2+1: Why the combination of two passive and one active mosquito trap may well be a control tool worthy of attention

Andreas ROSE ¹, Scott GORDON ¹, Jennifer MCCAW ¹, Alvaro EIRAS ², Marcelo RESENDE ², Luiz MOTA ², Martin GEIER ¹

¹ Biogents AG, Weissenburgstr. 22, 93053 Regensburg, Germany
² Universidade Federal de Minas Gerais, Belo Horizonte, Brazil

www.biogents.com
andreas.rose@biogents.com
Outline

• Focus on *Stegomyia* (*Aedes aegypti* & *Aedes albopictus*)
• Update on the current trap technology for these species
  – Trap for host-seeking mosquitoes
  – Traps for gravid mosquitoes (lethal ovitraps)
• Recent studies published on these traps used as control tools against *Stegomyia*
• Introduction of the 2 plus 1 concept
The BG-Sentinel catches host-seeking *Stegomyia*, but also males
BG-Sentinel: Mass trapping \textit{Ae. (St.) aegypti} in Manaus, Brazil

Evaluation of the Effectiveness of Mass Trapping With BG-Sentinel Traps for Dengue Vector Control: A Cluster Randomized Controlled Trial in Manaus, Brazil


6 intervention areas
1 BGS per house, 60.5% coverage
6 reference areas (=“control”)

Biweekly monitoring with 4 BGS/area

**Fig. 2.** Maps of (a) the study site Manaus containing a black circle that indicates the localization of the Cidade Nova neighborhood, (b) the localization of the six intervention clusters (white) and the six untreated control clusters (gray) within the study site, and (c) an example of one intervention cluster.
BG-Sentinel: Mass trapping *Ae. (St.) aegypti* in Manaus, Brazil

Table 3. Overview of the mean no. of female *Ae. aegypti* caught with BGS monitoring traps in 24 h at the baseline period and during three different periods after beginning of mass trapping

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<tbody>
<tr>
<td></td>
<td>Rainy season 1</td>
<td>Rainy season 1</td>
<td>Dry season</td>
<td>Rainy season 2</td>
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<tr>
<td></td>
<td>Intervention</td>
<td>Control</td>
<td>Intervention</td>
<td>Control</td>
</tr>
<tr>
<td>1</td>
<td>0.13 (0.25)</td>
<td>0.53 (0.41)</td>
<td>0.37 (0.36)</td>
<td>0.75 (0.72)</td>
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<tr>
<td>2</td>
<td>0.79 (0.62)</td>
<td>0.69 (0.77)</td>
<td>0.26 (0.32)</td>
<td>1.66 (0.97)</td>
</tr>
<tr>
<td>3</td>
<td>1.00 (0.79)</td>
<td>0.71 (0.82)</td>
<td>0.48 (0.21)</td>
<td>2.91 (1.84)</td>
</tr>
<tr>
<td>4</td>
<td>1.54 (0.98)</td>
<td>1.19 (0.62)</td>
<td>1.12 (1.14)</td>
<td>0.94 (0.53)</td>
</tr>
<tr>
<td>5</td>
<td>1.79 (1.01)</td>
<td>1.90 (2.27)</td>
<td>0.86 (1.04)</td>
<td>0.49 (0.40)</td>
</tr>
<tr>
<td>6</td>
<td>2.88 (3.33)</td>
<td>2.31 (1.39)</td>
<td>0.64 (0.60)</td>
<td>1.13 (1.06)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1.35 (1.26)</strong></td>
<td><strong>1.25 (1.29)</strong></td>
<td><strong>0.62 (0.74)</strong></td>
<td><strong>1.29 (1.28)</strong></td>
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</table>

Presented are mean catch rates (±SD) per pair and treatment category for the baseline and the postintervention periods. The number of trapping periods (N) per cluster varied between these periods, when eventually monitoring cycles were lost; bracketed values indicate the range.
BG-Sentinel: Mass trapping *Ae. (St.) aegypti* in Manaus, Brazil

**Fig. 4.** Entomological monitoring with BGS traps: mean catches of female *Ae. aegypti* in mass trapping and control arm. Solid line: mean value of six intervention clusters. Dotted line: mean value of six control clusters. Vertical lines indicate the four periods of the study: baseline (Weeks −8–0), first rainy season (Weeks 1–22), dry season (Weeks 23–42), and second rainy season (Weeks 43–73).
Mass trapping of *Ae. (St.) albopictus* in Cesena, Italy

Fig. 1. Satellite image of the 3 intervention (circles) and 3 control sites (square boxes) in the city of Cesena, Emilia–Romagna, Italy.
Reduction of human landing rate of *Ae. (St.) albopictus* in intervention sites

Fig. 4. Weekly median number of *Aedes albopictus* individuals collected per 1.5 h using human landing collection from intervention and control sites. Error bars represent the interquartile range.
The latest in deadly gravid traps

AGO = Autocidal Gravid Ovitrap
Mackay, Amador & Barrera (2013)

GAT = Gravid Aedes Trap
Eiras, Buhagiar & Ritchie (2014)
The AGO

https://www.springstar.net/products/ago
1 intervention area
/w 3 to 4 AGOs per house
81% coverage

1 reference area

3 months base line, then sourcereduction, larviciding, oviciding
in both areas

Monitoring with
BGS (3 days) and
AGO (7 days)

Fig. 3. (A, B) Weekly variation in the numbers of female Ae. aegypti captured in BG-Sentinel (sum of 3-d captures per week) and SAGO (7-d captures) traps, and accumulated rainfall (second and third weeks before sampling) in the reference (Villodas) and intervention (La Margarita) areas. Mosquitoes were monitored in both areas before applying control measures from October to December 2011 and afterwards until October 2012, following the intervention. Rainfall data are plotted with a forward lag time of 2 wk to facilitate visual association with the numbers of mosquitoes.
Sustained, Area-Wide Control of *Aedes aegypti* Using CDC Autocidal Gravid Ovitraps

Roberto Barrera, Manuel Armador, Verónica Acevedo, Ryan R. Hemme, and Gilberto Félix

Entomology and Ecology Activity, Dengue Branch, Centers for Disease Control and Prevention, Calle Canaúa, San Juan, Puerto Rico

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**Interventions**

- 2 intervention areas /w 3 AGOs per house
- 85% coverage

**References**

- Monitoring with AGO

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**Figure 5.** A comparison of average *Ae. aegypti* females per trap per week in two autocidal gravid ovitraps (AGO traps) intervention (IA-I, La Margarita; IA-II, Villodas) and two reference areas (RA-I, Arboleda; RA-II, Playa) in southern Puerto Rico from February 2013 to 2014.

<table>
<thead>
<tr>
<th>Community type</th>
<th>Participants</th>
<th>Anti-CHIKV IgG positive participants (%)</th>
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</thead>
<tbody>
<tr>
<td>Nonintervention communities (no AGO traps)</td>
<td>152</td>
<td>69 (45.4)</td>
</tr>
<tr>
<td>Community A</td>
<td>103</td>
<td>42 (40.8)</td>
</tr>
<tr>
<td>Community B</td>
<td>49</td>
<td>27 (55.1)</td>
</tr>
<tr>
<td>Intervention communities (AGO traps present)</td>
<td>175</td>
<td>40 (22.9)</td>
</tr>
<tr>
<td>Community C</td>
<td>101</td>
<td>19 (18.8)</td>
</tr>
<tr>
<td>Community D</td>
<td>74</td>
<td>21 (28.4)</td>
</tr>
</tbody>
</table>

Abbreviation: AGO = Autocidal Gravid Ovitrap; CHIKV = chikungunya virus; IgG = immunoglobulin G.
Introducing the GAT: lethal...

...because of an insecticide-treated net in the translucent chamber...

...or because of insecticide (e.g. metafluthrin) sprayed into the inside of the translucent chamber...

...or because of a thin layer of canola or perfumefree baby oil.

But no expensive sticky boards.
Scott Ritchie (James Cook University)
Field Latin Aquare trials in Cairns, Australia, 2014 & 2015: Comparison of Singapore Sticky Ovitrap – AGO - GAT
Pooled GAT and AGO data

Removed outlier GAT collection of 26 females (30 replications)
• Recent developments have greatly improved the efficacy of traps for Dengue / Zika / Chikungunya vectors (*Aedes* (*Stegomyia*)).

• Strong indications that traps for host-seeking mosquitoes and traps for gravid can significantly reduce *Aedes* (*Stegomyia*) population sizes → lower disease transmission.

• Combining both methods should widen the scope of targeted physiological mosquito stages, raising the probability of success.

• Problem so far: large scale availability and price (at least for the hostseeking trap).
Introducing the BG-Bowl

- All plastic
- Less than 2.4 W power consumption
- No catch bag → the trap body is the collection container
- For long-term mass trapping
2 plus 1 concept: using traps to control *Aedes (Stegomyia)*

**Approach**

- Initial source reduction

Then, per household:

- 2 traps targeting gravid mosquitoes (BG-GAT)
- 1 trap targeting host-seeking mosquitoes (BG-Bowl)

- Costs as low as ca. 50 US$ per set, if used in area-wide projects

- Monthly servicing can also be performed by household members

- 3 years minimum product life
Thank you!

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www.biogents.com

biogents@biogents.com