New strategy and alternative insecticides for larval control of the insecticide resistant dengue vector *Aedes aegypti* in Lao PDR

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Background

- **Dengue** is reemerging and endemic in Laos. Recent **outbreaks** occurred in 2010 (22,890 cases), 2013 (44,098) and 2017 (5,584).
- ***Aedes. aegypti* and *Ae. albopictus*** from Vientiane capital are **resistant to Temephos** (Abate®), the only larvicide used for vector control.
- **Urgent need** to provide public health authorities with **new strategies** and **alternative insecticides**.
- **Objectives:** - Test the **efficacy of alternative larvicides** with different modes of action (insecticide resistance (IR) and residual efficacy).
  - Assess the **efficacy** of the pyriproxyfen **auto-dissemination technic** in large scale field trial (**ECOMORE2 project**).

Alternative insecticides for Aedes larval control

Methods and Results.

- IR status of *Ae. aegypti* from Vientiane: temephos, *Bti*, diflubenzuron, pyriproxyfen and, spinosad (WHO protocol, **Table 1**).
- Residual efficacies of *Bti* and diflubenzuron formulations under simulated field conditions using 200L plastic containers (WHO protocol, **Fig.1**).

Insecticide resistance tests at IPL.

Table 1. Resistance status of *Aedes aegypti* against temephos and alternative insecticides. IPL strain (local), USDA (susceptible reference strain)

Larvicides	Class group	Mode of action	Strain	Number of larvae	LC50 (95% CI) (µg/L)	LC95 (95% CI) (µg/L)	RR50	RR95	χ^2	*p*	Slope (± se)
Bti	bacterial larvicide	cell membrane destruction	USDA	1501	14 (12-21)	54 (31-199)	-	-	0.2	0.89	2.8 (0.6)
			IPL	1600	11.8 (11.3-12.3)	21 (19-23)	0.8	0.4	5.5	0.24	6.6 (0.5)
diflubenzuron	benzoylureas	chitin biosynthesis inhibitor	USDA	1500	1.7 (1.5-1.8)	5.6 (4.6-7.2)	-	-	8.5	0.075	3.1 (0.3)
			IPL	804	1.8 (1.4-2.1)	4.1 (3.8-6.8)	1.1	0.7	20	0.0005	4.6 (0.3)
pyriproxyfen	insect growth regulator	juvenil hormone mimics	USDA	1500	0.086 (0.05-0.1)	0.049 (0.03-0.06)	-	-	4.4	0.11	1.4 (0.3)
			IPL	699	0.019 (0.017-0.022)	0.098 (0.074-0.12)	0.2	2	7.6	0.055	2.4 (0.2)
spinosad	spynosins	nicotinic acetylcholine receptors	USDA	1500	14 (12-19)	40 (26-96)	-	-	0.4	0.79	3.6 (0.3)
			IPL	1472	69 (62-77)	206 (170-270)	4.9	5.2	3.4	0.18	3.4 (0.3)
temephos	organophosphate	acetylcholinesterase inhibitor	USDA	1250	2.9 (2.7-3.1)	6.6 (5.8-7.6)	-	-	3.7	0.59	4.6 (0.3)
			IPL	2600	6.6 (6.2-6.9)	11.6 (10.5-13.5)	2.3	1.8	5.3	0.07	6.6 (0.5)

- **No resistance to alternative larvicides.**
- ***Bti* and diflubenzuron formulations remained effective after 28 weeks (semi-field trial).**
- **New policy on Larvicide use in Laos (2019)**

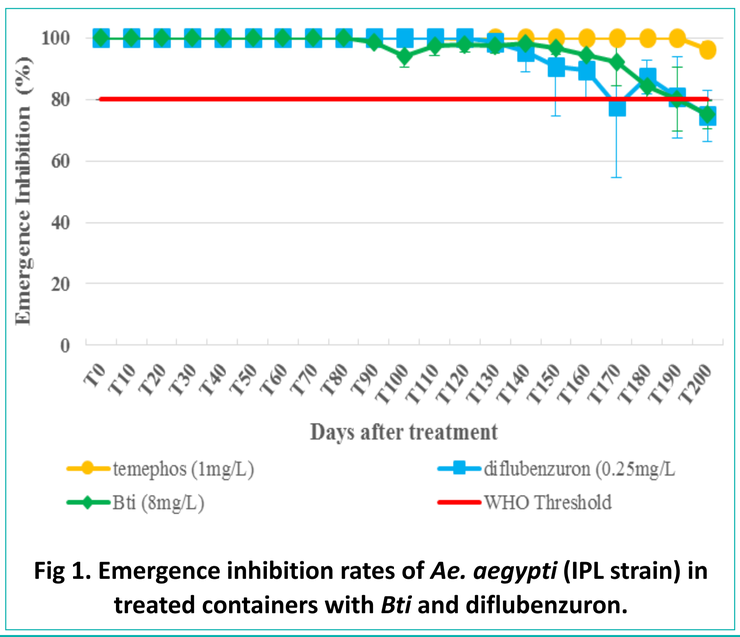


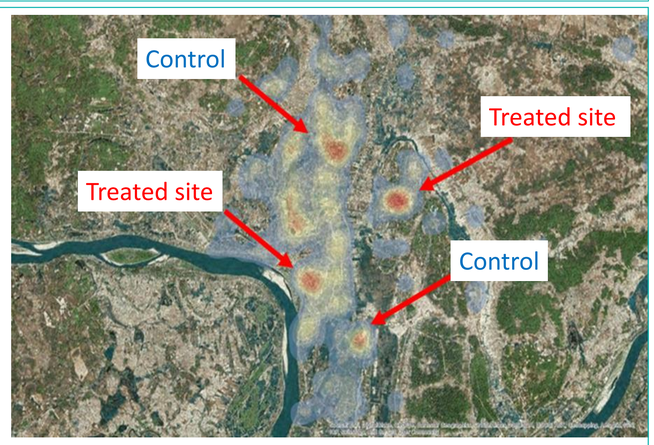
Fig 1. Emergence inhibition rates of *Ae. aegypti* (IPL strain) in treated containers with *Bti* and diflubenzuron.

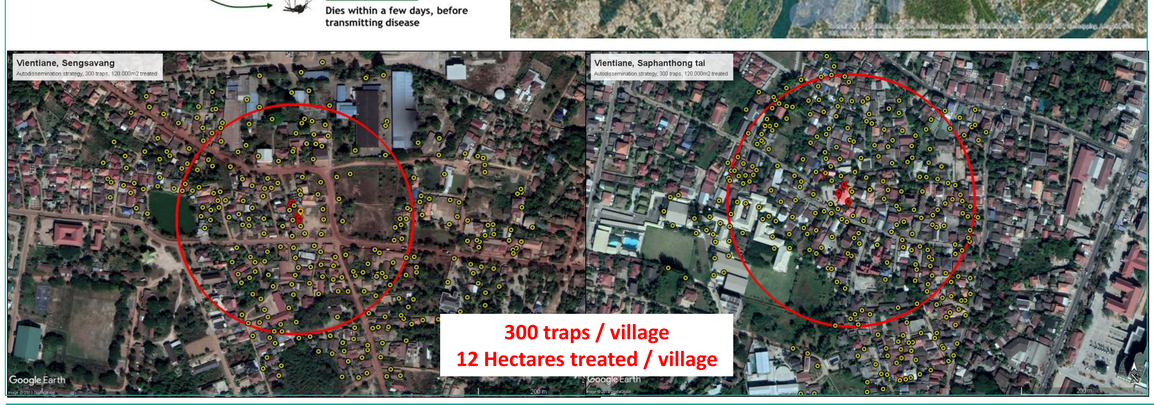
Semi-field trial settings

Innovative strategies for vector control in Laos: ECOMORE2

Methods and results. Entomology surveillance

- Dynamic of vectors (BG traps and Ovitraps weekly; **Fig.2&3**)
- Pyriproxyfen auto-dissemination strategy in urban areas (In2Care® traps)





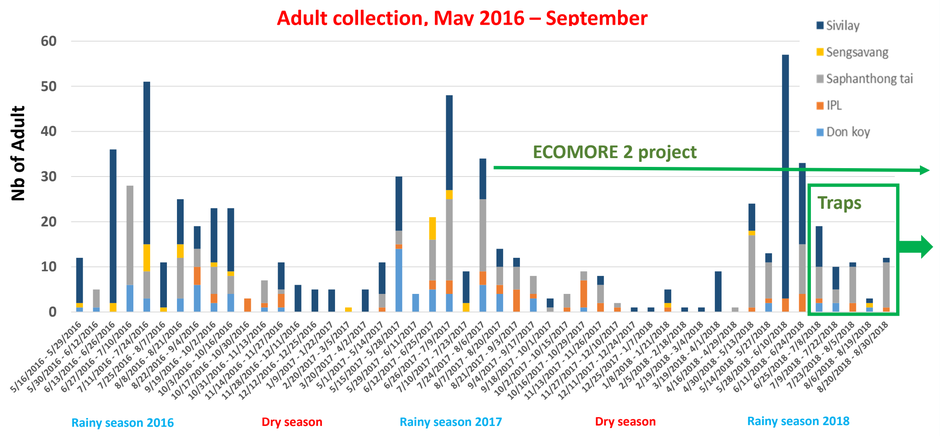


Fig 2. Number of Adult *Ae. aegypti* and *Ae. albopictus* collected biweekly between May 2016 and Sept. 2018 in Vientiane

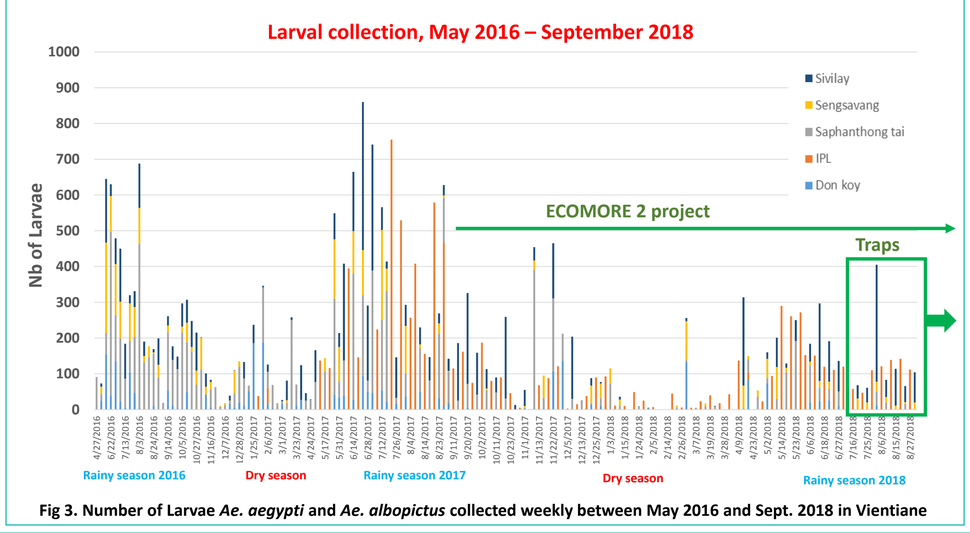


Fig 3. Number of Larvae *Ae. aegypti* and *Ae. albopictus* collected weekly between May 2016 and Sept. 2018 in Vientiane

- **Reduction of dengue cases in treated areas?**

Conclusions

- *Bti* and diflubenzuron may be promising alternative larvicides for controlling temephos resistant vectors in water-storage containers in Laos.
- Pyriproxyfen auto-dissemination strategy is undergoing, and if effective, may represent a potential tool to be used in combination with the new larval control strategies in Laos.

October 01-03th, 2018 - Grand Copthorne Waterfront Hotel, Singapore