Farm Advisor's Update

University of California
Agriculture and Natural Resources

LASSEN COUNTY

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Paraquat Regulation Update

The EPA has issued new regulations that are going to affect the use of paraquat nationwide. As paraquat is commonly used by Intermountain alfalfa growers, this could be an issue that affects you! Regulations have been under flux, due to an assessment of the toxicity of paraquat, resulting in the death of multiple individuals over misuse/handling of the product. There have been multiple incidences of paraquat poisonings, many because individuals have broken the law and transferred paraquat into a food or beverage containers for transport. Transferring ANY pesticides into a food or beverage container is prohibited by law.

More information can be found on the EPA's website and on this Stewardship Guide produced for California by one of the paraquat manufacturers. I wanted to summarize some of the upcoming/current restrictions, as well as some of the herbicide options available for growers that have less restrictions.

First, all paraquat users will need to be a certified applicator. This requires holding a QAL (Qualified Applicators License), QAC (Qualified Applicators Certificate) or PAC (Private Applicators Certificate). In the past, license holders were able to supervise the applications/uses of paraquat by others under them. Under the new regulations **ALL** applicators/users must become certified by the state to be allowed to use and apply paraquat. (Regulations on the supervision of other restricted materials application has not changed). Paraquat "uses" are defined as "mixing/loading, applying, transporting open containers, cleaning equipment, disposing of product, wash waters, and pesticide containers." Essentially all activities surrounding paraquat, will need to be performed by a license holder.

Which license do you need? QAC and QAL's are required by individuals who apply pesticides for pest control business as part of their job. PAC's are a certification that allows a landowner or land renter to apply restricted use material to their own agricultural commodities (*not* to others' agricultural commodities). All licenses require some continuing education training to maintain certification. More information on licensing and requirements can be obtained from the ag department.

Additionally, every user of paraquat will need to take a paraquat training course through the National Pesticide Safety Education Center every three years. This training is conducted online, and needs to be taken before any paraquat applications occur. The training consists of a 30-minute video followed by a quiz. The quiz is directly related to the content in the training video, and can be taken more than once if you do not receive 100%, which is required to pass. The content of the quiz mainly focuses on the proper personal protective equipment needed and regulations surrounding storage of the herbicide.

Changes to paraquat labels, effective as of November of 2019, include increased information about the toxicity of the product. Old product with old labels can be utilized this growing season, but all product purchased after November 2019 will be subject to these new regulations.

Furthermore, additional changes are coming for paraquat packaging in the fall of 2020. All non-bulk paraquat will be required to be in packaging that meet closed system packaging requirements. Closed mixing systems are designed to minimize/eliminate pesticide exposure to the loaders and handlers of the products. Products will not have traditional lids that would allow pouring of the product. Stay tuned to the manufacturers as they announce what types of closed mixing systems will be coming in the fall.

Photo of alfalfa treated with 2 oz. of Sharpen herbicide. The annual broadleaf weeds were controlled and the crop outgrew the injury. Note the annual grassy weeds were not controlled. Lack of annual grass control is a downside of alternative contact herbicides compared to paraquat (see Figures 4 and 7).

Alternatives to Paraquat?

Paraquat has been a very effective chemistry for weed control since it was released back in 1961. It is one of two compounds in the photosystem one electron diverter mode of action (group 22). Essentially it works by breaking down plant cell membranes, or dissolving/exploding cells. While this makes it an effective weed killer, it also has the ability to break down our cell membranes, making it a highly toxic product to humans as well.

With the toxicity aside, paraquat is a very effective relatively broad-spectrum contact herbicide. It can kill green tissue on many small broadleaf weeds and grasses. Contact herbicides do not move within the plant, but instead only kill the tissue they come into contact with, which is why spray coverage is very important when using contact products. Paraquat does not move into the roots of the plant, and good coverage is necessary to kill above ground growth. Most contact herbicides are only effective on smaller seedling weed species.

Paraquat is most commonly used in the Intermountain Region of California for weed control in the dormant season for winter annual species in alfalfa production. The general strategy is to apply paraquat with another herbicide that has residual activity (typically Velpar or Metribuzin) during the dormant season (late fall or very early spring). The paraquat will control or kill small emerged weeds, where the metribuzin or velpar will create a barrier of residual activity to prevent other weeds from germinating months after application. These dormant season applications often offer good weed control into the summer months and, as alfalfa is a highly competitive crop, additional weed control measures are often not needed throughout the year.

What can be used instead of paraquat? There are a couple of strategies that could be used to replace paraquat for weed control. Earlier fall applications for the residual herbicides (after crop dormancy) before **ANY** winter annual weeds germinate could be effective. However, there are two potential drawbacks to adopting an early application of residual herbicides. If there was some germination of weeds at time of application, they may not be controlled. Secondly these residual herbicides break down over time. Applications earlier in the fall will break down over the wintertime, and may offer less weed control throughout the growing season.

Another option would be to replace paraquat with another contact herbicide. Within the past six years there have been two alternative contact herbicides registered for use in California alfalfa: Sharpen and Shark. Both of these products have shown to offer relatively good broadleaf weed control, but little effect on grasses. Like paraquat they need to be applied when the crop is dormant, before any spring growth occurs. Applications of any of these

Paraquat is a highly toxic product. It bares the signal word "Danger/Poison" which is the highest category a pesticide can be classified as. Under new regulations there will be increased marking of toxicity on the label and additional restrictions placed on its use.

products after the crop breaks dormancy, will burn back the crop and risk yield loss. One benefit of both Shark and Sharpen is they are "Caution" products, indicating relatively low toxicity to the users. Paraquat is a "Danger/ Poison" product. Methylated seed oil can be used with both Shark and Sharpen to ensure efficacy. What neither Shark or Sharpen provide is control of winter annual grasses which are often problematic as they only target broadleaf species. Additions of a grass killing herbicide such as clethodim or sethoxydim (Select or Poast) could be added to the tank, but will increase the cost of the application. Another option, if grasses are problematic, would be to shift production to a Roundup Ready alfalfa system.

In 2017, I tested Shark and Sharpen in mixed alfalfa orchard grass stands in combination with Metribuzin. (Sharpen is not registered for use in mixed stands). Figure 1 shows the injury to the alfalfa crop, which was significant at first, but was minimal four weeks after application. Generally Sharpen provided slightly better control of two of the broadleaf weed species than Shark (Figures 2 and 3). However, neither Shark or Sharpen controlled cheatgrass present within the study (Figure 4). Cheatgrass control was only achieved in plots where Metribuzin was applied.

In 2019, another dormant season weed control trial was conducted in alfalfa. Applications were made in March before the crop broke dormancy. Alfalfa initially injured in all treatments showed little injury 4 weeks after application. Shepardpurse suppression was adequate in most treatments tested, but plots were not clean. In this trial, both Sharpen and Shark were tested mixed with clethodim for control of cheatgrass. While cheatgrass suppression was achieved 4 weeks after treatment in these mixes, control was better in plots where paraquat was applied. More research on unregistered herbicides, and paraquat alternatives are planned during the 2020 growing season.

In all Figures, treatments are listed in the amount of product/acre and were applied in a carrier volume of 20 gallons as a broadcast application.

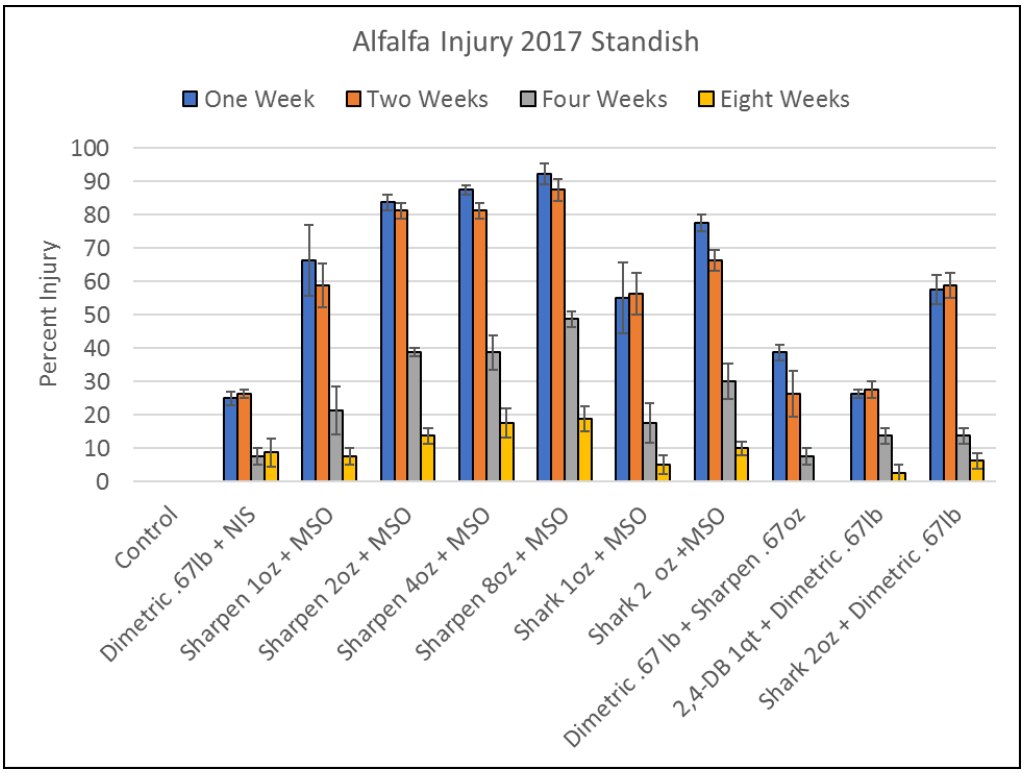

Figure 1: Depicts the injury to the alfalfa crop 1, 2, 4, and 8 weeks after application. While application of both Shark and Sharpen significantly injured the crop after application, the crop recovered and very little injury was apparent 8 weeks after application in any of the treatments.

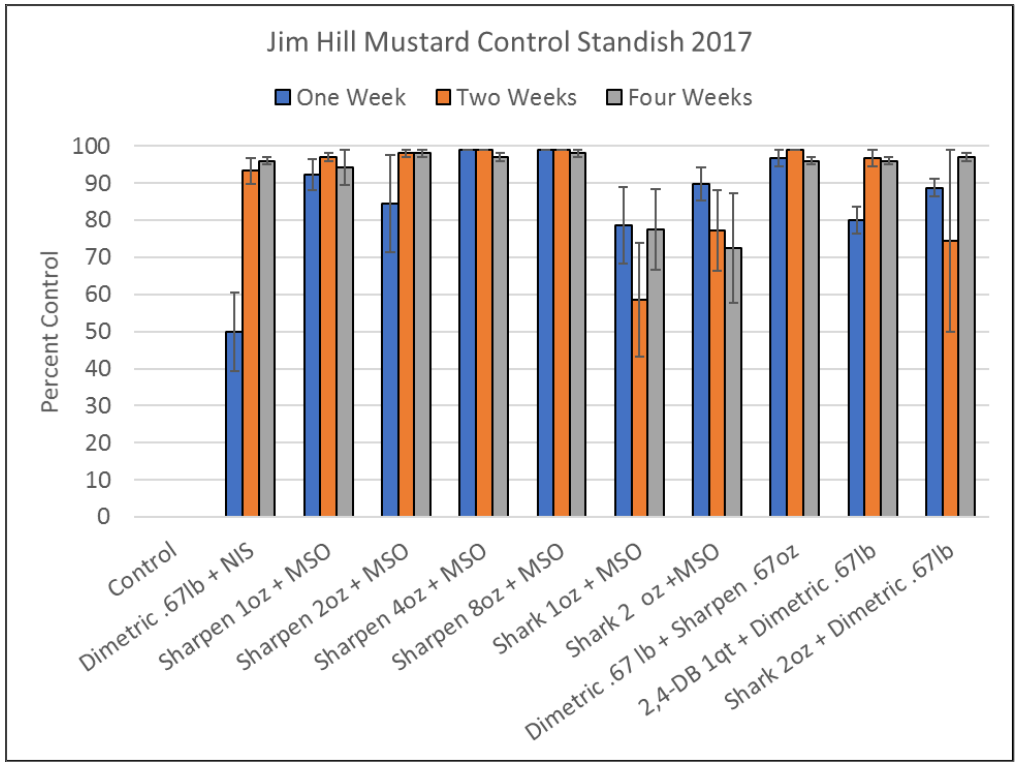

Figure 2: Depicts control of Jim Hill mustard or tumble mustard (Sisymbrium altissimum) 1, 2, and 4 weeks after application. All treatments offered similar control 8 weeks after application, except Sharp at 1 oz and 2 oz which offered slightly less control.

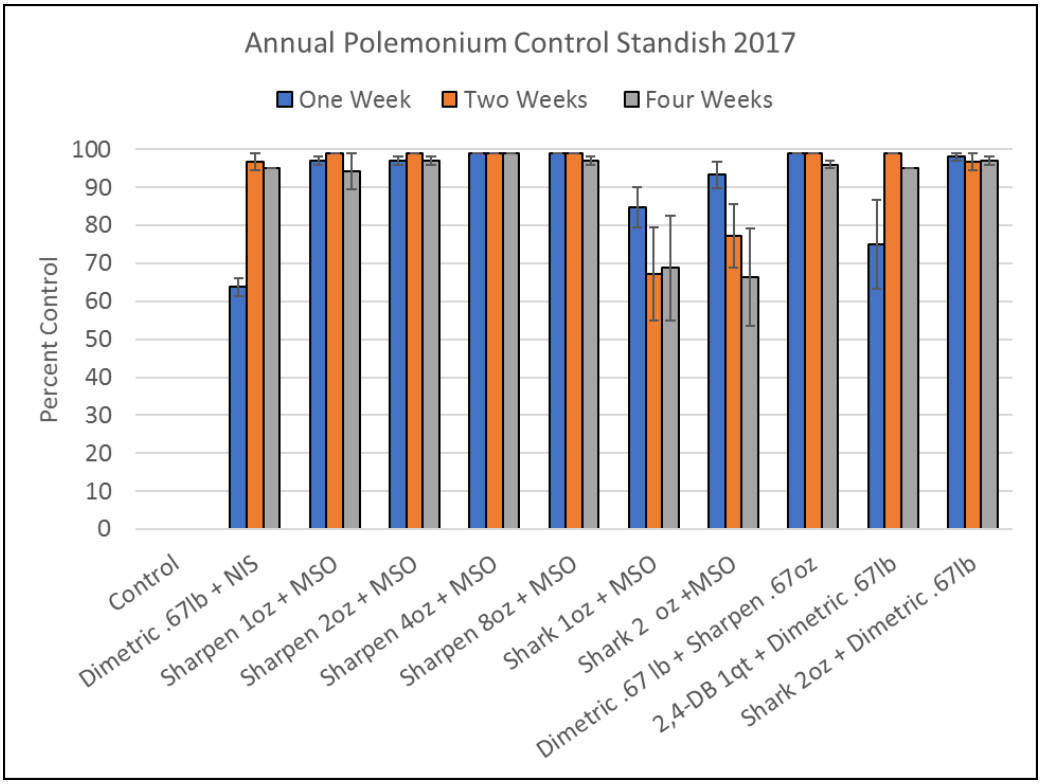

Figure 3: Depicts control of annual polemonium or Jacobs ladder (Polemonium micranthum) 1, 2, and 4 weeks after application. All treatments offered similar control of annual polemonium 8 weeks after application, except Shark at 1oz, and 2 oz which offered slightly less control.

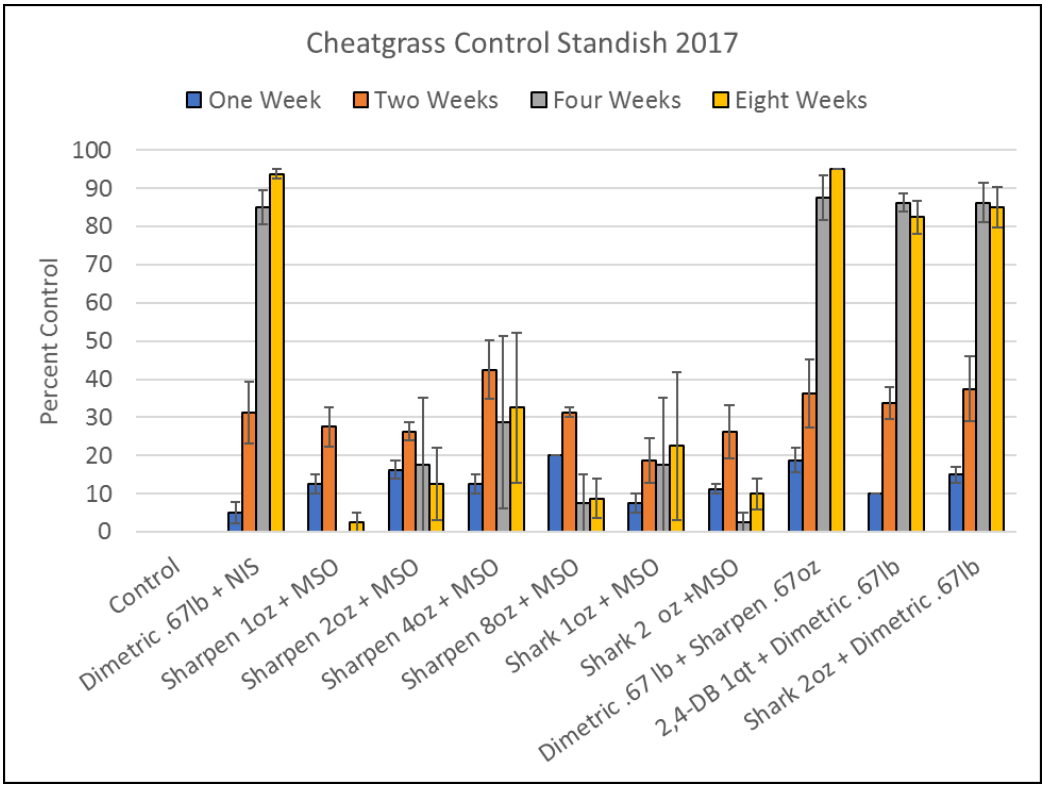

Figure 4: Depicts control of cheatgrass (Bromus tectorum) 1, 2, and 4 weeks after application. Shark and Sharpen alone did not offer effective control of cheatgrass. Dimetric (metribuzin), alone or in combination with Shark or Sharpen was needed to control cheatgrass in the trial.

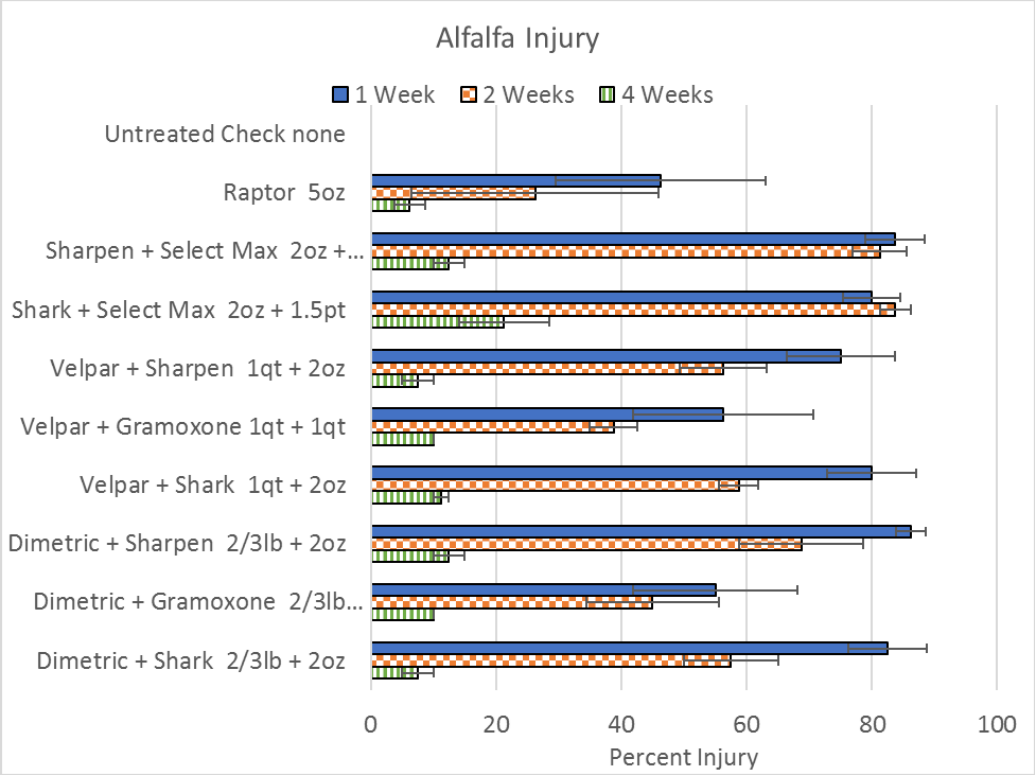

Figure 5: Depicts the injury to the alfalfa crop 1, 2, and 4 weeks after application. While applications of both Shark, Sharpen, and Gramoxone significantly injured the crop after application, the crop recovered and very little injury was apparent 4 weeks after application in any of the treatments.

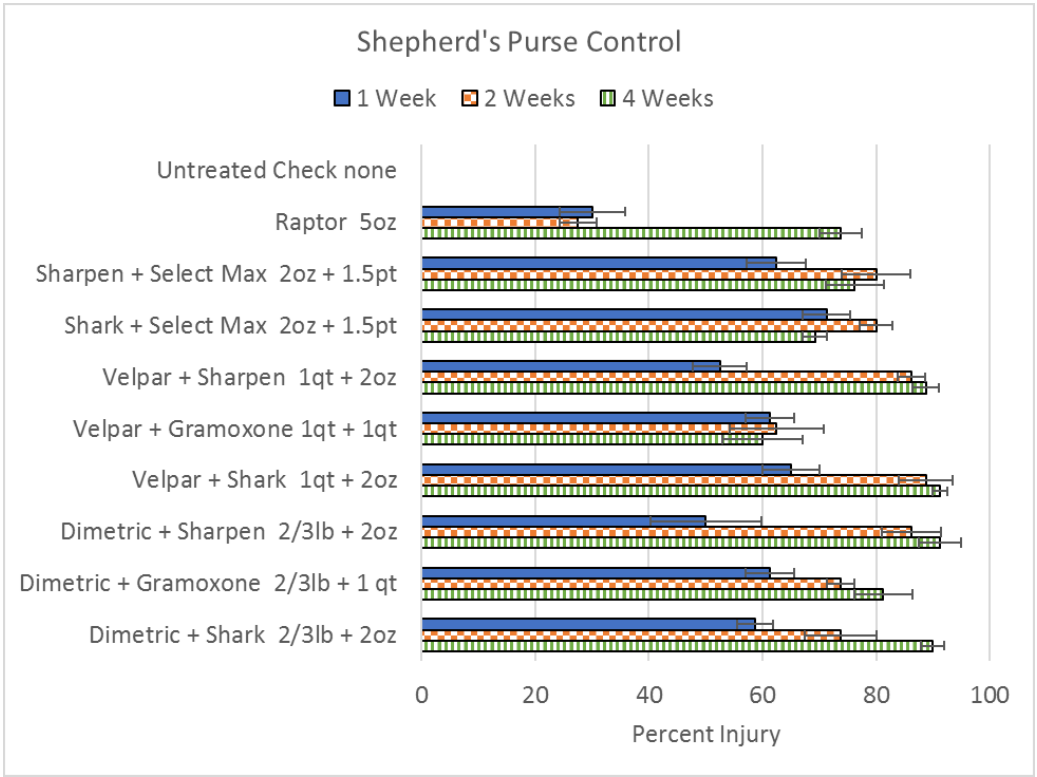

Figure 6: Depicts Shepherd's Purse (Capsella bursa-pastoris) control 1, 2, and 4 weeks after application. Treatment effectiveness 8 weeks after applications varied from 60% to 90% control.

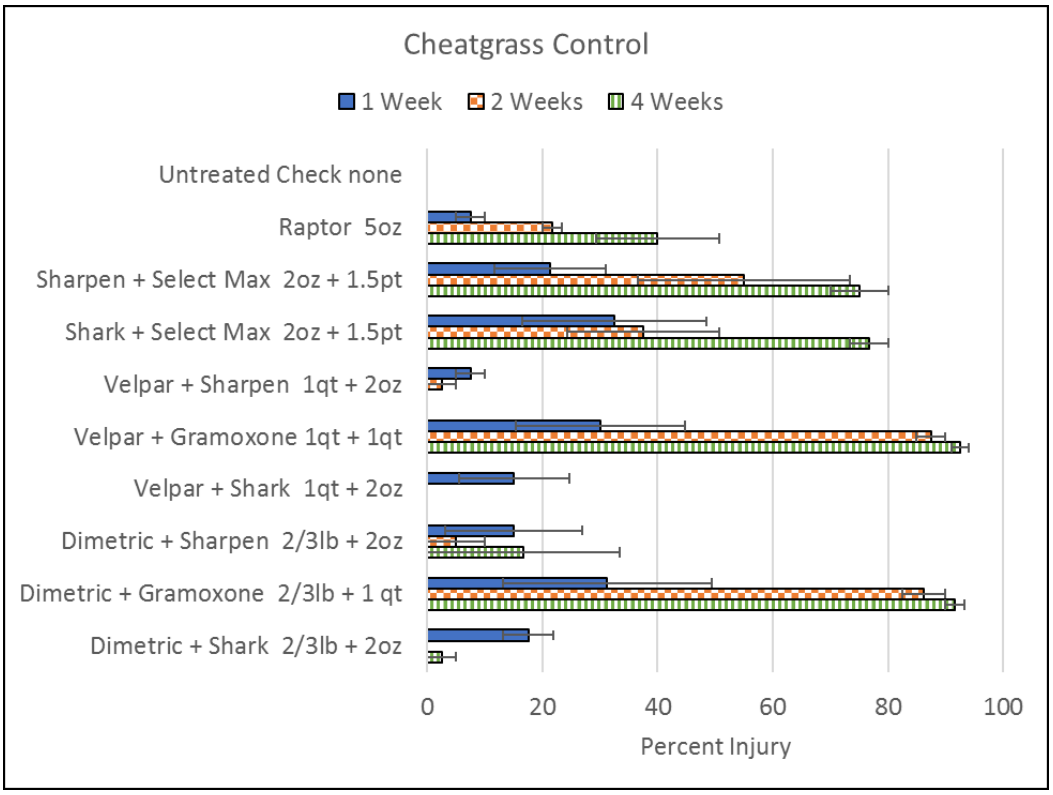

Figure 7: Depicts cheatgrass (Bromus tectorum) control 1, 2, and 4 weeks after application. Eight weeks after application Raptor provided suppression. Shark and Sharpen did not provide control in this trial, unless the tank was mixed with the grass killer Select Max, where 70% control was achieved. Gramoxone combined with either Velpar or Dimetric offered 90% control of cheatgrass eight weeks after application.

Chlorpyriphos Regulations and Alfalfa Weevil Resistance

Extensive restrictions were placed on the use of Chlorpyriphos before the 2019 growing season, which made any applications difficult. As of February 6, 2020, chlorpyriphos products will no longer be sold in California, and current stocks must be used by December 2020. No more chlorpyriphos leaves a gap for insect control for alfalfa. Back in 2014, UC entomologists wrote a report detailing the critical uses for chlorpyriphos in cropping systems within California. Three pests were identified as critical uses in alfalfa cropping systems: blue alfalfa aphids, cowpea aphids, and alfalfa weevils (due to other limited control options). So what options are left to deal with these pests?

Aphids

Aphid populations in the Intermountain Region are not something that needs to be dealt with using insecticides every year. Their populations are often kept in check by various natural predators, such as ladybeetles, lacewings, and parasitic wasps. Insect populations have up years and down years, which is why monitoring the aphids, as well as the natural predators, is important.

Identification between various aphid species is important because they affect the crop differently. Blue alfalfa aphid injects a toxin that can stunt alfalfa growth, significantly more than the common pea aphid. This toxin can stay in the plant and affect yields that cutting and sometimes into the following cutting.

Identification between these two aphid species can be tricky and a hand lens is needed. Both species are green and can only be distinguished by differences in their antennae. Blue alfalfa aphids have smooth antennae where pea aphids have black/dark bands on their antennae (Pictures 1 and 2). Other good identifying pictures between aphid species can be found on the UC IPM website.

Different economic thresholds have been developed for each of these species based on the crop height and number of insects present. Table 1 is adapted from the UC IPM website, which indicates how many aphids are acceptable before treatments are necessary. Monitoring should be conducted by choosing a few stems in four to five areas of each field and counting the number of insects on each stem. Shaking the stems into a sweep net, or onto a white surface, can aid in counting. Beneficial insects should also be monitored by sweeping the crop.

The first defense against aphids is to plant highly resistant alfalfa varieties. There are more alfalfa varieties resistant to pea aphids than blue alfalfa aphids, but there are some varieties resistant to both species of aphids. Varieties resistance rating for insects and diseases can be found in the NAFA Alfalfa Variety booklet produced each year.

When insecticides are needed, choosing the most selective products is important when using an integrated pest management system. Non selective insecticides will kill all insects, and aphids often recover much quicker than their natural predators because of their short lifecycle. When beneficial insect populations are high, insecticide use may not be warranted. Insecticides have been ranked by entomologists for their value in an IPM system on the UC IPM website. (An IPM system requires effective pest control, while minimizing impact on desirable species, water and the environment.) Some alternative insecticides besides chlorpyriphos with reasonable pre-harvest intervals are Sivanto and Dimethoate. Beleaf is also registered for alfalfa use in California, but has a 62 day preharvest interval. If you would like to see more detailed information on the effects of various insecticides on aphids in California, watch this presentation from the late (and missed) Dr. Larry Godfrey posted to the Alfalfa Symposium website. (If you are not aware, Symposium proceedings presentations are recorded and posted to the website if you missed them.)

Picture 1
Blue Alfalfa Aphid

Picture 2
Pea Aphid

Alfalfa Weevils

Weevils are an insect pest in alfalfa year in and year out, and often require insecticide treatment. Unlike many insect pests, alfalfa weevils just have one generation per year, and cause excessive damage in first cutting hay. There are some, but few natural predators to keep weevils populations in check. While there is a parasitic wasp and fungus, surveys for weevil biocontrol populations in California have shown low numbers in the Intermountain Region.

Cultural control methods are limited for alfalfa weevils. When weevil populations are high, the crop can be cut early in certain instances. While this will reduce damage and yield loss, there is the trade off, of cutting too early and missing out on yield potential in the first cutting. Likewise, with cutting early, high populations of weevils can result in continued feeding of the larvae under the windrow.

Aphid Economic Thresholds		
Plant height	**Number Pea Aphids Per Stem**	**Number Blue Alfalfa Aphids Per Stem**
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**

Table 1 (Adapted from the UC Integrated Pest Management Website)

Other cultural control methods are less studied. Grazing or sheeping off fields during the dormant season may reduce weevil population as eggs are laid in the stems of the alfalfa. However, grazing dormant alfalfa also has the potential to injure the crop crowns, increasing risk of disease. While in theory, grazing during the dormant season should reduce weevil populations, it has not been thoroughly tested. Likewise, limited research on flaming during the dormant season has show some effectiveness, but it is very expensive.

Insecticides are often relied upon for alfalfa weevil control. Monitoring should be conducted to justify if insecticide applications are warranted. The economic threshold for alfalfa weevils is 20 larvae per sweep (although this number is currently under evaluation). Multiple areas in the field should be monitored for weevil larvae, weekly to stay on top of the population.

Historically, pyrethroid insecticides (Warrior, Bathroid, etc.) and chlorpyriphos have been utilized for alfalfa weevils, providing effective control. Steward EC (indoxacarb) is another weevil control insecticide that is very effective. Other insecticides are registered for weevil control but have been less than effective in research trials.

However, in the past four years, pyrethroid resistance of alfalfa weevils has been confirmed in Scott Valley and down near Blythe, CA. Table 2 (see next page) shows the lab bioassays on Scott Valley weevil larvae conducted by Larry Godfrey. These results show weevils form organic fields which were not exposed to pyrethroids were effectively controlled by pyrethroids in the lab. Weevils from conventional fields that had been sprayed yearly with pyrethroids were not controlled. Similar bioassays were conducted in Blythe in 2018 confirming resistance. Generally insecticide resistance develops by using the same product, or mode of action, on the same population of insects year after year. Eventually insects that are not killed by the insecticide will be selected for and no longer be controlled by the product.

UCCE entomologist Michael Rethwisch gave a presentation at the Western Alfalfa Symposium in 2019, on alfalfa weevil pyrethroid resistance. He indicated the pyrethroid resistance may not be isolated to these two locations in California, and resistance is suspected throughout the western United States (full video of his presentation here). I would check it out, as Michael is a good speaker, and the presentation was enlightening.

With the loss of chlorpyriphos, and pyrethroid resistance occurring in other parts of the state, there are limited options for alfalfa weevil insecticides. Steward is one option left which offers effective control, and malathion can offer partial control. Entrust is an organic product that has been shown to offer suppression in research trials, but is very expensive.

In areas where pyrethroids are still effective, it is of upmost importance to rotate insecticide mode of action's to delay resistance from developing. Generally, entomologists do not recommend mixing insecticide mode of actions to combat resistance, but instead recommend rotation between different classes of chemistry. Pyrethroids are cheap, and we do not want to lose them as effective tools by developing resistant insect populations through overuse. If you are short on a few CE hours, there is a great online course focused on pesticide resistance available here.

Currently, Ian Grettenberger, UC Davis Entomologist, and Kevin Wanner, Montana State Entomologist, are conducting an alfalfa weevil project. They are going to be accepting samples of alfalfa weevil larvae to help categorize how widespread the resistance is, and come up with solutions to fight it. More information can be found at https://www.montana.edu/resistantalfalfaweevil/. I plan to send off some samples from our local area, and would encourage you to do the same.

If you have failures of an insecticide treatment (or herbicide treatment) please give me a call, because we would like to stay on top of resistant pest populations before they spread. (530) 251-2650.

Photo Three: The four larvae instars of alfalfa weevil. Smaller weevil instars are lighter yellow, and they turn green as they mature. (Photo courtesy of the UC Regents)

Percent Weevil Mortality From Pyrethroids	
Field Site	**Recommended Insecticide Rate**
Organic Field	92%
Conventional Fields 1-4	3-15%

Table 2.

Adapted from Orloff and Godfrey. Weevil larvae were collected from Scott Valley California from one organic field (no pyrethroid use), and four conventionally managed alfalfa fields (pyrethroid insecticides use over multiple seasons). A bioassay was conducted on weevil larvae in the lab by Dr. Godfrey at UC Davis. Weevil populations from the organic field were effectively controlled by pyrethroid insecticides, where populations from conventionally managed fields were not controlled. This bioassay confirmed the suspected resistance of alfalfa weevils from this region to pyrethroid insecticides.

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Irrigated Forage Crop Workshop

February 27th - 10am - Elks Lodge - Susanville, CA

Join us for a half-day workshop focused on production & management of irrigated pasture, grass hay, and alfalfa.

1.5 Hours CE Credit Requested

Agenda

10:00 - Registration

10:30 - Principles of Grass Hay Fertilization - Rob Wilson, UCCE

11:00 - Irrigated Pasture Management for Agricultural and Environmental Outcome - Leslie Roche and DJ Eastburn, UC Davis

11:30 - The Value of Winter Stubble to Optimize Regrowth and Production of Irrigated Pastures - David Lile, UCCE

12:00 - Lunch

1:00 - Update on Recent Weed Management Trials and LESA Irrigation - Tom Getts, UCCE

1:30 - Beefing Up Irrigated Pastures with New Species and Varieties - Charlie Brummer, UC Davis

2:15 - Soil Salinity and Alfalfa Salt Tolerance - Giuliano Galdi, UCCE

Register Online (Scan the QR Code)

http://ucanr.edu/forage2020

or Call 530-251-2601

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