Potential for Improved Spray Coverage and Reduced Drift Using Remotely-Piloted Aircraft (RPA) in Almonds

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Background

There is a continuing need in the almond industry for improved spray application technology that increases pesticide deposition while reducing spray drift and runoff. The size and canopy density of almond trees, coupled with the requirements for uniform and efficient deposition of pesticides, particularly when pest resistance is an issue, make the physical movement and successful deposition of pesticide sprays very challenging. Often the areas of poor spray deposition are in the tops of the trees, where ground-based, air blast sprayers have limited penetration. The traditional approach to address this problem has been to increase spray liquid volumes, increase the carrier air volume, modify the air blast flow characteristics or reduce ground speeds. These approaches, while somewhat successful, usually increase equipment, fuel and labor costs and can increase the time required for treatment. This approach can also result in over-application and wasted pesticide in lower areas of the trees. Aerial application is an alternative for some materials and pests but can be limited due to availability, cost, label prohibitions or urban interface issues.

Remotely-piloted aircraft, or RPA, are a new technology for agricultural use. While extensively used in military, defense and law enforcement, their use is now greatly expanding for inspection, sensing and imaging crops and tracking physical assets. In 2015, the Federal Aviation Administration (FAA) began to approve and license RPA for commercial use in the United States. Virtually all of the commercial approvals have been for imaging and sensing businesses, with the majority of those uses in agriculture, energy, telecommunications and entertainment industries. Aircraft for carrying small sensors aloft can be small and electrically powered and remain in the 1- 20 lb weight category.

Using RPA for payload delivery, such as pesticide spraying, is much less common. Since 2012, UC Davis ag engineers have been conducting research on pesticide applications from RPA. The UC Davis lab was the first group and still one of the very few to obtain FAA approval for spraying active ingredients from RPA and has received renewals and expansions of permits since then. Currently, RPA are much smaller than manned aircraft and therefore carry significantly less payload; however, designs in the RPA industry are underway to produce larger aircraft, with payloads approaching what can be carried by manned aircraft.

Outlook for Pest Control

Like manned aerial application, RPA spraying can provide advantages for pest control in almonds. Applications can be made when ground conditions prevent tractor-towed sprayers from entering the field. Applications can be made quickly and spray deposition can be focused in the hard-to-reach upper portions of the trees. However, there are also limitations to current RPA spraying in almond production. The small size of the aircraft and the limited payload mean that spray volumes (gallons per acre) will be limited, on the order of 5 – 10 gallons per acre, and frequent refilling of the spray tank will be required. Applications will be limited to materials that have aerial application labels.

Remotely Piloted Aircraft for Project

RPA Specifications

The RPA used for agricultural spraying in this project is the Yamaha RMAX™ helicopter shown above. This aircraft is the only aircraft currently approved by the FAA for agricultural crop spraying in the U.S. and has been used for over 2 million hours of flight for rice spraying in Asia. The aircraft weights 220 lbs, has a flight endurance of 1 hour and carries a payload of approximately 5 gallons. The aircraft is operated by a pilot, assisted by a visual observer who maintains radio communication with the operator and provides guidance for each pass of the RPA over the crop.

In 2016, commercial pest control operations with the RPA were approved by the US Federal Aviation Administration under Part 137 of the Federal Aviation Regulations and by California Department of Pesticide Regulation.

Research results from the UC Davis testing in vineyards for the past 3 seasons have found 5 - 10 gal/acre rates can be applied at work rates of 3 – 6 acres per hour with active ingredient spray deposition rates equivalent to those from ground-based sprays at 50 – 100 gal/acre. Disease control (powdery mildew) was maintained during the early season while later in the season, ground sprays were used to supplement RPA sprays in order to fully protect grape clusters.

System Testing

The RPA has been operated in limited test flights over almonds in Lost Hills, CA during late fall post harvest conditions. Test objectives were to determine the feasibility of operating the RPA over 25 – 30 foot tall trees. Deposition was observed by water sensitive paper. Work will continue, including measurement of spray deposition compared to ground-based sprayers, in the 2017 growing season.

Acknowledgements

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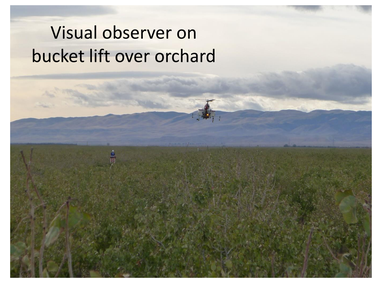
Field Testing



Preliminary Results

Preliminary results have indicated:

1. The RPA can be successfully deployed in almond orchards and used to spray mature trees;
2. Deposition, consistent with aerial application spray deposit, can be detected throughout the sprayed trees;
3. The requirement for the RPA operator and the visual observer to maintain visual contact with the RPA during all operations is a significant limitation to the technology and requires significant ground support, i.e., two or more bucket lifts in the orchard that must be repositioned as spraying progresses;
4. Initial RPA spraying in the almond industry may be best suited for young orchards due to the smaller target size;
5. RPA application of bio-control materials (lower volumes, fewer registration issues) may be a valuable use of the technology;
6. Future developments and regulatory approval of autonomous and auto-guided RPA spray flights will significantly improve commercial feasibility for almond spraying.