

MEDIA RELEASE

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SINGAPORE FACILITATES COLLABORATION ON NEW MOSQUITO SUPPRESSION TECHNIQUES ON ASEAN DENGUE DAY

Renowned international experts gather at Singapore-hosted Workshop to share knowledge and discuss collaborations needed to accelerate development of new mosquito control tools

Singapore, 7 June 2018 – Renowned scientists and international groups piloting new mosquito control tools have come together to share their knowledge and experience with Association of Southeast Asian Nations (ASEAN) and International Atomic Energy Agency (IAEA) Member States. In hosting the *ASEAN Dengue Day Workshop on Recent Developments and Impact Assessment of Sterile and Incompatible Insect Techniques for Mosquito Control*, held from 7 to 8 June 2018 in conjunction with ASEAN Dengue Day, Singapore hopes the knowledge sharing will help facilitate further collaboration and accelerate the development of the new technologies for the benefit of all parties, in particular, fellow ASEAN member states. More information on the Workshop and on ASEAN Dengue Day can be found in Annexes A and B.

The Global Burden of Mosquito-borne Diseases

2 The global burden of mosquito-borne diseases, such as dengue, chikungunya, Zika and Yellow Fever, have been increasing in the last few decades. Dengue is endemic in all ASEAN countries, and their residents are at risk of getting the disease. Global climate change is expected to favour the propagation and geographical spread of mosquitoes, and thus further increase the transmission of mosquito-borne diseases, resulting in human suffering and economic burden.

3 Mr. Masagos Zulkifli, Minister for the Environment and Water Resources, Singapore, who gave the opening address at the workshop said, “2018 is Climate Action Year in Singapore. As an island city state, climate change poses many challenges for us. We need to take individual and collective action to fight climate change for a sustainable Singapore. We must also prepare to be climate resilient. The National Environment Agency’s (NEA) Project *Wolbachia* is in fact one of the projects that aim to develop tools and strategies to prepare for the potential adverse impact of climate change – in this case, *Aedes*-borne diseases, such as dengue and Zika.”

Novel Control Tools to Mitigate Increasing Challenges in Mosquito-borne Diseases

4 Recent developments in novel mosquito control tools have given us an opportunity to augment existing methods to confront the challenges of dengue and other *Aedes* mosquito-borne diseases. The use of male *Wolbachia-Aedes* mosquitoes is a novel approach for suppressing the urban *Aedes* mosquito population. Termed the incompatible insect technique (IIT), it is based on the biological incompatibility between male mosquitoes that carry *Wolbachia* and urban females that do not carry *Wolbachia*. An alternative method, the sterile insect technique (SIT), involves the use of X-ray (or similar) treatment to sterilise mosquitoes prior to releasing them in the field. Both strategies have the potential to reduce

the mosquito vector population in the community, allow targeting of a single species, and thus have negligible effect on ecology. X-ray (or similar) treatment can also be combined with the *Wolbachia-Aedes* approach to prevent the release of fertile female *Wolbachia-Aedes* mosquitoes and thus avoid the build-up of female *Wolbachia-Aedes* mosquitoes in the field over time. The World Health Organization Vector Control Advisory Group (WHO–VCAG) has concluded that such a combined SIT–IIT approach has the potential for long-term control of *Aedes* mosquitoes. More information on new mosquito suppression technologies can be found in Annex C.

5 Professor Duane Gubler, Chairman of the Dengue Expert Advisory Panel (DEAP), and Founding Director of the Emerging Infectious Diseases Programme at Duke-NUS Medical School, Singapore, who delivered the keynote lecture at the workshop, said, “Dengue and other *Aedes*-transmitted diseases have become increasingly important global public health problems in recent decades. There is an urgent need for new tools to control the urban mosquitoes that transmit these epidemics. Singapore has been at the forefront of developing new approaches and tools to control *Aedes aegypti* for years as demonstrated by this international workshop and in sharing information on lessons learned, thus providing the leadership to help build regional capacity to use such tools effectively to reverse the trend of epidemic disease.”

6 In Singapore, the Phase 1 field study of Project *Wolbachia* – Singapore, conducted by the NEA from October 2016 to December 2017, saw a 50 per cent suppression of the urban *Aedes aegypti* mosquito population at the sites where male mosquitoes were released. The ongoing Phase 2 field study aims to combine the incompatible insect technique (IIT) and sterile insect technique (SIT) technologies, and to improve release methodologies for Singapore’s high-density and high-rise urban landscape. Singapore is not alone in exploring these technologies. Similar field studies, using single or combined technologies, have been conducted in French Polynesia (Tahiti), China (Guangzhou), Australia (Innisfail), USA (California) and Thailand (Chachoengsao).

7 The use of X-ray treatment (SIT) for control of insect pests is not new. Mr. Konstantinos (Kostas) Bourtzis, Molecular Biologist at the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, Austria, said, “The SIT has successfully suppressed and eradicated several insect pests worldwide over the last 50-60 years, for example the New World screwworm has been eliminated in North and Central America, and the tsetse fly on the island of Unguja, Zanzibar. More recently, the IAEA has initiated a new Technical Cooperation Project to support Member States to develop and apply SIT-based approaches to manage and control human disease mosquito vectors, such as *Aedes aegypti* and *Aedes albopictus*, which transmit major human pathogens such as dengue, chikungunya and Zika in the Southeast Asian region. The SIT is not a stand-alone technology and should always be used as a component of an area-wide integrated pest management approach.”

International Collaboration in the Development of New Technologies

8 Development of such mosquito control tools requires a multi-disciplinary team – from biology, engineering, to data analytics. Platforms to facilitate various experts from diverse disciplines coming together to share their experiences and insights amassed from their respective research and field trials, are useful to accelerate the development of the new tools.

9 In support of this, NEA and the Ministry of Foreign Affairs (MFA) under the Singapore Cooperation Programme, supported by IAEA, the Association of Southeast Asian Nations (ASEAN) and the Ministry of Health (MOH), are co-organising the *ASEAN Dengue Day Workshop on Recent Developments and Impact Assessment of Sterile and Incompatible*

Insect Techniques for Mosquito Control. It is one of the regional activities of the ASEAN Health Sector, organised in conjunction with ASEAN Dengue Day 2018.

10 Chair of the ASEAN Senior Officials Meeting on Health Development (SOMHD) from Cambodia, represented by H. E. Dr. Or Vandine, Director General for Health, Ministry of Health, Cambodia said: "This event supports the regional advocacy of this year's ASEAN Dengue Day theme of One ASEAN Community Against Dengue. This is based on the need to have an enhanced multi-stakeholder and multi-pronged approach in the prevention and control of dengue. The threat of dengue in the region is one of the challenges that is continually being addressed by the ASEAN Health Sector with its partners."

11 In this Workshop, we welcome 150 participants from 24 countries, representing 15 IAEA Member States and 9 ASEAN Member States, comprising researchers, vector control programme managers, policymakers, the pest control industry, and the product development industry. Collaboration has been central to ASEAN's effort in leveraging innovations and technologies to improve the lives of our people. Through this Workshop, Singapore hopes to have facilitated further collaboration as we collectively commit to tackle the recurrent scourge of dengue and other mosquito-borne diseases in the region.

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For media queries, please contact:

Brenda Xie (Ms)

Assistant Manager, Corporate Communications
National Environment Agency
DID/ HP: 6731 9535/ 9844 8603
Email: brenda_xie@nea.gov.sg

Bridget Chang (Ms)

Assistant Manager, Corporate Communications
National Environment Agency
DID / HP: 6708 6237/ 8481 8697
Email: bridget_chang@nea.gov.sg

About National Environment Agency

Formed on 1 July 2002, the National Environment Agency (NEA) is the leading public organisation responsible for improving and sustaining a clean and green environment in Singapore. The NEA develops and spearheads environmental initiatives and programmes through its partnership with the People, Public and Private sectors. It is committed to motivating every individual to take up environmental ownership and to care for the environment as a way of life.

By protecting Singapore's resources from pollution, maintaining a high level of public health and providing timely meteorological information, the NEA endeavours to ensure sustainable development and a quality living environment for present and future generations.

FACTSHEET ON ASEAN DENGUE DAY MOSQUITO SUPPRESSION WORKSHOP

About the ASEAN Dengue Day Mosquito Suppression Workshop

The *ASEAN Dengue Day Workshop on Recent Developments and Impact Assessment of Sterile and Incompatible Insect Techniques for Mosquito Control* is a capability-building programme for knowledge sharing and exchange. The technical workshop is Singapore's initiative in support of ASEAN Dengue Day 2018, and is one of the official regional activities of the ASEAN Health Sector.

It is jointly organised by the National Environment Agency (NEA)'s Environmental Health Institute (EHI) – a World Health Organization Collaborating Centre (WHO CC) – and the Ministry of Foreign Affairs (MFA) under the Singapore Cooperation Programme (SCP), with the support of the International Atomic Energy Agency (IAEA), Association of Southeast Asian Nations (ASEAN) and Ministry of Health (MOH).

Workshop Objectives

The objectives of the workshop are to enable the participants:

- To share knowledge and experience on recent developments and evidence-based impact assessment, among groups piloting the sterile and incompatible insect techniques (SIT and IIT) for *Aedes* mosquito control, namely *Wolbachia* technology and X-ray treatment;
- To accelerate development of these technologies.

Expected outcomes of the workshop are for the participants:

- To acquire a holistic perspective on the sterile and incompatible insect techniques (SIT and IIT) for *Aedes* mosquito control, to facilitate objective decision making on the feasibility of such approaches in the context of their own countries;
- To build capacity and acquire relevant knowledge on SIT and IIT for *Aedes* mosquito control, to strengthen their capability to plan, carry out and evaluate such approaches to control mosquito vectors in their own countries;
- To foster collaboration among countries exploring the use of SIT and IIT for *Aedes* mosquito control.

The trans-disciplinary workshop will focus on the sterile and incompatible insect techniques (SIT and IIT) for *Aedes* mosquito control, i.e. *Wolbachia* technology and X-ray treatment. Technical topics will include: entomology, epidemiology, molecular biology, data science, automation and engineering. Sessions will feature:

- Field studies – Successes and challenges;
- Community outreach and Stakeholder engagement;
- Trial design and Mathematical modelling;
- Strain development and Quality control;
- Mosquito production and Release mechanisms.

Experts and Participants of the Workshop

The workshop will engage the global community of scientific and public health professionals, as well as IAEA and ASEAN Member State participants.

Besides local experts from NEA, Duke-NUS Medical School, and NUS Saw Swee Hock School of Public Health, there will also be invited expert speakers from the following institutions/ organisations:

S/N:	Countries:	Institutions/ Organisations:
1.	World Health Organization (WHO)	<ul style="list-style-type: none">• WHO-HQ (Geneva)
2.	Australia	<ul style="list-style-type: none">• University of Melbourne<ul style="list-style-type: none">▪ School of Biosciences▪ Bio21 Molecular Science and Biotechnology Institute• University of Queensland• Commonwealth Scientific and Industrial Research Organisation (CSIRO)• James Cook University, College of Public Health
3.	Austria	<ul style="list-style-type: none">• International Atomic Energy Agency (IAEA), Insect Pest Control Section
4.	China (Guangzhou)	<ul style="list-style-type: none">• Sun Yat Sen University
5.	French Polynesia (Tahiti)	<ul style="list-style-type: none">• Institut Louis Malardé
6.	Germany	<ul style="list-style-type: none">• Biogents AG
7.	Italy	<ul style="list-style-type: none">• Centro Agricoltura Ambiente “G. Nicoli”, Medical and Veterinary Entomology Department
8.	Malaysia	<ul style="list-style-type: none">• Institute for Medical Research
9.	Thailand	<ul style="list-style-type: none">• Mahidol University, Centre of Excellence for Vectors and Vector-borne Diseases
10.	United Kingdom	<ul style="list-style-type: none">• Imperial College London<ul style="list-style-type: none">▪ School of Public Health▪ Centre for Environmental Policy▪ MRC Centre for Outbreak Analysis and Modelling▪ Department of Infectious Disease Epidemiology• UK National Institute for Health Research
11.	United States of America	<ul style="list-style-type: none">• Verily Life Sciences• M3 Consulting Group

Public Seminar

The workshop will be rounded off with a Public Seminar for ASEAN Dengue Day at the National Library Building, on 9 June 2018 evening, where expert speakers have been invited to share their valuable insights with the public, together with an expert panel for the discussion segment. Professor Duane Gubler (Duke-NUS Medical School) will speak about climate change and dengue. Professor Leo Yee Sin (National Centre for Infectious Diseases; NCID), will share on management of dengue disease. Dr. Christina Liew (Environmental Health Institute, NEA) will talk about *Wolbachia-Aedes* mosquitoes as our new ally to fight dengue.

FACTSHEET ON ASEAN DENGUE DAY

About the Association of Southeast Asian Nations (ASEAN)

The Association of Southeast Asian Nations (ASEAN) is a regional intergovernmental organisation comprising ten Southeast Asian countries (namely: Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam). It promotes intergovernmental cooperation and facilitates economic, political, security, military, educational and socio-cultural integration amongst its members, other Asian countries and globally.

About ASEAN Dengue Day

ASEAN Dengue Day is an advocacy event held annually on 15 June.

ASEAN Dengue Day aims to:

- Increase public awareness of dengue;
- Mobilise resources for dengue prevention and control;
- Demonstrate the commitment of ASEAN to tackling dengue.

This advocacy event was agreed upon during the 10th ASEAN Health Ministers Meeting in Singapore in 2010.

Indonesia hosted the launch of ASEAN Dengue Day in Jakarta in 2011, and developed the core messages and logo. The event was commemorated simultaneously through various activities that have been conducted at regional, national and sub-national levels amongst ASEAN Member States. These activities were supported by WHO and international and local partners.

Myanmar hosted the regional conference and observations of ASEAN Dengue Day in 2012, followed by Vietnam in 2013, Philippines in 2014, Lao PDR in 2015, Thailand in 2016, and Cambodia in 2017. Malaysia will be hosting the official observation of ASEAN Dengue Day in 2018.

The regional conferences and observations have been attended by representatives of ASEAN Member States, ASEAN Secretariat, Development Partners, private sector, civil society organisations, and community groups or members.

Key Collaborations between NEA's Environmental Health Institute (EHI) and ASEAN Countries

UNITEDengue (UNited In Tackling Epidemic Dengue) Regional Surveillance

- UNITEDengue is a cross-border partnership to achieve shared goals in dengue control, with the following objectives:
 - (i) Cross-border case and virological dengue surveillance to allow timely sensing of the dengue situation in the Asia-Pacific region;
 - (ii) Regional capacity building and strengthening for dengue viral and entomological surveillance; and
 - (iii) Regional capacity building and strengthening for dengue control.

- UNITEDengue is an outcome of the highly successful first two Asia-Pacific Dengue Workshops (2009 and 2010) [now known as the Singapore International Dengue Workshop], and was officially launched at the third workshop (2012). Since its official launch by the two founding partners (Singapore and Malaysia) in September 2012, the network has now expanded to 11 countries. Additional partners are: Brunei, Cambodia, Lao PDR, Myanmar, Pakistan, Philippines, Sri Lanka, Thailand, Vietnam.
- UNITEDengue has received the support and concurrence of the ASEAN Health Sector, as the platform for sharing of dengue data in the region.
- A joint publication with Malaysia Ministry of Health entitled '2013 Dengue Outbreaks in Singapore and Malaysia Caused by Different Viral Strains' was published in the American Journal of Tropical Medicine and Hygiene (June 2015). EHI also provides regular reports following analysis of available data on the dengue situation.

Regional External Quality Assessment (EQA) Programmes for Dengue and Chikungunya

- In collaboration with the World Health Organization (WHO) Western Pacific Regional Office (WPRO), EHI was the coordinating reference laboratory to provide External Quality Assessment (EQA) for the region, from 2013 to 2015.
- The objectives of the EQA Programme were to:
 - (i) Assess regional laboratories in molecular and serological detection of dengue;
 - (ii) Identify gaps in dengue and chikungunya detection;
 - (iii) Build up the core capacity of arbovirus laboratories; and
 - (iv) Stimulate networking and collaboration among regional arbovirus laboratories.
- The programme aimed to contribute to enhanced regional disease surveillance and outbreak response to dengue and emerging infectious diseases.
- The first run of the EQA programme: Regional External Quality Assessment (EQA) Programme for Dengue was successfully completed in 2013, in which a total of 19 national-level laboratories from 18 countries and areas in WPR participated. A joint publication entitled: 'First round of external quality assessment of dengue diagnostics in the WHO Western Pacific Region, 2013' was published in WPSAR in June 2015.
- Following the WHO Informal Consultation to Enhance the EQA Programme for Emerging Infectious Diseases, co-organised by EHI from 1–2 Apr 2014 in Singapore, the second run of the EQA programme: Regional External Quality Assessment (EQA) Programme for Dengue and Chikungunya was successfully completed in 2015, in which a total of 24 national-level laboratories from 22 countries in WPR and SEAR participated. A joint publication entitled: 'External quality assessment of dengue and chikungunya diagnostics in the WHO South-East Asia and Western Pacific Regions, 2015' was published in WPSAR in April 2016.
- In parallel with this exercise, EHI assisted 16 of the participating laboratories to set-up and validate their chikungunya virus detection capabilities, with the provision of virus reference controls and information on relevant assays.

Singapore International Dengue Workshop (SIDW)

- The Singapore International Dengue Workshop [formerly known as the Asia-Pacific Dengue Workshop] is a capacity building programme for knowledge sharing and

exchange, which supports the Western Pacific Regional Action Plan for Prevention and Control of Dengue (2016), endorsed by WPR Member States and the WHO Global Strategy for Dengue Prevention and Control (2012–2020).

- The workshop is organised by Singapore and the World Health Organization (WHO).
- It is the only workshop in this region that offers public health practitioners a holistic view of dengue surveillance and control, with an emphasis on the establishment of linkages between laboratory diagnosis and surveillance, clinical management and field control.
- To-date, more than 230 public health practitioners from 41 countries have benefited from the Dengue Workshop series, and have been trained over the four workshop runs held in 2009, 2010, 2012 and 2014.
- Evaluation of post-workshop surveys to gauge the impact of the workshop – gathered from alumni of the workshops – reveal the very significant gain in knowledge and skills; gain in confidence in executing their work; and application of the knowledge to their work back in their home countries. An informal social media network has also been initiated, for participants to share dengue updates and expand and sustain partnerships.
- The next run of the workshop will be held from 18–27 September 2018. Invitation to this workshop will be extended to WHO Member State countries in WPR, SEAR, EMR and AFR.

ASEAN Congress of Tropical Medicine and Parasitology

- The ASEAN Congress of Tropical Medicine and Parasitology (ACTMP) was inaugurated in 2004, to provide a platform for scientists, researchers and public health practitioners from ASEAN countries to present their findings, and network with other scientists from the region.
- The first meeting was held in Kuala Lumpur (Malaysia), followed by the second in Bandung (Indonesia), and the third in Bangkok (Thailand).
- The fourth run was jointly organised in Singapore by EHI, the Singapore Society of Microbiology and Biotechnology (SSMB), and the REDI Center. The theme was 'Tropical infectious diseases and vectors in a vibrant and ever-changing environment'. The congress gathered local and foreign experts who presented their scientific findings on tropical infectious diseases, stimulating interactive discussions and promoting collaborations, with the aim of reducing the burden of these diseases in the region.

FACTSHEET ON NEW MOSQUITO SUPPRESSION TECHNOLOGIES

About the Sterile Insect Technique (SIT)

The sterile insect technique (SIT) is a species-specific vector control approach, which relies on the production and release of sufficient sterile males to induce sterility in the females in the wild. Over time, this will cause the target species to decline. The sterility in the males is caused by using ionising radiation, which has been observed to be effective through field trials. This is also an environmentally friendly method as sterile insects cannot establish themselves in the environment, and do not introduce non-native species into an ecosystem.

Several successful SIT programmes worldwide have eradicated major insect pest species:

- New World screwworm, *Cochliomyia hominivorax* Coquil, in North and Central America;
- Tsetse fly, *Glossina austeni*, on the island of Unguja, Zanzibar.

About the Incompatible Insect Technique (IIT)

The incompatible insect technique (IIT) exploits the natural phenomenon of cytoplasmic incompatibility (CI), using the naturally occurring *Wolbachia* bacterium. CI is expressed as embryonic death after matings between *Wolbachia*-carrying males and non-*Wolbachia*-carrying females or females carrying a different *Wolbachia* strain. CI can be used to manage disease vectors and agricultural pests through population suppression or replacement approaches.

Feasibility studies for the use of IIT, with or without radiation, to control *Aedes* mosquito species have provided encouraging results in both the laboratory and the field.

About Wolbachia Technology

Wolbachia is a naturally occurring bacterium (non-genetically modified) found in more than 60 per cent of insect species around us, including butterflies, dragonflies, fruit flies, and various mosquito species such as *Aedes albopictus*, but not in *Aedes aegypti*, the main mosquito vector of dengue. Organisms in the natural environment have been continuously exposed to *Wolbachia* for millions of years. *Wolbachia* has not been shown to infect humans or other mammals, even when carried by biting insects.

Studies have shown that when male *Wolbachia*-carrying *Aedes aegypti* mosquitoes mate with female wild-type *Aedes aegypti* mosquitoes that do not carry *Wolbachia*, their resulting eggs do not hatch. This form of 'sterility' is due to a phenomenon known as 'cytoplasmic incompatibility (CI)'. The strategy is based on the fact that *Aedes aegypti* in the field does not carry *Wolbachia*. The release of male *Wolbachia*-carrying *Aedes aegypti* in the field, to compete with wild-type males for wild-type females, can theoretically lead to a reduction in the mosquito population over time. The ultimate goal is suppression of the *Aedes aegypti* population to a level that cannot sustain dengue transmission. This outcome of this suppression approach is consistent with the current emphasis on source reduction of the *Aedes* mosquito.

Field trials using the Wolbachia suppression approach

The first pilot study using the suppression approach, sponsored by the World Health Organization (WHO) in Myanmar in 1967, showed that the release of male non-native

Wolbachia-carrying *Culex quinquefasciatus* mosquitoes led to a zero per cent hatch rate of mosquito eggs by the twelfth week.

Such a strategy was followed by the successful trial in a Pacific Island in 2009, for suppression of the *Aedes polynesiensis* mosquito population. French Polynesia, Guangzhou and California have since reported successes in reduction of their target *Aedes* populations. The impact on disease remains as yet unknown.

Country	Location	Year of field release	Mosquito species targeted	Results
Myanmar	Myanmar	1967	<i>Culex quinquefasciatus</i> (vector of filariasis) (WHO trial)	100% non-viable <i>Culex quinquefasciatus</i> eggs by week 12
French Polynesia		2009 2012 2015	<i>Aedes polynesiensis</i>	Reported reduction in <i>Aedes polynesiensis</i> population Nearly eradicated <i>Aedes polynesiensis</i> mosquitoes from Tetiatao's Onetahi islet 6 months after the project began
USA	Kentucky	2014	<i>Aedes albopictus</i>	-
China	Guangzhou	2015	<i>Aedes albopictus</i>	Reported reduction in <i>Aedes albopictus</i> population
USA	Los Angeles county	2015	<i>Aedes albopictus</i>	-
USA	Clovis, California	2016 (May)	<i>Aedes aegypti</i>	-
Thailand	Chachoengsao (east of Bangkok)	2016 (Jun)	<i>Aedes aegypti</i>	-
USA	Fresco County, California	2017	<i>Aedes aegypti</i>	Reported reduction in <i>Aedes aegypti</i> population
Australia	Innisfail (south of Cairns)	2017	<i>Aedes aegypti</i>	-