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Newsletter #1

Blue Alfalfa Aphids Management

By Giuliano Galdi, Siskiyou Agronomy and Crops Advisor, Rob Wilson, Siskiyou County Director, and Tom Getts, Lassen Weed and Crop Systems Advisor

In early April, the UCCE office in Siskiyou County received calls regarding aphid infestations in alfalfa fields. Surprisingly, the infested crop was just breaking dormancy (picture 1), which is uncommon since aphid populations tend to increase later in the season when above ground growth is more prominent.

Picture 1. Aphid infestation on alfalfa as the crop was breaking dormancy (picture by Tom Getts)

The main two types of aphids that can be found in alfalfa fields are pea aphids (*Acyrthosiphon pisum*) and blue alfalfa aphids (*Acyrthosiphon kondoi*). While both of them are very similar in appearance, they can be distinguished by examining the antennae. The antennae of the pea aphids have narrow dark bands on each segment, whereas those of the blue alfalfa aphids gradually darken towards the tip. Despite their physical similarities, blue alfalfa aphid (picture 2) cause much more damage than its relative pea aphid (picture 3) by injecting a powerful toxin into the plant while feeding. This toxin retards plant growth, reduces yield, and may kill the plants.

Picture 2 and 3: Blue alfalfa aphid and its smooth and brownish antennae (left) and pea aphid with dark bands and segmented antennae (right).

In most years natural enemies such as parasitic wasps (picture 4), lady beetle, lacewigs larvae, soldier beetles, and syrphid larvae are enough to keep aphids population in check. However, insecticides may be necessary in case aphid populations are above the economic threshold as shown in the following table. Remember that these thresholds are guidelines and growers may need to treat earlier, especially if fields show significant stunting and chlorosis in the beginning of the season.

Plant height	Pea aphids	Blue alfalfa aphids
Under 10 inches	40 to 50 per stem	10 to 12 per stem
10 to 20 inches	70 to 80 per stem	40 to 50 per stem
Over 20 inches	100 + per stem	40 to 50 per stem

Picture 4: Aphid "mummies" infected with a parasitic wasp (picture by Tom Getts).

There are many insecticides labeled for aphid control. The widespread pyrethroid insecticides, such as Warrior (Lambda-Cyhalothrin), are efficient against aphids but their broad spectrum nature also kills many of the beneficial predators that can lead to increased aphid population after insecticide treatments. Pyrethroids can be applied in combination with organophosphates, which may improve control but this combination still has the same negative impact on aphid's natural enemies. Sivanto (Flupyradifurone), a more selective neonicotinoid insecticide, was the most effective insecticide for controlling blue alfalfa aphid in Intermountain UC trials. Sivanto was also effective in many grower fields in 2017 and 2020. The drawback is that Sivanto is more expensive when compared with most pyrethroids, but the added cost is usually justified as Sivanto is more effective at controlling blue aphid and preserving natural enemies.

Due the 2020 aphid outbreak in Siskiyou County, the Agricultural Commissioner's department put in for a special local needs (SLN) label for Transform (Sulfoxaflor) as an alternative neonicotinoid insecticide that performs similarly to Sivanto for blue alfalfa aphid control. The Department of Pesticide Regulation made a notice of decision on July 24th, 2020 approving the SLN and allowing Transform application in Siskiyou, Shasta, Lassen, and Modoc Counties for the 2021 growing season. While Transform can be toxic to pollinators and must be applied before the crop blooms, its risks are reduced as blue alfalfa aphids are most problematic in early season when crops are not flowering.

Aphid infestations in alfalfa fields are not an every-year problem in many locations of the Intermountain Region of California. Scouting fields and identifying the type and quantity of aphids is key for properly timing insecticide applications to prevent reductions in yield and quality at first cutting. Alfalfa fields can normally withstand high numbers of pea aphids without significant damage, but blue alfalfa aphid outbreaks especially at alfalfa green-up can cause substantial lingering crop damage (picture 5).

Picture 5: This bare-ground strip did not receive insecticide application like the rest of the field. Aphid feeding stopped plant growth in the untreated strip, whereas the adjacent crop, where aphids were controlled, was healthy and growing well. Picture by Tom Getts.

The Continued Saga of Injury to Roundup Ready Alfalfa Following Applications

By Tom Getts, Lassen Weed and Crop Systems Advisor, Giuliano Galdi, Siskiyou Agronomy and Crops Advisor, and Rob Wilson, Siskiyou County Director

Weed control in alfalfa can be challenging even with herbicides. Conventional products often have the ability to cause crop injury if applied at the wrong growth stage, or fail to control weeds if applied too late. Some would argue that Roundup Ready cropping systems are an “easy button” to control a whole slew of weeds. Roundup, or glyphosate, kills both grasses and broadleaves as long as they are green and actively growing. While it works better on smaller plants, it will also control more mature, taller weeds. It is “systemic” meaning that it can move down into the root system controlling perennial weeds (although more than one application may be needed). However, it has no pre-emergence activity and will not control seeds which have yet to germinate. This makes it an excellent chemistry to control weeds before seeding another crop.

Glyphosate works at the molecular level by inhibiting an enzyme in the ESPS synthase pathway, which plants need to produce amino acids. Roundup Ready (RR) crops are plants that have been genetically altered to have an enzyme that is not sensitive to glyphosate, so their ESPS pathway is not inhibited. This allows applications of glyphosate to be made over the top of the crop, killing weeds, but not injuring the crop. Research has shown excellent crop safety of the RR technology. There is RR cotton, corn, canola soybeans, sugar beets and alfalfa. The technology drastically altered how weeds were controlled in these crops, that is, until the advent of herbicide resistance. But, that is another story.

One of the main selling points of RR alfalfa is excellent control of hard-to-kill weeds, with no crop injury. Initial research found it to be an excellent fit, allowing growers to control even the toughest established perennial weeds, like Canada thistle and perennial pepperweed, in alfalfa fields.

But, hold off on the “easy button” at least for alfalfa in cold regions. Back in 2014, Steve Orloff and growers in Scott Valley observed injury to Roundup Ready alfalfa after applications of Roundup (glyphosate) were followed by frost. At the time, it was unclear what conditions, or agronomic practices, resulted in the injury occurring, and it was not known what role Roundup played.

During the field season of 2015, initial field trials were conducted, which replicated crop injury observed in 2014. The initial trials found significant yield differences between alfalfa treated with Roundup followed by a frost, compared to an untreated control plot. During the 2016 and 2017 growing seasons, research ramped up and numerous replicated field trials were conducted throughout the Intermountain Region of California. In the 2016 and 2017 trials, applications of a low rate and high rate of Roundup were applied at various heights after the alfalfa broke dormancy. While some trial locations had variable crop injury, many locations found significant alfalfa yield reductions after applications of Roundup were followed by frost. No visible injury occurred when applications were made to alfalfa shorter than 2 inches in height. However, applications to alfalfa 4 inches and taller resulted in lingering visible crop injury. Overall, the most injury occurred when higher rates of Roundup were applied to alfalfa plants between 6 and 8 inches. It was unclear how long after application frost can occur for visual injury to develop.

The injury is not typical symptomology associated with a glyphosate treatment. Following frost after application, individual alfalfa stems curl over and die, forming a shepherd’s crook (see Photo one).

Stems and plants continue to show this symptomology for weeks after treatment. Additionally, some of the alfalfa plants developed chlorosis and stunting following the application, resulting in yield loss. Injury is not always readily apparent at first glance, as stems in the understory often show the worst symptoms.

The shepherd's crook symptomology on the affected alfalfa stems looked eerily similar to symptoms caused by bacterial stem blight. Pseudomonas syringe is a common bacterium found many places. It has a protein that mimics a crystalline structure and helps start the formation of ice. When water freezes, it needs a starting point for ice crystals to form, which the bacteria provides. After ice formation occurs, damage to the plant tissue allows a pathway for the bacteria to enter the tissue of the plant, causing infection. Pseudomonas syringe and frost damage have been studied extensively in a variety of annual crops. However, it has not been the focus of much research, until recently, within alfalfa. Initial trials in 2016 and 2017 began to investigate the possibility of pseudomonas syringe playing an increased role in crop injury of applications of glyphosate, but trials were inconclusive.

In 2019, we started new trials and reconfirmed some of the agronomic practices to avoid crop injury. Early applications before the crop had 2 inches of growth resulted in less chance of injury. Applications of a 22 oz. rate of Roundup Powermax often resulted in less injury than applications of the higher rate of 44 oz. per acre. But, like previous trials, results were significant at some study sites and not significant at other study sites. Summaries for previous research can be found on the Alfalfa Symposium website in 2016 and 2019, and a written report of 2019 data is housed on the IREC website (page 25).

In 2019 we investigated if bactericides could be applied to reduce populations of pseudomonas and potentially decrease the amount of crop injury. We had four treatments: an untreated check, 44 oz. glyphosate alone at 8 inches, and the bactericides applied weekly with and without glyphosate. At our two trial locations, we had variable results. At the Honey Lake Valley location, we saw no impact from the bactericide applications. Roundup reduced crop height by four inches and total yield by 0.5 ton/acre with or without the bactericide. At the Tulelake site, there appeared to be some protection from the bactericide. Crop yield and height was reduced compared to the untreated check where glyphosate was applied alone, but there was no difference in yield or crop height where glyphosate was applied to plots treated with the bactericide (see Table one and Table two). While not consistent, this was promising!

We continued the research in 2020 with three research locations investigating the same four treatments: untreated, glyphosate alone, weekly bactericide alone, and weekly bactericide + glyphosate once. Trials were located at the research station in Tulelake, in Scott Valley, and in the Honey Lake Valley. Results again were variable in 2020. At the Scott Valley site, we saw no statistical differences in yield or crop height between the treatments. However, the glyphosate treatment alone numerically had a lower yield and height than all other treatments. In 2020, we did not see the same trend at the Tulelake location, as the bactericides had similar height and yield compared to glyphosate applied alone. The result trend at the Honey Lake location remained consistent from 2019 to 2020 with numerically lower yield and heights in plots treated with glyphosate with or without the bactericide. Stem samples sent to the lab continued to provide inconsistent results.

While the trials this year did not prove that pseudomonas is the cause of the injury, they replicated what had been seen in previous years, inconsistency of when injury occurred. Applications of glyphosate can cause significant yield reductions in some fields but not in all fields. Alfalfa yield reductions may be minor, or may range up to 0.5-0.8 tons/acre in first cutting. As it is not known exactly what is causing these yield reductions, we will continue to investigate our hypotheses over the coming years.

At this point, cultural practices to avoid crop injury include making applications before the crop has two inches of regrowth following winter dormancy. Consider tank-mixing a pre-emergent herbicide, such as metribuzin, with glyphosate to control weeds yet to germinate when the glyphosate application occurs. Make applications of lower glyphosate rates (22oz/acre) when applying in spring, as high rates have led to more injury in trials.

Bactericide Trial 2019 : Average Alfalfa Height Inches - First Cutting				
	Honey Lake Valley		Tulelake	
Treatment	Mean	Letter Report	Mean	Letter Report
Control	24	A	19	AB
Kocide DF+Manzate Max	24	A	20	A
Kocide DF+Manzate Max+Glyphosate 44oz	20	B	18	B
Glyphosate 44oz	20	B	17	C

Table one: Crop height in inches before first cutting at the HLV site and Tulelake in 2019. Letters indicate significant differences from tukey pairwise comparisons at each site. Values were colored to help visualize the numerical differences.

Bactericide Trial 2019: Yield in Tons/Acre - First Cutting				
	Honey Lake Valley		Tulelake	
Treatment	Mean	Letter Report	Mean	Letter Report
Control	2.59	A	2.13	A
Kocide DF+Manzate Max	2.53	A	2.39	A
Kocide DF+Manzate Max+Glyphosate 44oz	2.00	B	2.11	A
Glyphosate 44oz	1.97	B	1.71	B

Table two: Yield in dry tons/acre in inches before first cutting at the HLV site and Tulelake in 2019. Letters indicate significant differences from tukey pairwise comparisons at each site. Values were colored to help visualize the numerical differences.

Bactericide Trial 2020 : Average Alfalfa Height Inches - First Cutting						
Treatment	Scott Valley		Honey Lake Valley		Tulelake	
Control	24	a	20	a	22	ab
Kocide DF + Manzate Max	26	a	20	a	23	a
Glyphosate	21	a	17	b	21	b
Kocide DF + Manzate Max+ Glyphosate	24	a	16	b	21	b

Table three: Crop height in inches before first cutting at the Scott Valley site, HLV site and Tulelake in 2020. Letters indicate significant differences from tukey pairwise comparisons at each site. Values were colored to help visualize the numerical differences.

Bactericide Trial 2020: Yield in Tons/Acre - First Cutting						
Treatment	Scott Valley		Honey Lake Valley		Tulelake	
Control	1.58	a	2.15	a	2.24	a
Kocide DF + Manzate Max	1.94	a	2.04	ab	2.23	a
Glyphosate	1.19	a	1.64	ab	2.04	a
Kocide DF + Manzate Max+ Glyphosate	1.83	a	1.54	b	2.09	a
Kocide DF + Manzate Max+ Glyphosate	1.83	a	1.54	b	2.09	a

Table four: Yield in dry tons/acre in inches before first cutting at the Scott Valley site, HLV site and Tulelake in 2020. Letters indicate significant differences from tukey pairwise comparisons at each site. Values were colored to help visualize the numerical differences.

Photo one: Shepherd's crook symptoms in alfalfa treated with glyphosate.

Photo two: Untreated check at harvest. Notice deep rich color and full stand.

Photo three: Untreated check at harvest. Side view after the harvester cut through the middle of the plot. Notice tall green alfalfa with limited dead stems.

Photo four: Glyphosate 44 oz. at 8 inches in Honey Lake Valley at time of harvest. Notice chlorotic plants and some dead stems down in the understory.

Photo five: Glyphosate 44 oz. at 8 inches at time of harvest after the center of the plot was cut with the harvester. Dead stems are very apparent from the side view down in the understory of the alfalfa stand, many more are seen from this view than the top view.

Recent Weed Control Trials in Alfalfa

By Tom Getts, Lassen Weed and Crop Systems Advisor

Weeds are perennially persistent and problematic in cropping systems year after year. While a healthy stand of alfalfa can out compete most weeds, winter annual weeds are often problematic in first cutting. Species like tumble mustard, tansy mustard, prickly lettuce and shepherd's purse are common contaminants of hay fields. While these plants are not toxic, they detract from the quality of the hay, and are visual deterrents for consumers. Winter annual grasses, such as cheatgrass and foxtails, are a different story with seed heads that can get lodged in the mucus membranes of livestock causing infections. Hay contaminated with these grasses is much less marketable. Furthermore, there are toxic weeds, such as fiddleneck, which can lead to death of livestock if too much is consumed. But the real cost of weeds comes at the market, where weedy hay can be worth anywhere from $30-100 less per ton depending on the contaminant. This makes weed control an aspect that growers cannot afford to ignore.

Many growers of conventional alfalfa in the Intermountain Region often make applications of a residual herbicide combined with a burndown herbicide before the crop breaks dormancy in late winter. These applications can be an excellent way to control emerged weeds while creating a residual barrier for weeds yet to germinate. If made after dormancy is broken, unacceptable crop injury can occur. For the residual herbicides to be effective, they need to be incorporated into the soil profile by precipitation. Typically, in February and early March there is adequate precipitation to activate these soil residual herbicides. Some years are too wet, with muddy fields preventing applications by ground rigs from occurring at all.

This past spring, we had a couple of field trials which I wanted to share some data from. The first was investigating an experimental herbicide (CNV2243) for dormant season applications. This experimental herbicide is thought to be similar (yet different) than metribuzin giving some control of small emerged weeds, but mainly having pre-emergent activity. We were looking at crop safety and weed control compared to metribuzin with and without the burndown herbicides Shark, Sharpen, and Gramoxone. Applications were made in late winter (early February) just as green buds were seen down in the crowns of the alfalfa. No precipitation fell until early March to incorporate the residual herbicides. It is not uncommon for growers to miss the late winter application window, so we also tested applications after the crop had broken dormancy on April 2nd.

In conversations with some pest control advisors, there were other valleys in the region that never received any late winter precipitation to incorporate residual herbicides like metribuzin. Alfalfa had broken dormancy and they needed to apply a herbicide with more crop safety than a burn down product. While there are selective products like Pursuit and Raptor available to growers, they are not used as commonly outside of new seedings. Part of the reason for this is because of price, weed control spectrum, and potential for some injury. Some of the questions I was getting about Pursuit and Raptor I didn't have the answers to: Could you get adequate control with 3 oz. of Pursuit? Did adding AMS help with weed control but cause unacceptable crop injury? Did you need to add a grass killer like Select for adequate grass control? To help answer some of these questions, we put out an adjacent trial in the same field with a whole slew of post emergence treatments on April 2nd.

Both trials consisted of 10*20 ft. plots, replicated four times. Crop injury and weed control was evaluated at one-week increments following treatments and before harvest. Before harvest weed control data is shared in Table two. All treatments in both trials applied on April 2nd showed some crop injury, where any application of Shark or Gramoxone caused significant burn back of the crop. First cutting yields have been shown to be reduced by application of these contact burn down herbicides in previous research. All Pursuit and Raptor treatments also initially caused crop injury. While I cannot speak to the effect of the initial crop injury on yields in these two trials, all treatments outgrew any "visual" injury by the time of harvest (and could not be differentiated from the untreated check).

There were three weeds present at this field location: tumble mustard (*Sisymbrium altissimum*), prickly lettuce (*Lactuca serriola*) and cheatgrass (*Bromus tectorum*).

Generally, dormant season treatments provided the best broadleaf weed control. Tumble mustard was controlled with most treatments in both studies. Prickly lettuce was more difficult to control. In the dormant trials, satisfactory control of prickly lettuce was only achieved when Gramoxone or Sharpen was included in the tank at the February application. Only the tank mix with Gramoxone controlled prickly lettuce at the April application, with no control in any of the Pursuit or Raptor treatments. Cheatgrass was more difficult to target, and the best control was achieved in February applications that contained Select or Gramoxone in the tank. Cheatgrass was also controlled with 6oz Raptor + AMS, or a combination of Raptor + Select in April.

In terms of the questions we were trying to answer, the experimental herbicide seemed to have good crop safety in this trial, and offered good weed control as a tank mix partner but not as a stand-alone product. Pursuit at the 3 oz. rate was not very effective. Raptor had broader weed control activity and picked up cheatgrass when AMS was included. Shark and Sharpen looked pretty good on the broadleaf weeds, but did not control the cheatgrass like Gramoxone. Generally, only a few dormant season treatments tested controlled all three weed species effectively. Adding Prowl to the tank did not increase control of any species for the April applications, as most of the weeds had already germinated. There are a lot of alternatives but Metribuzin + Gramoxone still offers some of the best broad spectrum weed control out of options tested.

While often not emphasized in research reports, cost often drives what treatment a grower selects. Expensive treatments eat into the bottom line. However, an ineffective treatment will end up costing much more if the hay ends up weedy. It is a balance between treatment effectiveness and price. Tables Three and Four show the price of all treatments tested in these trials (herbicide only, not application cost). Some of the tank mix combinations cost significantly more than treatments which offered similar or even better weed control. One of the most cost-effective treatments was Metribuzin + Gramoxone in the dormant season trial. Raptor 6oz + AMS was one of the most cost effective treatments tested in April, with the caveat of limited prickly lettuce control. Knowing your weed spectrum by field can help guide what combinations should be chosen.

Dormant Trial: Percent Weed Control before Harvest						
	Tumble Mustard		Prickly Lettuce		Cheatgrass	
metribuzin (tricor 75df) .67 lb	91	a	83	ab	75	a
CNV2243 16 floz	35	bc	30	abc	14	bc
metribuzin (tricor 75df) .67 lb + gramoxone 1 qt	94	a	95	a	95	a
metribuzin (tricor 75df) .67lb + sharpen 2 oz	95	a	95	a	48	abc
metribuzin (tricor 75df) .67 lb + shark 2 oz	95	a	95	a	46	abc
CNV2243 16 floz + gramoxone 1 qt.	88	ab	91	a	88	a
CNV2243 16 fl oz + sharpen 2 oz	93	a	94	a	41	abc
CNV2243 16 fl oz + sharpen 2 oz + select 22 oz	93	a	95	a	94	a
CNV2243 16 oz + shark 2oz	89	ab	64	abc	3	c
2 in metribuzin (tricor 75df) .67 lb + gramoxone 2 qt	90	a	89	ab	43	abc
2 in metribuzin (tricor 75df) .67 lb + shark 2 oz	94	a	46	abc	5	c
2 in CNV2243 4L 16 fl oz + gramoxone 2 qt.	71	ab	90	a	63	ab
2 in CNV2243 4L 16 fl oz + Shark 2oz	71	ab	68	abc	10	bc
2 in CNV2243 16 fl oz + Shark 2 oz + Select 22 oz	68	ab	70	abc	64	ab
Control	0	c	0	c	0	c

Table One: Weed control ratings before the alfalfa was harvested in the Dormant Season Trial. Letters indicate significant differences. Colors do not indicate differences but were only added to help visualize high and low ratings: green=good control and red=bad control. "2 in" indicates treatment was made after crop growth had occurred on April 2nd. All treatments with Shark or Sharpen included MSO 1% v/v, where all other treatment use NIS 0.25% v/v.

April Second Trial: Percent Weed Control before Harvest						
Treatment	Tumble Mustard		Prickley Lettuce		Cheatgrass	
Pursuit 3oz	78	a	20	a	17	c
Pursuit 6oz	70	a	23	a	35	bc
Raptor 6oz	95	a	10	a	69	abc
Pursuit 3oz + Select 16oz	94	a	5	a	66	abc
Pursuit 6oz + Select 16oz	71	a	15	a	51	abc
Raptor 6 oz + Select 16oz	95	a	20	a	85	ab
Pursuit 3oz + AMS	95	a	20	a	18	c
Raptor 6 oz + AMS	95	a	33	a	93	a
Pursuit 3oz + Select 16 oz + Prowl 2qt	76	a	28	a	65	abc
Pursuit 6oz + Prowl 2 qt. + AMS	95	a	35	a	64	abc
Raptor 6oz + Prowl 2 qt. + AMS	95	a	38	a	90	ab
untreated **	0		0		0	

Table Two: Weed control ratings before the crop was harvested in the adjacent post emergence trial. Letters indicate significant differences. Colors do not indicate differences but were only added to help visualize high and low ratings: green=good control and red=bad control. The untreated control was not included in the statistical analysis because only two replications were evaluated. All treatments included NIS 0.25% v/v. AMS was added at 15lb/100 gallons of spray solution.

Cost of Herbicides Alone	
Tricor 75 df 2/3 lb	$13.59
Gramoxone 1 qt.	$8.10
Sharpen 2 oz	$13.00
Shark 2 oz	$18.00
Select 16 oz	$19.25
Pursuit 3oz	$8.65
Pursuit 6oz	$17.29
Raptor 6oz	$24.28
Prowl 2 qt.	$33

Table Three: Cost of the chemicals (approximations based on quotes and online retailers, prices may vary).

Cost of Tested Treatments	
Treatment	Cost
metribuzin (tricor 75df) .67 lb	$13.59
metribuzin (tricor 75df) .67 lb + gramoxone 1 qt	$21.69
metribuzin (tricor 75df) .67lb + sharpen 2 oz	$26.59
metribuzin (tricor 75df) .67 lb + shark 2 oz	$31.59
2 in metribuzin (tricor 75df) .67 lb + gramoxone 2 qt	$21.69
2 in metribuzin (tricor 75df) .67 lb + shark 2 oz	$31.59
Pursuit 3oz	$8.65
Pursuit 6oz	$17.29
Raptor 6oz	$24.28
Pursuit 3oz + Select 16oz	$27.90
Pursuit 6oz + Select 16oz	$36.54
Raptor 6 oz + Select 16oz	$43.53
Pursuit 3oz + AMS	$8.65
Raptor 6 oz + AMS	$24.28
Pursuit 3oz + Select 16 oz + Prowl 2qt	$60.90
Pursuit 6oz + Prowl 2 qt. + AMS	$41.65
Raptor 6oz + Prowl 2 qt. + AMS	$57.28

Table Four: Cost of the tank mixes (approximations based on quotes and online retailers, prices may vary).

Is Irrigating Alfalfa After Last Cutting a Good Idea?

By Rob Wilson, Siskiyou County Director

Over the years, I have observed a large discrepancy in the way Northeast California alfalfa growers irrigate after their last hay cutting. Some growers like to irrigate after their last cutting, some irrigate twice, and some growers do not irrigate. When I ask farm managers why they irrigate after last cutting they often tell me they like to put the alfalfa to sleep in wet soils, or they like refilling the soil profile for next year when alfalfa breaks dormancy. When I ask farm managers why they do not irrigate, they say the crop does need water or they are busy deer and elk hunting. This discrepancy has perplexed me as sprinkler irrigation after last cutting has a significant energy and water cost and irrigating after last cutting often serves as a gateway for winter weeds such as cheatgrass, shepherd's purse, and prickly lettuce to become well established in the fall. This topic is not covered in most Western States university alfalfa guidelines unlike the countless publications and research detailing spring and summer alfalfa irrigation. Thus, I thought I spend a little time summarizing what I have learned from irrigating alfalfa at IREC and what experts from other States recommend. Keep in mind these thoughts are specific to established alfalfa and cold weather conditions in Northeast California.

Pros and Cons of Irrigating After Last Cutting

The cons outnumber the pros when choosing to irrigate after last cutting. Irrigating in October stimulates winter annual weeds to germinate, and early weed establishment makes it much more difficult to control weeds with dormant herbicide treatments applied in late winter. Fall irrigation can increase the potential for winter kill in years with wet, cold winters. A few experts say fall irrigation on sandy soils can help moderate alfalfa winterkill, but most experts say well drained dry soils help alfalfa plants go dormant and survive extreme winter temperatures. As there is some discrepancy in recommendations, I reviewed two peer-reviewed studies that directly measured soil moisture and winter kill. Both studies showed saturated soils resulted in more winterkill under extreme cold. This is because high soil moisture does not allow for adequate air exchange and respiration in soils, saturated, flooded soils are more susceptible to ice sheeting, wet soils impede alfalfa plants from hardening off, and alfalfa roots need a period of dehydration to minimize cell freezing. I've visited several fields with significant winterkill over the years, and almost all of them had standing water and oversaturated soils. Another con with irrigating after last cutting is it can stimulate fall regrowth which often leads to mice and vole damage.

Tips for Maximizing Wheat and Barley Yields

By Rob Wilson, Siskiyou County Director

Growers commonly experience fluctuations in wheat and barley yields from year to year. In some cases, the difference is related to weather and water availability, and in other cases differences can be traced back to management. 2020 is a year most of us would like to forget and wheat and barley yields were no exception for some producers. I heard a lot of reports of lower yields especially in drought areas. Below I tried to highlight some of the key management practices to maximize yields. Growers cannot control drought and lack of water, but many can alter their management to boost their chances of a profitable yield. I hope these tips help increase wheat and barley yields in 2021.

Planting Date: Five years ago, Steve Orloff completed several studies at multiple sites looking at how seeding rate and planting date influenced spring and winter wheat yields http://cawheat.org/uploads/resources/645/orloff-wheatcommissionfinalrptseedrate.pdf and http://irec.ucanr.edu//files/229926.pdf . The spring wheat study showed planting in early April was best for some varieties while planting in early May was better for others. The early April planting had the highest yield averaged across varieties; thus, I recommend trying to plant irrigated spring wheat and barley in early April with the goal of getting everything planted by early May. For dryland plantings, March to early April is the preferred seeding time. I talked to several growers that planted wheat and barley in late May and June this year. I will tell you from personal experience this is too late to plant spring wheat and barley especially if you want to maximize grain yield. Young plants growing in the middle of summer require a lot more irrigation to avoid drought stress and the plants are often stunted, have less reproductive heads, and kernels per head. June plantings are often attacked by aphids and other insects more so than early plantings. Forage producers that plant wheat and barley in late May and June should expect low forage yields and a greater need for irrigation.

Planting winter wheat and barley from mid-October to mid-November gave the best grain yield over multiple years compared to planting early in September or late in early February. Winter wheat planted in September looks great in the fall and early spring, but the plants reach reproductive stages too early the next season (May) making the crop susceptible to frost damage. September plantings are acceptable for forage producers not worried about grain yield, but grain growers should avoid early plantings especially in cold areas. Planting in February resulted in high grain yields the first year and the lowest grain yield the second year of the study. The reason for this fluctuation between years was related to the weather after planting. Winter wheat and barley require a vernalization period to transition to reproductive growth. Many people think the vernalization period is a set amount of time but it is actually quite variable from to year to year depending on winter temperatures. One study showed vernalization can range from 40 days to 70 days for the same variety because of differences in winter temperatures. This variability in vernalization makes late winter planting very risky. You may get lucky and have great yields with a mid-February planting one year , but as Steve's study showed if wheat and barley do not get enough cool weather after emergence the plants will be short and have erratic seed production.

Variety / Planting date	Seeding rate Seeds/acre (x 1,000,000) 0.8	1.1	1.4	1.7	2
Yecoro Rojo	---tons/A---				
Early	3.13	3.06	3.22	3.06	3.14
Late	3.29	3.29	3.35	3.31	3.38
Fuzion					
Early	3.71	3.95	3.87	3.85	3.82
Late	3.24	3.62	3.42	3.71	3.59
Alpowa					
Early	4.87	4.51	4.37	4.12	4.32
Late	3.88	3.66	4.00	3.56	3.95
Nick					
Early	4.00	3.76	3.70	3.57	3.43
Late	3.94	3.98	3.78	3.81	3.78

The effect of seeding date and rate on the yield of four spring wheat cultivars in Tulelake, CA. Early seeding was in early April and late seeding was in early May. Seeding rates ranged from 80 to 211 lbs per acre.

Seeding Rate: Most growers have a favorite seeding rate for wheat and barley, but Steve's studies showed little difference in yield when wheat was seeded at rates between 100 to 200 lbs per acre in Tulelake. Wheat and barley have a remarkable ability to compensate for seeding rate by altering the number of tillers, spikes, and seeds produced per acre. Planting wheat at 100 lbs per acre will result in fewer plants per acre, but those wheat plants will produce more tillers, spikes, and seeds per plant compared to higher seeding rates. For this reason, I suggest planting wheat and barley at 100 to 130 lbs per acre when using a drill. One thing to note is there can be a 30% variability between kernel weights of different varieties and seed lots, so it is worth checking the kernel weight on the seed tag. The target plant population for irrigated wheat is 1.35 million plants per acre. For those that don't like math, Mark Lundy created a handy seeding rate calculator for determining wheat seeding rates (lbs/acre) with adjustments for kernel weight, germination rate, and desired plant population http://smallgrains.ucanr.edu/General_Production/Seeding_Rate/ . Higher seeding rates may be justified if you are planting into a poor seedbed or broadcasting seeds, but 200 lbs per acre is too much seed in most situations.

Irrigation: Wheat and barley irrigation needs are deceiving. Small grains are efficient water users, thus in wet years with timely spring rains growers have quite a bit of flexibility in irrigation especially on heavier soil types (loams, silt loams, and clay loams) with high water holding capacity. In drought years, this is not the case on all soil types. I heard many producers say they irrigated their wheat and barley crop once or twice this year. In a dry year, one or two irrigations is not enough irrigation frequency to meet crop water needs to maximize grain yield. Water use for wheat ranges from 19 to 23 inches for a grain crop, and it is around 16 to 18 inches for a forage crop cut at soft dough. Just as important as total applied water, irrigation frequency must keep the soil wet during critical growth stages with 70% of wheat water use occurring from late tillering to flowering. My best recommendation for grain growers is to monitor crop water use and dig in the field at least weekly to check soil moisture in the top 1 ft. Soil moisture monitors are also very helpful in monitoring soil moisture in grain fields. Darrin Culp, IREC Superintendent at IREC, has developed a great knack for irrigating small grains over the years. This is evidence by the fact that IREC yields often exceed 3.5 tons/acre for spring wheat and 5 tons/acre for winter wheat. When I asked him about his irrigation tips for small grains, he stressed wheat and barley's tremendous appetite for using water from tillering to flowering and how it is extremely to keep the soil moist during this time frame. It is extremely easy to get behind irrigating small grains and never catch up which will always reduce yields. This point is extremely important because many growers apply a big irrigation at tillering and then get busy irrigating other crops such as alfalfa and vegetables. Small grains appetite for water from stem elongation to flowering is extremely high and often requires multiple irrigations. Grain is also most susceptible to yield loss during these growth stages. At IREC, Darrin often applies 2 or 3 wheel-line irrigations during this time frame to keep up with water use (on a heavy silty clay loam soil).

Irrigating spring wheat at IREC shortly after applying urea fertilizer at tillering. This is when wheat really starts to need water. Don't worry about driving over the field when spreading fertilizer at tillering; you won't see the wheel tracks for long.

The last irrigation on heavy soils should correspond with flowering on heavy soil types, milk on medium soil types, and possibly early soft dough on sandy soil. Never water after soft dough! A good way to know if you timed your last irrigation correctly is to look at the kernels and test weights. If you have pinched grain and low test weights you likely need to irrigate a little later into the season. If the kernels are plump with good test weight but you have a problem with late emerging green tillers and slow dry down, you are watering too late. In dry years, 3 to 5 irrigation events with wheel-lines and possibly 6 to 15 passes with a Center Pivot depending irrigation amounts is needed throughout the season to meet the water demand for small grains. This assumes that sprinkler irrigation is not heavily influenced by wind. If irrigating on windy days make sure to have irrigators offset the wheel-line on the next irrigation to avoid wind strips.

Fertilizer: Nitrogen is often the key to maximizing grain yields. Steve Orloff and Mark Lundy carried out several studies in the Intermountain Region evaluating nitrogen fertilizer effects on grain yield over the last 10 years http://irec.ucanr.edu//files/213662.pdf . Darrin Culp and I use their recommendations in our management, and we have continued to try to fine tune their recommendations in recent years. What we can tell you is the lack of nitrogen at critical growth stages will dramatically decrease forage and grain yields. Yes, fertilizer costs money, but nitrogen will almost always pay for itself when used correctly even at today's mediocre grain prices. The key to nitrogen fertilizer is applying it at the correct time and making sure you water the crop enough to get the benefits of the fertilizer. Mark and Steve's studies showed the most efficient time to apply most of the nitrogen for wheat is at tillering as 70% of wheat's total nitrogen demand occurs from tillering to heading. If you apply all the nitrogen at planting, it is not available from stem elongation to flowering when wheat needs it most. If you are growing hard red wheat, it is extremely important to also apply nitrogen at flowering to boost protein. If you don't, you will likely not reach 13% grain protein. The total amount of nitrogen to apply throughout the season depends on your yield potential and preplant soil nitrogen test result. A good rule of thumb for irrigated wheat is 50 lbs of nitrogen per ton of grain. Thus, a 3-ton grain crop needs 150 lbs of nitrogen per acre. Twenty-five to 50 lbs of nitrogen per acre is also needed at flowering to boost protein in hard red wheat fields with 40 to 50 lbs needed for grain yields over 3 tons per acre.

The other side of equation when talking about nitrogen fertilization is the amount of nitrogen in the soil. Always soil test fields for fertility shortly before planting and again in early spring in the case of fall planted grain. Don't rely on a fall soil test for spring planted grain or a soil test from a couple years ago! If your nitrate soil test (NO3-N) is below 10 ppm, your soil is on empty and you have little available nitrogen in the soil. If your nitrate soil test is between 10-20 ppm, you have some nitrogen in reserve and you can reduce your fertilizer amount. If your soil nitrate test is over 30 ppm, you may not need to apply any nitrogen fertilizer. I'm guessing most fields are below 10 ppm unless they are following alfalfa or vegetables, but you should always test the soil to make sure. Another approach for testing soil nitrate is using a nitrate quick test; the process for this method is detailed in the following link put together by Mark Lundy's Lab http://smallgrains.ucanr.edu/Nutrient_Management/snqt/.

In the case of brew barley, the opposite fertilizer program is needed to meet quality standards. In many cases, growers have a problem with grain protein being too high to meet brew barley quality standards. This means you need to test your soil for nitrogen at planting and the tillering stage for brew barley. If the soil has more than 15 to 20 ppm nitrate, don't apply nitrogen fertilizer when growing brew barley. If the soil has less than 10 ppm nitrate, you should consider applying 50 to 75 lbs nitrogen per acre pre-plant or early in the season to boost yield but always be conservative especially if you have limited water.

When fertilizing with other nutrients, I'd recommend focusing on phosphorus and potassium. I often hear growers say they fertilize grain crops with sulfur and micronutrients every year. My response is you likely do not need these nutrients especially for grain and applying too much sulfur is great way of lowering your pH requiring you to buy lime fertilizer to boost pH next time you plant alfalfa. Lime is expensive! Most crops do not need more than 30 lbs of sulfur per year and if you apply sulfur repeatedly you probably have an excess in the soil. Soil test and tissue test for sulfur. If you have more than 5 to 10 ppm sulfur in the soil you don't need sulfur for grain. In the case of phosphorus and potassium, test the soil shortly before planting. If phosphorus in the top foot is over 15 to 20 ppm using the Olsen P soil test you likely have enough phosphorus in the soil. If potassium in the soil is over 75 ppm you likely have enough potassium. Apply phosphorus and potassium before your last tillage pass at planting or in the drill at planting for best results.

Choose a good variety: For those that have planted the same variety the last 10 years it may be time to change things up. Growing the same variety multiple years has the benefit of learning the ins and outs of the variety, but the genetics of new varieties keep improving and the best new varieties produce higher yields and have better pest resistance and quality compared to the best variety 10 years ago. On the following pages are the results for the winter and spring variety trials conducted at IREC in 2020. If you have questions or need more information, contact your local UC farm advisor or us at IREC 530-667-5117.

2020 IREC Irrigated Winter Wheat Grain Yield Summary, Tulelake, CA.

Entry #	Entry Name	Grain Yield (tons/acre)	
18	LWW16-71088	6.17	A
17	LCS Blackjack (LWW15-71945)	6.02	A B
4	Bobtail	5.69	A B C
15	LCS Ghost (LWW14-74143)	5.64	A B C
11	WB 1783	5.63	A B C
2	Mary	5.62	A B C
3	Rosalyn	5.50	A B C D
14	LCS Hulk	5.50	A B C D
6	Nixon (OR2121086)	5.35	A B C D E
23	OR2150346	5.34	A B C D E F
5	Norwest Duet	5.32	B C D E F
24	OR2150141	5.32	B C D E F
20	Stingray CL+	5.30	B C D E F G
9	SY Ovation	5.23	B C D E F G
13	WB 1532	5.17	C D E F G
22	OR2140401	5.16	C D E F G
1	Stephens	5.13	C D E F G
16	LCS Shine (LWW14-72916)	5.12	C D E F G
21	Magic CL+	5.07	C D E F G
7	VI Bulldog (IDN 07-28017B)	5.03	C D E F G
19	M-Press	4.75	D E F G H
10	SY Dayton	4.65	E F G H
12	WB 1604	4.50	F G H
25	OR5170022	4.47	G H
8	Pritchett	4.02	H
	Average	5.23	

2020 IREC Irrigated Winter Wheat Agronomic Characteristics.

Entry #	Entry Name	Heading Date	Maturity Date	Plant Height (cm)	% Lodged Plants	% Stripe Rust	Bushel wt.
1	Stephens	17-Jun	8-Aug	109	86	0	57.5
2	Mary	16-Jun	6-Aug	105	1	30	56.5
3	Rosalyn	19-Jun	6-Aug	109	0	0	56.6
4	Bobtail	17-Jun	7-Aug	106	0	0	57.6
5	Norwest Duet	19-Jun	5-Aug	115	56	0	56.7
6	Nixon (OR2121086)	18-Jun	9-Aug	112	0	0	56.3
7	VI Bulldog (IDN 07-28017B)	17-Jun	7-Aug	105	1	0	59.9
8	Pritchett	21-Jun	7-Aug	108	51	0	57.1
9	SY Ovation	19-Jun	5-Aug	104	10	0	57.4
10	SY Dayton	20-Jun	7-Aug	101	0	0	57.8
11	WB 1783	18-Jun	9-Aug	109	75	0	60.3
12	WB 1604	15-Jun	2-Aug	108	23	0	59.6
13	WB 1532	19-Jun	8-Aug	112	93	0	57.2
14	LCS Hulk	18-Jun	7-Aug	108	0	0	60.1
15	LCS Ghost (LWW14-74143)	17-Jun	6-Aug	109	1	0	57.2
16	LCS Shine (LWW14-72916)	13-Jun	2-Aug	91	0	0	59.9
17	LCS Blackjack (LWW15-7194ƹ	17-Jun	5-Aug	105	1	0	57.9
18	LWW16-71088	19-Jun	9-Aug	106	86	0	59.3
19	M-Press	20-Jun	8-Aug	107	0	0	58
20	Stingray CL+	18-Jun	8-Aug	109	4	0	55.9
21	Magic CL+	15-Jun	8-Aug	99	5	0	57.2
22	OR2140401	19-Jun	7-Aug	106	0	0	58.9
23	OR2150346	19-Jun	9-Aug	104	0	0	56.8
24	OR2150141	19-Jun	8-Aug	113	1	0	57
25	OR5170022	19-Jun	8-Aug	106	0	0	58
	Average	17-Jun	6-Aug	107	19.8	1.2	57.8

2020 IREC Irrigated Winter Barley Yield and Agronomic Characteristics									
Entry #	Entry Name	Barley Type	Grain Yield tons/A	Heading Date	Maturity Date	Plant Height (cm)	% Lodged Plants	% Stripe Rust	Bushel wt.
1	Alba	Feed	3.56	5-Jun	22-Jul	120	10	5	47.6
2	Strider	Feed	3.94	2-Jun	20-Jul	120	0	0	47.5
3	Wintmalt	Malt	2.91	6-Jun	24-Jul	105	55	55	46.8
4	Thunder	Malt	3.29	5-Jun	23-Jul	109	14	23	49.4
5	DH130910	Malt	3.02	5-Jun	18-Jul	112	5	8	48.6
	Average		3.34	4-Jun	21-Jul	113	17	18	48

2020 IREC Irrigated Spring Hard Red Wheat Grain Yields			
Entry #	Entry Name	Grain Yield (tons/acre)	
15	SY Teton	4.90	A
19	WB9699	4.75	A B
18	Softsvevo	4.68	A B C
16	IDO1203S-A	4.63	A B C
4	AP Renegade (SY3017-9)	4.51	A B C D
10	WB9668	4.49	A B C D
14	LNR16-1485	4.47	A B C D
7	WBPatron	4.44	A B C D
3	WA 8315	4.41	A B C D E
11	WB9904	4.39	A B C D E F
5	AP Venom	4.38	A B C D E F
9	WB9518	4.36	A B C D E F
17	IDO1804S	4.27	B C D E F
20	WB9990	4.19	C D E F
8	WB9303	4.08	D E F G
2	Alum	4.05	D E F G
6	AP Octane	4.01	D E F G
13	LNR16-1223	3.86	E F G
1	Yecora Rojo	3.85	F G
12	IDO1805S	3.56	G
	Average	4.31	

2020 IREC Irrigated Spring Soft Wheat Agronomic Characteristics.							
Entry #	Entry Name	Heading Date	Maturity Date	Plant Height (cm)	% Lodged Plants	% Stripe Rust	Bushel wt. (lbs)
1	WB6341	25-Jun	14-Aug	105	0	0	60.6
2	WB6121	24-Jun	13-Aug	91	0	0	61.3
3	IDO01405S	25-Jun	14-Aug	98	0	0	61.1
4	Ryan	24-Jun	14-Aug	97	44	0	58.5
5	Tekoa	27-Jun	16-Aug	112	23	0	61.8
6	Melba	28-Jun	19-Aug	96	78	0	60.3
7	IDO01702S	25-Jun	14-Aug	11	0	0	61.3
8	Alpowa	29-Jun	14-Aug	113	21	50	60.5
9	IDO1404S	27-Jun	18-Aug	100	0	0	61.3
10	IDO1401S	24-Jun	14-Aug	105	19	0	60.3
11	AP Coachman	29-Jun	17-Aug	109	91	0	56.8
12	10PN2013-02	26-Jun	14-Aug	108	0	0	60.8
	Average	26-Jun	15-Aug	95	23	4	60.4

2020 IREC Irrigated Spring Hard Red Wheat Agronomic Characteristics							
Entry #	Entry Name	Heading Date	Maturity Date	Plant Height (cm)	% Lodged Plants	% Stripe Rust	Bushel wt. (lbs)
1	Yecora Rojo	25-Jun	12-Aug	81	0	10	61.1
2	Alum	27-Jun	15-Aug	109	18	0	60.3
3	WA 8315	26-Jun	14-Aug	110	43	0	60.4
4	AP Renegade (SY3017-9)	27-Jun	17-Aug	104	0	0	60
5	AP Venom	2-Jul	14-Aug	106	0	0	59.1
6	AP Octane	27-Jun	14-Aug	86	0	0	59.1
7	WBPatron	25-Jun	12-Aug	88	0	0	60
8	WB9303	24-Jun	14-Aug	97	0	0	62.5
9	WB9518	27-Jun	13-Aug	94	0	0	50.5
10	WB9668	26-Jun	14-Aug	89	0	0	62
11	WB9904	28-Jun	14-Aug	94	0	0	60
12	IDO1805S	27-Jun	15-Aug	96	14	0	58.5
13	LNR16-1223	2-Jul	14-Aug	108	81	5	59.7
14	LNR16-1485	29-Jun	13-Aug	118	0	5	60.4
15	SY Teton	25-Jun	15-Aug	95	0	0	58
16	IDO1203S-A	25-Jun	14-Aug	95	0	0	61.2
17	IDO1804S	27-Jun	15-Aug	102	59	20	58.6
18	Softsvevo	26-Jun	14-Aug	102	3	10	60.1
19	WB9699	27-Jun	14-Aug	87	0	0	60.4
20	WB9990	30-Jun	13-Aug	89	0	0	59
	Average	27-Jun	14-Aug	98	11	2.5	59.5

2020 IREC Irrigated Spring Barley Grain Yields				
Entry #	Entry Name	Type	Grain Yield (tons/acre)	
5	Oreana	Feed	4.26	A
2	LCS Opera	Malt	4.22	A
8	Charger	Feed	4.04	A B
10	KWS Chrissie	Malt	4.02	A B
9	KWS Jessie	Malt	4.00	A B
1	Claymore	Feed	3.92	A B
7	LCS Diablo	Malt	3.92	A B
3	CDC Copeland	Malt	3.88	A B
4	Altorado	Feed	3.60	A B
13	Francin	Malt	3.51	A B C
11	AAC Connect	Malt	3.21	B C
12	Meg's Song	Food	3.08	B C
6	DH130910	Malt	2.60	C
			3.71	

2020 IREC Irrigated Spring Barley Agronomic Characteristics								
Entry #	Entry Name	Type	Heading Date	Maturity Date	Plant Height (cm)	% Lodged Plants	% Stripe Rust	Bushel wt. (lbs)
1	Claymore	Feed	28-Jun	31-Jul	113	0	8	50.8
2	LCS Opera	Malt	30-Jun	5-Aug	87	0	0	50.7
3	CDC Copeland	Malt	28-Jun	27-Jul	124	0	20	49.3
4	Altorado	Feed	28-Jun	29-Jul	102	0	0	52.4
5	Oreana	Feed	29-Jun	2-Aug	85	0	11	50
6	DH130910	Malt	29-Jun	29-Jul	103	0	4	48.2
7	LCS Diablo	Malt	30-Jun	5-Aug	86	0	3	46.2
8	Charger	Feed	25-Jun	29-Jul	109	0	11	52.4
9	KWS Jessie	Malt	30-Jun	1-Aug	83	0	6	50.5
10	KWS Chrissie	Malt	30-Jun	31-Jul	85	0	33	51.8
11	AAC Connect	Malt	27-Jun	25-Jul	110	0	10	49
12	Meg's Song	Food	26-Jun	31-Jul	115	0	6	56.2
13	Francin	Malt	29-Jun	1-Aug	87	0	4	49.4
			28-Jun	30-Jul	99	0	9	50.3

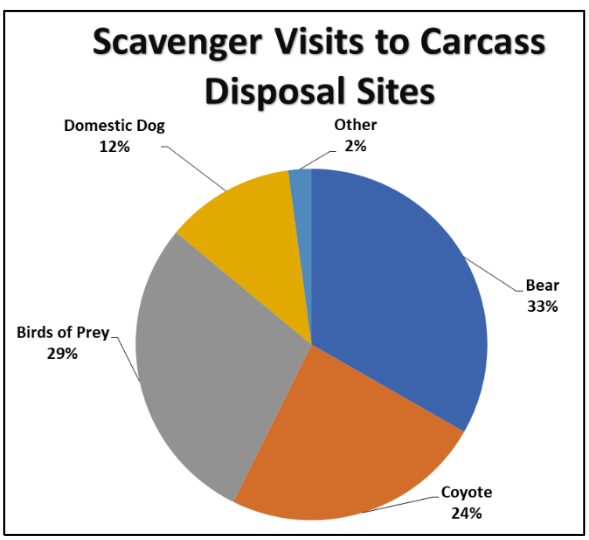
What to do When an Animal Dies? Composting could be the Answer

By Laura K. Snell, Modoc County Director and Nicole Stevens, Siskiyou Lab Assistant II

When a large animal dies on your farm or ranch, what are your options for disposal? In California, there are limited legal options especially as rendering facilities have closed, regulatory burden has increased, and predators have grown in numbers. Livestock Mortality Composting could be a viable solution. Composting of mammalian tissue is legal in most states and recommended for on-farm disposal of livestock mortalities. California has allowed composting to occur on farms only during emergency situations such as high heat events, natural disasters, and disease outbreak. This research aims to make composting a legal disposal option for livestock mortalities and to provide input to streamline the regulatory agency process.

California has one of the strictest composting requirements in the country - requiring yard waste, food scraps, and more be sent to composting facilities so why are we so behind on livestock mortality composting? With livestock and dairy production contributing $11.7 billion in 2018 (CDFA) to the state economy, change is needed to support these industries. There are currently three rendering facilities statewide located in central California between Sacramento and Fresno.
In many cases these facilities are too far from livestock operations to take mortalities and the cost to transport and process carcasses is prohibitive to operations. Rendering provides a beneficial use to the carcass like composting and unlike other disposal options. Landfills can get permitted to accept livestock mortalities but there is no beneficial use to the carcass and not many landfills are properly suited.

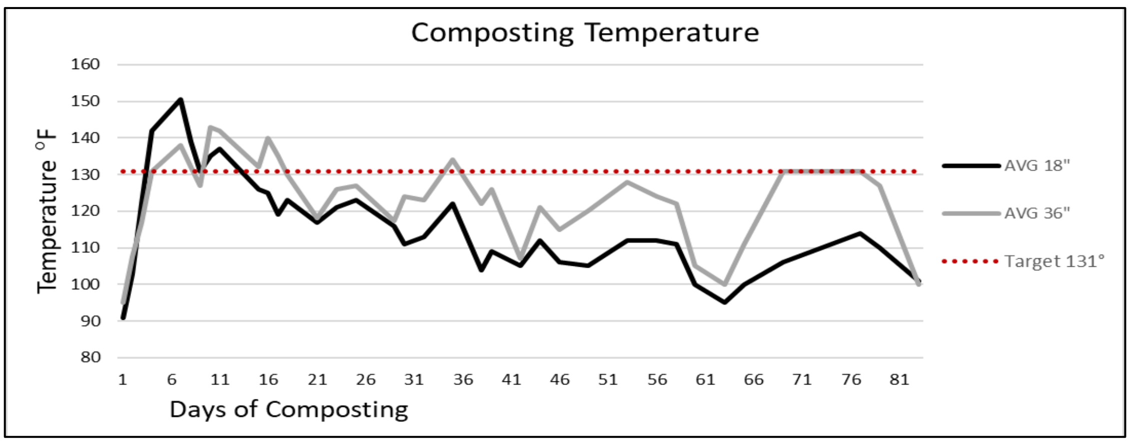
Many livestock operations have a “bone pile” where they place livestock mortalities. This option can attract large predators such as wolves, mountain lions, bears and others making it a hazard for livestock operations with decreased predator control options. It also increases the time needed for the mortality to decompose with bones existing for years. Part of this study was to monitor predator and scavenger visits to current livestock mortality disposal sites in Modoc and Siskiyou Counties. Trail cameras have been located on current disposal sites for a little over a year. The pie chart shows the percentages of several different predator and scavenger species visits. The most common predators are bears, coyotes, and birds of prey including golden eagles, bald eagles, hawks, turkey vultures and crows. Other species include skunk, bobcat, mountain lion, and raccoon. One surprising finding during this component of the study was the frequency of domestic dogs visiting the disposal sites. Some of the dogs at the sites included livestock guard dogs while others seemed to be neighboring pets.



In 2019, a team of UCCE and CSU Chico researchers began a study looking at how livestock mortality composting would work in California. What are the current regulations preventing composting? Have studies taken place in the past? What would a composting site look like that follows current state regulations? Are all these regulations needed? All these questions led to a composting site being established at the Intermountain Research and Extension Center in Tulelake, CA. Letters and permits were submitted to agency staff from the county environmental health department, CalRecycle, CDFA, CA State Veterinarian, and the regional and state water board.

An existing 3-sided structure with cement at the base was retrofitted to accommodate the permitting regulations for the composting pile. A metal roofed carport structure was installed within the structure as a roof, required by the regional water quality board. Base rock material was placed on the floor and a pond liner was put on top of the rock to act as an impermeable layer. Then tube sand was used to secure the pond liner and created a basin to deter any runoff from the site.

Livestock mortalities that have died only of natural causes are allowed to be composted. On August 10th we received a call that a cow was available for our project from a local producer. We were required to have a certified dead animal hauler move the animal. Once at the composting site, a layered base of fine and course wood chips and straw was laid out as an absorptive layer on top of the base rock. Materials were by-products from the Alturas Mill. The carcass was placed in the center of the structure and the carbon materials were layered on top. A sprinkler is available to add moisture as needed during the study.



Temperature readings are taken at 18 and 36 inches depth and moisture and pH are also taken. A temperature of 131 degrees Fahrenheit for 72 hours is required to kill potential pathogens in the compost pile. On day three, the pile achieved the target temperature and continued through day eight. Water is applied as needed and extra wood chips and straw are available as the pile shifts and needs extra material.

There is a good amount of research and educational material about livestock mortality composting from several university cooperative extension programs across the country. Navigating the regulatory process and coordinating with 8-10 government agencies with competing regulations makes this process currently unfeasible in California. By the end of this study, our objective will be to suggest best management practices from our research and other available science to create a streamlined approach to livestock mortality composting in California.

A big thank you to Carissa Koopman-Rivers who started this project in 2018, Dr. Kasey DeAtley at Chico State for her brilliance in study design and expertise, and the city of Alturas for carbon materials. We would also like to thank our local producer for the livestock mortality and the Intermountain Research and Extension center for their patience and monitoring help.