Characterization of Root Exudates From Crested Wheatgrass (Agropyron cristatum)

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Characterization of root exudates from crested wheatgrass (Agropyron cristatum)
Exudates are important to phytoremediation

- Co-metabolism
- Increased plant uptake
- Altered soil mobility
Objectives

1. Develop cultural system to grow healthy plants
2. Develop procedures for aseptic culture of:
   a. Seeds
   b. Plants
3. Develop procedures to manipulate exudation with: \( \text{K}^+, \text{NH}_4^+, \text{O}_2, \text{H}_2\text{O} \)
4. Develop procedures to quantify exudates
   a. TOC
   b. GC-MS, HPLC, ion chromatography
Plant Growth Containers

- sterile nutrient solution
- septum
- side-arm
- fine
- Ottawa sand
- coarse
- silicone stoppers
- glass wool wick
- amber collection vial
- amber collection vial
Growing healthy plants: Materials and Methods

• **Nutrient solution:** standard hydroponic solution, no chelate

• **Growth medium:** Ottawa sand

• **Photoperiod:** 16 hours
Techniques for sterilizing seeds

20% Clorox for 60 minutes

Rinse and plate on media for 3-5 days
Assessing microbial contamination in the columns
Days Since Planting

% Sterile Plants

In growth chamber
Plants are now grown in a laminar flow hood.
Increasing Exudation

- Changing NH$_4^+$:NO$_3^-$ ratio
- K$^+$ stress: 5 $\rightarrow$ 1 mM K$^+$
- Drought stress
- Hypoxia: flooding
Quantifying exudates: Total Organic Carbon

TOC in Leachate (ppm)

- Unplanted (n = 3)
- Small (n = 4)
- Medium (n = 8)
- Large (n = 9)
Carbon (µg) detected per 0.3 g glass wool

- Unwashed glass wool
- Washing
- Unwashed silanized glass wool
- Washing
- Washed glass wool
- Washed silanized glass wool
Quantifying exudates: GC-MS, HPLC, ion chromatography

- Organic acids
- Amino Acids
- Sugars
- Phenolics
- Enzymes
- Flavonoids
- Vitamins
Scaling to the field: Quantifying exudates in terms of growth rate
Transpiration Data ➔ Growth Rate

Relative growth rate

$y = 0.053e^{0.077x}$
RGR

\[ \mu g \text{ C exuded} \times g \text{ new growth}^{-1} \text{ day}^{-1} \]

Root: shoot

\[ \mu g \text{ C exuded} \times g \text{ new root growth}^{-1} \text{ day}^{-1} \]
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