Origins and Operational Uses in South East Asia, 1988 -

Seleena Benjamin
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Public Health Business
Asia/India Region

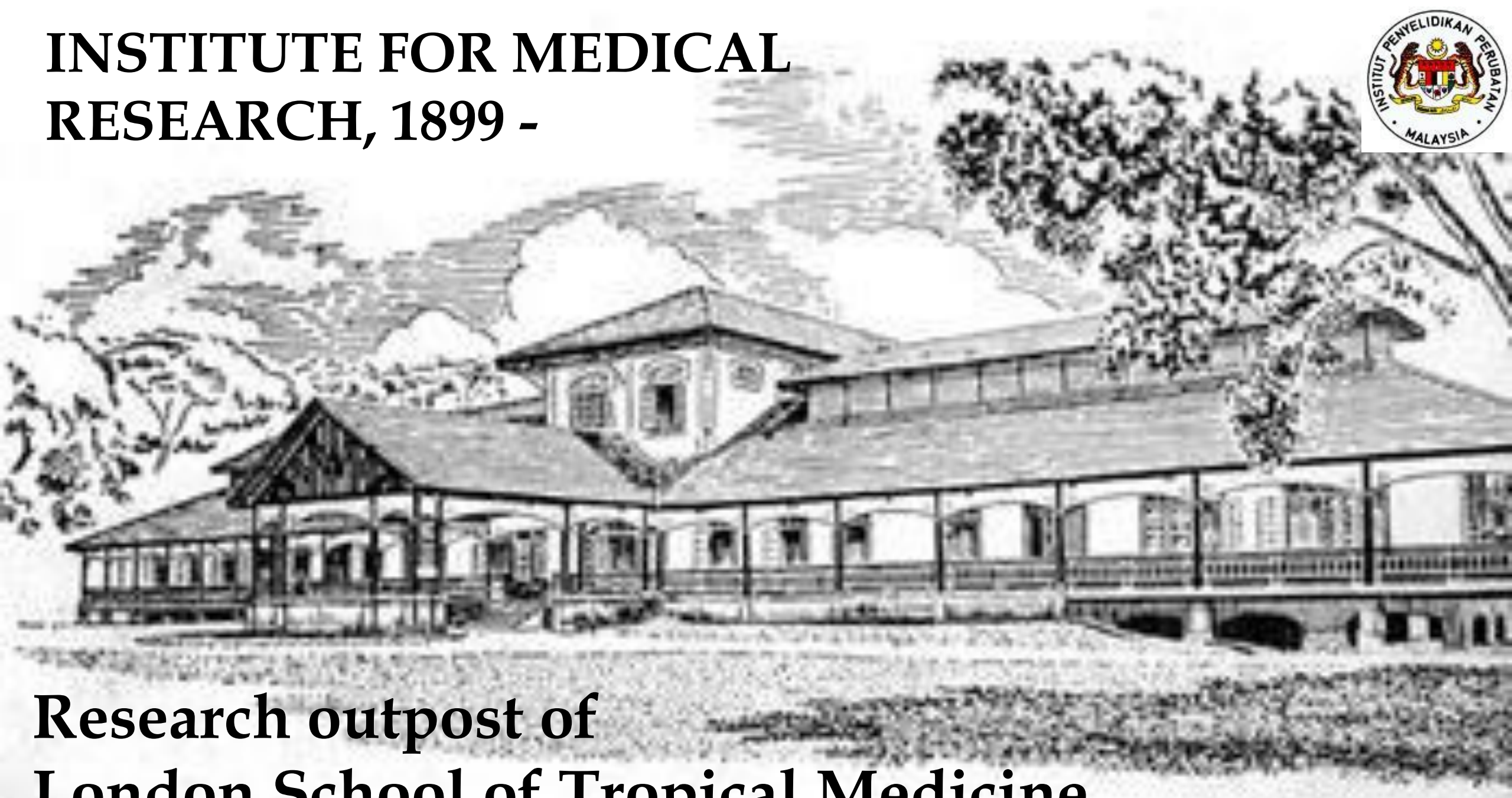

Alaska (US)
Greenland (Dk.)
Iceland
Canada
Russia
United States
Mexico
Caribbean Sea
Brazil
Argentina
Chile
Paraguay
Uruguay
Bolivia
Peru
Colombia
Venezuela
Guyana
Suriname
Fr. Guyana
Ecuador
Sweden
Norway
Finland
United Kingdom
France
Spain
Portugal
Germany
Poland
Belarus
Ukraine
Romania
Greece
Turkey
Italy
Mediterranean Sea
Kazakhstan
Mongolia
China
Japan
Afghanistan
Iran
Pakistan
India
Saudi Arabia
Yemen
Oman
Arabian Sea
Bay of Bengal
Philippines
Malaysia
Indonesia
East China Sea
Sea of Okhotsk
Barents Sea
Norwegian Sea
Greenland Sea
Morocco
Algeria
Libya
Egypt
Mauritania
Mali
Niger
Chad
Sudan
Nigeria
Ethiopia
Somalia
Kenya
Tanzania
Democr. Rep. of the Congo
Angola
Namibia
Botswana
Zimbabwe
Madagascar
South Africa
Australia
ATLANTIC OCEAN
PACIFIC OCEAN
INDIAN OCEAN
Equator

WEST MALAYSIA

EAST MALAYSIA

*__ASEAN__ : association of 11 South East Asian countries.

INSTITUTE FOR MEDICAL RESEARCH, 1899 -



Research outpost of London School of Tropical Medicine

Medical Entomology Unit

ASEAN countries: VBDCP

(Assoc of 11 SEA countries)

- Dengue throughout the year.
- Adulticiding: thermal & cold fogging with PY and OP.

SINGAPORE

MALAYSIA

ASEAN countries: VBDCP

(Assoc of 11 SEA countries)

- Dengue throughout the year.
- Adulticiding: thermal & cold fogging.
- Larviciding: temephos SG, AM oil, etc.
  "Obvious larval habitats were treated with granular larvicides or compression sprayers"

Hand held sprayers to spray larvicides.

VALENT BIOSCIENCES

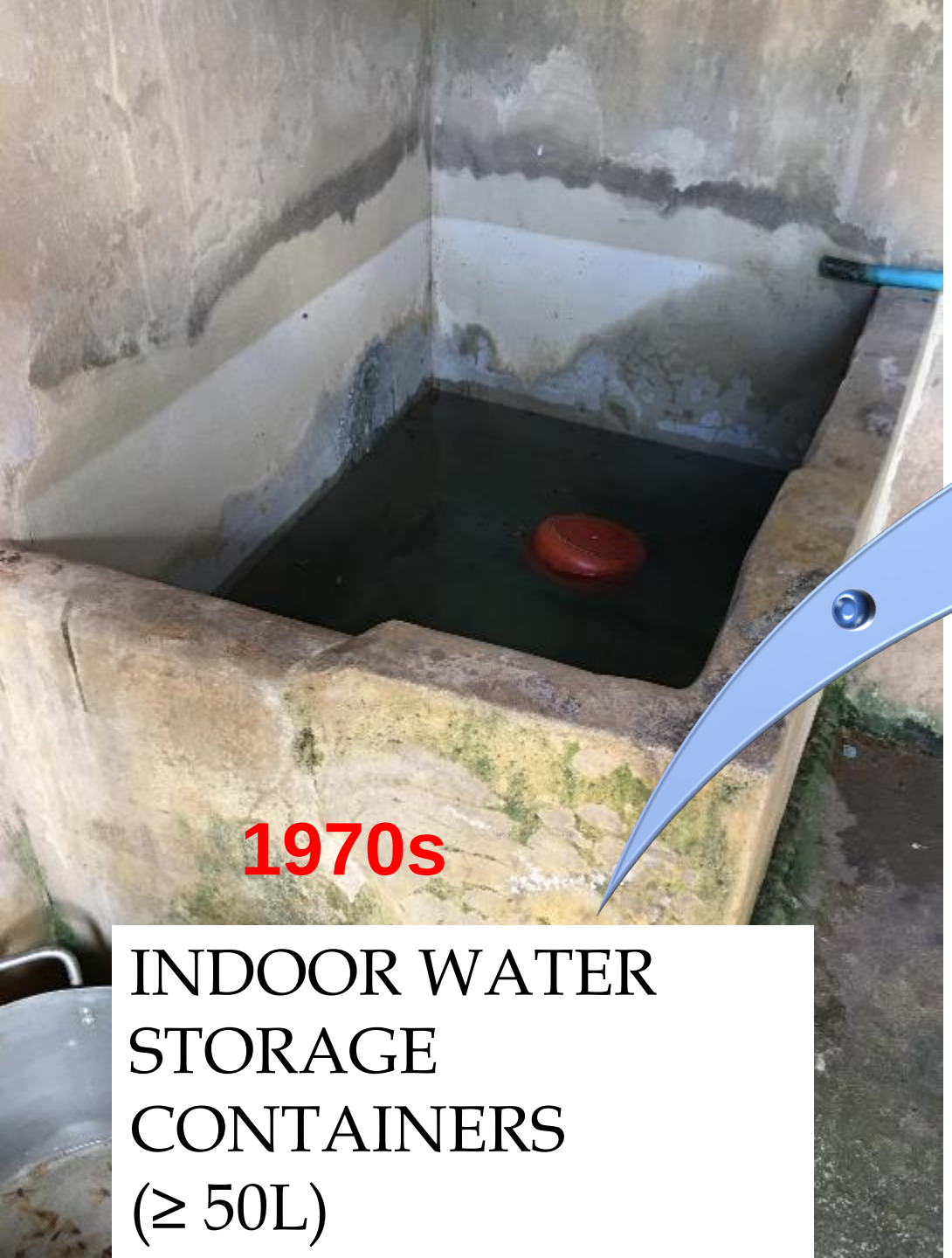
INDIA

SINGAPORE

Challenges faced by VBDCP:

- Dengue was persistent and the cases were increasing.
- Cases happened even when preventive vector control activities were in place.
- Transmission continued in spite of active vector control measures.
- Chemical insecticide resistance.
- Larvicides are impractical to apply in hard-to-reach sites.

Transition of larval habitats over the years



1970s

INDOOR WATER STORAGE CONTAINERS (≥ 50L)

1980s

1990s

OUTDOOR WATER RECEPTACLES

- artificial
- natural
- ≤ 20 L
- 3.5 fold more

Aedes mozzies can't be wiped out, say experts

National Environment Agency officers pouring oil into drains. Most of the Aedes aegypti's breeding habitats, such as gutters and crevices, are small and difficult to locate, making it hard to eradicate the mosquitoes.

September 15, 2015

National Environment Agency officers pouring oil into drains. Most of the Aedes aegypti's breeding habitats, such as gutters and crevices, are small and difficult to locate, making it hard to eradicate the mosquitoes. ST PHOTO: LIM SIN THAI

PUBLISHED SEP 15, 2016, 5:00 AM SGT

Transition of larval habitats over the years

1970s

INDOOR WATER STORAGE CONTAINERS (≥ 50L)

1980s

1990s

OUTDOOR WATER RECEPTACLES

- widespread
- numerous
- cryptic

CHANGE IN THE LARVICIDING APPLICATION STRATEGY

1988: Evaluated formulations & sprayers

- Bti granules, dunks, TP, WP, etc
- Compression sprayer.

Challenges faced by VBDCP:

- Dengue was persistent and the cases were increasing.
- Cases happened even when preventive vector control activities were in place.
- Transmission continued in spite of active vector control measures.
- Larvicides are impractical to apply in hard-to- reach sites.
- Chemical insecticide resistance.

- Bti requires frequent applications.
- Bti is not effective in polluted waters.
- Difficulty in application.
- Bti tends to settle to the bottom of water receptacle soon after application.
- Bti clogs the nozzle

Formulation issue
&
Application equipment issue

1988: Evaluated formulations & sprayers

X Bti granules, dunks, TP, WP, etc.

X Compression sprayer.

CHANGE IN THE LARVICIDING APPLICATION STRATEGY

Bti spray formulation(s) that can be spread as microdroplets, uniformly into the feeding zone of the target larval habitats.

Dengue Vector Control 1994 -

- Outdoor spray application
  - Open fields; Residential estates; Closed car parks

- Truck mounted ULV generators
  - Scorpion
  - Igeba U15
  - Dynafog MaxiPro 4

- Back pack mist blowers
  - Maruyama MD 300/301
  - Stihl SR 380/420

- Thermal fogger
  - AF 35

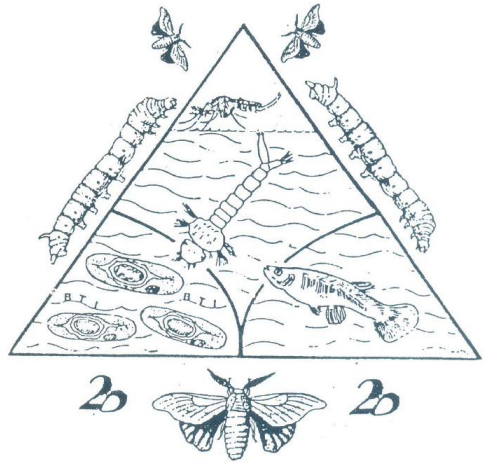
To disperse Bti micro droplets to reach a wide area

To use the available sprayers

To spray Bti + adulticide together

Cups with larvae – residual for 14 days
Cages with adults
MgO slides

VALENT BIOSCIENCES



Ben Gurion
University
of the Negev

The 20th Anniversary of the Bti Discovery

August 12-16, 1996

Shoresh
(near Jerusalem)
Israel

FIRST ANNOUNCEMENT AND CALL FOR PAPERS

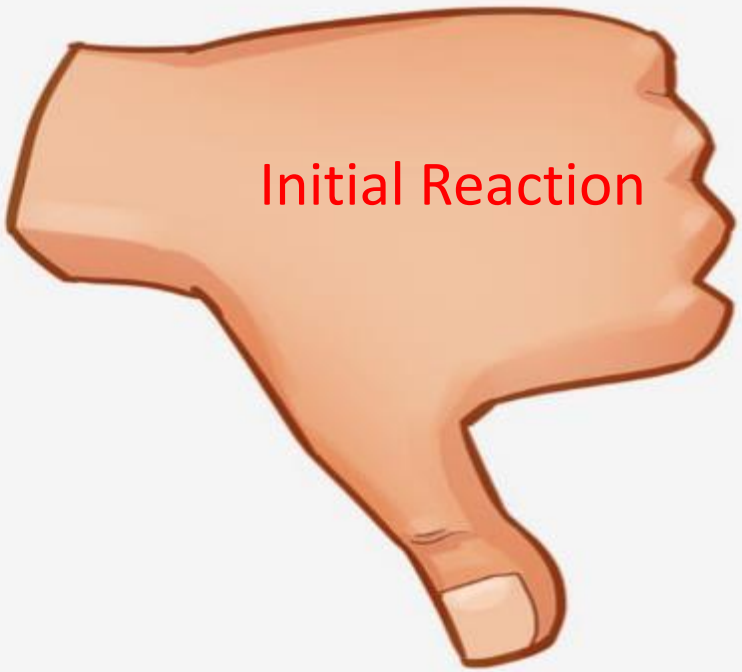
VALENT BIOSCIENCES

#21

Microdroplet Application of Mosquitocidal *Bacillus thuringiensis* Using Ultra Low Volume Generator for the Control of Mosquitoes

P. Seleena and H. L. Lee
Div. of Med. Entomology, Inst. for Med. Research, Malaysia

Ultra low volume (ULV) fogging trials of mosquitocidal *Bacillus thuringiensis* subsp. *israelensis* (B.t.i.) together with malathion against mosquito larvae and adults were conducted in an open air field, housing estates and in a construction site. Commercial aqueous B.t.i. formulation, VECTOBAC 12AS (Abbott Laboratories) containing 1200 ITU/mg against *Aedes aegypti*, and malathion 96% technical grade were used. ULV generators viz. IGEBA and Dynafog Maxipro4 were used to disperse these formulations at discharge rates ranging between 0.25 to 0.50 L/min. The effectiveness of the ULV fogging at various distances from the ULV generator was evaluated by measuring 4 different parameters: larval mortality, adult mortality, B.t.i. count from the test samples and ULV droplet analysis. These trials have indicated that ULV fogging is effective in dispersing the B.t.i. (9v) together with malathion (1v) to affect complete larval and adult mortality. However the mortality varied in relation to the distances from the ULV generator depending on the structure and surrroundings of the building and other environmental factors. Larval mortality remained the same in the test samples even 14 days after the fogging, indicating the persistency of the fogged B.t.i. particles at 28-32°C. These trials have shown that ULV fogging is effective in dispersing bacteria and malathion but to ensure a successful fogging operation the flow rates have to be adjusted in accordance to the ULV generator used and the environment.



INSTITUT PENYELIDIKAN PERUBATAN MALAYSIA

"I did not discover Bti to be used as such !"

"This method will not work !"

Malaria Control 1998-2001

Malaria Control 1998-2001

- *An balabacensis*
- Shallow muddy pools – footprints
- VectoLex WDG
- Backpack mister, sprayed the entire village
- Adult mosquito surveillance

Space spraying of bacterial insecticides against *Anopheles balabacensis* for the control of malaria in East Malaysia. SEAJTMPH 2004: 68-78

VectoBac® WDG WALS and its impact on mosquito vector control and disease transmission, 2004 - 2019

- **Outdoor spray application**
  - Residential estates
  - Dengue endemic sites
  - *Ae aegypti* and *Ae albopictus*
  - Ovitrap surveillance (Target < 10%)
  - Dengue cases/incidence rate

- **Outdoor spray application**
  - Dense vegetation with swamps
  - Malaria vector and *Ae albopictus*
  - Ovitrap surveillance
  - Adult mosquito surveillance.
  - Malaria cases

VectoBac® WDG WALS and its impact on mosquito vector control and disease transmission, 2004 - 2019

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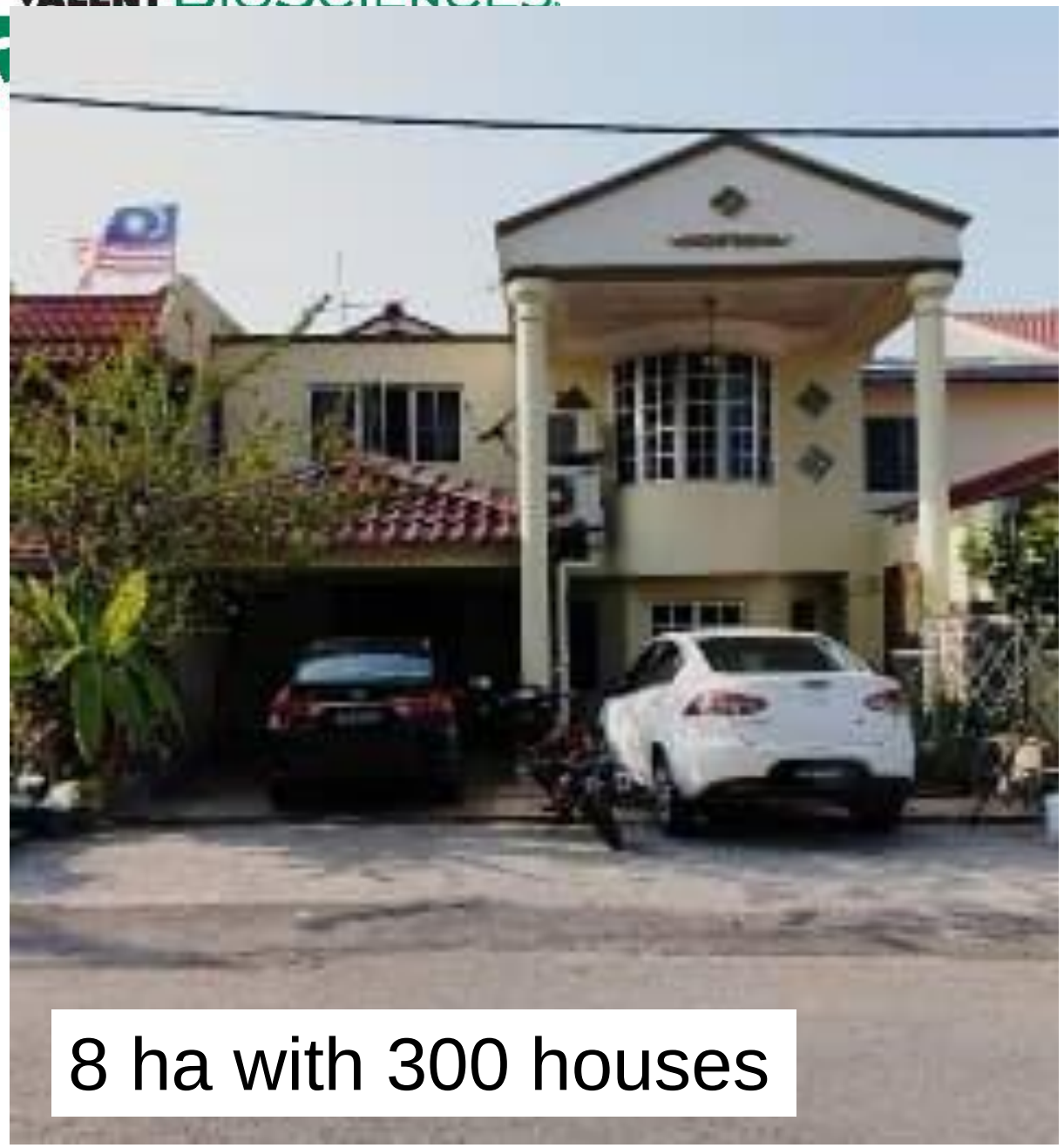
  - Adult mosquito surveillance.
  - Malaria cases

- ≤ 12 ha with back pack misters.
- ≥ 12 ha + tracks with truck mounted ULV generators.

VALENT BIOSCIENCES

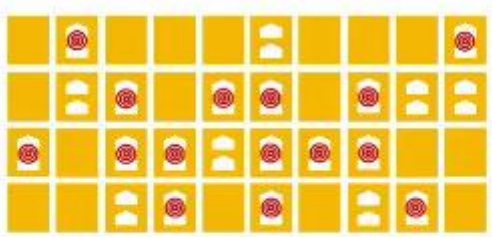


8 ha with 300 houses

One year study
60 ovitraps per site

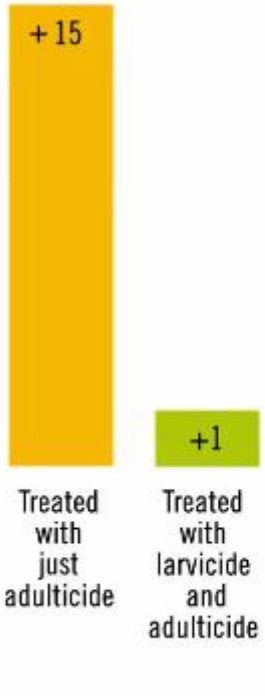
MALAYSIA

CONTAINER MOSQUITO CASE STUDY | 2007-2008



10 Hectares — 400 Houses

8 Hectares — 300 Houses



≥ 40% OI & 15 dengue cases in non Bti WALS treated area

≤ 10% OI & 1 dengue case in Bti WALS treated area

Tan AW et al (2012), SEAJTMPH, 296 – 310

1st publication to show that vector control impacted dengue transmission.

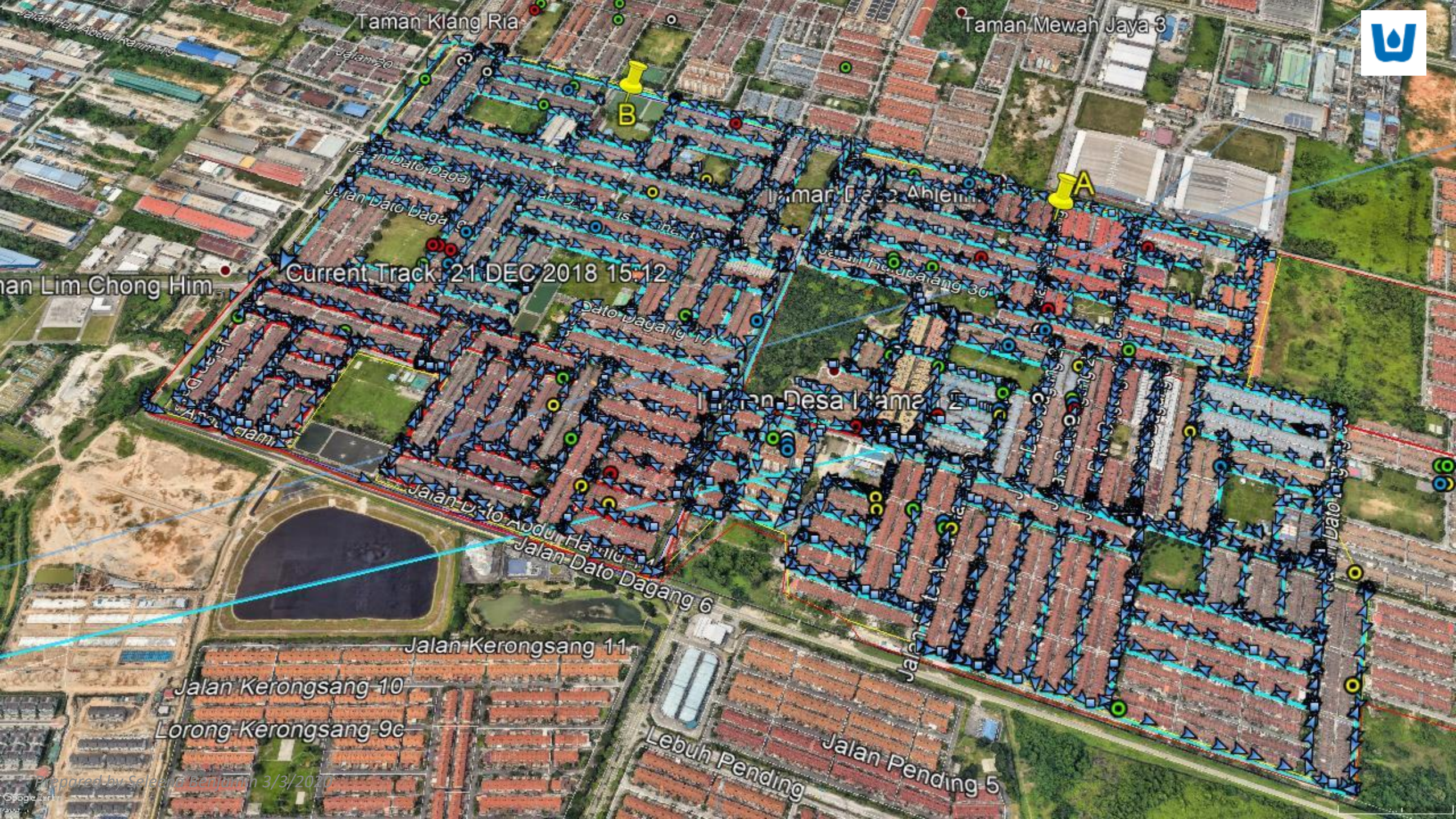
Selangor State, Malaysia

- 174 ha residential estate.
- Transmission from EW47/ 2019.
- WALS from truck mounted ULV.

TIFA ULV HD PLUS

Prepared by Seleena Benjamin 3/3/2020

Prepared by Seleena Benjamin 3/3/2020


Taman Klang Ria
Taman Mewah Jaya 3
B
A
Current Track 21 DEC 2018 15.12
Jalan Dato Dagang 6
Jalan Kerongsang 11
Jalan Kerongsang 10
Lorong Kerongsang 9c
Lebuh Pending
Jalan Pending 5
Prepared by Saleena Benjamin 3/3/2019

WALS Treatment Schedule, 2004 - 2019

Once a week for 4 weeks	Once in 2 weeks for 2 months	Once in 2 weeks for ?
○ Outbreak ○ OI ≥ 20 %	○ Reduction in cases ○ OI ≤ 10 %	

WALS Treatment Schedule, 2004 - 2019

Impact on transmission observed

- *Surviving adult mosquitoes.*
- *Virus incubation in mosquitoes and human.*

- Distance between the WALS treated and non WALS treated site is at a minimum 11 m apart.
- Flight range of 150 m.

Dengue cases categorized into 3 zones as indicated in the legend

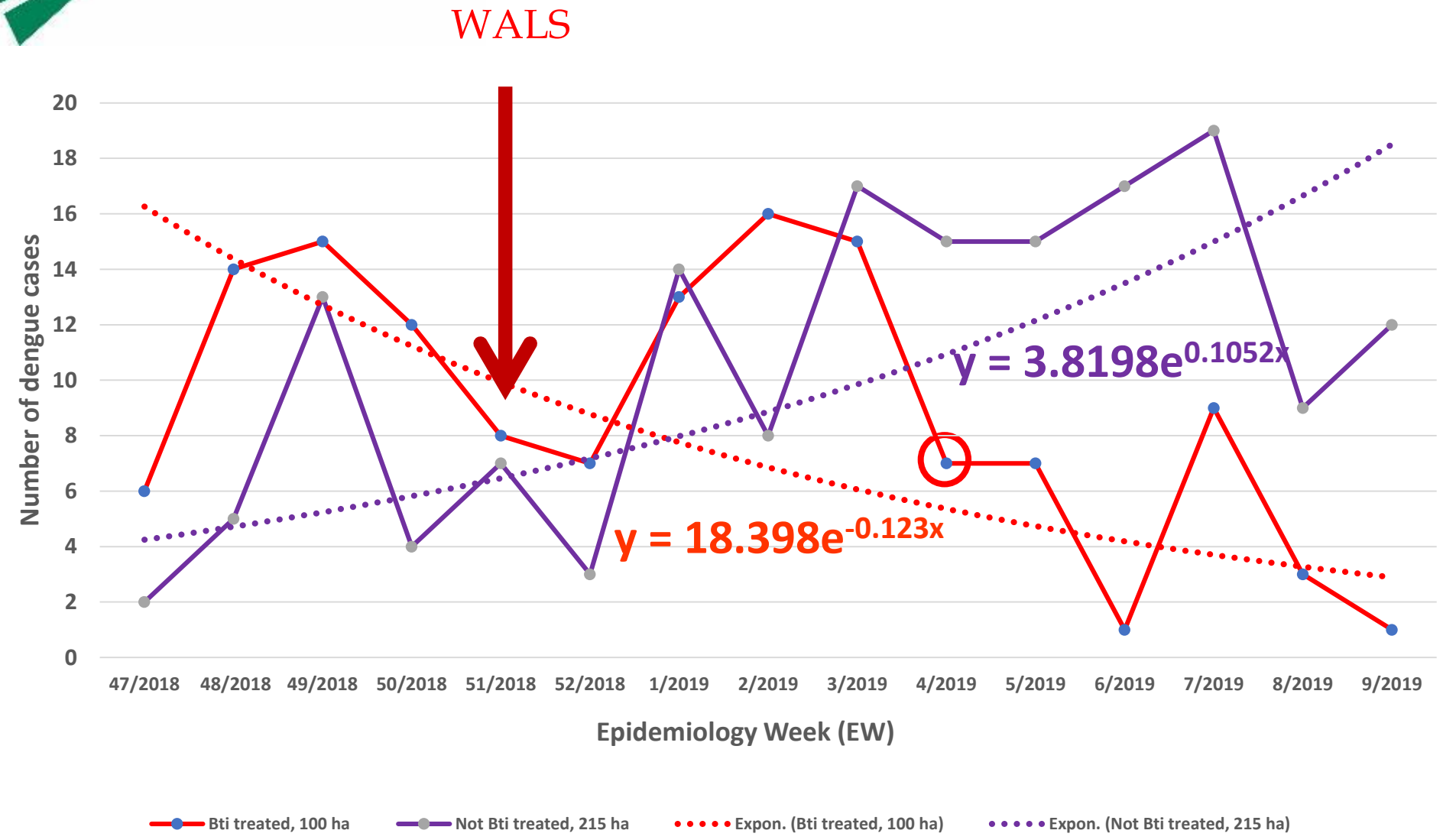
Non WALS treated site (215 ha)

WALS treated site (100 ha)

Buffer site (74 ha)

Prepared by Seleena Benjamin 3/3/2020

Number of dengue cases per epi week



EW 47/2018 – EW 9/2019

- Non WALS site 10.52 % average increase in cases per week
- WALS site 12.3 % average decrease in cases per week

Prepared by Seleena Benjamin 3/3/2020

Mean number of dengue cases per epidemiology week ± SE

Epi Week	WALS site 100 ha	Buffer site 74 ha	Non WALS site 215 ha
47/2018 -3/2019	11.78 ± 1.27 [a]	5.33 ± 0.65 [c]	8.11 ± 1.78 [d]
4/2019 – 9/2019 Impact of WALS	4.67 ± 1.41 [b]	5.83 ± 0.87 [c]	14.50 ± 1.46 [e]

60% reduction (p=0.003)

79% increase (p=0.024)

Prepared by Seleena Benjamin 3/3/2020

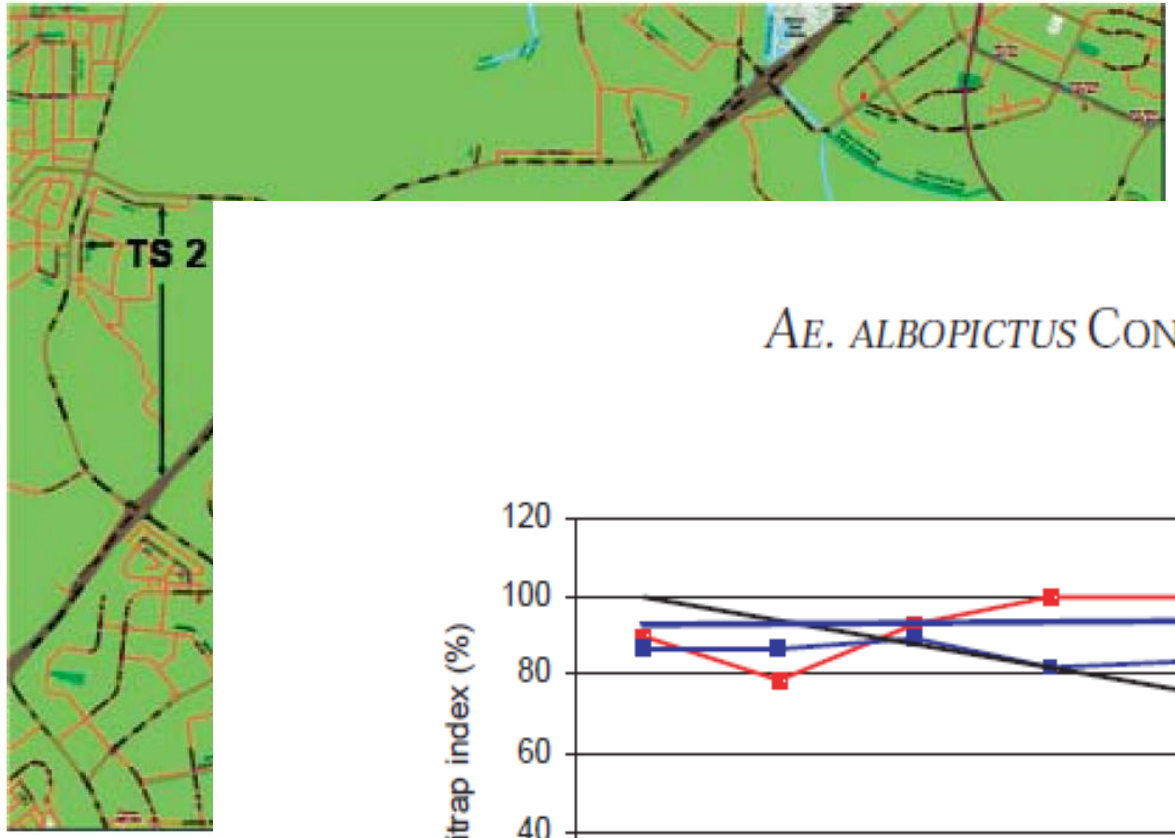
- VectoBac® WDG WALS spray from truck mounted ULV generator significantly aided in interrupting the dengue transmission.

- This application strategy is a key tool to suppress the vector population in wide areas with numerous larval habitats which are difficult to be treated by compression sprayers or direct application.

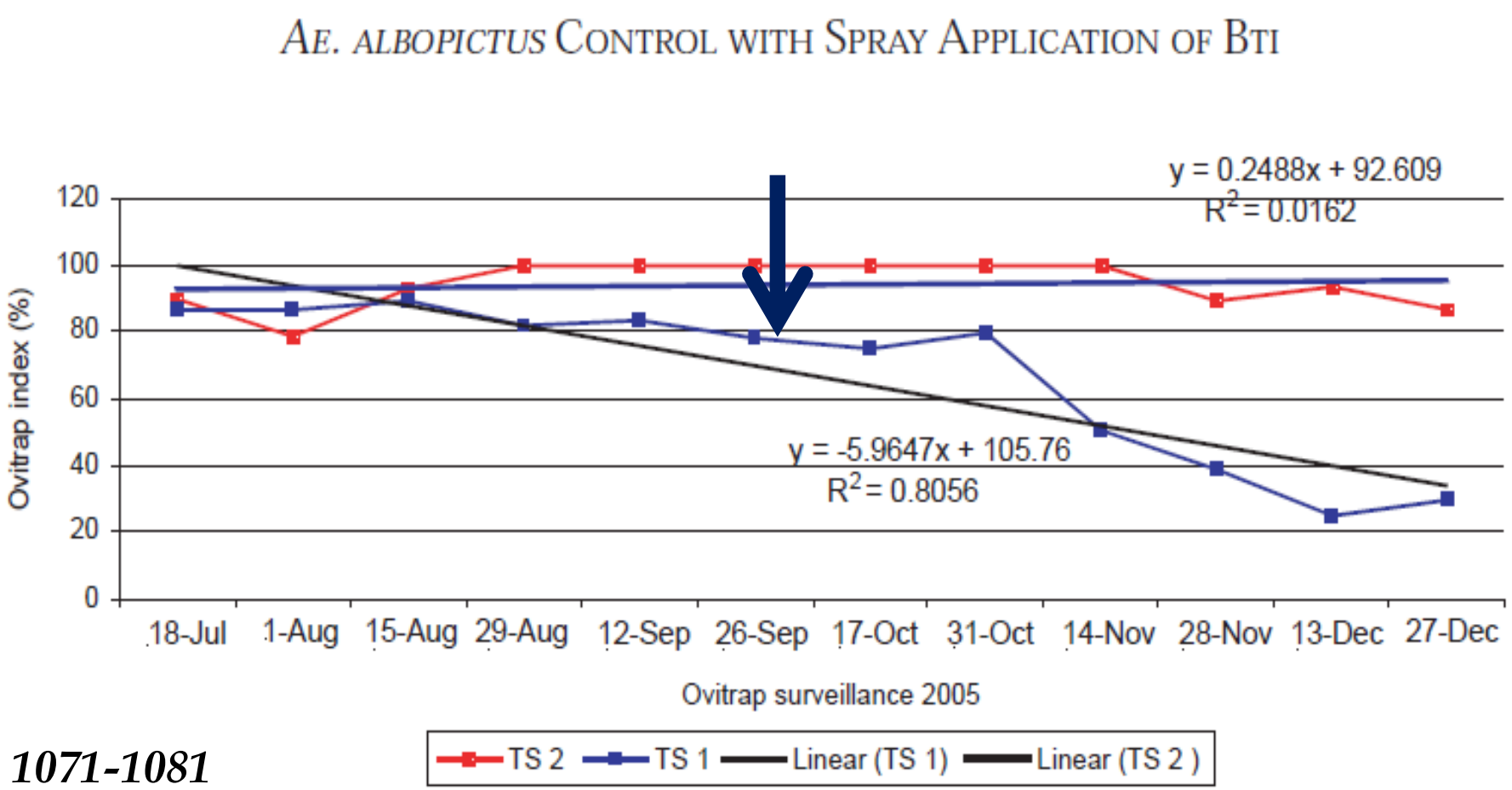
SINGAPORE ARMY 2001 -

- 130 ha
- Dense vegetated site
- *Ae albopictus*
- Igeba U40 and Stihl SR420
- Ovitrap surveillance

SINGAPORE ARMY 2001 -



- 130 ha
- Dense vegetated site

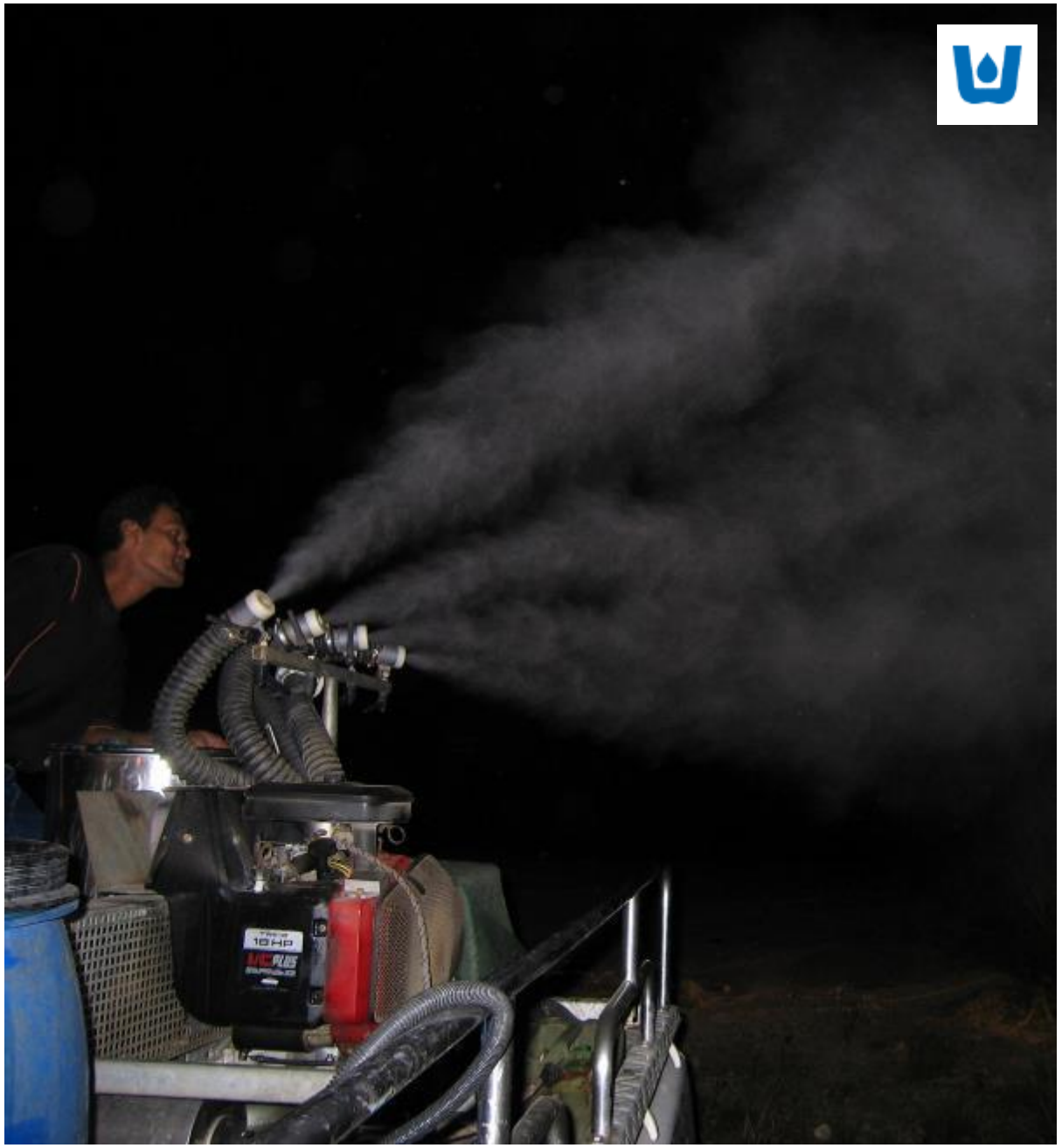


SEAJTMH 2010: 1071-1081

SINGAPORE ARMY 2007 -

- Routine malaria vector control and other mosquitoes
- Dense vegetated site, > 2000 ha
- Igeba U40 and Stihl SR420

VALENT BIOSCIENCES



SINGAPORE ARMY 2007 -

- Routine malaria vector control and other mosquitoes
- Dense vegetated site, > 2000 ha
- Igeba U40 and Stihl SR420

Am. J. Trop. Med. Hyg., 82(6), 2010, pp. 1024–1029
doi:10.4269/ajtmh.2010.09-0562

Elimination of Malaria Risk through Integrated Combination Strategies in a Tropical Military Training Island

✓ No malaria cases.
✓ Terminated chemoprophylaxis program

AMJTMH 2010: 1024-1029

Bti is not effective in polluted waters ?

But, VectoBac WDG WALS shows otherwise…

4 hours after VectoBac WDG WALS, all *Culex* larvae were dead

IMR studies have shown that Bti microdroplets kill *Culex* larvae faster than the *Aedes* larvae.

Dengue Control Program – *Culex* is killed !

VectoBac® WDG WALS, from truck mounted ULV generator or a back pack mistblower, is acknowledged as a key tool in disease control programs.

CHALLENGE:

- Efficient & sufficient sprayers.

THANK YOU