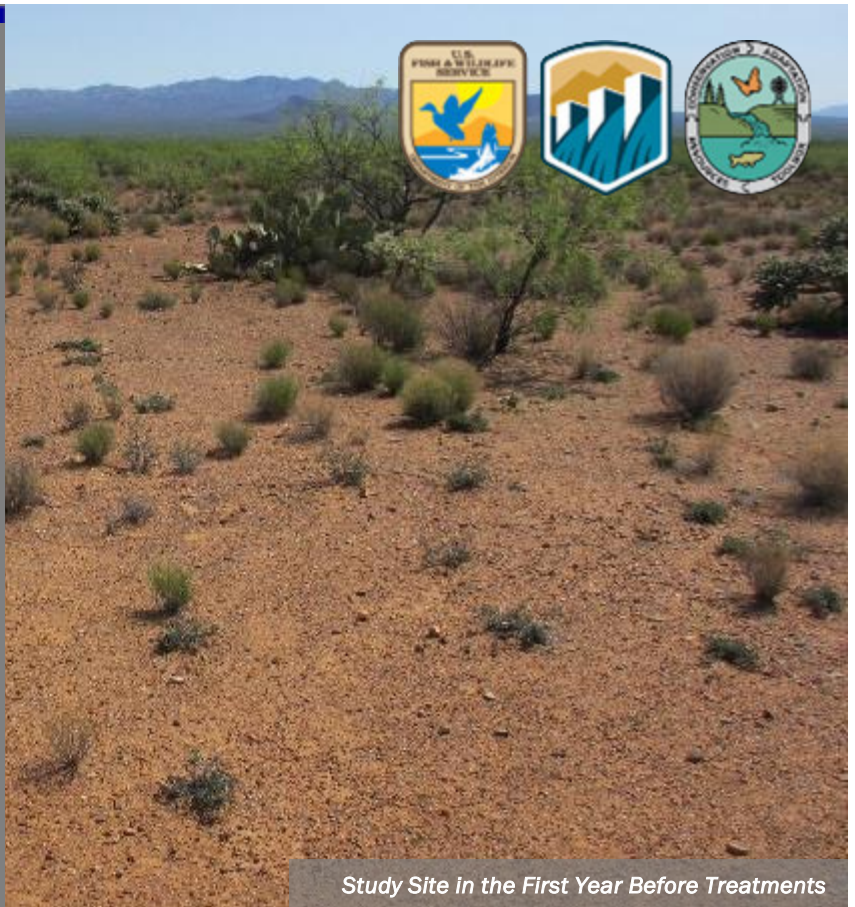


ACTIONABLE SCIENCE

Using Mulch and Compost for Rangeland Restoration



Increasing aridity is reducing the cover of herbaceous vegetation (grasses and forbs) in grasslands. Reduced cover leads to soil erosion and degradation, further diminishing the ability of soils to support plants. Concurrently, mesquite (*Prosopis velutina*) encroachment in grasslands can reduce cover of herbaceous plants and increase erosion when it surpasses certain thresholds, giving rise to mesquite removal projects. Branch mulch and compost are two organic materials that can improve soil health, offering promising restoration solutions to increase grassland plant cover and abundance. However, documentation of their use and effects on soil health remain limited, preventing greater adoption. Researchers from the University of Arizona analyzed the effects of mesquite branch mulch and compost on plant cover and soil health in a grassland in the Altar Valley of Southern Arizona.



KEY ISSUES ADDRESSED

Woody plants, such as mesquite, are encroaching into semi-arid grasslands and increasing bare ground by outcompeting native grasses and forbs. A decline in native vegetation exposes topsoil to erosion from wind and rain, impairing ecosystem function. Organic materials can be costly and difficult to apply in rangelands. For example, slopes and rocky soils impede tillage necessary to incorporate organic materials into the top layer of the soil. Although mesquite branches are accessible from trees on the landscape and from removal projects, there is insufficient data on the efficacy of branch mulch and compost to reestablish vegetation during drought, and of their impacts on soil health. Understanding the effects of branch mulch and compost on soil health may help land managers more effectively use organic materials for restoration.

PROJECT GOALS

- Test the effects of branch mulch, and branch mulch in combination with 2 amounts of compost, on cover and abundance of seeded native grasses and non-seeded plants.
- Measure the effects of branch mulch, and branch mulch in combination with compost, on multiple attributes of soil health.

WASTE AS RESOURCE

Mesquite is widely available in many arid landscapes. Rangeland managers can obtain mesquite branches from removal projects, turning waste into a valuable resource for ecological restoration.



Mesquite Mulch Alone Had the Most Plants in 2nd Year

PROJECT HIGHLIGHTS

Experimental Plot Design: From 2018 to 2019, researchers administered five treatments in plots of bare soil. Two control plots: one with no treatment, and one seeded with native grasses. Three experimental plots: mesquite branch mulch laid on top of seeded soil, branch mulch on top of 3 cm seeded compost, and mulch on 6 cm seeded compost. Researchers laid the branch mulch in 15-20 cm thick layers.

Cover and Abundance of Grasses: Grass abundance was greatest in the mulch-only treatment plot, with roughly 5.5 times greater abundance than all other treatments in both years.

Woody Shrubs: Only a single mesquite seedling was found over the entire 2-year study, indicating mesquite branch mulch and compost do not increase mesquite cover in the short term. Cover and abundance of other woody shrubs were lower in both treatments with compost than in control plots. Mulch-only treatment had similar cover and abundance of shrubs as control plots.

Attributes of Soil Health: The treatments with organic materials decreased soil temperatures and increased soil water availability by 50%. Plots with 3 cm and 6 cm of compost had higher soil moisture overall, but branch mulch alone had higher soil moisture during small rain events and drier times of the year.

Collaborators

- The University of Arizona
- The Joey Blankinship Soil Health Lab

CART Author: Jackelyn Alessi, Oregon State University, September 2023.

Photos courtesy of Ariel Léger, UArizona.

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LESSONS LEARNED

Researchers concluded branch mulch alone is more effective for reestablishing vegetation in semi-arid grasslands during drier years, which are projected to increase in the future. The success of branch mulch was partially attributed to how it improved the soil microclimate, as it did not significantly improve any other soil health attributes measured. The spaces between branches allowed light and precipitation to infiltrate into the soil, reduced evaporation, and protected the soil from raindrop impact and surface runoff. Furthermore, the many spaces between branches allowed the emergence of seedlings from the soil seed bank, whereas the complete cover in compost plots did not and were dominated by vegetation already present. If land managers apply branch mulch in restoration projects, they must harvest the mesquite before seed pods emerge on the branches to avoid contributing to woody plant encroachment. Branch mulch successfully increased plant cover and abundance at larger scales at Big Bend National Park in Texas, and might have similar effects if scaled in other areas of the Southwest.

NEXT STEPS

- Conduct a similar experiment but on a larger time and spatial scale
- Research the effects of smaller quantities of compost which may prove more beneficial than larger quantities by not preventing infiltration of rain and seedling emergence
- Conduct similar experiments on a variety of soils
- Place branch mulch and compost along contour lines and measure effects on soil erosion

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Mesquite Mulch Alone Increased Plant Cover & Abundance in Yr 1