

# AMADOR COUNTY RANGELAND SOIL HEALTH PROJECT

## 2021 PROJECT UPDATE

*A project by the Amador County Resource Conservation District and the University of California Cooperative Extension*

### COMPOST ON RANGELANDS

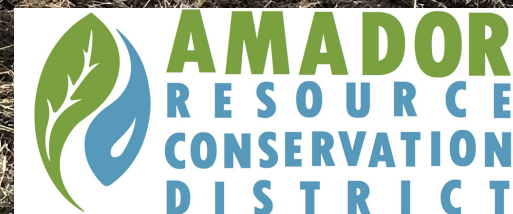
*This report summarizes the second year of data studying the effects of a one-time application of compost to annual rangelands.*

Rangeland covers more than half of California's land mass. These rangelands provide a multitude of beneficial uses, including open space, livestock grazing and wildlife habitat.

Applying compost to rangelands can provide multiple forage and soil benefits and can be an important way to divert organic waste from landfills, reduce greenhouse gas emissions that contribute to climate change, and benefit local ranchers by increasing forage productivity and forage quality.

Studies have shown a direct benefit from the one-time application of compost to rangelands, including increases in water holding capacity, forage productivity, and carbon sequestration (Silver et al 2010, Ryals and Silver 2013). Based on these preliminary studies, this project is testing a one-time addition of compost to annual rangelands in an area that currently lacks localized data.

By adding compost to the soil, we hope to see an increase in both soil fertility and water holding capacity which will ultimately increase the ability of desirable vegetation to be more resilient to climate variability and better able to compete against noxious weeds. In addition, the added fertility will make desirable forage more nutritious and more abundant for livestock, ultimately resulting in a financial benefit to the producer.



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# THE EXPERIMENT

The main purpose of the study is to gather localized data testing the one-time application of compost to annual rangelands. In addition, we want to test the potential effects compost may have on species composition particularly noxious weeds such as yellow starthistle, medusahead, and barb goatgrass. Some of our research questions include:



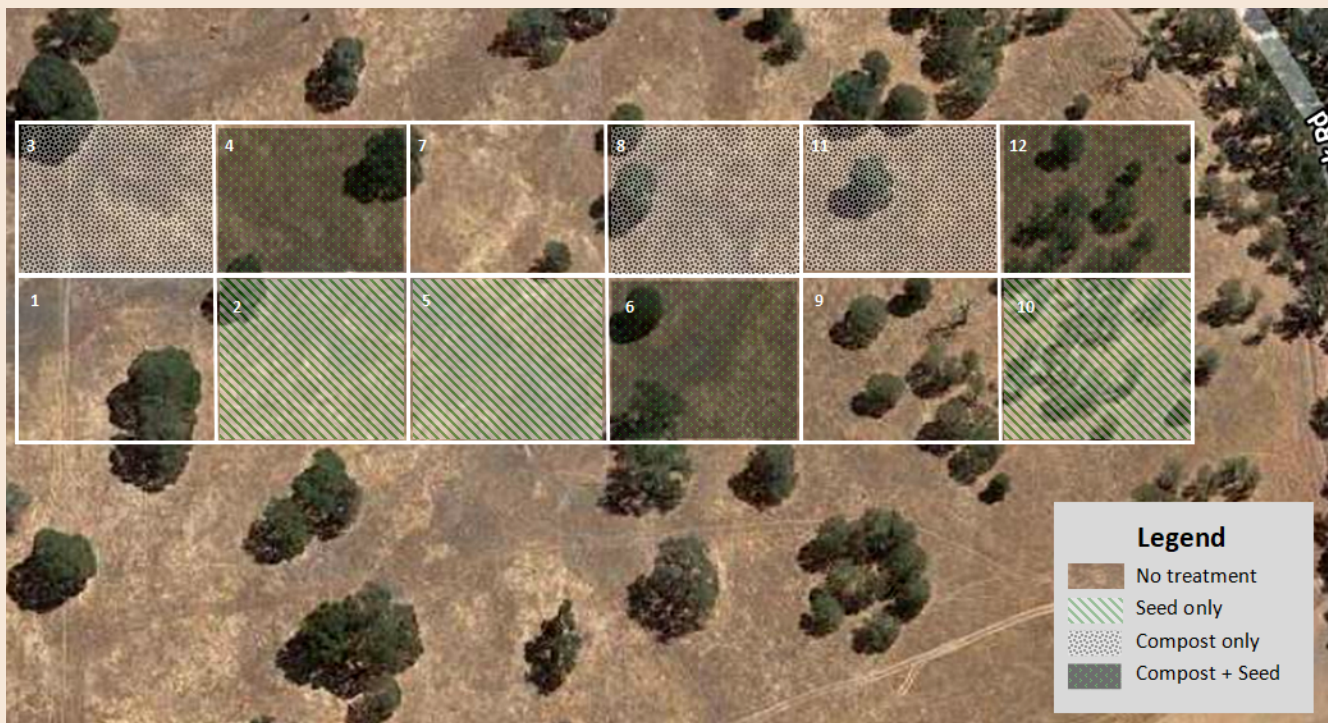
- Does the addition of compost increase weeds? Or does it shift the competitive advantage away from weeds to more desirable species?
- Can we outcompete weeds with the addition of desirable seed?
- Does compost and desirable seed have a bigger impact than compost or seeding alone?

To test this, we decided that four treatments would be required.

1. **Compost only treatment.** Applied 1/2 inch of compost (equivalent to 67 cubic yards/acre or about 34 tons, depending on moisture content and bulk density of material). Applied in September 2019 prior to fall rains.
2. **Seed only treatment.** Used a clover cover crop seed mix developed for medium rainfall areas (12-30 inches) which consists of several legume species (see label). Seed was broadcast applied at time of compost application at a rate of 20 lbs./acre.
3. **Compost and Seed treatment.** Received both compost and seed.
4. **Untreated control.** Received no compost and no seed.

## SETTING UP THE TRIAL

In spring 2019 the trial was established at five ranches in Amador County. Sites were selected based on soil type, slope, tree cover, forage productivity, and weed pressure. Each ranch has four treatments with each treatment replicated 3 times. Each treatment measures 0.5 acre with the entire experiment covering 6 acres at each ranch.





# INITIAL SOIL SAMPLING - SPRING 2019

*Extensive soil sampling was conducted in spring 2019 to get a baseline of soil conditions - special thanks to USDA Soil Scientists Andrew Paolucci, Luis Alvarez, Theresa Kunch, Jon Gustafson, USDA District Conservationist Bobette Parsons, and Resource Conservation District Resource Specialist, Gordon Long.*





# COMPOST APPLICATIONS AND SEEDING - FALL 2019

*200 yards of compost was delivered to each ranch in fall of 2019.*



*Compost was applied using a spreader at a rate of 1/2 inch per acre (roughly 67 cubic yards/acre). Special thanks to Mid Valley Ag in Linden, CA for use of the spreader.*



*Seed was spread at a rate of 20 lbs./acre using a broadcast seeder.*



## RS-321 MEDIUM RAINFALL (12 - 30 IN.)

LOSA SUB-CLOVER	10%
CAMPEDA SUB-CLOVER	15%
ANTAS SUB-CLOVER	15%
GOSSE SUB-CLOVER	15%
SEATON PARK SUB-CLOVER	10%
ROSE CLOVER	10%
FRONTIER BALANSA CLOVER	10%
NITRO PERSIAN CLOVER	10%
JESTER MEDIC	5%

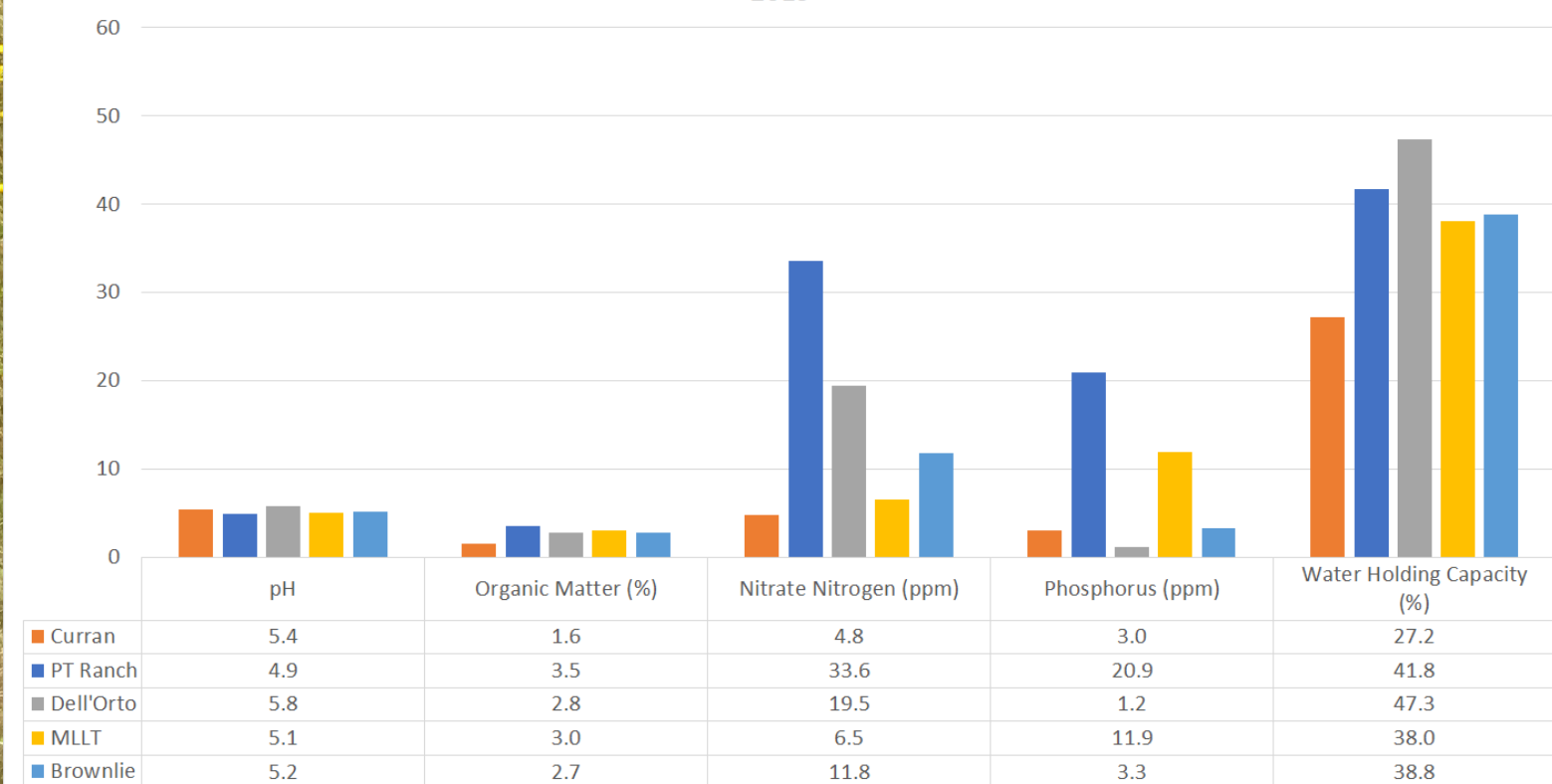


# SOIL CONDITIONS PRIOR TO TREATMENTS

*Soils across all five locations are slightly acidic with low organic matter and low in the macro nutrients nitrogen and phosphorus.*

*Soils data will be analyzed again at the end of the experiment in 2022 to determine if any of the soil conditions changed as a result of the treatments. Other factors not shown include water infiltration, cation exchange capacity, total organic carbon, and bulk density.*

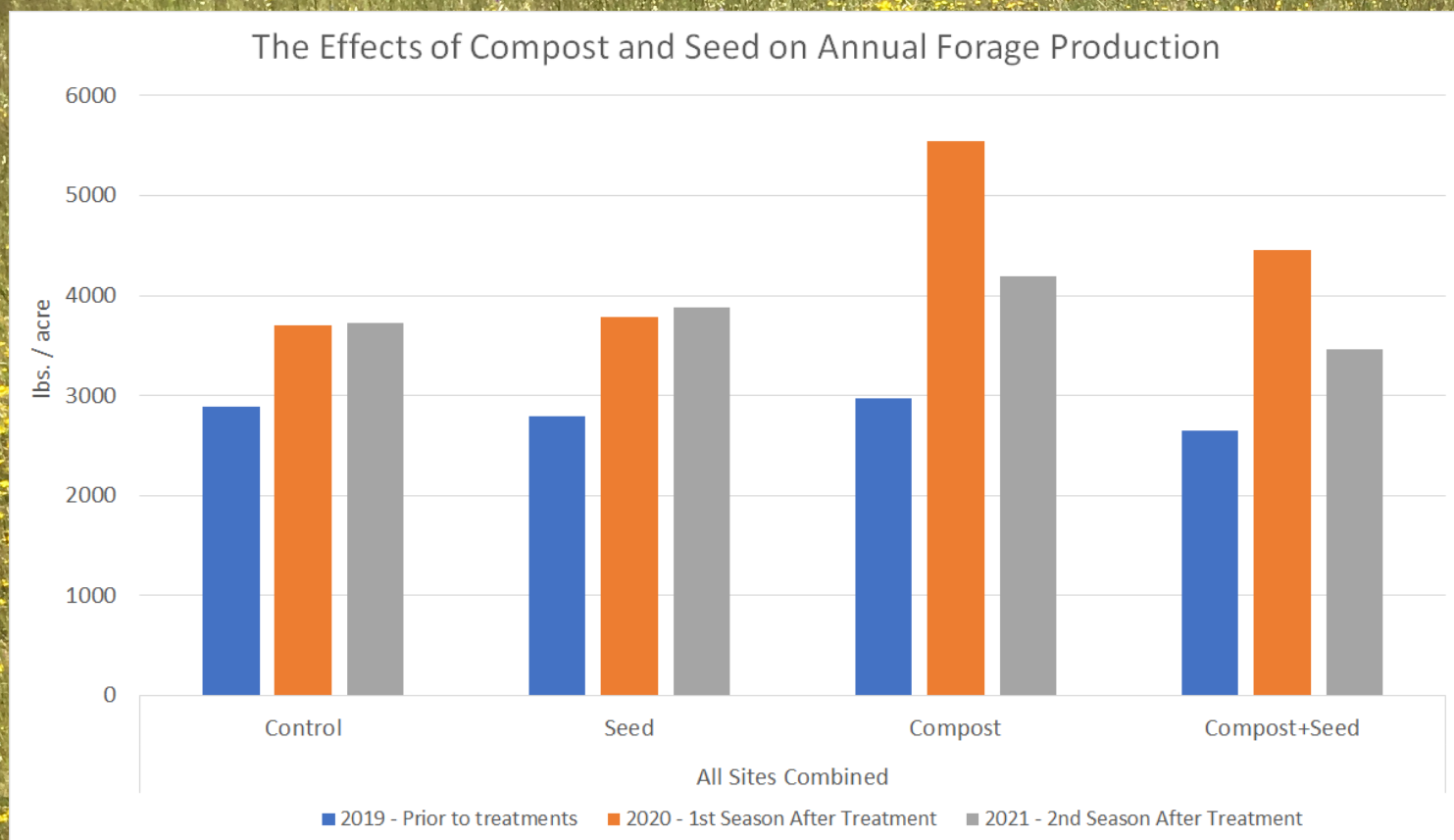
Soil Conditions at Research Sites Prior to Treatments  
2019





# FORAGE PRODUCTIVITY

Total forage production is measured at peak standing in late spring when the plants have reached their maximum total biomass.



Forage production varies from year-to-year on annual rangelands. The quantity and timing of precipitation, temperature, and sunlight are just a few factors that can influence total productivity.

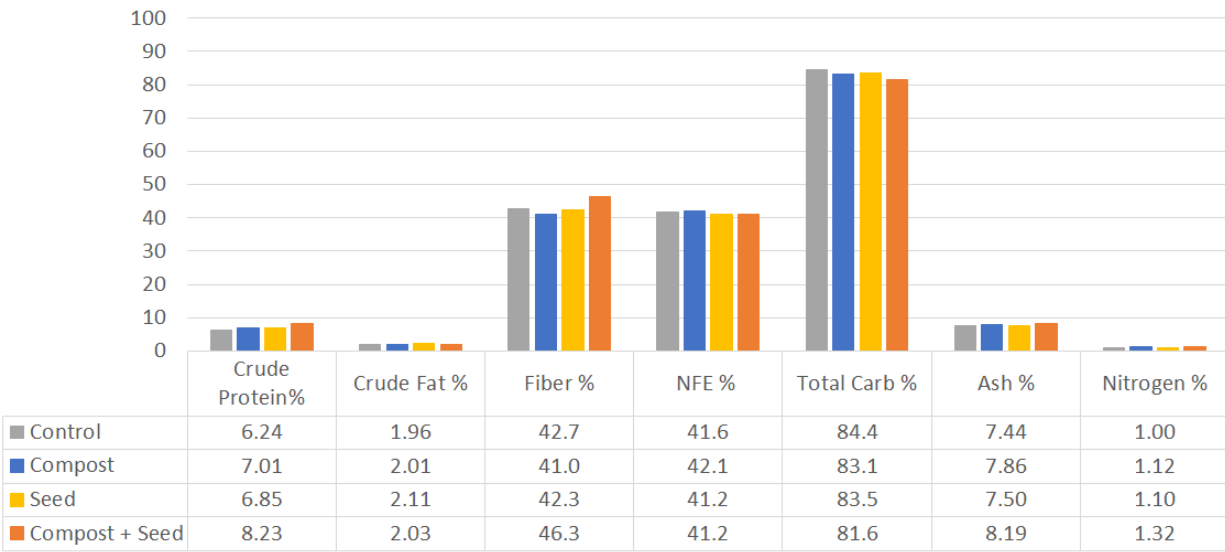
- 2019 - Prior to treatments: forage production averaged 2,826 lbs./acre across all five ranches (blue bars).
- 2020 - 1st season after treatments (orange bars):
  - Seed only treatment was nearly the same as the Control
  - Compost only treatment produced **33%** more forage than the Control
  - Compost plus Seed treatment produced **17%** more forage than the Control
- 2021 - 2nd season after treatments (gray bars):
  - Overall, less variation amongst treatments
  - Compost only treatment produced **11%** more forage than the Control
  - Seed only and Compost plus Seed produced nearly the same as the Control



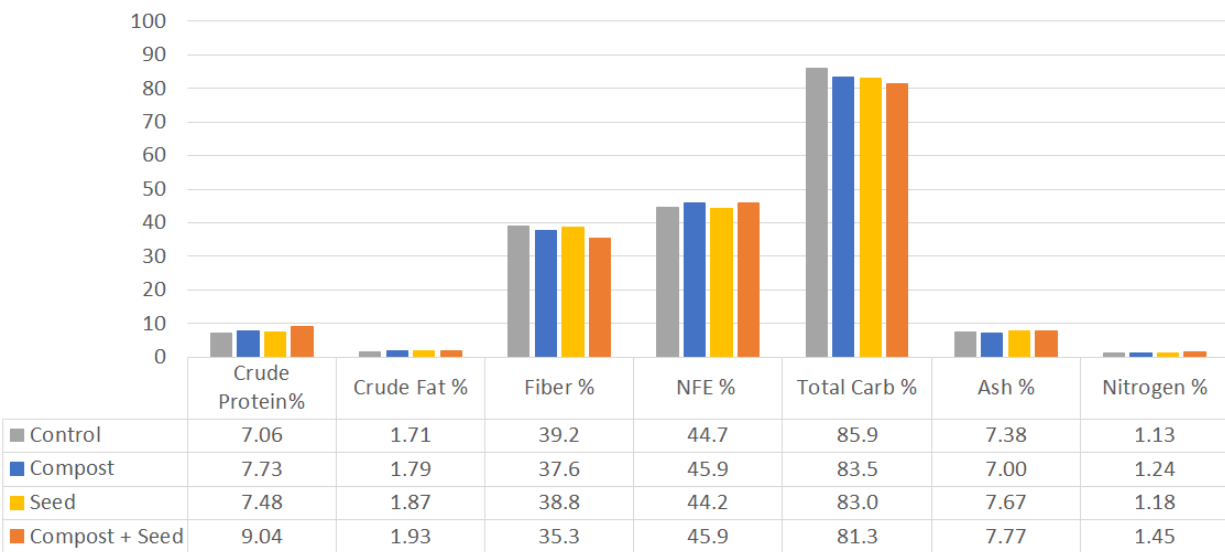
# FORAGE QUALITY

Forage quality is a measurement of the nutrient value of forage and varies with plant species, season, location and range practices. Indicators of high forage quality such as protein, energy, vitamins and minerals decline as the growing season progresses. Conversely, indicators of low quality such as fiber and lignin increase as forage plants mature.

The Effects of Compost and Seed on Forage Quality  
2019 - 2020 Season



The Effects of Compost and Seed on Forage Quality  
2020 - 2021 Season



In the Compost and Seed treatment (orange bar), crude protein was **31%** higher than the Control in 2019/2020 (1st season after treatment) and was **28%** higher in 2020/2021 (2nd season after treatment).



# PLANT DIVERSITY

One of the main goals of the project is to examine the effects compost and/or seeding with a clover seed mix may have on desirable forage and invasive weeds.

Season 1 after treatments: 2019 - 2020

## The Effects of Compost and Seed on Plant Cover

% Cover by Species  
2019 - 2020 Season

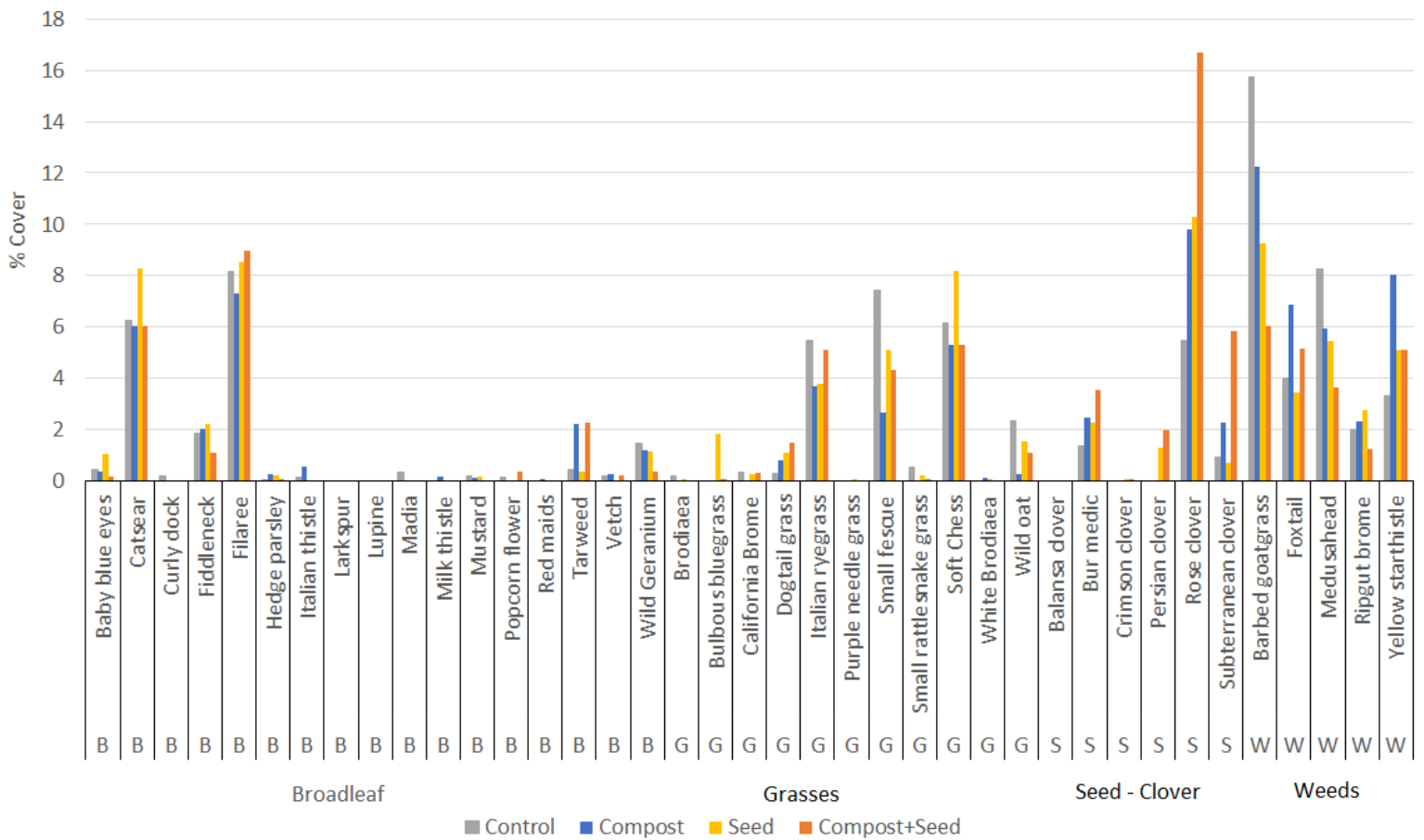


Chart shows plant cover at all five ranches. Plants are categorized based on type: Broadleaf, Grasses, Seed - Clover, and Weeds. Colored bars represent the four treatments. In the first season after treatment (2019/20), several clovers showed a significant increase in the Compost plus Seed treatment (orange bars). The invasive weeds, barb goatgrass and medusahead were less abundant in all treatments with the greatest decrease in the Compost plus Seed treatment.



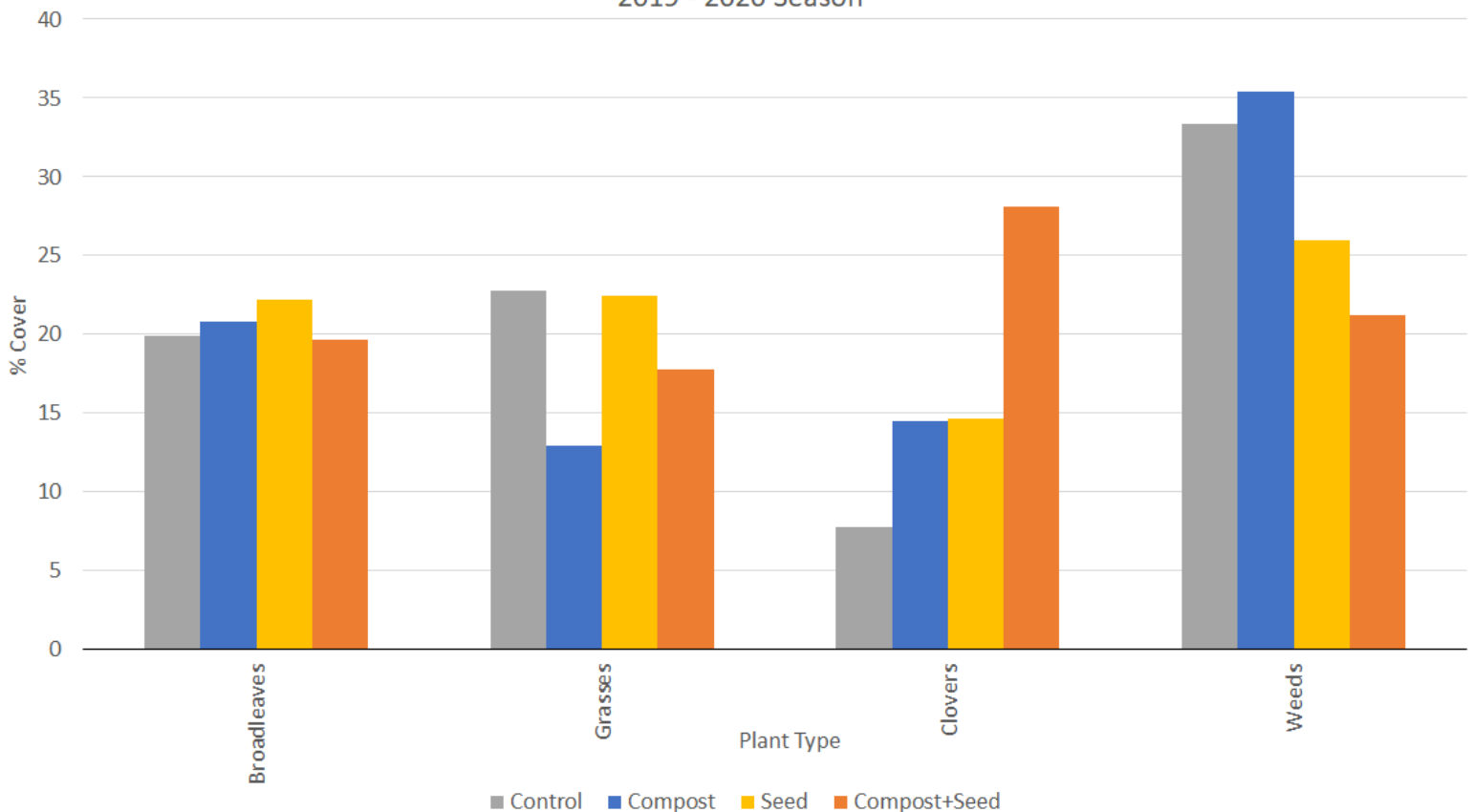
# PLANT DIVERSITY

*By combining plant species into major groups (Broadleaf, Grasses, Clovers, and Weeds), we can get a better understanding of what effects any of the treatments might have on each group.*

*Season 1 after treatments: 2019 - 2020*

## The Effects of Compost and Seed on Plant Cover

% Cover by Plant Type  
2019 - 2020 Season



In season 1 (2019/20), broadleaf plants showed no significant difference between treatments. For the desirable grasses, the Compost only treatment resulted in **43%** less grasses than the Control. The addition of compost might give a competitive advantage to broadleaf plants. In the clover category, the Compost only and Seed only treatments both resulted in an **87%** increase over the Control. The Compost plus Seed treatment resulted in **250%** more clover than the Control. In the weed category, the addition of compost alone didn't seem to impact weed populations. Likewise, in the Seed only treatment weeds were 21% less than the Control. The Compost and Seed treatment resulted in a **36%** decrease in weed cover.

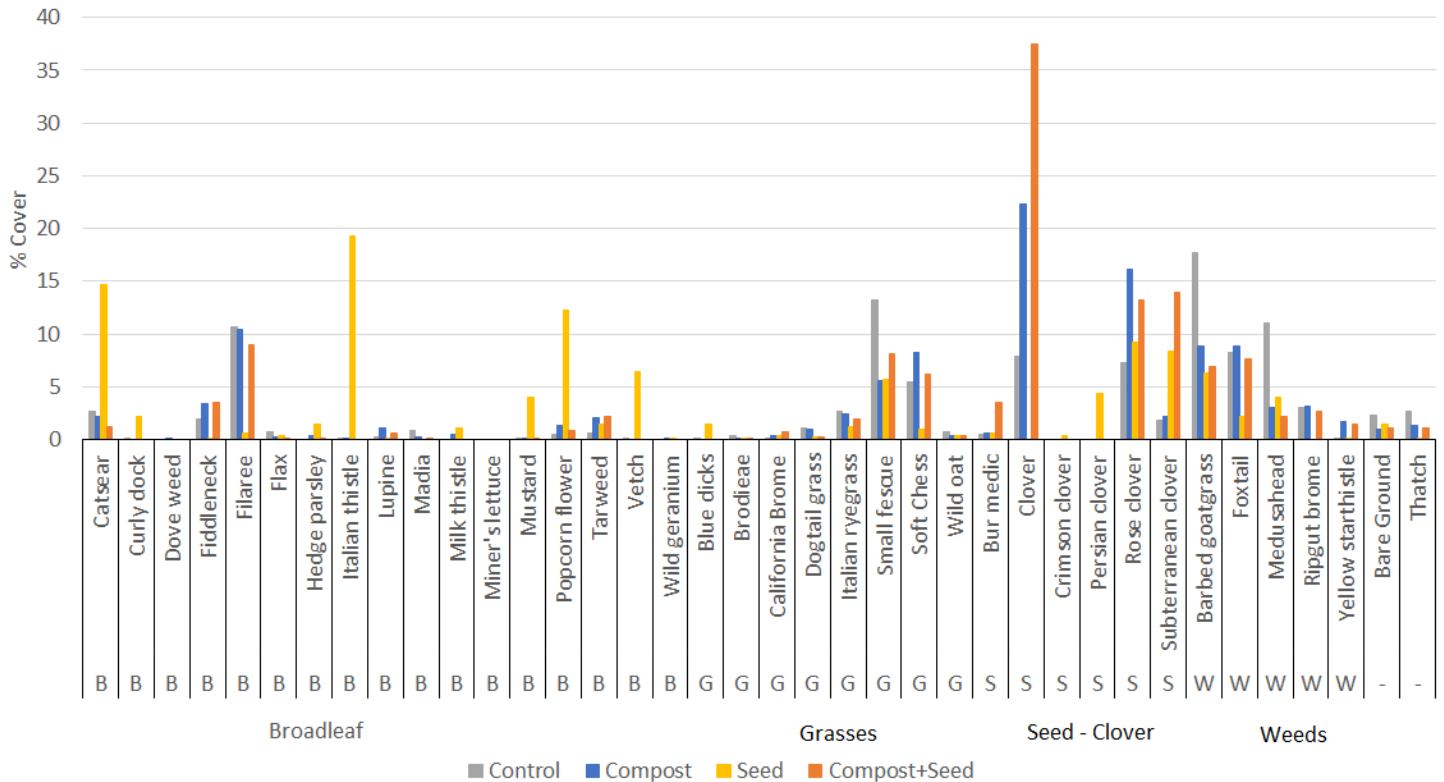


# PLANT DIVERSITY

Season 2 after treatments: 2020 - 2021

## The Effects of Compost and Seed on Plant Cover

% Cover by Species  
2020 - 2021 Season



In 2020/21, the 2nd season after treatment, we continued to see a dramatic increase in the amount of clovers in the Compost plus Seed treatments (orange bars). Likewise we continued to see a decline in the amount of both barb goatgrass and medusahead in the Compost plus Seed treatment when compared to the Control.

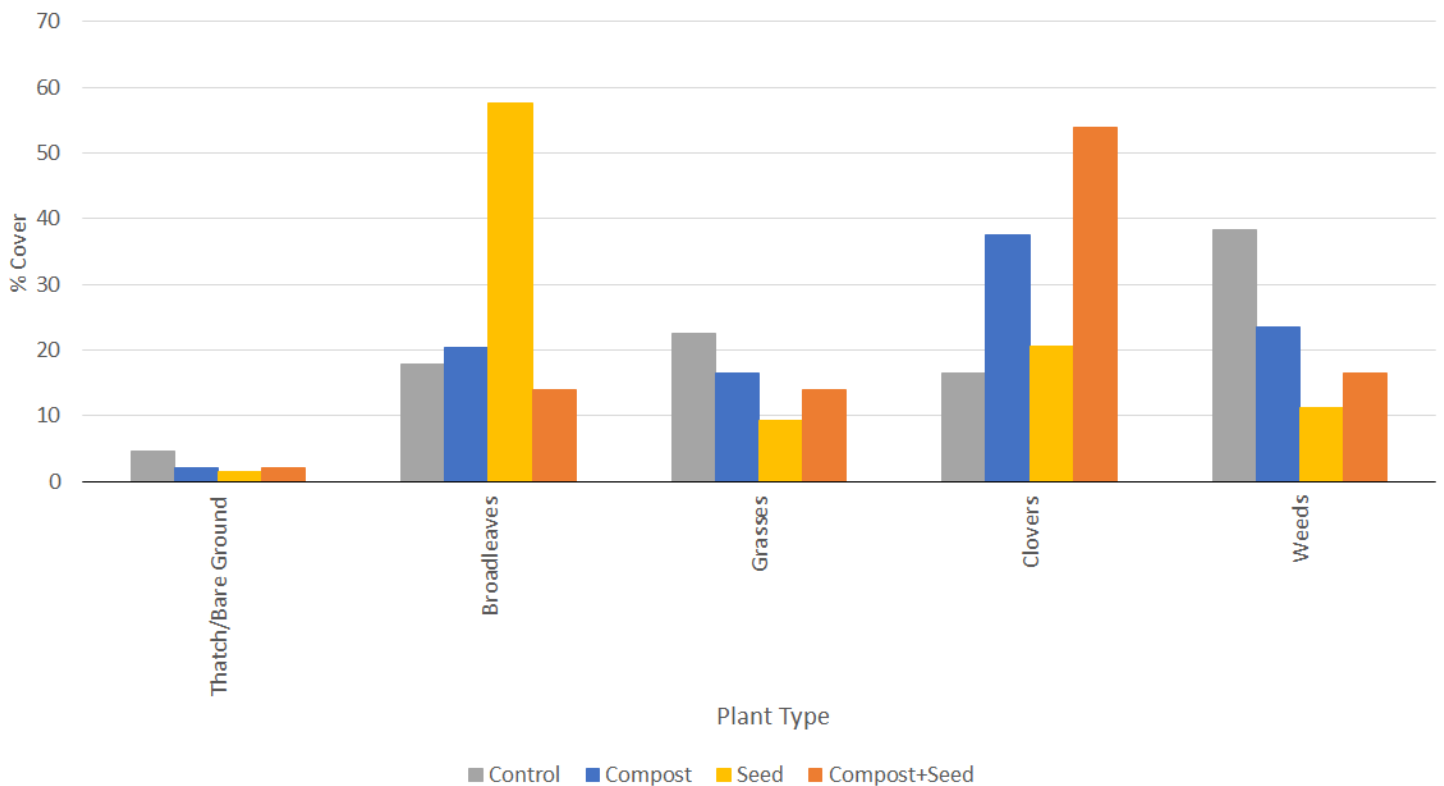


# PLANT DIVERSITY

Season 2 after treatments: 2020 - 2021

## The Effects of Compost and Seed on Plant Cover

% Cover by Plant Type  
2020 - 2021 Season

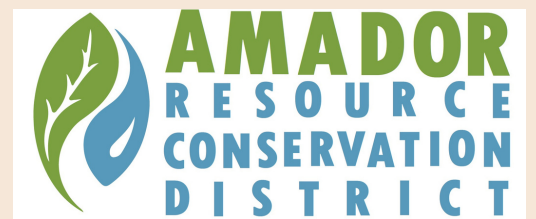


In season 2 (2020/21), broadleaves were most abundant in the Seed only treatment. Similar to season 1, clovers were highest in the Compost plus Seed treatment, with **217%** more clover than the Control. Seeding alone, did not yield similar results. The Seed only treatment resulted in only **23%** more clover than the Control. Also noteworthy, Compost only resulted in more clover than the Seed only treatment, however Compost plus Seed still resulted in the highest cover. In the weed category, the Compost plus Seed treatment had **55%** less weed cover than the Control, while the Compost only and Seed only treatments contained **39%** and **71%** less weeds respectively.





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