

2018 - 2019 Florida Coordinating Council on Mosquito Control FDACS Grant Research Abstracts

- Below are the final report abstracts from the researchers for the 2018 -2019 fiscal year. If you are interested in reading the complete report, please contact Caitlin Gill (Caitlin.Gill@fdacs.gov) with the title and Principal investigator.
- If you have specific questions regarding the research, please reach out to the researcher directly.

“Advancing a standard artificial blood-meal for mosquitoes”

FDACS Contract #025363

Principal Investigator: Dr. Chris Batich¹ cbati@ufl.edu

Abstract:

This project continued development of an artificial blood-meal for raising *A. aegypti* mosquitoes based on low cost protein and other additives. During this project, testing of alternative formulations was tested. The colony established using only the artificial blood is in the 12th generation without bovine or other animal blood as a food source. Earlier variability problems were resolved, and production of viable eggs was observed. Methods for faster data collection were developed based on engorgement extent rather than full evaluation of egg-laying. The cotton for sugar water feeding was modified to reduce bacterial growth and tested. Very little mold grew on the new cotton in contrast to the plain (untreated) cotton. Work progressed more slowly than anticipated given personnel and space needs, and some funds will be unspent and returned.

¹ University of Florida, Department of Material Science and Engineering

“Non-target effects of pesticides on native pollinators of Florida”

FDACS Contract # 025366

Principal Investigator: Nathan Burkett-Cadena¹ nburkettcadena@ufl.edu

Co-Principle Investigators: Herb Nigg² and H. Lee Nigg²

Abstract:

FL DACS Contract # 025366 (UF Project # 0093381) constitutes a collaborative project between UF-FMEL and Magnetar Designs (Co-PIs Nigg and Nigg) to quantify the effects of deltamethrin and malathion, pesticides utilized by mosquito control districts in Florida for control of domestic mosquitoes, for their acute and chronic toxicity to mosquitoes and native pollinators (Lepidoptera and Hymenoptera). In the current work, field and laboratory experiments were conducted to quantify the acute and chronic effects of domestic mosquito control pesticides (deltamethrin and malathion) on target and non-target arthropods, such as mosquitoes (lab-reared and wild-type), monarch butterfly (wild-type), bumble bee (commercial), and diverse pollinators (wild-type).

We conducted bottle bioassays to quantify acute effects of deltamethrin and malathion. *Bombus impatiens* was found to be highly resistant to malathion but sensitive to deltamethrin. In the field, we observed acute effects of deltamethrin from a truck-mounted fogger. All Culicidae (lab and wild-type), *Diachlorus ferrugatus* (wild-type), Neuroptera (wild-type), and *Plecia nearctica* (wild-type) exposed to deltamethrin at the 25 m spray line were knocked down 24 hours post-exposure. No statistical significant difference was observed for *B. impatiens* among the treatments at 1-hour ($F(2, 11)=3.982$, $p=0.554$) and 24-hours ($F(2, 11)=3.982$, $p=0.209$) post- exposure.

Danaus plexippus were reared from second instar larvae to adulthood or mortality on milkweed that had been treated with deltamethrin from a truck-mounted fogger. The survival distributions for the treatment groups was found to be significantly different ($\chi^2(2)=8.7$, $p=0.013$). We observed significant overall decrease in survival of *D. plexippus* reared on leaves exposed to deltamethrin at the 25 m spray line (hazard ratio [HR]=2.9 (1.38 – 6.2, $p=0.005$)). We were unsuccessful in attracting trap-nesting Hymenoptera to our treated and untreated nests.

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² Magnetar Designs

“Part two of developing SIT against *Aedes aegypti* in Florida: field population suppression studies”

FDACS Contract #25367

Principal Investigator: Dr. Daniel Hahn¹ dahahn@ufl.edu

Co-Principle Investigators: Dr. Kenneth Linthicum² and Dr. Seth Britch²

Abstract:

Aedes aegypti is a common domestic mosquito in multiple foci in South Florida as well as Jacksonville and St. Augustine. This mosquito is both a major nuisance and vectors several diseases threatening public health in Florida including Zika, dengue, chikungunya, and yellow fever viruses. *Aedes aegypti* use artificial containers that occur abundantly around homes for immature stage development that are difficult to reach with larvicides, and adults often rest in cryptic places in and around homes that are difficult to reach with adulticide sprays. *Aedes aegypti* populations can be suppressed by intensive and repeated conventional adulticide and residual sprays and larviciding, but they tend to quickly bounce back after treatment and some populations are developing resistance to common adulticides. New tools are desperately needed for *Ae. aegypti* integrated mosquito management in Florida and elsewhere. Autocidal techniques that release treated mosquitoes in public areas that can easily penetrate cryptic backyard habitats to disrupt local wild *Ae. aegypti* populations that may be difficult for mosquito control personnel to reach hold substantial promise. With a current FDACS-FMCC award in 2017-2018 we developed the fundamental building blocks for one such autocidal approach for *Ae. aegypti*, sterile insect technique (SIT). We have colonized local strains from Anastasia and Lee County Mosquito Control Districts that are appropriate for mass rearing. We have shown that a radiation dose of 50 Gy induces male sterility while maintaining excellent male performance and longevity in the Anastasia strain of *Ae. aegypti*. We are now finishing dose-response studies of the Lee County strain and by June 2018 we will have settled on an appropriate dose (probably also 50 Gy based on early data). Herein we propose to take our lab data into the field for population suppression studies in both districts. These field studies will test the extent to which SIT can be used to suppress suburban, domestic *Ae. aegypti* populations in two very different regions, Northeast vs. Southwest Florida. The ultimate outcomes of this grant will be to validate SIT as a method for *Ae. aegypti* control in Florida, and to develop best practice recommendations for mosquito control districts to integrate SIT into integrative mosquito management

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²U.S. Department of Agriculture, Agricultural Research Service, Center for Medical, Agricultural and Veterinary Entomology (USDA-ARS-CMAVE)

“Evaluation of a Vapor-Active Pyrethroid as a Barrier Treatment against Wild Mosquitoes”

FDACS Contract # 025365

Principle Investigator: Dr. Phillip E. Kaufman¹ pkaufman@tamu.edu

Co-Principle Investigator: Dr. Christopher S. Bibbs²

Proposal Abstract:

Adulticides are a critical part of mosquito management plans, and yet few active ingredients are recommended for the daytime management of container-inhabiting mosquitoes. Volatile pyrethroids are common active ingredients in spatial repellents, and can cause mortality in mosquitoes without droplet contact, supporting them as vapor active insecticides (FDACS project 23583). Despite this, volatile pyrethroids are constrained because vector management operations struggle economically to use consumer devices. One alternative delivery could be residual “barrier” sprays. Residual treatments conserve labor and circumvent the need to balance night-time treatments with a day-active mosquito. Therefore, we will address gaps in new adulticide development by embedding transfluthrin into a barrier spray formulation and evaluating it in both laboratory and field settings against *Aedes albopictus*, a domestically occurring container-inhabiting mosquito. A formulation blank will be acquired through either a company, at request, or through in-house formulation. The formulated transfluthrin will be evaluated in the laboratory for mode of action in olfactometer bioassays, and for residual longevity in aging bioassays. The field work will complement our investigation using applications to peridomestic barriers intended to intercept mosquitoes. Field surveillance proximal and adjacent to the field site will help estimate the push or kill effects observed in the field as it relates to what is observed in the laboratory. Leaf excision bioassays will be used to examine the longevity of treatment in field conditions and complement the aging bioassays conducted in the laboratory. The combined picture of laboratory and field assessment will be used to devise recommendations for development and assessments on viability of volatile pyrethroid residual sprays.

¹ Formerly at University of Florida, Department of Entomology and Nematology

² Formerly at Anastasia Mosquito Control District of St. Johns County

“Non-Target Impact Validation with Operational Mosquito Adulticides” FDACS Contract #25380

Principal Investigator: Dr. Philip G. Koehler¹ pgk@ufl.edu

Co-Principle Investigators: Dr. Daniel Dixon² and Dr. Roberto M. Pereira¹

Abstract:

The effects of five commercial formulations on *Apis mellifera* and *Aedes albopictus* were studied using applications on impregnated papers. Lethal doses for four insecticides against the insects were determined and a Honey Bee Tolerance Index was calculated demonstrating that honey bees are relatively tolerant of deltamethrin, have low tolerance of bifenthrin and prallethrin + phenothrin, but very low tolerance of chlorpyrifos and permethrin. Also, the effects of bifenthrin applications on *Apis mellifera* and *Aedes albopictus* were measured with on insect exposed directly to the insecticidal spray or insects exposed to leaves that were treated in the field. Mortality of insects exposed to direct spray lower at 10 to 20 ft away from the spray equipment. Mortalities of insects exposed to leaves collected from the field was lower for leaves collected 1 and 2 weeks after the insecticide application in relation to leaves tested immediately after application. Both mosquitoes and bees exposed in the field to direct applications of bifenthrin had similar mortality, indicating similar susceptibility of the insects to direct application of mosquito control products. These results highlight the importance of application of mosquito control products when bees are not expected to be foraging on treated vegetation.

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"Impact of Aerially Applied Naled on Monarch Butterflies"

FDACS Contract # 25381

Principal Investigator: Dr. John P. Smith¹ docmx8@gmail.com

Abstract:

This study was limited to one spray trial due to severe damages inflicted on the Florida State University Panama City (FSU PC) butterfly and milkweed rearing facilities by Hurricane Michael.

No acute mortality linked to a single swath of naled (Dibrom®) applied at 0.66 oz. per acre was observed in caged adult monarch butterflies (*Danaus plexippus plexippus*) set out at 0, 100, 500, 1000, and 1500 ft. in three replicated transects at Panama City Beach, FL. There was no mortality in the upwind controls. Laboratory bioassays of second instar larvae fed naled-treated milkweed leaves (*Asclepias incarnata*) for four days experienced little acute mortality that could be definitively linked to the insecticide. The mortality of caged 5-6 day-old female *Aedes taeniorhynchus* adults exposed at the same time and locations varied considerably and was attributed to differences in vegetation and application coverage. Mortality at 48 hrs. posttreatment in one transect ranged from 71-77% out to 1000 ft. and dropped to 55% at 1500 ft. Mortality in the other two transects ranged widely with 100% mortality at 100 ft. and 48% at 1000 ft. Mortality at all the other distances did not exceed 20%. Control mortality was <5% in one transect and zero in the other two.

¹Retired from Florida State University. Currently employed by Public Health Entomology Services, LLC (<http://mosquitoresearchlab.com>). Copy of the final report available under the "Adulticide" header at this website.

"New Nanoceria-Based Mosquito Pesticides"

FDACS Contract #25381

Principal Investigator: Dr. Bradley Jay Willenberg¹ Bradley.Willenberg@ucf.edu

Co-Principle Investigator: Dr. Sudipta Seal²

Abstract:

Effectively controlling vector mosquito populations while avoiding the development of resistance to said control measures remains a prevalent and increasing obstacle to integrated vector management. Long-used volatile pesticides such as pyrethroids spur resistance wherever they have been employed and novel control measures such as Wolbachia endosymbiont and Sterile Insect Technique (SIT) possess their own hurdles to utilize. Metallic nanoparticles have previously shown promise in controlling larvae populations with silver nanoparticles (AgNP) being the most prevalent. Herein, we explore these nanoparticles as well as ceria nanoparticles (CNP) and silver-doped CNPs (AgCNP) using chemically well-defined synthesis procedures to assess not only the larvicidal effects of synthesized particles but also the effects on adult mosquitoes and their fecundity following exposure.

Currently, we have been able to show a significant larvicidal effect of AgCNPs over CNPs (60% lethality over 20%) and a comparable effect to free silver ion (70%). These AgCNPs however contain much less silver metal (7.8ppb) than the amount of silver ion needed to achieve comparable larvicidal activity (4ppm), making them more environmentally conscientious.

Additionally, when mosquitoes are exposed to nanoparticles either as larvae or as adults, they have altered life history traits (decreased egg production, suppressed emergence rates and varied sex ratios) indicating that these particles may be able to affect mosquito biology while avoiding acting as a direct insecticide, thus reducing the

spurring of resistance. Imbibement of nanoparticles was confirmed via fluorescence microscopy. All particles were extensively analyzed for their physical and chemical characteristics. This work serves as an important step in the further utilization of metallic nanoparticles in the mosquito control efforts.

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