Do Spray Volume & Adjuvants Affect Insecticide Residues Depositing on Apples

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1 Introduction

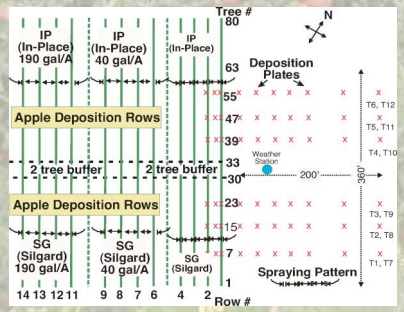
Agricultural production can be limited by scarce resources (e.g., water and fuel) as well as societal concerns about worker exposure to pesticides and environmental contamination. Tree fruit growers spray pesticides to protect their crops from insects and diseases. They typically spray ≥100 gal/acre. Spray tanks generally hold from 300-1000 gallons, limiting the acreage that can be treated with one full tank. The more times that applicators fill the spray tank, then the greater will be their pesticide exposure as well as use of fuel and water. If orchard sprayers could deposit residues on apples effectively at lower spray volumes per acre, water and fuel use would be less and workers would be exposed to less concentrated pesticide product. However, farmers need to know if volume of the spray and use of adjuvants affects deposition of pesticide residues on the apples.

Objectives

- Determine if the volume of insecticide spray applied per acre affects residue deposition on apples.
- Determine if the residues of the insecticide are affected by the type of adjuvant used at low and high volumes of spray.

2 Experimental Design

1. The study was conducted on a 5-acre block of 'Gala' apples at a commercial orchard located east of Prosser, WA.
2. Experimental Treatments:
   - Pak-Blast axial fan sprayer; Phosmet @ 3.5 lb AI/acre with In-Place or Sylgard adjuvant; 40 gal/acre (alternative practice) or 190 gal/acre (conventional practice)
3. The treatments were overlaid on the first fourteen rows of the 5-acre orchard block utilizing the first 60 trees of each row. Each treatment covered 30 trees in each of 4 rows.
4. The Pak-Blast sprayer had four separate tanks allowing both the Sylgard and In-Place treatments to be sequentially applied to treatments in the block.



3 Sampling

1. Apples were collected from 10 individual trees of each treatment within several hours after application resulting in 10 independent samples per treatment.
2. Random samples were chosen by assigning a sequential number to each tree in the 2nd and 3rd row of each treatment plot and then choosing the trees using the 'Sampling' statistical tool in the program Microsoft Excel.
3. Independent samples were collected from the middle (chest to extended arm length) and top of the canopy (higher than ~2 ft above extended arm length) of each tree.
4. Permissible trees for collection were from the canopy facing the aisle of rows 7/8 and rows 12/13 of the orchard block.

4 Apple Processing

1. Each bag of each set of apples were removed from the freezer and were weighed individually as well as measured across two perpendicular diameters.
2. Each apple was then cut into eighths and then ground in a RoboCoupe food processor with dry ice and refrozen until analyzed.

Measuring and Processing Apples

Preparing Apples for Weighing

Weighing Apples

Recording Apple Weight

5 Analytical Methods

1. 10 ± 0.3 g of ground apple from each bag was weighed into a Falcon (50 mL) centrifuge tube and 10 mL of acetonitrile (acidified with 1% acetic acid) was added and the tubes shaken. Then reagents of 4 ± 0.1 g $MgSO_4$ and 1 ± 0.05 g of NaCl were added, the tubes shaken by hand vigorously, and then shaken on a mechanical reciprocal shaker for 5 min.
2. The Falcon tubes were then centrifuged for ~5 min. A 5-mL aliquot from the Falcon tubes was then transferred to Nunc tubes (15mL). Then reagents of 125 ± 5 mg PSA sorbent and 300 ± 25 mg of $MgSO_4$ were added, and the extracts were vortexed for ~30 sec.
3. The extracts were then centrifuged for ~1 min and the supernatant poured into glass tubes. The volume was recorded and the extract was then evaporated in a Turbovap @ 60° C under nitrogen @ 0.7 bar. Five mL of ethyl acetate was added as the final volume and then extracts were transferred into vials. Quantification was by gas chromatography (GC) with a PFPD (Pulsed Flame Photometric Detector)(15 m x 530 µm id EC1 column).

Shaking Samples After Acetonitrile Was Added

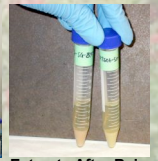
Adding Reagents

Centrifuging The Samples

Samples After Being Centrifuged

Transferring 5mL Aliquot To Nunc Tubes (15mL)

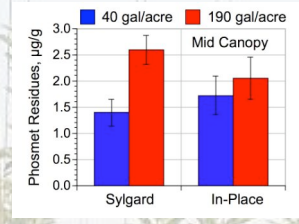
Vortexing 5-mL Aliquot Samples After Second Reagent was Added

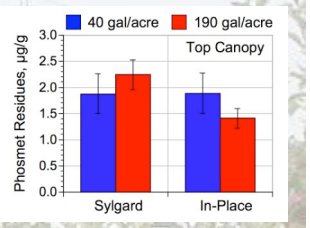


Extracts After Being Centrifuged The Second Time

Placing Vials On The GC

6 Results





1. The average phosmet residue on apples (as µg/g) and 95 % confidence interval were calculated and graphed for each treatment.
2. Deposition of phosmet on apples from the top of the canopy was not significantly influenced by spray volume nor addition of an adjuvant (see Top Canopy graph).
3. Deposition of phosmet on apples from the middle of the canopy was not significantly influenced by spray volume when In-Place was used as an adjuvant (see Mid Canopy graph).
4. However, when Sylgard was used as the adjuvant, phosmet residues on apples from the low volume spray treatment were significantly lower than residues on apples in the high volume treatment (Mid Canopy graph).
5. In general, little difference was observed in residues on apples collected from the top and mid canopy of the trees.

7 Conclusions

Except for the Sylgard treatment in the mid canopy location, spray volume seemed to not affect deposition of phosmet residues on apples. Furthermore, residues deposited on apples in the top of the canopy were not significantly different from those deposited in the middle of the canopy, even at the low spray volume. Thus, farmers can save resources by applying orchard insecticides in less water using their conventional airblast sprayers. Also, different adjuvants generally should not affect residue deposition sufficiently to affect insect control. The use of less water will require less fuel to control pests and result in less overall pesticide applicator exposure because of a reduction in the frequency that a tank must be refilled to spray a whole orchard.

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