



# Revitalizing Pastures and Controlling Weeds Through Soil Health via Nutrient Application



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## Background

This research was conducted in San Luis Valley, Colorado. People in this region heavily depend on agriculture as the primary driver of their local economy. Primary agricultural outputs are livestock, alfalfa hay, grains, and potato crops. The region has been in drought for more than 20 years and conditions are exacerbated by water management and aquifer draw-down. This project will inform conversion of cropland to naturalized pasture through treatment of invasive weeds and increasing forage production through the lens of soil health.

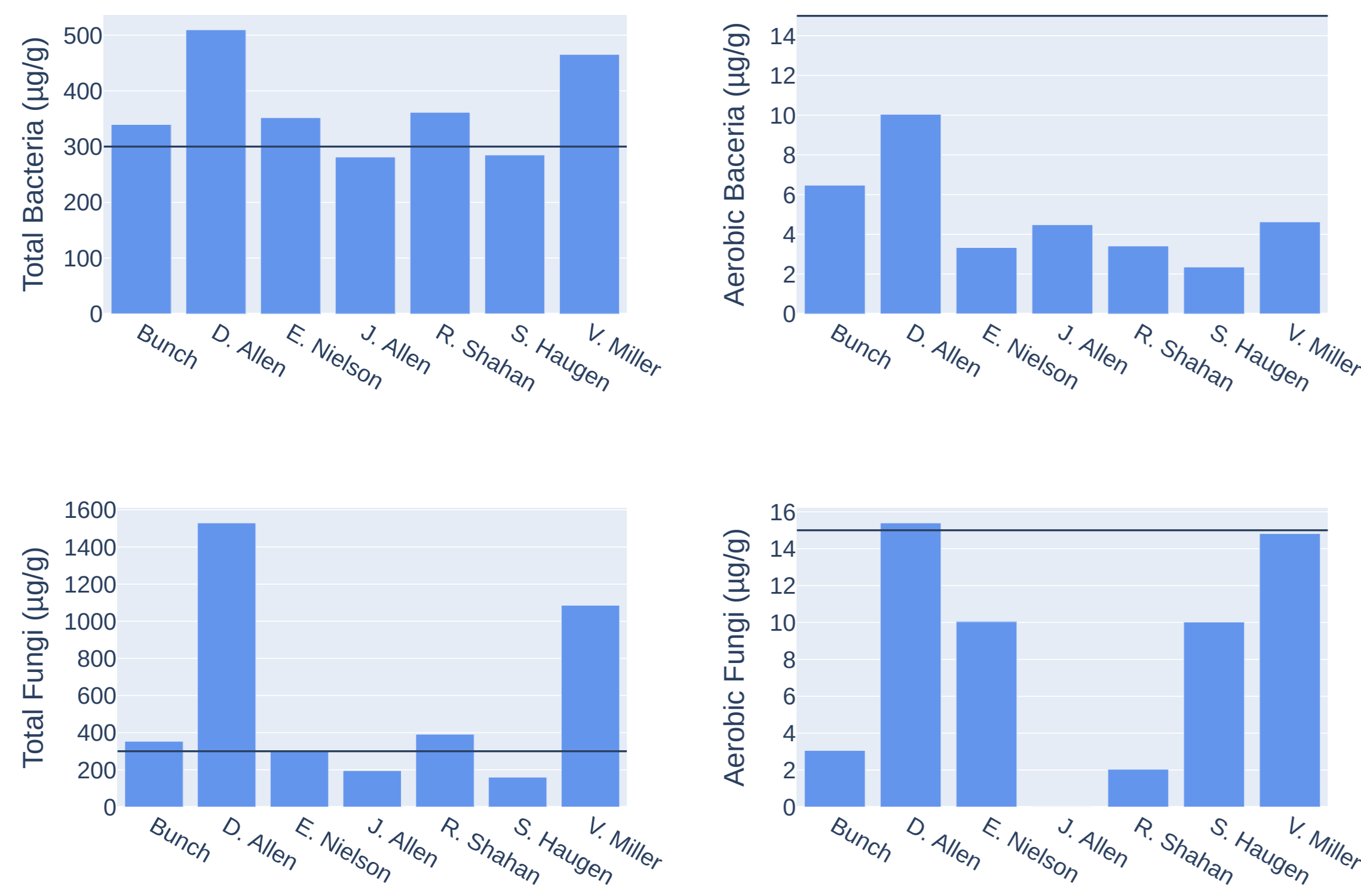


Figure 1. Baseline soil conditions measuring microbial activity. Soil samples were collected May and June 2022 and analyzed by Earthfort. A horizontal black line on the graph denotes the minimum level at which the respective measure should be (in healthy soil, as recommended by Earthfort).

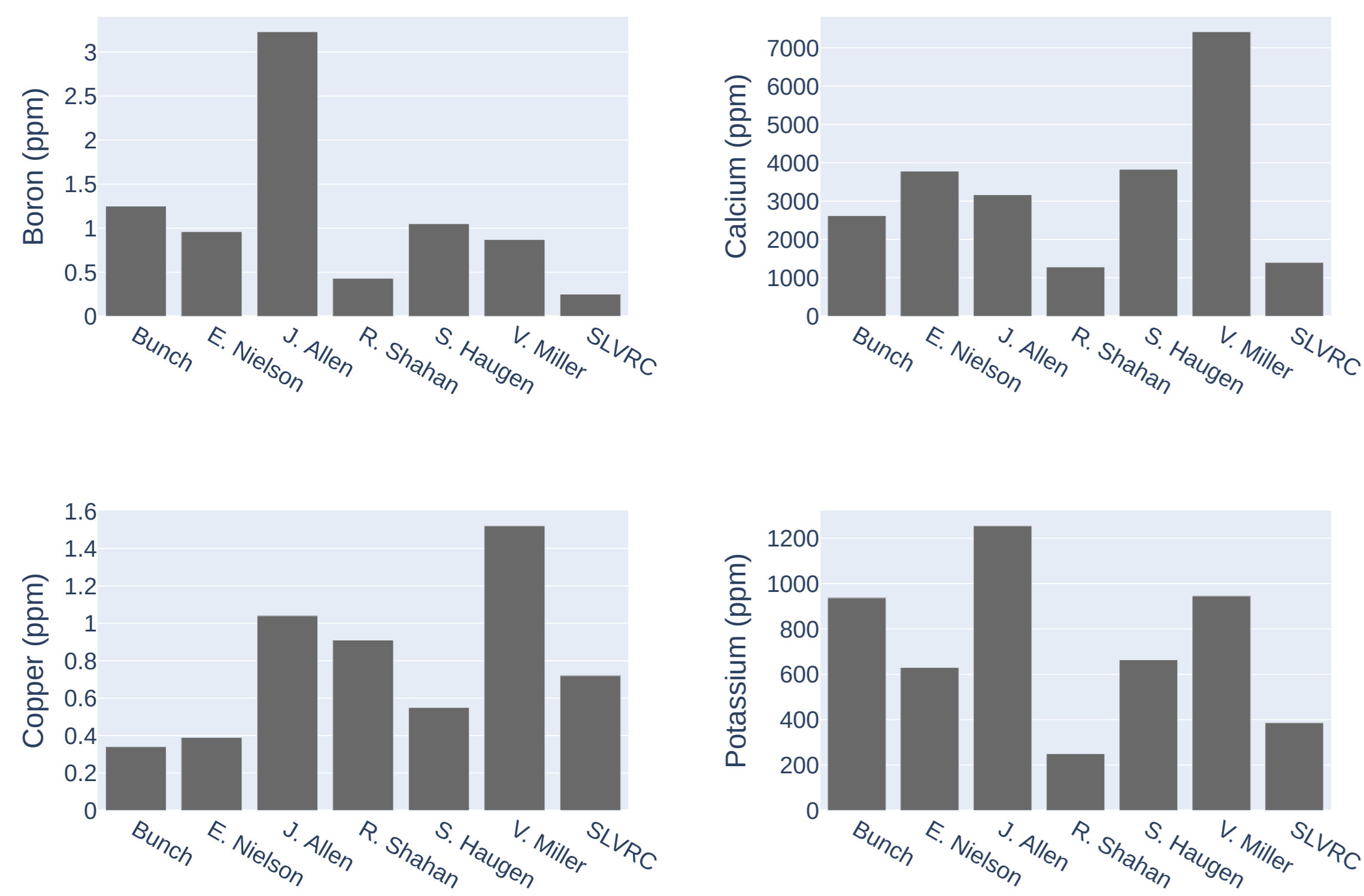


Figure 2. Baseline soil conditions measuring select nutrients. R. Shahan soil sample was collected January 2022; all others were collected May and June 2022. D. Allen sample was insufficient quantity. Analysis was done by Ward Laboratories.

## Research Questions

**Hypothesis:** We hypothesize that plots treated with particular soil prescriptions will show reduced weed growth and increased plant density and production.

**Questions:**

- Does improving soil health suppress weed presence on pasture and cropland?
- What soil treatment (nutrient “recipe”) best improves soil health markers (such as bacterial biomass, fungi biomass, and fungi to bacteria ratio)?
- What soil treatment, if any, most increases plant height and/or biomass?

## Methods & Preliminary Findings

- Soil samples have been collected from eight different properties (pasture and cropland) belonging to local ranchers/farmers who have partnered with San Luis Valley Area Extension.
- Lab results were analyzed. “Soil prescriptions” (different mixtures of various nutrients) targeted at each property were derived from this analysis. Thus far, the ingredients used throughout the various prescriptions include salt (Na), milk (M), compost extract (E), protist (alfalfa) tea (PT), humic acid (H), liquid kelp (K), boron (B), molasses (Mol), and gypsum (G).
- The treatments were mixed and applied via a portable hand-pump weed sprayer. Each treatment was applied to a set of nine discrete square meter plots. Control plots were also designated.
- In early fall 2022, plots will be clipped for production, and species will be analyzed by functional group (weeds, perennial grasses, etc...).

Soil health is currently a major area of study in agricultural research. This particular research project looks to see how this research applies to the San Luis Valley area. Past studies suggest that it takes at least several years of soil treatment application before any visual difference can be observed in vegetation/crops. While the ultimate goals of this project are to explore and answer the stated research questions, only baseline data (Figure 1 and Figure 2) can be established in 2022. The final data will not be available for years, however, there is one marker that can be measured early in soil health experiments to give an indication of treatment effectiveness: soil infiltration. This was measured on two properties. (Other properties were not measured due to time constraints.) All treatments that were measured showed promising findings (Table 1): a decrease in infiltration.

Location	Treatment	Mean (sec)	Decrease	Finished
R. Shahan	None (control)	99	0%	100%
R. Shahan	M,E(H),K	60	39%	100%
V. Miller	None (control)	363	0%	75%
V. Miller	H,PT,K	207	43%	67%
V. Miller	E(H),K	128	65%	67%

Table 1. Soil infiltration measurements for two properties taken in mid-August 2022. The “Finished” column refers to the percentage of measurements that completed within 30 minutes. Those that took longer were abandoned, as the soil was likely already at infiltration capacity or too compacted. The “Decrease” column refers to the treatment’s percentage decrease in infiltration when compared with its respective control. Treatment ingredients: M = milk, E(H) = high-fungal compost extract (where “(H)” is a reminder that the extract contains humic acid), K = liquid kelp, H = direct application of humic acid (not via the extract), and PT = alfalfa tea (food for protists).

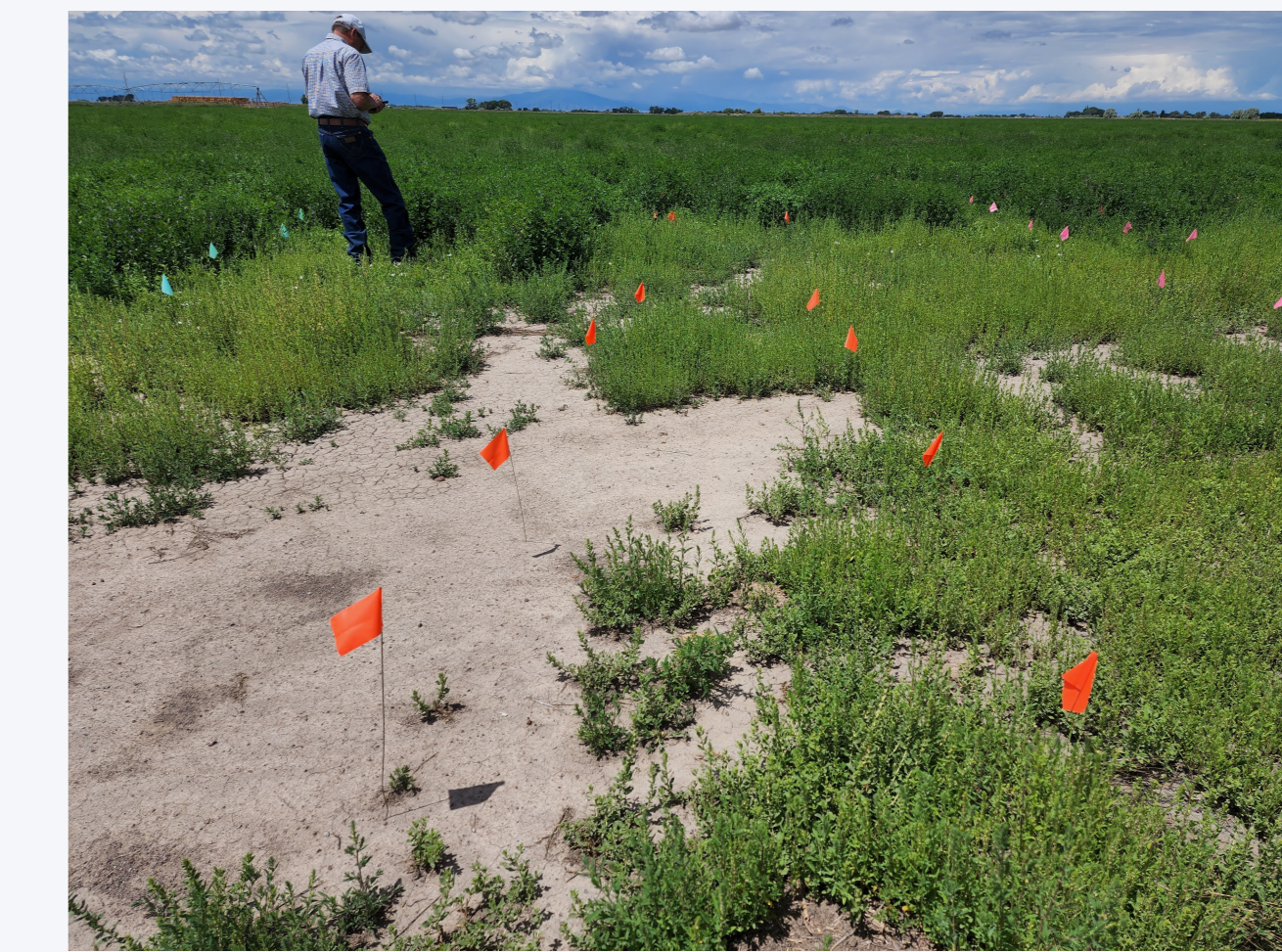
## Discussion & Limitations

**Discussion:**

An important consideration, assuming any of the prescriptions work well, is whether applying said prescriptions is economically viable for the local farmers/ranchers.

**Limitations:**

- Pre-existing differences in soil both within and between fields may influence results.
- For part of the project, adequate equipment to take pictures of plots over time was not available.
- Plots were not in a secure location. Thus, it is possible, though unlikely, that they were tampered with while unobserved.



## Next Steps

- Soil treatments should be reapplied to the same plots for at least three years. In 2025 (or later), vegetation should be clipped and measured (biomass, height, desirable to undesirable plant ratio, etc...).
- Assuming any soil prescription shows promising results, future research should focus on fine-tuning the recipes to make them even more effective.
- Following this research trial, future research should explore the relationship between climate change and the need to adapt soil prescriptions over time.

## References

[1] Douglas L Karlen, Diane E Stott, and Maysoun M Mikha. *Approaches to Soil Health Analysis, Volume 1*. American Society of Agronomy, Newark, 2021.



**Acknowledgements:** Annie Overlin, Jeff Davidson, Joseph Benavides, Larry Brown, Nina Jenson, and Zach Czarnecki. Community members who volunteered portions of their land for this research: Bunch (homestead), Darius Allen, Ed Nielsen, Jeannie Allen, Raymond Shahan, Sherry Haugen, and Vaughn Miller. This research was funded by the College of Agricultural Sciences, Warner College of Natural Resources, Colorado WSARE, and Saguache county.