



**ORGANIC
FARMING
RESEARCH
FOUNDATION**

P.O. Box 440
Santa Cruz, CA 95061

tel ~ (831) 426-6606
fax ~ (831) 426-6670

email ~ research@ofrf.org
web ~ www.ofrf.org

Project report submitted to the Organic Farming Research Foundation:

Project Title:

The impact of dust deposits on insectary-reared and released parasites in transitional and organic citrus orchards using perennial vs. annual tilled cover crops

FINAL PROJECT REPORT

Principal investigator:

Phil Phillips, PhD
UC Cooperative Extension
669 County Square Drive
Ventura, CA 95003

Cooperating growers:

John Wise, Sespe Creek Ranch (organic), Ventura County, CA
Monte Carpenter, McCreary Ranch (in transition to organic), Ventura County, CA

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SUMMARY

As a critical component to the sustainability of both transitioning and organic citrus orchards it is important to understand the impact of foliar dust deposits on the survival of insectary reared *Aphytis melinus* and *Metaphycus helvolus* used respectively for the biological control of California red scale and black scale. The effects of both ambient dust and dust generated by orchard operations such as harvesting, weed control or tillage of annual cover crops need to be determined to assist both organic citrus growers and conventional citrus growers in their conversion to sustainable or organic orchard systems. Viability of these two key parasite species (*Aphytis* and *Metaphycus*) was measured after exposure to foliage grown under a variety of orchard conditions generating varying levels of foliar dust deposits in both organic and in transitioning conventional orchards.

METHODS

Two lemon orchards, one organic with a perennial cover crop (Sespe Creek) and the other a transitioning, clean cultivated, conventional orchard (McCreary) were chosen within the citrus district of Fillmore. Biweekly foliage samples were collected from predetermined trees at varying intervals into the citrus orchards from surrounding roads and from internal "box" or "pick" rows as a transect through the citrus orchards. Every two weeks (alternating weekly between the two orchards), 1600 freshly collected, insectary-reared *Aphytis melinus* and 800 *Metaphycus helvolus* were exposed to both unwashed and washed (with distilled water) foliage sampled from the test trees. This occurred inside ventilated test chambers provided with a honey food source. Forty sets of twenty parasites each (only ten *Metaphycus*) were placed into separate chambers for each species tested. Mortality and longevity for each set of test parasites were recorded at 24 and 48 hours of exposure. This process was started in April after the last major rain event and continued through November so as to bracket all periods of wind generated dust deposits after cleansing winter rains as well as all dust producing cultural practices such as harvesting and pruning. Dust levels in each orchard were quantified using a 0.1 mg balance to weigh the dust which was washed and filtered from half of each week's foliage samples.

RESULTS

During 1996, dust levels within the test orchards were never considered high, but in fact appeared quite low during general observations walking through the orchards. Measured levels during the season never exceeded 0.15 mg per cm² leaf surface area. Dust levels for November were significantly reduced by a 3 inch rain storm November 1st. Dust deposits accumulated from all samples totaled 0.56 mg (organic, ground cover) and 0.32 mg (conventional, transitioning) per cm² leaf area respectively. There is no clear explanation for why the seasonal dust accumulation was greatest in the perennial cover orchard with the exception that it was bordered by dirt roads and was more directly in line and down canyon from a dry wash and a rock quarry. Although the dust levels never appeared to be very high, parasite mortality levels in the bioassays were lower than expected, never going beyond 15 to 17 percent. *Aphytis* mortality after 24 hours exposure to unwashed foliage from the dustier organic orchard averaged about 6% while it averaged 4.2% in the

conventional orchard. Even though mortality levels appear to be fairly low, one important finding was that with increasing dust levels over the season there was a corresponding increase in *Aphytis* mortality. Similarly, while there was an increase of 0.6% mortality from washed to unwashed foliage in the conventional orchard, there was an even greater increase of 1.9% for the dustier organic orchard for the 24 hour exposure tests. For the 48 hour exposure tests, dusty foliage increased mortality an average of 1.3% in the conventional orchard and 1.7% in the dustier organic orchard. Similar responses were found with *Metaphycus helvolus* except that overall mortality was only about half that of *Aphytis*.

In summary, although dust levels were not very high during the season and the differences between orchard types appeared to be more related to location than differences in cultural techniques, it is clear that dust contaminated foliage contributes to parasite mortality. It is also clear that *Aphytis melinus* is about twice as sensitive to dust caused mortality as *Metaphycus helvolus*. Considering that even very slight downward adjustments in parasite effectiveness through either disruption or mortality can have profound effects in the parasite's ability to successfully regulate its host, the increased mortality resulting from exposure to dusty foliage in this trial indicates that orchard dust control is even more critical to successful orchard biological control programs that was previously thought.