Improving Spray Deposition in Upper Canopies of Almond Trees

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Background and Problem

Spray deposition in the upper regions of almond trees is often difficult to obtain when spraying mature or dense canopied orchards. Typical air blast or "speed" sprayers are designed with a single large axial flow fan that is positioned near ground level and often with its center line directly aligned with the towing tractor's PTO shaft. While the low profile allows sprayers to easily transit the orchard, the release of all spray droplets and the air carrier in the lowest regions of the trees results in non-uniform spray deposition in the trees. As found in earlier ABC-funded field tests of spray efficiency, the lower regions have greater pesticide deposit and pest control while the upper regions have less deposit and can suffer greater pest damage.

Potential Solutions

Without changes to spray equipment, the only potential solutions to improving upper tree deposit and pest control have been:

-To increase the spray application rate, which does not necessarily improve the uniformity of deposition but instead only increases the overspraying of the lower tree parts and may increase ground deposit.

- To reduce the ground speed while keeping the spray application rate the same, this allows the air jet to increase the penetration into the tree canopy and carry more of the spray droplets into the upper regions of the tree. However, this reduces the productivity, i.e., the "acres per day", of the spraying.

Objective of this Work

The approach taken in this project was to modify an existing, typical orchard sprayer with the specific goal of increasing upper canopy spray deposit. The approach was to add air and liquid sources at the top of the canopy. This was accomplished by adding a single mast to the rear of the sprayer and on the mast, mounting hydraulically-powered axial flow fans with spray nozzles. The entire system was designed for ease of use in existing orchard settings.

The Design

Design Specifications

A conventional axial flow orchard sprayer (Oma TR1500) was modified by adding two hydraulically-powered axial flow fans (Vinetech,Inc., Pasco, WA, the distributor for SARDI of Australia).

The fans were driven by the tractor remote hydraulic system.

Each fan had standard disc-core spray nozzles installed radially around the outside the fan housing.

The existing spray plumbing system on the sprayer was retained for the conventional fan nozzles, a parallel plumbing system was added for the upper fans. The pressure could be controlled individually.

The supporting mast for the fans could be lowered by rotation on a mounting shaft at the rear of the sprayer. This rotation was done by a hydraulic cylinder, powered by the tractor hydraulic system.

Analysis

(i). Sprayer configurations:

All sprays were applied at 100 gal/acre total treatment.

Treatment 1: 100 gal/acre – lower (conventional) fan and nozzles only

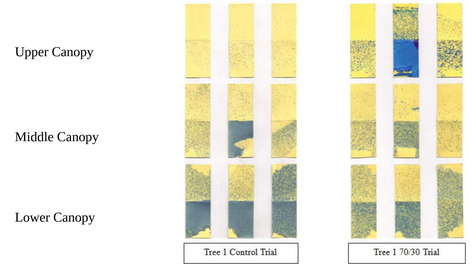
Treatment 2: 100 gal/acre – lower nozzles only, upper and lower fan

Treatment 3: 100 gal/acre – 50 gal/acre lower, 50 gal/acre upper

Treatment 4: 100 gal/acre – 70 gal/acre upper, 30 gal/acre lower

(ii). Water Sensitive Paper:

Water sensitive papers were placed in lower, middle and upper regions of the trees. Visual results indicated that uniformity was improved the most with the 70 upper / 30 lower configuration.



(iii). Spray liquid tracer:

Elemental tracers (Co, Mn, Mo, Cu) were added to each spray treatment and samples leaves removed from trees and analyzed for each tracer element. Results found the upper tree deposition to be improved by the 70/30 spray (compared to the conventional) by 2.7 to 3.5 times and the lower tree deposition to be reduced by only 40 to 50%. Uniformity was therefore increased by the modified sprayer.

(iv). Naval Orange Worm control:

Naval Orange Worm control was evaluated using standard methods by Dr. Joel Siegel at USDA ARS. Use of the 70/30 spray set up was found to result in statistically significant better pest control in the top areas of trees (12.4 % survival vs. 22 %) than the standard spray configuration but overall, control was lower than desired.