Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture and FAO/IAEA Agriculture and Biotechnology Laboratory, Seibersdorf

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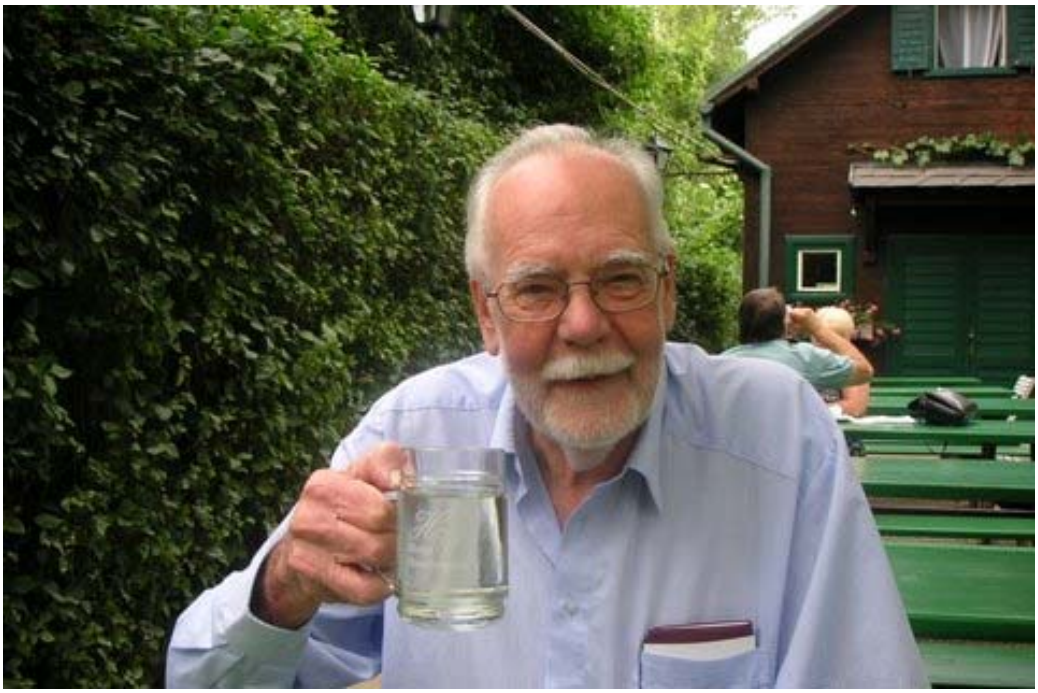

Donald A. Lindquist (1930 - 2011)

To Our Readers

It is with great sadness that we inform you of the death on August 17, 2011 of a prominent international entomologist and dear colleague and friend, Dr. Donald (Don) A. Lindquist, who dedicated his professional life to the development and implementation of more efficient and sustainable insect pest management approaches at the United States Department of Agriculture (USDA) and the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture in Vienna. He was a great leader and brilliant visionary who successfully bridged science with very practical and effective pest management.

Don was born in Lindsborg, Kansas in 1930. He studied entomology at Oregon State University and obtained his MSc and PhD (1958) at Iowa State University, following in the steps of his father, A.W. Lindquist. Don's father, together with E.F. Knipling and R.C. Bushland, were the pioneers of the very successful New World screwworm (*Cochliomyia hominivorax*) programme that was initiated in the south-eastern USA in the late 1950s and that first integrated the sterile insect technique (SIT) into the management of this major livestock pest, ultimately eradicating it from North and Central America.

He started his career with USDA in 1958 working as a researcher on cotton insect pests in the USDA Agricultural Research Service (ARS) laboratory at Texas A & M University. Like his father, Don was a passionate supporter of the area-wide concept, also promoting this approach to key cotton pests. His vision has lately become true and major invasive pests such as the boll weevil (*Anastrepha grandis*) and the pink bollworm (*Pectinophora gossypiella*) are close to being eradicated from most of the USA.

As the first director of the new Insect Attractants, Behavior and Basic Biology Laboratory in Gainesville, Florida, and later working on the National Programme Staff at ARS

headquarters in Beltsville, Maryland, he also guided the research on insects affecting man and animals in many ARS laboratories towards area-wide approaches. During that time, he was also intimately involved in the screwworm eradication campaign under way in the southwestern USA and Mexico.

Don first joined the Joint FAO/IAEA Division as Section Head of the Insect and Pest Control (IPC) Section in 1967, returning in 1972 and again in 1980, first as Head of the Agrochemical Section and then of the IPC Section until his retirement in 1994. Under his leadership the IPC sub-programme shifted from mainly using radioisotopes in academic investigations towards the development and application of the SIT to address key pest problems in FAO and IAEA Member States.

In view of the limited staff and other resources of the FAO/IAEA Programme and its Insect Pest Control Laboratory (IPCL) at Seibersdorf, he had the vision to focus on a few key pests, in particular tsetse flies that are among the main bottlenecks to agricultural development in Sub-Saharan Africa and the Mediterranean fruit fly, one of the most devastating pests of fruits in the world and a major target of insecticide use. He actively encouraged the implementation of the first larger pilot projects against tsetse flies in the United Republic of Tanzania and Nigeria and against the Mediterranean fruit fly in Central America and southern Mexico. The latter one culminated in the late 1970s in the large transboundary Moscamed programme, funded and implemented by Mexico, the USA and Guatemala, which has maintained Mexico, Belize and half of Guatemala free of this pest for over 30 years, while allowing Mexico to develop a multi-billion dollar fruit and vegetable export industry. Don also supported early control efforts against this pest in Peru and later in Chile, resulting eventually in the Mediterranean fruit fly-free status for Chile in the mid-1990s and more recently for several regions in southern Peru, thereby facilitating major increases in the horticultural industries of these countries.

During his entire professional career, Don vigorously and determinedly supported operational programmes in different parts of the world, while at the same time obtaining practical feedback to guide the research and development activities at the IPCL in Seibersdorf and the coordinated research networks towards improving all aspects of sterile insect technologies and overcoming the technical problems encountered in these field programmes. One example was the development of a workable membrane system for in vitro feeding of blood to tsetse flies, rather than continuing to use live animals to feed the tsetse colonies. Don's strong support to this successful effort was among the main reasons that the Zanzibar tsetse project achieved eradication in 1997 in spite of many and persistent doubters. This programme provided the proof of principle of the large potential and effectiveness of the approach to gradually address this major development problem in Sub-Saharan Africa.

His visionary approach is likewise exemplified in his drive for the development of synthetic female attractants for fruit flies (most available lures attracted only males), and of genetic sexing strains (GSS) for the Mediterranean fruit fly to eliminate females at the egg stage to enable the mass rearing and release of only sterile males. The use of GSS achieved significant reductions in production costs and considerably increased the effectiveness of the released sterile males who, in the absence of sterile females, could focus on wild females. His resolute and dogged pursuit of this goal enticed a number of Drosophila geneticists to work on more applied issues, thereby accelerating the progress in this field. Using classical genetics, a whole series of GSS were developed at the IPCL in Seibersdorf that drastically changed mass rearing of the Mediterranean fruit fly in most area-wide suppression or eradication programmes in the world, including in developed countries such as the USA and Australia. He also supported very early efforts to use molecular tools and approaches to develop release strains with special qualities, some of which are now starting to bear fruit.

His applied and practical can do attitude greatly influenced many careers of entomologists and programme managers in numerous locations in the world. Don was also a great mentor for many of us who had the opportunity to interact with him. We learned much from him and greatly valued his friendship and wise counsel. There were those who were put off by his directness, but others who knew him well valued this frankness because his advice was always practical and well-intended. While he might have appeared very tough on the exterior, his interior was warm and caring.

Late in his career, when the New World screwworm was accidentally introduced into Libya in the late 1980s and the FAO was given responsibility to manage the project, Don was selected as Co-Director to manage the Libyan screwworm eradication programme on site. Due to his technical competence, management skills and dedication, screwworm was eradicated from Libya in 1992 at a lower cost than foreseen and ahead of schedule. As a result the African continent remains to this day free from New World screwworm. Don also continued to advise some countries, including US Federal and State Agencies on campaigns to eradicate Mediterranean fruit fly outbreaks in California and Florida, and helped to implement the innovative, very successful and cost effective concept of preventively releasing sterile males in areas with a history of high risk of introductions, and as a result these US States are still free of Mediterranean fruit fly.

Don, on behalf of the many colleagues and friends in the entomological world, we thank you for your great example, guidance and friendship. We will never forget you; rest in peace.

Jorge Hendrichs
Head, Insect Pest Control Section

Insect Pest Control Subprogramme

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Forthcoming Events (2012)

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

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

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

First RCM of CRP on Use of Symbiotic Bacteria to Reduce Mass-Rearing Costs and Increase Mating Success in Selected Fruit Pests in Support of SIT Application. 21-25 May 2012, Vienna, Austria.

Third RCM of CRP on Development and Evaluation of Improved Strains of Insect Pests for SIT. 20-24 August 2012, Daegu, Republic of Korea.

Third RCM of CRP on Increasing the Efficiency of Lepidoptera SIT by Enhanced Quality Control. 12-16 September 2012, Phoenix, AZ, USA.

Third RCM of CRP on Development of Generic Irradiation Doses for Quarantine Treatments. October 2012, Buenos Aires, Argentina.

II. Consultants and Expert Meetings

Consultants Meeting on Diapause Management to Facilitate the Rearing of Temperate/Overwintering Pests. 7-11 May 2012, Vienna, Austria.

Consultants Meeting on the Effects of Mosquito Production and Release Methods on Male Competitiveness. 8-12 October 2012, Vienna, Austria.

III. Other Meetings/Events

FAO/IAEA Regional Training Course on Standardized Collection and Processing of Tsetse Flies for Molecular Tsetse Population Genetic and Morphometric Analyses (under TC Project RAF5060). 23 January - 3 February 2012, Muguga-Nairobi, Kenya.

5th International Meeting on Taxonomy and Natural History of Tephritoidea. 6-10 February 2012, Brisbane, Australia.

FAO/IAEA Regional Coordination Meeting / Technical Workshop under the regional TC project RAS5054 on Contributing to the Assessment of the Feasibility of SIT-Based Area-Wide Integrated Management of Old World Screwworm Flies in the Middle East. 6-15 February 2012, Pacora, Panama City, Panama.

FAO/IAEA Regional Training Course on Standardized Entomological Monitoring, Data Collection and GIS-Aided Data Processing as Needed for Area-Wide Integrated Pest Management Campaigns Against the Tsetse and Trypanosomosis Problem (under TC Project RAF5060). 6-24 February 2012, Bobo-Dioulasso, Burkina Faso.

FAO/IAEA Coordination Meeting of the TC regional project RAF5062 on Preventing the Introduction of Exotic Fruit Fly Species and Implementing the Control of Existing Species with the Sterile Insect Technique and other Suppression Methods. 13-15 February 2012, Quatre Bornes, Mauritius.

FAO/IAEA Coordination Meeting of the TC regional project RLA5058 on Building Capacity for Suppression of Fruit Flies using an Area-Wide Pest Management Approach. 27 February-2 March 2012, Lima, Peru.

Seventh Session of the Commission on Phytosanitary Measures, International Plant Protection Convention, FAO. 19-23 March 2012, Rome, Italy.

FAO/IAEA Workshop on Basic Surveillance and Control for Dengue Vectors (under TC Project RAS0059). 26-30 March 2012, Islamabad, Pakistan.

FAO/IAEA Coordination Meeting of the TC regional project RAF5065 on Promoting the Sharing of Expertise and Physical Infrastructure for Mass Rearing Mosquitoes and Integration of the Sterile Insect Technique (SIT) with Conventional Methods for Vector Control, Among Countries of the Indian Ocean Region. 10-13 April 2012, Port Louis, Mauritius.

Standards Committee Meeting, International Plant Protection Convention, FAO. 23-27 April 2011, Rome, Italy.

FAO/IAEA Regional Training Course on Fruit Fly Surveillance, Taxonomy and Identification (under TC Project RAF5061). 4-8 June 2012, Cotonou, Benin.

FAO/IAEA Coordination Meeting of the TC regional project RAF5061 on Supporting Capacity Building and a Feasibility Study on Control of Fruit Flies of Economic Significance in West Africa. 6-8 June 2012, Cotonou, Benin.

FAO/IAEA National Meeting on the Status of Tephritid Fruit Flies in China (under TC project CPR5020). 18-22 June, Fuzhou, Fujian, China.

FAO/IAEA Coordination Meeting of the TC regional project RER5018 on Supporting Fruit Fly Pest Prevention and Management in the Balkans and the Eastern Mediterranean. 2-6 July 2012, Kolymbari, Crete, Greece.

Second International Meeting of Tephritid Workers of Europe, Africa and the Middle East. 3-6 July 2012, Kolymbari, Crete, Greece.

8th Meeting of the Working Group on Fruit Flies of the Western Hemisphere. 30 July-3 August 2012, Panama City, Panama.

FAO/IAEA Coordination Meeting of the TC regional project RLA5057 on Establishing and Maintaining Fruit Fly Free and Low Prevalence Areas in Central America, Panama and Belize, Using the Sterile Insect Technique (SIT). 30 July-3 August 2012, Panama City, Panama.

Symposium on Development and Evaluation of Improved Strains of Insect Pests for the Sterile Insect Technique at the XXIV International Congress of Entomology. 19-25 August 2012, Daegu, Republic of Korea.

XXII Curso Internacional Sobre Moscas de la Fruta. 20-31 August 2012, Metapa de Dominguez, Chiapas, Mexico.

FAO/IAEA Workshop on Assessing Quality Management Aspects of Lepidoptera Mass-produced for the Sterile Insect Technique in a Large Operational Setting. 10-11 September 2012, Phoenix, AZ, USA.

VIII Curso Internacional de Capacitação em Moscas das Frutas de Importância Económica e Quarentenária, 18-26 September 2012, Juazeiro (Bahia) and Petrolina (Pernambuco), Brazil.

FAO/IAEA Regional Training Course on Quarantine and Pest Risk Analysis (under TC Project RER5018). 15-19 October 2012, Vienna, Austria.

2012 Insect Rearing Workshop, 21-26 October 2012, Mississippi State University, Starkville, MS, USA.

Standards Committee Meeting, International Plant Protection Convention, FAO. 5-9 November 2012, Rome, Italy.

2012 International Citrus Congress, 18-23 November 2012, Valencia, Spain.

FAO/IAEA Regional Training Course on Fruit Fly Detection (under TC Project RAF5062). 3-7 December 2012. St. Pierre, La Réunion, France.

Past Events (2011)

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

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

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

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

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

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

II. Consultants and Expert Meetings

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

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

Consultants Meeting on Enhancing Vector Refractoriness to Trypanosome Infection. 3-7 October 2011, Vienna, Austria.

FAO/IAEA Consultants Group Meeting on Using GPS Instruments and GIS Techniques in Data Management for Insect Pest Control Programmes. 31 October - 4 November 2011, Vienna, Austria.

III. Other Meetings/Events

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

Standards Committee Meeting, International Plant Protection Convention, FAO. 2-6 May 2011, Rome, Italy.

Standards Committee Meeting (SC-7), International Plant Protection Convention, FAO. 9-13 May 2011, Rome, Italy.

38th Congreso de Sociedad Colombiana de Entomologia (Socolen). 27-29 July 2011, Manizales, Colombia.

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

XXI Curso Internacional Sobre Moscas de la Fruta. 15 August-2 September 2011, Metapa de Dominguez, Chiapas, Mexico.

30th International Scientific Council for Trypanosomiasis Research and Control. 12-16 September 2011, Bamako, Mali.

FAO/IAEA Training Course on Taxonomía, Ecología y Control de Moscas de Importancia Económica (under TC regional project RLA5057). 26 September-1 October 2011, Panama City, Panama.

International Symposium on Mass Production & Commercialization of Arthropod Biological Control Agents. 21-24 October 2011, Beijing, China.

FAO/IAEA Worshop on 'The Integrated Control of *Aedes* Mosquitoes, Including Mass Rearing for the SIT as well as the Other Approaches Under Development' 8-11 November 2011, Vienna, Austria.

FAO/IAEA Workshop on Tsetse Wing Morphometrics (under TC regional project RAF5059). 14 November-2 December 2011, Pretoria, South Africa.

Workshop on Reviewing the Strategic Framework and the Plan of Action of the African Union Pan-African Tsetse and Trypanosomosis Eradication Campaign (AU-PATTEC). 24-25 November 2011, Africa Union Commission Headquarters, Addis Ababa, Ethiopia.

FAO/IAEA Coordination Meeting of the TC regional project RLA5057 on Establishing and Maintaining Fruit Fly Free and Low Prevalence Areas in Central America, Panama and Belize, Using the Sterile Insect Technique (SIT), 28 November-2 December 2011, Guatemala City, Guatemala.

African Union Pan-African Tsetse and Trypanosomosis Eradication Campaign (AU-PATTEC) Partners' Meeting. 9 December 2011, Nairobi, Kenya.

FAO/IAEA Coordination Meeting of the TC regional project RAS5053 on Assessing Feasibility for Area-Wide SIT-Based Control of the Mediterranean Fruit Fly in the Middle East, 12-16 December 2011, Vienna, Austria.

Technical Cooperation Field Projects

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

- Fruit flies
- Mosquitoes
- Moths
- Screwworm flies
- Tsetse flies

Country	Project Number	Title Continuing National Projects	Technical Officer
Afghanistan	AFG5004	Enhancing Crop Productivity Through Mutation Breeding and Pest Control	Rui Cardoso Pereira
Belize	BZE5002	Establishment of a Pilot Fruit Fly Free Area Using an Integrated Approach that Includes the Area-Wide Sterile Insect Technique	Jesús Reyes
Brazil	BRA5057	Establishment of Mediterranean Fruit Fly, Fruit Fly Parasitoids and Codling Moth Rearing Facility	Rui Cardoso Pereira
Chad	CHD5002	Assessing the Feasibility of Using Sterile Insect Technique Components to Create a Tsetse-Free Zone in the Mandoul Region	Udo Feldmann
Ethiopia	ETH5015	Creating a Tsetse-Free Zone in the Southern Rift Valley	Udo Feldmann
Guatemala	GUA5016	Establishment of Fruit Fly Free or Low Prevalence Areas using the Sterile Insect Technique	Jesús Reyes
Israel	ISR5015	Strengthening the Capacity to Use the Sterile Insect Technique for the Olive Fruit Fly	Jesús Reyes
Jordan	JOR5010	Strengthening the Capacity for the Area-wide Suppression of the Mediterranean Fruit Fly Using the Sterile Insect Technique	Jesús Reyes
Madagascar	MAG5017	Developing Strategies for Integrated Management of Fruit Flies Based on the Sterile Insect Technique (SIT)	Rui Cardoso Pereira
Mauritius	MAR5016	Feasibility Study for the Suppression of the Melon Fly (*Bactrocera cucurbitae*) in Selected Areas of Mauritius	Jorge Hendrichs
Morocco	MOR5031	Controlling the Mediterranean Fruit Fly Using the Sterile Insect Technique and Other Conventional Methods	Jesús Reyes
Myanmar	MYA5014	Support for a Feasibility Study on Using the Sterile Insect Technique against Diamond Back Moth	Jesús Reyes
Pakistan	PAK5043	Development of Biological Control for Cotton Pest Management Using Nuclear Techniques	Jorge Hendrichs
Panama	PAN5018	Maintaining and Operating a Mediterranean Fruit Fly Free Area, Implementing a Fruit Fly Emergency Plan, and Suppressing *Anastrepha* spp. Fruit Flies in the Azuero Peninsula Using the Sterile Insect Technique	Jesús Reyes

Senegal	SEN5031	Implementing the Pre-Operational Phase to Create a Zone Free of *Glossina palpalis gambiensis* Using the Sterile Insect Technique (SIT)	Marc Vreysen
Seychelles	SEY5003	Feasibility of Integrating the Sterile Insect Technique to the Ongoing Area-Wide Melon Fly Eradication Programme	Rui Cardoso Pereira
South Africa	SAF5011	Refining an Integrated Application of SIT Against Some Key Lepidopteran Pests of Southern African Agricultural Crops	Jorge Hendrichs
Sudan	SUD5032	Investigating the Use of the Sterile Insect Technique for Controlling Mosquitoes in Northern Sudan	Jeremie Gilles
Tunisia	TUN5026	Assessing the Use of Inherited Sterility as a Genetic Control Method against the Carob Moth	Marc Vreysen
Uganda	UGA5031	Assessing the Feasibility of Establishing a Tsetse Free Zone in Lake Victoria Basin	Jesús Reyes
Zimbabwe	ZIM5012	Feasibility Study on the Use of SIT to Eradicate Tsetse in Zimbabwe	Udo Feldmann
		Continuing Regional Projects	
Regional Africa	RAF5059	Supporting the Creation of a Tsetse-Free Zone in Southern Mozambique and North-East South Africa	Marc Vreysen Rui Cardoso Pereira
Regional Africa	RAF5060	Supporting the Use of the Sterile Insect Technique for Area-Wide Tsetse and Trypanosomosis Management (Phase II)	Udo Feldmann
Regional Asia	RAS5051	Developing Integrated Control of the Olive Fruit Fly	Jesús Reyes
Regional Asia	RAS5052	Sharing Regional Knowledge on the Use of the Sterile Insect Technique within Integrated Area-Wide Fruit Fly Pest Management Programmes	Rui Cardoso Pereira
Regional Asia	RAS5053	Assessing Feasibility for Area-Wide SIT-Based Control of the Mediterranean Fruit Fly in the Middle East	Jesús Reyes
Regional Asia	RAS5054	Contributing to the Assessment of the Feasibility of SIT-Based Area-Wide Integrated Management of Old World Screwworm Flies in the Middle East	Udo Feldmann
Regional Europe	RER5014	Suppressing the Mediterranean Fruit Fly by Integrating the Sterile Insect Technique on an Area-Wide Basis in Neretva Valley of Croatia and Bosnia and Herzegovina	Rui Cardoso Pereira
Regional Latin America	RLA5057	Establishing and Maintaining Fruit Fly Free and Low Prevalence Areas in Central America, Panama and Belize, Using the Sterile Insect Technique (SIT)	Jesús Reyes
Country	**Project Number**	**New National Projects to Start in 2012**	**Technical Officer**
Chad	CHD5003	Finalising the Feasibility Study to Assess Whether the Sterile Insect Technique (SIT) Can Be Applied for the Creation of Sustainable Tsetse-Free Zones	Udo Feldmann

China	CPR5020	Integrating the Sterile Insect Technique (SIT) for Area-Wide Integrated Pest Management of Tephritid Fruit Flies	Rui Cardoso Pereira
Costa Rica	COS5030	Supporting Biological Control of Stable Flies (*Stomoxys calcitrans*) through the Use of Parasitoids Reproduced on Fruit Flies	Jesús Reyes
Ethiopia	ETH5016	Creating Sustainable Tsetse and Trypanosomosis Free Areas for Enhancing Livestock and Agricultural Development	Udo Feldmann Andrew Parker
Guatemala	GUA5017	Using the Sterile Insect Technique (SIT) to Establish Fruit Fly Low Prevalence Pilot Areas and to Assess it as an Alternative for the Control of the Sugarcane Borer in Pilot Areas	Jesús Reyes
Honduras	HON5006	Using Sterile Insect Technique (SIT) to Obtain Recognition as a Mediterranean Fruit Fly Free Area in the Aguan River Valley	Jesús Reyes
Israel	ISR5017	Targeting the Olive Fly with SIT in Olive Orchards Located in the North and South of Israel	Jesús Reyes
Israel	ISR5018	Improvement of Artificial Mass-Rearing Systems for the Ethiopian Fruit Fly, *Dacus ciliatus*, and Establishment of Optimal Sterilizing Doses: Towards Small-Scale SIT	Jorge Hendrichs
Madagascar	MAG5021	Implementing the Sterile Insect Technique (SIT) in Integrated Fruity Fly Control for High Quality Fruit Production	Rui Cardoso Pereira
Mauritius	MAR5019	Supporting a Feasibility Study Using the Sterile Insect Technique (SIT) for the Integrated Control of Mosquitoes	Jeremie Gilles
Mauritius	MAR5022	Reducing Insecticide Use and Losses to Melon Fly (*Bactrocera cucurbitae*) through Environment-Friendly Techniques to Increase Production in Different Areas, Phase II	Jorge Hendrichs
Morocco	MOR5032	Supporting Control of the Medfly Using the Sterile Insect Technique for Citrus Fruits and Early Fruits and Vegetables to Establish Low Medfly Prevalence Zones	Jesús Reyes
Myanmar	MYA5021	Integrating Sterile Insect Technique with Other Biocontrol Tactics to Improve Diamondback Month Control	Rui Cardoso Pereira
Oman	OMA5002	Assessing the Suitability of Sterile Insect Technique (SIT) and Related Techniques for Combating Date Palm Insect Pests	Marc Vreysen
Panama	PAN5020	Strengthening Technical Capacity to Control Mediterranean Fruit Fly Using the Sterile Insect Technique (SIT)	Jesús Reyes
Senegal	SEN5033	Supporting the Operational Phase of Eliminating *Glossina palpalis gambiensis* from the Niayes Area by Promoting the Development of Integrated Stockbreeding	Marc Vreysen
Seychelles	SEY5005	Enhancing the Melon Fruit Fly Area-Wide Integrated Pest Management Programme Using the Sterile Insect Technique to Improve National Food Security	Rui Cardoso Pereira
Sri Lanka	SRL5044	Supporting a Feasibility Study Using the Sterile Insect Technique (SIT) for Integrated Control of Mosquitoes	Jeremie Gilles
South Africa	SAF5013	Assessing the Sterile Insect Technique for Malaria Mosquitoes in a South African Setting	Jeremie Gilles

Sudan	SUD5034	Supporting a Feasibility Study on the Suitability of the Sterile Insect Technique As a Strategy for the Integrated Control of *Anopheles arabiensis*	Jeremie Gilles
Tunisia	TUN5027	Supporting an Area-Wide Integrated Pest Management Pilot Project for Evaluating the Effectiveness and Economic Feasibility of Using SIT as a Component of Integrated Date Moth control	Marc Vreysen
T.T.U.T.J of T. Palestinian A.	PAL5004	Integrated management of fruit flies in Palestinian Territories	Jesús Reyes
Uganda	UGA5033	Demonstrating the Feasibility of a Sterile Insect Technique (SIT) Component as Part of an AW-IPM Approach against Glossina f. Fuscipes to Increase Livestock Productivity	Udo Feldmann
Vietnam	VIE5017	Supporting Area-Wide Integrated Pest Management to Improve the Quality of Fruit for Export	Rui Cardoso Pereira
Zimbabwe	ZIM5017	Improving Crop and Livestock Production through the Eradication of Bovine and Human Trypanosomiasis in Matusadona National Park	Udo Feldmann
		New Regional Projects to Start in 2012	
Regional Africa	RAF5061	Supporting Capacity Building and a Feasibility Study on Control of Fruit Flies of Economic Significance in West Africa	Rui Cardoso Pereira
Regional Africa	RAF5062	Preventing the Introduction of Exotic Fruit Fly Species and Implementing the Control of Existing Species with the Sterile Insect Technique and Other Suppression Methods	Rui Cardoso Pereira
Regional Africa	RAF5064	Supporting Area-Wide Tsetse and Trypanosomosis Management to Improve Livestock Productivity and Enable Sustainable Agriculture and Rural Development	Udo Feldmann
Regional Africa	RAF5065	Promoting the sharing of expertise and physical infrastructure for mass rearing mosquitoes and integration of the sterile insect technique (SIT) with conventional methods for vector control, among countries of the Indian Ocean region	Jeremie Gilles
Regional Asia	RAS5059	Supporting Area-Wide Integrated Pest Control of Native and Exotic Flies in the Middle East Subregion Incorporating the Sterile Insect Technique (SIT)	Jesús Reyes
Regional Europe	RER5018	Supporting Fruit Fly Pest Prevention and Management in the Balkans and the Eastern Mediterranean	Rui Cardoso Pereira
Regional Latin America	RLA5058	Building Capacity for Suppression of Fruit Flies using an Area-Wide Pest Management Approach	Jesús Reyes
		New Interregional Project to Start in 2012	
Interregional	INT5151	Sharing Knowledge on the Use of the Sterile Insect and Related Techniques for Integrated Area-Wide Management of Insect Pests	Jorge Hendrichs Jesús Reyes

Highlights of Technical Cooperation Projects

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

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

This regional training course that focused on taxonomy and ecology of exotic fruit flies for the American Hemisphere was held in Panama City, Panama, 26 September - 1 October, 2011 with the participation of twenty trainees from eight countries from Central and South America, and the Caribbean Basin. It was co-organized with the Regional Plant Protection Organization for Central America (OIRSA) and the University of Panama.

Participants of the regional training course on Taxonomy, Ecology and Control of Fruit Flies of Quarantine Importance (Panama City, Panama).

The training programme, spread over five days, consisted of several components, including: (1) biology, ecology and behaviour of fruit flies and their natural enemies, (2) biology and identification of *Rhagoletis* and *Anastrepha*, (3) biology and identification of *Ceratitis*, *Dacus* and *Bactrocera*, and (4) control of *Anastrepha grandis*. The course was conducted by the recognized tephridologists Pablo Liedo, Marc De Meyer, and Cheslawo Korytkowski.

RS-2400 X Ray Irradiator Put in Operation in Costa Rica

Under a cost sharing initiative between the government of Costa Rica and the IAEA, a new X-ray irradiator was installed last October in the facilities of the Fruit Fly Programme located in Pavas, San José, Costa Rica. The machine will serve to irradiate pupae of West Indian fruit fly (*Anastrepha obliqua*) and Mediterranean fruit fly; irradiated larvae of the latter will be used to rear *Diachasmimorpha longicaudata* parasitoids. The sterile flies and parasitoids are aimed at controlling fruit fly pest populations. Next year, the X ray machine will also serve to irradiate medfly pupae to assess the feasibility of producing *Sphalangia cameroni* parasitoids to suppress populations of the stable fly (*Stomoxys calcitrans*), in the North Atlantic and Huetar regions, as part of a new FAO/IAEA insect pest control project requested by the government of Costa Rica.

RS-2400 X ray machine recently installed (Pavas, San José, Costa Rica).

International Training Course on Area-wide Fruit Fly Pest Management

The XXI edition of this international training course was held in Tapachula, Chiapas, Mexico, from 15 August September 2, 2011. This course was aimed at training twelve technicians from five Central America countries participating in a regional TC project. Ten additional participants from Central and South America, funded by other organizations, also participated in this course.

Participants of the international training course on Area-wide Fruit Fly Pest Management (Tapachula, Chiapas, Mexico).

The training programme, spread over three weeks (132 hours of lectures and hands-on activities) consisted

of five modules that included all topics involved in area-wide integrated pest management programmes with an SIT component: (1) management of fruit fly control programmes, (2) taxonomy and biology of fruit flies and their natural enemies, (3) surveillance and fruit fly identification methods, (4) fruit fly suppression methods, and (5) all aspects of SIT application.

The course was conducted by 39 lecturers including 12 PhD., 15 MSc., and 12 other lecturers with over 15 years of experience in SIT application in fruit fly management projects.

National Coordinators Meeting

The meeting was held in Guatemala City, 28 November - 2 December, 2011 and it was attended by seventeen people. Ten of them were the project counterparts representing Belize, Costa Rica, Dominican Republic, El Salvador, Guatemala (2), Honduras, Nicaragua, and Panama (2), including representatives from the US Department of Agriculture, the Mexican Plant Protection Organization and the FAO/IAEA (2).

Participants of the national coordinators meeting during the visit to the tomato production greenhouse.

Each attendant gave a comprehensive report of the last year's activities in their respective country. The US Department of Agriculture and the Mexican Plant Protection Organization representatives presented lectures related to their activities against fruit flies and how these actions are complementary to the activities planned through this TC regional project. As a core issue, the group prepared the work plan for 2012. The participants discussed how this project will support the organization of the 8th International Symposium on Fruit Flies of Economic Importance.

The group also participated in a field visit to the tomato and bell pepper production area in Santa Rosa department, where the export industry of these vegetables is located. As a result of this and two former related projects based on development of areas of low fruit fly prevalence, this industry has exported US$25 million of tomatoes and bell peppers in 2011.

Pest Eradication Work Boosts Guatemalan Produce Exports

Over the years the Joint FAO/IAEA Division has helped deploy the sterile insect technology to assist in curbing Guatemala's fruit fly populations, thereby providing a host of new jobs and at least doubling, over the last four years, export earnings from non-traditional agricultural export crops of tomatoes, bell peppers and papaya.

While prices slumped over the past decade for Guatemala's traditional exports of coffee, banana and sugar cane, sales of tomatoes increased 10 times to US$23 million in 2011 from $2.5 million in 2007, with export income from bell peppers roughly tripling to $3.6 million in 2010, and papaya doubling, to $3.4 million. These increases vaulted Guatemala into first place as the largest Central American supplier to its nearest major international market, the USA, and created hundreds of rural jobs, typically for men in field pest control and for women in the packing and transportation services industries.

These successes are the result of programmes to which FAO/IAEA technical and management expertise have contributed, aiming at eradicating the invasive Mediterranean fruit fly in the northern parts of the country bordering Mexico and suppressing the native pest fruit fly populations. These flies do great damage to agricultural world trade, typically shutting countries out of export markets if they cannot prove the produce to be pest free. Given a short shelf life, fruits and vegetables tend to be the most valuable of agricultural export products.

A female native fruit fly lays its eggs just under the skin of healthy, ripening fruit on the tree. The eggs hatch in one to two days. The maggots begin to feed on the fruit's flesh and a localised rot develops causing the fruit to drop to the ground (photo: A. Rodriguez).

"If you want to export, and also avoid the application of costly post-harvest treatments that can reduce produce quality, you have to get rid of both the Mediterranean and native fruit flies", says Jesus Reyes Flores, an entomologist of the FAO/IAEA Division of Nuclear Techniques in Food and Agriculture.

The IAEA has provided support through a succession of three Guatemala projects since 2001 against native fruit flies and also provided technical expertise to the trilateral

Mediterranean Fruit Fly Programme, run by the governments of Guatemala, Mexico and the USA.

On 6 January 2011, the government of Guatemala officially declared some 220 000 ha, or 2200 square kilometres, of its north-western border region with Mexico Mediterranean fruit fly free. Based on this achievement, the government started negotiations with commercial partners to certify the region as Mediterranean fruit fly free. Simultaneously, the IAEA and FAO have supported the combating of native fruit flies, thereby facilitating from 2007 onwards the export of tomatoes, bell peppers and papayas from parts of the country where these populations had been suppressed.

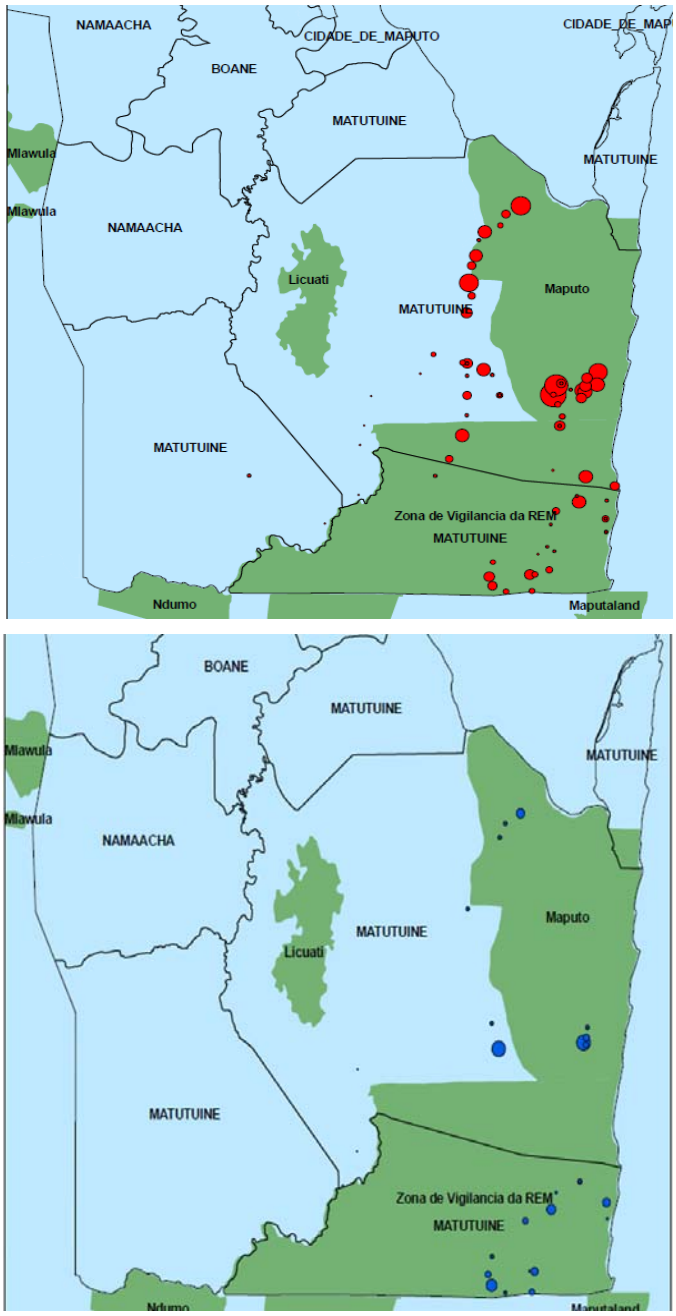
Supporting the Creation of a Tsetse Free Zone in Southern Mozambique and North-East South Africa (RAF5059)

The third regional coordination meeting of TC project RAF5059 was held in Pretoria, South Africa on 14-15 November 2011 and was hosted by the Onderstepoort Veterinary Institute (OVI). Scientists from the OVI, the Department of Veterinary Services, KwaZulu Natal (KZN), the Ministry of Agriculture, Mozambique and the Eduardo Mondlane University (EMU), Maputo, Mozambique attended the meeting. Dr Hassane Mahammat, the new Coordinator of the Pan African Tsetse and Trypanosomosis Eradication Campaign (PATTEC) was also present.

The tsetse and trypanosomosis situation in KZN has not changed, i.e. it is clear that both *G. brevipalpis* and *G. austeni* are omni-present in KZN and the trypanosomosis prevalence averages around 19%. The disease is mainly managed though the curative administration of tryopanocidal drugs, very often only after clinical diagnosis. The diptanks in KZN only use Amitraz, which is an acaricide ineffective against tsetse.

New research data on vector competence seem to indicate that *G. austeni* is a better vector of trypanosomosis than *G. brevipalpis*. Population genetics data using mitochondrial DNA as a marker indicate that the flies in Swaziland belong to a separate population, but the flies from Southern Mozambique and KZN constitute one population. This data however needs to be confirmed with other markers such as microsatellites.

In Mozambique, the entomological and veterinary baseline data surveys were further implemented. Entomological surveys were carried out in 30 of the 54 grids where a total of 171 traps were deployed that trapped 609 tsetse flies, i.e. 515 *G. brevipalpis* and 94 *G. austeni* (see map). Trap deployment needs to be done more effectively and there is therefore an urgent need to develop land cover maps to better guide these surveys. More than 2000 cattle were screened with the buffy coat in the target area giving an average trypanosomosis prevalence of 15%. *T. congolense* was the predominant species.



Survey data of Glossina brevipalpis *(above) and* Glossina austeni *(below) sampled with the H-trap in Southern Mozambique.The circles indicate the presence of these tsetse species. Dark green represents forest/protected areas (maps by Luis Neves).*

A formal document has been signed by Dr S.S. Mkhize, Head of the Department of Agriculture, Environmental Affairs and Rural Development and Dr B. Mkhize, CEO of the KZN Ezemvelo Wildlife, in which both parties endorse a programme to eradicate tsetse from KZN. This document is very important as it should clear the way to go ahead with the implementation of a tsetse eradication programme in KZN.

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

Major steps forward in this project occurred during 2011, in particular the completion of the fly emergence and release facility in Croatia with a capacity to handle 20 million pupae per week and the extension of the Mediterranean fruit fly releases to an expanded pilot area of 1250 ha.

Mandarine grove ready for harvesting in an area treated with sterile males (photo by Louise Potterton, IAEA).

Fruit sampling implemented as a routine method of evaluation of suppression activities, including the SIT, is a step forward for the project.

Fruit sampling from treated (SIT and other suppression techniques) and untreated areas.

Furthermore, the involvement of the mandarin industry of Croatia is gaining momentum and the farmers and fruit exporters are willing to pay for a cleaner suppression method that controls the Mediterranean fruit fly and allows them to export with low levels of infestation and insecticide residues, as required by the EU market.

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

Project Number	Ongoing CRPs	Scientific Secretary
D4.20.12	Improving SIT for Tsetse Flies Through Research on Their Symbionts and Pathogens (2007-2012)	Adly Abd Alla
G3.40.02	Biology of Male Mosquitoes in Relation to Genetic Control Programmes (2008-2013)	Jeremie Gilles
D4.20.13	Applying Population Genetics and GIS for Managing Livestock Insect Pests (2008-2013)	Udo Feldmann
D4.10.22	Increasing the Efficiency of Lepidoptera SIT Through Enhanced Quality Control (2009-2014)	Marc Vreysen
D6.20.08	Development of Generic Irradiation Doses for Quarantine Treatments (2009-2014, managed with Food and Environmental Protection Subprogramme)	Andrew Parker (co-secretary)
D4.20.14	Development and Evaluation of Improved Strains of Insect Pests for SIT (2009-2014)	Gerald Franz
D4.10.23	Resolution of Cryptic Species Complexes of Tephritid Pests to Overcome Constraints to SIT Application and International Trade (2010-2015)	Jorge Hendrichs
D4.10.24	Use of Symbiotic Bacteria to Reduce Mass-rearing Costs and Increase Mating Success in Selected Fruit Pests in Support of SIT Application (2012-2017)	Rui Cardoso Pereira

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

The third RCM of a CRP on Biology of Male Mosquitoes in Relation to Genetic Control Programmes was held in Bologna, Italy 3-7 October 2011 with twenty participants from fourteen countries.

Participants of the RCM on Biology of Male Mosquitoes in Relation to Genetic Control Programmes (Bologna, Italy).

The group reported good progress with studies on the biology and behaviour of male mosquitoes such as *Anopheles gambiae sl*, *Aedes albopictus* and *Ae. aegypti*. The coordinated research group is assessing the impact of various factors such as larval development conditions, diet, sterilization procedure, etc. on the sexual performance of male mosquitoes and their ability to inseminate females. Male swarming behaviour (e.g. location of the swarms, duration, swarm size…) was well described by colleagues from Sudan and Burkina Faso based on studies under natural conditions. Important efforts are also made to elucidate the chemical phenomena that occur during swarming and their effects on the sexual behaviour of mosquitoes.

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

The 3rd RCM under the CRP entitled Applying GIS and Population Genetics for Managing Livestock Insect Pests was held at the Centre International de Recherche-Développement sur l'Élevage en zone Sub-humide (CIRDES) in Bobo-Dioulasso, Burkina Faso, 10-14

October 2011. Seventeen research contract and agreement holders from 12 countries and observers from CIRDES and PATTEC-Burkina Faso and FAO and IAEA staff participated in the RCM.

Participants of the RCM on Applying Population Genetics and GIS for Managing Livestock Insect Pests (Bobo Dioulasso, Burkina Faso).

The meeting participants benefitted from three practical tutorial and working sessions on the use of free open source software (FOSS) for GIS aided field work. Based on the research progress reports by the participants the meeting generated specific technical recommendations regarding individual workplans under the research contracts and research agreements and identified the following 'targets' to be addressed during the remaining collaborative period until the final RCM in early 2013:

- Generation of further information on Old World screwworm (OWS) through geo-referenced trapping, their molecular characterisation, GIS-aided processing of relevant information and generation of OWS predictive maps;
    - Comparison of information obtained on OWS with another myiasis fly, i.e. *Wohlfahrtia magnifica*;
- Assessing the mating compatibility between different geographical populations of OWS in Asia;
- Determining the genetic structure of New World screwworm (NWS) within northern and southern Amazon groups and population west of the Andes;
- Evaluating non-sticky traps for OWS and possibly for NWS;
- Improved detection of OWS for Member States that are free of but endangered by OWS;
- Further development of specific techniques (population genetics and geometric morphometrics) and gathering of geo-referenced information for assessing differences between *Glossina pallidipes* populations;
- Confirming a) the updated northern limit for *G. p. gambiensis* and *Glossina tachinoides* in Burkina Faso through gathering additional entomological data and b) the absence of tsetse in the area of the 'Togo gap' (the two species are no longer trapped in this area of Burkina Faso), and assess the degree of 'isolation' (population genetics and geometric morphometrics);
- Strengthening FAO's support to CRP partners involved in tsetse and trypanosomosis research;
- Developing a standardised spatial platform to be linked with FOSS GIS software for use by the CRP participants and providing technical support in the use of these applications.

Consultants Group Meeting on *Enhancing Vector Refractoriness to Trypanosome Infection*. 10-14 October 2011, Vienna, Austria

Four consultants from Belgium, Greece, Guatemala, and USA and one observer from Austria met in Vienna to discuss the current state of knowledge on controlling the susceptibility of the vectors of trypanosomes to their pathogens, current research on methods to change the susceptibility and the need for future research and development in this area.

The success of the IAEA supported project to eradicate *Glossina austeni* from the island of Unguja, Zanzibar, integrating the SIT created considerable interest in utilizing this approach in other locations, and led to the African Union initiative on PATTEC (Pan African Tsetse and Trypanosomosis Eradication Campaign). To date, FAO/IAEA supported SIT projects have been in areas without human sleeping sickness, and disease transmission has in the past been minimized by adding trypanocidal drugs to the blood meal when feeding sterile males before release. Nevertheless, for future projects, which could include areas of actual or potential human disease transmission, it would be desirable to develop strains refractory to the transmission of trypanosomes as a much simpler and more effective method of ensuring that released sterile flies do not transmit any disease.

Several approaches are currently being investigated in this respect, including drug treatment, manipulation through *Wolbachia* infection and modification of the symbiont *Sodalis glossinidis* to express anti-trypanosome peptides.

The meeting concluded that more work on these approaches is needed to better understand the mechanism involved, to determine the level of refractoriness achievable and to develop the necessary tools to produce refractory strains. The meeting drafted a proposal for a CRP to start in 2013 or 2014 as a follow-up to the current CRP on Improving SIT for Tsetse Flies Through Research on the Symbionts and Pathogens.

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

FRUIT FLIES

Fruit Fly Rearing and Quality Control Activities

Cold treatment of *Bactrocera zonata*

The Insect Pest Control Laboratory (IPCL) has been collaborating with the USDA-APHIS Centre for Plant Health Science and Technology on a joint project entitled Development of phytosanitary and regulatory treatments for exotic tephritid fruit flies. The rationale is that there are a number of tephritid fruit flies that pose a high level threat of entry into the USA and other countries, but approved quarantine treatments are lacking for several important species. Adequate post-harvest treatment schedules for these pests are therefore required for use by often developing countries in combination with pre-harvest pest suppression measures, in order to facilitate the export of their produce by minimizing or preferably eliminating the risk of introduction of these exotic pests into importing countries. In addition, frequent outbreaks in the USA and the resulting temporary domestic quarantines require regulatory treatments to be available for growers in outbreak areas to be able to move fruit and vegetables to both domestic and international markets.

Thermotron equipment used in the study to develop adequate post-harvest treatment schedules.

The IPCL currently maintains more than thirty species and strains of exotic fruit flies of economic importance and is the ideal place to conduct tests to make treatment efficacy comparisons across species to standardize treatment schedules for a number of important commodities. The results of these tests will be used to develop standards for new phytosanitary and regulatory treatments. The project was initiated with work on *Bactrocera invadens* (see NL 76), which was found to be less cold tolerant than the Mediterranean fruit fly *Ceratitis capitata*. *C. capitata* treatment schedules can therefore be used for *B. invadens*. Work was continued in 2011 with the peach fruit fly *B. zonata* and the treatment currently investigated is 18 days of exposure in oranges at 1.7 °C. The establishment of *B. zonata* in Egypt and Libya, and recent detections of it in California (2006) and Florida (2010) highlight the importance of establishing reliable treatment for this pest insect.

Fruits being infested to further study of the adequate post-harvest treatment schedules.

It is expected to continue with cold treatment work with some *Anastrepha* and other *Bactocera* spp and with expanded hot water treatments and methyl bromide fumigation experiments. A post-doc scientist has been nominated and will join the IPCL in 2012 to continue with this post-harvest treatment work.

Dissections of oranges to search for dead larvae.

Establishment of new fruit fly colonies

The IPCL has been maintaining several colonies of the olive fly *Bactrocera oleae*, but with the exception of the Greek colony (which has been in culture for close to 100 generations) all of them are hybrids. Attempts have now been made to establish new colonies from Croatia,

France, Italy and Spain. The aim is to establish pure colonies that reach a size before the 5th generation in culture adequate to carry out mating compatibility studies. Infested olives were received from collaborators in these countries and 1664, 124, 157 and 268 pupae and 1204, 114, 66 and 112 flies were recovered from the olives received from France, Italy, Spain and Croatia, respectively.

An attempt is also being made to establish a colony of *Anastrepha grandis* mainly in support of the cold treatment work in collaboration with the USDA.

Mating compatibility studies of *Anastrepha fraterculus*

The IPCL hosted three visiting scientists from Argentina (Clara Liendo, Mariana Mendoza and Teresa Vera) in September-October 2011, who carried out research in relation to the CRP on Resolution of cryptic species complexes of Tephritid pests to overcome constraints to SIT application and international trade. The main aim of the scientific visit was to continue with experiments to test the mating compatibility of *Anastrepha fraterculus* populations from different populations (Xalapa (Mexico), Piura (Peru), Piracicaba and Pelotas (Brazil), and Tucuman (Argentina)). The experiments were carried out in field cage settings in a greenhouse following established standard procedures. The index of sexual isolation (ISI) was high between the Peruvian population and the two populations from Brazil, between the Piracicaba and Tucuman populations, and between the Mexican population and Tucuman, Vacaria and Peru populations, indicating sexual incompatibility. The ISI between the Piracicaba population and the population from Mexico was lower but still outside of the random mating range.

In addition, work was initiated to collect pheromone samples from the different pure *A. fraterculus* populations that are being maintained at the IPCL. The pheromone samples are now being analysed in collaboration with Peter Teal and Diego Segura, and preliminary results have already indicated some differences between the various populations.

Studies on the re-mating behaviour of two populations (Argentina – Peru) of *A. fraterculus* also revealed differences in latency time, duration of the mating, remating frequency and refractory period depending on the mating combination.

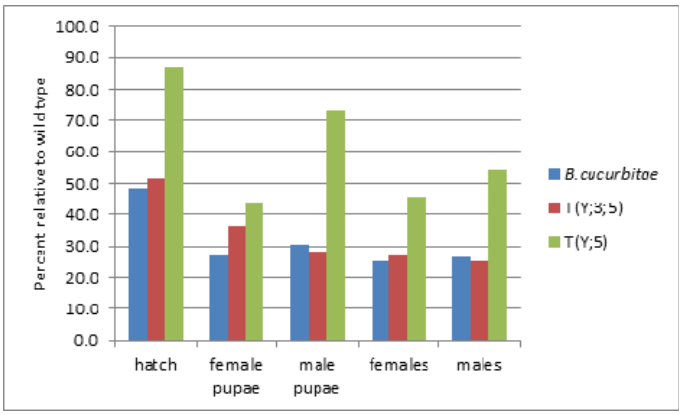
Fruit Fly Genetic Sexing Activities

Genetic analysis of a *Bactrocera cucurbitae* sexing strain

Recently, we have constructed a standard polytene chromosome map for the melon fly *Bactrocera cucurbitae* (A. Zacharopoulou, University of Patras). This map was used to determine the chromosome structure of the *B. cucurbitae* genetic sexing strain (GSS) named T1 (D.O. McInnis, USDA, Hawaii, USA). The analysis of the polytene chromosomes showed that the strain contains a complex Y autosome translocation involving two autosomes, i.e. a short fragment of chromosome 2R is transposed to chromosome 5, which in turn is linked to the Y chromosome via a reciprocal translocation. The GSS T1 is based on a white pupae (*wp*) mutation.

To analyse the strain further and to determine its genetic behaviour, the GSS was reared by inbreeding for nineteen generations without removing any aberrant phenotypes. The eggs were collected on slices of fresh melons. After two days in the cage the melon slices were removed and put on petri dishes with standard medfly larval diet based on carrot powder. For 24 h the Petri dishes were incubated at 26°C, while the remaining rearing was done at 25°C. During this test no recombinants were observed. However, due to the inefficiency of the egg collection system the number of flies obtained was relatively small and rather variable during the generations. In our evaluations of medfly strains one standard parameter that is determined during the long term rearing is the number of adults recovered from 40mL of pupae. To make these results comparable with those obtained for *B. cucurbitae* one has to take into account that this species has bigger pupae, i.e. 40mL contain only approximately half the number of pupae. As an example the current medfly GSS VIENNA 8 produces on average 1426 males and 1053 females per 40 mL of pupae. The recovery of adults from the *B. cucurbitae* GSS, normalized to medfly, is significantly lower, i.e. on average 1017 males and 785 females.

For the application of the melon fly GSS in Mauritius the strain was outcrossed with wild material. For four generations females were crossed with Mauritius wild type males. In the following generation the flies were inbred and the progeny was screened for individuals with *wp* phenotype. These flies were pooled and set up as a new strain. To generate a sexing strain, females from this strain were mated in two consecutive crosses with males carrying the Y autosome translocation. From then on the GSS was maintained by inbreeding.



Production parameters of the genetic sexing strain of Bactrocera cucurbitae. *Data presented compare the parameters for* Bactrocera cucurbitae *and two strains of* Ceratitis capitata *(Y-autosome 5 and Y-autosome 3 and 5 traslocations).*

In the first generation of inbreeding of the outcrossed GSS the egg to adult viability was determined. Eggs were collected for 5 h on fresh melon slices. To be able to

count the eggs these were rinsed out of the melon slices, transferred to medfly larval diet in petri dishes and incubated for 24 h at 26°C. After that egg hatch was determined. In total 16 replicates with 100 eggs each were scored. Furthermore, the number of white and brown pupae and the number of males and females was recorded. The values shown in the figure are normalized relative to the respective values of a medfly wild type strain (EgII). The absolute values for this wild type strain are (per 1000 eggs): egg hatch: 942, brown pupae: 908, males: 455, females 433. In comparison, two medfly Y autosome translocation strains are included in the figure; one with a simple translocation between the Y chromosome and autosome 5 and one with a more complex translocation involving in addition chromosome 3. The melon fly GSS shows a considerable amount of inherited sterility, i.e. a level of sterility that is comparable to the medfly strain where two autosomes are linked to the Y chromosome. Inherited sterility in Y autosome translocation strains is linked to the viability of different meiotic segregation products that are generated during male meiosis. Only alternate segregation products will result in genetically balanced offspring while adjacent-1 segregation results in offspring with either deletions or triplications. Both adjacent-1 classes are either lethal or show a significantly reduced viability. In cases where alternate and adjacent-1 segregation occur with equal frequency during male meiosis a simple translocation will reduce male fertility to 50% (measured as viable, fertile adult offspring); while males with a translocation involving two autosomes are 25% fertile. The genetic data shown here therefore corroborate the cytological finding that the *B. cucurbitae* GSS T1 has two autosomes involved in the translocation. As a consequence the productivity of the strain is reduced significantly, i.e. the strain is not ideal for mass rearing.

TSETSE FLIES

Development of *Glossina palpalis gambiensis* colony from Senegal

The Seibersdorf *Glossina palpalis gambiensis* SEN Pout colony, initiated at the end of 2009 with pupae produced by females collected in Pout near Thiès, Senegal, is still in an adaptation phase in the laboratory. A special feeding regime of 5-7 days per week is being applied, resulting in a progressive improvement in colony performance. Starting from 450 producing female flies at the end of December 2010, the colony reached 1700 females in October 2011. The pupal emergence rates were acceptable throughout the period with an average of 91% recorded in October 2011. The sex ratio averages 50.3% female and 49.6% male flies. This colony provided material for various experimental studies such as compatibility and competitiveness tests in the field cage.

The *G. p. gambiensis* BKF colony, originating from Burkina Faso, was entirely transferred to the semi-automated holding and feeding system TPU3.2 (tsetse production unit) in 2011. The colony is maintained using the standard 3 days per week feeding regime. The colony size is limited to about 12 000 producing female flies to reduce the workload, although the TPU3.2 could hold 60 000 female flies. For this, 36 TPU3.2 holding frames (324 holding cages) are in use. The fly performance is very good with average daily mortality less than 1% and >0.8 pupae produced per female per 10 days, confirming that *G. p. gambiensis* can be routinely maintained on the automated system.

Introgression experiment

The supply of good quality reared sterile male flies is one of the important components to guarantee the success of the tsetse control project in Senegal. Although preliminary observations of sterile males from BKF released in a favourable habitats in Senegal indicated good survival and performance, survival was very poor in other habitats of the target area. It therefore appeared that the sterile male flies originating from BKF may not be equally well adapted to all habitats in Senegal. It was therefore decided, in agreement with the counterparts, to cross the BKF colony females with SEN males (from the Pout colony) for four generations to introgress the Senegal genetic background into the colony adapted BKF strain. The programme was started in April 2011 in the IPCL. The 4th and final step has just started in October 2011 and the strain will then be built up through inbreeding. Field cage tests comparing the competitiveness of F_1 - F_4 male flies with BKF colony males are under way and are almost complete for the F_1 generation. The tests will be continued to assess the quality of the introgressed line once the fourth generation of crossing is complete.

Mating competitiveness studies of chilled flies

Continuing the support to the technical cooperation project in Senegal (SEN5031), further mating competitiveness tests on *G. p. gambiensis* males were conducted. In addition to the standard chilling and irradiation procedures as applied in the field in Burkina Faso, the adult experimental flies were chilled six days after emergence to simulate the chilling required for the adult release system. This treatment combined the chilling of the pupae for the handling, irradiation and shipment of flies from CIRDES, Burkina Faso, to Dakar, Senegal, followed by chilling the adults for the release in Senegal. The experiments were conducted using the BKF strain. For each field cage test two groups of forty males were used. The control group were males that emerged under normal colony conditions. Two adult treatments were tested, either 6 h or 30 h chilling at six days after emergence, with the field cage experiment being conducted 18 h after the end of the chilling.

The tests were performed in a cylindrical field cage, 2.9 m in diameter and 2.0 m high, set up in a large greenhouse where temperature was controlled at 24°C and humidity 60%. In each test 40 virgin BKF females were released at the centre of the cage and allowed to settle before the two groups of 40 males (control and treatment)

were released ten minutes later. Fly activity was observed for three hours and mating pairs were collected into individual vials as they formed.

The results showed that the combined chilling treatment had a significant detrimental impact on the performance of the males, with chilled males less successful in mating. Work will continue to try to reduce the negative impact of the chilling.

Maintenance of Glossina palpalis gambiensis *on TPU3.2.*

Salivary gland hypertrophy virus

As reported in the last newsletter (NL 77), attempts are continuing to develop a strategy to manage the salivary gland hypertrophy Virus (SGHV) that can hamper the development of *Glossina pallidipes* colonies due to reduced productivity. The virus management strategy is based on five approaches: (1) blocking virus replication using commercial antiviral drugs, (2) inhibiting virus infection by silencing virus specific genes using RNAi technology, (3) neutralizing the virus infection using virus specific antibodies, (4) modifying the feeding system using clean blood feeding and (5) impeding the SGHV infection using a peptide similar to SGHV ORF005 that could possibly bind to the gut epithelium.

Work is continuing to assess the impact of the antiviral drug Valacyclovir on the viral infection in *G. pallidipes* and to assess its long-term toxicity. Over 42 months of adding Valacyclovir at 300 µg/mL to the blood diet, a significant reduction in the prevalence of salivary gland hypertrophy (SGH) symptoms (close to complete elimination of the syndrome) has been obtained in the treated flies, while the non-treated flies continue to show a higher SGH prevalence. Moreover the treated flies continue to maintain acceptable levels of productivity and mortality, which permits an increase in colony size. This result strongly supports our recommendation to use Valacyclovir to reduce the SGHV in *G. pallidipes* colonies. Efforts were made to transfer and implement this technology to the tsetse mass rearing facility in Kaliti, Ethiopia and Bratislava, Slovakia.

Based on the results obtained with Valacyclovir, fifteen other antiviral drugs currently used against herpes viruses are being tested for their effect on virus replication. Further studies are planned to assess their effect on the tsetse fly's productivity and mortality.

Work is continuing to optimize the use of RNAi technology to silence some virus specific genes to inhibit virus infection. An experiment has been started to assess the effect of suppressing the expression of p74 by RNAi on virus infectivity. No significant results have so far been obtained on fly productivity and mortality and the prevalence of the SGH between the RNAi treated and untreated flies. Moreover some technical problems were encountered with the plasmid's stability in the transformed bacteria. The RNAi experiment is therefore put on hold until we resolve the above mentioned technical problems.

For neutralization of the virus infection using virus specific antibodies, five antibodies were produced. Experimental work to assess the efficacy of the antibodies to neutralize and block virus infection has been started. The preliminary results showed that injecting virus neutralized by antibodies against ORF 10 into tsetse flies significantly reduced virus infectivity. Moreover, adding p74 antibodies to the blood contaminated by feeding symptomatic flies significantly reduced the virus load compared to flies fed on contaminated blood without antibodies. Optimizing and assessing the antibody neutralization effect in more detail on the virus is continuing.

After demonstrating the role of horizontal transmission using the membrane feeding system in laboratory colonies, it was recommended to maintain tsetse flies on a clean blood feeding system. A clean feeding colony was therefore established (see details in NL 77) to provide additional evidence that the approach of feeding flies clean blood will reduce the virus load in the colony and to determine the time required to achieve an acceptable reduction in the virus load in the treated colony. Data so far collected show a significant reduction in the virus load and SGH prevalence. Moreover, the combination of the clean feeding with Valacyclovir treatment resulted in the complete elimination of SGH from the *G. pallidipes* colony.

Impeding the SGHV infection using a peptide similar to the SGHV ORF005 was mentioned in NL 77 as a new potential strategy to control SGHV (this is work carried out in collaboration with Bryony C. Bonning from Iowa State University, Ames, USA). One polypeptide sequence similar to the amino acid sequence used by B. Bonning was found on SGHV ORF005. An oligo-peptide was synthesized from this sequence and its impact on virus infection was tested. The preliminary results indicate a significant reduction in the virus load in the flies fed on virus infected blood with the oligo-peptide as compared to the flies fed on virus infected blood alone. Further studies to optimize and assess the impact of long term use of this approach are under way.

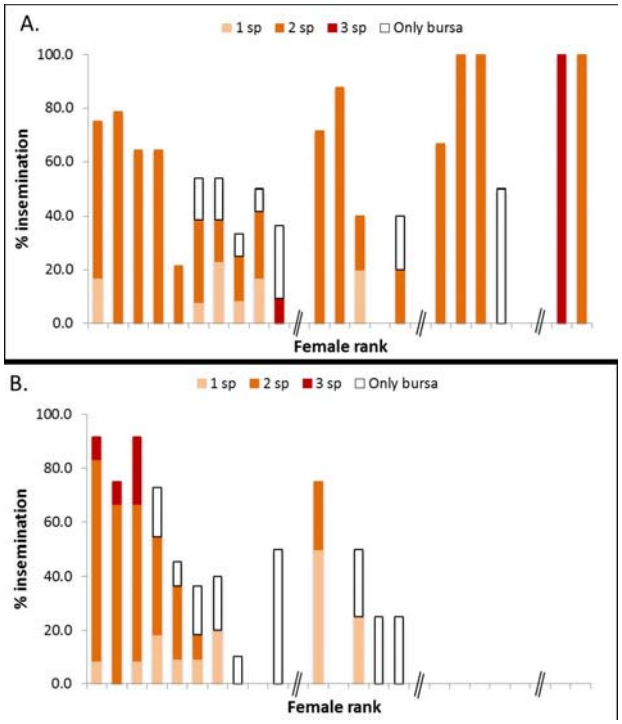
MOSQUITOES

Sperm transfer in male *Aedes albopictus*

Copulations of *Ae. albopictus* shorter than 30 sec resulted in a successful insemination of the females in less than 30% of the matings. However, 90% of the females were successfully inseminated when copulation lasted more than 30 sec. In all the cases the two spermathecae and the *bursa copulatrix* of the females were filled with sperm.

Males of *Ae. albopictus* transfer a mixture of sperm cells and fluid from the *vesicula seminalis* (granular mass) to the *bursa copulatrix* of the females. In the 5 min following copulation, sperm cells are transferred to the spermathecae. The granular mass solidifies in the *bursa copulatrix* during the first hour after insemination, preventing further sperm transfer to the female. After 48 h the granular mass dissolves and the *bursa copulatrix* is emptied. No differences were observed between untreated and sterile (irradiated at 40 Gy) males for all these parameters.

When allowed to mate with 10 females successively on the same day, untreated 3 day old male *Ae. albopictus* were able to fill two spermathecae of the first four or five females. Thereafter, untreated males continued to copulate normally with females, but these copulations did not lead to insemination (see figure below). After a few hours, untreated males were once again able to inseminate females, probably after testes replenishment. Sterile males were also able to inseminate 4-5 females, filling two spermathecae of each female, during the first day of mating, but no new sperm cells matured thereafter (see figure below).



Insemination capacity of (A) untreated and (B) sterile Aedes albopictus *males (40 Gy) during four successive mating periods separated by 2 days of rest. Percentage of females with 1, 2 or 3 spermathecae (sp) inseminated or with sperm contained only in the* bursa copulatrix.

The next mating periods show that untreated males were able to replenish their testes since they were able to inseminate efficiently virgin females during their entire adult life. Conversely, the sterile males were unable to mature new sperm for the remainder of their lives. Therefore, the behaviour and inseminate capacity of sterile males (40 Gy) appears to be unaffected by irradiation for the first 5 matings.

Experiments of multiple mating of female *Ae. albopictus* with untreated males followed by sterile males, or vice-versa, showed intermediate egg hatch rates indicating that sperm of both males was used. The proportion of each sperm type used in any gonotrophic cycle appeared to vary. The duration of mating, the quantity of sperm transferred, and the interval between two matings may affect the proportion of the two sperm types used by the female. The second ejaculation can be detected by the presence of a second distinct granular mass in the *bursa copulatrix* or by a bigger size of the *bursa*. In some of these females, the third spermatheca was also fully filled with sperm. These results show that in case of multiple mating the sperm of sterile males can compete with sperm of untreated males.

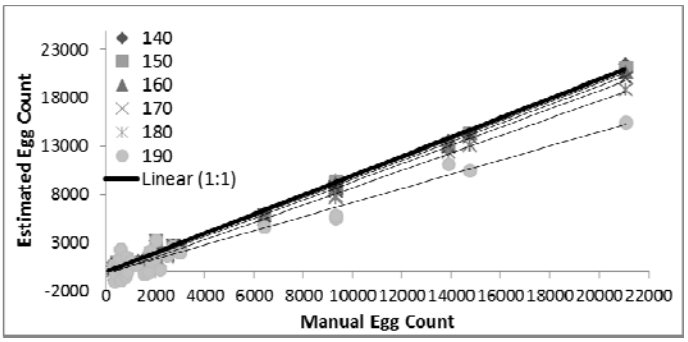
Digital estimation of egg production under mass rearing conditions

Quantification of female mosquito fecundity in a colony, i.e. the number of eggs oviposited, is an important production parameter in any mosquito mass rearing operation. Without accurate information on the productivity of a colony, no predictions can be made on the numbers of mosquitoes available for release. In the laboratory, egg quantification can be done by manually counting eggs under a microscope, a laborious and time consuming process that is not suitable in a mass rearing facility. A new method of assessing egg numbers of Aedine species, including *Ae. Albopictus*, was developed at the University of Kentucky in 2010 and involves the scanning of oviposition papers and digitally counting the number of eggs. While this technique was effective with relatively few eggs (<500) on the oviposition papers, the methodology needs to be refined for use in mass rearing where a single oviposition paper can have as many as 15 000 eggs.

The digital estimation of egg counts on oviposition papers is a two step technique whereby the papers are first scanned using a commercially available scanner and then digitally analysed with the free, open source software, ImageJ. The scanning process is straightforward and involves simply scanning and saving the oviposition paper as a full colour, high resolution image. The resulting image is then ready for analysis in ImageJ, where the image is converted to grayscale and any pixels not containing eggs are digitally removed. The subsequent pixels are analysed for their total area, which will be used to create an equation that is applied to estimate egg numbers. To digitally remove all background elements excluding eggs, the threshold of the image must be adjusted, a process in which an arbitrary limit (threshold) is set and pixels with

intensity values lower than this threshold will appear as black (eggs) and those with a value greater than the threshold will appear as white. Thus, to ensure that the equation created for estimation is as accurate as possible, it is our goal to find the optimal threshold that will include as many eggs as possible while excluding background elements such as shadows and debris.

A series of threshold values were tested to develop equations for estimating egg numbers and these resulting equations were further subjected to validation tests in which the accuracy of their estimations were tested. Threshold values between 140 and 180 were all deemed appropriate as estimators, with our highest threshold value of 190 being ruled out as its predicted values were significantly less than the actual egg count. Of those remaining thresholds, a value of 140 was chosen as its estimations are closest to a line with perfect estimation (i.e. slope = 1) (see figure below).



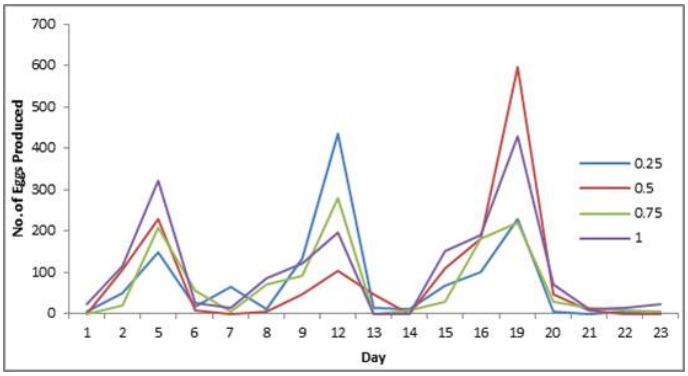
Relationship between manual egg counts and estimated egg counts for each threshold as compared to a line of perfect estimation (bold). Linear regressions for each data set are shown.

Effect of sex ratio on egg production in *Aedes albopictus*

In mass rearing operations, the ability to stock colony cages with a high female to male mosquito ratio would reduce the harassment of male mosquitoes trying to mate with unreceptive females (which could have a negative impact on egg production) and it would provide excess males available for sterilization and release or for experimental purposes. Because male *Ae. albopictus* can inseminate multiple females, this approach is applicable for their rearing, but it is important to ensure that egg production is not adversely affected.

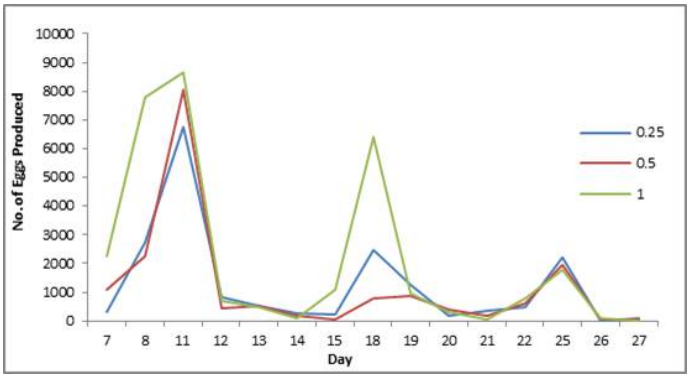
The effect of different sex ratios of *Ae. albopictus* on their reproduction was assessed. Each of four standard oviposition cages were loaded with 100 females and 25, 50, 75 or 100 adult males, giving male to female ratios of 0.25, 0.5, 0.75 and 1.0. The mosquitoes were provided with sugar *ad libitum* and offered a blood meal daily. Records of male and female mortality were kept daily. Oviposition papers were also collected daily and the number of eggs laid was counted.

Female mortality across all treatments was similar, though slightly higher with an equal sex ratio. Male mortality, on the other hand, was shown to be higher at the 0.25 sex ratio, suggesting a positive correlation between male competition/multiple mating efforts and male mortality. Total egg production, in contrast, was not different for any of the treatments (see figure below), indicating that a 0.25 male to female ratio is adequate to ensure that enough females are inseminated to maintain egg production.



Mean number of eggs produced per day with a male to female ratio of 0.25, 0.5, 0.75 and 1.0. Periods of high egg production were different for each treatment, but overall egg production was similar.

This trial was then repeated in similar cages but with higher insect densities (1000 females instead of 100) and using the following male to female ratios: 0.25, 0.50 and 1.0. A 0.25 male to female ratio resulted in the highest male mortality and lowest female mortality. Overall egg production was once again, very similar for all three treatments (see figure below).

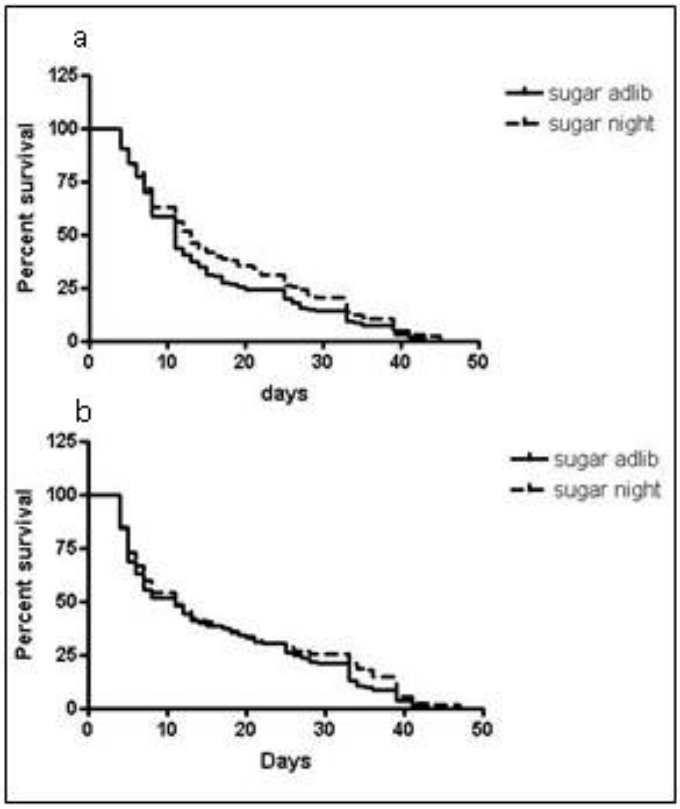


Number of eggs produced per day for each of the three treatments: male to female ratio of 0.25, 0.5 and 1.0.

Access to sugar before blood feeding on female egg production and survival

Sugar delivery is important for female mosquitoes, which use sugar as a nutrient source for flight, survival and fecundity. Sugar feeding, however, can have a negative impact on the blood feeding behaviour of female mosquitoes and consequently on their fecundity. Tests were carried out to assess the effect of continuous or intermittent access to sugar on egg production and adult survival. In all experimental cages, 100 adult male and 100 adult female *Anopheles arabiensis* were given continuous access to a 10% (w/v) sucrose solution during an initial 4 day period, referred to as the mating period, during which reproductive maturation and mating activity occurs. In the first treatment group (3 cages), mosquitoes were still given continuous access to the sugar solution (i.e. continuous access to sugar group) after the mating period, while

in the second treatment group (3 cages), sugar was removed every day at 8.00 a.m. until blood feeding at 3.00 p.m. (7 hours of starvation) (i.e. intermittent access to sugar group). Mosquitoes from the continuous access to sugar" group produced fewer eggs than mosquitoes from the intermittent access to sugar group, but survival of both male and female mosquitoes of the two treatment groups was not significantly different (see figure below).



Survival of a) male and b) female Anopheles arabiensis *in cage with sugar ad libitum or only sugar during the night.*

In *An. arabiensis*, the sugar deprivation before blood feeding enhanced egg production by 50% compared to the continuous sugar delivery without impairing male and female survival.

Blood feeding periods, egg production and hatch rate

A blood delivery device (Hemotek®) is routinely used to provide warm blood to the colony mosquitoes and tests were conducted to assess the effect of the delivery time of the blood in the Hemotek® on egg production and hatch rate. The blood was kept for 0, 1 h 30 min and 3 h in the Hemotek® in an experimental cage that contained 100 male and 100 female adults. The mosquitoes were given continuous access to a 10% sucrose solution during the first 4 days (i.e. the mating period during which reproductive maturation and mating activity occur). After this period, all the treatments were blood fed every day. The blood was placed in 3 heated modified large plates of the Hemotek® at 1.00 p.m. In the first treatment (control), cages were fed between 1.00-1.30 p.m., cages of the 1.30 and 3h blood age groups were fed with the same plates between 2.30-3.00 p.m. and 4.00-4.30 p.m., respectively. No significant difference was observed in egg production or hatch rate for the 3 different treatments.

Therefore, placing the blood in the Hemotek® for up to 3 hours does not seem to affect egg production or egg quality. That means that a single Hemotek® plate could be used to blood feed several cages. Longer feeding periods with the same blood will be further tested to increase the efficiency of blood management under mass rearing conditions.

Oviposition cages for *Anopheles arabiensis*

New prototypes of adult holding and oviposition cages for *An. arabiensis* and *Ae. albopictus* are being tested (see figure). They have a capacity of approximately 15 000 adults and allow easy handling with respect to egg collection, floor cleaning, blood feeding, sugar delivery and adult emergence. The preliminary tests showed two peaks of egg production during a week and up to 300 000 eggs were collected in one day; studies are being conducted to improve the homogeneity of the daily egg production by introducing new females every day.

Prototype of mass-rearing cage for Anopheles arabiensis.

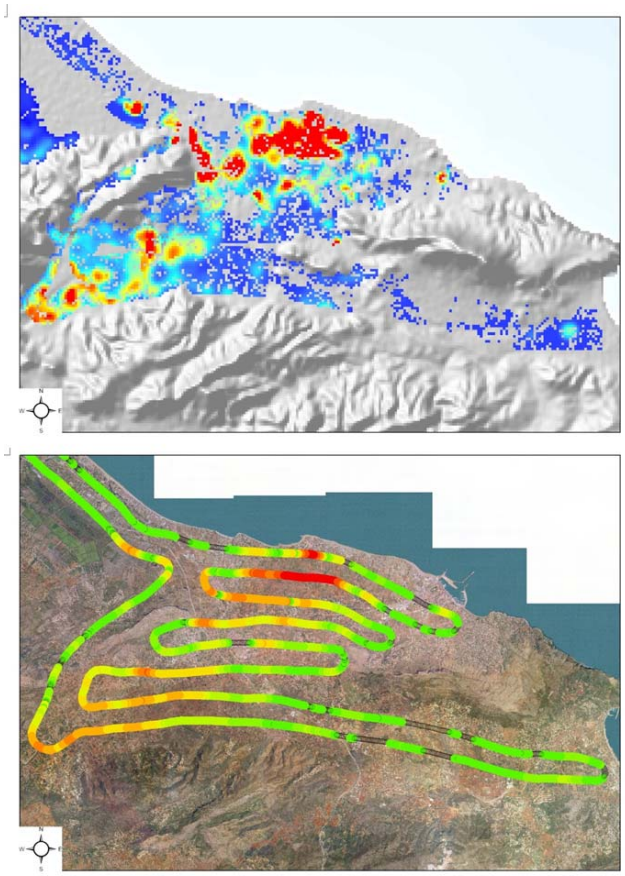
Reports

FAO/IAEA Consultants Meeting on Using GPS Instruments and FOSS GIS Techniques in Data Management for Insect Pest Control Programmes. 31 October-4 November 2011, Vienna, Austria

Area wide pest control programmes routinely use, produce and update large amount of geospatial data as part of their baseline surveys and monitoring activities. GIS is proven to be a very useful tool to understand and analyse these data, allowing the managers and researchers to have a spatial perception of the pest distribution.

There is increasing international consensus that intervention campaigns against major mobile pests should be based on the area wide concept of integrated pest management (AW-IPM). The area wide approach is not always easy to apply, but GIS techniques provide the necessary support to ensure effective compliance with this approach.

Despite this, not all the small or medium size pest control programmes take advantage of this useful tool, probably because GIS is often seen as an attractive but complicated software that is expensive and requires trained experts to be implemented in a programme.



Use of GIS techniques to release differential rates of sterile insects according to pest wild populations. SIT Programme against Medfly, Valencia (Spain).

In recent years, the software development known as Free Open Source Software (FOSS) has made great strides in producing high quality software applications, and GIS is no exception. A complete tool kit is available cost free on the internet including spatially enabled databases, sophisticated analysis programmes and GIS viewers.

This consultants meeting aimed at encouraging collaborators in Members States to benefit from the new technology by preparing an updated version of the existing tutorial Using GPS Instruments and GIS Techniques in Data Management for Insect Pest Control Programmes, that (a) promotes the use of FOSS and (b) addresses not only plant pests but also animal pests.

Meeting of the Technical Panel on Pest Free Areas and Systems Approaches for Fruit Flies. 22-26 August 2011, Recife, Pernambuco, Brazil

The Technical Panel on Pest Free Areas and Systems Approaches for Fruit Flies (TPFF) of the International Plant Protection Convention (IPPC) was convened by the Joint FAO/IAEA Division with the objective of drafting an annex of ISPM 26 on 'Establishment of fruit fly quarantine areas within a pest free area in the event of an outbreak'.

Participants of the technical meeting on Pest Free Areas and Systems Approaches for Fruit Flies (Recife, Brazil).

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

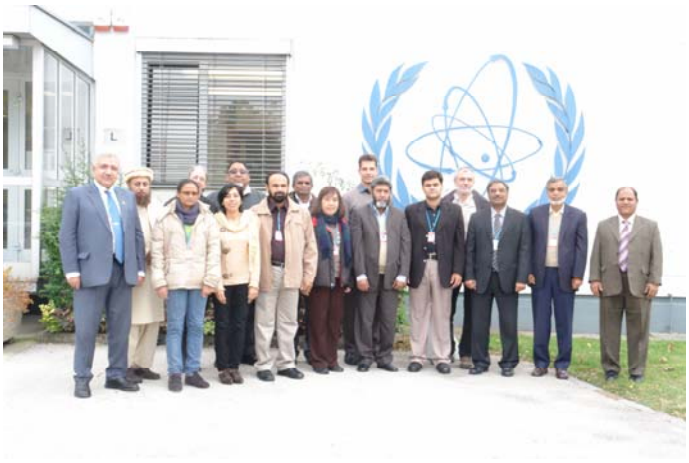
In previous meetings, the panel had developed the already adopted ISPMs 26 (*Establishment of pest free areas for fruit flies*), Appendix to ISPM 26 (*Fruit fly trapping*) and ISPM 30 (*Establishment of areas of low pest prevalence for fruit flies (Tephritidae)*). In addition the

panel had developed a draft ISPM on *Systems approaches for pest risk management of fruit flies*, a draft annex to ISPM *on Phytosanitary procedures for fruit fly (Tephritidae) management,* a draft ISPM on *Protocol to determine host status of fruits to fruit fly (Tephritidae) infestation,* and now at this last meeting a draft annex of ISPM 26 on *Establishment of fruit fly quarantine areas within a pest free area in the event of an outbreak.*

Workshop on the Integrated Control of *Aedes* Mosquitoes, Including Mass Rearing for the SIT as Well as the Other Approaches Under Development. 8-11 November 2011, Vienna, Austria

Dengue was first reported in Pakistan in 1994 and has been considered endemic since 2003. Since then Pakistan is experiencing multiple outbreaks of Dengue Haemorrhagic Fever (DHF), particularly in Punjab province and southern parts of Sindh province. Dengue is now a reportable disease in Pakistan and currently Pakistan is facing an epidemic with 27 547 confirmed cases of DHF to date and 313 deaths within a two month period.

Pakistan requested support from the IAEA to assess the feasibility of using nuclear based techniques as part of long term sustainable management approaches of the vectors of these diseases, in particular dengue fever. In response the IAEA hosted a workshop in Vienna from 8-11 November 2011 on the integrated control of *Aedes* mosquito vectors of dengue virus and other arboviruses. A delegation of national authorities of Pakistan, several experts from France, Sri Lanka, Thailand, Trinidad and Tobago, and the USA and FAO/IAEA staff participated in the workshop. Substantive technical discussions took place exploring the challenges, opportunities and immediate priorities of the country.



Participants of the workshop on the Integrated Control of Aedes Mosquitoes (Vienna, Austria).

An understanding was reached during the workshop that Pakistan lacks a process of collecting essential baseline data on the disease epidemiology, and vector biology and ecology. There is an immediate need for addressing this capacity gap before the next monsoon season to strengthen the national capacity for the implementation of a solid disease and entomological surveillance network and to enable the country to subsequently embark on a technical cooperation programme.

Results from such a baseline data collection effort will allow government health authorities to develop suitable vector control strategies in the framework of area wide integrated vector management approaches. People living in affected regions will directly benefit from successful mosquito control, reducing the burden of dengue disease. This will reduce the economic burden on both the public and private health care system.

The IAEA will assist the Government of Pakistan initially through a reserve fund project that aims at addressing some of the well established short term needs for capacity building. This project, in the short term, will have a major impact in terms of raising awareness of the national authorities and potential project counterparts on the necessity for baseline data collection for entomological and disease surveillance with the view to establish a sustainable vector control programme in the longer term. It will also contribute to building the required basic institutional capacity for developing a high quality technical cooperation programme and an effective management thereof.

Workshop on Fruit Fly Management: World Perspective and Control Opportunities. 28-30 November 2011, Vacaria, RS, Brazil

The southern region of Brazil is characterized by microclimates that make it possible to cultivate fruits that require a tropical to temperate climate. Over 150 000 ha are cultivated with fruit crops in this region, in which the most important crops are apple, peach, grapes (for both wine and fresh consumption) and citrus. Other fruits such as blackberry, raspberry, plums, nectarines and native fruits are also produced, still primarily by small farmers. One of the most technological advanced crop is apple, which occupies over 40 000 ha, producing about 1.2 million tonnes annually, supplying the Brazilian market and exporting to more than 20 countries.

The South American fruit fly, *Anastrepha fraterculus*, is the major fruit pest and can cause total loss of production. Native hosts and small home orchards are the repositories of the pest from where it moves to commercial orchards. The control of this pest is based on monitoring using McPhail traps with food lures, use of toxic lures in orchard peripheries and total area treatments with organophosphate insecticides. However, due to the past years' reduction of allowed residue levels of these insecticides by the European Union, the interval between the last treatment and harvest had to be extended, causing incidence of larvae in the fruits.

An apple grove close to Vacaria, RS, (Brazil).

In order to develop more environment friendly alternatives, including the sterile insect technique and biological control for this pest's integrated management, Embrapa Uva e Vinho, along with the regional fruit industry, organized the workshop on 'Fruit Fly Management: World Perspective and Control Opportunities', in Vacaria, RS, Brazil. The workshop facilitated discussions among stakeholders on possible alternatives for suppressing fruit flies. The main problems that apple producers face is the level of residues of insecticides on the fruits exported to the EU.

Among the decisions taken is the establishment of a group aiming at the elaboration of an economical viability study to assess the feasibility of a programme integrating the sterile insect technique and biological control. It was also decided that in the first months of 2012 fiel cage trials will be carried out comparing fertile and sterile *A. fraterculus* from the southern region of Brazil with the objective of determining the ideal doses of radiation for pilot release experiments.

International Symposium on Mass Production & Commercialization of Arthropod Biological Control Agents. 22-24 October 2011, Beijing, China

This international symposium was organized in Beijing by the Beijing Association for Science and Technology in association with the IOBC/MRQA, the Biological Control Committee of the Entomological Society of China, the Institute of Plant and Environmental Protection, Beijing Academy of Agriculture and Forestry Sciences and the Entomological Society of Beijing. Following the introductory presentations, the meeting was divided into three sections; (1) basic research in biological control agents, (2) mass production and commercialization of biological control agents and (3) field application and assessment of biological control agents. Eighty oral presentations were given and a number of posters were presented. The symposium was attended by more than 200 participants, including many students from the Beijing Academy of Agriculture and Forestry Sciences.

The Joint FAO/IAEA Divsion was represented by Andrew Parker who co-chaired the opening plenary session and presented a paper on Recent improvements in packaging for transport of beneficials covering improved insulation, phase change materials and humidity control.

Participants of the International Symposium on Mass Production & Commercialization of Arthropod Biological Control Agents (Beijing, China).

38th Annual Meeting of the Entomological Society of Colombia on Insects and Climate Change. 24-29 July 2011, Manizales, Colombia

In Bogotá discussions were held at the Instituto Colombiano Agropecuario (ICA) of the Ministry of Agriculture, responsible for managing all animal and plant health, protection, health, trade and food quality issues of Colombia. ICA has much experience in terms of pest risk analysis and monitoring for exotic pest species, while less operational experience in the area wide integrated application of mitigation measures. Colombia is a large exporter of coffee and cut flowers for which there are no serious phytosanitary barriers to international trade. However, Colombia's exports of fruit and vegetables are only minor, due to fruit fly pests that cause major losses and interfere with exports. A new subregional technical cooperation project for the Andean countries, to start in January 2012, was discussed, involving Colombia, Ecuador, Peru and Bolivia. The focus will be on carefully selecting one or two pilot areas with horticultural potential and on developing fruit fly low prevalence or free areas.

At the National Congress of Entomology in Manizales a keynote presentation on area wide pest management was given. Discussions were held with scientists and representatives of several organizations, including CIAT, Cenicafé and ICA, who pledged the support of their institutions to the fruit fly pilot projects to be established under the new regional TC project.

In Ibagué, at the University of Tolima, research activities are being carried out in relation to the ongoing FAO/IAEA CRP on cryptic fruit fly species. *Anastrepha fraterculus* flies are being collected along transects across elevational and latitudinal gradients, as well as larvae collected through different types of hosts. So far *A. fraterculus* populations have only been found at elevations between 700 and 2200 metres above sea level, although evidence is accumulating that these may belong to separate taxa.

Announcements

Call for Submission of Research Proposals for a new FAO/IAEA Coordinated Research Project on Enhancing Vector Refractoriness to Trypanosome Infection

The SIT relies on the release of sterilized male insects to mate with virgin wild female insects. In the case of disease vectors, such as tsetse, the sterilising dose that the insects receive does not reduce their vectorial capacity. It is therefore critical when large numbers of sterile male vectors are released, that the risk of transmission of the disease is minimized or eliminated. In the case of tsetse flies, disease transmission has in the past been minimized by holding sterile males after emergence and adding trypanocidal drugs to the blood meal when feeding them before release. The development of strains that would be refractory to the transmission of trypanosomes would however be a much simpler and hopefully more effective method of ensuring that released sterile flies do not transmit the disease. In that way, the SIT for tsetse and other trypanosome vectors could be significantly improved.

Tsetse flies (Diptera: Glossinidae) are the only cyclical vectors of African trypanosomes, protozoan parasites that cause sleeping sickness in humans (HAT) and animal African trypanosomosis (AAT). HAT is endemic to 36 countries in sub-Saharan Africa with about 70 million inhabitants at risk. In 2009, the number of new cases of HAT reported to WHO dropped below the symbolic number of 10 000. However, given that the disease affects hard to reach rural populations, and that active surveillance in war-torn areas is non-existent, the disease prevalence numbers are undoubtedly a gross underestimation. The related disease AAT, causes estimated losses to African agriculture of at least US $4.5 billion per year and has a profound effect on the development of the continent.

Most economically important African trypanosomes are transmitted during the bite of the tsetse fly. Humans are only infected by *Trypanosoma brucei rhodesiense* and *T. b. gambiense*. The 'nagana' causing related trypanosomatids *T. vivax*, *T. congolense* and *T. brucei brucei* are major pathogens of livestock. The natural transmission of the major medically and veterinary important trypanosome species (*T. brucei* ssp., *T. congolense* and *T. vivax*) relies on the specific biological relationship between the parasites and the blood feeding insect vector, the tsetse fly. Indeed, depending on the trypanosome species, the parasite has to go through an obligatory developmental cycle that varies from a short cycle in the mouthparts of the fly (*T. vivax*) to a longer, more complex life cycle in the tsetse fly midgut and mouthparts (*T. congolense*) or the midgut, mouthparts and salivary glands for the *T. brucei* subspecies. For both *T. congolense* and *T. brucei*, the molecular interplay at different stages of development will determine the success of parasite development in the fly to the final infective stage. A better understanding of the vector-trypanosomes-symbiont tripartite association is essential to develop methodologies that could result in the enhancement of refractoriness of the vectors to trypanosome infection.

Tsetse flies also harbour three maternally transmitted bacterial endosymbionts that presumably assume different roles with respect to their host's biology. *Wigglesworthia*, an obligate mutualist, is found in all tsetse flies examined to date. Tsetse's second symbiont, *Sodalis*, is a commensal bacterium found in all lab-colonized tsetse lines and some natural populations. Finally, some tsetse populations are colonized with *Wolbachia*. This bacterium is restricted to tsetse's germ line, and exhibits a parasitic phenotype in its host. All three of these symbionts are potentially exploitable for the purpose of reducing trypanosome transmission through tsetse. Interestingly, while only these three bacteria are found in laboratory colonies of tsetse, field caught flies house a taxonomically diverse bacterial population that further manipulates their host's biology.

The elucidation of these interactions is essential to understand the determinants of tsetse vector competence for a given trypanosome population and how they can be affected. This knowledge will help to develop tools to enhance refractoriness to trypanosome infection. In this context a new CRP will be initiated focusing on various aspects of this tripartite association. It will offer a unique opportunity to bring together different research groups working on tsetse and other vectors of trypanosomes from different regions in the world that are active in this scientific field stimulating inter-disciplinary discussions and collaborative work.

Four main research questions to be addressed by the CRP:

- Can the elucidation of tsetse-trypanosomes molecular interactions help to reduce or eliminate the transmission of trypanosomosis?
- Can the characterization and harnessing of the tsetse symbiome and pathogens help to improve the SIT?
- How are tsetse symbionts affected by radiation?
- Can tsetse symbionts be used to develop novel vector and disease control tools, complementary to the SIT?

A combination of the following priority topics will be targetted:

- Diversity in midgut, natural populations (symbiome), comparison lab-natural tsetse;
- *Sodalis*, *Wolbachia*, *Wigglesworthia* and others;
- Impact of host blood on symbiont populations;

- Sex differences in symbiont population (quantitative/qualitative);
- Environmentally acquired gut-microbiota;
- Vector microorganisms interactions (virus?; limitations for mass-rearing);
- Effect of irradiation on symbiont populations;
- Effect of irradiation on trypanosome infection;
- Symbiont-based control strategies;
- Paratransgenesis: Maternal transmission, optimization;
- Driving systems.

The expected duration of the CRP is 5 years (2013-2017) and the first Research Coordination Meeting is planned for June 2013 in Vienna, Austria. Scientists and researchers who are interested in collaborating in this new CRP should contact Andrew Parker (A.G.Parker@iaea.org).

Information on the IAEA Coordinated Research Programme and how to apply for research contracts and research agreements can be found at http://www-crp.iaea.org/. Applications should be submitted by 30 November 2012 to: Official.Mail@iaea.org.

Announcement of FAO/IAEA Regional Training Courses

Fruit Fly Surveillance, Taxonomy and Identification (under TC Project RAF5061). 4-8 June 2012, Cotonou, Benin (**Deadline for nominations: 30 March 2012).**

Quarantine and Pest Risk Analysis (under TC Project RER5018). 1-5 October 2012, Vienna, Austria (**Deadline for nominations: 31 July 2012).**

Fruit Fly Detection (under TC Project RAF5062). 3-7 December 2012. St. Pierre, La Réunion, France (**Deadline for nominations: 30 September 2012).**

Application procedure: Nominations should be submitted on the standard IAEA application form for training courses/workshops (downloadable from: http://www-tc.iaea.org/tcweb/participion/astrainee/default.asp).

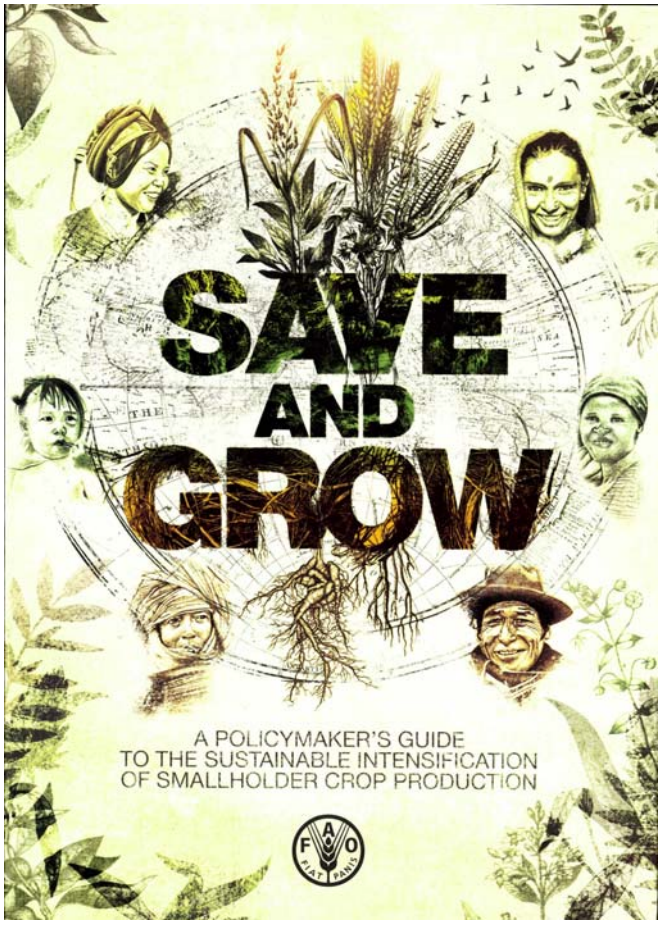
Completed forms should be endorsed by and submitted through the official channels established (either the Ministry of Foreign Affairs, the National Atomic Energy Authority, the Office of the United Nations Development Programme, the Office of the FAO Resident Representative or the Ministry of Agriculture).

The completed forms must be submitted to the International Atomic Energy Agency, Vienna International Centre, P.O. Box 100, 1400 Vienna, Austria. Advance nominations by facsimile (+43-1-26007) or email (official.mail @iaea. org) are welcome.

FAO Publication on Save and Grow: A Policymaker's Guide to the Sustainable Intensification of Smallholder Crop Production

The Green Revolution in agriculture, which swept much of the developing world during the 1960s, saved an estimated one billion people from famine. Thanks to high-yielding crop varieties, irrigation, agrochemicals and modern management techniques, farmers in developing countries increased food production from 800 million tonnes to more than 2.2 billion tonnes between 1961 and 2000. Intensive crop production helped to reduce the number of undernourished, drive rural development and make way for extensive farming.

Those achievements came at a cost. In many countries, decades of intensive cropping have degraded fertile land and depleted groundwater, provoked pest upsurges, eroded biodiversity and polluted air, soil and water. As the world population rises to a projected 9.2 billion in 2050, we have no option but to further intensify crop production. But the yield growth rate of major cereals is declining, and farmers face a series of unprecedented, intersecting challenges: increasing competition for land and water, rising fuel and fertilizer prices and the impact of climate change.



The present paradigm of intensive crop production cannot meet the challenges of the new millennium. In order to grow, agriculture must learn to save. Consider, for example, the hidden cost of repeated ploughing. By disrupting

soil structure, intensive tillage leads to loss of nutrients, moisture and productivity. More farmers could save natural resources, time and money if they adopted conservation agriculture (CA), which minimizes tillage protects the soil surface and alternates cereals with soil enriching legumes. Those simple practices help to reduce crops' water needs by 30 per cent and the energy costs of production by up to 60 per cent. In trials in southern Africa, they increased maize yields six-fold. Combining CA with precision irrigation produces more crops from fewer drops. Farmers can reduce the need for fertilizers by adopting precision placement, which doubles the amount of nutrients absorbed by plants. By using insecticides wisely, they can save pest predators and disrupt the cycle of pest resistance. Economizing on agrochemicals and building healthy agro-ecosystems would enable low-income farm families in developing countries (some 2.5 billion people) to maximize yields and invest the savings in their health and education.

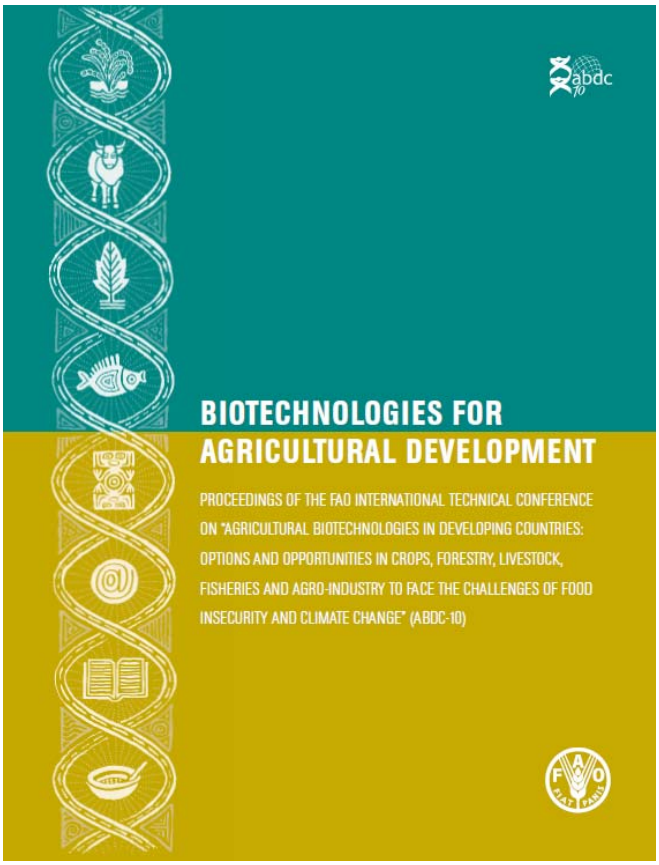
This new paradigm of agriculture is sustainable crop production intensification (SCPI), which can be summed up in the words save and grow. Sustainable intensification means a productive agriculture that conserves and enhances natural resources. It uses an ecosystem approach that draws on nature's contribution to crop growth - soil organic matter, water flow regulation, pollination and natural predation of pests - and applies appropriate external inputs at the right time, in the right amount. Save and grow farming systems offer proven productivity and economic and environmental benefits. A review of agricultural development in 57 low income countries found that ecosystem farming led to average yield increases of almost 80 per cent. Conservation agriculture, which is practiced on more than 100 million hectares worldwide, contributes to climate change mitigation by sequestering in soil millions of tonnes of carbon a year.

SCPI represents a major shift from the homogeneous model of crop production to knowledge intensive, often location specific, farming systems. Its application will require significant support to farmers in testing new practices and adapting technologies. Governments will need to strengthen national programmes for plant genetic resources conservation, plant breeding and seed distribution in order to deploy improved crop varieties that are resilient to climate change and use nutrients, water and external inputs more efficiently. Fundamental changes are also required in agricultural development strategies. Policy makers must provide incentives for adoption of SCPI, such as rewarding good management of agro-ecosystems. Developed countries should support sustainable intensification both locally and by increasing considerably the flow of external assistance to, and investment in, agriculture in the developing world.

Sustainable intensification of smallholder crop production is one of FAO's strategic objectives. The aim over the next fifteen years is to assist developing countries in adopting save and grow policies and approaches. This book provides a toolkit of adaptable farming systems, technologies and practices, and explores the policies and the institutional arrangements that will support the large-scale implementation of SCPI

FAO Publication on Biotechnologies for Agricultural Development

This book represents the proceedings of the FAO international technical conference on Agricultural biotechnologies in developing countries (ABDC): Options and opportunities in crops, forestry, livestock, fisheries and agro-industry to face the challenges of food insecurity and climate change (ABDC-10), that took place in Guadalajara, Mexico from 1-4 March 2010. The first section contains ten chapters with an extensive series of FAO background documents prepared before the ABDC-10. The second section contains five chapters dedicated to the outcomes of ABDC-10.

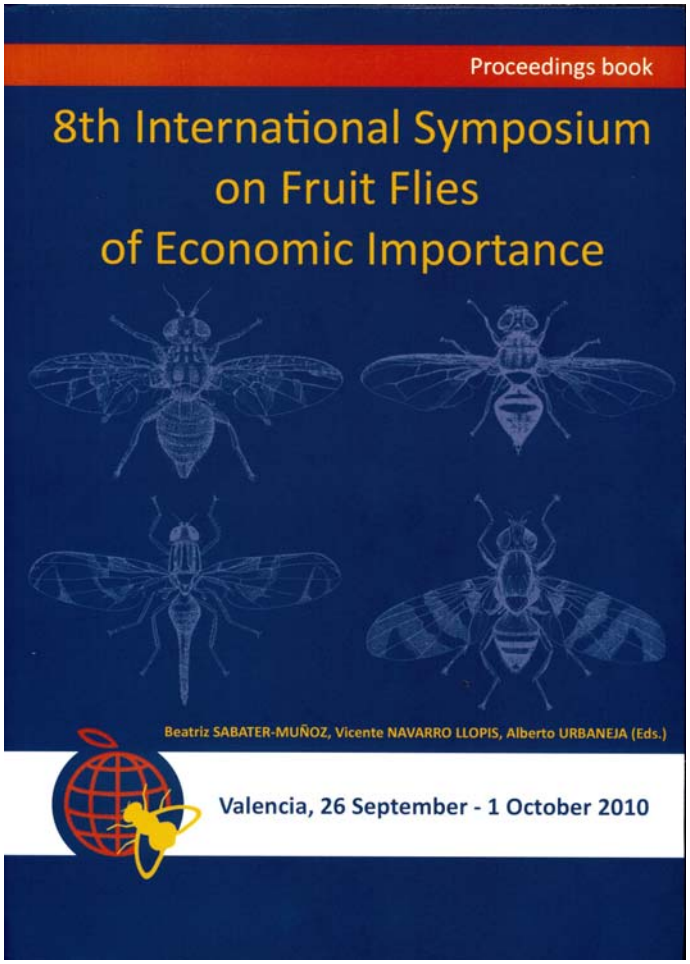


The sterile insect technique, which relies on the introduction of sterility into the females of a wild population, was included among the agricultural biotechnologies reviewed in these proceedings. Examples in the area of animal health include screwworm and tsetse flies, which cause widespread disease in livestock, with enormous economic consequences. The sterility is produced following the mating of females with released males carrying dominant lethal mutations in their sperm that have been induced by ionizing radiation. This method is usually applied as part of an area wide integrated pest management (AW-IPM) approach and has been used not only in the livestock sector, but also for the control of crop pests.

Proceedings of the 8 th International Symposium on Fruit Flies of Economic Importance

For all International Symposia on Fruit Flies of Economic Importance (ISFFEI), starting in 1982, proceedings have been published. This tradition has been continued for the 8 th symposium, which took place from September 26 to October 1, 2010 at the Universitat Politècnica de València (UPV), one of the Campuses of Excellence in the city of Valencia. The symposium was organized by the Instituto Valenciano de Investigaciones Agrarias (IVIA), Universitat Jaume I (UJI) and the Agroalimed Foundation.

The event brought together 372 scientists, extensionists, action programmes people and students from 58 different countries. Thanks to the financial support of Spanish governmental agencies and the IAEA and other donors, as detailed in the proceeding acknowledgements, 30 students obtained a 50% discount in their registration rate and 5 delegates from developing countries received full free registration, among others.



Four plenary conferences were held by recognized international scientists of the four key topics selected: insecticide resistance, host plant relationships, attractants and pheromones, and invasive species history of recent invasions. These four topics were selected by their renewed importance in the control of fruit flies all around the world. A total of 249 contributions were presented, of which 68 were oral presentations and 181 posters.

The editors and members of the organizing committee have summarized the works presented during the symposium in this volume, including the plenary discussions. This gives readers a fast view of topics treated, and also provides a record of the works that were not presented as full papers for those readers who did not attend the symposium.

This volume brings together 35 papers covering all the topics dealt with in the 8th ISFFEI, including those works presented as posters. All these papers have been subjected to peer review and editing to meet the scientific standards that are expected for this kind of publication.

The accepted papers are divided and presented in the same sequence of session topics as presented in the abstract book. However, due to the on site modification of the symposium programme (general strike on September 29 and change of symposium venue), the scientific programme is reproduced at the end of the papers section for reference. An update to the poster list is also included after the programme to bring to light the posters missed in the abstract book, and to acknowledge the contributions of all the delegates to the success of this edition of the ISFFEI.

And finally but not least, we're indebted to all fruit fly colleagues who attended the meeting and participated by presenting their results and/or contributions to the session discussions. Without their work and efforts these events could not take place. The next symposium will take place in Thailand in 2014.

Source: B. Sabater-Muñoz, V. Navarro Llopis and A. Urbaneja.

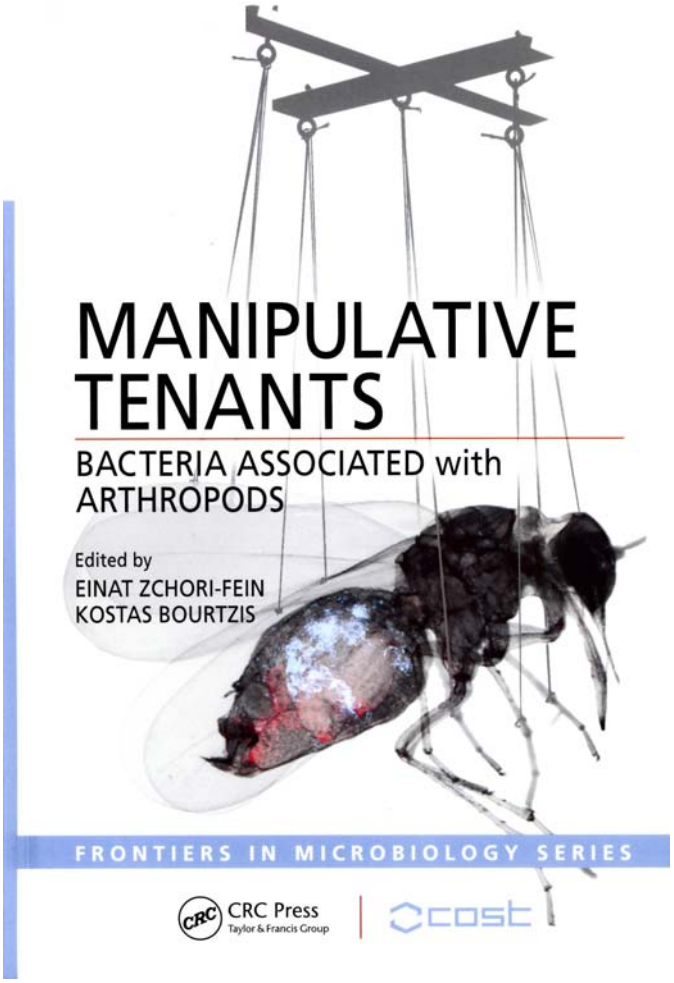
Manipulative Tenants: Bacteria Associated with Arthropods

In the English edition of his landmark book Endosymbiosis of Animals with Plant Microorganisms (1965), Paul Buchner, probably the most prominent founder of systematic symbiosis research, wrote: “I too soon fell victim to the spell of this subject, and from 1911 on devoted myself to it”.

Almost half a century later, a growing number of entomologists are recognizing the impact that arthropod-bacteria symbiosis has on virtually all aspects of the biology of both host and symbiont. The discussion of this subject tends to be system based, with primary emphasis on the insect host. However, recent screening studies have revealed that the diversity of bacteria associated with arthropods may not be as wide as initially expected, and some genera are constantly being found in hosts that belong to distantly related taxa.

‘Manipulative Tenants: Bacteria Associated with Arthropods’ introduces the fascinating world of bacteria-arthropod associations with an emphasis on the bacterial partner. Written by an interdisciplinary team of

international contributors, this book provides an overview of the diversity of bacterial symbionts identified to date as frequent partners of terrestrial arthropods. It discusses primary (obligatory) symbionts as well as the most abundant secondary (facultative) symbionts currently known.



Summarizing the most up to date information available on each symbiont, the book presents a synopsis of the field from the bacterial angle. Chapters examine Proteobacteria, including *Sodalis* and *Wigglesworthia* in tsetse flies and *Stammerula* and other symbiotic bacteria in fruit flies, as well as *Bacteroidetes* such as *Blattabacterium* and *Cardinium*. The book also identifies questions that emerge from the study of these systems. This comprehensive reference introduces the topic of bacteria-arthropod associations to researchers who are not familiar with it, enlarges the scope of knowledge of those who are, and provides a textbook for students in microbiology and other branches of biology.

Source: E. Zchori-Fein and K. Bourtzis.

Principles and Procedures for Rearing Quality Insects. 21-26 October 2012, Mississipi State University, Starkville, MS, USA

In 2000, the Department of Entomology & Plant Pathology at Mississippi State University (MSU) initiated formal education for those who rear insects under laboratory conditions. The idea of a workshop devoted to insect rearing was conceived by USDA/ARS and MSU researchers who had spent many years rearing insects professionally. Not only did they recognize a need for insect rearing education in this country but, based on their extensive international travels, they also recognized a global need for such education. Thus, an intensive five-day workshop entitled Principles and Procedures for Rearing High Quality Insects designed to cover all the major areas of laboratory rearing of insects and advertised on a world-wide basis was born.

This course will be offered once more in 2012 (21-26 October). It will include classroom and laboratory instruction, an insect rearing manual/CD, the book Principles and Procedures for Rearing High Quality Insects, facility tours, social events and refreshments. The cost of the course will be $1050 (US funds). The entire amount may be paid with the registration form, or a deposit of $275 (US funds) may be paid and the balance when arriving at the workshop. Registration will be limited to 26 individuals on a first come first serve basis. Cancellation after 20 September 2012 will result in forfeiture of the registration deposit. Confirmation of registration and MSU and Starkville area information will be mailed to each participant.

For additional information, please contact Frank Davis (fdavis@entomology.msstate.edu), or visit: http://www.irc.entomology.msstate.edu/workshop/

In Memoriam

Donald (Don) Lindquist (1930-2011)

The text below by Leo LaChance is a reproduction of the 2004 tribute that was presented to Don Lindquist during the 5th Meeting of the Working Group on Fruit Flies of the Western Hemisphere, May 2004 in Fort Lauderdale.

Today, 16 May 2004, in Ft. Lauderdale, Florida, we honour an esteemed colleague, Don Lindquist, who has worked with many of us through several fruit fly and other programmes. He is a unique leader who has applied his considerable talents to three separate but interwoven jobs in his 40 year career. Don has worked for the USDA, the Joint FAO/IAEA Division, and as a worldwide consultant on varied area wide SIT control programmes.

Don Lindquist (left) with Leo LaChance (right).

He started his USDA career in the 1960s working at an ARS laboratory at Texas A & M University. In 1969 he became the first director of the new Insect Attractants and Basic Biology Laboratory in Gainesville, FL. He spent many years working at the ARS headquarters in Beltsville, MD on the National Programme Staff in charge of Insects Affecting Man and Animals. He was associated with research under way in many ARS laboratories and also intimately involved in the area wide screwworm eradication programmes then under way in the USA, Mexico and Central America. As is typical of Don's career, he finished his US government career working for APHIS on loan to the Joint FAO/IAEA Division.

Don first joined the Joint FAO/IAEA Division as section head of the Insect and Pest Control Section in 1967. His presence was immediately felt and changed the course of IAEA involvement in insect control programmes. The direction of the section immediately changed its focus from conducting small developing country coordinated research and teaching programmes, involving radiation and radioisotopes in entomology, to involvement in larger scale programmes involving area wide insect control in developing countries.

Within a year (1968) Don had convinced the UNDP to fund a medfly suppression programme in Costa Rica and Nicaragua, to prevent the further spread of medflies, which had been recently introduced into Nicaragua. Unfortunately this programme was abandoned by UNDP in 1971 because three experts who audited the programme concluded that the medfly posed no serious economic problems for Central America. Within 10 years medflies were in southern Mexico invading the southern State of Chiapas from where it was eradicated in 1982 using the SIT. Since then a sterile insect biological barrier has kept medfly populations at the border area between Chiapas and Guatemala preventing its northern spread for 25 years. Nevertheless, medfly has since been established in Central America where it has been a major limiting factor for the development of the fruit and vegetable industry.

Don came back to the USA for a short while and returned to the Joint Division in Vienna in 1972 and was Head of the Agrochemical Section for some years before returning to the Insect and Pest Control Section. Again, he became the driving force for area wide suppression programmes against tsetse flies in Nigeria, and medfly in Egypt, Peru and later the Maghrebmed project in North Africa, just to mention a few.

When the New World Screwworm was introduced into Libya in the late 1980s and the FAO was given responsibility for an eradication programme, Don was selected, in view of having the right experience, to head the programme as Co-Director of the Libyan Screwworm Eradication Programme. As most of you know, this was a very successful programme involving much coordination, and sorting out of international and political problems. Thus, screwworms were eradicated from Libya ahead of schedule and for this reason the rest of the African continent remains New World screwworm free today. This was undoubtedly one of Don's major career achievements.

Another major contribution was his vision and leadership for moving forward the development of genetic sexing strain (GSS) for medfly. We all know that availability of medfly GSS strains has made a huge difference in cost effectiveness of SIT application against this major worldwide pest of fruits and vegetables. Since the early 1980s Don was eager to push the development of GSS and used any opportunity to tell his colleague and dear friend Leo LaChance "I want to talk about medfly genetic sexing strains, how much longer will it take to have usable strains available?"

As a consultant on area wide SIT programmes, Don has worked with US State and Federal Agencies on medfly programmes in California as well as international agencies with medfly programmes in Madeira, South America and other SIT programmes too numerous to mention, always continuing to be a passionate supporter of an area-wide approach to insect control. Now for his overwhelm-

ing personality. Anyone who has ever worked with Don knows he can be very set in his ways. He has been known to rant and rave against his collaborators who fail to see his point of view, but he also has an extremely soft spot in his heart for his friends and esteemed colleagues. Many of Don's co-workers know that with him there were no dead end jobs. He was a great supporter of upward mobility and convinced many colleagues to excel and move on upward.

When retirement time started to appear on the horizon Don had the vision and ethics to foster the new generation of professionals to take over and carry the SIT flag in the international arena. The team left by Don has since significantly advanced SIT technology. No doubt this is a lesson to be learned. Most of us who are fortunate to be his friends and associates wish him the best and hope he will be able to assist us in the years to come.

In the name of the fruit fly workers of the Western Hemisphere and other fruit fly colleagues around the world, a plaque was presented to Don to honour his: "Outstanding lifetime professional contributions to entomology, in particular for being a driving force worldwide in the field of area-wide pest control, integrating the Sterile Insect Technique against major key insect pests, including fruit flies".

Leo LaChance.

Patrick Patton Tom (1954-2011)

On September 13, 2011, Patrick Patton Tom died tragically in a car accident in Colima, Mexico.

Patrick, a Mexican entomologist with a MSc from Monterrey Institute of Technology, was the founder and first director of the Moscamed Programme in Mexico, the joint Mexico, USA, and Guatemala programme against the Mediterranean fruit fly. In the late 1970s, this programme was established to stop the northward spread of the Mediterranean fruit fly, which had invaded Costa Rica in the 1950s, gradually expanding throughout Central America and finally invading southern Mexico in 1977.

To achieve this goal, the programme needed to integrate detection and control measures on an enormous scale and under difficult tropical conditions with few roads and very mountainous terrain. The Metapa mass rearing facility, in the state of Chiapas was rapidly built with the goal of producing 500 million sterile flies per week, unprecedented at that time.

Patrick was the man for the task. He was a natural leader, a team worker, and he demanded maximum effort from his team mates and himself. Those of us who had the privilege to work under his leadership and that of our visionary National Plant Protection Director, Jorge Gutierrez Samperio, learned what was later called the MOSCAMED School: wake up early, work hard, maximum cleanliness, excellent performance, exercise and enjoyment of life. This philosophy of life formed people who are now leaders in different fields of fruit fly research and control.

Patrick Patton with one of his daughters.

Against all odds, in 1982, the programme achieved its goal of halting the spread of this pest and then eliminating it from areas that it had already invaded in Mexico. Since then, for more than thirty years, a permanent barrier has excluded this pest from Mexico, Belize, the USA and half of Guatemala.

In 1983, after leaving the MOSCAMED programme, Patrick started a prosperous business in the ornamental plant industry in Colima, Mexico.

His technical competence, dedication and professionalism that motivated and guided us will not be forgotten. He is survived by his wife Makoto, his daughters Jackie, Jenny and Patty, his grandson Kaoru and his brother Steve.

Pablo Liedo, Walther Enkerlin, Martin Aluja, Dina Orozco, Gerardo Ortíz, Jesus Reyes, Arturo Schwarz, Antonio Villaseñor, Jose Luis Zavala and Jorge Hendrichs.

Robert (Bob) Heath (1945-2011)

We are deeply saddened to report that Robert (Bob) Heath passed away on December 29, 2011. In his 43years of service with ARS, he served as research leader/supervisory research chemist as well as location coordinator at the Subtropical Horticultural Research Station, Miami, FL (1999-2011), research chemist at the Center for Medical, Agricultural, and Veterinary Entomology, Gainesville, FL (1978-1999) and in support staff positions at Beltsville, MD (1968-1972) and Gainesville, FL (1972-1978).

Bob Heath in action with a fruit fly trap in a citrus orchard.

Mr Heath was an internationally recognized scientist with specialization in the development and applications of insect semiochemicals and other attractants for the control of agricultural insect pests. He developed considerable expertise in the areas of chemical separation science, microanalytical techniques, formulations of semiochemicals, and identification of novel pheromones. The international recognition and pioneering status of Mr Heath's research is evidenced by his 210 refereed publications and book chapters. He authored or co-authored three symposia chapters, nine book chapters, nine patents recorded and two pending. Twenty-two of his publications were the result of collaborative efforts with scientists from several countries world-wide.

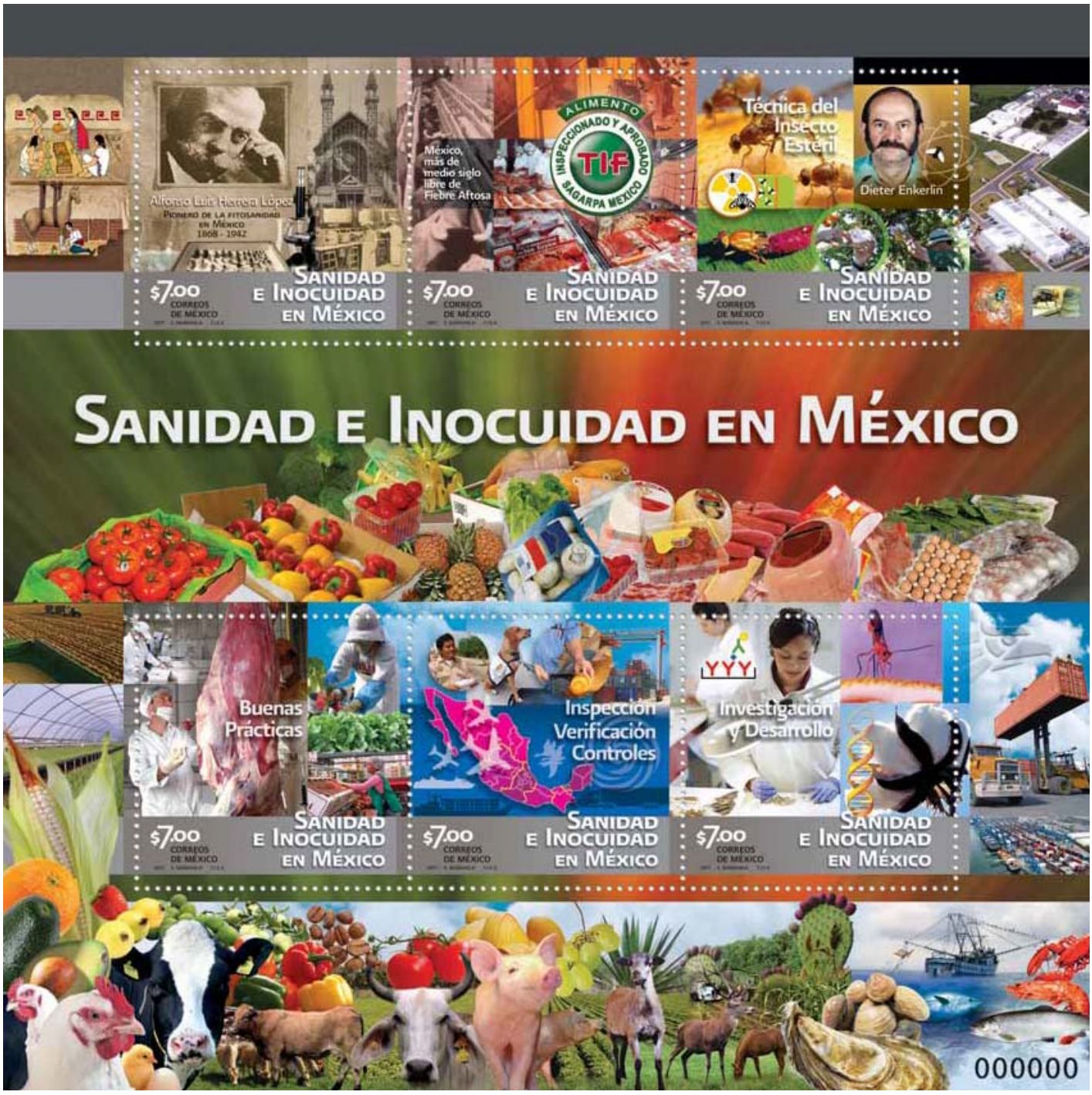
Additionally, Mr Heath contributed numerous invited presentations at local, national scientific, regulatory and/or action agencies, such as APHIS International Services and MOSCAMED (USA, Mexico, Central America), international organizations, such as IAEA, as well as grower meetings. Mr Heath received several research grants and two CRADA fundings, totaling approximately $3.6 million dollars awarded by regulatory and action agencies, industry, international organizations and grower groups, which demonstrates the importance and impact of the research conducted by Mr Heath. Eleven patents were issued to Mr Heath covering new insect attractants and formulation systems.

In his capacity as a technical advisor to IAEA Regional Research Projects, Mr Heath served as the chief technical advisor to scientists located in fourteen different countries on the use of his new attractant for detecting and monitoring Mediterranean fruit flies. Involvement by Mr Heath in the transfer of this technology resulted in several awards, press releases and numerous requests from agriculture administrators, scientists and industry leaders at the local, national and international level.

Mr Heath is survived by his wife, Martha, and his two daughters, Beth and Cathy.

Deborah Brennan, USDA Director South Atlantic.

Other News



First Series of Postal Stamps Making Reference to the SIT

A new series of SIT postal stamps (pictured above) was announced on 18 October 2011 in Mexico by the Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food (SAGARPA) and the National Director of the Postal System. It is dedicated to plant protection and food safety in Mexico and one stamp (upper right) specifically refers to the SIT. It shows Dr Dieter Enkerlin, a prominent Mexican entomologist, who promoted its use and trained many entomologists throughout Latin America.

Source: SAGARPA (18 October 2011).

Designation of the Centro Agricoltora e Ambiente 'Giorgio Nicoli' (Bologna, Italy) as an IAEA Collaborating Centre

Since 2004 the IAEA has been designating as IAEA Collaborating Centres selected partner institutions with which the IAEA has worked successfully in support of its regular programme through research and development and training in any nuclear technology. The IAEA, and particularly the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, has collaborated for many years with the Centro Agricol-

tora e Ambiente 'Giorgio Nicoli' (CCA) in Bologna, Italy.

The CAA is an independent organization funded by the municipalities of the Emilia-Romagna Region and dealing with the development and application of sustainable technologies for environment management. The Medical & Veterinary Entomology Department, one of the six departments of CCA, is mainly committed to developing new techniques for controlling blood sucking arthropods and to apply advanced integrated environment friendly biological pest control technologies for the control of mosquito populations using area wide integrated pest management approaches.

For more than ten years, the CAA has been developing the SIT technology against *Aedes albopictus* and has produced many publications on the subject. Progressively over the years, all aspects relevant to the optimization of SIT strategy have been addressed and the CAA is now preparing to scale up operations. The IAEA Collaborating Centre designation, in effect from November 2011, is for a period of four years, with the possibility of re-designation for additional four-year terms.

Source: Romeo Bellini, Medical & Veterinary Entomology Department, Centro Agricoltora e Ambiente 'Giorgio Nicoli', Bologna, Italy.

Inauguration of an Industrial Irradiation Facility in Matehuala, Mexico

The national and international trade in fruits and vegetables is regulated through international standards to protect importing countries from introductions of invasive pests. These standards regulate the production, harvesting, packing, movement, and in some cases the required post-harvest treatment to enable the trade of the product.

Irradiation of fruits and vegetables is a recognized option and Benebión inaugurated an industrial facility specifically designed to treat mango, citrus, guava, carambola and chilli, according the standards required.

The Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food (SAGARPA in Spanish) is responsible for establishing and regulating the measures that prevent the spread of pests that can cause damage to Mexican fruit and vegetables production. The Mexican standard NOM-075-FITO-1997 requires that fruit fly hosts receive post-harvest treatment before being shipped to areas of low pest prevalence in the north of the country or to export markets. The irradiation treatment at the Benebión plant was approved by SAGARPA for the mentioned fruits to ship to the north of the country, and by USDA-APHIS to export to the USA. This situation has opened the possibility of exporting high quality fruit to new markets, with producers obtaining much higher value for their horticultural products.

Source: Ana Julia Montaño; www.benebion.com (14 July 2011).

Pan-African Tsetse and Trypanosomiasis Eradication Campaign (PATTEC) has a New Coordinator, Ten Years after its Foundation

During the handover ceremony in the African Union Office of the Director of Rural Economy and Agriculture, on 2 August 2011, the Pan-African Tsetse and Trypanosomiasis Eradication Campaign (PATTEC) 'instruments of power' were given to Dr. Hassane Mahamat by Dr. John Kabayo. The instruments consisted of a report, the tsetse gun (PATTEC flag) and a PATTEC cap. The ceremony took place in the presence of some staff from the Commission and particularly the Department of Rural Economy and Agriculture (DREA).

Handover ceremony to the new PATTEC coordinator, Dr. Hassane Mahamat (left).

Speaking during the handover ceremony, Dr. Abebe Haile Gabriel, Director, DREA hailed the occasion as a sign of maturity for power transfer. He commended Dr. Kabayo's efforts and commitment in serving Africa through the fight against tsetse flies and trypanosomiasis. He pledged to support the new Coordinator.

Meanwhile, PATTEC celebrated its tenth anniversary during the 17th Ordinary Session of the Assembly of the African Heads of State and Government that took place in Malabo, Equatorial Guinea, 30 June-1 July, 2011. H.E. Teodoro Obiang Nguema Mbasogo, the President of Equatorial Guinea and the Chairperson of the African Union is the PATTEC Patron for the ECCAS Region, while H.E. Prof. Bingu wa Mutharika, the President of the Republic of Malawi and former Chairperson of the African Union, is the Patron of PATTEC in the SADC Region.

Worth noting, PATTEC is one of the six regional technical offices of DREA, which address specialized issues and needs of Africa. Other agencies include: Inter-Africa Bureau for Animal Resources based in Nairobi, Kenya; Pan-African Veterinary Vaccine Centre based in Debre Zeit, Ethiopia; Fouta Djallon Highlands Integrated Resources Programme based in Conakry, Guinea; Inter-African Phytosanitary Council based in Yaounde, Cameroon; as well as Semi-arid Food Grain Research and Development based in Ouagadougou, Burkina Faso.

Source: African Union Commission press release 84/2011 www.africa-union.org (2 August 2011).

Clementines from South Africa 100 Per cent Pest Free

South Africa's Western Cape Citrus Producers Forum (WCCPF) is proud to report 100 per cent clearance by the USDA of its clementines bound for the USA. It is a zero per cent rejection rate in an industry where anything below 10 per cent is considered acceptable. Before leaving South Africa and again on arrival in the USA, samples of all citrus are examined for live insects or larvae by USDA inspectors.

Clementines from South Africa 100 per-cent pest free.

Growers the world over take steps at the grove level and all along the production chain to eliminate pests from their products. Among the most successful is the aggressive effort in the Western Cape region to supress the false codling moth (FCM). Endemic to sub-Saharan Africa, the pest has become resistant to customary treatments. Growers of the WCCPF have embraced an advanced scientific programme known as X-SIT, involving SIT application, where FCM insects are sterilized. When released to mate with the pest population, there are no resulting offspring. The effort has reduced the population of FCM by 95 per cent.

"The dedicated and committed growers who are part of the X-SIT programme have seen excellent results to control these problem pests," said van der Merwe. "Those who have resisted the programme find the FCM continues to be an issue for them and puts their fruit as well as that of others at risk." The programme is most effective when applied area wide across an entire region.

The X-SIT programme was pioneered with support from the FAO/IAEA in Citrusdal, South Africa, a primary growing region for fruit exported to the USA. An additional step taken by the Western Cape Citrus Producers Forum is in shipping the citrus cold from Cape Town to the port of Philadelphia in special refrigerated reefer vessels or temperature controlled containers.

The fruit remains at a cold 32°F for 24 days to ensure that any errant pests will be eliminated from the shipment. Other countries exporting to the USA prefer to use fumigation or chemical treatments of their fruit on arrival in the USA. While that may kill pests on their fruit, it introduces chemicals to the product and reduces the freshness and shelf life in stores and for consumers.

Citrus from South Africa is a welcomed addition to consumer tables across the USA from June through October. As a wintertime fruit, domestic citrus such as oranges and Clementines from Florida and California are not available in the summer months there. Since exporting to the USA from South Africa began in 1999, the shipments have grown from an initial 50 tons then to some 41,000 tons in 2010.

Next to Spain, South Africa is the second largest exporter of citrus in the world, producing 60 per cent of all citrus fruits grown in the Southern Hemisphere. Other than the USA, South Africa's primary export markets include the European Union, Far and Middle East, Russian Federation, the United Kingdom, and Africa.

The WCCPF facilitates logistical, marketing and sales support coordination of products for its members. Its mission is to maintain and expand its role as the preferred supplier in the USA and throughout the world, and continue to be a reliable supplier of safe summer citrus for the USA and all global markets.

Source: www.freshplaza.com and www.freshfruitportal.com (16 August 2011).

New Website of the Mexican American Commission for the Eradication of Screwworm

The new web address of the Mexican American Commission for the Eradication of Screwworm is now active and can be visited any time at: http://www.gusanobarrenador.org.mx

Source: Marisol Baca Esquinca, Mexican American Commission for the Eradication of Screwworm, Chiapas, Mexico (14 October 2011).

Official Launch of Entomon Technologies (Pty) Ltd

On Friday, 7 October 2011, the new codling moth rearing facility of Entomon Technologies (Pty) Ltd, situated at the Welgevallen Experimental Farm, on the University of Stellenbosch campus, South Africa, was launched. Anton Rabe, Executive Director of HORTGROSERVICES and Hugh Campbell, General Manager FruitgroSCIENCE officially opened the facility. The function was attended by representatives of the South African Nuclear Energy Corporation (Necsa), the Agricultural Research Council (ARC), University of Stellenbosch, a number of agrochemical companies and other fruit industry stakeholders. Guests had the opportunity to tour the facility with Entomon staff explaining the production process.

ENTOMON
STERILE INSECT RELEASE

Codling moth (CM) is a major economically important pest in the South African pome fruit (apple and pear) industry. Pressure on conventional control measures to move towards more environmentally friendly methods and the need for lower/zero residue fruit focuses the emphasis on the use of sterile insects as an economically feasible method contributing to CM management. CM sterile insect release is thoroughly researched in South Africa, especially focusing on its financial impact.

Codling moth rearing cabinets, housing up to 100 000 developing moths for 28 days.

Researchers Matthew Addison, Daleen Stenekamp and Martin Wohlfarter have been on IAEA funded scientific visits to the OKSIR CM facility, in British Columbia, Canada, where this method has been applied to manage CM since the early 1990s. Here they gained valuable experience on the application of CM sterile insect release, aiding in the development of the South African programme. Since 2003 Mr Addison researched the efficiency of local CM SIR in the Elgin area of the Western Cape.

The original laboratory produced around 1500 moths per week, sufficient to service 1 ha, yet swiftly expanded to a larger facility at the Agricultural Research Council (ARC) Infruitec campus in Stellenbosch, peaking production at 300 000 moths per week by 2010, servicing 120 ha. The current 560 m² facility at the Welgevallen Experimental Farm was commissioned late 2010 and is geared to produce in excess of 2 million moths per week, currently supplying moths to just over 3% of the local apple & pear industry.

Early season field release of sterile codling moths in Elgin, Western Cape Province (South Africa) from an ATV.

At Entomon codling moth are reared from egg to adult within 28 to 30 days on a wheat based diet. Novel individually sealed rearing cabinets, housing about 100 000 growing moth are used in an effort to prevent contamination by fungi and/or other insects. Temperature and humidity conditioned HEPA filtered air is supplied to each cabinet, ensuring sufficient ventilation throughout the production process. Shortly before the moths begin emerging, the cabinets are moved to an emergence room, where moths are attracted to a UV light and transported by vacuum into a cold room.

Depending on the area to be treated the following day, the necessary amount of moths is sterilized at 150 Gy gamma radiation, whereas the rest are retained to support the production cycle of the facility. Sterilized moths are packed in cooled wheat bran, to ensure they are not damaged during transport to farms. Field releases are done from all terrain vehicles (ATV's) at approximately 1000 moths/ha, twice weekly. Doing so Entomon ensures sufficient flooding ratios of beyond 40:1 (sterile: wild) moths.

Within the next five years Entomon aims to expand production and delivery to further areas of the Western and Eastern Cape, to service at least 10% of the local apple and pear industry.

Source: Martin Wohlfarter, Entomon Technologies (13 October 2011).

Relevant Published Articles

Mobile mating disruption of light brown apple moths using pheromone-treated sterile Mediterranean fruit flies

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Abstract

Background: Public opposition to aerial application of sex pheromone for mating disruption of light-brown apple moth (LBAM), *Epiphyas postvittana* (Walk.), in California stopped its further use in the ca $ 74 million eradication programme in 2008, underscoring the need for other eradication tactics. It is demonstrated that pheromone-treated sterile Mediterranean fruit flies (medflies), *Ceratitis capitata* Wied., can disrupt communication in male moths.

Results: Medflies topically dosed with moth pheromone (E)-11-tetradecenyl acetate showed a no observed effect level (NOEL) of ~ 10 µg fly^{-1}, with increasing toxicity from 30 to 100 µg fly^{-1}. Greater potency and longevity of attraction and lower mortality were achieved using microencapsulated pheromone. Releases of 1000 pheromone-treated medflies ha^{-1} prevented male moth catch to synthetic lures in treated 4 ha plots for 1 day in suburban Perth, Australia. Releases of ca 3000 pheromone-treated medflies ha^{-1} disrupted catch to single female moths in delta traps, and to synthetic pheromone lures. Percentage disruption on the first four nights was 95, 91, 82 and 85%.

Conclusions: Disruption of moth catch using pheromone-treated medflies is a novel development that, with future improvement, might provide a socially acceptable approach for application of the insect mating disruption technique to control invasive insects in urban environments. Adequacy of payload and other issues require resolution.

The full paper was published in: Pest Management Science (2011) 67 (8):1004-1014.

Successful establishment of *Wolbachia* in *Aedes* populations to suppress dengue transmission

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Abstract

Genetic manipulations of insect populations for pest control have been advocated for some time, but there are few cases where manipulated individuals have been released in the field and no cases where they have successfully invaded target populations. Population transformation using the intracellular bacterium *Wolbachia* is particularly attractive because this maternally-inherited agent provides a powerful mechanism to invade natural populations through cytoplasmic incompatibility. When *Wolbachia* are introduced into mosquitoes, they interfere with pathogen transmission and influence key life history traits such as lifespan. Here we describe how the *w*Mel *Wolbachia* infection, introduced into the dengue vector *Aedes aegypti* from *Drosophila melanogaster*, successfully invaded two natural *A. aegypti* populations in Australia, reaching near-fixation in a few months following releases of *w*Mel infected *A. aegypti* adults. Models with plausible parameter values indicate that *Wolbachia*-infected mosquitoes suffered relatively small fitness costs, leading to an unstable equilibrium frequency, 30% that must be exceeded for invasion. These findings demonstrate that *Wolbachia*-based strategies can be deployed as a practical approach to dengue suppression with potential for area-wide implementation.

The full paper was published in: Nature (2011) 476:454-457.

Suppressing resistance to *Bt* cotton with sterile insect releases

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Abstract

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

The full paper was published in: Nature Biotechnology (2010) 28 (12):1304-1307.

Conceptual Model for Assessing the Minimum Size Area for an Area-Wide Integrated PestManagement Program

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Abstract

A conceptual model was developed based on the two basic spatial elements of area-wide integrated pest management (AW-IPM), a core area and a buffer zone, to determine the minimum size of the protected area for the program to be technically feasible and economically justifiable. The model consisted of a biological part (insect dispersal) and an economic part. The biological part used random walks and diffusion equations to describe insect dispersal and to determine the minimum width of the buffer zone required to protect the core area from immigration of pests from outside. In the economic part, the size of the core area was calculated to determine the point at which the revenues from the core area equal the control costs. This model will need to be calibrated and validated for each species and geographic location. Tsetse flies and the Mediterranean fruit fly are used as case studies to illustrate the model.

The full paper was published in: International Journal of Agronomy (2011) 409328.

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