

# APPROACHING IPM PROGRAM FOR ALFALFA WINTER INSECT PESTS OF SOUTHWEST DESERT

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## ABSTRACT

Irrigated non-dormant Alfalfa hay dominates the cropping system in Arizona. Major winter/spring insect pests attacking alfalfa in the region include alfalfa weevil (AW), *Hypera postica*, and an aphid complex of pea aphid (PA) *Acyrtosiphon pisum* (Harris), the blue alfalfa aphid (BAA) *Acyrtosiphon kondoi* L., cowpea aphid *Aphis craccivora*, and spotted alfalfa aphid, *Therioaphis maculate*. The current economic threshold for AW is erroneous, and that there is a need to revisit this threshold as part of a comprehensive alfalfa IPM program to reduce the number of applications and amounts of chemical pesticides to improve profitability of alfalfa farming. The efficacy of current collection of broad-spectrum insecticides against alfalfa aphid complex, particularly blue alfalfa aphid is declining. We re-establish sound economic thresholds for AW and aphids; evaluate efficacy of selective alternative chemicals that can be used to replace broad spectrum pesticides; and provide IPM training to PCAs in managing alfalfa weevil and alfalfa aphid complex in Arizona and the southwest.

**Key Words: alfalfa weevil, alfalfa aphids, IPM, economic threshold**

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## Alfalfa Weevil and Damage Symptoms

The alfalfa weevil (AW), *Hypera postica*, is the most damaging arthropods in southwest grown alfalfa. The larvae feed heavily on alfalfa leaflets leading to skeletonizing of the plant (Fig. 1) that significantly lowers yield as well as stem to leaf ratio that is highly coveted by the dairy and livestock industries. The AW start activating in the southwest desert in winter when temperatures reach ~42°F and continue to be present in the fields during the first, second, and sometimes third cuttings of the season. Generally marketed to the dairy industries, these cuttings are the premium of the entire year. The current economic threshold of 15-20 per sweep of the AW larvae was established in California in 1975 (Koehler and Rosenthal 1975), but not suitable or adapted by growers in the low desert. Multi-year of field study have been conducted at the University of Arizona's Maricopa Agriculture Center (MAC) to investigate this economic threshold in low desert grown alfalfa.

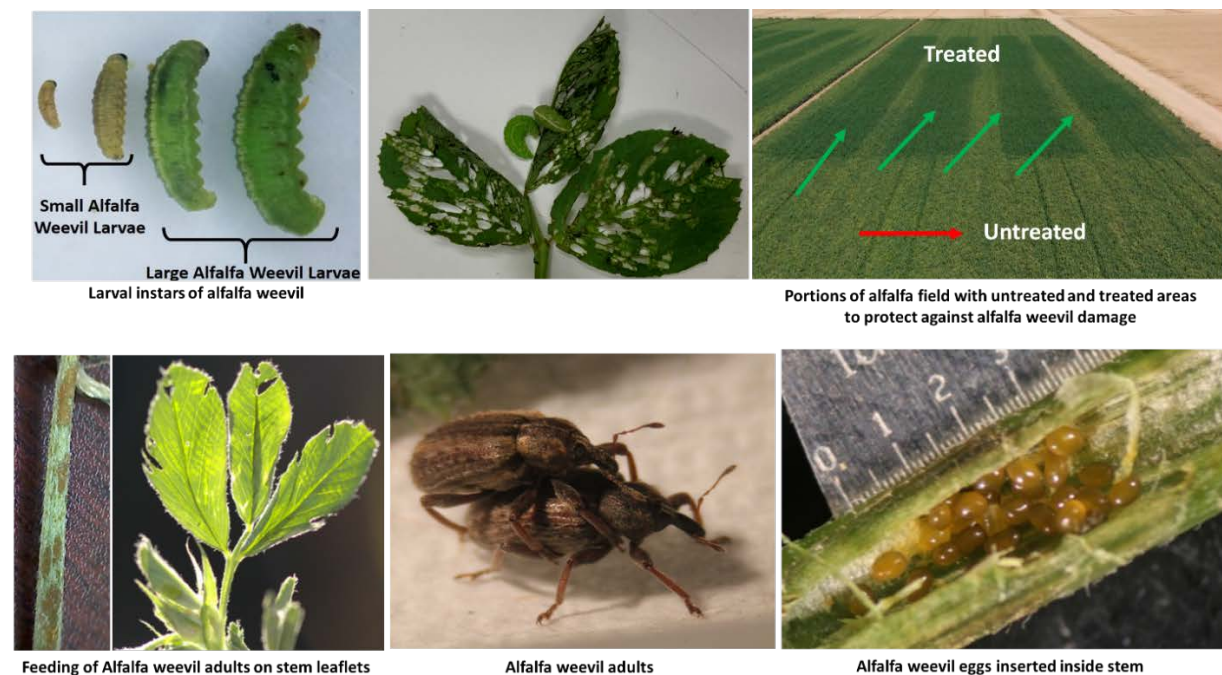


Fig. 1. Different stages, damages, and injury symptoms of alfalfa weevil.

## Alfalfa Weevil Economic Threshold

Multi years field study have been conducted at the Maricopa Agriculture Center (MAC) to investigate alfalfa weevil economic threshold in low desert Arizona grown alfalfa. Giving the cost of application per acre plus the price of the product, as well as common production yields averaging more than one ton per acre, the study expressed that the economic threshold is well lower the previous 15-20 per sweep threshold, with 2-4 large larvae per sweep justifying control measure according to \$170-250 / ton of hay. Data reveal that economic thresholds for some years could even be as low as a single large larva per sweep if hay price to be higher.

We built the following tables based on a scenario were the costs of application is \$30, and we adjusted to the price of hay per ton vs large larva populations:

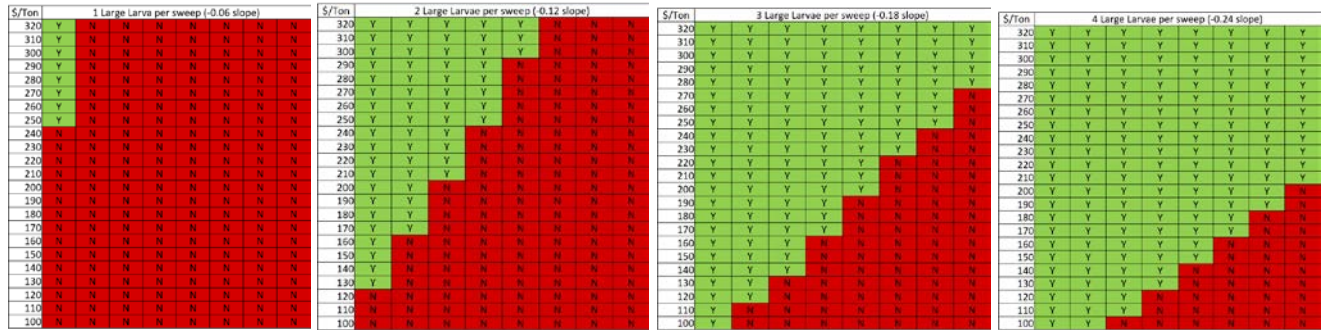


Fig. 2. Threshold models based on different prices of hay/ton at fixed application cost of \$30.

### Alfalfa Weevil Efficacy Trials

Several insecticides were tested for their efficacies against alfalfa weevil in 2018 and 2019 at University of Arizona’s Maricopa Ag Center. In 2018-2019 season, early insecticides application, once alfalfa weevil larvae were detected, resulted in better control of the larval population than late treatment on March (Figs 4 a & b).

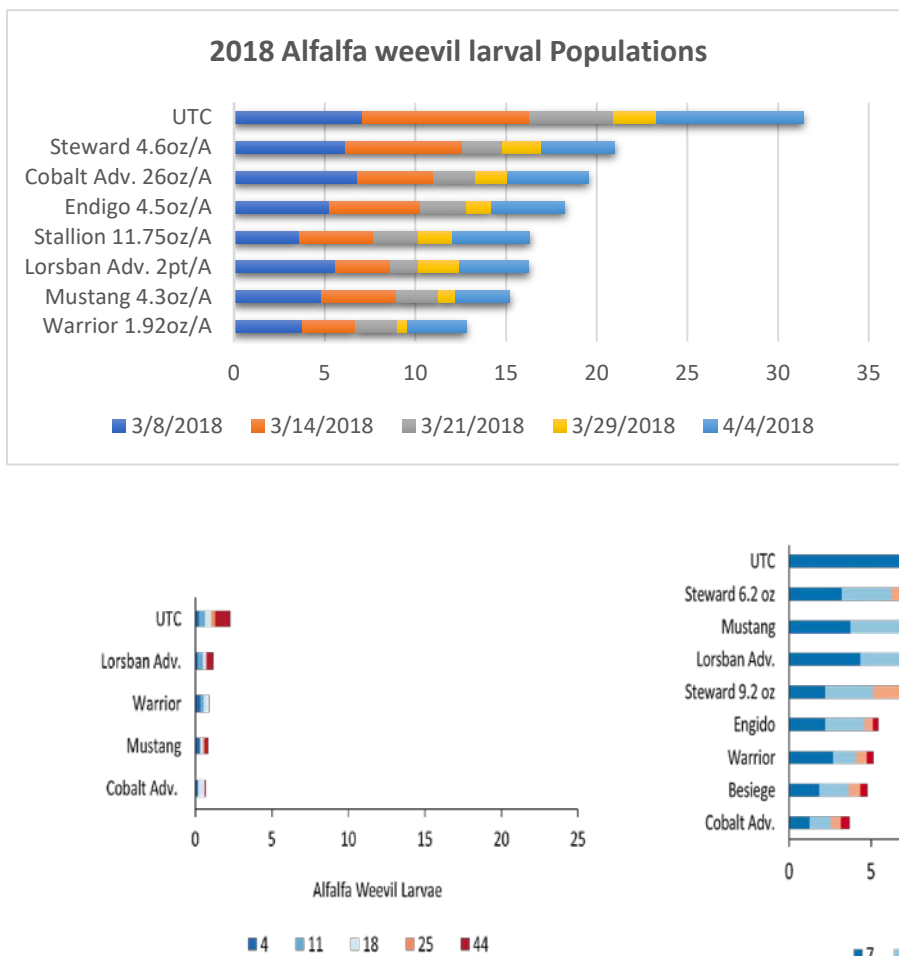


Fig. 3. 2018 efficacy trial for alfalfa weevil at MAC

Fig 4.a. Early Season Insecticide Treatment for AW, December 17, 2018

Fig 4.b. Late Season Insecticide Treatment for AW, March 20, 2019

## Alfalfa Aphids Economic Threshold

Economic thresholds currently in use for alfalfa aphids in Arizona and the southwest apparently are based on scanty experimental evidence. The economic threshold of aphid never been studied in the region. We conducted multi-year study to reestablishing the economic threshold for aphids in the region as an essential component of alfalfa IPM program. Various insecticidal materials and/or rates were applied to produce different densities of pea aphid and blue alfalfa aphid populations. The results showed that yields were affected significantly only in years where blue alfalfa aphid is abundant without natural fungal infection (2014) (Fig. 5). When pea aphid populations were most abundant, there were no significant yield losses due to infestation.

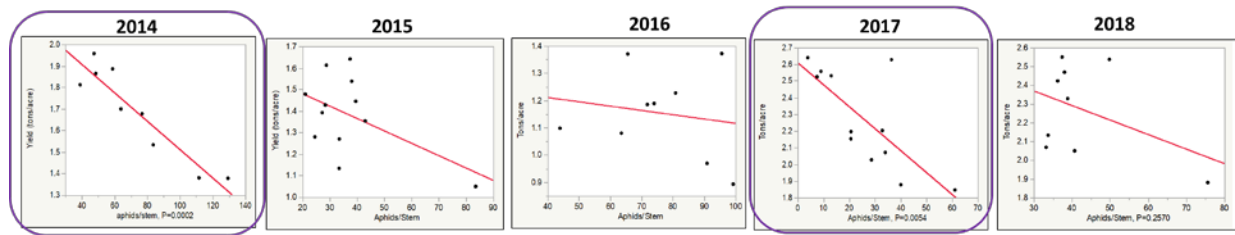


Fig. 5. Relationship between alfalfa aphid populations and yields over five-year economic threshold study at MAC.

## Entomopathogenic Fungi Infections of Alfalfa Aphids

Since 2015, we have observed aphids naturally infected by an entomopathogenic fungus (Fig 6), which identified as *Zoophthora* sp. and *Isaria* sp., in many alfalfa fields in Arizona, and other western states. The natural infection rate reached 80% in some fields in 2016-17 resulting in thousands of acres receiving no insecticide applications and gave much relief for many growers.

In efficacy studies conducted in 2017 and 2018 at MAC, the commercial formula of pathogenic fungus, PFR-97, *Isaria fumosorosea*, had a high aphid population compared to the broad spectrum products, however most of these aphids showed symptoms of infection, and were not feeding on the plant samp. The yield from the PFR-97 treatment was comparable to, and even greater, than many of the broad spectrum insecticides. It resulted in over 0.5 and 0.17 ton per acre increase in yield compared to the untreated control (UTC) in 2017 and 2018, respectively (Figs. 7 & 8).



Fig. 6. Natural infections of *Isaria* sp & *Zoophthora* sp. fungi to alfalfa aphids

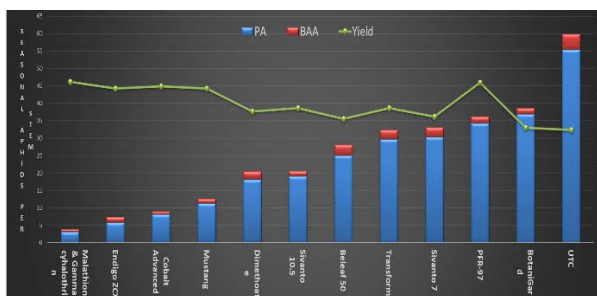


Fig. 7. Population of aphids per stem vs Yield (ton/A) for 2017 insecticide efficacy trials at MAC.

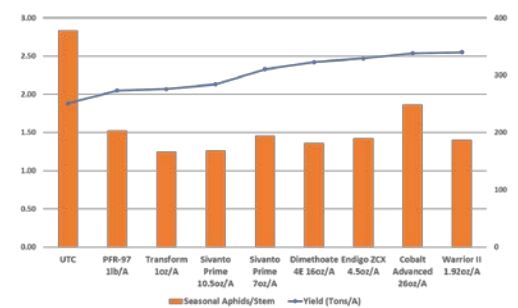


Fig. 8. Population of aphids per stem vs Yield (ton/A) for 2018 insecticide efficacy trials at MAC.

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