Spring Stubble Application in Alfalfa for Season Long Management of Threecornered Alfalfa Tree Hopper, *Spissistilus festinus* Say

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Abstract

In 2010 a 2-year study was initiated to evaluate the feasibility of a single application of Cyfluthrin (32.4 g [AI]/ha) made to early spring "stubble" alfalfa (*Medicago sativa* L.) to mitigate season-long populations of Threecornered alfalfa tree hopper , *Spissistilus festinus* Say as part of a reduced pesticide application program. Three replicated forage alfalfa fields (≈12.14 ha each) contiguous with irrigation drainage ditches were used to establish split plot comparisons. A single directed "stubble" application of Cyfluthrin was made immediately after the first alfalfa cutting was removed from the field. Bi-weekly sampling of fields began in May to determine the effect of treatments on population dynamics of TCAH and the potato leafhopper (complex) which includes the Potato leafhopper, *Empoasca fabae* (Harris), the Garden leafhopper, *Empoasca Solana* DeLong, and the Mexican leafhopper, *Empoasca mexera* Ross and Moore. Each sampling date consisted of sweep-net, beat-net and mean alfalfa stem height. Alfalfa forage quantity and quality was determined with bail counts, weights and tissue samples taken on harvest dates. No treatment effect was observed between either Threecornered alfalfa tree hopper (f = 4.12, df = 69, P = 0.42) or Potato leafhopper populations (f = 4.12, df = 69, P = 0.49). A possible alternative to direct management of hoppers in alfalfa fields would be to manage hoppers in the drainage ditches themselves and disrupt the overwintering/reproductive areas.

Introduction

Alfalfa, Medicago sativa L. production in California exceeded 950 (x1,000) acres in 2009 with production exceeding 6,650(x1,000) tons with an estimated value of 1,383,200 (x1,000) dollars (Anonymous 2009). Given that California is an alfalfa "poor" state and must import alfalfa to supplement the states production needs makes it critical that alfalfa hay production be bolstered. Wild vegetation areas (ie. drainage ditches) adjacent to alfalfa fields act as a refuge and continuous source of Threecornered alfalfa tree hopper (TCAH). Both the Potato leafhopper (PLH) and TCAH mechanically wound alfalfa during feeding and/or ovipositing by adult females. Damage also includes reduced stem length and mass, increases leaf/stem ratio, chlorisis/necrosis, and decreases morphological stage of

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development. Weakened plant stems are prone to breakage and/or lodging. Once alfalfa has lodged it becomes difficult to harvest and lodged areas that remain in the field can harbor greater hopper populations compared to stubble alfalfa (Cuperus et al. 1986, Delong 1938, Hower and Flinn 1986, Hutchins and Pedigo, 1990, Oloumi-Sadeghi et al. 1988, 1989). If TCAH populations remain untreated they can significantly reduce alfalfa hay yield and quality (Miner 1959, Rethwisch 2000). This project seeks to develop a reduced pesticide use program as an economic and environmental beneficial approach to hopper pest management in alfalfa grown in the desert region.

Materials & Methods

Commercial alfalfa fields in their 2nd year of production were selected with a history of high populations of TCAH prior to establishment of experimental plots (**Fig. 1**). The experiment consisted of a split plot field design that was replicated three times in California's southern desert. The replicated field study included a whole plot factor of endemic TCAH and PLH populations and the sub-plot factor consisted of a single directed "stubble" application of Cyfluthrin at the labeled rate of 32.4 g [AI]/ha made immediately after the first alfalfa cutting was removed from the field. Whole plots consisted of cv. 'WL-535'alfalfa (≈12.14 ha each) with sub-plots of (≈ 6.07 ha each) established at each location. Each treatment plot was delineated into 4 equal quadrants (≈ 1.5 ha each). Approximately 10d after initial alfalfa stubble treatment was made bi-weekly sampling began. On each sampling date 10-180^{O} sweeps were taken per quadrant with a standard University of California sweep net (0.37 m diameter), for a total of 40 sweeps per treatment (80 per field). Beat net samples were taken at 3 locations within quadrants consisting of 3 plants per location with a standard University of California sweep net (0.37 m diameter) and a 0.65 m baton, for a total of 24 beat net samples per treatment (48 locations/144 plants per field). Both sweep net and beat net materials were immediately transferred into individual 3.8 L plastic bags and placed in a cooled ice chest. Samples were immediately processed afterwards by first freezing the bags and their contents and then hand sorting by hopper type/stage. Numbers of TCAH and PLH adults and nymphs were then totaled and averaged to produce the mean abundance of TCAH and PLH per treatment. Plant stand vigor was also assessed on sampling dates by measuring mean plant height of 5 randomly selected alfalfa stems per quadrant for a total of 20 stems per treatment (40 stems per field). Alfalfa yield was determined on harvest dates by summing the number of alfalfa bales and randomly weighing 10 bales per treatment (20 per field). Paired t-tests were used at the $P < 0.05$ level of significance to analyze potential treatment differences in mean abundance of TCAH and PLH and alfalfa yield at harvest.

Results

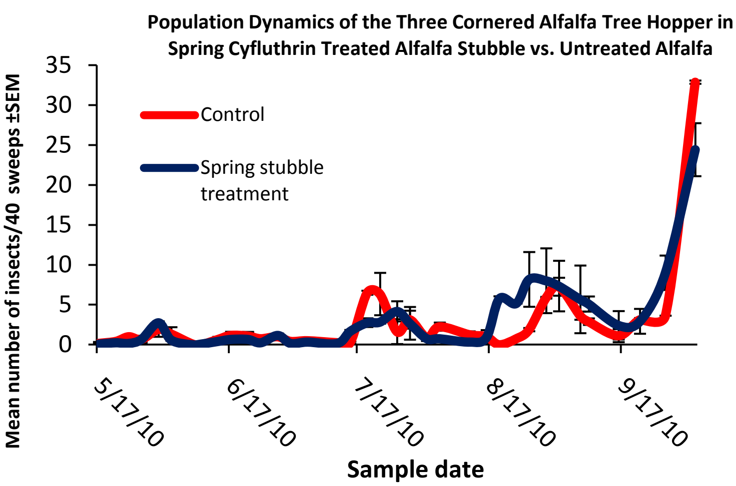
Population trends for both TCAH adults (**Fig. 2**) and PLH (**Fig. 3**) followed closely with one another and were not significantly different ($f = 3.13$, $df = 69$, $P = 0.42$, $f = 3.13$, $df = 69$, $P = 0.49$ respectively) between alfalfa stubble treated with Cyfluthrin after the first cutting in the early spring and untreated controls . Few TCAH adults and nymphs were recovered using the beat-net sampling method (TCAH adults, 0.07 ± 0.02 and 0.05 ± 0.02, TCAH nymphs 0.005 ± 0.003 and 0.01 ± 0.005) compared to conventional sweep-net sampling (TCAH adults, 109.17 ± 0.76 and 97.03 ± 0.93, TCAH nymphs 1.13 ± 0.01 and 1.83 ± 0.04) in the spring stubble and control treatments (**Fig. 4**). No significant differences were observed in alfalfa stem length (f = 4.12, df = 72, P = 0.39) over the 36 sample dates (**Fig 5**) between Cyfluthrin treated stubble alfalfa and untreated controls. Alfalfa yield ($^{\#}$ of bales of dry alfalfa) per treatment was not significantly different (f = 3.91, df = 69, P = 0.27) with 223.5 ± 29.5 bales produced in Cyfluthrin treated stubble alfalfa compared to 188.67 ± 35.09 bales of alfalfa produced in untreated controls. Alfalfa bales from control plots were significantly (f = 3.91, df = 145, P = 0.003) heavier than alfalfa bales (45.47 ± 0.38 and 47.45 ± 0.57 Kg respectively) from alfalfa stubble treated with Cyfluthrin.

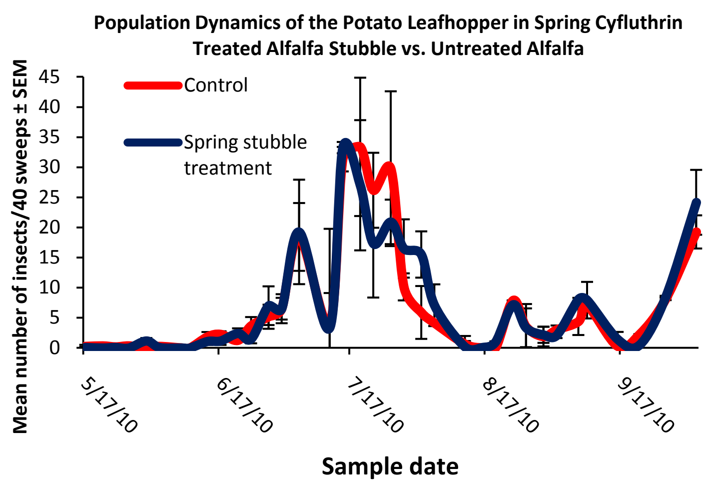
Discussion

Development of an Integrated Pest Management Program (IPM) to manage TCAH and PLH in alfalfa could potentially be useful in reducing the number of insecticide applications necessary to manage these pests. The alfalfa plant with its dense upper canopy effectively acts as a barrier to insecticides penetrating into the crown of the alfalfa plant where TCAH immature stages can be found feeding near the soil line. Effectively, this creates a pesticide free space that allows populations of TCAH to build. A directed application of insecticide into the alfalfa crown was suggested as a possible management strategy for reducing TCAH populations early on in the forage alfalfa production cycle; potentially reducing the need for future chemical applications. The work presented here from the first year of the project demonstrates that TCAH and PLH populations in alfalfa are not effectively reduced with a single directed stubble application of insecticide to the alfalfa crown.

Both TCAH and PLH appear to be continuously emerging from adjacent drainage ditches and "overwhelm" the single application of Cyfluthrin at the beginning of the season. Hoppers can only be indirectly managed with materials applied to the crop itself which is directly impacted by residual activity of Cyfluthrin in the alfalfa crown/plant. A possible alternative to direct management of hoppers in alfalfa fields would be to manage hoppers in the drainage ditches themselves and disrupt the overwintering/reproductive areas. A possible way of compensating for shortcomings in residual activity of materials applied to the alfalfa crown would be development of improved timing of applications to the plant crown. This along with a better understanding of overwintering of TCAH movement into alfalfa fields from wild areas would be foundational to an improved TCAH IPM program in alfalfa.

Fig. 1. Plot maps of spring “stubble” alfalfa treatments for season-long management of populations of Threecornered alfalfa tree hopper, potato leafhopper





Figs 2 & 3. Hopper population dynamics in alfalfa; a, Three cornered alfalfa tree hopper in Cyfluthrin versus untreated alfalfa, b, Potato leafhopper complex in in Cyfluthrin versus untreated alfalfa .

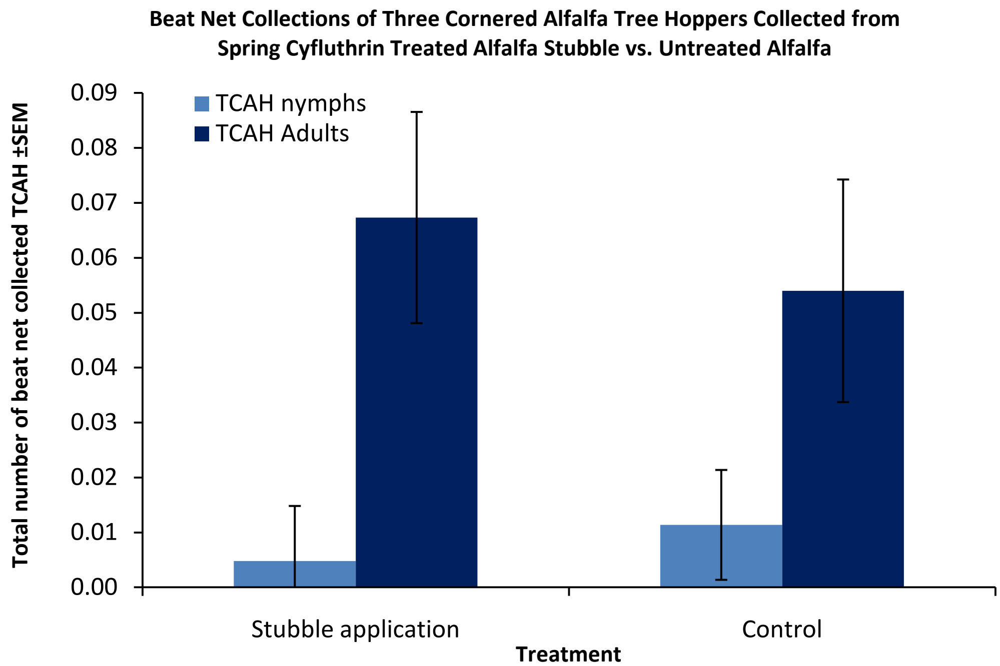


Fig. 4. Three cornered alfalfa tree hopper adult and nymphs recovered using the beat net sampling method

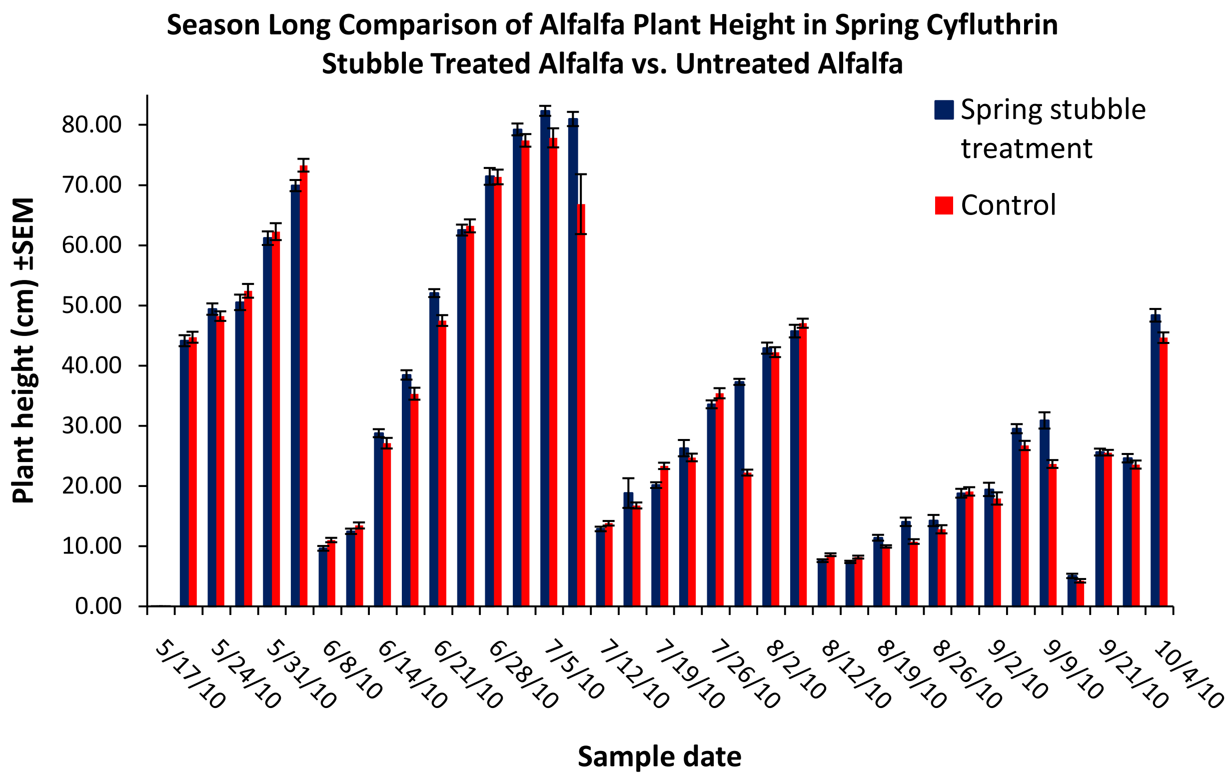


Fig. 5. Alfalfa plant height in early spring stubble treated alfalfa versus untreated alfalfa

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