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Avocado Thrips Subproject 3: Pesticide Screening, Sabadilla Resistance Monitoring, and *Goetheana incerta* Studies

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Benefit to the Industry

We hope to develop solutions to the avocado thrips problem as quickly as possible. Substantial research has and is being done on biological and chemical control of citrus thrips, *Scirtothrips citri,* which may be applicable to avocado thrips. Morse will coordinate communication between the citrus thrips and avocado thrips projects and much of the preliminary research on chemical control will be funded jointly, thus providing a savings to both projects. Promising new chemicals will be evaluated in laboratory and greenhouse trials and the most promising of these will be evaluated in field trials. Much of the initial emphasis will be on sabadilla and oil since other effective materials which may be used on avocados have not been identified and registration of new materials may take 2-4 years. If sabadilla is used several times a year, development of avocado thrips resistance is a serious concern based on the history of resistance development in other *Scirtothrips* spp. — we will develop means of monitoring for sabadilla resistance and to determine if and when it occurs. We strongly suspect that *Goetheana incerta will* attack avocado thrips. If so, how effective it might be in reducing economic populations remains to be determined.

Objectives

1 Grow avocado plants to be used in an avocado thrips colony which will be needed for basic biology studies and pesticide screening trials.

1 Do preliminary laboratory pesticide screening against avocado thrips. Prioritize materials to be evaluated in field trials. Work on addition of sun screens to sabadilla, evaluate addition of molasses vs. sugar, evaluate various means of making sabadilla more effective in the field.

2 Develop a method for monitoring avocado thrips populations for sabadilla resistance and obtain baseline resistance levels at several field sites before sabadilla is used extensively.

1 Import *Goetheana incerta* from South Africa, clear it through quarantine,

develop a laboratory colony, release it in the field, verify establishment, and evaluate impact.

Summary

Funding was received (via the Hansen Trust) and this subproject officially began work in August, 1997.

Avocado Thrips Colony. Despite considerable effort by Hoddle's project and ours, development of a laboratory avocado thrips colony has proven problematic. This has greatly slowed our ability to make progress on basic biology studies and preliminary screening of pesticides.

Our initial method of laboratory rearing of avocado thrips was modeled after that used for many years in rearing citrus thrips. Small avocado seedlings of several varieties were grown free of insect and mite contamination and as healthy new flush growth was present which was deemed to be attractive to avocado thrips, plants were moved into a glasshouse colony on a weekly basis. Avocado thrips were introduced from field collected material on a regular schedule. After observing low turnover in avocado thrips numbers, we attempted a number of modifications to the basic rearing method but were unable to develop a productive glasshouse colony.

Recent developmental studies run by Hoddle (see subproject 1) at various temperatures have indicated that avocado thrips may be quite sensitive to moderately high temperatures (e.g., above 85° F). In retrospect, this is consistent with field observations during August at the Irvine Ranch where despite the presence of substantial amounts of new flush growth suitable for thrips feeding and reproduction, thrips numbers were very low. Avocado thrips may be a species better adapted to winter and early spring in California.

We have now obtained use of a controlled environment walk-in chamber equipped with high intensity lights suitable fa-plant growth, have set the temperature to fluctuate between 78 and 82° F, and will see if this cooler environment will allow us to rear avocado thrips successfully. Availability of a healthy colony (e.g., the citrus thrips colony can yield 600 or more adults per week) would greatly facilitate many aspects of our laboratory research.

Preliminary Pesticide Screening. Because a high-yielding laboratory colony of avocado thrips is unavailable, all pesticide screening to date has been done in the field by collecting adult female avocado thrips and exposing them to pesticide treated leaves. We have confirmed that our standard citrus thrips pesticide bioassay method works well for avocado thrips with the exception that modifications to the basic procedure (dipping of young leaves in pesticide solutions for 5 seconds) were needed with abamectin and sabadilla (addition of oil and sugar, respectively resulted in excessive mortality from these additives alone; use of a leaf spray appears to work well, however) in order to reduce control mortality to acceptable levels (the oil was toxic to the thrips and they became stuck in the sugar at the concentrations remaining after dipping).

We have been conducting field pesticide efficacy trials with citrus thrips since 1982 (see e.g., Khan & Morse 1997) and have built up an extensive data base regarding alternative

methods of pesticide application, the effectiveness of different treatments, use of additives (like oil to abamectin or sugar to sabadilla), etc. Field efficacy trials will be run as quickly as possible with avocado thrips but until results from such trials are available, bioassays comparing avocado thrips against citrus may provide useful data.

We have prioritized our bioassays as follows:

1 Develop and validate the avocado thrips bioassay method adapted from the citrus thrips method.
2 Conduct bioassays with new chemicals identified in citrus thrips trials to have strong potential for control of avocado thrips while still being relatively selective -- especially chlorfenapyr and spinosad.
3 Conduct bioassays with abamectin and sabadilla.
4 Conduct bioassays with cyflutnrin or any other materials showing promise in control of avocado thrips.

To date, we have run 9 bioassays and are mid-way through priority 2. A bioassay with chlorfenapyr at a commercial avocado grove in Ventura County resulted in an LC50 (lethal concentration necessary to kill 50% of the avocado thrips females; this is a standard way of expressing how toxic the material is) of 0.656 mg ai / liter, hi contrast, Khan & Morse (1998) evaluated the chlorfenapyr tolerance of 7 field populations of citrus thrips previously unexposed to chlorfenapyr and found LC50s which varied from 0.130 - 0.487 mg ai / liter with a mean value of 0.272. Thus, avocado thrips appears to be slightly less susceptible to chlorfenapyr compared with citrus thrips but their levels of susceptibility are similar. We would like to replicate this bioassay at several more sites but if this result holds up, we will suggest that Cyanamid pursue registration of chlorfenapyr on avocados based on the strong field results when this material is applied against citrus thrips and the similar levels of bioassay susceptibility observed with the two thrips species.

Sabadilla Resistance Studies. We are quite concerned about the possibility that avocado thrips may develop resistance to sabadilla if multiple treatments are applied within a season and / or across several seasons. Sabadilla resistance has been suspected in the past with citrus thrips but because it was previously unclear which of the several alkaloids present in sabadilla were responsible for toxicity, resistance evaluations were not conducted. The work of Hare (1996) and Hare & Morse (1997) have solved this problem and sabadilla resistance bioassays will be conducted as our next major priority.

Improving Field Performance of Sabadilla and Evaluating Other Toxicant-Bait Mixtures. Mr. Kris Tollerup is an M.S. graduate student who has initiated research on novel methods of controlling citrus thrips. These studies could yield results which might be directly applicable to control of avocado thrips. In addition to evaluating various protectants or sun screens which might increase persistence of sabadilla residues (and thus improve field performance), Mr. Tollerup plans to evaluate several toxicants which might be added to sugar or molasses to form a bait-toxicant combination. This research has begun by evaluating 8 different molasses products to determine which is the most attractive bait.

Goetheana incerta Studies. Triapitsyn & Morse (unpublished data) conducted a search for parasitoids attacking citrus thrips in California in 1994-95 and results were quite disappointing — no parasitoids were found associated with citrus thrips on

citrus and only 3 thrips-attacking parasitoid specimens were found on the native host plant, laurel sumac, which may or may not have associated with citrus thrips. Recently, Grout & Stephen (1995) discovered a eulophid parasitoid, *Goetheana incerta* Annecke, attacking South African citrus thrips. Morse obtained a shipment of *G. incerta* from Grout in May, 1997, determined that the species does attack (California) citrus thrips, but the small number of adult parasitoids received were not propagated through quarantine successfully.

We plan to conduct a second importation of *G. incerta* soon but believe it would be wise to first attempt to pre-clear the culture for release out of quarantine once it has been reared through 1 to 2 generations and has been shown to be free of hyperparasitoids or other contaminants. If we wait to submit the paperwork until after the culture is initiated in quarantine, the delay in obtaining release permission may make it difficult to maintain a viable colony.

It is interesting that very low levels of parasitism of avocado thrips have been observed in the field — Lynn Wunderlich and several others have observed a parasitoid attacking avocado thrips and Dr. Serguei Triapitsyn of UC Riverside identified the *2* specimens sent him as *Ceranisus menes* (Walker), another eulophid which has been previously collected from California attacking several thrips species.

Predation Studies. In addition to the work that Hoddle is doing on biological control of avocado thrips, Ms. Cressida Silvers, an M.S. student, is currently trying to decide on a research topic but she has settled on probably evaluating one cf the predators which attacks citrus and avocado thrips. In cooperation with Hoddle, Ms. Silvers may evaluate predaceous mites in the genus *Euseius* or green lacewings *(Chrysoperla* spp.).

Entomopathogenic Nematodes. Recently, we have been approached by Dr. Kirk Smith of Buena Biosystems about evaluating 3 species of nematodes against citrus and avocado thrips. Some preliminary lab trials will be run as time permits. If the nematodes are shown to be effective, it would still be necessary to determine what percent of avocado thrips normally pupate beneath the tree, similar to what Schweizer & Morse (1996, 1997) did with citrus thrips on citrus. Such a treatment, if shown to be effective and economical, however, would have the advantage of being quite selective against avocado thrips.

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