Sacramento Valley Field Crops Newsletter
Issue 11 July, 2022

In This Issue

Submitted by:

Sarah Light
UCCE Farm Advisor
Sutter-Yuba and Colusa Counties

Nitrogen Uptake of Sunflowers Grown in the Sacramento Valley

Daniel Geisseler and Suzette Santiago
Department of Land, Air and Water Resources, UC Davis

In spring 2021, we started a 3-year study where we investigate the capacity of the soil to supply crop-available nitrogen during the growing season. One component of the study is to monitor the changes in total nitrogen in the aboveground biomass of different crops during the growing season. We did this by collecting the entire aboveground biomass in 3-week intervals in different commercial fields. The plants were collected from an area in the fields where fertilization and crop management followed growers' practice. In this summary, we will focus on the results from five sunflower fields for hybrid seed production located in Solano, Yolo and Colusa counties.

Nitrogen uptake pattern

Nitrogen uptake during the first weeks after seeding was low (Figure 1). 40 days after seeding, only about 30 lb N/ac had accumulated in the aboveground biomass. For comparison, the residual nitrate-N in the top foot of the soil ranged from 9 to 89 lb/ac. Even though the roots of young plants may not yet access the entire pool of residual nitrate-N in the top foot and our estimate of nitrogen in the plant does not include the roots, the residual nitrate, complemented with a small starter application, can supply enough nitrogen for the first few weeks after seeding in most fields. However, residual nitrate can vary considerably from one field to the next and from one year to another. For a reliable estimate of residual soil nitrate, a soil sample needs to be taken and analyzed from a field in spring.

After about 40 days, nitrogen demand by the plants increased rapidly (Figure 1). Between day 40 and 90, the plants took up on average 145 lb N/ac, or almost 3 lb N/ac per day. During this period, it is crucial to supply enough N to the plants so that growth and yield are not nitrogen limited. After 90 days, which coincided roughly with the date the pollinator (male) plants were terminated, little additional nitrogen was taken up from the soil until harvest, on average only about 10 lb N/ac. Most of the nitrogen that ends up in the seeds is translocated from other parts of the plant and not taken up from the soil during seed development.

Total nitrogen in the aboveground biomass ranged from 150 to 220 lb/ac at harvest, averaging 190 lb/ac across the five fields. On average, 32% of the total nitrogen was in the achenes, while 68% was in the stalks and heads of female and male plants.

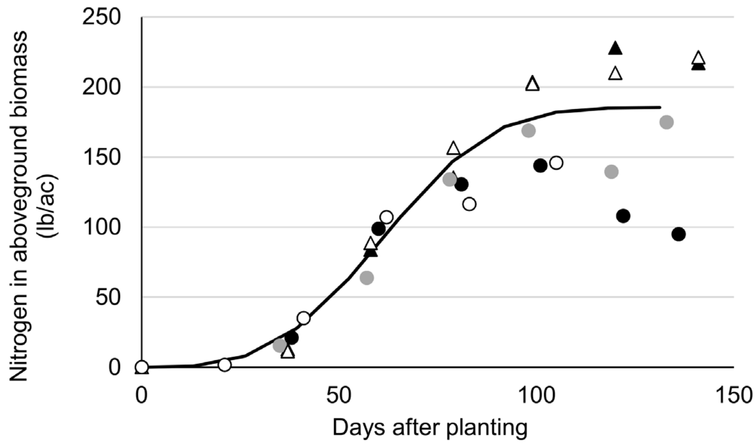


Figure 1: Increase in the total nitrogen in the aboveground biomass of sunflowers grown in the Sacramento Valley in 2021. Different symbols represent different fields.

Total nitrogen in the aboveground biomass

Nitrogen in the biomass of male and female plants differed considerably. In the fields included here, every fifth bed was planted with males, which were terminated after flowering, between 80 and 90 days after seeding. By this time, the total nitrogen in their aboveground biomass averaged 23 lb/ac. In other words, if the entire field had been planted with male plants, the total nitrogen in their biomass would have been 115 lb/ac. The female plants, which were harvested on average 135 days after seeding, contained 168 lb N/ac. Again, if the entire field had been planted with female lines and not just 4 out of 5 beds, nitrogen in the aboveground biomass would have been 210 lb/ac. Therefore, the amount of nitrogen in the biomass of female lines was almost twice the amount in the male lines.

Achene yield was well correlated with total nitrogen in the biomass (Figure 2). However, this correlation need to be interpreted with some caution, as it is based on only five fields, all of them monitored during the 2021 season. Our project is ongoing and by the end of the 2023 season, we will have a much more robust dataset.

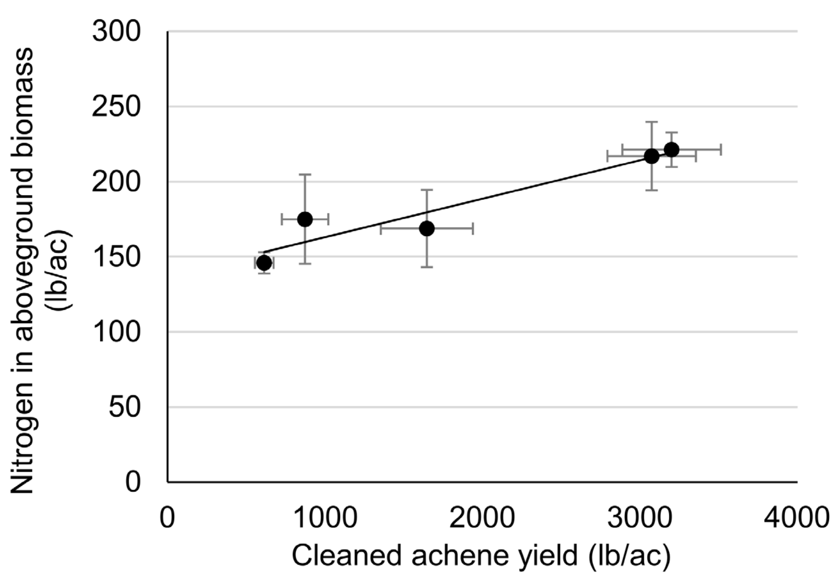


Figure 2: Correlation between yield and total nitrogen in the aboveground biomass.

The nitrogen concentration in the achenes ranged from 3.0 to 4.6%, averaging 3.6%. This concentration corresponds to 67.5 lb N/ton (at 8% moisture). This value is close to the 63.2 lb N/ton we obtained previously when determining nitrogen removed from 25 fields in the Sacramento Valley, which were separate from the fields included in this project.

In summary, we found that the total amount of nitrogen in the aboveground biomass of sunflowers grown for seed production averaged 190 lb/ac across five fields. Differences across fields were large, with yield explaining most of this variability. Nitrogen in the biomass of female plants was almost twice the amount in male plants. Most of the nitrogen was taken up during the second and third month after seeding, with little nitrogen being taken up from the soil during the first month and after flowering.

Herbicide applications between cutting In Alfalfa, a cautionary tale.

Tom Getts, Weed Ecology and Cropping Systems Advisor, UCCE

The best way to control weeds in alfalfa is to have good agronomic practices and a strong stand. A strong stand is highly competitive and will crowd out annual weeds, by not allowing them space to grow during the active season. During the dormant season winter annual weeds can become established, and this is when much of the weed control in alfalfa takes place. In conventional production systems dormant season herbicide applications are made. These often consist of a burn down herbicide, which is used to control emerged weeds, combined with a residual herbicide to provide control of any seeds yet to germinate. While not common in the mountains, summer annual weeds can also be problematic in alfalfa especially in thinning stands nearing the end of their life. Anytime there are large enough spaces between crop plants for other weeds to grow, they will with a vengeance.

Over the past few years we have been testing a residual herbicide to generate data for registration in the California market. One of these trials looked specifically at crop safety during the season of growth where the herbicide was applied between cuttings. The idea would be to target some of the annual summer weeds that can be problematic in weaker stands. We also used various other herbicides as side by side comparisons to measure for crop injury. Unfortunately, these stands where in good and there were not many weeds to assess, but crop injury was evaluated.

The weed control trials were laid out in a typical fashion, 10*20 ft plots, four replications, and randomized complete block design. The first trial took place at the Intermountain research station located in the Klamath basin on a soil with good water holding capacity. Herbicide applications were made directly after the hay was taken off the field before an irrigation was made. The crop had 3-4 inches of regrowth at the time of application and was actively growing. Crop injury was assessed visually the weeks following applications, and a yield was taken to assess the damage (Tables 1 and 2).

The good news was the experimental herbicide didn't cause any significant damage to crop as it appeared to be tolerant to the application. The bad news is that Shark (carfentrazone) did cause damage to the crop and resulted in a 0.3 ton yield reduction compared to the untreated check. While a little crop damage may be expected with an in-season herbicide application, the cost of weed control vs crop damage must be weighted, Yield reduction of 0.3 ton/s per acre may or may not be acceptable to a grower.

What is Shark? Well, it is a burn down herbicide active on small broadleaf weeds often used during the dormant season. But it is also labeled for in season weed control for alfalfa between cuttings to target small summer annual weeds. On the label it indicates that Shark can be applied between cuttings as long as the crop is than 6 inches tall. Some of the weeds it controls range from pigweeds and lambsquarter to Kochia. Shark would have potential to be applied as a burn down treatment between cuttings for summer annual weed control. We noted in this trial that it completely burned the crop back to the ground (even more so that paraquat) causing significant yield reduction (photo one).

In 2020, I put out a couple of more trials in order to continue to assess the crop injury potential of the experimental herbicide, as well as reevaluate the injury from Shark. Both of these trials were on lighter soil in Big Valley by Bieber California. In the first trial, potential thunderstorms delayed cutting, and also irrigation prior to cutting. Unfortunately, at the time of herbicide application there was not much regrowth on the crop due to lack of water, and correspondingly, there wasn't much injury observed (Table 3 and 4). A second trial was put out after second cutting. At this application timing there was 1-3 inches of alfalfa growth. Again, the experimental herbicide didn't cause any damage. As expected, Shark burned the crop back down to the ground, but the crop was able to outgrow the injury and no significant yield reductions were found (Table 5 and 6).

I think the biggest difference in these trial sites were the soils, and how actively thew crop was growing at the time of application. At the Intermountain research station, the soils are deep with high amounts of organic matter and water holding capacity which allowed the crop to be actively growing at the time of application. Alternately, on the two field sites in 2020 there were more common scenarios. The crop was moisture stressed after water being held off during the haying process. While there was some alfalfa growth in the third trial (and corresponding Shark injury) the crop was not really pushing because it had yet to be irrigated.

In conventional weed control for alfalfa, it is often a trade off between some crop injury and successful weed control, as many of the herbicide options operate in the goldy locks zone. In many instances Shark can be used safely between cuttings for summer annual weed control. However, if there is a lot of residual moisture in the soil and the crop is really growing, expect the potential for alfalfa injury. Regardless, in the next couple of years keep your eye out for a new residual herbicide for alfalfa in the Californian market, where crop safety doesn't seem to be an issue!

Table 1. Crop Phytotoxicity Observed 2019 Trial Klamath Basin

	1 Week		2 Weeks		3 Weeks	
Treatment	mean	Letter	Mean	Letter	mean	Letter
untreated check	0	E	1.25	C	0	C
CNV2243 16 oz	15	C D	11.25	B C	1.25	B C
Metribuzin 2/3 lb	20	C D	11.25	B C	2.5	B C
Gramoxone 1 pt.	40	B	12.5	B C	5	B C
Shark 2 oz	87.5	A	61.25	A	27.5	A
Raptor 6 oz	18.75	C D	6.25	B C	1.25	B C
Pursuit 6 oz	12.5	D	10	B C	0	C
Gramoxone + Prowl + Select 1 pt. + 2 qt. + 22oz	37.5	B	16.25	B	3.75	B C
Shark + Prowl + Select 2 oz + 2 qt. + 22oz	92.5	A	65	A	32.5	A
Raptor + Prowl + Select 6 oz + 2 qt. + 22oz	17.5	C D	16.25	B	2.5	B C

Table 1: Percent of visual injury observed on the alfalfa crop one two and three weeks after application. (*color coded by site for visualization of data) Letter reports indicate means with the same letter were not statically different using the Tukey HSD test at the 95% confidence interval. By the second cutting the crop outgrew injury, for all treatments except the Shark treatment.

Table 2. Yield Klamath Basin Trial		
	Ave Tons/acre	Letter Report
untreated check	1.73	A
CNV2243 16 oz	1.61	A B C
Metribuzin 2/3 lb	1.60	A B C
Gramoxone 1 pt.	1.61	A B
Shark 2 oz	1.34	B C
Raptor 6 oz	1.69	A
Pursuit 6 oz	1.81	A
Gramoxone + Prowl + Select 1 pt. + 2 qt. + 22oz	1.68	A
Shark + Prowl + Select 2 oz + 2 qt. + 22oz	1.29	C
Raptor + Prowl + Select 6 oz + 2 qt. + 22oz	1.59	A B C

Table 2: Second cutting alfalfa yields in tons/acre (*color coded by site for visualization of data). Letter reports indicate means with the same letter were not statically different using the Tukey HSD test at the 95% confidence interval. By the second cutting the crop outgrew injury, for all treatments except the shark treatment.

Table 3. Crop Phytotoxicity Observed First 2020 Big Valley Trial								
	Week One		Week Two		Week Three		Before Cutting	
Treatment	Mean	Letter	Mean	Letter	Mean	Letter	Mean	Letter
Untreated	0	d	6.25	a	3.75	a	1.25	a
CNV2243 8oz	1.25	cd	5	a	0	a	2.5	a
CNV2243 16oz	7.5	abcd	5	a	2.5	a	2.5	a
CNV224324oz	13.8	a	7.5	a	5	a	2.5	a
Dimetric 2/3lb	12.5	ab	10	a	6.25	a	6.25	a
Shark 1oz	2.5	bcd	2.5	a	3.75	a	3.75	a
Shark 2oz	6.25	abcd	7.5	a	6.25	a	6.25	a
Dimetric 2/3lb + Shark 2oz	7.5	abcd	2.5	a	2.5	a	2.5	a
CNV2243 16oz + Shark 2oz	11.3	abc	11.3	a	5	a	6.25	a
CNV2243+ Powermax 22oz	12.5	ab	2.5	a	1.25	a	2.5	a

Table 3: Percent of visual injury observed on the alfalfa crop one two and three weeks after application (*color coded by site for visualization of data). Letter reports indicate means with the same letter were not statically different using the Tukey HSD test at the 95% confidence interval. All treatments were similar by the time cutting occurred.

Table 4- Crop Height and Yield Frist 2020 Big Valley Trial						
	3 Week Crop Height		BC crop Height		Yield Dry Tons/Acre	
Treatment	Mean	Letter	Mean	Letter	Mean	Letter
Untreated	21.3	a	30.9	a	2.3	a
CNV22438oz	20.9	a	30.1	a	2.3	a
CNV2243 16oz	20.5	a	30.5	a	2.2	a
CNV2243 24oz	20.0	a	30.4	a	2.2	a
Dimetric 2/3lb	20.2	a	30.6	a	2.1	a
Shark 1oz	20.3	a	30.7	a	2.4	a
Shark 2oz	19.9	a	30.0	a	2.4	a
Dimetric 2/3lb + Shark 2oz	20.6	a	31.4	a	2.1	a
CNV2243 16oz + Shark 2oz	21.1	a	31.1	a	2.3	a
CNV224316oz + Powermax 22oz	21.1	a	30.9	a	2.4	a

Table 4: Second cutting alfalfa yields in tons/acre and crop height in inches (*color coded by site for visualization of data). Letter reports indicate means with the same letter were not statically different using the Tukey HSD test at the 95% confidence interval. All treatments were statically similar to the untreated check.

Table 5. Crop Phytotoxicity Observed Second 2020 Big Valley Trial								
	1 Week		2 Week		3 Week		Before cutting	
Treatment	Mean	Letter	Mean	Letter	Mean	Letter	Mean	Letter
Untreated	3.75	e	1.25	d	7.5	a	0	a
CNV2243 8oz	6.25	de	5	cd	5	a	3.75	a
CNV2243	20	cde	15	bcd	6.25	a	3.75	a
CNV2243	27.5	cde	17.5	abcd	7.5	a	8.75	a
Dimetric 2/3lb	12.5	de	6.25	cd	8.75	a	8.75	a
Shark 1oz	33.75	bcd	15	bcd	7.5	a	5	a
Shark 2oz	42.5	abc	28.75	ab	13.75	a	10	a
Dimetric 2/3lb + Shark 2oz	58.75	ab	28.75	ab	10	a	3.75	a
CNV2243 16oz + Shark 2oz	66.25	a	33.75	a	17.5	a	11.25	a
CNV2243 16oz + Powermax 22oz	31.25	bcde	20	abc	11.25	a	8.75	a

Table 5: Percent of visual injury observed on the alfalfa crop one two and three weeks after application (*color coded by site for visualization of data). Letter reports indicate means with the same letter were not statically different using the Tukey HSD test at the 95% confidence interval. All treatments were similar by the time cutting occurred.

Table 6- Crop Height and Yield Second 2020 Big Valley Trial				
	Height Inches		Dry Tons/ Acre	
Treatment	Mean	Letter	Mean	Letter
Untreated	21.2	a	1.3	a
CNV2243 8oz	20.8	a	1.3	a
CNV2243 16oz	19.7	a	1.3	a
CNV2243 24oz	19.2	a	1.4	a
Dimetric 2/3lb	20.3	a	1.3	a
Shark 1oz	19.6	a	1.3	a
Shark 2oz	19.9	a	1.4	a
Dimetric 2/3lb + Shark 2oz	20.2	a	1.3	a
CNV2243 16oz + Shark 2oz	19.7	a	1.3	a
CNV2243 16oz + Powermax 22oz	20.3	a	1.3	a

Table 6: Second cutting alfalfa yields in tons/acre and crop height in inches. (*color coded by site for visualization of data) Letter reports indicate means with the same letter were not statically different using the Tukey HSD test at the 95% confidence interval. All treatments were statically similar to the untreated check.

*Not all treatments tested are labeled applications in California and were evaluated for research purposes. Make sure to read and follow the label prior to any pesticide application

* Any mention of pesticide is for informational purposes only, and is not an endorsement or recommendation by myself or the University of California.

Photo 1- Shark treatments 1 week after applications in the 2019 Klamath basin trial. Significant crop injury occurred and stunted the crops growth and yield in the following cutting.

Photo 2- Plots at the time of application in the second 2020 big valley trial. This site had much less regrowth at the time of application, and while injury was observed, the crop was able to grow out of the injury by the time cutting occurred.

Soil Health in Alfalfa Receiving Full and Deficit Irrigation

Michelle Leinfelder-Miles, Delta Farm Advisor, UCCE

Over the last few years, I have been working on a project to characterize a suite of soil health properties in alfalfa receiving full and deficit irrigation. Soil health has been described as the ability of soil to function and is characterized by biological, chemical, and physical soil properties that are sensitive to changes in management. The idea for this project developed after the 2012-2015 drought when water shortages and regulatory curtailments meant that growers had to make tough decisions on how to apply scarce water resources. Some growers opted to cut irrigation to alfalfa since it is a deep-rooted crop that can scavenge water and nutrients from the soil profile. (See this recent blog post by UC Alfalfa and Forage Specialist Dan Putnam, and Farm Advisor Rachael Long on the resiliency of alfalfa during drought: https://ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=51887.) I had a hunch, however, that while alfalfa may be adapted to survive drought conditions, soil health properties might be negatively impacted because water is essential to life in the soil, facilitates nutrient movement and availability, and influences soil physical characteristics, among other things. Fortunate for me, there was a research trial at UC Davis where I could test this idea.

The UC Davis trial was initiated by Dan Putnam and Isaya Kisekka (UCD Associate Professor of Agricultural Water Management) and managed by graduate student Umair Gull. Their interest was in evaluating alfalfa yield and survival under different levels of deficit irrigation. The replicated treatments were: 1) full irrigation (100 percent of crop evapotranspiration, ETc), 2) full irrigation at the beginning of the season with a sudden cutoff toward the end of the season (60 percent ETc CT), 3) sustained deficit where each irrigation imposes restriction (60 percent ETc SD), and 4) more-severe sustained deficit (40 percent ETc SD). The treatments were applied using overhead irrigation – an 8000 series Valley 500-ft, four-span linear-move system (Figure 1). The primary soil classification at the site is a Yolo silt loam. Soil sampling occurred twice each year – in the spring before irrigation began and in the fall after the last irrigation. We conducted a comprehensive nutrient analysis, as well as testing organic matter, total carbon and nitrogen, salinity, compaction, bulk density, N mineralization, and particulate organic carbon.

I view alfalfa as a model crop for studying soil health under restricted water conditions because practices like crop rotation and tillage do not occur over the four or more years of an alfalfa stand. Therefore, those practices would not confound our results. From this experiment, we are learning how imposing varying levels of deficit at different stages of the cropping season impact soil properties, which will help us optimize deficit irrigation strategies for alfalfa. Additionally, the deficit treatments serve as a proxy for drought and could potentially demonstrate how prioritization of water uses during drought may impact soil conservation outcomes.

Data analysis is ongoing, but preliminary results suggest that soil health may not be resilient under deficit irrigation or drought, even if alfalfa is. When the trial began in Spring 2019, there were no differences in rootzone salinity among treatments, which averaged 0.41 dS/m. After two cropping seasons where deficits were imposed, the 60 percent ETc treatment with the water cut-off toward the end of the season (CT) resulted in significantly higher rootzone salinity down to the 36-inch depth (Figure 2). The salinity in that treatment was higher than even the 40 percent ETc treatment that had the sustained deficit (SD) throughout the entire season. In other words, it appears that the timing of the deficit is more important than the amount of deficit and applying water throughout the season – even if the amount is severely reduced – appears to mitigate salinity build-up in the rootzone. Of note, salinity is not high enough to be problematic at this site. The overall ECe of the soil is low, and water quality is generally good at this location. I would expect, however, that in locations where soil and/or water has higher salinity to begin with, then deficit irrigation that includes a water cut-off could be problematic.

Figure 1. UC Davis trial location with overhead irrigation system used to apply irrigation treatments.

There will be a lot more information to come about this project in the near future, but the salinity information seemed timely to share given our current water year. In addition to Dan, Isaya, and Umair, I want to acknowledge Daniel Geisseler (UC Nutrient Management Specialist), Will Horwath (Professor of Soil Biogeochemistry), and graduate student Veronica Suarez Romero who

have helped on soil nitrogen and carbon testing. I also want to acknowledge the South Delta Water Agency for financial support of the project.

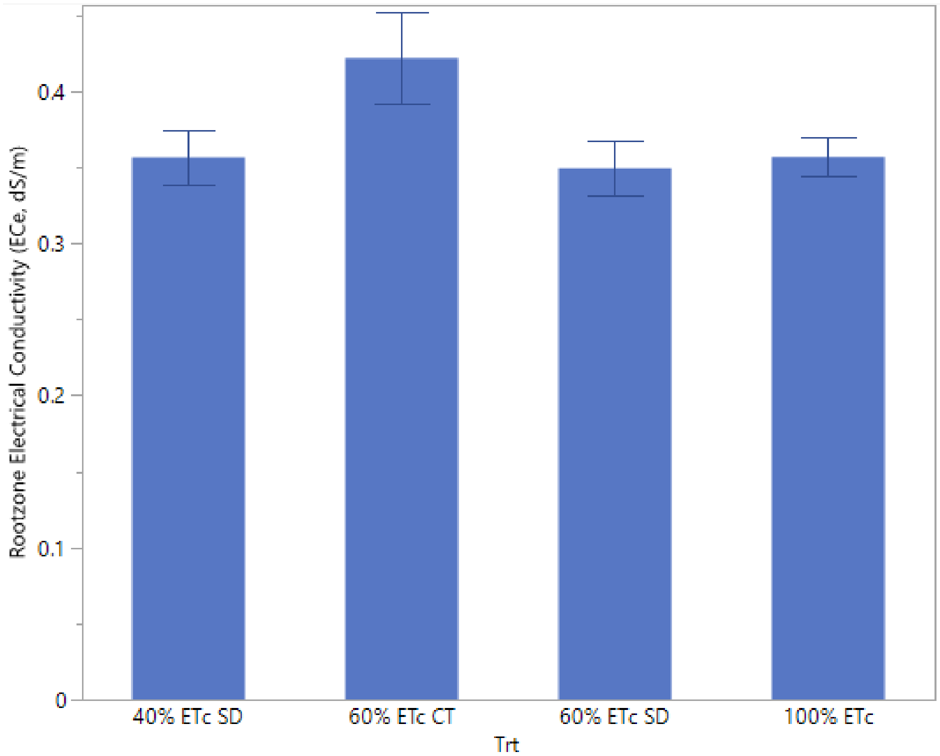


Figure 2. Rootzone salinity from the soil surface to 36-inch depth across three seasonal readings (Fall 2019, Spring 2020, Fall 2020). Of note, the statistical analysis from all three seasons, including Spring 2020, indicated that not even winter (2019-20) rainfall leaching was adequate to bring rootzone salinity down in the 60% ETc cut-of (CT) treatment.

Is vetch a friend or foe to livestock?

Rachael Long, UCCE Field Crops & Pest Management Advisor, Capitol Corridor
Morgan Doran, UCCE Livestock & Natural Resources Advisor, Capitol Corridor
Robert Poppenga, UC Davis Veterinary School of Medicine
Dan Putnam, UC Davis Plant Sciences

Vetch (*Vicia spp.)* is growing like a weed everywhere this year, carpeting our hills with great swaths of purple flowers (see photo).

What is Vetch? There are several species that are commonly grown as crops, cover crops or weeds (see below table). Vetch a winter-hardy legume that's favored by early fall rains, which we had lots of last October (5.5-in in 24-hr in Sacramento). Vetch is also a nitrogen-fixing plant that works well as a cover crop in farming systems. It's also a good forage for bees and other pollinators and has extra floral nectaries (glands on stems that produce nectar) that attract beneficial insects like parasitoid wasps that prey on pests.

Vetch, Vicia spp., photo UC SAREP.

Is it a good livestock feed? Yes and No. As an annual leguminous vigorous herbaceous plant, vetch has high protein and relatively low fiber and reasonably high yields. It's vigorous growth and N fixing qualities is why it is so valuable as a cover crop, but it can also be grazed or fed as hay. Its quality is lower than that of alfalfa or clovers (protein levels from 15-20% depending upon stage of growth). It is commonly grown in mixes with small grains or grasses as a mix in different parts of the US. Vetch hay is difficult to handle due to the vine-like characteristics, and caution should be used due to anti-nutritional compounds and livestock palatability.

Vetch is sometimes grown with small grains, for example rye.

Anti-nutritional compounds. However, Vetch hay can cause serious (and potentially fatal) animal health problems, so is not recommended as a primary forage for horses and cows. Most of the anti-nutritional compounds are concentrated in the seeds, so immature harvests are recommended. Vetch seeds are poisonous; they contain cyanogenic glycosides and a diglucoside that can cause a neurologic disease. Although hairy vetch (*V. villosa*) and purple vetch (*V. benghalensis*) seed are the most toxic (being very closely related), other vetches have toxic seeds too, including common vetch (*V. sativa*). In addition, a toxin in vetch foliage is associated with a dermatitis or skin sensitivity disease, though this is extremely rare and not well understood. Most cases of vetch-induced dermatitis involve black cattle, such as Angus or Holstein, and horses can also be affected, so there may be specific susceptibility explained by a genetic predisposition. Lack of good information makes is difficult to assess vetch hay suitability for small ruminants like sheep, though there is anecdotal information that suggests it might be okay for goats.

How about rangelands? Vetch growing on grazing rangelands is actually a good, high-protein feed for livestock. In open range, cattle typically won't graze vetch until it dries down and seeds have shattered. On a hot day you can hear dry pods snap, crackle, and pop, like a bowl of Rice Krispies. Vetch is not favored by livestock when green due to low palatability (bitterness).

How about pastureland? Fenced pastures loaded with vetch going to seed could spell trouble for horses and cows, especially if there is little else to eat. Toxicity risk can be alleviated by ensuring other forage options are available and by stocking animals at very low densities and giving them the option to selectively consume non-toxic plants and avoid toxic plants. Again, once the plant has dried down and seeds have shattered (detached and fallen), it should be okay as grazing feed.

How big a problem is vetch toxicity? The California Animal Health and Food Safety Laboratory at UC Davis has had a few cases of vetch toxicity to cattle and horses over the years, but not many. It's still unclear if this means few cattle are exposed to vetch or few cattle actually develop disease. It's still kind of a mystery as to why vetch is sometimes a problem and other times not. It might be a matter of the degree of its presence in animal diets – low percentage is okay, high percentage more problematic. "Dose makes the poison" as a toxicologist would say.

How about croplands? Oats and vetch used to be a popular mix for feed, but not anymore and hay growers try to keep it out of their forage crops. If cereal grains are in a crop rotation, vetch seed is about the same size as wheat and barley kernels, making it hard and expensive to separate during seed cleaning. Vetch is also hard-seeded, meaning seed can lie in the ground dormant for years and germinate when not wanted, though the viability for most seed is about 5 years, allowing opportunities for management. For control, one can mow prior to pod and seed set or use broadleaf or pre-emergent herbicides if needed.

Vetch identification. To differentiate different species of vetch one needs to look at the flowers. Common vetch (*V. sativa*) has flowers with a short stalk (peduncle), meaning the flowers are attached close to the stem from where it originates (picture). Hairy vetch (*V. villosa*), purple vetch (*V. benghalensis*), and American vetch (*V. americana*) all have flowers with long stalks. Hairy and purple vetch flowers are aligned on one side of the flower axis (picture) whereas American vetch flowers are more upright (picture). Purple vetch will generally have flowers about the same size as the leaflets (picture), while the flowers on hairy vetch are generally larger or longer than the leaflet (picture).

What types of vetch are found around California on agricultural and rangelands? According to Dr. Alison Colwell, curator, UC Davis Herbarium, following are the rankings of vetch *(Vicia)* species abundance by county. This information comes from the Consortium of California Herbaria (cch2.org). The data are from all years that collections were made, which is basically the past 100 years. The take-home point of this analysis is that there are several similar vetch species that are all spottily dominant around California.

Yolo County (all ag)

1. *V. villosa* (hairy; lana/woollypod subsp. *varia*)

2. *V. sativa* (common)

3. *V. benghalensis* (purple)

Mariposa County (mostly ranch/public land, central)

1. *V. americana* (American vetch; native plant)

2. *V. sativa*

3. *V. benghalensis*

Butte County (part ag, part ranch, north)

1. *V. villosa*

2. *V. sativa*

3. *V. americana*

Tulare County (ag, arid, south)

1. *V. americana*

3-way tie for third place, with 3 each: *V. benghalensis, V. sativa* and *V. villosa*.

Stanislaus County (ag, central)

1. *V. villosa*

2. *V. sativa*

3. *V. americana*

Cover Crops and Winter Weed Management: Considerations for Annual Rotations in Wet and Dry Years

Sarah Light, Agronomy Advisor, University of California Cooperative Extension
Sequoia Williams, Graduate Student, UC Davis

Cover crops are typically planted in ground that is otherwise fallow. In an annual crop rotation in the Sacramento Valley, cover crops are commonly planted in the fall, grown over the winter, and terminated in late winter/early spring. Thus, cover crops can take up space outcompeting winter weeds. Cover crops have to establish well to be competitive, otherwise there will be room for weeds to grow. Establishment and significant cover crop growth can be challenging in a drought year. This article presents some of the considerations for weed management based on observations from various cover crop trials in the Sacramento Valley. In addition to weed reduction, cover crops provide a range of other soil health benefits and management considerations that will not be discussed in this article.

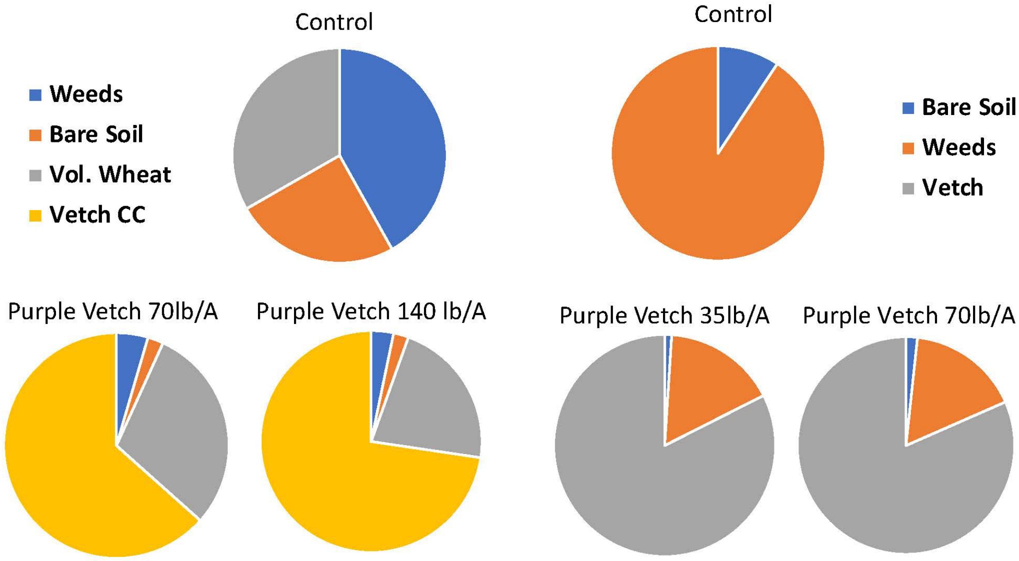
Some of the benefits of cover cropping including increased water infiltration, reduced runoff, and increased organic matter can be achieved by leaving winter weeds uncontrolled in the field. However, this can lead to increased weed pressure in the long term if the weeds go to seed and are introduced into the field. An acre of weeds allowed to go to seed can attribute millions of non-desirable seeds to the soil seed bank which can live for a few years up to a few decades. Cover crops can prevent weeds from growing and producing seeds. Some growers report up a savings of up to $65/acre in material, gas, and labor costs from not applying a winter herbicide spray. This does not include the cover crop management costs.

Wet vs dry years, and an early planting date:

Competition with weeds can be maximized by planting cover crops early, before the first fall rain. Cover crop seeds can be planted as soon as groundwork is done in the fall. The seeds can sit in the dry field and wait for the first rain, thus planting does not have to be timed in advance of a rain forecast. Early planting will allow cover crops to take advantage of all precipitation for the season and to get a head start in canopy development ahead of weeds. Planting early also allows cover crops to take advantage of the longer fall days, as their growth slows during the short, cold, winter days.

In two years of data from a trial on a silt loam soil in the Sacramento Valley, a drill-seeded vetch cover crop was able to effectively suppress weeds in both a wet (2018-2019) and dry year (2019-2020) (Figure 1, pictures 1 and 2). In year one, it rained 16 inches between November and March when the cover crop was in the ground. In addition, the field had come out of wheat and there was a lot of volunteer wheat in the field that acted like a cover crop mix with the vetch. The vetch and wheat combined were very effective at outcompeting weeds and providing soil coverage. In year two, seeding rates were cut in half from the previous year. It was a very dry year, with a total of only 6 inches of precipitation during the cover crop season. However, of those 6 inches, 4.7 inches of rainfall occurred in November and December. There was no volunteer wheat in year two, and despite the lower seeding rate, this early season precipitation enabled the vetch cover crop to thrive, and out compete weeds, even though the rest of the winter was very dry.

Figure 1. Left, year one, 16” rain total. Right, year two, 6” rain total but 4.7” in Nov and Dec.



Pictures 1 (wet year) and Picture 2 (dry year)

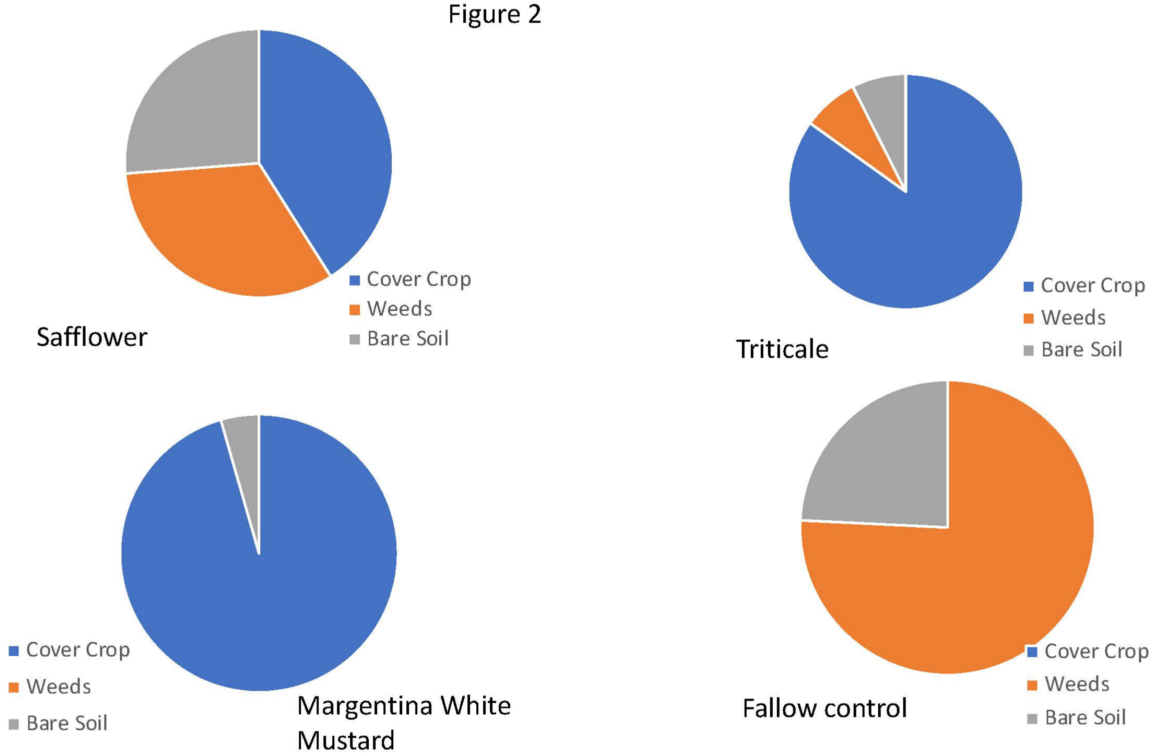
If you cannot plant before the first rain you can kill the weeds that emerge after the first rain *before* planting the cover crop. If needed mechanical cultivation or an application of herbicide without residual activity (like glyphosate) can be used to kill the weeds. This additional work is costly but needed to achieve weed suppression with cover crops, otherwise emerged weeds can be prolific. Irrigation at planting can also give the cover crop a competitive advantage, though prioritization of water for cover crops is unlikely given our current water situation.

Plant Family:

In fall of 2020 replicated research plots were established and the weed suppressing ability of white mustard, triticale, safflower, was compared to a fallow control. The mustard and triticale were the most effective at outcompeting weeds (Figure 2, pictures 3 and 4) despite very low early season precipitation (a little more than one inch of precipitation from the fall to the end of the year). Safflower was relatively ineffective at suppressing weed in this trial (picture 5).

In addition, small plots were planted of various cover crop species in 7 locations in the Sacramento Valley. It was hard to get consistent seeding with the single plot planter as it was a very dry year, leading to poor emergence for many species. However, across all sites, brassicas were consistently the most competitive cover crop (picture 6) at suppressing weeds closely followed by grasses. Legumes were less competitive with weeds because they did not close canopy as fast allowing weeds to take hold (picture 7).

Figure 2



Picture 3

Picture 4

Legume growth accelerates as days get longer in late winter, providing an opening for weeds to flourish in the colder winter months before the legume has closed canopy. It can be difficult for legumes to catch up later in the season if weed pressure is heavy. Full results for this more extensive small plot trial can be found on the Sutter-Yuba Field Crops Cooperative Extension website.

Fluke years, and considerations for when things go wrong:

During one project year, fallow control plots were maintained free of winter weeds with a mix of several herbicides. Treatment plots that had the cover crop in them were not sprayed with this tank mix as the cover crops were actively growing. Cover crop plots were sprayed with glyphosate in early March to terminate the cover crop stand, and then the field was chopped. However, there was common mallow in the field that was growing within the cover crop stands. As common mallow is not very susceptible to glyphosate, young mallow plants continued to grow after application. The field was planted into sunflower, which has very limited broadleaf herbicide options. The cover cropped areas of the field had to then be hand weeded to remove the glyphosate tolerant mallow. In the cover cropped plots there was significantly more mallow than in the fallow control plots and the grower estimated hand weeding costs to be about $80/acre in those portions of the field. Glyphosate can be effective as a chemical termination for cover crops, but care should be taken if there is a history of tolerant or resistant weeds in the field. Cover crop management, like all farm management practices, need to be adjusted according to the field history, cropping system and year.

Picture 5 - Unirrigated yellow pea ~ mostly weeds

Picture 6 - Unirrigated black mustard – closed canopy

Summary and final considerations:

Picture 7

When managing winter cover crops for weed control, a few key considerations must be kept in mind. The history of the field and the existing weed pressure will play a big role in how many weeds germinate and develop in the field. Successful and robust cover crop stand establishment is key for success as cover crops must outcompete weeds in order to effectively suppress them. Thus, planting before the first rain to ensure rapidly canopy development can help. Legumes generally are less effective at suppressing weeds when there is heavy weed pressure in a field. However, a mix with small grains (even volunteers) and legumes may be effective as the small grains can reduce early season weed pressure as the legume is taking off. Finally, cover crops (particularly brassica family like mustards) can become weeds in the field if they set seed. Some growers, especially organic growers, have stayed away from brassicas for this reason. Cover crops should be terminated before they set viable seed to avoid creating more weed pressure in the future. If timely cover crop termination is not an option for whatever reason (weather, equipment access, timing, cover crops are in a mix and actively growing), a high mow can be effective at cutting off flowers or seed heads from brassicas before they become viable. Termination can be delayed to a later date without risk of introducing new weeds to the field.

Though cover crop management, like all farm operations, may be variable from year to year, and expected challenges may arise, winter cover crops are generally effective at suppressing winter weeds and bring other additional benefits to the field. Please contact Sarah Light, selight@ucanr.edu, for more information.

Thank you to the CDFA Healthy Soils Program for funding this research and to our grower collaborators, without whom the work would not be possible.

University of California Agronomic Crops Survey Results available online

Thank you to those of you who participated in our Agronomic Crops Statewide Survey. Your feedback is valuable, and we will use it to shape UCCE programming in agronomic crops. The results are available online and can be explored with a new website. https://www.uccesurveyresults.com. The site allows results to be sorted by crop type and location. Your feedback is always appreciated, even without a survey! Please reach out to me anytime with comments, questions, or observations from the field. Thank you!