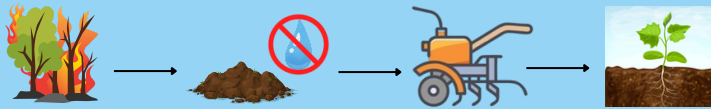


# Designing a Robot to Measure Soil Hydrophobicity and Optimize Tilling for Hydration

Sanvi Venkayala, Shrewsbury

**Engineering Problem:** Wildfires burn organic matter and alter soil properties, creating hydrophobic soil that prevents water infiltration.

**Objective:** To build a robot that detects and autonomously tills hydrophobic soil to restore water absorption.



Wildfires cause hydrophobic soil

Tillage restores hydrophobic soil

IMPROVING SOIL  
HYDROPHOBICITY  
IMPROVES  
ECOSYSTEM  
HEALTH

**Major Criteria:** The robot will be able to accurately detect soil hydrophobicity, effectively scarify soil through a tiller with adjustable depth settings, and easily navigate terrain.

1.



Create a water dropper system

3.



Code hydrophobicity detection: try ML & OpenCV

2.



Take 100+ videos of water absorption

4.



CAD and assemble robot with tiller & test on soils

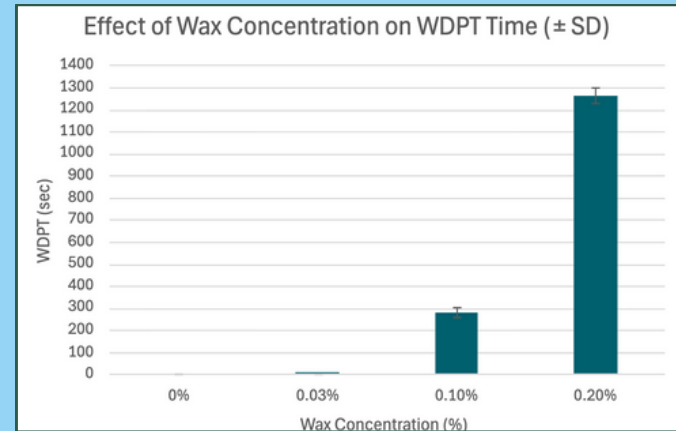


Figure 2. Water Drop Penetration Time (WDPT) measured for each sample using water dropper across increasing wax concentrations ( $n = 5$ ). These concentrations simulate varying degrees of soil hydrophobicity. Error bars represent one standard deviation.

The data shows a clear trend: WDPT increased as the wax concentration increased, confirming that the treated sand simulates hydrophobic behavior and that

WDPT testing is a reliable method of measuring soil hydrophobicity. The WDPT values found have small error bars or standard deviations, demonstrating relatively low variability in the test. This result also proves that the water dropper is functioning correctly and dispensing droplets of the same volume.