PacMOSSI
Pacific Mosquito Surveillance Strengthening for Impact

AEDES VECTOR INSECTICIDE RESISTANCE MONITORING IN THE PACIFIC

Short Course

25-29 November 2024 | Suva, Fiji

Course Report

Rationale

Insecticide resistance (IR) in *Aedes* vectors threatens the effectiveness of vector control. Resistance data are needed to inform the selection of interventions and the design of vector-borne disease control strategies. However, there is no recent data available for many countries in the Pacific. This training was designed to support participants to generate IR data after returning to their countries.

Course Overview

The short course was held from 25 to 29 November 2024 in Suva, Fiji. Sessions were held at the Fiji Centre for Disease Control of the Ministry of Health and Medical Services.

Objectives
The objectives of the course were for participants to understand the purpose of IR assays and to develop competence in their implementation and analysis, including to:

1. Rear *Aedes* species in low-capacity insectaries for use in resistance assays;
2. Identify the genera of mosquito larvae (*Aedes*, *Culex* and *Anopheles*) and differentiate adult males and females;
3. Evaluate IR using the WHO tube test; and,
4. Record IR data and understand its implications for vector control strategies.

Schedule
Sessions were held over 5 days and included classroom learning, practical demonstrations, and hands-on participation. There was an emphasis on ensuring that participants developed the capacity to conduct resistance testing upon returning to their workplaces.

Attendees
In attendance at the course were 16 participants from 11 Pacific Island Countries, 4 facilitators from 3 organizations (James Cook University, QIMR Berghofer Medical Research Institute and Fiji Ministry of Health and Medical Services), and 2 observers from The Pacific Community (SPC).

Participants

Country	Name
Cook Islands	Paul Maaka
Cook Islands	Nelson Ngaiorae
Fiji	Kirthi Krishnita Kapoor

Fiji	Tulia Kuruduadua
Fiji	Adi Litiana Malokibau
Fiji	Apolosi Waqalevu
Fiji	Raijeli Salato
Kiribati	Tabomoa Tinte
Niue	Mia Talagi
Nauru	Felila Peter
Samoa	Soimavi Brown
Solomon Islands	Joy Kaimauri
Tonga	Tevita Faka'iloatonga
Tokelau	Tenali Losefa
Tuvalu	Miliesi Kapuafe
Vanuatu	Johnny Nausein

Facilitators and observers

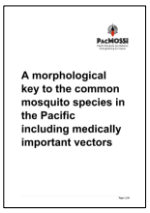
Organisation	Name
QIMR Berghofer Medical Research Institute	Gregor Devine
QIMR Berghofer Medical Research Institute	Elina Panahi
James Cook University	Amanda Murphy
Fiji Ministry of Health and Medical Services	Vineshwaran Rama
Beyond Essential Systems	Geoff Fisher
The Pacific Community	Mark Ero
The Pacific Community	Sala Saketa

Resources

The following key resources were used during the course:

PacMOSSI Participant Handbook: the Short Course Handbook provides a simplified overview of key technical content with links to relevant presentations, resources, and videos.

PacMOSSI SOP: the Standard Operating Procedure for testing IR with WHO tube tests presents an adapted protocol for IR testing of *Aedes* using tube tests in a low-capacity field insectary/laboratory.



PacMOSSI Identification key: *A morphological identification key to the mosquito disease vectors of the Pacific including medically important vectors* [interim draft] provides a basic guide to adult mosquito identification relevant to the 21 PICs supported by the PacMOSSI consortium.

PacMOSSI Presentations: Selected topics were overviewed in PowerPoint presentations developed by PacMOSSI, including content from the online course.

Training and other materials for the short course are also available on the PacMOSSI website at https://pacmossi.org/event/pacmossi-hands-on-training-for-aedes-vector-insecticide-resistance-monitoring/ or by emailing pacmossi@jcu.edu.au

Content

This short course builds on content from the PacMOSSI online course. Modules can be accessed by registering via the PacMOSSI Online Course webpage.

The course also drew on materials from others sources, in particular the WHO Manual for monitoring insecticide resistance in mosquito vectors and selecting appropriate interventions.

The Standard Operating Procedure for testing insecticide susceptibility of adult mosquitoes in WHO tube tests and the accompanying video provide further details on the procedure used during the course.

Topics covered included:

- Topic 1: Review IR in *Aedes* and the importance of IR monitoring
- Topic 2: Collect *Aedes* from the field for resistance monitoring
- Topic 3: Identify the genus of mosquito larvae
- Topic 4: Distinguish between male and female adult mosquitoes, and identify a subset to species
- Topic 5: Rear *Aedes* in a low-tech field insectary
- Topic 6: Prepare and set up WHO tube tests for adult *Aedes*
- Topic 7: Run, record and interpret data from WHO tube tests for adult *Aedes*
- Topic 8: Manage and report *Aedes* resistance data using the Tupaia app
- Topic 9: Use resistance data to guide interventions against *Aedes*

Schedule

Key	*Classroom learning*	*Practical demonstrations*	*Hands-on participation*	*Field activity*

	25 November	26 November	27 November	27 November	28 November
09:00-09:15	**Opening**	Review of Day 1	Review of Day 2	Review of Day 3	Course recap
09:15-10:30	**Introduction**	**Topic 3: Identify the genus of mosquito larvae**	**Guest presentation: Overview of agricultural IR monitoring**	**Topic 9: Use resistance data to guide interventions against *Aedes***	**Guest presentations: PacMOSSI and SPC support for vector control**
	Group discussion on current practices	**Topic 5: Rear *Aedes* in a low-tech field insectary**			
10:30-10:45	*BREAK*	*BREAK*	*BREAK*	*BREAK*	*BREAK*
10:45-12:30	**Pre-workshop test**	**Topic 6: Prepare and set up WHO tube tests for adult *Aedes***	**Topic 7: Record and interpret data from WHO tube tests (24-hour endpoint)**	**Topic 3 (continued): Identify the genus of mosquito larvae**	**Course review and group discussion session**
	Topic 1: Review IR in *Aedes* and the importance of monitoring			**Topic 4 (continued): Distinguish the sex and species of adult mosquitoes.**	**Closing** Post-workshop test and feedback forms
12:30-13:30	*LUNCH*	*LUNCH*	*LUNCH*	*LUNCH*	*LUNCH*
13:30-15:30	**Topic 8: Manage and report *Aedes* resistance data in Tupaia**	**Topic 6: Prepare and set up WHO tube tests for adult *Aedes***	**Topic 4 (continued): Distinguish the sex and species of adult mosquitoes**	**Review of Topics 5-7: *Aedes* rearing procedures and WHO tube test process**	
	Topic 2: Collect *Aedes* from the field for resistance monitoring	**Topic 3: Identify the genus of mosquito larvae**			
15:30-15:45	*BREAK*	*BREAK*	*BREAK*	*BREAK*	
15:45-17:00	**Topic 4: Distinguish the genus of mosquito larvae and the sex and species of adult mosquitoes**	**Walking tour of mosquito breeding sites**	**Group discussion: trouble-shooting, and data entry into Tupaia**	**Group discussion and revision of key course concepts**	

Proceedings

Field, laboratory, and classroom sessions were held to develop competence in how to collect *Aedes* mosquitoes from the field for use in IR testing assays, how to identify *Aedes* mosquitoes, how to conduct IR testing using the WHO Tube Test method, and how to enter and use the data generated.

Mosquitoes collected in Suva by the Fiji MOH were used in IR tests conducted during the course. For most activities, participants worked in pairs, sharing microscopes and WHO test kits. Other activities (*e.g.*, collecting *Aedes* from the field, rearing *Aedes* in a low-tech field insectary) were done as a group.

An overview of the Tupaia Meditrak software co-developed with PacMOSSI was provided to participants, and there were opportunities throughout the course to practice input of data into the software using tablets (provided on loan by Beyond Essential Systems). During the course, participant IR data was also recorded in excel spreadsheets in order to review the outcomes in detail.

Results of IR test on *Aedes* collected in Suva were used to illustrate how data could be used to inform the choice of vector control tools.

Outcomes

Basic training in field collection and identification of mosquitoes for IR testing was delivered to the satisfaction of the participants (see course evaluation results below).

On the evening before the final feed-back session, a social opportunity organised by one of the facilitators allowed participants to discuss the proceedings in an informal setting. All participants had something to contribute to the group discussion the following day, as included in the conclusions section.

Media coverage

A media release was developed (see here), with additional coverage by James Cook University (see here) and radio coverage on FIVEAA Breakfast (Adelaide), 3GG Local News (Warragul), Radio 4KZ Rural Northern News (Innisfail) and 2CC News (Canberra).

There were 9 social media posts on owned channels, including Facebook, Twitter, and LinkedIn. For example:

- https://www.facebook.com/share/p/1YCr1U1fAQ/
- https://www.facebook.com/share/p/19hYRbYtaR/
- https://www.facebook.com/share/p/186baaq4NG/

Assessments

Pre- and Post-Course Tests
Participants were issued a standardised written assessment at the beginning and end of the short course. This included a self-assessment of activities related to IR monitoring and 10 multiple-choice questions.

For the self-assessment, every participant reported an overall improvement in competence. At the beginning of the short course, across all topics, 85% of responses indicated that participants (n=15) were unable to perform most tasks or needed significant assistance. After the short course, 99% of responses indicated that participants (n=16) could perform tasks independently or with limited assistance. This indicated that the self-assessed competence of the participants had increased significantly.

For the multiple-choice test, the average score was 6.1 out of 10 before the short course. This increased to 8.3 out of 10 for the post-course test (using the same questions). Every participant (n=16) improved on their score between the pre- and post-course assessment. This confirmed that participants had improved their technical knowledge during the short course.

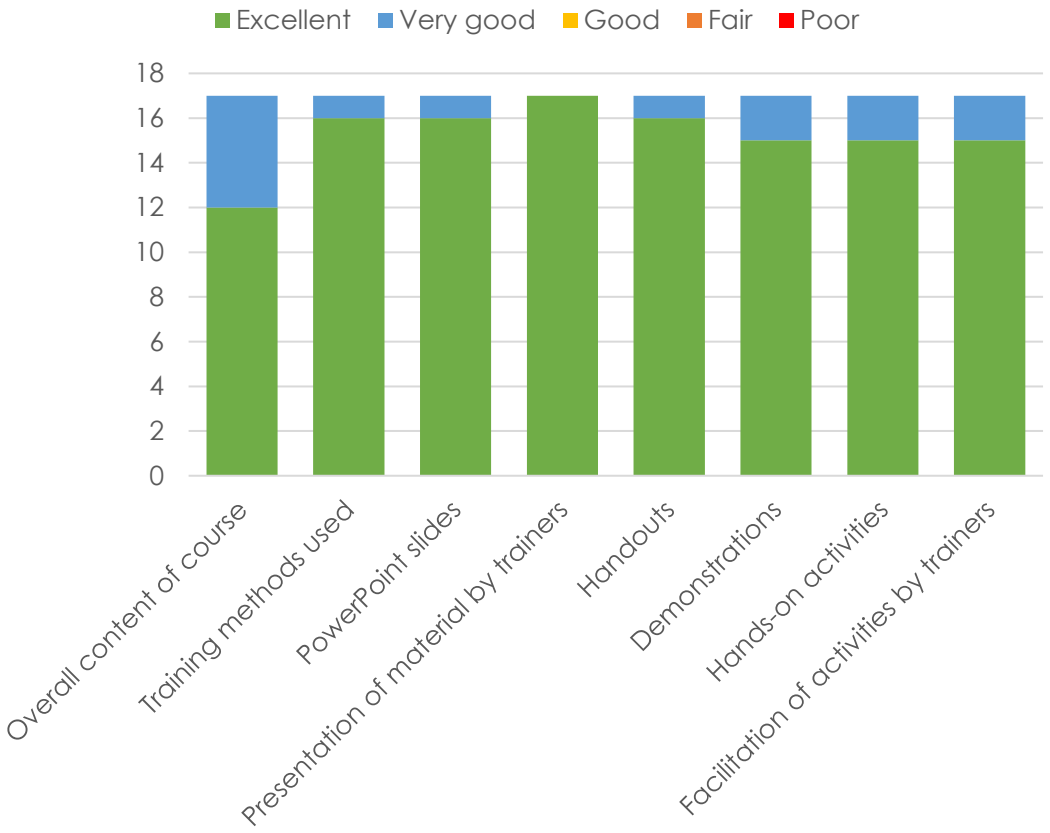
Therefore, the pre- and post-course test indicated a substantial improvement in the skills and technical understanding of the participants.

Self-reported competence in 10 domains related to IR monitoring before and after the short course.

Course Evaluation

Participants completed an evaluation of the short course at the conclusion of the technical program. The evaluation included rating various course components (content, exercises, handouts, and facilitation) as 'poor', 'fair', 'good', 'very good', or 'excellent'. 17 participants completed course evaluation forms. All elements were rated as 'excellent' (90%) or 'very good' (10%), as shown below.

Ratings of 8 course components by participants (n=17).



Four open-ended questions requested: course topics respondents would like more information on, which course topics were most and least useful for their *Aedes* control programs, and any other comments or suggestions to improve future trainings. The most common points of feedback provided were:

1. Practical aspects of the course were most valued, but participants requested more field activities (e.g., collection of mosquitoes) and more taxonomy.
2. More follow up support and regional collaboration were requested, including ongoing/refresher training for the same participants plus greater partnership between countries.
3. Some participants wanted more information on chemicals and how to use them and asked for the list of WHO prequalified products.

Conclusions

During the final plenary session, feedback was sought from participants on the short course and how PacMOSSI activities could be further expanded to best support Ministries of Health in the Pacific to enhance IR monitoring specifically and vector surveillance and control more generally. Participants emphasised the importance of ensuring that activities related to IR monitoring for *Aedes* spp. continue in the Pacific, in line with the *Global vector control response (2017-2030)*. It was stressed that these should build on the high-quality support provided through the PacMOSSI project since its establishment in 2020. After the short course, facilitators also provided feedback.

The following summarises priorities indicated that are within the scope of PacMOSSI work and for which support may be provided, including for advocacy, training, or the contribution of other technical or financial resources.

Summary of participant and facilitator feedback on the in-country challenges facing Aedes IR monitoring in the Pacific.

Component	Observations and suggestions
Resource Constraints & Challenges	• Limited resources, such as lack of space, facilities for lab work, and trained staff • Difficulty in prioritizing vector activities within public health programs due to competing priorities.
Training Continuity & Participation	• Difficulty in ensuring continuity training due to challenges in identifying the most appropriate technicians and gaining management approval for their participation. • Repeat training for specific individuals, rather than for continually changing staff would improve skill development. • Coordination between training and the actual implementation of activities will ensure more immediate application of learned skills upon returning home
Training Needs & Support	• Requests for additional training in specific areas, such as courses emphasising *Anopheles* collection, identification and testing, CDC bottle assays, and more taxonomy. • Optimisation of data recording tools and platforms for field use along with clear SOPs for testing.

	• Interest in mentoring, network support for species validation, and ongoing regional collaboration for skills reinforcement.
Regional Collaboration & Leadership	• The need for partnership between countries with stronger programs and those with less resources. ability • Request for dedicated regional support roles, with experienced individuals, based in the Pacific, to assist with extension and support. • Some participants called for attachments to larger, more experienced teams to gain hands-on experience and mentorship.

Closing

The final session concluded with facilitators thanking participants for the active and positive engagement throughout the entire course program. Participants and facilitators acknowledged that further work is required in each country to ensure that *Aedes* IR monitoring is strengthened based on standard procedures and requirements to guide evidence-informed vector control.

A vote of thanks was then issued by participants for the work of the facilitators and support staff to ensure the course was useful, well-organised and enjoyable.

About the PacMOSSI consortium

PacMOSSI is a regional partnership of 21 Pacific Island Countries and areas with 7 international institutions working to combat mosquito-borne diseases throughout the Pacific. It comprises a series of initiatives coordinated by James Cook University in collaboration with The Pacific Community (SPC). Support to PacMOSSI – including for this short course – is provided by the Australian Government through Partnerships for a Healthy Region, the French Government, the New Zealand Government, and the European Union.

Selected images from the course

Additional images are available here.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