

# The Effect of Residual IGRs on *Aedes albopictus* and *Aedes aegypti*

## Abstract

Mosquito-borne viruses, namely chikungunya and dengue, are quickly becoming an increasing problem in the western hemisphere. *A. aegypti* and *A. albopictus* mosquitoes, the principle vectors of these viruses, are vigorously breeding in water containers around people's homes. Unlike other mosquitoes, they are daytime biters and good disease vectors. Insect growth regulators (IGRs) are known to impact the juvenile hormones of insects, effectively preventing them from reaching adulthood. The purpose of this experiment was to record the effect of the insect growth regulator pyriproxyfen on mosquito development and to classify how mortality occurs. *A. aegypti* and *A. albopictus* were exposed to water containing flooring tiles treated with pyriproxyfen (Nyguard) in a polymer coating to produce 0.01% (30 PPB), 0.001% (3 PPB) and 0.0001% (0.3 PPB) concentrations of pyriproxyfen in 350 ml of clean, unchlorinated water contained in 500 ml polypropylene cups. Mosquitoes were observed daily until two days after all control mosquitoes had emerged as adults. Mosquitoes were classified and given a number ranging 0-4 according to the stage when they died: larva (0), deformed pupae (1), healthy pupae (2), deformed adult (3) and living adult (4). Results showed that the 0.01% and 0.001% doses of pyriproxyfen were most effective at killing mosquitoes at the larval and pupal stages, thereby preventing them from reaching adulthood. In this study, the 0.0001% dose of pyriproxyfen allowed some adults to live while others died half-enclosed in their pupal case. The IGR hindered the mosquito's ability to completely form new cuticle in the larval and pupal stages, preventing normal development and causing death before adult mosquito development.

## Introduction

### Vector transmitted Arboviruses

- Dengue virus (DENV) and chikungunya virus (CHIKV) are two increasingly important mosquito transmitted arboviruses.
- Diseases are transmitted primarily by *Ae. albopictus* and *Ae. aegypti*.

### *Ae. albopictus* and *Ae. aegypti*

- Container-breeding mosquitoes (e.g., in flower vases, tires, buckets, cisterns, etc.).
- Daytime feeders.

### Pyriproxyfen and Insect Growth Regulators (IGRs)

- Pyriproxyfen is an IGR used against human health pests (e.g., houseflies, cockroaches, mosquitoes).
- WHO allows 0.01 mg pyriproxyfen/l in drinking water (10 PPB) as safe for consumption.
- Pyriproxyfen allows insects to live as immatures but kills emerging adults.

## Objective

Determine the effects of pyriproxyfen in a slow-release mosquito larvicide, and determine the longevity of the formulation.

## Materials and Methods

### First use tile experiment

- Small hexagonal flooring tiles were treated on the porous side with 100  $\mu$ l of formulations with 0.01%, 0.001% and 0.0001% pyriproxyfen (Nyguard in a slow-release polymer formulation).
- Maximum final concentrations of pyriproxyfen expected in water were 30, 3 and 0.3 PPB.
- Tiles were added to water (350 ml) + brewers yeast and liver powder as food.
- Mosquitoes were exposed to water cups until two days after complete adult emergence in controls.
- Experimental design Fig 1, and Fig 2.



Bioassay setup showing treated tile in water container with mosquito larvae.

### Data collection and recording

- Cups were observed daily.
- Dead specimen was given a rating of 0-4.
  - 0 – Normal larva
  - 1 – Healthy pupa
  - 2 – Deformed pupa
  - 3 – Deformed adult
  - 4 – Normal adult

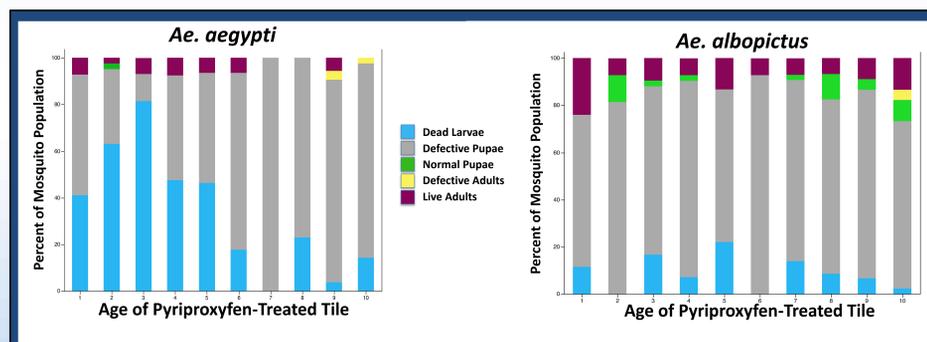


2- Deformed pupa



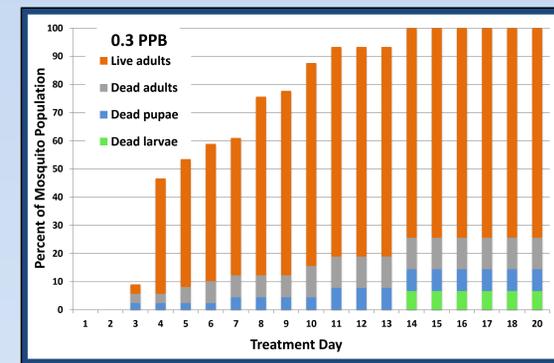
3- Deformed adult

## Results

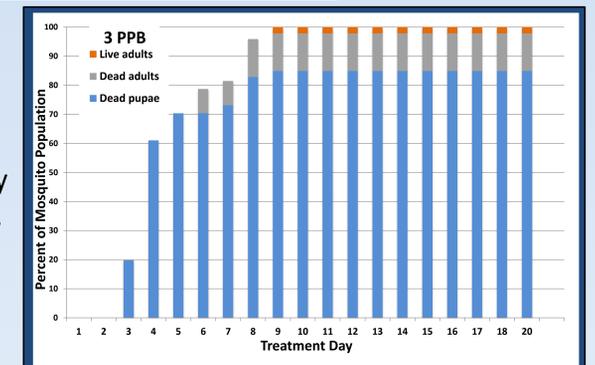


A high percentage of *Ae. aegypti* and *Ae. albopictus* died when exposed to pyriproxyfen-treated tiles that had been reused in different water containers for 10 consecutive days.

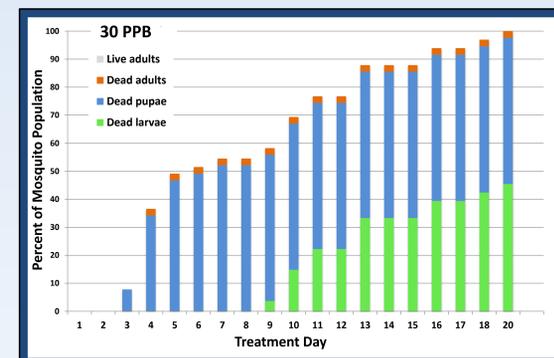
## Results (Cont.)



Pyriproxyfen at 0.3 PPB in water does not kill sufficient numbers of immature mosquitos.



Pyriproxyfen at 3 PPB in water kills mosquitoes mostly at the pupal stage.



At the high dose of pyriproxyfen (30 PPB in water) 100% mortality was reached, but long-living larvae were observed.

## Discussion

- Pyriproxyfen in a slow-release formula is efficient at killing mosquitoes.
  - The pyriproxyfen tiles can be used in any water-holding container (cisterns, cemetery vases, ponds, etc) to effectively eliminate disease-carrying mosquitoes.
- However, with 0.3 PPB pyriproxyfen in water, the treatment becomes less effective at killing mosquitoes, whereas 30 PPB allows for long-living larvae.
  - Mosquito larvae cause no problems for human health; furthermore, long-lasting larvae serve as food for aquatic organisms such as fish.
- The majority of mosquitoes died as larvae or pupae.
  - Larvae or pupae do not cause any human health issues.
- The pyriproxyfen in a slow-release formulation is long lasting.
  - 1 treatment of tiles will last at least 20 days and probably much longer.

## References

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