Quarter 5 (4/01/2020 - 6/30/20) 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

Prepared by:

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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 within the 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 three 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 three 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 1,724 Aedes eggs collected, there was ≈ 64% hatch rate, resulting in 1,109 Aedes adults emerging. The 31 Culex quinquefasciatus rafts collected had a ≈82% hatch rate, resulting in 3,546 Culex quinquefasciatus adults emerging. The species identification for the resulting Aedes adult mosquitoes was Aedes albopictus. The Aedes eggs processed this quarter came (county followed by site name):
   a. Indian River
      i. VLE

   The Culex quinquefasciatus rafts processed this quarter came from (county followed by site name):
   b. Citrus
      i. Rose
   c. Palm Beach
      i. Clint Moore
      ii. Delaware
      iii. N. Main St.
      iv. Sysco
   d. Polk
      i. Paint Shop
   e. St. Lucie
      i. Fairwinds

2. Since the end of the previous quarter, 4 populations of Aedes aegypti, 2 populations of Ae. albopictus and 10 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, developing resistance, or resistant to the various active ingredients. These results were incorporated into maps and can be found on pages 7 - 20 of this report.

3. CDC bottle bioassay testing was performed on mosquitoes from 13 sites against at least one pyrethroid (permethrin) and one organophosphate (malathion) 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://fmel.ifas.ufl.edu/.
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 21 of this report. The distribution map can also be found at [https://fmel.ifas.ufl.edu/](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 Clint Moore, Delaware, and Sysco sites in Palm Beach County, Golf Club site in South Walton County, and Rose site in Citrus County were forwarded to the FDOH Contract Manager to meet requirement of documenting the distribution of results for 3 sites. An example report can be found on pages 22-23.

6. This Quarterly Report in combination with the information posted on the Reporting website at [https://fmel.ifas.ufl.edu/](https://fmel.ifas.ufl.edu/) satisfies this task.

7. All necessary information will be provided in the Final Annual Report.

<table>
<thead>
<tr>
<th>Species Tested</th>
<th>County</th>
<th>Site</th>
<th># of AIs Tested</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Aedes aegypti</em></td>
<td>Miami-Dade</td>
<td>Brickell</td>
<td>4</td>
</tr>
<tr>
<td><em>Aedes aegypti</em></td>
<td>Miami-Dade</td>
<td>Little Havana</td>
<td>5</td>
</tr>
<tr>
<td><em>Aedes aegypti</em></td>
<td>Miami-Dade</td>
<td>Flagler Cemetery</td>
<td>5</td>
</tr>
<tr>
<td><em>Aedes aegypti</em></td>
<td>Miami-Dade</td>
<td>Kings Bay</td>
<td>5</td>
</tr>
<tr>
<td><em>Aedes albopictus</em></td>
<td>Seminole</td>
<td>Halsey</td>
<td>4</td>
</tr>
<tr>
<td><em>Aedes albopictus</em></td>
<td>South Walton</td>
<td>Golf Club</td>
<td>4</td>
</tr>
<tr>
<td><em>Culex quinquefasciatus</em></td>
<td>Citrus</td>
<td>Rose</td>
<td>4</td>
</tr>
<tr>
<td><em>Culex quinquefasciatus</em></td>
<td>Indian River</td>
<td>Vista Royal</td>
<td>4</td>
</tr>
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<td><em>Culex quinquefasciatus</em></td>
<td>Indian River</td>
<td>WB Storm Drain</td>
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</tr>
<tr>
<td><em>Culex quinquefasciatus</em></td>
<td>Palm Beach</td>
<td>Clint Moore</td>
<td>3</td>
</tr>
<tr>
<td><em>Culex quinquefasciatus</em></td>
<td>Palm Beach</td>
<td>Delaware</td>
<td>3</td>
</tr>
<tr>
<td><em>Culex quinquefasciatus</em></td>
<td>Palm Beach</td>
<td>N. Main St.</td>
<td>1</td>
</tr>
<tr>
<td><em>Culex quinquefasciatus</em></td>
<td>Palm Beach</td>
<td>Sysco</td>
<td>5</td>
</tr>
<tr>
<td><em>Culex quinquefasciatus</em></td>
<td>Polk</td>
<td>Paint Shop</td>
<td>2</td>
</tr>
<tr>
<td><em>Culex quinquefasciatus</em></td>
<td>Seminole</td>
<td>Halsey</td>
<td>2</td>
</tr>
<tr>
<td><em>Culex quinquefasciatus</em></td>
<td>Seminole</td>
<td>Lake Mary</td>
<td>1</td>
</tr>
</tbody>
</table>
Species: Aedes aegypti
Active Ingredient: permethrin

Credit: E. Buckner & D. Ramirez,
UF/IFAS Florida Medical Entomology Laboratory
Species: Aedes aegypti
Active Ingredient: malathion

Susceptible: > 97% Mortality
Developing Resistance: 90-96% Mortality
Resistant: < 90% Mortality

Credit: E. Buckner & D. Ramirez,
UF/IFAS Florida Medical Entomology Laboratory
Species: Aedes aegypti
Active Ingredient: deltamethrin

Susceptible: > 97% Mortality
Developing Resistance: 90-96% Mortality
Resistant: < 90% Mortality

Credit: E. Buckner & D. Ramirez,
UF/IFAS Florida Medical Entomology Laboratory
Species: Aedes aegypti
Active Ingredient: etofenprox

Susceptible: > 97% Mortality
Developing Resistance: 90-96% Mortality
Resistant: < 90% Mortality

Credit: E. Buckner & D. Ramirez,
UF/IFAS Florida Medical Entomology Laboratory
Species: Aedes aegypti
Active Ingredient: sumithrin

Susceptible: > 97% Mortality
Developing Resistance: 90-96% Mortality
Resistant: < 90% Mortality

Credit: E. Buckner & D. Ramirez,
UF/IFAS Florida Medical Entomology Laboratory
Species: Aedes *albopictus*
Active Ingredient: permethrin

Credit: E. Buckner & D. Ramirez,
UF/IFAS Florida Medical Entomology Laboratory
Species: Aedes *albopictus*
Active Ingredient: malathion

Credit: E. Buckner & D. Ramirez,
UF/IFAS Florida Medical Entomology Laboratory
Species: Aedes *albopictus*
Active Ingredient: deltamethrin

Susceptible: > 97% Mortality
Developing Resistance: 90-96% Mortality
Resistant: < 90% Mortality

Credit: E. Buckner & D. Ramirez,
UF/IFAS Florida Medical Entomology Laboratory
Species: Aedes *albopictus*
Active Ingredient: etofenprox

Susceptible: > 97% Mortality
Developing Resistance: 90-96% Mortality
Resistant: < 90% Mortality

Credit: E. Buckner & D. Ramirez, UF/IFAS Florida Medical Entomology Laboratory
Species: Culex quinquefasciatus
Active Ingredient: permethrin

Credit: E. Buckner & D. Ramirez,
UF/IFAS Florida Medical Entomology Laboratory
Species: Culex quinquefasciatus
Active Ingredient: malathion

Susceptible: > 97% Mortality
Developing Resistance: 90-96% Mortality
Resistant: < 90% Mortality

Credit: E. Buckner & D. Ramirez,
UF/IFAS Florida Medical Entomology Laboratory
Species: Culex *quinquefasciatus*
Active Ingredient: deltamethrin

Credit: E. Buckner & D. Ramirez,
UF/IFAS Florida Medical Entomology Laboratory
Species: Culex quinquefasciatus
Active Ingredient: etofenprox

Credit: E. Buckner & D. Ramirez,
UF/IFAS Florida Medical Entomology Laboratory
Species: Culex quinquefasciatus
Active Ingredient: sumithrin

Credit: E. Buckner & D. Ramirez,
UF/IFAS Florida Medical Entomology Laboratory
Distribution of domestic mosquito populations tested for insecticide resistance
April 1 - June 30, 2020

Credit: E. Buckner & D. Ramirez,
UF/IFAS Florida Medical Entomology Laboratory
Assay: CDC bottle bioassay
Conducted by: UF/IFAS FMEL – Buckner Lab
Species: Aedes albopictus
Source: Reared from eggs
Site: South Walton County (Golf Club)
Address: Santa Rosa Golf Beach Club, 334 Golf Club Drive, Santa Rosa Beach, FL 32459
Coordinates: 30.355084, -86.240399
Date of assay: 4/2/20


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 a strain of susceptible Aedes albopictus
Column 4: Site specific Aedes albopictus % mortality at the CDC diagnostic time

| 1                     | 2                     | 3                                          | 4                     |
|-----------------------|-----------------------|============================================|-----------------------|
| CDC diagnostic dose   | Active ingredient     | CDC diagnostic time; 100% mortality        | Golf Club Aedes      |
| (per bottle)          | tested                | expected at given time using strain of     | albopictus %         |
|                       |                       | susceptible Aedes albopictus               | mortality at the     |
| 43 ug/bottle          | Permethrin            | 10 min                                     | CDC diagnostic time  |
|                       |                       |                                            |                       |
| 400 ug/bottle         | Malathion             | 30 min                                     | 100%                 |
|                       |                       |                                            |                       |
| 12.5 ug/bottle        | Etofenprox            | 30 min                                     | 80%                  |
|                       |                       |                                            |                       |
| 0.75 ug/ bottle       | Deltamethrin          | 15 min                                     | 100%                 |


The Golf Club population of Aedes albopictus is resistant to Etofenprox; susceptible to Permethrin, Malathion and Deltamethrin.
Overview of Insecticide Resistance Testing Algorithm