

Year 3 Quarter 1 (4/01/21 – 6/30/21) Report

Florida Department of Health Contract CODQJ

Improving our understanding of domestic mosquito control of *Aedes aegypti*, *Ae. albopictus*,
and *Culex quinquefasciatus* through assessments of insecticide susceptibility

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Task List

1. Deploy traps each quarter to collect a minimum of 100 eggs from adult *Aedes* and *Culex* mosquitoes or collect 100 *Aedes* and *Culex* larvae from a minimum of 12 identified sites or collect eggs from adult *Aedes* and *Culex* mosquitoes hatched from previously collected eggs from identified sites that were reared to adulthood and allowed to blood feed and lay eggs. Document the number of eggs and larvae collected and the number and the species of adult mosquitoes that hatched from collected eggs in the Quarterly Report.
2. Conduct insecticide resistance testing on mosquitoes collected as eggs (parental generation) or successive generations (within two generations of parental generation) of mosquitoes within 60 days of collection and hatching of eggs. Document the insecticide resistance testing and results in the Quarterly Report.
3. Conduct CDC bottle bioassay testing on mosquitoes from a minimum of 3 identified sites against one pyrethroid and one organophosphate each quarter. Document the bioassay testing and results in the Quarterly Report and post the CDC bottle bioassay results to Provider's reporting website, <https://fmel.ifas.ufl.edu/>.
4. Map the distribution of where *Aedes* and *Culex* eggs or larvae are collected and used in CDC bottle bioassays each quarter. Document the mapped distribution in the Quarterly Report.
5. Distribute the results of the CDC bottle bioassay testing to the Florida Mosquito Control Program managers in the counties of a minimum of the 3 identified sites each quarter. Document the distribution of the results in the Quarterly Report.
6. Prepare a Quarterly Report, post it on Provider's reporting website, and submit it to the Contract Manager within 15 days following the end of each quarter, but no later than invoice submission. At a minimum, include the following information in the report:
 - a. The number of eggs and larvae from adult mosquitoes collected and hatched;
 - b. The number of eggs and larvae from adult mosquitoes in which insecticide testing was conducted;
 - c. Documentation of mapping of egg collection results including species identification and location of collection;
 - d. Documentation of results of CDC bottle bioassay testing of mosquitoes for insecticide resistance; and
 - e. Documentation of CDC bottle bioassay testing results distribution to Florida Mosquito Control Program Managers.
7. Identify the methods for distributing information on resistance to tested insecticide active ingredients. Prepare an Annual Report, including the identified methods, and submit it to the Contract Manager within 45 days from the end of the contract term, but no later than submission of the final invoice. At a minimum, include the following in the report:
 - a. The method for informing Florida Mosquito Control Programs, the Department, and the general public on the regions of Florida that are most likely to have

populations of Zika, Dengue, Chikungunya, and West Nile Virus mosquito vectors;

- b. The method for informing Florida Mosquito Control Programs and the Department on the efficacy of the insecticides that are currently being used in their programs (i.e., whether the chemicals are working as they should to reduce the mosquito populations); and
- c. The method for informing Florida Mosquito Control Program managers on the relationship between the CDC bottle bioassay (a lab assay) and the efficacy of spraying mosquitoes at the insecticide label rates.

Tasks Progress

1. Traps were deployed this quarter, and *Aedes* eggs and *Culex quinquefasciatus* rafts were collected from the traps. Of the 7812 *Aedes* eggs collected, there was \approx a 67% hatch rate, resulting in 5234 *Aedes* adults emerging. The 108 *Culex quinquefasciatus* rafts collected had \approx a 49% hatch rate, resulting in 10,584 *Culex quinquefasciatus* adults emerging. The species identification for the resulting *Aedes* adult mosquitoes were *Aedes aegypti* and *Aedes albopictus*. The *Aedes* eggs processed this quarter came (county followed by site name):
 - a. Broward
 - i. 8th Street
 - b. Collier
 - i. Golf & Country Club
 - c. Miami-Dade
 - i. Hialeah
 - d. Pasco
 - i. Pleasure Drive

The *Culex quinquefasciatus* rafts processed this quarter came from (county followed by site name):

- a. Brevard
 - i. 3865 N Wickham Road
- b. Broward
 - i. SR-7
- c. Citrus
 - i. Curt Terrace
 - ii. West Pine Circle
- d. Escambia
 - i. Lyman Street
- e. Glades
 - i. Neighborhood Pond
- f. Hillsborough
 - i. Oaklawn
- g. Indian River
 - i. Atlantic Blvd
 - ii. Bridge Plaza Drive
- h. Palm Beach
 - i. Lyons
 - ii. Old Boyton
 - iii. Wells Fargo
- i. Pasco

- i. Creek Pub
 - ii. Gulfside Drive
- j. Pinellas
 - i. Sawgrass
 - ii. Sundown Drive
- k. St. Lucie
 - i. FPL
- l. St. Johns
 - i. Cartwheel Bay
 - ii. Dupont
- m. Sumter
 - i. Walden Street

2. Since the end of the previous quarter, 5 populations of *Aedes aegypti* and 25 populations of *Culex quinquefasciatus*, respectively, have been tested using the CDC bottle bioassay. Based on the mortality observed at a diagnostic time, the mosquito populations were classified as susceptible (S), developing resistance (DR), or resistant (R) to 6 active ingredients: malathion, naled, deltamethrin, etofenprox, permethrin, and sumithrin. These results can be found in the table below. If a population was not tested against an active ingredient, no data (ND) is documented in the table.

Species	County	Site	Malathion	Naled	Deltamethrin	Etofenprox	Permethrin	Sumithrin
<i>Ae. aegypti</i>	Broward	8 th Street	S	S	R	R	R	R
<i>Ae. aegypti</i>	Collier	Golf & Country Club	S	R	R	R	R	ND
<i>Ae. aegypti</i>	Miami-Dade	Hialeah	S	S	R	R	R	R
<i>Ae. aegypti</i>	Miami-Dade	Westchester	S	S	DR	R	R	ND
<i>Ae. aegypti</i>	Pasco	Pleasure Drive	S	S	R	R	R	R
<i>Cx. quinquefasciatus</i>	Brevard	3865 N Wickham	R	R	ND	ND	R	ND
<i>Cx. quinquefasciatus</i>	Broward	SR-7	S	R	R	R	R	R
<i>Cx. quinquefasciatus</i>	Citrus	Curt Terrace	S	ND	ND	ND	R	ND
<i>Cx. quinquefasciatus</i>	Citrus	West Pine Circle	ND	R	ND	ND	R	ND
<i>Cx. quinquefasciatus</i>	Escambia	Lyman Street	R	ND	ND	ND	R	ND
<i>Cx. quinquefasciatus</i>	Glades	Neighborhood Pond	S	R	R	ND	R	ND
<i>Cx. quinquefasciatus</i>	Hillsborough	Oaklawn	S	R	ND	ND	R	ND
<i>Cx. quinquefasciatus</i>	Indian River	Atlantic Blvd	S	R	ND	ND	R	ND
<i>Cx. quinquefasciatus</i>	Indian River	Bridge Plaza Drive	DR	R	ND	ND	R	ND
<i>Cx. quinquefasciatus</i>	Palm Beach	Boyton	R	R	R	R	R	R
<i>Cx. quinquefasciatus</i>	Palm Beach	Ibis Reserve	DR	R	ND	ND	R	ND
<i>Cx. quinquefasciatus</i>	Palm Beach	Lyons Road	S	R	R	ND	R	ND
<i>Cx. quinquefasciatus</i>	Palm Beach	New Castle Terrace	R	R	R	R	R	R
<i>Cx. quinquefasciatus</i>	Palm Beach	Old Boyton Road	S	R	R	R	R	R
<i>Cx. quinquefasciatus</i>	Palm Beach	Shower Tree Way	S	R	R	R	R	R
<i>Cx. quinquefasciatus</i>	Palm Beach	Villas Santorini Drive	S	R	R	R	R	R

<i>Cx. quinquefasciatus</i>	Palm Beach	Wells Fargo	DR	R	R	ND	R	ND
<i>Cx. quinquefasciatus</i>	Pasco	Creek Pub	R	ND	ND	ND	R	ND
<i>Cx. quinquefasciatus</i>	Pasco	Gulfside Drive	R	R	ND	ND	R	ND
<i>Cx. quinquefasciatus</i>	Pinellas	Sawgrass	R	R	R	ND	R	ND
<i>Cx. quinquefasciatus</i>	Pinellas	Sundown Drive	DR	ND	ND	ND	R	ND
<i>Cx. quinquefasciatus</i>	St. Lucie	FPL	ND	R	ND	ND	R	ND
<i>Cx. quinquefasciatus</i>	St. Johns	Cartwheel Bay	R	R	R	ND	R	ND
<i>Cx. quinquefasciatus</i>	St. Johns	Dupont	S	R	ND	ND	R	ND
<i>Cx. quinquefasciatus</i>	Sumter	Walden Street	S	R	ND	ND	R	ND

3. CDC bottle bioassay testing was performed on mosquitoes from 30 sites against at least one pyrethroid (deltamethrin or permethrin) and one organophosphate (malathion or naled) active ingredient (AI). The total number of active ingredients that each mosquito population was tested against can be found in the table below. The CDC bottle bioassay results for each active ingredient can be found at <https://fme1.ifas.ufl.edu/>.

Species	County	Site	# of AIs Tested
<i>Aedes aegypti</i>	Broward	8 th Street	6
<i>Aedes aegypti</i>	Collier	Golf & Country Club	5
<i>Aedes aegypti</i>	Miami-Dade	Hialeah	6
<i>Aedes aegypti</i>	Miami-Dade	Westchester	5
<i>Aedes aegypti</i>	Pasco	Pleasure Drive	6
<i>Culex quinquefasciatus</i>	Brevard	3865 N Wickham	3
<i>Culex quinquefasciatus</i>	Broward	SR-7	6
<i>Culex quinquefasciatus</i>	Citrus	Curt Terrace	2
<i>Culex quinquefasciatus</i>	Citrus	West Pine Circle	2
<i>Culex quinquefasciatus</i>	Escambia	Lyman Street	2
<i>Culex quinquefasciatus</i>	Glades	Neighborhood Pond	4
<i>Culex quinquefasciatus</i>	Hillsborough	Oaklawn	2
<i>Culex quinquefasciatus</i>	Indian River	Atlantic Blvd	3
<i>Culex quinquefasciatus</i>	Indian River	Bridge Plaza Drive	3
<i>Culex quinquefasciatus</i>	Palm Beach	Boyton	6
<i>Culex quinquefasciatus</i>	Palm Beach	Ibis Reserve	3
<i>Culex quinquefasciatus</i>	Palm Beach	Lyons Road	4
<i>Culex quinquefasciatus</i>	Palm Beach	New Castle Terrace	6
<i>Culex quinquefasciatus</i>	Palm Beach	Old Boyton Road	6
<i>Culex quinquefasciatus</i>	Palm Beach	Shower Tree Way	6
<i>Culex quinquefasciatus</i>	Palm Beach	Villas Santorini Drive	6
<i>Culex quinquefasciatus</i>	Palm Beach	Wells Fargo	4
<i>Culex quinquefasciatus</i>	Pasco	Creek Pub	2
<i>Culex quinquefasciatus</i>	Pasco	Gulfside Drive	3
<i>Culex quinquefasciatus</i>	Pinellas	Sawgrass	4
<i>Culex quinquefasciatus</i>	Pinellas	Sundown Drive	2



<i>Culex quinquefasciatus</i>	St. Lucie	FPL	2
<i>Culex quinquefasciatus</i>	St. Johns	Cartwheel Bay	4
<i>Culex quinquefasciatus</i>	St. Johns	Dupont	3
<i>Culex quinquefasciatus</i>	Sumter	Walden Street	3

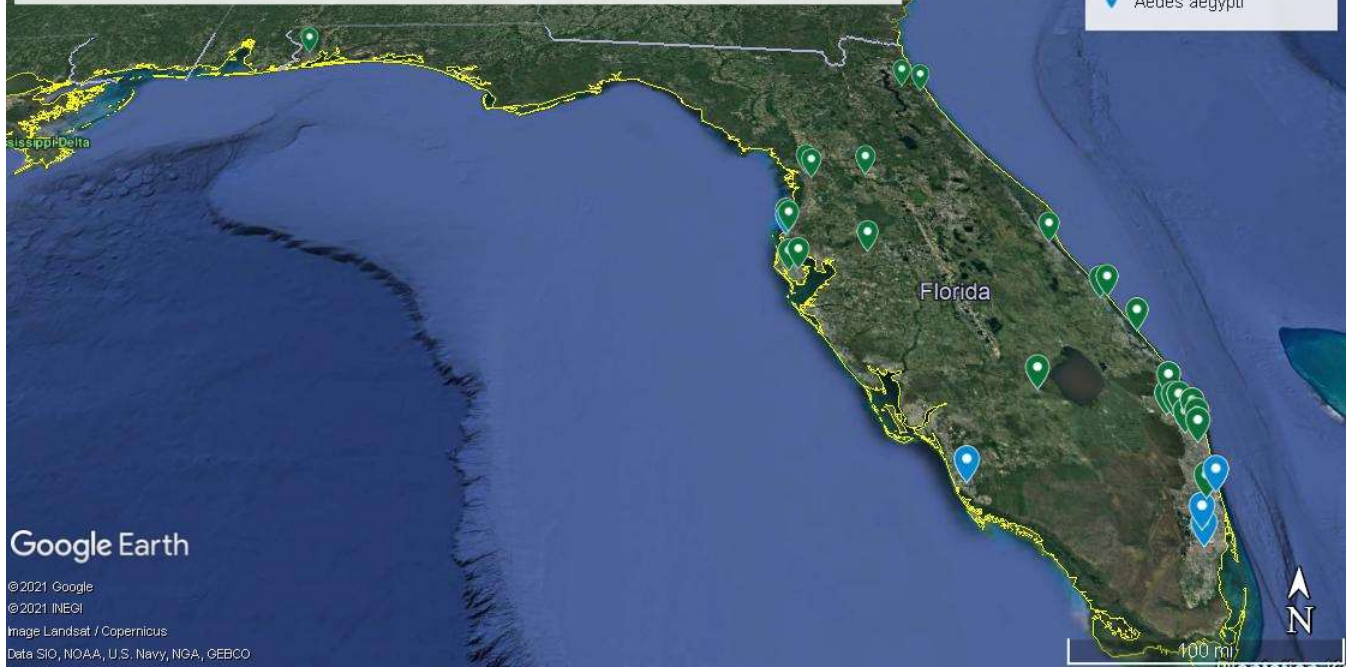
4. The distribution of where *Aedes* eggs and *Culex* egg rafts or larvae were collected from and used in CDC bottle bioassays was mapped and can be found on page 9 of this report. The distribution map can also be found at <https://fmel.ifas.ufl.edu/>.
5. Results of the CDC bottle bioassay testing were distributed as reports by email to Florida mosquito control program managers. Specifically, the results sent to program managers for the Hialeah and Westchester sites in Miami-Dade County; SR-7 and 8th Street sites in Broward County; Boyton, Ibis Reserve, Lyons Road, New Castle Terrace, Old Boyton Road, Shower Tree Way, Villas Santorini Drive, and Wells Fargo sites in Palm Beach County were forwarded to the FDOH Contract Manager to meet the requirement of documenting the distribution of results for sites. An example report can be found on pages 10-11.
6. This Quarterly Report in combination with the information posted on the Reporting website at <https://fmel.ifas.ufl.edu/> satisfies this task.
7. All necessary information will be provided in the Final Annual Report.

Florida mosquito populations tested for insecticide resistance

Distribution of domestic mosquito populations tested during quarter of April 1 - June 30, 2021

Legend

-  Culex quinquefasciatus
-  Aedes aegypti



Assay: CDC bottle bioassay
 Species: *Aedes aegypti* (Generation F₁)
 Site: Broward Co. 8th Street
 Address: 1101 SE 8th St, Fort Lauderdale, FL 33316
 Coordinates: 26.11261, -80.13147

Following the CDC Guidelines for insecticide resistance monitoring <http://www.cdc.gov/zika/vector/insecticide-resistance.html>, resistance is determined by the percentage of mosquitoes that die (mortality rate) at the diagnostic time. The knockdown resistance (kdr) mechanism is being phenotypically expressed if % mortality at 24 hours is less than % mortality at the end of the 2-hour long bioassay.

The data shown below provides:

Column 1: CDC recommended diagnostic dose (per bottle)

Column 2: Active ingredient tested

Column 3: Diagnostic time from FMEL assays; 100% mortality expected at given time using strain of susceptible *Aedes aegypti*

Column 4: Site-specific *Aedes aegypti* % mortality at the CDC diagnostic time

Column 5: Site-specific *Aedes aegypti* % mortality at end of 2-hour bioassay

Column 6: Site-specific *Aedes aegypti* % mortality 24 hours after bioassay started (Pyrethroids only)

1	2	3	4	5	6
CDC diagnostic dose	Active ingredient tested	Diagnostic time	8 th Street <i>Aedes aegypti</i> % mortality at diagnostic time	8 th Street <i>Aedes aegypti</i> % mortality at 2 hours	8 th Street <i>Aedes aegypti</i> % mortality at 24 hours
0.75 ug/bottle	Deltamethrin	15	44%	100%	32%
12.5ug/bottle	Etofenprox	45	2%	35%	0%
43 ug/bottle	Permethrin	15	64%	100%	100%
20 ug/bottle	Sumithrin	30	0%	98%	20%
400 ug/bottle	Malathion	30	100%	100%	N/A
2.25 ug/bottle	Naled	30	100%	100%	N/A

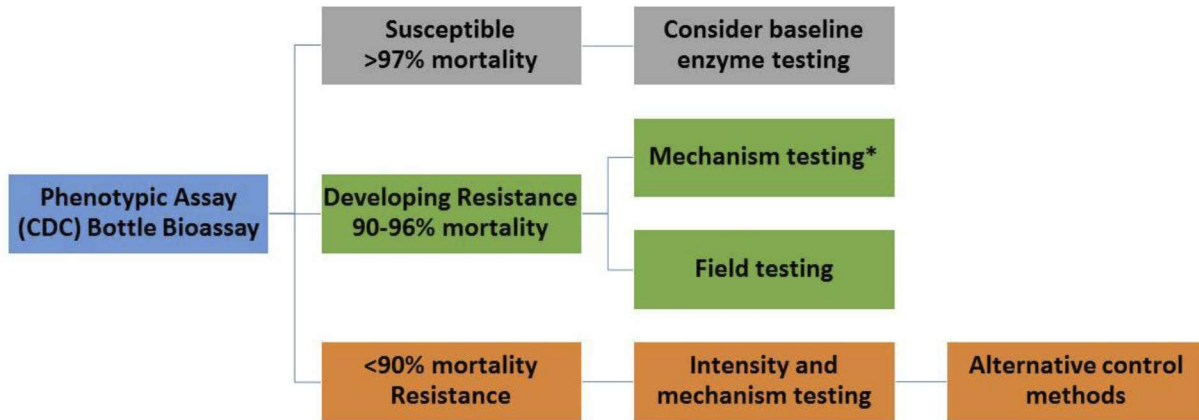
Using the CDC guidelines (provided on next page and found here: <http://www.cdc.gov/zika/vector/insecticide-resistance.html>) on interpreting the data for management purposes:

The 8th Street population of *Aedes aegypti* is resistant to Deltamethrin, Etofenprox, Permethrin and Sumithrin.

The 8th Street population of *Aedes aegypti* exhibited knockdown resistance to Deltamethrin, Etofenprox and Sumithrin.

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*Mechanism testing options: enzymes, molecular assays, bottle bioassay with inhibitors