

INVESTIGATION OF HYDROCHAR TO ENHANCE WATER AND NUTRIENTS RETENTION IN THE ROOT ZONE

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- Introduction
- Objectives & Work Scope
- Methodology
- Results & Discussion
- Future Research

Outline

Introduction

Background

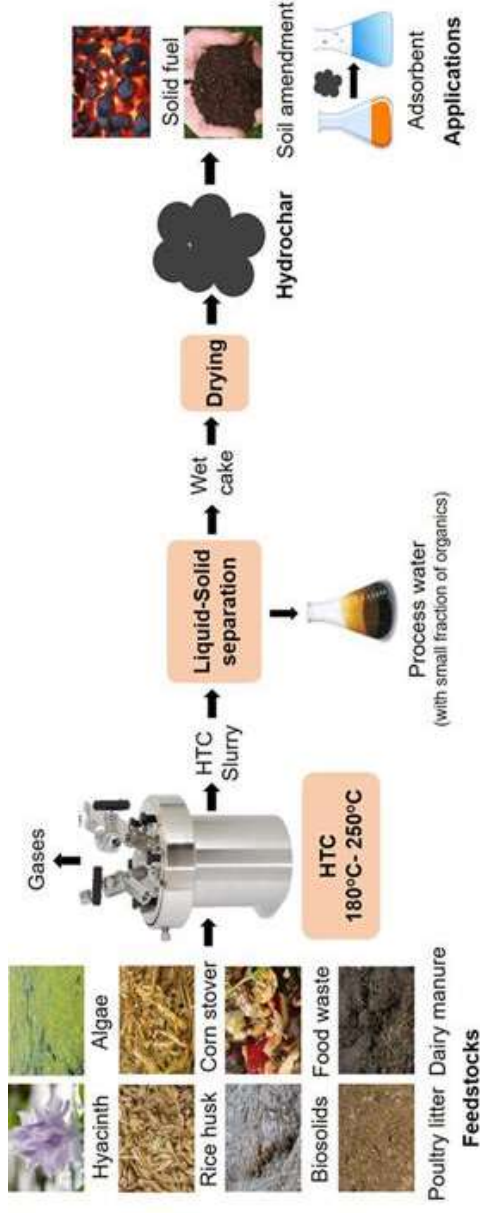
- The retention capacities of water and nutrients impact plant growth and water use in agriculture
- Hydrochar has the potential to improve agricultural soil quality by holding water and nutrients for a longer period



Introduction

Background

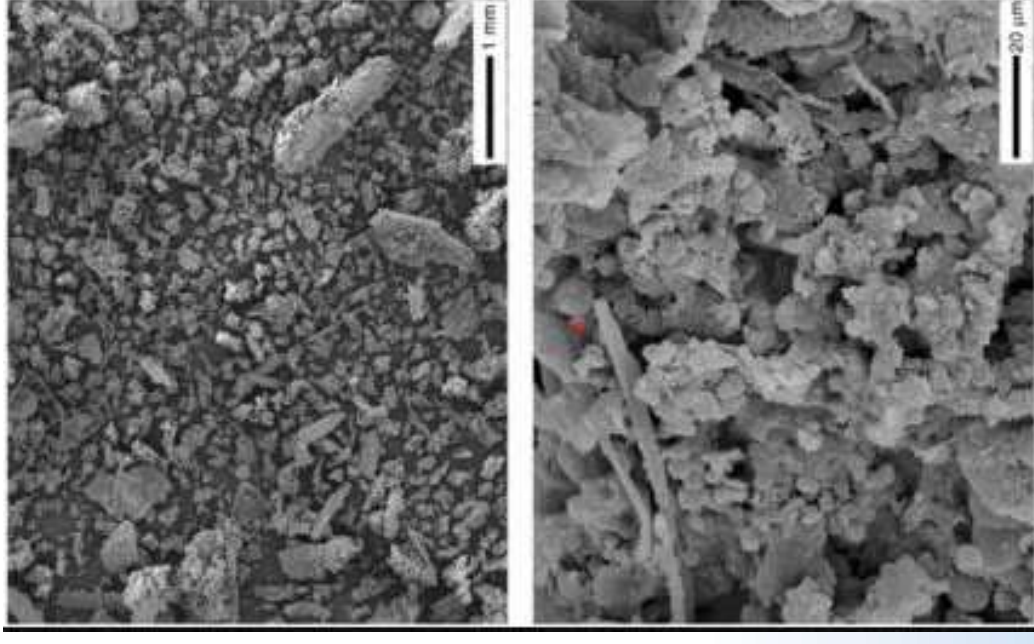
- Hydrochar
 - Feedstocks: Biomass
 - Food wastes, biosolid, industry sewer, etc.
 - HTC- Hydrothermal carbonization
 - Using heat cover biomass to hydrochar
 - Holding water and nutrients



Introduction

Literature Review

- Raising the soil PH value, and adjust nitrogen fertilization in the arable field and horticultural pot production (Bargman et al., 2013)
- Enhancing effects of fertilizer, and the lower production temperature can retain more nutrients in the soil. (Neethu and Dubey, 2018)
- Decreasing the bulk density and increasing pore volume to allow more water retained by soil (Fang et al., 2017)



Objective & Work Scope

Objective

- To investigate how the addition of hydrochar will affect water and nutrients capacities in soil column and rhizobox.



Objective & Work Scope

Work Scope

Conditions of with and without hydrochar

- Temporal variation of soil moisture vs. depth
- Temporal variation of water potential vs. depth
- Temporal variation of nutrient concentrations vs. depth
- Distribution of soil moisture under different irrigation practices
- Distribution of potential head under different irrigation practices
- Distribution of nutrients under different irrigation practices

Methodology

1. Soil column without hydrochar (In processing)

- One dimensional
- Potential and water content sensors install in the 6 inch, 12 inch, and 18 inch of soil depth
- Using the data logger to record sensors' reading for each 15 minutes



Methodology

1. Soil column without hydrochar (In processing)

-Sensors and data logger



ZL6 Data Logger
(METER GROUP, 2021)



Moisture Sensor_ TEROS 12
(METER GROUP, 2021)

Range:
Mineral soil calibration:
0.00–0.70 m³/m³
Soilless media calibration:
0.0–1.0 m³/m³

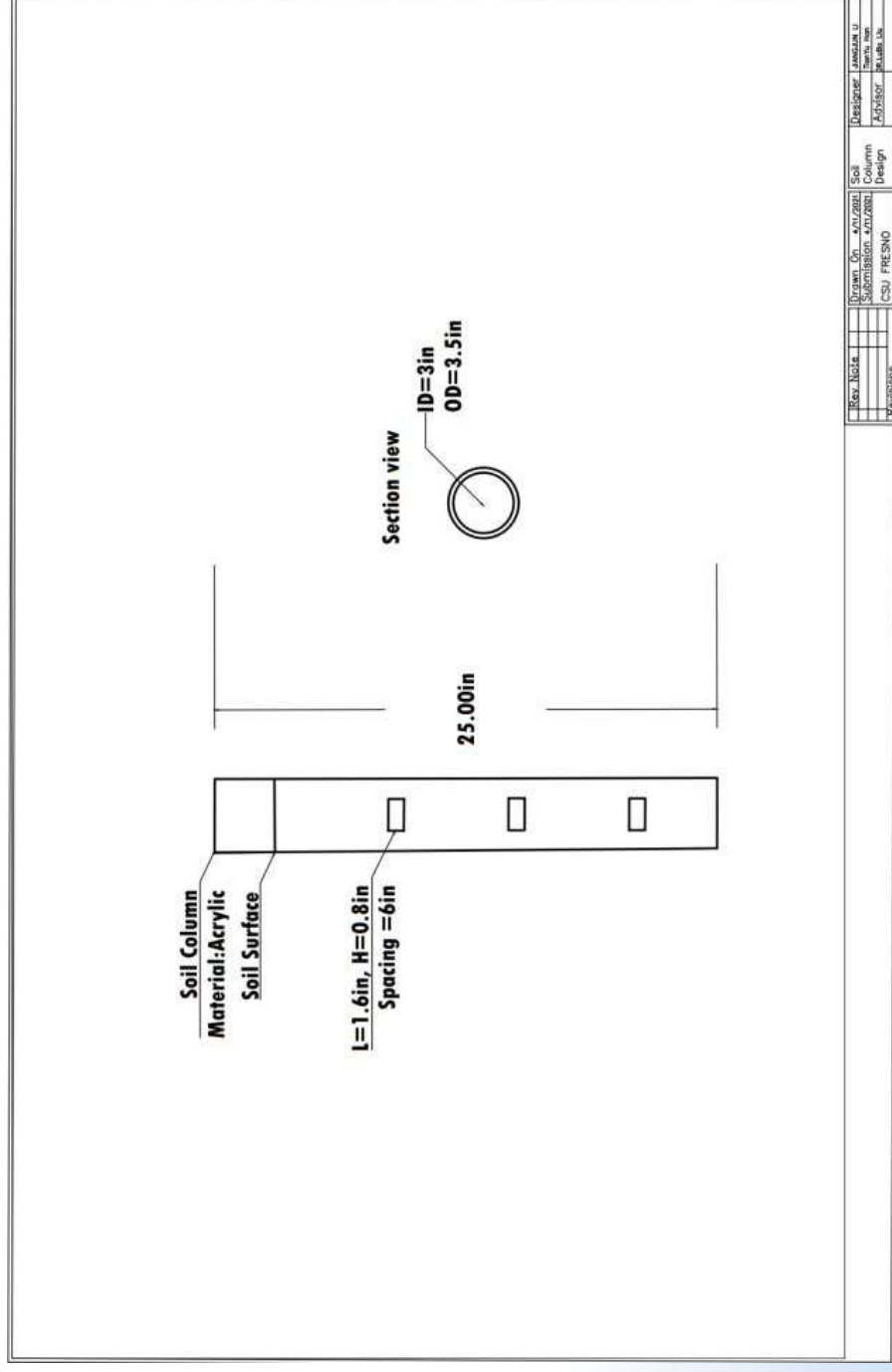
Potential Sensor_ TEROS 21
(METER GROUP, 2021)

Range: –5 to –100,000 kPa
(1.70 to 6.00 pF)
Resolution: 0.1 kPa
Accuracy: ±(10% of
reading + 2 kPa) from –100
to –5 kPa

Methodology

1. Soil column without hydrochar (In processing)

-Soil column
dimensions



Methodology

2. Soil column with hydrochar (Future experiment)

- Mixing hydrochar with soil in three different weight ratio
- Adding the same amount of hydrochar mixture on the top, middle, and bottom separately in the three soil columns as one set
- Building up two more sets with different weight ratio of hydrochar mixture
- Installing the potential and water content sensors at depth of 6 inch, 12 inch, and 18 inch



Methodology

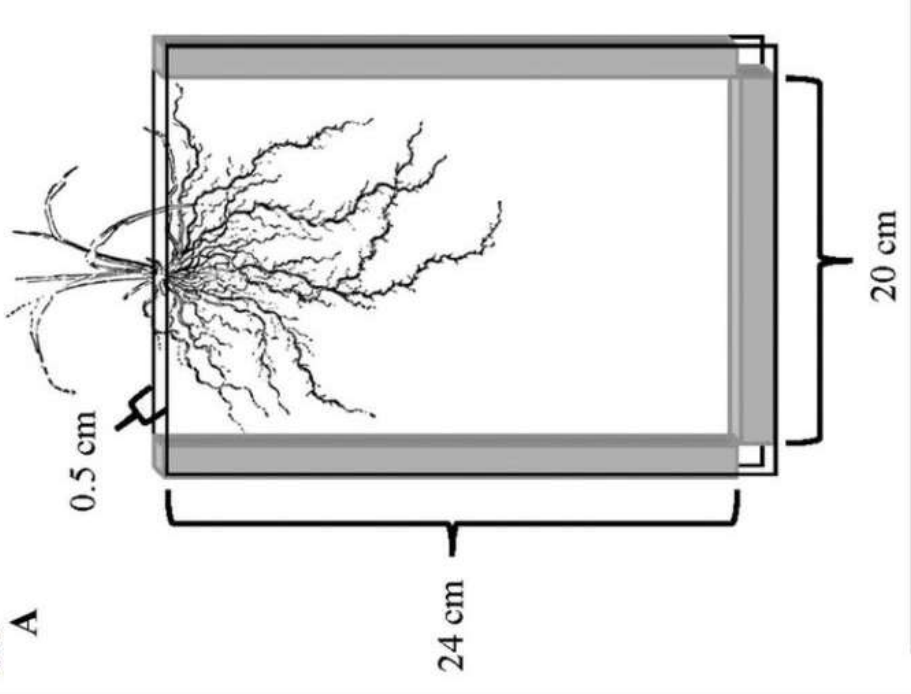
3. Rhizobox with hydrochar (Future experiment)

- Three dimensional
- Cultivating plants in the rhizobox
- Similar established method
- More sensors needed on the horizontal direction at the specify soil depth

4. Modeling (In processing)

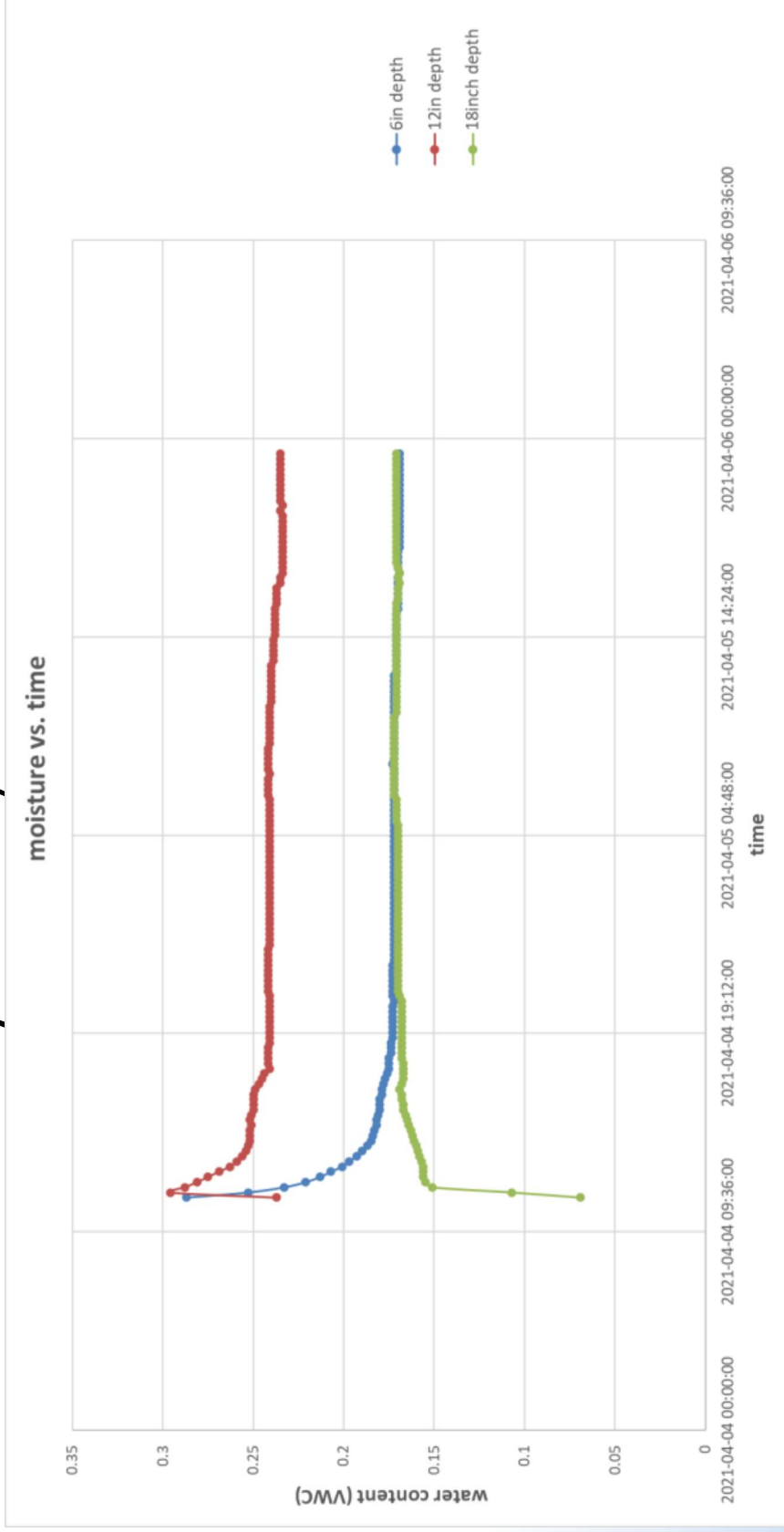
- Hydrus-1D

Fig. 1.



Results & Discussion

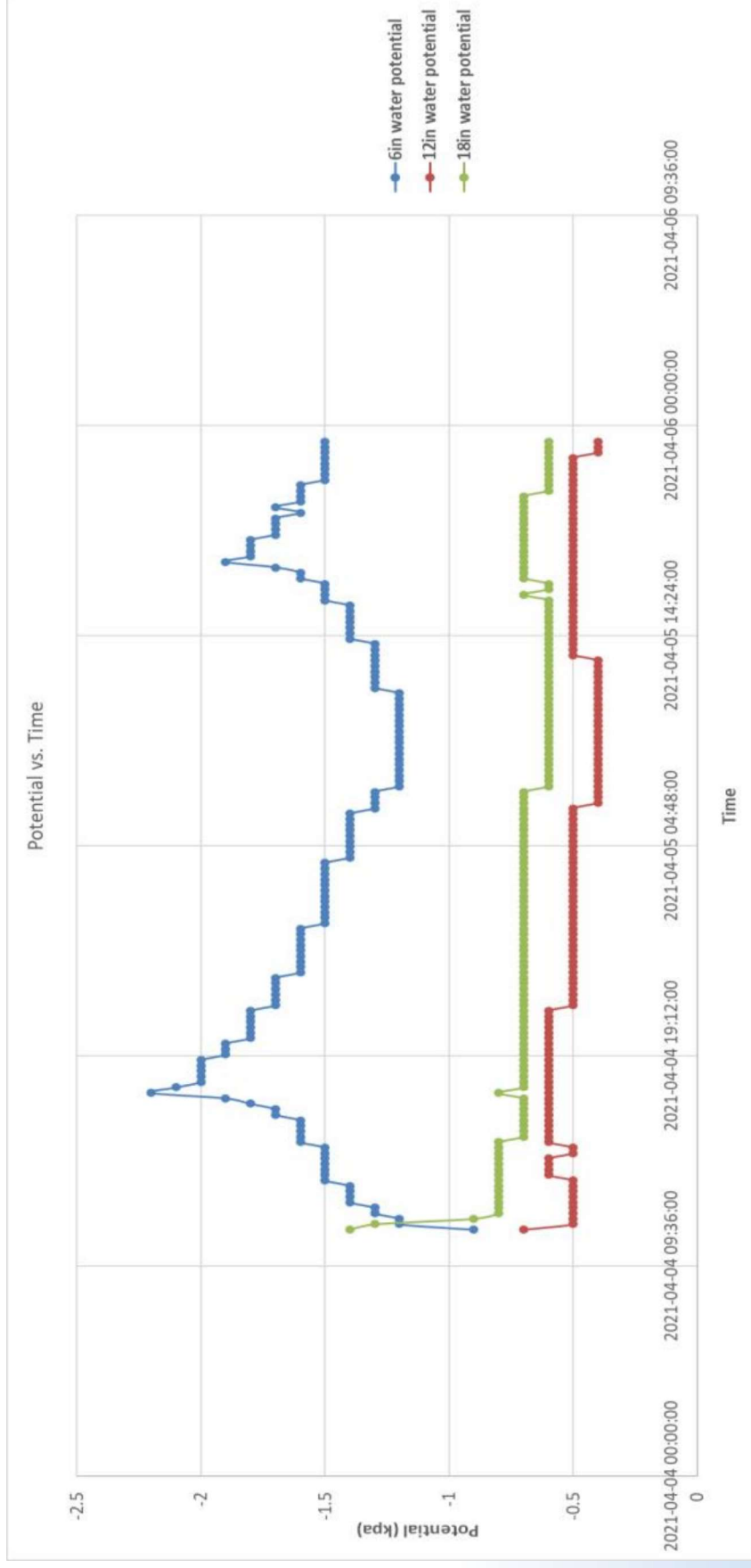
1. Water Content vs. Time (Soil column without hydrochar)



Results & Discussion

2. Water Potential vs. Time

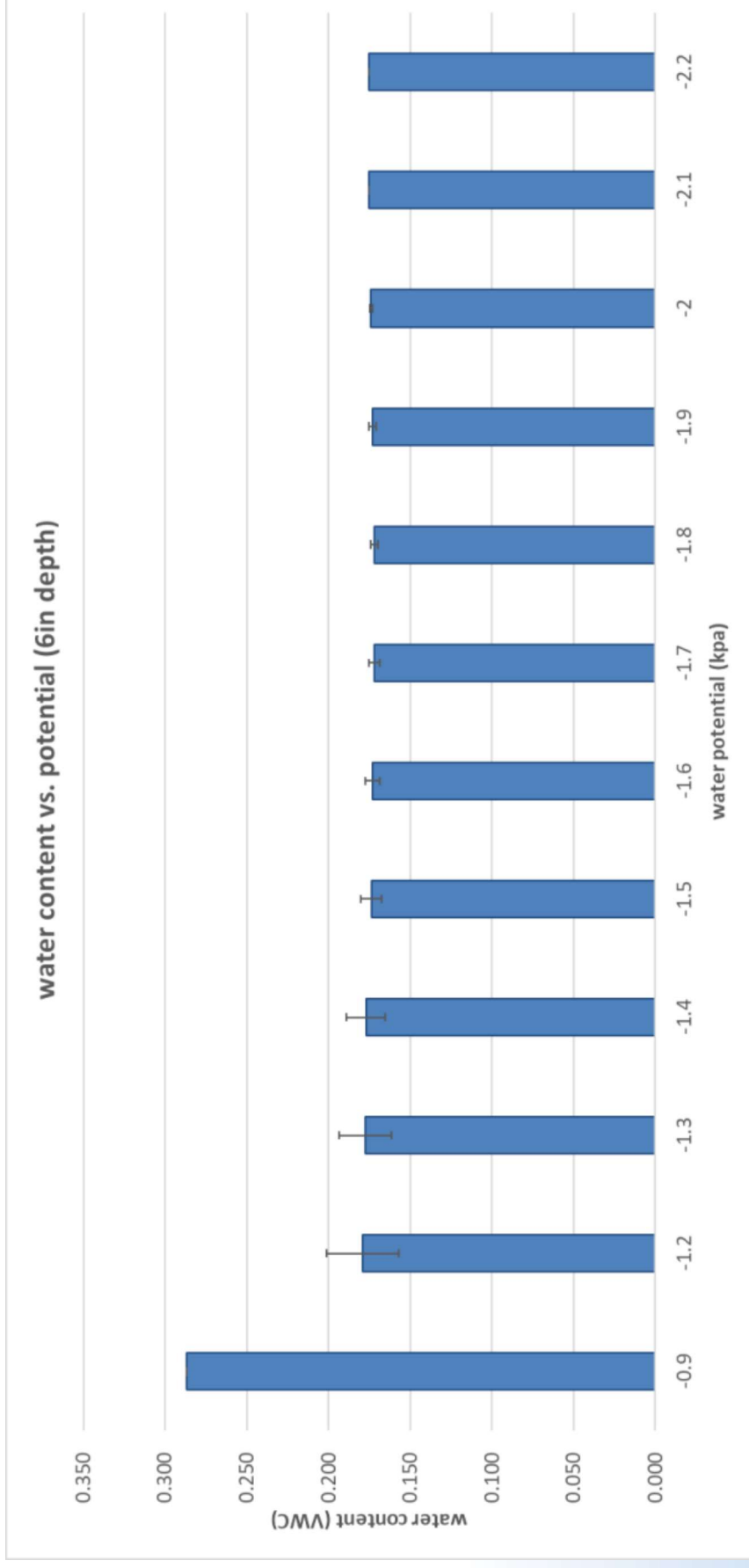
(Soil column without hydrochar)



Results and Discussion

3. Water Content vs. Water Potential

(Soil column without hydrochar)



Future Research

- To investigate the most suitable amount of hydrochar on enhancing water and nutrients retention in the root zone
- To explore the hydrochar applied position in the root zone for improving the water and nutrients holding capacity
- To study the impact of hydrochar on plant productivity

Questions?

Thank you

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