LARVICIDING APPLICATION TECHNOLOGY

SCIENCE-DRIVEN SOLUTIONS TO TODAY’S PUBLIC HEALTH VECTOR CONTROL CHALLENGES

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IT CAN BE DONE!

Effective larviciding for mosquito vector control has been achieved worldwide. Malaria vector control in Africa is not technically unique.

Technology transfer will drive success.
Rice Mosquito Control Italy

Zika virus vector control USA

Culex Control Brazil

Floodwater Mosquito Control Germany
DIFFICULT HABITATS CAN BE MANAGED

Larviciding is effective in complex habitats including those that are large, cryptic and difficult to access.
• Many and varied sources
• Small and hard to find
• Appear to be too numerous to treat

Courtesy: NPR.org
Wide Area Larvicide Spray (WALS™)
Wide Area Larvicide Spray (WALS™)

- **Research since 1996**
  - >20 Studies
  - >10 Publications
  - Seven countries

- **Multiple Platforms**
  - Backpack
  - Vehicle mounted
  - Aerial

- **Disease impacts documented**
  - Dengue – Malaysia, Florida
  - Zika virus – Florida
  - Malaria - Singapore
Focal WALSTM of Clustered Natural Containers In Jungle
Elimination of Malaria Risk through Integrated Combination Strategies in a Tropical Military Training Island

Vernon J. Lee,* Samuel Ow, Harold Heah, Meng Yaw Tan, Patrick Lam, Lee-Ching Ng, Sai Gek Lam-Phua, Abdul Qadir Imran, and Benjamin Seet

Biodefence Center, Singapore Armed Forces, Singapore; Headquarters Army Medical Services, Singapore Armed Forces, Singapore; Environmental Health Institute, National Environmental Agency, Singapore; Headquarters Medical Corps, Singapore Armed Forces, Singapore

Am J Trop Med Hyg 2010, 82 (6), 1024 - 1029
Spray application targeting multiple habitats:
- wet & dry habitats
- obvious & cryptic habitats
- artificial & natural containers
Adult anopheles population rapidly declined to near zero with larvicide treatments.

- No malaria cases.
- Terminated chemoprophylaxis program.
LARVICIDES CAN BE APPLIED EFFICIENTLY TO COMPLEX HABITATS IN RESOURCE LIMITED SETTINGS!

We must think about our approach.
LSM is not IRS
Effective, but not efficient for LSM

- Compressed air sprayers with flat fan nozzles are best for precision delivery of residual sprays in IRS.
- This equipment configuration and method are not efficient for coverage of larval sources.
Mission Impossible!

One Meter Swath
Coarse Spray Swathing Method to Deliver 10 Meter Swaths
Coarse Spray Equipment for Liquid Larvicides

Figure 4. Examples of suitable spray equipment for high volume, hand application of liquid larvicides

Figure 5. Examples of solid stream nozzle configurations

Disk – no core

Solid stream
Swathing Spray of Clustered Rock Holes in Mali
APPLICATION TECHNOLOGY CAN BE TRANSFERRED!

Vector Control Field workers worldwide have been successfully trained to apply larvicide to complex habitats.
My football patch is flooded and full of malaria mosquitoes!
What would Soper do?
Train Local Talent!
The skills are teachable.
Swathing Method Training Mali
THINK BIG!

Advanced application methods have enabled control of DENV, ZIKV & CHIKV vectors in cryptic habitats across broad geographies, interrupting disease transmission.

It is possible for malaria vector as well.
IVM with *Bti* AM65-52 WG
WALS™ for Zika Vector Control
Wynwood Neighborhood
Miami, Florida 2016
During June 30–August 5, 2016, the first recognized outbreak of mosquito-borne transmission of Zika virus in the continental United States occurred in a neighborhood in Miami-Dade County, Florida. Twenty-nine persons with Zika virus infection had likely exposure within an approximate 6-block area. The outbreak ended after aerial spraying to control mosquitoes. No increases in short-term health effects were associated with spraying.

Source: MMWR September 23, 2016
IVM with *Bti* AM65-52 WG
Aerial Spraying for Zika Vector Control
Wynwood Neighborhood
Miami, Florida 2016

**Air attack on Zika mosquitoes**

Since Aug. 4, Miami-Dade County has been conducting aerial spraying to kill mosquitoes. Numbers are dropping in a 2-square-mile area where chemicals are sprayed to kill both adult mosquitoes and eggs. But numbers are up in a 10-mile area where only adults are being targeted.
Dengue vector control
WALS™ Application of Bti strain AM65-52 WG
2011-2017

22 cases of dengue 2009
65 cases of dengue 2010
House inspections, public education and source reduction
and ULV adulticide spraying
A large scale biorational approach using Bacillus thuringiensis israeliensis (AM65-52 strain) for managing Aedes aegypti populations to prevent dengue, chikungunya, and Zika transmissions.


Dengue control with Bti strain AM65-52 WG
Aerial Wide Area Spray 2011-2016

Zero confirmed cases of dengue 2011-2015
One case in 2016.
House inspections and public education continued.
# Spray Parameters

<table>
<thead>
<tr>
<th>Cayman WG Target Parameters</th>
<th></th>
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<tbody>
<tr>
<td><strong>Atomizer</strong></td>
<td>AU4000</td>
<td></td>
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<tr>
<td><strong>Number</strong></td>
<td>8</td>
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<td></td>
</tr>
<tr>
<td><strong>Spacing</strong></td>
<td>9-19 ft from CL</td>
<td>even</td>
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<tr>
<td><strong>RPM</strong></td>
<td>6500</td>
<td></td>
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<tr>
<td><strong>Blade angle</strong></td>
<td>45 deg</td>
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<tr>
<td><strong>Mix w/w</strong></td>
<td>24%</td>
<td>2.0 lbs/gal</td>
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<tr>
<td><strong>lbs WG/ac</strong></td>
<td>0.50</td>
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<tr>
<td><strong>Volume</strong></td>
<td>32.0 oz/ac</td>
<td>0.250 gpa</td>
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</tr>
<tr>
<td><strong>speed</strong></td>
<td>145 mph</td>
<td></td>
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<tr>
<td><strong>swath</strong></td>
<td>400 ft</td>
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<tr>
<td><strong>VRU</strong></td>
<td>13</td>
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<tr>
<td><strong>flow/atomizer</strong></td>
<td>3.66 gpm</td>
<td>29 gpm</td>
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<tr>
<td><strong>Pressure</strong></td>
<td>25 psi</td>
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= 116 acres per minute
## Aerial Application Capacity in Africa

### Table: Aerial Application Capacity

<table>
<thead>
<tr>
<th>Country for Tsetse fly control</th>
<th>Year</th>
<th>Per spray (area km²)</th>
<th>Total coverage for year (sequential area km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botswana</td>
<td>2001</td>
<td>8,560</td>
<td>42,800</td>
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<tr>
<td>Botswana, Namibia, Angola, Zambia</td>
<td>2006</td>
<td>10,000</td>
<td>50,000</td>
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<tr>
<td>Angola &amp; Zambia</td>
<td>2009</td>
<td>10,000</td>
<td>50,000</td>
</tr>
<tr>
<td>Ghana &amp; Burkina Faso</td>
<td>2010</td>
<td>8,680</td>
<td>50,000</td>
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<tr>
<td>Ethiopia</td>
<td>2012</td>
<td>5,000</td>
<td>34,720</td>
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<tr>
<td>Zambia</td>
<td>2014</td>
<td>6,300</td>
<td>20,000</td>
</tr>
</tbody>
</table>

Sources: John Clayton, Mark Latham, Dave Malone, Graham Matthews, MEI Vector Control Team, Airspray K. Ltd.
Why Not?
Conclusions

• Effective larviciding for mosquito vector control has been achieved worldwide.

• Larviciding is effective in complex habitats including those that are large, cryptic and difficult to access.

• Larvicide application methods can be utilized effectively in resource limited settings.

• Vector control field workers worldwide have been successfully trained to apply larvicide to complex habitats.

• Advanced larvicide application methods have enabled control of DENV, ZIKV & CHIKV vectors in cryptic habitats across broad geographies, interrupting disease transmission.