Sacramento Valley Field Crops Newsletter

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Grazing Summer Cover Crops: Species Selection is Key

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Two years of a field trial in Colusa County have been completed evaluating the economic opportunity and soil health benefits of grazing summer cover crops. This project team brings together Benden Farms and Kingsley Farms as well as UC Cooperative Extension Advisors Sarah Light and Josh Davy.

The project evaluated termination treatments for a summer cover crop. The cover crop mix was planted at the end of summer and irrigated up. After good growth and establishment, plots were terminated in one of three ways:

- Control: chopping and discing to incorporate the cover crop
- Grazing: cows grazed directly in the plots and weighed before and after for weight gain
- Baling: cover crop was cut and windrowed, then baled for forage

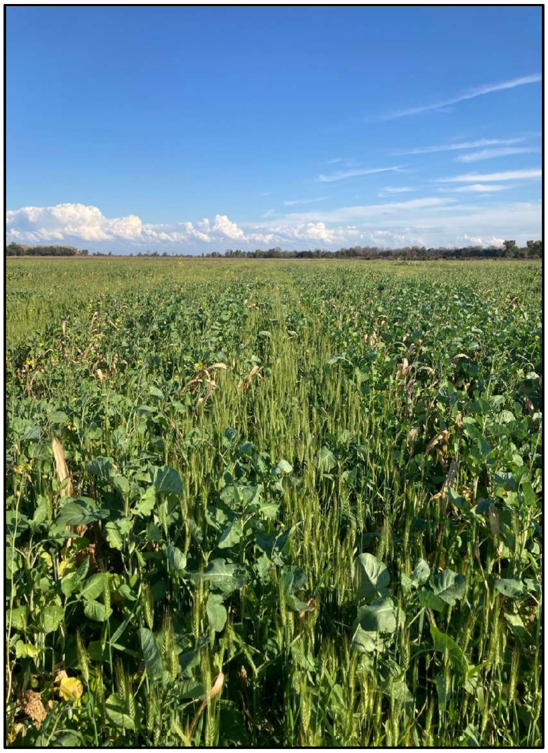
Soil samples, crop yield, cattle weight gains, and economic data were collected.

Lessons have already been learned. In the first year a mix of sunnhemp, blackeyes, kale, and Piper sudangrass were planted at the end of August and grew rapidly in the warm weather. Cows were put on the field about a month later and grazed the mixture.

Picture 1: Cows grazing in plots in year one. In the foreground is a treatment plot that has been cut and baled.

The second year we doubled the size of the trial area and planted mix of buckwheat, blackeyes, kale, turnips, white proso millet, and 'Piper' sudangrass. Plots were planted in August and the cover crop again established well and grew rapidly. However, when the cover crop was ready to be grazed, cows were calving and could not be moved to the planting location. This caused a delay in grazing by several weeks.

This pushed the grazing time into early fall, which unfortunately was met with an early frost. 'Piper' sudangrass is a variety with a reputation for not developing as much prussic acid during dry spells when compared to other sudan varieties, however, all varieties are susceptible after frost. This early frost triggered the need to test the cover crop for prussic acid prior to putting the animals on the field. Forage samples were submitted to the UC Davis CAHFS lab for analysis and produced dangerously high toxicity levels. When ingested, prussic acid converts to a cyanide compound that will cause death in livestock. With these risks the decision was made to not graze the field. Instead, the cover crop was incorporated into the soil for increased organic matter and the associated soil health benefits.



Picture 2: Ungrazed cover crop mix year two.

We originally chose sudangrass as a main component in our summer cover crop for several reasons. Sudangrass is a fast-growing species and produces substantial biomass in a short period. The seed is low in cost and the forage is high quality if not allowed to mature. However, if it is not grazed prior to frost, it can be toxic for animals.

To avoid this risk in the future, the team plans to select a different cover crop mix and repeat the same trial harvest design this summer.

In this scenario the cover crop is planted in mid to late summer after a cash crop has already been harvested. The risk with sudangrass is that although there is ample time to grow a large amount of biomass, it also creates a short grazing window due to the risk of toxicity. In addition, the summer planted cover crops are grazed at a very busy time of year for other farm operations. Having a cover crop with a more flexible grazing window will make it easier to implement harvest strategies and will ensure animal safety. The results from this project will be shared once the next season is completed.

Thank you to the Western SARE Farmer/Rancher Research and Education Grant program for funding this project.

Compost Application to Alfalfa

Michelle Leinfelder-Miles, UCCE Delta and Agronomic Crops Farm Advisor
Radomir Schmidt, UC Davis Center for the Environment

The term 'soil health' has become a common term in agricultural research and management. While most of us are familiar with testing soil for chemical properties, like nutrients, salinity, and pH, soil health also considers soil physical characteristics – like compaction, aggregation, and water infiltration – and biological characteristics – like soil respiration, active carbon, and nitrogen mineralization.

These properties influence the soil's ability to function, and enhancing these properties can improve soil functioning to grow crops and produce ecosystem services. We often relate soil health to management practices like crop rotation, cover cropping, reducing tillage, and adding compost because these have been shown to increase soil functioning in agricultural landscapes. They are also some of the practices that are financially incentivized by the CA Department of Food and Agriculture Healthy Soils Program.

With a Healthy Soils Program grant, we have been evaluating the use of green waste compost on established alfalfa. Compost is decomposed organic matter from plants or animals. Plant-derived composts – like green waste compost – have a high carbon-to-nitrogen ratio (C:N), which is the relative amount of carbon and nitrogen in the material. Animal-derived composts have a low C:N. The C:N ratio is important because it affects microbial metabolic functioning and plant-available nitrogen.

There is a regulatory framework for diverting green waste from landfills to make compost. In 2014, AB 1826 was passed in California, which required businesses to recycle organic wastes and jurisdictions to set up organic waste recycling programs to divert green waste from landfills. In 2016, AB 1383 established organic waste reduction targets (75% reduction by 2025, compared to 2014). The bill also required jurisdictions to do education and outreach. Green waste diversion is expected to reduce greenhouse gas emissions by 4 million metric tons per year and increase food recovery by 20 percent. Agricultural land could serve to receive green waste compost recovered by this regulatory framework.

Our project objectives were to learn whether green waste compost improves soil nutrient status or other soil health characteristics, whether it improves alfalfa yield or quality, or if its application affects greenhouse gas emissions from the system. Alfalfa was chosen for this study because it has a large footprint on the state's agricultural landscape and because it has a high phosphorus (P) and potassium (K) nutrient need which compost could help supply. Also, as a 'high-traffic' crop, alfalfa soils can have poor physical traits (e.g. compaction, water infiltration), which could potentially be ameliorated with compost.

The study was conducted on commercial farms in Yolo and San Joaquin (SJ) counties. The Yolo site had a mineral soil with high clay content (approximately 50 percent clay), and the SJ soil was a mucky clay with high organic matter (approximately 8 percent). We are comparing two green waste compost rates (3 and 6 tons per acre) to the untreated control. Compost applications were annually (2020-2022) surface-applied in the fall/winter ahead of rain.

Our preliminary results indicate no statistically significant differences in total carbon and nitrogen among treatments (Fig. 1). There is a trend, however, for compost to increase carbon at the Yolo site, which is inherently low in organic matter. An interesting observation about the SJ site, where the soil is inherently low in K, is that the compost increased soil K (statistically significant, Fig. 2). The compost analysis showed that the product was roughly 1 percent K. Therefore, the 3-ton compost rate should have added approximately 50 lb of K per acre, and the 6-ton rate approximately 100 lb of K per acre. Based on the amount of change in soil K and the compost analysis, the compost was likely what contributed to the increase in soil K. This appears to be translating into higher tissue K (Fig. 2), and in turn, higher yields (though neither tissue K nor yield are statistically higher than the control, Fig. 3).

Greenhouse gas emissions have not differed among treatments (Fig. 4), indicating that the carbon that is added by the compost is not being respired from the system. There are higher CO_2 emissions at the SJ compared to the Yolo site, which we attribute to the inherently higher carbon of the SJ soil. Additionally, we have observed that the soil acts as a methane sink. This is noteworthy because methane is a more potent greenhouse gas than CO_2.

Based on our experiences working on this project, we have the following guidance for growers interested in applying green waste compost. While green waste compost is a relatively cheap input, transport cost can be high. In 2021, we estimated that material plus hauling cost was approximately $27/ton and spreading was an additional $10/ton. The highest demand for compost is in the fall. To ensure availability, growers should aim to purchase compost in the spring or summer and store it on-site until fall. Ordering the compost in spring or summer also tends to result in a higher quality product delivered (i.e. less trashy). Timing compost application can be a challenge (i.e. after all harvests but before soil gets too wet), so having the compost already on-site may help in getting it applied more readily. We still have more data to analyzed for this project, so more information will be forthcoming. We want to thank the growers in Yolo and San Joaquin counties for collaborating with us on this project.

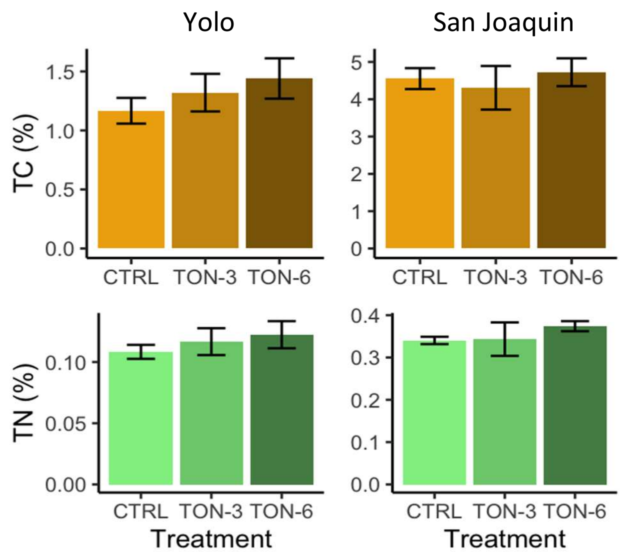


Figure 1. There were no statistically significant increases in soil carbon (C) or nitrogen, but there was an observed trend for C to increase at the Yolo site, which has inherently low soil organic matter.

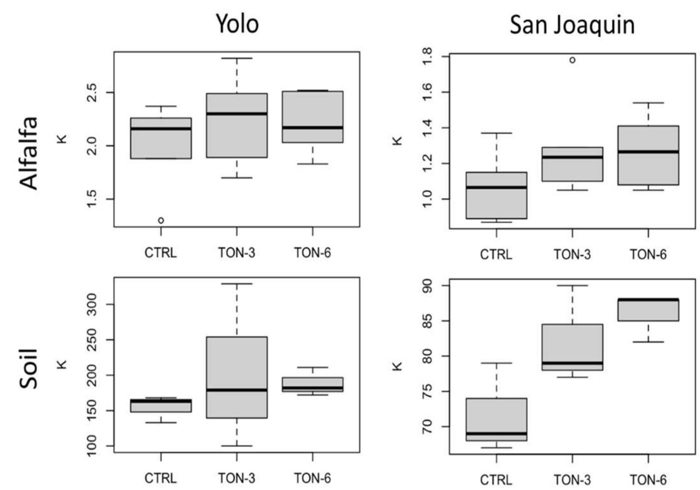


Figure 2. Compost increased soil potassium (K) at the SJ site, where soil K is inherently low. There was a trend for alfalfa tissue K to increase at the SJ site, which was likely the due to the higher soil K.

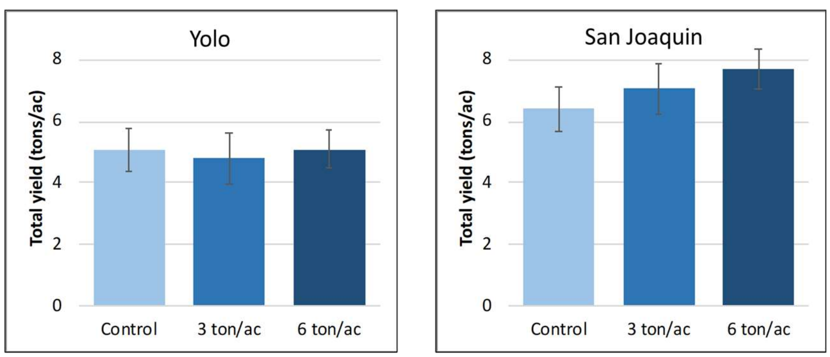


Figure 3. Compost amendment did not statistically improve alfalfa yield, but there was a trend for yield to increase at the SJ site, which we attribute to improved K availability.

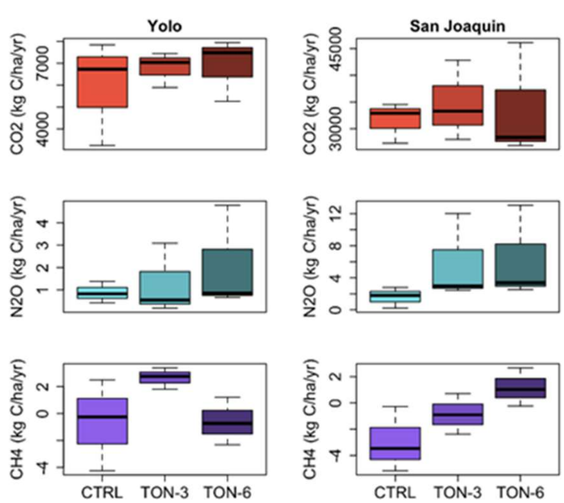


Figure 4. Greenhouse gas emissions did not increase with compost amendment.

Herbicide Resistance and How to Prevent It

Ryan Hill, UCCE Agronomy and Weed Science Advisor, Tehama, Shasta, Glenn Counties

Herbicide resistance has been documented in hundreds of weed species and found all over the world. Weeds can use a surprisingly wide range of methods to overcome the best tools we have to control them.

This article will shed light on some of the different types of resistance and how these differences can affect our weed management decisions. Generally, herbicide resistance can be classified into two basic categories: target-site resistance and non-target-site resistance.

Target-Site Resistance:

The simplest form of resistance is target-site resistance. The "target-site" refers to the molecule inside of a plant that an herbicide targets to cause the desired effect. These are referred to on the label as modes of action (MOA). When that molecule inside the plant has a slightly different shape or structure it can make the herbicide unable to interact with it. This can make the herbicide ineffective for killing that weed. Resistant plants of this type are rare in a wild population, but in an agricultural field those plants might be the only ones to survive an herbicide application. If unchecked, they can reproduce rapidly and their progeny will also have the resistant gene. This type of resistance can be referred to by the lock-and-key analogy. Figure 1 demonstrates how a change in an herbicide's target can result in strong herbicide resistance, as if the herbicide "key" no longer interacts properly with its target "lock".

Changing herbicide modes of action used to control a given weed works well to control target-site resistance. Each herbicide is assigned a mode of action based on what process it targets in a plant. These modes of action are designated by a number, found on the front page of the product label. For example, carfentrazone (Shark) and pyraflufen-ethyl (ET) are both group 14 herbicides so rotating between these would NOT be effective for resistance management. Instead, group 4 herbicides like 2,4-D or MCPA could be a good option, depending on the weeds targeted.

Rotating chemicals is important because it prevents resistant weed populations from reproducing and spreading within one field or a larger region.

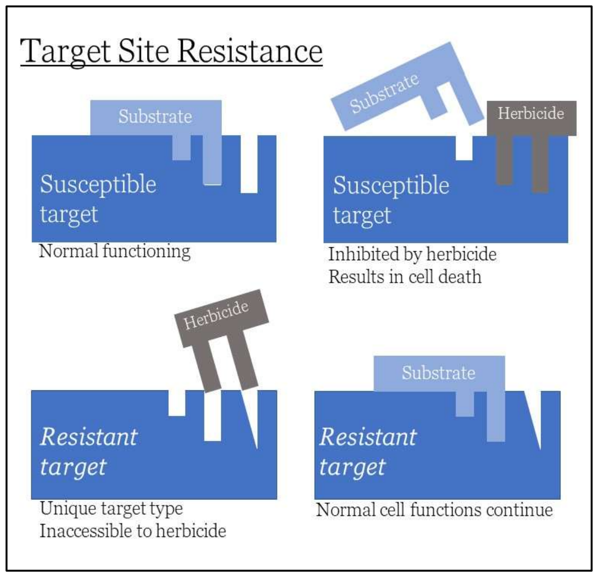


Figure 1

Non-target-Site Resistance:

Non-target-site resistance is a term used to describe every other form of resistance. This type of resistance is more complex and resistant traits are typically more difficult to nail down. Have you noticed that your weeds aren't quite as susceptible as they used to be to the herbicides you use? Do you have weed populations that are resistant to many different herbicide modes of action? If so, you might be dealing with some of these traits.

Weeds can develop complex traits to improve their chances of escaping your treatments. A few types of complex traits are as follows:

1. Reduced herbicide absorption
    a. Waxier leaves can reduce absorption.
    b. Fewer leaf hairs can lead to less of the herbicide being held on the leaf surface.
2. Reduced herbicide movement
    a. Weeds can use a variety of methods to prevent systemic herbicides (glyphosate, 2,4-D) from being transported throughout the plant.

3. Increased herbicide metabolism
    a. Herbicide can be broken down quickly within the plant before it can cause injury.

Some of these traits can also be found in our crops. For example, mesosulfuron (Osprey) can be sprayed over the top of wheat because the crop can quickly break the herbicide down, while the weeds [usually] can't.
This catch-all category needs more research to be better understood and there is certainly a longer list of possible traits that allow weeds to survive herbicide treatments. Why is it important to know if you have target-site or non-target-site resistance? Non-target-site resistance traits may provide resistance to multiple modes of action. This can make the gold standard of herbicide rotation less effective.
Pre-emergent herbicides have less risk of developing non-target-site resistance because they target weeds when they are the most susceptible. While some weeds can develop resistance by reducing herbicide absorption through the leaves there are no documented instances where herbicide absorption through the roots has been reduced. S-metolachlor (Dual Magnum) and pendimethalin (Prowl) are examples of herbicides that can be absorbed through roots.

Final comments:
UCCE Agronomy Advisor Nick Clark confirmed pyroxsulam, mesosulfuron, and tribenuron (Group 2) resistant populations of common chickweed in some small grain fields in the Southern San Joaquin Valley. Group 2 herbicide resistance in Italian ryegrass in small grains has been well-documented throughout much of the western United States and various UCCE Advisors have worked on control methods over the years. Group 2 herbicides are ALS-inhibitors. Resistance to ALS-inhibitor herbicides is the most common type of resistance and the use of these products must be particularly careful.

Do not use the same herbicide repeatedly. Even one application a year can lead to resistance if you are targeting the same weed species with that application. Roundup Ready crops are prime candidates for herbicide resistance development due to repeat applications of a single herbicide mode of action. For example, if last year you used glyphosate to control jungle rice in your Roundup Ready alfalfa, consider using a clethodim or pendimethalin-based product this year. Different types of herbicide resistance may require different management techniques. Rotating post-emergent herbicides may not be adequate to keep weed populations controlled so consider rotating between pre- and post- herbicides as well as between different modes of action. Non-chemical options are also important to include in a weed management plan. Cultivation prior to planting and in-season is an effective way to manage weeds. Crop rotation and suppressing weeds with cover crops can also be components of a comprehensive weed management plan that reduces the chances of resistance development.

Though industry is conducting research to identify new modes of action, a new MOA has not been registered for several decades. It is important to practice good herbicide rotation and non-herbicide weed management to keep the MOAs that we currently have on the market. Contact your local Farm Advisor if you suspect herbicide resistance on your farm.

Save the Date!

On **May 9th, 2024** the Small Grains Field Day will be held at the UC Davis Agronomy Field Headquarters.

The program will start in the morning and include lunch with presentations on small grain variety development and agronomic management of small grain crops. Full details and registration will be posted on the UC Small Grains Blog closer to the date. We hope to see you there!