Canada