Introduction

Tropical forages (i.e., plants used to feed animals, mostly cattle) can lead to a more sustainable land management. Currently, the Alliance of Bioversity-Center for Tropical Agriculture, as part of the GROW Colombia project, is researching two aspects that have been somehow neglected in Colombia:

1) the ability to reclaim cadmium polluted land by the use of tropical grasses and;
2) the inclusion of multispecies pastures as a way to increase their resiliency under uncertainties such as the ones originated by the current climatic emergency.

This work is mostly performed from an eco-physiological point of view and aims to gather data from experiments under semi-controlled (greenhouse) and field conditions.

Objective

Cadmium phytoextraction potential

- To identify tropical grasses able to tolerate and uptake Cadmium.
- Test methods to extract cadmium from plant tissue that might allow the use of such tissue for another purposes (e.g., feed for animals, biofuel).

Multispecies pastures

- Testing whether there are synergies of trade-offs (e.g., productivity and tolerance to abiotic stress) in mixing different grasses and legumes.
- Test the effect of multispecies pastures on soil health (e.g., soil organic matter, soil aggregates, soil friability).

Methodology

Cadmium phytoextraction potential

1. Hydroponic solution culture experiments with 100 ppm Cadmium added (to mimic Cadmium polluted soils).
2. Harvesting of plants (fractioning of leaves, stems and roots) after 20 days of growth under solutions of or without added Cadmium.
3. Analyses of biomass accumulation under different treatments, Cadmium content in tissues and other relevant physiological responses (e.g., chlorophyll content, stomatal conductance, root elongation rates).

Multispecies pastures

1. Greenhouse experiments: Short term experiments (~3 weeks). Different species are mixed to test if their responses under a particular stress are affected (e.g., mixing Brachiaria humidicola—tolerant to waterlogging—and Brachiaria hybrid Mulato II—sensitive to waterlogging—). 2. Field experiment: Longer term experiment recently established (November, 2019) where productivity and other parameters (e.g., protein content and fibers) will be recorded over time.

Results

Cadmium phytoextraction potential

- Two plants with contrasting type of growth were tested (B. humidicola, creeping plant; Napier grass, erect one)

- After 60 days of growth under high Cadmium (100 ppm). Napier grass phyto-extracted up to 73 ppm, whereas B. humidicola less than 40 ppm.

- Albeit Cadmium extracted was two fold greater in Napier grass, root elongation was less inhibited in Napier grass.

- Evapotranspiration (the driver of most Cadmium uptake) was not affected as much in Napier grass.

Multispecies pastures

Greenhouse experiment

• Mulato II (sensitive to waterlogging) benefits from growing together to B. humidicola (tolerant).

Field experiment

• Multispecies (grasses + legumes) trial established where drought and waterlogging stress can be managed

• Images collected with drones are used to record changes over time

• Deep learning and object based segmentation are used for analyses

Conclusions

Our preliminaries results show that:

- Among a number of grasses tested (Brachiaria spp., Megathyrsus maximus, Napier grass), the latter one can extract significant amounts of Cadmium, to the level of a hyper-accumulator plant.
- Greenhouse studies have shown that mixing species have great potential to increase tolerance to abiotic stresses (e.g., waterlogging).
- Research is underway to test responses of a number of grasses for Cadmium phytoextraction and mixtures of species under soil and field conditions respectively.

We expect that information originated from this project will increase awareness of the roles and utilities of tropical forages can brought up at farm, catchment and landscape levels, and can also further enrich their multifunctional use in Colombia and elsewhere.

References