



Hydroponics Study

Sulfolane Uptake by Plants

Deanna Cottrell
Water and Sulfolane SME

Dr. Paul Westlund
Water Specialist

Scott Wilde
Shell Superintendent

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Agenda

1. Introduction

2. Experimental Design

4. Result Summary

5. Path forward – Phase II

Purpose of Study

- Study the degree of Sulfolane uptake in hydrophylic plants found at impacted sites.
- Determine which species have fastest up-taking rate, observe any trends over time and compare the results.



Objectives

1. Phase I

Phase II (b)



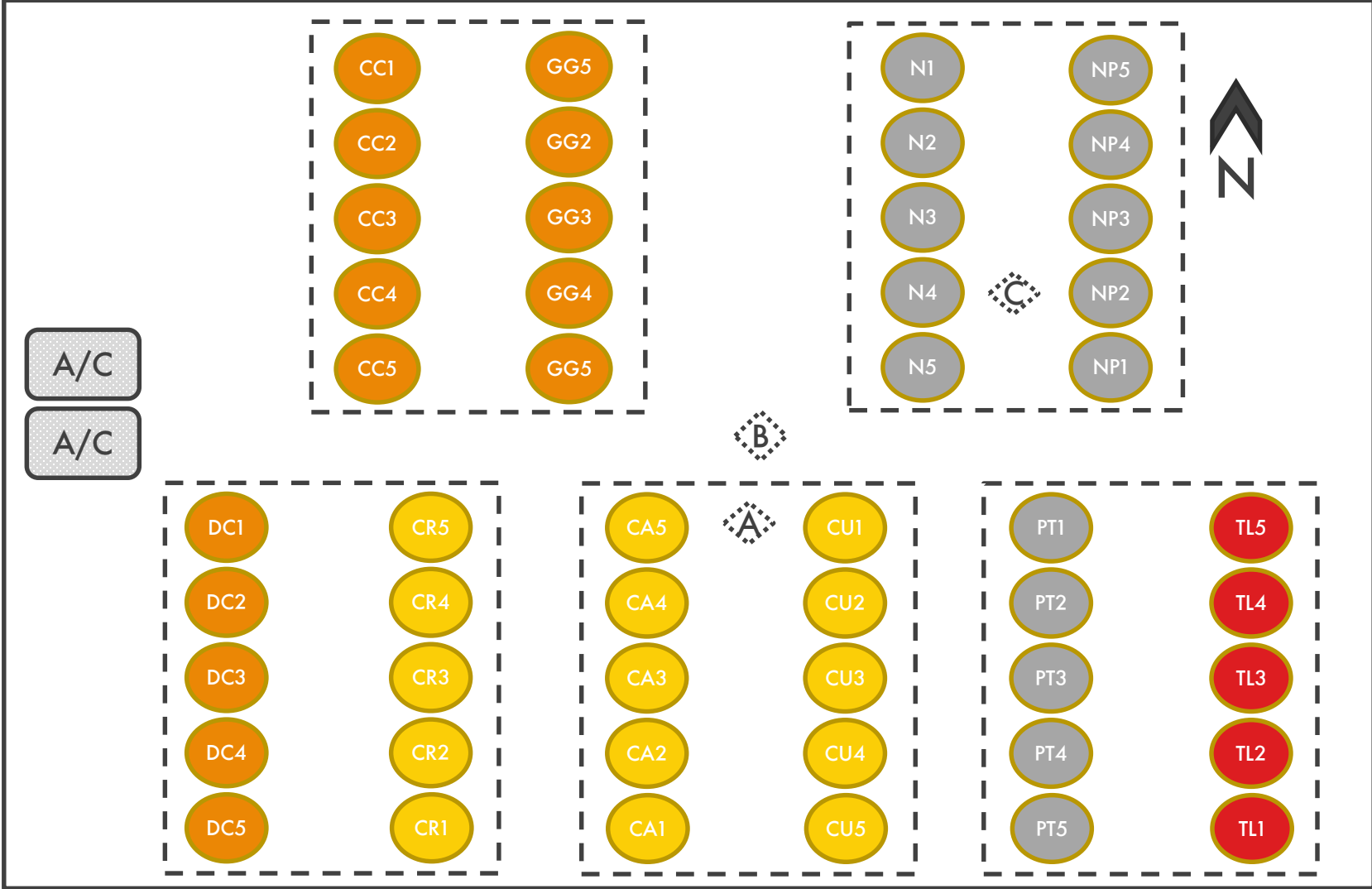
Phase II (a)








Considerations and Experimental Design – Phase I

- Water loss through evaporation
- Soil media interference
- Influence of nutrients
- Influence of bacteria
- Influence of Sulfolane density
- Impact to plant overall health



Greenhouse Set-Up



-  sedges
-  grasses
-  cattails
-  controls
-  Temperature and humidity gauge
-  Argus temperature and humidity sensor
-  Argus temperature and humidity sensor

Sedges – *Carex Utriculata* (CU)



Day 0
19 L



Day 14
15.2 L



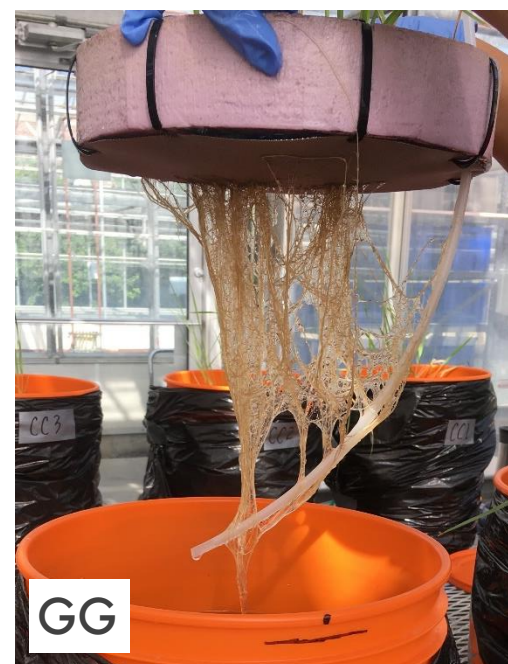
Day 21
14.6 L



Day 26
13.2 L



Day 35
11.3 L remaining

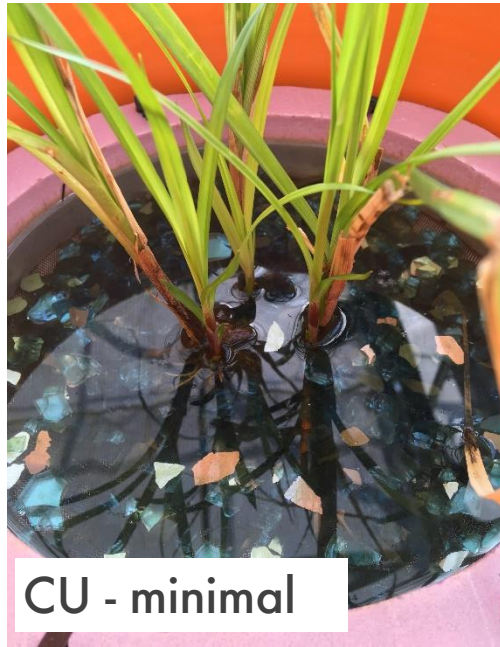


Root growth after 3 weeks

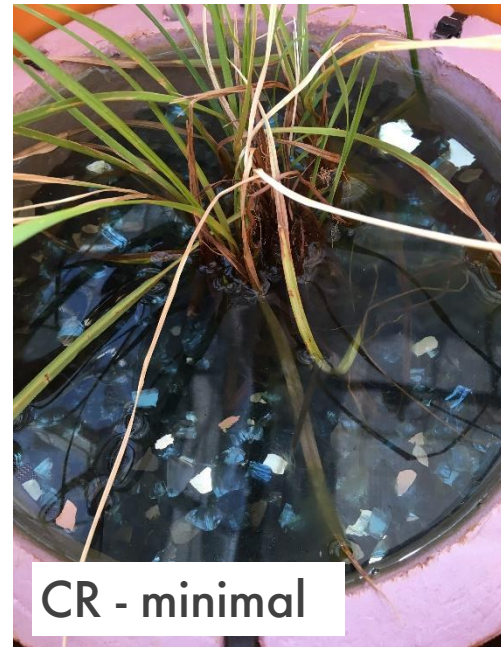
- Grasses have more extensive root network



CA - most



CU - minimal



CR - minimal



DC - some



GG - minimal



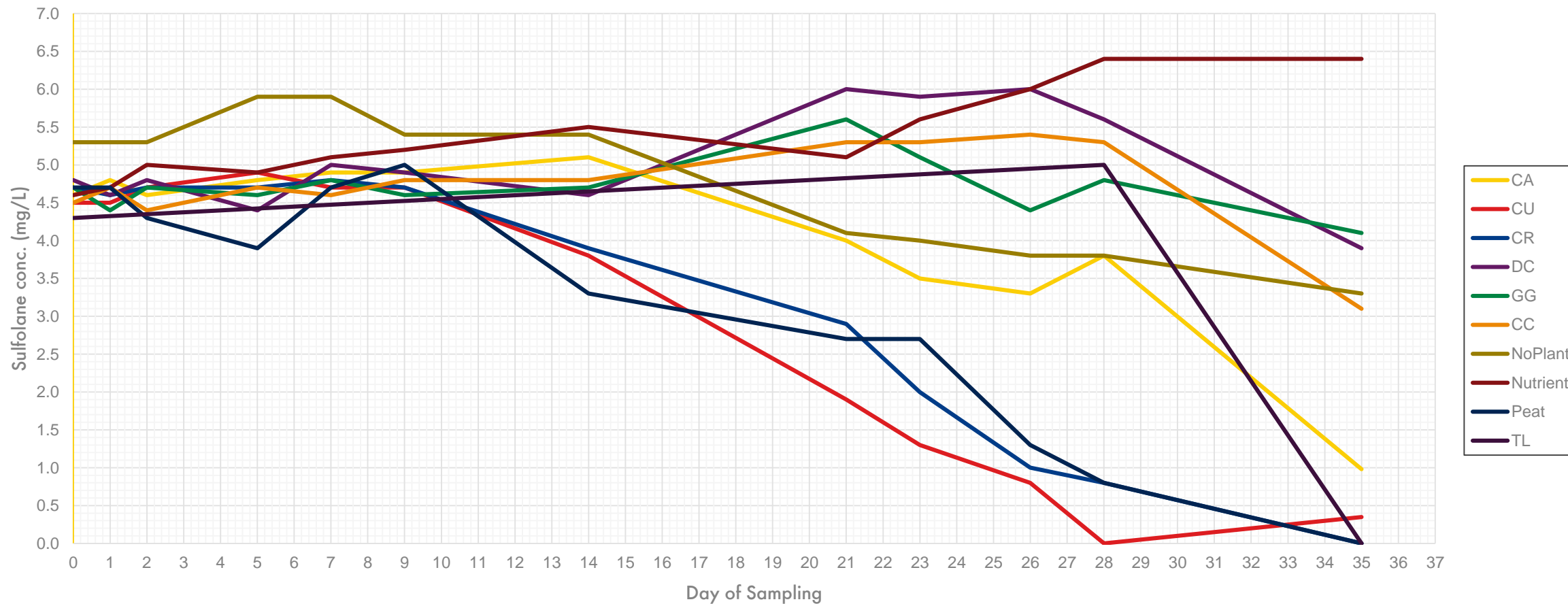
CC - some

Algae growth after 3 weeks

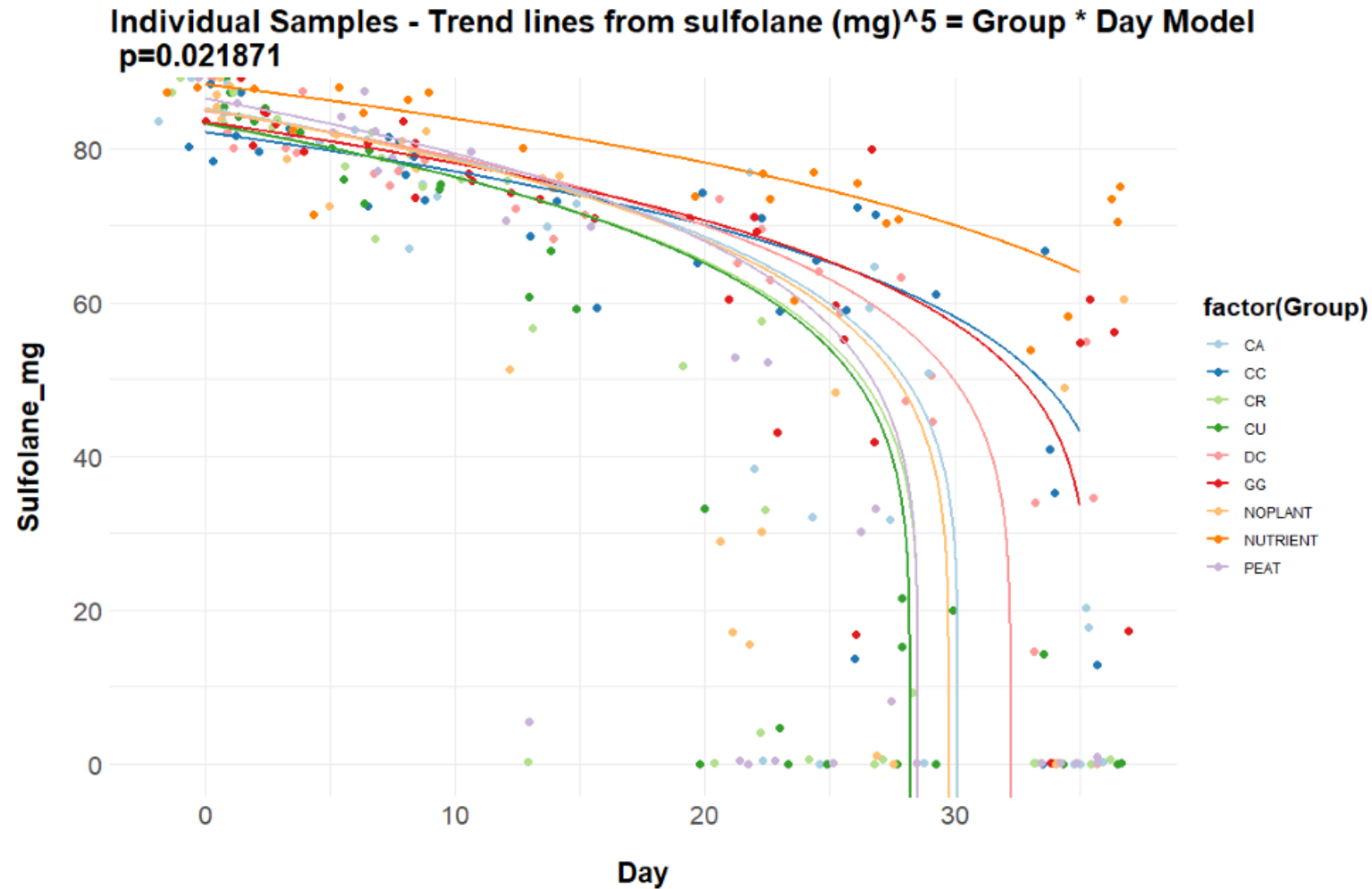
- Presence of algal blooms; may be an indication of excess nutrients.
- CA have the most algae; cloudiest water.
- Some algae in CC, CR, and DC.
- Minimal algae in CU and GG.

Result Summary – Composite Samples

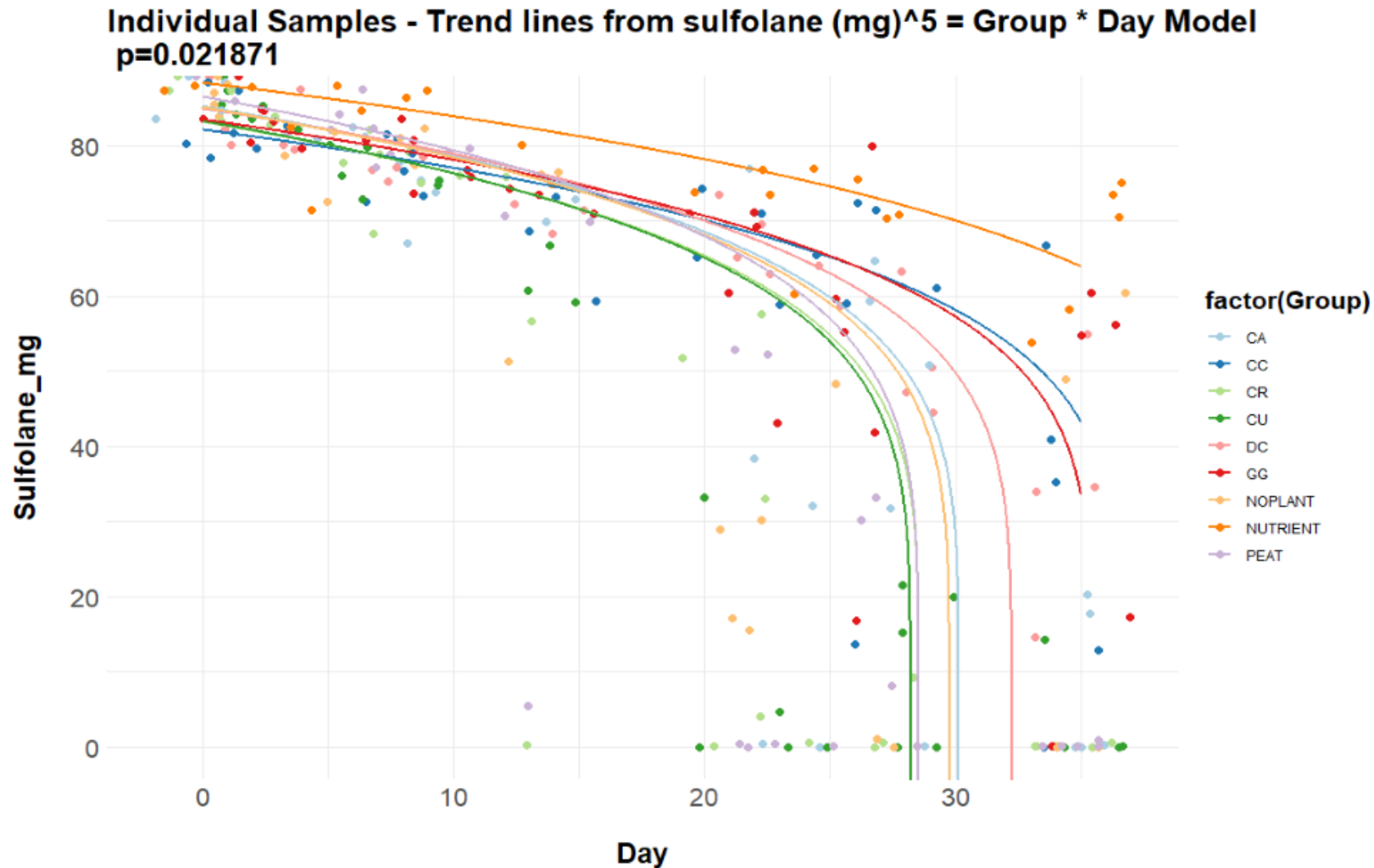
Sulfolane Concentrations of the different Vessel Types



Result Summary – Phase I



Result Summary



Next Steps:

- Use larger, more mature plants and repeat
- Add Sulfolane continuously
- Evaluate secondary reaction not related to plants
- Evaluate nutrient solution limitations

Sidebar – Secondary Reaction Microbial?

Table 3: Survey of common microbial community members amongst samples tested

Potential Sulfolane Degradere	DC Comp	Nutrient Comp	CA Comp	CU Comp	No Plant Comp	Peat Comp	DC Root	CA Root	CU Root
<i>Rhodoferax</i>							X		X
<i>Pseudomonas</i>	X	X	X	X	X	X			
<i>Variovorax</i>							X		
<i>Shinella</i>									
* <i>Acidovorax</i>	X		X	X		X			
* <i>Novosphingobium</i>	X		X	X	X		X		X
* <i>Azospirillum</i>	X		X			X		X	

“X” indicates presence of bacteria in sample

*Not known sulfolane degraders, but frequently detected in this study

Considerations and Experimental Design – Phase II (a)

- Extraction Technique
- Matrix interference
- Absorption potential
- Adsorption potential
- Influence of Sulfolane density
- Transpiration required?

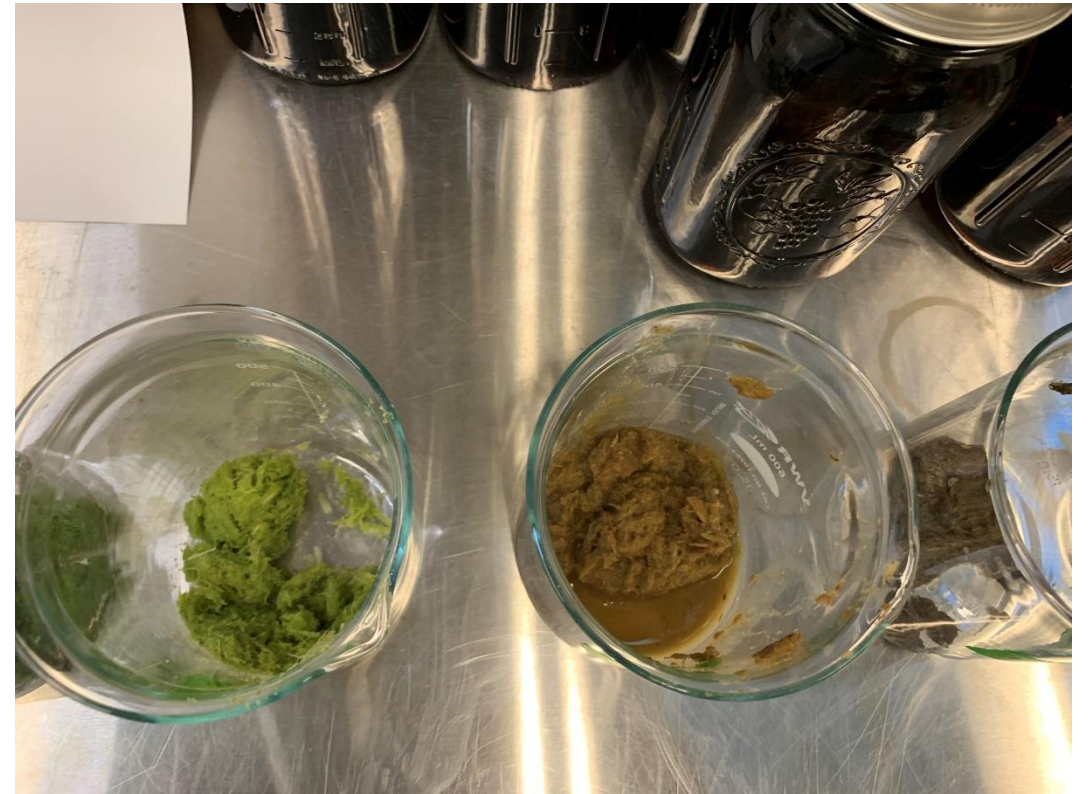


Result Summary – Phase II (a) - Sulfolane recovery from ground plant tissue

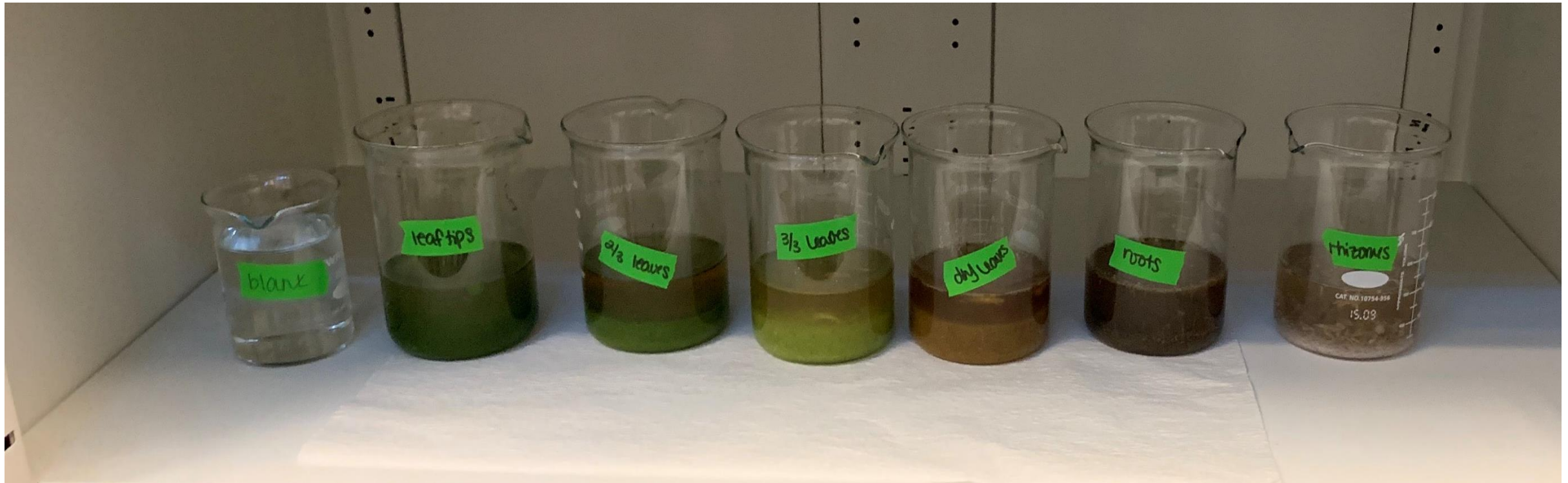
- Healthy plants weighed + measured pre exposure



- Extraction trial: plant tissue separated and ground

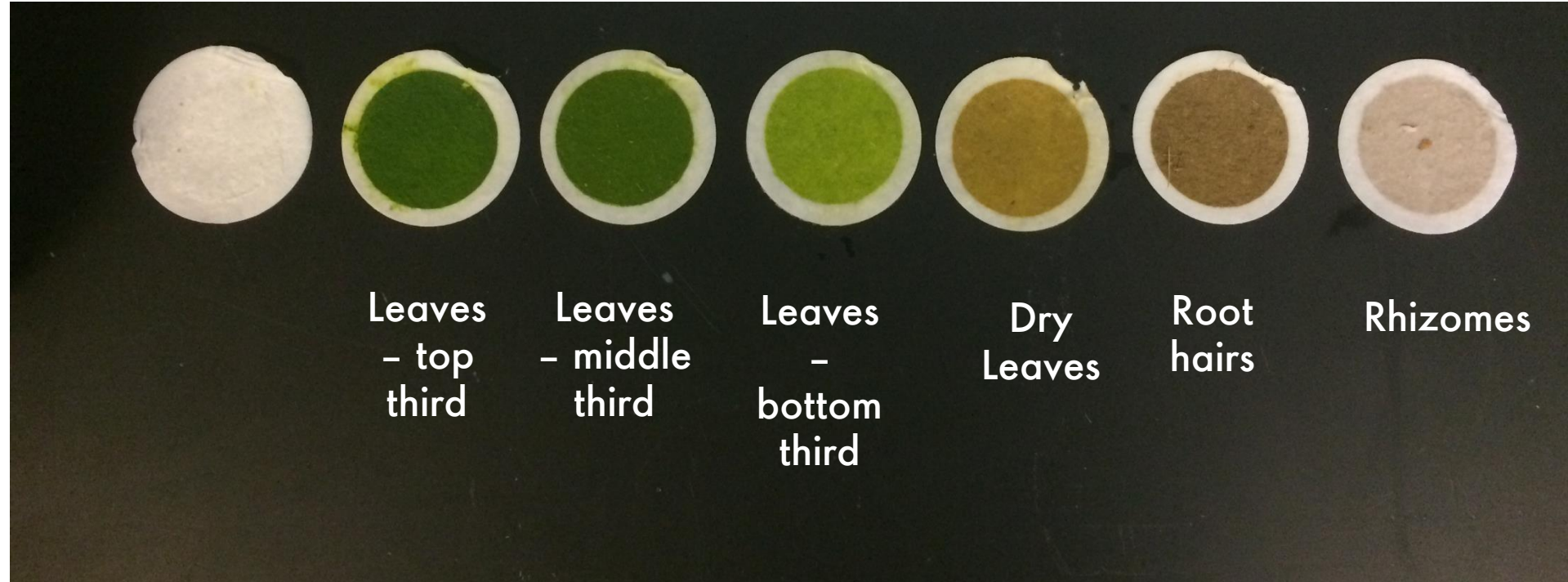


Result Summary – Phase II (a) cont'd



■ Plant tissue exposed to Sulfolane

Result Summary – Phase II (a) cont'd



- Filter cake after initial sulfolane exposure (on 0.7 μm filter paper)

Experimental Design – Phase II (a)

- Cattails (TL) grown in rain water spiked with Sulfolane.
- Presence or absence of Sulfolane in plant tissue.

Experimental Design – Phase II (b)

- Quantification of the detected Sulfolane in plant tissue.
- Mass balance of the hydroponic system.
- Estimation of the recovery efficiency of the extraction procedure.



Questions and Answers

Q&A

