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Nuclear Techniques in Food and Agriculture

Insect Pest Control Newsletter

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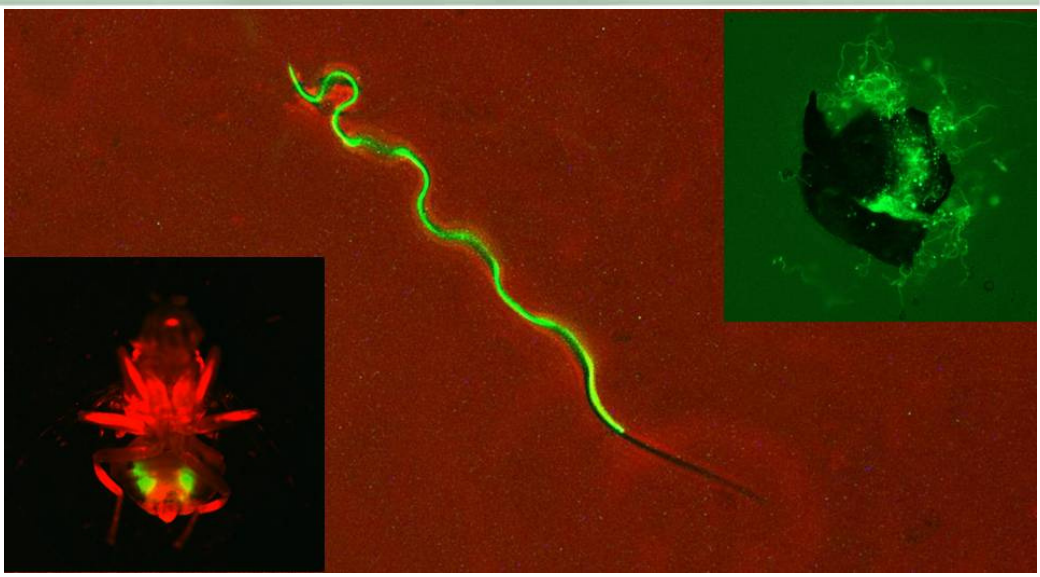

Transgenic Mediterranean fruit fly strain labelled with 2 different fluorescent markers: a body marker, polyubiquitin promoter-DsRed (body-lower left) and a sperm marker, β2 Tubulin promoter-turboGFP (testes area-lower left, dissected testes-upper right, and isolated sperm-centre) (photos by F. Scolari and M. Schetelig)

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IAEA International Atomic Energy Agency

To Our Readers

I would like to thank all our collaborators in many parts of the world, as well as our staff and colleagues in Vienna and Seibersdorf for a fruitful year 2009. Besides our participation and support to many events and interesting research, field, and knowledge management activities, the Insect Pest Control Subprogramme has been involved in a number of external reviews and is undergoing change as part of a major reform process at FAO and also important restructurings and new leadership at IAEA.

It is now 45 years ago that FAO and IAEA joined forces in a partnership through a Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, the oldest example of institutionalized interagency cooperation in the United Nations system. The Joint Division has been developing and is building on the synergies that exist between the mandates of FAO, as the lead agency in food security, agriculture and rural development, and the IAEA, as the global forum for scientific and technical cooperation in the peaceful uses of atomic energy. Nevertheless, during the past two years, as a result of the above reform process, the Joint FAO/IAEA Division has been subject to a period of much uncertainty about the future of this partnership.

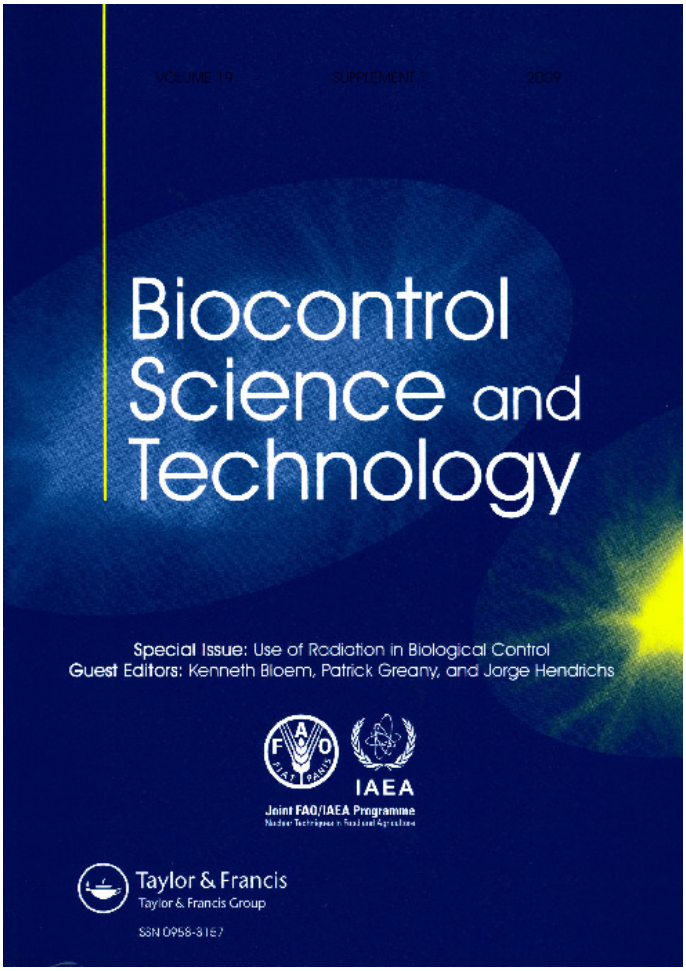
I am now very pleased to be able to inform that following an exchange of formal notes between the senior management of FAO and IAEA in mid 2009, the Arrangements between the Directors General of FAO and IAEA for the Joint FAO/IAEA Division on Nuclear Techniques in Food and Agriculture remain in force. This is a confirmation of the strong support that has been received from Member States of both FAO and IAEA during the last two years requesting the continuation of the successful partnership between both organizations.

Member States guiding the reform process at FAO had already endorsed the inclusion of the Joint Division in the Immediate Plan of Action for the reform of FAO, in its new medium-term plan, in the organizational structure of the Agriculture Department of FAO, and recently also in the budget for the 2010-2011 biennium. All this has now been endorsed by the final deliberations of the FAO Conference in November 2009. As a result of this very positive development, and taking into account the recommendations of the external reviews that are still ongoing, we are hopeful that soon we can focus again on strengthening our support to Member States in the field of food and agriculture.

Changing the subject, mid-2010 is the deadline to submit concept notes for technical cooperation (TC) projects for the financial cycle 2012-2013. With few exceptions, these are normally confined to insect sterilization as part of the area-wide integrated application of the sterile insect technique (SIT) and related genetic control methods. The application of radiation to increase the cost-effectiveness, trade and safety of inoculative and inundative releases of parasitoids and predators in support of the biological control of insect pests is an area that has been underrepresented in the past. There is, however, great potential in this area, not only for research, but also for applied use of natural enemies in many situations. All these applications are presented in a 362 pp. special issue of the journal Biocontrol Science and Technology containing 25 articles on The Use of Radiation in Biological Control that are the result of a Coordinated Research Project with 18 research teams from 15 countries. We therefore encourage submissions of TC concept notes in this new exciting area (http://www.informaworld.com/openurl?genre=issue&issn=09583157&volume=19&supp=1&uno_jumtype=alert&uno_alerttype=new_issue_alert,email).

As stated by the Editor-in-Chief of the journal Biocontrol Science and Technology in the Editorial of the issue: "When I was first contacted regarding this proposed publication, my initial reaction was that there would not be enough information for a whole issue, as at that time my knowledge on use of radiation in biological control was limited. However, I was very naive as in this Special Issue are presented numerous innovative ways to apply radiation technology to biological control. I hope that this issue enlightens you as much as it did me. Radiation does have a role in biological control in more ways than one! I know of no similar compilation of research on use of nuclear techniques in support of biological control and it should help prompt researchers to consider using radiation in the future."

The numerous innovative ways to apply radiation technology to biological control he refers to, and that are described in the special issue, range from expanding the period of host suitability for parasitoids, increasing shelf life, studying host-parasitoid physiological interactions, stimulating reproduction, reducing the cost and logistics of holding and separating of parasitoids and non-parasitized pest adults before being able to ship to customers, eliminating the risk of shipping fertile non-indigenous hosts/prey, supplementing hosts in the field for survival or early build-up of biological control agents, and reproductively inactivating hosts as sentinels in the field, to screening classical biological control agents for host-specificity without risk under field conditions.



Supplement to Biocontrol Science and Technology with the proceedings of the CRP on Use of Irradiation on Biological Control.

In respect to encouraging biological control of pest insects and promoting the role radiation applications can play in support of biological control, we will be hosting from 19-22 October 2010 in Vienna the 12th Workshop of the International Organization of Biological Control's Global Working Group on Arthropod Mass Rearing and Quality Control (see details of the meeting under http://www.iobc-wprs.org/events/20101019_First_Announcement.pdf), to be held in collaboration with the Association of Natural Bio-control Producers (ANBP), the American Society for Testing and Materials (ASTM) Subcommittee on Natural Multi-Cellular Biological Control Organisms, and the International Biocontrol Manufacturers Association (IBMA), Invertebrate Biocontrols Group. For more information please contact Andrew Parker (A.Parker@iaea,org) who is our focal point for this event.

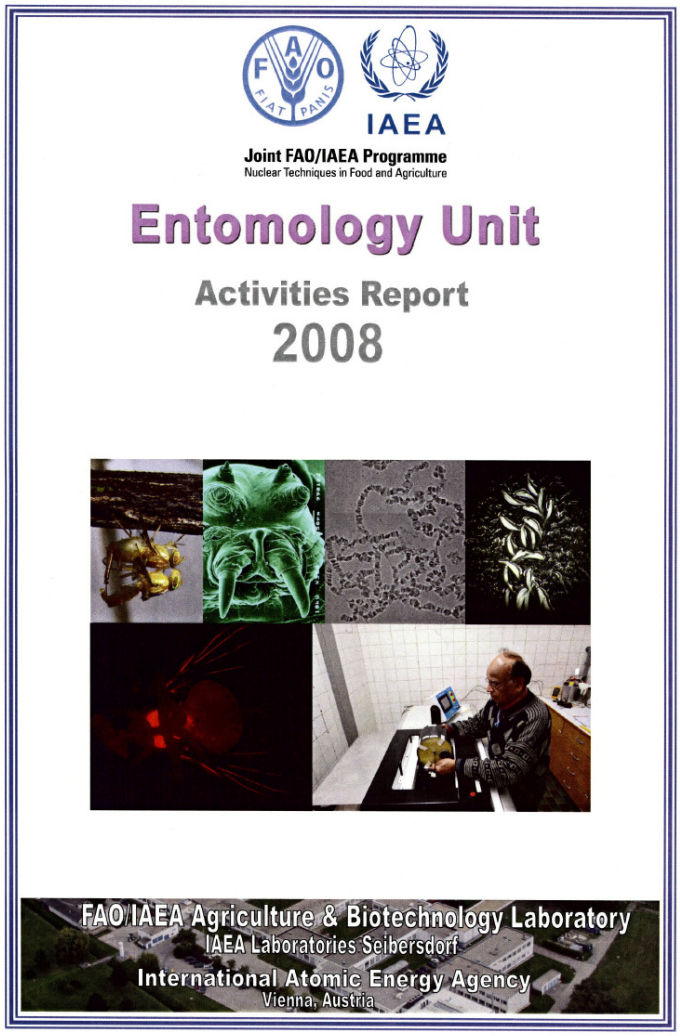
This international workshop will focus on the principles and practices of quality assurance and all issues related to

moving from small scale to industrial production of high-quality entomophagous and phytophagous insects, mites and nematodes for biological control, SIT, research and other current and future applications. Whilst rearing natural enemies and sterile insects each has its own peculiarities, there are many issues in common, particularly in the field of formalizing and standardizing quality control protocols. We hope that the meeting, for which we expect over 100 participants, will lead to enhanced interaction between the leaders in natural enemy rearing and the rearing for SIT applications. It also affords the opportunity to present to the biological control community some of the above described uses of nuclear techniques in relation to natural enemy rearing and deployment.

In late 2009 we concluded two six-year Coordinated Research Projects (CRPs). The first one entitled Improving Sterile Male Performance in Fruit Fly Sterile Insect Technique (SIT) Programmes involved researchers and managers from most fruit fly SIT programmes in the world who focused their research for the first time on the post-factory factors that could maximize the effectiveness of the mass produced and sterilized insects. This CRP was extremely productive, demonstrating in many fruit fly pest species that the provision of or exposure of maturing sterile adults to hormone, nutritional / microbiological and/or semiochemical supplements significantly accelerates male sexual maturation, increases pheromone release and mating performance, reduces wild female remating, etc. The validation of these findings on a large scale for several pest fruit flies, as well as improved fly emergence, holding and release procedures, and the compilation of all this knowledge into a manual, has benefited operational fruit fly SIT programmes. The proceedings of this CRP are being prepared as a special issue of the Journal of Applied Entomology.

The CRP on Development of Mass Rearing for New World (*Anastrepha*) and Asian (*Bactrocera*) Fruit Fly Pests in Support of SIT was likewise finalised. Twenty one scientists from 15 countries participated in this CRP, whose overall objective was to develop and improve rearing technologies for fruit fly species of economic importance for SIT application. This CRP focused on 21 tephritid fruit fly species and included species where knowledge on rearing and colonization was limited, requiring increased efforts in basic research in these areas, as well as species already used in ongoing SIT programmes but where there was a clear need to improve mass rearing protocols and control processes. The proceedings of this CRP will be prepared as a special issue of the International Journal of Tropical Insect Science.

Here I would like to call your attention to a new CRP on Resolution of Cryptic Species Complexes of Tephritid Pests to Overcome Constraints to SIT Application and International Trade that will start in mid-2010, and for which we are encouraging the submission of relevant research contract and agreement proposals. The objective for the CRP is to provide a clear description of biological characteristics of some major pest species complexes with taxonomic uncertainty and the development of diagnostic tools for each, resulting in facilitation of world trade and an enhancement of area-wide integrated pest management programmes that include SIT application (see description under Announcements).



In closing I would like to remind our readers that each year we issue an extensive annual Activities Report on the methods development and other activities carried out at our laboratory at the Seibersdorf Agriculture and Biotechnology Laboratory. You can find the 2008 report (see picture) on our website together with reports of all previous years as of 1996 (http://www-naweb.iaea.org/nafa/ipc/public/newsletters-ipc.html). Please be aware that these reports are not formally published and should therefore not be cited in publications. We value the comments we receive from our readers and look forward to your inputs, particularly in view that we are currently starting to plan the programme of activities and budget for the cycle 2012-2013.

As 2009 draws to a close, I would like to send you our season's greetings on behalf of all of us at headquarters and the laboratory. We look forward to a productive year and wish you a very successful 2010.

Jorge Hendrichs
Head,
Insect Pest Control Section
December 2009

Insect Pest Control Subprogramme

http://www-naweb.iaea.org/nafa/ipc/index.html
http://www.fao.org/ag/portal/age-index.html

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Forthcoming Events

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 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, Valencia, Spain.

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 the 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 the TC Project RAF5060). 1-19 February 2010, Bobo-Dioulasso, Burkina Faso.

FAO/IAEA National Coordinators Meeting / Workshop on Area-Wide Management of Fruit Fly Pests, (under the TC Project RAS5052). 6-10 February 2010, Muscat, Oman.

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 the TC Project RAF5059). 15 February - 5 March 2010, Maputo, Mozambique.

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.

FAO/IAEA National Coordinators Meeting / Workshop on Standardised Entomological Monitoring of Old World Screwworm (OWS) Flies (*Chrysomya bezziana*), (under the TC Project RAS5054). 14-17 March 2010, Muscat, Oman.

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

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

FAO/IAEA Workshop on Fruit Flies of Quarantine Importance for Latin America and the Caribbean Basin (under the TC Project RLA5057). May 2010, Panama City, Panama.

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

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

12th Workshop of the IOBC Global Working Group on Arthropod Mass Rearing & Quality Control (AMRQC). 19-22 October 2010, Vienna, Austria. (http://users.ugent.be/~padclerc/AMRQC/announcements.htm)

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

Past Events (2009)

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

Second RCM of CRP on Improving SIT for Tsetse Flies Through Research on their Symbionts and Pathogens. 16-20 February 2009, Bobo Dioulasso, Burkina Faso.

First RCM of CRP on Increasing the Efficiency of Lepidoptera SIT Through Enhanced Quality Control. 27 April-1 May 2009, Christchurch, New Zealand.

Final RCM of CRP on Improving Sterile Male Performance in Fruit Fly Sterile Insect Technique (SIT) Programmes. 21-25 September 2009, Pereybere, Mauritius.

Final RCM of CRP on Development of Mass Rearing for New World (*Anastrepha*) and Asian (*Bactrocera*) Fruit Fly Pests in Support of Sterile Insect Technique (SIT). 21-25 September 2009, Pereybere, Mauritius.

Third RCM of CRP on Development of Standardized Mass Rearing Systems for Male *Anopheles arabiensis* Mosquitoes. 21-25 September 2009, Bologna, Italy.

First RCM of CRP on Development of Generic Irradiation Doses for Quarantine Treatments. 5-9 October 2009, Vienna, Austria.

First RCM of CRP on Development and Evaluation of Improved Strains of Insect Pests for SIT. 16-20 November 2009, Vienna, Austria.

II. Consultants and Expert Meetings

Workshop on Suppressing the Mediterranean Fruit Fly by Integrating the Sterile Insect Technique on an Area-Wide Basis in Neretva Valley (Croatia and Bosnia and Herzegovina). 13-15 January 2009, Metković, Croatia.

Technical Panel on Phytosanitary Treatments under the International Plant Protection Convention, FAO. 26-30 January 2009, Tokyo, Japan.

Consultants Meeting to Develop a Design Concept for a Tsetse Fly Aerial Release System. 3-5 February 2009, Vienna, Austria.

Workshop on DNA Isolation and Detection of Tsetse Pathogens and Symbionts Using PCR. 9-13 February 2009, Bobo Dioulasso, Burkina Faso.

Workshop on Assessment of the Feasibility of SIT-Based Area-Wide Integrated Management of Old World Screwworm Flies in the Middle East. 17-19 March 2009, Vienna, Austria.

Planning Meeting for Coordination of Activities of IRD, CRVOI and the FAO/AIEA in Relationship to Feasibility of Mosquito Sterile Insect Technique for La Réunion. 22-24 March 2009, Vienna, Austria.

Consultants Meeting on Development of a Standard Planning and Design Format for New SIT Mass-Rearing Facilities. 20-24 April 2009, Vienna, Austria.

Consultants Meeting on Improved Understanding of *Bactrocera* and *Anastrepha* Pests Species Complexes for Enhanced SIT Application to Facilitate International Trade. 6-10 July 2009, Vienna, Austria.

Technical Panel on Pest Free Areas and Systems Approaches for Fruit Flies under the International Plant Protection Convention, FAO. 31 August-4 September 2009, Vienna, Austria.

III. Other Meetings/Events

PATTEC/FAO/IAEA Tsetse Management Training Course. 23 February–13 March 2009, Mansini, Swaziland.

Eleventh Pacific Science Intercongress. Pacific Countries and their Ocean: Facing Local and Global Changes. 2-6 March 2009, Tahiti, French Polynesia.

Fourth Session of the Commission on Phytosanitary Measures, International Plant Protection Convention, FAO. 30 March-3 April 2009, Rome, Italy.

Standards Committee Meeting, International Plant Protection Convention, FAO. 4-8 May 2009, Rome, Italy.

FAO/IAEA Meeting of Programme Against African Trypanosomiasis (PAAT) Programme Committee Meeting. 7-8 May 2009, Smolenice, Slovakia.

Fourth Meeting of the IOBC, Working Group on Integrated Plant Protection in Olive Crops. 1-4 June 2009, Córdoba, Spain.

UN Workshop on Science and Food Security, 2 July 2009, Geneva, Switzerland.

Workshop to Develop a Detailed Action Plan for the Collection of Entomological Baseline Data for Tsetse Management in Southern Mozambique (under TC Project RAF5059), 20-31 July 2009, Maputo, Mozambique.

FAO/IAEA Meeting of Asia Regional Project Coordinators on Assessing Feasibility for Area-Wide SIT-Based Control of the Mediterranean Fruit Fly in the Middle East, 4-6 August 2009, Vienna, Austria.

42nd Annual Meeting of the Society for Invertebrate Pathology. 16-20 August 2009, Salt Lake City, Utah, USA

XIX Curso Internacional Sobre Moscas de la Fruta. 17-28 August 2009, Metapa de Dominguez, Chiapas, Mexico.

First National Coordinators Meeting of TC project RLA5057 “Establishing and Maintaining Fruit Fly Free and Low Prevalence Areas in Central America, Panama and Belize, Using the Sterile Insect Technique (SIT)”. 18–21 August 2009, Guatemala City, Guatemala.

30th Meeting of International Scientific Council for Trypanosomiasis Research and Control (ISCTRC). 21-25 September 2009, Kampala, Uganda.

FAO/IAEA Regional Indian Ocean Fruit Fly Meeting. 21-25 September 2009, Pereybere, Mauritius.

5th Training Course on Fruit Flies, 21-29 October 2009, Juazeiro (Bahia) and Petrolina (Pernambuco), Brazil.

Symposium: The Sterile Insect Technique, an Environment-Friendly Control Tactic for Preventing the Establishment of Invasive Pest Insects at International Congress on Biological Invasions. 2-6 November 2009, Fuzhou, China (www.icbi2009.org).

FAO/IAEA Regional Training Course on Area-wide Integrated Pest Management of Tephritid Fruit Flies (under the TC Project RAS5052). 2-6 November 2009, Fuzhou, China.

Meeting of Programme Against African Trypanosomiasis (PAAT) Advisory Group Coordinators. 1-3 December 2009, Mombasa, Kenya.

Symposium: The Sterile Insect Technique: Achievements and Challenges for Area-Wide Integrated Pest Management at Annual Meeting of the Entomological Society of America. 13-16 December 2009, Indianapolis, Indiana, USA (www.entsoc.org/am/index.htm).

Coordinators Meeting / Workshop on Standardised Collection, Processing and Differential Diagnosis of Old World Screwworm (OWS) Fly (*Chrysomya bezziana*) Larvae (under the TC Project RAS5054). 13-16 December 2009, Muscat, Oman,

Note: Reports available upon request

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

Project Number	Country	Title Continuing Projects	Technical Officer
BKF/5/004	Burkina Faso	Feasibility Study on Applying the Sterile Insect Technique to Create a Tsetse-Free Zone	Andrew Parker
BOT/5/004	Botswana	Establishment of a Capacity for Integrating the Sterile Insect Technique into the National Tsetse and Trypanosomosis Control Programme	Udo Feldmann
BRA/5/057	Brazil	Establishment of Medfly, Fruit Fly Parasitoids and Codling Moth Rearing Facility	Rui Cardoso Pereira
BZE/5/002	Belize	Establishment of a Pilot Fruit Fly Free Area Using an Integrated Approach that Includes the Area-Wide Sterile Insect Technique	Jesús Reyes
CRO/5/002	Croatia	Feasibility Study for the Suppression of the Mediterranean Fruit Fly by Integrating the Sterile Insect Technique on an Area-Wide Basis in the Neretva Valley	Rui Cardoso Pereira
GUA/5/016	Guatemala	Establishment of Fruit Fly Free or Low Prevalence Areas using the Sterile Insect Technique	Jesús Reyes
INT/5/145	Interregional	Promotion of Insect Pest Control Using the Sterile Insect Technique	Jorge Hendrichs
ISR/5/012	Israel	Feasibility Study to Assess the Integration of the Sterile Insect Technique into Olive Fly Suppression Programmes	Andrew Jessup
JOR/5/010	Jordan	Strengthening the Capacity for the Area-wide Suppression of the Mediterranean Fruit Fly Using the Sterile Insect Technique	Jesús Reyes
KEN/5/022	Kenya	Integrated Area-wide Tsetse and Trypanosomosis Management in Lambwe Valley	Udo Feldmann
MAL/5/020	Mali	Feasibility Study for the Creation of a Zone Free of Tsetse	Udo Feldmann
MAR/5/016	Mauritius	Feasibility Study for the Suppression of the Melon Fly (*Bactrocera cucurbitae*) in Selected Areas of Mauritius	Jorge Hendrichs
MEX/5/029	Mexico	National Prevention Campaign Against the Cactus Moth	Rui Cardoso Pereira
MYA/5/014	Myanmar	Support for a Feasibility Study on Using the Sterile Insect Technique against Diamond Back Moth	Jesús Reyes
PAK/5/043	Pakistan	Development of Biological Control for Cotton Pest Management Using Nuclear Techniques	Jorge Hendrichs
PAN/5/016	Panama	Capacity Building for Suppression of Fruit Flies of the Genus	Jesús Reyes

		Anastrepha from the Azuero Peninsula using an Area-Wide Pest Management Approach	
RAF/5/052	Regional Africa	SIT Development for Control of *Anopheles* Mosquito	Marc Vreysen
SAF/5/007	South Africa	Expanding the Use of the Sterile Insect Technique Against Fruit Pests in the Western and Northern Cape	Jorge Hendrichs
SEN/5/029	Senegal	Feasibility Study to Create a Tsetse-Free Zone Using the Sterile Insect Technique	Marc Vreysen
SEY/5/003	Seychelles	Feasibility of Integrating the Sterile Insect Technique to the On-going Area-Wide Melon Fly Eradication Programme	Rui Cardoso Pereira
TUN/5/025	Tunisia	Use of Inherited Sterility as a Genetic Control Method Against the Carob Moth	Marc Vreysen
UGA/5/027	Uganda	Feasibility for a *Glossina fuscipes* Free Zone in the Lake Victoria Basin	Jesús Reyes
URT/5/022	United Republic of Tanzania	Assistance to a Feasibility Study for the Use of the Sterile Insect Technique	Udo Feldmann
YEM/5/009	Yemen	Emergency Assistance for Monitoring and Control of Old World Screwworm Flies in Yemen	Udo Feldmann
ZIM/5/012	Zimbabwe	Feasibility Study on the Use of SIT to Eradicate Tsetse in Zimbabwe	Udo Feldmann
		Projects that Started in 2009	
AFG5004	Afghanistan	Enhancing Crop Productivity Through Mutation Breeding and Pest Control	Rui Cardoso Pereira
CHD5002	Chad	Assessing the Feasibility of Using Sterile Insect Technique Components to Create a Tsetse-Free Zone in the Mandoul Region	Udo Feldmann
ETH5015	Ethiopia	Creating a Tsetse-Free Zone in the Southern Rift Valley	Udo Feldmann
ISR5015	Israel	Strengthening the Capacity to Use the Sterile Insect Technique for the Olive Fruit Fly	Andrew Jessup
MAG5017	Madagascar	Developing Strategies for Integrated Management of Fruit Flies Based on the Sterile Insect Technique (SIT)	Rui Cardoso Pereira
MOR5031	Morocco	Controlling the Mediterranean Fruit Fly Using the Sterile Insect Technique and Other Conventional Methods	Jesús Reyes
PAN5018	Panama	Maintaining and Operating a Medfly-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
RAF5059	Regional Africa	Supporting the Creation of a Tsetse-Free Zone in Southern Mozambique and North-East South Africa	Marc Vreysen Rui Cardoso Pereira
RAF5060	Regional	Supporting the Use of the Sterile Insect Technique for Area-	Udo Feldmann

	Africa	Wide Tsetse and Trypanosomosis Management (Phase II)	
RAS5051	Regional Asia	Developing Integrated Control of the Olive Fruit Fly	Andrew Jessup
RAS5052	Regional Asia	Sharing Regional Knowledge on the Use of the Sterile Insect Technique within Integrated Area-Wide Fruit Fly Pest Management Programmes	Rui Cardoso Pereira
RAS5053	Regional Asia	Assessing Feasibility for Area-Wide SIT-Based Control of the Mediterranean Fruit Fly in the Middle East	Jesús Reyes
RAS5054	Regional Asia	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
RER5014	Regional Europe	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
RLA5057	Regional Latin America	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
SAF5011	South Africa	Refining an Integrated Application of SIT Against Some Key Lepidopteran Pests of Southern African Agricultural Crops	Jorge Hendrichs
SEN5031	Senegal	Implementing the Pre-Operational Phase to Create a Zone Free of *Glossina palpalis gambiensis* Using the Sterile Insect Technique (SIT)	Marc Vreysen
SUD5032	Sudan	Investigating the Use of the Sterile Insect Technique for Controlling Mosquitoes in Northern Sudan	Jeremie Gilles
TUN5026	Tunisia	Assessing the Use of Inherited Sterility as a Genetic Control Method against the Carob Moth	Marc Vreysen
UGA5031	Uganda	Assessing the Feasibility of Establishing a Tsetse Free Zone in Lake Victoria Basin	Jesús Reyes

Highlights for Technical Cooperation Projects

Developing Strategies for Integrated Management of Fruit Flies Based on the Sterile Insect Technique (SIT) (MAG5017)

This project in Madagascar is focusing on 3 main activities: (1) studying of the distribution, importance and hosts of the existing fruit fly species (Diptera: Tephritidae) in Madagascar; (2) strengthening the official quarantine activities, including inspection and early detection of potential invasive fruit flies; (3) conducting a suppression programme in two pilot areas, one for vegetables in Ivato (20 km north of Antananarivo) and another for fruits in Ambohijafy (15 km west of Antananarivo).

According to the data so far collected, 13 species of fruit flies exist in Madagascar: 8 species belong to the genus *Ceratitis* (*C. capitata, C. malgassa, C. manjakatompo, C. tananarivana, C. andronotobaka, C. giffardi, C. cosyra*, and *C. pedrestris*), 4 to the genus *Dacus* (*D. demmerezi, D. bivittatus, D. punctatifrons* and *D. melanaspis*) and 1 to the genus *Neoceratitis* (*N. cyanescens*). Among these species the more important fruit pest species are *C. malgassa, C. manjakatompo,* and *C. cosyra,* and for vegetables the more important pest species (of Cucurbitae) is *D. demmerezi.*

Aspect of the citrus production area at Ambohijafy

The work being done so far has focused on the collection of some baseline data, training of project staff and selection of the pilot areas. Two years of trapping data from the citrus production pilot area (Ambohijafy) were already collected and can serve to define the management strategies in this specific area.

Knowledge of the fruit fly species present, their distribution and the infested hosts (and their relative importance) represent key aspects for designing any suppression activity against fruit fly pests. Developing the knowledge of these aspects is also part of capacity building and will improve the chances of success of the project.

Quarantine measures with the objective of preventing the introduction of new fruit fly species should be improved (no *Bactrocera* pest has so far reached Madagascar), and surveillance systems at the ports of entry (ports and airports) need to be established to allow the implementation of early warning systems.

Finally, suppression techniques against fruit flies that infest fruits and vegetables should be tested in the two pilot areas. This will serve for hands-on training of the project staff and farmers, and will allow extending the activities in the future to other areas.

Feasibility Study for the Suppression of the Melon Fly (*Bactrocera cucurbitae*) in Selected Areas of Mauritius (MAR5016)

The melon fly, *Bactrocera cucurbitae* (Coquillett), is the most important insect pest of cucurbit crops in Mauritius (Mascarenes island in the Indian Ocean) causing heavy damage. To control this pest, planters have recourse to regular conventional insecticide cover sprays with all their disadvantages. Besides, this practice adds up to their cost of production.

A project entitled Feasibility Study for the Suppression of the Melon Fly in Selected Areas of Mauritius – MAR 5/016 was launched in June 2007. The main objectives of the project are to produce quality cucurbits through effective environment-friendly suppression methods and to minimise the use of pesticides for melon fly management. An isolated area of 110 ha occupied by some 135 cucurbit growers was selected. The growers were sensitised on the project through meetings, pamphlets, stickers and video film. As an incentive to participate fully, they were all given knapsack sprayers, plastic bags and fruit disposal cages, protein bait and MAT blocks. The growers were introduced to the techniques used in area-wide melon fly suppression. Gradually they started to adopt the recommended methods, which include targeted bait applications, male annihilation technique and sanitation.

The FAO/IAEA has provided technical expertise for the implementation of the project and has also contributed financially. Besides expert support, largely from Hawaii, officers have received fellowships on fruit fly rearing, IPM and extension.

Monitoring of fruit flies in the pilot area is carried out with 125 dry traps baited with Cuelure and Malathion, 20 wet traps baited with laboratory modified waste brewer's yeast and fruit collection and incubation in the laboratory.

To evaluate the progress of the project, a survey was carried out and the following results were obtained:

- The melon fly is the most serious pest of cucurbits in the locality.

- More than 97% of the growers adopted the use of protein baits and MAT blocks.
- Above 60% practised good sanitation, i.e. proper disposal of infested fruits.
- A decrease in the frequency of pesticide application was noted. 25% of the planters were treating their crops with pesticides thrice a week before the project was started compared to 5% one year after the project was implemented.
- A decrease in pesticide use was noted. 45% of the planters used to apply pesticides twice a week compared to only 25% one year later.
- An increase in cucurbit production was noted. 85% of planters claimed to have obtained an increase in both quality and quantity of cucurbits.
- 60% of cucurbit growers noticed an increase in their profit.
- Above 97% of the growers were satisfied with the project and claimed that the melon fly project was beneficial to them.

Gradually, planters are adopting an integrated approach for melon fly control. Cucurbit infestation by the melon fly has been reduced to 5% already one year after project implementation was initiated. Growers are producing quality cucurbits by adopting environment-friendly methods of melon fly control. The cost of cucurbit production has been reduced through a decrease in use of pesticides as well as application costs. The project has demonstrated the use of an integrated approach to reduce insecticide use, and to produce better quality fruits.

Maize plants as trap crop for the melon fly in a plantation of squash at Plaine Sophie

Side by side, research is being carried out in the laboratory in order to improve mass rearing the melon fly. Moreover, a genetic sexing strain based on the Mauritian melon fly is under development at the Entomology Unit in Seibersdorf, using a Hawaiian white pupae strain. Eventually, the sterile insect technique will be integrated for sustainable melon fly suppression.

Given the positive results, growers from other areas in Mauritius have shown interest in participating in the project. The Mauritian Government is keen to support the extension of the programme in other cucurbit growing localities.

Contributed by P. Sookar

National Coordinators Meeting, of the project on Establishing and Maintaining Fruit Fly Free and Low Prevalence Areas in Central America, Panama and Belize, Using the Sterile Insect Technique (SIT) (RLA5057)

The purpose of this meeting held in Guatemala City, Guatemala, August 18 – 21, 2009 was: (1) to interchange information on the fruit fly status in each of the countries in the region, (2) to coordinate with actions carried out in the region by other international organizations regarding the control of fruit flies, (3) to develop a working plan for implementing the project in each of the participating countries and (4) to visit the new USDA mass rearing facility in Guatemala to produce Mexican fruit fly and West Indian fruit fly species. The meeting was attended by 14 people. Ten of them were the project counterparts representing Belize, Bolivia, Costa Rica, Dominican Republic, El Salvador, Guatemala, Haiti, Honduras, Nicaragua, and Panama. In addition three people represented the Regional Plant Protection Organization for Central America (OIRSA) and the FAO/IAEA the Project Technical Officer.

Group photo of the National Coordinators Meeting held in Guatemala city, Guatemala

Developing Integrated Control of the Olive Fruit Fly (RAS5051)

The First Co-ordination Meeting on Technical Co-operation Project RAS5051 was held in conjunction with the 4th European Meeting of the IOBC/WPRS Working Group on Integrated Protection of Olive Crops in Córdoba, Spain (1-4 June 2009).

During the IOBC/WPRS meeting presentations on olive fly were divided into 8 main issues: Trapping and monitoring (9 presentations), Ecology (7), Parasitoids (6), General biological control (5), Sterile insect technique (3), Economics (2), Pesticide resistance (2) and Genetics (1).

The First Co-ordination Meeting on Technical Co-operation Project RAS5015 was attended by 11 people representing Israel, Jordan, Turkey, Cyprus, Greece and the UK. Each attendant supplied a short abstract of their involvement with olive fly control in their respective regions and presented a talk during the meeting. There was much discussion on future research and development requirements for olive fly management and how it should be supported under TC Project RAS5051. Participants also attended sections of the IOBC/WPRS Meeting related to olive fly management.

Regional workers on olive fly in both Europe and Asia are now aware of what each other is involved in with respect to olive fly research and control in their country. Also some preliminary discussion on the TC Project RAS5051 was held to work out details for a major meeting on this project where local technicians and workers plus the country counterparts, scientists and consultants can get together for detailed planning. It was decided to hold this meeting in Jordan during 2010.

National Coordinators Meeting, of the Project on Assessing Feasibility for Area-Wide SIT-Based Control of the Mediterranean Fruit fly in the Middle East (RAS5053)

The purpose of this meeting held in Vienna, Austria, August 4 - 6, 2009 was: (1) to interchange information on the fruit fly status among Israel, Jordan and the Territories under the Jurisdiction of the Palestinian Authority (TUJPA), (2) to review outstanding activities carried out in the Region through the projects ISR5011 Strengthening the Capacity for the Area-wide Control of the Mediterranean Fruit Fly Using the Sterile Insect Technique, JOR5010 Strengthening the Capacity for Area-wide Suppression of the Mediterranean Fruit Fly Using the Sterile Insect Technique, and PAL5003 Strengthening the National Capacity for the Area-wide Suppression of the Mediterranean Fruit Fly, (3) to develop a working plan for implementing the project in each of the participating countries, and (4) to visit the Entomology Unit of the FAO/IAEA Agriculture and Biotechnology Laboratory at Seibersdorf, Austria. The meeting was attended by 9 people, 3 participants from Israel, 3 participants from Jordan and for the IAEA the Programme Manager Officer, the Insect Pest Control Head, and the Technical Officer.

Due to the fact that TUJPA counterparts were not able to attend the meeting, the National Plant Protection Organization (NPPO) of Israel hosted a special follow-up meeting in the Biofly facilities (Sde Eliyahu, Israel, see aerial picture) on October 24, 2009, where the TUJPA and Israeli counterparts discussed the implementation of the delivery and release of sterile flies funded under PAL5003 and defined the practical steps to implement project RAS5053 in the Tubas area in the north of the West Bank, contiguous to planned release areas in Israel and Jordan.

Biobee facilities, including Biofly building with capacity to produce sterile Mediterranean fruit flies for the region

Implementing the Pre-Operational Phase to Create a Zone Free of *Glossina palpalis gambiensis* using the Sterile Insect Technique (SIT) (SEN5031)

As reported in NL 71, the Government of Senegal has embarked on a project to eradicate the tsetse fly *Glossina palpalis gambiensis* from the Niayes and La Petite Côte in Western Senegal. This initiative was supported by TC project SEN5029 (Feasibility Study to Create a Tsetse Free Zone using the Sterile Insect Technique) from 2005 to 2008. As a result of the good progress made, the project moved into the next phase (TC project SEN5031 Implementing the Pre-Operational Phase to Create a Zone Free of *Glossina palpalis gambiensis* Using the Sterile Insect Technique (SIT)).

In 2008, entomological base line data were collected throughout the areas that allowed defining accurately the current distribution of the fly. Suitable habitat is extremely fragmented and *G. p. gambiensis* has apparently adapted very well to the harsh ecological conditions of the Niayes. The data collected has indicated high population densities in certain areas. In view of the small size and the high number of suitable habitat patches, the release of sterile males seems to be indicated, as it will be nearly impossible to treat all the suitable habitat areas with traps or targets. The high population density areas will need to be suppressed using a combination of traps and targets, insecticide pour ons on livestock and insecticide foot baths.

First wild flies collected from the target area in Senegal and maintained at the newly established insectary at ISRA, Dakar

The following steps have been undertaken to prepare for the phase of sterile male releases. An insectary has been established at the ISRA (Institut Sénégalais de Recherche Agricole) in Dakar which has a double purpose. First, wild flies from the Niayes are being collected and maintained in the insectary. Offspring of these flies are being sent to the Entomology Unit in Seibersdorf for the establishment of a local *G. p. gambiensis* strain. Secondly, the insectary will serve as a dispersal centre for the release of sterile male flies. The sterile flies will be received as pupae, sterilised at their place of origin (CIRDES, Bobo Dioulasso, Burkina Faso) and transported as pupae by air to Dakar. The sterile male flies will emerge from the pupae in the insectary, fed several times on a blood source, before being released in the target areas. The local strain of *G. p. gambiensis* will serve as a back up in case the flies which originate from Burkina Faso will not perform as desired in the harsh environment of the Niayes.

In early October 2009, the first wild flies were collected in the Parc de Hann and in Pout and a first batch of produced pupae were hand carried to the laboratory in Seibersdorf. The establishment of a colony from the Niayes has therefore been initiated.

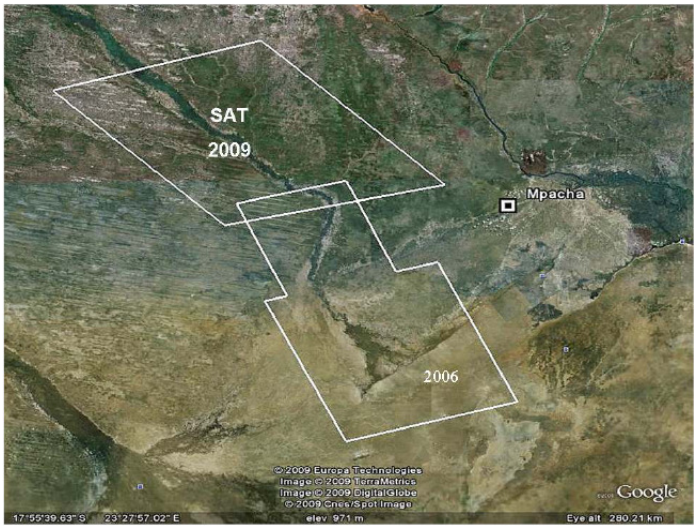
Preparations are ongoing for the trial releases of sterile males. The aim of the trial releases is to assess the efficiency of the used handling and transport methods, the behaviour of the sterile males after release in the field, their survival, dispersal, dispersion capacity and their sexual competitiveness.

Establishment of a National Capacity in the National Tsetse and Trypanosomosis Control Programme (BOT5004)

Over the past 10 years Botswana increased its efforts to establish and expand zones that are free of the tsetse fly species *Glossina morsitans centralis* and the disease it transmits (trypanosomosis). It has been a well-planned initiative, involving all relevant stakeholders. A range of tsetse control tactics were considered for application in an area-wide integrated pest management (AW-IPM) campaign. Field activities in the tsetse-infested Okavango delta, Ngamiland, Botswana, started in 2001-2002 with a two-phase Sequential Aerosol Technique (SAT, repeated (3–5×) aerial spraying of ultra-low volume formulations of non-persisting insecticides) campaign. In case the SAT campaign would not lead to the sustained removal of *G. m. centralis*, the national strategy of Botswana foresaw pursuing the tsetse elimination efforts by introducing the SIT.

The campaign in Botswana received IAEA support under two TC projects, namely '*Support of Tsetse Eradication from Ngamiland*' (BOT5002) and '*Integrating the Sterile Insect Technique into the National Tsetse and Trypanosomosis Control Programme*' (BOT5004). Relevant Agency assistance focused on components in support of establishing a national tsetse SIT capacity and on support to standardised entomological monitoring in intervention areas to assess the probability of the tsetse and trypanosomosis (T&T) problem being eliminated.

In 2006 SAT operations were undertaken in the Kwando/Linyanti areas of northern Botswana and, facilitated by AU-PATTEC, were extended into adjacent tsetse infested areas in Namibia. In 2009, under AU-PATTEC coordination, the sub-regional tsetse elimination effort was expanded into south-eastern Angola and south-western Zambia by treating a total of 10 000 km² tsetse infested area in the two countries with the SAT.



Regional aerial spraying programme to eliminate tsetse flies from southern Angola and Zambia 2009 (Source: P. Kgori)

A review of the entomological field monitoring data from the standardised tsetse surveys in the Okavango delta and the Kwando/Linyanti areas and their analysis suggest a high probability of *G. m. centralis* being eliminated from these areas. As the *G. m. centralis* elimination operations have meanwhile been shifted to areas in southern Angola and Zambia, the risk of active reinvasion of *G. m. centralis* appears substantially reduced. However, the risk of passive reintroduction of *G. m. centralis*, for example by tourist aircraft landing on air strips in the Okavango delta, and through north to south road transport of goods, particularly from Zambia to Botswana, requires continued attention.

The SAT-based AW-IPM efforts need to be pursued throughout the entire remaining *G. m. centralis* infested areas of south-eastern Angola and south-western Zambia. To plan and implement these activities in a thorough manner and to minimise the risk of leaving small habitat pockets of the target tsetse species untreated, it appears advisable to make use of new habitat-classified satellite imagery.

The interaction between Botswana and FAO/IAEA, through two IAEA technical cooperation projects, helped generating sound expertise in standardised entomological monitoring and in geographic information system (GIS) management, as needed for planning and implementing AW-IPM campaigns and entomological surveys. In addition, training and equipment were provided for laboratory rearing of *G. m. centralis*, which is an important component for establishing a national or sub-regional tsetse SIT capacity. The existence of such special expertise in Botswana represents a valuable resource for fostering relevant capacity building efforts in other T&T affected FAO and IAEA Member States.

Sharing Regional Knowledge on the Use of the Sterile Insect Technique within Integrated Area-Wide Fruit Fly Pest Management Programmes (RAS5052)

The Regional Training Course (RTC) on Area-wide Integrated Pest Management of Tephritid Fruit Flies was held in Fuzhou (Fujian, China) from 2 to 6 of November 2009 with the participation of 21 students from 12 Countries (Bangladesh, Indonesia, Israel, Jordan, Malaysia, Myanmar, Pakistan, Sri Lanka Thailand, Vietnam, Yemen and China) of the Asia and Pacific Region. The RTC was successfully conducted, contributing to the capacity building on fruit fly management of the participants from this region.

The training course consisted of lectures and laboratory and field visits, addressing the following aspects: (1) Fruit fly classification and identification; (2) Fruit fly biology, ecology and behaviour; (3) Monitoring systems (traps, density, attractants); (4) Concept of AW-IPM; SIT, and MAT; (5) Other suppression techniques; (6) Integration of suppression techniques in an AW-IPM approach; (7) Visit to the Oriental fruit fly rearing facility and parasitoid rearing facility recently inaugurated at Fujian Agriculture and Forestry University (Fuzhou); (8) Field visit to the ongoing field activities under the pilot Oriental fruit fly suppression programme with an SIT component; (9) Exercise in groups where the participants were asked to plan an area-wide integrated fruit fly management programme. Additionally, the participants attended the Symposium on The Sterile Insect Technique, an Environment-friendly Control Tactic for Preventing the Establishment of Invasive Pest Insects, organized by the FAO/IAEA, as part of the International Congress on Biological Invasions.

Group photo of participants of the Regional Training Course held in Fuzhou, Fujian, China

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

Project Number	Ongoing CRPs	Scientific Secretary
D4.10.20	Improving Sterile Male Performance in Fruit Fly SIT programmes (2004-2009)	Jorge Hendrichs
D4.10.21	Development of Mass Rearing for New World (*Anastrepha*) and Asian (*Bactrocera*) Fruit Flies (2004-2009)	Andrew Jessup
G3.40.01	Development of Standardised Mass Rearing Systems for Male Mosquitoes (2005-2011)	Fabrizio Balestrino
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
	New CRP to Start in 2010	
D4.20.23	Resolution of Cryptic Species Complexes of Tephritid Pests to Overcome Constraints to SIT Application and International Trade (2010-2015)	Andrew Jessup

The Final Research Coordination Meeting of the CRP on *Development of Mass Rearing for New World (*Anastrepha*) and Asian (*Bactrocera*) Fruit Flies*, 21-25 September 2009, Pereybere, Mauritius

The meeting was formally opened by the Honourable S. V. Faugoo, the Minister of Agro Industry, Food Production and Security from the Mauritian Government, who also welcomed the participants. In his remarks he praised the initiatives of the FAO/IAEA in setting up networks, and implementing and guiding research and development in controlling pest fruit fly species of economic importance in collaboration with many Member States.

Twenty one RCM participants presented research relevant to the CRP on mass rearing *Anastrepha* and *Bactrocera* species. Presentations covered R&D on 17 species of pest fruit fly. During the second half of the meeting discussions were held to summarize project achievements by each scientist against R&D objectives set up during the first RCM and reviewed during the second and third RCMs and carried out during the 5 year CRP.

The CRP had the following main achievements and impact:

1. Demonstrated potential of rearing and mass producing newly emerging pestiferous fruit flies not previously studied;
2. Established the basis for improving mass rearing of pest fruit flies having basic unsolved problems and upgraded the knowledge and methodologies for ongoing mass-reared fruit flies;
3. Gained relevant knowledge and know-how on behaviour and ecology of poorly known pestiferous fruit flies;

Group photo of the participants of the CRPs held in Pereybere, Mauritius

4. Initiated transfer of technology to the private sector for mass production
5. Enhanced worldwide networking and collaboration among and between researchers in fruit fly mass rearing.
6. Increased awareness of the growers and policy makers of the benefits of the SIT.

It is planned to publish the proceedings of the CRP as a Special Issue of the International Journal of Tropical Insect Science.

The Final Research Coordination Meeting of the CRP on *Improving Sterile Male Performance in Fruit Fly SIT Programmes*, 21-25 September 2009, Pereybere, Mauritius

Twenty nine participants presented research relevant to the CRP on *Improving Sterile Male Performance in Fruit Fly SIT Programmes*.

The overall objective of this CRP was to ultimately reduce the cost and increase the effectiveness of SIT programmes by improving the performance of mass produced sterile males in operational fruit fly SIT programmes, specifically through manipulations implemented at the emergence and release facilities.

The CRP demonstrated that hormone therapy coupled with feeding protein to adults significantly accelerates male maturation and sexual performance among *Anastrepha* species and some *Bactrocera* species with no negative side effects (survival and competitiveness). Additionally, because females do not become mature as rapidly as males after hormone therapy sterile males can mate with wild females early in their lives rather than mating with sterile females. These factors result in significant cost savings associated with holding males prior to release in SIT programmes and fewer males die before mating with wild females. The validation in a large number of pest fruit flies of these findings has resulted in the incorporation of this major breakthrough into large scale action programmes against several pest species. For several other pest species, laboratory and semi-field tests strongly indicate that application of nutritional and/or hormonal pre-release treatments will also produce an increase in SIT efficiency, and thus can also be adopted by programme managers.

The development of cost-effective semiochemical treatments that improve sterile male mating performance has also been highly desirable. Implementation of such feasible treatments has significantly increased the effectiveness of SIT programmes for several *Bactrocera* and *Ceratitis* pest species, leading to reduced chemical applications to the environment, and increased food production and quality. Improved fly emergence, holding and release procedures, have benefited all operational fruit fly SIT programmes. Knowledge gained and practical procedures developed during this CRP are transferable, at least in part, to other insect pest species. The proceedings of this CRP are being prepared as a special issue of the Journal of Applied Entomology.

The Third Research Coordination Meeting of the CRP on *Development of Standardised Mass Rearing Systems for Male Mosquitoes,* 21-25 September 2009, Bologna, Italy

The 3rd RCM on Development of Standardised Mass Rearing Systems for Mosquitoes was an opportunity to evaluate the collaborative efforts between the participants of the CRP and to evaluate the status of the different mosquito research activities.

The RCM was held in Bologna, Italy from 21 to 25 September 2009 and was attended by different participants from various African, Asian and European countries.

The researchers presented the results of their research activities of the last 18 months and shared new hypotheses, proposals, impressions and suggestions to reach the common objective of the CRP, i.e. the development of efficient mass-rearing systems that can be used for operational mosquito field projects.

The CRP initially focused on *Anopheles arabiensis* but now also includes the study of *Aedes* species. This expansion was driven by the increased interest that the sterile insect technique as a potential control tactic for integrated mosquito control has been receiving in different parts of the world.

Irrespective of the sterilization strategy selected for the different control approaches, all of these strategies require an efficient and standardized rearing system to produce large numbers of sterile mosquito males for release. Quality control measures, transportation and release methods for the male insects are in addition aspects under evaluation for the feasibility evaluation of this technique against these mosquito species.

The outcome of this CRP will be of particular importance for the collaborative efforts between the FAO/IAEA and Sudan. The latter has embarked on a pilot programme to integrate the sterile insect technique against *An. arabiensis* in the Northern State, and methods and technologies developed under the CRP may be applied and validated in this Sudan project.

The FAO/IAEA as part of this RCM hosted an Italian seminar entitled: SIT in the Integrated Vector Management of *Aedes albopictus* in Italy: Tools, Problems, Surveillance and Control. This meeting was attended by many regional politicians, representatives of the Italian National Health Service and scientists coming from different regions of Italy. The meeting focused on the expanding distribution of this invasive species in Italy and Europe, its sanitary risks and the possible role of the sterile insect technique as part of an integrated pest management strategy. Besides promoting this event, Dr Romeo Bellini, the host of the meeting, also organized a full day scientific visit to the "Centro Agricoltura Ambiente" laboratories in Crevalcore (Bologna, Italy) and the areas where semi-field and field activities are under evaluation for the suppression of natural population *Ae. albopictus* through various methods, including the release of sterile males.

The First Research Coordination Meeting of the CRP on *Development of Generic Irradiation Doses for Quarantine Treatments*, 5-9 October 2009, Vienna, Austria

The first Research Coordination Meeting for this CRP was held in Vienna from 5 to 9 October 2009. The meeting was attended by all fourteen participants from eleven countries and two observers. The objective of the CRP is to support the International Plant Protection (IPPC) in the establishment of generic irradiation doses for groups of arthropod pests other than tephritid fruit flies, and if possible for all arthropods (except for pupae and adults of Lepidoptera). The purpose of the meeting was to review the current work of the participants and to agree standardized protocols and work plans for each of the participants.

The meeting emphasised the critical importance of adopting a common approach to the application and reporting of absorbed radiation dose to ensure that the results of the research are reliable and repeatable and that the work will be accepted by the IPPC for setting new standards. The necessary components of a dosimetry system were presented and the details of each participants dosimetry discussed. Although all participants have access to some form of dosimetry, this is often provided as a service by the irradiation facility and is outside their direct control and does not necessarily provide all the information required. There seemed, therefore, to be a need for some independent measure of dose and the Dose Comparison Scheme already established by the Entomology Unit was offered to the participants.

The participants propose to work on 29 species from 13 arthropod families, including several for which no data is currently available. The meeting recognised that it is necessary to investigate factors beyond absorbed dose that may affect efficacy and which have not been previously addressed. In recognition of the importance of common procedures in research and dosimetry, a research protocol was developed.

Representation from the Technical Panel on Phytosanitary Treatments (TPPT) of the IPPC was recognized to be critical in providing valuable feedback on IPPC operations and in facilitating the consideration of irradiation treatments in the development of further ISPM standards. It was also recognized that the increasing utilisation of irradiation technology will require further training of quarantine inspectors and regulatory authorities.

The second RCM is scheduled for 11-16 April 2011 at Texas A & M.

Recommendations from the meeting:

1. The meeting strongly recommended continued close collaboration and cooperation with the TPPT in order to address issues raised by Member States and to further facilitate the application of irradiation for phytosanitary purposes, including the development of international standards.
2. Immediate and continuing liaison with the IPPC Secretariat is necessary to facilitate the adoption of the 6 withheld irradiation treatments and to coordinate the submission of the additional irradiation treatments developed under this coordinated research project.
3. The use of the IDIDAS (International Database on Insect Disinfestation and Sterilisation) database to collate published information relating to irradiation treatments of pests is strongly encouraged.
4. It was strongly recommended that agreement holders should collaborate and assist contract holders in order to facilitate the efficient and thorough generation of data, especially between participants studying similar pests.
5. The meeting encouraged international organization funding and implementation of training courses related to the application of international standards, the operation of irradiation facilities and quarantine inspection and regulatory control.

Proceedings of the CRP on *Use of Irradiation in Biological Control*

A special issue on Use of Radiation in Biocontrol was published recently in the journal Biocontrol Science and Technology (Vol. 19, Supplement 1, 2009). Applications of the use of nuclear techniques were identified in the following six major areas with potential to increase the cost-effectiveness, trade and safety in the use of biological control agents (http://pdfserve.informaworld.com/399100__912521188.pdf):

1. Improving rearing

a) Understanding host-parasitoid physiological interactions to be able to modulate defensive reactions of hosts/prey insects

b) Expanding the time window suitable for host parasitisation

c) Allowing for increased storage/stockpiling of hosts or prey insects

d) Using very low-dose radiation to stimulate reproduction by entomophagous insects

e) Improving rearing media (either natural hosts/prey or artificial diets) through irradiation to reduce the microbial load and also to allow terminal sterilization after packaging

f) Utilising by-products of mass rearing facilities producing sterile insects for simultaneous production of biological control agents

2. Facilitating handling, shipment, trade and release

a) Eliminating the cost and logistics of holding and separating of parasitoids and non-parasitized pest adults before being able to ship to customers

b) Avoiding the emergence of pest adults from non-parasitized immature stages

c) Ameliorating concerns relating to the incidental presence in commercial shipments of fertile individuals of other hitchhiking pests

d) Provisioning of sterilised natural prey to be used as food during commercial shipments of predators

3. Supplementing hosts in the field for survival or early build-up of biological control agents

a) Provisioning of sub-sterile or sterile hosts or prey in the field as supplemental food to increase the initial survival of inoculatively released biological control agents

b) Provisioning of sub-sterile or sterile hosts or prey in the field as supplemental food to increase the early build-up of native biological control agents in advance of pest population build-up

4. Integrating SIT or F_1 sterility and biological control

a) Integrating natural enemies with the Sterile Insect Technique (SIT) or inherited sterility results in synergistic action, particularly with biological control agents reproducing/feeding on sterile or substerile offspring

b) Applying the SIT against biocontrol agents that have become pest insects

5. Reproductively inactivated hosts as sentinels in the field

a) The exploration for, and collection of, new biological control agents

b) The monitoring of populations of parasitoids, predators and microorganisms

6. Screening classical biological control agents under field conditions

a) Facilitating the importation of exotic species for classical biological control, through sterilisation (particularly insect herbivores of weeds), where host specificity doubts remain, so that they can be released and assessed in the field without the risk of establishing breeding populations

The First Research Coordination Meeting of the CRP on *Development and Evaluation of Improved Strains of Insect Pests for SIT*, 16-20 November 2009, Vienna, Austria

The first Research Coordination Meeting of the Coordinated Research Project on Development and Evaluation of Improved Strains of Insect Pests for SIT was held at the Vienna International Centre, Vienna, Austria from16-20 November, 2009. This CRP was initiated as a consequence of a recommendation from a Consultants Group Meeting held in Antigua Guatemala, in August of 2008.

Group photo of the Participants of the CRP held in Vienna, Austria

Seventeen scientists from thirteen participating countries attended this first RCM. The attendees were selected from countries that develop technologies for improving the SIT and countries that apply it to insect pests of agriculture. Scientists actively working on relevant molecular technologies in fruit fly pests, blow flies, mosquitoes and various lepidopteran pests were present, with an expanded focus on those working on moths. All attendees are considered world experts in their respective areas and it was of particular note that the authors of some recent ground-breaking published research in developing elegant genetic tools for use in pest insects were present. The CRP will focus primarily on the following research areas:

- To transfer existing technologies (genetic and/or molecular) for the construction of sexing strains to key insect pests.
- To develop and integrate molecular and genetic marker strains to monitor released insects in the field, to tag transgenes and to determine the mating status of females in the field.
- To establish targeted and stabilized transgenic strains to expand the safe and effective use of improved strains for SIT.

Developments at the Entomology Unit Seibersdorf

TSETSE FLIES

In line with our increased support for the tsetse project in Senegal (SEN5031) we have expanded the *Glossina palpalis gambiensis* colony originating from CIRDES, Burkina Faso to our target of 10 000 colony females, producing over 5 000 pupae per week. The availability of this material has allowed us to start work on chill-holding of male pupae after female emergence to simulate the conditions we would expect to encounter in shipping irradiated male pupae from CIRDES in Bobo Dioulasso to Dakar, Senegal and on field cage evaluation of mating performance and compatibility under various different handling conditions. We have also started to receive in October field collected material from the Niayes in western Senegal and once sufficient material is available we will start crossing experiments with the CIRDES colony flies.

The work on the salivary gland hypertrophy virus in *G. pallidipes* continues and work on the separation of the sexes in the pupal stage by near-infrared spectroscopy (SKNIR) has been restarted with the receipt of a new feed system for the pupae. A number of problems have been encountered with the integration of the new feeder with the SKNIR machine and we are working with the manufacturers of the SKNIR to resolve these.

Competitive mating performance of *Glossina palpalis gambiensis*

The effect of age on male *G. p. gambiensis* competiveness was investigated. The mating competitiveness of males, 3-, 6- and 9-days after adult eclosion was assessed. Flies received a blood meal the day before field cage observation and marking of groups was also done a day before field cage observation. The unmarked group was also subjected to the low temperature experienced during marking. A walk-in field-cage was used in order to approximate as closely as possible the actual field scenario during sterile insect release programmes. The field cage was erected inside a green house without environmental controls.

Observations were conducted from 0900h and ended at 1200h. Temperature ranged from 18°C at the start to 36°C at the end, humidity ranged from 67% down to 26%. There was hardly any flight activity below 20°C with the exception of flight immediately after release. Most flies rested in darker spots in the lower portions of the cage when temperature breached 27°C. It was shown that 9- and 6-day old males were significantly more competitive than 3-day old males, with the greatest number of mating pairs involving the oldest males and the youngest having the least number of pairs.

The ability of *G. p. gambiensis* to inseminate was not age dependent, and insemination occurred in most females that mated regardless of male age; however, 3-day old males transferred lower volumes of seminal contents. Mating duration was significantly shorter for 3-day old males, whereas it was the same for 6- and 9-day old males. We had not anticipated such a delay in the development of mating performance, which is more like that of *G. pallidipes*, and the proposed timing of field releases of sterilized males should be reviewed.

In a similar field cage environment males irradiated as adults with 110 Gy were equally competitive with unirradiated males from the same Burkina Faso stock. Equal numbers of seven-day old irradiated and unirradiated males were presented with mating opportunities with 3-day old females. Spermathecal fill for females that mated with irradiated males was slightly lower than for females that mated with unirradiated males. The time that elapsed from release to initiation of mating was longer for irradiated males and the duration of copulation marginally shorter in irradiated males.

Morphometric analysis of *G. palpalis gambiensis* wings

Wings of *G. p. gambiensis* collected from Senegal in May 2009 were subjected to morphometric analysis. Images of the wings were captured using a Dino-Lite® microscope and landmark recording was done using the software COO by Jean-Pierre Dujardin. The coordinate data were used for procrustes fit. A procrustes analysis of variance and regression analysis on centroid size were carried out using the software MorphoJ version 1.01a.

The results show the biggest differences between Parc de Hann and Diacksao Peul and between Parc de Hann and Sebikotane groups. There are lesser differences between Pout - Diacksao Peul, Pout - Parc de Hann, Pout - Sebikotane groups. The most similar samples are Sebikotane and Diacksao Peul. There is no significant difference between these two groups after the permutation test.

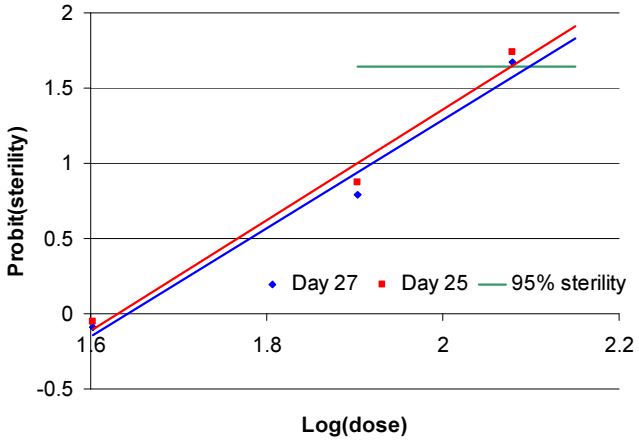
An analysis of wings of *G. p. gambiensis* from the Seibersdorf colony (originally obtained from Burkina Faso) from February 2009 to June 2009 was also carried out using the same software as described in the preceding paragraph. In February the size of the Seibersdorf colony flies was more variable but by May – June the variability was similar to the sample from Senegal.

Emergence, transportation and handling of *G. p. gambiensis*

The FAO/IAEA has been requested to determine the optimal conditions for irradiation, packaging and transportation of *Glossina palpalis gambiensis* males at the pupal stage to ensure good quality and competitiveness of sterile males in support to the upcoming tsetse eradication project in Senegal.

The *G. p. gambiensis* from Burkina Faso was introduced into laboratory conditions in the early 80's and fed 6 days /week on fresh defibrinated cattle blood. This strain was easily adapted to the standard rearing conditions and procedures at Seibersdorf including day 0 mating at 3:1 ratio (60 females/20 males) and 3 feeds per week. Good performance was recorded and the colony size has arisen quickly, from about 3000 female after complete emergence of the last pupal batch received from CIRDES at end February 2009, to 8000 within 4 months. Therefore some of the applied research on this tsetse strain was started. Priority was given to evaluating the radiation sensitivity to gamma rays of *G. p. gambiensis* in the late pupal stage and to determine the effect of chilling on male pupae.

Pupae batches were gamma irradiated on day 25 and day 27 at different doses between 40 and 130 Gy. Preliminary results showed no significant differences between irradiating on day 25 or 27 (see graph). A subtotal sterility of at least 96.43% was induced to the colony females mated with male flies irradiated between 110 and 120 Gy. A further test was performed by irradiating pupae on day 29 because a pupal incubation period of 32 - 33 days to first female emergence was observed from April to October. This important detail will be useful for the pupae scanning protocol with the SKNIR.



Sterility induced by irradiation of pupae at day 25 and day 27 post larviposition

The effect of cooling on male pupae after female emergence is also being evaluated. Pupae collected on a daily basis are incubated at 23-24°C and RH 75-80%. The female flies are first allowed to emerge and the remaining male pupae are use for the experimental treatments kept in cool temperature up to 7 days and one treatment kept as a control in normal incubation conditions. Chilling tests at 10 and 15 ºC have already been done and another test using 12.5ºC is being evaluated. The emergence of male flies is delayed by chilling at 10ºC for 7 days with no emergence throughout the seven days.

The preliminary results showed no significant differences in flies' performances (emergence rate and male survival following the cooling period) between the control group and the experimental treatments kept at 10ºC for 3, 5 and 7 days. During chilling at 15ºC a total of 60% of male pupae emerged by 7 days, indicating that such a cooling temperature could not be used for the transportation of male pupae from Burkina Faso to Senegal. Further investigations are being undertaken to have a complete evaluation of the effects of chilling and irradiation on emerging flies and finalise the optimal condition for handling, irradiation and transportation of male pupae.

Salivary gland hyperplasia virus

As reported in the last newsletter (July 2009), attempts are continuing to develop a strategy to manage the Salivary Gland Hypertrophy Virus (SGHV) that is hampering colony development of *Glossina pallidipes* due to reduced productivity. The virus management strategy is based on three approaches, (1) blocking virus replication using commercial antiviral drugs, (2) inhibiting virus infection by silencing virus specific genes using RNAi technology and (3) neutralizing the virus infection using virus specific antibodies.

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 drugs Acyclovir and Valacyclovir, were selected for further work. *G. pallidipes* flies fed on blood diet with Valacyclovir for three generation showed a lower mortality and higher productivity compared to flies fed with blood diet that contained Acyclovir. Quantitative PCR analysis was used to assess the effect of the antiviral drugs on viral DNA replication.

The results indicate that using Valacyclovir leads to a slight reduction in virus copy number in F0 and F1, whereas using the Acyclovir did not reduce the virus copy number in F0 but causes significant reduction in virus copy number in F1. In F2 no difference in virus copy number was observed between the treatment and control due to a marked reduction in the control virus level. The quantitative PCR results did not show significant differences in virus copy number between male and female, but the result show significant reduction in virus copy number over generations regardless of the treatment (including the control). Due to this observation, some modifications were made in the antiviral drugs experimental protocol to insure a virus contamination source in the experiment.

An experiment has been started to assess the effect of suppressing the expression of p74 by RNAi on virus infectivity. Three regions of the gene were amplified by

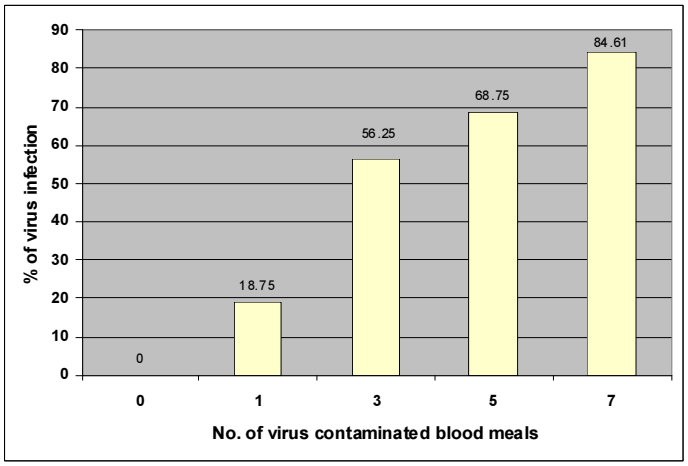
PCR covering the N-terminal region, the C-terminal region and the whole length of the gene sequence. The PCR product was cloned into a 28i and 38i LITMUS vector, after which the recombinant plasmid was checked by restriction enzyme pattern and transformed into HT115 (DE3) bacteria. The transformed bacteria were added to the blood diet for the flies and their effects on the virus copy number were monitored by quantitative PCR.

The results indicate that while there was no clear difference between the treatment and the negative control in F0, a significant reduction in the virus copy number was observed between two treatments and the negative control in F1. No significant difference in the virus copy number was observed between male and female. The results also indicate a significant reduction in the virus copy number between generations as observed in the antiviral drug experiment. As in the antiviral drugs experiment some changes were made in the RNAi experimental protocol to insure a virus infection source and to focus on the promising treatments.

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 Prof. Just Vlak from Wageningen University, The Netherlands and Prof. Max Bergoin from Montpellier University, France. Experiments to assess the efficacy of the antibodies to neutralize and block virus infection have started.

Several experiments were carried out to better understand the virus transmission and biology. The result confirmed that symptomatic infected flies release large numbers of virus particles into the blood during feeding. Injecting virus into flies leads to increasing virus copy number over time, the injected female producing progeny with high virus copy number, but the injected flies did not develop hypertrophy in the same generation.

The reduction in virus copy number over two generations seen in all treatments, including the controls, in the antiviral drug and RNAi experiments above, suggests that the high virus level seen in the colony may be maintained by horizontal transfer between individuals during routine feeding as several cages are fed successively on each membrane. When the blood is changed after each cage is fed (clean feeding), this horizontal transfer is minimized, leading to a progressive reduction in virus level. To test this, flies were first selected by PCR for low virus prevalence then given 1, 3, 5 or 7 feeds on blood contaminated by first feeding flies excreting virus. Following the contaminated feeds the flies were clean fed to a total of 7 feeds, and then the blood residue after feeding (the 8th blood meal, with clean blood) was analysed for the presence of virus. With increasing numbers of feeds the proportion excreting virus with the saliva into the blood progressively increases (see figure below).



Effect of the horizontal transmission of the virus spread

Based on this information a clean feeding colony has been initiated. Monitoring the virus infection by PCR and the development of symptomatic infection by dissection shows a significant reduction in virus in the clean feeding colony compared to the regular colony. This new colony will be used to provide flies with low virus levels for future experiments.

FRUIT FLIES

Rearing and Quality Control

Research and development in the fruit fly rearing and quality control group over the last year 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.

South American fruit fly (*Anastrepha fraterculus*)

A fellow from Brazil is currently studying methods of assessing field survival and competitiveness of fruit flies. She is using a series of controlled-temperature field cages to test differences in mating habits and re-mating tendencies between different geographical populations of the South American fruit fly.

Mexican fruit fly (*Anastrepha ludens*)

A visiting scientist on sabbatical from Mexico has completed his studies on selection of beneficial traits in laboratory colonies of Mexican fruit fly and Mediterranean fruit fly. His results show that there is some scope for preserving mass-reared strains in SIT programmes by selecting individuals with beneficial traits such as high irritability and mating performance, and then maintaining these in relaxed mother stocks.

Melon fly (*Bactrocera cucurbitae*)

A PhD student from Pakistan and a fellow from Mauritius are currently working on melon fly. The former is looking at improving sterile male performance in the field by adding a juvenile hormone analogue and protein to adult feed prior to release. The latter is studying mating compatibility and possible differences between popu-

lations from different geographical origins, and is developing a genetic sexing strain for the project in Mauritius.

The *Bactrocera dorsalis* cryptic species complex of pest fruit flies

The FAO/IAEA laboratories at Seibersdorf house 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*) and the carambola fruit fly (*Bactrocera carambolae*). Work has progressed on interbreeding these species to investigate how closely related these species are. In the laboratory the first three species readily interbreed with each other resulting in vigorous hybrids. Preliminary field cage testing on *B. invadens* crossing with *B. dorsalis* show that they will interbreed under simulated field conditions.

These studies form part of the research being carried out in support of the new Co-ordinated Research Project entitled: 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 in collaboration with workers from other countries such as Israel, Italy, Jordan, Spain, Greece, the USA and the UK.

Promising results show that there are other forms of protein that can be used in adult feed than the current expensive and tedious mixture of protein hydrolysate, dried chicken egg yolk and sugar. We have collaborated with the mosquito group of the Entomology Unit to test some of the cheap protein sources used in their work and found that some proteins sources are at least equal to the standard mixture in terms of egg production, egg hatch rate and egg to pupal recovery. More replication of these experiments is under way.

A scientist on leave from Mexico has finished her work resulting in significant improvement in knowledge on laboratory ecology and behaviour of olive fly.

Mediterranean fruit fly (*Ceratitis capitata*)

Upon request by counterparts, the FAO/IAEA fruit fly laboratory at Seibersdorf continues to supply the VIENNA 8 temperature sensitive lethal (*tsl*) genetic sexing strain of Mediterranean fruit fly to mass rearing facilities in the world for testing and use in SIT programmes.

Shipments of fruit flies and rearing materials to other researchers and/or SIT programmes

The FAO/IAEA fruit fly rearing and quality control 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. During 2009 one to several shipments of olive fruit fly were made to Italy, Spain and USA; of Mediterranean fruit fly to Portugal, the Czech Republic and Greece; of South American fruit fly to the Czech Republic; and of insect feed and equipment to Italy, Spain, Portugal, Guatemala and the UK.

Visiting Scientists and Fellows

The FAO/IAEA fruit fly rearing and quality control group is also an excellent place for fellows, visiting researchers, and scientists on sabbatical for two-way development and exchange of knowledge and ideas on improving fruit fly R&D. During 2009 several visiting scientists and fellows worked with our technicians and scientists. They came from: Brazil (1), Pakistan (1), Mexico (2), Mauritius (1), the Philippines (1) and the USA (2).

Genetic Sexing

Verification of strain identity of the GSS being mass reared in Guatemala and Hawaii

The first Mediterranean fruit fly genetic sexing strain (GSS) transferred to an operational mass-rearing facility (Guatemala) was VIENNA 4 (1994). Before this transfer the strain was outcrossed with wild material from Guatemala (Toliman strain) to boost the genetic diversity. In 1999 the VIENNA 4 translocation was replaced by the more stable VIENNA 7 version. This was achieved by crossing males of the VIENNA 7 strain three times with females from mass-reared VIENNA 4.

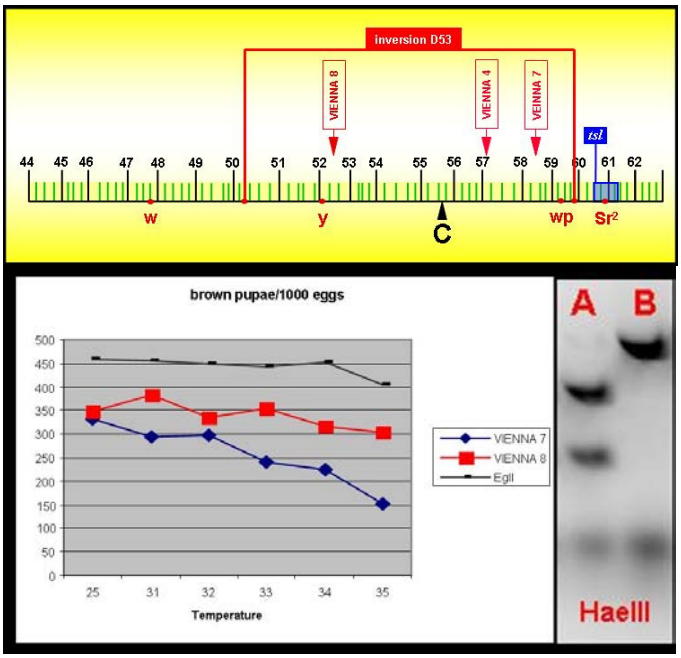
The resulting strain is called VIENNA 7/Tol and it should be identical to VIENNA 4/Tol except for the translocation, i.e. the genetic background, chromosome 5 carrying *wp* and *tsl* without inversion and the mitochondrial haplotype should be the same as in VIENNA 4/Tol. This new strain was reared successfully for many years in the El Pino mass rearing facility in Guatemala and in 2001/2002 it was also introduced into the newly renovated mass-rearing facility in Hawaii.

Since 2003 the next version of GSS, VIENNA 8, became available. This strain is as stable as VIENNA 7 but shows a significantly higher productivity/viability. Because of this improvement it is used by the mass-rearing facilities in Israel, Spain and South Africa. It was therefore recommended to introduce this new strain also into the mass-rearing facilities in Guatemala and Hawaii because for Guatemala alone a reduction in mass-rearing costs of US$ 2 million per year would be expected.

In 2006 a sample of the VIENNA 7/Tol from Guatemala was evaluated in Seibersdorf to compare this strain that was reared for many years under very selective mass-rearing conditions directly with VIENNA 8. The surprising result was that VIENNA 7/Tol is as productive as VIENNA 8. To clarify this result and to exclude the possibility that this effect is caused by the selection in mass-rearing a more in-depth analysis of the VIENNA 7/Tol strain was conducted.

Each GSS has certain characteristics that can be used to distinguish it from any other strain (see figure below): a) the position of the Y-autosome translocation breakpoint

on chromosome 5, b) as a consequence of that, the level of overall viability, c) the presence or absence of an inversion (e.g. D53), and d) the mitochondrial DNA (mtDNA) haplotype.



Characteristics that can be used to distinguish a GSS from any other strain (upper: the position of the Y-autosome translocation breakpoint on chromosome and the presence or absence of an inversion; lower left: the level of overall viability; lower right: mitochondrial DNA (mtDNA) haplotype)

These parameters were determined for VIENNA 7/Tol from the Guatemala mass rearing facility and, in part, also for the strain mass-reared in Hawaii (see table). The comparison with data for the original VIENNA 7/Tol and VIENNA 8 strains maintained in Seibersdorf shows that both, the Guatemala strain and the Hawaii strain, are mixtures. Cytological analysis of the Y-autosome translocation shows that the Guatemala strain contains the VIENNA 8 translocation with its breakpoint at 52B and this explains why this strain is as productive as VIENNA 8. However, it lacks the inversion D53 that is present in VIENNA 8 to stabilize this strain.

	VIENNA 7/Tol Original strain reared in Seibersdorf	*VIENNA 8* Original strain reared in Seibersdorf	*Guatemala* Nominally: VIENNA 7/Tol	*Hawaii* Nominally: VIENNA 7/Tol
Translocation breakpoint	57A	52B	52B	Not determined
Viability	ca 50%	ca 75%	ca 75%	Not determined
Inversion	No	Yes	No	Not determined
mtDNA haplotype	AAAB	AAAA	AAAA	81%AAAA 19%AAAB

Furthermore, all individuals analysed from the Guatemala strain contain the AAAA haplotype (EcoRV/XbaI/MnlI/HaeIII) and not the AAAB haplotype as it would be expected from the way how the strain was constructed. The only parameter determined for the Hawaii strain so far is the mtDNA haplotype. A mixture of the expected AAAB haplotype and the haplotype found in VIENNA 8 was detected, i.e. 81% of the individuals analysed are AAAA and only 19% show the expected AAAB haplotype. To analyse the other parameters life material will be sent from Hawaii to Seibersdorf.

It can be concluded that the GSS from Guatemala and Hawaii do not show the characteristics that they originally had and that are expected to be present based on the way how they were constructed. Both strains are mixtures and there is currently no good explanation how this could have happened.

MOSQUITOES

Mass-rearing tray design, rack prototype, larva-pupa separator, adult mass rearing cage and oviposition behaviour studies

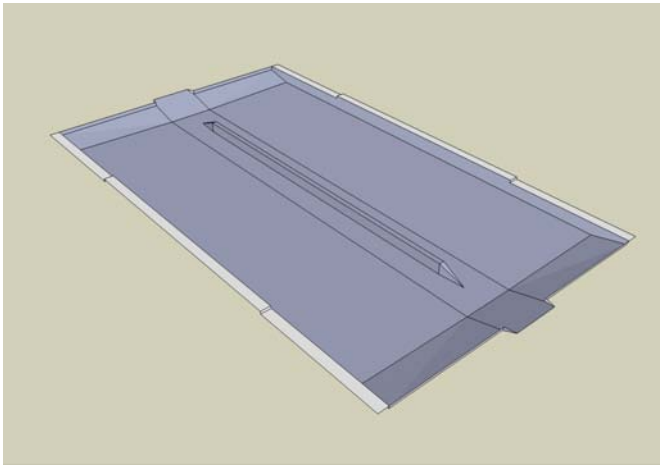
A prototype larval tray made of thermoformed 5 mm thick ABS plastic has been produced. The tray has an external dimension of 60 × 100 cm and an overall thickness of 3.5 mm. Available literature indicates that a surface area of 2 cm^2/ larva and a water depth between 0.5-2.5 cm is adequate. Based on this parameter, we should be able to culture 3000 larvae/tray at a larval density of about 1 larva/ml using 3 litres of water. The tray is designed to be drained by tilting it 15°. Trays will be stacked for filling and tilted to remove and collect larvae and pupae (see picture next page).

To create water movement in the central part of the tray during the draining process, symmetric slopes run toward the middle. Two other slopes of 15° angle were added at both ends of the tray to direct the flow of water towards the dedicated lips. This inclination degree permits the complete discharge of water by raising one end of the tray approximately 25 cm. A 72 cm long, 3 cm high ridge is located in the centre of the tray (see picture next page). The purpose of this ridge is manifold: to give the tray additional structural stability and to increase the resting space available to the larvae.

In addition, by drilling one or more holes in the ridge, an overflow system is created. A stack of trays will be filled using a water inlet at the top in a cascade. To avoid a direct flow of water from tray to tray before filling, a plastic plate will guide water overflowing from one tray away from the outlet of the tray below. Tests to evaluate these trays for the rearing of *Anopheles arabiensis* and *Aedes albopictus* larvae are now underway.

The trays described are stacked in a rolling steel rack that holds 50 trays manufactured in stainless steel. The rack can be lifted on one side (using a dedicated jack fixed on the rack frame) to collect the mosquitoes from the opposite side, where a plastic curtain will break the fall of the larvae and pupae and direct them towards a catch tray in the bottom of the structure. Complete removal of larvae

and pupae is not expected, so an operator will spray the rack with water to remove the remaining individuals. The larvae and pupae will be collected in a basket, where they will be concentrated and filtered from culture water in preparation for separation.

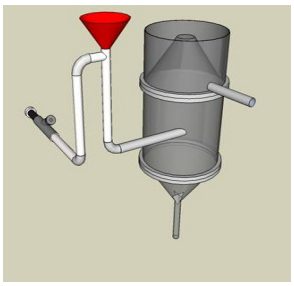


Tray prototype (upper); first trial with tray containing 3500 eggs (lower)

After collecting the larvae and pupae, they need to be separated so that larvae can be returned to the culture system to complete development and the pupae can be prepared for irradiation and release. The larvae must be uncontaminated by pupae so that excessive numbers of adults do not emerge into the facility. For this purpose a larva-pupa separator has been developed at the Entomology Unit (see picture at bottom, left diagramme). Its working principles are based on the natural difference in buoyancy between larvae and pupae. A gentle vortex is created in a cylinder in which the more buoyant pupae can be collected from the top and the more dense larvae are directed towards the bottom of the cylinder. The vortex is generated by a flow of water at 10-15°C regulated by a flow valve and introduced tangentially into the chamber. The effects of the two methods (vortex and cold water) are combined to achieve nearly 100% separation.

Modifications to the mass-rearing cage included changes to the blood feeding device; the original 4 cm reservoir was replaced with a 17 cm aluminium plate so that many mosquitoes can be fed simultaneously (see below, right picture).

Rack that can be tilted to remove the water with the larvae and pupae from the larval holding trays



Larval separator (left) and modified Hemotech blood feeding device (right)

Optimal conditions for rearing mosquito larva, effects of food concentration and larval density

Anopheles arabiensis larvae were reared from egg hatch to adult in the laboratory under a range of diet and larval concentrations using a factorial design. The range of larval densities and diet concentrations selected were such to allow larval growth and survival using the particular diet formulation and water volume tested. We determined how these variables affected 3 outcomes: development rate, survival and wing length.

As has been reported previously, negative density dependence of survival as a function of increased larval density was the prevalent effect on all outcomes when diet was limiting. When diet was not limiting, 2 cases of positive density dependence were observed – that is, the survival rate increased when more larvae were present. These results can be viewed in the context of diet and larval densities for mass-rearing and a possible ecological context in which increased numbers of con- or hetero-

specifics might play a role that we call larval habitat conditioning resulting in positive density dependence. The predicted effect of this interaction would be the ability of anophelines to inhabit polluted habitats that would otherwise be inhospitable.

Elaboration and formulation of a new diet for mass rearing of *Anopheles arabiensis* and *Aedes albopictus*

Mosquitoes have been maintained using numerous larval diets that were usually mixtures of commercially available products. Their usefulness was generally determined by consistent production of mosquitoes for colony maintenance purposes. Males being used for release, e.g. the sterile insect technique must be capable of mating competitively. Given that much of the potential adult performance is determined by the diet provided in the larval stage, it is important to develop and to select diets which not only allow colony keeping, but also provide necessary components for adult performance, including longevity and flight performance.

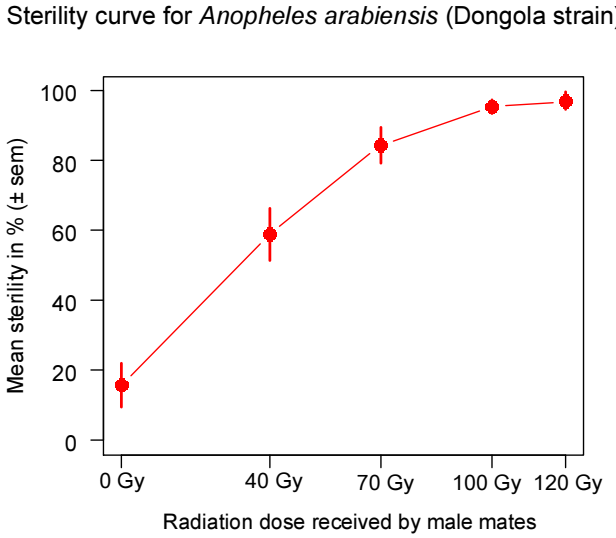
We tested several powdered larval diets for their capacity to support *Anopheles* mosquito culture in trays. In addition to nutritional value, we considered cost and global availability. We performed a stepwise selection procedure in which the principal components were selected, followed by determination of the optimal proportions of each using a mixture design. The initial outcome variables considered were survival to the pupae and adult stages, pupation and emergence times and male and female wing length. Because it has been demonstrated that essential polyunsaturated fatty acids (PUFA) are necessary for flight and mating competitiveness, we analyzed a subset of the diets for their composition of PUFAs and that of mosquitoes cultured on them. We also determined the effect of additives including algae and vitamins.

The final diet developed at a small scale (in Petri dishes) is a mixture of beef liver powder and tuna meal with a vitamin mix as additive. The synergistic effect of beef liver powder and tuna meal significantly decreased the duration of development and increased the survival of the immature stages. Furthermore, the diet is made with widely available components and a cost around 20 Euros/kg which is conducive to culturing millions of mosquitoes. Using this new diet, *An. arabiensis* showed good flight ability and extended longevity. Our new diet looks promising but we are still looking to improve it in terms of quality and cost. At present, the diet is being tested on *Ae. albopictus* and work on applying this diet in mass production is ongoing.

Effect of irradiation on sterility and mosquito development

Dose-response studies – Dose response experiments with late stage pupae showed that full sterility was obtained by exposure to 120 Gy (see graph). Sterility levels of the Dongola strain (Sudan) were slightly lower than those observed by M. Helinski with the KGB strain of *An. arabiensis* (Zimbabwe). This suggests a slight difference in resistance to radiation between the two strains.

From our experiments, it has also become clear that the sex-separation of any irradiation experiment should be done at the pupal stage and not the morning following emergence, as our observations indicate that our laboratory reared Dongola male mosquitoes were able to mate earlier than 16hrs after emergence.



Sterility (in %) in A. arabiensis mosquitoes exposed as late pupae to different radiation doses

Recovery of fertility - The evolution of male and female sterility over 3 successive gonotrophic cycles is being investigated. The preliminary results suggest that female fertility does not vary between each gonotrophic cycle. However, some recovery of fertility is observed when females are allowed to re-mate with males during each gonotrophic cycle, suggesting the possibility of male recovery of fertility over time or after successive matings.

Radio-protection - Preliminary experiments showed good radio-protective potential of 3 chemicals used as additive to the larval diet: nordihydroguaiaretic acid (NDGA), chitosan and bee venom. Results suggest that, when fed with these products, irradiated males in competition with non-irradiated males competed better for females than irradiated males fed with normal diet. However, the sterility problem described above did not enable us to confirm these results yet.

Influence of background tray colour - Investigations were carried out on the effect of the colour of the rearing trays on mosquito growth parameters. Larvae reared in trays with either white, black or 3 different shades of grey showed different pigmentations corresponding to the colour of the rearing containers. This phenomenon, called homochromy, was observed for the larvae as well as for the emerging adults. Larval and pupal survival was similar between each of these treatments. Larval stage duration was shortened in dark containers as compared to white ones, but the differences were not statistically significant.

Reports

Symposium: The Sterile Insect Technique, an Environment-friendly Control Tactic for Preventing the Establishment of Invasive Pest Insects as part of the International Congress on Biological Invasions 2-6 November, Fuzhou, China

Alien invasive insect pests are increasingly threatening agriculture and the environment, especially in current times of globalisation, increased international trade and climate change. In spite of numerous efforts to establish effective quarantine procedures and other preventive measures, preventing the introduction and establishment of invasive pest insects remains a continuous challenge.

The Convention of Biodiversity, the International Plant Protection Convention, and other binding global or multilateral treaties stipulate that once prevention of introduction of invasive pests fails, countries should give priority to eradication over containment or suppression efforts. However, effective and environment-friendly control tactics are often not developed or available to prevent establishment and spread of these invasions.

While the judicious use of selective insecticides remains an important tool for insect pest management, it is generally very ineffective in achieving final eradication of incipient invasive pest introductions. In addition, increasing public concerns about environmental damage and human health resulting from such indiscriminate insecticide spraying necessitates increased efforts to develop new and apply more effectively existing environmentally-friendly pest control options.

The sterile insect technique is an effective and ecologically-friendly method to suppress, contain or eradicate low-density insect pest infestations. Unlike insecticides, traps and other bait techniques, the SIT acts inversely density dependent (increased efficiency with decreasing population densities) and when applied as part of an area-wide approach is particularly well suited to deal with incipient invasive pest introductions. Provided that adequate sterile to wild male over-flooding ratios are maintained, that the sterile males are competitive with the wild ones, and the sequential releases are conducted during a sufficiently long period, the target invasive population can be driven to extinction.

The well-attended symposium reviewed the area-wide application of the SIT to prevent establishment or eliminate established invasive pest insects and discussed the state of the technology and the need for a proactive approach to develop the SIT package for other potential major invasive insect pests. The programme included the following presentations:

1. The sterile insect technique, an environment-friendly tool for preventing the establishment of invasive pest insects (by J. Hendrichs, M. Vreysen and R. Pereira)
2. The light brown apple moth, *Epiphyas postvittana*: Development of the SIT as a weapon against this invasive pest (by D. McInnis, B. Woods, E. Jang and M. Suckling)
3. Development of the sterile insect technique to suppress false codling moth, *Thaumatotibia leucotreta* (Meyrick) (Lepidoptera: Tortricidae (by J.H. Hofmeyr, J.E. Carpenter, S. Bloem and M. Hofmeyr)
4. Development and deployment of the sterile insect technique to eradicate and contain *Cactoblastis cactorum* in North America (by J.E. Carpenter and S. Hight)
5. The use of SIT to prevent exotic fruit fly establishment in the United States (by K. Hoffman)
6. Deployment of the sterile insect technique (SIT) to prevent the spread of the invasive Mediterranean fruit fly, *Ceratitis capitata* (Wied.) in Central America (by P. Rendon, T. McGovern and P. Velasquez)
7. Recent invasions by Tephritid fruit fly pests and research and development advances to improve sterile insect technique application (by R. Pereira and J. Hendrichs).

Consultants Meeting on Improved Understanding of *Bactrocera* and *Anastrepha* Pests Species Complexes for Enhanced SIT Application to Facilitate International Trade, 6-10 July 2009, Vienna, Austria

Group photo of the Consultants Meeting held in Vienna, Austria

Considerable concern has been expressed by Member States that some major pest species complexes include taxonomically described species that are actually only geographical variants of the same species. Conversely, some insect populations grouped taxonomically within the same pest species display different biological and ge-

netic traits and show reproductive isolation which suggest that they are different species.

This uncertain taxonomic status is having important practical implications on the effective development and use of the SIT against such complexes with respect to the rearing of the correct species and significantly affects international movement of fruit and vegetables resulting in the establishment of trade barriers to important agricultural commodities which are host to pest tephritid species.

A ranking of the major pest complexes with respect to the economic damage and regional impacts indicates that a number of species complexes are of concern to Member States. The Consultants' Meeting discussed the complexes noted above and related issues and prioritised them as to economic importance and potential for SIT application. Three complexes and a suspected complex were identified to be of significant importance that needed to be resolved to facilitate world agricultural trade and SIT programmes. They are:

- *Anastrepha fraterculus*
- *Bactrocera dorsalis*
- *Bactrocera cucurbitae*
- *Ceratitis rosa*

Meeting of the Technical Panel on Pest Free Areas and Systems Approaches for Fruit Flies, 1-5 August 2008, 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 31 August to 4 September 2009 with the objective to draft the ISPM on Phytosanitary Procedures for Fruit Fly (Tephritidae) Management.

Participants of the FAO-TPFF held in Vienna, Austria

The panel reviewed specification number 39, reviewed a discussion paper prepared by the outgoing steward, and completed a draft ISPM. The TPFF discussed how the topic should be developed and whether it should be a stand-alone standard or an annex to another fruit fly standard, noting that it would need to contain more general information if stand-alone and more technical information if an annex. Questions were raised by the panel about the appropriate level of technical detail in annexes of ISPMs.

The panel decided to develop a stand-alone standard for fruit fly management and noted that some technical detail would need to be omitted from the body of the standard itself and would be incorporated into annexes or appendices.

Regional Indian Ocean Fruit Fly Meeting, 21-25 September 2009, Pereybere, Mauritius

A Regional Meeting took place from 21-25 September 2009 with the objective to discuss common fruit fly problems and particularities of the knowledge and control of these pests among Indian Ocean countries, and to discuss common strategies and regional cooperation. The meeting was attended by 17 representatives of Seychelles, Madagascar, Comoros, France (Reunion), Mauritius and FAO/IAEA.

During the first half of the meeting the participants attended the presentations of the CRPs on Improving Sterile Male Performance in Fruit Fly Sterile Insect Technique (SIT) Programmes and on Development of Mass Rearing for New World (*Anastrepha*) and Asian (*Bactrocera*) Fruit Fly Pests in Support of Sterile Insect Technique (SIT).

The second half was dedicated to the discussion about the Indian Ocean fruit fly problems. As a result of the discussions, two main actions were agreed: (1) to explore the possibility of the presentation to the IAEA of a Concept for a Regional Project; and (2) to request from FAO the organization of a fruit fly identification, surveillance and early warning workshop with the objective to face the threat of the introduction of *Bactrocera invadens* (which is already in Comoros and Mayotte).

Participants of the Indian Ocean fruit fly meeting during a field trip to an area of cucurbits

Announcements

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

The Arthropod Mass Rearing and Quality Control (AMRQC) Global Working Group of the IOBC will hold its 12th workshop in cooperation with the Joint FAO/IAEA Division. The objective of this international workshop is to address the audacious goal of moving from "bug farms" to industrial production of high-quality insects, mites and nematodes for biological control, SIT, research and other current and future applications. The workshop will focus on all issues related to the rearing of entomophagous and phytophagous insects and mites, and entomopathogenic nematodes, and to principles and practices of quality assurance.

The programme will consist of invited papers presenting an overview of selected topics and contributed presentations on the different aspects of arthropod rearing as it relates to quality control. Papers will serve as a basis for discussion and exchange, with the final aim of improving collaboration among scientists and practitioners. There will be a session on quality control in relation to the use of nuclear techniques in natural enemy rearing and mass rearing for the SIT.

The meeting will be held at the IAEA headquarters in Vienna from 19-22 October 2010. Further details are available under Announcements on the AMRQC web site at http://users.ugent.be/~padclerc/AMRQC/announcements.htm.

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

This FAO international technical conference is co-organized by FAO and the Government of Mexico, and co-sponsored by the International Fund for Agricultural Development (IFAD). The Consultative Group on International Agricultural Research (CGIAR), the World Bank and the International Centre for Genetic Engineering and Biotechnology (ICGEB) are major partners in this initiative. Participation at the conference is by invitation only.

Impetus for the conference comes from the need for concrete steps to be taken to move beyond the "business-as-usual" approach and to respond to the growing food insecurity in developing countries, particularly in light of climate change that will worsen the living conditions of farmers, fishers and forest-dependent people who are already vulnerable and food insecure. The conference encompasses the crop, forestry, livestock, fishery and agro-industry sectors, as well as the entire range of agricultural biotechnologies currently available.

The SIT and related techniques are among the many biotechnologies that will be covered by this conference.

For more information visit:

http://www.fao.org/biotech/abdc/conference-home/en/

Announcements of FAO/IAEA Regional Training Courses

During the first semester of 2010, the following FAO/IAEA Regional Training Courses will take place:

- *Surveillance of Tephritid Fruit Flies in Support of Planning and Implementing Area-wide Integrated Pest Management Programmes* (under the TC Project RAS5052). 18-22 January 2010, Bangkok, Thailand.
- *Standardised Collection and Processing of Entomological and other Relevant Geo-Referenced Data as Needed in SIT-Based AW-IPM Campaigns against Tsetse* (under the TC Project RAF5060). 1-19 February 2010, Bobo-Dioulasso, Burkina Faso
- *Collection of Baseline Data for the Planning and Implementing of Tsetse Area-wide Integrated Pest Management in Southern and Eastern Africa* (under the TC Project RAF5059). 15 February - 5 March 2010, Maputo, Mozambique

Application procedure: Nominations should be submitted on the standard IAEA application form for training courses/workshops (downloadable from: http://www-tc.iaea.org/tcweb/participion/astrainee/default.asp). Completed forms should be endorsed by and submitted through the official channels established (namely the Ministry of Foreign Affairs, the National Atomic Energy Authority, the Office of the United Nations Development Programme, or the office of the FAO Resident Representative or the Ministry of Agriculture). The completed forms must be received by the International Atomic Energy Agency, P.O. Box 100, A-1400 Vienna, Austria. Advance nominations by facsimile (+43-1-26007), or e-mail (official.mail@iaea.org) are welcome.

Call for Submission of Research Proposals for a new Coordinated Research Project on Resolution of Cryptic Species Complexes of Tephritid Pests to Overcome Constraints to SIT Application and International Trade

Fruit flies are among the worst plant pests in agriculture, causing major losses in fruit and vegetable production, and are major targets of insecticide use in nearly all tropical, subtropical and some temperate countries worldwide. They are also of major economic importance because they result in the establishment of quarantines and the disruption of international agricultural trade.

The Sterile Insect Technique (SIT) is increasingly applied operationally against the Mediterranean fruit fly; however, there are some important constraints to its use against other major fruit fly pests.

There are increasing demands from Member States in Africa, Asia and Latin America to resolve the uncertain taxonomic status of some key pest fruit fly species which exist as species complexes, i.e. fruit fly species that are morphologically similar and are not real separate species but only geographical variants.

This uncertainty is having significant negative impacts on international trade and is resulting in the establishment of technically unjustified trade barriers to important commercial fruit and vegetable commodities.

Also, some fruit fly populations grouped within the same species display significantly different biological, behavioural and genetic traits, which have important practical and economic implications for the effective use of the SIT.

The resolution of some of the major cryptic species (i.e. insects whose specific status is questionable) complexes is therefore critical both for SIT application and to assist mainly subtropical and tropical Member States to overcome non-tariff trade barriers in order to export their fresh fruit and vegetable commodities to international high value markets.

This problematic taxonomic situation occurs in four of the most important pest genera within the Tephritidae family: *Anastrepha*, *Bactrocera*, *Ceratitis* and *Rhagoletis*. After a detailed analysis, a Consultants Meeting selected the following main targets for research: *Anastrepha fraterculus* (Mexico, Central and South America), *Bactrocera dorsalis* (Asia, Africa and South America), *Bactrocera cucurbitae* (Asia and Pacific Ocean, Indian Ocean and Africa) and *Ceratitis rosa* (Africa and Indian Ocean) species complexes.

The objective of this CRP is to provide a clear description of biological characteristics of the species and the development of diagnostic tools for each species, resulting in facilitation of world trade and an enhancement of area-wide integrated pest management programmes that include SIT application.

Cryptic pest fly species within each complex will be maintained in the laboratory and mating propensity, compatibility and competitiveness assessed under semi-natural conditions in field cages. In addition, the CRP will seek collaboration with researchers studying morphological, cytogenetic, molecular, and pheromone differences between populations or species.

The expected duration of the CRP is 5 years (2010-2015) and the first RCM is planned for August 2010 in Vienna, Austria. Scientists and researchers who are interested in collaborating in this new CRP should contact Andrew Jessup (A.Jessup@iaea.org).

A call to Member States to participate in this new CRP was made in October, 2009 with applications to be forwarded to the FAO/IAEA by early January 2010.

Information on the IAEA Coordinated Research Programme and how to apply for research contracts and research agreements can be found at http://www-crp.iaea.org/

News

The new Fruit Fly Control Center recently inaugurated (1 August 2009) in Fuzhou, Fujian, China

New Fruit Fly Control Center, Fuzhou, Fujian, China

A fruit fly control center was inaugurated on 1 August 2009 in Fuzhou, Fujian, China. This centre is located at the campus of the Fujian Agriculture and Forestry University.

The facility was designed for research purposes and to produce *Bactrocera dorsalis* to support an ongoing pilot suppression project that integrates the sterile insect technique (SIT) with other suppression techniques. In order to guarantee the production of enough insects to apply the SIT for suppression in the pilot area the Government of China has supported the construction of this Centre.

The actual strain under mass rearing is a Genetic Sexing Strain (white pupae), developed by the USDA-ARS in Hawaii with the objective to separate sexes of the pupae with a colour sorting machine to allow the release of only males on the field.

Additionally, this facility is now producing 4 species of fruit fly parasitoids to assess the potential integration of the SIT with augmentative parasitoids releases:

- *Fopius arisanus*
- *Fopius vandenboschi*
- *Psitalia incise*
- *Diachasmimorpha longicaudata* (2 strains)

Source: Qinge Ji, Fujian Agriculture and Forestry University, Fuzhou, Fujian, China.

Progress in the Programme to Eradicate Sweet-potato Weevils Using a Combination of Male Annihilation by Sex-pheromone and Sterile Insect Releases on Kume Island, Okinawa, Japan

The sweet-potato weevil (SPW), *Cylas formicarius* (Fabricius), is the most devastating pest of sweet potatoes in tropical and subtropical areas worldwide, including the southern islands of Japan. SPW is designated as a plant quarantine pest in Japan, so transporting fresh sweet potatoes from Okinawa to weevil-free mainland Japan is pro-

hibited. Therefore, an experimental pilot project to eradicate SPW was started on Kume Island (ca. 6,000 ha) in 1994.

An estimated 0.5 million wild male weevils were estimated on Kume Island during the peak season (September and October) of 1994. Before the sterile insects release, suppression of wild weevils by the male annihilation technique (MAT) was implemented in high-density weevil areas from November 1994 to January 1999. Wood fibre-board squares (4.5 to 6.0 cm × 4.5 to 6.0 cm × 0.9 cm) soaked with synthetic sex pheromone and MEP (insecticide) were used for the MAT. The toxicant squares were distributed at a rate of 8 to 16 squares per hectare per month in target areas by helicopter and by hand. We checked the efficacy of the control by pheromone traps and host plant surveys. The infestation and trapping data indicated that the density of the SPW population on the island was decreased to approximately one tenth of that before control was applied.

Following the suppression phase, we began mass releases of sterile weevils in February 1999. The weevils used for releases were mass-reared on sweet-potato roots. The adults emerging from roots were irradiated at a dose of 100 Gy (in the early stage of the project) or 200 Gy. They were then separated into batches of 1,000 to 3,000 insects that were placed in paper bags.

These bags with sterile weevils were dropped from a helicopter once a week in the designated areas. From February 1999 through June 2001, fewer than 400,000 sterile weevils were released per week. After July 2001, however, production of weevils was stable and over 500,000 weevils were constantly released each week.

In 2000 and 2001, we conducted intensive host surveys to detect the remaining high-density areas (hot spots). We then released weekly additional sterile weevils into these hot spots. After 2002, a small number of wild weevils were sporadically detected from wild host plants in several limited areas, mainly mountainous areas. In such areas, the lure-toxicant was distributed and the wild host plants were cut down, followed by additional releases of sterile weevils. Consequently, no wild weevils were found except along the southeastern coastline of the island in 2008. In March 2009, however, an infested host plant was detected from a bush in a mountainous area. Since then until the present (October 2009), no wild weevils have been found. Therefore, we believe that SPW appears close to being eradicated from Kume Island.

Source: Tsuguo Kohama, Okinawa Prefectural Agricultural Research Center, Itoman, Okinawa Japan, and Dai Haraguchi, Okinawa Prefectural Plant Protection Center (former Fruit Fly Eradication Project Office, Okinawa Prefectural Government), Naha, Okinawa, Japan

The Tephritid Workers of the Western Hemisphere (TWWH) Database

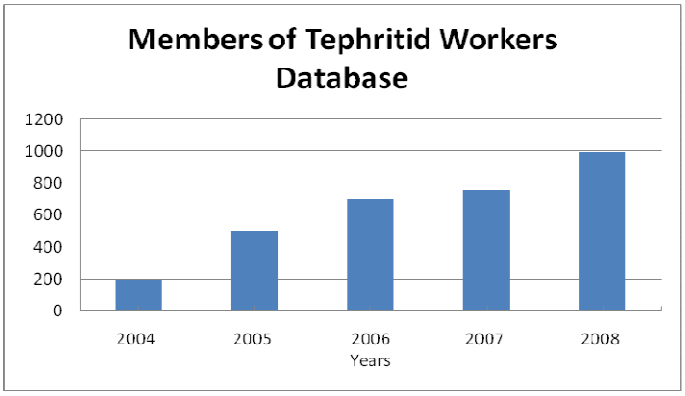
The development of a web site for the Tephritid Workers of the Western Hemisphere (TWWH) is a major step forward since this region encompasses the largest group of tephritid workers in the world. The TWWH can be accessed through http://www.tephritid.org/twd.twwh/srv/en/home.

This space is intended to be used as a platform for sharing information relevant to the region, such as posting addresses, news, alerts, proceedings or meeting minutes, photos, relevant documents and guidelines helpful for the community members. The value and usefulness of this web site will depend of the active participation of the members. Therefore, all the community is invited to contribute.

For your information, existing records of the Tephritid Workers Database (TWD) (http://www.tephritid.org/twd/srv/eng/home) of all members from the Americas were transferred to TWWH web site, although they continue to be TWD members. However, if you were not already a TWD member, you should register directly at TWWH web site by filling out the membership form.

TWD members: How many are they and from where do they come?

The number of subscribed tephritid-workers (see graph) and the countries increased over the years since the database was launched in 2004. Up-to-date, there are about 1000 members from 105 countries registered and using TWD.



Source: Abdel Bakri (TWD)

Effect of gamma irradiation on the morphology and physiology of the reproductive organs of the VIENNA genetic sexing strains of the Mediterranean fruit fly at different male and female ages.

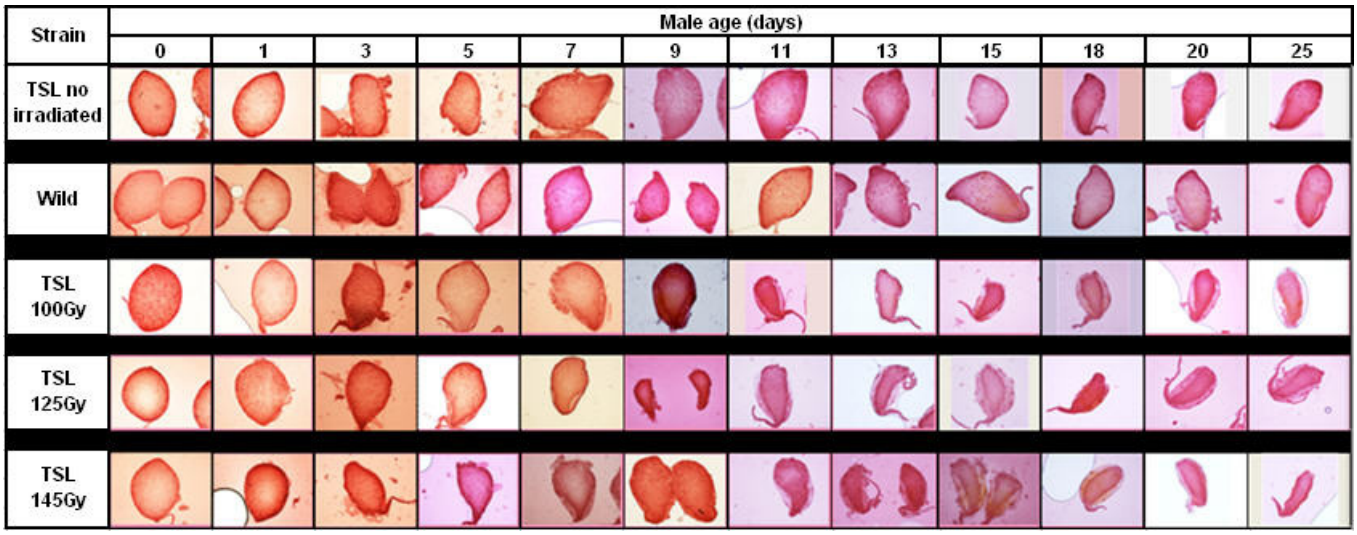
Accurate discrimination of wild and sterile insects is critical to area-wide insect pest control programmes integrating the release of sterile insects. Failures in this activity can lead to implementation of unnecessary actions and can be costly in terms of funds and time and resources expended, e.g., identifying a sterile fly as a fertile individual can result in unnecessary and costly control actions.

The only marking system currently used routinely for distinguishing fertile insects from wild ones involves the detection of the presence of fluorescent dye in the ptilinum of flies, which is most visible when viewed under an epi-fluorescent microscope or under ultraviolet light. Although this method is overall reliable, still a certain small amount of flies are not sufficiently marked so that the reproductive organs need to be examined to determine whether the fly has been irradiated.

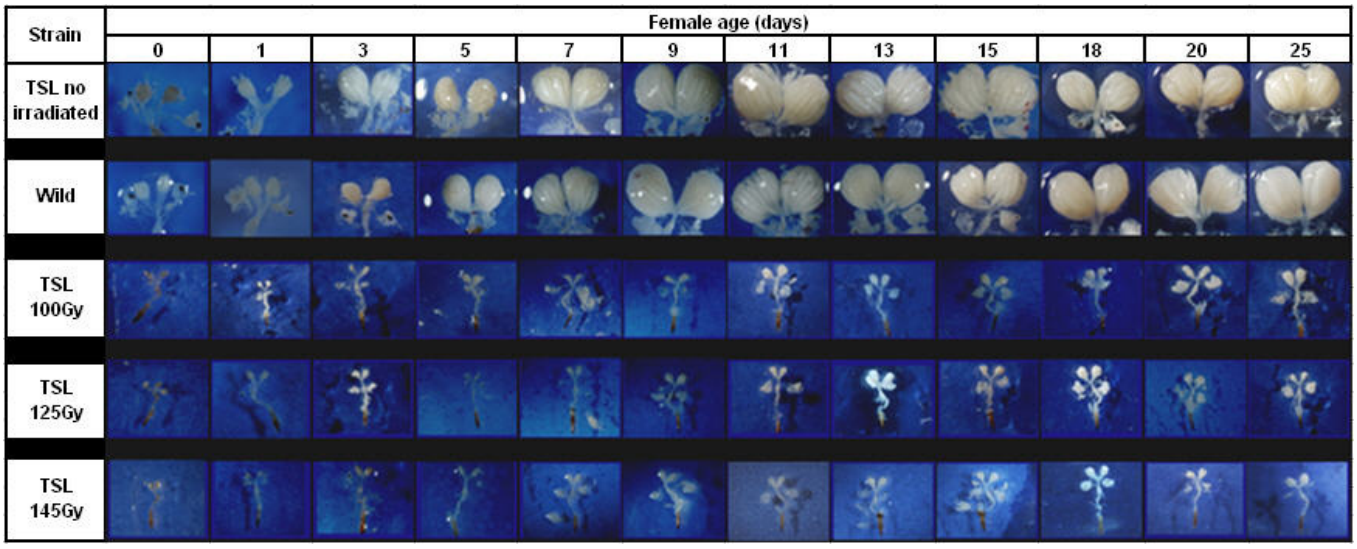
Distinguishing differences between the reproductive organs of 1-6 days old sterile flies from the VIENNA genetic sexing strains from those of wild individuals has apparently been more difficult due to the similarity of cells related with the spermatogenesis of fertile and sterile males. The damage of the reproductive organs of irradiated VIENNA genetic sexing flies is not as clear as it is in bisexual strains.

To overcome this difficulty, research is currently in progress at the Moscamed Programme in Mexico. So far, around 4,000 microscope mounts of dissections and 1,600 pictures of male and female reproductive organs of sterile and wild flies between zero and 25 days of age have been prepared and examined, and over 300 pages of data ready for analysis have been gathered. The two figures depict a summary of male and female reproductive systems.

Source: Jorge Guillen-Aguilar, Moscamed Programme, Mexico



Mediterranean fruit fly male's gonads microscope mounts.



Mediterranean fruit fly female's ovaries microscope mounts

Mathematical simulation of the radiation field of an RS-2400 X ray irradiator.

The increasing difficulties with shipping cobalt-60 for research irradiators, and the withdrawal of the Nordion Gamma Cell 220 from the market two years ago, lead the Insect Pest Control Section to look for alternative means of sterilizing insects for the SIT. As a result, in 2008 we obtained a self-contained, low energy X ray irradiator (model RS2400) from the company Rad Source Technologies Inc., for evaluation.

Because of the unconventional configuration of this irradiator, the photon spectrum in the centre of the load is not known and hence, it is very difficult to calibrate a suitable dosimetry system. Therefore the PENELOPE software suite was used to model the physical environment of the irradiation chamber and nuclear composition of insect pupae and dummy material. The Monte Carlo modelling produced photon spectra for the inside an irradiation canister under various conditions, which will allow us to calculate the mass energy absorption coefficients for insect pupae. This will permit to transfer the dose measurements from an ion chamber, as the primary dosimeter, to the Gafchromic radiochromic film system and to apply corrections factors for dose measurement and dose mapping.

Source: Roberto Uribe-Rendon, Kent State University, USA

Invasive Nettle Moth Triggers Hawaii Research

Like children everywhere, kids in Hawaii love to run barefoot through tall grass. But an invasive pest called the nettle moth caterpillar can take the fun out of this simple childhood pleasure, according to Eric E. Jang (USDA-ARS).

The sharp, spiky hairs of the caterpillar, *Darna pallivitta,* can cause a painful, stinging sensation. Besides being a hindrance to childhood play, this agricultural pest poses a hazard to people working with palm plants and other commercially grown ornamentals that the insect attacks.

Nettle moth caterpillar, Darna pallivitta *(Photo by Eric Jang, USDA-ARS)*

In a highly experimental approach, USDA plans to use sexually sterilized fruit flies, such as sterilized melon flies, as winged carriers of an alluring nettle moth scent, a component of what's known as a pheromone. Sterile melon flies are a logical choice because techniques for producing large numbers of them (to disrupt their normal reproduction and cause their populations to crash) are already in place.

In theory, sterilized melon flies, each carrying a drop of the nettle moth chemical on its back, could be set free in moth-infested locales in Hawaii to quickly and inexpensively distribute the scent wherever they fly. Like decoys, the melon flies would create confusion among amorous male moths that use the scent to find female moths. The pheromone component can also be placed in traps to detect the caterpillar and monitor its spread.

Source: USDA-ARS (18 November 2009)

The Biology, Behaviour and Control of the Chinese Citrus Fruit Fly, *Bactrocera minax*

The Chinese citrus fruit fly, *Bactrocera minax* (Enderlein), has been recognized as a serious pest of citrus in China. The first occurrence record of *B. minax* dated back to Song dynasty in ancient China, 1000 years ago. It is most likely that *B. minax* originated and evolved with the plant genus *Citrus* in the region from China to India and Bhutan.

The current infestation areas cover 8 provinces around China, mostly in south-western and central China. The larval host range of *B. minax* is largely restricted to wild and cultivated species of *Citrus*. The *B. minax* infestation is serious and common in mid and high altitude orchards.

The typical damage symptom is as follows: the egg-laying puncture mark by the female fly is a small hole in the fruit; the young green fruits turn yellow prematurely in July; the flesh of fruits becomes rotten and dry because of the infestation of the larvae; the yellow infested citrus fruits drop to the ground prematurely in October.

Bactrocera minax is a univoltine pest. Eggs are laid under the skin of the fruits from July to August. The larval stage is between August and October and the larvae become easily visible in October. The larvae pupate in November in the soil. The pupal stage last 6 months, from November to next April. Adult flies emerge in late April/early May. Usually male flies emerge first when adult flies emerge from pupae.

We divided female ovaries into five categories corresponding to the characteristics of development and mating information: ⅰ. Ivory-white and hyaline period (day 1 to day 12); ⅱ. Yolk deposition period (day 13 to day 20); ⅲ. Sexually mature and mating period (day 21

to day 30); ⅳ. Peak period of oviposition (day 30 to day 40); ⅴ. Late period of oviposition (after day 41). When females became sexually mature, they extended intensely the ovipositor, sometimes bent to 90℃, or made punctures in the fruits, by which to attract males. The mating time lasted one to two hours. We observed mating competition behaviour when several males encountered single female.

Mating pair of Chinese citrus fruit fly, Bactrocera minax

Before laying eggs, the females kept moving around on the surface of the fruits, in order to look for suitable laying area. Then the female rotated and punctured up and down with the ovipositor as an axis in the fruit, until laying eggs. In China there are several control measures for *B. minax*. First, collected dropped fruits from mid October to late November and destroyed through burial in pits. Second, chemical spray during the peak population of adults in mid May. Third, protein bait plus pesticides to attract and kill adults from late May to mid June in that adults need to supplement nutrition for sexually mature. Forth, SIT is a potential method by which Chinese government managed *B. minax* successfully in 1980s in Guizhou province.

Source: Changying Niu and Yongcheng Dong (Huazhong Agricultural University, Wuhan, Hubei, China)

Designation of the Mexican Fruit Fly Programme as an IAEA Collaborating Centre.

Since 2004 the IAEA has been designating as IAEA Collaborating Centres selected partner institutions with which the IAEA is familiar and has worked successfully in support of its regular programme through research and development and training in any nuclear technology. The IAEA, and particularly the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, has worked for many years with the Mexican Fruit Fly Programme in different aspects of the nuclear application to control major insect pests, and now this collaboration will be enhanced in the application of the Sterile Insect Technique against fruit flies. The designation, in effect from September 2009, is for a period of four years, with possibility of re-designation for additional four-year terms.

Source: José Manuel Gutierrez Ruelas, Moscamed Programme, Mexico

Mediterranean Fruit Fly Protection Expands to Broward County

Florida Agriculture Commissioner Charles H. Bronson today announced that Florida has added more troops to its defense against the Mediterranean fruit fly with preventive sterile fly releases over an expanded area of South Florida.

The additional release area in Broward County is a proactive measure to expand the coverage of the program with no additional cost. This is possible due to the efficiency of the sterile insect release technology and effective operation of the Sterile Insect Release Facility in Sarasota.

The expanded release is part of the Sterile Insect Technique Mediterranean Fruit Fly Preventive Release Program based in Sarasota, and is a cooperative effort between the United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine (USDA, APHIS, PPQ) and the Florida Department of Agriculture and Consumer Services, Division of Plant Industry (FDACS, DPI).

“Since the sterile fly release initiative’s inception in 1999, no major Mediterranean fruit fly outbreak has occurred,” Bronson said. “Prior to that time, over $50 million had been spent to eradicate just two outbreaks in the late 1990s,” Bronson added.

The sterile flies are reared and sterilized in Guatemala and then the fly pupa are sent by airfreight to Sarasota where they are reared to adults and aerially released throughout designated areas of the state. The state’s fruit fly monitoring and detection program checks over 55,000 traps to ensure no wild (non-sterile) Mediterranean fruit flies have been introduced through Florida’s ports of entry by travelers or commercial carriers on fruits or vegetables and to monitor sterile fly population levels to assure optimum sterile fly coverage in release areas.

Currently, sterile male Mediterranean fruit flies are released aerially five times a week over 300 square miles in Hillsborough County, three times a week over 160 square miles of Sarasota County, and three times a week over 140 square miles of Miami-Dade County. All of these areas are considered high risk for an introduction of exotic fruit flies, especially Mediterranean fruit flies. Due to a busy international airport and deep-water seaport, Broward County is also considered a high-risk area for introduction of exotic fruit flies.

On October 13, 2009, the Sterile Insect Technique Mediterranean Fruit Fly Preventive Release Program will begin releasing sterile Mediterranean fruit flies three times a week over 16 square miles in Broward County and is referred to as Phase I. Phase I releases will be made in an area that lies between the Miami-Dade/Broward County Line and the Fort Lauderdale International Airport. Phase I will run from October 2009 to January 2010, at which time further expansion to the north will be discussed by USDA, APHIS, PPQ and FDACS, DPI.

Source: www.fl-dpi.com (12 October 2009)

Screwworm outbreak hits livelihoods in central region (Yemen)

A new outbreak of screwworm in Taiz, Ibb and Dhamar governorates in central Yemen has killed hundreds of livestock, particularly in Taiz's Sharaab District where half the estimated 40,000 population depend on livestock for a living, local officials say.

Some 100-200 cows, sheep and goats died in the past two weeks in the villages of Mahmadan, al-Aridha, al-Ahtoub and Hajifa as a result of the outbreak, Anwar Abdullah, a local councillor in Taiz, told IRIN on 28 September 2009. Dozens of cattle had also died in southern parts of Ibb Governorate, he said.

Livestock farming is an important source of livelihood for about 30 percent of rural residents, who make up 71 percent of Yemen's 22-milion people (Photo by Adel Yahya/IRIN)

"I have lost my camel and seven sheep as vets didn't get to my village in time," said Saleh Mohammed, a 75-year-old herder from Ans District in Dhamar Governorate, who has four additional infected goats and one infected cow. "My neighbour was given insecticide for his infected cow but it didn't help save its life."

The screwworm fly lays its eggs in a cut or open wound on a warm-blooded animal. Maggots then feast off the living flesh, and can kill the animal if the wound is not cleaned and treated with insecticide in time.

Another treatment technique - not yet tried in Yemen but successful in the USA and other countries - is called the sterile insect technique: Millions of male screwworm flies are bred and sterilized with radiation, then released into the wild.

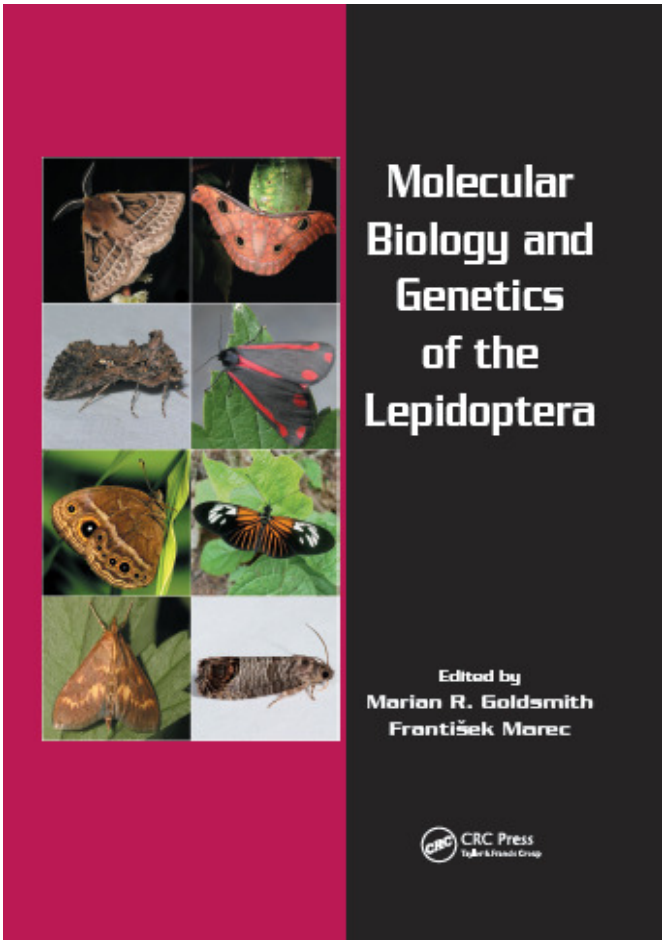
Since the first screwworm outbreak in 2007, over 20,000 livestock had been affected, but there had been relatively few deaths.

Prompter reporting of the disease by herders could have saved scores of cattle over the past few months, according to Taiz councillor Abdullah. "The Ministry often learns of new outbreaks only after it is too late to do anything about them," he said.

Source: Humanitarian news and analysis (www.irinnews.org, 24 November 2009)

Molecular Biology and Genetics of the Lepidoptera

This recently published book by CRC Press presents a wide-ranging collection of studies on the Lepidoptera, treating them as specialized insects with distinctive features and as model systems for carrying out cutting-edge research. Leading researchers provide an evolutionary framework for placing moths and butterflies on the tree of life.



The book covers progress in deciphering the silkworm genome and unravelling lepidopteran sex chromosomes. It features new information on sex determination, evolution, and the development of butterfly wing

patterns, eyes, vision, circadian clocks, chemoreceptors, and sexual communication.

The contributors discuss the genetics and molecular biology of plant host range and prospects for controlling the major crop pest genus *Helicoverpa*. They also explore the rise of insecticide resistance, the innate immune response, lepidopteran minihosts for testing human pathogens and antibiotics, and the use of intrahemocoelic toxins for control.

The book concludes with coverage of polyDNA virus-carrying parasitoid wasps, and the cloning of the first virus resistance gene in the silkworm. Understanding the biology and genetics of butterflies and moths may lead to new species-selective methods of control, saving billions of dollars in pesticide use and protecting environmental and human health—making the sections on strategies for pest management extremely important. This book will open up new paths to the research literature for a broad audience, including entomologists, evolutionary and systematic biologists, geneticists, physiologists, biochemists, and molecular biologists.

Source: CRC Press

Spotted Wing Vinegar Fly, *Drosophila suzukii* (Matsumura) (Diptera: Drosophilidae), a fruit pest new to North America

The first Florida detections of this fly were made on 4 August 2009 in rural Hillsborough Co. where a single male fly was captured in each of two separate multi-lure traps located about 3 miles apart. Delimiting trapping is under way to better understand the fly's distribution and population levels.

Drosophila suzukii *male (Photography credit: G. Arakelian, Los Angeles County Agricultural Commissioner/Weights & Measures Department)*

In the fall of 2008, the first reports emerged of an unfamiliar fruit pest in the Watsonville area of central coastal California (Santa Cruz Co.). Vinegar fly (Drosophilidae) larvae were found in maturing fruits of raspberries and strawberries, apparently as primary pests. This was quite out of the ordinary, as vinegar flies (including the well-known and ubiquitous *Drosophila melanogaster*) typically lay eggs on damaged and decaying fruit. This pest, new to North America, was determined to be *Drosophila suzukii*.

The problem in California has since escalated. Fly populations are now widespread in central California and detections have been made over the entire length of the state from San Diego Co. in the south to Siskyou Co. in the north. Flies have been found infesting fresh cherries with severe production losses in some areas.

Cherries damaged by Drosophila suzukii*. (Photography credit: University of California Cooperative Extension, Mariposa County)*

Infestation in cherry initially is manifested by scars in the fruit surface left by "stinging" (ovipositing) females. As egg hatch time is very short (about 1 day), larvae soon begin feeding inside the fruit. Within as little as 2 days, the fruit begins to collapse around the feeding site. Thereafter, mold and infestation by secondary pests may contribute to further damage.

Source: www.fl-dpi.com (5 August 2009)

African Union Commission Launches PATTEC Postage Stamp

The eradication of selected tsetse and trypanosomiasis populations from Sub Saharan Africa is moving in the right direction, but we need to enhance the pace". Mrs. Rhoda Peace Tumusiime, Commissioner for Rural Economy and Agriculture of the African Union Commission, was speaking while launching the Postage Stamps of the Pan African Tsetse and Trypanosomiasis Eradication Campaign (PATTEC) on 21 July 2009, at the headquarters of the Africa Union (AU) in Addis Ababa, Ethiopia.

Postage Stamps of the Pan African Tsetse and Trypanosomiasis Eradication Campaign (PATTEC)

Commissioner Tumusiime hailed the launching of the PATTEC Commemorative Postage Stamps as a historic occasion, "first of its kind in any Pan African advocacy work aimed at eventually ridding the continent of tsetse and trypanosomiasis". The Commissioner reiterated the success story of Botswana and Namibia as testimony of a success story that could be emulated within the framework of the campaign against tsetse species.

Source: www.africa-union.org

European Grapevine Moth, *Lobesia botrana*: A New Pest in California

Lobesia botrana, European grapevine moth was first reported in the USA from Napa County vineyards in October 2009. Native to southern Italy, it was first described from Austria and is now found throughout Europe, North and West Africa, the Middle East, and eastern Russia. It was more recently introduced into Japan, and in 2008, it was first reported on the American continent in Chile. It belongs to the family Tortricidae, sub-family Olethreutinae. Earlier species names included *Polychrosis botrana* and *Eudemis botrana*. In Europe, some of the common names are *eudemis* (France); *tignolleta della vite* (Italy); *Bekreuzter Traubenwickler* (Germany); *polilla del racimo* (Spain); and *European grape berry moth* and *European vine moth* (English-language literature).

Studies of the European grapevine moth show that larvae feed primarily on the flowers and fruit of grape. Other hosts include olives, blackberries, cherries, nectarines, persimmons and pomegranates

Damage cause by the European grapevine moth, Lobesia botrana

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Source: www.ipm.ucdavis.edu

Irradiation of plant products in Mexico

Irradiation as a post-harvest phytosanitary treatment offers great technical and economic advantages as opposed to traditional treatments such as methyl bromide or hot water treatment. Its commercial application for plant quarantine uses has an important growth potential.

Through the years, Mexico has exported a considerable volume of plant products to different parts of the world, mainly to the USA. Some of the plant products can be exported only after receiving phytosanitary treatment either by physical or chemical means. This situation affects in one way or another the organoleptic characteristics of products causing changes in colour, smell or flavour. Also, these changes can reduce the produce shelf life. Methyl bromide fumigation is the quarantine treatment widely used. However, its major setback is that it affects the ozone layer and therefore contributes to global warming.

Irradiation as a phytosanitary treatment was approved by NAPPO in a regional phytosanitary standard in 1997. In 2003 the International Plant Protection Convention (IPPC) of the Food and Agriculture Organization (FAO) of the United Nations approved the International Standard for Phytosanitary Measures No. 18 titled *Guidelines for the use of irradiation as a phytosanitary measure*. This international standard provides technical guidance on the specific procedures for the application of irradiation as a phytosanitary treatment for regulated pests or articles and establishes that phytosanitary authorities should be in charge of evaluation, adoption and use of irradiation as a phytosanitary measure.

Irradiated mangoes for export to the USA

Once the United States Department of Agriculture implemented this international standard in its national regulations they accepted irradiation as phytosanitary treatment for imported fruit products. SAGARPA included gamma rays in the modification to the Mexican Official Norm NOM-022-FITO-1995, *Requirements and specifications that a legal entity must comply with to provide phytosanitary treatment services*. The objective of the standard is to establish the requirements and specifications for persons interested in starting a business to provide phytosanitary treatment services for plants, plant products, by-products for importation, exportation or domestic movement. This is in order to sign an equivalency agreement with USDA, as well as several work plans that presently allow export of guava, mango, citrus (orange, grapefruit and mandarin), carambola and manzano chili peppers.

Mexico started implementing this technology in November 2008. This has allowed exports of approximately 1000 tons of Mexican guava to the United States. Additional to this fruit, last July Mexico exported two shipments of irradiated Manila mango (34 tons) to the United States and starting September 2009 irradiated citrus (grapefruit, orange and mandarin), manzano chili pepper and carambola can be send to the United States.

Source: Mario Puente. Phytosanitary Regulation, Plant Health General Directorate, SENASICA, Mexico

Interesting Published Articles

Incompatible insect technique: incompatible males from a *Ceratitis capitata* genetic sexing strain

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Abstract

Wolbachia are obligatory intracellular and maternally inherited bacteria that infect and spread through natural arthropod populations by inducing male-killing, feminization, parthenogenesis and, most commonly, unidirectional and bidirectional cytoplasmic incompatibility (CI). Cytoplasmic incompatibility can be used to control natural populations of insect pests, in a way analogous to the sterile insect technique (SIT), namely through the incompatible insect technique (IIT). For the successful application of the ITT (based on a unidirectional CI approach) against a target species, it is essential that only males are released, as the release of females would lead to fertile matings between the released males and the released females and the establishment of a *Wolbachia*-carrying field population. In the present study, we describe a *Wolbachia*-infected line of the VIENNA 8 genetic sexing strain of the Mediterranean fruit fly, *Ceratitis capitata* (Wiedermann) (Diptera: Tephritidae), that carries the selectable marker *temperature sensitive lethal* (*tsl*). We show that (1) transferred *Wolbachia* induce high levels of CI even after the temperature treatment required for the male-only production, and (2) the *Wolbachia*-infected genetic sexing *C. capitata* line can be used in cage population suppression experiments analogous to the SIT. We also discuss our results in a comparison between IIT and SIT, investigating whether irradiation and cytoplasmic factors can be combined toward the development of novel strategies for insect pest control.

The full paper was published in: Entomologia Experimentalis et Applicata 132: 232-240 (2009)

The future of IPM: whither or wither?

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Abstract

The acronym IPM (integrated pest management) has been around for over 50 years and now not only supposedly guides research and extension in pest management but also markets pesticides, is claimed to be undertaken by many growers, and even resonates with public perceptions and politicians. Whether or not IPM programs are sustainable in the longer term under the conflicting stresses and strains of the modern agricultural environment is debatable. We analyse three case studies of IPM development in Australia: citrus IPM in central Queensland, *Brassica* IPM in southeast Queensland and *Helicoverpa* management in cotton in eastern Australia. Many management practices for these pests have changed over time. In the more stable citrus system classical biological control along with changed practices (reduced pesticide use) have effectively controlled imported scale insect pests. In *Brassicas* and cotton, IPM is predominantly of the sample and spray variety where, increasingly, less broad-spectrum insecticides are used and, in cotton, *Helicoverpa* management includes the deployment of transgenic plants. We question whether or not IPM principles are always consistent with market forces and whether or not the approach is universally applicable for all pest insects when implemented at the small (field or farm) scale. Farmers will adopt cost-effective approaches that minimise their financial risks. For Australia as a whole over the last 30 years insecticide input costs per hectare have increased faster than the price index, reflecting more costly insecticides, changes to the combinations of crops grown and an increase in the overall area of crops cultivated together with possible concomitant changes in pest abundance. Any pest crisis will ensure rapid changes in practice and adoption of technologies, in order to mitigate the short-term financial stresses caused. However, regression to former practices tends to follow (e.g. in *Brassica* crops). In most cases, we cannot objectively test if changed management practices are responsible for changes in pest abundance, as is often claimed, or if the latter is simply a consequence of the weather and/or related large-scale landscape features (e.g. area of host plants).We argue that for many systems the future of pest management practice will require a change to landscape or area-wide approaches. We suspect, given how entrenched the acronym has become, whatever the nature of the approach it will be called IPM.

The full paper was published in: Australian Journal of Entomology 48: 85-96 (2009)

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