Texas Imported Fire Ant Research and Management Project
*Final Progress Report - October 2001*

# Pheromone and Endocrine Control of Reproduction in Fire Ants

**Principal Investigator:**

Edward Vargo
Department of Entomology
North Carolina State University
Raleigh, NC 27695-7613
Phone:919-513-2743; Fax: 919-513-7746
Email: ed_vargo@ncsu.edu

Lawrence E. Gilbert
Section of Integrative Biology
The University of Texas
Austin, TX 78712-1064
Phone:512-471-4705; Fax: 512-471-9651
Email: lgilbert@mail.utexas.edu

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**Summary of Work to be Done:**

In this project we are investigating pheromones that fire ant queens produce, including studies of glandular origin, pheromone ontogeny, and pheromone composition. We are also investigating the role of juvenile hormone in regulating reproductive activity of queens.

**Major accomplishments to date (Sept. 1, 1999 through Aug. 31, 2001):**

- Using a combination of behavioral assays and analytical chemical techniques, we have tentatively identified several components of a pheromone produced by the queen that elicits worker attraction. These components are invictolide, alpha pyrone, z-9-tricosene and z-9-pentacosene. One or more alkanes also appear to be involved, but these have not yet been identified.
- Using a radiochemical assay, we have determined the rate of juvenile hormone biosynthesis by corpora allata dissected from maturing queens at different stages of development. We have also confirmed that JH III is the hormone analog being produced by the fire ant corpora allata. GC-MS is currently being used to measure corresponding hemolymph titers.

**Goals achieved:**

We had five goals for this project: 1) to isolate, purify and structurally characterize the pheromone responsible for queen recognition; 2) to synthesize the pheromonal components to confirm structure; 3) to determine if the queen recognition pheromone also has primer effects; 4) to determine if the queen recognition pheromone or other queen-produced compounds elicit antennal firing from virgin queens and workers, and if so, to identify the active compounds; 5) to quantify the relationship between JH production, JH titer and vitellogenin titer. We have almost completely achieved objectives 1, 2 and 5, which we expect to finish shortly, and we are currently working on 3 and 4.

**Relevance to the Texas Imported Fire Ant Research Ant Management Project:**
The results of these studies will lead to the identification of queen pheromones and a better understanding of fire ant reproductive endocrinology. This work will set the stage for possible development of biorational methods for managing fire ant populations.

**Publications submitted/published; presentations/posters presented at national technical meetings/conferences**

**Publications:**

Vargo, E. L. 1999. Reproductive development and the ontogeny of queen pheromone production in the fire ant *Solenopsis invicta.* Physiological Entomology 24: 370-376.

Vargo, E. L. and C. D. Hulsey. 2000. Multiple glandular origins of queen pheromones in the fire ant *Solenopsis invicta.* Journal of Insect Physiology 46: 1151-1159.

Shoemaker, D. D., K. G. Ross, L. Keller, E. L. Vargo and J. H. Werren. 2000. *Wolbachia* infections in native and introduced populations of fire ants (*Solenopsis* spp.). Insect Molecular Biology 9: 661-673.

Passera, L., S. Aron, E. L. Vargo and L. Keller. 2001. Queen control of sex ratio in fire ants. Science 293: 1308-1310.

**Presentations:**

Vargo, E. L. (1999) Signals, sources and social regulation: Lessons from fire ant queen pheromones. Thirteenth Congress of the International Union for the Study of Social Insects, Adelaide, Australia

Vargo, E. L. (1999) Update in pheromone and phorid fly research from North Carolina and Texas. National Fire Ant Research Conference, Charleston, SC

Vargo, E. L. (2000) Fire ant queen pheromones: functions, glandular sources, ontogeny. National Fire Ant Research Conference, Chattanooga, TN (poster presentation).

Vargo, E. L. (2000) Research report: North Carolina State University. Whitmire-Microgen Institute of Technology, Boston.

C.S. Brent, E.L. Vargo (2001). Endocrine and pheromonal regulation of reproduction in the red imported fire ant, *Solenopsis invicta.* Imported Fire Ant Research Conference, San Antonio, TX.