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(upper) Construction of the false codling moth mass-rearing facility in Citrusdal, South Africa, (lower, left) diet sterilizer, and (lower, right) adult holding cages.

To Our Readers

The application of the sterile insect technique (SIT) as part of an area-wide integrated approach against lepidopteran pests has largely been confined to containment and recently eradication of the pink bollworm *Pectinophora gossypiella* in the south-western USA, suppression of the codling moth *Cydia pomonella* in western Canada (and now also in Mendoza, Argentina – see inside newsletter), and recently eradication of Australian painted apple moth *Teia anartoides* outbreaks in New Zealand. Considerable efforts have been made to develop the technology against a number of other Lepidoptera pests, including gypsy moth, diamondback moth, carob moth, corn earworm, oriental fruit moth, etc., but for various reasons did not reach large-scale application as yet, or were not considered essential or cost-effective. We would like to report that good progress has been made in developing the SIT technology for two other lepidopteran pests: the false codling moth (FCM) *Thaumatotibia leucotreta* in South Africa and the cactus moth *Cactoblastis cactorum* in the USA and Mexico. In both cases, the use of sterile moths is currently being applied as part of operational area-wide IPM programmes.

The FCM is endemic to sub-Saharan Africa, where it is considered to be a key pest of citrus and many other crops. This pest represents a serious invasive threat to many countries that are free of this pest, and it features prominently on the lists of most feared invasive species of many regional plant protection organizations that have expressed concern of its potential spread as a result of the increasing international trade. FCM thus carries phytosanitary status for many of the markets to which South Africa exports citrus fruits, such as the lucrative US market and the promising Chinese market. In addition, this pest has developed resistance to the commonly applied organophosphate and other insecticides normally used for its control in South Africa.

Therefore, a research project was started in 2002 to develop the SIT (or its derivative, the inherited sterility (IS)) as an area-wide pest management tactic in South Africa, but also as an eradication tool should FCM be introduced into other countries. This multi-agency effort included Citrus Research International, the Citrus Growers Association, the Agricultural Research Council (ARC) of South Africa, as well as the FAO/IAEA (under project SAF/5/007), and USDA's Agricultural Research Service (USDA-ARS). The research topics addressed include improving mass-rearing methods, basic radiation biology, and field-cage studies to assess the effect of different untreated : irradiated FCM male ratios on the incidence of inherited sterility and fruit damage. Studies also included the egg parasitoid *Trichogrammatoidea cryptophlebiae*, showing that it accepts and successfully develops in sterile FCM eggs, indicating a potential for simultaneous field application of FCM-SIT/IS and augmentative releases of the parasitoids for synergistic suppression.

This research led to a commercial pilot-scale SIT trial in an isolated 35 ha citrus orchard in the Citrusdal Valley 200 km north of Cape Town. The season-long pilot trial, carried out in 2005/2006, gave excellent results, with 95% control of the FCM population and subsequent significant reductions in FCM-related fruit damage. Based on these encouraging results and the need to rapidly overcome increasing difficulties to export, the citrus industry decided to move towards area-wide application and plans were initiated for fast-tracking the commercialization of FCM SIT. A private company, *Xsit* (Pty) Ltd, was established to commercialize the project, with 50% of shareholding held by the industry's commercialization company, and 50% by a government-funded initiative to support South African biotechnology, with continued support from FAO/IAEA and ARC. A decision was made to build a mass-rearing facility in Citrusdal, Western Cape, where the majority of the citrus is produced that is exported to the US market. The plan foresees this as a first phase of development, with the option of constructing additional facilities for other major citrus producing areas, once this project is well established and has proven to be economically viable and sustainable. The rapid construction and equipping of the rearing and irradiation facility with a production capacity of 15 million sterile moths per week is nearing completion (see picture front page). The Citrusdal Valley will be the first to be treated with sterile moths and the first releases on 1500 ha of commercial citrus are scheduled for late 2007-early 2008. In 2010-2011, it is planned to gradually expand the treated area to 6000 ha.

Once an example of successful classical biological control of weeds, the cactus moth *C. cactorum* invaded southern Florida in the late 1980s and has been consistently advancing westward along the coast of the Gulf of Mexico, already reaching Alabama. There is grave concern that this pest will eventually spread to the cactus-rich south-western USA, Mexico and Central America, where entire ecosystems are based on *Opuntia*, and where the pest also represents a major threat to an important food and fodder *Opuntia* industry. With the support of the FAO/IAEA and other partners, USDA-ARS has been developing a pheromone monitoring system and various components of the SIT to be used in an integrated approach to prevent further expansion of the cactus moth. With FAO/IAEA support (project MEX5029), a preventive programme was established in Mexico to create awareness and to develop a monitoring network. Likewise, a bi-national Mexico-USA programme, funded by USDA-APHIS and Mexico's SAGARPA, and with thechnicla support of other organizations, was established

Adult Cactoblastus cactorum *(Photo from Ignacio Baez).*

with the objective to contain the advance of the pest along the US Gulf coast.

Fortunately these measures are already showing results. The programme in the USA has been successful in stopping further spread of the pest towards the west along the coast of the Gulf of Mexico. The pest has not been detected west of Dauphin Island, Alabama, were it has been since 2004. Stripping of *Opuntia* plants in Fort Morgan, Dauphin Island and Little Dauphin Island combined with the release of sterile moths have been the main control activities. Extensive surveillance activities through visual inspection of *Opuntia* plants and pheromone traps are conducted routinely in infested areas and beyond the leading edge of the infestation to assess the population levels and spread of the pest. The cactus moth pro-

gramme is evolving from experimental and validation pilot activities, led by USDA-ARS, to an operational programme managed by USDA-APHIS-PPQ. The cactus moth rearing technology will be transferred from ARS laboratories in Tifton, Georgia to a Department of Plant Industry rearing facility in Gainesville, Florida. This will allow an increase in production levels to satisfy the demand of sterile moths in the infested areas in the eastern USA, as well as for potential future outbreaks in Mexico. ARS will continue supporting the programme with R&D focused on improving mass-rearing methods and the optimization of the cactus moth pheromone. A priority will be the expansion of the surveillance network towards the west along the Gulf coast in Mississippi and Louisiana and into the interior areas of these states and Florida.

In Mexico, the establishment of an efficient monitoring network allowed the detection of outbreaks of cactus moth on the island of Mujeres in August 2006, and the island of Contoy and also in Cancun in early 2007; all in the Yucatan peninsula. After intensive eradication activities in Isla Mujeres no biological stage of the pest has been found on this island since February 2007. The technical criteria to declare eradication is three generations of the pest which in the case of *C. cactorum* is equivalent to 12 months. In Isla Contoy limited suppression activities are being conducted as it is a protected natural area and no extensive host stripping activities can be enforced or insecticides applied. This is problematic as Isla Contoy can become a permanent cactus moth reservoir and thus a permanent threat to *Opuntia* cactus for mainland Yucatan Peninsula. The shipment of sterile moths from the USA into these areas started with test shipments to check if the biological material can easily pass customs and phytosanitary authorities in the USA and Mexico and to assess the effects of transportation on the quality of the sterile moths. These shipments are scheduled to continue until the eradication goal is achieved. Efforts in Mexico will in addition continue to focus on assessing if the cactus moth has been eradicated from Isla Mujeres and Cancun, and to strengthen the surveillance efforts along the coast of the Yucatan Peninsula.

In terms of new publications, I would like to highlight the new text book on Area-Wide Control of Insect Pests. From Research to Field Implementation (789 pp.) published in November 2007 by Springer in The Netherlands (see more details within this newsletter). Another recent release is the FAO/IAEA Standard Operating Procedures for Mass-Rearing of Tsetse Flies, which is an excellent contribution to the African Union's Pan-African Tsetse and Trypanosomosis Eradication Campaign (PATTEC).

With respect to Coordinated Research Projects (CRPs), the proceedings of the five-year CRP on "Development of Improved Attractants and their Integration into Fruit Fly SIT Management Programmes" have been published in October 2007 as an IAEA-TECDOC. The issue is freely available upon request, and includes 24 papers prepared by CRP participants from 18 countries, addressing a majority of fruit flies of economic importance.

I would also like to call attention to two new CRPs, that will be initiated in the first half of 2008, and for which we are encouraging the submission of relevant research proposals. The first CRP entitled "Applying GIS and Population Genetics for Managing Livestock Insect Pests", was recommended by a consultants meeting and has now been approved for the period 2008-2012. It will focus on the integration of three tools that have great potential to improve the planning, implementation and progress-monitoring of area-wide IPM campaigns with an SIT component: (1) modelling of pest population dynamics, (2) satellite-imagery-derived distribution and prediction maps and other Geographic Information System (GIS)-aided data processing, and (3) information on population genetics, providing evidence on isolation or confinement of target pest populations.

The second new CRP on Field Biology of Male Mosquitoes in Relation to Genetic Control Programmes is also based on the outcome of a consultants meeting and will likewise be initiated in 2008. The CRP will focus on research related to adult male mosquito biology, and particularly on those factors that affect the ability of males to attract, court, and inseminate females in the field. The ultimate goal of the CRP is to establish the specific biological and behavioural determinants that contribute to male mosquito sexual competitiveness.

Concerning staff news, as reported in the last newsletter, the IPC Subprogramme is currently undergoing a significant staff turn-over, largely due to various staff members completing their fixed seven year appointment with the IAEA. Carlos Cáceres, the next staff member who left us in August, has been an important member of the Subprogramme, responsible for fruit fly mass-rearing and related technology development and transfer to many Member States. In addition, he managed coordinated research activities related to fruit fly quality control, developed a generic model for designing and equipping mass-rearing facilities, as well as a number of other activities. We all much appreciate his professionalism and hard work. Carlos has moved back to Guatemala, where as a USDA research scientist, he is leading a new programme on *Anastrepha* fruit flies. We will miss him much as a friend and colleague, and have no doubt that he will be very successful in this new position. Carlos can be reached by email at caceres-ce@hotmail.com.

We want to congratulate and welcome Andrew Jessup from Australia, who will be replacing Carlos in March 2008. Andrew has been Senior Research Horticulturist of the New South Wales Department of Plant Industry, were he has been responsible for R&D into market access for fruit fly host commodities, field control of fruit flies (including surveillance and the integration of baits, sterile insects, and parasitoids), and the development of various quarantine treatments. Andrew has had numerous interactions over the years with the FAO/IAEA Agricultural

Programme as an expert, consultant, and researcher in coordinated research projects. He has considerable management experience gained as manager of the Queensland fruit fly programme. We wish him much success in his new position.

Colin Malcolm has been carrying out the tasks of the mosquito entomologist, a position that has been vacant for more than one year. We much appreciate Colin's dedication in support of this new R&D area, as well as the continued progress made in rearing technology and genetic sexing. We would like to thank Colin for his support and hope he can continue his fruitful involvement in the mosquito project. We wish him a good return to his position at Queen Mary, University of London. At the same time we want to welcome Mark Benedict, who as research biologist at the Center for Disease Control in Georgia, USA, was responsible for conducting the research programme in genetics and molecular biology of *Anopheles* mosquitoes, including the maintenance of the Malaria Research and Reference Reagent Resource Center. He returns to the IAEA after a break of about 18 months.

Finally, I would like to take this opportunity, on behalf of myself and all staff of the Subprogramme, to thank all our collaborators for a fruitful 2007, and to wish you all the very best for the year 2008. We are certainly looking forward to an exciting and rewarding year, and hope that you can share successes with us in the next twelve months.

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Forthcoming Events

I. Research Coordination Meetings (RCMs)

CRP on Development of Standardized Mass-Rearing Systems for Male *Anopheles arabiensis* Mosquitoes, second RCM. 11-15 February 2008, Ghent, Belgium.

CRP on Improving Sterile Male Performance in Fruit Fly SIT Programmes, third RCM. 1-5 April 2008, Valencia, Spain.

CRP on Development of Mass-Rearing for New World (*Anastrepha*) and Asian (*Bactrocera*) Fruit Fly Pests in Support of SIT, third RCM. 1-5 April 2008, Valencia, Spain.

CRP on Biology of Male Mosquitos in Relation to Genetic Control Programmes, first RCM. 21-25 April 2008, Vienna, Austria.

CRP on Applying GIS and Population Genetics for Managing Livestock Insect Pests, first RCM. 7-11 July 2008, Vienna, Austria.

CRP on Molecular Technologies to Improve the Effectiveness of SIT, fourth RCM. 19-23 August 2008, Antigua, Guatemala.

CRP on Improved and Harmonized Quality Control for Expanded Tsetse Production, Sterilization and Field Application, fourth RCM. 6-10 October 2008, Addis Abeba, Ethiopia.

II. Consultants and Other Planning Meetings

Workshop on Improving SIT for Tsetse Flies through Research on their Symbionts and Pathogens, ICIPE, Nairobi, Kenya, 14-19 April 2008.

Technical Panel (IPPC) on Pest Free Areas and Systems Approaches for Fruit Flies. 13-17 October 2008, Vienna, Austria.

Consultants Meeting on Development of Bait Stations for Fruit Fly Suppression in Support of SIT. 29 October-1 November 2008, Mazatlan, Mexico.

III. Other Meetings/Events

Second FAO/IAEA/PATTEC Regional Training Course on Principles of Baseline Data Collection for Integrated Area-Wide Tsetse Control. 18 February-14 March 2008, Dakar, Senegal.

First International Meeting of Tephritid Workers of Europe, Africa and the Middle East. 7-9 April 2008, Majorca, Spain.

Satellite Meeting on the Use of Area-Wide Tsetse Fly Suppression Techniques in Preparation of the SIT. May 2008 (exact dates to be confirmed), Zambia.

Symposium on African Trypanosomosis (Symposium 1 - Medical and Veterinary Entomology) at the International Congress of Entomology. 6-12 July 2008, Durban, South Africa.

7th International Conference on Integrated Fruit Production. IOBC, working group on Integrated Plant Protection in Fruit Crops. 27-30 October 2008, Avignon, France.

Past Events (2007)

I. Research Coordination Meetings (RCMs)

Fourth RCM of the Coordinated Research Project (CRP) on Improvement of Codling Moth SIT to Facilitate Expansion of Field Application, 19-23 March 2007, Vacaria, Brazil.

Third RCM of the CRP on Improved and Harmonized Quality Control for Expanded Tsetse Production, Sterilization and Field Application, 7-11 May 2007, Muguga, Kikuyu, Kenya

First RCM on Improving SIT for Tsetse Flies Through Research on their Symbionts and Pathogens. 1-5 October 2007, Vienna, Austria.

II. Consultants and Other Planning Meetings

Consultants Meeting on Finalizing the Genome Sequence of the Tsetse Salivary Gland Hypertrophy Virus, 11-13 April 2007, Vienna, Austria.

Consultants Meeting on the Integration of GIS and Population Genetics for Livestock Insect Pests, 16-20 April 2007, Vienna, Austria.

Workshop on The Development of a Detailed Action Plan for the Collection of Entomological Base Line Data on Tsetse, 21 May-1 June 2007, Dakar, Senegal.

Consultants Meeting on Increasing the Efficiency of Lepidoptera SIT by Enhanced Quality Control. 3-7 December 2008, Vienna, Austria.

III. Other Meetings/Events

The Leverhulme Trust Tsetse Research Network (LTTRN) European Workshop, 2-4 March 2007, CIRAD/IRD, Montpellier, France.

Meeting of the Commission of Phytosanitary Measures-2 (CPM-2) of the International Plant Protection Convention (IPPC), 26-30 March 2007, Rome, Italy.

National workshop on The Control of the Red Palm Weevil *Rhynchophorus ferrugineus* Oliver, 2-3 April 2007, King Abdulaziz City for Science and Technology (KACST), Riyadh, Saudi Arabia.

WHO/TRD Meeting on Consultation on Framework for the Transition from Current Activities and Implementation of the New Vector Research Strategy, 23-24 April 2007, Geneva, Switzerland.

11th PAAT Programme Committee Meeting, 24-25 April 2007, Geneva, Switzerland.

First International *Cactoblastis cactorum* Conference, 7-10 May 2007, Phoenix, Arizona, USA.

Regional Coordination Meeting of National Tsetse Counterparts. 16-18 July 2007, Vienna, Austria.

Workshop on the Status and Future of Tsetse Control in South Africa. 6-8 August 2007, Richards Bay, South Africa.

Meeting of the Panel of the PAAT Advisory Group (PAG) Coordinators. 27-28 September 2007, Luanda, Angola.

29th Meeting of the International Scientific Council for Trypanosomiasis Research and Control (ISCTRC), 1-5 October 2007, Luanda, Angola.

Workshop on Status and Future of Mediterranean fruit fly Control in Croatia. 18 October 2007, Metković, Croatia.

Meeting on Regional Designated Centres for Training on Tsetse and Trypanosomosis Control, 15-19 October 2007, Vienna, Austria.

Tenth Meeting of the Arthropod Mass-Rearing and Quality Control Working Group of the IOBC, 28 October-1 November 2007, Montreal, Canada.

Meeting of Asia Regional Project Coordinators on Sharing Regional Knowledge on Area-Wide Integrated Fruit Fly Pest Management, 19-23 November 2007, Vienna, Austria

FAO/IAEA/PATTEC Regional Training Course on Principles of Tsetse Population Genetic Sampling and Tsetse Morphometrics. 29 November-7 December 2007, Tororo, Uganda.

Meeting on Chikungunya and other Arboviruses in the Tropics. 3-4 December 2007, Saint Pierre, La Réunion.

Technical Panel on Pest Free Areas and Systems Approaches for Fruit Flies (IPPC). 3-7 December 2007, Vienna, Austria.

The Leverhulme Trust Tsetse Research Network (LTTRN) Workshop on Tsetse Elimination in Guinea and Neigbouring Countries. 9-14 December 2007, Conakry, Guinea.

Note: Reports available upon request

Technical Cooperation Projects

The IPC 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 under five major areas, namely:

- Tsetse flies
- Fruit flies
- Old and New World screwworm flies
- Lepidoptera
- Mosquitoes

Project Number	Title	Technical Officer
	Continuing Projects	
ALG/5/019	Control of Date Moth Using the Sterile Insect Technique	Marc Vreysen
BGD/5/025	Studying the Feasibility of Integrating the Sterile Insect Technique in Sun-Dried Fish Industry Project	Udo Feldmann
BKF/5/004	Feasibility Study on Applying the Sterile Insect Technique to Create a Tsetse-Free Zone	Marc Vreysen
BRA/5/057	Establishment of Medfly, Fruit Fly Parasitoids and Codling Moth Rearing Facility	Rui Cardoso Pereira
EGY/5/025	Area-Wide Fruit Fly Control in Eastern Egypt	Jorge Hendrichs
ETH/5/012	Integrating SIT for Tsetse Eradication	Udo Feldmann
INT/5/145	Promotion of Insect Pest Control Using the Sterile Insect Technique	Jorge Hendrichs
IRQ/5/016	Field Monitoring and Rearing of Old World Screwworm	Udo Feldmann
JOR/5/010	Strengthening the Capacity for the Area-wide Suppression of the Mediterranean Fruit Fly Using the Sterile Insect Technique	Jorge Hendrichs
KEN/5/022	Integrated Area-wide Tsetse and Trypanosomosis Management in Lambwe Valley	Udo Feldmann
MAL/5/020	Feasibility Study for the Creation of a Zone Free of Tsetse	Marc Vreysen
MAR/5/015	Feasibility Study for Integrated Use of the Sterile Insect Technique for Area-Wide Tephritid Fruit Fly Control	Jorge Hendrichs
MEX/5/029	National Prevention Campaign Against the Cactus Moth	Rui Cardoso Pereira
MOR/5/028	Assessing the Feasibility of Medfly Suppression through the Sterile Insect Technique	Udo Feldmann
PAL/5/003	Strengthening the National Capacity for the Area-Wide Suppression of the Mediterranean Fruit Fly	Jorge Hendrichs
PAK/5/043	Development of Biological Control for Cotton Pest Management Using Nuclear Techniques	Jorge Hendrichs
RAF/5/051	SIT for Tsetse and Trypanosomosis Management in Africa	Udo Feldmann
RAF/5/052	SIT Development for Control of *Anopheles* Mosquito	Alan Robinson Colin Malcolm
SAF/5/007	Expanding the Use of the Sterile Insect Technique Against Fruit Pests in the Western and Northern Cape	Jorge Hendrichs

SAF/5/009	Preparation for the Creation of Zone Free of G. *brevipalpis and* G. *austeni*	Marc Vreysen
SEN/5/029	Feasibility Study to Create a Tsetse-Free Zone Free Using the Sterile Insect Technique	Marc Vreysen
TUN/5/022	Implementation of the Pilot Programme Using Sterile Insect Technique Against the Mediterranean Fruit Fly, Phase II	Rui Cardoso Pereira
URT/5/022	Assistance to a Feasibility Study for the Use of the Sterile Insect Technique	Marc Vreysen
	New Projects Started in 2007	
BOT/5/004	Integrating the Sterile Insect Technique into the National Tsetse and Trypanosomosis Control Programme	Udo Feldmann
BZE/5/002	Establishment of a Pilot Fruit Fly Free Area Using an Integrated Approach that Includes the Area-Wide Sterile Insect Technique	Rui Cardoso Pereira
CRO/5/002	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	Establishment of Fruit Fly Free or Low Prevalence Areas using the Sterile Insect Technique	Rui Cardoso Pereira
ISR/5/012	Feasibility Study to Assess the Integration of the Sterile Insect Technique into Olive Fly Suppression Programmes	Jorge Hendrichs
MAR/5/016	Feasibility Study for the Suppression of the Melon Fly (*Bactrocera cucurbitae*) in Selected Areas of Mauritius	Jorge Hendrichs
MYA/5/014	Support for a Feasibility Study on Using the Sterile Insect Technique against Diamond Back Moth	Marc Vreysen
PAN/5/016	Capacity Building for Suppression of Fruit Flies of the Genus *Anastrepha* from the Azuero Peninsula using an Area-Wide Pest Management Approach	Rui Cardoso Pereira
RAS/5/049	Sharing Regional Knowledge on the Use of the Sterile Insect Technique within Integrated Area-Wide Fruit Fly Pest Management Programmes.	Jorge Hendrichs Rui Cardoso Pereira
SEY/5/003	Feasibility of Integrating the Sterile Insect Technique to the Ongoing Area-Wide Melon Fly Eradication Programme	Rui Cardoso Pereira
TUN/5/025	Use of Inherited Sterility as a Genetic Control Method Against the Carob Moth	Marc Vreysen
UGA/5/027	Feasibility for a *Glossina fuscipes* Free Zone in the Lake Victoria Basin	Marc Vreysen
ZIM/5/012	Feasibility Study on the Use of SIT to Eradicate Tsetse in Zimbabwe	Udo Feldmann

The following provides some highlights of technical co-operation projects that are technically supported by the IPCS.

Workshop on the Status and Future of Tsetse Control in South Africa, 6-8 August 2007, Richards Bay, South Africa (SAF5009).

The tsetse problem in South Africa is well documented and studied, and remains in many respects unique, i.e. (1) the problem is confined to one province of South Africa (KwaZulu Natal (KZN)), (2) the infested area is of a reasonable size (12 000 km^2) and located at the most southern limit of the tsetse distribution, and (3) probability of presence maps have indicated that the infested area (KZN and southern Mozambique) is completely isolated from the remainder of the tsetse belt. From a technical point of view, the tsetse situation in KZN provides an ideal situation to create a sustainable tsetse-free zone on Africa mainland (more info in **Kappmeier Green, K., Potgieter, F.T., and Vreysen, M.J.B. 2007.** A strategy for an area-wide control campaign with an SIT component to establish a tsetse-free South Africa, pp. 309-323. *In* M.J.B. Vreysen, A.S. Robinson, and J. Hendrichs (eds.), Area-wide control of insect pests. From research to field implementation. Springer, Dordrecht, The Netherlands).

The KwaZulu Natal Directorate of Veterinary Services (KZN DVS) organized a workshop in Richards Bay (6-8 August 2007), to discuss with all stakeholders the status and future of tsetse control in South Africa. The workshop was attended by representatives of the KZN DVS, the National Directorate of Veterinary Services of Mozambique, the Onderstepoort Veterinary Institute (OVI), the KZN Wildlife Services, the Nuclear Energy Corporation of South Africa (NECSA), the Pan African Tsetse and Trypanosomiasis Eradication Campaign (PATTEC) and the FAO/IAEA.

At the workshop, the DVS KZN endorsed the "Feasibility Study Document" (prepared with the assistance of the IAEA – see IPCS Newsletter No 67, pp. 22-23) and confirmed its full commitment to create a tsetse-free zone in KZN in collaboration with Mozambique. The Government of Mozambique expressed likewise its commitment to the project. However, adequate funding is required to implement such an operational programme, and for this, the support and endorsement of the Department of Agriculture (DOA National Government) is required. The seriousness of the trypanosomosis problem was again exemplified by recent survey data that indicated average trypanosomosis prevalence rates in livestock of 25-45% in the communal farming areas of KZN. It was likewise noted that sufficient data have been collected over the past years to develop and start implementing an operational area-wide integrated pest management programme to create a tsetse-free zone in KZN and southern Mozambique. Therefore, the workshop recommended the establishment of a task force to develop a comprehensive, bankable project document and a business plan.

Both South Africa and Mozambique have submitted a concept note to the Department of Technical Cooperation for further IAEA support for their tsetse projects for the programme cycle 2009-2011.

Regional Meeting of National Tsetse Co-ordinators, 16-18 July 2007, Vienna, Austria (RAF5051).

A regional meeting of tsetse coordinators, funded under Technical Cooperation Project RAF5051, was convened at the IAEA, Vienna, Austria, from 16-18 July 2007. The objectives of the meeting were: (1) to review the progress in the tsetse projects of the PATTEC (Pan African Tsetse and Trypanosomosis Eradication Campaign) "List 1" Countries that are supported with funds (loans and grants) from the African Development Bank (AfDB) under project: the Creation of Tsetse and Trypanosomiasis-Free Areas in East and West Africa (Mali, Burkina Faso, Ghana, Ethiopia, Kenya and Uganda), (2) to identify gaps that require urgent attention (i.e. what is missing to make progress) and assistance/resources required to ensure the attainment of project objectives, and (3) to provide some lessons to "List 2" countries that have likewise requested financial support from the AfDB. The meeting was attended by the national project coordinators of the List 1 Countries, representatives from some List 2 countries, the PATTEC coordinator, and representatives of IAEA, WHO, and FAO. Key issues discussed were (1) entomological baseline data collection, (2) requirements for area-wide pest management, (3) project management, and (4) area-wide suppression tactics and the various methods for tsetse suppression and eradication within the context of area-wide pest management.

The meeting recognized that the scope of the AfDB-funded projects was too ambitious and in many instances not realistic. It was recommended to modify the objectives of the project, based on the data that will emanate from the baseline data collection, to ensure that the goal of the different projects can be reached within the projected time frame.

The meeting likewise recognized, that in most projects of the List 1 countries, inadequate baseline data is available that would allow the development and implementation of a sound intervention strategy. It was noted that some funds were allocated under the AfDB-projects for the baseline data collection and that terms of reference were developed to guide the surveys. It was however, also noted that the funds allocated were highly insufficient to cover the large target areas in the List 1 countries (this with the exception of Ethiopia that finished the baseline data collection several years ago).

The meeting noted that there are several control tactics available for tsetse suppression and eradication, but that

only few methods are suitable for large scale, area-wide tsetse programmes. It was also noted that the sustainability of tsetse-free zones was largely dependant on the selection of the project area.

The meeting observed that the "project management and coordination units" of List 1 countries have sufficient autonomy to make technical decisions. It was however noted with concern, that at the operational level, project administrative arrangements are dependant on government rules and procedures, which are likely to affect management autonomy in the implementation of critical technical decisions.

The meeting recognized the difficulties encountered by countries in the production of required numbers of good quality sterile males. The meeting recommended to the FAO and IAEA to give technical and financial assistance to the countries concerned to assess the technical and managerial arrangements and competencies available with a view to identifying and filling gaps (e.g. through the use of regional IAEA TC experts) and to expedite action as necessary for the timely mass-production of sufficient numbers of good quality sterile males.

Feasibility Study for the Suppression of the Mediterranean Fruit Fly by Integrating the Sterile Insect Technique on an Area-Wide Basis in the Neretva River Valley, Croatia (CRO5002).

The Neretva River Valley is located partially in Croatia and partially in Bosnia and Herzegovina. The valley produces 90% of the mandarins of Croatia of which 80% are destined for the internal market and 20% for export mainly to Europe. The annual production of mandarins in the valley reaches 41 000 ton a year, but this is expected to increase to 60 000 ton a year over the next three years; mainly because of new areas being cultivated and the use of better irrigation techniques.

The Mediterranean fruit fly, *Ceratitis capitata* has become a serious pest in the valley with losses to the citrus industry up to 30% in certain areas. The Croatian Government already in 2002 expressed interest to introduce the sterile insect technique (SIT) as an alternative to the insecticide-based Mediterranean fruit fly control. The Croatian Institute for Plant Protection, in consultation with the Joint FAO/IAEA Division, determined that the Neretva river valley would be a good location to implement a programme where this environmentally friendly pest control method is used as part of an integrated pest management system.

The Neretva River Valley has a number of characteristics that are conducive for the application of the SIT, i.e. (1) commercial hosts are well concentrated, (2) high value of the commercial hosts, (3) few wild hosts in the surrounding mountains, (4) most of the valley has a flat topography, (4) low insecticide application by growers to control citrus and stonefruit pests, (5) excellent geographical isolation of the target valley, (6) the trend to increase the area under citrus cultivation, (7) natural suppression of the Mediterranean fruit fly populations in winter, (8) the citrus producers are well organized, and (9) a good road network for the release of the strerile males by ground.

(upper) General overview of the Neretva River Valley in Croatia showing the geographical isolation and the structure of the commercial farming areas, and (lower) workshop participants, Metković, Croatia.

The Plant Protection Institute of Croatia, supported by the IAEA under TC project CRO5002, organized a workshop at Metković, Croatia on 18 October 2007. The objective of the workshop was to discuss the actual pest status of the Mediterranean fruit fly in the valley and future prospects and commitments of the local public and private sector for controlling the pest using an area-wide IPM approach that integrates the SIT.

Representatives of the Ministry of Agriculture, Forestry and Water Resources, Croatia, the Plant Protection Institute, Croatia (including both the Director General and the Technical Director), the Croatian Agriculture Extension Service (including the phytossanitary inspectors of the Neretva River Valley), and the IAEA participated in the

workshop. As a portion of the Neretva River Valley is located in Bosnia Herzegovina, professionals from the Ministry of Agriculture, Forestry and Water Resources of Bosnia and Herzegovina likewise attended the workshop.

The workshop made the following recommendations: (1) a study of the overwintering Mediterranean fruit fly population needs to be conducted. This should include the use of synthetic food attractants in the trapping system and a fruit survey, (2) the involvement of the private sector on the project is needed, and (3) the Bosnia and Herzegovina Plant Protection authorities should be involved to ensure the inclusion of all agricultural areas of Neretva River Valley in the area-wide approach.

Meeting on Regional Designated Centres for Training on Tsetse and Trypanosomosis Control, 15-19 October 2007, Vienna, Austria (RAF5051).

A team of experts from Addis Ababa University (Ethiopia), the Free University of Berlin (Germany) and the Institute of Tropical Medicine, Antwerp (Belgium) convened in Vienna, Austria, 15-19 October 2007, to develop questionnaires and criteria for assisting African Member States to select a limited number of regional designated centres (RDC) for training on specific disciplines/topics relevant to addressing the tsetse and trypanosomosis problem. The team used available documents, including the 2000 Lomé Decision by Heads of State and Government, the PATTEC plan of action, and other relevant international work, resolutions and recommendations, as a basis. The team underlined the need to interact closely with relevant partners, particularly FAO, WHO and PATTEC, proposed to use an existing mechanism under the African Regional Cooperation Agreement for Research, Development and Training Related to Nuclear Science and Technology (AFRA) for identifying, pre-selecting and auditing candidate RDCs and outlined a one-year time frame for anticipated progress under this initiative.

Meeting of Asia Regional Project Coordinators on Sharing Regional Knowledge on Area-Wide Integrated Fruit Fly Pest Management, 19-23 November 2007, Vienna, Austria (RAS/5/049).

The first coordination meeting under Asia regional technical cooperation project RAS/5/049 was held in Vienna on 19-23 November 2007. The aim of this regional project is to facilitate the sharing of experience and knowledge of environment-friendly strategies of fruit fly control among the Member States of the Asia/Pacific region, in order to help them (1) to reduce losses and insecticide use, (2) eventually overcome trade barriers by using a systems approach, and (3) to promote detection systems and emergency preparedness procedures to detect and deal with outbreaks of exotic species.

Participants from 16 Asian Member States participated in

Participants from Asia/Pacific of the first coordination meeting of RAS5049.

this first coordination meeting, whose objectives were to review current technologies and strategies of fruit fly control used in the Member States of the Asia/Pacific region, in order to achieve project objectives. National project coordinators presented their country reports on activities and current priority and focus areas of their national programmes in the field of tephritid fruit fly control, after which working groups discussed a generic phased conditional approach, specific country recommendations, as well as the work plan for future regional project activities.

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

The First Research Coordination Meeting of the CRP on *Improving SIT for Tsetse Flies through Research on their Symbionts and Pathogens*, 1-5 October 2007, Vienna, Austria.

The first RCM of the CRP Improving SIT for Tsetse Flies through Research on their Symbionts and Pathogens was held in Vienna from 1-5 October, 2007, with 18 participants from Africa (8), Europe (7), and the USA (3).

The activities of the RCM, including presentations and the discussion of future work plans, were divided into two main subjects:

(1) The symbionts of tsetse including *Sodalis*, *Wolbachia* and *Wigglesworthia*, with the general objective to better understand the relation between the symbionts, tsetse and the trypanosome. The specific objectives will be to determine the prevalence of *Wolbachia* in field and laboratory populations; the occurrence of cytoplasmic incompatibility; and the localization of the symbionts in tsetse tissues.

(2) The pathogens of tsetse including the salivary gland hypertrophy virus and a pathogenic fungus. The objectives will be to determine the prevalence of the virus in the field population from different countries, understand the mode of transmission of the virus and compare the genome of the virus with the genome of a house fly virus.

The future work plan for each participant was discussed and agreed to and collaborations established. The topics for training some participants in genetics and microbiological techniques in a workshop were discussed and the period, location (tentatively ICIPE, Nairobi, Kenya) and participants were determined.

Call for Submission of Research Proposals for New CRP on Applying Population Genetics and GIS for Managing Livestock Insect Pests.

Livestock insect pests, such as screwworm and tsetse flies, cause severe losses to livestock systems, wildlife and even affect humans in vast areas all over the world. There is broad international consensus that intervention campaigns against such pests should be based on the area-wide concept of integrated pest management (AW-IPM) and that the sterile insect technique (SIT) is to be considered as a key tactic for creating pest-free areas.

In the past years three new “tools” became available that have big potential to improve the planning, implementation and progress-monitoring of AW-IPM campaigns with an SIT component: (1) modelling of pest population dynamics, (2) satellite-imagery-derived distribution and prediction maps and other Geographic Information System (GIS)-aided data processing, and (3) information on population genetics, providing evidence on isolation or confinement of target pest populations. However, these techniques are insufficiently refined and standardized and not adequately accessible for collaborators in Member States.

The Agency approved a new CRP on Applying Population Genetics and GIS for Managing Livestock Insect Pests (2008-2012), which aims at enabling collaborators in Member States to benefit from the mentioned new technologies by (1) exploring computer simulation modelling for a better understanding of and predicting insect pest population dynamics, (2) standardizing GIS and population genetic techniques for broad and practical use by insect control personnel in Member States, and (3) generate an open-access data base for various relevant information, including population genetic and GIS-processed data, partially in the form of improved pest distribution maps.

Insect population geneticists, screwworm and tsetse control personnel, GIS specialists and computer simulation modellers that are working in relevant fields and are interested in collaborating in the CRP should contact Udo Feldmann (U.Feldmann@iaea.org).

Developments at the Entomology Unit Seibersdorf

FRUIT FLIES

Cytology

The development of a standard polytene chromosome map for *Ceratitis capitata* was one of the essential prerequisites for the construction and analysis of chromosome rearrangements, e.g. Y-autosome translocation for use in genetic sexing strains. To identify translocation strains with optimal genetic structure, the translocation breakpoints on the autosome as well as on the Y chromosome have to be mapped in relation to the cytological position of the selectable marker(s) used. This information is important for the construction of stable and productive sexing strains.

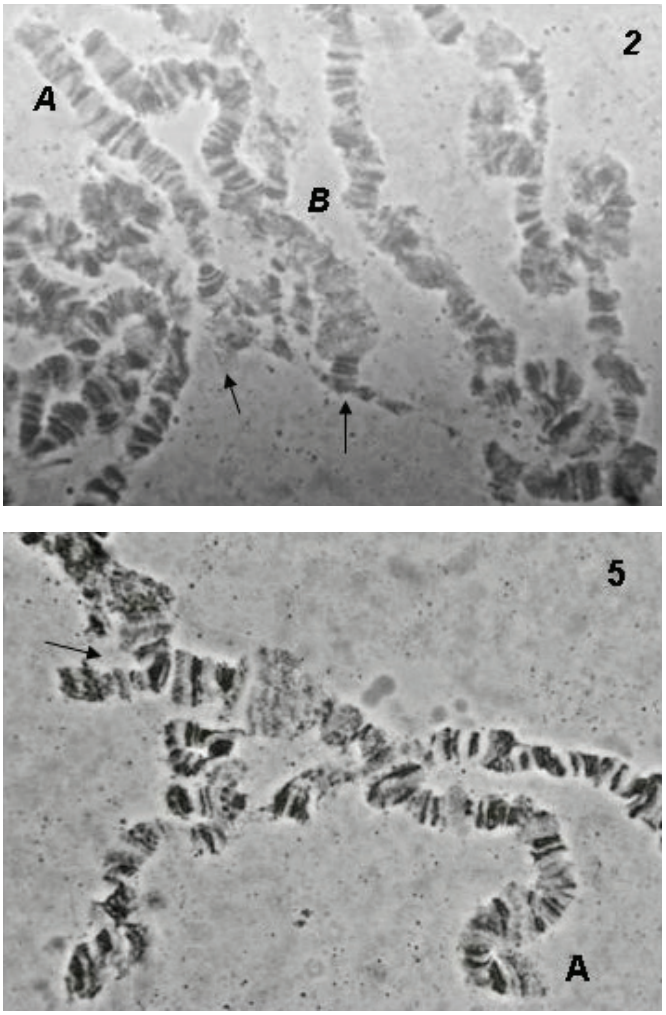
Polytene chromosome maps of the Mexican fruit fly *Anastrepha ludens*

Polytene chromosome maps of the Mexican fruit fly *Anastrepha ludens* have been constructed using larval salivary glands. There are five polytene elements in polytene nuclei that possibly correspond to the autosomes. There are now several Y-linked translocation strains available in this species and these maps will be used to assign selectable markers to specific chromosomes. The sex chromosome, as in all other tephritid species analysed so far is highly heterochromatic and does not form polytene elements. This work has been carried out in collaboration with the Genetic Sexing Group in Mosca Fruta, Tapachula, Mexico.

Genetic sexing strains for *Bactrocera cucurbitae* and *Bactrocera dorsalis*

These strains were isolated some time ago in Hawaii (Department of Entomology, University of Hawaii/ USDA/ARS Pasific Basin Area Research Center) and transferred to the Entomology Unit for quality control and cytological analysis. Cytological analysis was performed on mitotic chromosomes as well as on larval salivary gland polytene chromosomes to map the chromosomal breakpoints of the Y-autosome translocations.

Bactrocera cucurbitae – Mitotic and polytene chromosomes from the Y-autosome translocation strain were prepared and they showed that the induced rearrangement is a multiple translocation in which at least two autosomes are involved. The polytene chromosome analysis is shown in the upper figure where A and B indicate the two different autosomes and the arrows indicate the autosome breakpoints in the multiple translocation. These types of rearrangement can only be seen in polytene chromosomes but not in metaphase spreads. The chromosomal segments exchanged between the autosomes are of equal size and thus undetectable on mitotic chromosomes. These data are in full agreement with the quality control (QC) data which showed a very low viability of the strain. Genetic sexing strains exhibiting such characteristics cannot be used in SIT programmes due to their low productivity.



Polytene chromosomes of (upper) Bactrocera cucurbitae *and (lower)* Bactrocera dorsalis.

Bactrocera dorsalis – The mitotic karyotype of a wild-type strain showed that the Y chromosome is very small in comparison to the X chromosome and C-banding of the translocation strain revealed a single Y-autosome translocation. Polytene chromosomes confirmed that this was a single Y-autosome translocation as shown in the lower figure. The autosomal breakpoint is mapped very close to the centromere of this specific chromosome as can be deduced by comparing the mitotic chromosomes to the polytene chromosomes. The QC data for this strain was consistent with that for a single Y-autosome translocation.

Both genetic sexing strains are based on the white pupae (*wp*) mutation. Since the two species belong to the same

genus it is expected that this mutation maps to the same chromosome in both species. A comparative analysis of the two autosomes involved in the translocation in both species showed a significant similarity in banding pattern; evidence that these chromosomes are homologous.

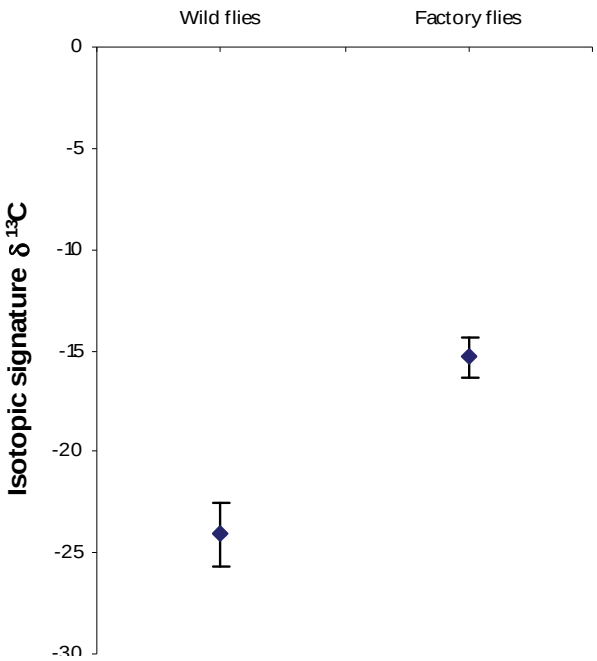
Anastrepha fraterculus Hybrids

A number of studies indicate that the nominal species *Anastrepha fraterculus* is in fact a series of cryptic species. Previous studies on mating compatibility showed high levels of pre-zygotic isolation between two laboratory populations from Argentina and Peru. To further analyze this observation a series of experiments was carried out on the same populations and on the reciprocal hybrids between them. This included karyotypic analysis of mitotic and polytene chromosomes, biochemical analysis of male sexual pheromones, genotyping of *Wolbachia* infections, mating compatibility under field cage conditions and viability and fecundity studies. A high level of sexual isolation had been maintained between the parental populations despite three years of laboratory rearing. The level of sexual isolation was reduced when the hybrids were tested. There were also differences in other components of mating behavior between the parental populations and the hybrids. These pre-mating isolation barriers were complemented by high levels of post-mating infertility, sex ratio distortion, or both. There were quantitative and qualitative differences in the pheromone blend between the two populations, with the hybrids producing a mix of the parental blends. Karyotypic analysis of mitotic and polytene chromosome revealed a high level of asynapsis in the hybrids as well as critical differences between the parental types. The combined results of this study would indicate that these two populations belong to different species in the *Anastrepha fraterculus* complex and cannot be considered to be the same species.

Marking Mass-Reared Fruit Flies

Monitoring of sterile to wild insect ratios is essential to follow the progress in SIT programmes. The main methods used for marking fruit flies are dyes in the diet or fluorescent dusts. In some instances there maybe doubt as to the presence of a marker. Another issue especially from a legal perspective is the unintentional release of fertile un-marked factory-reared flies. Having a factory-specific intrinsic marker overcomes some of these difficulties and complements existent marking technologies.

Fortunately nature itself provides us with an elegant marker. Mass-reared Mediterranean fruit flies are usually reared on a sugar rich diet and in most tropical countries the source of sugar in the factory diet is sugar cane. Sugar cane has a different photosynthetic pathway to most other commercial crops, in particular fruit crops. This photosynthetic difference leads to a distinctive stable isotope signature of the cane sugar; this isotopic signature is conserved in the mass-reared flies and can be easily detected using an elemental analyzer linked to an isotope ratio mass spectrometry (EA-IRMS). This may sound a complex procedure; however it is a simple case of collecting the fruit fly and placing it in a small tin capsule, drying it and then running it on the EA-IRMS. A sample typically takes 5-10 minutes to analyze and the procedure is fully automated. This isotopic analysis is available on a contract basis from a number of semi-commercial laboratories and costs between USD 5-25 per sample.



The isotopic signature of wild and mass-reared Mediterranean fruit flies.

At the Entomology Unit of the Agency's Laboratory in Seibersdorf we have been evaluating the presence and persistence of the isotopic marker in Mediterranean fruit flies. Field and mass-reared flies have been collected from around the world to determine whether there is a distinctive isotopic difference in sugar cane mass-reared flies and wild flies. Additional experiments have been conducted to determine whether isotopic signature of the mass-reared flies is persistent throughout the lifetime of released Mediterranean fruit flies.

It was shown that it was possible to use the isotopic signature of mass-reared flies to distinguish them from wild populations. It was also shown that the isotopic signature persists long enough in the adult fly to confidently distinguish mass-reared flies from wild flies. We thank collaborators in Guatemala for their help in providing wild flies. The beauty of this method is that SIT factory managers do not need to change their production practices in any way, but when there is doubt about the origin of a particular fly this method could be used for conformation of origin without further method development. Another advantage of this technique is that it can be used as an intrinsic marker of any factory-reared insect species using a sugar-based diet. Given the simplicity and the robustness of the method, factories currently using sugar beet

sugar, which does not have a distinctively different isotopic signature to most commercial crops, may consider switching to a sugar cane sugar source. In most cases this would not confer significant increases in production costs but would provide them with a simple factory marker. A paper detailing these experiments is in preparation.

Effect of Juvenile Hormone Analogue and Dietary Protein on Sexual Behaviour of *Bactrocera cucurbitae*

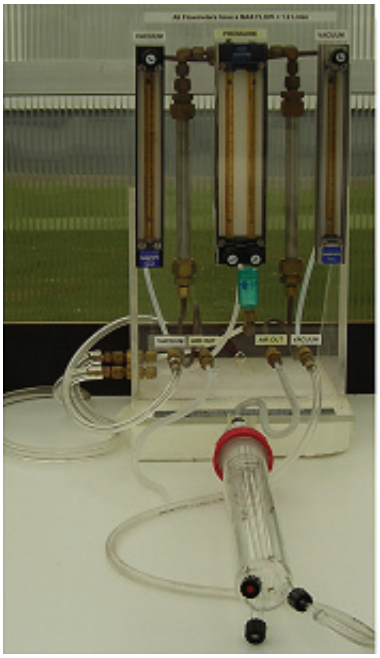
The effects of a juvenile hormone analogue, methoprene and protein on the acceleration of male sexual maturity, sexual competitiveness, lekking behaviour and pheromone production were studied. The males fed on protein treated with methoprene (M+P+) has a significantly higher mating performance at the age of sexual maturity when compared to protein-fed males (M-P+) of the same age and fully mature males fed only sugar (M-P-). Methoprene without protein does not affect either sexual maturation or sexual competitiveness.

Mating Bactrocera cucurbitae.

Bearing in mind the application of methoprene to males in a mass-rearing facility, where the holding of males for each additional day increases the cost of production and reduces the quality of males, it was important to assess the effect of methoprene if males are fed on protein for a shorter period of time. The males treated with methoprene and fed on protein for four days and then switched to sugar for next two days were more competitive than sugar-fed fully mature males.

Mr Ihsan Ul-Haq in a field cage to test competiveness of methoprene-fed males.

The influence of methoprene only and with protein diet on lekking behaviour of males was observed in a field cage and a positive effect on lek initiation, lek participation, sexual calling and mating was observed. For longevity of males the role of protein is critical while methoprene has no adverse affect on longevity. The pheromones are now being collected from males given the treatments and their quantity and chemical composition will be analysed in collaboration with Peter Teal of USDA-ARS.



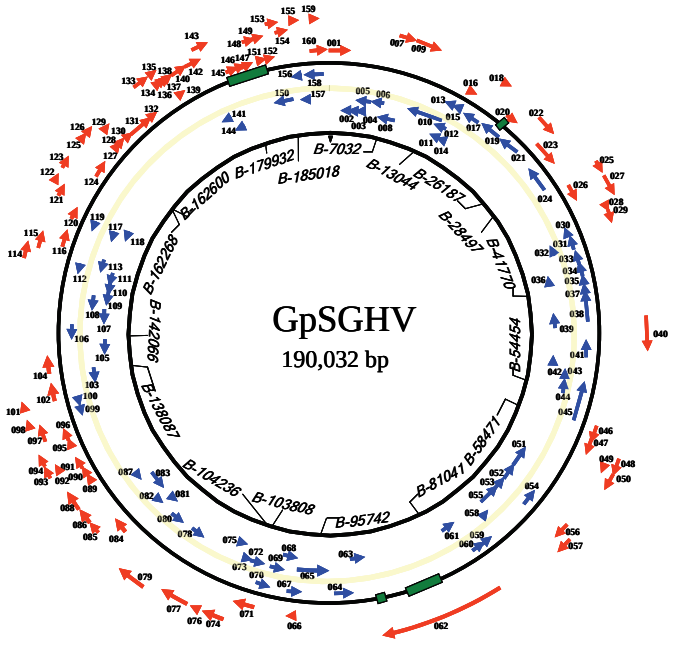
Device to collect the pheromone from male Bactrocera cucurbitae.

TSETSE FLIES

Salivary Gland Hyperplasia

As reported in Newsletter No. 69, sequencing of the salivary gland hypertrophy virus was approached using two techniques: the shotgun method by fragmenting the genome with EcoRI restriction endonuclease, which resulted in 415 clones being sequenced totalling 60-90 kpb, and the pyrophosphate sequencing by 454 Life Science in the USA which gave more than 34 000 reads, assembled into 402 contigs. Intensive work has continued to combine these sequences with additional sequences extracted from the 454 data and new sequences from targeted PCR reactions, which has resulted in determining that the genome is circular with a sequence of 190 032 nucleotides. Checking of the sequence was completed, and the GpSGHV sequence has been submitted to GenBank (EF568108). http://www.ncbi.nlm.nih.gov/sites/entrez?term=EF568108&cmd=Search&db=nuccore&QueryKey=1

Work has now begun on analysis of the genome sequence of the GpSGHV isolated from tsetse originated from



The circular genome of GpSGHV with a sequence of 190 032 nucleotides.

Ethiopia with an objective to compare the gene organization and content between the two virus isolates. We completed around 90% of the genome sequence of the Ethiopian isolate. The analysis of the first 15kb of the genome indicates a difference between the two isolates of around 1% including the silent and real mutation.

Preliminary work has been undertaken to produce antibodies against the p47 protein to be used in the detection of the virus by serological tools and to evaluate the efficiency of antibodies in neutralizing the virus infection. Another important aspect is the study of the impact of antiviral drugs on viral infection in the fly; four antiviral drugs were tested to determine their toxicity on tsetse. From preliminary screening two drugs, acyclovir and valacyclovir, were selected for further work, the other two drugs being too toxic for use in tsetse feeding. To analyse the effect of the antiviral drugs on viral DNA replication a quantitative PCR test was established by choosing two primers and a preliminary test to quantify the number of viral DNA copies was made. Work will continue on this aspect, principally using valacyclovir.

Evaluation of Tsetse Production Unit (TPU)3.2

The testing work on TPU3.2 was pursued at the Entomology Unit in Seibersdorf to improve the efficiency of this semi-automated system for tsetse holding and feeding. Some minor modifications such as changing the cage support or replacing the aluminium saddle by moulded plastic supports for the cage frame were introduced to improve stability and prevent rotation of cages. A cable release for the feeding trolley locating mechanism was also added. Front and back clips were also used to secure the feeding trays flat on the heating plate to ensure homogeneity of the heating in all areas of the trays.

A problem related to the climatic conditions was observed in the vicinity of the feeding station due to the type of temperature regulator on the heating plate. Humidity and temperature were variable affecting the survival of flies of the last frame to be fed. Following the necessary modification on the temperature regulator by the supplier the situation has considerably improved. Larger feeding trays and also larger membranes are now being used.

Pupal Sexing

Discussions with partners followed further testing have continued to determine the best conditions under which to run the pupal sex sorting. Some promising new neural network software has been evaluated to try to reduce variability of the results. In the meantime a new protocol is being evaluated in which from each of the pupal batches, a sample of 100 pupae is first sorted to calculate the midpoint of the distribution each day and this is then used to adjust the sorting limits. The rest of the pupae can then be sorted according to sex

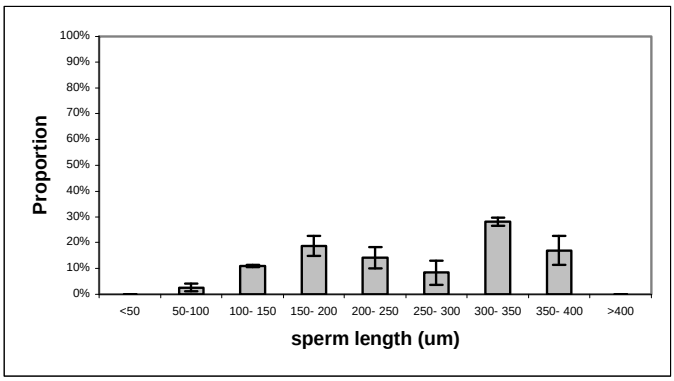
MOSQUITOES

Sterilization and Competitiveness

The competition studies discussed in Newsletter no. 69 have been completed. In these experiments, irradiated male *Anopheles arabiensis* competed with normal males for normal females at a ratio of 1:1:1. Males were irradiated in the pupal or adult stage and two irradiation doses were tested; a high, almost fully sterilizing dose of 120 Gy, and a lower, semi-sterilizing dose of 70 Gy. It was concluded that adult irradiation resulted in more competitive insects compared to pupal irradiation. The lower competitiveness of males irradiated in the pupal stage might to some extent be compensated for by increasing the ratio of irradiated males and this will be pursued in future experiments.

Sperm Morphology and Quantity

A protocol was developed to determine the quantity of sperm in the testis. This protocol is currently used to de-



Sperm length polymorphism in Anopheles arabiensis.

termine the quantity of sperm present in the testes of male *An. arabiensis* irradiated as pupae or adult compared to unirradiated males. The presence of sperm-length polymorphism had been observed in the closely related species *Anopheles gambiae* s.s. After training was received in the Klowden laboratory, the distribution of sperm lengths was determined in the colony of the Entomology Unit in Seibersdorf. The influence of irradiation on the distribution of sperm lengths will be determined in the near future.

Stable Isotopes

After the suitability of ^{13}carbon as a semen-label had been established (see previous newsletters); experiments to determine the use of ^{15}nitrogen as an additional semen-label were performed. Results showed that after adding ^{15}N glycine label to the larval rearing water, males transferred detectable amounts of label to the females. This novel dual labeling system will be used to detect multiple mating events in competition experiments.

Genetic Sexing Strain

The genetic sexing strain was derived using a dieldrin resistant strain, Sennar (Malaria Research and Reference Reagent Resource Center) and the dieldrin-susceptible strain from Dongola, Northern State, Sudan. The response of both strains to dieldrin was confirmed by exposing 4th instar larvae to 0.2 ppm dieldrin. As expected, none of the Dongola survived the treatment; the surviving resistant Sennar males were irradiated with 40 Gy (^{60}Co) and mated to Dongola females. The males from this cross were backcrossed to Dongola females. From this cross, approximately 500 females were individually isolated for egg laying; and only fifteen families displayed semi-sterility in the preliminary screening. Later screening of the fifteen lines revealed the presence of resistant females in some of the lines and those lines were discarded; only one line was kept (named 5-33 Rdl). Due to the inherent low sterility of 5-33 Rdl, it took several generations before the line was secured. This strain, following larval treatment with a discriminating dose of dieldrin produces almost all male progeny. En masse screening of the line showed a fertility of only 27%, and the sterility of the line is monitored in every generation. The sterility of 5-33 Rdl irradiated males with 40 and 70 Gy is currently being assessed. Future experiments planned include studies on the genetic stability of the line under mass-rearing conditions, the development of a protocol for en masse dieldrin exposure of 1st or 2nd instar larvae, and experiments to assess the competitiveness of the males.

A Simple Method to Identify Dieldrin Resistance Allele in Inseminated Female Mosquitoes in the Field.

An enhanced methodology for detecting dieldrin resistance in susceptible *An. arabiensis* females inseminated by sterile males, heterozygous for dieldrin resistance, has been developed to provide a tool in evaluating and assessing the conventional genetic sexing strain 5-33 Rdl. The method involves a standard PCR assay used to verify the presence of sperms carrying the resistance allele in spermathecae. The simplicity of the approach lies with the use of the actual spermathecae in the PCR reaction as the source of DNA. However, the spermathecae is first digested with a chitinase solution to partially digest the chitinase layer of the spermathecae. The reaction is then treated with lysis buffer to break open the cells and release sperm cells in to the PCR reaction. The method is simple, rapid and high throughput and can be further developed for the use in the identification of sterile males in the field on a larger scale.

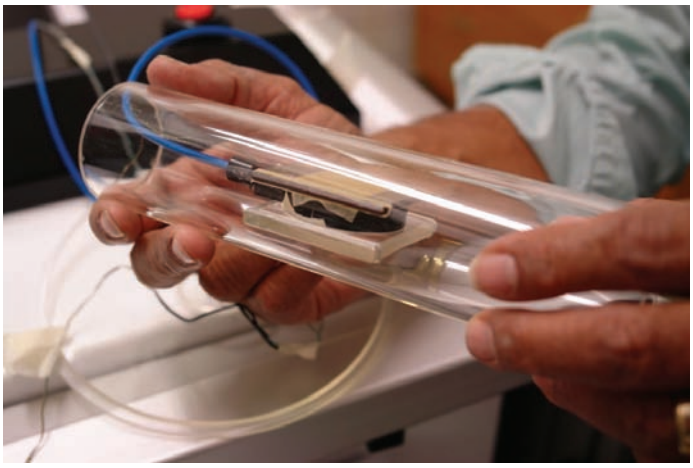
The initial experiments were carried out on Dongola females (homozygous susceptible) that were crossed to Sennar males (homozygous resistance). Bright bands were obtained at approximately 200 bp indicating the presence of homozygous resistance sperms. Future experiments will be carried out on the 5-33 Rdl strain to demonstrate the effectiveness of the approach in the identifying wild females that are inseminated by released sterile males.

X-RAY IRRADIATOR

The RS2400 X-ray irradiator unit was received in the laboratory in September and the installation was completed in October. A consultant, Dr Kishor Mehta, started a two month contract in October to characterize the unit and develop a revised dosimetry manual suitable for the X-ray system.

The RS2400 uses a single, horizontally oriented, axial X-ray tube around which are arranged five canisters on a carousel system. The carousel system, when rotated, ensures the canisters are irradiated from all sides to improve dose distribution. Each canister can hold about 5 litres, but the exact total irradiation volume is still being investigated. Cooling for the X-ray tube is provided by a self-contained water-to-air heat exchanger.

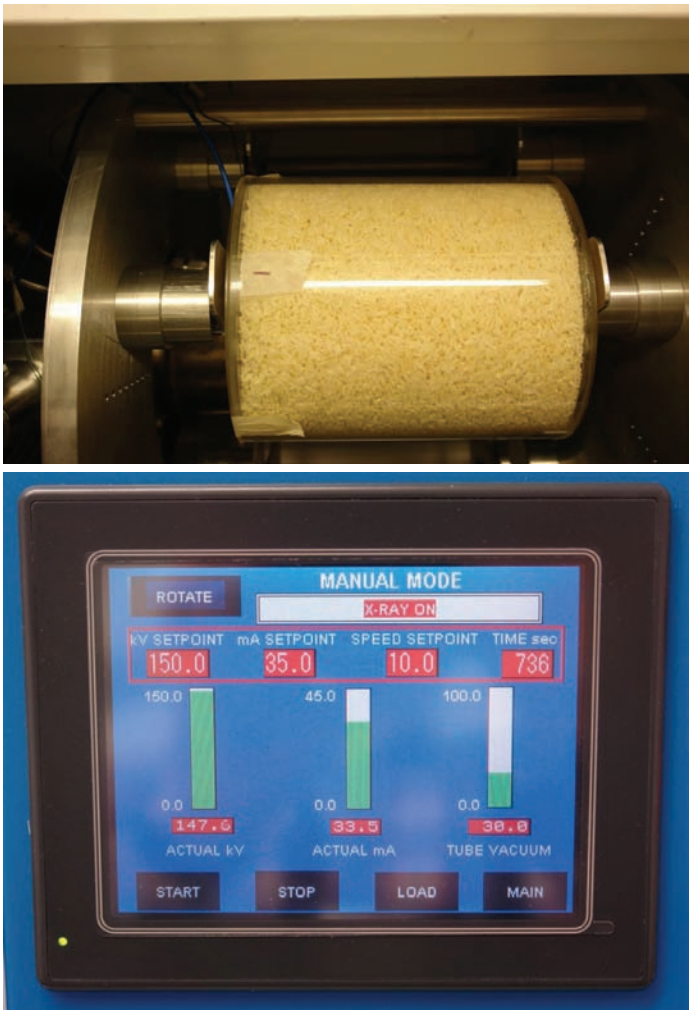
Characterizing a cabinet X-ray unit poses a challenge, as



The holder that contains the ion chamber for positioning in the center of one of the canisters.

the X-ray photons are scattered off all the internal surfaces of the chamber. These scattered photons have a much

lower energy than the primary photons, but none the less can contribute significantly to the total dose received by the sample. Unfortunately radiation measuring devices tend to have a photon energy dependant response, so calibrating them in a radiation field with a high, but unquantified, scattered component is difficult. For this a calibrated



(upper) One of the cannisters of the X-ray machine filled with rice, and (lower) the control panel of the X-ray machine.

ion chamber with a low energy dependence will be used.

For the characterization, a holder to position the ion chamber at the centre of one of the canisters was designed; the canister was then filled with instant rice, which with a density of about 0.41 is similar in density and composition to insect pupae (about 0.45-0.48). A thermocouple was also used to monitor the temperature. Cables from the ion chamber and thermocouple pass out through a port in the bottom of the chamber and can be read whilst the X-rays are on. Radiochromic film dosimeters were placed either side of the ion chamber to expose them to the same average dose rate. For field mapping a sheet of radiochromic film was held between two pieces of Perspex in the middle of one canister. The canister was filled with rice and exposed to an estimated centre dose of 100 Gy with the carousel rotating. The exposed film was scanned on a flat bed scanner and the image analysed with ImageJ software. Small dosimeters will also be used and read on a densitometer in the normal manner.

The RS2400 falls short of the original specification. Whilst the maximum voltage remains 150 kV, the maximum current with the present tube is only 35 mA rather than the stated 65 mA, and the dose rate at the centre of the canister is about 11.5 Gy/min instead of 45 Gy/min.

This reduction in performance will reduce the throughput to one quarter of the original specification. We have been promised an improved X-ray tube, but this will only take up to 45 mA which is also the maximum of the power supply and controller, giving a total power of 6750 W rather than the stated 10 000 W, and an estimated dose rate to the centre of the canisters of 15 Gy/min. This reduction in performance from the original specification significantly reduces the usefulness of the irradiator, but in view of the increasing difficulties experienced with obtaining and shipping cobalt-based irradiators, further improvements will no doubt soon lead to X-ray irradiation becoming an important alternative means of irradiation in sterile insect programmes.

The cost of the X-ray machine will also be considerably higher than originally anticipated.

GREENHOUSE EXPANSION

A major expansion of the greenhouse facilities in the Entomology Unit is underway. Greenhouse facilities are becoming more and more important in terms of assessing, under semi-field conditions, many aspects of field mating behaviour of strains to be used in SIT programmes and for studies on mating compatibility. The new greenhouse facility provides 250 m^2 of space for field cage experiments and will have temperature and humidity control so that it can be used all year round. With the increasing interest in, and development of, transgenic strains for use in SIT the greenhouse has been designed so that it can safely be used

Picture of the new greenhouse facilities at the Entomology Unit.

to evaluate these strains. It is hoped that the greenhouse will be completed in 2008 for use by the subprogramme and also by visiting consultants.

CAMERA AND LIGHT SOURCE FOR TSETSE WING MORPHOMETRICS

The Entomology Unit in conjunction with the Instrumentation Unit (Physics, Chemistry and Instrumentation Section) and the mechanical workshop in Seibersdorf have put together a package for the field collection of images for morphometric analysis. The set consists of a small digital camera with stand and light source, both of which run from the USB sockets of a notebook computer.

(upper, left) The Dino-Lite AM413 handheld digital microscope connected to a laptop, (upper, right) components of the unit, (lower, left) the LED light source, and (lower, right) a picture of a wing of G. brevipalpis*, taken with the miocrscope.*

The camera is a Dino-Lite AM413 handheld digital microscope from ANMO Electronics Corporation (http://www.anmo.com.tw/). This digital microscope focuses continuously from infinity to a magnification of about 20X and again about 100X and has a resolution of 1280 x 1024 pixel. The camera is controlled from the supplied software, and has built-in LED illumination. For capturing wing images the built-in LEDs are switched off and a flat, white back-light is used. The back-light consists of a flat panel LED light source (MTBL8526-WT, Marktech Optoelectronics, 3 Northway Lane North, Latham, New York 12110 USA) with a DC/DC power supply (R-783.3-0.5, 6 Watt, RS Components) and USB cable. The flat panel and power supply are built into a plastic housing and covered with clear Perspex to protect them. An aluminium slip case is provided for protection during transport. The camera is mounted in a custom made support constructed to tightly fit the conical front of the camera, and is supplied with two spacing rings of 5 and 10 mm to provide standard magnifications for different size tsetse wings.

Camera and light sets are being provided to the participants of two training workshops, the first in Uganda, East Africa and the second in Senegal, West Africa, funded by the regional Technical Cooperation project RAF5051.

Special News and Reports

Dr. Jacques Diouf, Director General of the FAO, Visits the IAEA General Conference, 18 September 2007.

During the IAEA General Conference of 2007, a Scientific Forum on Global Challenges and the Development of Atomic Energy: the Next 25 Years was organized. Dr. Jacques Diouf, Director General of the Food and Agriculture Organization of the United Nations presented a keynote statement during the session on Meeting New Challenges in Food and Agriculture. The following is an excerpt from that speech:

"FAO has been enjoying a successful partnership with IAEA for four decades. The creation in October 1964 of the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture marked the beginning of what is certainly one of the best examples of inter-agency cooperation within the whole UN family.

Among the most notable and sustainable successes of this programme of cooperation are: (1) the millions of hectares of higher-yielding or more disease-resistant food and industrial crops grown in fields all over the world resulting from radiation-induced mutations, (2) the huge savings in fertilizers made possible by using isotopes to determine the optimal placement and timing of applications or to let plants fix nitrogen from the atmosphere, (3) the eradication of screwworm from the Libyan Arab Jamahiriya, fruit flies from several countries in Latin America and the tsetse fly from Zanzibar using the sterile insect technique, and (4) the widespread use of immunoassay technology now being made by countries in all regions to diagnose and progressively control transboundary animal diseases like rinderpest and foot-and-mouth. But even more important is the capacity building in developing countries with a great number of people trained and many institutions strengthened.

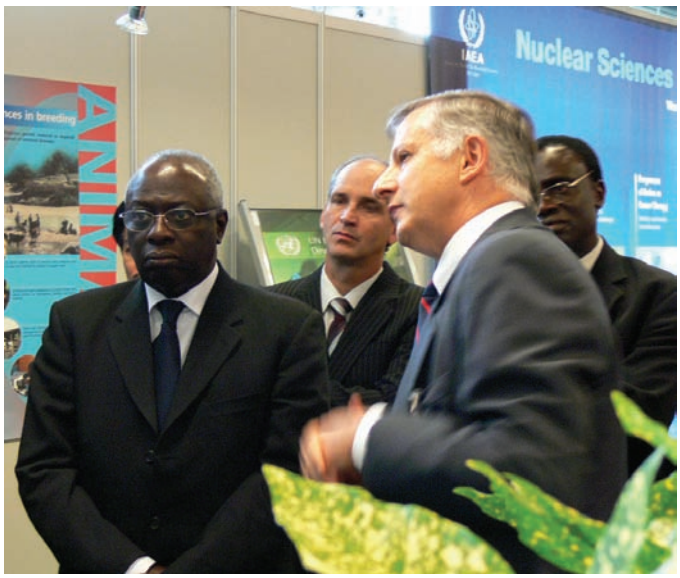
Water is one of the major challenges of the 21st century. To keep pace with the growing demand for food, 14 percent more freshwater will need to be withdrawn for agricultural purposes in the next 30 years. But that task will be complicated by climate change.

The rapidly growing bioenergy industry is now using increasingly large amounts of field crops – normally supplying the three traditional "Fs" of Food, Feed and Fibre - to supply fuel. One phenomenon observed in the last months has been the record increases in corn and wheat prices on world markets, and while higher prices are not normally bad news for farmers, political and social tensions may soon arise unless appropriate safety nets are put in place for the poorest countries and vulnerable population groups.

Another grave risk we shall increasingly face in the coming decades is the spread of diseases originating in animals. This heightened probability is a consequence of human and livestock population growth, dynamic changes in livestock production, the emergence of worldwide agro-food networks, and a significant increase in mobility of people and goods. Experts predict that as animals and humans crowd closer together, most of the diseases to emerge in the future will have animal origins.

So far, we have managed to keep a step ahead of emerging health threats. For instance, FAO and the World Organisation for Animal Health (OIE) can rightly take pride in having helped countries across the world to check the terrifying spread of avian influenza in animals. But there is no room for complacency. Though the tools for avian influenza's elimination from the poultry sector are well known, their proper implementation and support to veterinary services are still deficient in most countries.

FAO's Global Rinderpest Eradication Programme completely eradicated the disease from Asia; the disease is also believed to have been eliminated in the last hot zone of known infection in Africa. The programme's success could hold out lessons for continental, regional, and national efforts to progressively control future transboundary animal diseases.



Dr. Jorge Hendrichs (right), Head IPCS explaining the activities of the Subprogramme to Dr. J. Diouf (left), DG of the FAO at the IAEA General Conference in September 2007.

A further threat - to human health - comes from food itself as global trade moves staples, specialities and delicacies over huge distances.

Hundreds of regulations have been established in more than 40 years of work by the Codex Alimentarius Commission, which is jointly run by FAO and the World Health Organization. The Commission has set more than

1000 maximum limits for food additives and contaminants and 3000 maximum residue limits for pesticides and veterinary drugs in food commodities.

Continued vigilance by Codex – and respect of its standards – are essential to guarantee the safety of the food on our tables in years to come and allow consumers to continue enjoying an unprecedented quality and variety of food.

Only ten years remain before the 2015 Millennium Development deadline. This target can still be reached, but only if we redouble our efforts and take the right steps in the right regions to make a concrete and significant difference in a relatively short time. World leaders have expressed new determination to accelerate progress towards meeting these goals. Translating these into action will require, among other things, the political will of national governments to commit adequate funds to revitalize the agriculture and rural sectors while developed countries are also required to fulfil their pledge to increase development assistance.

The UN system on its part is expected to cooperate more to provide the services expected by the Member States.

IAEA and FAO are committed to this goal in relation with other members of the UN family.

The joint FAO/IAEA division will however have to evolve to adapt to changes in the world environment and new demands to be able to deal with the new challenges. In that framework it should provide more support to capacity building in food quality and safety."

The PAAT Advisory Group (PAG) Meeting, 27-28 September 2007, Luanda, Angola.

The 13th PAAT (Programme Against African Trypanosomiasis – a forum of four mandated international organizations FAO (Food and Agriculture Organization), IAEA (International Atomic Energy Agency), WHO (World Heatlh Organization) and AU/IBAR (African Union/Interafrican Bureau for Animal Resources) advisory group coordination meeting (PAG) was hosted by the Ministry of Agriculture and Rural Development in Luanda, Angola on 27-28 September 2007. The PAG meeting was chaired by Prof. A. Ilemobade, chairman of the PAAT and attended by the national PATTEC (Pan African Tsetse and Trypanosomosis Eradication Campaign) Coordinators of the PATTEC List 1 countries (i.e. those benefiting from a loan from the African Development Bank (AfDB)), and representatives of international organizations, international, regional and national research institutes.

The meeting was opened by H.E. D. Katata, the vice-minister of the Ministry of Agriculture and Rural Development, in the presence of H.E. J. Dias Van-Dúnem, the vice-minister of the Ministry of Health, the Resident Representative of FAO, and a representative of WHO in Angola. The vice-minister emphasized the importance of human African trypanosomosis (HAT) and of African animal trypanosomosis (AAT) as a hindrance to the development of agriculture in Africa, in general and in Angola, in particular. He underlined that Angola is one of three countries in sub-Saharan Africa where more than 1000 cases of HAT are still detected per year. The vice-minister called for "speaking less and doing more" in the fight against the tsetse fly and the disease they transmit, and hoped that the PAG meeting would contribute in this respect.

The five PATTEC coordinators presented an up-date on the tsetse activities in their country with the following highlights: (1) in Burkina Faso, a detailed action plan for the collection of entomological baseline data was developed, the field teams were established and detailed vegetation maps are being developed, (2) in Mali, good entomological baseline data have been collected in the past five years from the Niger River basin, but baseline data are lacking from the adjacent Bani River basin. In April 2007, 3900 insecticide impregnated traps were re-deployed in the Niger River Basin (as a reaction to the re-invasion of flies), which after 4 months, resulted in a reduction of 91% in tsetse fly density, (3) in Ghana, the use of the sequential aerosol technique (SAT) for area-wide suppression is being considered, as the large-scale use of insecticide-impregnated traps and targets would logistically be very difficult, (4) in Kenya, efforts are underway to revitalize insecticidal (deltamethrin) ground-spraying activities and first tests are scheduled soon, and (5) in Uganda, a comprehensive plan of action for the collection of entomological baseline data has been developed. In addition, the government has the intention to allocate adequate resources for the use of SAT in the project area.

In addition to the reports of the national PATTEC coordinators, presentations were made by representatives of international organizations and research institutes.

Dr. R. Saini of ICIPE reported on the training requirements for the PATTEC projects, and in this respect, a questionnaire was developed and circulated to the six PATTEC List 1 countries, with the goal to prioritize training needs. As a result, the projects ranked courses on (1) GIS, data management/data bases, and networking, (2) project planning, development, and management, (3) basic tsetse ecology/biology, and entomological base line data, as their top three priorities. It was likewise agreed that there is need for more harmonization and collaboration between the various organizations and institutes that organize and fund training courses.

29th Conference of the International Council for Trypanosomiasis Research and Control (ISCTRC), 1-5 October 2007, Luanda, Angola.

The 29th Conference of the International Council for Trypanosomiasis Research and Control (ISCTRC) of the Af-

rican Union was hosted by the Ministry of Health and the Ministry of Agriculture and Rural Development of Angola at the Palacio dos Congressos of the National Assembly from 1-5 October 2007, in Luanda, Angola.

The meeting was opened by H.E. Sebastião Sapuile Veloso, the Minister of Health following presentations by H.E. J. Dias Van-Dúnem, the Vice-Minister of Health, Dr. M. Traore, the Director of AU-IBAR, Prof. Theofile Josenando, the Secretary of the National Organizing Committee and Director General of the ICCT (Instituto de Combate e Controlo das Tripanossomiases), and Ms Rosebud Kurwijila, Commissioner of the Directorate of Rural Economy and Agriculture of the African Union (AU).

The meeting was attended by more than 150 delegates from Africa, Europe and the USA whom presented 31 oral presentations (not including the country reports) and 54 posters. Only four oral presentations were given on tsetse biology, which confirms the trend that has become apparent in the last years, that less research is being conducted on the vector and more on the disease. Burkina Faso, Ghana, Mali, Kenya, Somalia (again represented at the ISCTRC since 20 years), Botswana, Mozambique, Zimbabwe, Democratic Republic of the Congo, Guinea, Benin, Togo, United Republic of Tanzania, Sudan, Zambia, and Uganda provided updates on their research and tsetse control activities in their country reports.

The following are some highlights: (1) the sequential aerosol technique (SAT) operations in Botswana, Namibia and Southern Angola have apparently been very successful. More than 2000 trap days and more than 600 fly rounds did not reveal the presence of tsetse in the Okavango Delta. The availability of accurate navigation systems (SATLOC), the use of insecticide-impregnated targets in the barrier zone, and the improved use of the insecticides were listed as the main reasons for the success, (2) baseline data collected on the genetic structure of *G. palpalis gambiensis* on the Loos Islands of Guinea, revealed an isolated population, opening perspectives for the creation of a sustainable tsetse-free zone, (3) Zimbabwe intends to explore the possibility of using the SIT in the Matusadona National Park, as the park is surrounded by a tsetse-free area, and the difficult terrain is not conducive for the use of SAT, and (4) Zambia expressed its intension to use the SAT in the Kwando-Zambesi project.

The 29th edition of the ISCTRC adopted three recommendations which were of particular relevance and importance to the implementation of tsetse projects under the PATTEC initiative: (1) the ISCTRC recommends that projects use the FAO/IAEA document "Guidelines to assessing the feasibility of creating tsetse- and trypanosomosis-free zones" to clearly assess the status of their project implementation and to assess which next steps to take, (2) the ISCTRC recommends that projects ensure that the prerequisites identified for the successful planning and implementation of tsetse AW-IPM are in place before embarking on the operational phase of the project, (3) taking into consideration the limited number of research papers on tsetse biology and tsetse control during the meeting, the ISCTRC recommends that research and academic institutions, scientists and government and donors make more resources available to strengthen and enhance this type of research. This research should however be focused on supporting the PATTEC initiative to address problems encountered in the field.

It was proposed that the next ISCTRC be held in Accra, Ghana in 2009.

The Tenth Meeting of the Arthropod Mass-Rearing and Quality Control Working Group of the IOBC, 28 October-1 November 2007, Montreal, Canada.

The tenth meeting of the Arthropod Mass-Rearing and Quality Control (AMRQC) Working Group of the IOBC, entitled Maintaining worldwide connections for quality assurance in arthropod and nematode rearing, was hosted by the Biocontrol Network of Canada in Montreal, Canada from 28 October to 1 November 2007. The meeting was held jointly with the Association of Natural Biocontrol Producers, ASTM subcommittee E35.30 and the International Biocontrol Manufacturers Association, Invertebrate Biocontrols Group. The meeting was attended by more than 50 participants from more than 15 different countries.

Sessions were presented on: (1) welcoming partnerships in biological control, (2) quality assurance concept: product to customer, (3) state of the biological control industry, (4) rearing and quality assurance methods for arthropods and nematodes, (5) rearing entomophagous arthropods emphasizing artificial diets, (6) production of sterile insects and their quality control, (7) future concepts for mass-production of phytoseiid mites, (8) education and training in arthropod rearing and quality control, (9) fitness, cold storage, and effectiveness, (10) microorganisms, genomics, and insect quality, and (11) a round table on industry needs for research.

The session on production of sterile insects and their quality control had presentations on: (1) "Biocontrol and SIT under the same roof" by Bio-Bee, Israel, (2) "Egg disinfection of mass-reared *Ceratitis capitata* (Wiedemann) genetic sexing strain" from Tunisia, (3) "Impact of mass-rearing and irradiation on male *Eldana saccharina* moths used in SIT programmes" from South Africa, (4) "Sterile insect technique against onion fly *Delia antiqua* (Meigen) in the Netherlands" from De Groene Vlieg, and (5) "Effect of rearing strategy and handling on the quality of mass-reared codling moth" from the Okonagan-Kootenay Sterile Insect Release Program, Canada. Other presentations directly related to rearing for SIT in other sessions were (1) "Improving fruit fly nutrition and performance through proteomics" by Stella Chang, Hawaii,

and (2) "Characterization of a novel virus from mass-reared tsetse flies" presented by Andrew Parker, FAO/IAEA.

The AMRQC meeting was followed by a small workshop on "Sterile Insect Production and Quality Control". Three participants were joined by six observers from the AMRQC meeting. The main issues discussed were the role of commercial producers in the development of quality control and the correlation between QC parameters as measured in the laboratory or rearing facility and field performance of the insects.

Inauguration of a New Multi-Purpose Rearing Facility in Mendoza, Argentina.

The province of Mendoza, Argentina, has a long tradition of sustained control against quarantine pest species that are a serious limitation for the international trade of fruits and vegetables. It is due to these past successes in Patagonia (e.g. see Newsletter No. 67, pp. 22) and Mendoza that Argentina is now in a position to export to the major commercial fruit markets around the world.

The "Instituto de Sanidad y Calidad Agropecuaria Mednodoza" (ISCAMEN) has successfully implemented an eradication programme against the Mediterranean fruit fly in various oasis in Mendoza, treating a total surface area of 147 800 ha with sterile males. An intensive monitoring system, using 4700 traps which are all checked on a weekly basis, is implemented to constantly evaluate the status and progress made.

The new multi-purpose insect rearing facility in Mendoza, Argentina.

To be able to respond to the increasing need for sterile male Mediterranean fruit flies from other provinces like Patagonia, Rioja and San Juan, and in view of the demand for sterile codling moth *Cydia pomonella* and Oriental fruit moth *Grapholita molesta* to protect the Mendoza fruit industry from these quarantine pests, a new multi-purpose facility was constructed. The new facility is located at "Ruta N° 71, km 11,5 – Paraje El Ortizano – Dpto. de Santa Rosa" on a 6.5 ha compound. The construction of the facility (surface area of 16 000 m^2) was financed by the BIRF and the Provincial Government of Mendoza. The facility will have a capacity to produce 400 million of sterile male Mediterranean fruit flies and 20 million of codling moths per week.

Consultants Meeting on Finalizing the Genome Sequence of the Tsetse Salivary Gland Hypertrophy Virus, 11-13 April 2007, Vienna, Austria.

A consultants meeting on the "Finalizing the Genome Sequence of the Tsetse Salivary Gland Hypertrophy Virus" was held in Vienna, Austria from 11 to 13 April 2007. During the meeting the sequence data were discussed, the repeat regions found in the sequence analysed, and a phylogenetic analysis of the DNA polymerase carried out. This analysis indicated that SGHV DNA polymerase does not cluster with the Baculoviruses or Nudiviruses but with Iridoviruses, Herpesviruses and Phycodnaviruses, which suggests that the SGHV might represent a new virus family. The virus has some genes which have homology with other insect viruses, especially the genes involved in the early infection steps of baculoviruses. The core genes which are conserved in all baculoviruses were absent, which indicates a common ancestor of these viruses but they diverged long ago.

Development of an Effective Method of Production and Distribution of Mosquitoes in Support of the Trial SIT Programme in Sudan.

A team of the School of Industrial and Systems Engineering at Georgia Tech, is designing a cost-effective production and distribution system for the mass-rearing and releasing of sterile male mosquitoes. The project has 5 main components:

The team of the School of Industrial and Systems Engineering at Georgia Tech, who is designing a new production and distribution system for mosquitoes.

(1) the development of a probabilistic model to demonstrate the feasibility of SIT by providing insight into what variables impact the effectiveness of sterile insect release into a wild population,

(2) population forecasting, based on larva data collected in Merowe, Sudan. Using site surveying data, larval breeding sites will be predicted based on land use of the area. From there, larval density per dip data will be used to predict the overall larval concentrations in the collection sites,

(3) development of production scenarios. A production process will be designed to coordinate all activities to provide an efficient output of sterile mosquitoes. These activities include sex separation, separating release and broodstock batches, and male sterilization,

(4) release modelling to determine which approach is best in eliminating mosquitoes across the entire release area. The main approaches are releasing simultaneously across the entire area and progressively releasing into zones. Each method will be evaluated in terms of transportation feasibility and impact on the time to eradicate the mosquito population, and

(5) transportation logistics, which will vary depending on the choice of facility location. If the production facility is located in Khartoum, the mosquitoes must be transported from the facility to the release site in Merowe. This can be accomplished either by ground transportation or airplane. If the production facility is in Merowe, the mosquitoes must be transported to the release locations, either by truck, boat, or air. Methods to transport mosquitoes from production to release will be identified.

Combining all methodologies and recommendations, a document will be created for distribution to market the potential impact of both this particular release program and elimination programs in general. The document will outline the steps taken to strategically plan this elimination program. Also, specific aspects such as estimated time to complete the program and overall program costs will allow potential donors to fully understand the requirements of elimination.

Text from Dr Mark Benedict, CDC, USA.

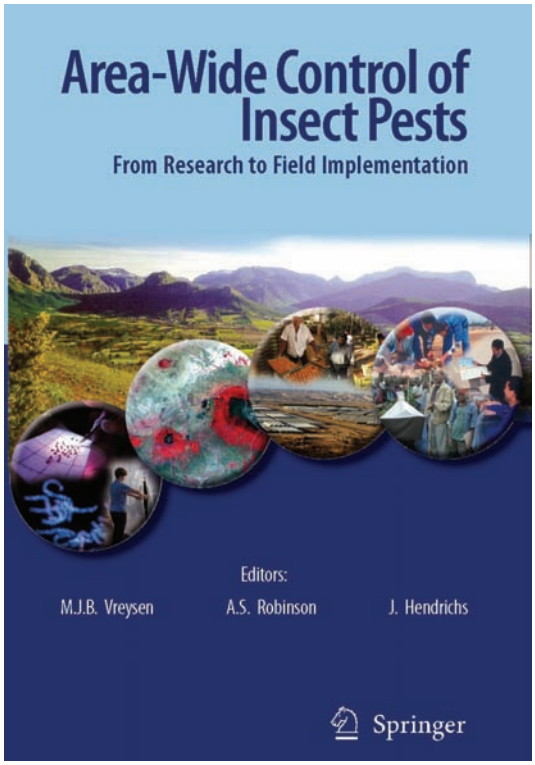
The International Congress of Insect Biotechnology and Industry, 19-24 August 2007, EXCO Daegu, Republic of Korea.

The International Congress of Insect Bio-technology and Industry emphasized the potential industrial applications in the entomological field including silk production, biological control agent production, bumble bee production and sterile insect production. There was also considerable attention given to the use of transgenic insects including the development of a Daegu Protocol to support regulatory frameworks for the release of these insects. Genomics was much discussed including work on the tsetse fly and the medfly. During a plenary lecture, there was a very strong plea to expand the use of the SIT for codling moth control. The session on genetically modified insects covered topics on sperm marking in Mediterranean fruit fly, genetic transformation of the codling moth and genetic sexing in mosquitoes. On the final day of the congress there was a special session on regulatory issues including a discussion of a North American Plant Protection Organization (NAPPO) standard on the release of transgenic insects.

Announcements

A New Text Book on Area-Wide Control of Insect Pests. From Research to Field Implementation Has Been Published (November 2007).

Area-wide integrated pest management (AW-IPM) or "total population management" is a coordinated, sustainable and preventive approach that targets an entire pest population within a delimited geographical area. The pest is targeted in all areas including non-commercial urban settings, non-cultivated and wild host areas. The integration of control tactics against an entire pest population is often more efficient and sustainable as compared to field-by-field IPM, which has the objective of protecting crops or livestock that is largely under the control of each farmer, with little collaboration or any coordinating structure. Here, control is exercised only in areas of economic interest, often resulting in pest population pockets remaining in the surrounding areas.



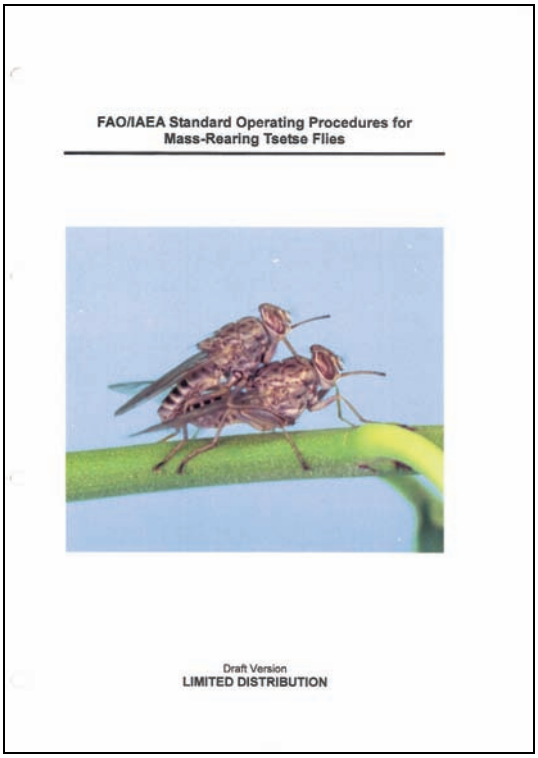
The book is a compilation of 66 papers authored by experts from more than 30 countries. The selected papers attempt to address various fundamental components of AW-IPM, e.g. the importance of relevant problem-solving research, the need for essential baseline data, the significance of adequate tools for appropriate control strategies, and the value of pilot trials, etc. Of special interest are the numerous papers on pilot and operational programmes that pay special attention to practical problems encountered during programme implementation.

The book (pp. 789) can be purchased from Springer:

http://www.springer.com/east/home/generic/search/results?SGWID=5-40109-22-173732027-0

Draft FAO/IAEA Standard Operating Procedures for Mass-rearing Tsetse Flies Now Available.

A draft version of the new "FAO/IAEA Standard Operating Procedures for Mass-rearing Tsetse Flies" is now available at the Insect Pest Control Section. The document is intended for technicians and entomologists working in



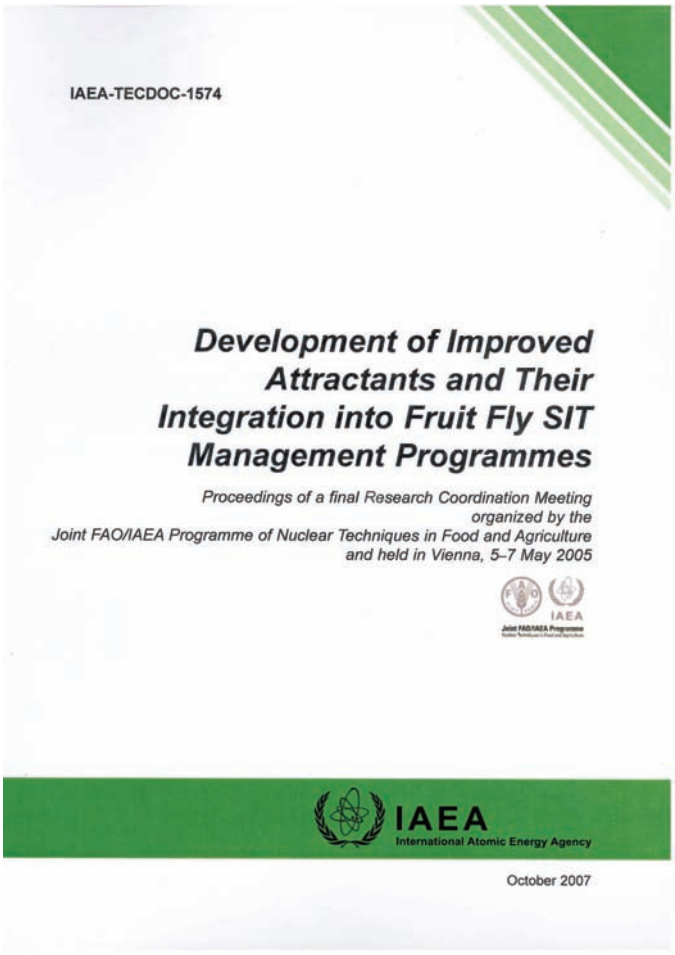
laboratories and other facilities that rear tsetse flies. The document outlines procedures for colony initiation and mass-rearing and includes aspects of fly production quality control. The procedures described are those developed at the Entomology Unit of the FAO/IAEA Agriculture and Biotechnology Laboratory, Seibersdorf, Austria.

New IAEA TECDOC: Development of Improved Attractants and their Integration into Fruit Fly SIT Management Programmes.

Information provided by trapping systems is used to assess the presence, seasonal abundance, spatial distribution, host sequence and infestation levels of fruit fly pests. This information is essential for implementation of effective fruit fly control programmes. Most commercially available trapping systems are based on male specific para-pheromones and have been used as the main survey tool in area-wide fruit fly control programmes.

However, as a result of a previous Coordinated Research Project (CRP) entitled Development of Female Medfly Attractant Systems for Trapping and Sterility Assessment the first effective female-biased synthetic food lure was developed for the Mediterranean fruit fly (*Ceratitis capitata*, Wied.) (IAEA-TECDOC-1099 in 1999). This lure, with the commercial name of Biolure, is now being used in large-scale medfly control programmes worldwide.

To further advance this field, the Joint FAO/IAEA Programme approved in 2000 a five year CRP entitled "Development of Improved Attractants and their Integration into Fruit Fly SIT Management Programmes". The research conducted under this CRP focused mainly on (1) developing female-biased trapping systems for other fruit fly species of quarantine and economic importance within the *Anastrepha*, *Bactrocera*, *Ceratitis* and *Dacus* genera, (2) optimization of current trapping devices, (3) efficiency of the attractant Biolure, (4) evaluation of mass-trapping as a method for population suppression, and (5) the development of "lure and kill" devices or "bait stations" for fruit fly control.



The results of the CRP (2000-2005) have now been published in a new IAEA TECDOC. The data indicate that significant progress has been made in optimization of current trapping systems and on developing female-biased attractants for surveillance of some of the major fruit fly pests. Furthermore, a solid basis for continuing the development of bait stations has been established.

The setting of the CRP, with scientists from research institutions in 18 different Member States interacting with the manufacturers and suppliers of trapping materials and under the coordination of the Joint FAO/IAEA Programme, showed to be a very effective model to reduce the time period from the development of the technology to the commercialization and utilization by the end user.

New Website on Invasive Fruit Fly Pests in Africa.

Fruit flies (Diptera, Tephritidae) are considered an insect group of major economic significance. Many representatives are known to attack different types of commercial and wild fruits and vegetables, causing considerable damage to agricultural crops. The African fauna comprises almost 1000 described species. More than 50 of them are of economic significance. Although most of these are species native to the African mainland or to any of the Indian Ocean islands, some were accidentally introduced from other regions, in particular from Asia. So far, four Asian species belonging to the genus *Bactrocera* invaded Africa, two of which in recent years. These accidental introductions greatly aggravate the pest problems encountered by farmers in African countries, and result in great losses both in local sales and in export potential. There is, therefore, an urgent need for considerable strengthening of the human and physical quarantine and monitoring infrastructures in Africa, in order to avoid any further unwanted introductions.

With financial assistance of the International Atomic Energy Agency, researchers of the Royal Museum for Central Africa (Tervuren, Belgium), the Plant Protection Research Institute (Dokki, Egypt) and the Natural History Museum (London, UK) have compiled a website with relevant information on these invasive species. This website aims to provide a diagnostic tool for the identification of the Asian introductions already established in Africa. Rather than using the traditional system of diagnostic identification keys, the site takes a more user-friendly approach with several questions and images in order to allow the non-specialist user to narrow down to the actual species. The site also provides information on the host plant range (both in Africa and elsewhere) and distribution, and references to studies on their biology either in their native range or outside.

URL of the website:
http://www.africamuseum.be/fruitfly/AfroAsia.htmpackage

Light Brown Apple Moth Discovered in California, USA.

Light brown apple moth (LBAM) *Epiphyas postvittana* is an exotic pest that has recently been discovered in portions of the San Francisco Bay Area and Los Angeles. LBAM is a native pest to Australia and has been introduced into

New Zealand, New Caledonia, Hawaii, the United Kingdom and Ireland. This moth can affect a wide variety of plants, flowers, fruits and vegetables.

Light Brown Apple Moth

Mating disruption using synthetic moth pheromones is the primary tool for the current eradication efforts against LBAM. This material confuses the male moths and prevents them from finding females, thereby stopping the mating and reproduction process. Mating disruption products may be applied either by ground or by air, depending upon the size of the infestation. Application of the organic insecticide *Bacillus thuringiensis* (Bt) in limited areas by ground may also be used in situations where the LBAM population is high, in order to enhance the effectiveness of the mating disruption materials.

More info on: www.cdfa.gov

Papers in Peer-Reviewed Journals

In Press

BENEDICT, M.Q. and A.S. ROBINSON. Impact of technological improvements on traditional control strategies, *In* Aksoy, S. (ed.), Transgenesis and management of vector-borne diseases (in press).

CORONADO GONZALEZ, P.A., S. VIJAYSEGARAN, and A.S. ROBINSON. Mouthpart structure and feeding mechanisms of adult *Ceratitis capitata* (Wied.) (Diptera: Tephritidae). Insect Science (in press).

FARIA, M.J., R. PEREIRA, T. DELLINGER, and P.E.A. TEAL. Influence of methoprene and protein on survival, maturation and sexual performance of male *Ceratitis capitata* (Diptera: Tephritidae). Journal of Applied Entomology (in press)

KNOLS, B.G.J., H.C. BOSSIN, W.R. MUKABANA, and A.S. ROBINSON. Transgenic mosquitoes and the fight against malaria: managing technology push in a turbulent GMO world. American Journal of Tropical Medicine and Hygiene (in press).

ROBINSON, A.S., B.G.J. KNOLS, M.Q. BENEDICT, A. BOUSSAHA, G. VOIGT, P. ANDREO, Y. TOURE, and J. HENDRICHS. Development of the sterile insect technique for African malaria vectors. I. Conceptual framework and rationale. Malaria Journal (in press).

2007

ABD-ALLA, A., H. BOSSIN, F. COUSSERANS, A. PARKER, M. BERGOIN, and A.S. ROBINSON (2007). Development of a non-destructive PCR method for detection of the salivary gland hypertrophy virus (SGHV) in tsetse flies. Journal of Virological Methods 139: 143-149.

ALEMU, T., B. KAPITANO, S. MEKONNEN, G. ABOSET, M. KIFLOM, B. BANCHA, G. WOLDEYES, K. BEKELE, and U. FELDMANN. (2007) Area-wide intervention against the tsetse and trypanosomosis problem: the Ethiopian experience in the Southern Rift Valley, pp. 325-335. *In* M.J.B. Vreysen, A.S. Robinson, and J. Hendrichs (eds.), Area-wide control of insect pests. From research to field implementation. Springer, Dordrecht, The Netherlands.

BRICEÑO, R.D., W.G. EBERHARD, and A.S. ROBINSON (2007). Copulation behaviour of *Glossina pallidipes* (Diptera: Muscidae) outside and inside the female, with a discussion on genitalic evolution. Bulletin of Entomological Research 97:1-18.

CÁCERES C., E. RAMÍREZ, V. WORNOAYPORN, S.M. ISLAM, and S. AHMAD (2007). A protocol for storage and long-distance shipment of Mediterranean fruit fly (Diptera: Tephritidae) eggs. I. Effect of temperature, embryo age and storage time on survival and quality. Florida Entomologist 90: 103-109.

CÁCERES C., D. MCINNIS, T. SHELLY, E. JANG; A.S. ROBINSON, and J. HENDRICHS (2007). Quality management systems for fruit fly (Diptera: Tephritidae) sterile insect technique. Florida Entomologist 90: 1-9.

GARCIA, R., L. MENDEZ, E. SERRANO, and M.J.B. VREYSEN (2007). Insecticidal wound treatment of livestock on Isla de la Juventud, Cuba: an efficient suppression method of New World screwworm *Cochliomyia hominivorax* prior to the release of sterile males, pp. 393-403. *In* M.J.B. Vreysen, A.S. Robinson, and J. Hendrichs (eds.), Area-wide control of insect pests. From research to field implementation. Springer, Dordrecht, The Netherlands.

GARIOU-PAPALEXIOU, A., G. YANNOPOULOS, A.S. ROBINSON, and A. ZACHAROPOULOU (2007). Polytene chromosome maps in four species of tsetse flies *Glossina austeni, G. pallidipes, G. morsitans morsitans* and *G. m. submorsitans* (Diptera: Glossinidae): a comparative analysis. Genetica 129: 243-251.

HELINSKI, M.E.H., R. HOOD-NOWOTNY, L. MAYR, and B.G.J. KNOLS (2007). Stable isotope-mass spectrometric determination of semen transfer in malaria mosquitoes. Journal of Experimental Biology 210: 1266-1274.

HENDRICHS, J., P. KENMORE, A.S. ROBINSON, and M.J.B. VREYSEN (2007). Area-wide integrated pest management (AW-IPM): principles, practice and prospects, pp. 3-33. *In* M.J.B. Vreysen, A.S. Robinson, and J. Hendrichs (eds.), Area-wide control of insect pests. From research to field implementation. Springer, Dordrecht, The Netherlands.

HENDRICHS, M.A., V. WORNOAYPORN, B.I. KATSOYANNOS, and J. HENDRICHS (2007). Quality control method to measure predator evasion in wild and mass-reared Mediterranean fruit flies (Diptera: Tephritidae). Florida Entomologist 90: 64-70.

HOOD-NOWOTNY, R. and B.G.J. KNOLS (2007) Stable isotope methods in biological and ecological studies of arthropods. Entomologia Experimentalis et applicata 124: 3-16.

KAPPMEIER GREEN, K., F.T. POTGIETER, and M.J.B. VREYSEN (2007). A strategy for an area-wide control campaign with an SIT component to establish a tsetse-free South Africa, pp. 309-323. *In* M.J.B. Vreysen, A.S. Robinson, and J. Hendrichs (eds.), Area-wide control of insect pests. From research to field implementation. Springer, Dordrecht, The Netherlands.

KNOLS, B., R.C. HOOD, H. BOSSIN, G. FRANZ, A.S. ROBINSON, W.R. MUKABANA, and S.M. KEM

(2007). GM sterile mosquitoes – a cautionary note. Nature Biotechnology 24: 1067-1068.

MAMÁN, E., and C. CÁCERES (2007). A protocol for storage and long-distance shipment of Mediterranean fruit fly (Diptera: Tephritidae) eggs. II. Assessment of the optimal temperature and substrate for male-only production. Florida Entomologist 90: 110-114.

M'SAAD GUERFALI M., A. RAIES, H. BEN SALAH, F. LOUSSAIEF, and C. CÁCERES (2007). Pilot Mediterranean fruit fly *Ceratitis capitata* rearing facility in Tunisia: constraints and prospects, pp. 535-543. *In* M.J.B. Vreysen, A.S. Robinson, and J. Hendrichs (eds.), Area-wide control of insect pests. From research to field implementation. Springer, Dordrecht, The Netherlands.

NESTEL, D., E. NEMNY-LAVY, A. ISLAM, V. WORNOAYPORN, and C. CÁCERES (2007). Effect of pre-irradiation conditioning of medfly pupae (Diptera: Tephritidae): hypoxia and quality of sterile males. Florida Entomologist 90: 80-87.

PARKER, A.G., and K. MEHTA (2007). Sterile insect technique: dose optimization, dosimetry, and irradiation for improved sterile insect quality. Florida Entomologist 90: 88-95.

PEREIRA, R., N. SILVA, C. QUINTAL, R. ABREU, J. ANDRADE, and L. DANTAS (2007). Sexual performance of mass-reared and wild Mediterranean fruit flies (Diptera: Tephritidae) from various origins of the Madeira Islands. Florida Entomologist 90: 10-14.

PEREIRA, R., N. SILVA, C. QUINTAL, R. ABREU, J. ANDRADE, and L. DANTAS (2007). Effect of acclimation to outdoor conditions on the sexual performance of mass-produced medflies (Diptera: Tephritidae). Florida Entomologist 90: 171-174.

PEREIRA, R., G. J. STECK, E. VARONA, and J. SIVINSKI (2007). Biology and natural history of *Anastrepha interrupta* (Diptera: Tephritidae). Florida Entomologist 90: 389-391.

REYES, J.X. CARRO, J. HERNANDEZ, W. MENDEZ, C. CAMPO, H. ESQUIVEL, E. SALGADO, and W. ENKERLIN (2007). A multi-institutional approach to implement fruit fly-low prevalence and fly free areas in Central America, pp. 627-640. *In* M.J.B. Vreysen, A.S. Robinson, and J. Hendrichs (eds.), Area-wide control of insect pests. From research to field implementation. Springer, Dordrecht, The Netherlands.

SIVINSKI, J., T. HOLLER, R. PEREIRA, and M. ROMERO (2007). The thermal environment of immature Caribbean fruit flies, *Anastrepha interrupta* (Diptera: Tephritidae). Florida Entomologist 90: 347-357.

VREYSEN, M.J.B., A.S. ROBINSON, and J. HENDRICHS (eds.) (2007). Area-wide control of insect pests. From research to field implementation. Springer, Dordrecht, The Netherlands.

VREYSEN, M.J.B., J. GERARDO-ABAYA, and J.P. CAYOL (2007). Lessons from area-wide integrated pest management (AW-IPM) programmes with an SIT component: an FAO/IAEA perspective, pp. 723-744. *In* M.J.B. Vreysen, A.S. Robinson, and J. Hendrichs (eds.), Area-wide control of insect pests. From research to field implementation. Springer, Dordrecht, The Netherlands.

2006

BARNES, B.N., A. TARGOVSKA, and G. FRANZ (2006). Origin of a Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann), outbreak determined by DNA analysis. African Entomology 14: 205-209.

BOURTZIS, K. and A.S. ROBINSON (2006). Insect pest control using *Wolbachia* and/or radiation, pp. 225-246. *In* K. Bourtzis and T. Miller (Eds.), Insect Symbiosis II. CRC Press, Boca Raton, Florida, USA.

BRAGA SOBRINHO R., C. CACERES, A. ISLAM; V. WORNOAYPORN, and W. ENKERLIN (2006). Diets based on soybean protein for Mediterranean fruit fly. Pesq. Agropec. Bras. 41: 705-708.

CHANG, C. L., R. VARGAS, C. CACERES, E. JANG, and IL KYU CHO (2006). Development and assessment of a liquid larval diet for *Bactrocera dorsalis* (Diptera: Tephritidae). Annals of the Entomological Society of America 99: 1191-1198.

FRANZ, G. (2006). Transgenic arthropods and the sterile insect technique, pp. 37-44. *In* Status and risk assessment of the use of transgenic arthropods in plant protection. IAEA-TECDOC-1483, IAEA, Vienna, Austria.

GOOSSENS, B., H. MBWAMBO, A. MSANGI, D. GEYSEN, and M.J.B. VREYSEN (2006). Trypanosomosis prevalence in cattle on Mafia Island (United Republic of Tanzania). Veterinary Parasitology 139: 74-83.

HELINSKI, M.E., A.G. PARKER, and B.G. KNOLS (2006). Radiation-induced sterility for pupal and adult stages of the malaria vector *Anopheles arabiensis*. Malaria Journal 5: 41.

HELINSKI, M.E., B. EL-SAYED, and B.G.J. KNOLS (2006). The sterile insect technique: can established technology beat malaria? Entomologische Berichten 66: 13-20.

HOOD-NOWOTNY, R.C., L. MAYR and B.G.J. KNOLS (2006). Use carbon-13 as a population marker for *Anopheles arabiensis* in a sterile insect technique (SIT) context. Malaria Journal 5: 6.

IAEA (2006). Status and risk assessment of the use of transgenic arthropods in plant protection. IAEA-TECDOC-1483, Vienna, Austria.

KNOLS, B.G.J., and C. LOUIS (Eds.) (2006). Bridging laboratory and field research for genetic control of disease vectors. *In* Proceedings volume of the joint WHO/TDR, NIH/NIAID, IAEA and Frontis workshop on bridging laboratory and field research for genetic control of disease vectors, 14-16 July 2004, Nairobi, Kenya. Springer/Frontis, Volume 11, pp 225.

KNOLS, B.G.J., and H. BOSSIN (2006). Identification and characterization of field sites for genetic control of disease vectors, pp. 203-209. *In* B.G.J. Knols, and C. Louis (eds), Bridging laboratory and field research for genetic control of disease vectors. Springer/Frontis, Volume 11, Chapter 20. The Netherlands.

KNOLS, B.G.J., R. HOOD-NOWOTNY, H. BOSSIN, G. FRANZ, G. ROBINSON, W.R. MUKABANA, and S.K. KEMBOI (2006). GM sterile mosquitoes — a cautionary note. Nature Biotechnology 24: 1067-1068.

MUKABANA, W.R., K. KANNADY, G.M. KIAMA, J. IJUMBA, E.M. MATHENGE, I. KICHE, G. NKWENGULILA, L.E.G. MBOERA, D. MTASIWA, Y. YAMAGATA, I.M.C.J. VAN SCHAYK, B.G.J. KNOLS, S.W. LINDSAY, M. CALDAS DE CASTRO, H. MSHINDA, M. TANNER, U. FILLINGER, and G.F. KILLEEN (2006). Ecologists can enable communities to implement malaria vector control in Africa. Malaria Journal 5: 9**.**

MUTIKA, G.N., and A.G. PARKER (2006). Induced sterility of *Glossina pallidipes* Austen males after irradiation in a nitrogen atmosphere: Entomological Science 9: 47-53.

NJIRU, B.N., W.R. MUKABANA, W. TAKKEN, and B. G. J. KNOLS (2006). Trapping of the malaria vector *Anopheles gambiae* with odour-baited MM-X traps in semi-field conditions in western Kenya. Malaria Journal 5: 39.

SCHOLTE, E.-J., B.G. J. KNOLS, and W. TAKKEN (2006). Infection of the malaria mosquito *Anopheles gambiae* with the entomopathogenic fungus *Metarhizium anisopliae* reduces bloodfeeding and fecundity. Journal of Invertebrate Pathology 91: 43-49.

VAN DEN BERG, H., and B.G.J. KNOLS (2006). The Farmer field school: a method for enhancing the role of rural communities in malaria control? Malaria Journal 5: 3.

VAN DEN BOSSCHE, P., K. AKODA, B. DJAGMAH, T. MARCOTTY, R. DE DEKEN, C. KUBI, A. PARKER, and J. VAN DEN ABBEELE (2006). Effect of isometamidium chloride treatment on susceptibility of tsetse flies (Diptera: Glossinidae) to trypanosome infections. Journal of Medical Entomology 43: 564-567.

VERA, M. T., C. CÁCERES, V. WORNOAYPORN, A. ISLAM, A.S. ROBINSON, M.H. DE LA VEGA, J. HENDRICHS, and J.P. CAYOL (2006). Mating incompatibility among populations of the South American fruit fly *Anastrepha fraterculus* (Wied.) (Diptera: Tephritidae). Annals of the Entomological Society of America 99: 387-397.

VREYSEN, M.J.B., H.J. BARCLAY, and J. HENDRICHS (2006). Modelling of preferential mating in area-wide control programs that integrate the release of strains of sterile males-only or both sexes. Annals of the Entomological Society of America 99: 607-616.

VREYSEN, M.J.B. (2006). Prospects for area-wide integrated management of tsetse flies (Diptera: Glossinidae) and trypanosomes in sub-Sahara Africa. Revista de la Sociedad Entomologica Argentina 65: 1-21.

VREYSEN, M.J.B., J. HENDRICHS and W.R. ENKERLIN (2006). The sterile insect technique as a component of sustainable area-wide management of selected insect pests of fruits. Journal of Fruit and Ornamental Plant Research 14: 107-131.

2005

ATKINSON, P.W., D.A. O'BROCHTA, and A.S. ROBINSON (2005). Insect transformation for use in control, pp. 403-411. *In* S.S. Gill, L.I. Gilbert, and K. Iatrou (Eds.), Insect pharmacology and control - Comprehensive Insect Biochemistry. Oxford, Elsevier Pergamon.

BAKRI, A., K. MEHTA, and D.R. LANCE (2005). Sterilizing insects with ionizing radiation, pp. 233–268. *In* V.A. Dyck, J. Hendrichs, and A.S. Robinson (eds.), Sterile insect technique. Principles and practice in area-wide integrated pest management. *Springer*, Dordrecht, The Netherlands.

BAKRI, A, N. HEATHER, J. HENDRICHS, and I. FERRIS (2005). Fifty years of radiation biology in entomology: lessons learned from IDIDAS. Annals of the Entomological Society of America 98: 1-18.

BILLINGSLEY, P.F., J.D. CHARLWOOD, and B.G.J. KNOLS (2005). Rapid assessment of malaria risk using entomological techniques: Taking an Epidemiological Snapshot, pp 51-67. *In* W. Takken, and P. Martens (Eds.), Environmental change and malaria risk. Frontis series no. 9. Kluwer Academic Publishers, The Netherlands.

CALKINS, C.O. and A.G. PARKER (2005). Sterile insect quality, pp. 269–296. *In* V.A. Dyck, J. Hendrichs, and A.S. Robinson (eds.), Sterile insect technique. Principles and practice in area-wide integrated pest management. Springer, Dordrecht, Netherlands.

COX, J.St.H., and M.J.B. VREYSEN (2005). Use of geographic information systems and spatial analysis in area-wide integrated pest management programmes that integrate the sterile insect technique, pp. 453-477. *In* V.A. Dyck, J. Hendrichs, and A.S. Robinson (Eds.), Sterile insect technique. Principles and practice in area-wide

integrated pest management. Springer, Dordrecht, The Netherlands.

DOWELL, F.E., A.G. PARKER, M.Q. BENEDICT, A.S. ROBINSON, A.B. BROCE, and R.A. WIRTZ (2005). Sex separation of tsetse fly pupae using near-infrared spectroscopy. Bulletin of Entomological Research 95: 248-257.

DYCK, V.A., J. HENDRICHS, and A.S. ROBINSON (Eds.) (2005). Sterile insect technique. Principles and practice in area-wide integrated pest management. Springer, Dordrecht, The Netherlands.

DYCK, V.A., E.E. REGIDOR FERNÁNDEZ, J. REYES FLORES, T. TERUYA, B. BARNES, P. GÓMEZ RIERA, D. LINDQUIST and R. REUBEN (2005). Public relations and political support in area-wide integrated pest management programmes that integrate the sterile insect technique, pp. 547–559. *In* V.A. Dyck, J. Hendrichs, and A.S. Robinson (eds.), Sterile insect technique. Principles and practice in area-wide integrated pest management. Springer, Dordrecht, The Netherlands.

DYCK, V.A., J. REYES FLORES, M.J.B. VREYSEN, E.E. REGIDOR FERNÁNDEZ, T. TERUYA, B. BARNES, P. GÓMEZ RIERA, D. LINDQUIST, and M. LOOSJES (2005). Management of area-wide integrated pest management programmes that integrate the sterile insect technique, pp. 525-545. *In* V.A. Dyck, J. Hendrichs, and A.S. Robinson (Eds.), Sterile insect technique. Principles and practice in area-wide integrated pest management. Springer, Dordrecht, The Netherlands.

ENKERLIN, W.R. (2005). Impact of fruit fly control programmes using the sterile insect technique, pp. 651-676. *In* V.A. Dyck, J. Hendrichs, and A.S. Robinson (Eds.), Sterile insect technique. Principles and practice in area-wide integrated pest management. Springer, Dordrecht, The Netherlands.

FELDMANN, U., V.A. DYCK, R.C. MATTIOLI and J. JANNIN (2005). Potential impact of tsetse fly control involving the sterile insect technique, pp. 701-723. *In* V.A. Dyck, J. Hendrichs, and A.S. Robinson (Eds.), Sterile insect technique. Principles and practice in area-wide integrated pest management. Springer, Dordrecht, The Netherlands.

FERGUSON, H.M., B. JOHN, K. NG'HABI, and B.G.J. KNOLS (2005). Redressing the sex imbalance in vector biology knowledge. Trends in Ecology and Evolution 14: 202-209.

FRANZ, G. (2005). Genetic sexing strains in Mediterranean fruit fly, an example for other species amenable to large-scale rearing for the sterile insect technique, pp. 427-451. *In* V.A. Dyck, J. Hendrichs, and A.S. Robinson (Eds.), Sterile insect technique. Principles and practice in area-wide integrated pest management. Springer, Dordrecht, The Netherlands.

HENDRICHS, J., M.J.B. VREYSEN, W.R. ENKERLIN, and J.P. CAYOL (2005). Strategic options in using sterile insects for area-wide integrated pest management, pp. 563-600. *In* V.A. Dyck, J. Hendrichs, and A.S. Robinson (Eds.), Sterile insect technique. Principles and practice in area-wide integrated pest management. Springer, Dordrecht, The Netherlands.

IAEA (2005). Environmental benefits of medfly SIT in Madeira and their inclusion in a cost-benefit analysis. IAEA-TECDOC-1475, IAEA, Vienna, Austria.

KNOLS, B.G.J. (2005). Breath gas analysis and vector-borne disease diagnosis: the case of malaria, pp 327-336. *In* A. Amman, and D. Smith (Eds.), Breath analysis for clinical diagnosis and therapeutic monitoring. World Scientific Publishing Co. Pte. Ltd..

KNOLS, B.G.J., and C. LOUIS (Eds.) (2005). Bridging laboratory and field research for genetic control of disease vectors. Proceedings volume of the joint WHO/TDR, NIH/NIAID, IAEA and Frontis workshop on bridging laboratory and field research for genetic control of disease vectors, 14-16 July 2004, Nairobi, Kenya. Springer/Frontis. The Netherlands.

KNOLS, B.G.J., and H. BOSSIN (2005). Identification and characterization of field sites for genetic control of disease vectors, pp. 203-209. *In* B.G.J. Knols, and C. Louis (Eds.), Bridging laboratory and field research for genetic control of disease vectors. Springer/Frontis, The Netherlands.

MAREC, F., L.G. NEVEN, A.S. ROBINSON, M. VREYSEN, M.R. GOLDSMITH, J. NAGARAJU, and G. FRANZ (2005). Development of genetic sexing strains in Lepidoptera: from traditional to transgenic approaches. Journal of Economic Entomology 98: 248-259.

MATHENGE, E.M., G.O. MISIANI, D.O. OULO, L.W. IRUNGU, P.N. NDEGWA, T.A. SMITH, G.F. KILLEEN, and B.G.J. KNOLS (2005). Comparative performance of the Mbita trap, CDC light trap and the human landing catch in the sampling of *Anopheles arabiensis*, *An. funestus* and culicine species in a rice irrigation scheme in western Kenya. Malaria Journal 4: 7.

NG'HABI, K.R., B. JOHN, G. NKWENGULILA, B.G.J. KNOLS, G.F. KILLEEN, and H.M. FERGUSON (2005). Effect of larval crowding on mating competitiveness of *Anopheles gambiae* mosquitoes. Malaria Journal 4: 49.

NIYAZI, N., C. CACERES, A. DELPRAT, V. WORNOAYPORN, E. RAMIREZ SANTOS, G. FRANZ, and A.S. ROBINSON (2005). Genetics and mating competitiveness of *Ceratitis capitata* (Diptera: Tephritidae) strains carrying the marker *Sergeant*, *Sr2*. Annals of the Entomological Society of America 98: 119-125.

PARKER, A.G. (2005). Mass-rearing for sterile insect release, pp. 209-232. *In* V.A. Dyck, J. Hendrichs, and A.S. Robinson (Eds.), Sterile insect technique. Principles and practice in area-wide integrated pest management. Springer, Dordrecht, Netherlands.

ROBINSON, A.S., and J. HENDRICHS (2005). Prospects for the future development and application of the sterile insect technique, pp. 727-760. *In* V.A. Dyck, J. Hendrichs, and A.S. Robinson (Eds.), Sterile insect technique. Principles and practice in area-wide integrated pest management. Springer, Dordrecht, The Netherlands.

SCHOLTE, E-J., K. NG'HABI, J. KIHONDA, W. TAKKEN, K. PAAIJMANS, S. ABDULLA, G. F. KILLEEN, and B.G.J. KNOLS (2005). An entomopathogenic fungus for control of adult African malaria mosquitoes. Science 308: 1641-1642.

VAN SCHAYK, I.M.C.J., R.O. AGWANDA, J.I. GITHURE, J.C. BEIER, and B.G.J. KNOLS (2005). El Niño causes dramatic outbreak of *Paederus* dermatitis in East Africa, pp 240-247. *In* P.S. Low (Ed.). Climate Change and Africa. Cambridge University Press.

VREYSEN, M.J.B. (2005). Monitoring sterile and wild insects in area-wide integrated pest management programmes, pp. 325-361. *In* V.A. Dyck, J. Hendrichs, and A.S. Robinson (Eds.), Sterile insect technique. Principles and practice in area-wide integrated pest management. Springer, Dordrecht, The Netherlands.

VREYSEN, M., and J. HENDRICHS. (2005). The potential of integrating the Sterile Insect Technique as an environmentally friendly method for area-wide management of the codling moth (*Cydia pomonella*), pp. 65-71. *In* Proceedings of the 6th International Conference on Integrated Food Production, Baselga di Piné, Italy, 26-30 September 2004. IOBC/WPRS.

Priced and Unpriced Publications

In Press

ENKERLIN, W. (ed.). 2008. Guidance for Packing, Shipping, Holding and Release of Sterile Flies in Area-Wide Fruit Fly Control Programmes. FAO, Rome, Italy. (unpriced)

2007

FAO/IAEA. 2007. Cost-Benefit Analysis Model: A Tool for Area-Wide Fruit Fly Management. CD ROM, Vienna, Austria. (unpriced)

IAEA. 2007. Development of Improved Attractants and their Integration into Fruit Fly SIT Management Programmes. IAEA TECDOC-1574, ISBN 987-92-0-109407-0. IAEA, Vienna, Austria. (unpriced)

FAO/IAEA. 2007. Proceedings of an FAO/IAEA Co-ordinated Research Project on Quality Assurance of Mass-Reared and Released Fruit Flies for use in SIT Programs. Florida Entomologist 90: 1-179. Free available on http://www.fcla.edu/FlaEnt

2006

FAO/IAEA. 2006. Using GPS Instruments and GIS Techniques in Data Management for Insect Pest Control Programs. Tutorial CD produced by Arava Development Co. for FAO/IAEA. IAEA, Vienna, Austria. (unpriced)

IAEA. 2006. Designing and Implementing a Geographical Information System. A Guide for Managers of Area-wide Pest Management Programmes. Non-serial IAEA publication. IAEA, Vienna, Austria. (unpriced)

IAEA. 2006. Status and Risk Assessment of the Use of Transgenic Arthropods in Plant Protection. IAEA-TEC-DOC-1483, ISBN 92-0-113005-8. IAEA, Vienna, Austria. (Euro 15)

2005

IAEA. 2005. Environmental Benefits of Medfly SIT in Madeira and Their Inclusion in a Cost-Benefit Analysis. IAEA-TEC-DOC-1475, ISBN 92-0-110505-3. IAEA, Vienna, Austria. (Euro 15)

IAEA. 2005. The Cactus Moth *Cactoblastis cactorum*: An Economic, Social and Ecological Threat. CD ROM, Video NTSC available in English. IAEA, Vienna, Austria. (unpriced)

2004-1995

ZIMMERMAN, H., S. BLOEM, AND H. KLEIN. 2004. Biology, History, Threat, Surveillance, and Control of the Cactus Moth, *Cactoblastis cactorum*. Non-serial publication, ISBN 92-0-108304-1. IAEA, Vienna, Austria. (Euro 30)

IAEA. 2003. Automation for Tsetse Mass Rearing for Use in Sterile Insect Technique Programmes. IAEA-TECDOC-1353, ISBN 92-0-104303-1. IAEA, Vienna, Austria. (Euro 15)

IAEA/FAO. 2003. Trapping Guideline for Area-Wide Fruit Fly Programmes. Non-serial publication (English and Spanish versions). IAEA, Vienna, Austria. (unpriced)

IAEA. 2003. Improved Attractants for Enhancing Tsetse Fly Suppression. IAEA-TECDOC-1064, ISBN 92-0-110403-0. IAEA, Vienna, Austria. (Euro 15)

FAO/IAEA. 2002. Proceedings of an FAO/IAEA Research Coordination Project on Medfly Mating. Florida Entomologist 85: 1-181. Free available on http://www.fcla.edu/FlaEnt

IAEA. 2002. The Sterile Insect Technique. An Environment-Friendly Method of Insect Pest Suppression and Eradication. Video (NTSC, PAL format) – CD (English, Spanish and French). IAEA, Vienna, Austria. (unpriced)

IAEA. 2002. Evaluation of Lepidoptera Population Suppression by Radiation Induced Sterility. IAEA-TECDOC-1283, ISSN 1011-4289. IAEA, Vienna, Austria. (Euro 15)

TAN, K. H. (ed.). 2000. Proceedings: Area-Wide Control of Fruit Flies and Other Insect Pests. International Conference on Area-Wide Control of Insect Pests, and the 5th International Symposium on Fruit Flies of Economic Importance, 28 May-5 June 1998, Penang, Malaysia. Penerbit Universiti Sains Malaysia, Pulau Pinang, Malaysia. ISBN 983-861-195-6. (unpriced)

IAEA. 1999. Development of Female Medfly Attractant Systems for Trapping and Sterility Assessment. IAEA-TECDOC-1099, ISSN 1011-4289. IAEA, Vienna, Austria. (Euro 15)

IAEA. 1999. The South American Fruit Fly, *Anastrepha fraterculus* (Wied.) Advances in Artificial Rearing, Taxonomic Status and Biological Studies. IAEA-TECDOC-1064, ISSN 1011-4289. IAEA, Vienna, Austria. (Euro 15)

IAEA. 1998. Genetic Engineering Technology for the Improvement of the Sterile Insect Technique. IAEA-TECDOC-993, ISSN 1011-4289. IAEA, Vienna, Austria. (Euro 15)

IAEA. 1997. Evaluation of Genetically Altered Medflies for Use in Sterile Insect Technique Programmes. Proceedings of Symposium, 92-0-103897-6. (Euro 29)

IAEA. 1997. Control of the Mediterranean Fruit Fly in the Near East Region Using the Sterile Insect Technique. Non-serial publication STI/PUB/1020. IAEA, Vienna, Austria. (unpriced)

IAEA. 1996. Standardization of Medfly Trapping for Use in Sterile Insect Technique Programmes. IAEA-TECDOC-883, ISSN 1011-4289. IAEA, Vienna, Austria. (Euro 15)

IAEA. 1996. A Farewell to Tsetse 1996. Video (English - PAL, SECAM). IAEA, Vienna, Austria. (unpriced)

IAEA. 1995. EASTMED A Proposal for Medfly Control or Eradication with the Sterile Insect Technique. Non-serial publication STI/PUB/982. IAEA, Vienna, Austria. (unpriced)

IAEA. 1995. Economic Evaluation of Damage Caused by, and Methods of Control of, the Mediterranean Fruit Fly in the Maghreb. IAEA-TECDOC-830, ISSN 1011-4289. IAEA, Vienna, Austria. (Euro 15)

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