Joint FAO/IAEA Programme
Nuclear Techniques in Food and Agriculture

Insect Pest Control Newsletter

https://www.iaea.org/topics/food-and-agriculture
http://www.fao.org/agriculture/fao-iaea-nuclear-techniques/en/

ISSN 1011-274X

No. 104, January 2025

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To Our Readers

Eradication of Mediterranean fruit fly in Dominican Republic: in February 2024, and September 2024, two Technical Advisory Committees (TACs) composed of IAEA, FAO, and OIRSA experts visited the area to provide guidance on eradication strategies and offer technical recommendations. Weekly releases of 3 million sterile flies for 26 weeks integrated with field surveillance and control measures, such as sanitation, insecticide-bait sprays and bait stations. The eradication of the pest was officially declared on 27 September 2024, less than ten months after the initial detection, with no quarantine restrictions imposed by importing countries (Photo: David Midgarden).

We are glad to inform our readers that the Dominican Republic was able to successfully contain a new incursion of the Mediterranean fruit fly, a highly destructive pest threatening agricultural production worldwide in 2024. This marks a second time the country has eradicated this invasive insect using the Sterile Insect Technique (SIT), an environmentally friendly pest control method.

The Dominican Republic's rapid eradication in 2024 reflects significant capacity-building efforts since the first Mediterranean fruit fly incursion in 2015, which resulted in quarantine restrictions from the United States, leading to an estimated loss of US$ 40 million within nine months and putting 30 000 jobs at risk. The pest was eventually eradicated in 2017 after two years of intensive efforts, which included the release of 4.06 billion sterile flies.

In 2024, only 78 million of sterile insects were released and only an area of 1 km^2 was infested compared with the 2 000 km^2 in the 2015 incursion. This shows the importance of a proper detection system and a rapid response turning the eradication this time much more cost-effective.

Another very recent achievement was the establishment of the first mass-rearing facility, dedicated to the production of the South American fruit fly *Anastrepha fraterculus*. The mass-rearing facility has the capacity of producing 60 million flies per week. The mass-rearing and irradiation facility was established at the National University of Piura, Peru. It was inaugurated by the Minister of Agricultural Development and Irrigation, Mr. Angel Manuel Manero, on 18 November 2024. This new facility will benefit from recent R&D conducted at the Insect Pest Control Laboratory, focusing on the development of the new black pupae genetic sexing strain of *A. fraterculus*. The strain was backcrossed with genetic material from Peru, and it is ready to be evaluated at large scale in the new facility. More detailed information can be found on page 18 of this newsletter.

In relation to the New World Screwworm (NWS), all news received from Panama, Central America and Mexico are immensely worrying. After May 2022, when, for reasons not yet determined, cases began to emerge north of the 'Sterile Fly Barrier' in Panama (until where the fly was eradicated), spreading northward rapidly like wildfire, despite the control efforts deployed by the countries of the Central American isthmus. In 2023 it quickly re-infested entire Panama and in July 2023 it infested Costa Rica, in April 2024 it was introduced to Nicaragua, and in September 2024 it spread to Honduras. In October 2024, it continued to expand to Guatemala, reaching South Mexico in November 2024 and El Salvador in December 2024.

Since this is an emergency, many national and international organizations are starting to work together on this continental re-invasion, including the establishment or expansion of the mass-rearing(s) facilities to make sterile insects available to be used in the invaded pest free areas.

For more information on the situation, I invite our readers to read the articles in the section 'Other News'. This includes a summary on the reinvasion of Central America and Mexico, the increase of import restrictions on animal products from Mexico to the USA and the creation of an Emergency Fund from USDA to tackle the threat of the Screwworm reinvasion.

In October 2024, the Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture celebrated its 60th anniversary. Established in 1964, this partnership between the FAO and the IAEA has advanced the use of nuclear science to boost food security, agricultural productivity and environmental sustainability. For more information, please visit: https://www.iaea.org/newscenter/news/celebrating-60-years-of-the-unique-fao-and-iaea-partnership.

I cannot close this time highlights without expressing my appreciation and the condolences to Alan Robinson's family, on behalf of the Insect Pest Control Subprogramme.

Alan was a Head of the Insect Pest Control Laboratory (IPCL) from 1994 until his retirement in 2007. During this period, he managed IPCL with an outstanding performance, contributing to the R&D advances towards the SIT field application. Alan was an outstanding scientist with excellent technical knowledge of insect genetics. His in-depth scientific knowledge and outstanding research work on insect pests and disease vectors will be greatly missed. Above all, we will miss his kindness, generosity, and his great personality.

On behalf of all colleagues at Seibersdorf and Headquarters, I would like to thank you for your continuing interest and support to our activities. We really do appreciate your feedback regarding this newsletter and hope you continue to find it a source of useful information.

Rui Cardoso Pereira
Head, Insect Pest Control Section

Staff

Insect Pest Control Subprogramme

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Forthcoming Events (2025)

I. Research Coordination Meetings (RCMs) of FAO/IAEA Coordinated Research Projects (CRPs)

Second RCM on Reproductive Biology of Male *Aedes* Mosquitoes for SIT Applications. 7–11 April 2025, Vienna, Austria.

Fourth RCM on Mosquito Irradiation, Sterilization and Quality Control. 5–9 May 2025, Athens, Greece.

First RCM on Enhancement of Dacine Fruit Fly Management by Combining SIT with MAT and Female Suppression. 7–11 July 2025, Vienna, Austria.

Third RCM on Improving the Mass-rearing of Lepidoptera Pests for SIT Programmes. 8–12 September 2025, Stellenbosch, South Africa.

First RCM on Tsetse Population Genetics. 20–24 October 2025, Vienna, Austria.

Second RCM on Improvement of *Drosophila suzukii* Mass-Rearing and Released Methods for SIT Programmes. 3–7 November 2025, Mendoza, Argentina.

II. Consultants and Expert Meetings

Consultancy Meeting on *Aedes* Mosquito Sterile Insect Technique Package and its Implementation: Review and future perspectives. 2–4 April 2025, Vienna, Austria.

III. Other Meetings/Events

FAO/IAEA Regional Training Course on GIS and Database on Fruit Fly Management (under Regional TC Project RAS5097). 3–7 March 2025, Hanoi, Viet Nam.

Nineteenth Session of the Commission on Phytosanitary Measures (CPM-19), International Plant Protection Convention, FAO. 17–21 March 2025, Rome, Italy.

FAO/IAEA/PAHO Theoretical and Practical Regional Workshop on New Technologies for *Aedes aegypti* control: Mass Rearing System for Mosquitoes (under Regional TC Project RLA5092). 24–28 March 2025, Merida, Mexico.

FAO/IAEA Regional Workshop on Sterile Insect Technique (SIT) for Fruit Fly Area Wide Integrated Pest Management (under Regional TC Project RAF5092). 28–30 April 2025, Agadir, Morocco.

FAO/IAEA Regional Training Course on Developing National-level Information Systems/atlases on Tsetse Flies and Animal Trypanosomosis for Evidence-based Decision Making in Surveillance and Control Activities (under Regional TC Project RAF5087, English edition). 19–23 May 2025, Republic of Tanzania.

FAO/IAEA Regional Training Course on Fruit Fly Molecular Identification (under Regional TC Project RAS5097). 7–11 July 2025, Beijing, China.

FAO/IAEA Regional Training Course on Developing National-level Information Systems/atlases on Tsetse Flies and Animal Trypanosomosis for Evidence-based Decision Making in Surveillance and Control Activities (under Regional TC Project RAF5087, French edition). 14–18 July 2025, Senegal.

FAO/IAEA Final Project Coordination Meeting (under Regional TC Project RAS5095). 25–27 August 2025, Colombo, Sri Lanka.

16th Workshop of the IOBC – MRQA Working Group, Innovations in Rearing High-quality Invertebrates, Joint Meeting of the IOBC Global Working Group on Mass Rearing & Quality Assurance Association of Natural Biocontrol Producers (ANBP). 27–31 October 2025, Tucson, AZ, USA,

FAO/IAEA National Coordination Meeting on Strengthening and Harmonizing Surveillance and Suppression of Fruit Flies in Regional Asia and the Pacific (Under Regional TC project RAS5097). 3–7 November 2025, Kathmandu, Nepal.

12th International Symposium on Fruit Flies of Economic Importance. 19–24 April 2026, in Agadir, Morocco.

Past Events (2024)

I. Research Coordination Meetings (RCMs) of FAO/IAEA Coordinated Research Projects (CRPs)

Fourth RCM on Improvement of Colony Management in Insect Mass-rearing for SIT Applications. 4–8 March 2024, Agrinio, Greece.

Fourth RCM on Assessment of Simultaneous Application of SIT and MAT to Enhance Bactrocera Fruit Fly Management. 22–25 April 2024 (virtual).

Second RCM on Improve the Mass-rearing of Lepidoptera Pests for SIT Programmes. 10–14 June 2024, Vienna, Austria.

First RCM on Improvement of Drosophila suzukii Mass-Rearing and Released Methods for SIT Programmes. 8–12 July 2024, Vienna, Austria.

Third RCM on Improving Rearing, Handling, and Field Components for Fruit Fly SIT Application. 11–15 November 2024, Pretoria, South Africa.

Fourth RCM on Generic Approach for the Development of Genetic Sexing Strains for SIT Applications. 9–13 December 2024, Vienna, Austria.

II. Consultants and Expert Meetings

Consultancy Meeting on Thematic Plan for Fruit Flies Sterile Insect Technique. 24–28 June 2024, Vienna, Austria.

Consultancy Meeting on Tsetse Population Genetics. 11–15 November 2024, Vienna, Austria.

III. Other Meetings/Events

FAO/IAEA Midterm Coordination Meeting on Enhancing Regional Capacity for the Implementation of the Sterile Insect Technique as a Component for Area-Wide Tsetse and Trypanosomosis Management (under Regional TC Project RAF5087). 5–7 February 2024, Vienna, Austria.

FAO/IAEA Workshop on Dosimetry and Irradiation Procedures Applied in SIT Programmes for Control Tsetse Fly (under Regional TC Project RAF5087). 18–22 March 2024, Vienna, Austria.

FAO/IAEA Coordination Meeting on Validating the Sterile Insect Technique for the Control of the South American Fruit Fly (under Regional TC Project RLA5087). 8–12 April 2024, Lima, Peru.

Fifth TEAM (Tephritid Workers of Europe, Africa and the Middle East) Meeting. 15–18 April 2024, Belle Mare, Mauritius.

Eighteen Session of the Commission on Phytosanitary Measures (CPM-18), International Plant Protection Convention, FAO. 15–19 April 2024, Rome Italy.

Second TAAO (Tephritid Workers of Asia, Australia and Oceania) Meeting. 6–10 May 2024, Beijing, China.

FAO/IAEA Regional Training Course on Genetic Population Studies to Support Tsetse Field Projects (under Regional TC Project RAF5087). 6–17 May 2024, Yaoundé Cameroon.

FAO/IAEA National Coordination Meeting on Strengthening and Harmonizing Surveillance and Suppression of Fruit Flies in Regional Asia and the Pacific (Under Regional TC project RAS5097). 11–13 May 2024, Beijing. China.

FAO/IAEA National Training Course on Fruit Fly Surveillance Systems (under national TC Project JAM5015). 28–31 May 2024, Kingston, Jamaica.

11th TWWH (Tephritids Workers of Western Hemisphere) Meeting. 3–7 June 2024, Montego Bay, Jamaica.

FAO/IAEA Regional Workshop on Designing Aedes Population Suppression Trials for Sterile Insect Technique Validation (under Regional TC project RLA5092). 24–28 June 2024, Montevideo, Uruguay.

Meeting of the Technical Panel on Phytosanitary Treatments (TPPT), International Plant Protection Convention FAO. 24–28 June 2024, Tucuman, Argentina.

FAO/IAEA Regional Training Course on Fruit Fly Surveillance and Identification (under Regional TC Project RAS5097). 29 July–2 August 2024, Serdang, Malaysia.

FAO/IAEA Regional Training Course on Mastering Colonization and Characterization of Aedes Mosquito Strain as an Initial Step towards Sterile Insect Technique (under Regional TC project RLA5092). 2–6 September 2024. Buenos Aires, Argentina.

FAO/IAEA Regional Meeting on the Establishment and Implementation of a New World Screwworm Eradication Programme (under Regional TC Project RLA5088). 14–18 October 2024, Montevideo, Uruguay.

FAO/IAEA Regional Training Course on Collection of Entomological Baseline Data, and Data Management Tools to Support SIT Projects for Mosquito Control (under Regional TC Project RAS5095). 14–18 October 2024, Quezon, Philippines.

FAO/IAEA Regional Training Course on Identification and Dissection Techniques to support SIT programmes for Controlling Tsetse Fly (under Regional TC Project RAF5087). 25–29 November 2024, Pretoria, South Africa.

Technical Cooperation Projects

The Insect Pest Control Subprogramme currently has technical responsibilities for the following technical cooperation projects that are managed by the IAEA. They can be classified under four major topics, namely:

- Biocontrol using radiation
- Human disease vectors
- Livestock pests
- Plant pests

Country	Project Number	Ongoing National Projects	Technical Officer
Bangladesh	BGD5035	Validating the Sterile Insect Technique as a Key Component of an Area-Wide Integrated Pest Management Programme Against *Aedes aegypti* in Dhaka	Maylen Gómez
Bolivia	BOL5023	Fruit Fly Control in Bolivia Using Integrated Pest Management Including the Sterile Insect Technique	Walther Enkerlin
Brazil	BRA5062	Application of the Sterile Insect Technique for the Control of *Aedes aegypti*	Rui Cardoso Pereira
Burkina Faso	BKF5023	Implementing the Sterile Insect Technique to Reduce Wild Populations of *Aedes aegypti* and Tsetse	Adly Abdalla
Cameroon	CMR5026	Supporting the National Fruit Fly Management Programme	Daguang Lu
Cambodia	KAM5011	Establishing SIT-based Area-wide Integrated Management of *Bactrocera zonata* and *Bactrocera dorsalis*	Daguang Lu
Chad	CHD5011	Implementing the Sterile Insect Technique to Control *Glossina fuscipes fuscipes* — Phase II	Adly Abdalla Chantel de Beer
Chile	CHI5051	Implementing Pilot Level of Sterile Insect Technique for Control of *Lobesia botrana* in Urban Areas	Walther Enkerlin
China	CPR5027	Demonstrating Feasibility of the Sterile Insect Technique in the Control of the Codling Moth, *Cydia pomonella*	Walther Enkerlin
China	CPR5028	Demonstrating the Feasibility of Applying Area-Wide Integrated Management Strategies Based on the Sterile Insect Technique in the Green Control of *Spodoptera litura*	Rui Cardoso Pereira
Cyprus	CYP5021	Preventing the Spread of the *Aedes albopictus* and *Aedes aegypti* Mosquitoes	Maylen Gómez
Dominican Republic	DOM0006	Building and Strengthening the National Capacities and Providing General Support in Nuclear Science and Technology	Walther Enkerlin
Ecuador	ECU5035	Assessing the Feasibility of the Sterile Insect Technique to Control the Invasive Vector Mosquito *Aedes aegypti* and the Mediterranean Fruit Fly at a Pilot Level	Maylen Gómez Walther Enkerlin
Ethiopia	ETH5024	Enhancing Livestock and Crop Production through Control of Tsetse and Trypanosomiasis to Contribute to Food Security	Chantel de Beer

El Salvador	ELS5015	Integrated Management of Fruit Flies using the Sterile Insect Technique to Establish Areas of Low Prevalence of Fruit Flies	Walther Enkerlin
Fiji	FIJ5007	Implementing Pesticide Free Suppression and Management of Fruit Flies for Sustainable Fruit Production — Phase II	Daguang Lu
Grenada	GRN0001	Building National Capacity through the Applications of Nuclear Technology	Rui Cardoso Pereira
Israel	ISR5022	Establishing the Sterile Insect Technique Methodology for the Management of the False Codling Moth, *Thaumatotibia leucotreta*, and Enhancing Integrated Pest Management Against the Peach Fruit Fly, *Bactrocera zonata*	Walther Enkerlin
Jamaica	JAM5015	Strengthening National Capacities for the Introduction of the Sterile Insect Technique for Pest Control, Mutation Breeding of Crops and Post-Harvest Treatment of Agricultural Produce Using a Self-Contained Gamma Irradiation Facility	Maylen Gomez
Kingdom of Eswatini	SWA5004	Utilizing the Sterile Insect Technique Integrated with Other Suppression Methods for the Management of the False Codling Moth	Daguang Lu
Mauritius	MAR5028	Enhancing National Capabilities on the Suppression of *Aedes albopictus* in an Urban Locality Using the Sterile Insect Technique as Part of an Integrated Vector Management Strategy	Maylen Gómez
Mexico	MEX5032	Scaling Up the Sterile Insect Technique to Control Dengue Vectors	Kostas Bourtzis
Morocco	MOR5040	Improving the Productivity of Livestock and Crops	Walther Enkerlin Teresa Vera
Myanmar	MYA5029	Improving Fruit Yield and Quality by Using Sterile Insect Techniques as Part of Area-Wide Integrated Pest Management of Fruit Flies in the Mandalay Region	Daguang Lu
Oman	OMA5009	Establishing SIT-based Area-wide Integrated Management of *Bactrocera zonata* and *Bactrocera dorsalis*	Daguang Lu
Palau	PLW5003	Facilitating Sustainability and Ensuring Continuity of Area-wide Pest Management — Phase III	Daguang Lu
Panama	PAN5031	Validating the Sterile Insect Technique for the Control of the Mediterranean Fruit Fly, *Ceratitis capitata*	Walther Enkerlin
Portugal	POR5006	Integrating the Sterile Insect Technique in the Control of the Invasive Vector Mosquito *Aedes albopictus*	Maylen Gómez
Philippines	PHI5037	Assessing the Feasibility of the Sterile Insect Technique to Suppress the *Aedes aegypti* Population	Maylen Gomez
Senegal	SEN5044	Developing National Capacity for Implementing the Sterile Insect Technique against Tsetse Flies in the Sine-Saloum for 2024–2027	Chantel de Beer

Serbia	SRB5006	Strengthening National Capacity to Integrate the Sterile Insect Technique in the Control of *Aedes* Invasive Mosquitoes by Establishing a Mass Rearing Facility	Maylen Gomez
Seychelles	SEY5012	Establishing Area-wide Integrated Pest Management by Using the Sterile Insect Technique in Combination with Other Control Methods on the Suppression of the Melon Fly	Rui Cardoso Pereira
South Africa	SAF5019	Testing the Sterile Insect Technique Intervention as a Vector Control Tool against the Primary Malaria Vector, *Anopheles arabiensis*	HananoYamada
South Africa	SAF5020	Radiation Biology and Population Genetics of *Glossina brevipalpis* in Preparation of a Sterile Insect Technique (SIT) in Affected Communal Areas of North-eastern KwaZulu-Natal Province, South Africa	Adly Abdalla
Sri Lanka	SRL5054	Using Field Application of the Sterile Insect Technique in a Pre-Operational Trial for the Control of Dengue and Evaluating the Feasibility of the Application of the Sterile Insect Technique for the Control of Melon Fruit Flies	Kostas Bourtzis
Sudan	SUD5042	Implementing the Sterile Insect Technique for Integrated Control of *Anopheles arabiensis* — Phase III	Adly Abdalla
Turkey	TUR5026	Conducting a Pilot Program on Integrated Management of *Aedes aegypti* Including Sterile Insect Technique	Maylen Gómez
Turkey	TUR5027	Implementation of SIT for Suppression and Eradication of Medfly in Turkey	Daguang Lu
United Republic of Tanzania	URT5034	Implementing Pre-Operational Activities for the Elimination of *Glossina swynnertoni* through Area-wide Integrated Pest Management with a Sterile Insect Technique Component	Chantel de Beer
United Republic of Tanzania	URT5035	Implementing the Sterile Insect Technique as Part of Area-wide Integrated Pest Management for Controlling Invasive Fruit Fly Populations	Daguang Lu
		Ongoing Regional Projects	
Regional Africa	RAF5087	Enhancing Regional Capacity for the Implementation of the Sterile Insect Technique as a Component for Area-Wide Tsetse and Trypanosomosis Management (AFRA)	Maylen Gómez
Regional Africa	RAF5092	Enhancing Agricultural Productivity for Improved Food Security in Africa	Daguang Lu Rui Cardoso Pereira
Regional Asia & the Pacific	RAS5090	Advancing and Expanding Area-wide Integrated Management of Invasive Pests, Using Innovative Methodologies Including Atomic Energy Tools	Walther Enkerlin
Regional Asia & the Pacific	RAS5095	Enhancing the Capacity and the Utilization of the Sterile Insect Technique for *Aedes* Mosquito Control	Rui Cardoso Pereira
Regional Asia & the Pacific	RAS5097	Strengthening and Harmonizing Surveillance and Suppression of Fruit Flies	Daguang Lu Rui Cardoso Pereira

Regional Europe	RER5026	Enhancing the Capacity to Integrate Sterile Insect Technique in the Effective Management of Invasive *Aedes* Mosquitoes	Wadaka Mamai Rui Cardoso Pereira
Regional Latin America	RLA5082	Strengthening Food Security through Efficient Pest Management Schemes Implementing the Sterile Insect Technique as a Control Method	Walther Enkerlin
Regional Latin America	RLA5084	Developing Human Resources and Building Capacity of Member States in the Application of Nuclear Technology to Agriculture	Walther Enkerlin Rui Cardoso Pereira
Regional Latin America	RLA5087	Validating the Sterile Insect Technique for the Control of the South American Fruit Fly (ARCAL)	Walther Enkerlin
Regional Latin America	RLA5088	Advancing Surveillance and Progressive Control of the New World Screwworm Using the Sterile Insect Technique	Walther Enkerlin
Regional Latin America	RLA5092	Enhancing Regional Capacity for the Adoption of the Sterile Insect Technique as a Component of Mosquito Control Programmes (ARCAL CLXXXVII)	Maylen Gomez
Regional Latin America	RLA7027	Applying Nuclear Technology in Agriculture, Water Resource Management and the Environment in Caribbean Member States (CARICOM)	Walther Enkerlin
		Ongoing Interregional Project	
Interregional	INT5159	Atoms4Climate Adaptation and Mitigation: Non-Power Technologies for the Terrestrial Landscape	Rui Cardoso Pereira

Highlights of Technical Cooperation Projects

Validating the Sterile Insect Technique for the Control of the South American Fruit Fly (RLA5087)

New Mass Rearing and Sterilization Facility for South American Fruit Fly Has Been Inaugurated in Piura, Peru

The newly established facility for the mass-production and sterilization of South American fruit fly *Anastrepha fraterculus* Wied. was established at National University of Piura, Peru. It was inaugurated by the Minister of Agricultural Development and Irrigation, Mr. Angel Manuel Manero, alongside the Head of the National Agricultural Health Service (SENASA), Ms. Vilma Gutarra, and Inter-American Development Bank (IDB) official, Mr. Luis Enrique Miranda. The event was also attended by local authorities from Piura, as well as fruit growers, fruit exporters. (For more details, please visit the inauguration news at:

https://www.gob.pe/institucion/senasa/noticias/1061099-piura-gobierno-inauguro-amoderno-centro-para-el-control-y-erradicacion-de-la-plaga-mosca-de-la-fruta).

The South American fruit fly mass-rearing and sterilization facility Piura, Peru.

Anastrepha fraterculus is the primary pest affecting fruits in the northern region of Peru. The facility has the capacity to produce 60 million sterile fruit flies per week, which is sufficient to protect commercial crops affected by *A. fraterculus* across the country. This initiative will benefit over 33 000 fruit growers in the region and will consolidate the Province of Piura, located north of Peru as the leading exporter of mangoes.

Peru is positioned as a leader in the development of the sterile insect technique (SIT) for its application against this important pest in the region, aiming for the suppression and if possible, its eradication in selected fruit production areas.

Pupae maturation room at the South American fruit fly mass-rearing and sterilization facility in Piura, Peru.

This work is attributed firstly to SENASA, to the International Atomic Energy Agency (IAEA), the Food and Agriculture Organization of the United Nations (FAO) for its technical contributions and to the IDB for its financial support.

Strengthening and Harmonizing Surveillance and Suppression of Fruit Flies (RAS5097)

FAO/IAEA Regional Training Course on Fruit Fly Surveillance and Species Identification, 29 July–2 August 2024, Serdang, Malaysia

The training course took place at Universiti Putra Malaysia (UPM) and was co-hosted by Malaysian Nuclear Agency (Nuklear Malaysia) and Universiti Kebangsaan Malaysia (UKM). The course aims to train participants in basics of fruit fly trapping, surveillance, and identification.

A total of 21 participants from 10 Member States in Asia and Oceania, including China, Fiji, Indonesia, Lao PDR, Malaysia, Myanmar, Nepal, Papua New Guinea, Thailand and Viet Nam attended the course. The training spanned five days and included formal lectures in the morning and hands-on practical sessions in the afternoon, both in the laboratory and field.

Two international fruit fly experts from Australia and Pakistan, along with a local course director and a resource person, delivered the course content. Topics covered included fruit fly taxonomy, morphometrics, surveillance and trapping, leading to the practical application of identifying the principal diagnostic characters of various pest fruit flies primarily in the Asia-Pacific and Australasian region. Two reference books were provided to all participants: "*Keys to the tropical fruit flies (Tephritidae: Dacinae) of South-East Asia*" and "*Tropical fruit flies (Tephritidae: Dacinae) of South-East Asia*".

Practical training on fruit fly identification in the laboratory during the FAO/IAEA Regional Training Course on Fruit Fly Surveillance and Species Identification (Serdang, Malaysia).

Participants learned how to perform fruit fly trapping, pin fly specimens, and dissect male and female fruit fly genitalia. They were also instructed in the use of reference texts, dichotomous keys and online resources particularly the Fruit Fly Identification Australia website and its associated multi-entry image-rich keys.

The course also introduced participants to the international fruit fly network, including the Tephritid Workers of Asia, Australia and Oceania (TAAO) and sister groups in different regions, highlighting the importance of networking. A half-day technical visit was also made to Nuclear Malaysia campus that included the irradiation facility.

At the end of the training course, an open-book test assessed participants' ability to identity morphological characters, key out an unknown species, and locate information about specific species, including if it has occurred in their country. The review of test answers provided insight into participants' proficiency in fruit fly identification whilst acknowledging the diverse background of the participants as to their experience in performing the task. These insights will be valuable in designing future courses on fruit fly identification.

Developing National Capacity for Implementing the Sterile Insect Technique against Tsetse Flies in the Sine Saloum (SEN5044)

National Training Course on Strategy Development for the Collection of Entomological and Parasitological Baseline Data for the Sine Saloum Area of Senegal, 11–15 November 2024, Dakar, Senegal.

The training was held at the Institut Sénégalais de Recherches Agricoles (ISRA), focusing on enhancing and developing national capacities in the principles of entomological and parasitological baseline data collection. The knowledge, skills, and capabilities developed during this training will facilitate the advancement of a detailed strategy for the collection of entomological and parasitological baseline data. These data will be used to develop an area-wide integrated pest management (AW-IPM) programme for the eradication of tsetse flies from the Sine-Saloum.

Participants of the IAEA national training course on strategy development for the collection of entomological and parasitological baseline data for the Sine Saloum area of Senegal (Dakar, Senegal).

The participants included 32 professionals from Senegal, the Gambia and Burkina Faso as well as representatives from FAO and the French agricultural research and cooperation organization (CIRAD). During the training, the principles of designing a baseline sampling strategy were discussed and the current entomological and parasitological situation in the Sine Saloum and the Gambia was reviewed.

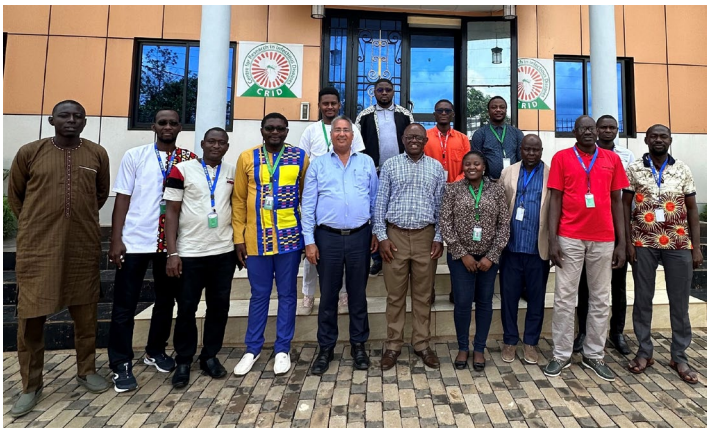
The training also included topics such as defining a study area that meets the AW-IPM criteria, dividing the area into operational units. The requirements such as number and composition of teams, equipment, and training needs were discussed, and the proper project budgeting was also outlined. Participants joined a field visit to observe the current sampling sites in Niayes to demonstrate the topics discussed in the training. The highlight of the training was the creation of a first draft of the action plan for the collection of basic entomological data in the Sine Saloum area.

Enhancing Regional Capacity for the Implementation of the Sterile Insect Technique as a Component for Area-Wide Tsetse and Trypanosomosis Management (RAF5087)

FAO/IAEA Regional Training Course on Population Genetic Studies to Support Field Projects, 6–17 May 2024, Yaoundé, Cameroon

The training course aimed to develop regional capacity on molecular techniques for population genetic analysis to support tsetse sterile insect technique (SIT) field programmes. It was hosted by the Centre for Research in Infectious Diseases (CRID), Cameroon. The course

commenced on 6 May 2024, and was officially opened by Prof. Charles Wondji, the Executive Director CRID and the course director. The first week activities proceeded according to the agenda, as lectured by Mr Tito Trésor Melachio Tanekou (University of Bamenda) and Mr. Bertrand Mbakam (CRID).



Participants of the FAO/IAEA Regional Training Course on Population Genetic Studies to Support Field Projects (Yaoundé, Cameroon).

The course was attended by six participants as follow: Burkina Faso (2), Chad (1), Côte d'Ivoire (1), Mali (1), and Senegal (1), as well as six local participants from Cameroon. The training had the first week dedicated to data generation, and the second week to date analysis. The data analysis focused on the data generated during the first week, with the initial two and a half days devoted to quality control tests. The data analyses included genetic variation between populations, effective population size, isolation by distance, dispersal and number of immigrants, and migration rates.

The workshop was evaluated and rated as very good by the participants. The closing session was attended by Prof. Flobert Njiokou, the Deputy Executive Director of CRID, who distributed the certificates to the participants along with Mr. Tito Trésor Melachio Tanekou and Mr. Adly Abdalla from the IAEA.

FAO/IAEA Regional Training Course on Tsetse Identification and Dissection Techniques, 25–29 November 2024, Pretoria, South Africa

The training was held at the Agricultural Research Council-Onderstepoort Veterinary Institute (ARC-OVR) and attended by 18 professionals from 18 African Member States, all actively involved in tsetse monitoring activities and engaged in the IAEA TC project RAF5087 (Angola, Burkina Faso, Cameroon, Chad, Côte d'Ivoire, Democratic Republic of the Congo, Ethiopia, The Gambia, Ghana, Kenya, Mozambique, Nigeria, Senegal, South Africa, Uganda, United Republic of Tanzania, Zambia, and Zimbabwe).

The training focused on the technical aspects of tsetse identification and dissection, which are essential tools for entomological baseline data collection. These aspects are a crucial component of Area-Wide Integrated Pest Management (AW-IPM) programmes targeting tsetse flies. The training course aimed to (i) enhance and develop regional capabilities on basic principles of tsetse identification using classical morphological characteristics, and (ii) develop knowledge, skills, and capabilities to preform tsetse dissections for estimating crucial entomological indicators, which are relevant for planning, implementing, and evaluating an AW-IPM with a sterile insect technique (SIT) component.

Participants of the FAO/IAEA Regional Training Course on Tsetse Identification and Dissection Techniques (Pretoria, South Africa)

Each participating Member State received a 'dissection package', which included an updated key identification manual to strengthen capabilities on tsetse fly species identification in field projects at the regional level. At the end of the training, the upcoming targets and priorities for the region related to these topics were also discussed and agreed upon.

Enhancing Regional Capacity for the Adoption of the Sterile Insect Technique as a Component of Mosquito Control Programmes (RLA5092)

FAO/IAEA Regional Training Course on Mastering Colonization and Characterization of *Aedes* Mosquito Strain as an Initial Step towards Sterile Insect Technique (SIT). 2–6 September 2024, Buenos Aires, Argentina

The application of the sterile insect technique (SIT) within an area-wide integrated pest management (AW-IPM) programme to control vector mosquitoes has been increasingly adopted in response to requests from Member States (MSs) in Latin America and the Caribbean region, which have faced severe dengue outbreaks during the recent years. Under the framework of the RLA5092 project and in collaboration with the Argentinian National Commission of Atomic Energy (CNEA), the IAEA organized a training course on colonisation and characterisation of life history traits under artificial rearing conditions for local strains of *Aedes aegypti*.

Participants of the FAO/IAEA Regional Training Course on Mastering Colonization and Characterization of Aedes *Mosquito Strain as An Initial Step towards Sterile Insect Technique (SIT). (2–6 September 2024, Buenos Aires, Argentina).*

The participants included 21 technical staff from eight MSs in the region (Antigua & Barbuda, Argentina, Bolivia, Chile, Nicaragua, Panama, Paraguay, Venezuela). The objectives were to develop the knowledge and skills of the participating MSs on the basic procedure of colony-rearing as an initial step towards SIT field implementation. This included a fundamental understanding of the biology and behaviour of the selected local strains to establish reference values for appropriately planning and scaling up sterile male production during the suppression phase of the pilot projects.

Technical lectures covered essential aspects, including life history traits, small-scale production, mass-rearing, quality control, and irradiation procedures. Hands-on sessions provided valuable practical experience, allowing participants to engage in all steps of the mosquito rearing process. Additionally, reviewing the country's procedures on colonisation and characterisation of local strains was a crucial evaluation exercise during the training.

By examining the Phase Conditional Approach for SIT and identifying remaining challenges, the training facilitated the development of a work plan for each country, targeting colonisation, characterisation and routine *Aedes* mosquito-rearing procedures. This crucial training also strengthened regional capacities and harmonised information about the procedures of colony rearing as an initial step towards SIT implementation, fostering networking and information exchange.

Enhancing the Capacity and the Utilization of the Sterile Insect Technique for *Aedes* Mosquito Control (RAS5095)

FAO/IAEA Regional Training Course on Collection of Entomological Baseline Data, and Data Management Tools to Support SIT Projects for Mosquito Control. 14–18 October 2024, Quezon, Philippines

The training aimed to equip participating Member States (Bangladesh, China, Indonesia, Iran, Malaysia, Myanmar, Pakistan, Philippines, Singapore, Sri Lanka, Thailand and Viet Nam) with essential information on baseline data collection procedures, GIS tools, and data management as crucial components to plan and prepare field interventions using sterile insect technique (SIT) to control *Aedes* mosquitoes.

Participants of the FAO/IAEA Regional Training Course on Collection of Entomological Baseline Data, and Data Management Tools to Support SIT Projects for Mosquito Control. (Quezon, Philippines).

The progress and challenges in applying SIT to control *Aedes* mosquito in Indonesia and Singapore were presented. This was followed by lectures on establishing baseline information for *Aedes* SIT. Key aspects of baseline data information, such as site selection criteria, trapping systems, sample collection, analysis of entomological indices, and data interpretation were covered. The sessions were further enriched with quizzes to reinforce key concepts and promote engagement among participants, ensuring a dynamic learning experience. Finally, hands-on sessions on ovitrap installation and servicing procedures were conducted.

In conclusion the training course demonstrated significant success in addressing the challenges faced by member states in implementing SIT projects. The high level of engagement and active participation from attendees throughout the sessions indicate the relevance and effectiveness of the training content. The interactive and hands-on approach fostered a deeper understanding of the critical elements necessary for successful SIT implementation.

Coordinated Research Projects (CRPs)

Project Number	Ongoing CRPs	Project Officer
D4.40.03	Generic Approach for the Development of Genetic Sexing Strains for SIT Applications (2019–2024)	Kostas Bourtzis
D4.40.04	Mosquito Radiation, Sterilization and Quality Control (2020–2025)	Hanano Yamada
D4.10.29	Improving Rearing, Handling, and Field Components for Fruit Fly SIT Application (2021–2026)	Chronis Rempoulakis
D4.10.28	Improve the Mass-Rearing of Lepidoptera Pests for SIT Programmes (2022–2027)	Daguang Lu
D4.40.05	Reproductive Biology of Male Aedes Mosquitoes for SIT Applications (2023–2028)	Maylen Gomez
D4.10.30	Improvement of *Drosophila suzukii* Mass-Rearing and Released Methods for SIT Programmes (2024–2029)	Teresa Vera
D4.10.31	Enhancement of Dacine Fruit Fly Management by Combining SIT with MAT and Female Suppression (2025–2030)	Rui Cardoso Pereira
D4.20.18	Tsetse Population Genetics (2025–2030)	Adly Abd Alla

Third RCM of the CRP on *Improving Rearing, Handling, and Field Components for Fruit Fly SIT Application*. 11–15 November 2024, Pretoria, South Africa

Participants of the Third RCM of the CRP on Improving Rearing, Handling, and Field Components for Fruit Fly SIT Application (Pretoria, South Africa).

The RCM was successfully hosted by the Department of Zoology and Entomology, the University of Pretoria, and attended by 16 CRP contract and agreement holders from 12 Member States including Argentina, Australia, Brazil, Burkina Faso, Guatemala, Israel, Mauritius, Mexico, Spain, South Africa, United States of America, and Viet Nam.

During the first two days of the meeting, the participants presented their research outputs relevant to the CRP, as well as their research plans for the next 18 months. In the last three days, general discussions were held to review the thematic areas and achievements of the CRP. Participants were also divided into three working groups according to their research topics, to develop the R&D plans for the next 18 months and draft the RCM Report.

The findings from the third RCM indicate significant progress in the collaboration among partners for the optimisation of fruit fly mass-rearing systems including larval diets and novel strains testing, pre-release protocols such as adult diets and nutritional supplements and field operations on methods of release, trapping systems and population surveillance models.

Fourth RCM of the CRP on *Generic Approach for the Development of Genetic Sexing Strains for SIT Applications.* 9–13 December 2024, Vienna, Austria

The RCM was held at Vienna International Centre and attended by 21 research contract and agreement holders (three of them virtually), as well as five observers from Argentina, Australia, Cameroon, Canada, China, Czech Republic, Germany, Greece, Israel, Italy, Mexico, South Africa, Switzerland, Thailand, United Kingdom, and United States of America.

Participants of the Fourth RCM on Generic Approach for the Development of Genetic Sexing Strains for SIT Applications (Vienna International Centre, Vienna, Austria).

Research progress was presented by the participants on the work related to the three main objectives of this CRP: (i) the isolation of selectable markers to be used for generic strategies for the construction of GSS, which has resulted in the identification of genes responsible for key phenotypes such as white pupae, brown pupae, temperature sensitive lethal, and red-eye; (ii) the development of generic approaches for the construction of GSS for SIT targeted agricultural pests and human disease vectors, which has resulted to the development of mutant lines in several new species targeted by SIT using gene-editing approaches and (iii) the development and evaluation of novel GSS strains using classical genetic and gene-editing approaches.

During this meeting, also a new CRP proposal has been prepared.

Consultancy Meeting on *Tsetse Population Genetics.* 11–14 November 2024, Vienna, Austria

The objective of this consultancy meeting was to facilitate a thorough and in-depth discussion among experts on the rationale and importance of analysing the impact of tsetse population genetics for the implementation of the sterile insect technique (SIT) within the framework of a coordinated research project (CRP). To achieve this, four experts were invited, one from France, one from Uganda, and two from the USA. Their selection was based on their expertise in tsetse population genetics and landscape modelling.

Participants of the consultancy meeting on Tsetse population genetics (Vienna, Austria).

The meeting commenced on Monday, 11 November 2024, with oral presentations where each participant showcased their previous and ongoing work. The remainder of the day was dedicated to discussing available tools, expertise, and knowledge gaps related to tsetse population genetics and landscape modelling. Discussions included recent work and prior experience in tsetse population genetics, including the development of a landscape friction map for the SIT project in Senegal.

The consultants concurred that the CRP is the proper mechanism to address these challenges. The remaining time of the meeting was devoted to developing the new CRP proposal.

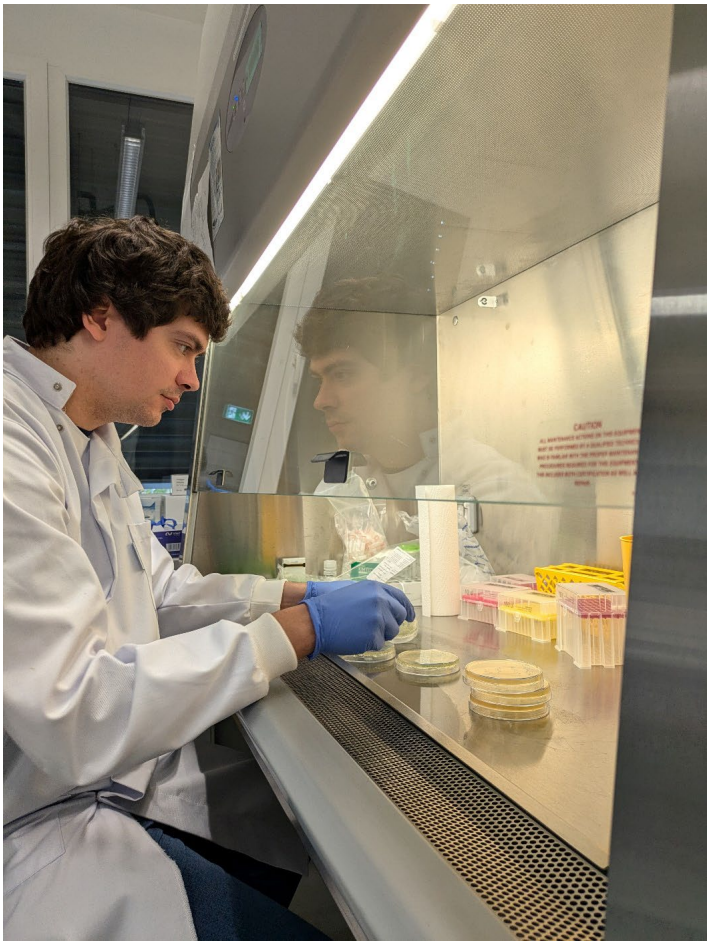
The new CRP proposal was approved by the Committee for Coordinated Research Activities (CCRA) in December 2024. Please find the announcement of the new CRP on page 27.

Developments at the Insect Pest Control Laboratory (IPCL)

Genetics and Molecular Biology

Neoclassical Development of Genetic Sexing Strains in the Oriental Fruit Fly *Bactrocera dorsalis*

The sterile insect technique (SIT) has been successfully used in the context of area-wide integrated pest management (AW-IPM) against fruit flies, tsetse flies, moths, mosquitoes, and several other insect species. For SIT to be efficient and cost-effective, it is essential to release only sterile males over an extended period of time. Therefore, it is crucial to have an efficient sexing method to separate males from females. This can be done through the development of genetic sexing strains (GSSs). These strains present a marker that is differentially expressed between males and females, allowing for easy separation. Commonly, this marker is a recessive visible phenotypic trait, such as a differently coloured puparium or eye.



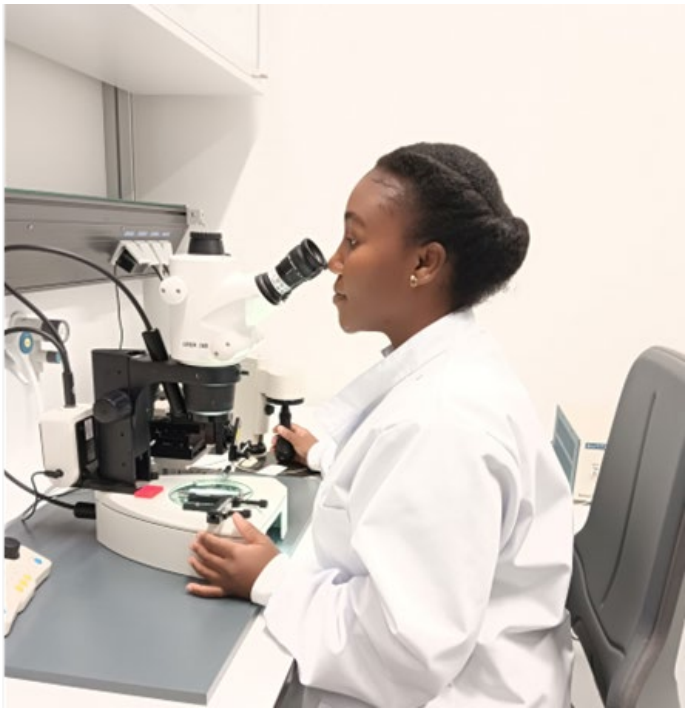
Mr Giovanni Petrucci carrying out experimental work towards the construction of the mini-wp gene of Bactrocera dorsalis.

Developing a novel method of generating GSSs could be extremely advantageous. In recent years, genome editing techniques have seen significant progress. In particular, the CRISPR/Cas9 system allows to target and cut genomic DNA with high specificity, using a single guide RNA (gRNA) and inducing a double strand break. Following cleavage, DNA can be repaired via two pathways: Non-Homologous End Joining (NHEJ) and Homology Directed Repair (HDR). In NHEJ, DNA is repaired by direct ligation of the DNA ends. Such a pathway is prone to generate indels in the target sequence, and it has been exploited for gene knockouts. For example, in *C. capitata* NHEJ has been exploited to generate white pupae lines by targeting the *wp* gene. HDR relies on a homologous DNA template sequence to repair double stranded breaks. This can be exploited for gene introgression into a specific genomic locus, by providing a template that contains the desired sequence between the flanking region of the homologous target site. In the context of the GSS, this could be exploited to generate rescue phenotypes exclusively in males. A wild-type version of the selected marker can be inserted into the male determining region, generating males with a rescue wild-type phenotype. If successful, this "neoclassical" approach could be the new standard for generating GSS.

In the frame of the IAEA Coordinated Research Project "Generic approach for the development of genetic sexing strains for SIT applications" and the Europe Horizon funded project REACT (the latter being co-ordinated by the Justus Liebig University of Giessen, Germany), we are trying to develop neoclassical GSS for the oriental fruit fly *Bactrocera dorsalis.* As a first step, we have developed three CRISPR/Cas9-based white pupae mutant lines in *B. dorsalis*. For the second step, the linkage of the wild-type allele of the white pupae gene to the male determining region located on the Y chromosome, has been carried out through bioinformatic analysis, and validated by PCR. Several genomic loci have been confirmed to be Y-specific and three of them were further analysed. The surrounding region of these loci has been sequenced to allow the design of homology arms for HDR. gRNAs have also been designed to target these regions, and *in vitro* cleavage assays confirmed the specific activity of three of them. In parallel, the *m*RNA of the *B. dorsalis wp* gene has been sequenced *via* Rapid Amplification of cDNA Ends PCR (RACE-PCR). Moreover, the promoter region of the gene has also been successfully sequenced. Assembly of these two sequences will allow to generate an intron-less version of the *B. dorsalis wp,* called mini-*wp* gene. This construct will then be injected, together with CRISPR-Cas9 and the appropriate gRNA, into developing embryos of *B. dorsalis*. The injected line will need to be homologous for the mutant phenotype of the *wp* gene. If successful, the resulting neoclassical GSS line will carry the rescue *mini-wp* gene into the Y, resulting in brown pupae males and white pupae females.

Development of Genetic Sexing Strain in *Anopheles arabiensis*

The SIT application against *Ano*pheles *arabiensis,* a main malaria vector, would greatly benefit from the development of a genetic sexing strain (GSS). The GSS allows for the separation of males from females, which is a critical step in the SIT programmes against mosquitoes, since only sterile males should be released in the field. A major reason that any accidental female release needs to be avoided is that females are the only ones that bite and can transmit the *Plasmodium* parasite that causes malaria. The development of a GSS requires two main components: (*a*) a selectable marker and (*b*) the linkage of the wild type allele of the selectable marker to the male sex. Therefore, in a GSS, males will be wild type whereas females will be mutants and based on their phenotypic difference the two sexes can be separated. Selectable markers can be genes that regulate visible phenotypic traits or conditional lethal genes such as the *temperature sensitive lethal* (*tsl*) gene used in *Ceratitis capitata*. The South African SIT project which is partly supported by the IAEA Technical Cooperation Programme (SAF5019: Testing the Sterile Insect Technique Intervention as a Vector Control Tool against the Primary Malaria Vector, *Anopheles arabiensis*). The lack of an efficient sex separation system, which is necessary to distinguish male mosquitoes prior to their sterilization and subsequent release, has been a major bottleneck in the project.



Ms Witness Ramashia injecting embryos of Anopheles arabiensis *towards the establishment of a mutant line carrying a selectable marker for the construction of a genetic sexing strain for this species.*

To accelerate the development of an efficient GSS in *An. arabiensis*, the development of knock-out mutants using the CRISPR/Cas9 technology is being investigated. The Insect Pest Control Laboratory (IPCL) in collaboration with the South African SIT project has identified several pigmentation genes that are currently being used for the development of mutants in *An. arabiensis*. Microinjections are performed in *An. arabiensis* embryos and survivors are checked for any phenotypic mutations. The aim is to develop a pure mutant line that will carry a visible marker and it will be subsequently used for the construction of a GSS.

Plant Pests

Induction of Sterility by Gamma Radiation in *Bactrocera correcta*

Two tephritid species namely the oriental fruit fly *Bactrocera dorsalis* and the guava fruit fly *Bactrocera correcta* are considered key insect pests affecting fruit production in several Southeast Asia countries, causing great yield losses and quarantine restrictions from importing countries. The combination of the sterile insect technique (SIT) with the male annihilation technique (MAT) as part of area-wide integrated pest management (AW-IPM) strategies can be implemented to suppress those species. Determining the proper irradiation dose and conditions is part of the R&D needs to implement SIT against *B. correcta*.

Ms Hoa Thi Thanh Nguyen assessing Bactrocera correcta *adult emergence 48 hours after irradiation.*

At IPCL, Ms Thi Thanh Hoa Nguyen is performing this study as part of a six-month fellowship supported by TC project RAS5097 (Strengthening and Harmonizing Surveillance and Suppression of Fruit Flies). The experimental protocol involves six different irradiation doses under two atmospheric conditions: normoxia and hypoxia (O2 levels between 5-1%). The colony being evaluated was derived from wild material collected in Viet Nam and maintained at IPCL. Two irradiation events (replications) have already been conducted. After adult emergence, flies were sorted by sex and were allowed to complete sexual maturation. All the possible crosses were

set up and eggs were collected after mating took place. Once all replicates are complete, and the optimal dose is determined, the mating competitiveness of irradiated males will be evaluated under field conditions with a recently established colony derived from wild material of the target area.

New Black Pupae Genetic Sexing Strain of *Anastrepha fraterculus* with Genetic Background from Peru Ready to be Evaluated

The South American fruit fly, *Anastrepha fraterculus*, is a cryptic species complex. Previous studies have demonstrated high levels of mating isolation between populations from South Brazil and the coastal areas of Peru. These findings indicate the need for a series of crosses and backcrosses to introgress the genetic background from Peru into the Af-IPCL-89 black pupae genetic sexing strain (GSS), which was originated from a population from South Brazil. The introgression scheme involves conducting backcrosses and crosses between wild males from Peru and females from the black pupae GSS Af-IPCL-89, as well as translocated males from the same strain and wild females from Peru.

This crossing scheme was initiated as part of a six-month fellowship supported by TC project RLA5087 (Validating the Sterile Insect Technique for the Control of the South American Fruit Fly), hosted at IPCL, and conducted by Mr Edgardo Ortiz Carpio from Peru. After the completion of the fellowship, the crossing scheme was continued at IPCL and has now been completed. This enables us to initiate the evaluation of the mating compatibility of the new GSS and a population from Peru. Once this is confirmed, the genetic stability as well as the productivity will be evaluated. Finally, the new GSS will be sent to the mass-rearing facility in Peru to scale up the production and conduct further quality control tests prior to implementing the SIT against this species in Peru.

Vapor Heat Treatments Targeting *Bactrocera dorsalis* and *Bactrocera carambolae*

The most tolerant stages of *Bactrocera dorsalis* population from Mauritius to vapor heat treatments ranging from 39 to 46.5°C have been determined. Our findings indicated that the third instar, followed by the egg, was the most tolerant stage of *B. dorsalis* in naturally infested mangoes. Comparative studies have been initiated using third instars and eggs from wild-collected insects maintained in fruit (F5 and F17) and laboratory-reared colonies kept in an artificial larval diet (F3 and F17). Our goal is to determine the extent to which laboratory adaptation affects fruit fly tolerance to vapour heat treatments.

Mango being infested by Bactrocera dorsalis *prior to vapour heat treatment.*

We also have initiated new experiments aiming to validate a vapor heat treatment schedule for *Bactrocera carambolae* in mangoes. Currently, there is no internationally recognized vapour heat treatment schedule for *B. carambolae*. We aim to determine the most tolerant stage(s) of the pest and estimating the optimal temperature and treatment duration to achieve quarantine security against *B. carambolae*.

Livestock Pests

Red Eye Mutation in Tsetse: A Promising Selectable Marker for the Development of a Genetic Sexing Strain

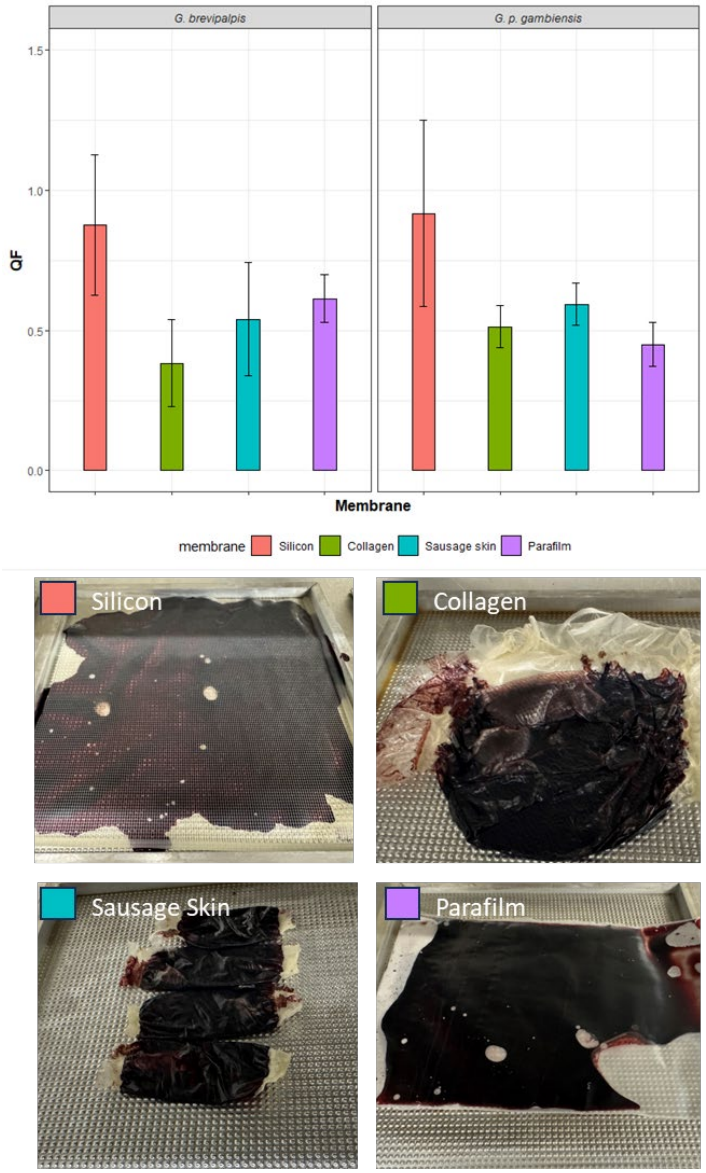
In the past, sex separation in tsetse was primary done manually with adult insects, as adult male flies are morphologically readily distinguishable from females by the presence of the hypopygium. However, separating tens of thousands of female flies from the males that is needed for the SIT programme is time consuming. With the newly developed Near Infrared Pupae Sex Sorter, accurate sex separation of tsetse pupae is now possible. However, this system does have its limitations as it requires a very stable tsetse pupae incubation environment to have an accurate sorting.

Glossina brevipalpis mating pair, red eye female and brown eye (wild type) male.

Other methods such as genetic sexing strains using morphological markers are being considered to improve the sex separation methods for tsetse through collaborative efforts of the Livestock Pests and the Genetics and Molecular Biology groups at IPCL. Morphological markers considered include eye colour and pupal colour genes. The wild-type eye colour in tsetse is dark brown. A stable red eye *Glossina brevipalpis* line has been maintained at the IPCL for many years, producing consistently offspring with only red eyes. This morphological colour marker, that is evident in the late pupal and adult stage, occurred naturally in the colony. The genetic characterization of this mutation in *G. brevipalpis* showed that it is due to a recessive gene which is sex-linked. A similar red eye mutation was recently identified also in *Glossina palpalis gambiensis* and a mutant strain is currently being established at the IPCL. The possibility of incorporating the red eye phenotype as a selectable marker in a genetic sexing strategy is currently being investigated.

Assess Novel Membranes for In vitro Feeding of *Glossina palpalis gambiensis* and *Glossina brevipalpis*

The development of appropriate in vitro feeding systems is essential for the implementation of the sterile insect technique (SIT) and the mass-rearing of blood feeding insects such as tsetse. Although during the last years, significant progress was made in improving and optimizing the rearing process aiming to reduce cost and improve tsetse quality, improvements are still required to produce feeding systems at lower cost, minimize the labor required for cleaning, and ensure that the system is suitable to produce high quality males, measured by key biological characteristics. Investigation into the development of a low cost, single use feeding membrane for tsetse feeding has continued at the IPCL. Membranes that are readily available on the market, such as collagen and parafilm, were used to produce single use blood pockets and was compared with the standard silicon membrane using the 25-day bioassay feeding test. This test has a simple numerical system, the quality factor (QF), that adequately summarizes and combines the various data obtained from survival, pupal production, and dissections. An appropriate feeding temperature between 35-36°C was only achieved with the silicon membrane, all other membranes were not able to reach the required feeing temperature. The highest QF value for both tsetse species was obtained for the flies that fed on the standard silicon membrane. All other QF values for the other membranes tested were significantly lower when compared to the standard silicon membrane and is thus not suitable for tsetse feeding. If collagen membranes are considered in the future, changes to the heating plates needs to be done as the current system combined with a collagen membrane is not sufficient to heat up and keep it at the appropriate temperature leveled needed for successful tsetse feeding.



Quality factor (QF) for each membrane type as determined by the standard 25-day bioassay feeding test. The QF adequately summarizes and combines the various data obtained from survival, pupal production, and dissections.

Infectivity of In vitro Cultured *Glossina fuscipes fuscipes* Endosymbiont *Spiroplasma*

Tsetse flies harbor diverse endosymbiotic bacteria, including *Wigglesworthia, Sodalis, Wolbachia*, and *Spiroplasma*, which significantly impact tsetse mass-rearing. *Spiroplasma* is a bacterial symbiont detected only in the palpalis group (*Glossina fuscipes fuscipes* (Gff) and *Glossina tachinoides*) and has not been found in any other tsetse species. To further analyze the interaction between *Spiroplasma* and its host, attempts were made to establish an in vitro culture from *Spiroplasma* isolated from Gff adults. The complete genome of the cultured *Spiroplasma* was sequenced and compared with that of *Spiroplasma* found in wild flies, confirming that the cultured strain is almost identical to the wild strain.

To assess the ability of cultured *Spiroplasma* to establish infection in Gff adults, teneral adults were screened for *Spiroplasma* infection using non-destructive PCR on DNA extracted from one intermediate leg, and only negative adults were injected with the *Spiroplasma* culture. The titre of *Spiroplasma* in injected adults was quantified with qPCR at various time intervals post-injection, and results confirmed an increase in *Spiroplasma* density in injected adults, while no increase was observed in adults injected with *Spiroplasma*-free media.

The possibility of vertical transmission of *Spiroplasma* from injected adults to their offspring is currently under investigation. Additionally, the potential for cultured *Spiroplasma* to initiate an oral infection through blood-feeding with cultured *Spiroplasma* is also being explored.

Human Disease Vectors

Sterilization of Mosquitoes and Tsetse with the Cabinet Style irradiator X-Rad320

Gamma irradiators are more common in SIT programmes, especially for large scale programmes where the large processing capacity of industrial, panoramic irradiators is required.

Mr Bénéwendé Aristide Kabore loading the environment box of the Precision X-rad320 model with chilled adult tsetse flies.

Self-shielded Co60 gamma irradiators have also been commonly used in smaller programmes and have proven to be a reliable method for achieving the desired sterility levels in various insect species. The development of X ray irradiators with suitable dose uniform rates (DURs) and processing capacity have provided an alternative to gamma irradiators for some SIT programmes. This has spurred research in the application potential of X ray irradiators for the SIT, and the comparison of X ray and gamma irradiators in terms of relative biological effectiveness in insects. Following the assessment of an off-the-shelf blood X ray irradiator, a cabinet style, small animal irradiator equipped with a novel environmental chamber designed for insect irradiation has been evaluated. The ability to chill the sample box to required temperatures, or enable altered atmospheres, and change dose rates and energy makes the Precision X-Rad320 model a versatile device for a variety of insects, especially if adult irradiation is required. Dose response curves for pupal and/or adult stages (chilled) of mosquitoes (*Aedes aegypti*, *Anopheles arabiensis* and *Anopheles stephensi*) and the tsetse (*Glossina palpalis gambiensis*) irradiated in chilled or non-chilled conditions were established and showed comparable results to previous experiments using gamma-irradiation.

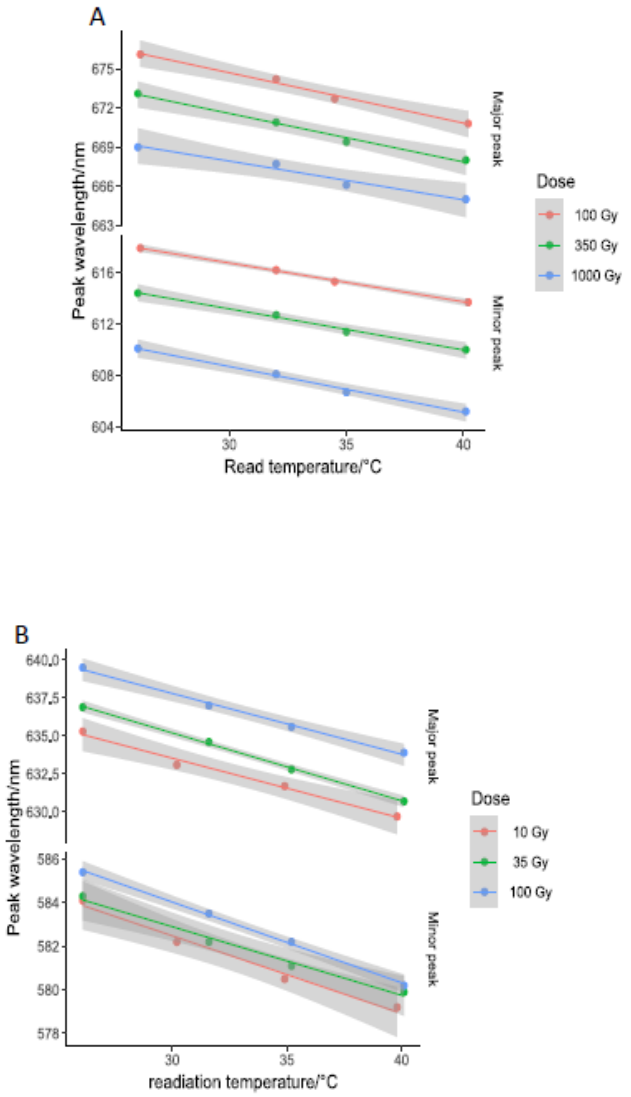
Mating competitiveness of *Aedes aegypti* and *Aedes albopictus* following radiation sterilization at pupal versus adult stage

Recollection of mated females from the semi-field mating competitiveness cages tests.

Male *Aedes aegypti* and *Aedes albopictus* were fully sterilized in a Co60 Gamma irradiator (Gammacell 220 either as pupae, or as adults, were marked with fluorescent dye, and were subsequently released into semi-field cages (aged 3 days old) to compete with untreated (fertile) males to mate with virgin females at a 1:1:1 ratio. Female mosquitoes were recollected after 2 days and exchanged for new virgin females. Females were exchanged in this way every two days for a period of 2 weeks to follow the competitiveness index of the sterile males over time based on egg hatch. For both species, males irradiated as adults were more competitive than males irradiated as pupae over the full 2 weeks. After 2 weeks, both fertile and sterile males showed reduced mating success. Although sterile males

cannot replenish their sperm stock, they seem to still succeed in competing and mating for longer than they are expected to survive in the field upon being released. These results provide encouraging insights for the SIT against two important disease vectors.

Gafchromic™ Dosimetric Film Reading Temperature Significantly Affects Optical Density Results

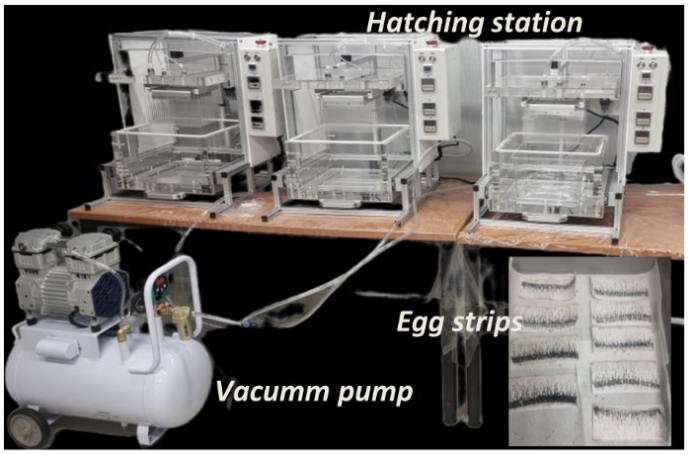


Influence of reading temperature on the wavelengths of the major and minor peaks of the spectrum of A: HD-V2 and B: MD-V3 film at three doses.

Reliable dosimetry is essential for dose verification following the irradiation of insects for the sterile insect technique (SIT). Gafchromic™ films are convenient and reliable, and thus are a popular choice in many SIT programmes. Although several publications characterizing the properties of Gafchromic films exist, these mostly describe older versions of the films which have since been improved, altering the response of the films to certain external factors. Following a series of experiments to examine the effects of temperature during irradiation on the films' response, the effects of reading temperature on exposed films have now been evaluated. It was found that Gafchromic film reading temperature affects results, with less dose readout with increasing temperatures. Therefore, a temperature stable environment is recommended for highest precision in Gafchromic film analysis.

Assessing the Efficiency of an Automated Egg Hatching System for *Aedes mosquitoes*

The egg hatching process in *Aedes* mosquitoes is a fundamental step in laboratory mass-rearing operations, especially for the SIT. Ensuring optimal and synchronized hatching is key to successful larval development and pupae production. Various systems have been designed to enhance hatching rates, typically involving the placement of *Aedes* mosquito eggs in containers or jars filled with deionized water or nutrient-enriched hatching solutions. However, these approaches are often time- and space-consuming and prone to variability. The development of automated hatching systems has therefore become essential, offering faster, more accurate, and reproducible results. An automatic hatching system was developed by a Singaporean company, Orinno Technology Pte. Ltd. to address the challenges associated with manual hatching and thus aiming to synchronize hatching and improve the overall egg hatching rates of *Aedes* mosquitoes. The equipment was tested at the IPCL with a comparative approach against the traditional hatching method (overnight hatching in jars with hatching solution) to assess its efficiency. In comparison to the jars method, the automated egg hatching system performed 5% lower in terms of hatching success, but offered better synchronization and was more time efficient. This automated system constitutes an additional tool in *Aedes* egg hatching and shows promise in streamlining mosquito rearing operations to support the large-scale implementation of SIT programs.



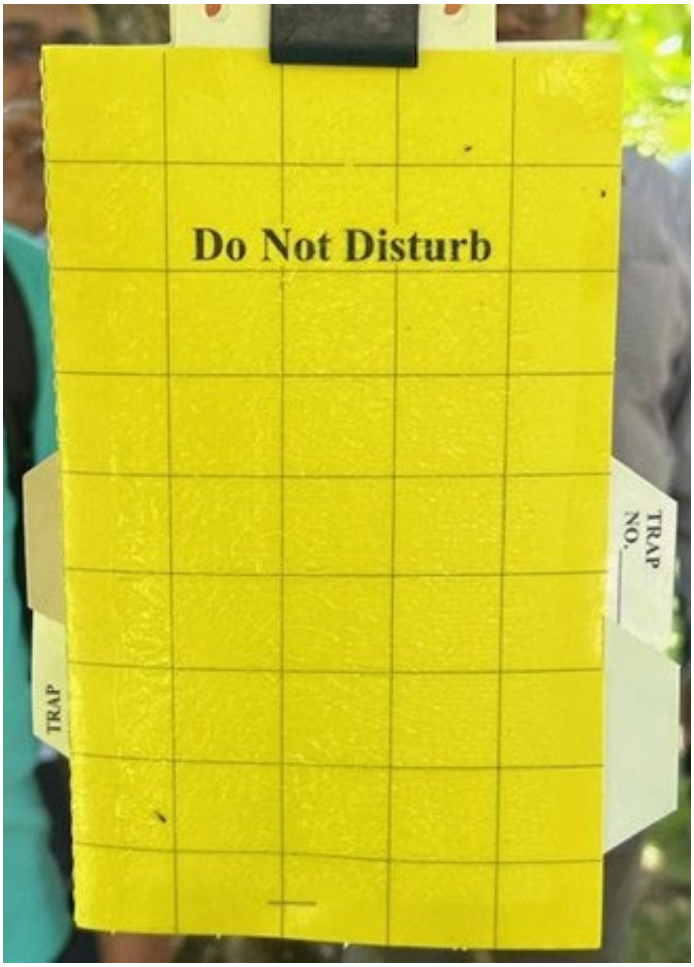
The automatic hatching system developed for Aedes *mosquitoes by Orinno Technology Pte. Ltd.*

Reports

Dominican Republic Successfully Eradicate Mediterranean Fruit Fly Infestation

In record time, the Dominican Republic was able to successfully contain a new incursion of the Mediterranean fruit fly, a highly destructive pest threatening agricultural production worldwide in 2024. This marks the second time the country has eradicated this invasive insect using the Sterile Insect Technique (SIT), an environmentally friendly pest control method.

Lessons learned from the first eradication effort in 2015, supported by the IAEA, United Nations Food and Agriculture Organization (FAO), and the International Regional Organization for Agricultural Health (OIRSA), enabled the swift and effective response to the 2023 outbreak.



Yellow Panel trap with trimedlure in use for the confirmation of the Mediterranean fruit fly eradication. (Photo: R. Cardoso Pereira/FAO/IAEA).

In December 2023, the Dominican Republic's Ministry of Agriculture detected the Mediterranean fruit fly near Punta Cana, triggering the activation of an emergency response protocol to contain the outbreak. Thanks to the Ministry's surveillance network, the pest was detected early and declared transient, which confined the affected area to less than 50 km² — a significant improvement compared to the 2015 outbreak that affected over 2000 km².

In February 2024, a Technical Advisory Committee (TAC) composed of IAEA, FAO, and OIRSA experts visited the area to provide guidance on tailored eradication strategies and offer technical recommendations. The National Plant Protection Organization (NPPO) implemented a contingency plan that included:

- Weekly releases of 3 million sterile flies for 26 weeks
- Field surveillance and control measures, such as insecticide-bait sprays and bait stations
- Continuous technical support from international experts

The eradication of the pest was officially declared on 27 September 2024, less than 10 months after the initial detection, with no quarantine restrictions imposed by importing countries.

"The success of this project in the Dominican Republic shows how close international cooperation can protect farmers from insect pests that can have a devastating impact on harvests and a country's agricultural production and trade," said Rui Cardoso Pereira, Section Head of the Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture in Vienna, Austria.

Jackson trap with trimedlure in use for the detection of Mediterranean fruit fly. (Photo: R. Cardoso Pereira/FAO/IAEA).

Rodrigo Castañeda, FAO Representative in the Dominican Republic, praised the nation's swift and coordinated response, highlighting the collaboration between agencies and with partner countries as a model of triangular cooperation. He specifically acknowledged the support of the Moscamed Program of Guatemala and Mexico, which provided weekly sterile flies, and the financial backing of FAO, OIRSA, and other stakeholders. "This achievement demonstrates the power of international collaboration to tackle agricultural threats and protect livelihoods," said Castañeda.

The Dominican Republic's rapid eradication in 2024 reflects the significant capacity-building efforts since the first

Mediterranean fruit fly incursion in 2015. That outbreak resulted in quarantine restrictions from the United States, leading to an estimated US$ 40 million in losses within nine months and putting 30 000 jobs at risk. The pest was eventually eradicated in 2017 after two years of intensive efforts, which included the release of 4.06 billion sterile flies.

This earlier experience equipped the country with the knowledge and tools to address future incursions more effectively. "Today, we continue trapping and maintaining quarantines at entry points, supported by additional phytosanitary measures such as insecticide-bait sprays, bait stations, and the use of SIT," said Dario Vargas, Deputy Minister of Agriculture Extension.

The 2024 eradication underscores the importance of early detection, international cooperation, and advanced pest management techniques like SIT. By leveraging nuclear technology and sustained capacity-building, the Dominican Republic has demonstrated how timely, coordinated action can prevent agricultural crises and safeguard food security. As Najat Mokhtar, Deputy Director General of the IAEA, stated, “The Dominican Republic’s success is a testament to the transformative power of nuclear technology, capacity-building efforts, and the dedication of local teams. These partnerships will continue to play a pivotal role in safeguarding food security and supporting agricultural resilience worldwide.”

Source: IAEA News. By Sophie Ramirez, 9 December 2024.
https://www.iaea.org/newscenter/news/dominican-republic-successfully-eradicate-mediterranean-fruit-fly-infestation-in-record-time.

Celebrating 60 Years of the Unique FAO and IAEA Partnership

October 2024, the Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture is celebrating a remarkable milestone its 60th anniversary. Established in 1964, this partnership between FAO and IAEA has advanced the use of nuclear science to boost food security, agricultural productivity and environmental sustainability.

Over the past six decades, the Joint FAO/IAEA Centre has harnessed nuclear technologies to support countries in tackling critical global challenges, from increasing crop yields and protecting livestock to controlling pests, advancing soil and water management and safeguarding food safety and authenticity.

The FAO/IAEA Biotechnology laboratories have been a central part of the Joint FAO/IAEA Centre’s work since its establishment. These state-of-the-art laboratories are the backbone of the Joint FAO/IAEA Centre’s operations, focusing on the development of technologies to help address agricultural and environmental challenges. Today, the laboratories remain at the forefront of science, technology and innovation, continuing to provide essential research, capacity development and technology transfer to countries.

Since its establishment, the Joint FAO/IAEA Centre has provided significant contributions towards the improvement of agrifood systems through the application of nuclear science and nuclear-related techniques in five key working areas:

Insect Pest Control

The Joint FAO/IAEA Centre actively advances the development and application of the Sterile Insect Technique (SIT) and other radiation-based pest management technologies. Since the Joint FAO/IAEA Centre’s infancy, SIT has been one of its core functions, allowing it to effectively control insect pests while reducing or eliminating reliance on chemical pesticides. By using SIT, male insects of targeted species can be sterilized by using ionizing radiation. In Fort Myers, Florida in the United States of America, SIT is being used to suppress mosquitoes that have become resistance to insecticides.

In 2024, SIT played a key role in eradicating the Mediterranean fruit fly from the Dominican Republic, after a resurgence since the first eradication in 2017. SIT has been instrumental in helping the country to regain access to important export markets.

Rearing of Tsetse flies in the FAO/IAEA Insect Pest Control Laboratory. (Photo: M. Casling/FAO/IAEA).

Celebrating 60 Years of Innovation and Collaboration

As the Joint FAO/IAEA Centre marks its 60th anniversary, it reflects on a legacy of innovation and collaboration that underscores the critical role of science and international cooperation in tackling global challenges in agrifood systems transformation. The Joint FAO/IAEA Centre is dedicated to developing solutions to promote access to nutritious and safe food for a growing population while minimizing agriculture's environmental impacts and addressing climate change threats.

To help boost global food production and food and nutrition, the IAEA and FAO launched the Atoms4Food initiative in 2023 during the World Food Forum. It offers tailor-made approaches in food and agriculture. The initiative supports countries in using innovative nuclear techniques to enhance agricultural productivity, increase the resilience of agrifood

systems, enhance food production, improve food safety, and the challenges of climate change.

The Joint FAO/IAEA Centre will continue to drive innovation and deliver tangible solutions to the ever-changing agricultural challenges facing our world by fostering research for development, enhancing capacity development and knowledge sharing, and strengthening partnerships.

Historical Achievements

While there have been many noticeable achievements in recent years, the centre has been developing and applying valuable nuclear techniques for its entire six-decade existence, with notable impacts in the field. For example, a project started in 1979 to control the tsetse fly in Nigeria, which cleared the entire project area of the pest by 1987. In 1978, the salt-tolerant varieties of barley and wheat in Pakistan transformed saline soils into productive farmlands. Another key example comes from the early 1980s, when the centre helped eradicate rinderpest.

Source: IAEA. By Matteo Louis, Casling 2 October 2024. https://www.iaea.org/newscenter/news/celebrating-60-years-of-the-unique-fao-and-iaea-partnership.

The Screwworm Menace Affecting Animals and Threatening Humans in Senegal

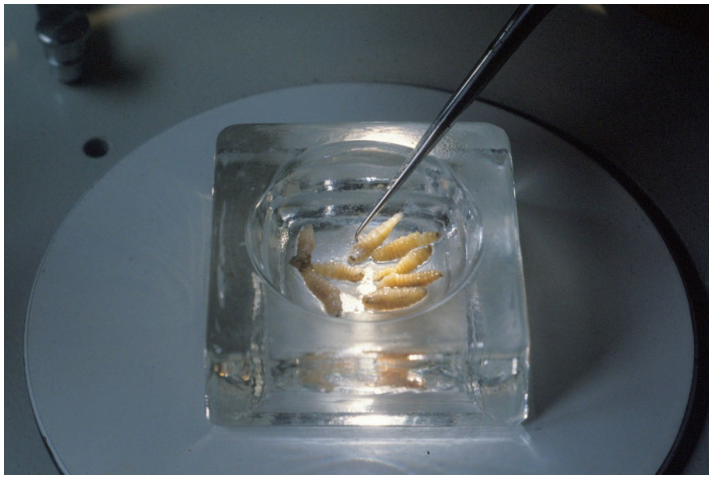
Senegal's farmers and vets had never seen anything like it before. An infestation tore across the country, inflicting myiasis, a parasitic invasion of a wound by maggots. All mammals, including humans, can fall victim to them. So it is little wonder that the suddenness and severity of the screwworm outbreak set off alarm bells.

"The novelty and the violence of the cases were the trigger" for the country to request a mission by the Food and Agriculture Organization of the United Nations (FAO), says FAO Senior Veterinarian, Frederic Poudevigne, who was part of the Emergency Management Centre (EMC) mission team.

The Screwworm fly lays its eggs in pre-existing wounds of live animals or humans. In Senegal, thousands of animals were affected during the rainy season of July to December 2023 and while some were treated with larvicides or more homemade cures, others were so seriously affected that they died. Adding to the impact on farmers' livelihoods was the time spent inspecting animals and the cost of veterinary consultations and products.

As part of their joint mission, FAO, the Joint FAO/IAEA Centre and the Senegalese authorities visited seven of the country's 14 departments, collecting a total of nearly 2 000 reports of cases from farmers and vets. Only 16 cases were previously known by the animal health authorities. Though Screwworm can also affect humans, no confirmed cases were found in Senegal.

Besides supporting the country in planning its response, one of the key tasks for the experts was to establish which species of Screwworm was behind the outbreak - a question which would have important implications for the response and for future outbreaks.



The outbreak was initially thought to be a new introduction of the invasive New World Screwworm. Instead, DNA tests identified it as caused by the Old World Screwworm, already endemic on the African continent. ©FAO/Sergio Pierbattista.

A preliminary diagnosis of two samples sent to the national veterinary laboratory in Dakar pointed to the New World Screwworm (*Cochlyomyia hominivorax*) as the culprit. This would have meant the first introduction of a highly aggressive and invasive American species in Sub-Saharan Africa.

Back in the early 1990s, a serious New World Screwworm outbreak was successfully halted in Libya in less than three years by an emergency programme led by FAO and the IAEA. The response focused on the effective Sterile Insect Technique (SIT). In SIT, insects are bred in captivity and irradiated at the pupa stage with gamma radiation to sterilize them. The sterile flies are then dispersed and their mating with fertile wild flies produces no offspring, helping to reduce and eventually eradicate this parasitic population.

Confirming the DNA tests that ruled out New World Screwworm, the Senegal mission together with a senior expert from the IAEA analysed the available samples and confirmed the involvement of the Old World Screwworm (*Chrysomya bezziana*) instead.

The Old World Screwworm species is endemic to a great portion of the African continent, meaning the ecological impact is far less than that of an invasive species. Unfortunately, the SIT cannot be used for the Old World Screwworm at current stage, so authorities must instead rely on preventive measures including insecticides and larvicides.

The Screwworm's sudden appearance in Senegal remains a mystery given that there have been no reports of it in the country for over 60 years. Moreover, as mysteriously as it

appeared, the wave of Screwworm myiasis decreased in Senegal in January 2024, at the end of the rainy season. But the possibility of a higher number of cases cannot be ruled out when the next rainy season begins; the moisture could cause the flies to reemerge from the soil, having completed their life cycle and remained dormant in pupa form.

Amid these concerns and the lack of evidence demonstrating how the infestation evolved, the FAO One Health team conducted extensive interviews with farmers, vets and hospital staff. Based on these field assessments, together with laboratory analyses and data collection, the experts came up with a series of recommendations to mitigate the impact of a potential recurrence.

These include measures at national level to step up surveillance of livestock imports from countries where Screwworm is endemic; make the best treatment available to all and put in place a stockpile if needed; ensure awareness of the population, including farmers, vets and public health workers on Screwworm diagnosis and treatment systematically in both animals and humans.

As Poudevigne sums it up, “It’s not as dramatic as an infectious disease, but in the absence of SIT, it’s all about prevention and communication.”

Thousands of animals were affected by the outbreak in Senegal, leading to many dying or becoming unproductive and having a serious impact on farmers’ livelihoods. © Benedicte Kurzen/NOOR for FAO.

The FAO-IAEA mission has underlined the crucial importance of taking early action and ensuring that samples are brought immediately to laboratories for analysis. These measures will help ensure that Senegal will be in a better position to confront any future outbreak of Screwworm and can doubtless also hold lessons in other countries where a similar threat might emerge.

Source: FAO, 1 August 2024. https://www.fao.org/newsroom/story/the-screwworm-menace-affecting-animals-and-threatening-humans-in-senegal/en.

Announcements

Call for Research Proposals on a New FAO/IAEA CRP D42018: Tsetse Population Genetics

The IAEA is launching a new five-year Coordinated Research Project (CRP) to enhance the implementation of sterile insect technique (SIT) against tsetse flies though identification of isolated population that can be targeted with the SIT.

In the context of area-wide integrated pest management (AW-IPM) applied to tsetse flies that are vectors of African Trypanosomosis, which remains one of the major constraints to agriculture and cattle breeding in Africa, understanding the spatial population genetic structure of target tsetse species helps identifying isolated populations that are potential candidates for eradication using the SIT.

Particularly, species distribution models (SDMs), combined with genetic connectivity maps, can significantly enhance decision-making by helping to identify areas critical for vector control. The SDMs predict where vector species are likely to thrive under current and future environmental conditions, while genetic connectivity maps reveal the movement and connectivity of vector populations across landscapes. Expansion of these methods and tools, as well as the development of improved markers for species and subspecies identification and discrimination between sterile and wild males, and for population genetic studies, are needed.

The proposed CRP aims to conduct an extensive sampling of tsetse flies in the African continent mainly in areas where have not been conducted, gather the SDMs and genetic connectivity maps to enable the effective choice for SIT implementation against tsetse flies through a multidisciplinary approach involving expert entomologists, epidemiologists, geneticists, modelers, and ecologists.

CRP Overall Objectives

To utilize population genetics and spatial ecological modelling to identify tsetse populations that can be targeted for sterile insect technique (SIT) applications, as part of qrea-wide integrated pest management (AW-IPM) programmes.

Specific research objectives

The specific research objectives for this CRP will include:

- To develop and validate prediction models and maps to identify areas of interest for sample collection in key SIT targeted species.
- To design and validate tools and protocols for use in identification of key tsetse species, subspecies, and genetic lineages for SIT applications.
- To determine the vector population structure and gene flow to predict the degree of isolation between neighbouring populations in fragmented or changing habitats.
- To integrate species distribution models and population genetics outputs to identify candidate populations for SIT applications.

How to join this CRP

Research organizations interested in joining the CRP must submit their Proposal for Research Contract or Agreement by email, no later than 30 April 2025 to the IAEA's Research Contracts Administration Section (research.contracts@iaea.org), using the appropriate template on the CRA web portal (https://www.iaea.org/services/coordinated-research-activities). The IAEA is committed to gender equality and to promoting a diverse workforce. Applications from qualified women and candidates from developing countries are strongly encouraged.

For further information related to this CRP, potential applicants should use the contact form under the CRP page. https://www.iaea.org/projects/crp/d42018.

Call for Research Proposals on a New FAO/IAEA CRP D44006: Advanced Approaches for the Development of Genetic Sexing Strains (GSS) for SIT Applications

The IAEA is launching a new five-year Coordinated Research Project (CRP) to explore advanced approaches for the development of genetic sexing strains (GSS) in support of SIT Applications.

Climate change and globalization have been playing a critical role in the expansion of the ecological range of invasive species including insect pests and disease vectors. This has increased requests from Member States to develop and apply the Sterile Insect Technique (SIT) as a component of area-wide integrated pest management (AW-IPM) programmes for their population control. Although SIT can be carried out with sterile releases of both males and females, it has been shown that male-only releases are more efficient and cost-effective. In the case of insect disease vectors, such as mosquitoes, the removal of females before the release of sterile insects is critically important as females are the ones that bite, blood feed, and transmit human

pathogens. Male-only production and releases can be achieved through genetic sexing strains, which allow the separation or elimination of females as early in their development as possible.

This new CRP aims to establish a comprehensive framework for advancing the development of genetic sexing strains (GSS) to improve the efficiency and cost-effectiveness of the SIT within AW-IPM programs. The focus will be on leveraging innovative genetic, molecular, biotechnological, and AI-based robotic tools to address key knowledge gaps including the transfer of genetic markers for sexing to novel target species, the generation and analysis of complex datasets to understand sex chromosome structure and evolution, and to develop next-generation GSS systems for target pest species. The anticipated outcome is a significant enhancement of SIT implementation, contributing to environmentally sustainable pest and vector control globally.

CRP Overall Objectives

The main objective of this CRP is the development of new or improved sexing systems to be used for sterile insect technique (SIT) applications, by targeted transfer of visual or physiological traits to new species, characterizing and manipulating sex determination pathways, increasing the fitness of genetic sexing strains (GSS) with genome editing technologies, and exploiting robotics and AI. By integrating cutting-edge genetic and data science technologies with rapid advances in fundamental insect biology, this CRP has the potential to modernize GSS applications for a broad range of pest species.

Specific research objectives

The R&D efforts which will be carried out in the frame of this CRP aim:

- To validate the effective transfer and expression of generic markers in SIT target species.
- To sequence genomes of selected SIT-target species and produce robust chromosome assemblies emphasizing sex-specific regions.
- To develop and validate reliable approaches to efficiently link selectable markers to sex-determining regions.
- To establish and evaluate advanced sexing systems using classical genetics, gene editing, robotics, and AI.

How to join this CRP

Research organizations interested in joining the CRP must submit their Proposal for Research Contract or Agreement by email, no later than 15 November 2025 to the IAEA's Research Contracts Administration Section (research.contracts@iaea.org), using the appropriate template on the CRA web portal (https://www.iaea.org/services/coordinated-research-activities). The IAEA is committed to gender equality and to promoting a diverse workforce. Applications from qualified women and candidates from developing countries are strongly encouraged.

For further information related to this CRP, potential applicants should use the contact form under the CRP page. https://www.iaea.org/projects/crp/d44006.

12th International Symposium on Fruit Flies of Economic Importance. 19–24 April 2026, Agadir, Morocco

We are pleased to announce the organization of the 12th International Symposium on Fruit Flies of Economic Importance, to be held from **19–24 April 2026**, in Agadir, Morocco.

The meeting will be conducted in a presential format to stimulate innovation, create new synergies, and strengthen links within the scientific community.

Since the first symposium in Athens, Greece (1982), the aim of these meetings is to gather scientists, researchers, and those involved in plant protection agencies and phytosanitary operational programs to share their knowledge, technologies and experiences regarding tephritid fruit flies. It is with great satisfaction to underline that in the past 40 years, these symposia have contributed to the development and improvement of environmental-friendly control methods and management strategies that minimize the negative effects of fruit fly pests worldwide, as well as the conformation of a very strong and friendly community of tephritidologists.

The symposium sessions will be in English and the programme will cover all relevant disciplines ranging from basic knowledge to applied research such as Area-wide

Integrated Pest Management and Social, Economic and Policy Issues in Action Programmes, Biology, Ecology, Physiology, Behavior, Taxonomy, Genetics, Biotechnology, Chemical Ecology, Sterile Insect Technique, Biological Control and other disciplines.

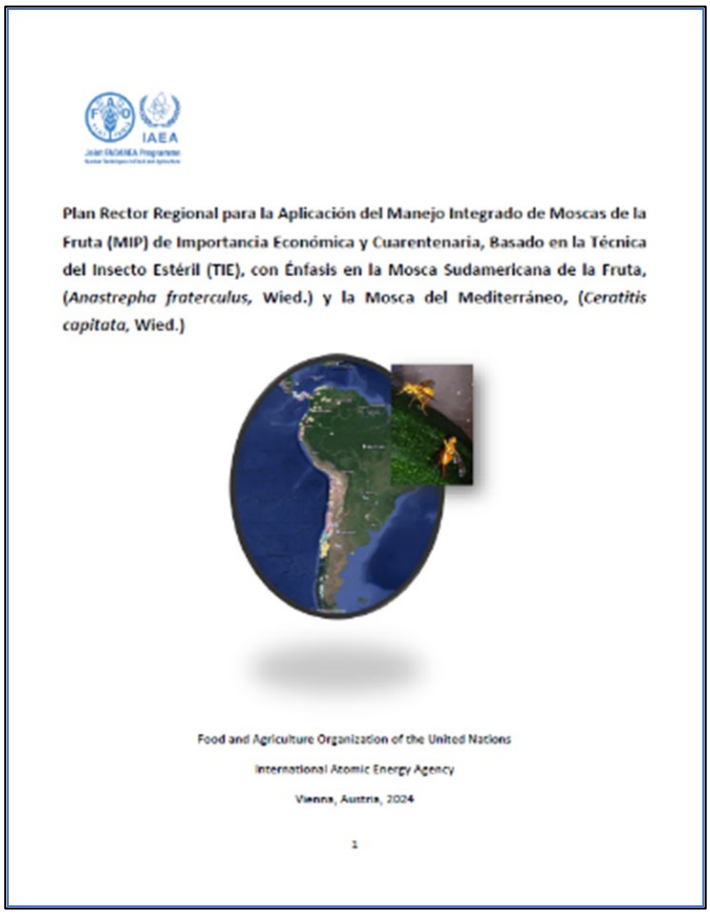
Participants are welcome to present their work as an oral presentation or as a poster. The fruit steering committee and organizing committee will evaluate all the abstracts and organize the agenda of the Symposium.

Further information about the registration fees, abstract and poster guidelines, the programme, technical tours and other useful general information, will be soon available at: www.12isffei.com.

Plan Rector Regional para la Aplicación del Manejo Integrado de Moscas de la Fruta (MIP) de Importancia Económica y Cuarentenaria, Basado en la Técnica del Insecto Estéril (TIE), con Énfasis en la Mosca Sudamericana de la Fruta, (Anastrepha fraterculus, Wied.) y la Mosca del Mediterráneo, (*Ceratitis capitata*, Wied.)

The Regional Master Plan for the Application of Integrated Fruit Fly Management based on the Sterile Insect Technique (SIT), addresses the problems caused by fruit flies of economic and quarantine importance, with a special emphasis on the South American fruit fly (*Anastrepha fraterculus*) and the Mediterranean fruit fly (*Ceratitis capitata*). The plan therefore proposes close collaboration among South American countries through the creation of a Regional Commission to coordinate fruit fly pest management activities.

This collaboration includes the exchange of information and research results on the biology, surveillance and control of fruit flies, the implementation of pilot programs in different countries to validate the effectiveness of the SIT integrated with other control methods, and the coordination of efforts to establish common quarantine measures and facilitate international trade in fruits and vegetables. The Plan is available at Insect Pest Control (IPC) publications website https://www.iaea.org/sites/default/files/plan_rector.pdf.



Mr Fabian Gstöttenmayer obtains his PhD from Technical University of Vienna (TU WIEN)

Mr Fabian Gstöttenmayer from Austria successfully defended his PhD thesis at Technical University of Vienna (TU WIEN) in September 2024. His PhD research was conducted at the Insect Pest Control Laboratory (IPCL) of the Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture, located in Seibersdorf, Austria.

Mr Gstöttenmayer's thesis entitled "Population genetics and research of host-symbiont interactions of the tsetse fly (*Glossina* spp.)" https://doi.org/10.34726/hss.2024.107469 aimed to develop new genetic markers to study the population genetics of *Glossina brevipalpis* and therefore provide molecular tools to assist vector control strategies of this tsetse fly species. In addition, his thesis focused extensively on the interplay between the tsetse fly and their endosymbiotic bacteria such as *Sodalis* and *Spiroplasma*, which are of interest due to their potential implications for disease transmission and the fitness effects in tsetse mass-rearing for sterile insect technique (SIT) applications.

Mr Gstöttenmayer presented his thesis through four scientific studies. The first study focused on the development and characterization of microsatellite markers for *G. brevipalpis*. These markers are intended to support future population genetic studies, enhancing the understanding of population structure in wild populations and providing decision-makers of control programmes with measures of gene flow and dispersal.

The second study explores the prevalence of *trypanosomes* and *Sodalis* in various wild populations of tsetse flies, their potential interactions and implications for SIT programmes. It presents prevalence data from 10 different species across a multitude of sampling locations throughout 15 countries. This work concludes that infection patterns vary by species and geographic location, with statistically significant correlations in some species.

TECHNISCHE UNIVERSITÄT WIEN
Vienna | Austria

DISSERTATION

Population genetics and research on host-symbiont interactions of the tsetse fly (*Glossina* spp.)

ausgeführt zum Zwecke der Erlangung des akademischen Grades eines Doktors der Naturwissenschaften unter der Leitung von

Univ. Prof. Dr. Robert. L. Mach

E166

Institut für Verfahrenstechnik, Umwelttechnik und technische Biowissenschaften

eingereicht an der Technischen Universität Wien

Fakultät für Technische Chemie

von

Fabian Gstöttenmayer

[redacted]

Wien, 2024

The third and fourth studies focused on the interaction between the vector of Human African Trypanosomosis (HAT) *Glossina fuscipes fuscipes* and the endosymbiont *Spiroplasma*. These studies highlighted the negative effects of this bacterium on the metabolic and reproductive fitness of laboratory-reared flies. Remarkably, *Spiroplasma* infection negatively impacts both females and males, as evidenced by prolongation of female gonotrophic cycles and reduction of male sperm motility. To further investigate this interaction, the fourth study provided a detailed report on the successful cultivation of *Spiroplasma* and its genome sequencing. Comparative genomic analysis was undertaken to identify genomic synteny of *Spiroplasma* from different sample sources, as well as potential genes that are involved in the symbiosis between the host and the bacterium.

In Memoriam

Alan Stuart Robinson (1945–2024)

With great sadness we announce the passing of Alan Robinson, former Head of the Insect Pest Control Laboratory (IPCL), on 30 November 2024. Alan was born on 21 November 1945 in Littleborough, Manchester, Lancashire, United Kingdom. He earned his BSc Honours in Applied Biology from University of Salford in 1968. During his undergraduate studies he became fascinated with Genetics and Entomology, leading him to the University of Bristol where he completed his PhD in Population Genetics of Chromosomal Translocations (1968–1971). It was during that time that he realized the importance of genetics and began experimenting with translocations as a tool for insect pest control, a field on which he excelled and devoted the rest of his research and professional career.

During his postdoc at the Summerland Research Station, Canada Agriculture, British Columbia, Canada, he focused his research efforts on the use of irradiation and sterile insect technique for the population control of the codling month (1971–1972). Alan was initially appointed Scientific Officer and later become Senior Scientific Officer at the Research Institute ITAL, Wageningen, The Netherlands where he led the Genetics Group for almost fifteen years (1972–1987). During this period, Alan and his collaborators studied the biology, genetics, and ecology of a major pest, the onion fly, *Delia* (=*Hylemya*) *antiqua* and set the groundwork for the development of the sterile insect technique package against it.

It was also during this period that Alan began using irradiation to induce translocations for the development of genetic sexing strains (GSS) for insects, initially using *Drosophila melanogaster* as a model organism and the alcohol dehydrogenase (*adh*) locus as a selectable marker. His efforts were then expanded to *Delia antiqua* and the malaria vector, *Anopheles stephensi*, for the construction of a GSS using dieldrin resistance as a selection marker.

For the Mediterranean fruit fly, *Ceratitis capitata*, Alan was one of the pioneers in the development of GSS based on the white pupae mutation. By chance, one of the translocations isolated by Alan in 1982 resulted in the best translocation currently used in almost all *C. capitata* mass-rearing facilities around the world. This translocation was renamed recently and is now known as Vienna-8, which is currently used in combination with the white pupae mutation and the temperature-sensitive selectable markers.

In 1987, he moved to the Institute of Molecular Biology and Biotechnology (IMBB) in Heraklion, Crete, Greece, initially as EEC Senior Fellow (1987–1989) and later as an Associate Research Professor (1989–1994), where he continued his genetic and molecular biology work on *Ceratitis capitata*. In 1994, Alan was appointed Head of the IPCL of the Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture in Seibersdorf, Austria, where he remained until his retirement (2007). This was also an extremely productive period during which he coordinated all the R&D activities of the IPCL. Initially focused on insect plant pests and livestock pests, these activities were expanded during his tenure to include human disease vectors as well.

During his long career, Alan collaborated with many research groups from all over the world. He was a visiting Professor in University of Pavia, and he also served as a consultant for IAEA (before his recruitment as Head of IPCL and after his retirement), FAO and WHO/TDR; invited lecturer for training courses including the graduate course "Genetics and Insect Control" at the University of Crete, Greece; Director of the course "Biology of Disease Vectors in Crete, Greece (1994), and panel member of external review committees including those of the Screwworm Genetics Programme (2000) and the Moscamed Programme (2001).

Alan supervised the work of several young scientists including three PhD students; he was a great teacher and mentored many insect geneticists and SIT workers. He published more than 150 research papers and book chapters,

and he has served as Guest Editor for special issues on SIT-related topics (mainly outcomes of IAEA Coordinated Research Projects) of several peer-reviewed scientific journals. More importantly, Alan was the co-editor of three seminal books: (a) Fruit Flies: their Biology, Natural Enemies, and Control (1989); (b) Sterile Insect Technique: principles and practice in area-wide integrated pest management (first edition in 2005; second edition in 2021) and (c) Area-wide Control of Insect Pests: from Research to Field Implementation (2007).

Alan was an outstanding scientist with excellent technical knowledge of insect genetics. He was also a fantastic colleague, with a great personality and always positive attitude, a good team player, a wonderful person, a real gentleman. His in-depth scientific knowledge and outstanding research work on insect pests and disease vectors will be greatly missed. But above all, we will miss his kindness, generosity, and his great personality.

Other News

New World Screwworm an Emerging Transboundary Problem in Central America and Mexico

Myiasis caused by the New World Screwworm (NWS) *Cochliomyia hominivorax* is an important transboundary parasitic disease that affects livestock, domestic pets, wild animals, and humans. Native to the American continent, it causes severe economic losses, impacts animal and human well-being, and negatively affects food security, particularly the low-income people in endemic countries.

Due to its transboundary nature, international eradication programmes were implemented in North and Central America. These programmes utilized strict control measures, including preventive and curative treatment of wounds in animals and humans, and regulation of animal and human movement. When the parasite's wild population was suppressed, the sterile insect technique (SIT) was then introduced immediately, thus eradicating the parasitosis.

This disease was eradicated in 1982 from the United States of America, in 1991 from Mexico and Belize, in 1994 from Guatemala, in 1995 from El Salvador, in 1996 from Honduras, in 1999 from Nicaragua, in 2000 from Costa Rica, and in 2006 from Panama, where an NWS sterile fly production facility was built and a 'Sterile Fly Barrier' was established at its international border with Colombia to prevent the migration of fertile flies from endemic countries in South America.

Aspect of an animal with a miases caused by Cochliomyia hominivorax *(Source: Mariano Arroyo Sanchez, SENASA Costa Rica).*

The situation remained stable until May 2022, when, for reasons not yet determined, cases began to emerge north of the "Sterile Fly Barrier", spreading northward rapidly like wildfire, despite the control efforts deployed by the countries of the Central American isthmus, by Panama-United States Commission for the Eradication and Prevention of Screwworm (COPEG) and international organizations including OIRSA, FAO and IAEA. In 2023, it quickly re-infested the entire Panama and by 9 November 2024, 35 043 cases in animals and 79 in humans had been recorded. In July 2023, it infested Costa Rica, currently with 14 313 cases in animals, 36 in humans with 2 deaths. In April 2024, it was introduced to Nicaragua with a cumulative total of 10 513 cases in animals and 3 in humans. In September 2024, it spread to Honduras, which currently has 466 cases in animals, and in October 2024, it continues to expand to Guatemala with 112 cases in animals.

Mexico, seeing the dizzying spread of the disease, established a national emergency preventive programme in July 2024, focusing on its border with Guatemala and Belize, aimed at disseminating preventive and curative treatment for myiasis, reporting of larval samples, quarantine inspection, including spray baths and parenteral larvicidal treatment. As a result of this effort, on 21 November 2024 at 00:15 hours, a young bovine with myiasis in one ear was detected in a quarantine station located in the south-central part of the state of Chiapas. It was pre-identified at 02:30 by tele-diagnosis and confirmed as *C. hominivorax* later that day. The animal along with 99 others that were transported were quarantined. The origin of this mobilization was possibly Central America. With the assistance of the COPEG, this case immediately received treatment with sterile flies. So far 38 cases in South Mexico (Chiapas and Campeche).

Furthermore, in recently was detected for the first time in El Salvador in the week 50 of 2024 with 25 cases until now and in Belize detected in the last week of 2024 and with 8 cases so far.

The above event re-confirms the transboundary nature of this parasitosis, as previously seen when its infested Libya (1988–1992) through the importation of infested sheep from South America. The successful eradication in Libya proved the need for joint efforts among affected countries and international organizations led, in the case of Libya, by FAO and IAEA.

Source: 4 February 2024. By Moises Vargas-Teran, International Animal Health Expert, moisesvargasteran@gmail.com.

USDA Approves Emergency Funding to Protect USA Livestock and Animals from New World Screwworm

The United States Department of Agriculture (USDA)'s Animal and Plant Health Inspection Service (APHIS) is announcing US$165 million in emergency funding from the Commodity Credit Corporation to protect U.S. livestock and other animals from New World screwworm (NWS) and to increase USDA's ongoing efforts to control the spread of

NWS in Mexico and Central America. NWS are fly larvae that infest living tissue of warm-blooded animals, causing infection. Over the last two years, NWS has spread throughout Panama and into Costa Rica, Nicaragua, Honduras, and Guatemala. On 22 November 2024, the Chief Veterinary Officer of Mexico notified APHIS of a positive detection in southern Mexico, near the Guatemalan border.

The funding announced bolsters USDA's work in Mexico and Central America to stop the spread of NWS from moving north in Mexico, further protecting the United States through surveillance, animal health checkpoints and domestic preparedness, and by working with partners in Mexico and Central America to establish a barrier on the Isthmus of Tehuantepec, eradicate NWS from the affected areas, and reestablish the biological barrier in Panama.

"The current outbreaks in Central America demonstrate the need for USDA to increase its investment in NWS eradication and prevention," said Jenny Lester Moffitt, USDA Under Secretary for Marketing and Regulatory Programs. "If NWS were to spread to the United States, it would result in significant economic losses and threats to animal health and welfare. This funding will allow for a coordinated emergency response to control the outbreak and prevent NWS from spreading to the United States."

APHIS is working with partners in Mexico and Central America to stop the spread of NWS into the United States and asking all producers along the southern border to watch their livestock and pets for signs of NWS and immediately report potential cases to their local veterinarian, State Veterinarian's Office, or APHIS Veterinary Services.

Eradicating NWS is only possible through sterile insect technique. With this method, sterile flies are released into an area where a known population has become established. The sterile male screwworm fly mates with fertile female screwworm fly, causing the population of screwworm flies to decrease until it eventually dies out.

Source: USDA-APHIS, 13 December 2024. https://www.aphis.usda.gov/news/agency-announcements/usda-approves-emergency-funding-protect-us-livestock-animals-new-world.

USDA-APHIS Increases Import Restrictions on Animal Products from Mexico on Confirmed Case of New World Screwworm

On 22 November 2024, Mexico's Chief Veterinary Officer informed United States Department of Agriculture (USDA) about a confirmed case of New World screwworm (NWS) in Chiapas, near the Guatemala border. These fly larvae infest warm-blooded animals, including humans, causing severe infections.

According to APHIS, New World screwworm (NWS) is a devastating pest. When NWS fly larvae (maggots) burrow into the flesh of a living animal, they cause serious, often deadly damage to the animal. NWS can infest livestock, pets, wildlife, occasionally birds, and in rare cases, people (APHIS).

The USDA's Animal and Plant Health Inspection Service (APHIS) has heightened import restrictions on animal products from Mexico and intensified efforts in Central America to contain the pest's spread. APHIS is collaborating with regional partners, releasing sterile flies and maintaining vigilance along the southern U.S. border.

Producers are urged to inspect livestock and pets for signs of infection, such as wounds or larvae, and report suspected cases promptly. Human infections, though rare, require immediate medical attention.

"Although USDA eradicated NWS from the United States in 1966 using sterile insect technique, there is a constant risk of re-introduction into the United States," APHIS stated on its website.

Market Impact: This will primarily impact feeder cattle imports from Mexico, and feeder cattle prices popped on the news. Mexico ships around 100 000 head a month to the U.S. The trade is seasonable, and we are on the backside of the Fall season. The restrictions are estimated to be in force for at least a month, sources note.

One trade source said, "Feeder cattle supply in the January inventory could show a 1.2 million head reduction. Anything to shorten Mexico supplies is important."

USDA's Preventive Measures: The APHIS has taken several steps to protect U.S. livestock and wildlife from the New World Screwworm:

- Enhanced import restrictions: Stricter controls have been placed on animal products entering the U.S. from Mexico.
- Increased surveillance: APHIS is likely to have intensified monitoring at border crossings and ports of entry.
- Collaboration with Mexican authorities: USDA is working closely with Mexican officials to address the situation at its source.

Impact on Trade and Travel: The detection of New World Screwworm in Mexico and the subsequent USDA actions may have significant implications:

- Trade disruptions: Importers of Mexican animal products may face delays or restrictions.
- Travel advisories: Travelers returning from Mexico might encounter additional screening measures for pets or animal-derived goods.

Background: New World Screwworm is a serious veterinary pest that can cause severe damage to livestock and wildlife populations. Its detection in Mexico represents a potential threat to animal health in the region, necessitating swift and coordinated action from agricultural authorities on both sides of the border.

USDA's proactive approach underscores the importance of international cooperation in preventing the spread of agricultural pests and diseases. As the situation develops, further updates from APHIS and other USDA agencies are expected to guide stakeholders and the public on necessary precautions and compliance with new regulations.

Source: Bovine Veterinarian. By Jim Wiesemeyer, 24 November 2024. https://www.bovinevetonline.com/news/industry/aphis-increases-import-restrictions-animal-products-mexico-confirmed-case-new-world.

Millions of Sterile Flies to be Released on Kangaroo Island in Plan to End Flystrike

A world-first sterile insect technique (SIT) facility has opened on South Australia's Kangaroo Island to try and eradicate a condition that costs the Australian sheep industry almost A$ 300 million a year. The facility will breed and release millions of sterile sheep blowflies, with the goal of fully eradicating sheep flystrike from the island. It can then be replicated elsewhere around Australia.

Flystrike occurs when Australian blowflies bite the skin and lay eggs in the wool around a sheep's backside, the eggs hatch, and the resulting larvae feed off the irritated skin. Sheep often suffer pain and sometimes death.

Primary Industries Minister Clare Scriven said the new facility would produce up to 50 million sterile flies every week when fully operational. "It's not a full capacity yet, but it will be releasing the first flies this month (September 2024)," she said.

"These are sterile male (flies) and when they mate with the females, there are no eggs produced and so it's a way of really interacting with the wild flies to be able to reduce and hopefully eliminate sheep blow fly from Kangaroo Island."

Agriculture is the biggest industry on Kangaroo Island, which is home to around 680 000 sheep. (Landline: Prue Adams).

"That's something that hasn't occurred before and really does present a lot of potential benefits for the rest of our state as well," Ms Scriven said. "A cost-benefit analysis has shown that if we were to eradicate sheep blowfly on [Kangaroo Island], producers could save up to $88 million over 25 years, and it's also going to improve animal well-being."

Facility manager Helen Brodie, from the South Australian Research and Development Institute (SARDI), said the fly species being bred was responsible for starting around 90 per cent of fly strike cases.

The SIT facility is made out of shipping containers and can be relocated to the mainland (Supplied: Roshni Harding).

The sterile flies will be released in their pupal stage and testing has occurred in recent months to perfect the release method from an aircraft.

"We're kind of throwing them out of the plane in their sleeping bags and hoping that they land well and emerge happily," Ms Brodie said. "We're hoping that by releasing them in their pupal cases, they're a little bit more resilient and it also saves us a fair bit of labour and time." "We should

release them, and then the very next day, they emerge from their cases and off they go."

Ms Brodie said it would not be possible to eradicate flystrike on the mainland, but the relocatable station would be a "significant tool" for reducing its occurrence.

Kangaroo Island sheep farmer and chair of AgKI Jamie Heinrich agreed it could be a game changer for the sheep industry, which made up a large part of the island's economy.

Helen Brodie says the project will be a test to see if eradicating flystrike is possible through the use of sterile flies. (Supplied: PIRSA).

"This particular blowfly is the really bad one that can affect sheep really quickly and be bad for animal welfare, and also cause a lot of time and effort in prevention and treatment," Mr Heinrich said. "It's going to be great for farmers on the island if it's successful."

Source: ABC News. By Selina Green, 4 September 2024. https://www.abc.net.au/news/rural/2024-09-04/sheep-flystrike-hope-sterile-insect-technique-kangaroo-island/104300678.

Dacus frontalis in Canary Islands, Spain

Adults of Dacus frontalis.

The pumpkin fruit fly or greater melon fly *Dacus frontalis* is widely distributed in Africa, being present in Morocco, Tunisia, Argelia, Cabo Verde Egypt, Kenya, Libya, South African and United Republic of Tanzania. Is also distributed in Asian countries as Yemen and Saudi Arabia.

The fly was detected in Canary Islands, Spain for the first time in the island of Lanzarote at the end of 2018, in Fuerteventura in 2019 and later in Gran Canaria. In Tenerife it was detected for the first time in August 2023.

A manual in Spanish entitled La mosca de la calabaza *Dacus frontalis*: Identificación y control (Pumpkin fruit fly *Dacus frontalis*: Identification and control) has been produced by Island Council of Tenerife Canary Islands Institute of Agricultural Research (Cabildo Insular de Tenerife, Instituto Canario de Investigaciones Agrarias), Canary Islands Rural Environment Management (Gestión del Medio Rural de Canarias) and Department of Agriculture, Livestock, Fisheries and Food Sovereignty of the Government of the Canary Islands (Consejería de Agricultura, Ganadería, Pesca y Soberanía Alimentaria del Gobierno de Canarias). It includes the fly's lifecycle, damage, monitoring, and integrated pest management (sanitation, biocontrol, biotechnological control and chemical control).

Larvae of Dacus frontalis.

The manual is posted on AgroCabildo.org, and can be accessed via https://www.agrocabildo.org/publica/Publicaciones/otra_848_Dacus%20frontalis.pdf.

Source: agrocabildo.org, 3 December 2024.

South African Deciduous Fruit Industry Launches Centre of Excellence for Monitoring

The South African deciduous fruit industry proudly announces the launch of a Centre of Excellence dedicated to advancing pest monitoring and safeguarding the future of the industry. This new initiative, spearheaded by industry association Hortgro, addresses the increasing challenges posed by invasive pests and diseases.

Hortgro Executive Director Anton Rabe emphasized the urgent need for comprehensive pest surveillance as new pests increasingly threaten the industry's sustainability and profitability, from crop damage to quarantine risks. "We must understand where pests occur and where they don't, as this directly influences crop protection strategies and practices," Rabe stated. Catching an invasive pest as soon as it arrives in the county may allow us to eradicate it before it has gained a foothold. In addition, warning on the arrival of a pest or disease buys our industry critical time to develop management practices and manage phytosanitary concerns.

To meet this goal, the Centre of Excellence will build upon the monitoring capacity of FruitFly Africa (FFA), an operating company with industry-wide support, which has managed pest monitoring services since 2001. The FFA has been instrumental in tracking and controlling pests like the Mediterranean fruit fly across all major deciduous fruit production areas. Their initiatives include monitoring more than 6000 traps and producing and releasing millions of sterile Mediterranean fruit flies annually to manage populations.

The Centre will enhance these efforts, expanding surveillance to other significant pests, including the Polyphagous Shot Hole Borer and Spotted Wing Drosophila. This strategic expansion positions the deciduous fruit industry as a proactive leader in pest and disease surveillance. The capacity established at FFA can also be utilized by other industries, such as berries, wine and table grapes.

The Centre of Excellence initiative will ensure that the deciduous fruit industry remains resilient and internationally competitive despite the threat of invasive pests.

Fruit Fly Africa fast facts

FFA monitors more than 6 000 traps in all major deciduous fruit production areas:

- Mediterranean fruit fly 3 300 traps
- Oriental fruit fly 1 290 traps
- Spotted Wing drosophila 57 traps
- False codling moth 1 550 traps
- Polyphagous shot hole borer 174 traps

In 2023/24 FFA produced about 65 million sterile Mediterranean fruit flies perweek (summer programme), and about 30 million sterile flies/week (winter programme) and coordinated a total of 42 statutory aerial baiting applications (with GF-120NF™) which covered a total of more than 176000 hectares of commercial orchards and vineyards.

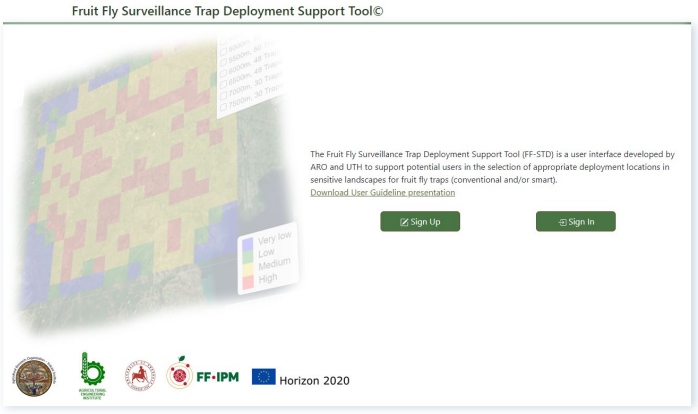
Source: Hortgro Press Release, 11 November, 2024. https://www.hortgro.co.za/wp-content/uploads/docs/dlm_uploads/2024/11/Centre-of-Excellence_launched_11Nov_final-2.pdf.

Fruit Fly Surveillance Trap Deployment Support Tool

The Fruit Fly Surveillance Trap Deployment Support Tool (FF-STD) is a user interphase developed by Agricultural Research Organization/Volcani Center (ARO), Isael and University of Thessaly (UTH), Greece to support potential users in the selection of appropriate deployment locations in sensitive landscapes for fruit fly traps (conventional and/or smart).

FF-STD was conceived and developed within the framework of the Horizon project FF-IPM. During the last decades, and as a result of increasing trade, people movement and climatic change, exotic fruit fly species of economic importance are invading and expanding into new regions, threatening agricultural fruit production costs and the environment.

The FF-IPM project approached the problem of exotic fruit fly invasion by increasing and deepening our knowledge on the biology and ecology of these flies, and by developing methods and strategies to improve detection and mitigate their damage and geographic expansion.



ARO - Agricultural Research Organization

The FF-STD tool was conceived and developed as an instrument to support users and stakeholder's organization to optimize surveillance trap-networks in large landscapes by directing the placement of traps into locations with higher probability of intercepting and detecting fruit flies. The developed tool is based on several years of research.

FF-STD algorithm ponders "risk level" of potential fruit fly presence in the pre-characterized landscape by incorporating biological and ecological knowledge on the fruit flies, and by weighing different elements in the landscape and their geographic extent by a panel of experts. The FF-STD algorithm then determines specific geographic locations in the landscape of interest to deploy a pre-determined number of traps. The level of trap aggregation in the landscape, and the extent of land covered by the surveillance network is interactively determined by the user through the determination of number of traps and by "step" increments in the distance between adjacent traps.

Initially, FF-STD users upload either a classified tif (raster) in UTM or a kml of the study area in WGS84 coordinates. After processing, FF-STD user downloads shapefiles containing the risk grid and points corresponding to the selected cells, along with land cover raster. These rasters include the original ESRI land cover data and a version that has been reclassified.

Source: https://ffstd.agri.gov.il//#/.

Sex, Radiation and Mummies: How Farms Are Fighting a Pesky Almond Moth Without Pesticides

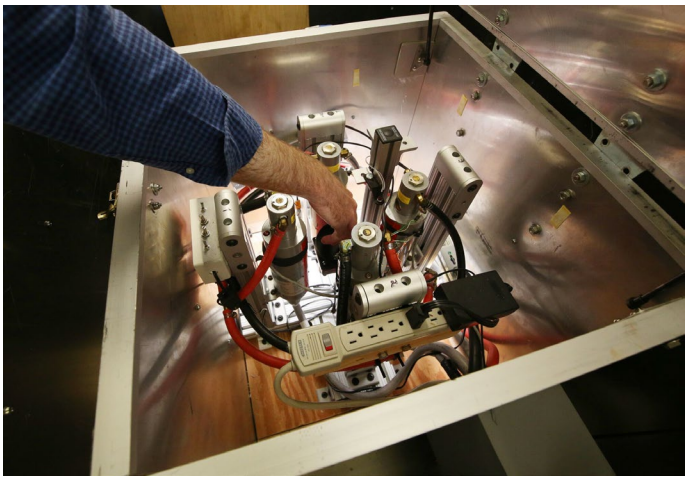
Every year, the navel orangeworm eats through roughly 2% of California's almonds before they can make it to grocery store shelves. California produces 80% of the world's almonds, yet in 2022 the production value of the nut fell 34% compared with the previous year.

Scientists say climate change could make the navel orangeworm problem even worse, with hotter temperatures allowing the moths to reproduce even faster. (Despite its name, the insect has largely left citrus farms unbothered and is in fact a moth.)

Every year, navel orangeworms eat through roughly 2% of California's almonds before they can make it to grocery store shelves. (Gary Kazanjian / For the Times).

Traditionally, nut farmers have tackled the insect with chemical pesticides, or by destroying "mummies" — almonds left over after harvest. Mummies are a favorite winter shelter for the bugs. However, research is increasingly showing that chemical pesticides are not only harmful to the environment but to people as well. One new study found that the impact of nearby pesticide use on cancer incidence "may rival that of smoking." So farmers and researchers have been searching for other non-pesticide alternatives.

Removing almost every last mummy from every tree in an orchard can be effective, but since it must be done manually, it can become too expensive and complex for some growers. Another tactic that's been used since around 2010 is to cover orchards with disorienting levels of sex pheromones to confuse horny moths — a technique known as "mating disruption." But, with limited budgets and climate change threatening to make the pest situation worse, researchers are studying another yet-to-be-proven approach: sterilizing almost a million moths a day with radiation and dropping them out of planes.



An X-ray machine designed to sterilize moths is shown at the Kearney Agricultural Research and Extension Center. (Gary Kazanjian / For the Times).

The idea behind the technique is that by flooding orchards with sterilized insects, they will mate with fertile insects and produce no offspring, reducing the overall population. The simplest way to sterilize the bugs is to use radiation. Since their reproductive genes tend to mutate faster, the right dose can leave them relatively unfazed but unable to reproduce. At the request of almond and pistachio farmers, the California Department of Food and Agriculture has been working with the Animal and Plant Health Inspection Service of the U.S. Department of Agriculture since 2018 to source sterilized moths from a Phoenix lab.

The lab sterilizes about 750 000 bugs per day, then chills the moths to put them to sleep and ships them off to California. The bugs are dropped from an airplane hundreds of feet in the air. Often too sleepy to fly, the insects crash into the hard ground or almond trees. From there, the survivors have only one job: have sex. Through this test program, the USDA hopes to perfect the best ways to get moths to reproduce in the lab and give them the right dose of radiation that will sterilize them but not severely injure or disorient them.

The program has yet to put a significant dent in the moth population, though, because they can't produce enough sterile bugs.

Right now, researchers are only finding a couple of sterile insects in traps for every hundred wild fertile moths. For the technique to be effective, they'll need to deploy dozens of sterile bugs for every wild one.

Matthew Aubuchon, national policy manager at the USDA's Animal and Plant Health Inspection Service, estimated that the Phoenix facility could produce up to 8 million moths per day with enough staff working around the clock.

While opening more facilities in California would help, the program uses cobalt to produce high-energy radiation to sterilize the bugs — which is expensive and requires the lab to take extensive safety and security measures.

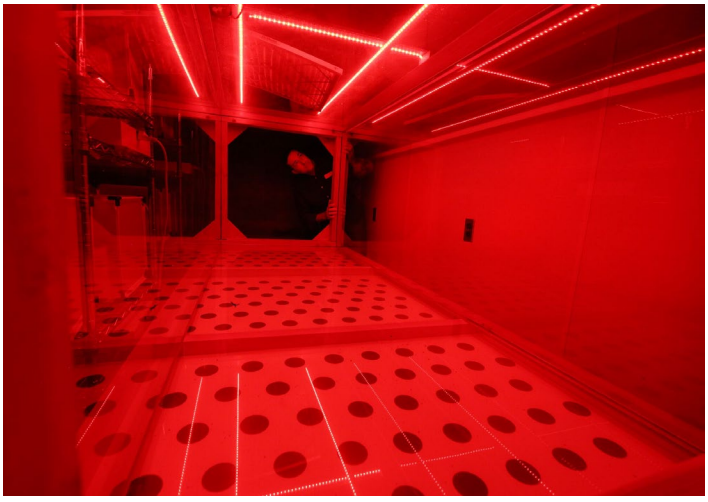
Houston Wilson, a UC Riverside entomology researcher established a sci-fi shack at Kearney might hold a solution that is cheaper and easier to scale.

Instead of using cobalt or other radioactive materials, Wilson's team uses an X-ray machine to irradiate the pests. (Unlike a radioactive substance, an X-ray machine will not emit radiation when it is turned off.)

Then, the team puts their X-rayed bugs and the sterilized insects from Phoenix through a series of tests to determine which methods produce the healthiest, sterile moths.

The tests include gluing moths to the end of a stick suspended in the air. The stick rotates like a carousel as the moths flutter around and researchers record how well they can fly.

The researchers also place moths in a wind tunnel and release sex pheromones to see if the excited bugs are able to locate the smell. (Unfortunately for the insects, there are no potential mates at the end of the tunnel.)



Houston Wilson looks into an insect wind tunnel as researchers look for innovative ways to manage an invasive almond pest (Gary Kazanjian / for The Times).

While the team doesn't yet produce enough X-rayed moths to test them in a full-blown almond orchard, they do send the Phoenix moths into their final test: releasing them into their seven-acre almond farm on the Kearney campus to see how good they are at actually finding fertile moths to mate with.

While researchers say the sterile insect technique still has a lot of hurdles to clear before it will be widely effective, they say it holds great promise.

"You're literally managing a pest by preventing it from being born in the first place," said Haviland of both sterile insect technique and pheromone mating disruption. "To think that something like that was possible 10 or 15 years ago nobody could imagine that growers would be using such innovative techniques as those."

Source: Los Angeles Times. By Noah Haggerty, 7 October 2024. https://www.latimes.com/environment/story/2024-10-07/how-almond-growers-battle-a-pesky-moth-without-pesticides.

Alicante's Mosquito Makeover: Sterile Swarms to Combat Summer Pests

In 2025, the province of Alicante in Spain is expected to see the release of hundreds of thousands of sterile tiger mosquitoes to curb their population.

The Valencian Government of Spain plans to expand the sterile insect technique (SIT) to Alicante after successful trials in municipalities across Valencia and Castellón.

This method, which has been in use since 2016, aims to tackle the invasive tiger mosquito (*Aedes albopictus*), notorious for its aggressive summer bites and potential to spread diseases such as chikungunya, dengue, andZika .

The SIT involves breeding large numbers of male mosquitoes in specialized facilities and sterilizing them through irradiation. These males, which do not bite, are then released into the environment. When they mate with females, the females' eggs fail to develop, reducing the overall mosquito population.

Trials have shown that in some towns, this method has reduced tiger mosquito numbers by up to 80 per cent.

This initiative aims to significantly lower the nuisance of mosquito bites and the risk of disease transmission across the region. This summer in 2024, the regional ministry began releasing 1.3 million sterile male tiger mosquitoes in the Viveros gardens of Valencia, deploying about 45 000 mosquitoes per week until the end of the year.

Over the past four years, the treated area in the Valencian Community has expanded significantly, growing from 45 hectares to 177 hectares. Despite this progress, Alicante has not yet been included in this initiative. However, with the planned expansion of the SIT to Alicante in 2025, the province is expected to benefit from this effective population control method.

Source: Euro Weekly News. By Anna Ellis, 9 Sep 2024. https://euroweeklynews.com/2024/09/09/alicantes-mosquito-makeover-sterile-swarms-to-combat-summer-pests/.

Relevant Published Articles

The effects of diet and semiochemical exposure on male *Bactrocera dorsalis* (Hendel) (Diptera: Tephritidae) metabolic rate at a range of temperatures

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Abstract

The oriental fruit fly, *Bactrocera dorsalis* (Hendel) (Diptera: Tephritidae), is an invasive species that has rapidly spread across the African continent, endangering the security of agricultural industries. The sterile insect technique (SIT) is being investigated as a viable additional pest management tool to suppress *B. dorsalis* populations after its successful implementation in other parts of the world. There is evidence to suggest that pre-release nutritional and semiochemical treatments for sterilised males can enhance their competitive performance against wild type males in SIT programs. This study examined how sterilisation, a diet rich in protein (addition of yeast hydrolysate) or containing semiochemicals (methyl eugenol or eugenol) affected the resting metabolic (RMR) of male *B. dorsalis* at different temperatures (15–30 °C), measured using flow-through respirometry. Our results indicated that the negative effect of sterilisation on RMR decreased as temperature increased and that duration of exposure to semiochemicals for 1 to 4 days was not a significant influencing factor on male *B. dorsalis* RMR. Protein-rich diet increased average RMR, but the difference in RMR between dietary groups decreased as temperature increased. Semiochemical feeding reduced the average RMR in male *B. dorsalis*. The difference in RMR between males that consumed semiochemical and those that did not increased with as temperature increased.

Keywords: Oriental fruit fly; Respirometry; Methyl eugenol; Yeast hydrolysate.

The full paper was published in: Journal of Insect Physiology. https://doi.org/10.1016/j.jinsphys.2024.104718.

Biotechnology-enhanced Genetic Controls of the Global Pest *Drosophila suzukii*

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Abstract

Spotted wing Drosophila (*Drosophila suzukii* Matsumura, or SWD), an insect pest of soft-skinned fruits native to East Asia, has rapidly spread worldwide in the past 15 years. Genetic controls such as sterile insect technique (SIT) have been considered for the environmentally friendly and cost-effective management of this pest. In this review, we provide the latest developments for the genetic control strategies of SWD, including sperm-marking strains, CRISPR-based sex-ratio distortion, neoclassical genetic sexing strains, transgenic sexing strains, a sex-sorting incompatible male system, precision-guided SIT, and gene drives based on synthetic *Maternal effect dominant embryonic arrest* (Medea) or homing CRISPR systems. These strategies could either enhance the efficacy of traditional SIT or serve as standalone methods for the sustainable control of SWD.

Keywords: Spotted wing Drosophila; Pest management; Genetic control; Sterile insect technique; CRISPR; Gene drive.

The full paper was published in: Trends in Biotechnology. https://doi.org/10.1016/j.tibtech.2024.09.005.

Papers in Peer Reviewed Journals

In Press

DERA, K.S.M., S. PAGABELEGUEM, T.T. MELACHIO TANEKOU, M.J.B. VREYSEN, A.M.M. ABD-ALLA et al. Impact of long-term mass-rearing on the genetic structure of tsetse fly *Glossina palpalis gambiensis* colonies. Insect Science (in press).

2025

ENKERLIN, W., E. AREVALO, J. E. CABALLERO, T. FEZZA, E. GARAVELLI et al. (2025). Searching for More Effective Food Baits for Tephritid Fruit Flies (Diptera: Tephritidae): Performance of Newly Developed Vial-Lures Relative to Torula Yeast Borax. Insects, 16(1), 53.

NIKOLOULI, K., A. COMPTON, J. TU and K. BOURTZIS (2025). Evaluation of ebony as a potential selectable marker for genetic sexing in Aedes aegypti. Parasites & Vectors 18:76.

PARKER, A.G., J. LYU, and W. MCLAUGHLIN (2025). Dosimetric evaluation of a chilled X-ray irradiator for high throughput insect sterilization. Radiation Physics and Chemistry, 226, 112289.

PAULO, D.F., T.N.M. NGUYEN, A.A.S. CARDOSO, G. GOUVI, K. BOURTZIS et al. (2025). Functional genomics implicates *ebony* in the black pupae phenotype of tephritid fruit flies. Communications Biology 8, 60.

2024

ALUJA, M., S.M. OVRUSKI, F.R. MELLO GARCIA, M. HURTADO, W. ENKERLIN (2024). Fruit Fly (Tephritidae) Management in the Neotropical Region: History, State of the Art, and Perspectives. In: Mello Garcia, F.R. (eds) Management of Fruit Flies in the Americas. Springer, Cham. pp 11-66.

AMARO, F.I.F., P. SOARES, P.E. DIKOLLI, D.O. CARVALHO, M. GOMEZ et al. (2024). Mark–Release–Recapture Trial with *Aedes* albopictus (Diptera, Culicidae) Irradiated Males: Population Parameters and Climatic Factors. Insects 15, 685.

BALATSOS, G., V. KARRAS1, F. BALESTRINO, W. MAMAI, J. BOUYER et al. (2024). Sterile Insect Technique (SIT) field trial targeting the suppression of *Aedes albopictus* in Greece. Parasite, 31:17.

BALESTRINO, F., N.S. BIMBILE SOMDA, M. SAMUEL, S. MELETIOU, O. BUENO et al. (2024). Mass irradiation of adult *Aedes* mosquitoes using a coolable 3D printed canister. Scientific Reports 14, 4358.

BALESTRINO, F., A, PUGGIOLI, W. MAMAI, R. BELLINI and J. BOUYER (2024). A mass rearing method to aliquot and hatch *Aedes* mosquito eggs using capsules. Scientific Reports 14, 30276.

BELL-SAKYI, L., L.R. HAINES, G. PETRUCCI, A. BELIAVSKAIA, A.M.M. ABD-ALLA et al. (2024) Establishment and partial characterisation of a new cell line derived from adult tissues of the tsetse fly *Glossina morsitans morsitans*. Parasit&Vectors 17, 231.

BOUYER, J. (2024). Current Status of the Sterile Insect Technique for the Suppression of Mosquito Populations on a Global Scale." Infectious Diseases of Poverty 13.1:68.

COSTA, D.R., S.A. LEITE, M.P. SANTOS, B.S. COELHO, V.S. DIAS et al. (2024). Can the use of particle films for fruit protection against Medfly alter the behavior of the parasitoid *Diachasmimorpha longicaudata*? Entomologia Experimentalis et Applicata 172:123–131.

DESCHEPPER. P., S. VANBERGEN, M. VIRGILIO, A. SCIARRETTA, K. BOURTZIS et al. (2024). Global invasion history with climate-related allele frequency shifts in the invasive Mediterranean fruit fly (Diptera, Tephritidae: *Ceratitis capitata*). Scientific Reports 14:25549.

FEUDJIO SOFFACK, S., T.T. MELACHIO TANEKOU, O. FARIKOU, G.I. KAME NGASSE, A.M.M. ABD-ALLA et al. (2024). The internal transcribed spacer 1 sequence polymorphism brings updates to tsetse species distribution in the northern Cameroon: Importance in planning efficient vector control. Medical and Veterinary Entomology, mve.12717.

FOLEY, N., F. FOUQUE, Q. ZHONG, Q. H. BOSSIN, J. BOUYER et al. (2024). Building Capacity for Testing Sterile Insect Technique Against *Aedes*-borne Diseases in the Pacific: A Training Workshop and Launch of Sterile Insect Technique Trials Against *Aedes aegypti* and Arboviral Diseases. Infect Diseases of Poverty 13, 75.

GALVÃO-SILVA, F.L., A.S. ARAÚJO, V.S. DIAS VS, A.S. DO NASCIMENTO, I.S. JOACHIM-BRAVO (2024). Responses of two *Anastrepha* species' immature stages infesting preferential hosts to different temperature exposures. Neotropical Entomology. 9 January.

GOMES, I.V., A.C.F.P. SOBREIRA, J.S. AGUILAR, L.G. CARRERA, J.L. ANDRADE et al. (2024). Phytosanitary Irradiation as an Effective Treatment for *Drosophila suzukii*. Scientific Reports 14, 22225.

GOMES, I.V., A.K.P. RORIZ, A.S. ARAÚJO, V.S. DIAS, A.S. NASCIMENTO et al. (2024). Sexual behaviour of *Anastrepha obliqua* (Macquart) (Diptera: Tephritidae): Do laboratory domestication conditions influence male courtship behaviour? Physiological Entomology, 49(2):99–109.

GOMULSKI, L.M., M.T. VERA, S.B. LANZAVECCHIA, C. Cárceres, W. Enkerlin et al. (2024). Molecular Markers for Analyses of Genetic Diversity within the *Anastrepha fraterculus* Complex with Emphasis on Argentine Populations. Insects. 2024; 15(10):748.

GONG J., W. MAMAI, H. MAIGA, N.S.B. SOMDA, C. MARTINA et al. (2024). Upscaling the Production of Sterile Male Mosquitoes with an Automated Pupa Sex Sorter. Science Robotics 9, eadj6261.

KABORÉ, B.A., S.D. TAQI, A. MKINGA, A.E. MORALES ZAMBRANA, M.J.B. VREYSEN, et al. (2024). Radiation dose fractionation and its potential hormetic effects on male *Glossina palpalis gambiensis* (Diptera: Glossinidae): a comparative study of reproductive and flight quality parameters. Parasite. 31:4.

MAMAI, W., O. BUENO, T. WALLNER, S.A. NIKIEMAM, S. MELETIOU et al. (2024) Efficiency assessment of a novel automatic mosquito pupae sex separation system in support of area-wide male-based release strategies. Scientific Reports 14:9170.

MARQUEREAU, L., H. YAMADA, D. DAMIENS, A. ECLERCQ, B. DEREPAS et al. (2024). Upscaling irradiation protocols of *Aedes albopictus* pupae within an SIT Program on Reunion Island. Scientific Reports 14:12117.

MIRIERI, C.K., G.D. UZEL, A.G. PARKER, J. BOUYER, A.M.M. ABD-ALLA et al. (2024). Rearing of *Glossina morsitans morsitans* tsetse flies for the sterile insect technique: evaluating the impact of irradiation and transportation during early and late-stage pupal development on the quality of emerging adults. Parasite 31, 73.

MORREALE, R., S. STENHOUSE, D.O. CARVALHO, D.A. HAHN, K. BOURTZIS et al. (2024) Seasonal insights for integrative mosquito management from multi-year baseline entomological data on Aedes aegypti in Lee County, Florida. PLOS ONE 19 (10): e0311407.

PURIFICACION, M., R.B.M. SHAH, T. DE MEEÛS, M.J.B. VREYSEN, A.M.M. ABD-ALLA et al. (2024). Development and characterization of microsatellite markers for population genetics of the cocoa pod borer *Conopomorpha cramerella* (Snellen) (Lepidoptera: Gracillaridae). PLOS ONE 19, e0297662.

SOLLAZZO, G., K. NIKOLOULI, G. GOUVI, R. A. AUMANN, K. BOURTZIS et al. (2024). Deep orange gene editing triggers temperature sensitive lethal phenotypes in *Ceratitis capitata*. BMC Biotechnology 24:7.

YAMADA, H., R. HOOD-NOWOTNY, C. RESCH, J. BOUYER, R. GRUBER et al. (2024). Sperm Storage and Use Following Multiple Insemination in *Aedes albopictus*: Encouraging Insights for the Sterile Insect Technique. Insects 15, 721.

ZHANG, D., H. MAIGA, W. MAMAI, N.S.B. SOMDA, T. WALLNER et al. (2024). Mating harassment may boost the effectiveness of the sterile insect technique for *Aedes* mosquitoes. Nature Communications 15, 1980.

2023

ARGILES-HERRERO, R., G., SALVADOR-HERRANZ, A.G. PARKER, M.J.B. VREYSEN, C.J. DE BEER et al. (2023). Near-infrared imaging for automated tsetse pupae sex sorting in support of the sterile insect technique. Parasite 30, 17.

BENEWENDE A.K., A. NAWAJ, H. MAIGA, O. SOUKIA, C.J. DE BEER et al. (2023). X-rays are as effective as gamma-rays for the sterilization of *Glossina palpalis gambiensis* Vanderplank, 1911 (Diptera: Glossinidae) for use in the sterile insect technique. Scientific Reports 13, 17633.

BOUYER, J. (2023). When less is more: accounting for overcompensation in mosquito SIT projects. Trends in Parasitology 39:235-237.

CACERES, C., K. BOURTZIS, G. GOUVI, M.J.B. VREYSEN, N.S.B. SOMDA et al (2023). Development of a novel genetic sexing strain of Ceratitis capitata based on an X-autosome translocation. Scientific Reports 13, 16167.

DERA, K.-S.M., M.M. DIENG, C.J. DE BEER, M.J.B. VREYSEN, A.M.M. ABD-ALLA et al. (2023). Prevalence of *Spiroplasma* and interaction with wild *Glossina tachinoides* microbiota. Parasite 30, 62.

DIAS, V.S., G.J. HALLMAN, A.S. ARAÚJO, I.V.G. LIMA, F.L. GALVAO-SILVA et al. (2023). High cold tolerance and differential population response of third instars from the *Zeugodacus tau* complex to phytosanitary cold treatment in navel oranges. Postharvest Biology and Technology 203:112392.

DIAS, V.S., I.S. JOACHIM-BRAVO and B.A.J. PARANHOS (2023). Comportamento das moscas-das-frutas, *In:* Zucchi, R.A., Malavasi, A., Adaime, R., Nava, D., (Eds.), Moscas-das-Frutas no Brasil: Conhecimento Básico e Aplicado, 2nd ed., FEALQ, Piracicaba, SP, Brasil. pp 227-259.

DIAS, V.S. and A.G. MOREIRA (2023). Tratamentos fitossanitários com fins quarentenários, *In:* Zucchi, R.A., Malavasi, A., Adaime, R., Nava, D., (Eds.), Moscas-das-Frutas no Brasil: Conhecimento Básico e Aplicado, 2nd ed., FEALQ, Piracicaba, SP, Brasil. pp 527-549.

DROSOPOULOU E., A. GARIOU-PAPALEXIOU, G. GOUVI, A.A. AUGUSTINOS, K. BOURTZIS et al. (2023). A comparative analysis of the chromosomes of three FARQ species complex members, *Ceratitis rosa*, *C. quilicii*, and *C. fasciventris* F2 (Diptera: Tephritidae). Bulletin of Entomological Research 113:537-545.

GÓMEZ, M., B.J. JOHNSON, H.C. BOSSIN, R. ARGILÉS-HERRERO (2023). Joint FAO/IAEA

Coordinated Research Project on "Mosquito Handling, Transport, Release and Male Trapping Methods" in Support of SIT Application to Control Mosquitoes. Insects, 14, 108.

GSTÖTTENMAYER, F., P. MOYABA, M. RODRIGUEZ, C.J. DE BEER, M.J.B. VREYSEN et al. (2023). Development and characterization of microsatellite markers for the tsetse species *Glossina brevipalpis* and preliminary population genetics analyses. Parasite 30, 34.

JOACHIM-BRAVO, I.S., V.S. DIAS and A.K.P. RORIZ (2023). Alimentação, nutrição e dietas artificiais, *In:* Zucchi, R.A., Malavasi, A., Adaime, R., Nava, D., (Eds.), Moscas-das-Frutas no Brasil: Conhecimento Básico e Aplicado, 2nd ed., FEALQ, Piracicaba, SP, Brasil. pp 183-206.

MAHAMAT, M.H., R. ARGILES-HERRERO, A.G. PARKER, A.M.M. ABD-ALLA, J. BOUYER et al. (2023). Vector competence of sterile male *Glossina fuscipes fuscipes* for *Trypanosoma brucei brucei*: implications for the implementation of the sterile insect technique in a sleeping sickness focus in Chad. Parasites Vectors 16, 111.

MAÏGA, H., M.T. BAKHOUM, W. MAMAI, N.S.B. SOMDA, T. WALLNER et al. (2023). From the lab to the field: long-distance transport of sterile *Aedes* mosquitoes. Insects, 14(2), 207.

MANOUKIS, N.C., A. MALAVASI and R. PEREIRA (2023). Técnica de aniquilação de machos, *In:* Zucchi, R.A., Malavasi, A., Adaime, R., Nava, D., (Eds.), Moscas-das-Frutas no Brasil: Conhecimento Básico e Aplicado, 2nd ed., FEALQ, Piracicaba, SP, Brasil. pp 429-435.

MANRIQUE, V. and W. ENKERLIN (2023). The use of the sterile insect technique as part of an integrated pest management approach to control fruit flies in Ecuador. In: Ruane, J., Mba, C., Boettcher, P., Koskela, J., Mair, G. & Ramasamy, S., (eds.). Case studies of the use of agricultural biotechnologies to meet the needs of smallholders in developing countries. Rome, FAO. pp 61-68.

MIRIERI, C.K., A.M.M. ABD-ALLA, A.M.M., V.I.D. ROS, M.M. VAN OERS (2023). Evaluating the Effect of Irradiation on the Densities of Two RNA Viruses in *Glossina morsitans morsitans*. Insects 14, 397.

PAGABELEGUEM, S., B.A. KABORÉ, K.M. DERA, H. MAIGA, M.J.B. VREYSEN, J. BOUYER et al. (2023). Gamma-radiation of *Glossina palpalis gambiensis* revisited: effect on fertility and mating competitiveness. Parasite, 30: 11.

PEREIRA, R. and A. MALAVASI (2023). Áreas livres, de baixa prevalência e systems approach, *In:* Zucchi, R.A., Malavasi, A., Adaime, R., Nava, D., (Eds.), Moscas-das-Frutas no Brasil: Conhecimento Básico e Aplicado, 2nd ed., FEALQ, Piracicaba, SP, Brasil. pp 459-465.

PEREIRA, R., J. HENDRICHS and A. MALAVASI (2023). Técnica do inseto estéril, *In:* Zucchi, R.A., Malavasi, A., Adaime, R., Nava, D., (Eds.), Moscas-das-Frutas no Brasil: Conhecimento Básico e Aplicado, 2nd ed., FEALQ, Piracicaba, SP, Brasil. pp 419-427.

PUPPATO, S., G. FIORENZA, D. CARRARETTO, L.M. GOMULSKI, C. CACERES et al. (2023). High promiscuity among females of the invasive pest species *Drosophila suzukii*. Molecular Ecology. 32:6018-6026.

RAVEL, S., M.H. MAHAMAT, A. SÉGARD, R. ARGILÉS-HERRERO, J. BOUYER et al. (2023). Population genetics of *Glossina fuscipes fuscipes* from southern Chad. Peer Community Journal, 3:e31.

SOLLAZZO, G., G. GOUVI, K. NIKOLOULI, R.A. AUMANN, K. BOURTZIS et al. (2023). Genomic and cytogenetic analysis of the *Ceratitis capitata* temperature-sensitive lethal region, G3 Genes|Genomes|Genetics, jkad074.

TUSSEY, D.A., R. MORREALE, D.O. CARVALHO, S. STENHOUSE, A.M. LLOYD et al. (2023). Developing methods for chilling, compacting, and sterilizing adult *Aedes aegypti* (Diptera: Culicidae) and comparing mating competitiveness between males sterilized as adults versus pupae for sterile male release, Journal of Medical Entomology, 60:1038–1047.

VAN OERS, M.M., E.A. HERNIOU, J.A. JEHLE, P.J. KRELL, A.M.M. ABD-ALLA et al. (2023). Developments in the classification and nomenclature of arthropod-infecting large DNA viruses that contain pif genes. Archives of Virology. 168:182.

VASQUEZ, M.I., G. NOTARIDES, S. MELETIOU, E. PATSOULA E, J. BOUYER et al. (2023). Two invasions at once: update on the introduction of the invasive species *Aedes aegypti* and *Aedes albopictus* in Cyprus - a call for action in Europe. Parasite. 30:41.

YAMADA, H., B.A. KABORE, N.S. BIMBILE SOMDA, N.L. NTOYI, C.J. DE BEER et al. (2023) Suitability of Raycell MK2 blood X-ray irradiator for the use in the sterile insect technique: dose response in fruit flies, tsetse flies and mosquitoes. Insects 14 92.

YAMADA, H., D. ZHANG, A.G. PARKER, M.J. VREYSEN (2023). Sterilizing insects with X rays or gamma rays-which irradiator to select? Frontiers in Tropical Diseases, 4:1224386.

YAMADA, H., H. MAÏGA, C. KRAUPA, N.S.B. SOMDA, W. MAMAI et al. (2023). Radiation dose-fractionation in adult *Aedes aegypti* mosquitoes. Parasite 30:8.

ZHANG, D., S. YAN. H. YAMADA, G. WANG, Q. FENG, D. PAERHANDE, H. MAIGA, J. BOUYER, J. QIAN, Z. WU, X ZHENG (2023). Laboratory evaluations of a Wolbachia-free Aedes albopictus strain to control the wild mosquito population in the frame of the Sterile Insect Technique. Pest Management Science, 79:4115-4705.

Other Publications

2024

FAO/IAEA. (2024). Guideline on phytosanitary procedures for area-wide management of fruit fly pests. Vienna, FAO, 194 pp. https://doi.org/10.4060/cc9843en.

FAO/IAEA (2024). Thematic Plan for the Development and Application of the Sterile Insect Technique for Tsetse Area-Wide Integrated Pest Management Programmes, Vienna, Austria. 82 pp. https://www.iaea.org/sites/default/files/thematicplantsetse.pdf.

FAO/OIEA. (2024). Plan Rector Regional para la Aplicación del Manejo Integrado de Moscas de la Fruta (MIP) de Importancia Económica y Cuarentenaria, Basado en la Técnica del Insecto Estéril (TIE), con Énfasis en la Mosca Sudamericana de la Fruta, (*Anastrepha fraterculus*, Wied.) y la Mosca del Mediterráneo, (*Ceratitis capitata*, Wied.). Vienna, Austria, 188 pp. https://www.iaea.org/sites/default/files/plan-rector.pdf.

DERA, K. S. M. (2024). Improvement of tsetse mass-rearing for the Sterile Insect Technique (SIT) through the evaluation of the impact of *Spiroplasma* (Doctoral dissertation, Technische Universität Wien). https://doi.org/10.34726/hss.2024.107304.

DIENG, M. M. (2024). Interaction between tsetse symbiont, pathogens on trypanosome infection in wild tsetse populations (Doctoral dissertation, Technische Universität Wien). https://doi.org/10.34726/hss.2024.75781.

GOUVI, G. (2024). Symbiosis, genetic and cytogenetic analyses of Tephritids. (Doctoral dissertation, University of Patras).

GSTÖTTENMAYER, F. (2024). Population genetics and research of host-symbiont interaction of the tsetse fly (Glossina spp.). Dissertation, Technische Universität Wien. https://doi.org/10.34726/hss.2024.107469.

KABORÉ, B. A. (2024). Advancing the Sterile Insect Technique for tsetse (Diptera: Glossinidae): Exploring alternative radiation sources and protocols (Doctoral dissertation, Technische Universität Wien). https://doi.org/10.34726/hss.2024.107302.

YAMADA, H., (2024). Nuclear applications in insect pest control: SIT for mosquitoes, vectors of human diseases. (Doctoral dissertation, Justus-Liebig University Giessen).

2023

Insects (2023). Special Issue on "Mosquito Handling, Transport, Release and Male Trapping Methods". Brian J. Johnson, Hervé Christophe Bossin and Maylen Gomez Pacheco (eds.). https://www.mdpi.com/journal/insects/special_issues/Mosquit_Handling_Transport_Release_and_Male_Trapping_Methods.

Insects (2023). Special Issue on "Improved Field Performance of Sterile Male Lepidoptera to Ensure Success in SIT Programmes" Marc Vreysen, Des Conlong and Rachael M. Horner (eds.). https://www.mdpi.com/journal/insects/special_issues/Improved_Field_Performance_Sterile_Male_Lepidoptera.

FAO/IAEA. (2023). Guidelines for Biosafety and Biosecurity in Mosquito Rearing Facilities (Version 2.0), Food and Agriculture Organization of the United Nations/International Atomic Energy Agency. Vienna, Austria. 7 pp. https://www.iaea.org/sites/default/files/guidelines_for_mosquito_facilities.pdf.

FAO/IAEA. (2023). International Guidelines for Transboundary Shipments of Irradiated Sterile Insects. W.R. Enkerlin, C. Nelson, M. Quinlan, R. Griffin, R. Bellini, G. Yaacobi, J. Bouyer & R. Pereira, eds. Vienna, Austria. 43 pp. https://doi.org/10.4060/cc8029en.

FAO/IAEA. (2023). Guidelines for Mark-Release-Recapture Procedures of Aedes Mosquitoes, Jérémy Bouyer and Wadaka Mamai (eds.), Food and Agriculture Organization of the United Nations/International Atomic Energy Agency. Vienna, Austria. 26 pp. https://www.iaea.org/sites/default/files/guidelinesmrr_v2.pdf.

FAO/OIEA. (2023). Directrices generales para facilitar la apertura de mercados internacionales de frutas y hortalizas hospedantes de moscas de la fruta con base en las normas internacionales de medidas fitosanitarias. Viena. https://doi.org/10.4060/cc0361es.

SOLLAZZO, G. (2023). Characterization of genes used as selectable markers for the development of genetic sexing strains for SIT applications against tephritid pest species using CRISPR/Cas9. (Doctoral dissertation, Justus-Liebig-University Gießen) http://dx.doi.org/10.22029/jlupub-18161.

MIRIERI, C. K. (2023). Evaluating the impact of stressors on the quality and performance of tsetse flies for the sterile insect technique. (Doctoral dissertation, Wageningen University). https://www.wur.nl/en/activity/evaluating-the-impact-of-stressors-on-the-quality-and-performance-of-tsetse-flies-for-the-sterile-insect-technique.htm.

2022

FAO/IAEA. (2022). E-learning course on Basic Techniques for Tsetse Flies Dissection. https://elearning.iaea.org/m2/course/index.php?categoryid=50.

FAO/IAEA. (2022). Guidelines for Mass Rearing and Irradiation of *Drosophila suzukii* for Sterile Insect Technique Application, version 1.0., Robin Guilhot, Gustavo Taret, Keke Gembinsky and Carlos Cáceres (eds.), Food and Agriculture Organization of the United Nations/International Atomic Energy Agency. Vienna, Austria. 29 pp. https://www.iaea.org/sites/default/files/massrearing-and-irradiation-swd.pdf.

FAO/IAEA. (2022). International Guideline for Transboundary Shipments of Irradiated Sterile Insects. Food and Agriculture Organization of the United Nations/International Atomic Energy Agency. Vienna, Austria. 38 pp. https://www.iaea.org/sites/default/files/2022.transboundary_shipments_of_sterile_insects.pdf.

FAO/IAEA. (2022). General Guidelines to Facilitate the Opening of International Markets for Fruits and Vegetables that are Fruit Fly Hosts Based on International Standards for Phytosanitary Measures. Food and Agriculture Organization of the United Nations/International Atomic Energy Agency. Vienna, Austria. https://doi.org/10.4060/cc0361en.

FAO/IAEA/USDA. (2022). Manual de Control de Calidad del Producto en la Cría masiva y Liberación de Moscas de la Fruta Estériles. Traducción de la Versión 7.0 de 2019. Agencia Internacional de Energía Atómica, Viena, Austria, 149 pp. https://www.iaea.org/sites/default/files/qcv7-en-espanol.pdf.

FAO/IAEA. (2022). Dosimetry for SIT: Standard Operating Procedures for Gafchromic™ Film Dosimetry System for Gamma Radiation v. 1.0, Andrew Parker, Kishor Mehta and Yeudiel GómezSimuta (eds.), Food and Agriculture Organization of the United Nations/International Atomic Energy Agency. Vienna, Austria. 40 pp. https://www.iaea.org/sites/default/files/gamma-sop-en-excel-embedded.pdf.

FAO/IAEA. (2022). Dosimetría para la TIE: Procedimiento Operativo Estandar para el sistema de dosiemetría de películas Gafchromic™ para Radiación Gamma v. 1.0, Andrew Parker, Kishor Mehta y Yeudiel Gómez-Simuta (eds.), Organización de las Naciones Unidas para la Agricultura y Alimentación/Organismo Internacional de Energía Atómica. Viena, Austria. 46 pp. https://www.iaea.org/sites/default/files/22/03/gamma-sop-es-excel-embedded.pdf.

FAO/IAEA. (2022). Dosimetry for SIT: Standard Operating Procedures for Gafchromic™ Film Dosimetry System for Low Energy X Radiation v. 1.0, Andrew Parker, Kishor Mehta and Yeudiel Gómez-Simuta (eds.), Food and Agriculture Organization of the United Nations/International Atomic Energy Agency. Vienna, Austria. 42 pp. https://www.iaea.org/sites/default/files/x-ray-sop-en-excel-embedded.pdf.

FAO/IAEA. (2022). Dosimetría para la TIE: Procedimiento Operativo Estándar para el sistema de dosimetría de película Gafchromic™ para Radiación X de Baja Energía v. 1.0, Andrew Parker, Kishor Mehta and Yeudiel Gómez-Simuta (eds.), Organización de las Naciones Unidas para la Agricultura y la Alimentación /Organismo Internacional de Energía Atómica. Viena, Austria. 51 pp. https://www.iaea.org/sites/default/files/22/03/x-ray-sop-es-excel-embedded.pdf.

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Impressum

Insect Pest Control Newsletter No. 104

The Insect Pest Control Newsletter is prepared twice per year by the Insect Pest Control Section, Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture and FAO/IAEA Agriculture and Biotechnology Laboratories, Seibersdorf

International Atomic Energy Agency
Vienna International Centre, PO Box 100, 1400 Vienna, Austria
Printed by the IAEA in Austria, January 2025

25-01326