Effect of Passive Metofluthrin Emanators on Pyrethroid-Resistant Aedes aegypti

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Managing Aedes-Borne Diseases

Current tools targeting *Aedes aegypti*

- Vary in efficacy
- Transient or localized epidemiologic impacts
- Complicated by insecticide resistance

Potential new tool-

- Indoor deployment of passive emanators w/ metofluthrin
Objectives

Determine whether exposure to metofluthrin emanators affects landing and mortality of locally-derived *Ae. aegypti* strains in experimental houses within Mérida, Mexico.

Compare response of pyrethroid-susceptible and pyrethroid-resistant strains.
Rented Houses within Mérida, MX
Rented Houses within Mérida, MX

Casa 1
Casa 2
Casa 3
Casa 4
Casa 5
Casa 6
Casa 7
Casa 8
Rented Houses within Mérida, MX

Casa 1
Casa 2
Casa 3
Casa 4
Casa 5
Casa 6
Casa 7
Casa 8
Creating Experimental Houses

Size: $144.5 \pm 7.12\ m^3$
- 2 Bedrooms
- 1 Bathroom
- 1 or 2 living rooms
Creating Experimental Houses

Size: 144.5 ± 7.12 m³
  - 2 Bedrooms
  - 1 Bathroom
  - 1 or 2 living rooms

Windows closed
Temp range: 29-34C
Humidity range: 62-82%
Creating Experimental Houses

Sealing the Houses
Creating Experimental Houses

Sealing the Houses
Creating Experimental Houses

Sealing the Houses

Screened the inside and outside of all windows and doors

Screening the windows

Sealing the doors and other furniture
Sealing the Experimental Houses

Screened all drains w/in the houses
Creating Experimental Houses

Standardize furniture
- Main/Living rooms
  - 2 tables (black plastic)
  - 4 chairs (2 white & 2 dark colored)
Creating Experimental Houses

Standardize furniture

-Main/Living rooms
  2 tables (black plastic)
  4 chairs (2 white & 2 dark colored)

-Ant baits at each entrance
Creating Experimental Houses

Standardize furniture

- Main/Living rooms
  - 2 tables (black plastic)
  - 4 chairs (2 white & 2 dark colored)

- Ant baits at each entrance

- Buckets of water w/ cloth
Creating Experimental Houses

Standardize furniture
- Main/Living rooms
  - 2 tables (black plastic)
  - 4 chairs (2 white & 2 dark colored)
- Ant baits at each entrance
- Buckets of water w/ cloth
- Oscillating fans
Creating Experimental Houses

Standardize furniture

- Bedrooms
  1 bed (PVC & black cloth)
  1 small table (black plastic)
  6 hung clothes
    (3 white shirts & 3 colored shirts)
Passive Emanators

Treatments
SumiOne® passive emanator (Sumitomo)
10% metofluthrin-impregnated mesh (16 x 9.5 cm)
  Act as confusant rather than repellent

Can be rapidly deployed indoors
  Potential large-scale implementation

Require no heat or power
Treatments
SumiOne® passive emanator

1- Control
   0 emanators / room

2- Emanators
   n = 1 emanators / room
   [n = 4 emanators / house]
Aedes aegypti Strains Tested

Susceptible Strains
1- New Orleans (NO); Laboratory-derived
2- Cienega de Flores (CdF); Field-derived

Pyrethroid-Resistant Strains
3- Itzincab (ITZ); Field-derived
4- Juan Pablo (JP); Field-derived
Experimental Design

Released $n = 25$ female *Ae. aegypti* / house

3-7 days old
**Experimental Design**

Released n = 25 female *Ae. aegypti* / house 3-7 days old

**Landing counts**
1. 30 minutes after release (Baseline, no emanators)
Experimental Design

Released $n = 25$ female *Ae. aegypti* / house
3-7 days old

Landing counts
1. 30 minutes after release (Baseline, no emanators)
   Add emanators
Experimental Design

Released n = 25 female *Ae. aegypti* / house
  3-7 days old

**Landing counts**
1. 30 minutes after release (Baseline, no emanators)
   Add emanators
2. 60 minutes after release (30 min exposure)
Experimental Design

Released $n = 25$ female *Ae. aegypti* / house
3-7 days old

**Landing counts**
1. 30 minutes after release (Baseline, no emanators)
   - Add emanators
2. 60 minutes after release (30 min exposure)
3. 24 hours after release (24 hr exposure)
**Experimental Design**

Released n = 25 female *Ae. aegypti* / house

3-7 days old

**Landing counts**

1. 30 minutes after release (Baseline, no emanators)
   - Add emanators
2. 60 minutes after release (30 min exposure)
3. 24 hours after release (24 hr exposure)

n = 4 counts / sampling period; 2 minutes each
Experimental Design

Released \( n = 25 \) female *Ae. aegypti* / house
3-7 days old

**Landing counts**
1. 30 minutes after release (Baseline, no emanators)
   - Add emanators
2. 60 minutes after release (30 min exposure)
3. 24 hours after release (24 hr exposure)

\( n = 4 \) counts / sampling period; 2 minutes each
Mosquitoes not allowed to feed
Experimental Design

Released n = 25 female Ae. aegypti / house
3-7 days old

Landing counts
1. 30 minutes after release (Baseline, no emanators)
   Add emanators
2. 60 minutes after release (30 min exposure)
3. 24 hours after release (24 hr exposure)

   n = 4 counts / sampling period; 2 minutes each
Mosquitoes not allowed to feed
Counted landings from feet to knees
Experimental Design

Released n = 25 female *Ae. aegypti* / house
3-7 days old

Landing counts
1. 30 minutes after release (Baseline, no emanators)
   Add emanators
2. 60 minutes after release (30 min exposure)
3. 24 hours after release (24 hr exposure)

n = 4 counts / sampling period; 2 minutes each
Mosquitoes not allowed to feed
Counted landings from feet to knees
Personnel kept consistent within room and house
Experimental Design

Released \( n = 25 \) female *Ae. aegypti* / house
3-7 days old

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1. 30 minutes after release (Baseline, no emanators)
   - Add emanators
2. 60 minutes after release (30 min exposure)
3. 24 hours after release (24 hr exposure)

**Mortality**
Collected live and dead mosquitoes after 24 hours
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Experiment repeated 3 times
Experimental Design

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1. 30 minutes after release (Baseline, no emanators)
   Add emanators
2. 60 minutes after release (30 min exposure)
3. 24 hours after release (24 hr exposure)

Mortality
Collected live and dead mosquitos after 24 hours

Experiment repeated 3 times
  Each repetition contained 8 houses
  Each strain in 2 houses
  Strains within 1 control & 1 emanator house
Emanator Mortality
Significantly Greater Mortality with Emanators

Mean 24 Hr Mortality (+SEM)

Strain

NO
CdF
ITZ
JP

New Orleans
Cienega de Flores
Itzincab
Juan Pablo
Control
Emanator

Preliminary Data
Mortality Similar Among Control Houses

Treatment*Strain $F = 3.9$; df = 3, 16; $P = 0.028$

Preliminary Data
Significantly Greater NO Mortality w/ Emanators

Mean 24 Hr Mortality (+SEM)

Strain

Treatment*Strain $F = 3.9; \, \text{df} = 3,16; \, P = 0.028$

Preliminary Data
Mean 24 Hr Mortality (+SEM)

Strain

- NO
- CdF
- ITZ
- JP

Treatment*Strain $F = 3.9$; $df = 3, 16$; $P = 0.028$

Resistant Strain Mortality did Not Differ

Preliminary Data
Landing Counts
No Difference in Landings at Baseline

Preliminary Data

Mean Landing / Mosquito (+SEM)

30 Minutes

Time within Experimental Houses
No Difference in Landings at Baseline

Preliminary Data

Treatment*Strain $F = 1.5; \text{ df } = 3,16; P = 0.25$

Time within Experimental Houses

Mean Landing / Mosquito (+SEM)
Landings Significantly Reduced Initially

Mean Landing / Mosquito (+SEM)

Emanators Introduced

30 Minutes

60 Minutes

Time within Experimental Houses

Treatment*Strain $F = 3.6; \text{ df } = 3,16; \ P = 0.036$
No Differences in Resistant Strains Landing

Treatment*Strain $F = 4.9; \text{df} = 3,16; P = 0.013$

Mean Landing / Mosquito (+SEM)

Emanators Introduced

Time within Experimental Houses

30 Minutes

60 Minutes

24 Hours

New Orleans
Cienega de Flores
Itzincab
Juan Pablo
Control
Emanator

Preliminary Data
Metofluthrin Emanators Affect *Ae. aegypti*

Emanators significantly increased mortality
For susceptible NO strains only
No difference with pyrethroid-resistant strains
Metofluthrin Emanators Affect Ae. aegypti

Emanators significantly increased mortality
For susceptible NO strains only
No difference with pyrethroid-resistant strains

Landings significantly reduced with emanators
Initially both susceptible and resistant strains
Resistant stains landings increased after 24hrs
Metofluthrin Emanators Affect *Ae. aegypti*

Emanators significantly increased mortality
  For susceptible NO strains only
  No difference with pyrethroid-resistant strains

Landings significantly reduced with emanators
  Initially both susceptible and resistant strains
  Resistant stains landings increased after 24hrs

Start testing emanators in the field
Test Ticul Strain within Experimental Houses

**Preliminary Data**

Mean 24 Hr Mortality (+SEM)

<table>
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<th>Strain</th>
<th>NO</th>
<th>CdF</th>
<th>ITZ</th>
<th>JP</th>
<th>Ticul</th>
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<td>0.8</td>
<td>n.s.</td>
<td>n.s.</td>
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* $T = 4.1; \text{df} = 4; P = 0.014$
Test Ticul Strain within Experimental Houses

Mean Landing / Mosquito (+SEM)

Time within Experimental Houses

- 30 Minutes
- 60 Minutes
- 24 Hours

New Orleans
Cienega de Flores
Itzincab
Juan Pablo
Ticul
Control
Emanator

Emanators Introduced

Preliminary Data
Placing Emanators within Homes

Identified 200+ households in Ticul
n ≈ 100 Control & n ≈ 100 Emanator

Collected Mosquitoes
Baseline, no emanators
Add emanators
Every 3 weeks
Change emanators
Field Collections from Ticul Homes

Emanators Introduced

Mean Ae. aegypti / House (+SEM)

Sampling Date

Baseline  +3 Wks  +6 Wks  +9 Wks  +12 Wks

Preliminary Data
Field Collections from Ticul Homes

Preliminary Data

Mean Ae. aegypti / House (+SEM)

Sampling Date

Baseline  +3 Wks  +6 Wks  +9 Wks  +12 Wks

Emanators Introduced

All Ae. aegypti -Control
Bloodfed Ae. aegypti -Control
All Ae. aegypti -Emanator
Bloodfed Ae. aegypti -Emanator

Preliminary Data
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