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(upper) Satellite image showing Moquegua and Tacna provinces in southern Peru, (lower) aspects of some agricultural areas of Moquegua (left) and Tacna (right) valleys.

To Our Readers

Peru has a long history of combating the Mediterranean fruit fly, *Ceratitis capitata*, a polyphagous tephritid that attacks numerous commercially important fruit crops. Since the late 1960s/early 1970s, when the La Molina mass-rearing facility was established near Lima by the visionary Juan Simón, suppression efforts were mainly focused on the regions of Tacna and Moquegua in the southern coastal valleys. Unfortunately, soon after completion of this large rearing facility it was severely damaged by a major earthquake. Therefore it was only in partial operation until the late 1990s, when major refurbishment was initiated in conjunction with the establishment of a genetic sexing mass-rearing system. During these decades the FAO/IAEA Joint Programme of Nuclear Techniques in Food and Agriculture has provided technical support to the different fruit fly control activities in Peru, through several technical cooperation projects and Coordinated Research Projects (CRPs).

We are glad to report that in January 2008, the Animal and Plant Health Service (SENASA) of Peru, a decentralized public institution of the Ministry of Agriculture, announced in a press release that after many years of dedicated efforts and over a year of no fly captures, it has achieved the eradication of the Mediterranean fruit fly and *Anastrepha* fruit flies from the regions of Tacna and Moquegua using an area-wide integrated approach that included the sterile insect technique (SIT).

IAEA International Atomic Energy Agency

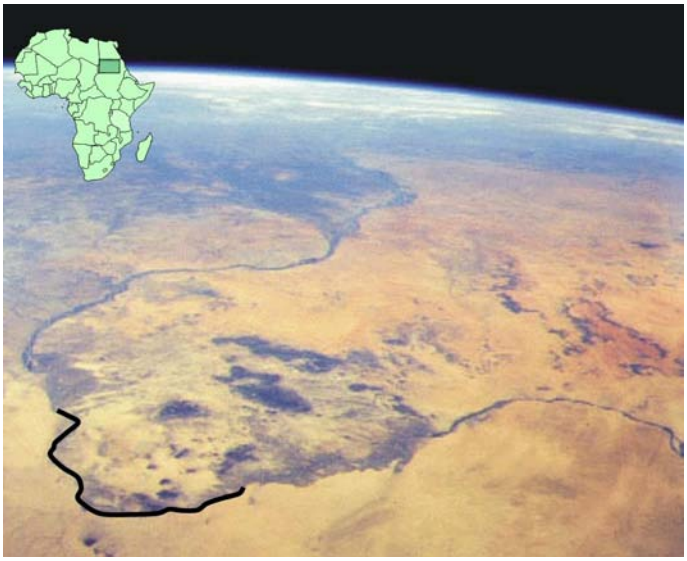
This success has been achieved by the Peruvian State together with producers, exporters, regional and local authorities and the general public in these regions, as well as financial support from the Interamerican Development Bank, and technical and financial support from the FAO and the IAEA.

According to the press release, this achievement benefits the country by:

- avoiding the annual use of an average of 602,120 litres of pesticides, thereby helping to preserve the environment
- avoiding the loss of more than US $12 million in the yearly production of fruit and vegetable crops in the regions of Tacna and Moquegua (where losses amounted to approximately 40% of the total crop) and contributing to improving the quality of life of producers and consumers
- generating gains and direct benefits to 17,876 fruit and vegetable producers on approximately 38,000 hectares of agricultural land located in the coastal districts and inter-andean valleys of both regions
- creating opportunities for national and in particular international trade of these products within the framework of the Free Trade Agreement with the USA, as well as other treaties
- modernizing the internal systems of commercialization through the direct linking of producers, traders and exporters, and incorporating the national and international private sector in the investment for fruit and vegetable production.

This extension of fruit fly-free areas along the coast to the north is an important contribution to Peru's successful strategy of expanding agricultural exports into high quality international markets. The success achieved so far has been instrumental in gaining the confidence of the financial sector and national and international institutions. Within the framework of the national fruit fly programme, new projects have recently been approved, which foresee the gradual expansion of the eradication areas to other regions where fruit fly populations are already under suppression (Arequipa, Ica, Lima), and eventually to Ancash, La Libertad and Lambayeque. Already the elimination of isolated populations of *C. capitata*, *Anastrepha fraterculus*, *A. distincta* and *A. chiclayae* from the inter-andean valley of Huaura-Sayan, north of Lima appears to have been achieved.

In the early 1990s, The FAO/IAEA Joint Programme also provided technical support to neighbouring Chile with the establishment of the Arica mass-rearing facility and the implementation of an AW-IPM programme with an SIT component. Eradication of the Mediterranean fruit fly was achieved in the mid-1990s. As a result of the fruit fly-free status, Chile could significantly expand its fresh fruit exports to important and lucrative international markets. The eradication campaign was followed by a binational Chile-Peru IAEA technical cooperation project to facilitate the transboundary collaboration and the harmonization of technical approaches between both countries. For example, both sterile fly mass-rearing facilities in Arica, Chile and La Molina, Peru use a Mediterranean fruit fly genetic sexing strain that was developed by the Joint FAO/IAEA Programme. Eradication of fruit flies in Tacna and Moquegua valleys is also the result of this close binational collaboration and the multi-institutional efforts.



Field pilot site along Nile in Northern State, Sudan, where malaria is transmitted by Anopheles arabiensis*. The area is relatively small, but distances are long and there are few roads. The vector population breeds throughout the year, but the density is low.*

Changing to the development of the SIT for mosquitoes, collaboration between IAEA staff, international experts and national counterparts is resulting in good progress. Significant advances have been made with the rearing of the target malaria vector, *Anopheles arabiensis*, and more in-depth knowledge has been gained on the radiation biology. In addition, a genetic sexing strain has been developed that allows the elimination of female mosquitoes before the sterile males are released (released sterilized female mosquitoes would continue to feed on people and transmit the malaria parasite). By producing only males the cost of the technology is also significantly reduced, while increasing the efficiency of the sterile males in the field.

This technology, largely developed at the Entomology Unit of the FAO/IAEA Agriculture and Biotechnology Laboratory in Seibersdorf, is now being transferred to a potential target area in the Northern State of Sudan, i.e. the most northern edge of *An. arabiensis* distribution on the Dongola and Abri-Delgo reaches of the Nile River. In this target area it has been shown that irradiated and released male *An. arabiensis* are competitive with wild male mosquitoes in both indoor and outdoor cage studies. Recently also field release trials of sterilized *An. arabiensis* males were initiated to study their dispersal and survival. While several technical components and capabilities for mosquito production and release have yet to be developed, it is expected that these will be sufficiently advanced within the next three years to initiate release operations along the Nile in the Northern State of Sudan.

Detailed data on the distribution and size of the larval mosquito population have already been collected in the target area in Northern State as part of the base-line data collection for the feasibility study. In addition, a systematic series of studies are underway to study adult ecology and behaviour at release sites. The studies have shown strong natural seasonal variation in population size and favourable low-abundance periods for initiating sterile releases.

Population studies have also been conducted for more than ten years by French colleagues in a second potential target site, the island of Reunion in the Indian Ocean, where *An. arabiensis* is the only potential vector of malaria. During a recent meeting in Vienna, French authorities stated that they intend to proceed, in collaboration with the IAEA, with a control programme on the island that includes an SIT component. While these two sites are extremely different geographically and economically, both represent appropriate sites to assess the feasibility of controlling *An. arabiensis* using an AW-IPM approach with an SIT component.

Broad government support is essential for these mosquito pilot studies and political backing has been achieved in both sites. The Sudanese government has been strongly supportive of the project at all relevant ministerial levels. In November 2007, two Ministers sponsored a donor's meeting at which in excess of US $1 million were committed to the project from private sources. Additional fund-raising efforts are planned to attain the goal of US $3 million necessary to establish a small mass-production facility in Khartoum.

In addition to the planned control efforts against *An. arabiensis* on la Reunion, the French authorities have increased their support for developing a control programme with an SIT component against *Aedes albopictus*, the vector of the arbovirus Chikungunya, a disease that has reached epidemic proportions on this and other islands of the Indian Ocean region in recent years. A major study that will establish the base-line data for an SIT feasibility study is currently planned for the island.

For the first time, both laboratory and field studies are indicating that integration of SIT against a malaria transmitting mosquito can be seriously considered in special niche situations in Africa and the Indian Ocean.

In terms of new publications, I would like to highlight the "Guidance for Packing, Shipping, Holding and Release of Sterile Flies in Area-wide Fruit Fly Control Programmes" (134 pp.) published in 2008 under the FAO Plant Production and Protection Series (see more details within this Newsletter). Another recent release is the "Model Business Plan for a Sterile Insect Production Facility" (386 pp.), which is an updated and much improved version of the 2003 edition that was jointly developed with colleagues of Imperial College in the UK.

I would also like to draw your attention to two new CRPs that are being initiated in mid-2008. The first CRP on "Applying GIS and Population Genetics for Managing Livestock Insect Pests" was recommended by a Consultants Meeting and has 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 a SIT component: a) modelling of pest population dynamics; b) satellite-imagery-derived distribution and prediction maps and other Geographic Information System (GIS) aided data processing; and c) 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" also follows the recommendations of a Consultants Meeting. The CRP will focus on key knowledge gaps of adult male mosquito biology, in particular those factors that affect the ability of male mosquitoes 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, the Insect Pest Control Subprogramme is continuing to undergo significant staff turn-over largely due to retirement and some staff members completing their seven year term with the IAEA. Most significant is the retirement at the end of 2007 of Alan Robinson, who very effectively directed the Entomology Unit at the FAO/IAEA Agriculture and Biotechnology Laboratory in Seibersdorf since 1994. Alan has been a key asset in helping to set the technical direction of the Insect Pest Control Sub-programme during these last thirteen years and has been the critical driver in expanding its infrastructure and the scope of its activities, including the new mosquito R&D programme that was initiated at Member States' request. Besides managing very successfully the Unit activities, Alan was also involved in technology development through the management of CRPs and the transfer of the technology to many Member States, thereby maintaining a direct link to operational AW-IPM programmes and their practical problems that have to be addressed by focused applied R&D. We all admire Alan much for his technical excellence, outstanding professionalism, and hard work during all these years. Even though Alan had to retire, he fortunately continues to provide technical support to the Subprogramme under special short-term contracts, and represents an extremely important pillar for the team during the current transition period.

We also want to congratulate Marc Vreysen, who is the new Entomology Unit Head since March 2008. Marc has served FAO and IAEA with dedication and many accomplishments for the last 20 years, of which three years were at the Entomology Unit in the late 1980s as a research entomologist, over ten years in the field as manager of technical cooperation projects in Africa, and the last seven years as an Entomologist for tsetse, screwworm and moths projects at the Section in Vienna Head-

quarters. Marc is much respected by all staff, and combines his vast experience with technical competence, interest in R&D, managerial skills, and an intimate knowledge of FAO and IAEA. We welcome Marc back to the Entomology Unit in Seibersdorf, and wish him much success in his new position as research leader, where he will assure managerial continuity and technical excellence.

We are also welcoming Jesus Reyes, a new Technical Officer at headquarters, who arrived in late May 2008. Jesus worked for USDA in Guatemala, and previously for five years as IAEA regional manager in the Central American region, where he was responsible for fruit fly projects in six countries focused on the development of fruit fly low prevalence and free areas in this subregion. In addition, Jesus has also had numerous interactions over the years with the FAO/IAEA Programme as an expert for technical cooperation projects, and as consultant supporting standard-setting under the technical panel on fruit flies of the International Plant Protection Convention (IPPC). He has considerable management experience gained as director establishing and managing the large National Fruit Fly Campaign in Mexico. We wish him much success in his new position.

On behalf of all colleagues at Seibersdorf and Headquarters, I would like to thank you for your continuing interest and support to our activities. We really do appreciate feedback from you regarding this newsletter and hope you continue to find it a source of useful information. Please also access our improved website, where you can find additional information and previous Newsletters and Annual Reports.

Jorge Hendrichs
Head,
Insect Pest Control Section

Staff of the Insect Pest Control Subprogramme

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Forthcoming Events

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

First RCM of CRP on Biology of Male Mosquitoes in Relation to Genetic Control Programmes. 14-18 July 2008, Vienna, Austria.

First RCM of CRP on Applying GIS and Population Genetics for Managing Livestock Insect Pests. 18-22 August 2008, Vienna, Austria.

Fourth RCM of CRP on Molecular Technologies to Improve the Effectiveness of SIT. 18-22 August 2008, Antigua, Guatemala.

Fourth RCM of CRP on Improved and Harmonized Quality Control for Expanded Tsetse Production, Sterilization and Field Application. 13-17 October 2008, Addis Abeba, Ethiopia.

First RCM of CRP on Increasing the Efficiency of Lepidoptera SIT Through Enhanced Quality Control. Early 2009.

II. Consultants and Other Planning Meetings

Consultants Meeting on Review of Opportunities and Requirements for Implementing a CRP on Assessing the Potential for Improved Strains of Insect Pests for SIT. 18-22 August 2008, Antigua, Guatemala.

Technical Panel on Pest Free Areas and Systems Approaches for Fruit Flies under the International Plant Protection Convention. 1-5 September 2008, Vienna, Austria.

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

III. Other Meetings/Events

Symposium on African Trypanosomiasis (Symposium 9.1 – Medical and Veterinary Entomology) at the International Congress of Entomology. 6-12 July 2008, Durban, South Africa.

Symposium on Sterile Insect Technique on Perennial Crops (Symposium 1.8 – Pest Management: Perennial Crops) at the International Congress of Entomology. 6-12 July 2008, Durban, South Africa.

FAO/IAEA Regional Training Course on Protein Bait Technology for Suppression of Tephritid Fruit Flies as a part of SIT Application under the TC Project RAS5049 "Sharing Regional Knowledge on the Use of the Sterile Insect Technique within Integrated Area-Wide Fruit Fly Pest Management Programmes". 15-19 September 2008, Hanoi, Vietnam.

FAO/IAEA Regional Training Course on Pest Risk Analysis as a part of SIT Application under the TC Project RAS5049 "Sharing Regional Knowledge on the Use of the Sterile Insect Technique within Integrated Area-Wide Fruit Fly Pest Management Programmes". 12-16 October 2008, Amman, Jordan.

Meeting of Programme Against African Trypanosomiasis (PAAT) Advisory Group Coordinators. 14-15 October 2008, Kampala, Uganda.

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

7th Meeting of the Working Group of Fruit Flies of the Western Hemisphere (WGFFWH). 2-8 November 2008, Mazatlán, Mexico.

Past Events (July 2007 – June 2008)

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

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

Second RCM of CRP on Development of Standardized Mass-Rearing Systems for Male *Anopheles arabiensis* Mosquitoes. 17-20 March 2008, Ghent, Belgium.

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

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

II. Consultants and Other Planning Meetings

Consultants Meeting on Increasing the Efficiency of Lepidoptera SIT by Enhanced Quality Control. 3-7 December 2007, Vienna, Austria.

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 Neighbouring Countries. 9-14 December 2007, Conakry, Guinea.

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.

Consultants Meeting to Elaborate the Details of a GIS Training Course Tailored for the Special Needs of Tsetse Control Personnel. 12-14 March 2008, Vienna, Austria.

FAO/IAEA National Planning Workshop on Entomological Baseline Data Collection in Preparation on Integrated Area-Wide Management of *Glossina swynnertoni* in the United Republic of Tanzania. 19 May - 6 June 2008, Monduli, United Republic of Tanzania,

III. Other Meetings/Events

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.

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.

Expert Meeting on Climate Related Transboundary Pests and Diseases, Including Relevant Aquatic Species. 25-27 February 2008, FAO, Rome, Italy.

Meeting with High Level Delegation from France on Mosquito SIT in Reunion. 25 March, 2008, Vienna, Austria.

First International Meeting of Tephritid Workers of Europe, Africa and the Middle East. 7-8 April 2008, Mallorca, Spain.

Meeting for the Formulation of the TC Programme for 2009-2011 and of Regional Projects on Sterile Insect Technique with Israel and Jordan counterparts. 7-11 April 2008, Vienna, Austria.

Third Commission on Phytosanitary Measures, International Plant Protection Convention, FAO. 7-11 April 2008, Rome, Italy.

Meeting with High Level Delegation from Yemen to Discuss and Plan FAO and IAEA Assistance Against a Severe Outbreak of Old World Screwworm (OWS) Flies. 15-18 April, 2008, Vienna, Austria.

Meeting on Livestock Research within the Africa Livestock Partnership Programme (ALIVE) Platform Framework. 24-25 June, 2008, Rome, Italy.

Planning Meeting for Transboundary Tsetse and Trypanosomosis Management in Mozambique and South Africa. 30 June-2 July, Vienna, Austria.

Note: Reports available upon request

Technical Cooperation Projects

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

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

Project Number	Title Continuing Projects	Technical Officer
ALG/5/019	Control of Date Moth Using the Sterile Insect Technique	Rui Cardoso Pereira
BKF/5/004	Feasibility Study on Applying the Sterile Insect Technique to Create a Tsetse-Free Zone	Andrew Parker
BRA/5/057	Establishment of Medfly, Fruit Fly Parasitoids and Codling Moth Rearing Facility	Rui Cardoso Pereira
CHI/5/047	Decreasing the Population of the Mediterranean Fruit Fly in the Arica Region	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
ISR/5/011	Strengthening the Capacity for the Area-wide Suppression of the Mediterranean Fruit Fly Using the Sterile Insect Technique	Jorge Hendrichs
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	Udo Feldmann
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	Jesús Reyes Flores
PAK/5/043	Development of Biological Control for Cotton Pest Management Using Nuclear Techniques	Jorge Hendrichs
PAL/5/003	Strengthening the National Capacity for the Area-Wide Suppression of the Mediterranean Fruit Fly	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	Marc Benedict

RLA/5/045	Preparation for Pilot Fruit Fly Free Area Using the Sterile Insect Technique	Jesús Reyes Flores
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
URT/5/022	Assistance to a Feasibility Study for the Use of the Sterile Insect Technique	Udo Feldmann
	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	Jesús Reyes Flores
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	Jesús Reyes Flores
ISR/5/012	Feasibility Study to Assess the Integration of the Sterile Insect Technique into Olive Fly Suppression Programmes	Andrew Jessup
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	Jesús Reyes Flores
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	Jesús Reyes Flores
RAS/5/049	Sharing Regional Knowledge on the Use of the Sterile Insect Technique within Integrated Area-Wide Fruit Fly Pest Management Programmes.	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	Jesús Reyes Flores
ZIM/5/012	Feasibility Study on the Use of SIT to Eradicate Tsetse in Zimbabwe	Udo Feldmann
	Projects Started in 2008	
YEM/5/009	Emergency assistance for Monitoring and Control of Old World Screwworm Flies in Yemen	Udo Feldmann

The following provides some highlights of technical co-operation projects that are technically supported by the Insect Pest Control Subprogramme.

Integrating Sterile Insect Technique for Tsetse Eradication (ETH5012)

Staff of the IPCS participated in the 5th Technical Advisory Committee (TAC) meeting of the Southern Rift Valley Tsetse Eradication Project (STEP), held on 22 January 2008 at the Kaliti Mass Rearing and Irradiation Centre in Addis Ababa and in the 5th meeting of the STEP Steering Committee (SC), held on 24 January 2008 in Addis Ababa. The TAC and SC meeting participants were of the opinion that the project is gaining momentum, i.e. (1) the colony of *Glossina pallidipes* had at the time of the meeting reached 160 000 females at the Kaliti mass-rearing centre (i.e. a doubling in size in the last 12 months), (2) since week 48 2007 female *G. pallidipes* flies have gradually been transferred from the temporary facility into the first module of the new facility, (3) pupae derived from the colonies maintained at the Slovak Academy of Sciences (SAS) in Bratislava, Slovakia were used to establish start-up colonies of *G. fuscipes fuscipes* (Central African Republic origin) and of *G. pallidipes* (Uganda origin), (4) routine suppression is being maintained in several important livestock areas of the STEP project, and (5) a pilot trial has been initiated in a 100 km^2 test area north of the town of Arba Minch.

The goal of this pilot trial test is to assess the impact of insecticide-impregnated targets deployed at a density of six targets per km^2 combined with insecticide pour-on treatment on 50% of the livestock in the area. Once the monitoring activities indicate that the fly population has been reduced sufficiently, the targets will be removed and sterile male releases initiated. It is scheduled to release 10 000 sterile males per week (the current colony size would permit around 15 00 sterile males per week), which would give a density of 100 sterile flies per km^2 in the test area. Releases would be carried out from the ground at a rate of one release box of 100 flies per km^2. The impact of the releases of these sterile flies will be monitored through careful dissections of all female flies sampled.

This test will provide the programme with a good number of valuable data (the effect of insecticide-impregnated targets on the fly population, obtained ratios of sterile to wild insects and the correlated rate of induced sterility and its effect on the native population) important for the further planning and implementation of the operational phase of the programme. The test has already indicated the logistical problems that are associated with the deployment of these targets in a relatively small area. An indication for the programme management that the use of insecticide-impregnated targets is not a suitable method to cover efficiently the remaining >5000 km^2 of block 1. Other area-wide suppression methods (e.g. the use of the sequential aerosol technique (SAT)) most likely will have to be incorporated in the integrated approach to efficiently suppress the total fly population.

Insecticide impregnated target in the pilot trial area.

Progress has likewise been made with the establishment of an autonomous and sovereign management structure that would allow the payment of an adequate remuneration to the staff and would have the required independence to make all the necessary day-to-day decisions that a project of this nature requires. A draft document outlining such a structure was prepared and has been endorsed by the Director General of the Ethiopian Science and Technology Agency and is ready for submission to the relevant authorities.

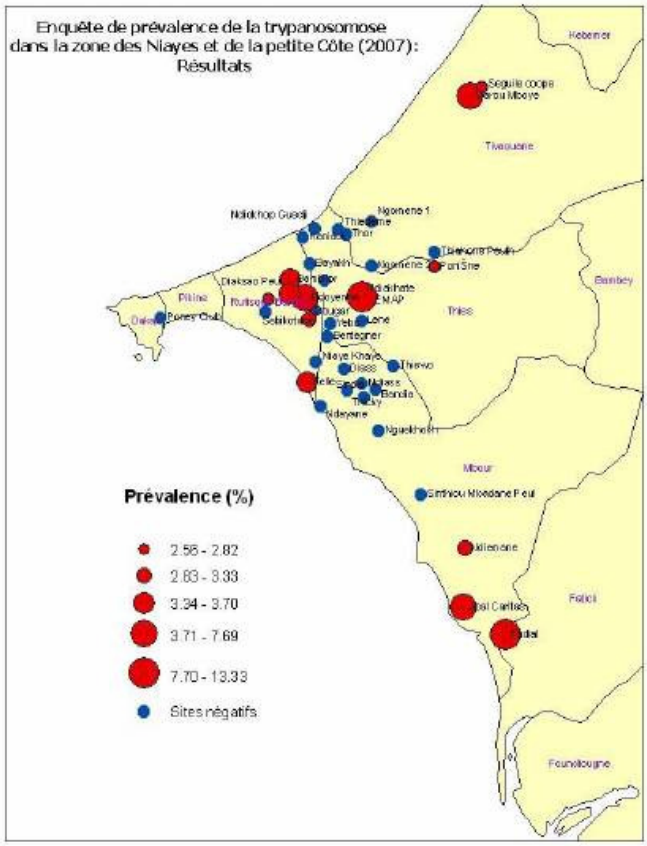
Feasibility Study to Create a Tsetse-free Zone Using the Sterile Insect Technique (SEN5029)

The Government of Senegal has embarked on a project that aims at the elimination of the tsetse fly *Glossina palpalis gambiensis* from the Niayes area (north west of Dakar) and La Petite Côte (south east of Dakar). Assistance was requested from the IAEA and since 2005, technical support is provided through technical cooperation project SEN5029. During the last two years, excellent progress has been made in this project largely due to the commitment of the Government of Senegal and the good leadership and organisational talents of the counterpart Dr. Baba Sall. In the initial phase of the project, emphasis was given on training and to date, 12 technical staff has received training at the Centre International de Recherche-Développement de l'Elevage en zone Subhumide (CIRDES), Bobo Dioulasso, Burkina Faso in tsetse biology, tsetse control methods, GIS, data analysis, etc. Four more are scheduled to receive training soon.

In addition, the following activities have been implemented with the support of project SEN5029 in the last two years: (1) the collection of *G. p. gambiensis* flies from different areas inside and outside the target area for population genetic studies, (2) the development of a detailed plan of action for the collection of entomological

baseline data, (3) a parasitological and serological survey of livestock in the target area, and (4) the initiation of the entomological baseline data recently in January 2008.

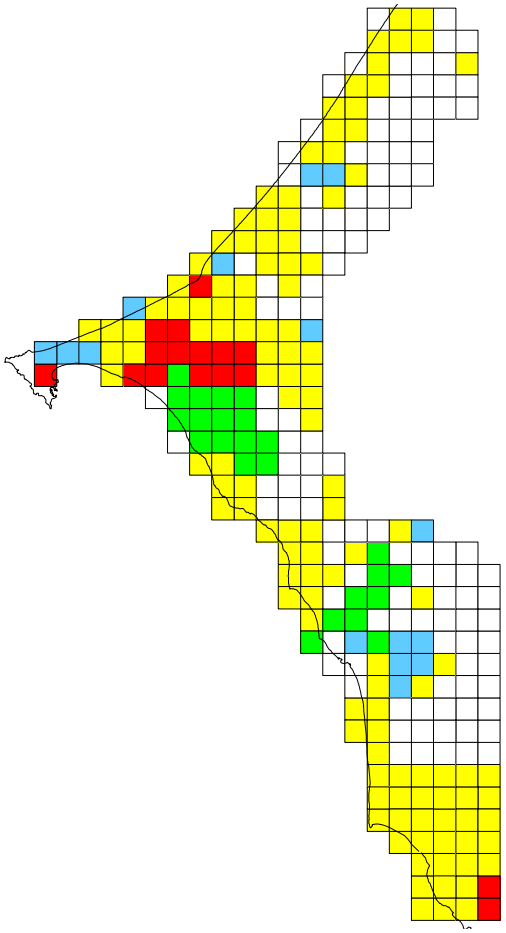
Procedures were developed to select representative sampling sites in each of the identified grids of the target area, taking into account the ecological affinities of *G. p. gambiensis.* As suitable habitat of the fly seems always associated with the availability of fresh water during the dry season (allowing the growth of forest trees or artificial, man-made vegetation (i.e. fruit trees), this 'humid vegetation' was mapped for each grid in a GIS (unsupervised classification). This has been improved recently through some 'ground truthing' (supervised classification). The entomological baseline data collection will most likely be largely completed by the start of the rainy season (July 2008), but may continue in certain areas during the next dry season, starting in September-October 2008, if required.



The results of the veterinary baseline data (data from Baba Sall) indicating disease prevalence in livestock.

During the veterinary survey of 2007, 1329 cattle and 31 horses were screened for trypanosome infection using the buffy coat technique. Positive animals were found in 13 of the 39 sites were animals were screened. Interestingly, infections were found in Mboro (north of Dakar) and in Joal (in La Petite Côte – south east of Dakar) where so far no flies have been trapped. The infestation rate in livestock varied between 2.5% to 13.3%, which can be considerated as high for a vertical parasitological survey with a moderate sensitivity (microscopic observation of the buffy-coat).

Preliminary analysis of the gene frequencies of the *G. p. gambiensis* flies sampled in the various areas of the Niayes and in Missira (population in the south eastern part of the country and part of the larger tsetse fly belt of West Africa) indicate *complete isolation* of the two main *G. p. gambiensis* populations of the Niayes (Sebikotane, Pout, Diacksao Peul and Hann) from those of the main belt in the south-eastern part of the country. The fly population in the Parc de Hann (in Dakar) seems likewise strongly isolated from the remaining fly pockets in the Niayes. Gene flow however, seems to exist between the different fly populations in Pout, Diacksao Peul, Sebikotane, which probably occurs during the rainy season when the fly populations spread from their dry season foci. These data are extremely important as they confirm the isolated character of the fly pockets in the Niayes.



Status of the entomological baseline data collection as of 13/05/2008. Yellow: grids still to be surveyed, White: grids with no humid vegetation and will not be surveyed, Green: surveyed grids but no flies sampled, Red, surveyed grids with flies sampled, Blue: grids currently being surveyed.

The Director of the Direction d'Elevage has requested increased support from the Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD) to reinforce the expertise within the project. As such, CIRAD has agreed to transfer a tsetse ecologist Dr. Jeremy Bouyer from CIRDES in Burkina Faso to Senegal for an initial period of two years.

Following the collection of the entomological base line data, a workshop is scheduled to take place in September 2008 in Dakar to discuss and analyse the available collected data which will be used as a basis for the development of a comprehensive action plan. It is likewise anticipated that trial releases with sterile male flies originating from CIRDES will be initiated in early 2009, to develop transport methods and to assess the performance of the sterile male flies in the field.

FAO/IAEA/PATTEC Regional Training Course on the Principles of Baseline Data Collection for Integrated Area-wide Tsetse and Trypanosomosis Intervention (RAF5051)

The second "FAO/IAEA/PATTEC Regional Training Course on the Principles of Baseline Data Collection for Integrated Area-wide Tsetse and Trypanosomosis Intervention" was hosted by the Direction d' Elevage of the Ministry of Livestock of Senegal and held at the Centre Africain d'Etudes Supérieures en Gestion in Dakar from 18 February to 14 March 2008. The course was attended by 26 participants from 14 African nations, i.e. Burkina Faso (2), Central African Republic (1), Chad (1), Democratic Republic of Congo (1), Ethiopia (2), Kenya (3), Mali (1), Mozambique (1), Niger (1), Nigeria (1), Sudan (2), Uganda (3), United Republic of Tanzania (2), Zambia (1) and Senegal (4).

Training course participants deploying tsetse traps during a field trip.

The course addressed various topics related to the collection of essential baseline data for area-wide integrated pest management (AW-IPM) programmes, e.g. basic tsetse biology, the phases of the entomological baseline data collection, data bases, principles of GIS/RS and GPS, GIS software, control methods, genetics, morphometrics, socio-economics, environmental issues and general principles of AW-IPM. Most of the tsetse-infested countries in sub-Saharan Africa that are planning to embark on the creation of tsetse-free zones under the PATTEC (Pan African Tsetse and Trypanosomiasis Eradication Campaign) initiative are in the second phase of the "phased-conditional approach" (i.e. the feasibility study), and therefore the organization of such a training course was most opportune.

Most participants rated the course as very important and relevant for their future tsetse control activities in their country. In most countries, there is a shortage of relevant expertise to develop actions plans for the collection of entomological baseline data and to implement the actual surveys, and therefore, the training provided through this regional course will greatly assist in filling these gaps.

Capacity Building for Suppression of Fruit Flies of the Genus *Anastrepha* from the Azuero Peninsula using an Area-Wide Pest Management Approach (PAN5016)

Under technical cooperation project PAN5016 "Capacity Building for Suppression of Fruit Flies of the Genus *Anastrepha* from the Azuero Peninsula using an Area-Wide Pest Management Approach", Panama has been working to develop the Azuero Peninsula (8 500 Km^2) into a fruit fly free area to enhance the production and export of fresh fruit and vegetables. Establishment of commercial mango plantations is being concentrated in Azuero and the mango industry has been requesting assistance from the Ministry of Agricultural Development (MIDA) for effective fruit fly control. Panama requested from the IAEA technical support and a TC project was approved for the cycle 2007-2008.

As a follow-up to regional project RLA/5/045, the Azuero Peninsula is in the process of being declared free of *Ceratitis capitata* (Mediterranean fruit fly). This process will also involve the establishment of an emergency plan to be able to react immediately as soon as any Mediterranean fruit fly or *Bactrocera* spp. is detected (trapping systems are already in place). Additionally, 5 internal quarantine stations are being installed, mainly to prevent the movement of fruit fly infested fruit (originating from other areas of the country) to the Azuero Peninsula.

During 2007, the field work concentrated on the completion of a trapping grid according to specifications of the FAO/IAEA Trapping Guidelines. Consistent data from these traps has now been collected during 2007. All the traps are geo-referenced and data are compiled in a computer database. These data show zero trap captures for Mediterranean fruit fly and for *Bactrocera* spp. in the past 3 years, which is solid evidence to declare the Azuero Peninsula free of these fruit fly species.

With respect to *Anastrepha* spp., trap data of *A. obliqua* indicated densities which are above the minimum low prevalence limit of 0.1 FTD during 6 months (March to August) of the year. The control of this species by integrating the SIT can represent an opportunity for the expansion of the production of mango for export.

Feasibility of Integrating the Sterile Insect Technique to the Ongoing Area-Wide Melon Fly Eradication Programme (SEY5003)

Between 2003 and 2006, the Government of the Seychelles has made attempts to eradicate the melon fruit fly (MFF), *Bactrocera cucurbitae*, with the assistance of the European Union. However for several reasons this goal was not achieved. As a follow up the Government of the Seychelles requested support from the International Atomic Energy Agency (IAEA) through a technical cooperation project to reassess the feasibility of an MFF eradication programme. Project (SEY5003) was approved for the cycle 2007-2008 with the following title "Feasibility of Integrating the Sterile Insect Technique to the Ongoing Area-Wide Melon Fly Eradication Programme".

The MFF was detected in Seychelles in 1999 (Mahe Island) and by 2005 it had already spread to 7 other islands of Seychelles (Praslin, La Digue, St. Anne, Long, Fregate, Surf and Dennis). A better knowledge of the actual situation of all other inhabited islands will be necessary. The Mediterranean fruit fly (*Ceratitis capitata*) is the only other fruit fly on the islands and was first recorded in 1908.

The previous EU project was conceived as an eradication project. The counterparts have developed the new TC project with the same ambitious goal, i.e. eradication.

*This introduced wild host (*Mamordica charantia*) of* Bactrocera cucurbitae *has spread only to a few spots in some islands of Seychelles.*

However, to reach this final objective, several conditions need to be in place: (a) strengthening of the quarantine measures (it is a waste of resources to eradicate a pest without making efforts to avoid other exotic pests that can be even more aggressive), (b) assessing through a benefit-cost analysis whether eradication is economically viable and desirable, and (c) engaging in suppression activities to reduce losses and to bring the pest population to certain low levels at which the SIT can be effective. Among the suppression techniques, sanitation and bait application technique using safe insecticides must be the first approach, followed by the use of male annihilation technique after the initial suppression of the population.

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

Project Number	CRP Title	Scientific Secretary
D4 10.19	The Use of Molecular Tools to Improve the Effectiveness of SIT (2003-2008)	Gerald Franz
D4 20.10	Improved and Harmonized Quality Control for Expanded Tsetse Production, Sterilization and Field Application (2003-2008)	Andrew Parker
D4 10.20	Improving Sterile Male Performance in Fruit Fly SIT programmes (2004-2009)	Jorge Hendrichs
D4 10.21	Development of Mass Rearing for New World (*Anastrepha*) and Asian (*Bactrocera*) Fruit Flies (2004-2009)	Andrew Jessup
G 34.001	Development of Standardised Mass Rearing Systems for Male Mosquitoes (2005-2011)	Mark Benedict
D4 20.12	Improving SIT for Tsetse Flies through Research on their Symbionts and Pathogens (2007-2012)	Adly Abd Alla
	New CRP to Start in 2008 and 2009	
G 34.002	Field Biology of Male Mosquitoes in Relation to Genetic Control Programmes (2008-2013)	Mark Benedict
D4 20.13	Applying Population Genetics and GIS for Managing Livestock Insect Pests (2008-2013)	Udo Feldmann
D4 10.22	Increasing the Efficiency of Lepidoptera SIT Through Enhanced Quality Control (2009-2014)	Marc Vreysen

The Second Research Coordination Meeting of the CRP on *Development of Standardized Mass-Rearing Systems for Male* Anopheles arabiensis *Mosquitoes*, 17-20 March, Ghent, Belgium

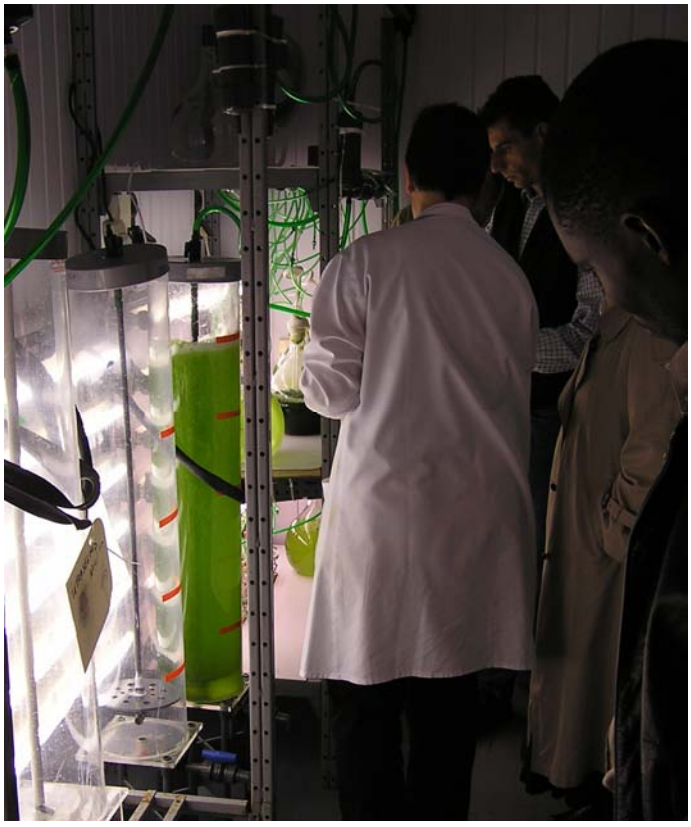
A novel and stimulating venue for the 2nd RCM held 17-20 March was selected: the Laboratory of Aquaculture & Artemia Reference Center in Ghent, Belgium. The meetings consisted of lively and useful discussions toward the goal of developing novel approaches to mass production of mosquitoes.

The 2nd RCM provided an opportunity to assess progress and to perform 'mid-course correction' of the trajectories of projects in light of the information presented at the meeting and developed elsewhere. Two days consisted of presentations and two on assessment and planning.

RCM contract and agreement holders have made significant progress in the areas of rearing methods, larval culture and alternative diets. Larval culture characteristics associated with adult male mating aggressiveness have also been identified, in particular lower density. This condition was not associated with measurable increase in the size of the adults however. This finding highlighted the fact that there are no good standards for assessing male fitness in a production setting. This lack of knowledge will in part be filled by the second mosquito CRP on Male Biology but at this time is impeding efforts to develop quality standards for mosquito SIT.

Two possibilities engaged the imagination of the attendees. Mr. Atulo presented data indicating that deep tank rather than shallow tray culture of *Anopheles arabiensis* might be possible - a process utilizing off-the-shelf components that have been developed for aquaculture. If this is accomplished and produces competitive males, it allows the possibility of high-density recirculating culture

systems that would require less space and investment in space, racks, trays and environmental control. A second report by Mukabana indicated that reasonable adult emergence rates were obtained from older pupae held on dry filter paper and excellent emergence from damp filter paper. These findings offer the tantalizing possibility of pupa release which would be easier to perform from aircraft than adult release.



RCM attendees inspecting an alga production system for aquaculture.

The Third Research Coordination Meeting of the CRP on *Development of Mass Rearing for New World (*Anastrepha*) and Asia (*Bactrocera*) Fruit Fly Pests in Support of SIT,* 1-5 April 2008, Valencia, Spain

The 3rd RCM of the CRP on "Development of Mass Rearing for New World (*Anastrepha*) and Asian (*Bactrocera*) Fruit Fly Pests in Support of SIT" was successfully held with the participation of 21 scientists and 2 observers from 16 countries. Current SIT programmes, producing several billion male insects every week sterilised by irradiation and packaged, shipped, reared and released on all continents, have mainly *Ceratitis capitata*, the Mediterranean fruit fly (medfly) as target.

It has been recognized by the IAEA that SIT programmes for other fruit fly species of high pest status need to be improved to the medfly level. The CRP addresses this by targeting the development of techniques in laboratory colonization, mass rearing and quality assessment on nominated fruit fly species with significant adverse effects on food production and trade.

Some species are new to SIT (e.g. *Bactrocera xanthodes* from the Pacific Ocean region and *Ceratitis cosyra* from Africa); others have been colonised in the laboratory but have not progressed to mass-rearing levels suited to SIT (e.g. *Bactrocera oleae* from the Mediterranean region and now in California and *Anastrepha fraterculus* from South America); while others are already in SIT programmes but need improvements in process control to ensure more efficacious SIT (e.g. *Bactrocera dorsalis* from Asia, Hawaii, Africa, Indian Ocean and *Anastrepha ludens* from Central America). Good progress is being made in each of these three categories and very encouraging results are being obtained in improving laboratory establishment, artificial mass rearing and quality assessment in 21 fruit fly species:

A. For fruit fly species new to SIT:

- Laboratory colonies have been established: *Anastrepha zenildae, Bactrocera pyrifoliae, Bactrocera invadens, Bactrocera xanthodes*, *Bactrocera kirki, C. cosyra, Ceratitis fasciventris, Ceratitis rosa*, *Ceratitis anonae,* and *Dacus ciliatus*
- Devices for mass collection of eggs have been tested and evaluated as the first step to mass-rearing: *Anastrepha zenildae, B. invadens, Ceratitis fasciventris, C. rosa*, *C. anonae* and *D. ciliatus*
- New liquid larval diets as developed by USDA/ARS have been tested, or will be during the third phase of the CRP for all species. Starter kits from the USA have been received by all researchers

B. For species that need building up to mass-rearing level:

- Standardisation of adult cage, egg collection method, adult and larval rearing environments, and adult and larval diets has been achieved: *Anastrepha serpentina, A. fraterculus, B. oleae* and *Bactrocera zonata*. A larval diet for *A. striata* has been developed.
- Quality testing procedures tested the effects of laboratory establishment of *A. fraterculus* on morphometric traits, adult survival and mating behaviour. Results were encouraging in that the measured impact of laboratory establishment on these traits was minimal.
- Research on *B. oleae* over the years has shown that this species is particularly difficult to rear consistently in the laboratory. While *B. oleae* is an excellent candidate for SIT the development of mass-rearing techniques has been problematic. R&D from this CRP has been very promising in the development of a cheaper larval diet (using chromatographic cellulose as a protein source). A reduction in the use of antibiotics in the adult diet resulted in better quality flies. A hybrid strain of flies from Crete and Israel was shown to be as sexually compatible and competitive as wild flies.

- Studies on the symbiotic relationships with endogenous microflorae with their host flies have shown promising results, especially with *B. oleae,* that suggest that sterile fly quality can be improved with the management of these bacteria in sterile fruit fly production facilities.

C. Species already under SIT but which need R&D to improve viability:

- A generic larval diet has been developed for all *Anastrepha* species under SIT.
- Field cage testing has shown that sterile *A. ludens* and *A. obliqua* are adversely affected compared with fertile insects. Sterile *Bactrocera cucurbitae* are equally compatible with fertile flies as a result of field cage studies.
- The liquid larval diet is ready for full implementation for *B. dorsalis* mass-rearing for SIT.
- The development of production protocols and new larval diets using better bulking agents has improved mass rearing outputs for *Bactrocera philippinensis*.

A visit to the nearby Medfly Mass Rearing Facility was arranged by our hosts as part of the RCM. The importance of this facility has been highlighted in several FAO/IAEA and European news reports. It is regarded as the second biggest SIT production facility in the world after El Pino, Guatemala. The facility is of great importance to the Valencia region in managing the fruit fly problem which if left unchecked would adversely affect the significant production and export of citrus from this region. This visit was an excellent practical example to the RCM's research agreement and contract holders of how FAO/IAEA sponsored R&D can result in the successful application of SIT.

The Third Research Coordination Meeting of the CRP on *Improving Sterile Male Performance in Fruit Fly SIT Programmes,* 1-5 April 2008, Valencia, Spain

The 3rd RCM of the CRP on "Improving Sterile Male Performance in Fruit Fly SIT Programmes" was successfully held with the participation of 20 scientists and 12 observers from 18 countries. Several billion sterile male insects are being mass reared and irradiated every week in factories on all continents, and shipped (as pupae) to their destination where the emerging flies are maintained in emergence/release facilities. The CRP addresses this critical post-production process during which the sterile males may be manipulated in a manner that will significantly improve their sexual performance following release. It begins with the arrival of pupae at the emergence facility and ends with their release in the field, and involves the biotic environment (hormones, nutrients, microorganisms, semiochemicals), as well as the abiotic environment and release methods.

*Participants of the two RCMs ("Development of Mass Rearing for New World (*Anastrepha*) and Asian (*Bactrocera*) Fruit Fly Pests in Support of SIT" and "Improving Sterile Male Performance in Fruit Fly SIT Programmes") held in Valencia, Spain (1-5 April 2008).*

Good progress is being made and very encouraging results are being obtained in understanding and assessing the effects on sterile male performance of exposure of adult flies to hormonal, nutritional, microbiological and semiochemical supplements in ten fruit fly species of economic importance:

- Effects of hormone analogs supplements assessed for *Anastrepha fraterculus*, *A. ludens*, *A. obliqua*, *A. suspensa*, *Bactrocera cucurbitae*, and *Ceratitis capitata*.
- Hormone supplements procedures developed for incorporation into pre-release protocols for ongoing *Anastrepha ludens* SIT operations.
- Good progress made on optimal pre-release adult diet for sterile males for *Anastrepha ludens*, *A. obliqua*, *A. suspensa*, *Bactrocera cucurbitae, B. dorsalis*, *B. philippinensis*, *B. tryoni*, and *Ceratitis capitata*.
- Structure and possible function of microbial community in the gut of *Ceratitis capitata* determined.
- Effects of semiochemical supplements assessed for *Anastrepha suspensa*, *Bactrocera correcta*, *B. cucurbitae*, *B. dorsalis*, *B. philippinensis*, *B. tryoni*, *B. zonata*, and *Ceratitis capitata*.
- Delivery systems involving ginger root oil for *C. capitata* tested at operational scale and transferred to most of the SIT programmes.
- "Guidance for packing, shipping, holding and release of sterile flies in area-wide fruit fly control programmes" manual published by FAO/IAEA.
- Effects of fly immobilization by chilling assessed in *A. ludens* and *C. capitata* in terms of sexual performance. Effect of holding density on sexual performance determined in *C. capitata*, and new release system developed.

The RCM reports have been prepared, where details on all CRP activities and technical aspects can be obtained.

Developments at the Entomology Unit Seibersdorf

TSETSE FLIES

Evaluation of Tsetse Production Unit (TPU)3.2

The testing work on the semi-automated tsetse production unit (TPU3.2) is progressing well at the Entomology Unit in Seibersdorf. The improvement of the efficiency of the system for tsetse holding and feeding previously reported has lead to a progressive increase in the number of flies being maintained on the system. About 18,000 *Glossina pallidipes* females are now being maintained using four new, larger feeding trays (see figure). It was observed that 320 mL of defibrinated cattle blood provided to each tray can feed up to five TPU3.2 frames (3,375 flies). To avoid frequent reloading of the trays with fresh blood during the feeding process, larger feeding membranes covering the whole surface of the trays will be introduced soon. Such a feeding system should offer advantages like stable feeding temperature on the top of the membrane, increased blood holding capacity and reduced risk of external bacterial contamination.

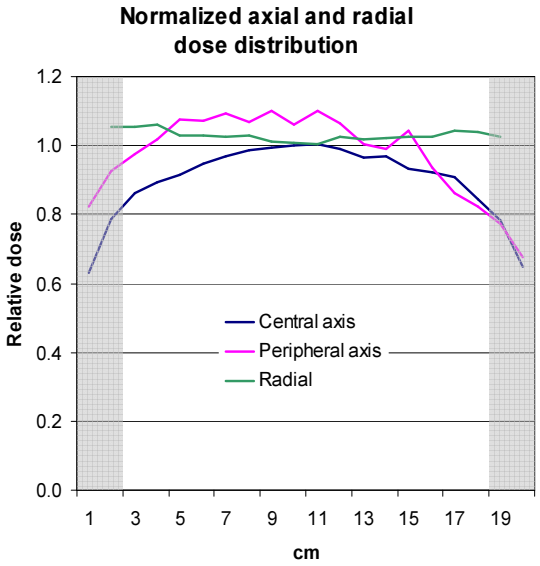
TPU3.2 at the Entomology Unit of the IAEA's Laboratories in Seibersdorf loaded with 18,000 Glossina pallidipes *since March 2008.*

X Ray Irradiator

With technical support from the consultant, Dr. Kishor Mehta, work has continued on checking and calibrating the RS2400 X ray irradiation system. The principal obstacle to completing this during 2007 was the many delays and unreliability of the X ray tube which continually interrupted the work. A new tube, of a modified design, was supplied and fitted by the manufacturers in February 2008, and this has proved reliable to date. Conditioning of the new tube was much quicker than before, and arcing (sparking) within the tube almost completely eliminated. As a result the characterization has advanced considerably.

The original dose distribution was unacceptable, with a dose uniformity ratio (DUR, ratio of the highest to the lowest dose) greater than 2. To be acceptable the DUR should be as small as possible, and not greater than about 1.3. To improve the DUR, various filters were tested including a graded aluminium step filter directly attached to the X ray tube's outer surface, and various filters on the outside of the exposure canisters. The longitudinal uniformity of the tube X ray output was significantly improved by the addition of the step filter but of itself this did not greatly improve the DUR in the canisters. Additional filtering using high atomic number (Z) material (steel, copper or brass) on the surface of the canister produced a marked improvement in DUR, at the expense of a lowered dose rate. With this high Z filtering it was shown that the step filter had no significant effect and was subsequently removed.

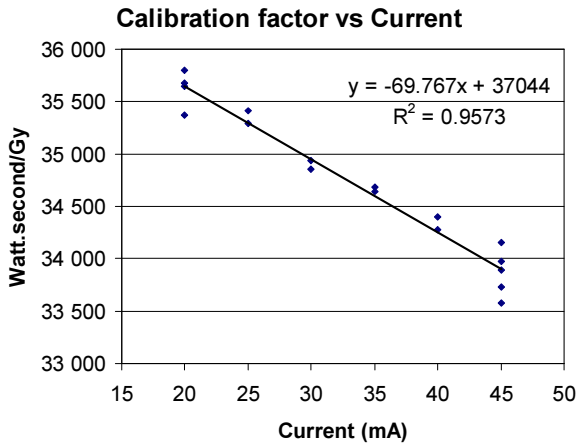
Using 0.5 mm stainless steel filtering on a 180 mm diameter by 200 mm long canister, the radial dose distribution (across the canister diameter, perpendicular to the X ray tube) is very uniform, with a maximum variation of about 5%. The axial dose distribution (parallel to the X ray tube axis) still shows a marked fall off at each end (see figure) as the canister approaches the limits of the active X ray emission surface of the tube, but by blocking off 20 mm at each end the canister the maximum drop is about 20%. This could be improved further by increasing the amount blocked off at each end, with a correspondingly reduced volume implying that increasing the canister diameter and reducing the length further would maintain or increase the volume whilst maintaining an acceptable dose uniformity.



Radial and two axial dose distribution curves for the X ray irradiator using instant rice as a dummy. Canister with 0.5 mm stainless steel filtering and 20 mm plexiglass end plugs. The volume blocked by the plexiglass plugs is shaded.

The use of a 0.5 mm stainless steel filter on the canister reduces the dose rate in the centre of the canister by about 30%. Removing the step filter restores a little of the dose, but the final dose rate is about 11.5 Gy min^{-1}. The new tube, however, should be able to operate at 55 mA (compared to 45 mA currently) once the cooling system is upgraded, which will increase the dose rate by about 20%. At the moment the cooling system is operating close to its pressure limit; this will be increased to reduce the pressure drop whilst maintaining or increasing the flow rate to reach the higher power.

One significant change in the control system is the inclusion of a calculation of the energy output of the power supply, measured in Watt.seconds. The energy conversion from the input power to X ray is dependant on the electron energy (and hence acceleration voltage), but at constant voltage there should be a constant relationship between this input power and the dose at a given location within the canister. We find, however, that there is a small current dependence in the relationship that we did not expect (see figure). This will have to be investigated further, and if necessary, a calibration calculated at each current setting that will be used. However, as we expect to normally use the irradiator at maximum current for all irradiations this is not a significant issue. The control system also needs reorganizing so that the normal operator has access only to the automatic exposure modes, with all other functions password protected to prevent accidental changes.



Relationship between Watt.second/Gray and current at constant voltage (150 kV).

One problem that has been encountered is in estimating the X ray energy spectrum in the insects being irradiated; knowing the spectrum is important for calibrating dose measurements and for transferring the dose measurements from the instruments to the samples, as the mass energy absorption coefficient of many materials changes rapidly in the energy range from 10 to 100 keV. The tube produces a spectrum of photons that can be calculated, but the configuration of the X ray machine produces complex absorption and scattering of the photons so that the final spectrum is very complicated to determine. In order to help resolve this problem a research contract has been awarded to Dr. Uribe of Kent State University, USA to run a Monte Carlo simulation to estimate the energy spectrum in the chamber and samples.

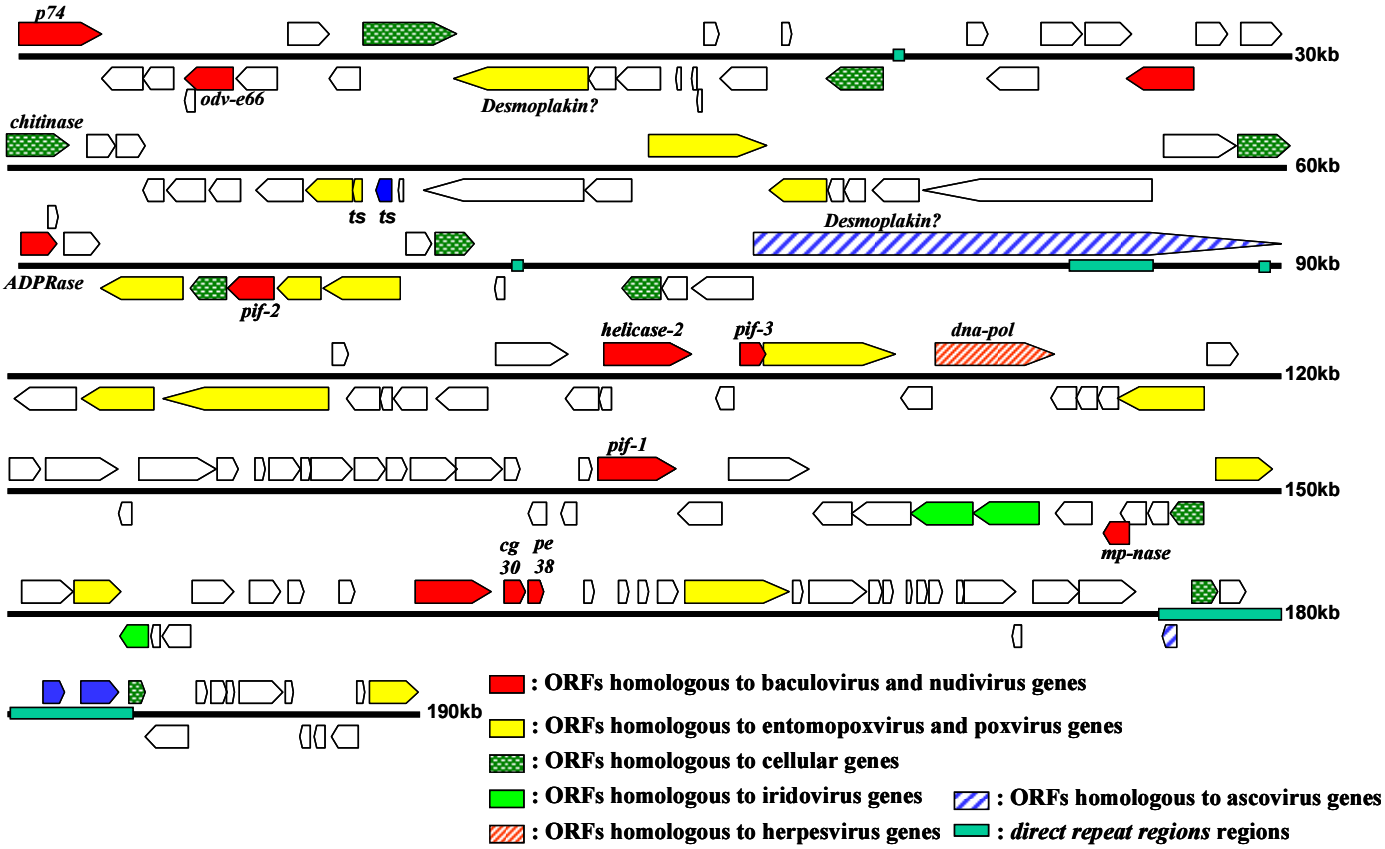
Salivary Gland Hyperplasia

As reported in newsletter 70, sequencing of the salivary gland hypertrophy virus (SGHV) was published[1] and it is know available in the GeneBank data base with the accession number (EF568108) http://www.ncbi.nlm.nih.gov/entrez/viewer.fcgi?db=nuccore&id=158906364 (see figure next page).

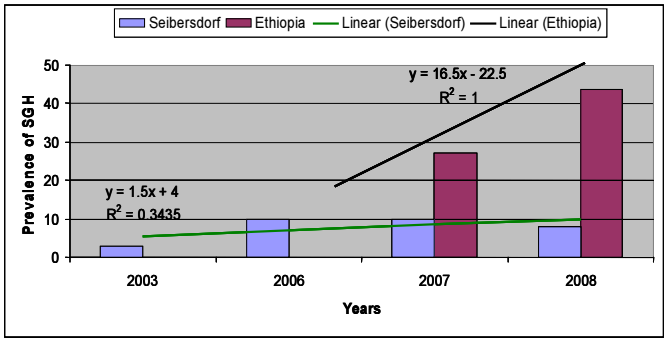
The relationship between the SGHV isolated from the *Glossina pallidipes* colony, Uganda origin maintained at the Entomology Unit and that of the *G. pallidipes* colony in Ethiopia was examined. Differences in pathology were already observed between the *G. pallidipes* colony that originated from Arba Minch, Ethiopia and was maintained at the Entomology Unit in 2002 (but the colony proved not to be self-sustainable and became extinct) and the *G. pallidipes* tsetse colony that originated from Uganda and that has been stable at the Unit since 20 years. It was likewise observed that the prevalence of SGHV (i.e. flies with the symptoms expressed) has increased in the Ethiopian colony from 20% in 2007 to 35% in 2008, whereas the prevalence of SGH in the *G. pallidipes* colony (Uganda origin) maintained at the Entomology Unit has been stable at around 10% (see Graph next page).

To assess whether these phenotypic differences could be related to differences at the sequence level, the entire genome of the SGHV isolated from *G. pallidipes* originating from Ethiopia was sequenced. Hypertrophied salivary glands were collected from infected flies of the colony that is maintained at the Kaliti mass-rearing facility in Addis Ababa. The virus was purified by sucrose gradient and the DNA was extracted by phenol/ chloroform methods. Based on the published sequence of SGHV from the Uganda strain of *G. pallidipes*, 136 pairs of primers were selected and PCR was carried out using SGHV DNA from the Ethiopia strain as a template. The Sanger method was used to sequence PCR products from both ends using the selected primers. Currently, 95% of the genome of the SGHV from the Ethiopian strain of *G. pallidipes* has been sequenced and the results indicate a 98.3% similarity between the virus of the two *G. pallidipes* strains. Most of the open reading frames (ORF) are the same in both strains, with some ORFs having insertion and/or deletion (22%) and the remaining ORFs having amino acid changes with synonymous and non synonymous mutations. Transcription analysis to compare the initial step of the ORF expression between the two virus strains is being undertaken.

[1] ABD-ALLA, A.M.M., COUSSERANS, F., PARKER, A.G., JEHLE, J.A., PARKER, N.J., VLAK, J.M., ROBINSON, A.S., BERGOIN, M., Genome analysis of a *Glossina pallidipes* salivary gland hypertrophy virus (GpSGHV) reveals a novel large double-stranded circular DNA virus, J. Virol. 82 9 (2008) 4595-611.



Linearized representation of the GpSGHV genome. The genome was linearized at the ATG start codon of p74 (=SGHV001). Arrows indicate the position and direction of transcription for potential open reading frames (ORFs), which are coloured according to suggested homology to those of other viruses. Blue boxes indicate position of repeat regions.



Prevalence of salivary gland hypertrophy in the colony maintained at the Entomology Unit in Seibersdorf and in Ethiopia.

Currently, work is continuing (1) to produce antibodies against the p47 protein with the aim to detect the virus by serological methods and to evaluate the efficacy of antibodies in neutralizing the virus infection, (2) to analyse the effect of the suppression of the expression of p74 by RNAi on virus infectivity, and (3) to study the impact of antiviral drugs on viral infection in the fly. So far, the toxicity of four antiviral drugs for *G. pallidipes* flies has been tested and as a result of this preliminary screening, acyclovir and valacyclovir have been selected for further work. The two other drugs were too toxic for use in tsetse feeding. To analyse the effect of the antiviral drugs on viral DNA replication a quantitative PCR test was developed and two primers were selected and the number of viral DNA copies was quantified in a preliminary test.

FRUIT FLY GENETICS

Standard cytological maps for *Anastrepha ludens*

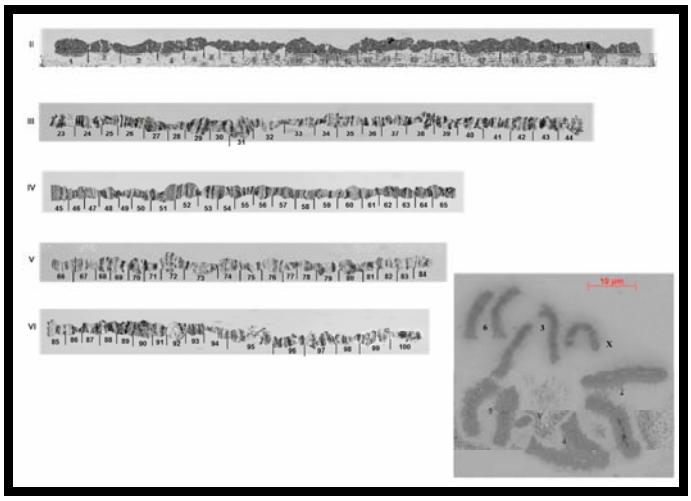
Polytene chromosomes have proven to be an essential tool in genetic analysis of *Drosophila* since the first publication of hand-drawn maps of Bridges in 1935. Polytene chromosome maps are now available for about 270 species of *Drosophilids* and for more than 250 other Diptera. Genetic and cytogenetic analyses of Diptera have been greatly facilitated by the existence of these maps because of the reproducible banding pattern of polytene chromosomes within each species.

Polytene chromosomes are also an excellent material for studies related to the chromosome structure and function, gene activity, phylogenetic relationships among closely related species and to distinguish members of a species complex. Polytene chromosome maps are also essential tools to determine the structure of chromosome rearrangements such as translocations and inversions, which are used in basic genetic studies as well as in practical applications. They also provide a means for accurate mapping of any cloned DNA sequence by *in situ* hybridization, thus contributing to the construction of detailed genetic/cytogenetic maps.

The Mexican fruit fly, *Anastrepha ludens* (Loew), is a major pest in a variety of fruits in Central America from Mexico to Panama. In addition, its natural distribution includes the Rio Grande Valley of Texas, while invasions have occurred in Southern California and Arizona.

The species is the target of intensive suppression and eradication campaigns in Mexico and the USA. In spite of its economic importance, no genetic or cytogenetic information exists for the species. Only one report describes the mitotic karyotypes of nine *Anastrepha* species including *A. ludens*.

During the last year, the mitotic karyotype has been analysed at the Entomology Unit at Seibersdorf and photographic maps of larval salivary glands polytene chromosomes of *A. ludens* have been developed (see figure). These maps could be used for any future cytogenetic study in this species and could also be used as reference material for the other *Anastrepha* species where currently no data on polytene chromosomes exists.



Standard polytene chromosome map (salivary glands) of the autosomes of Anastrepha ludens. *The sex chromosomes do not form banded polytene chromosomes. Autosomes were numbered according to their length. A correlation between the mitotic chromosomes (right lower corner) and the polytene chromosomes was not established yet*.

The mitotic karyotype has a diploid complement of 12 acrocentric chromosomes, including five pairs of autosomes and a XX/XY sex chromosome pair. The analysis of salivary gland polytene chromosomes has shown a total number of five polytene elements that correspond to the five autosomes. The characteristic features and the most prominent landmarks of each chromosome were determined. By comparing chromosome banding pattern, the possible chromosomal homology between *A. ludens* and *C. capitata* was established.

FRUIT FLY REARING

General

Research and development in the fruit fly rearing group over the last year has concentrated on streamlining production methods for a range of pest fruit fly species with a view to facilitating the transfer of insects from small-scale laboratory culture to large scale mass rearing colonies.

Fruit Fly Species Strains Currently Maintained at the Entomology Unit at Seibersdorf

- *Anastrepha fraterculus*: 9 strains: 1) Peru lab, 2) Argentina lab, 3) Hybrid P X A plus 6 strains all from different locations in Peru: 4) Lima, 5) Lambayeque, 6) La Libertad, 7) Piura, 8) Ancam, 9) Ica
- *Bactrocera dorsalis*: 2 strains: 1) Genetic sexing strain (GSS) strain (Hawaii), 2) Wild strain (Thailand)
- *Bactrocera correcta*: Thailand
- *Bactrocera cucurbitae*: 2 strains: 1) GSS strain (Hawaii), 2) Wild strain (Seychelles)
- *Bactrocera oleae*: 5 strains: 1) Lab, 2) Croatia, 3) Valencia, 4) Israel, 5) Greece lab
- *Ceratitis capitata*: 5 strains: 1) Transgenic #66, 2) Transgenic #67, 3) Oxitec transgenic strain, 4) Vienna-8 *tsl* strain, 5) Argentina.

General R&D

Laboratory technicians have shown that the larval rearing diet developed at the Entomology Unit for the rearing of *Ceratitis capitata* (Mediterranean fruit fly) can also be used, with slight modifications, to rear *Bactrocera dorsalis* (Oriental fruit fly), *Bactrocera correcta* (guava fruit fly), *Bactrocera cucurbitae* (melon fly), *Anastrepha fraterculus* (South American fruit fly), *Anastrepha ludens* (Mexican fruit fly), but not *Bactrocera oleae* (olive fruit fly). These diets are based on the following ingredients: bran, brewer's yeast, sugar, sodium benzoate, hydrochloric acid and water. These diets are now in use in our laboratory for each of these fruit fly species (see figure).

Larval rearing diet developed at the Entomology Unit and now being used for the rearing of various species.

Feeding wheat germ powder to adult flies in addition to hydrolysed protein, sugar and water.

Work is progressing on developing a new method to potentially mass-rear *Anastrepha fraterculus* that produces high egg fertility. Adding wheat germ powder to protein hydrolysate and sugar (1:1:3) as an adult fruit fly diet increases egg fertility significantly. Adult diet which consists of hydrolysate yeast and sugar (1:3) shows very low egg fertility (25% to 35%) but, on the other hand, adult diet with wheat germ powder shows very high egg fertility. Currently, the egg hatch rate in our *A. fraterculus* colony is up to 90-95%. Egg-to-pupa recovery is now up to 38-40% (using the normal mass-rearing larval rearing tray) and 60-70% (based on recovery from 1000 eggs in small batches of diet). Adult emergence rate is 80-90% and flight ability is 80-85%. Pupal weight is 15-16 mg. It is hoped that very soon higher egg-to-pupa recovery rates will be achieved from mass-rearing trays.

Some facilities use corn protein as an adult diet additive, but at the Entomology Unit it resulted in sudden fly mortality in the colony. So far, no investigation has been done as to why this occurred. Preliminary data show that wheat germ powder has no adverse effect on the colony. An added benefit is that wheat germ powder is cheap and easy to obtain.

Results suggest that the addition of wheat germ powder to colonies newly established from field infested fruit, which have notoriously low egg fertility rates when transferred from the field to the laboratory, may be of benefit to establishing a laboratory colony more quickly and effectively than without wheat germ powder. This work will be replicated and also tested on other fruit fly species.

Specific R&D

Rearing of *Bactrocera oleae*

Bactrocera oleae (olive fly) is a very serious pest of olives all around the Mediterranean region and now in California, Arizona and northwestern Mexico. The olive, produced for both the table and for its oil, is a major crop in these regions and the damage caused by this insect reduces farmer incomes and regional export opportunities. Separate colonies of olive fly sourced from Greece, Croatia, Israel and Spain as well as a lab-adapted strain have been established at the Entomology Unit.

Diego Segura, a consultant from Argentina (September 2007 - April 2008), carried out several trials on olive fly. He supervised Ester Lavi and supported Ioannis Dimou (see below) in their studies on olive fly and also assisted Anne Estes, University of Arizona, USA, on a Research Contract through the CRP entitled "Improving Sterile Male Performance for Fruit Fly SIT".

Esther Lavi, from Israel, visited the Entomology Unit from 1 to 15 December, 2007 to "Conduct a preliminary study on irradiation doses required to sterilize the Israel-Greek Hybrid Strain of the Olive Fly" in collaboration with Diego Segura and FAO/IAEA technicians. Olive fly pupae were irradiated at 0, 20, 40, 60, 80, 100 and 120Gy. Esther found that a dose of 120Gy did not completely sterilise males. Females were completely sterile after a dose of only 40Gy. Adult emergence rates, pupal weight, sex ratio and flight ability were not affected by irradiation dose. A repeat of this experiment was subsequently carried out by Diego Segura, and Esther's findings were confirmed.

Ioannis Dimou, a consultant from the University of Crete, Laboratory of Applied Entomology, Heraklion, Greece, worked at the Entomology Unit with Diego Segura and FAO/IAEA technicians from 24 October to 21 December 2007 to assist with the development of improved methods for mass rearing the olive fly. Ioannis made a series of useful recommendations for improvements to our rearing system including reducing the egg incubation (bubbling in water) from 48h to 24h, dissolving nipagen (antibacterial larval diet ingredient) completely in hot water before adding it to the diet, including periodical checks of diet pH and reducing it to 3.9 from 4.2, and ideas on the humidification of egging devices, lighting and sanitation.

New procedure for collecting olive fly eggs in the laboratory

Laboratory reared olive flies have adapted to laying eggs through wax-coated cloth. Previously a sheet of terylene was used coated with wax and formed into a cone as an egg collection device. To maintain humidity in the egg collection device a small piece of water-soaked sponge was added into the cone. Subsequently it was found that this wet sponge was one of the causes of fungal contamination of the larval diet. So the sponge was removed and the design of the egg collection device changed to a plastic bottle covered with waxed cloth as the egg collection device. However the volume of eggs recovered from each cage of flies was still not very satisfactory.

A new egg collection device has now been designed which appears to be superior to both the waxed cloth cone and bottle and this new technique is being tested and assessed currently (see Table next page). On one or two sides of the cage, whole side screen (a flat waxed cloth panel) is used as an egg collection device through which flies can oviposit directly. Eggs are collected from the outside of the cage very smoothly and easily with the aid of a wash bottle of water. The side screen also provides more space for flies to lay the eggs. In this case there is no wax device inside the oviposition cages. The flies have now adapted to laying their eggs through the side screen. The side screen also increases egg volume per cage rapidly.

Results of studies on changing the egg collection method for laboratory reared olive fly.

Former method: Wax coated cloth cone placed inside fly cage	New method: Wax coated cloth cage side panel
Volumes of eggs collected per cage per day are very low (0.1 mLcage/day)	Daily volume of eggs collected per cage has improved (0.3-0.4 mL/cage/day)
Egg collection procedure was complicated (constructing the dome, keeping it moist, contamination, having to open the cage when placing and removing the cone, etc.)	The easy way of egg collection procedure (more time-effective construction of the device, eggs collected from the outside of the cage, egging device stays in place for the life of the cage, etc.)
Changing the wax nets was not easy	The changing procedure for wax nets is very easy
Fungal contamination of larval diets after seeding can occur quickly	Larval diets are no longer prone to fungal contamination
The larval diet fermented rapidly producing offensive odours and affecting adult size adversely	Less fermentation problem, which is better for the rearing environment and insect quality
Low egg hatch rate (about 45%)	Improved egg hatch rate (85%). It appears that ambient humidity conditions in the rearing room are high enough to reduce egg desiccation problems
Low egg-to-pupa recovery (about 15%)	Egg-to-pupa recovery has increased (45%)

Preliminary research has suggested that egg hatch and egg-to-pupa recovery can be further improved by modifications to egg handling methods. Incubation of eggs on damp filter paper in air rather than the normal process of holding them on filter paper in water has resulted in preliminary results which show a 10% increase in egg hatch rate and more than a 100% increase in the volume of pupae produced. These are early data from two replicate experiments. Further testing is currently being carried out.

Other *Bactrocera* spp.

Bactrocera cucurbitae

Ihsan ul Haq, a doctoral student from Pakistan has been working on the effects of the addition of methoprene, a juvenile hormone analogue and protein to the diet of *Bactrocera cucurbitae* (melon fly) on their lekking and mating behaviour. The topical application of juvenile hormone analogue and protein diet induced early sexual maturity in *B. cucurbitae*. One of the parameters for efficient SIT implementation is that released males should participate in leks efficiently. The objective was to assess the performance of early matured males at lek sites.

Young males treated with methoprene and fed on protein (M+P+) initiated wing vibration earlier than any of the males of same age fed on protein (M-P+) only, or males treated with methoprene and fed only sugar (M+P-), or sexually mature males without methoprene fed sugar only (M-P-) in competition for mating with females.

Participation in leks and sexual success was significantly higher in M+P+ males than that of any of the other males (M-P+, M+P- and M-P-). The males (M+P+) were better defenders of lek sites than males from any other treatment. There was a synergistic effect on the mating behaviour of males by methoprene when males were also fed protein. Without protein in the pre-release adult diet, methoprene had no beneficial effect on the mating behaviour of males.

Female Bactrocera dorsalis.

Genetic Sexing Strains

The laboratory also houses genetic sexing strains (GSS) of both melon fly and *Bactrocera dorsalis* (Oriental fruit fly) obtained for evaluation from USDA in Hawaii. Current quality parameters for these species are shown in the following table.

Current egg and pupa quality parameters of Bactrocera genetic sexing strains maintained at the Entomology Unit.

Species	Egg hatch (%)	Egg-to-pupa (%)
Bactrocera dorsalis GSS	60 - 70	50 - 55
Bactrocera cucurbitae GSS	40 - 45	30

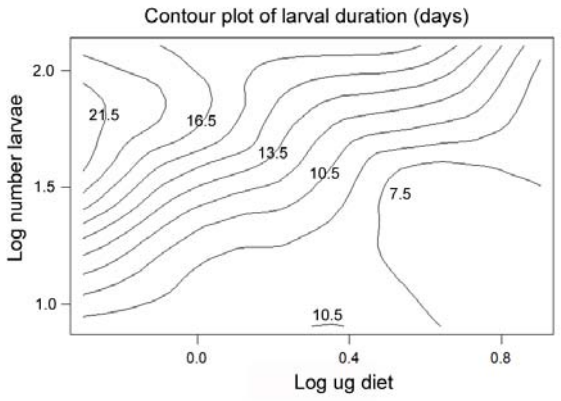
Research on the standardization of methods used to determine and report on % egg hatch and % egg-to-pupa recovery for use in all SIT programmes is being carried out currently at the Entomology Unit.

MOSQUITOES

With usable sexual sterilization methods and a genetic sex-separation strain in hand for *Anopheles arabiensis*, the project is focusing on the pressing need to have production methods available for deployment in a mass-rearing facility in Sudan in late 2009. Among the efforts are testing cold storage and synchronization of pupae, the effects of egging tray height on the number of eggs collected, and the effects of larval and diet density on the survival and development rates and size of *Anopheles arabiensis*.

Experiments have demonstrated the permissive conditions for culture of *A. arabiensis* larvae and will be applied to the optimization of larval culture conditions. Because released males will be semi-sterile and sex-separation is based on males carrying dieldrin resistance, a second application of these experiments is to determine the relative survival and development of the genetic sex separation strain relative to wild-type mosquitoes under a wide range of conditions.

A contour plot of the duration of the larval stage (in days) as a function of the log of number of larvae and the micrograms of diet provided is presented in the Figure below:

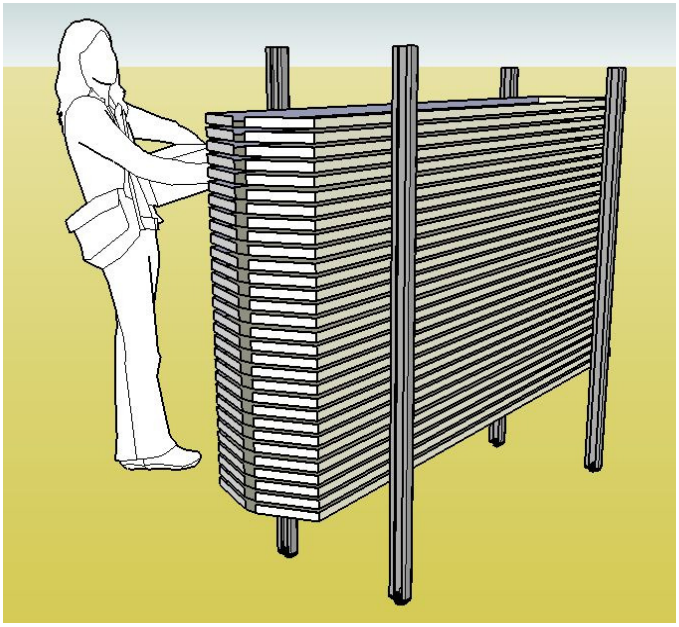


Contour plot of duration of the larval stage (in days) as a function of the log of number of larvae and the micrograms of diet provided. While lower larval densities with more diet increase the development rate, these data include only the individuals that survived and do not take into account mortality.

While lower larval densities with more diet increase the development rate, these data include only the individuals that survived and do not take into account mortality. The decision on the optimum will likely be a compromise between size and productivity. Methods and equipment need to be developed that are capable of future automation and expansion. The first small SIT projects must be the beginning, not the end.

Equipment for mass-production is being developed with specific design criteria in mind: economical construction and operation, ready availability of materials and use of commercially available devices - all while maintaining biological compatibility. With this challenging perspective, the development of the prototype mass-rearing cage continues with modifications determined to be necessary by testing both in Vienna and elsewhere. Among these is the observation that the number of eggs collected is greater if the egging tray is placed lower in the cage.

The team is also working on several devices including one for electronic dosifying of L1 and L2 larvae, a high density disposable-cling-wrap film mosquito tray (see figure), and three larva/pupa separation devices. Prototypes of all of these will be designed and tested at the Entomology Unit before deployment elsewhere.



Concept for larval culture using cling-wrap-lined aluminium trays. A unit such as this would contain more than 150,000 larvae at a density previously determined to be suitable. Prototypes of these trays are currently being tested.

Special News and Reports

Consultants Meeting on Increasing the Efficiency of Lepidoptera SIT by Enhanced Quality Control, 3-7 December 2007, Vienna, Austria

There is international consensus that intervention campaigns against most insect pests should be based on the area-wide concept of integrated pest management (AW-IPM), i.e. the management of entire pest populations within a delimited geographical area. The sterile insect technique (SIT) can be considered as a key control tactic for creating pest-free areas or areas of low pest prevalence within some of these area-wide IPM programmes.

Pest species of Lepidoptera such as codling moth, diamondback moth, oriental fruit moth, cotton bollworms, and pink bollworm are among the most damaging species of food and fiber crops in the world. These pests cause severe losses to agricultural crops in vast areas all over the world, and are the target of very significant quantities of broad-spectrum and persistent insecticides in developed and developing countries. The economic, social and environmental consequences of these insecticide interventions are immense, and hence, are unsustainable. In addition, global increases in trade and travel have resulted in an increase in the rate of invasion of lepidopteran pest species, which threaten agricultural systems, markets, communities, and biodiversity on a worldwide basis.

A Coordinated Research Project (CRP) on Lepidoptera SIT that focused on improvements of codling moth (*Cydia pomonella*) SIT to facilitate its expansion in the field ended in March 2007. This successful project resulted in a number of tangible benefits, including new research findings, as exemplified by the more than 50 peer-reviewed scientific publications and reports (to date), and improvements to existing operational pest management programmes against the pest in several countries.

A consultants meeting was convened at IAEA HQ in Vienna, Austria from 3-7 December 2007, where four international renowned consultants (by Drs Matthew Addison, Jim Carpenter, Gregory Simmons and Max Suckling) together with IPC sub-programme staff discussed a follow-up of the codling moth CRP. The meeting considered that further expansion of SIT application to target other key lepidopteran pests will require improvements that increase the quality control and management of mass-rearing, irradiation, shipping, release and field assessment activities. A CRP was considered as an ideal mechanism to network and address these research topics. A comprehensive document was developed that outlines the objectives, outcomes, research activities of such a new CRP. The title of the CRP is “Increasing the Efficiency of Lepidoptera SIT by Enhanced Quality Control”.

The objective of this CRP will be met through the development and use of improved quality control/management systems for all aspects of the SIT by:

a) identifying and characterizing factors and variables that affect quality and field performance of released moths;

b) developing and improving tools and methods to assess, predict and enhance the field performance of released moths based on insect quality;

c) developing new and improved methods for enhancing rearing systems, facilitating the selection for performance and fitness traits that improve colony establishment, refurbishment and production, and the field performance of released moths.

The CRP has recently been approved by the senior management of the IAEA for initiation in early 2009. Research proposals can be submitted in case your research area is within the remit of the CRP. The scientific secretary for this CRP is Marc Vreysen and he may be contacted in case more information is needed (m.vreysen@iaea.org).

Meeting of the Technical Panel on Pest Free Areas and Systems Approaches for Fruit Flies, 3-7 December 2007, Vienna, Austria

The technical panel on pest free areas and systems approaches for fruit flies (TPFF) of the International Plant Protection Convention (IPPC) convened in Vienna from 3-7 December 2007 with the objective to draft an annex to International Standards for Phytosanitary Measures (ISPM) N° 26 (Establishment of pest free areas for fruit flies (Tephritidae) on Fruit Fly Trapping. Mr. Walther Enkerlin, served as steward for this annex and the draft document developed was based on the FAO/IAEA publication (*Trapping guidelines for area-wide fruit fly programmes)*, taking into account updates on new trapping procedures, pest status of new species, and quality assurance.

This annex provides detailed information for trapping surveys under different scenarios of pest population and control situations for different fruit fly species (Tephritidae) of economic importance. Different traps, densities and procedures should be used depending on the fruit fly status of the target area, which can be either an infested area, an area of low pest prevalence, or a pest free area. The information in this annex can therefore be applied to other ISPMs relating to fruit flies. The annex describes the most widely used trapping systems and procedures; nevertheless, there are others available that may be applied to obtain equivalent results for fruit fly surveys.

The document was presented to and approved by the Standards Committee in May 2007 and, as part of the process for adoption as an annex of ISPM N° 26, has now been sent to Member States for consultation, for eventual submission to the Commission of Phytosanitary Measures in April 2009.

First Meeting of the Tephritid Workers of Europe, Africa and Middle East (TEAM), 7-8 April 2008, Majorca, Spain

The Tephritid Workers of Europe, Africa and the Middle East (TEAM) group was established during the 2nd FAO/IAEA International Conference on Area-Wide Control of Insect Pests held in Vienna, Austria in May 2005. The FAO/IAEA has a member on TEAM's Scientific Committee.

The inaugural meeting of TEAM was held in Palma de Mallorca, Spain following two IAEA RCMs the previous week in Valencia. FAO/IAEA provided financial support, and participed in the Organizing Committee for this meeting. The prime objectives of TEAM include promoting research, the collaboration and communication on fruit fly problems, and the sharing of fruit fly management strategies between regions and among scientists, Governments and the community, within Europe, Africa and the Middle East region. The very successful meeting was attended by 160 researchers, plant protection officials and institutions from 32 countries.

Participants of the TEAM meeting held in Majorca, Spain (7-8 April 2008).

The meeting's structure was four oral sessions (symposia), four issue-specific fora and two poster sessions. There were discussion sessions associated with each symposium, forum and poster session. Dominant issues addressed included fruit fly demography in the region, fruit fly invasions (current and potential), biological control, trapping and monitoring, and bacteria associated with fruit flies.

The TEAM meeting demonstrated a very high quality research and development community within its region both with regards to scientific excellence and also to practical application in the field. The FAO/IAEA has a significant collaborative role with TEAM based on its mandate on the development of SIT as an additional tool for the area-wide suppression/eradication of fruit fly pests.

Guest Article

Population Dynamics and On-Farm Fruit Fly Integrated Pest Management in Mango Orchards in the Natural Area of Niayes in Senegal

Mbaye NDIAYE[1], Elhadji Omar DIENG[1], and Gilles DELHOVE[2]

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2. PIP/COLEACP, Brussels, Belgium

Summary

The trend of the populations of fruit flies in the Niayes area of Senegal follows the dynamics of the rains. This tendency is more visible in *Bactrocera invadens* than in *Ceratitis cosyra*. Based on trap captures, *B. invadens* was largely the dominant pest species, and this was confirmed by the incubation of host fruits, showing that mango, loquat, guava and grapefruit were the favoured commercial host fruits of *B. invadens*. This recently introduced pest species seemed to displace the presence of the indogenous *C. cosyra* and other related fruit fly species. Interspecific competition could explain the fact that *C. cosyra* dominated emergence (up to 87%) in incubated fruits from alternate or wild host plants such as *Cactus* sp., *Capparis* spp., *Cordyla pinata*, and *Momordica balsamina*.

An integrated pest management (IPM) package was tested cooperatively at the village level, which included: (1) male annihilation using wood blocks soaked in insecticide (malathion 500 EC) and lure (methyl eugenol for *B. invadens* and terpinyl acetate for *C. cosyra*); (2) two protein hydrolysate bait applications (Success Appat (spinosad) at 1 litre per ha); and (3) sanitation trough weeding and destruction of collected fallen fruits by the following practices: using black plastic bags, burying holes, burning on the ground surface, and incinerating with a barrel transformed into incinerator.

The aim of this work was to develop an improved management system for fruit flies in mango orchards. Fruit fly infestations were up to 83% lower in the treated orchard compared to the 6 km distant untreated orchard. The *C. cosyra* population was higher in the treated orchard where *B. invadens* was suppressed. Results obtained might be improved if the IPM package is implemented on an area-wide basis. From all above sanitation methods implemented to destroy collected fruits, a reinforced black plastic bag would be recommended as the most effective and practical for popular use.

When comparing methyl eugenol to the home-made baits of ground nutmeg and also to NET, a beauty cream, we found that methyl eugenol attracted significantly more *B. invadens*. Methyl eugenol's half life is also significantly longer (5 weeks) than the ground nutmeg (less than 1 week) (P=0.0109; t=9.4935; df=2), while no capture was recorded in the NET-based trap. In case of lack of methyl eugenol, the ground nutmeg might be recommended as an alternative product, however, that needs to be renewed at least once every week.

Interesting Published Articles

Autocidal Control of Ticks by Silencing of a Single Gene by RNA Interference

José de la FUENTE[1,2], Consuelo ALMAZÁN[1], Victoria NARANJO[2], Edmour F. BLOUIN[1], John M. MEYER[1], and Katherine M. KOCAN[1]

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Abstract

Ticks impact human and animal health worldwide and new control methods are needed to circumvent drawbacks of tick control by acaricide application including selection of drug resistant ticks and environmental pollution. Using RNA interference we silenced the expression of a single gene, subolesin, and produced ticks with diminished reproductive performance and prevented successful mating and production of viable offspring. We propose a sterile acarine technique (SAT) for reduction of tick populations by release of subolesin-silenced ticks. Conservation of subolesin among tick species suggests that SAT may be useful for control of many medically and economically important tick species.

The full paper was published on: Biochemical and Biophysical Research Communications 344: 332-338 (2006).

Improving the Biological Control of Leafminers (Diptera: Agromyzidae) Using the Sterile Insect Technique

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Abstract

The leafminer *Liriomyza trifolii* (Burgess) (Diptera: Agromyzidae) is a worldwide pest of ornamental and vegetable crops. The most promising nonchemical approach for controlling *Liriomiza* leafminers in greenhouses is regular releases of the parasitoid *Diglyphus isaea* (Walker) (Hymenoptera: Eulophidae). In the current study, we examine the hypothesis that the use of *D. isaea* for biological control of leafminers in greenhouse crops may be more practical and efficient when supplemented with additional control strategies, such as the sterile insect technique (SIT). In small cages, our SIT experiments suggest that releases of sterile *L. trifolii* males in three sterile-to-fertile male ratios (3:1, 5:1, and 10:1) can significantly reduce the number of the pest offspring. In large cage experiments, when both parasitoids and sterile males were released weekly, the combined methods significantly reduced mine production and the adult leafminer population size. Moreover, a synergistic interaction between these two methods was found, and a model based on our observed data predicts that because of this effect, only the use of both methods can eradicate the pest population. Our study indicates that an integrated pest management approach that combines the augmentative release of the parasitoid *D. isaea* together with sterile leafminer males is more efficient than the use of either method alone. In addition, our results validate previous theoretical models and demonstrate synergistic control with releases of parasitoids and sterile insects.

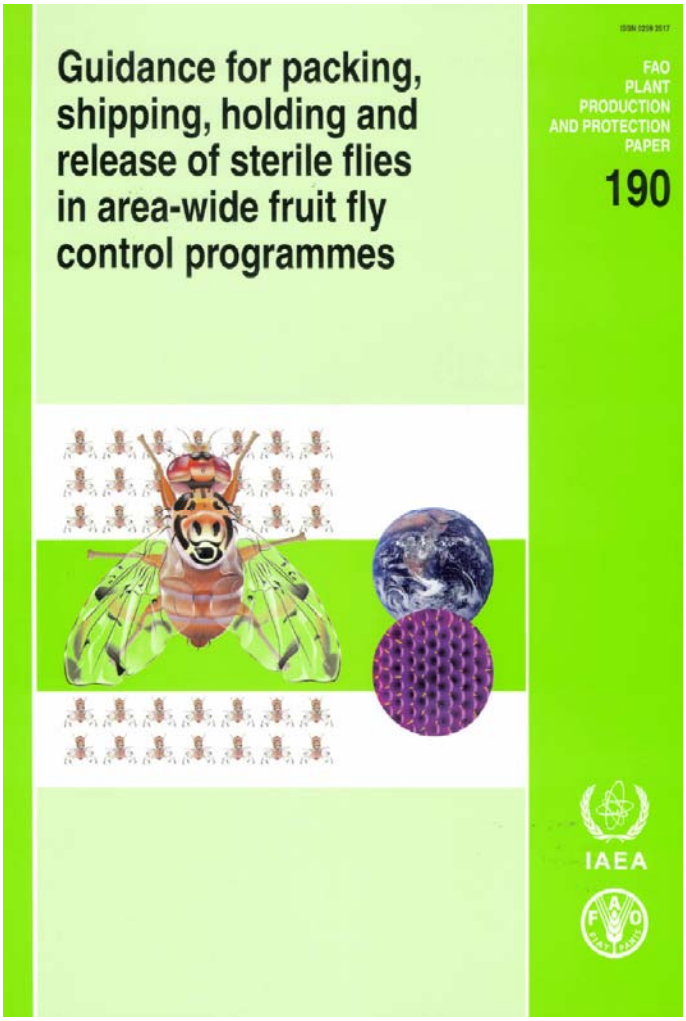
The full paper was published on: J. Econ. Entomol. 99 (4): 1168-1175 (2006).

Announcements

A New FAO/IAEA Manual on Guidance for Packing, Shipping, Holding and Release of Sterile Flies in Area-Wide Fruit Fly Control Programmes has been Published (134 pp., December 2007)

The revised International Standards for Phytosanitary Measures (ISPM) No 3 "Guidelines for Export, Shipment, Import, and Release of Biological Control Agents and Other Beneficial Organisms" (2005) by the International Plant Protection Convention (IPPC) also includes the release of sterile insects.

In view of these developments, the need was recognized for harmonized guidelines and standard operating procedures for the various post-production processes and procedures involved in SIT application, so that they can be used in relation to the above mentioned revised ISPM No 3 and other relevant ISPMs in fruit flies, such as ISPM No 26 "Establishment of Pest Free Areas for Fruit Flies (Tephritidae)".



These has been little harmonization for the processes involved in the handling and release of sterile insects after the production in mass rearing facilities. Therefore harmonized guidance is required to be able to transfer this technology to FAO or IAEA Member States that want to embark on SIT activities. There is also increased interest by the private sector in investing in sterile insect production and/or SIT application.

This guidance, published as part of FAO's Plant Production and Protection Paper Series, resulted from two FAO/IAEA consultants meetings with representatives of relevant SIT programmes, the first held in Sarasota, Florida (April 2004) and the second in Vienna (August 2005). It has identified a number of gaps in knowledge as well as procedures that are often based on conventional wisdom, but which need scientific verification and optimization.

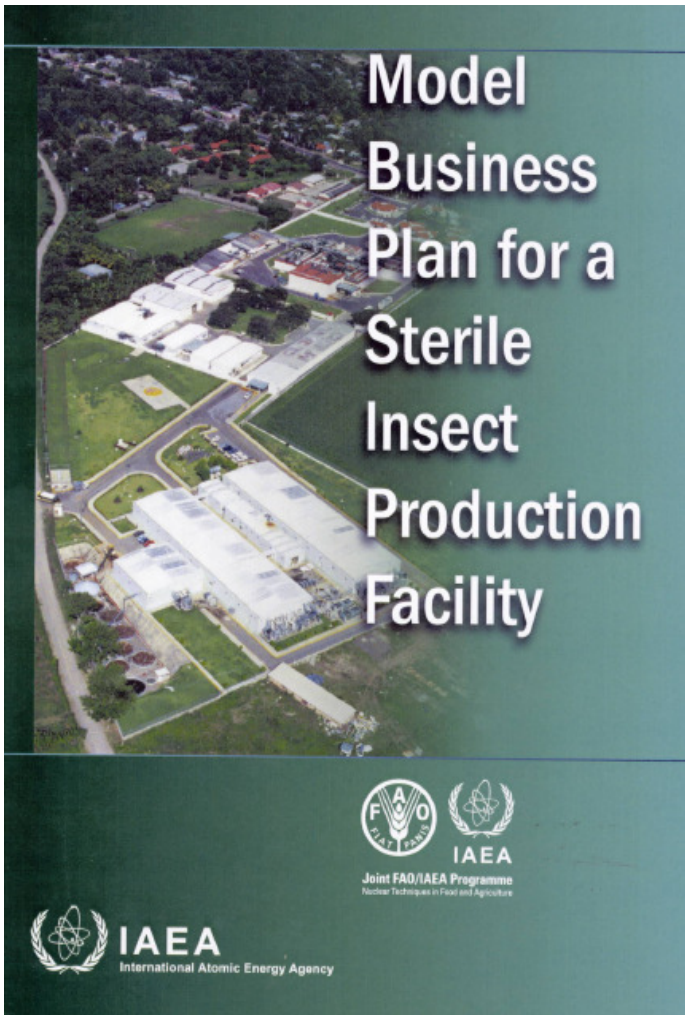
Updated Edition of Model Business Plan for a Sterile Insect Production Facility has been Published (386 pp., April 2008)

For over 50 years the sterile insect technique (SIT) is a pest control strategy which has been used for eradication, suppression, containment and prevention, of unwanted insect pest populations. Examples of successful applications of SIT, almost always applied in conjunction with other control methods in an area-wide integrated approach, are available from around the world. The development and application of SIT has relied overwhelmingly on public or donor initiative and funding throughout its history, although the private sector has always been involved as participants, cooperators or partners in funding.

The demand for SIT application, and therefore the market for sterile insects and related services, has increased in recent years. This increase coincides with the introduction of new pests through the expansion of global trade and, at the same time, widespread pressure to find alternatives to pesticides. Recent improvements in the technology supporting SIT implementation facilitate its application and suggest lower costs can be achieved. The conditions are therefore met for a greater commercialization of the technique to bring it in line with other pest control approaches that are fully integrated into a market approach. Several challenges arise, however, in pursuing sterile insect production as a commercial venture, ranging from intellectual property protection to pricing of the product. Routine insurance requirements, for instance, are complicated by the biological aspects of the business.

This model business plan is aimed at facilitating private sector involvement in the production of sterile insects for use in pest control. It provides guidelines and tools to support the development of specific business plans for a new SIT venture. By providing an international perspective on such issues as initial capital costs and recurring operational expenditures for a sterile insect facility, it may be used to evaluate the feasibility of proceeding with

the construction or expansion of a sterile insect production facility. Informed decisions will allow government planners and private investors alike to account for the opportunities and risks unique to SIT application and to plan accordingly. The significant contributions by colleagues from Imperial College London are gratefully acknowledged.



Panama Removed from the List of Regions where Screwworm is Considered to Exist

The US Department of Agriculture (USDA) has announced the eradication of screwworm from Panama. This has been accomplished through the efforts of COPEG, a cooperative programme (COPEG) involving Ministerio de Desarrollo Agropecuario (MIDA) and USDA. COPEG serves as the veterinary authority, and in this role directly controls the specifics of the eradication and prevention programme, with the full cooperation of Panama's veterinary infrastructure, as well as financial and scientific support from USDA. COPEG applied the preexisting infrastructure and legal framework developed within Panama for the eradication of foot-and-mouth disease (FMD), and shares many of the FMD programme resources developed under the Panama-US Commission for the Prevention of Foot-and-Mouth Disease (COPFA). USDA/APHIS has determined that Panama has available the necessary legal authority, infrastructure, budget, and supporting resources to maintain its screwworm-free status.

USDA is proposing to amend the regulations regarding the importation of live horses, ruminants, swine, and dogs by removing Panama from the lists of regions where screwworm is considered to exist. The confirmation of eradication of screwworm from Panama will relieve certain screwworm-related certification and inspection requirements for live animals imported from Panama into the screwworm-free areas in Central and North America.

Interstate Movement of Fruit from Hawaii

USDA/APHIS is amending its regulations to allow, under certain conditions, the interstate movement of commercial shipments of mangosteen, dragon fruit, melon, pods of cowpea, breadfruit, jackfruit and fresh moringa pods from Hawaii to the continental United States. This regulation was published on the Federal Register, Vol. 73, No 88 (6 May 2008).

To ensure that plant pests do not enter the continental United States by importing these commodities, the fruit must undergo irradiation treatment. In addition, the fruit must meet other inspection and treatment requirements specific to the commodity and its pest risk.

This action allows for the importation of these seven fruits from Hawaii while continuing protecting against the introduction of quarantine pests into the continental United States.

Light Brown Apple Moth in California

First detected on Feb. 27, 2007, in Berkeley (Alameda County), the light brown apple moth (*Epiphyas postvittana*) may have arrived in California via nursery stock from its native Australia.

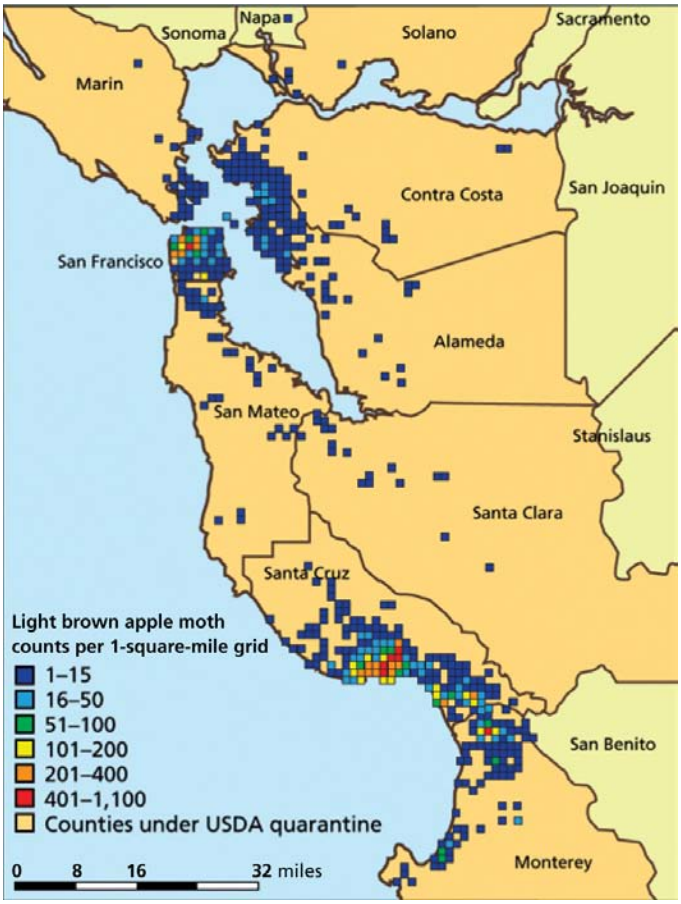
According the California Department of Food and Agriculture (CDFA), the light brown apple moth threatens the state's multibillion dollar agricultural industry by potentially destroying, stunting or deforming young seedlings; spoilings the appearance of ornamental plants; and injuring citrus, grapes and deciduous fruit tree crops.

Of greater concern to growers, however, is the threat of export restrictions imposed on California crops by trading partners. Already, Mexico and Canada have restricted imports of crops and plants from infested areas; China has taken steps toward such restrictions. Others (including Chile, Republic of Korea, Peru and South Africa) list the moth as a quarantine pest and might require certification that each California export is free of this pest.

Even inside the USA, other states are concerned and when the first light brown apple moth was found, Florida immediately threatened to impose restrictions on ship-

ments of fruits, vegetables and nursery products from California.

The use of pheromone application to confuse males and cause mating disruption to suppress populations is planned (see figure). An early and aggressive aerial application could contribute to the moth's eradication. However, public opposition to this strategy has temporarily stopped plans for aerial application over urban and suburban areas. The integration of the SIT is also being considered.



Light brown apple moth finds in Northern California through Dec, 5, 2007 (Source: USDA/APHIS 2007, from CDFA data).

This note (including the figure) was based on the published research new "Plans to control light brown apple moth stir controversy". California Agriculture. April-June 2008: 55-56.

For more information, please visit the webpage: www.cdfa.ca.gov/phpps/PDEP/ibam/lbam_main.html

Screwworm Outbreak in Yemen

The Joint FAO/IAEA Division has been collaborating during the last years with the Arab Organization of Agricultural Development (AOAD) and FAO in supporting Member States in the West Asia subregion in terms of training on screwworm area-wide control and feasibility studies for possible eradication in some pilot areas.

Until 2007, Yemen was reported free of Old World Screwworm (OWS) *Chrysomya bezziana*, together with Jordan, Syrian Arab Republic, Lebanon and Egypt, while the pest has been reported invading and causing different levels of damage in Iraq, Iran, Kuwait, Oman, Saudi Arabia, and United Arab Emirates.

In December 2007 OWS has invaded Yemen from southwestern Saudi Arabia and has rapidly spread to four Governorates in the coastal northwest areas of Yemen, causing thousands of myiasis cases mainly in sheep, goats, cows, camels, donkeys and dogs. It started in December 2007 in Sa'dah Governorate in the northwest next to Saudi Arabia, and has been spreading since south, being detected first in January in Hajjah, in February in Al-Hudaya, and Al-Mahweet in March. The large number of farm animal losses being reported have become a political problem. Lack of training and insecticides for wound treatment have been major technical problems.

Recently, a Ministerial Delegation from Yemen visited the IAEA in Vienna, Austria, to seek assistance from the international community to fight the pest. The menacing fly lays its eggs in a cut or open wound of a warm-blooded animal. The maggots then feast off the living flesh (see figure) and can kill the animal if it's not treated in time.

Old World Screwworm case seen in the field showing maggots in wound (Photo by Mansoor).

Veterinarian, Mansoor AlQadasi, General Director of the Central Veterinarian Laboratory, says it's the first official outbreak of OWS in Yemen. "There are about 20,000 cases of livestock affected. Most of these are sheep and goats. We have also found some human cases, mainly in children and older people,"

"This can lead to a severe impact on the lives of people. We have a huge population who rely on animals. They do not own land, but they own animals. It can lead to severe social and economical problems for those families who totally rely on the marketing of animals and get income from this. This is a source of their life," Mr. AlQadasi said.

Emergency assistance to fight the pest is needed. AOAD, FAO and the IAEA are collaborating to provide immediate assistance and also assist exploring longer-term options for managing the screwworm problem.

AOAD provided expertise to help assessing the situation, and FAO supplied larvicides to treat affected animals.

The IAEA, using technical expertise available in the Joint FAO/IAEA Division and funding generated though a new technical cooperation reserve fund project (YEM5009) is helping to generate capacity for differential diagnosis of larvae and for entomological monitoring.

In the long term, while OWS sterile insect technology is available to a certain extent from Australia and Malaysia, and New World Screwworm was eradicated from Libya in the early 1990s, expectations should not be raised of easy screwworm eradication under the very difficult topographic and socioeconomic conditions of Yemen. The Yemeni delegation was informed of the complexities involved, as well as technical preconditions and commitments required for the successful integrated area-wide application of the sterile insect technique.

Immediate efforts will focus on suppressing the pest in the infested areas and confining the outbreak to the infested Governorates. Benefit-cost studies will need to be carried out to assess whether containment and integrated management should remain the goal, or whether the importance of the national livestock industry merits embarking on feasibility studies involving an area-wide eradication campaign.

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