



Integrated Pest Management Laboratory

Cindy McKenzie

Research Entomologist – Vegetables and Ornamentals



CRIS Project: IPM Technologies and Biological Control of Exotic Pests.



Dr. Cindy L. McKenzie
Research Entomologist

B.S. 1983 – Sul Ross State University, Alpine, TX; Agricultural Business.
M.S. 1987 – SRSU, Range Animal Science.
M.S. 1987 – SRSU; Biology/Entomology – Parasitoids of the horn fly of rangeland ecosystems of Trans-Pecos TX.
Ph.D. 1991 – New Mexico State University, Las Cruces, NM; Biology/Entomology – Continuous, alternating and mixed insecticides affect development of resistance in the horn fly (Diptera: Muscidae).

Research Interests: I am an applied entomologist primarily developing Integrated Pest Management (IPM) strategies for the control of whiteflies and whitefly-vector diseases in vegetable and ornamental crops. Research is focused on providing basic information on host plant-pest, pest-natural enemy and vector-pathogen interactions and plant disorders associated with whitefly feeding, as well as other exotic pests of vegetables and ornamentals such as the lobate lac scale.



Gary Quellette
Biological Science Technician

B.S. 1997 - University of Massachusetts, Entomology
M.S. 2003 - Sonoma State University, Biology

Research Background: My personal interests lie in taxonomy, systematics and the evolution of ants (Formicidae). My thesis research investigated the molecular systematics of a putatively primitive ant tribe whose biology and cryptic behaviors provide many interesting questions concerning the evolution of this group. By resolving the relationships, we set forth a better understanding not only for this dynamic tribe, but also ants as a whole. Professionally, I have worked on the Integrated Pest Management of the silverleaf whitefly. Research has focused on improving and designing new management strategies to control whiteflies and whitefly transmitted viruses.

Whitefly Background:

- Recent upgrade in pest status of the sweet potato whitefly (SPWF), *Bemisia tabaci* has been attributed to the invasion of a new biotype (B) which was subsequently described as a new species, the silverleaf whitefly (SLWF), *Bemisia argentifolii*.
- In Florida, the status change was accompanied by reports of a silverleaf disorder of squash and an irregular ripening disorder of tomato.
- Since the introduction of SLWF, Bean Golden Mosaic, Tomato Mottle and Tomato Yellow Leaf Curl geminiviruses have appeared in Florida.

Research Approach: To identify genetic bases of tomato resistance to physiological disorders, plant viruses and transmission of these viruses by silverleaf whitefly.

Microarrays being constructed from a funded SLW functional genomics collaboration among scientists from the USDA-ARS-USHRL (Drs. Shatters and McKenzie), Israel (Dr. Henryk Czosnek) and University of Arizona (Dr. Judy Brown) will be used for transcriptome analysis. The influence on SLW gene expression of two plant pathogenic begomoviruses (tomato yellow leaf curl virus and tomato mottle virus) that are vectored by SLW will be characterized using these microarrays. These two begomoviruses differ in their transmission efficiencies and their influence on whitefly biology. Colonies for both types of viruliferous whiteflies are already maintained at the USHRL. Microarray results will be verified by real-time RT-PCR, northern blots and when applicable by enzymatic assays. Genes of interest will be characterized in detail to study tissue specific expression and to characterize functional role in virus transmission. This information will be used to develop strategies to block the transmission of begomoviruses by the SLW. Commercially available tomato microarrays will be used to study transcriptome differences among begomovirus tolerant and susceptible tomatoes. Differences in gene expression will be verified as described above for virus transmission work. Information from this research will be used to develop strategies for improved virus resistance and for identification of molecular markers to be used by breeders in development of new virus resistant tomato varieties.

Lobate lac scale background:

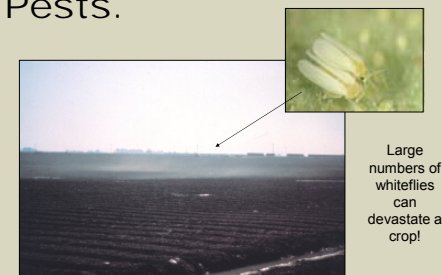
- Virtually unknown before its introduction into the USA, the lobate lac scale (LLS), *Paratachardina lobata* (Chamberlin) (Hemiptera: Kerriidae), has spread at lightening speed in Florida.
- After initial discovery on hibiscus in Davie, Florida (Broward County) in 1999, the LLS has been reported on over 160 economic and native species representing 49 different plant families.
- This little known scale has exploded to potentially one of the most devastating pests of trees and shrubs in the state's history

Research Approach: Describe basic interactions between Lobate lac scale and entomopathogenic fungi.

Lobate lac scale life cycle will be studied on susceptible ornamental host plants. Assay techniques for screening entomopathogenic fungi will be developed. The effect of commercially available fungal pathogens such as *Beauveria bassiana* (Mycotrol WP or ES), *Metarhizium anisopliae* (AGO BIOCONTROL METARHIZIUM 50), *Paecilomyces fumosoroseus* (PFR-97™ biological insecticide) or *Verticillium lecanii* (Mycotal) will be screened in the laboratory, greenhouse and field situations. A grower standard will be included for comparison. Effects of entomopathogenic fungi on lobate lac scale biology will be investigated as a possible management tactic alone or in combination with exotic parasitoids and predators to be imported by ARS (collaborations with Pemberton on classical biological control of the scale have been established).



Lobate lac scales secrete large amounts of honey dew and cause tip die back in trees & shrubs



Cloud of whiteflies migrating across a field

Large numbers of whiteflies can devastate a crop!



Squash silverleaf Disorder

Tomato Irregular Ripening Disorder (TIR)

TIR Symptoms do not appear on tomato foliage, but appear as an uneven fruit color development. **Internal symptoms** lack internal coloring of the fruit.



External symptoms have longitudinal white or yellow streaks.



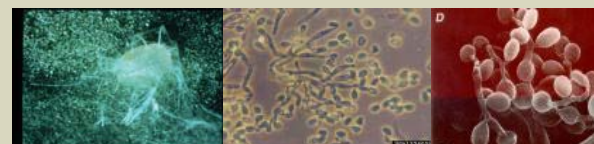
Whitefly transmitted plant pathogenic viruses:

Bean Golden Mosaic virus ▶



◀ Tomato Mottle Virus

Tomato Yellow Leaf Curl Virus ▶



Several fungi known to attack insects have been commercialized as microbial agents and registered as biopesticides for control including *Verticillium lecanii* (left), *Metarhizium anisopliae* (center), and *Beauveria bassiana* (right)