

Progress Report: August 18, 2013

Total funds approved: \$62,000

Project contract number: CAC 65101

Project Title: Survey for armored scales and their natural enemies on California avocados

Project start date: November 1, 2011

Project end date: August 31, 2013 (Following two no cost extensions)

Project leader: Joseph Morse and Richard Stouthamer

Position titles: Professor of Entomology

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Project Update and Summary of Results (200 word limit):

Armored scales present on California avocados are under excellent biological control and rarely build to economic levels. This study is the first to determine which species of parasitoids attack these scales and the results are somewhat different than what we expected. The dominant parasitoids in California are 5 species of unidentified and poorly studied *Signiphora* wasps. These account in aggregate for ca. 68% of all collected parasitoids. Fortunately, the world's authority on signiphorid wasps, Dr. John Woolley (Texas A&M), has collaborated on this project and helped us identify these species.

Our survey for armored scales in California has so far failed to find that any of the exotic species of Mexican scales have established in California. If such a population establishes, it is difficult to know how quickly it will be detected.

A detailed study has been completed, comparing how well *Aphytis melinus* attacks *Acutaspis albopicta* (one of the major armored scales entering CA on MX avocados) in comparison to California red scale. This wasp is produced in insectaries in CA and is sold to citrus growers at a cost of ca. \$0.90 per thousand wasps. Manuscripts are being prepared reporting on results of both milestones of this project.

Progress to date (500 word limit):

Dr. Rebeccah Waterworth has completed the project testing how well the commercially available *Aphytis melinus* parasitoid will attack the exotic *Acutaspis albopicta* vs. a known preferred host, i.e. California red scale. Note that because this project will not be continued beyond current funding, we feel it is important to bring it to a strong and logical conclusion. Thus, we decided to expand what was done so that a scientific publication could be produced. Rebeccah has provided an initial draft of this manuscript and plans to complete a second and more complete draft by the end of August 2013. We are committed to getting this work published and don't anticipate any problem doing so.

We have terminated the field survey for armored scales and parasitoids in California. We feel we have an excellent data set and we are now preparing a second manuscript for publication, which lists in detail what we have found in comparison to previous data on Mexican parasitoids (the Mexican survey finished 10-31-11).

Four different taxonomic experts have helped us by identifying adult parasitoids that were slide mounted by Dr. Vladimir Berezovskiy. Results have been excellent matching genetic signatures to identifications

made by taxonomic experts. In no case are genetic results in conflict and in several cases, genetic signatures have identified cryptic species that taxonomic experts cannot tell apart – this is a common theme in genetic work of this nature over the past several years (e.g., Rugman-Jones et al. 2010). As with the *Aphytis* manuscript, we anticipate no problem in getting the parasitoid work published.

Project work plan:

Year 1 Milestones	Activities	Est. Date Complete (month/year)	Progress %	Budget
1	- Test <i>Aphytis melinus</i> against <i>Acutaspis albopicta</i> in UCR’s Quarantine facility using California red scale as a standard - Summarize and analyze all past data gathered on parasitoids present on Mexican versus California armored scales	Original estimate 04/2012; Revised 08/2013	100%	\$31,000
2	- Complete the survey to determine which armored scales are present in California avocado groves - Complete the survey of parasitoids of armored scale insects present in California avocado groves - Complete the survey of natural enemies captured with oleander scale versus latania scale out-plants	Original estimate 10/2012; Revised 08/2012	100%	\$31,000
Year Total				\$62,000

Variation from milestones:

Given that funding for this research will not continue, we have made adjustments so that we can bring things to a logical and fruitful conclusion. We feel it is important to head both major efforts of this project (Milestones 1 and 2) towards a publication (one for each milestone) that will provide a summary of what has been accomplished as a baseline for any future research in this area.

At some point, exotic armored scales (likely of Mexican origin but some of the same species and others are present in other countries exporting to the U.S.) will appear in California. One of the more dangerous species is *Acutaspis albopicta* because of its very broad plant host range. Not only is this species common on Mexican fruit but it is also the only armored scale that APHIS included in their risk assessment for Peruvian avocados. The manuscript on *Aphytis* will address how well that parasitoid is likely to attack this armored scale. Similarly, the manuscript dealing with armored scales and parasitoids already present on CA avocados will be important when new armored scale species are detected on CA avocados.

Reference Cited:

Rugman-Jones, P.F., M.S. Hoddle, and R. Stouthamer. 2010. Nuclear-mitochondrial barcoding exposes the global pest western flower thrips (Thysanoptera: Thripidae) as two sympatric cryptic species in its native California. *J. Econ. Entomol.* 103(3): 877-886.