Control of malaria vectors by the autodissemination of insecticides

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The quest for more tools for malaria vector control

• LLINs and IRS have significantly reduced malaria transmission however they only target INDOOR biting and resting mosquitoes

• More tools are needed to complement these and address the outdoor transmission, and for insecticide resistance management.
Challenges to conventional larviciding

Targeting the most productive sites for cost-effectiveness of the operation
Using mosquitoes to do targeted larviciding? Proof of concept

Control of malaria vectors by the autodissemination of insecticides (pyriproxyfen)

Mosquitoes exposed to PPF while resting

transfer of PPF on body

contamination of water habitats during oviposition
Understanding mosquito ecology

Screen houses for the study of mosquito ecology

Resting preference for *Anopheles arabiensis*

- **29 x 21 x 4.5 m**

![Graph showing the average number of mosquitoes collected per day in different locations (Pot, Walls, Roofs) with error bars indicating the standard error. The graph compares two blocks: Block=4000 Mosquitoes and Block=2000 Mosquitoes.](image_url)
Sterilization of adult mosquitoes with pyriproxyfen

- 0.6 – 0.8 g AI of PPF powder was dusted per m² of black cloth
- 4 breeding habitats (2.5L water and 250 g soil) were set inside control and treatment SFS
- A cow was used as the source of blood meal
- 5000 unfed An. arabiensis females were released per section

An overwhelming 96% reduction in adult production was achieved in pyriproxyfen-treated sections.
Autodissemination of pyriproxyfen into breeding habitats

- 8 PPF-treated / untreated clay pots were set inside SFS
- 2 breeding habitats (2.5L water and 250 g soil) were set inside a control and treated SFS
- A cow was used as the source of blood meal
- 5000 unfed *An. arabiensis* females were released per section

Results

PPF autodissemination by adult mosquitoes caused 82% reduction in mosquito emergence.
Modelling the autodissemination impact

\[ C_{l,x} = 1 - e^{-\frac{C_M U_x M_{l,x,z,d}}{T_{1,x,z,d}}} \]

\(C_{l,x}\) is the proportion of subsets of aquatic habitats which are effectively contaminated with PPF

\(C_M\) is the proportion of the adult mosquito population contaminated with PPF that visit the breeding habitats.

\(T_{1,x,z,d}\) is the minimum number of PPF contaminated ovipositing females caught per sticky trap in one night required to render a habitat unproductive.

\(M_{l,x,z,d}\) is the number of mosquitoes caught per sticky trap per night at samples of natural habitats.

\(U_x\) is the mean time that subsets of habitats persist but remain unproductive following contamination with PPF.

*Kiware et al 2014*. Predicting scenarios for successful autodissemination of pyriproxyfen by malaria vectors from their resting sites to aquatic habitats; Description and simulation analysis of a field-parameterizable model (under review, PLoS One)
Moving to real field settings (June 2015)

Marker 1 in clay pots

Marker 2 + PPF in clay pots

no PPF

PPF

buffer

1-2km (mean dispersal distance)
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