MINOR INSECT PESTS OF ALFALFA: ARE TREATMENTS ECONOMICAL?

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ABSTRACT

A number of minor insect pests can be problems in alfalfa hay production. These include twospotted spider mites, *Empoasca* spp. leafhoppers, and threecornered alfalfa hoppers. New pests in recent years have also included a South American species of bean thrips. Recent research indicated that spider mites are causing more yield loss than quality reduction. Threecornered alfalfa hoppers are still prevalent and often occur with *Empoasca* leafhoppers. Economic yield/quality increases have been noted from control of these pests. Definitive treatment thresholds still need to be developed but are hindered by several factors.

Key Words: threecornered alfalfa hopper, insects, economics, twospotted spider mites, bean thrips, *Caliothrips phaseoli*, leafhoppers, *Cercospora*, alfalfa, quality, yield

INTRODUCTION

A number of insect pests can potentially affect alfalfa production in California, especially in the low desert. Ede (1991) noted that pests and diseases seem to be attracted to desert alfalfa, and pointed out recent outbreaks of whiteflies, leafhoppers, summer black stem and leaf spot (*Cercospora medicaginis*), as well as occurence of root rot (*Phymatotothrichum omnivorum*), nematodes and crown gall. More recently, new insect pests have been noted attcking alfalfa, and requiring control These have included cowpea aphids (which are being discussed in another presentation) as well as a South American species of bean thrips (*Caliothrips phaeseoli* (Hood)).

Minor insect pests of California alfalfa hay production have been infrequently discussed at the California Alfalfa Symposium. Of the pests that Ede (1991) noted, nematodes have been the most discussed during the past 20 California Alfalfa Symposiums (Nigh 1983, 1987; Hafez 1994,1998; Westerdahl 1991, 2001; Miller and Hafez, 2003). The exact reason for the very few discussions on minor insect pests may be that they are indeed (as the name implies) minor/ infrequent pests, nothing was/is registered that provided economic control, and/or the fact that little work had been conducted upon these pests.

In the past several years a number of field trials were conducted in the low desert that have provided some information about several of the minor pests and their effects upon alfalfa hay yields and quality. These pests have included two-spotted spider mites, *Empoasca* spp. leafhoppers, threecornered alfalfa hoppers, and interactions of the latter two pests with the disease summer black stem and leaf spot (*Cercospora medicaginis*).

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Bean Thrips *Caliothrips phaseoli* (Hood)
This species of bean thrips is very similar in appearance to the bean thrips, *Caliothrips fasciatus* (Pergande). Adults of these thrips are black with white bands on the wings, while immature stages found on alfalfa are yellow with pink/reddish markings. Feeding by this thrips is different than that of the western flower thrips, *Frankliniella occidentalis* (Pergande) which results in scarred leaf material. Feeding by *C. phaseoli* results in whitened areas on tops of leaves where all chlorophyll containing cellular material has been removed, and is accompanied by copius small dark deposits of fecal materials. In Riverside County it is often found on prickly lettuce earlier in the year, with populations noted on alfalfa in late May-early June, and with most widespread occurance in the fall.

This South American species of bean thrips has been reported from alfalfa in both Imperial and Riverside County (Natwick, 2003; Rethwisch et al., 2004). Treatments for this insect were necessary on seedling stands during the fall of 2001 in Imperial County (Natwick 2002), and were very high in seedling and mature stands in 2002 (Natwick, 2003).

Twospotted spider mites -*Tetranychus urticae* Koch
Spider mites are not generally considered to be a problem on alfalfa in the US. In the desert southwest, however, twospotted spider mites have been problematic in recent years, especially on alfalfa using bedded production systems in counties adjacent to the Colorado River. PCAs from Imperial County have noted populations necessitating treatments as early as January, and treatments can be needed until mid-May. Little, if any, research has been conducted to document spider mite effects on alfalfa yields and/or quality as this pest is apparently only a problem in the desert southwest.

Local small plot field research conducted in 2002 evaluated a number of potential miticide chemistries for alfalfa hay (Rethwisch et al., 2003). Large plot research to compare several effective chemistries was the next logical step, especially as economic data would be needed to obtain a section 18 (emergency exemption) registration. As such few data are available for growers and PCAs to make research based decisions for spider mite control on alfalfa, it was also important to increase the existing data base.

Three miticide treatments (active indgredients consisting of milbemectin, clarified neem oil, and chlorpyrifos plus dimethoate) were compared with an untreated check to obtain information on the effects of twospotted spider mite feeding on alfalfa yields, quality and economics, as well as crop responses to miticides. Mite infested alfalfa was treated just prior to first irrigation after cutting in spring 2003, and numbers of spider mites and western flower thrips (*Frankliniella occidentalis*) were obtained at weekly intervals thereafter for the next several weeks. Data for plant parameters (stem widths, numbers of leaves, internode lengths) were obtained at harvest, as were hay yields and quality.

<u>*Control and hay yield*</u>
The milbemectin treatment resulted in quickest reduction (88.5% at 5 days after application) of spider mites (Tables 1-3) and also resulted in significantly higher yields (0.18 tons of hay/acre) than the untreated check (Table 5), attributed to the longer internodes and resultant tallest plants

and significantly thicker stems than the untreated check (Rethwisch et al, 2004). Clarified neem oil and Lorsban plus dimethoate treatments did not control spider mites as quickly as milbemectin and yields were increased by only 0.04-0.05 tons hay per acre in this experiment compared with the untreated check. These two treatments also differed in their effects on stem widths and internode lengths, indicating that some results noted were a result of interactions of miticides with alfalfa as well as spider mite control. These data indicate that feeding of spider mites can result in significant yield loss from just a single cutting.

Table 1. Mean number of spider mites/alfalfa stem at 5 days post treatment

	Rate/acre		TSSM/alfalfa stem - 5 May				
Treatment	Product	(lbs/AI)	Eggs	Immatures	Adults	Motiles	Total
Dimethoate 400	16 oz	0.5	64.5a	2.92ab	3.48a	6.4a	70.9a
+ Lorsban 4E	16 oz	0.5					
Koromite 0.125EC	16 oz	0.0156	38.0a	0.75a	2.39a	3.1a	41.1a
Trilogy	32 oz		61.4a	3.90ab	6.63a	10.5a	71.9a
Untreated	-----------		116.1 b	6.50 b	21.17 b	27.7 b	143.8 b

Means in columns followed by the same letter are not significantly different at the p<0.05 level (Fisher's LSD test).

Table 2. Mean number of spider mites/alfalfa stem at 12 days post treatment

	Rate/acre		TSSM/alfalfa stem - 12 May				
Treatment	Product	(lbs/AI)	Eggs	Immatures	Adults	Motiles	Total
Dimethoate 400	16 oz	0.5	3.85a	4.00a	0.96a	4.96a	8.81a
+ Lorsban 4E	16 oz	0.5					
Koromite 0.125EC	16 oz	0.0156	1.31a	1.00a	0.08a	1.08a	2.40a
Trilogy	32 oz		6.04a	7.21a	0.65a	7.85a	13.90a
Untreated	------		71.06 b	28.40 b	12.00 b	40.40 b	111.46 b

Means in columns followed by the same letter are not significantly different at the p<0.01 level (Fisher's LSD test).

Table 3. Mean number of spider mites/alfalfa stem at 19 days post treatment

	Rate/acre		TSSM/alfalfa stem - 19 May				
Treatment	Product	(lbs/AI)	Eggs	Immatures	Adults	Motiles	Total
Dimethoate 400	16 oz	0.5	24.48a	2.63ab	7.21a	9.83a	34.31a
+ Lorsban 4E	16 oz	0.5					
Koromite 0.125EC	16 oz	0.0156	0.52a	0.08a	0.42a	0.50a	1.02a
Trilogy	32 oz		8.96a	3.69 b	5.19a	8.88a	17.83a
Untreated	------		83.38 b	13.44 c	32.29 b	45.73 b	129.10b

Means in columns followed by the same letter are not significantly different at the p<0.01 level (Fisher's LSD test).

Table 4. Percentage of nodes with leaves and number of leaves present at first five nodes

Treatment	Rate/acre	Percent of nodes with leaves present Node 1	2	3	4	5	Average number of trifoliate leaves/node Node 1	2	3	4	5
Dimethoate 400	1 pt	62.5a	81.2a	95.6a	96.3a	99.4a	1.36a	1.98ab	3.38a	4.18a	4.66a
+ Lorsban 4E	1 pt										
Koromite	1 pt	51.2ab	81.2a	93.1a	98.8a	99.4a	0.96a	1.72ab	2.51 b	3.28a	4.08a
Trilogy	1 qt	48.8ab	86.3a	93.1a	97.5a	99.4a	1.17a	2.33a	3.01ab	3.88a	4.68a
Untreated check		26.3 b	55.6 b	85.0a	94.4a	96.9 b	0.58a	1.41 b	2.64ab	3.53a	4.46a

Means in columns followed by the same letter are not statistically different at the p<0.05 level.

Table 5. Alfalfa hay yields and quality data from May 23 harvest following April 30, 2003, miticide application, Blythe, CA

Treatment	Rate/acre	Yield Tons/acre	ADF	MCF	NDF	TDN	Protein percent Crude	Digestible	RFV
Dimethoate 400	1 pt	1.64a	31.7ab	24.15a	41.9ab	52.75a	21.4ab	15.0ab	142.8ab
+ Lorsban 4	1 pt								
Koromite	1 pt	1.78 b	32.15 b	24.8 b	42.35 b	52.4 a	21.1a	14.8a	140.4a
Trilogy	1 qt	1.65a	31.5a	23.9a	41.1a	52.83a	21.7 b	15.2 b	145.75 b
Untreated check		1.60a	31.5ab	23.6a	41.4ab	52.85a	21.6 b	15.1ab	144.8ab

Means in columns followed by the same letter are not statistically different at the p<0.05 level (Fisher's LSD test).

All quality data are reported at the 90% dry matter with the exception of TDN, which is reported at 100 % dry matter.

ACF = Acid detergent fiber, reported at 90% dry matter

MCF = Modified crude fiber, reported at 90% dry matter

NDF = Neutral detergent fiber, reported at 90% dry matter

TDN = Total digestible nutrients, reported at 100% dry matter.

RFV = Relative feed value

Hay Quality

Spider mites that were uncontrolled resulted in 73.7% of the stems without leaves (26.3% with trifoliate leaves present) at the first node above cutting (Table 4) while miticide treatments resulted in 48.7% (Trilogy) to 62.5% (Lorsban + Dimethoate) of stems with trifoliate leaves present at first node. Percentages of stems with leaves present at nodes 2-5 were very similar for all miticide treatments, and were 25-30% more at node 2 and about 9% greater at node 3 than the untreated check.

Treatment differences for percentage of stems with trifoliate leaves present were not as noticeable at nodes 4 and 5. Slightly more stems were without trifoliate leaves in the untreated check at these nodes, thought due to defoliation by spider mites. Differences for treatments were statistically different than the untreated check at nodes 2 and 5.

Miticide treatments also resulted in retaining more trifoliate leaves present at the various lower nodes when compared with the untreated check. Data for node 1 (Table 4) was similar to that of nodes with leaves present, but treatments differed by node thereafter. Trilogy had significantly more leaves at node 2 than the untreated check, while the dimethoate + Lorsban treatment had the most trifoliate leaves/node at node 3 (significantly more than resulted from the Koromite treatment). Koromite treatments resulted in the fewest numbers of trifoliate leaves/node for nodes 3-5, even less than the untreated check. Trilogy as well as the Dimethoate + Lorsban combination treatments had more leaves/node than either Koromite or the untreated check at each of the five nodes. Overall quality was very similar for the treated and non-treated alfalfa (Table 5).

Quality in the untreated check was actually higher than several of the treatments, even though significantly more defoliation than treated alfalfa was noted at several of the five lowest nodes. This was thought partially due to shorter plants in the untreated check resulting in a higher height:node ratio, as well as differences in stem diameters (Rethwisch et al., 2004). Neither of the registered treatments in this experiment (Trilogy, Lorsban + Dimethoate) resulted in economic benefit solely in terms of alfalfa with this 30 day cutting cycle, however, adjacent crops and a longer or additional cutting cycle are aspects will affect the related economics and associated decisions that growers should consider. An effective quick acting miticide may also change the economic outcome.

Potato Leafhopper complex -*Empoasca* spp. (*M. mexara, M. fabae,* etc.)

In many of the states east of the Rockies, potato leafhoppers (*Empoasca fabae*) are considered to be a major pest, but are more of minor pest in the western U.S. Several species of *Empoasca* leafhoppers occur in alfalfa in the western U.S. They all have the same general overall appearance: small (0.125 inch long), bright green, wedge-shaped bodies. Nymphs (immatures) also have green wedge-shaped bodies and run rapidly when disturbed. They may run forward, backward, or from side to side. Their curious movement plus their shape serves to distinguish them from lygus bug nymphs and slower moving aphids. Other green leafhoppers may be present in alfalfa but they are much larger in size. Other small leafhoppers found in alfalfa are brown or gray in color, such as the clover leafhopper, and do no apparent damage.

As the *Empoasca* leafhoppers feed they inject a toxin, resulting in a symptomatic yellowish colored diamond shaped area on the end of a leaflet, known as hopperburn. Frequently, the leaf margin and tissue surrounding this area turns red. This symptom may occasionally be confused with boron deficiency but can easily be distinguished from it by the presence of the insect. Plants may become stunted and have very short internodes, and also lower yields. When entire fields turn yellow it is known as hopper yellows. Rethwisch and Tickes (1987) noted that a rapid fall off of alfalfa protein occurred as percentage of leaves yellowed from leafhopper feeding. Natwick (1987) noted that researchers have indicated approximately 34 lbs./acre yield loss for every increase of 1 leafhopper/sweep. Recent research involving *Empoasca* leafhoppers also noted a decrease in digestible hay protein with increasing numbers of *Empoasca* sp. leafhoppers. (Rethwisch, 2000).

Lehman et al. (1987) noted that *Empoasca* leafhoppers are a problem in parts of Arizona/low desert almost every year and only occasionally in the rest of the southwest. It may be found throughout the year, but damage in the Central Valley is generally found during July, August, and occasionally September. In the low desert where *E. mexara* is encountered, damage may occur as early as June; for alfalfa near cotton, highest populations often occur in the fall as cotton is defoliated.

Current UCCE IPM guidelines note that yield losses are greatest when plants are shorter when infested by these leafhoppers. If alfalfa is two or more weeks away from harvest, treatments should be applied if counts reach five leafhoppers per sweep. Alfalfa scheduled to be harvested in 10 days to 2 weeks should be treated if counts reach 10 per sweep. Often, leafhopper infestation of treatable magnitude are confined to the first 50 to 100 feet of the field margin. If this is the case, treat only the field edges where high leafhopper counts are found.

Threecornered alfalfa hopper - *Spissistilus festinus* (Say)
Less research has been conducted on the threecornered alfalfa hopper (also referred to as 3CAH hereafter) than on *Empoasca* leafhoppers. The adult 3CAH is triangular when viewed from above. The general color of the insect is a bright green. Two reddish lines run from the head area and converge dorsally along the back. These lines are more prominent on males than on females. The adult is about 1/5 inch long, and weighs about 1 gram when dry.

The nymphs resemble the adults in general shape but do not have the greatly enlarged pronotum which is present on the adult. The nymph is straw or buff when young but later become light green. Its body is covered with conspicuous spines. Eggs are deposited in the stems of the host plant and hatch in 7 - 10 days. It requires approximately 24 days for the nymphs to reach the adult stage. There are several generations annually. The overwintering adult is active except during freezing temperatures.

Typical damage associated with this insect is a complete girdling of stems of the host plant. Most of the girdling is done by the nymphs or by females inserting eggs. The girdle is the result of many punctures made in a ring around the stem of the plant. In reality very few stems are girdled in this manner in relation to the populations of 3CAH actually in the fields.

Research conducted in Louisiana found that populations of 3CAH reduced alfalfa plant height, root carbohydrate concentration, forage yield, and forage quality, in addition to the nymphal feeding significantly increasing *Fusarium* crown rot severity (Moellenbeck et al., 1992). Reduction in root carbohydrate concentration can weaken stands, making them more susceptible to severe weather conditions, weed competition, or disease (Kitchen et al., 1990). Similar responses may occur under low desert conditions, especially when potato leafhopper complex *(Empoasca* spp.) populations are present.

A few studies have recently been conducted along the Arizona side of the Colorado River involving the biology of the threecornered alfalfa hopper in the desert southwest (Knowles et al., 1999, Rethwisch and Kruse, 1999). These studies indicated that 3CAH populations (Fig. 1) are highest from mid-August through early October from (Knowles et al., 1999).

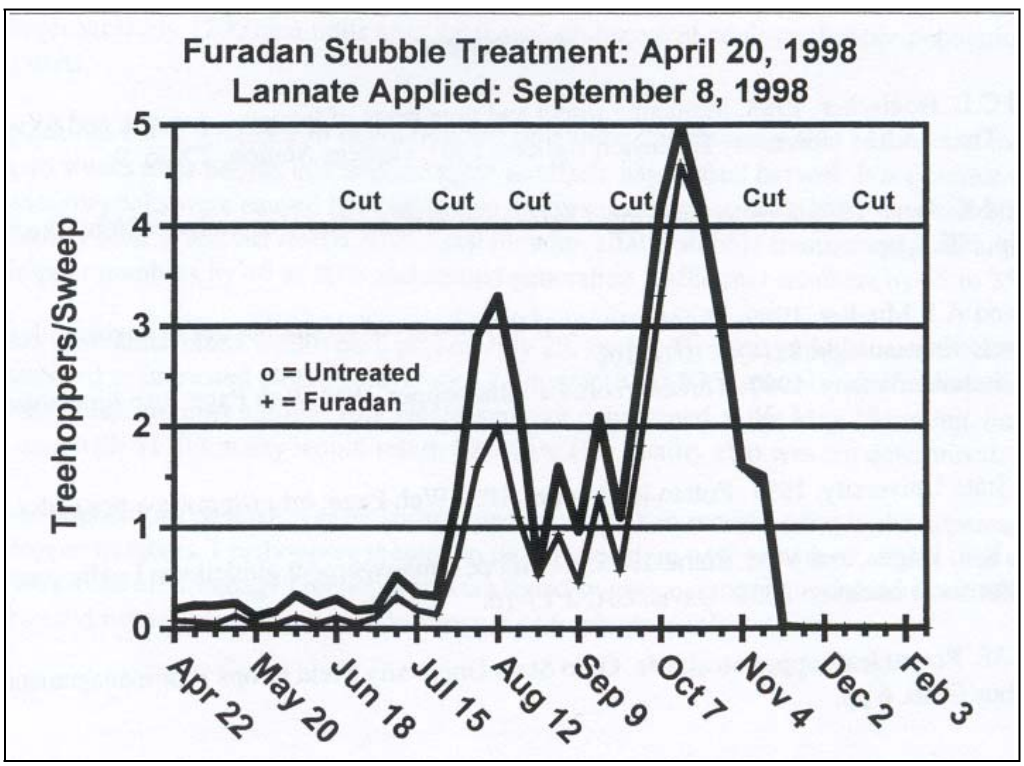

Fig. 1. Population dynamics of adult threecornered alfalfa hoppers in the low desert.

More recent studies have noted that treatments for threecornered alfalfa hoppers resulted in increased forage quality parameters in 1999 when the disease summer black stem and leaf spot (*Cercospora medicaginis*) was present (Rethwisch, 2000). However, in the absence of this disease in 2000, control of 3CAH did not result in significant increase in alfalfa forage quality. This was a previously unknown relationship between insect feeding pressures and summer black stem and leaf spot.

In the 2000 experiment usage of Baythroid 2 increased alfalfa hay yield by 0.3 tons/acre compared to the untreated check, and out-yielded all other treatments by at least 0.2 tons. The exact reason for this yield increase was unclear and was not correlated with control of insects monitored in this experiment (Rethwisch and Nelson, 2001).

Economics for many of these pests and pest interactions still need to be resolved. The data indicate that economic losses are occurring, but determinations of population levels needed to justify insecticide treatment still need further research. This may be further complicated by preliminary data which indicates that alfalfa yields are also influenced by insecticide formulation and product in addition to insect control (Rethwisch et al., 2004)

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