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Parasitoid female of Diachasmimorpha longicaudata *probing with her long ovipositor into fruit to inject eggs into their pest host that is infesting the commodity. These biological control agents and other mass-reared insects were the subject of the recent international workshop of the IOBC Global Working Group on Arthopod Mass Rearing & Quality Control held in Vienna, Austria (October 2010).*

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To Our Readers

Looking back at yet another productive and successful year 2010, I would like to thank all our collaborators in many parts of the world, as well as staff at the Insect Pest Control Section at headquarters in Vienna and at the Insect Pest Control Laboratory in Seibersdorf, Austria. During the last twelve months the Insect Pest Control Subprogramme hosted an international symposium and co-sponsored another one; organized five research coordination meetings, four regional training courses, three consultants meetings and two workshops; participated in many interesting and successful research activities; provided technical support to over thirty technical cooperation projects in FAO and IAEA Member States, and actively contributed to a number of other international events, panels and advisory committees.

In this newsletter you will find information and details about some of the activities enumerated above. These reflect not only our growing commitments and increasing research and normative responsibilities, but also our expanding involvement with additional pest species, although our budget and staff have not increased in proportion.

IAEA International Atomic Energy Agency

The success of the subprogramme has historically been guaranteed by its focussed approach on a few major pest problems which allowed us to provide our Member States the best support in terms of research, normative assistance and implementation of operational programmes. Despite the continuous demand of FAO and IAEA Member States to expand our support and include more pest insects, we remain conscious that diluting our human and financial resources may jeopardise the high quality service that our Member States deserve.

Cases in point are tephritid fruit flies, which are undoubtedly among the worst plant pests in agriculture and where the demand for assistance has remained extreme. In the past decades, the Subprogramme has played a significant role developing and transferring the SIT (sterile insect technique) package for the Mediterranean fruit fly, including the development of genetic sexing strains that are now used in almost all SIT programmes against this pest in the world. Subsequently there has been much demand to provide similar support for other tephritid pests, such as the development of sexing systems for the Mexican fruit fly *Anastrepha ludens*, a mass rearing system for the olive fly *Bactrocera oleae*, and support for several other important invasive species.

The Insect Pest Control Laboratory in Seibersdorf has the conditions to contain these insects that are quarantine pests in many parts of the world. It is uniquely positioned to carry out research in Austria that due to its temperate climate and especially it very harsh winters offers ideal conditions for comparative studies that cannot be carried out in other countries or regions. Currently, an important project is focussed on resolving the uncertain taxonomic status of some key pest fruit fly species complexes, such as *Anastrepha fraterculus* (Latin America) and *Bactrocera dorsalis* (Asia, Africa and South America), whose specific taxonomic status as real separate species or only geographical variants is questionable. This is critical both for SIT application and to assist many subtropical and tropical Member States to overcome non-tariff trade barriers for their fresh fruit and vegetable exports to international high value markets. A Coordinated Research Project addressing these and other fruit fly species complexes was recently initiated, involving twenty-two research teams from seventeen participating countries. Many of the greenhouse comparative behaviour and cross-mating compatibility studies among geographic variants under this CRP are being/will be carried out at the Insect Pest Control Laboratory in Seibersdorf.

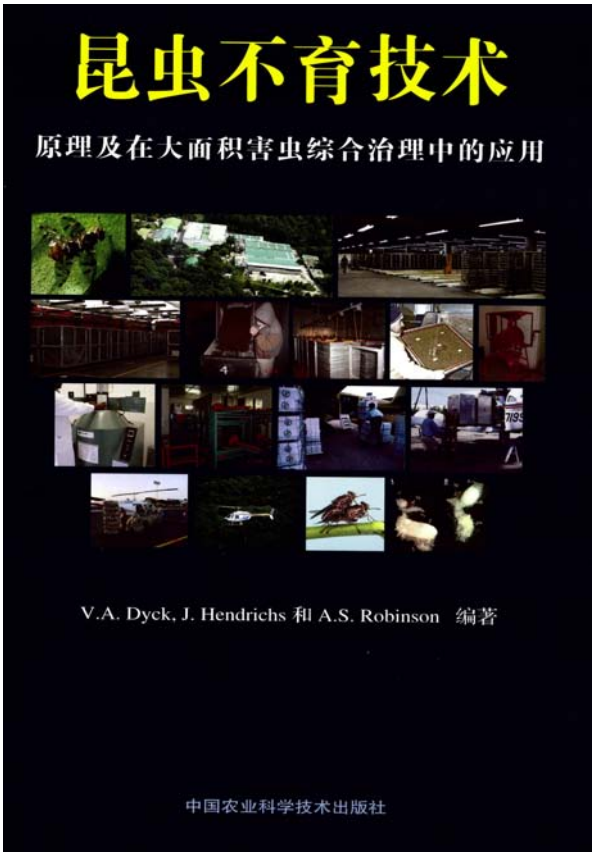
The availability of many colonies of these different exotic species and strains at the Insect Pest Control Laboratory has been attracting additional visiting scientists, sabbaticals, cost-free experts and PhD students to Seibersdorf as it provides a unique opportunity to conduct comparative studies on behaviour, physiology and even post-harvest treatment efficacy that cannot be conducted elsewhere. As a consequence the number of pest fruit fly species held at the Insect Pest Control Laboratory in Seibersdorf has been continuously growing and currently stands at 14 species representing the genera *Anastrepha, Bactrocera, Ceratitis* and *Rhagoletis*, including for several species a number of geographical variants (e.g. 7 colonies of *A. fraterculus*, 6 colonies of *B. oleae*, and 2 colonies of *B. cucurbitae* from different geographical regions), sex-linked populations (e.g. sexing strains of *B. cucurbitae* and *C. capitata*), as well as strains being characterized and reference mutants (e.g. > 90 strains of *C. capitata* with visible markers or different chromosome arrangements, and >50 transgenic strains of *C. capitata* and *B. ludens*).

The maintenance of all these strains is of course not sustainable in the long term and is putting considerable additional workload on our technicians (although we greatly acknowledge the extra budgetary support we have been receiving from some the US Government in this respect). As a result, we plan to gradually outsource, transfer or eliminate some of these colonies and strains, as was already done during the last years with tsetse colonies. Cryopreservation to hold valuable strains that are not in immediate use is an additional alternative, that we cannot afford at this moment. However, in view that it requires a significant initial investiment.

On the other hand it is important to recognize that some requests for support received from Member States are technically not justifiable as the biology of the target pests renders them as not amenable to SIT development (such as species which are difficult to rear or to manage) or SIT application (where the released stage is a pest or nuisance). Recent examples in this category are desert locust, ticks and other blood-feeding arthropods. Other requests, although technically justifiable, would address pests of only local or subregional importance, and investing years of research required to develop and implement the SIT is often not warranted. The Subprogramme continues to give priority to international and regional pest problems, or very important pest species with the potential of becoming major international invasive species, without neglecting at the same time our principles that the SIT should only be integrated where it has a comparative advantage and where there are no other effective methods to deal with the problem.

Changing subject, I would like to draw your attention to the tremendous progress made by the pink bollworm eradication programme in the south western USA and north western Mexico (see on page 39 the abstract of an article in Nature Biotechnology). The programme against this major introduced cotton pest has been in operation since the 1960s and has for decades effectively protected important cotton production areas in California, mainly through the release of sterile moths. Taking advantage of the large scale suppression of pink bollworm populations through the extensive growing of Bt-cotton, the programme shifted in 2006 to an eradication strategy that included the replacement of non-Bt-cotton refuges as part of pink bollworm resistance management with 100 % Bt-

cotton and season-long releases of sterile pink bollworms originating from the mass rearing facility in Phoenix, Arizona.



During the last four years, this multi-tactic approach has eliminated all insecticide spraying against pink bollworms in the south western USA and north western Mexico, and pest populations have been reduced by more than 99.9 %. The benefits of this very successful programme far outnumber its cost of ca. USD 30 million per year.

Finally I would like to inform you that at the request of and in collaboration with the Chinese Academy of Agricultural Sciences a Chinese translation of the textbook 'Sterile Insect Technique, Principles and Practice in Area-wide Integrated Pest Management' was recently published. In addition to the book's original text (800 pages), the Chinese translation includes an SIT glossary of ca. 150 pages, which gives an extra bonus to Chinese readers. This was a complex project, and we would like to thank Arnold Dyck and in particular Daguang Lu and his Chinese collaborators for the hard work of this multi-year effort. The Chinese version is being distributed to relevant research institutes, national and local libraries, agricultural universities, other public institutions and agricultural authorities in China, and will hopefully raise awareness and interest in SIT application.

As 2010 draws to a close, our best seasonal greetings on behalf of all of us at the Subprogramme. We look forward to another fruitful year and wish you a very successful 2011.

Jorge Hendrichs
Head,
Insect Pest Control Section
January 2011

Insect Pest Control Subprogramme

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Forthcoming Events (2011-2012)

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

Final RCM of CRP on Development of Standardized Mass-Rearing Systems for Male *Anopheles arabiensis* Mosquitoes. 7-11 March 2011, St. Clotilde, La Réunion, France.

Second RCM of CRP on Development of Generic Irradiation Doses for Quarantine Treatments. 11-15 April 2011, College Station, Texas, USA.

Second RCM of CRP on Development and Evaluation of Improved Strains of Insect Pests for SIT. 9-13 May 2011, Nanjing, China.

Third RCM of CRP on Biology of Male Mosquitoes in Relation to Genetic Control Programmes. 3-7 October 2011, Bologna, Italy.

Third RCM of CRP on Applying GIS and Population Genetics for Managing Livestock Insect Pests. 10-14 October 2011, Bobo Dioulasso, Burkina Faso.

Second RCM of CRP on Resolution of Cryptic Species Complexes of Tephritid Pests to Overcome Constraints to SIT Application and International Trade. 30 January-3 February 2012, Brisbane, Australia.

Fourth RCM of CRP on Improving SIT for Tsetse Flies through Research on their Symbionts and Pathogens. 26-30 March 2012, Vienna, Austria.

II. Consultants and Expert Meetings

Consultants Meeting on the Role of Bacteria on Nutritional Status and Reproductive Success in Fruit Fly Pests in Support of SIT Application. 7-11 February 2011, Vienna, Austria.

Technical Panel on Pest Free Areas and Systems Approaches for Fruit Flies under the International Plant Protection Convention, FAO. 22-26 August 2011, Recife, Brazil.

Consultants Meeting on Enhancing Vector Refractoriness to Trypanosome Infection. 14-18 November 2011, Vienna, Austria.

Consultants Meeting on the Effects of Mosquito Production and Release Methods on Male Competitiveness. June 2012, Vienna, Austria.

III. Other Meetings/Events

Sixth Session of the Commission on Phytosanitary Measures, International Plant Protection Convention, FAO. 14-18 March 2011, Rome, Italy.

FAO/IAEA Training Course on Taxonomía, Ecología y Control de Moscas de Importancia Económica, June 2011, Panama City, Panama.

VII Curso Internacional de Capacitação em Moscas das Frutas de Importância Económica e Quarentenária, 11-19 August 2011, Juazeiro (Bahia) and Petrolina (Pernambuco), Brazil.

XXI Curso Internacional Sobre Moscas de la Fruta. 15-26 August 2011, Metapa de Dominguez, Chiapas, Mexico.

Second International Meeting of Tephritid Workers of Europe, Africa and the Middle East. 2-6 July 2012, Kolymbari, Crete, Greece.

Past Events (2010)

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

Second RCM of CRP on Biology of Male Mosquitoes in Relation to Genetic Control Programmes. 1-5 February 2010, Vienna, Austria.

Second RCM of CRP on Applying GIS and Population Genetics for Managing Livestock Insect Pests. 22-26 February 2010, Bali, Indonesia.

Third RCM of CRP on Improving SIT for Tsetse Flies through Research on their Symbionts and Pathogens. 26-30 July 2010, Nairobi, Kenya.

First RCM of CRP on Resolution of Cryptic Species Complexes of Tephritid Pests to Overcome Constraints to SIT Application and International Trade. 2-6 August 2010, Vienna, Austria.

Second RCM of CRP on Increasing the Efficiency of Lepidoptera SIT by Enhanced Quality Control. 15-19 November 2010, Stellenbosch, South Africa.

II. Consultants and Expert Meetings

Consultants Meeting on Development of Generic Design for Mosquito Mass-Rearing Facility. 3-7 May 2010, Vienna, Austria.

Consultants Meeting on Applications of Area-Wide IPM Programmes as Part of Systems Approaches for Pest Risk Management. 7-11 June 2010, Vienna, Austria.

Technical Panel on Phytosanitary Treatments under the International Plant Protection Convention, FAO. 26-30 July 2010, Tokyo, Japan.

Technical Panel on Pest Free Areas and Systems Approaches for Fruit Flies under the International Plant Protection Convention, FAO. 4-8 October 2010, Vienna, Austria.

Consultants Meeting to Update International FAO/IAEA/USDA Manual on 'Product Quality Control and Shipping Procedures for Sterile Mass-Reared Tephritid Fruit Flies'. 18-22 October 2010, Vienna, Austria.

III. Other Meetings/Events

FAO/IAEA Regional Training Course on Surveillance of Tephritid Fruit Flies in Support of Planning and Implementing Area-Wide Integrated Pest Management Programmes (under TC Project RAS5052). 18-22 January 2010, Bangkok, Thailand.

FAO/IAEA/PATTEC Regional Training Course on Standardised Collection and Processing of Entomological and other Relevant Geo-Referenced Data as Needed in SIT-Based AW-IPM Campaigns against Tsetse (under TC Project RAF5060). 1-19 February 2010, Bobo-Dioulasso, Burkina Faso.

FAO International Conference on Agricultural Biotechnologies in Developing Countries: Options and Opportunities in Crops, Forestry, Livestock, Fisheries and Agroindustry to Face the Challenges of Food Insecurity and Climate Change (ABDC-10). 1-4 March 2010, Guadalajara, Mexico.

Fifth Session of the Commission on Phytosanitary Measures, International Plant Protection Convention, FAO. 22-26 March 2010, Rome, Italy.

FAO/IAEA National Coordinators Meeting / Workshop on Area-Wide Management of Fruit Fly Pests, (under TC Project RAS5052). 12-14 April 2010, Muscat, Oman.

31st FAO Regional Conference for Latin America and the Caribbean (LAC). 26-30 April 2010, Panama City, Panama.

Standards Committee Meeting, International Plant Protection Convention, FAO. 26-30 April 2010, Rome, Italy.

FAO/IAEA Training Course on Taxonomía, Ecología y Control de Moscas de Importancia Económica, 4-13 June 2010, Panama City, Panama.

FAO/IAEA Regional Training Course on Collection of Baseline Data for the Planning and Implementing of Tsetse Area-Wide Integrated Pest Management in Southern and Eastern Africa (under TC Project RAF5059). 7-24 June 2010, Maputo, Mozambique.

XI Commissioners Meeting of the Panama-United States Commission for the Eradication and Prevention of Screwworm. 8-9 June 2010, Panama City, Panama.

FAO/IAEA National Coordinators Meeting of TC project RAF5059 'Supporting the Creation of a Tsetse-Free Zone in Southern Mozambique and North-East South Africa'. 28-30 June 2010, Maputo, Mozambique.

FAO/IAEA Workshop on Genotyping Analysis of Tsetse Fly Symbionts and Pathogens. 20-24 July 2010, Nairobi, Kenya.

XX Curso Internacional Sobre Moscas de la Fruta. 16-27 August 2010, Metapa de Dominguez, Chiapas, Mexico.

8th International Symposium on Fruit Flies of Economic Importance. 26 September - 1 October 2010, Valencia, Spain. (http://www.fruitflyvalencia2010.org).

FAO/IAEA National Coordinators Meeting / Workshop on Standardised Entomological Monitoring of Old World Screwworm (OWS) Flies (*Chrysomya bezziana*), (under TC Project RAS5054). 28-29 September 2010, Muscat, Oman.

Inception Workshop on Area-Wide Integrated Pest Management of Fruit Flies in South and Southeast Asian Countries. 1-3 September 2010, Bangkok, Thailand.

12th International Workshop of the IOBC Global Working Group on Arthropod Mass Rearing & Quality Control (AMRQC). 19-22 October 2010, Vienna, Austria. (www.tinyurl.com/amrqcreg)

VI Curso Internacional de Capacitação em Moscas das Frutas de Importância Económica e Quarentenária, 3-11 November 2010, Juazeiro (Bahia) and Petrolina (Pernambuco), Brazil.

FAO/IAEA Workshop on Evaluation of Field Cages for Lepidoptera SIT Behavioural Assessments. 21-22 November 2010, Stellenbosch, South Africa.

Technical Cooperation Field Projects

The Insect Pest Control Subprogramme currently has technical responsibilities for the following technical cooperation projects that are managed by the IAEA's Department of Technical Cooperation. They can be classed under five major topics, namely:

- Fruit Flies
- Mosquitoes
- Moths
- Screwworm Flies
- Tsetse Flies

Country	Project Number	Title	Technical Officer
		National Projects	
Afghanistan	AFG5004	Enhancing Crop Productivity Through Mutation Breeding and Pest Control	Rui Cardoso Pereira
Belize	BZE5002	Establishment of a Pilot Fruit Fly Free Area Using an Integrated Approach that Includes the Area-Wide Sterile Insect Technique	Jesús Reyes
Botswana	BOT5004	Establishment of a Capacity for Integrating the Sterile Insect Technique into the National Tsetse and Trypanosomosis Control Programme	Udo Feldmann
Brazil	BRA5057	Establishment of Mediterranean Fruit Fly, Fruit Fly Parasitoids and Codling Moth Rearing Facility	Rui Cardoso Pereira
Chad	CHD5002	Assessing the Feasibility of Using Sterile Insect Technique Components to Create a Tsetse-Free Zone in the Mandoul Region	Udo Feldmann
Ethiopia	ETH5015	Creating a Tsetse-Free Zone in the Southern Rift Valley	Udo Feldmann
Guatemala	GUA5016	Establishment of Fruit Fly Free or Low Prevalence Areas using the Sterile Insect Technique	Jesús Reyes
Israel	ISR5015	Strengthening the Capacity to Use the Sterile Insect Technique for the Olive Fruit Fly	Andrew Jessup
Jordan	JOR5010	Strengthening the Capacity for the Area-wide Suppression of the Mediterranean Fruit Fly Using the Sterile Insect Technique	Jesús Reyes
Kenya	KEN5022	Integrated Area-wide Tsetse and Trypanosomosis Management in Lambwe Valley	Udo Feldmann
Madagascar	MAG5017	Developing Strategies for Integrated Management of Fruit Flies Based on the Sterile Insect Technique (SIT)	Rui Cardoso Pereira
Mauritius	MAR5016	Feasibility Study for the Suppression of the Melon Fly (*Bactrocera cucurbitae*) in Selected Areas of Mauritius	Jorge Hendrichs
Morocco	MOR5031	Controlling the Mediterranean Fruit Fly Using the Sterile Insect Technique and Other Conventional Methods	Jesús Reyes
Myanmar	MYA5014	Support for a Feasibility Study on Using the Sterile Insect Technique against Diamond Back Moth	Jesús Reyes

Pakistan	PAK5043	Development of Biological Control for Cotton Pest Management Using Nuclear Techniques	Jorge Hendrichs
Panama	PAN5018	Maintaining and Operating a Mediterranean Fruit Fly Free Area, Implementing a Fruit Fly Emergency Plan, and Suppressing *Anastrepha* spp. Fruit Flies in the Azuero Peninsula Using the Sterile Insect Technique	Jesús Reyes
Senegal	SEN5031	Implementing the Pre-Operational Phase to Create a Zone Free of *Glossina palpalis gambiensis* Using the Sterile Insect Technique (SIT)	Marc Vreysen
Seychelles	SEY5003	Feasibility of Integrating the Sterile Insect Technique to the Ongoing Area-Wide Melon Fly Eradication Programme	Rui Cardoso Pereira
South Africa	SAF5011	Refining an Integrated Application of SIT Against Some Key Lepidopteran Pests of Southern African Agricultural Crops	Jorge Hendrichs
Sudan	SUD5032	Investigating the Use of the Sterile Insect Technique for Controlling Mosquitoes in Northern Sudan	Jeremie Gilles
Tunisia	TUN5026	Assessing the Use of Inherited Sterility as a Genetic Control Method against the Carob Moth	Marc Vreysen
Uganda	UGA5031	Assessing the Feasibility of Establishing a Tsetse Free Zone in Lake Victoria Basin	Jesús Reyes
Zimbabwe	ZIM5012	Feasibility Study on the Use of SIT to Eradicate Tsetse in Zimbabwe	Udo Feldmann
		Regional Projects	
Regional Africa	RAF5059	Supporting the Creation of a Tsetse-Free Zone in Southern Mozambique and North-East South Africa	Marc Vreysen Rui Cardoso Pereira
Regional Africa	RAF5060	Supporting the Use of the Sterile Insect Technique for Area-Wide Tsetse and Trypanosomosis Management (Phase II)	Udo Feldmann
Regional Asia	RAS5051	Developing Integrated Control of the Olive Fruit Fly	Andrew Jessup
Regional Asia	RAS5052	Sharing Regional Knowledge on the Use of the Sterile Insect Technique within Integrated Area-Wide Fruit Fly Pest Management Programmes	Rui Cardoso Pereira
Regional Asia	RAS5053	Assessing Feasibility for Area-Wide SIT-Based Control of the Mediterranean Fruit Fly in the Middle East	Jesús Reyes
Regional Asia	RAS5054	Contributing to the Assessment of the Feasibility of SIT-Based Area-Wide Integrated Management of Old World Screwworm Flies in the Middle East	Udo Feldmann
Regional Europe	RER5014	Suppressing the Mediterranean Fruit Fly by Integrating the Sterile Insect Technique on an Area-Wide Basis in Neretva Valley of Croatia and Bosnia and Herzegovina	Rui Cardoso Pereira
Regional Latin America	RLA5057	Establishing and Maintaining Fruit Fly Free and Low Prevalence Areas in Central America, Panama and Belize, Using the Sterile Insect Technique (SIT) (ARCAL CVI)	Jesús Reyes

Highlights for Technical Cooperation Projects

Suppressing the Mediterranean Fruit Fly by Integrating the Sterile Insect Technique on an Area-Wide Basis in the Neretva Valley of Croatia and Bosnia and Herzegovina (RER5014)

Inauguration of a Mediterranean Fruit Fly Emergence and Release Facility in Croatia

A *Ceratitis capitata* emergence and release facility was inaugurated on 22 September 2010 in Opuzen, Croatia in the presence of representatives of the Governments of Croatia, Bosnia and Herzegovina, the FAO/IAEA and grower associations. The facility allows applying the environment-friendly Sterile Insect Technique to the Neretva river valley of Croatia and Bosnia and Herzegovina, to reduce insecticide use in citrus orchards and facilitate fresh fruit exports.

Paper bags with the pupae ready for emergence at the Emergence and Release Facility (Opuzen, Croatia).

This facility of the Croatian Centre for Agriculture, Food and Rural Affairs with a capacity of 20 million sterile males / week has been in operation since April 2010 for the packing, handling and release of sterile Mediterranean fruit fly males over a 1,000 ha pilot area (mainly of mandarins, *Citrus reticulata*) in the Neretva River Valley in Croatia.

The area produces 80% of the mandarins of Croatia, from which 70% are exported (about 13 million US$ a year) to the European Union (EU). The objective of applying the environment-friendly sterile insect technique, integrated with other sustainable control methods, is to suppress the Mediterranean fruit fly population, to decrease fruit losses and to contribute to the reduction of pesticide residues on fruits. This aspect is extremely important to export to markets that request low fruit insecticide residues, such as the EU.

General view of the citrus production area where the SIT pilot project is taking place (Neretva Valley, Croatia).

For more information about the project visit the Croatian Centre for Agriculture, Food and Rural Affairs website at the URL: http://www.hcphs.hr/de-fault.aspx?id=213 (only available in Croatian).

Creating a Tsetse-Free Zone in the Southern Rift Valley (ETH5015)

In tropical and subtropical rural areas of Africa several tsetse fly species, while sucking blood on humans and livestock, transmit trypanosomes, unicellular blood parasites which eventually affect the central nervous system, causing sleeping sickness among humans and a similar disease among livestock, called nagana. The diseases particularly affect poor rural communities and their livestock and agriculture, which is why the tsetse fly vector is often referred to as the 'poverty insect'.

Since its inception in 1997, the FAO/IAEA-supported Southern Rift Valley Tsetse Eradication Project (STEP) has managed to train and involve more than 220 000 farmers in methods for suppressing tsetse fly populations and the disease they transmit, African animal trypanosomosis (AAT). The project applies pour-on formulations of insecticides onto livestock and, in addition, positions into the fly habitats insecticide-impregnated blue / black fabric targets, which attract tsetse flies and kill them.

It is anticipated that, once developed for large scale application in Ethiopia, the sterile insect technique will complement the area-wide pest management efforts, aiming at a complete elimination of the tsetse and trypanosomosis (T&T) problem in the Ethiopian Southern Rift Valley.

In July a review of STEP was jointly undertaken by FAO, IAEA, African Development Bank (AfDB) and other relevant partners. While the above mentioned field progress was commended, the review team also discussed some critical issues – managerial and technical – to be addressed with a sense of urgency, before the SIT component will be available to STEP:

a) The project will need to consider in some areas the area-wide use of sequential aerosol technique (SAT) for pre-SIT tsetse suppression;

b) Particular attention will need to be given to T&T control in the Nech Sar National Park;

c) A decision is needed on the mass-rearing and field use of most appropriate strains of the target tsetse fly species (*Glossina pallidipes* and *G. f. fuscipes*);

d) The implementation of a small SIT pilot / demonstration operation in a confined part of the project area needs to be considered;

e) The establishment of a maintenance unit for the Kaliti insectary has been advised;

f) With increasing size of mass-reared fly colonies substantial amounts of blood diet will need to be decontaminated, which will require respective-size sterilisation equipment,

g) Some issues relevant to STEP management need to be addressed.

So far about 10 000 km² of land with good opportunities for sustainable agricultural and rural development have been covered by the STEP tsetse suppression activities. The experienced substantial reduction of the T&T problem already permitted an increase of productive livestock in the area. For the first time the rural communities can make use of horses and donkeys in the Southern Rift Valley, where previously they were unable to be used, because of their high susceptibility to tsetse-transmitted trypanosomosis. The project intends to expand the tsetse suppression operations to some 25 000 km² in the next 1–2 years.

A recent (Nairobi, July 2010) workshop of the EU-funded and FAO-executed Livestock Policy Initiative under the Intergovernmental Authority on Development (IGAD-LPI) in the Horn of Africa concluded that rural livestock development areas like the Southern Rift Valley will benefit substantially from a complete elimination of the T&T problem: Investments between 1 500 and 3 000US$ per km² are likely to result over a 20-year period in benefits of 12 500 to 15 000 US$ per km².

Excluding urban areas in the Southern Rift Valley, some 700 000 rural households are expected to eventually benefit from the efforts coordinated by STEP.

Expanding the Use of the Sterile Insect Technique against Fruit Pests in the Western and Northern Cape (SAF5007)

Expansion of the SIT Africa Mediterranean fruit fly facility in Stellenbosch, South Africa

A new wing has recently been added to the SIT Africa Mediterranean fruit fly facility in Stellenbosch, South Africa, thus ensuring that the rearing of all stages can now take place under modern and hygienic conditions. Besides a substantial increase in potential production capacity, improvements in fruit fly quality are already evident.

Background: In 1999 a small Mediterranean fruit fly rearing facility was commissioned in Stellenbosch for an IAEA-funded feasibility study for suppressing Mediterranean fruit fly in the Hex River Valley. An old building, not designed for this purpose, was used. The starter colony was the *tsl* genetic sexing strain Vienna 7-97, and maximum output was ±8 million sterile males per week. Funding constraints dictated that the equipment and apparatus were not always high-specification; maintenance was also not always up to the required level.

A provincial government grant in 2000 enabled the erection of a new adult room. However, production and quality remained very variable due to unfavourable and steadily degrading larval and pupal rearing conditions, and a lack of proper quality management. Three years later a Quality Management System was designed and implemented, and the *tsl* strain Vienna 8 was introduced. Production was more stable and quality was good, but infrastructure conditions for larval rearing and pupal handling continued to deteriorate, affecting the reliability of sterile fly delivery to the Hex River Valley. Production varied from 5 to 7 million sterile males per week, and all sterile releases were by air.

Commercialisation of SIT: In 2003 Mediterranean fruit fly SIT was transferred to the private sector, and SIT Africa (Pty) Ltd started business using the existing infrastructure and staff. Additional fruit production areas were gradually brought into the SIT programme, and 8 to 10 million sterile flies were released weekly in three separate areas, protecting about 13,500 ha of fruit. Aerial releases were replaced by ground releases (focused on all backyards and other hotspots), due to the unaffordably high cost of aerial releases in relation to the area treated.

New Mediterranean fruit fly facility in Stellenbosch, South Africa.

Negotiations with government and growers for a statutory SIT levy started in 2008. This levy, covering 5 of the main export production regions of deciduous fruit in the Western Cape, was introduced in mid 2009. At this time

the National government also started to provide matching funding for the fruit fly SIT programme.

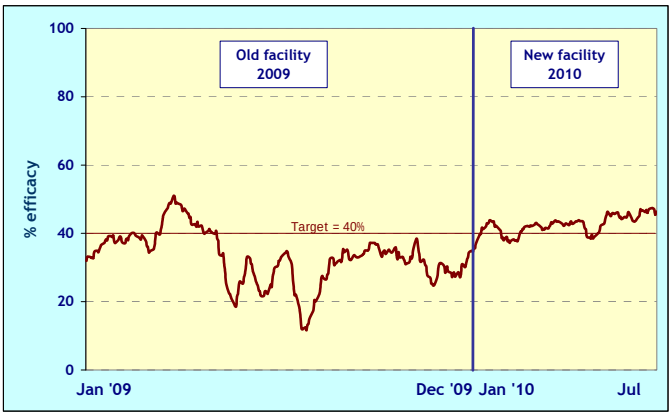
New facility: With the additional funding a new wing for rearing larvae and pupae was erected in late 2009 adjacent to the adult and QC room, and a filter rearing unit has recently been added to the new complex, giving a total rearing area of 780 m^2. High-end specification equipment has been fitted throughout. The maximum production capacity is estimated at 40-50 million sterile flies per week, although it will be some years before production reaches that level because new fruit production areas still have to be brought into the programme. After a 'dry run' to test the equipment, and after carefully planning the process, the larval and pupal colonies were moved to the new building in December 2009. Fortunately there were no losses, and production was hardly interrupted. Currently there are eight production and quality control staff, and output is currently 15 million sterile flies per week.

Production and quality parameters: Increases in production and quality parameters from the new building were already evident within 6 months. For illustration, statistics for a few selected parameters from the period January to December 2009 (old building) are compared below with the period January to July 2010 (new building). As example see the egg to pupae efficacy obtained in the old and new facilities.

In summary: Egg production in the new building steadily increased to levels far above the initial target of 600 mL/day. This, together with improvements in egg to pupa efficacy in the new building, enabled the egg production target to be reduced to 400 mL/day.

Egg to pupa efficacy in the new building increased steadily, and stabilized within a much narrower band than in the old building to maintain or exceed target levels.

Egg hatch, flight ability and pupal weight increased less dramatically, but nevertheless increased to levels which generally met or exceeded target levels.



Egg to pupae efficacy obtained in the old and new facilities.

Production is currently very stable, and all quality control parameters have increased, some substantially. Between 11 million and 15 million sterile males are released per week (in winter and summer respectively), protecting an area of approximately 33,000 ha of deciduous fruit. Roll out to other areas and crops will be negotiated in the next few years on an area by area basis.

The above improvements in production capacity, stability and quality bode well for the intended expansion of Mediterranean fruit fly SIT in the Western Cape and further afield in the near future.

Following an injection of funding into the SIT programme, more fruit production areas are due to be included in the SIT programme.

With this additional security in production and quality, SIT Africa can now more confidently plan the future of the Mediterranean fruit fly SIT programme in South Africa, to the benefit of the South African export fruit industry and the country.

Source, Brian Barnes

Contributing to the Assessment of the Feasibility of SIT-Based Area-Wide Integrated Management of Old World Screwworm Flies in the Middle East (RAS5054)

A Regional Coordination and Planning Meeting was held in Muscat, Oman, 28–29 September 2010, under IAEA TC project 'Contributing to the Assessment of the Feasibility of SIT-Based Area-Wide Integrated Management of Old World Screwworm (OWS) Flies in the Middle East' (RAS5054). Nineteen participants from nine OWS infested or endangered Member States in the region participated, namely: Bahrain, Iran, Iraq, Jordan, Oman, Saudi Arabia, Syria, United Arab Emirates, and Yemen. In addition, one and two staff members from FAO and IAEA, respectively, participated.

The meeting assessed work done under this project in the context of joint efforts by Arab Organization for Agricultural Development (AOAD), FAO and IAEA. Following a summary presentation by FAO/IAEA on the results of components so far completed, the meeting concluded that, based on an earlier assessment by Anaman (2005) for Bahrain, Iraq and Oman, OWS elimination appears to be a 'modestly strong' economic viable project, with an acceptable internal rate of return of 21%, and a predicted social benefit-cost ratio of 2.1 : 1. The economic viability of an AW-IPM campaign involving SIT against OWS in the region is expected to be even greater if other benefits, such as (i) the absence of fly strikes on humans, (ii) environmental benefits (less chemicals), and (iii) benefits to other producers and consumers in the region (e.g. in Iran and Yemen) are included.

The meeting also reviewed an earlier assessment of the likely sustenance of OWS freed areas, submitted to FAO by Gilbert (2005) and concluded that good evidence has been generated by Normalized Difference Vegetation Index (NDVI)- and temperature-models to assume a reasonably good confinement of OWS problem scenarios introduced into the region, suggesting that results of an

OWS eradication effort in the Middle East will likely be sustainable, provided necessary quarantine and other measures will be in place.

This meeting also discussed the remaining major component of the overall feasibility assessment, namely to demonstrate the technical feasibility of an OWS SIT component in the Middle East. For this a relatively small (2 000–3 000 km²) and confined candidate SIT field release area needs to be identified, and candidate sites for a pilot methods development laboratory for small scale OWS rearing (target production 3–5 million sterile males per week) need to be screened.

In two sessions the meeting participants undertook an effort to identify and screen candidate sites for the laboratory and for the pilot SIT field releases. The meeting also looked into needs by the OWS affected and endangered Member States in terms of equipment, expert services and training / fellowships / scientific visits, and some action for follow up in 2011 were agreed.

Establishing and Maintaining Fruit Fly Free and Low Prevalence Areas in Central America, Panama and Belize, Using the Sterile Insect Technique (SIT) (RAS5057)

Training Course on Taxonomy, Ecology and Control of Fruit Flies of Quarantine Importance

This regional training course that focused on taxonomy of exotic fruit flies for the American Hemisphere was held in Panama City, Panama, 4-13 June, 2010 with the participation of 33 trainees from 11 countries from Central and South America, and was co-organized with the Regional Plant Protection Organization for Central America (OIRSA) and the University of Panama.

Group photo of the Training Course participants (Panama City, Panama).

The training programme, spread over nine days, consisted of several components, including: (1) biology, ecology and behaviour of fruit flies and their natural enemies, (2) biology and identification of *Rhagoletis* and *Anastrepha*, (3) biology and identification of *Ceratitis*, *Dacus* and *Bactrocera*, (4) control of *Anastrepha grandis*, and included a field visit to the area in Darien Province where the South American melon fly *Anastrepha grandis* was first detected and eliminated from Central America. The course was conducted by the recognized tephridologists Martin Aluja, Marc De Meyer, Cheslawo Korytkowski, Aldo Malavasi and Allen Norrbom.

National Coordinators Meeting

The meeting was held in Valencia, Spain, September 26 – October 1, 2010 and it was attended by 12 people. Eight of them were the project counterparts representing Belize, Bolivia, Costa Rica (2), El Salvador, Guatemala, Honduras (2), Nicaragua, and Panama (2), including representatives from OIRSA and the FAO/IAEA.

Each attendant gave a comprehensive report of the last year's activities in their respective country. The OIRSA representative also presented a report related to the actions this regional organization is doing in Central America against fruit flies and how these actions are complementary to the activities planned through this TC-IAEA regional project. As a core issue, the group prepared the work plan for the upcoming 2010.

The meeting also included participation in the 8th International Symposium on Fruit Flies of Economic Importance, a field visit to the Mediterranean fruit fly control activities in Valencia, including the mass rearing and the release centre of the Mediterranean fruit fly suppression programme.

Assessing Feasibility for Area-Wide SIT-Based Control of the Mediterranean Fruit Fly in the Middle East (RAS5053)

A National Coordinators meeting was held at the Dead Sea, Jordan, from 4-8 July 2010 and was attended by 6 participants from Israel, 3 participants from Jordan, 3 participants from the Territories under the Jurisdiction of the Palestinian Authority, the IAEA Programme Manager Officer, and the FAO/IAEA Technical Officer.

National Coordinators meeting participants (Dead Sea, Jordan).

This meeting was instrumental to:

(1) to exchange information and local experience on the Mediterranean fruit fly situation in the affected countries,

(2) to review the technical and organizational limitations faced by the participating countries in the transboundary implementation of AW-IPM programme with an SIT component,

(3) to evaluate the progress and update the work plan of the project on the basis of the information provided by the participants,

(4) to define and agree upon the next steps that should be taken to ensure a successful implementation of this project,

(5) to discuss the progress of a common field operations standard procedures manual, which includes harmonized monitoring, chemical control, fly emergence and releases and harmonized data bases for Mediterranean fruit fly,

(6) to develop and/or optimize common infrastructure, such as the regional training centre in Jordan for handling, packing and releasing of sterile flies,

(7) to plan the next regional and sub-regional coordination meetings with the potential expansion of the project so that it can include also neighbouring countries.

Transfer of Genetic Sexing Mass-Rearing Technologies for Fruit Fly Production (MEX5027)

Scaling Up and Assesment of Mexican Fruit Fly (*Anastrepha ludens)*, Genetic Sexing Strain Tapachula Tbp-7

Considerable progress has been obtained after six years of technical cooperation between Mexico and the FAO/IAEA Joint Division, in collaboration with USDA, to develop a genetic sexing strain (GSS) of the Mexican fruit fly *Anastrepha ludens* at the Genetics Laboratory of the Moscafrut Program in Metapa de Dominguez, Chiapas, Mexico. The GSS that are now available are based on the colour of the puparium, which makes it possible to separate at the pupal stage (brown males; black females). After their development, these strains were subjected to small-scale assessments, culminating in the selection of one of them: T(Y:bp^{+}) **-7,** Tapachula 7 (Tbp-7). This strain was proposed for upscaling of mass rearing at the Moscafrut facility, taking into account the experience and infrastructure for the mass-rearing of this species.

In May 2010 the Moscafrut mass-rearing facility received 2 315 mL of pupa (64 820 pupae) of the Tapachula 7 (Tbp-7) strain. The goal was to scale up the mass-rearing process and to evaluate the sexual behavior (sexual maturity of females, male mating competitiveness and sexual compatibility), and the product quality (pupal weight, flight ability, sex ratio and survival). Three female densities per cage were evaluated (750, 2000 and 4560) under the standard mass-rearing system currently used in the Moscafrut facility.

Anastrepha ludens *pupae of the strain Tbp-7 (females: black puparium and males: brown puparium).*

Production rates achieved comparing the Tbp-7 strain under the relaxed rearing system (mother colony) and the release system are presented in the Table below.

Production rates of the Anastrepha ludens *strain Tbp at different cage densities.*

Production rates	Females per cage		
	Tbp-7 (4,560)	Relaxed colony (35,000)	Release colony (70,000)
Egg/female/day	40	126	63
Egg hatch (%)	64	94	90
Viable eggs/female/day	26	118	57
Millions of larva/ton of diet	1.0	2.5	3.6
Transformation egg to larve (%)	43	81	75
Mature larvae /female/day	11	96	43
Transformation larva-pupae (%)	82	97	97
Pupae/female/ day	9	93	42

The quality data of Tbp-7 males and females, in comparison with the standard release strain produced at the Moscafrut facility, are shown in the Table below.

Quality control parameters of Anastrepha ludens *standard mass-rearing and Tbp-7 strains.*

Parameters	Mass-rearing pupae	Tbp-7 females pupae	Tbp-7 males pupae
Egg hatch (%)	89-93	73-60	73-60
Pupal weight (mg)	18.32	22.15	20.44
Adult emergence (%)	96	88-76	92-78
Fliers (%)	94	77-68	78-76
Longevity (50% hrs)	70.83	68.14	76.05
Sex ratio (F:M)	1:1.15	1	1.02
Survival (5 days, %)	ND	48	66
Time for 50% adult emergence (hrs)	55	60	48
Female sexual maturity (days)	9	8	ND

The sexual competitiveness was evaluated using wild females and males as a reference, comparing three different strains (Tbp-7, standard released and wild males). No

significant difference was found in male competitiveness at a 95% confidence level.

These mass-rearing, quality control and competitiveness results suggest the Tbp-7 strain could be adapted to the standard mass-rearing processes, with some modifications that are common to all GSS.

Source: Dina Orozco Dávila, Julio Dominguez Gordillo, Refugio Hernández Ibarra, Eduardo Solís Echeverría and J. Luis Quintero Fong, (Moscafrut Mass Rearing Facility, Metapa de Domínguez Chiapas, Mexico).

Supporting the Creation of a Tsetse-Free Zone in Southern Mozambique and North-East South Africa (RAF5059)

FAO/IAEA Regional Training Course

The FAO/IAEA Regional Training Course on 'Surveillance of Tsetse Flies in Support of Planning and Implementing Area-wide Integrated Pest Management in Southern Mozambique and North-East South Africa' was hosted by the Veterinary Faculty of the University of Eduardo Mondlane and the National Directorate of Veterinary Services in Maputo, Mozambique from 7 to 24 June 2010. The counterpart of TC project RAF5059, Luis Neves was the course director and 15 participants from Malawi, Mozambique, South Africa, United Republic of Tanzania, Zambia, and Zimbabwe attended the course.

The three-week training course covered topics from basic tsetse biology, anatomy and ecology of the tsetse fly, species identification, principles of developing a grid-based sampling frame, data bases and data management, GPS, GIS and remote sensing, population genetics and morphometrics, dissection techniques and a field exercise to put these issues in practice. Lectures were likewise given on principles of area-wide integrated pest management and on the sterile insect technique.

Most of the participants found the course extremely useful, well organised, and with adequate facilities. From the feedback received from the participants, it was obvious that the 'take home' message of the training course was very clear, i.e. that a lot of the planning and preparations for an entomological base line data collection exercise (i.e. the development of a grid-based sampling frame using GIS and remote sensing and the selection of representative sampling sites in suitable habitat) can be done in the office behind a computer rather than in the field. In this way, surveys will not only be more accurate but also more cost effective.

Second Technical Regional Meeting

The Agency is supporting a tsetse project in southern Africa that comprises Matutuini province in Mozambique, KwaZulu Natal in South Africa, and Eastern Swaziland. The second regional technical meeting of this joint regional TC project RAF5059 was hosted by the Veterinary Faculty of the University of Eduardo Mondlane, Maputo, Mozambique from 28-30 June 2010 and attended by staff of the Onderstepoort Veterinary Institute (OVI), Pretoria, South Africa, of the Directorate of Veterinary Services of KwaZulu Natal (DVS KZN), South Africa, of the Veterinary Faculty of the University of Eduardo Mondlane, Mozambique and of the Ministry of Agriculture, Mozambique.

Reports were presented on:

- The workshop that was held in December 2009 in Maputo to develop a detailed action plan for the collection of entomological base line data. The area to be surveyed is close to 40 000 km^2 and is divided into 3 blocks. The first block (9000 km^2) is bordered in the south by South Africa and in the north by the imaginary horizontal line between Maputo and the border with Swaziland. The action plan follows the principles of grid-based sampling and representative deployment of traps in various vegetation types.
- Increased resistance of trypanosomes to the commonly used trypanocidal drugs. Isolates of *Trypanosoma congolense* were collected from all regions in Mozambique and the isolates originating from the middle and northern parts of Mozambique were all resistant to the drugs. Only in Matutuine District, some isolates were still sensitive or heterogeneous. This clearly indicates that chemotherapy is not sustainable in Mozambique and preferably, needs to be replaced or supplemented by vector control strategies.
- Population genetics studies. *Glossina austeni* populations sampled in Swaziland, Mozambique and South Africa were compared using mitochondrial DNA and wing morphometrics as a marker. Initial results indicated limited gene flow between populations of Swaziland and South Africa. Separation between both the populations became more distinct when the geographical distances between the populations increased.
- The collection of entomological base line data in Matutuine District. Data were collected from 73 trapping sites in 10 grids (each of 10 × 10 km). A total of 368 flies were sampled of which *G. brevipalpis* was the most prevalent. This study was complemented with a veterinary survey in the Bela Vista and Zitundo areas. A total of 1789 blood samples were collected in 49 sampling sites. A prevalence of 18.8% and 16% was found in Bela Vista and Zitundo, respectively.

Future activities will focus on

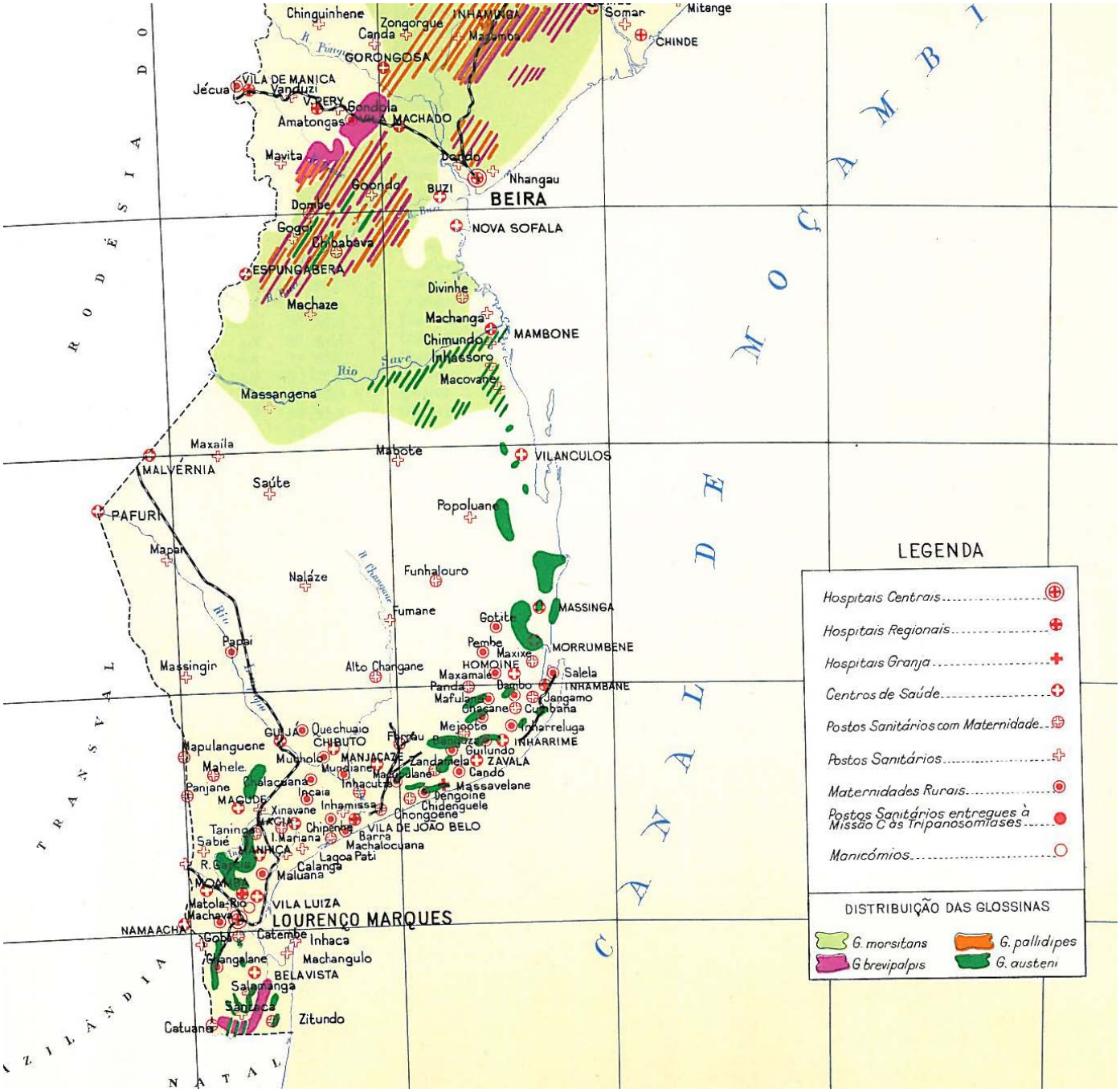
(1) collection of flies from more areas for population genetic studies, including the use of microsatellites as markers

(2) collection of entomological base line data

(3) assessement of gaps in the distribution north of Maputo

(4) collection of data on the dynamics of the population of both tsetse species in South Africa and Mozambique

(5) field cage studies using colony flies from both species (*G. austeni* and *G. brevipalpis*) to assess various components of the behaviour of sterilised males (e.g. irradiation as pupae or as adults, optimal age for mating, optimal age for irradiation, remating capacity, etc.) under semi-natural environment.



Map with the distribution of the tsetse species in southern Mozambique in the 1950s.

Coordinated Research Projects (CRPs) and Research Coordination Meetings (RCMs)

Project Number	Ongoing CRPs	Scientific Secretary
G3.40.01	Development of Standardised Mass-Rearing Systems for Male Mosquitoes (2005-2011)	Jeremie Gilles
D4.20.12	Improving SIT for Tsetse Flies through Research on their Symbionts and Pathogens (2007-2012)	Adly Abd Alla
G3.40.02	Biology of Male Mosquitoes in Relation to Genetic Control Programmes (2008-2013)	Jeremie Gilles
D4.20.13	Applying Population Genetics and GIS for Managing Livestock Insect Pests (2008-2013)	Udo Feldmann
D4.10.22	Increasing the Efficiency of Lepidoptera SIT Through Enhanced Quality Control (2009-2014)	Marc Vreysen
D6.20.08	Development of Generic Irradiation Doses for Quarantine Treatments (2009-2014, managed by Food and Environmental Protection Subprogramme)	Andrew Parker (co-secretary)
D4.20.14	Development and Evaluation of Improved Strains of Insect Pests for SIT (2009-2014)	Gerald Franz
D4.10.23	Resolution of Cryptic Species Complexes of Tephritid Pests to Overcome Constraints to SIT Application and International Trade (2010-2015)	Andrew Jessup

The Third RCM of CRP on *Improving SIT for Tsetse Flies through Research on their Symbionts and Pathogens.* 26-30 July 2010, Nairobi, Kenya

This third meeting was hosted by the International Centre of Insect Physiology and Ecology (ICIPE) and locally organised by Jean Maniania, the Head of Entomopathology Unit. Twenty participants from fifteen countries attended the meeting together with one consultant from the United States and four observers (three from Kenya and one from the USA) (see group photo).

The first two days of the meeting were devoted to presentations of the agreement/contract holders and a consultant, whereas during the reminder of the meeting the participants discussed in two working groups further research on tsetse pathogens and on tsetse symbionts. During the discussions it was concluded that tsetse physiology, including fecundity, seems to depend on the fitness of its symbiotic fauna. Therefore, it was decided that correlations and interactions between the presence of virus, disease symptoms and the occurrence of bacterial symbionts (*Wigglesworthia*, *Sodalis* and *Wolbachia*) need to be explored further.

Participants of the third RCM on Improving SIT for Tsetse Flies through Research on their Symbionts and Pathogens (Nairobi, Kenya).

The group discussed the various management strategies of the Salivary Gland Hypertrophy Virus which have been proposed and are being researched and validated to mitigate / manage the disease in tsetse colonies. These strategies are based on:

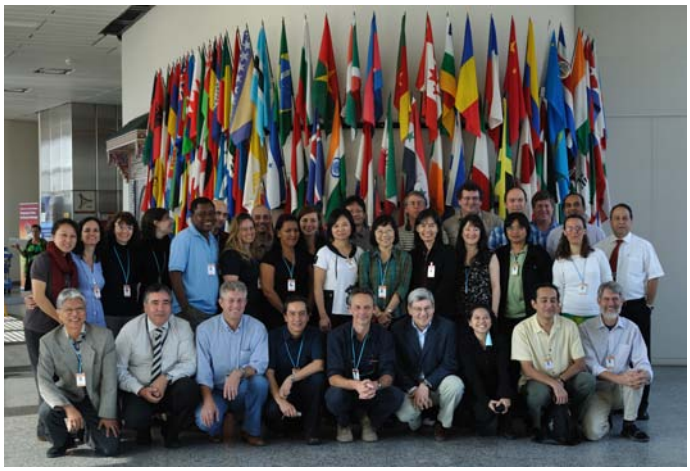
- monitoring viral loads for colony quality control
- blocking virus transmission using specific antibodies, and/or clean feeding practices
- blocking virus replication by applying specific inhibitors of virus replication.

The group also recommended strategies designed to:

- monitor prevalence and loads of tsetse symbionts and pathogens
- augment current feeding regimes to improve tsetse fecundity
- improve the application of the SIT by harnessing tsetse symbionts to develop pathogen resistant fly lines and to introduce natural sterility.

The First RCM of CRP on *Resolution of Cryptic Species Complexes of Tephritid Pests to Enhance SIT Application and Facilitate International Trade.* 2-6 August 2010, Vienna, Austria

The overall objective of this new CRP is to assist Member States in achieving sustainable fruit and vegetable production and in facilitating international trade and the area-wide integrated application of the SIT as part of suppression/eradication programmes against fruit flies of economic importance in Africa, Asia & Pacific, and Latin America.



Participants of the first RCM on Resolution of Cryptic Species Complexes of Tephritid Pests to Enhance SIT Application and Facilitate International Trade (Vienna, Austria).

The main targets are the *Anastrepha fraterculus* (Latin America), *Bactrocera dorsalis* (Asia & Pacific, Africa), and *Ceratitis rosa* (Africa) species complexes and *Bactrocera cucurbitae* (Asia & Pacific, Africa). In each of these groups there are questions concerning either the validity of some of the species or their capacity to be diagnosed.

The specific objectives are to define the species limits within the target complexes, followed by the development of robust species-specific diagnostic tools. The tools identified as useful for studies under the CRP include molecular biology (DNA, genomics, microsatellite analyses, etc), taxonomy (morphology, morphometrics, host range, distribution), behaviour (pre- and post-zygotic compatibility, developmental physiology) and chemical ecology (pheromones, response to parapheromones, cuticular hydrocarbons).

The objectives of the first RCM were as follows:

- To present and discuss the results of related additional research carried out independently by some participating researchers.
- To co-ordinate the processing and analysis of the experimental results.
- To discuss and agree on protocols for the next phase of the CRP.
- To prepare work plans for each participating institute for the next phase of the CRP.
- To co-ordinate the needs and provisions of material over the next 18 months.
- To set up logical and harmonised systems for collection and transport of live and preserved fruit fly specimens.
- To harmonise research and administrative linkages between institutions.

The meeting was attended by 31 scientists and observers from 17 countries: Argentina, Australia, Belgium, Brazil, China, Colombia, Czech Republic, France (La Reunion), Greece, Italy, Kenya, Malaysia, Mexico, New Zealand, Thailand, United Republic of Tanzania and USA.

On the first two days participants presented their progress reports for the first phase of the CRP. During the following days of the RCM participants were divided into three separate working groups to review recommendations from the consultants meeting, prepare conclusions, general technical administrative recommendations, as well as work plans and recommendations for each participating institute.

Participants also discussed common issues that exist among institutes. The first was a protocol for collection and shipment of live and dead insects for rearing, morphology, chemical biology and molecular assays and the second was a discussion and review of procedures for field cage tests.

The Second RCM of CRP on *Increasing the Efficiency of Lepidoptera SIT Through Enhanced Quality Control.* 15-19 November 2010, Stellenbosch, South Africa

The University of Stellenbosch, South Africa, hosted the 2nd RCM of the CRP on 'Increasing the Efficiency of Lepidoptera SIT by Enhanced Quality Control' 15-19 November 2010. The RCM was very well organised and we thank Matthew Addison for his great efforts.

The CRP aims at the development and use of improved quality control/management systems for all aspects of lepidopteran SIT by:

- identifying and characterizing factors and variables that affect quality and field performance of released moths
- developing and improving tools and methods to assess, predict and enhance the field performance of released moths based on insect quality
- developing new and improved methods for enhancing rearing systems, facilitating the selection for performance and fitness traits that improve colony establishment, refurbishment and production, and the field performance of released moths.

ATV's with release devices in front being off-loaded from trailer for releases of false codling moth.

The RCM was opened by M. J. Samway, Head of the Department of Conservation Ecology and Entomology of the University of Stellenbosch, who in his opening speech emphasised the need for more 'green' control tactics against important fruit pests. In this respect, South Africa is certainly a frontrunner, as it currently can boast three operational programmes that contain an SIT component, i.e. against the Mediterranean fruit fly, the codling moth and the false codling moth (FCM).

Chilled sterile false codling moth being transferred from petri dishes to the release device.

The first two days of the RCM were devoted to presentations of the participants, who described the progress made with their research since the last RCM in Christchurch, New Zealand. Optimal radiation doses (sterilising dose for the female and sub-sterile dose for the male moths) were established for various species like carob moth (200-250 Gy), European grape vine moth (150 Gy), litchi stem borer (200 Gy), and sugarcane stalk borers (200 Gy).

Work with stable isotopes showed the feasibility of discriminating between wild cactus moth and laboratory-reared insects and good progress was likewise made with the assessment of volatiles of cabbage that attract female diamond back moth.

Further work was presented on:

- sperm behaviour of *Spodoptera litura*
- development of rearing methods of the mahogany shoot borer *Hypsipyla grandella*
- thermo tolerance of codling moth
- mating compatibility between codling moth populations from different regions in Argentina
- quality control tools for the light brown apple moth
- quality control in the FCM programme in Citrusdal, South Africa
- the importance of handling procedures on the quality of sterile cactus and codling moths.

Most of citrus production for export in the Western Cape Province is now under area-wide integrated SIT application against false codling moth, and expansion is foreseen to citrus areas in other provinces.

Field visits were made to the codling moth rearing facility on the premises of the University of Stellenbosch, the Mediterranean fruit fly facility at ARC, Stellenbosch and the FCM suppression programme in Citrusdal.

Developments at the Insect Pest Control Laboratory (IPCL), Seibersdorf

FRUIT FLIES

Fruit Fly Rearing Group Activities

Research and development in the Fruit Fly Rearing laboratories over the last six months has concentrated on streamlining production methods for a range of pest fruit fly species with a view to facilitating the transfer of insects from small-scale laboratory culture to large-scale mass-rearing colonies to be used for SIT programmes.

Melon Fly *(Bactrocera cucurbitae)*

Ihsan Ul Haq, a consultant from Pakistan, is studying the effect of pre-release feeding of hydrolysed yeast and methoprene on male *Bactrocera cucurbitae* Coquillett (Diptera: Tephritidae) longevity to improve the effectiveness of SIT programmes.

It has been shown that enhanced male melon fly mating success due to the application of methoprene (a juvenile hormone analogue) and feeding with a sugar-protein (hydrolysed yeast) diet prior to release will improve the efficacy of SIT programmes. However enhanced mating success may have a cost in terms of shortened sterile male longevity. The effect of methoprene treatment and addition of protein to the adult diet and then switching from a sugar-protein diet to sugar only on male longevity was studied. Results showed that access to a sugar-protein diet actually enhanced male survival, with sugar-protein fed males showing the highest longevity. Males treated with both methoprene and sugar-protein reach sexual maturity several days earlier than flies fed sugar alone, and these males are therefore closer to sexual maturity when released in SIT programmes. This is without adverse effects on male longevity. This work supports the use of methoprene and a sugar-protein diet application as a routine pre-release treatment to improve sterile male performance.

The *Bactrocera dorsalis* Cryptic Species Complex of Pest Fruit Flies

The IPCL houses laboratory-reared cultures of several pest species within this complex. They are the Oriental fruit fly (*Bactrocera dorsalis*), the invasive fruit fly (*Bactrocera invadens*), the Philippines fruit fly (*Bactrocera philippinensis*), the carambola fruit fly (*Bactrocera carambolae*) and the Asian papaya fruit fly (*Bactrocera papayae*).

Mark Schutze, a visiting scientist from Queensland University of Technology, Brisbane, Australia, is currently stationed at the IPCL and is working on various identification tools to distinguish species within the *B. dorsalis* complex. In collaboration with the FAO/IAEA and scientists in Australia, New Zealand, South East Asia and the USA he is assessing morphometric, acoustic and behavioural differences between the species.

Bactrocera carambolae *ovipositing in star fruit.*

Experiments have shown that some of species within the *B. dorsalis* complex can crossbreed with each other, producing hybrids that are fertile and some are morphologically distinct from their parents. Simulated field experiments, in field cages with host trees, have shown that *B. dorsalis* will freely mate with *B. invadens*. To date, Mark Schutze has undertaken mating compatibility tests using *B. dorsalis s. s.*, *B. carambolae*, and *B. philippinensis* flies sourced from Thailand, Suriname and the Philippines, respectively. Soon to be included is *B. papayae* which was recently obtained from Peninsular Malaysia. Field cage results so far have revealed relatively high levels of mating isolation between *B. carambolae* and *B. dorsalis* and between *B. carambolae* and *B. philippinensis*. This work is co-funded through an Australian Co-operative Research Centre for National Plant Biosecurity project and also represents a component of the CRP 'Resolution of Cryptic Species Complexes of Tephritid Pests to Overcome Constraints to SIT Application and International Trade'.

Olive Fruit Fly *(Bactrocera oleae)*

Research on improving and streamlining mass-rearing of olive fly for SIT programmes continues at the IPCL in

collaboration with workers from other countries such as Greece, Israel, Italy, Jordan, Spain, the UK, and the USA.

There have been marked improvements in olive fly rearing as a result of trials carried out between July and December 2010. Our flies are now being reared routinely in large cages formerly used for mass-production of Mediterranean fruit fly. These cages and the environmental conditions under which they have been placed have demonstrated low early adult mortality, high egg production and acceptable egg fertility for four generations so far. All *B. oleae* populations in culture at the IPCL (the Greek 'Demokritos' strain and laboratory cultures colonized based on flies sourced from Israel and Greece, plus three hybrid strains between the Demokritos strain with French wild flies, with Greek wild flies, and with Israely wild flies) showed similar high levels of production. The numbers of fertile eggs produced per cage is at least as good as those for Mediterranean fruit fly mass-rearing.

The new 'mass-rearing' cages developed for the rearing of olive fly (top), and the removal of eggs with water from the egging panel (bottom).

The new olive fly cage is an aluminium frame mesh-covered unit which measures about 200 cm long × 100 cm high and 20 cm wide. It contains two water channels accessed from outside the cage for topping up water, two length-wise troughs for adult feed and pupae. One wall of the cage (about 196 cm long × 96 cm high) has been replaced with a panel of waxed terylene cloth (the 'egging panel') and this is covered with a 'plastic door' which aids in reducing egg desiccation (see Figure). Trials so far have populated the cage with from 200 mL to 1 200 mL pupae (about 15 000 and 90 000 pupae, respectively). Data for the 1 200 mL trial are not complete as yet. Data from cages of the Israel / Demokritos hybrid from 200 mL, 350 mL and 500 mL of pupae per cage showed hatched-egg to pupal recovery rates of 20%, 15% and 19%, respectively. These results were lower than expected due to adult starvation because, as was unusual at that time, flies consumed all their food within a few days. New data from well-fed flies at 1 200 mL of pupae per cage and the quantity of food required for this volume of flies will be available soon.

This work represents a major improvement in the ability to mass-rear olive fly under artificial conditions and points to the technical and economic feasibility of using the SIT against this pest. Over the next period we will be testing new larval diet mixtures, carrying out field cage trials to assess the compatibility of mass-reared olive flies with wild flies and complete assessments of costs of production.

South American Fruit Fly (*Anastrepha fraterculus*)

Adalecio Kovaleski, a visiting scientist on sabbatical, from Brazil, is currently working on assessing the possible differences between several geographically-isolated populations of the South American fruit fly in collaboration with two other scientists from Argentina (Solana Abraham) and Mexico (Juan Rull) who spent about a month at the IPCL on this project. This work is likewise tied to the CRP on the 'Resolution of Cryptic Species Complexes of Tephritid Pests to Overcome Constraints to SIT Application and International Trade'.

The South American fruit fly, *Anastrepha fraterculus* is one of the most economically important pests of fruit production in Latin America. It ranges from Texas (USA) to Argentina, and causes greatest economic damage in South America and in particular south central Brazil, which is a major production area for apples, peaches, plums, grapes and oranges, among others.

Recently international markets have imposed stiff restrictions on the use of many of the pesticides against this pest, forcing researchers and growers to develop alternative technologies. On the other hand, same results can be used to overcome non-tariff trade barriers in order to export fresh fruit and vegetable commodities to international high value markets. This can be the case of the Mexican populations which seems to be a different species.

The use of natural enemies and the application of the SIT are among those viable technologies for *A. fraterculus* population suppression. Both of these techniques are dependent upon insect mass-rearing. Furthermore, SIT is strongly dependent on compatibility between laboratory reared insects and wild populations. The wide range of both climatic conditions and host plants within the distri-

bution zone of *A. fraterculus* influences the establishment and selection of strains. Assessing strain compatibility with wild populations from target regions is therefore fundamental for the decision of which strain to select for colonization and mass-rearing in order to apply SIT to a specific area.

Current studies at the IPCL involve populations from Argentina (Tucumán), Brazil (Vacaria, Pelotas and Piracicaba), Colombia (4 regions), Mexico (Xalapa) and Peru (La Molina). Results obtained so far indicate a high degree of compatibility among Southern Brazilian and Argentinean population and strong isolation of the Mexican population. Adults from two Brazilian and one Argentinean population mated randomly in field cages and produced viable progeny in laboratory crosses. By contrast Mexican and Argentinean flies displayed almost complete assortative mating and laboratory crosses of Mexican flies with Argentinean, Brazilian and Peruvian populations failed to yield fully viable F_1 adult flies.

Current results and previous studies appear to support the idea that an AW-IPM programme with an SIT component that targets an area covering all of Argentina and Southern Brazil all the way up to Piracicaba can be covered using a single strain. A hybrid between laboratory adapted Tucumanian strain and wild male populations from this region could be developed and tested both for ease of laboratory rearing and mating compatibility with wild populations.

Mediterranean Fruit Fly *(Ceratitis capitata)*

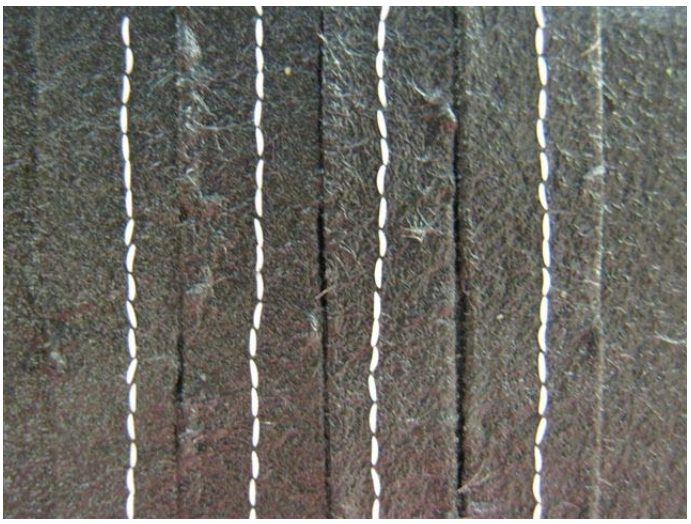
The IPCL continues to supply the Vienna 8 *temperature sensitive lethal* (*tsl*) genetic sexing strain of Mediterranean fruit fly to different facilities around the world for testing and use in SIT programmes.

Examination of Fruit Fly Eggs

Nwe Nwe Yin, a fellow from Myanmar is currently carrying out studies on fruit fly egg size and shape. The reason for interest in this is that the number of eggs per mL of egg suspension is necessary to be exact for optimal seeding rates of fruit fly eggs on SIT larval diets for correct quality control procedures. This figure impacts heavily on such quality assessment tests as the calculation of egg to pupa recovery – an important figure used to assess the efficacy of fruit fly mass-rearing for SIT purposes. Eggs of flies from many species have been measured in two different ways. The first is to standardise volumetric measurement by using a 0.2 mL PCR Softtube® and counting the number of eggs in that volume.

The second method is to measure average egg length and width using Motic® morphometric software. Eggs from *Anastrepha fraterculus, A. ludens, Bactrocera oleae, B. zonata, B. cucurbitae, B. tryoni, B. dorsalis, B. carambolae, B. philippinensis* and *B. invadens* have been tested. In addition four geographically different populations of *A. fraterculus*, and 'wildish' and genetic sexing strain variants of *C. capitata*, *B. dorsalis* and *B. cucurbitae* have been compared.

An artificial egg collection device containing about 5 mL of mango fruit juice was set up in a rearing cage measuring 120 × 50 × 50 cm for each fruit fly species / population to collect the eggs. It was removed from the rearing cage for two hours. PCR Softtube® (0.2 mL) was used to measure the volume of eggs. Eggs were put into the PCR Softtube to the 0.2 mL mark and allowed to stand for 10 minutes to create a standard settling time for the eggs. Five of these tubes per species / population were used. Eggs were decanted onto damp black filter paper and 'lined out' to facilitate counting (using a hand-held counter) under a dissecting microscope (see Figure).



Eggs of Bactrocera invadens *collected and prepared for egg hatch counting.*

Results so far have shown that there is sizable variation between species in both egg dimensions and the number of eggs/mL. Some species however are not sufficiently different to enable species identification on egg size alone. Some of the *A. fraterculus* populations are significantly different from each other. More work is being conducted. So far there is a high degree of repeatability in egg counts from the 0.2 mL tube. Further trials will be done to examine the possibility of using this technique as an international quality control measure.

Phytosanitary Treatments for *Bactrocera invadens* and other Quarantine Pest Fruit Flies: Collaborative Investigations of Quarantine Treatments for Invasive Fruit Flies between USDA/APHIS and FAO/IAEA

Bactrocera invadens, Bactrocera correcta and *Bactrocera zonata* have been identified as high level threats of entry into many countries that are currently free of these invasive pest tephritids. For the USA there are no approved quarantine treatments for these species. If any of these species invades the USA, cost of eradication would be thousand times higher than the cost of preventions as the use of quarantine treatments. In addition, if any of these species invades the USA, the international market can impose quarantine restrictions to the fruit trade. Ideally new quarantine treatments should be developed for each species, but an alternative, more rapid technique is to test treatment tolerances of each pest and compare

them under the same conditions with those of other fruit fly species (the 'controls') whose treatment tolerances are already known. Such tests should be conducted at a location with colonies of all of these species. The IPCL at Seibersdorf meets this standard by maintaining colonies of all six species to be tested. The test species are *Bactrocera invadens, Bactrocera correcta* and *Bactrocera zonata;* and the control species are *Anastrepha ludens, Bactrocera dorsalis* and *Ceratitis capitata*.

The goal is to conduct confirmatory tests of postharvest treatments to establish quarantine treatment of host commodities of *Bactrocera invadens, Bactrocera correcta* and *Bactrocera zonata*. The establishment of quarantine treatments for these commodities could potentially open up more markets and enable greater movement of produce from countries that have these pest species.

Studies so far have assessed the suitability of fruit types for artificial infestation by *B. invadens* in future disinfestations experiments. Three different fruits namely, apple, orange and plum were chosen. All fruits were collected from the local market and thoroughly examined to ensure freedom from fruit fly infestation. Fruits were soaked in 96% ethanol for about 1 minute to prevent fungal contamination and then wiped dry with fine tissue paper. Each fruit was punctured with five fine holes (each about 1 mm in diameter) using a No. 5 entomological pin.

Shipments of Fruit Flies and Rearing Materials to other Researchers and/or SIT Programmes

The Fruit Fly Rearing group is considered by Member States and other countries as a valuable resource for fruit fly species and for its experience in rearing fruit flies of various species in the laboratory. From July to December 2010 several shipments of olive fruit fly were made to Italy; of Mediterranean fruit fly to Argentina; of South American fruit fly to the Czech Republic, Germany, and Italy; mixed shipments to Australia and Singapore; Oriental fruit fly complex species to Greece and Australia and of insect feed and equipment to Croatia, Israel and Suriname.

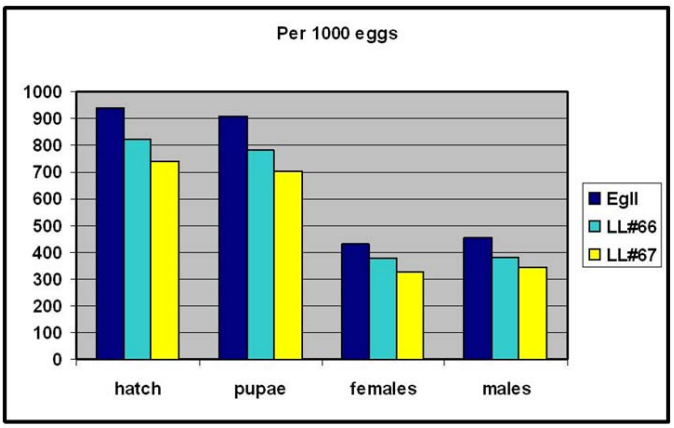
Flies were imported from France (olive fly) and Malaysia (Asian papaya fruit fly).

Fruit Fly Genetic Sexing Group Activities

Analysis of two transgenic strains

Two conditional embryonic lethal strains of *C. capitata*, named LL#66 and LL#67, were analysed over 11 generations. They were developed by Marc Schetelig at the University Göttingen, Germany. Both strains contain the same transgenic construct consisting of 2 components: a) the early embryonic promoter of the Mediterranean fruit fly serendipity gene (C.c.-*sry* α) controlling the bacterial tTA/tRE system (combined with a PUB-DsRed marker) that allows controlling the early embryonic expression via the presence or absence of tetracycline in the diet and b) the Mediterranean fruit fly *hid*^{Ala5} lethal gene (in combination with a PUB-EGFP marker). This effector construct has a common location in both strains and it is inserted at 70B on the salivary gland polytene map. Both strains differ, however, in the chromosomal location of the *sry* α-tTA/tRE driver construct. In LL#66 it is located at 74B and in LL#67 at 63B. In the absence of tetracycline the tTA/tRE activates the *hid*^{Ala5} in early embryos which leads to lethality.

To maintain the strain 100 µg/mL tetracycline were added to the adult drinking water and the larval diet. During nine generations 2 samples with 100 eggs each were collected for 5 hours. This was repeated for several days. Egg hatch, pupal recovery and male and female recovery were determined. In total 11 800 eggs were counted for each strain. The recovery results are summarized in the following Figure. The comparison with the wild type strain EgII shows that the overall adult recovery is reduced by ca. 16 and 25% in LL#66 and LL#67, respectively. The reduction stays more or less constant in all life stages so that it can be assumed that this additional lethality is primarily found in the embryos. Furthermore it can be assumed that the difference between the strains is linked to the chromosomal location of the *sry* α-tTA/tRE driver construct.

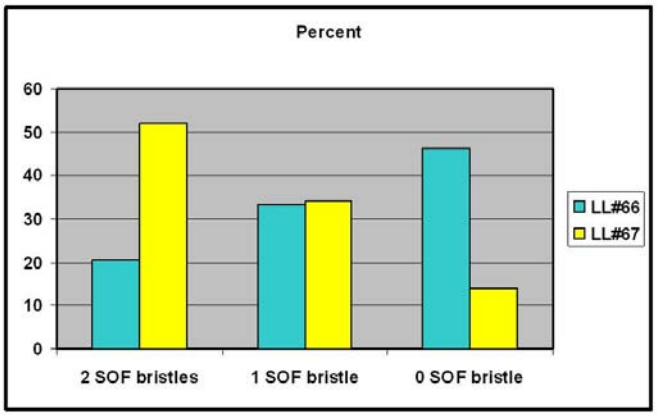


Recovery at the different life stages in two transgenic strains in comparison to the wild type strain EgII.

The males in both strains show an unusual phenomenon. Many males have lost one or both of the male-specific sub-orbital-frontal (SOF) bristles. However, the relative proportion of these males is different in the 2 strains. The following Figure shows that in strain LL#67 52% of the males are normal while 34 and 14% have lost one or even both SOF bristles, respectively. In strain LL#66 the situation is reversed. In the literature conflicting results about the function of the SOF bristles in Mediterranean fruit fly mating behaviour were reported. The mating competitiveness of strain LL#67 has been analysed previously and no obvious differences with an Argentinean wild type strain were observed. These limited results seem to indicate that the SOF bristles play no major role during mating.

It can be concluded that both strains suffer from the presence of the transgene. However, the reduction in the overall productivity is, particularly in LL#66, relatively

minor considering that they carry two transgenes. It is not known what causes the loss of the SOF bristles but at least the effect on male mating performance seems to be negligible although require more analysis. It has to be stressed that these strains are not sexing strains; i.e. they would be used to induce lethality in the target population without irradiation through the mating between released males and females and the wild population.



Relative proportion of males with reduced number of SOF bristles in two transgenic strains.

TSETSE FLIES

Glossina palpalis gambiensis mating compatibility studies in field cages

The SIT applied as part of an area-wide integrated pest management (AW-IPM) approach, requires the production of the target insect in large numbers, the sterilisation of the male flies, and the sequential release over the target zone of these sterile flies to outnumber the wild male population. Aside from mating competitiveness, the mating compatibility of the strain used for the rearing and the release with that of the target area is a prerequisite for success. This is especially the case when flies are used from a strain that is not indigenous to the target area.

This situation presents itself in Senegal, where the Government has embarked on a project to eradicate the tsetse fly *Glossina palpalis gambiensis* (Gpg) from the Niayes area (see reports in the IPC NL 71, 74 and 75). A population genetics study revealed that the *G. p. gambiensis* populations in the Niayes are very much isolated from the population in the east (Missirah) of the main tsetse belt of Senegal. An eradication strategy was therefore selected by the Government of Senegal, using an AW-IPM approach with the release of sterile male flies as the last control tactic to drive the Niayes Gpg population to extinction.

The Government of Senegal likewise opted not to develop its own mass-rearing facility, but to procure the sterile flies from the CIRDES (Centre International de Recherche-Développement sur l'Elevage en Zone Subhumide), which has maintained a colony of Gpg since the 1980's in Bobo-Dioulasso, Burkina Faso. The flies from that colony were used to eradicate a Gpg population from Sidéradougou in Burkina Faso. As the colony was established with flies from Sidéradougou, an important question was that of mating compatibility with the flies from the target area in the Niayes of Senegal.

At the IPCL, the mating compatibility and competitiveness of Gpg males were assessed using Burkina Faso (BKF) and Senegal (SEN) strains competing for mating opportunities with SEN females. A cylindrical field cage, 2.9 m in diameter and 2.0 m high, was used and set up under 58W fluorescent lights (8 tubes) in a room with ceramic tiles on the floor and walls where temperature was controlled between 24-25°C and humidity between 60-65%. The light intensity within the cage varied from 300-550 Lux with areas immediately under the frames ranging from 100-300 Lux. A tree was positioned in the middle of the cage to simulate more natural conditions.

Flies received a blood meal the day before field cage observation and marking of groups was also done a day before field cage observation. Flies were immobilised in a gentle breeze at 4ºC during marking with a small dot of acrylic paint on the notum. Observations were conducted from 08.50 h to 12.00 h. In each test 30 virgin SEN female flies were released at the centre of the cage and allowed to settle before 30 male flies of each strain were released ten minutes later.

Fly activity was observed for three hours and mating pairs were collected into individual vials as they formed and the time recorded. Also when the pairs separated the time was recorded. The premating time was then calculated as the period in minutes between time when males were released and formation of each mating pair. Mating duration was calculated as the length of copulation in minutes, i.e. from formation of mating pair to separation.

The propensity of mating (PM) (the overall proportion of released female flies that mated), the relative mating index (RMI) (the number of pairs of one strain as a proportion of the total number of matings) were the indices assessed.

Pupae production was assessed for flies that mated with SEN female flies in the field cage from the first four replicates in addition to two groups where females of BKF strain were mated with males of BKF and SEN strain in colony production cages.

The propensity of mating ranged from 0.4 to 0.8 with a mean of 0.64±0.14 for the nine replicates. Only one out of the 61 mated females dissected was not inseminated. The premating time, mating duration and relative mating index were not significantly different for both strains. The mating performance indicators showed that the male flies of the BKF strain can mate and copulate with females from the SEN strain and that mating was not significantly different from random mating.

Salivary gland hypertrophy virus

As reported in the last newsletter (July 2010), attempts are continuing to develop a strategy to manage the Sali-

vary Gland Hypertrophy Virus (SGHV) that is hampering colony development of *Glossina pallidipes* due to reduced productivity. The virus management strategy is based on four approaches, (1) blocking virus replication using commercial antiviral drugs, (2) inhibiting virus infection by silencing virus specific genes using RNAi technology, (3) neutralizing the virus infection using virus specific antibodies and (4) modifying the feeding system to clean feeding.

Work is continuing to assess the impact of two antiviral drugs on the viral infection in *G. pallidipes* and to assess their toxicity for tsetse fly. The use of Valacyclovir and Acyclovir during normal colony feeding for two years shows two interesting observations (i) the numbers of flies fed on Acyclovir drug declined over time due to low productivity and the treatment had to be ended, while the flies fed on blood supplemented with Valacyclovir still maintained acceptable productivity; (ii) the virus load in the flies treated with Valacyclovir was not stable and slightly increased in time which could indicate development of resistance against the drug by the virus, but this observation needs to be confirmed. Based on the results achieved with Acyclovir and Valacyclovir, another 15 antiviral drugs currently used against herpesviruses were selected to test their effect on virus replication. The toxicity of these drugs to tsetse flies is under evaluation. A new test was developed to evaluate the effect of the antiviral drugs on virus replication, whether by feeding or injecting the drugs into the flies over three weeks.

An experiment has been started to assess the effect of suppressing the expression of p74 by RNAi on virus infectivity. The results of fly productivity and mortality and the prevalence of the SGH between the RNAi treated and non-treated flies did not show so far a significant result. Moreover the qPCR results did not support a significant difference between treated and non treated flies. Attempts to develop efficient methods to initiate a virus infection by virus oral infection or virus injection and the assessment of the RNAi impact on the DNA replication in the infected flies are underway. As the p74 gene was arbitrarily selected for the RNAi test, preparations are underway to test RNAi for various other virus genes. More than 30 genes have been cloned and sequenced and their impact on viral replication is being assessed.

For neutralization of the virus infection using virus specific antibodies, five antibodies were produced. Two antibodies against the p74 protein were produced by a commercial company, and one antibody against each protein expressed by the open reading frame (ORF) 10, 17 and 96 were produced in collaboration with Just Vlak from Wageningen University, Netherlands, and Max Bergoin from Montpellier University, France. Experimental work to assess the efficacy of the antibodies to neutralize and block virus infection has been started. The preliminary results showed that injecting virus neutralized by antibodies against ORF 10 into tsetse flies significantly reduced virus pathogenicity. Optimization and assessing the antibody neutralization effect on the virus is underway.

Lab technician C. Marin dissecting *Glossina pallidipes* flies with salivary gland hypertrophy (top). Abdomen of male *G. pallidipes* showing the enlarged infected and hypertrophied salivary glands (bottom).

After demonstrating the role of horizontal transmission through the membrane feeding system used in the laboratory colony, it was recommended to maintain tsetse flies or the clean feeding system. A clean feeding colony was established by putting fly cages on a fresh membrane and providing blood to the flies that had not been used for feeding any other flies. After feeding, the remainder of the blood was used for other normal colony feeding. The clean feeding colony was maintained separately from the other colony and fly samples were taken regularly to assess the virus load and the prevalence of SGH. The qPCR results indicate a significant decrease in virus load in the clean feeding colony in comparison with the normal feeding colony. Fly dissections indicate that after nine months the clean feeding colony became virtually SGH free while 10% of the flies in the normal feeding colony still show SGH. The virus prevalence by PCR on the leg of teneral flies indicated that the clean feeding colony is continuing to have very low virus prevalence.

MOSQUITOES

The tray developed at the FAO/IAEA's IPCL (outside dimension 60 × 100 × 3.5 cm) was tested for its suitability for rearing larvae of *Anopheles arabiensis.* At 26 and 27°C (70-80% RH), trials were conducted to gather data

on speed of larval development and pupae and adult survival. 4000 larvae were reared in each tray containing 6 litres of deionized water, *i.e.*, 1.5 larva/cm² of water surface or 0.67 larvae/mL. 50 mL of the FAO/IAEA diet (which constitutes 5 g of tuna meal, 5 g of bovine liver powder, and 4.6 g of vitamin mix, 1% w/v), was given to each tray at the start (days 1 and 2) and at the end (days 9 and 10) of the experiment. L2, L3 and L4 larvae were given twice that amount .*i.e.* 100 mL apportioned twice at 50 mL. The mean larval development time (L1-pupae) was 9 and 11 days at 27°C and 26°C, respectively. At 26°C and 27°C larval survival was 62.9% and 93%, respectively. Tests are underway to evaluate the same parameters in trays placed on the holding rack.

A new prototype of the larval tray has also been produced, which has a double overflow system. This system will allow quicker loading with water using the cascade system, and it is assumed to have a better water and food distribution creating more uniform rearing conditions. This is currently being tested (see following Figure).

The new prototype of the larval tray with a double overflow system.

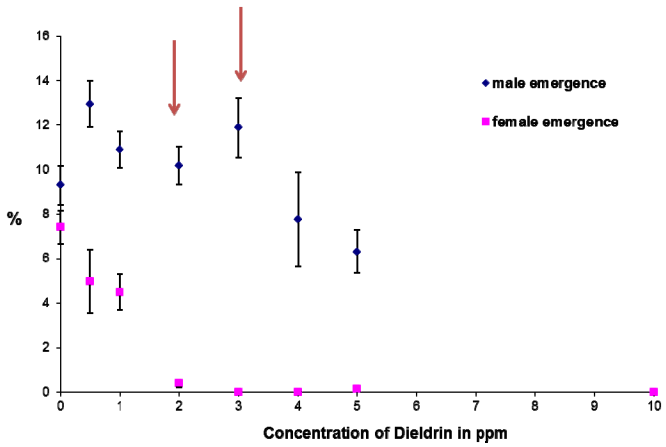
The first design of the tilting rack to hold the larval trays was modified to improve the efficiency of larvae and pupae collection. A transparent undulated plastic sheet was fixed at the draining side of the rack to regulate and ease the flow of water containing larvae and pupae as the rack is titled. The water cascading from the stacked trays converges at a metallic plate placed at the bottom of the plastic sheet before entering the collection basket. Batches of 100 larvae and 100 pupae were placed at the mid- and bottom sections of the rack. After filling each of the 50 trays with 6 litres of water, and holding them for the development time, the rack was tilted. Most of the larvae and pupae were recovered and showed no signs of stress.

In this rack, trays are stacked 3 cm apart; the bottom and top trays are 50 and 200 cm from the floor, respectively. Ambient temperature is not uniform in the climatic room where these tests were conducted. As can be expected, there was a gradual increase in temperature with increasing height. The gradual increase in ambient air temperature was also seen in the water temperature in the trays. The water in a tray at any given height was always 2.5 degrees lower than the air temperature at the same height. It would appear therefore, that the rack does not affect the temperature in the trays. Enhancing air circulation in the room would maintain the temperature of the water in the trays within the 28 ± 1 °C range.

Sex separation in *Anopheles arabiensis* at egg stage

The genetic sexing strain (GSS) of *Anopheles arabiensis* that is being maintained at the IPCL (GSS S-33) is based on a dieldrin resistant mutation. Treatments with dieldrin have so far been carried out on larvae. Shifting dieldrin treatments from larval to egg stage for the purpose of sex separation could significantly enhance practicality and accuracy, and reduce costs, space and labour requirements by rearing and feeding only half of the volume of larvae prior to the release of sterile males. Also, a complete elimination of female mosquitoes is the desired outcome as their release is inacceptable due to their vectorial capacity as well as their added biting nuisance.

The effects and efficiency were evaluated for the treatment of eggs of the *An. arabiensis* GSS. The ideal treatment conditions to obtain males only were also assessed. A total elimination of the females was achieved with a treatment of approximately 500 eggs using a dieldrin solution at a concentration between 2 and 3 ppm and an exposure time of 2 to 6 hours. The treatment of the eggs with these conditions did not significantly affect hatch rates, larval survival or male emergence (see following Figure).



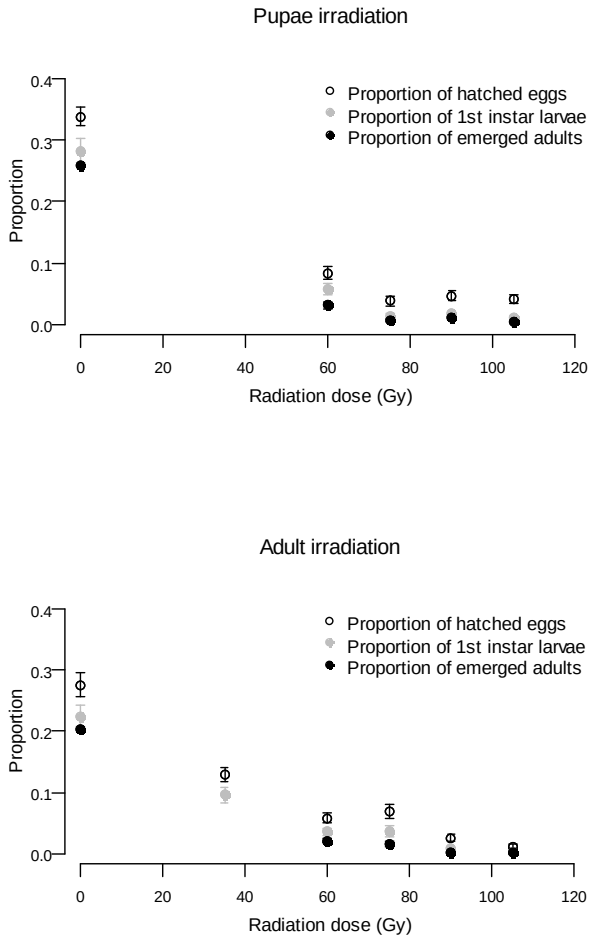
Percentage of male and female Anopheles arabiensis *emergence (±SEM) from the original number of eggs treated at varying concentrations of dieldrin. Arrows indicate good conditions to eliminate all females while obtaining the maximum number of males.*

Prolonging the treatment duration to 24 hours or increasing the ambient temperature had little effect on the outcome, whereas the maturity of the egg was acutely important to the treatment's success. Contact to the dieldrin was reduced with embryos aged 24 hours allowing females to survive treatment. A simple permeability test showed that the egg chorion becomes increasingly impermeable to the dieldrin solution with age of the embryos. An approximate cut-off time when the dieldrin solution is no longer being absorbed sufficiently to eliminate all females was set at 16 hours post oviposition. Ideally, the eggs should be collected and treated every morning to ensure that they are no older than 12 hours.

This method has been reliable and consistent for treating batches of up to 500 eggs. Further trials are needed to assess these parameters when treating a larger quantity (≥ 10 000) of eggs for mass releases. The integrity of fitness and quality of the males after exposure to dieldrin must also be assessed and ensured.

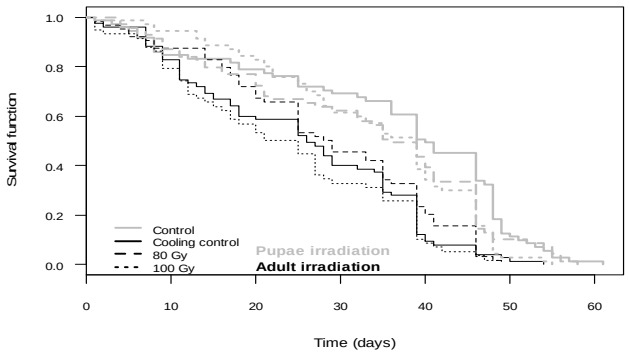
Effect of gamma irradiation on *Anopheles arabiensis* genetic sexing strain (GSS 5-33)

The radiation induced sterility (according to Abbott's formula) indicated that the gamma irradiation affected similarly the fertility of *An. arabiensis* Dongola pupae (wild strain), GSS pupae and GSS adults. A high mortality was observed between the egg hatch and the first larval instar (L1) stage of the resulting progeny for the GSS. Thus when considering the proportion of eggs leading to surviving L1 larvae, the 75 Gy treatment induced a similar reduction of fertility than the 105 Gy treatment (see following Figure). This might allow us irradiating at a reduced dose, which would result in less somatic damages and better competitiveness of sterile males.



Mean proportion of survivors (± SEM) of the different stages (egg, 1st instar larvae and adult) as a function of radiation dose. The results show the survival of the progeny of single females that mated with males irradiated at the pupal stage (above) and adult stage (below).

During the first 10 days of life the survival of sterile males did not differ between all treatments. After that period all groups showed a significantly lower survival as compared to the control group (see following Figure). As performed during these experiments, the cooling process during the adult irradiation affected strongly the survival of adults, thus improvement of the adult irradiation method is required. However, as released mosquitoes are expected to be effective during the first 10 days, the irradiation process seemed not to be detrimental to this objective.



Survival function (Kaplan Meier estimates) of adult males irradiated as adults (black lines) or pupae (grey lines).

X ray induced sterility in *Aedes albopictus* and longevity following irradiation

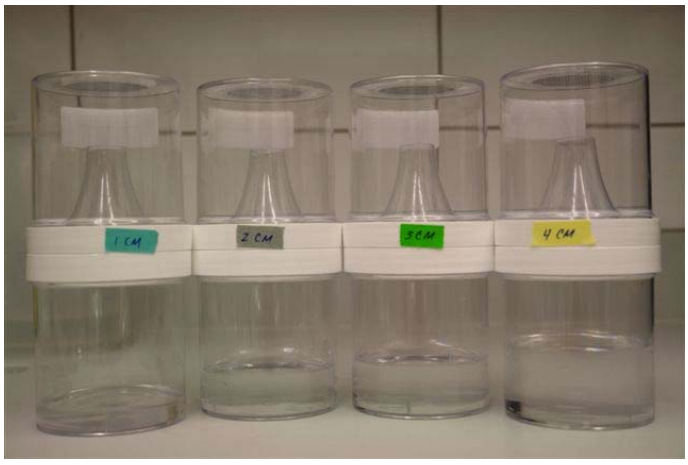
Self-shielded Cobalt-60 gamma-ray irradiators are becoming increasingly difficult to purchase, transport, or reload because of increased controls on radioisotopes due to the fear of terrorism. Therefore the self-shielded, low energy X ray irradiator, the RS 2400 may be an alternative for the sterilisation of insects as it is more accessible to most countries. There is no continuous emission of radiation, no radioactive waste, and it requires lower transportation costs, although higher operation and maintenance costs. The chamber of the X ray irradiator contains 5 rotating cylinders (see Figure). Each cylinder, which has been specially modified for mosquito pupae, can hold approximately 70 000 pupae on 12 stackable plastic plates.

The opened chamber of the RS 2400 X ray irradiator holds 5 rotating cylinders (left side), which have been modified for the irradiation of mosquito pupae.

With the potential advantages of using the X ray irradiator, the effects of X ray induced sterility in *Ae. albopictus* were evaluated. When male pupae were irradiated in the RS 2400, the mean fertility rates decreased linearly and the distribution of the egg hatch rates narrowed as the radiation dose increased. Radiation induced sterility approached 99% following exposure to doses of 40 Gy and higher. Further effects of X rays on adult fitness still need to be evaluated before considering the replacement of the gamma irradiator with the X ray irradiator. When assessing the longevity of sterile males after irradiation at increasing doses, a slight trend was seen between the treatment groups, although none were significantly different from the control.

Effect of water depth on development of *Aedes albopictus*

Since 2009, a colony of *Ae. albopictus* from Bologna (Italy) has been kept at the IPCL. *Ae. albopictus*, a species endemic to Asia and the Pacific Islands, is an proficient invader of new habitats and an important vector of Chikungunya and Dengue. Releases of sterilized *Ae. albopictus* males are already being conducted in pilot projects near Bologna, Italy though more studies pertinent to mass-rearing of the species are still being conducted. One such parameter of mass-rearing studied by the mosquito group was the water depth in which larvae are reared. Four water depths, one, two, three and four centimetres were tested. All other rearing parameters, including larval density, diet concentration and amount of diet remained constant. A six percent solution of the FAO/IAEA-developed diet (tuna meal, beef liver powder and vitamin mix) was used for the experiment. Results indicate that though water depth had no effect on immature stage duration, wing length and sex ratio, survival rates were significantly affected as water depth increases. Nevertheless, at one centimetre depth, survival from hatch to adult stage was 92%, while two, three and four centimetre depths resulted in 72-77% survival.

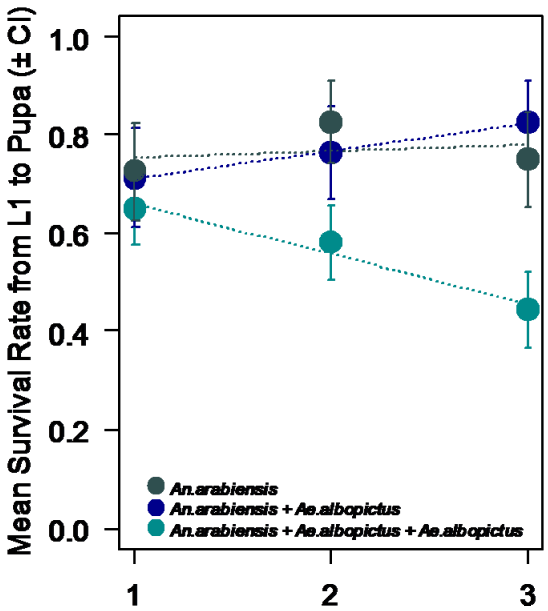


Experimental set-up to study the effect of water depth on Aedes albopictus *larvae*.

Effect of diet concentration on development of *Anopheles arabiensis* when reared in conjunction with *Aedes albopictus*

Experiments on the effect of diet on immature stage development of *An. arabiensis* and *Ae. albopictus* show that each species requires a different feeding regime. *Ae. albopictus*, a container-breeding species, is much more tolerant to a wider range of diet concentrations (between 2 and 8%), whereas *An. arabiensis* is much more sensitive and requires 1-2% of diet concentrations. Because of these differences, the two species are rarely found in the same breeding sites, though in certain environments such as the French island of La Réunion, where both species occur, there could be a potential of interspecies interactions that would allow sequential or simultaneous rearing of both species. Specifically, if larvae of the two species were reared in conjunction, perhaps the presence of the much more tolerant *Ae. albopictus* larvae could sufficiently clean a too-saturated rearing medium enough to allow increased development of *An. arabiensis*.

Using 1, 2 and 3% FAO/IAEA diet, two combined rearing treatments, one with equal initial numbers of both species and a second with additional *Ae. albopictus* added after pupation, were tested. For the heartier *Ae. albopictus*, combined rearing did little to change any of the measured parameters significantly from the control treatment. In contrast, *An. arabiensis* reared in conjunction with *Ae. albopictus* showed a clear increase, not only in survival (see following Figure), but also in wing length as compared to the control. In fact, the only shortcoming noted from combined rearing occurred in competition treatments reared with a 1% diet, where the paucity of available nutrients caused increased larval and pupal development time for *An. arabiensis*.



Survival from L1 to pupal stage (±CI) for An. arabiensis *reared on three diet concentrations (1, 2 and 3%) and under three different treatments with and without* Ae. albopictus.

Reports

Participants of the 8th International Symposium on Fruit Flies of Economic Importance (Valencia, Spain).

8th International Symposium on Fruit Flies of Economic Importance. 26 September - 1 October 2010, Valencia, Spain

The symposium was attended by more than 350 registrants from over 50 different countries. There were 3 plenary presentations, 68 oral presentations and 175 posters given to the symposium. Representatives from 42 countries presented oral talks and posters:

- Americas: 9 countries were represented and 90 presentations
- Europe: 12 countries, 84 presentations
- Africa: 11 countries, 27 presentations
- Asia Pacific: 10 countries, 45 presentations

It was evident from the symposium that fruit flies impact all regions of the world where horticultural production and trade are practiced and that there is much interest in, and research and development on, ways to mitigate the damage caused by fruit flies to production, livelihood, health, the environment and trade.

Presentations, both oral and by poster, concentrated on 23 fruit fly species and 4 pest fruit fly genera. Presentations on specific species dealt with Mediterranean fruit fly, followed by Oriental fruit fly, South American fruit fly, olive fly and melon fly, and others. The fruit fly family Tephritidae, as a whole, was also discussed at length, followed by *Anastrepha* species, *Bactrocera* species and *Rhagoletis* species.

Technical themes concentrated on SIT development and application and area-wide management principles (including integrated pest management and systems approaches), followed by biological control, fruit hosts (including fruit host status), genetics, chemical ecology, taxonomy and others. Apart from a couple of presentations on host status testing and one on quarantine issues in the EU there was very little discussion on postharvest issues with pest fruit flies despite the real evidence that much international and domestic trade in fruit fly host commodities hinges on postharvest treatments.

We would like to thank our Spanish hosts. The event was well organized and resulted in an excellent opportunity for the interchange of ideas among the fruit fly workers. The 9th International Symposium will be organized in Bangkok, Thailand in April 2014.

12th International Workshop of the IOBC Global Working Group on Arthropod Mass Rearing & Quality Control. 19-22 October 2010, Vienna, Austria

The 12th workshop of the IOBC global working group on Arthropod Mass-Rearing & Quality Control (AMRQC) was held in Vienna, Austria from 19 to 22 October 2010, under the theme of '*Blueprint for the future of arthropod rearing and quality assurance*'.

This international workshop was organized as a joint meeting of AMRQC, the Association of Natural Biocontrol Producers (ANBP), the International Biocontrol Manufacturers Association (IBMA), and the ASTM Subcommittee E35.30 on Natural Multi-Cellular Biological Control Organisms in cooperation with the FAO/IAEA. The workshop was co-chaired by AMRQC co-convenors Thomas Coudron (USDA-ARS, USA) and Patrick De Clercq (Ghent University, Belgium) and Andrew Parker (Insect Pest Control Laboratory, FAO/IAEA), who acted as the meeting's host.

Participants of the IOBC Global Working Group on Arthropod Mass-Rearing & Quality Control (Vienna, Austria).

Some 100 delegates from 29 countries participated in the event. The workshop focused on different issues related to the rearing of entomophagous and phytophagous insects and mites and of entomopathogenic nematodes, and gave attention to the principles and practices of quality

assurance. 41 oral presentations and 23 posters addressed the different aspects of arthropod and nematode rearing as it relates to quality assurance. The workshop was organized in seven symposia:

1. The Role of Microbiota in Insect Mass Rearing and Quality Control (chair: Patrick De Clercq, Ghent University, Ghent, Belgium)
2. Entomopathogenic Nematodes: Producing a High Quality, Effective Product for Expanding the Agricultural Market (chair: Lynn LeBeck, ANBP, Clovis, CA, USA)
3. SIT Applications and Other Uses of Irradiation Technology (chair: Andrew Parker, FAO/IAEA, Seibersdorf, Austria)
4. Application of New Technology to Mass Insect Rearing and Quality Control (chair: Tom Coudron, USDA-ARS, Columbia, MO, USA)
5. New, Novel, Innovative and Emerging Applications of Insect Rearing (chair: Karel Bolckmans, Koppert BV, Berkel en Rodenrijs, Netherlands)
6. New and Future Applications for Mass-Rearing Insects and Quality Control (chair: Norman Leppla, University of Florida, Gainesville, FL, USA)
7. Predatory Mites (chair: Kim Gallagher Horton, Sterling Insectary, Delano, CA, USA)

Papers in these symposia served as a basis for discussion and exchange, with the final aim of improving collaboration among scientists, practitioners and regulators. An important take-home message for the meeting was that workers on invertebrate rearing in the field of integrated pest management, biological control or sterile insect techniques can learn from those who are producing invertebrates for very different purposes, like insects reared for human or animal food, as they face similar challenges.

The presentations and posters are available at: http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=38586

Discussions between FAO, IAEA and AU-PATTEC on tsetse fly management. 5–8 October 2010, Addis Ababa, Ethiopia

Two staff members from the FAO Animal Production and Health Division, Rome, and the Joint FAO/IAEA Division, Vienna, Raffaele Mattioli and Udo Feldmann, respectively, paid a visit to the Headquarters of the African Union (AU) Commission in Addis Ababa, 5–8 October 2010, in an effort to further streamline and harmonise the support of the two mandated specialised UN organisations to the AU–Pan African Tsetse and Trypanosomosis Eradication Campaign (AU-PATTEC). During a courtesy visit to Her Excellency Rhoda P. Tumusiime, AU-Commissioner for Rural Economy and Agriculture (see picture), the Commissioner thanked the IAEA for its role in supporting the establishment of PATTEC and acknowledged the assistance of the FAO in its efforts to support the implementation of the PATTEC initiative.

FAO, IAEA and AU-PATTEC experts on tsetse flies meeting with African Union Commissioner for Rural Economy and Agriculture (Addis Ababa, Ethiopia).

With reference to a Memorandum of Understanding in support of PATTEC, signed at the request of the AU Commission with IAEA in November 2009, and respective resolutions both from the FAO Conference and the IAEA General Conference to assist in planning and implementing of projects under the PATTEC initiative, detailed discussions were held on several general areas of collaboration:

a) IAEA was specifically requested to provide support on tsetse SIT as part of an area-wide integrated pest management (AW-IPM) effort, on tsetse mass rearing, on baseline data collection, and on relevant operational research;

b) FAO was requested to support efforts directed at sustainable agriculture and rural development (SARD) as well as aspects relevant to land use and animal health;

c) continued WHO support is needed on intervention against human African trypanosomosis (HAT, i.e. sleeping sickness);

d) cooperation is needed in the development of national legislation and relevant regulatory measures;

e) an effort will be made to enhance joint planning, implementing and monitoring of intervention projects;

f) a major focus of the cooperation will be joint training and capacity development in three main areas: (i) project management; (ii) laboratory and field techniques; (iii) studies and project implementation, including baseline data collection and feasibility confirmation.

The meeting also discussed the need to revise the PATTEC Plan of Action, in an effort to ensure that all availa-

ble tactics for T&T intervention are appropriately considered and made use of as part of an AW-IPM campaign. The meeting agreed to intensify the exchange of relevant information, to organise frequent joint meetings and to support each other in awareness generation and fund raising activities.

Consultants Meeting on the Development of Guidelines for Implementing Systems Approaches for Pest Risk Management of Fruit Flies. 7-11 June 2010, Vienna, Austria

International trade in plant products provides food, consumer goods, and a livelihood to millions of people around the world. However, it can also spread pests into new areas, where serious damage to commercial crops and to the environment may result. Under the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS) of the World Trade Organisation (WTO), essentially all trading countries of the world have agreed to individual country sovereignty in preventing new pests, while allowing free trade to the degree possible within this context.

Systems Approach, as described in the International Standard on Phytosanitary Measures (ISPM) no. 14 developed under the International Plant Protection Convention, provides a flexible method for achieving an importing country's or region's appropriate level of protection against pest risk, while facilitating risk management that is proportional to the estimated pest risk.

The document prepared by the consultants provides a guidance on the fundamental building blocks as well as the more complex concepts and challenging aspects of applying Systems Approaches in the context of fruit fly control. This guidance draws on substantial global experience in evaluation, selection and design of pest risk management options aimed at one or more fruit fly species, specifically the use of a combination of phytosanitary measures integrated into a Systems Approach.

FAO/IAEA Workshop on Genotyping Analysis of Tsetse Fly Symbionts and Pathogens. 20-24 July 2010, Nairobi, Kenya

A workshop on 'Genotyping analysis of tsetse symbionts and pathogens' was organised from 20 to 24 July 2010 and hosted by the International Centre for Insect Physiology and Ecology (ICIPE), Nairobi, Kenya and was attended by twelve participants and three lecturers from nine countries. Several oral presentations were given that provided an overview on general principles of genotyping analysis, the genotyping methods used for insect symbionts *Sodalis*, the Multi Locus Sequence Typing (MLST) method used for *Wolbachia* research and the methods used for virus genotyping.

Several practical sessions were organized on DNA extraction for virus and detection of symbionts and demonstrations were given on extraction of the genomic DNA of tsetse flies using DNeasy kit (Qiagen) followed by PCR to detect various genes from *Sodalis*, *Wolbachia* and the salivary gland hypertrophy virus. Demonstrations on PCR product purification and preparation of the DNA samples for sequence were also given.

Participants of the Workshop on DNA Genotyping Analysis of Tsetse Symbionts and Pathogen (2010 Nairobi, Kenya).

Several online training sessions of the manipulation of sequence data and using the online software to do the genotyping analysis were given.

Meeting of the Technical Panel on Phytosanitary Treatments. 26-30 July 2010, Kyoto, Japan

The Technical Panel on Phytosanitary Treatments (TPPT) for the International Plant Protection Convention (IPPC) meets about once a year to a) review contributions from signatories for new internationally recommended phytosanitary post harvest treatments; b) to draft responses to those submissions (approving the submission to be forwarded to the Standards Committee (SC) and then to the Commission on Phytosanitary Measures (CPM) or a request for more technical supporting information; and c) to discuss calls for new phytosanitary treatments. This year, the TPPT met in Kyoto, Japan. The meeting was attended by 11 TPPT members, two representatives from the host nation and two representatives from the IPPC Secretariat. The 11 TPPT members are experts in various fields of research, development and application of post-harvest phytosanitary treatments. They came from Argentina, Austria, China, Japan, Jordan, the Republic of Korea, New Zealand, South Africa, the UK and the USA.

All three activities mentioned above were carried out following presentation and review of in excess of 105 items including papers, submissions and recommendations. The

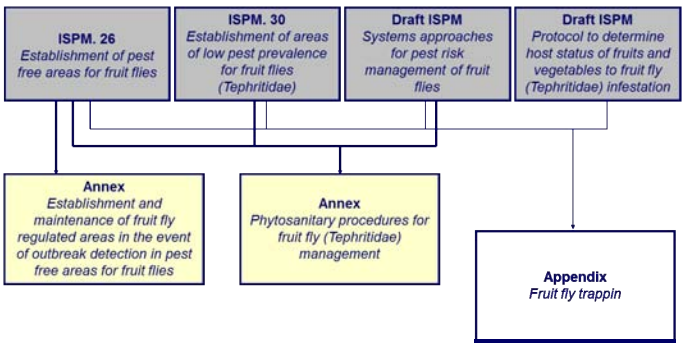
items dealt with international phytosanitary treatments ranging from wooden packaging materials (e.g. crates and pallets) to fresh fruits, vegetables, cut flowers and planting material. Treatments reviewed included fumigation of wooden material with methyl iodide, phosphine and sulfuryl fluoride; microwave irradiation of wooden material; cold and heat (including vapour heat and hot water) treatment of fresh horticultural commodities and irradiation.

Of interest / relevance to the FAO/IAEA were discussions and resolutions on submissions dealing with irradiation. Supporting documents were put forward in 2007, by the USDA for 'Generic irradiation treatments for all insects (Arthropoda: Insecta) except lepidopteran pupae and adults (Insecta: Lepidoptera) in any host commodity'. At the 2007 meeting of the TPPT, a request for more information was drafted and subsequently sent to the USDA. These extra data were received by the IPPC Secretariat prior to the 2009 meeting of the TPPT for discussion at the 2010 TPPT meeting.

Meeting of the Technical Panel on Pest Free Areas and Systems Approaches for Fruit Flies. 4-8 October 2010, Vienna, Austria

The Technical Panel on Pest Free Areas and Systems Approaches for Fruit Flies (TPFF) of the International Plant Protection Convention (IPPC) convened in Vienna from 4 to 8 October 2010 with the objective of drafting a ISPM on 'Protocol to Determine Host Status of Fruits and Vegetables to Fruit Fly (Tephritidae) Infestation'.

The TPFF was established in 2004 by the International Plant Protection Convention (IPPC) to review scientific and technical data and to draft International Standards for Phytosanitary Measures (ISPM) in support of international agricultural trade through the establishment of pest free areas and systems approaches for fruit flies.



Proposed organization of the fruit fly International Standards for Phytosanitary Measures (ISPMs)

Previously, the panel had developed the already adopted ISPMs Nos. 26 (*Establishment of pest free areas for fruit flies*) and 30 (*Establishment of areas of low pest prevalence for fruit flies (Tephritidae)*). In addition the panel has developed a draft ISPM on *Systems Approaches for Pest Risk Management of Fruit Flies*, a draft appendix to ISPM No. 26 on *Fruit Fly Trapping*, a draft ISPM *on Phytosanitary Procedures for Fruit Fly (Tephritidae) Management*, and now the draft *Protocol to Determine Host Status of Fruits to Fruit Fly (Tephritidae) Infestation.*

Inception Workshop on Area-wide Integrated Pest Management of Fruit Flies in South and Southeast Asian Countries. 1-3 September 2010, Bangkok, Thailand

The Asian Institute of Technology (AIT), in collaboration with the Bio-Control Research Laboratory (BCRL), Bangalore, India, the FAO Regional IPM Programme in Asia and associated National IPM Programmes in Cambodia, Lao PDR, Myanmar, Thailand and Vietnam, has been awarded a regional Mekong river basin project *'Area-wide Fruit Fly Integrated Pest Management in South and Southeast Asia'* supported by the Global Horticulture Initiative (GHI). The project is intended to test, and promote among smallholder farmers a range of novel IPM options for fruit fly management within the context of on-going IPM farmer training and action research programmes in the Mekong basin countries (Cambodia, Lao PDR, Myanmar, Thailand and Vietnam).

As a starting point of this project an inception workshop was organized with a total of 35 participants from all the 5 counterparts and various resource persons from the University of Hawaii, FAO/IAEA, CABI and an FAO International Consultant formerly associated with ACIAR supported fruit fly IPM work.

Participants of the Inception Workshop on Area-wide Fruit Fly Integrated Pest Management in South and Southeast Asia (Bangkok, Thailand).

The overall objectives were:

- To share highlights of accomplishments and challenges of previous and on-going research and development projects related to fruit fly management in the implementing countries and in the region

- To share experiences of innovative and latest management options for clean and safe fruit fly management and its adoption at farmers' level
- To share the country strategy highlighting area, season, crop, fruit fly species, plans for action research and other trainings as per the agreed project work plans along with monitoring and evaluation plans and budget requirements
- To strengthen regional networking on matters concerning Fruit Fly IPM research and development, as well as farmer/community education among nationals and partner.

For more information, please visit the FAO Regional Vegetable IPM Programme in Asia webpage at http://www.vegetableipmasia.org/News.html

Consultants Meeting to Update International FAO/IAEA/USDA Manual on Product Quality Control and Shipping Procedures for Sterile Mass-Reared Tephritid Fruit Flies. 18-22 October 2010, Vienna, Austria

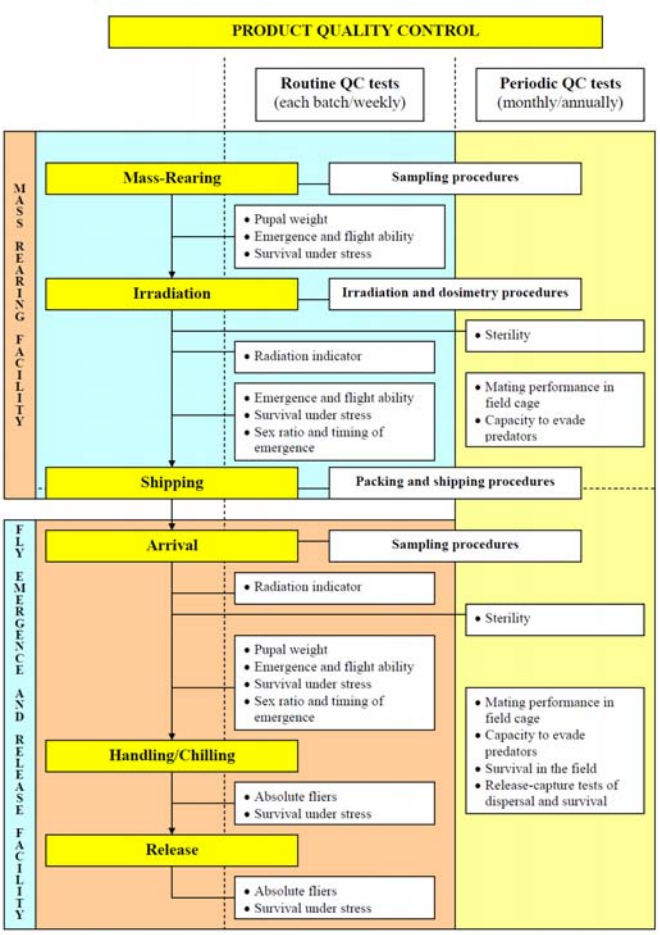
Since 1997, the FAO/IAEA/USDA manual on 'Product Quality Control and Shipping Procedures for Sterile Mass-Reared Tephritid Fruit Flies' has provided and continues to provide an objective set of standards for assessing quality of sterile fruit flies used in sterile insect technique (SIT) programmes. The manual addresses an essential need of those working in fruit fly control programmes to measure insect performance in concert with other operational activities. Use of insects demonstrating good quality equates to successful pest control. Conversely, use of poor quality insects leads to a lack of effective control and higher programme costs.

The procedures set forth in this manual are based on published scientific findings for the most part. In the absence of peer-reviewed findings, expert opinion and consensus reached through open dialog also plays a role determining the recommended practices cited. This is particularly important where transboundary shipment and release of sterile insects occurs. It also bolsters confidence in the production and use of sterile insects especially where private sector investment in mass-rearing facilities and fly production and release is involved.

This manual is a living document and has been subject to periodical updates; the most recent version (2003) is available at: http://www-naweb.iaea.org/nafa/ipc/public/ipc-mass-reared-tephritid.html.

The new version of the document being developed is based on a global compilation of comments and suggestions received from action programmes. It represents the recommendations, reached by consensus of an international group of quality control experts, on the standard procedures for product quality control for sterile mass-reared and released tephritid flies that are to be used both at the mass-rearing facilities and fly emergence and release facilities.

A new addition in this updated version is a flow chart showing the sequence of routine and periodic quality control tests to be carried out at the mass-rearing and fly emergence and release facilities (see below). Furthermore, this international manual describes recommended procedures for sampling, irradiation, dosimetry packaging and shipping.

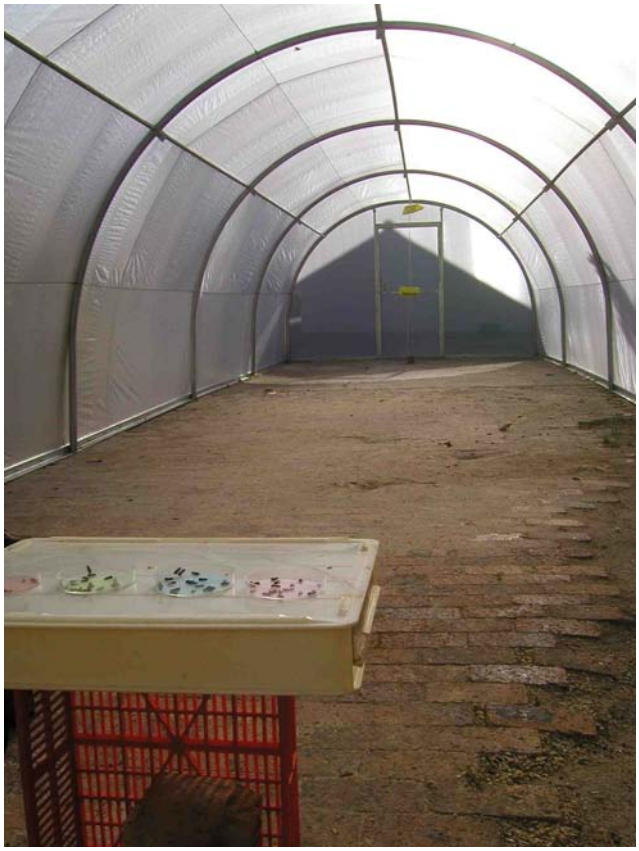


Proposed flow chart of the updated FAO/IAEA/USDA Quality Control Manual.

FAO/IAEA Workshop on Evaluation of Field Cages for Lepidoptera SIT Behavioural Assessments. 21-22 November 2010, Stellenbosch, South Africa

The University of Stellenbosch, South Africa hosted a workshop (21-22 November 2010) where various methods and tools to assess quality of Lepidoptera were demonstrated and discussed. These included:

- automatic counting of eggs on eggs sheets in a rearing facility using custom designed software
- automatic counting and identification of insects trapped on sticky sheets of traps using custom designed software



Large wind tunnel to assess flight performance of radiation treated codling moths (top). Workshop participants viewing the release of sterile codling moths in an apple orchard (bottom).

- the use of smart traps as a cost effective means of monitoring control and sterile moth release programmes
- video and software to analyse flight patterns of moths in a wind tunnel as a potential quality management tool
- the use of a large outdoor wind tunnel/field cage to study the behaviour of released sterile moths.

Sessions were in addition organised on the labelling of insects for stable isotope analyses and on dissection methods for detection of spermatophores and sperm content in the spermathecae.

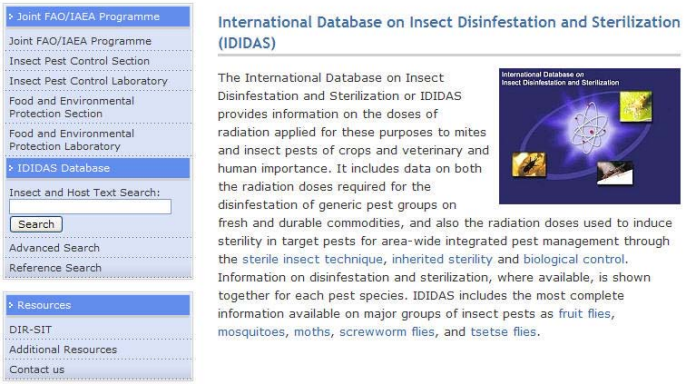
In addition, Tom Blomefield of ARC, in collaboration with Jim Carpenter of USDA, had set up an experiment to assess simultaneously quality of sterile codling moth using five different methods, i.e. flight tubes in the laboratory, small mating cages in the laboratory, standard field cages, large outdoor wind tunnel, and a field release in an orchard. Radiation dose (0 Gy, 150 Gy, 300 Gy and 450 Gy) was the parameter assessed as this is known to be a quality-reducing factor. The experiment was run for the entire RCM and workshop period. The preliminary data showed that the field cage and the flight tubes gave results which were very similar to the data from the field release-recapture study. The data from the small mating cages in the laboratory were completely aberrant in comparison to the field data, skewing results in favour of the sterile moths. The recaptures in the large outdoor wind tunnel were too small to make any sound conclusions.

Announcements

The International Database on Insect Disinfestation and Sterilization (IDIDAS) and the World-Wide Directory of SIT Facilities (DIR-SIT)

The International Database on Insect Disinfestation and Sterilization (IDIDAS) provides information on the doses of radiation used in the control of pest insects and mites of agricultural, commercial, health or quarantine significance. Recently, IDIDAS was upgraded in order to improve its presentation and user-friendliness. IDIDAS continues to provide searchable bibliographic references on species and doses, but also related resources classified into categories: food irradiation, e-learning, glossaries, technical information, and tools.

For more information, please visit IDIDAS at: http://ididas.iaea.org/.



New IDIDAS home page with simple and easy left hand navigation panel.

The World-Wide Directory of SIT Facilities (DIR-SIT) provides information on facilities mass-rearing insects to be used for the sterile insect technique. DIR-SIT (http://dirsit.iaea.org/) describes the species and the strains mass-reared, the production levels capacity and the current production levels. In addition, details of irradiation parameters are provided.

DIR-SIT home page showing simple left hand navigation panel. Clicking on «List all DIR-SIT Facilities» retrives a list of 36 mass-rearing facilities worldwide.

DIR-SIT was recently upgraded with its own domain, and to improve the presentation and user-friendliness. Furthermore, in the past, DIR-SIT data were supposed to be updated by the facilities' designated focal point and the access to pages' editing was via a username and a password. From now on, data will be updated by the Insect Pest Control Section (IPC) based on the information you provide for your facilities. Therefore, the facility directors are encouraged to take a look at the information in their DIR-SIT record and send us an update through an email to abdeljelil_bakri@yahoo.com.

If you want your facility to be listed on DIR-SIT, we would be very happy to hear from you.

Publication of Chinese Translation of FAO/IAEA Textbook on the Sterile Insect Technique

The book 'Sterile Insect Technique, Principles and practice in area-wide integrated pest management' provides a wealth of information and reference materials on this topic never before available in one volume. It has become a standard reference on this effective and environment-friendly pest control method.

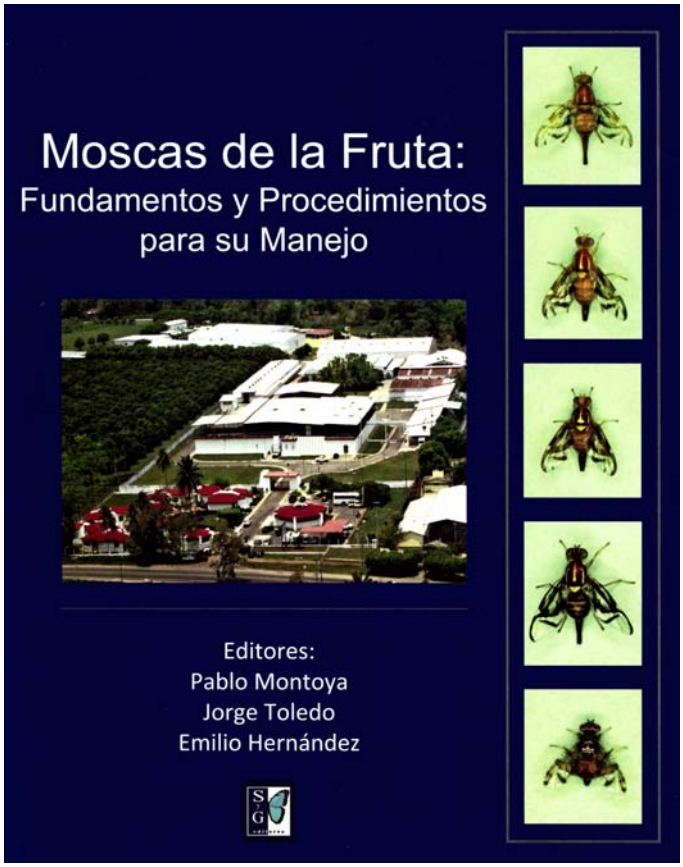
The publication of the new translated version was carried out with the Chinese Academy of Agricultural Sciences and co-funded by the Government of China. The book encompasses ca. 800 pages and the 28 chapters were written by 50 authors from 19 countries, highly experienced in the subject, reviewing all aspects of the Sterile Insect Technique. In addition to the book's original text, the Chinese translation includes an SIT glossary of ca. 150 pages, which gives an extra bonus to Chinese readers. The book covers a wide variety of topics written from a generic perspective: History and principles of the SIT, Technical components of the SIT, Supportive technologies to improve the SIT, Economic, environmental and management considerations, Application of the SIT, Impact of area-wide integrated pest management programmes that integrate the SIT, and Future development of the SIT.

The Chinese version is being distributed freely to the relevant research institutes, national and local libraries, agricultural universities, and other public institutions throughout China. The English original version was published by Springer in 2005.

The English version of the glossary is available online (available at: http://www-naweb.iaea.org/nafa/ipc/public/sterile-insect-technique-glossary-jun10.pdf

Moscas de la Fruta: Fundamentos y Procedimientos para su Manejo (Fruit Flies: Basics and Procedures for their Management)

This book is a product of 20 editions of the 'International Course on Fruit Flies' that has been organized since 1986 at the Moscamed and Moscafrut facilities in Metapa, Chiapas, Mexico, by the National Programme against Fruit Flies under the direction of the Mexican National Plant Protection Organization.



Its content is a fine-tuned version of the proceedings issued in every course and which serves as a guideline to the course participants. It represents the topics covered by the course, from the management principles of an area-wide integrated fruit fly management programme, through the use of the Sterile Insect Technique, to augmentative biological control applications, and ending with a section addressing relevant scientific and technological advances in this field.

This book, will not only be part of future training courses for the Latin American region, but also can be acquired by those which do not have the opportunity to assist to the course, and it also can be used as a reference text on the subject. This book reflects the technologies used by the Mexican government and the fruit producers to maintain Mexico as a fresh fruit and vegetable exporting country.

USDA Website Dedicated to E. F. Knipling

In January 2010, the USDA National Agricultural Library established a website dedicated to Edward Fred Knipling and the screwworm eradication program at: http://tinyurl.com/efknipling.

This site lists the papers donated by the Knipling family that now are on file at the National Agricultural Library. The collection is 59 linear feet and occupies 91 archival boxes. A list of the contents of the collection are available for downloading. It also provides an extended biography and the history of sterile insect technique.

Source: USDA

Other News

Defining Environment Risk Assessment Criteria for Genetically Modified Insects to be Placed on the EU Market

Global efforts towards the development of genetically modified (GM) arthropods have progressed to a stage where some might possibly be placed on the EU market within the next decade. Risk assessment issues, therefore, need to be addressed, and adequate and comprehensive risk assessment guidelines need to be developed. This report first describes the on-going developments in the field of GM-arthropods (transformed species, development purposes, and construction of GM-arthropods), and subsequently identifies potential adverse effects as well as methods to investigate these. Crucial arthropod characteristics and necessary baseline information are discussed, and the surrogate and modelling approach evaluated for their usefulness regarding the environmental risk assessment (ERA) of GM-arthropods. Expertise needed is presented in terms of scientific disciplines, expertise fields, research institutes and individual experts.

It is concluded that the ERA of GM-arthropods should consider various issues regarding the genetic modification, the respective species and the receiving environment. Potential risks could be identified concerning gene flow and its consequences, effects on target and non-target organisms, management practices and measures, biogeochemical processes and human health. Since potential risks depend on the method used for modification, the purpose of the GM-arthropod and the species itself, it is recommended to follow a case-by-case approach for the ERA of GM-arthropods

The EFSA report can be found at: www.efsa.europa.eu/en/scdocs/scdoc/71e.htm).

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Source: efsa.europa.eu (15 September 2010)

Israeli Oranges Have a New Ally against Pests

Citrus farmers in the Besor region of the Western Negev are going green. A special project launched jointly by the Agriculture Ministry, the Citrus Growers Association and the pest control company Bio-Fly is encouraging more and more farmers in the area to stop using chemical pest control substances in favour of an environmentally friendly method known as Sterile Insect Technique.

According to the company's website, the method is based on the ‘mass release of sterile insects of the target species, which compete with wild males for the wild females prevalent in the field. Due to the quantitative advantage of the sterile males, a large percentage of the females mate with them, producing eggs that are infertile, leading to a gradual reduction in the pest population."

The method is now employed on over 10,000 dunams in the area, a number expected to double next year.

"We grow the flies in the Bio-Fly factory until the pupa phase, then sterilize them and place them in a special container we set up in Kibbutz Gvulot, in the Eshkol area," said project director Gal Yaakobi. "There we pack the flies into packages, and special teams with the company spread them around nearby orchards."

"Green pest control - that's how it's described by local farmers - has several advantages. Consumers receive cleaner, fresher fruit and growers are spared having to perform arduous labour," Yaakobi said.

Yaakobi added that this pest-control technique is no more expensive than traditional chemical methods.

Gal Yaakobi showing the ground release of sterile flies. The method is used on over 10,000 dunams (Photo by: Eliyahu Hershkovitz).

"The farmer pays about the same for Sterile Insect Technique as for chemical methods, thanks to subsidies from the Agriculture Ministry," he explained to Haaretz. "With time, this technique will succeed and the price will fall significantly, and then the subsidies can be abolished."

Yaakobi said area farmers have set a precedent for growers nationwide. "Farmers in the Besor region are leading this process of change in growing culture, in terms of product quality as well as its marketing and branding. It's clear to all of us that this is the future of agriculture in this country - both green and economically viable," he said.

Source: Haaretz.com (23 November 2010)

South Africa Discovers Fruit Fly Specimens of 'Serious Concern'

South Africa, the world's second- biggest citrus-fruit exporter, said it has discovered specimens of a fruit fly species that has spread across the continent over the last seven years.

Fruit fly specimens caught in traps on May 5 in the northern Limpopo Province near the country's border with Zimbabwe were later identified as *Bactrocera invadens*, a fruit fly strain that first appeared in Africa in Kenya in 2003, the Department of Agriculture, Forestry and Fisheries said in an e-mailed statement today.

The strain is "a quarantine pest of serious concern to the southern African region," the department said. Movement of fruit from the area has been controlled and "eradication procedures" are being be carried out.

The insect, also known as the invader fruit fly, originaes from Sri Lanka and has spread south from Kenya, with specimens found in Namibia, Zambia and Mozambique in 2008. The flies are more vigorous than similar species and can damage a wide range of fruit.

The insects, which can travel as much as 100 kilometres (62 miles) over their three-month lives, lay eggs inside fruits and the resulting larvae destroy it. South Africa started a fruit fly surveillance program for early detection in January 2006. In addition to citrus, South Africa produces apples, plums and grapes.

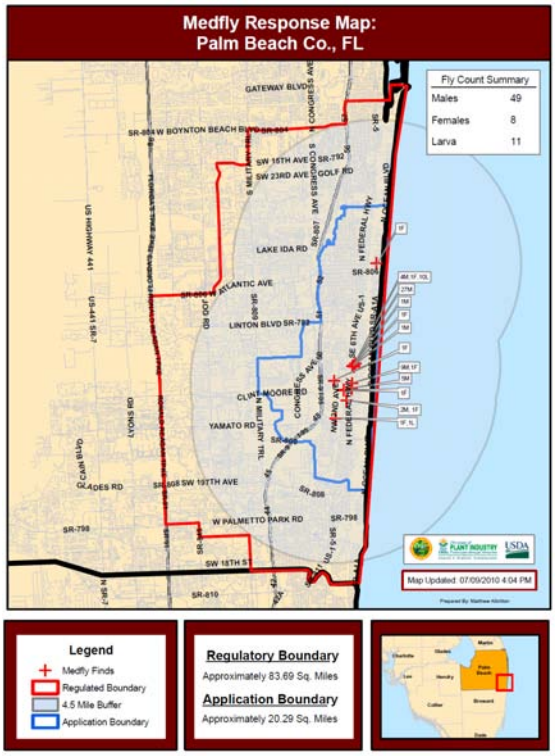
Source: businessweek.com (6 September 2010)

Successful Mediterranean Fruit Fly Eradication Programme in Florida

In Palm Beach County, Florida, two separate Jackson traps baited with Trimedlure were found to have detected 5 Mediterranean fruit flies each on 2 June 2010. One trap was in a loquat tree and captured 5 males; the second trap was in a mango tree a few blocks away and captured 4 males and 1 female. None of the flies was marked with the fluorescent dye that is used to mark the millions of sterile flies released weekly in neighbouring Broward Co, as part of a preventive release programme. None of the males showed signs of irradiation, and the female was observed to be gravid. Thus, it became apparent that an active Mediterranean fruit fly infestation was underway, the first detected in Florida since 1998.

After the major Mediterranean fruit fly outbreak of 1997 and 1998, preventive release of sterile Mediterranean fruit fly was established on a permanent, year-round basis in large parts of the Miami to Ft. Lauderdale and Tampa to Sarasota areas with the result that only two single-fly Mediterranean fruit fly detections were made in Florida in the intervening period. Additionally, over 55 000 detection traps are maintained on a year-round basis throughout Florida.

A high-density delimitation trapping network was quickly implemented in an area of approximately 45 square miles of Palm Beach Co. around the initial detection sites. Two sites with larvae-infested fruits were found within the core colonization area of about 2 square miles. On 23 June, a single female fly was detected in Delray Beach, about 3 miles from the original core area. This discovery enlarged the total survey and regulated area to about 85 square miles.



Eradication was achieved by multiple approaches. Foliar bait sprays containing the toxicant spinosad were applied on more than 32 000 properties. Over 76 000 pounds of fruit were stripped in the vicinity of adult detection sites to remove any larva-infested fruit that may have been present. Sterile male medflies were released on a regular basis in huge numbers beginning on June 22, and totalling approximately 290 million by the end of August. Finally, a quarantine area of approximately 85 square miles was established to regulate the movement of plant material and prevent potentially infested fruit from leaving the area. High density survey trapping continued throughout the program to monitor the effectiveness of eradication efforts. At its peak, approximately 204 personnel from the Florida Department of Agriculture & Consumer Services and the USDA were involved in the eradication effort. There were a total of 49 males, 8 females, and 11 larvae detected at 12 different sites during the course of the survey program, and the last detection occurred on 3 July. The presumption is that a population has been eradicated when a time equal to an estimated three full life cycles passes without a further detection. That was achieved on 29 August. Therefore, an official declaration of eradication was made on 1 September 2010. The total program cost was an estimated US$4.3 million.

Source: Gary Steck, Division of Plant Industry, Gainesville, Florida.

Interesting Published Articles

Suppressing resistance to *Bt* cotton with sterile insect releases

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Abstract

Genetically engineered crops that produce insecticidal toxins from *Bacillus thuringiensis* (*Bt*) are grown widely for pest control. However, insect adaptation can reduce the toxins' efficacy. The predominant strategy for delaying pest resistance to *Bt* crops requires refuges of non-*Bt* host plants to provide susceptible insects to mate with resistant insects. Variable farmer compliance is one of the limitations of this approach. Here we report the benefits of an alternative strategy where sterile insects are released to mate with resistant insects and refuges are scarce or absent. Computer simulations show that this approach works in principle against pests with recessive or dominant inheritance of resistance. During a large-scale, four-year field deployment of this strategy in Arizona, resistance of pink bollworm (*Pectinophora gossypiella*) to *Bt* cotton did not increase. A multitactic eradication program that included the release of sterile moths reduced pink bollworm abundance by >99%, while eliminating insecticide sprays against this key invasive pest.

The full paper was published online in: Nature Biotechnology *(7 November 2010) doi:10.1038/nbt.1704*

For more information and discussion of the article, please visit Nature Online, doi:10.1038/news.2010.585 (7 November 2010).

Prolonged colonisation, irradiation, and transportation do not impede mating vigour and competitiveness of male *Anopheles arabiensis* mosquitoes under semi-field conditions in Northern Sudan

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Abstract

Background. In Sudan, the Sterile Insect Technique (SIT) is being developed to suppress populations of *Anopheles arabiensis*. The present study was carried out to evaluate the impact of long-term colonisation, irradiation, and transportation on male vigour and mating competitiveness under controlled semi-field conditions.

Materials and Methods. Male mosquitoes were irradiated in Khartoum as pupae and transported 400 km to the field site in Dongola. Wild males and females were collected as immature stages (larvae and pupae) from the field site and sexed immediately after adult emergence. Competition experiments were carried out to test the mating competitiveness and vigour of colonised males (non-irradiated or irradiated) against wild conspecifics in the semi-field system.

Results. Mortality resulting from packaging and transportation from Khartoum to Dongola was low for adults (1.1% for irradiated and 1.3% for non-irradiated males). In contrast, all irradiated pupae died on their way to the field site. On average, 54.9% females were inseminated after one night. There were no differences between the number of females inseminated by colony males and those inseminated by wild males. Only a slightly significant difference between the numbers of females inseminated by irradiated males (14.0±1.7) or by wild males (19.7±1.7) was observed. However, the competitive index (CI) for irradiated and colony males when competed with wild males were 0.71 and 0.81 respectively.

Conclusions. Packing and transportation methods for pupae need to be improved. Prolonged colonisation (68 generations), irradiation and transportation of adult males did not affect their ability to locate virgin females and compete against wild conspecifics. Irradiation, in contrast to many reports, only had a marginal effect on released males during the first night after their release. These findings support the feasibility of staging an SIT campaign against this malaria vector.

The full paper was published in: Malaria World Journal 1:2.

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