

FIELD-SCALE RESEARCH TRIAL TO DEMONSTRATE *EX SITU* REMEDIATION OF BROMACIL IN SOIL



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INNOTECH ALBERTA

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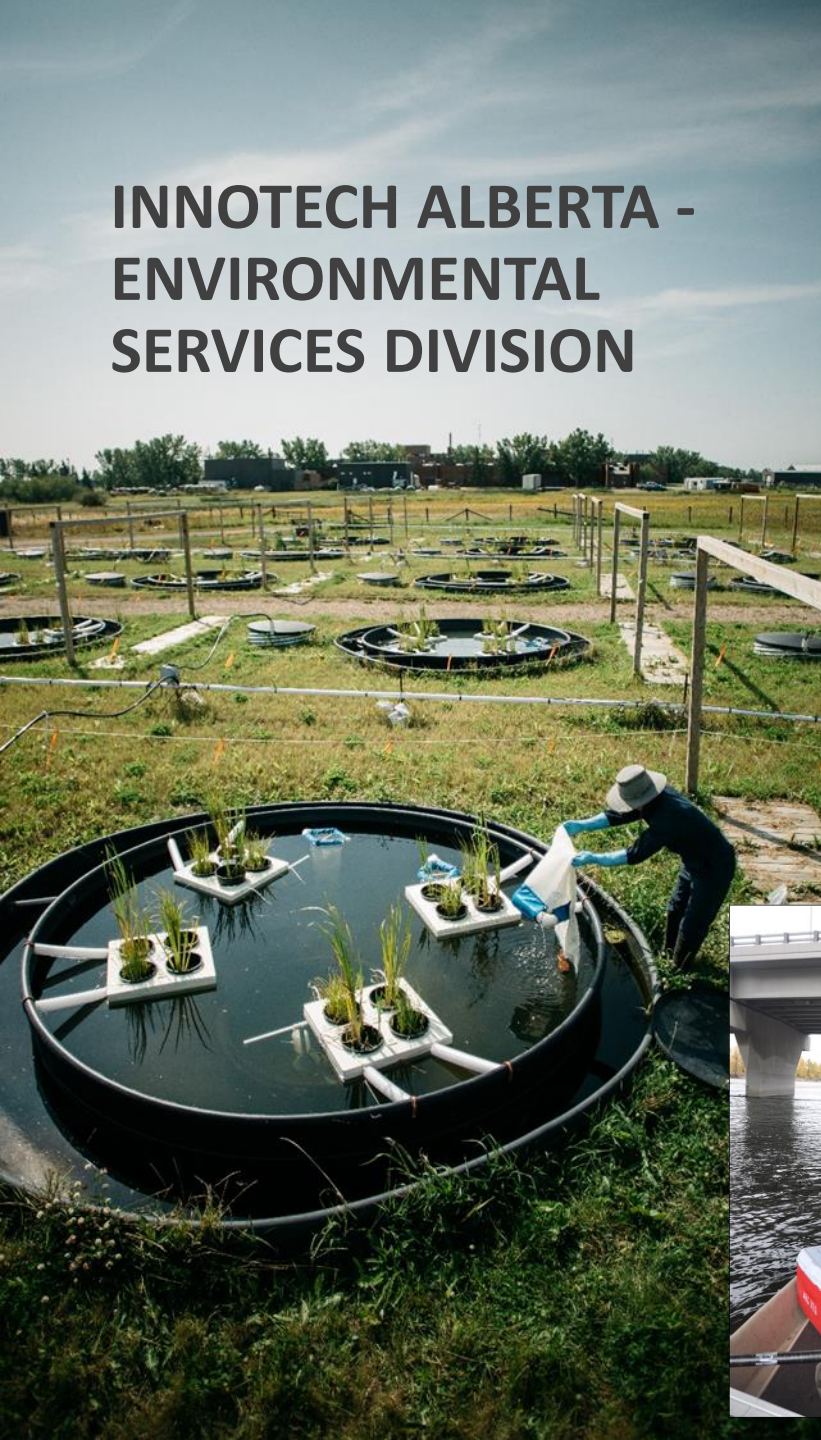


INNOTECH ALBERTA - ENVIRONMENTAL SERVICES DIVISION

Environmental Impacts



- Contaminant fate and behavior in the environment – microcosms (anaerobic and aerobic conditions), bench scale columns, above and below ground mesocosms, field investigations
- Water resource investigations and impact assessments using isotopic tracers
- De-risking technologies and processes



OUTLINE

- Soil sterilant sources and impacts
- Soil Sterilants Program (SSP) – overview and objectives
- Remediation approach:
 - Bench-scale: Validation and optimization
 - Field/meso-scale: Testing under field conditions
- Assessment of labile sterilant fraction

WHAT ARE SOIL STERILANTS?



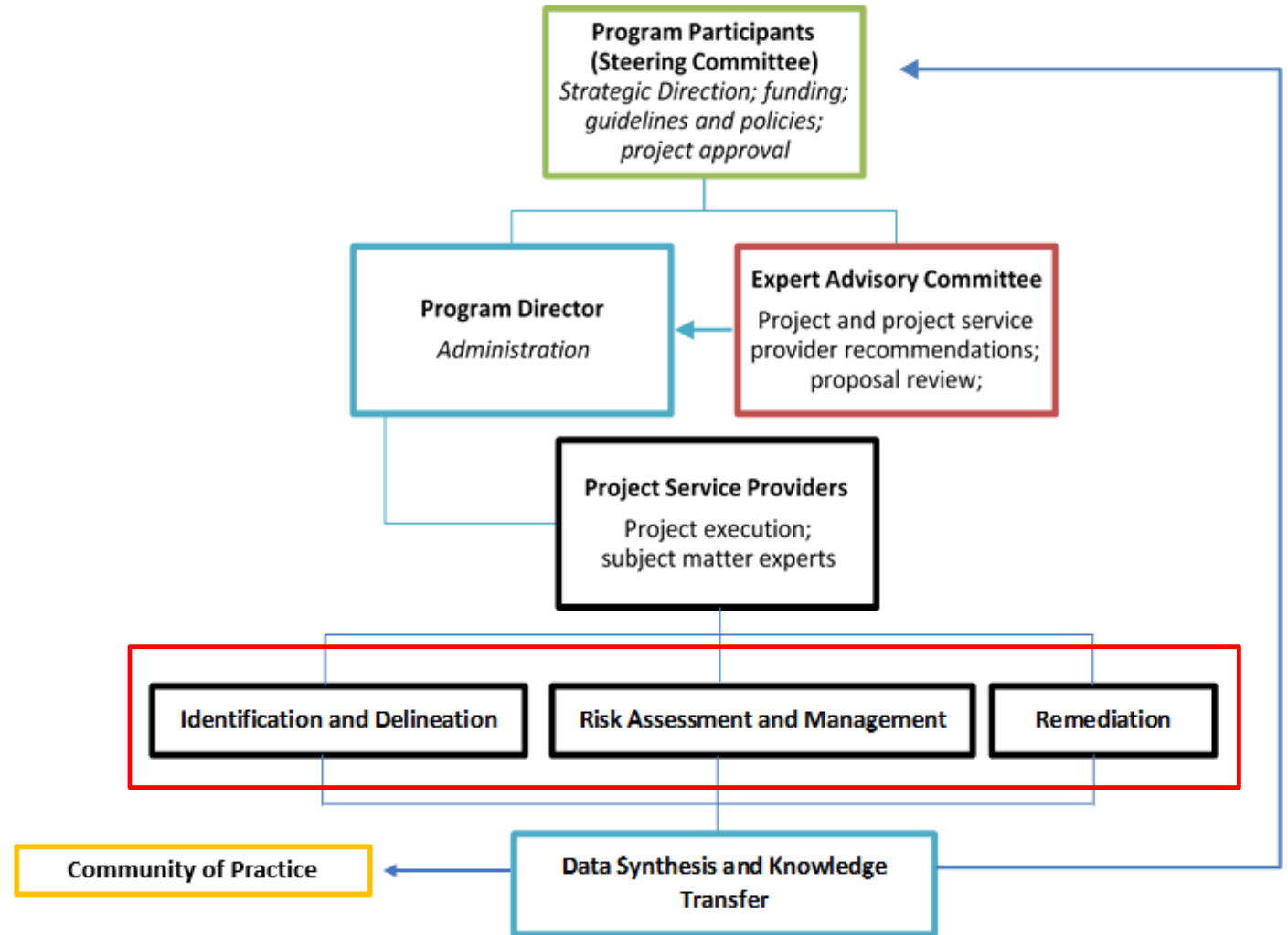
Non-selective, persistent, residual herbicides that render treated soil unfit for plant growth

- Applied historically at wellsites, transmission lines, oil and gas distribution and industrial facilities, pipelines and electric substations, railways
- Program participants halted use in 1990s based on **persistence** and **mobility**
- **Secondary impacts** through leaching, runoff or wind dispersion
- Best estimate - **>60,000** sites in Alberta



PROGRAM DETAILS

- 5-year Program
 - Initiated in 2019
- Scope
 - Address challenges specific to AB
 - *Applied* research
 - Bromacil and tebuthiuron focus
- Structure
 - Program management and delivery agent – InnoTech
 - Steering Committee
 - Expert Advisory Committee



PHASED REMEDIATION TESTING APPROACH

1. Desktop Evaluation

- Identify and screen remediation technologies for bromacil and tebuthiuron
- Clarify AB-based remediation challenges

2. Bench-scale validation and optimization

- Activated carbon for immobilization
- *Ex situ* chemical oxidation/reduction
- *In situ* anaerobic, saturated soil conditions
- *Ex situ* water treatment via electrocoagulation

3. Field-scale demonstration

- Import soil with bromacil impacts from site destined for remediation
- Test technologies proven at bench-scale
- Develop best practices for remediation



BENCH-SCALE TESTING

STAGE 1. VALIDATION AND OPTIMIZATION

- ACTIVATED CARBON
- CHEMICAL OXIDATION
- CHEMICAL REDUCTION

CHEMCO INC. – PROJECT PARTNER

INVESTIGATION OF LONG-TERM EFFECTIVENESS OF ACTIVATED CARBON



PROJECT GOAL

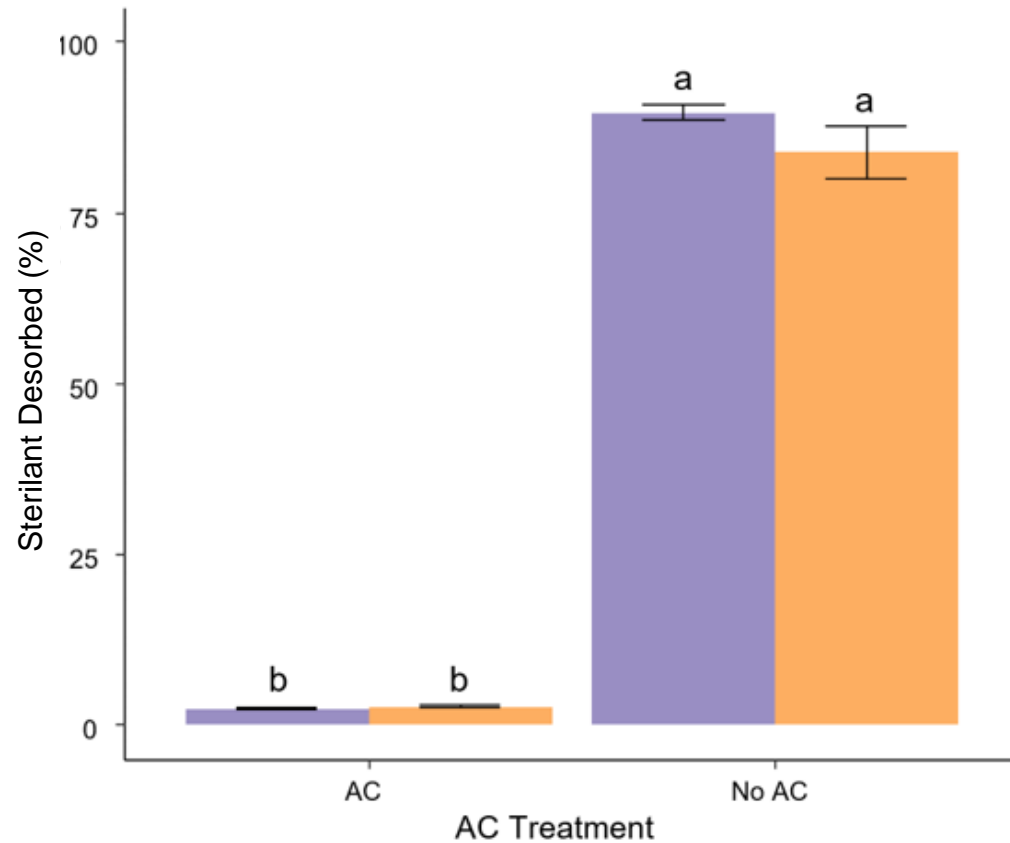
Assess the long-term ability of activated carbon (AC) to immobilize bromacil and tebuthiuron in soil to evaluate AC as a valid remediation technology

RESEARCH QUESTIONS

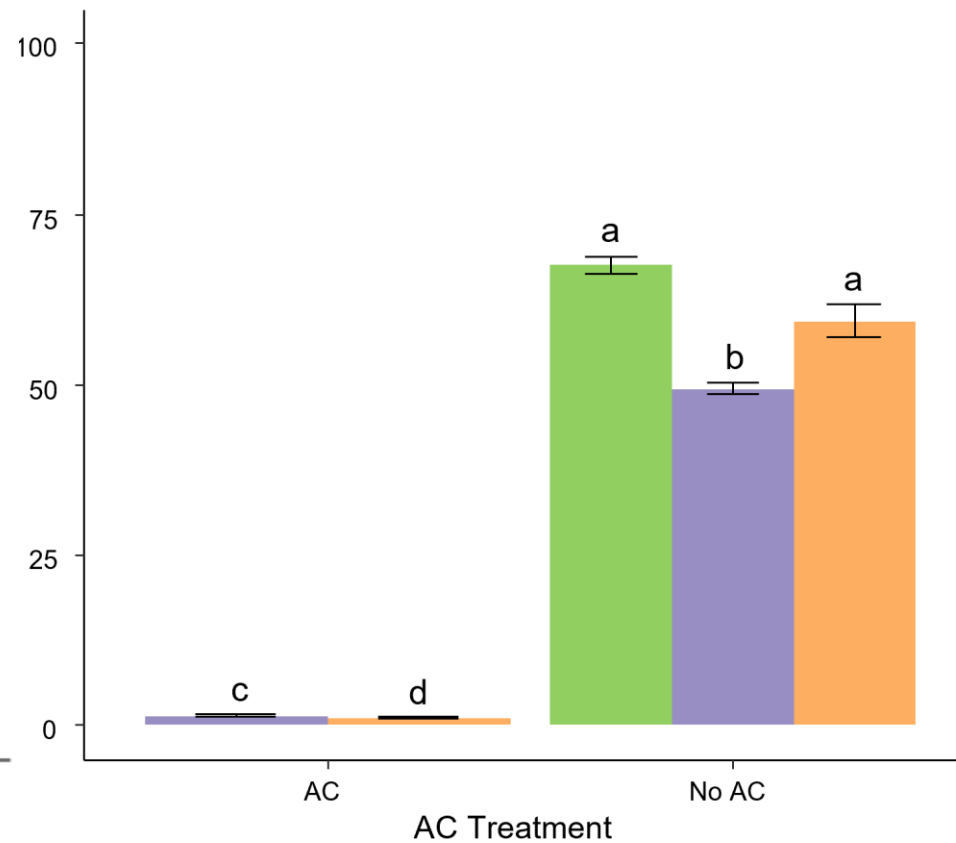
- 1) What is the percent effectiveness of AC in immobilizing soil sterilants when applied to soil at ratios established in previous research (i.e., 400:1)?
- 2) If proven sufficiently effective in immobilizing soil sterilants, under what conditions could AC release soil sterilants, thus making them available to vegetation and/or leaching through the soil profile?



INVESTIGATION OF LONG-TERM EFFECTIVENESS OF ACTIVATED CARBON



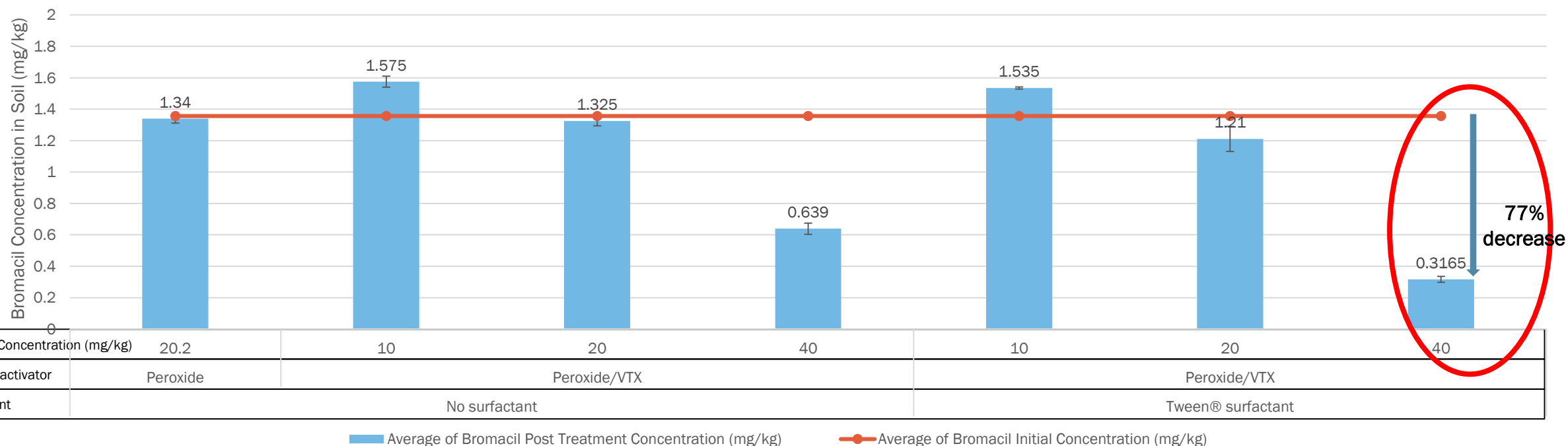
TEBUTHIURON



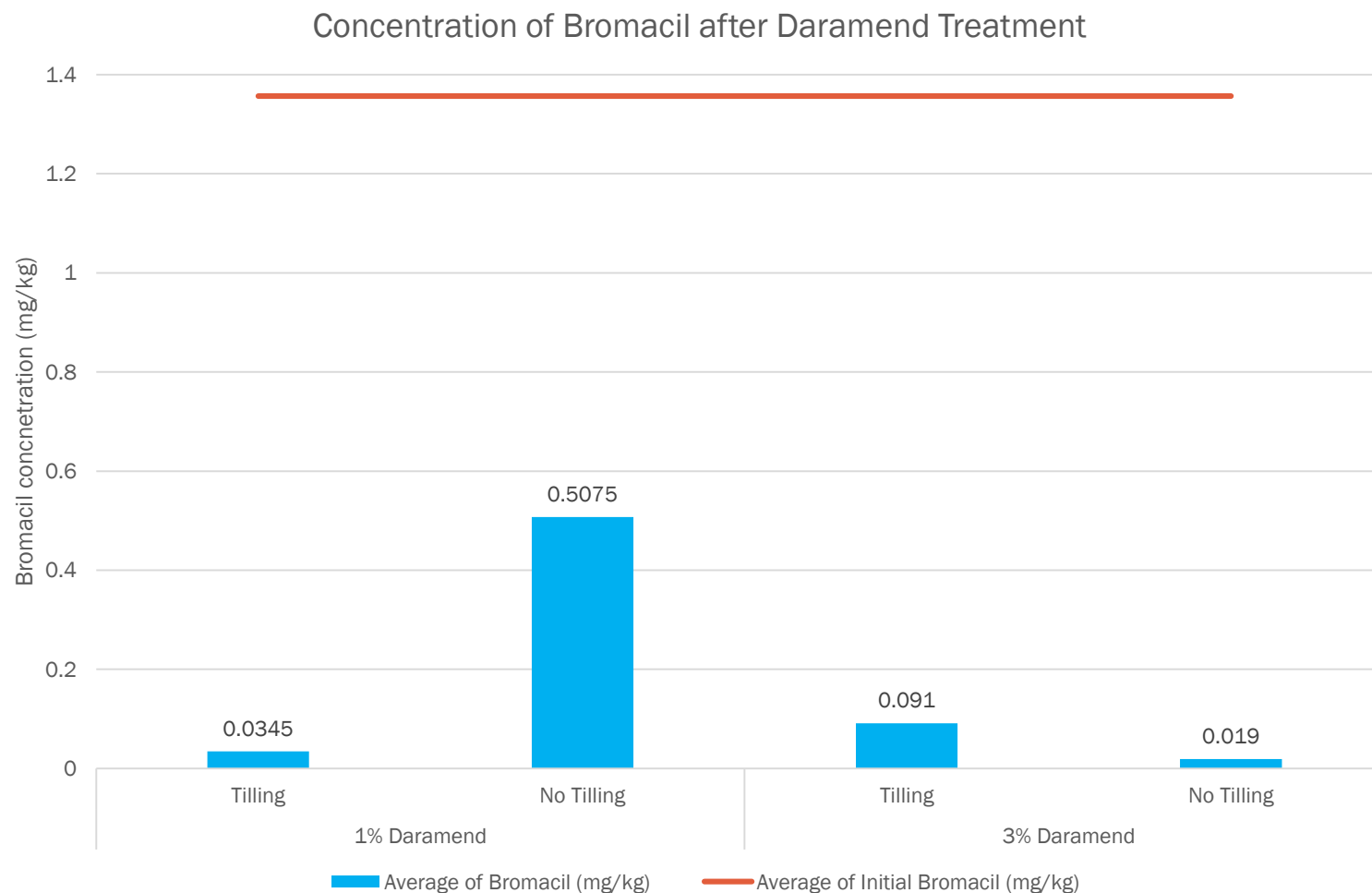
BROMACIL

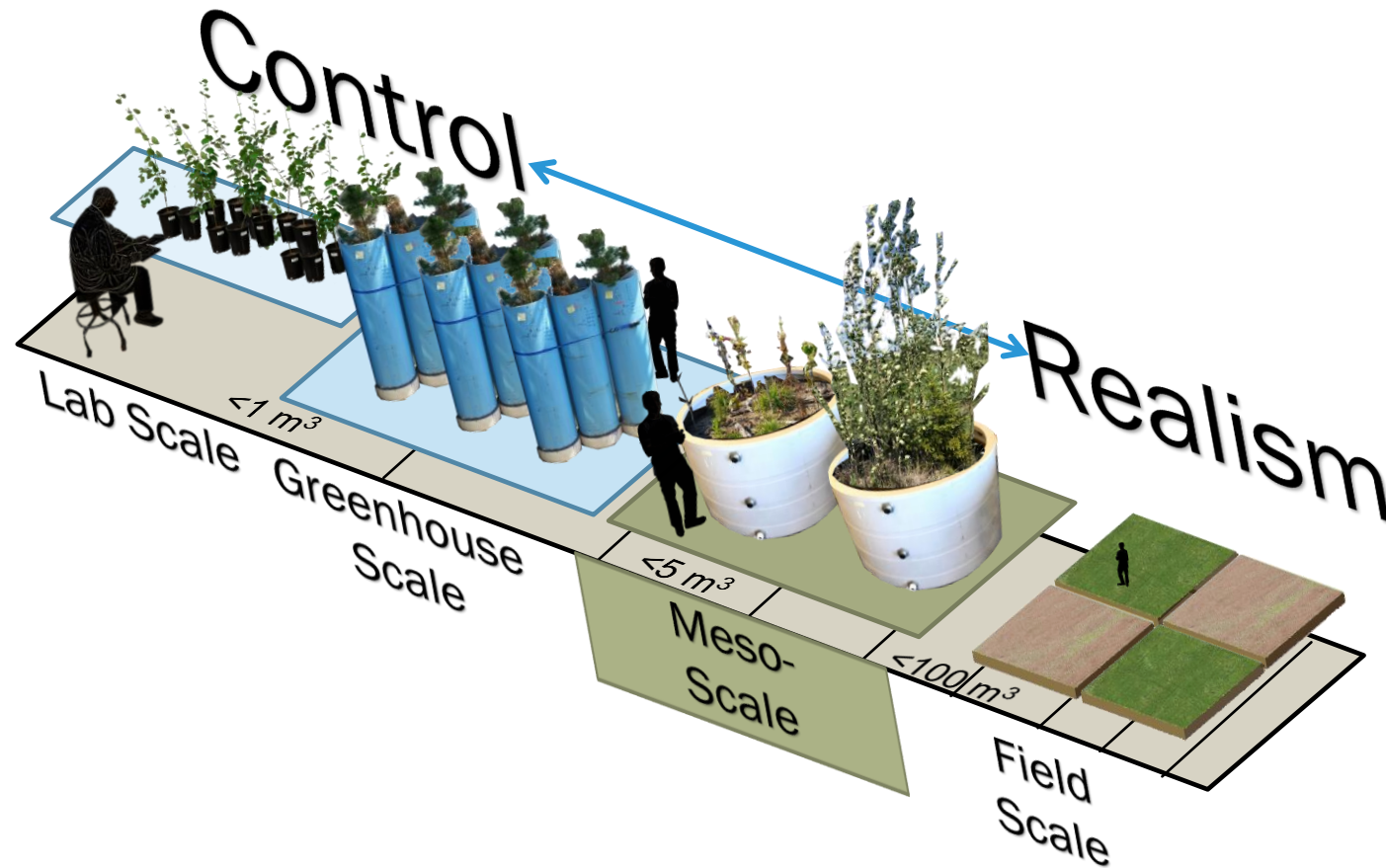
BROMACIL –CHEMICAL OXIDATION RESULTS

Concentration of Bromacil after Hydrogen Peroxide Treatment



BROMACIL – CHEMICAL REDUCTION (DARAMEND®)





FIELD/MESO-SCALE TESTING

STAGE 2. 'REAL WORLD' TESTING



Treatment legend

- White: Control
- Green: Peroxide/VTX/Tween®
- Blue: Activated carbon
- Black: Daramend®



HYDROGEN PEROXIDE, ACTIVATOR AND SURFACTANT



ACTIVATED CARBON



**DARAMEND
(REDUCTANT
WITH
ORGANIC
AMENDMENT)**

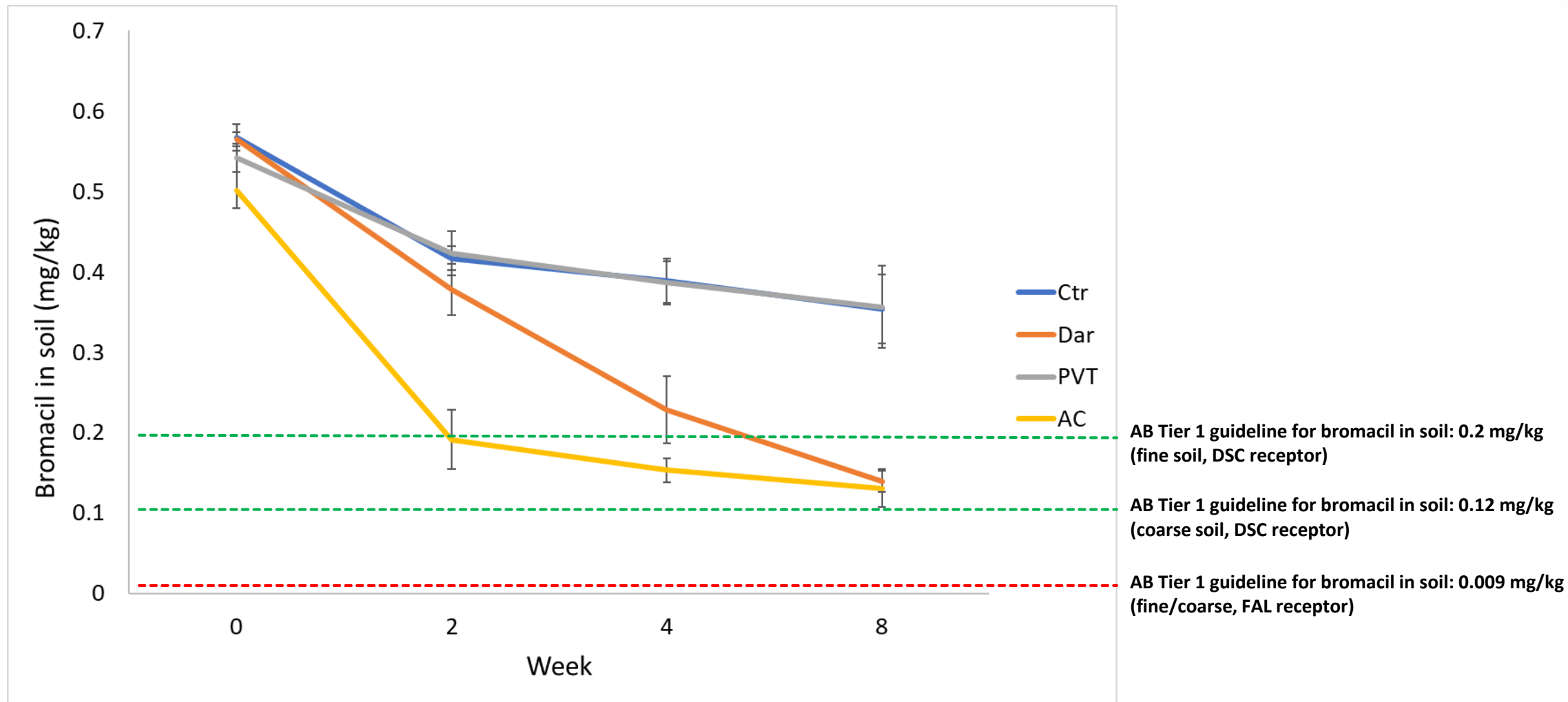


Program

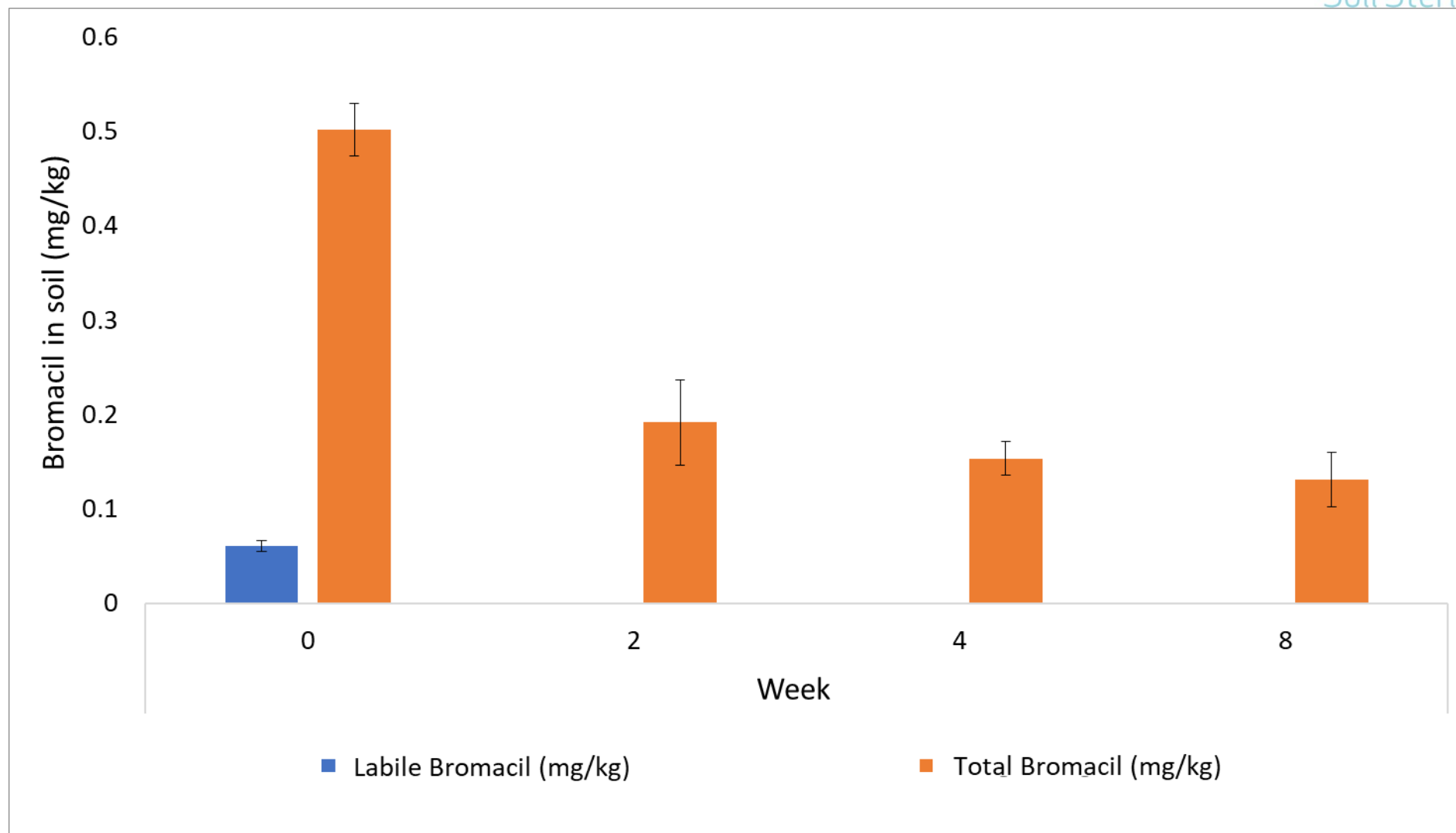
SENSORS

Moisture and temperature sensors installed in each plot; data downloaded weekly for monitoring and mitigation

REMEDIATION DEMO – WEEK 8 RESULTS FOR TOTAL BROMACIL



TOTAL VERSUS LABILE BROMACIL RESULTS – ACTIVATED CARBON



SUMMARY

- Remediation field demo informed by:
 - Desktop evaluation
 - Bench-scale evaluation and optimization
- Week 8 data indicates promising results for Daramend® and activated carbon
- Field demo will wrap up in October
- Other bench-scale studies are ongoing
 - *In situ* anaerobic, saturated soil conditions
 - *Ex situ* water treatment via electrocoagulation



FOR ADDITIONAL INFORMATION:

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