ALFALFA APHIDS, CATERPILLARS, INSECTICIDES AND IPM: WHAT DID WE SEE IN 2018 AND IMPLICATIONS FOR 2019

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ABSTRACT

Management of alfalfa insects is usually in a stage of adjustment. Weather factors and patterns are variable, available tools such as insecticides can differ annually, and economics related to control and hay values change by the cutting. Insects can also change. Blue alfalfa aphids have been difficult to control pests of California alfalfa beginning in 2013 following many years of effective integration of various pest management techniques and tools. Yellow-striped armyworms were noted as the predominant armyworm in 2018 alfalfa rather than the typical beet armyworm. A review of the 2018 growing season, including data obtained from insecticide efficacy trials, provides important information for 2019 decisions regarding caterpillars and aphids in alfalfa.

Key words: Blue alfalfa aphid, pea aphid, insecticide, biotype, alfalfa caterpillar, yellow-striped armyworm, integrated pest management, *Trichogramma*

INTRODUCTION

Winter 2018 was noted to be unique in certain aspects of the growing season. Temperatures in the low desert were above normal, allowing almost continuous alfalfa production without a typical production pause. The warm winter also resulted in blue alfalfa aphids being present in January, but also with lady beetles very numerous and feeding on aphids, making aphids difficult to find by late January.

The latter part of January through February 10 noted 14 consecutive days with each high temperature at least 9° F above normal. The high heat, combined with low host availability, resulted in lady beetles migrating from fields, and an almost complete lack of aphid predators and/or parasites present in low desert fields to assist with aphid control.

Blue alfalfa aphid

The blue alfalfa aphid, *Acyrthosiphon kondoi*, has re-established itself as a major pest of alfalfa in California, causing damage in the spring of 2013 and subsequent years. (Godfrey et al., 2015, and references therein). This insect has been managed for over 30 years via integrating control measures that include alfalfa variety pest resistance (ex. Cuf-101), biological controls (several lady beetle species and parasitic wasps, primarily *Aphidius ervi*), and insecticides.

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In 2018 very high numbers of blue alfalfa aphids (BAA) were again noted in low desert alfalfa fields, resulting in reduced alfalfa yields and alfalfa being sticky with honeydew at harvest in some fields. The high BAA numbers were coupled with the previously noted almost complete lack of beneficial insects in 2018.

Local pest control advisors reported that insecticide applications did not provide levels of desired control, with some fields requiring more than one application/cutting cycle for aphid control. Insecticide efficacy trials verified that that no insecticide provided greater than 90% control of BAA, with very few providing 80% control of pea aphids, *Acyrthosiphon pisum* (Figs 1-2).

While no insecticide is expected to provide 100% control, those not controlled may be developing insecticide tolerance, and many aphids are often giving birth to 'clone' aphids within a few days of insecticide application. This can lead to reduced control, especially when there are not beneficial insects present to feed upon aphids that survive an insecticide application.

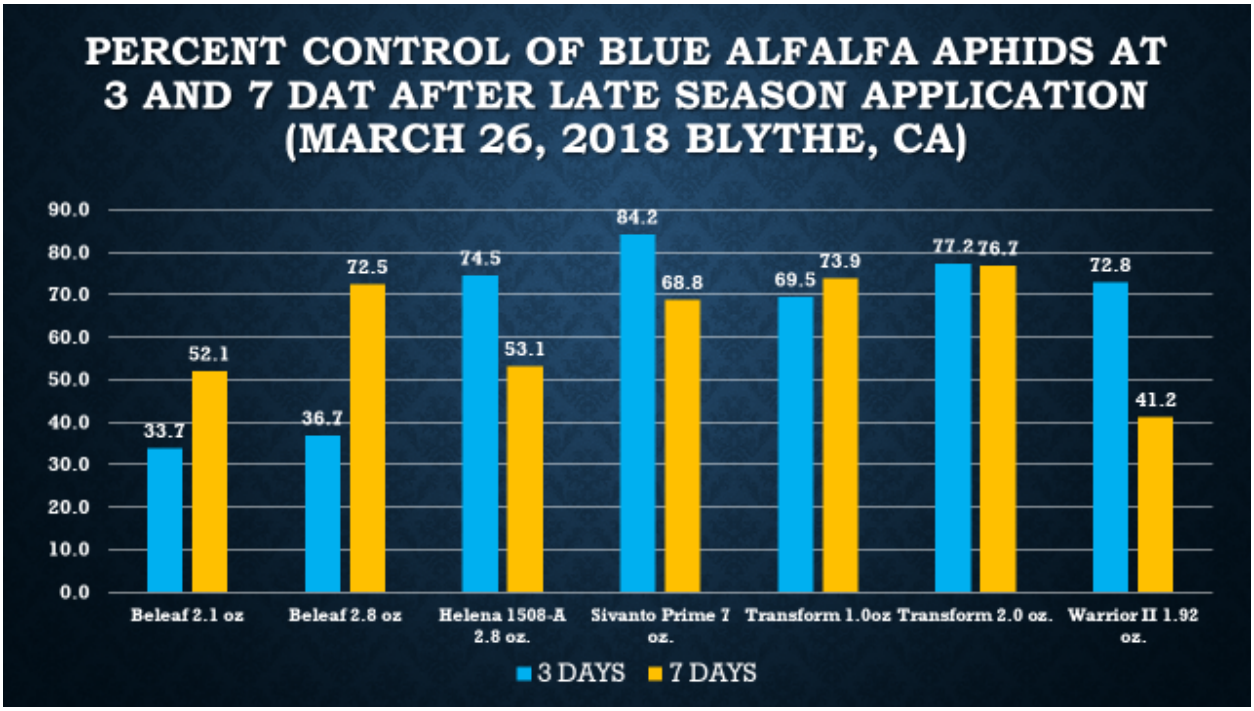

Fig. 1. Mean percent aphid control of blue alfalfa aphids by potential new and currently registered insecticides following March 26, 2018, application, Blythe, CA.

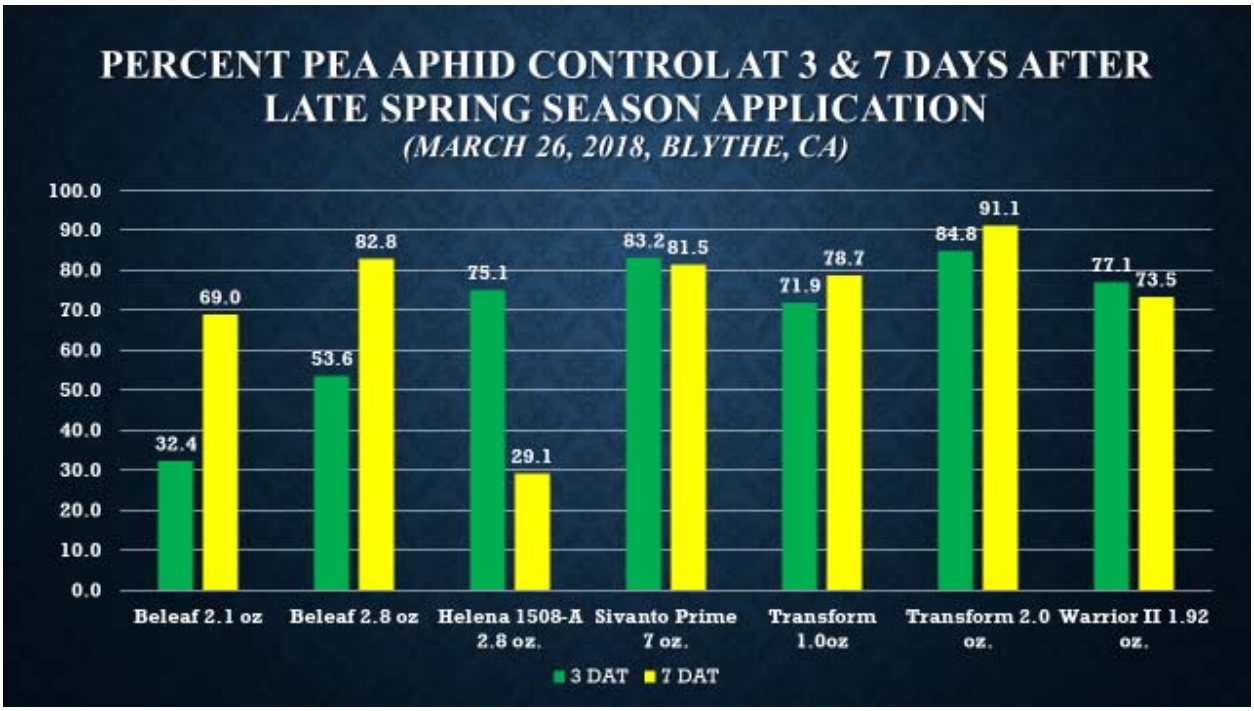

Fig. 2. Mean percent control of pea aphids by potential new and currently registered insecticides when applied March 26, 2018, Blythe, CA.

One BAA aspect that needs thorough researching in California is the possibility that a new biotype is present. Several BAA biotypes have been documented, including a recent highly virulent biotype in Australia just prior to the 2013 problematic outbreak in California.

Some Historical Aspects Related to Blue Alfalfa Aphid for California Consideration

1974 – Blue alfalfa aphid, a native of Asia, found in US for first time (Kern Co., California)

1975 - Damage in California alfalfa reported

1977 – CUF-101, an alfalfa variety selected/developed for BAA resistance, released.

1991 - First report of a new blue alfalfa biotype, noted as BAOK90 (Oklahoma)

1998 – Three to seven (3-7) phenotypes identified in Australia. Clones differed in life history traits that included survival, fecundity, growth rates and percentage of winged aphids.

2001 – Variation in growth rates of various BAA aphids (Australia)

2009 – South Australia – Blue alfalfa aphids collected from certain locations had much greater virulence on all previously resistant alfalfa varieties, producing high rates of plant mortality.

2012 – South Australia – Confirmation of the 2009 discovery that a new, highly virulent blue alfalfa aphid exists in south Australia. Expansion of range noted. (Humphries et al, 2012)

2013 – Severe and damaging outbreaks of blue alfalfa aphid in California.

The ramifications of a new BAA biotype for which CUF101 and related varieties no longer provide resistance are of great concern, as host plant resistance is a significant integrated pest management that is the often the most effective means of controlling aphids. Lack of host plant resistance also increases the selection pressures on insecticides used for aphid control.

It is known that varieties differ in their stated resistance to BAA. CUF 101 is highly resistant, while UC Cibola has a low resistance rating. If new BAA biotypes are found to exist in California, current varieties will need to be retested for their resistance as appropriate.

A very wide percentage range of resistant plants exists within the High Resistance level, and producers should inquire of alfalfa seed companies for the actual percentage of resistant plants in their varieties. The wide range in the High Resistance level suggests that a revision/further refinement of this particular level is needed.

Resistance Level		% Resistant Plants	% Susceptible Plants
S	**Susceptible**	**0-5**	**95-100**
LS	**Low Resistance**	**6-14**	**84-96**
MR	**Moderate Resistance**	**15-30**	**70-85**
R	**Resistance**	**31-50**	**50-69**
HR	**High Resistance**	**51+**	**0-49**

Caterpillars

A number of caterpillars can be pests of alfalfa production in California. These caterpillar species include the alfalfa butterfly, *Colias eurytheme* Boisd., the beet armyworm *Spodoptera exigua* (Hübner), the western yellow-striped armyworm *Spodoptera praefica* Grote, the yellow-striped armyworm *Spodoptera ornithogalli* Guenée, and the dingy cutworm *Feltia jaculifera (*Guenée*).*

Environmental factors can also affect insect development, survival and biological interactions. High temperatures and low humidity are also factors that are noted as favorable for outbreaks of alfalfa caterpillars, *Colias eurytheme* (UC IPM website), due to their negative effects on *Trichogramma spp.* wasps that parasitize alfalfa butterfly eggs.

Trichogramma semifumatum (Perkins) is the major alfalfa butterfly egg parasitoid in the low deserts of California, often credited with keeping alfalfa butterfly populations from reaching economic thresholds. Reports of near 100% egg parastism have been noted in late summer in the low desert (Stern and Bowen, 1963). Low humidity (which often accompanies desert temperatures above 110ºF) were often noted to be fatal to maturing *T. semifumatum* in laboratory studies (Stern and Bowen, 1963).

Trichogramma retorridum (Girault) occurs in many parts of California, being reared from alfalfa butterfly eggs in central and northern California (Stern and Bowen, 1963) but was never found in the low deserts of California during the early 1960s (Stern and Atallah, 1965).

Armyworm eggs are not as readily available for *Trichogramma* wasps to attack, as they are covered with scales. Other insects provide biological control of armyworms, with 96+% of total mortality occurring in the egg and early larval stages. Most of this was attributed to predation, with the most important species being minute pirate bugs, *Orius tristicolor* (White) (Hemiptera: Anthocoridae); bigeyed bugs, *Geocoris* spp. (Hemiptera: Lygaeidae); and damsel bugs, *Nabis* spp. (Hemiptera: Nabidae). The western lygus bug, *Lygus hesperus* Knight (Hemiptera: Miridae), was a facultative predator, often feeding on armyworm eggs. (Bisabri-Ershadi and Ehler, 1981).

Insecticides are often necessary when biological agents do not provide adequate control of caterpillars. Insecticides which resulted in initial armyworm provided approximately 10 days of control in a 2018 experiment (Table 1). Yields and quality were not statistically different however and varied by insecticide in this low desert experiment which was growing in high stress conditions. Highest yields were obtained from the DiPel DF treatment, although higher quality was noted from other chemistries. Additional research is necessary to verify the trends noted in this experiment, and results are also expected to differ by California alfalfa growing region due to differing summer temperatures and accompanying stress levels.

Table 1. Mean total number of armyworm (beet, yellow-striped, and western yellow-striped) caterpillars (number/10 sweeps) following insecticide application on July 6, 2018, Blythe, California.

Insecticide and Rate/Acre		July 9	July 13	July 16	July 20
Coragen®	3.5 oz.	0.75a	0.25a	3.25a	4.25a
DiPel® DF	8 oz.	10.00 b	24.75 b	12.50 bc	15.75ab
DiPel® DF + Steward*	8 oz. 3.2 oz.	1.50a	2.00a	3.50ab	12.50ab
Steward® EC	8 oz.	0.50a	1.50a	2.25a	4.75a
Zylo™	8 oz.	0.75a	1.00a	4.75ab	15.50ab
Untreated	-----	10.25 b	14.75ab	15.50 c	19.50 b
	P value	*0.01*	*<0.01*	*<0.03*	*0.01*

Means in columns followed by the same letter are not statistically different at the 0.05 level of probability (Tukey's HSD test, JMP Pro 13).

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