**Final Report**
**WTFRC Project# CCAB**

**Project Title:** Use of Surfactants to Remove Surface Pests

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**Objectives**:
The overall objective of this program is to determine the removal and lethal effects of food grade silicone-based materials on surface pests of sweet cherries that are suitable for commercial packing lines. Efficacious parameters to be determined are:

1. **Identification of best material**. Specific formulations of emulsions and defoamers that best remove or kill will be determined for a range of surface arthropods.

2. **Exposure duration**. Time-efficacy curves will be calculated to determine the most efficacious dip duration.

3. **Physical methods.** A shower will be used to dispense the best surfactant and compared to efficacy of submersions of the same material. In other tests, the bath material will be circulated within dip bins.

4. **Surface arthropods examined.**
    a. Grape mealybug, *Pseudococus maritimus* (Ehrhorn) (Homoptera: Pseudoccidae).
    b. Obliquebanded leafroller (OBLR), *Choristoneura rosaceana* (Harris) (Lepidoptera: Tortricidae).
    c. Western flower thrips, *Frankliniella occidentalis* (Pergande) (Thysanoptera: Thripidae).
    d. Twospotted spider mite, *Teranychus urticae* Koch (Acari: Tetraychidae).
    e. Tydeid mites, spp. (Acari: Tydeidae).

**Significant findings:**
- The waxy coverings of grape mealybugs and the silk shelters of OBLR larvae dissolved more thoroughly with increased concentrations of sodium hypochlorite (bleach) (Fig. 1 and 2).
- The waxy coverings of mealybugs also dissolved more with increased exposure to bleach (Fig. 1).
- Water baths with bleach, followed by water showers effectively removed OBLR larvae (Fig. 3).
- Tydeid mites were difficult to expunge, but showers aided in their removal (Fig. 4).
- Water and water with surfactant were efficacious in removing two-spotted spider mites (Fig. 5).
- The "360" formulation of the silicone emulsion surfactant was more effective in removing western flower thrips than the "335" formulation (Fig. 6).

**Methods**:

**Experimental Design.** Test materials were examined as dips. Efficacy was determined by submerging specific arthropods for predetermined durations. No dips were longer than 5 minutes. Applicable life stages of selected surface arthropods were examined. A spider mite colony and an OBLR colony at YARL were used as sources for the test subjects, and tydeid mites were field collected on grape leaves. Mealybugs from an established colony at YARL represented generic surface insects. To test efficacy, a known number of arthropods (live and dead) were placed on cherry fruits, then recounted (live and dead) after treatment.

Specific objectives were obtained by the following procedures.

1. **Identification of best material**. Food grade silicone-based surfactants were examined at different concentrations. Physical properties of the materials, such as foaminess and residue formation, were noted.

2. **Exposure duration**. Dip efficacy was tested at 2, 3, and 5 min. Longer durations would not be practical for the packing line.

3. **Physical methods.** A shower system, previously built to test hot water systems, was used to wash surface arthropods with ambient water. A pump system was used to test circulating baths within dip baths.

**Results and discussion:**

The two surfactants that were examined are food grade polydimethyl silicone emulsions. The "360" formulation has 60% active ingredients (ai) whereas the "335" has 35% ai. Both chemicals are rated for indirect food contact at the recommended 1% formulation rate and both materials were shown not to cause fruit damage to cherries in recent tests conducted at UC-Davis.

Mealybugs are covered with a waxy protective material and OBLR larvae reside within protective silk shelters (Fig. 1 and 2). Both the wax and the silk can be dissolved by using bleach at concentrations that do not damage cherry fruits. The OBLR has become a phytosanitation problem in California exports when the silk shelters become attached to cherry fruits. Elimination of the silk will aid in larval removal. Further studies will examine the use of showers to wash away bare OBLR larvae.

The OBLR larvae used in the shower tests were more active than the ones used in the bleach bath tests above and inclined to move off the fruits. However, the water showers effectively removed those remaining when used after a bleach bath (Fig. 3). In this test, the showers were the same duration as the preceding baths. This procedure shows promise and additional refinements are needed to make the methods compatible with commercial operations.

The tydeid mites were the most difficult to remove (Fig. 4). They are very small and hide in tight places. Unlike the other arthropods we examined, these mites were treated on grape leaves, their natural host. This was necessary because of the numbers needed to conduct tests and these mites are uncommon in cherry fruits from the Pacific Northwest. The surfactant baths alone were not sufficient for their removal. The showers increased the efficiency in removal, but addition experimentation is needed to develop procedures that can be used on cherry fruits.

Spider mites have also been a phytosanitation problem for exported cherries. Our studies indicate that water alone will remove a third of the pretreatment population, but the rate of removal is increased with a surfactant (Fig. 5). The two formulations we examined worked equally well, with a slight edge going to 360 EFG.

The 360 EFG surfactant was significantly effective in removing western flower thrips when exposed to 3 min or less (Fig. 6). Thrips are sometimes a phytosanitation problem, but not as severe as mites or OBLR. The numbers were examined were from natural infestations and were lower than the artificial infestations of the other arthropods. Yet, our study indicates that methods for OBLR removal are compatible to thrips elimination.

Water baths, particularly those with bleach, were effective in removing protective waxes and silks of the surface pests. Incorporating a shower also increased removal efficacy. Additional studies will be conducted to improve these removal techniques and to test a combination surfactant with bleach. Further research will be conducted using immature apples to represent cherry fruits during the winter months.

**Budget:**

**Project title:** Use of Silicone-based Materials to Eliminate Surface Pests
**PI:** James D. Hansen
**Project duration:** 2005
**Current year:** 2005
**Project total ( 1 year):** $8,700
**Current year request:** $8,700

| Item | Year 1 (2005) |
|---|---|
| Wages[1] | 7665 |
| Benefits | 767 |
| Supplies[2] | 268 |
| Total | 8,700 |

[1] GS-5, with 10% benefits, for 10 weeks .
2 Supplies: Maintenance of arthropod colonies; routine laboratory equipment (towels, holding containers, vials, etc.); purchase of fruits.

**YARL Contribution:**

1. Materials and equipment
   a. holding cages and environmental rooms for test arthropods
   b. chemicals to be evaluated
   c. test facilities
   d. shower unit and circulating dip baths
   e. temperature probes and data acquisition
2. Transportation for obtaining fruits
3. Labor: GS-8 lead technician to supervise activities

**Acknowledgements:**

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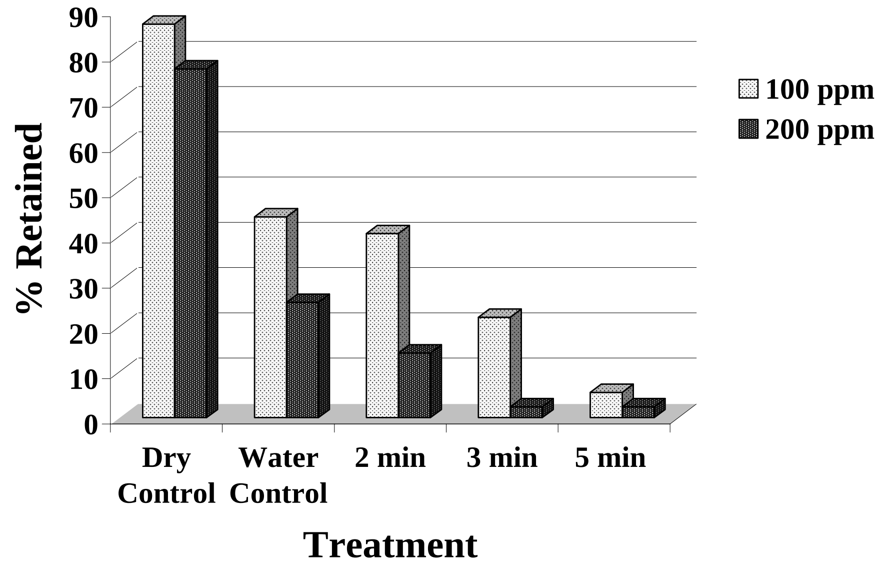


Fig. 1. Retention of grape mealybugs exposed to two bleach concentrations for three time periods.

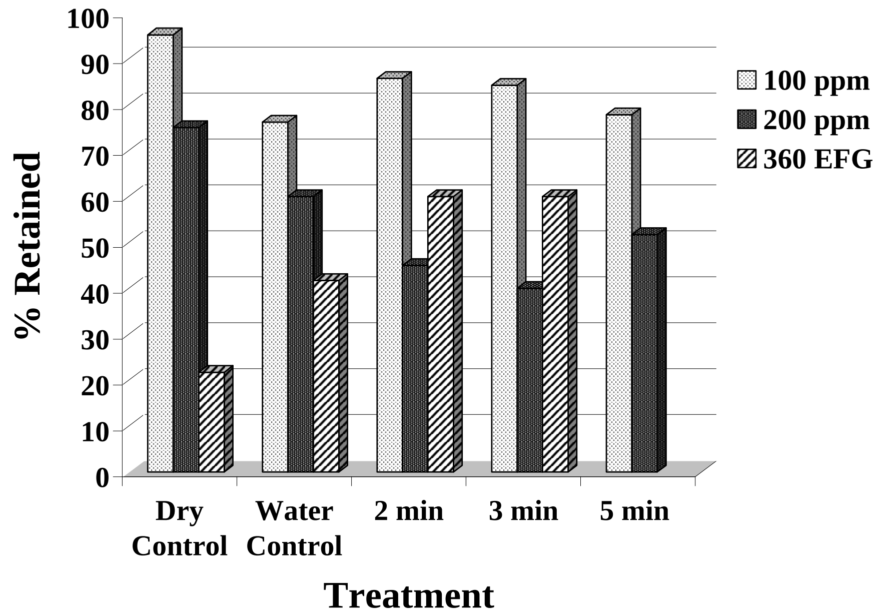


Fig. 2. Retention of OBLR larvae exposed to different bleach concentrations or 1% 360 EFG surfactant for three time periods.

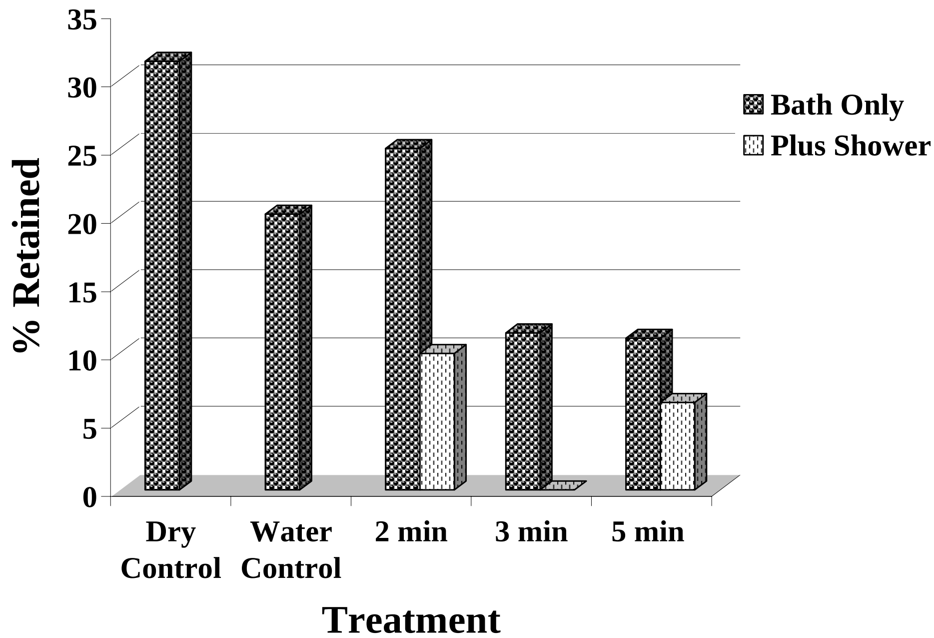


Fig. 3. Retention of OBLR larvae exposed to 100 ppm bleach concentrations in baths for three time periods, with some followed by water showers at the same durations as their respective baths.

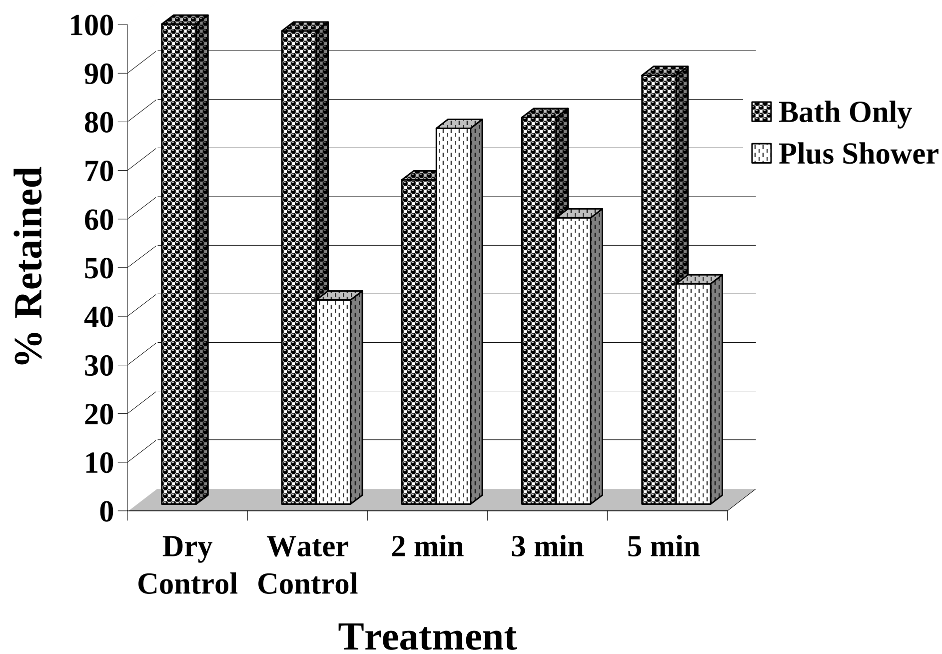


Fig. 4. Retention of tydeid mites exposed to 1% 360 EFG surfactant in baths for three time periods, with some followed by water showers at the same durations as their respective baths.

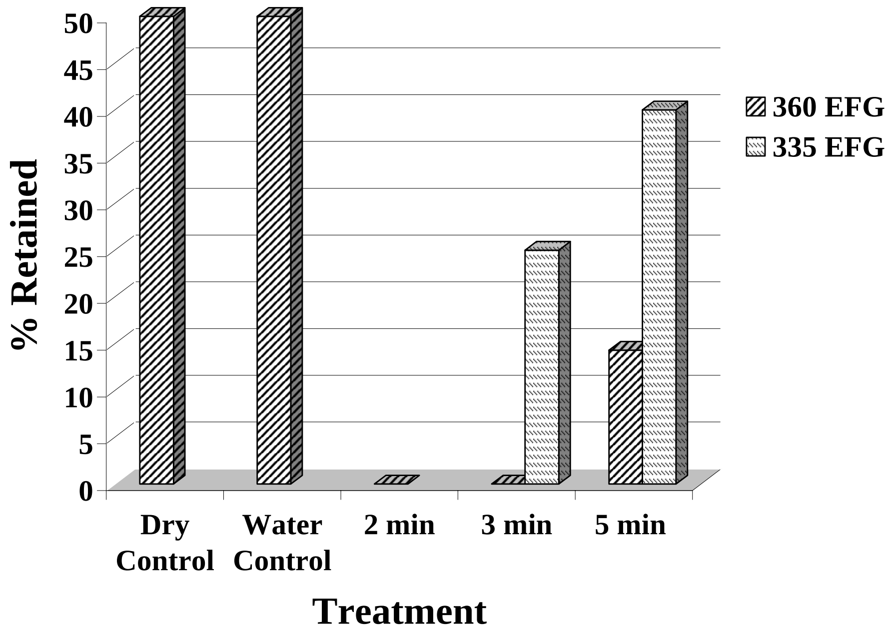


Fig. 5. Retention of western flower thrips exposed to three time periods of two surfactant formulations.

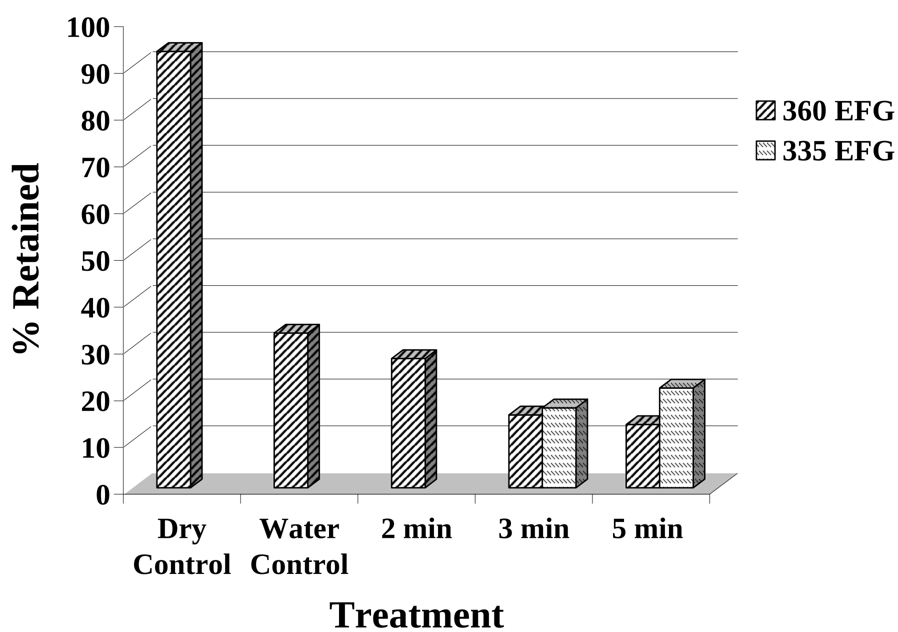


Fig. 6. Retention of twospotted spider mites exposed to three time periods of two surfactant formulations.