MANAGING WEEVILS IN ALFALFA HAY

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ABSTRACT

The alfalfa weevil and the clover root curculio (CRC) are two key weevil pests that can cause significant yield and quality losses in alfalfa hay fields. Overall, the alfalfa weevil is more problematic and widespread than CRC. These weevils are similar in appearance, but the alfalfa weevil larvae feed on the plant foliage, while the CRC larvae feed on the plant roots. Alfalfa is the primary host, but they can also feed on select legumes. This paper summarizes the biology of both weevils and integrated pest management practices for controlling these pests, including biocontrol, cultural practices, field scouting, and the use of insecticides, to maximize alfalfa hay production and economic returns.

INTRODUCTION

There are two weevil species of economic importance in alfalfa hay production across the United States. One is the alfalfa weevil (*Hypera postica*), a complex of two weevil strains in California (western and Egyptian), and the other is the clover root curculio (CRC, *Sitona hispidulus*). Both of these beetles cause significant damage to alfalfa in the larval stage, with the alfalfa weevil feeding on plant foliage and the CRC feeding on roots. Adults of both species feed on alfalfa foliage, but are generally not economically damaging, except perhaps occasionally for very young seedling stands by CRC in fall plantings.

Adults of both species look similar, but the CRC tends to be smaller and has a shorter and broader snout than alfalfa weevils. Clover root curculios also have setae or hair-like bristles on their back, distinguishing them from pea weevils. The larvae of alfalfa weevils are green, whereas clover root curculios are whitish, with both species having dark heads. The Egyptian strain of the alfalfa weevil is found in warmer areas, including the Central Valley and low desert, while the western strain is found in cooler areas, including the Intermountain Region. Clover root curculio is primarily a pest of cooler areas, including the Intermountain Region, but occasionally can be found in the Sacramento Valley.

Both weevil species share the common trait that they are introduced pests from Eurasia with few natural enemies to help control them, and their primary host is alfalfa. However, the CRC has a bit broader host range, including most all clovers in the *Trifolium* group (red, white, berseem) as well as soybeans and cowpeas, whereas alfalfa weevil is more specific to alfalfa and a few

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legumes, such as bur clover. This host preference for alfalfa makes crop rotation to non-host plants for at least two years the key management practice for controlling CRC. Adult weevils can live for a year, so rotating fields out for one year is not enough.

ALFALFA WEEVIL MANAGEMENT

Lifecycle and damage. The alfalfa weevil has one to two generations per year, a major one during winter or early spring, depending on field location, and a potential smaller second one, in late spring or early summer (Fig. 1). Most adults leave the field during the summertime and aestivate (go dormant) in protected areas (such as behind tree bark), though some stay in the field. During winter, adults migrate back into fields and lay eggs in old alfalfa stems. When eggs hatch, the larvae feed on the developing foliage, producing holes in the leaves and tattered foliage, which results in significant yield and quality losses to the first and sometimes even the second hay cutting. Stubble fields that are beginning to break dormancy are most at risk to injury by weevils. These should be monitored to ensure that weevils are not suppressing stand growth. Once the alfalfa is growing, it is more resilient to weevil damage. Healthy, actively growing alfalfa stands damaged by weevils can recover once weevil infestations are controlled.

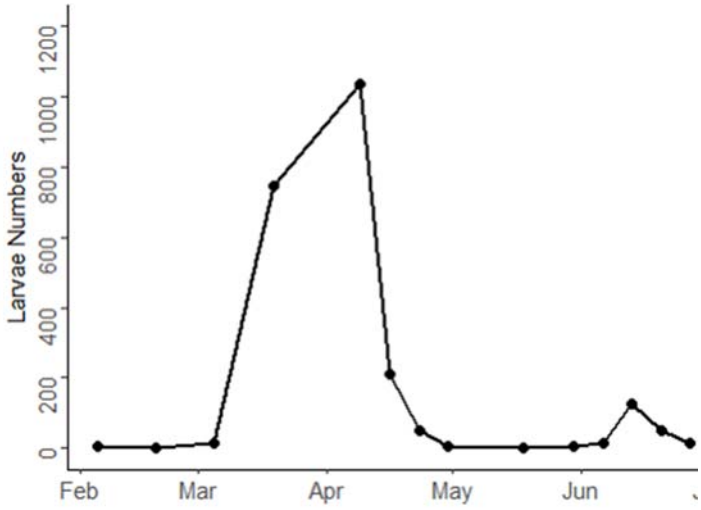

Figure 1. Alfalfa weevil larval counts from the Sacramento Valley, 2018.

Monitoring and Control

Biocontrol. Alfalfa weevils have natural enemies, but they are not effective enough to provide good control early in the season when most needed. The parasitoid wasp, *Bathyplectes curculionis* can provide up to 30% parasitism of larvae late season, but is frequently encapsulated and killed by the Egyptian strain. The parasitoid *Oomyzus incertus* is very effective, with up to 50% parasitism of the weevil larvae late season (Fig. 2), which, together with *B. curculionis,* likely explains the smaller second generation, as appears to be under good biocontrol. The fungus *Zoophthora phytonomi* can infect and kill larvae, providing up to 30% weevil suppression (Fig. 3), but is dependent on

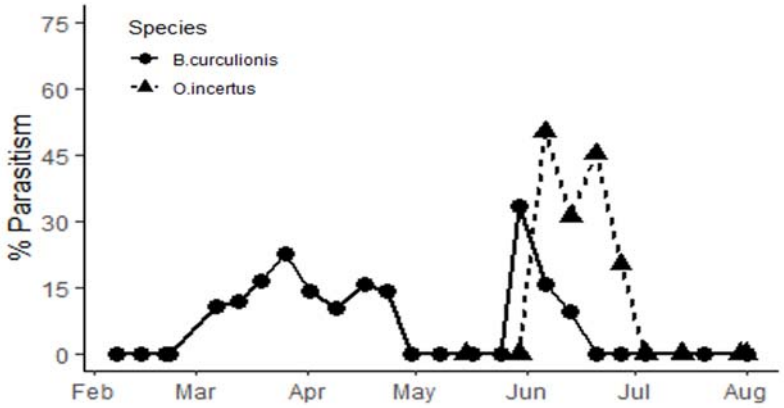

Figure 2. Percent parasitism of alfalfa weevil by the parasitoid wasps, *B. curculionis* and *O. incertus* in the Sacramento Valley, 2018.

environmental conditions with high humidity or rainfall favoring infection (in dry years there is little infection).

Cultural practices. Cultural options for alfalfa weevil control are limited. Early harvest can avoid some damage, but this practice reduces yields and puts the stand at risk with surviving weevils feeding on stubble plants under windrows, potentially causing stand losses. 'Sheeping-off', or bringing in sheep to graze alfalfa during the wintertime, helps reduce weevil pressure when the sheep feed on the old stems and devour the weevil eggs, but is not always effective at completely controlling weevils. Overseeding fields with other forages not preferred by weevils (such as berseem clover or oats) does not prevent alfalfa damage, but fills in and makes up for a loss in production by the weevils. However, mixed hay changes the forage quality and marketability of the hay (Canevari et al. 2000; Leinfelder-Miles 2016).

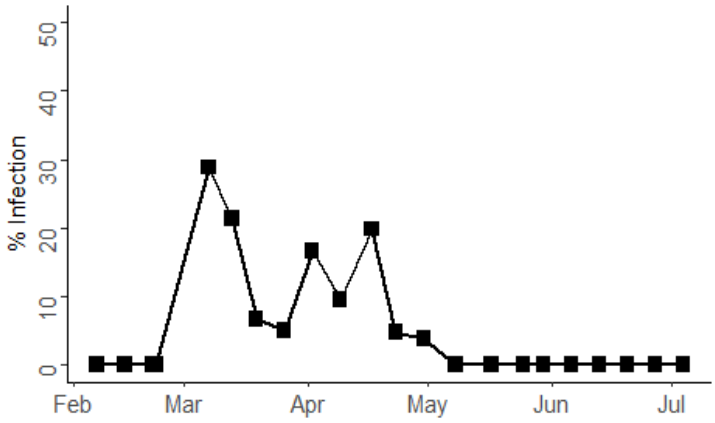

Figure 3. Percent infected weevil larvae by the fungus, *Zoophtora phytonomi,* in the Sacramento Valley, 2018.

Pesticides. Insecticides are the primary tool for controlling alfalfa weevils. Conventional insecticides include organophosphates (primarily chlorpyrifos, e.g. Lorsban), pyrethroids (e.g. Warrior), and an oxadiazine (e.g. Steward). Entrust (spinosad) is registered for organic production and only suppresses weevils (about 70% control; Long and Getts 2018). To find additional tools for weevil control, insecticide trials were conducted at UC Davis and Tulelake in 2018, using materials shown in Table 1, and in Riverside County in the low desert. Figures 4, 5, and 6 show the results of these trials, comparing registered and unregistered insecticides (noted by an asterisk, "*") for percent weevil control.

Table 1. Insecticides tested for alfalfa weevil control in alfalfa at UC Davis and Tulelake, CA, 2018. Experimental insecticides (not registered for use in alfalfa), are noted by an asterisk "*". A spreader sticker was included with all treatments.

Insecticide	**Chemical name**	**Rate/Ac**
Warrior II	lambda-cyhalothrin	1.92 fl oz
Lorsban Advanced	chlorpyrifos	32 fl oz
Cobalt Advanced	lambda-cyhalothrin+chlorpyrifos	38 fl oz
Steward EC	indoxacarb	11.3 fl oz
Steward EC+Warrior II	indoxacarb+lambda-cyhalothrin	8 fl oz+1 fl oz
Entrust SC	spinosad	4 fl oz
Exirel*	cyantraniprole	20 oz/ac
Torac 15EC*	tolfenpyrad	21 fl oz
Rimon 0.83EC* (IGR)	novaluron	12 fl oz
DoubleTake*	diflubenzuron (IGR)+lambda-cyhalothrin	4 fl oz
Knack (IGR)*	pyriproxyfen	10 fl oz

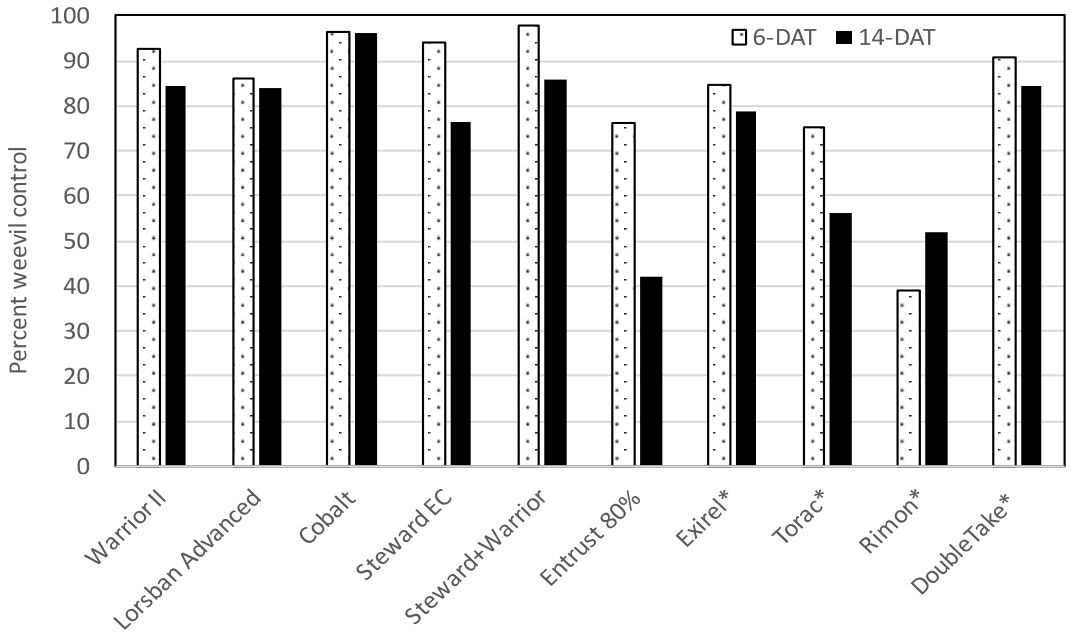

Figure 4. Alfalfa weevil insecticide trial, UC Davis, 2018. An asterisk (*) after an insecticide = NOT registered in alfalfa (experimental). Results are percent weevil control compared to an untreated check, 6 and 14 days after treatment (DAT).

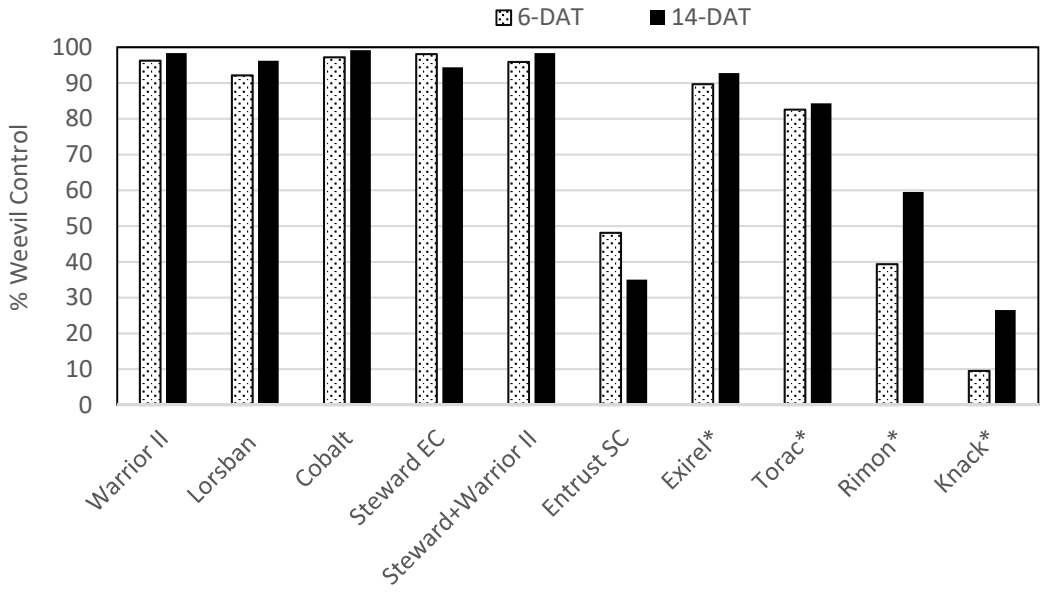

Figure 5. Alfalfa weevil insecticide trial, Tulelake, 2018. An asterisk (*) after an insecticide = NOT registered in alfalfa (experimental). Results are percent weevil control 6 and 14 days after treatment (DAT). Untreated plots for both DAT were about 45 weevils per sweep.

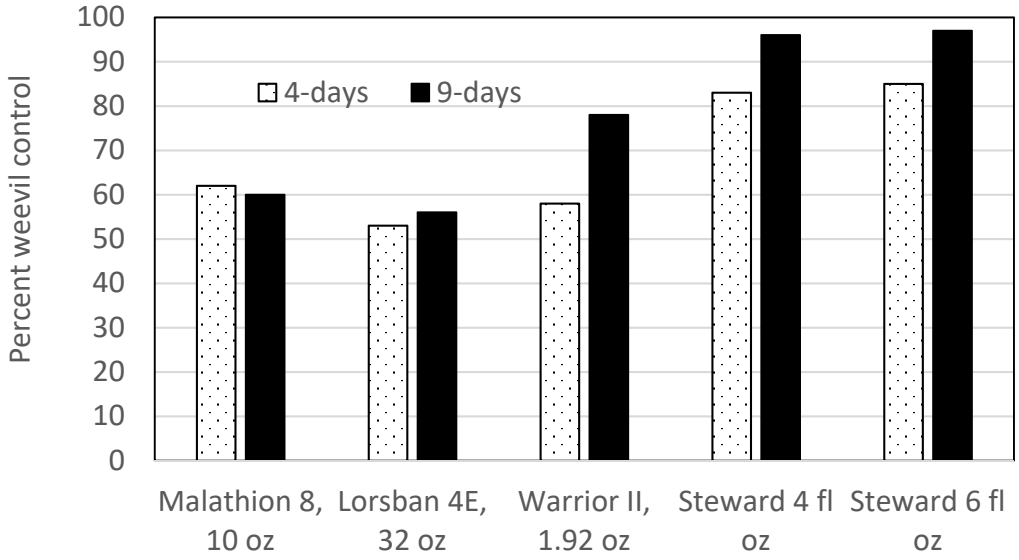

Figure 6. Alfalfa weevil insecticide trial, Riverside County, Low Desert, 2018. Results are percent weevil control 4 and 9 days after treatment (DAT).

Threshold. Sample alfalfa fields with a sweep net to time insecticide treatments to weevil outbreaks. Sprays applied to fields too early may need a second treatment, which is costly, and could contribute to insecticide resistance problems. The current threshold is about 20 weevils per sweep, depending on treatment costs and the value of the hay (Table 2). Thresholds will also depend on the height of the alfalfa, so it is important to watch fields for injury, especially stubble fields that cannot be sampled with a sweep net. If the alfalfa is short, and not actively growing (such as after a frost), the threshold for damage will be much less than 20 per sweep, so watch for plant injury, as well as potential damage to stands under windrows at harvest. Alfalfa is resilient, so if there is weevil damage to the hay, control the weevils and then allow the hay to outgrow weevil damage before harvesting, to avoid yield losses associated with alfalfa weevil damage.

Table 2. Number of larvae per sweep justifying treatment, relative to the cost of the insecticide application and value of the hay (adapted from Koehler and Rosenthal, 1975 and Yolo Co. unpublished data, 2018).

Cost of application per acre	**Value of Alfalfa, $/Ton**						
	180	**200**	**220**	**240**	**260**	**280**	**300**
$15.00	18	16	15	14	13	12	11
$20.00	24	22	20	18	17	16	15
$25.00	31	27	25	23	21	20	18
$30.00	37	33	30	27	25	24	22
$35.00	43	38	35	32	30	27	26

CLOVER ROOT CURCULIO MANAGEMENT

Lifecycle and damage. The clover root curculio has one generation per year (Fig. 7). They overwinter in fields in the egg and adult stages. In the Klamath Basin, CA, adults begin to emerge mid-spring, when temperatures begin to warm (highs around 50ºF) and lay eggs at the base of alfalfa crowns, in the soil or duff. When eggs hatch, the larvae feed on the roots during the growing season, mostly in the top 8-inches of the soil, causing significant damage via reduced plant growth and stand losses. Feeding damage also creates entry wounds for secondary pathogens, including *Fusarium* and *Phytophthora,* further injuring them. Most adults leave the field during the summertime and come back in the fall to lay eggs that stay dormant until the following spring.

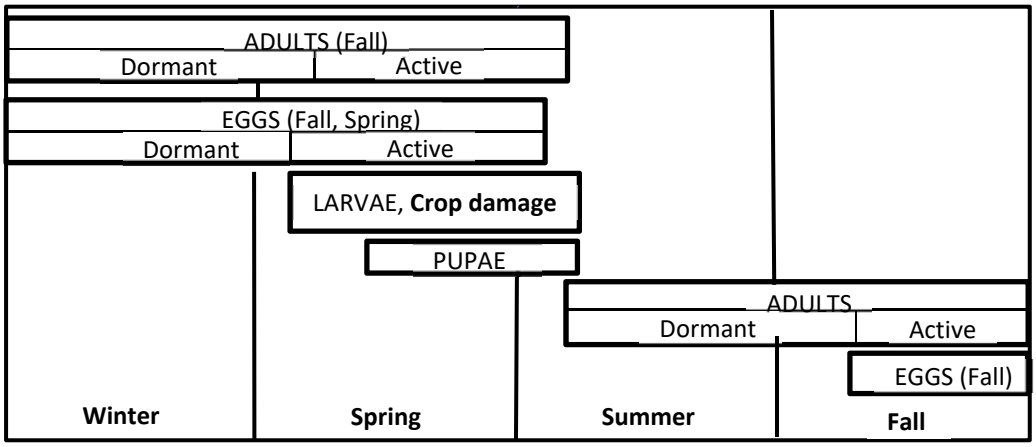

Figure 7. Clover root curculio life history in the Klamath Basin, CA, based on 2018 sampling and Wenniger and Shewmaker (2014).

Monitoring and Control

The easiest way to determine if you have clover root curculio in your field is to look for patches of alfalfa plants that are not growing or wilted and then dig up plants to look for feeding damage on the roots. Larvae furrow and girdle plant roots, often leaving large gouges. The larvae are difficult to spot because they are small and cryptic.

Table 3. Insecticide trial for clover root curculio control applied on May 10, 2018, Tulelake, CA. An experimental insecticide (not registered for use in alfalfa), is noted by an asterisk "*". There were no differences for larval counts or yield between treatments.

Insecticide	Chemical name	Rate/Ac
Coragen	chlorantraniliprole	5 fl oz
Entrust SC	spinosad	4 fl oz
Agri-Mek*	abamectin	16 fl oz
Besiege 2X	chlorantraniliprole+lambdacyhalothrin	9 fl oz

Unfortunately, there are no insecticides registered to control CRC larvae in alfalfa. A trial was conducted in 2018 to look at the efficacy of insecticides listed in Table 3. However, there was no significant reduction in the number of larvae, root damage, or yield differences between treatments at harvest. Insecticide sprays in the springtime targeted to weevil adults are not effective because the adults are active and lay eggs for a long time (spring to summer), escaping pesticide treatment. We are currently evaluating whether a late spray for adult control at the end

of the season, when adults come back into the field, might help reduce the adult population and subsequent egg and adult overwintering numbers, reducing infestations the following spring.

Current management recommendations for CRC include rotating infested fields to a non-host crop (something other than alfalfa and legumes, including clovers, soybeans, or cowpeas), avoiding planting new alfalfa next to infested fields, and proper irrigation and nutrient management, to ensure a heathy stand that is better able to withstand larval damage (especially accompanying secondary diseases). In addition, equipment should be cleaned after visiting infested fields to prevent spreading the pest to new fields (Wilson and Askew 2016).

SUMMARY

Managing weevil pests in alfalfa, including alfalfa weevils and clover root curculio, takes an integrated approach. This includes crop rotation for at least two years, monitoring pests, and applying insecticides (for alfalfa weevil) when thresholds are reached. Clover root curculio is more challenging to control with infestations occurring below the soil line in alfalfa fields and no insecticides registered to control them. Research will continue in 2019 to investigate ways to better manage these two key weevil pests in alfalfa hay production. This research is supported by grants from the California Department of Pesticide Regulation (DPR), which does not necessarily recommend or endorse any opinion, commercial product, or trade name used, and USDA-NIFA funds. Thanks to the staff at UC Davis and the Tulelake IREC for their help in collecting and processing alfalfa samples.

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