AMADOR COUNTY RANGELAND SOIL HEALTH PROJECT

2022 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 third, and final, 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.

AMADOR RESOURCE CONSERVATION DISTRICT

University of California
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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:

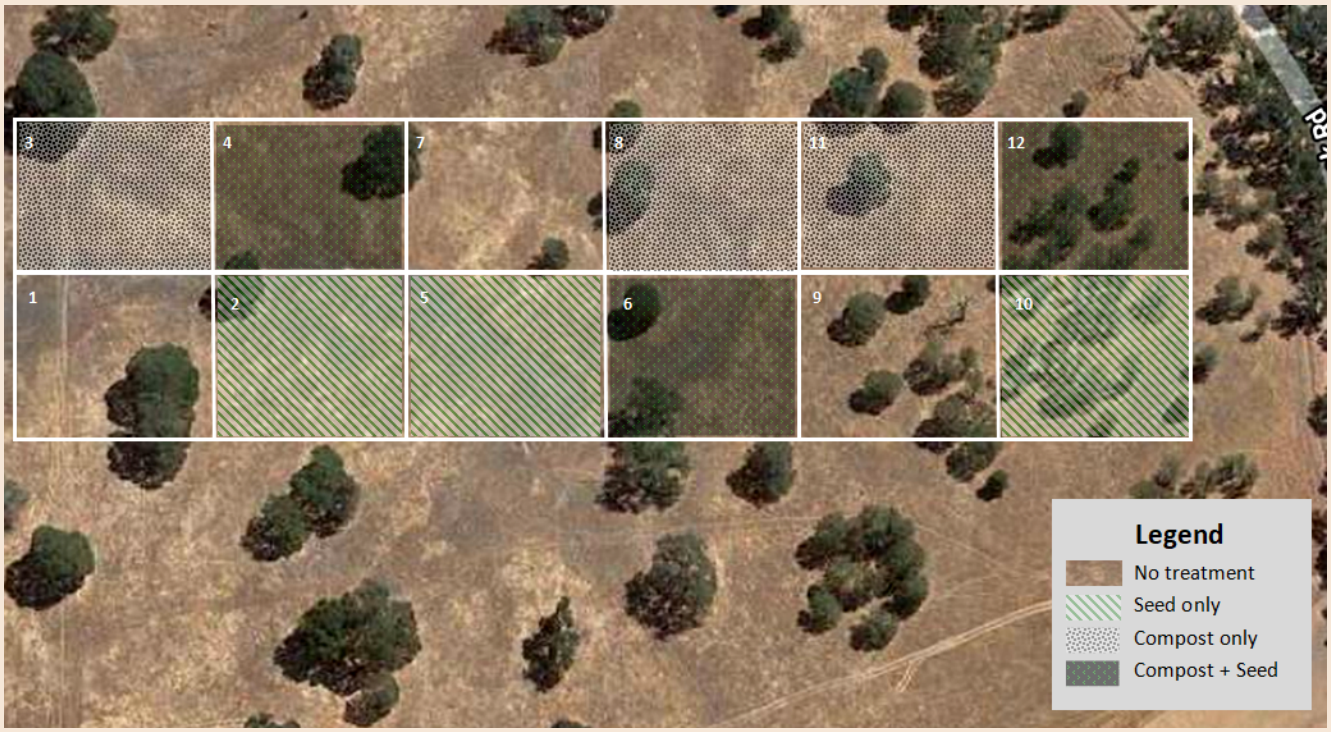
- Does the addition of compost increase weeds? Or does it shift the competitive advantage away from weeds to more desirable species?
- Can we outcompete weeds with the addition of desirable seed?
- Does compost and desirable seed have a bigger impact than compost or seeding alone?

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.

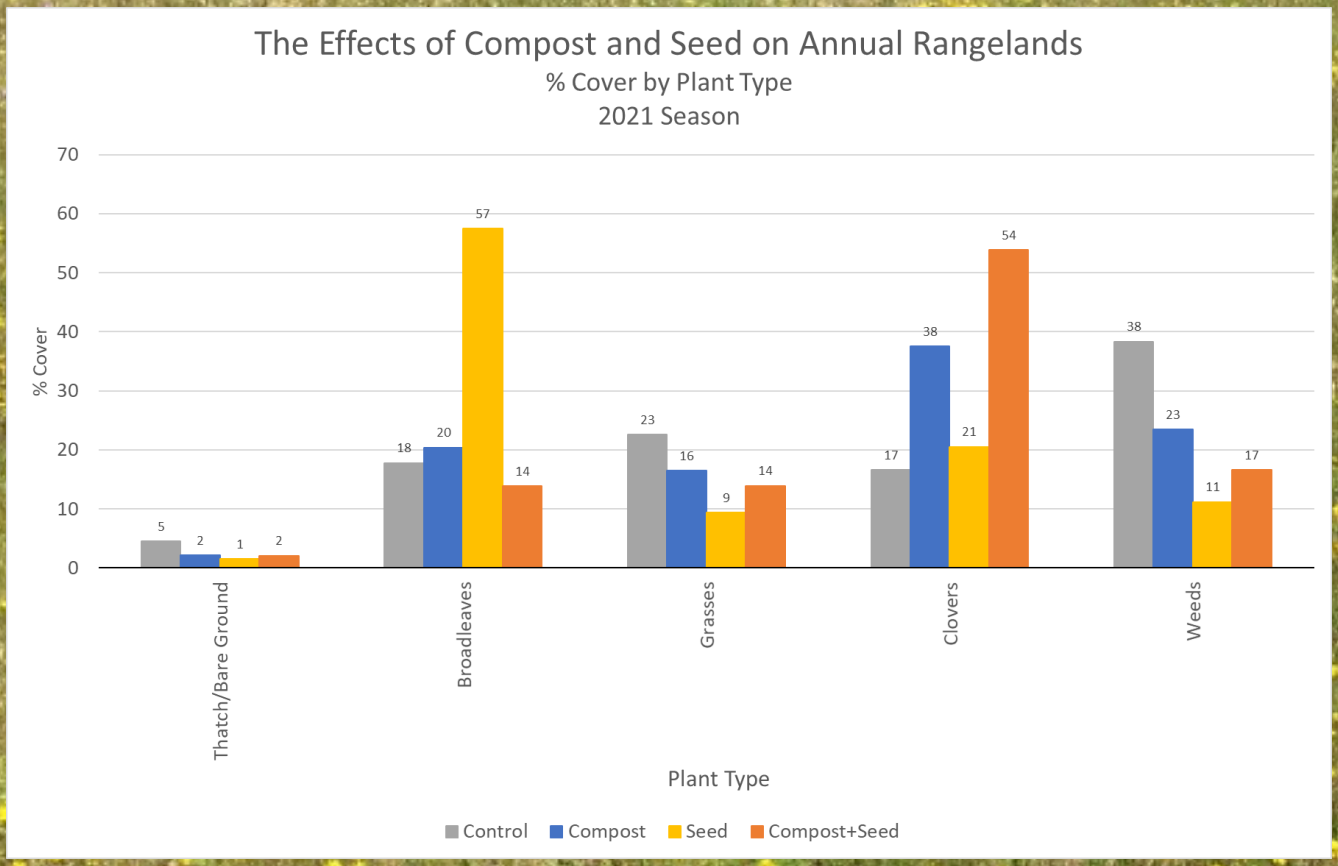
Compost was applied using a spreader at a rate of 1/2 inch per acre (roughly 67 cubic yards/acre). Special thanks to Mid Valley Ag in Linden, CA for use of the spreader.

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%

RESULTS: PLANT DIVERSITY

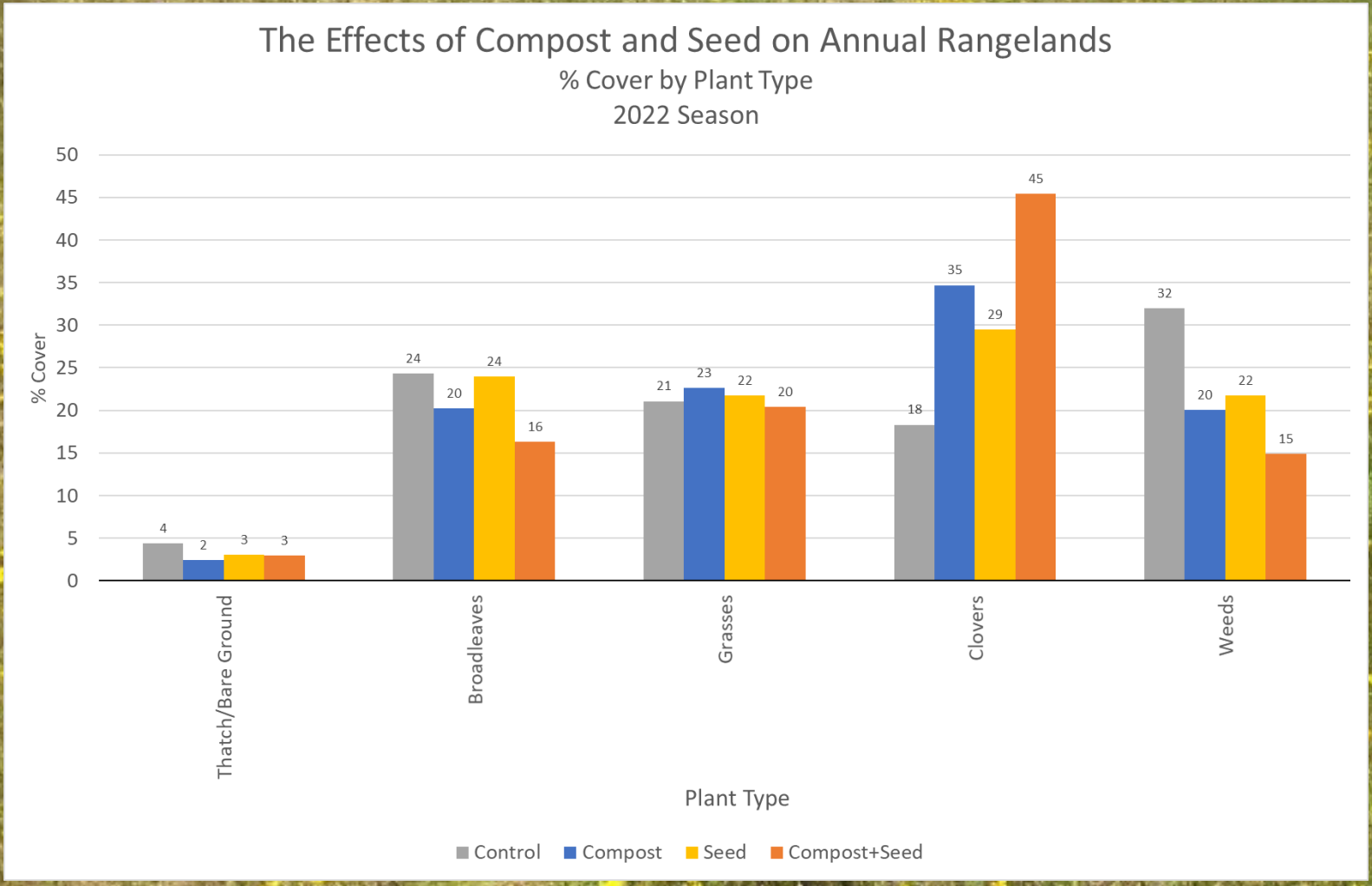
One of the goals of the project was to determine if the addition of compost either alone or in combination with desirable cover crop seed could increase the amount of clovers (which would ultimately be better for range conditions in the long term as it would fix nitrogen in the soil). The other factor was would either of those treatments have an impact (negative or positive) on invasive weed populations. The weeds of concern included: yellow starthistle, medusahead, barb goatgrass, ripgut brome. We also were curious about the quantity of forage and the nutritional value of the forage.



In 2021, two years after treatment we saw a **217% increase in the amount of clover across all ranches in the compost + seed treatment**. This is very drastically different than when you just put seed out on the rangeland. In the **seed only treatment we only saw 23% more clover** (going from 17% cover in the untreated to 21% cover in the seed only treatment). The compost + seed on the other hand had 54% clover! Even in the compost only treatment we saw an increase in clover establishment. Meaning the clover seed is there, it just is not able to compete with the grasses and other broadleaf plants. **With the addition of compost only, we saw an increase in clover from 17% to 38% which is a 123% increase.**

When it comes to the effects of compost and cover crop seeds on noxious weeds, we also saw some really interesting treads. In 2021, across all ranches we had 38% cover on noxious weeds in the untreated plots. **When we add compost only, we saw a decrease of 39% in total weed cover** (38% down to 23%). In the seed only we also saw a decrease in weeds from the control, **meaning the addition of cover crop seeds does compete with invasive weeds.** In the **compost + seed treatment we also saw a drastic 55% decrease in weed cover**, going from 38% cover in the untreated to only 17% cover in the compost + seed.

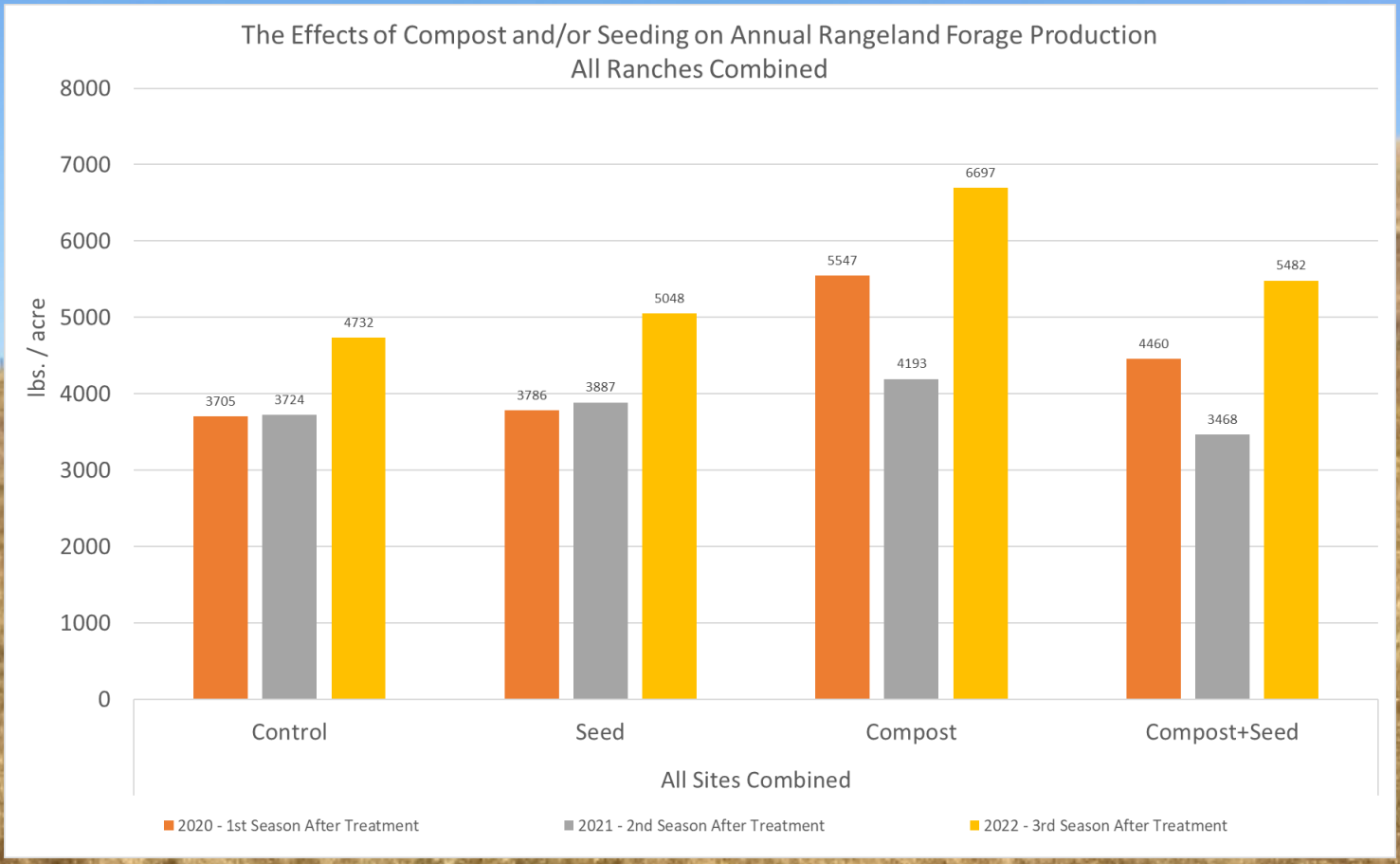
RESULTS: PLANT DIVERSITY



In 2022, the third year after treatment, we saw very similar trends as in 2021. In terms of percent clover, we saw nearly identical trends in all treatments. Clover was lowest in the untreated plots (18%) and we saw the **highest amount of clover in the compost + seed treatments 45%. This is again a 150% increase in clover from this treatment**. For noxious weeds, we again saw a nearly identical trend as in 2021. Noxious weeds were highest in the untreated plots were we had 32% cover of weeds. **In the compost only and seed only treatments we saw a 37% decrease in weeds** in each of those treatments, but **the greatest decrease in weeds was in the compost + seed treatment where we saw a 53% decrease in weed cover.**

RESULTS: FORAGE PRODUCTION

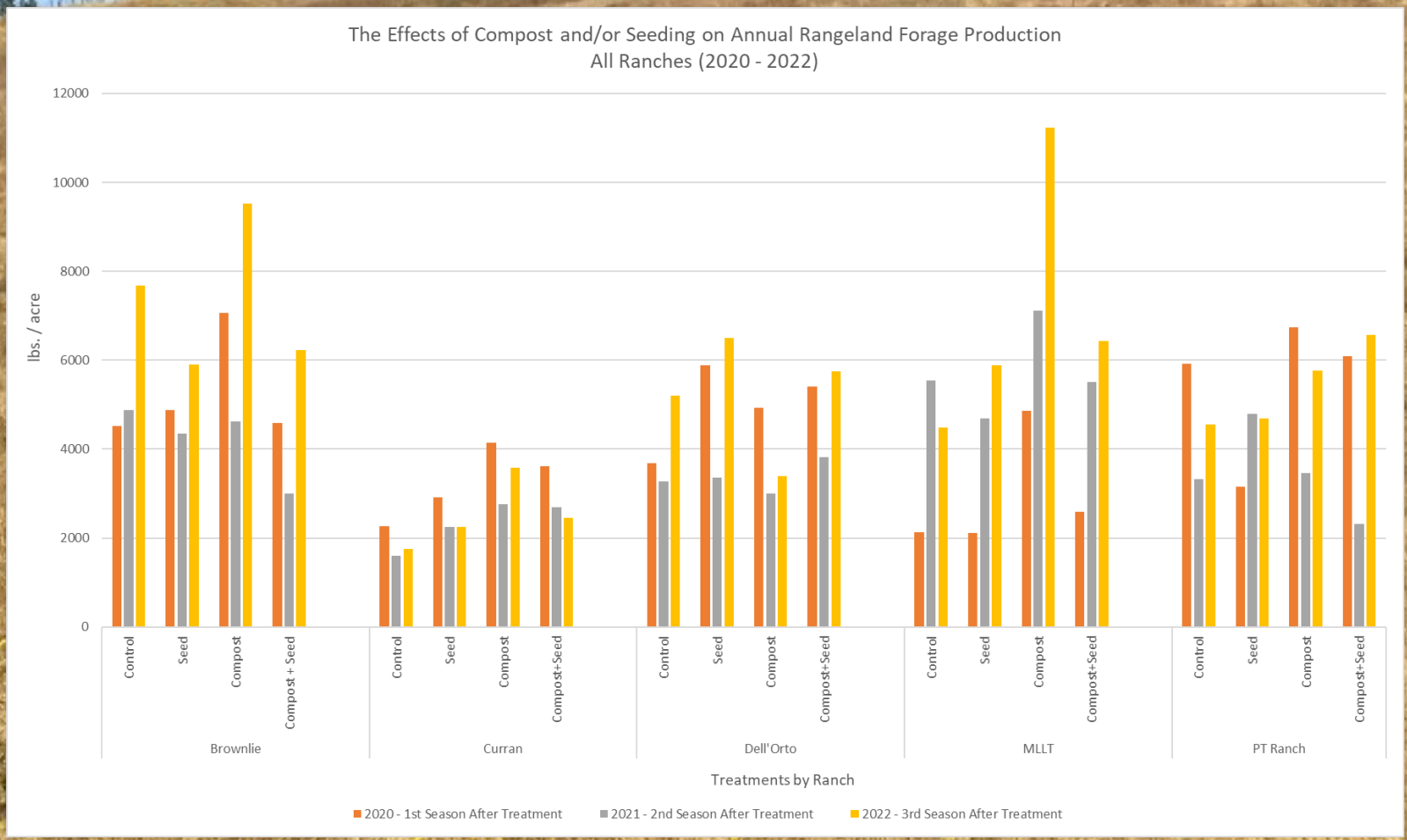
Total forage production is measured at peak standing in late spring when the plants have reached their maximum total biomass. Forage production varies from year-to-year on annual rangelands. The quantity and timing of precipitation, temperature, and sunlight are just a few factors that can influence total productivity.



As for forage production, the above graph shows what forage production did across all 5 ranchers over the entire project. Each color represents a year, so for example compare all the blue bars as a unit and all the orange bars as a unit. Across all years, the seed only treatment was no different than the control plots. As for the **compost only and the compost+seed, in general we saw an increase in forage production in both those treatments in all years as compared to the control.** For example, in the compost only treatment we saw a 33% increase in forage in the first year after treatment, a 11% increase in the second year two, and a 29% increase in year three, for an ***average increase of 25% over the control***! For the compost plus seed treatment again we saw an increase in every year (except one), ***for a total average increase of 8% over the control***. There were more significant increases at individual ranches, and that graph is on the following page.

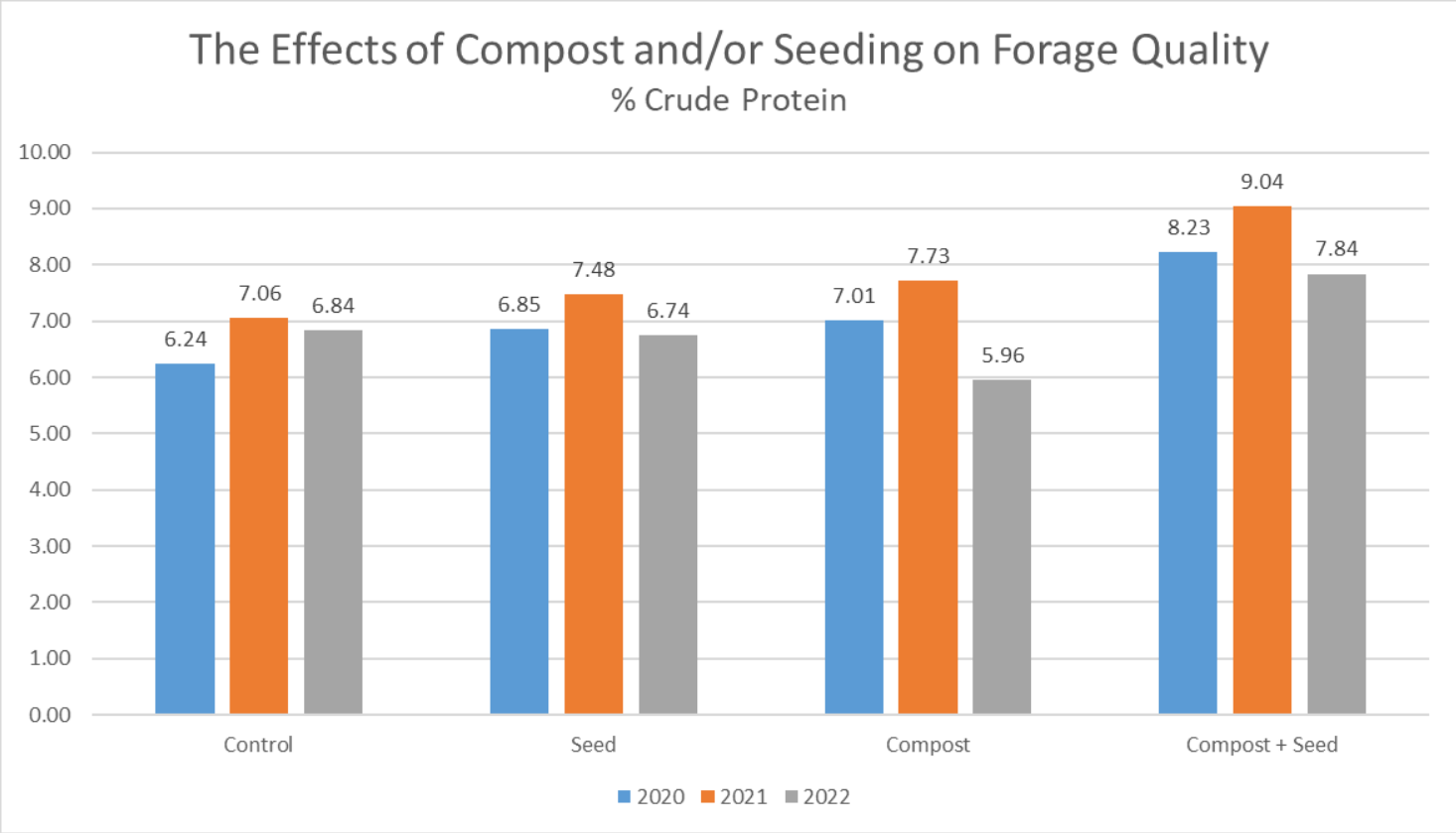
RESULTS: FORAGE PRODUCTION

The below graph shows forage productivity for the individual ranches over the three years of the project.



RESULTS: 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.



One of the best indicators of forage quality is crude protein. Data shows on average (across all three years) across crude protein was 25% higher than control plots.

The compost + seed treatment had the highest crude protein every year.

WESTERN SARE
Sustainable Agriculture Research & Education

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