USING DRONES TO CONTROL PESTS IN ALFALFA

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ABSTRACT

Integrating drones (unmanned aerial vehicles, UAV) as a new method of pesticide application into existing commercial crop protection systems requires extensive research and comparison to conventional, proven application technology. Spray performance, expressed as efficacy against target pests, spray quality expressed as coverage, and chemical residue are three key criteria for evaluating the new technology. We investigated and compared these quantitative parameters between a multi-rotor electric UAV, conventional piloted airplanes, and a ground sprayer rig in three commercial alfalfa fields in California in 2020-21. Effective and equivalent control of leaf-feeding insect pests was achieved with all three methods when delivering Prevathon® and Vantacor™ insect control (chlorantraniliprole) at the same active ingredient labeled use rate in different spray volumes (2, 5, and 10 gpa) on alfalfa (Vantacor registration expected in 2022). Residue levels and spray coverage were also comparable and consistent between the UAV and airplane applications across three sampling techniques as measured by residue levels on alfalfa foliage, insecticide recovery from filter paper sentinel targets, and spray coverage on water sensitive cards. Differences in droplet size and deposit characteristics were more variable for the UAV than airplanes based on analysis of deposition images. The results of this study provide confidence supporting the use of drones for pesticide application on agricultural crops. According to the parameters tested, UAV application quality and crop protection performance were comparable to that of the conventional fixed wing airplane and ground applications. However, the droplet spectrum and the short-term fate of droplets from unmanned aerial spray system may require further characterization and optimization for reliable crop protection.

Keywords: Drone, UAV, pesticides, insect pest control.

INTRODUCTION

Use of drones (UAV, unmanned aerial vehicle) for pesticide applications in agricultural crops is increasing commercialized and becoming a reality for farm production. Drone technology potentially provides an additional tool for growers to control pests on farms, supplementing traditional ground and aerial spraying practices. This could be especially helpful where there's a shortage of farm labor for applying pesticides or for small, tough to reach places that require spot treatments.

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Drone trials, 2020-21. We compared the performance of a small six-rotor UAV sprayer (PV35X, Leading Edge Associates) versus a traditional manned airplane and ground sprayer rig for applying insecticides for controlling armyworm and alfalfa caterpillars in alfalfa hay fields in the Sacramento Valley. These summer worm pests can be highly damaging to alfalfa as the larvae feed on the foliage, causing significant losses in yield and forage quality if left uncontrolled. We conducted trials in two alfalfa fields using Prevathon® insect control at 16 oz/ac and in a third field with Vantacor™ insect control at 1.38 fl oz/ac (= 0.054 lb/acre chlorantraniliprole, active ingredient for both insecticides), along with surfactants.

In our 2020 trials using Prevathon® insect control, fields A and B were divided into two sections each, with one area sprayed by conventional airplane, and the other by drone to compare the performance of each application method. The application volumes were 5 and 10 gallons per acre (gpa) for both drone and airplane. For the 2021 efficacy trial using Vantacor™ insect control, field site C was divided into three sections with one area sprayed by ground rig, and the other two areas by drone. The drone spraying was tested at two application volumes of 2 and 5 gpa, respectively, and the spray by the ground rig was at the application volume of 10 gpa. Note that 2 gpa is the minimum aerial labeled rate for aerial application of Vantacor™ insect control.

Spray cards (water sensitive paper) were positioned in the alfalfa canopy prior to spraying to assess spray coverage for both the drone and airplane applications. Plant samples were taken after the fields were sprayed to determine the residue concentrations of Prevathon® and Vantacor™ insect control on the alfalfa plants. We also took summer worm and natural enemy counts before and after spray treatments using a standard sweep net to compare the efficacy of the different spray application methods on summer worm control and secondary impacts on beneficial insects.

RESULTS AND DISCUSSION

The spray cards revealed that the drone and airplane insecticide application methods had equivalent spray coverage. The drone application had a bit more variability in terms of spray deposition uniformity than by airplane. This was not due to inherent qualities of the drone, but instead that the drone-based spray technology may require more optimization. Airplanes have been used for applying pesticides for decades and that technology is refined. Drones are new and there's a bit more work that needs to be done to fine tune them for optimum pest control in crops, such as exploring different nozzle types for maximum coverage. While more research is underway, our results show that effective drone applications can be made now with commercial equipment.

There were few differences in the residue concentrations of Prevathon® and Vantacor™ insect control on the alfalfa plants between the drone and airplane application methods for 2, 5 and 10 gpa spray volumes (Figure 1). Likewise, there were no significant differences in summer worm counts between the three treatment methods with drone, ground rig, and airplane applications significantly reducing summer worms compared to the untreated control at 2, 5 and 10 gpa spray volumes at 3-7 days after treatment, DAT (Figure 2). Prevathon® and Vantacor™ insect control conserved natural enemies in both application methods, with no visible impacts to predators (e.g. ladybird beetles) or parasitoid wasps that were found in a 50:50 ratio in fields (Figure 3).

CONCLUSION: FUTURE OF DRONES IN CALIFORNIA

Drones are a promising and viable option for aerial application of insecticides for pest control in alfalfa fields. Overall, summer worms were controlled equally well with Prevathon® and Vantacor™ using drone, ground sprayer rig, and manned airplane insecticide application methods. California now has a specific UAV ("unmanned") ag pilot license category which means that, for most commercial applications, the pilot of the drone is not required to have a commercial pilot certificate, only the FAA UAV certificate and the CA DPR license.

A current limitation for the use of drones for aerial spraying of crops is the 55-pound weight limit mandated by FAA regulations (Federal Aviation Administration) for the category of "small" UAV's. Some drone companies, such as Yamaha, have obtained certification for handling more than 55-pounds in the U.S. and many others are in the process. This will help to pave the way for more people to use drone technology on a larger scale in crop production. Additionally, an industry-wise UAV Task Force is being formed to coordinate the development of labels and standards.

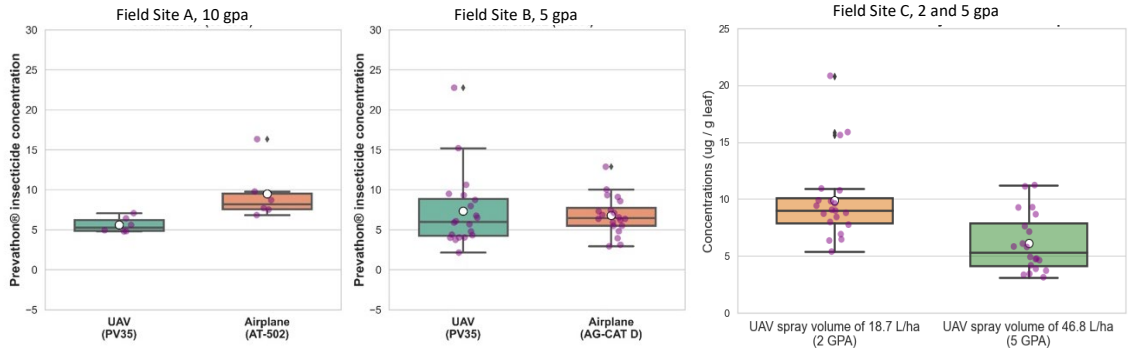

Figure 1. Prevathon® (Field A, B) and Vantacor™ (Field C) insect control insecticide residue concentrations on alfalfa plants showed equal coverage for drone and airplane application methods at 2, 5, and 10 gpa.

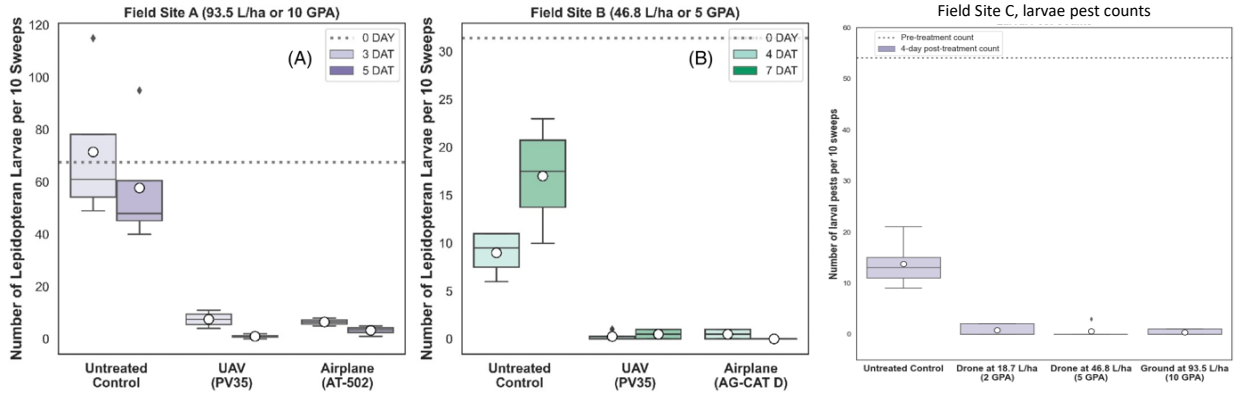

Figure 2. Prevathon® and Vantacor™ insect control showed excellent summer worm control by drone, ground, and airplane application methods at 2, 5 and 10 gpa, 5-7 DAT, compared to the untreated control, dashed line with pre-treatment counts 30-70 summer worms/10 sweeps.

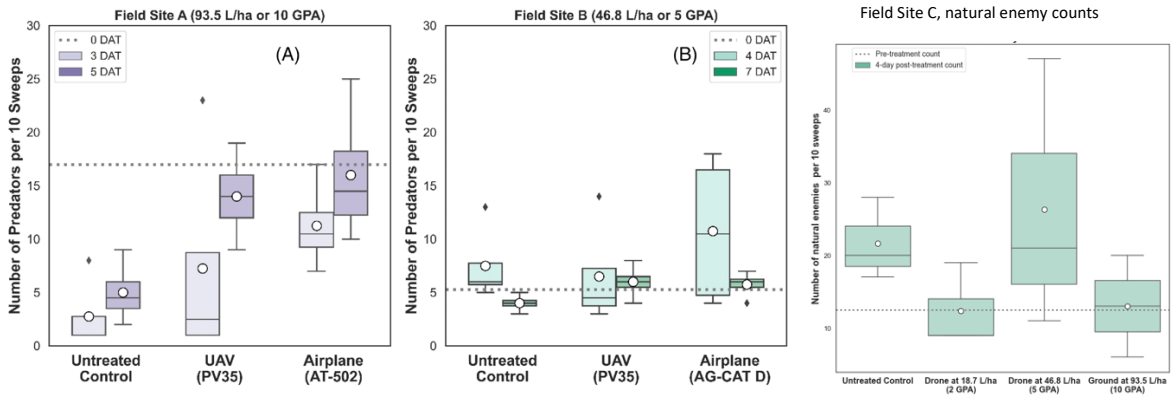

Figure 3. Prevathon® and Vantacor™ insect control showed no adverse impacts to natural enemies (predators and parasitoid wasps) for drone, ground, and airplane application methods at 2, 5, and 10 gpa, 3-7 DAT, compared to the untreated control, dashed line showing 5-20 natural enemies/10 sweeps.

Reference

Li X, DK Giles, JT Andaloro, R Long, EB Lang, LJ Watson I Qandah. 2021. Comparison of UAV and fixed-wing aerial application for alfalfa insect pest control: evaluating efficacy, residues, and spray quality Pest Management Science, 77:4980-4992.