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Dose Responses of Field Populations of Alfalfa Weevil from Various Western States to Lambda-Cyhalothrin® Using a Feeding and Contacting Assay

Ayman M. Mostafa and Kyle G. Harrington

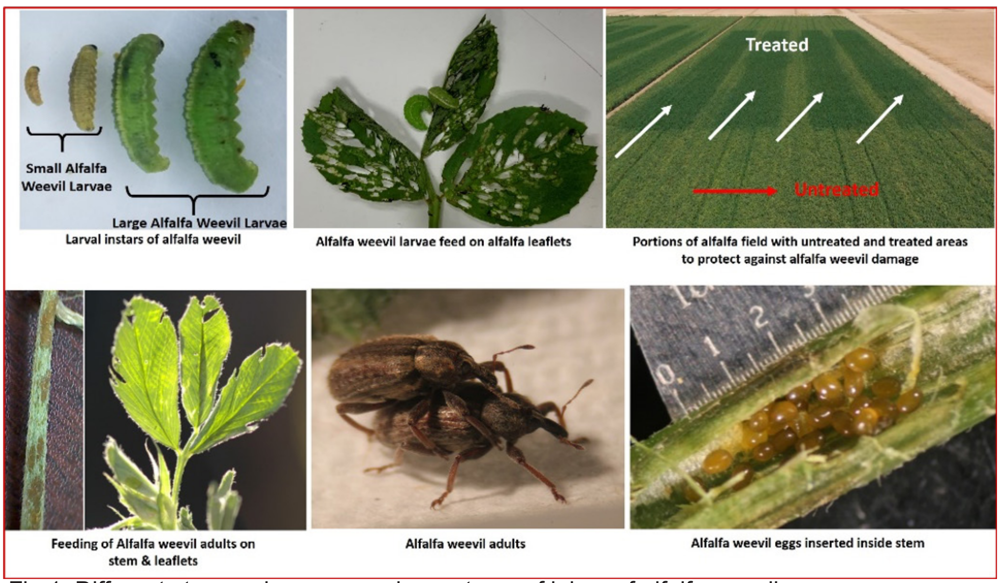

Fig 1. Different stages, damages and symptoms of injury of alfalfa weevil.

Abstract

Formulated insecticide, lambda-cyhalothrin, was diluted with water to form a series of desired concentrations to examine a dose response by field populations of alfalfa weevil using feeding assays. Alfalfa weevil larvae were collected from 14 different locations in seven different states during 2019. Results showed responses of alfalfa weevil larvae to different doses of lambda-cyhalothrin. Mortality rates ranged from 88-100% for the higher two doses in all locations. Weaker responses to lower doses have been detected in populations from northern CA and TX in this assay. Further investigation is planned for the 2020 season, including testing a wider range of lower doses.

Introduction

Irrigated, non-dormant alfalfa hay dominates the cropping system in the western United States. Alfalfa weevil (AW), *Hypera postica*, is the major yield reducing insect pest attacking alfalfa in the region (Fig. 1). Our economic threshold data showed that AW larvae can reduce the yield by half a ton per acre or more (Mostafa, 2019). Because of this economic consequence, growers use control measures against this serious pest. There are a variety of insecticides that can combat AW; however, almost all these insecticides are broad-spectrum. Our surveys of growers and pest control advisors showed that the efficacy of current broad-spectrum insecticides against alfalfa pests, particularly alfalfa weevil, is declining. We have evaluated the efficacy of an alternative selective chemical that could be used to replace broad-spectrum pesticides; however, the pace of registrations of novel insecticides is dilatory.

Insects, including AW, are known for their ability to develop resistance to insecticides. Resistance is a genetic phenomenon. In a population of an insect species, there may be a few individuals that carry the genes for resistance to a chemical. Upon exposure to insecticides, insects that do not carry the resistance genes die, thus allowing the individuals with the resistance genes to survive and reproduce, creating more resistant insects. With every subsequent generation and continued selection, the number of resistant insects increases; therefore, the insecticide becomes less effective in controlling the pest population.

We investigated lambda-cyhalothrin (Warrior II™) against AW to test for any resistance by comparing the dose response of field populations of AW from seven states using feeding assays. The results of these experiments will be helpful to growers and the agriculture industry in the western region and around the nation as they decide which insecticides to use on their crops and which ones are most effective.

Materials and Methods

Insect

Alfalfa weevil larvae were collected from alfalfa fields from 14 locations in seven states. These locations were near: Maricopa, AZ; Scottsdale, AZ; Tonopah, AZ; Wellton, AZ; Poston, AZ; Blythe, CA; Holtville, CA; Yreka, CA; Tulelake, CA; Radersburg, MT; Los Lunas, NM; Stillwater, OK; Muleshoe, TX; and Logan, UT. The sweep net collected samples were put into brown paper bags with some alfalfa plants, stored in a cooler, and shipped to our laboratory in Phoenix. Larvae of AW were collected and sorted from samples. Third-instar larvae were placed into cages overnight, for conditioning, with alfalfa plants as food.

Insecticide

The formulated insecticide product of lambda-cyhalothrin was diluted with distilled water. A series of dilutions was made to yield concentrations of 1500, 1000, 500, 250, 50, 10 ppm (parts per million), along with a control check of distilled water.

Procedures

The substrate used to hold the insecticide solution was alfalfa leaflets. Alfalfa leaflets were dipped individually in containers with the different insecticide concentrations. Each leaflet was then inserted into 1-oz plastic cup that

Fig 2. Setup of the assay of alfalfa weevil to lambda-cyhalothrin.

contained a thin layer of agar. One, third-instar, AW larva was added to each cup and then capped. Six small holes were punctured into each cap. A total of 25 insects were evaluated at each concentration for each population. Insects were kept at room temperature (Fig 2). Results were recorded at 24 and 48 hours after treatment. Insect responses were assessed using four categories: alive, dead, lethargic and moribund. Insects described as dead showed no movement when probed and no legs kicking when flipped over. Insects described as moribund were unresponsive to probing, but legs were kicking and mouthparts or their body were still contracting. Insects described as lethargic showed slow, sluggish, and clumsy movements; they did not speed up when probed. Insects described as alive showed normal evasive tendencies when probed; quick, alert movements. For these experiments, dead and moribund were categorized as mortality, while lethargic and alive were categorized as alive.

Results

Results showed that lambda-cyhalothrin caused 100% mortality of AW larvae from 9 of the 14 locations at higher doses of 500 ppm or greater after 48 hours of exposure (Fig. 3). For all locations, the average mortality at 48 hours was greater than 80% for doses of 50 ppm or greater (Fig. 4). A rate response was evident for the average percentage of AW larval mortality decreasing with the decrease of concentrations at both 24 and 48 hours (Fig. 4). There were differences in responses to concentrations by location (Fig. 3). Mortality percentages in response to the 250 ppm dose were 75% or more, except for the Yreka, CA and Muleshoe, TX (Fig. 3).

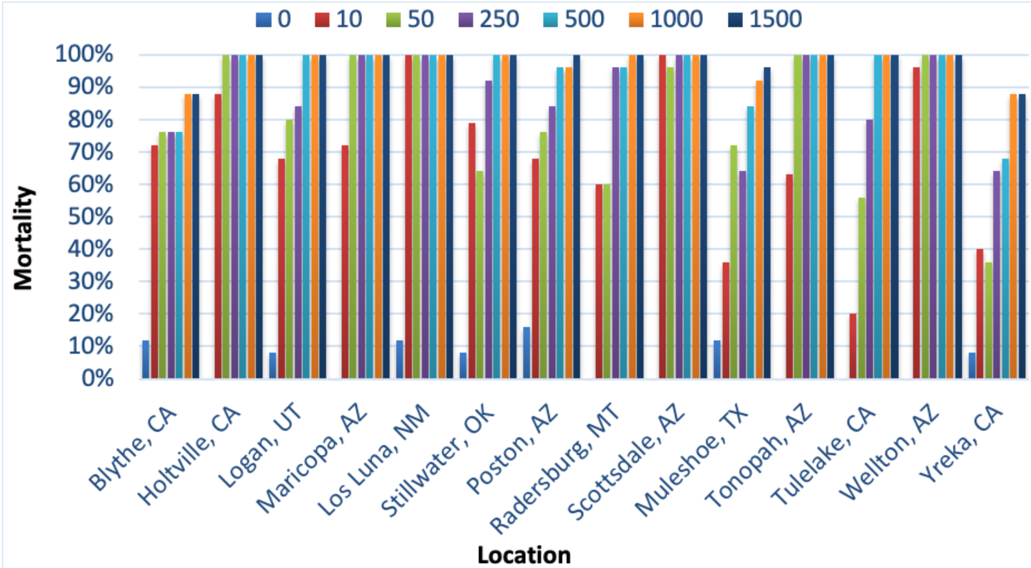

Fig. 3. Average percentage mortality of AW larvae in response to different concentrations of lambda-cyhalothrin at 48 hours after treatment in 2019 from 14 different locations.

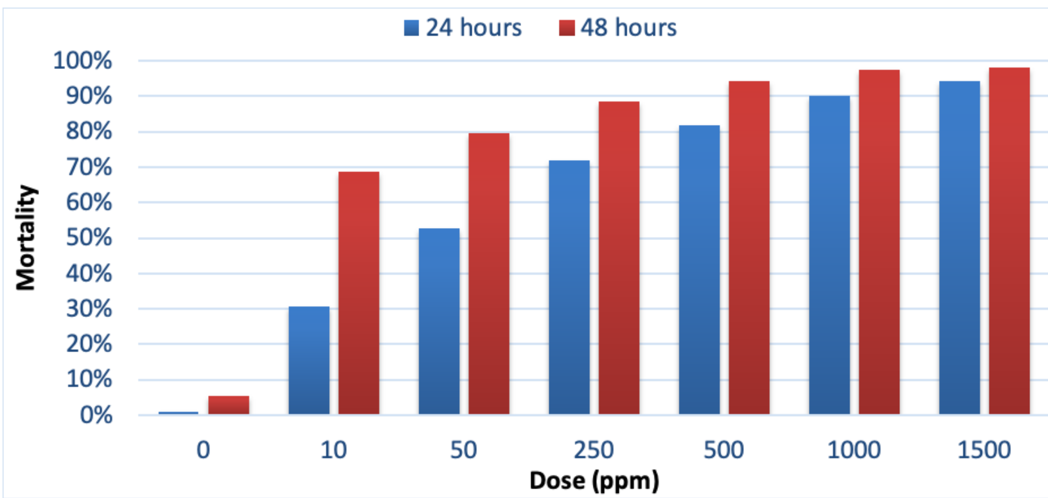

Fig. 4. Average percentage mortality of AW larvae in response to different concentrations of lambda-cyhalothrin at 24 and 48 hours after treatment in 2019.

Conclusion

Results showed variable responses by AW larvae from different locations to a range of concentrations of lambda-cyhalothrin. AW larvae from all locations showed mortality rates ranging from 88-100% for the higher two doses. The results showed 100% mortality at 500 ppm in the majority of locations. Weaker responses have been detected in the populations collected from northern California (Yreka and Tulelake) and Texas (Muleshoe) at the same dose. The results indicate that no resistance has developed for this insecticide in the tested low desert locations of Arizona and California. Further investigation is planned for the 2020 season, including testing a wider range of lower doses.

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Cooperative Extension

The University of Arizona
College of Agriculture and Life Sciences
Tucson, Arizona 85721

AUTHORS

Ayman Mostafa
Associate Programmatic Area Agent, ANR/Field Crops IPM, Regional Specialist, Entomology Dept.

Kyle G. Harrington
Assistant in Extension

CONTACT
Ayman Mostafa
ayman@cals.arizona.edu

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