UNLOCKING POTENTIAL: PROMOTING DIVERSITY THROUGH SOIL HEALTH IN A YOUNG ORCHARD ECOSYSTEM

Kayla Foster[1], Sarah Elizabeth Stockman[2]

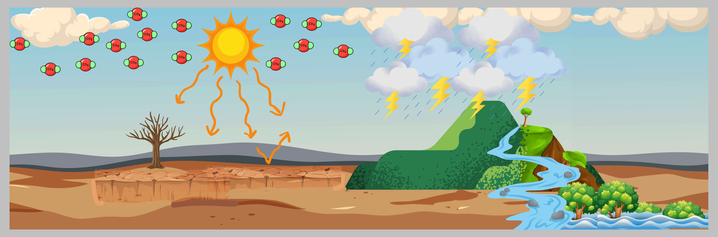
1. Research Experience for Community College Students | San Juan College
2. Ecology & Evolutionary Biology | University of Colorado - Boulder

Research Question

Does functional diversity of the plants (e.g nitrogen fixing) influence soil health (water-holding capacity & organic matter content)?

INTRODUCTION

- The Boulder Apple Tree Project (BATP) is a collaborative research program that aims for the preservation of apple trees and the improvement of ecosystem services within their care.
- Ecosystem services are essential benefits that directly or indirectly affect humans through the relationship of ecological and evolutionary processes[1]. Ecosystem services and biodiversity are intricately connected to one another since biodiversity is fundamental to how well ecosystem services can perform under various conditions. Lack of nutrients and declining soil health due to weather events in apple orchards can negatively affect fruit trees in terms of crop production, tree health, and water intake.
- Elevated global temperatures related to climate change have negatively impacted ecosystem services with increased occurrences of drought and precipitation/flooding[2]. These weather anomalies deteriorate topsoil health, which leads to soil erosion that reduces water-holding capability and nutrient absorption in soil[3].



METHODOLOGY

Through a young apple orchard established by the BATP, I will be analyzing soil under the sapling's canopy understory to examine these plant's impact on the soil. I will be focused on two areas: Water Holding Capacity & Organic Matter Content.

Soil samples were taken with an auger from the right side of two quadrats surrounding the apple saplings. Two types of soil analysis were performed on these samples:

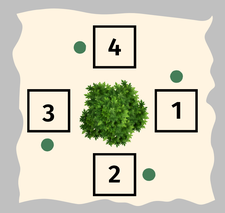
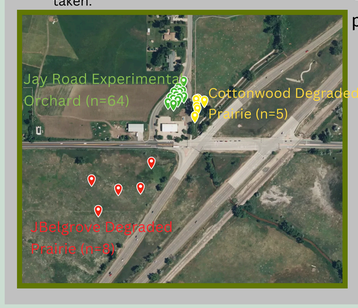


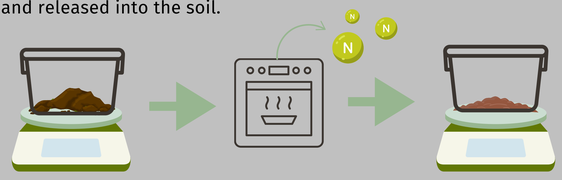
Fig. 1 Diagram of soil collection areas. The green dots represent the areas where the soil samples were taken.



Water Holding Capacity: An estimate of how much water a soil texture can hold.

The weight difference of the soil is found by soaking the sample overnight then baking it in an oven until dry.

Organic Matter Content: The amount of elements (e.g nitrogen) created by plant roots and released into the soil.

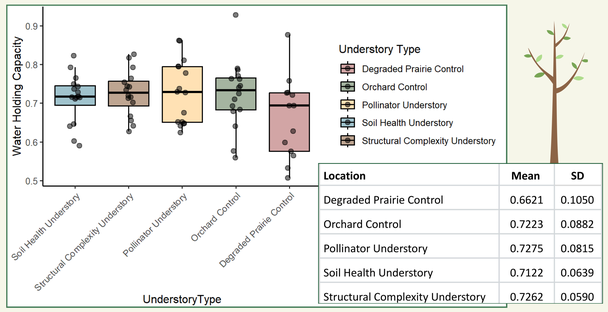


The dirt sample is first weighed in a metal tin, then baked at 550C for 4 hours and reweighed when cool. The difference is the organic content matter that was in the soil.

Fig. 2A, 2B, 2C: Photo of Experimental Jay Road Orchard in North Boulder, CO (left). (B) Photo of Cottonwood area (center) and (C) photo of Belgrove area (right), which are both degrade lands.
Photo Credit: Amy-Dunbar Wallis, Kayla F. (left) & Google Maps (right)

RESULTS

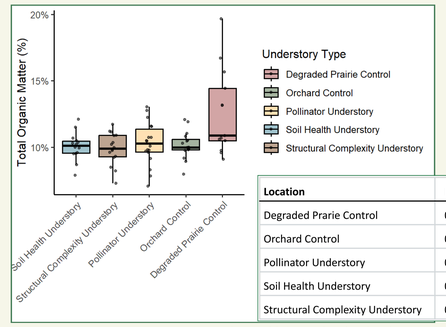
Water Holding Capacity



Location	Mean	SD
Degraded Prairie Control	0.6621	0.1050
Orchard Control	0.7223	0.0882
Pollinator Understory	0.7275	0.0815
Soil Health Understory	0.7122	0.0639
Structural Complexity Understory	0.7262	0.0590

Fig. 4, Table 1: Boxplot showing the water holding capacity of soil (percent) from three understory treatments in an experimental orchard and two degraded prairies (left). Table 1: mean and standard deviation of WHC levels based on understory plants (right).

Organic Matter



Location	Mean	SD
Degraded Prarie Control	0.1261	0.0323
Orchard Control	0.1016	0.0103
Pollinator Understory	0.1028	0.0162
Soil Health Understory	0.1006	0.0106
Structural Complexity Understory	0.0989	0.0120

Fig. 5, Table2: Boxplot showing the organic matter content of soil (percent) from three understory treatments in an experimental orchard and two degraded prairies (left).
Table 2: mean and standard deviation of Organic Matter Content levels based on understory plants(bottom right).

- **Water Holding Capacity** of the orchard trees that receive treatment average the same as the orchard's control, which is around 0.71-0.72 g. Trees with pollinator understory plants have the biggest range of values including the most consistent maximum values (0.79-0.86 g, n=5).
- The degraded prairie control has a 9.3% lower water holding capacity than the pollinator understory.
- The **Total Organic Matter** of the degraded prairie control is 20% higher than the pollinator understory in the orchard; however, it also contained the largest variability of organic matter content (SD 0.03). The trees in the orchard have a mean organic content matter of 0.09-0.1 g (n=5).
- The pollinator understory yielded the highest mean of both organic matter and water holding content, but the difference between the understory types *does not vary significantly*.
- The pollinator understory trees in the orchard is an important contributor to the ecosystem's diversity. They not only attract pollinators but also enhance soil health, unlocking its potential.

FUTURE WORK

The Jay Road Orchard, established by the Boulder Apple Tree Project, is still in it's beginning phases of development. The data gathered this summer will be compiled for future comparison of soil analysis. Examining this data will show how soil biodiversity will improve resistance and resilience towards increased climate events, such as drought and flooding.

This information can be used by future orchardists to create more sustainable apple orchards through the use of understory plants and the influence they can have on soil health.

References, Abstract, & Acknowledgements

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