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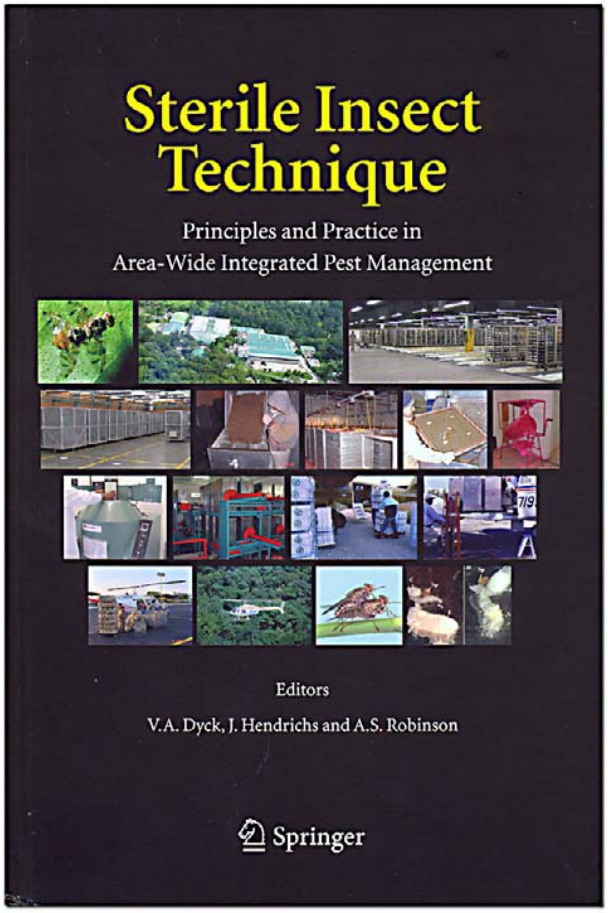

It is a challenge to bring together all relevant information related to the Sterile Insect Technique (SIT) and its application in area-wide integrated pest management (AW-IPM) programmes; this book, published in 2005, is the first attempt to do this in a thematic way.

To Our Readers

I would like to thank all our collaborators in many parts of the world, as well as all staff at the Entomology Unit and the Section at headquarters, for a very productive and successful year 2005. During the last twelve months the Insect Pest Control Subprogramme implemented an international conference, eight research coordination meetings and several consultants meetings, participated in many interesting and successful research activities, provided technical support to over thirty technical cooperation projects in FAO and IAEA Member States, and actively contributed to a number of other international events, panels and advisory committees.

In this Newsletter you will find details about some of the above-enumerated activities. These reflect not only our growing commitments and increasing research and normative responsibilities, but also our expanding involvement with additional pest species, although our budget and staff have not increased in proportion. As a result of request of FAO and IAEA Member States, we have become engaged with several new fruit

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fly, moth and tsetse species, as well as the rapidly growing mosquito project, which is still largely in a research and development phase.

The demand to embark on other insect pest problems, as a consequence of the successful area-wide integration of the sterile insect technique (SIT) to suppress, contain or eradicate in some selected situations, major insect pests, is nevertheless still much larger. However, we have to be very careful to avoid overextending our staff and limited financial resources. The success of the subprogramme has historically been its focus on a few major pest problems to be able to provide our Member States the best support in terms of research, normative assistance and implementation of operational programmes.

Some of the requests to develop or implement the SIT, although technically justifiable, would address only local or subregional pests, and investing years of reseach required to develop and implement the SIT is often not warranted. Cosmopolitan pest problems, or very important pests with the potential of becoming major international invasive species, have of course priority, although our principles are that the SIT should only be integrated where it has a comparative advantage and there are no other effective methods to deal with the problem.

One example of repeated requests from Member States and some international organizations is the red palm weevil (RPW), *Rhynchophorus ferrugineus* Oliv., a serious pest of coconut in Asia. Since its appearance in the United Arab Emirates in 1985, it has spread westward and northward, invading date palm plantations in Saudi Arabia in 1987, Qatar in 1989, the Islamic Republic of Iran in 1992, Kuwait and Egypt in 1993, and then Jordan, Israel and Palestine in the late 1990s. More recently this major pest has expanded also into Spain. Control efforts based on a number of approaches have unfortunately been only partially effective. Alone in the Arabian Gulf region, where it is now widely considered the most devastating insect pest of the ca. 50 million date palm trees, this weevil has seriously affected the estimated 1.2 million tons of the annual production of dateds for local consumption and export.

Experts on weevil SIT have determined the required research and development aspects that need to be addressed to be able to effectively assess the potential of developing RPW SIT. Pilot trials in India, headed by the Bhabha Atomic Research Centre, Mumbai, in collaboration with three agricultural universities, indicate that there may be some potential in adding an SIT component to the management of this pest. A rearing technique has been developed using coconut petioles, sugarcane and other ingredients, and a sterilizing dose was confirmed. Currently, small SIT pilot tests are in progress in three relatively isolated RPW hot spots, to assess the feasibility of applying the SIT for the management of RPW. In response to a request of interested countries, a regional technical cooperation project for the Asia region may be approved for the next funding cycle, to facilitate the networking of among scientists working on RPW control in interested countries.

The biology of the pest is another determinant aspect that needs to be taken into account when considering the development of the SIT for a particular pest insect. Some insects are clearly more amenable to SIT application than others. For example insects that are migratory over large distances, or where the released adult stage is a pest or nuisance, are generally not suitable for effective SIT application.

A relevant example here is the desert locust. Over the years there have been increasing demands to develop the SIT as an additional tool to control desert locust. The recent locust emergency in Africa, with major swarms and plagues causing devastating losses in various African countries, have resulted in renewed calls by Member States and the press for the Joint FAO/IAEA Programme to take a new look at the potential of SIT as a component of locust suppression operations. However, our repeated consultations with the desert locust coordination group at FAO in Rome have clearly confirmed our position (see text within this newsletter) that there is no role for the SIT, even when focusing only on the recession phase where the pest is in low numbers and not in a migratory phase. A preventive area-wide approach for the recession phase is not feasible economically or even technically with current technologies. The pest population is widely scattered over many millions of square kilometres, and the capacity and infrastructure to distinguish sparsely vegetated locust habitats and forecast repeated rains reliably is not available. Furthermore donor funding tends to disappear during recession periods in between plagues to address other more pressing priorities. Nevertheless, in spite of the above, IAEA Member States adopted a resolution during the last General Conference in September 2005, asking the Secretariat to consider embarking on research to develop desert locust SIT. In response, further analysis and consultations with locust experts will take place in order to avoid wasting resources and diverting our attention from more realistic pest situations in Member States.

In January 2006 we are starting the new programme cycle for 2006-2007. Some of the main programme changes involve a continued realignment towards management of risks to agriculture and the environment from exotic and invasive pests, such as a few major moth and beetle pests, as well as major fruit flies still confined to certain regions of the world, the increased application of nuclear techniques in biological control, as well as an increased involvement in various normative activities. We are currently also starting the planning of the programme of activities and budget for the cycle 2008-2009, and look forward to the input from our readers.

As 2005 draws to a close, I would like to send seasonal greetings on behalf of all of us at the Subprogramme. We look forward to another fruitful year and wish you a very successful 2006.

Jorge Hendrichs
Head,
Insect Pest Control Section

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Forthcoming Events

I. Research Coordination meetings (RCMs)

RCM on Improving Sterile Male Performance in Fruit Fly SIT Programmes. 4-8 September 2006, Bahia, Brazil. Second RCM.

RCM on Development of Mass Rearing for New World (*Anastrepha*) and Asian (*Bactrocera*) Fruit Fly Pest in Support of SIT. 4-8 September 2006, Bahia, Brazil. Second RCM.

RCM on Enabling Technologies for the Expansion of SIT for Old and New Screwworm. Canberra, Australia. 27 November to 1 December 2006. Fourth RCM.

RCM on Molecular Technologies to Improve the Effectiveness of the Sterile Insect Technique. Bangkok, Thailand. January 2007. Third RCM.

II. Consultants and Other Planning Meetings

Consultants meeting on Role of Symbionts and Pathogens in Tsetse SIT. Vienna, Austria, 6-10 March 2006.

Consultants meeting on Assessing the Minimum Size Area for Application of an Area-wide SIT Programme Against Selected Insect Pests. Vienna, Austria, 3-7 April 2006.

III. Other Meetings/Events

FAO/IAEA Regional Training Course on Principles of Base-line Data Collection for Integrated Area-wide Tsetse and Trypanosomosis Inervention Projects with a Sterile Insect Technique Component, Nairobi, Kenya, 13 March to 7 April 2006. Deadline for nominations **16 January 2006**.

Third meeting of the Fruit Fly Technical Panel of the International Plant Protection Convention (IPPC). 4-8 September 2006, Salvador, Bahia, Brazil.

Seventh International Symposium on Fruit Flies of Economic Importance and Sixth Meeting of the Working Group on Fruit Flies of the Western Hemisphere, 10-15 September 2006, Salvador, Bahia, Brazil.

Workshop on Standardizing Sampling and Processing of Tsetse Flies for Population Genetic Analysis. Uganda, 2nd quarter of 2006.

Workshop on Standardizing Sampling and Processing of Tsetse Flies for Population Genetic Analysis. Burkina Faso, late 2006.

FAO/IAEA Interregional Training Course on "The Use of the Sterile Insect and Related Techniques for the Integrated Area-wide Management of Insect Pests", University of Florida/USDA, Gainesville, Florida, USA, 10 May – 7 June 2006

Nominations should be submitted on the standard IAEA application form for training courses available on the web site: (http://www-tc.iaea.org/tcweb/participation/astrainee/default.asp). Completed forms should be endorsed by and returned through the official channels (Ministry of Foreign Affairs, Ministry of Agriculture, National Atomic Energy Authority, Office of the United Nations Development Programme or Office of the FAO). Nomination forms must be received by the IAEA, P.O. Box 100, A-1400, Vienna, Austria not later than **6 January 2006**. A course prospectus is available upon request.

Past Events (in 2005)

I. Research Coordination Meetings (RCMs)

RCM on Development of Mass Rearing for New World (*Anastrepha*) and Asian (*Bactrocera*) Fruit Flies. 28 March–1st April 2005, Manila, Philippines. First RCM.

RCM on Developing of Product and Process Quality Control for Standardization of Tsetse Mass Production, Sterilization and SIT Production. 4-8 May 2005, Vienna, Austria. Second RCM.

RCM on Development of Improved Attractants and Their Integration into Fruit Fly SIT Management Programmes. 5-8 May 2005, Vienna, Austria. Fourth and Final RCM.

RCM on Evaluating the Use of Nuclear Techniques for the Colonization and Production of Natural Enemies of Agricultural Insect Pests. 13-16 May 2005, Vienna, Austria. Fourth and Final RCM.

RCM on Use of Molecular Tools to Improve the Effectiveness of SIT. 14-17 May 2005, Vienna, Austria. Second RCM.

RCM on Enabling Technologies for the Expansion of SIT for Old and New Screwworm. 30 May to 3 June 2005, Montevideo, Uruguay. Third RCM.

RCM on Improvement of Codling Moth SIT to Facilitate Expansion of Field Application. 16-20 September 2005, Mendoza, Argentina. Second RCM.

RCM on Development of Standardised Mass Rearing Systems for Male Mosquitoes. 5–9 December, 2005, Vienna, Austria. First RCM.

II. Consultants and Other Planning Meetings

Consultants Meeting To Prepare Harmonized Guidelines for Transport, Packing and Release of Sterile Fruit Flies, 22-26 August, Vienna, Austria.

Consultants Meeting to Refine Manual on Entomological Baseline Data Collection for Tsetse Control Programmes with Special Attention to GIS, Population Genetics and Database Management, 10-14 October 2005, Vienna, Austria.

III. Other Meetings/Events

Second Meeting of the Fruit Fly Technical Panel of the IPPC. 19-23 September 2005, San Jose, Costa Rica.

Roundtable on Codling Moth in Conjunction with the Sixth Argentinean Congress of Entomology. 12-14 September 2005, Tucuman, Argentina.

Workshop on Pest and Weed Control in Sustainable Fruit Production, organized by the Research Institute of Pomology and Floriculture. 1-3 September 2005, Skierniewice, Poland.

Eleventh Meeting of the Advisory Group of the Programme Against African Trypanosomiasis (PAAT). 21-22 September 2005, Addis Ababa, Ethiopia.

Thirtieth Meeting of the Executive Committee of the International Scientific Council for Trypanosomosis Research and Control (ISCTRC). 25 September 2005, Addis Ababa, Ethiopia.

Twenty-eighth Meeting of the ISCTRC. 26-30 September 2005, Addis Ababa, Ethiopia.

The Second Meeting of the International Organisation for Biological and Integrated Control of Noxious Animals and Plants West Palaearctic Regional Section Group on Integrated Protection of Olive Crops. Polo Scitifico of Sesto Fiorentino, 26-28 October, 2005, Florence, Italy.

Note: Reports available upon request

Technical Cooperation Projects

The Subprogramme has currently technical responsibilities for the following technical cooperation projects that are managed by the Technical Cooperation Department. They fall under five major areas, namely:

- Tsetse
- Fruit flies
- Old and New World Screwworm
- F-1 Sterility for the Control of Lepidopteran Pests
- Mosquitoes.

Project Number	Title	Technical Officer
ALG/5/019	Control of Date Moth Using the Sterile Insect Technique	Marc Vreysen
BOT/5/002	Support of Tsetse Eradication from Ngamiland	Udo Feldmann
EGY/5/025	Area-Wide Fruit Fly Control in Eastern Egypt	Jorge Hendrichs
ETH/5/012	Integrating SIT for Tsetse Eradication	Udo Feldmann
INT/5/145	Promotion of Insect Pest Control Using the Sterile Insect Technique	Jorge Hendrichs
IRQ/5/016	Field Monitoring and Rearing of Old World Screwworm	Udo Feldmann
ISR/5/010	Upgrading the Area-wide Control of Mediterranean Fruit Fly using the Sterile Insect Technique	Jorge Hendrichs
JOR/5/009	Upgrading the Area-wide Control of the Mediterranean Fruit Fly using the Sterile Insect Technique	Jorge Hendrichs
KEN/5/022	Integrated Area-wide Tsetse and Trypanosomosis Management in Lambwe Valley	Udo Feldmann
MAG/5/011	Feasibility Study of SIT-based Integrated Pest Management of Fruit Flies	Walther Enkerlin
MAR/5/015	Feasiblity Study for Integrated Use of the Sterile Insect Technique for Area-wide Tephritid Fruit Fly Control	Jorge Hendrichs
MEX/5/027	Transfer of Genetic Sexing Mass Rearing Technologies for Fruit Fly Production	Walther Enkerlin
PAL/5/002	Area-wide Application of SIT for Medfly Control	Jorge Hendrichs
RAF/5/051	SIT for Tsetse and Trypanosomosis Management in Africa	Udo Feldmann
RAF/5/052	SIT Development for Control of Anopheles Mosquito	Bart Knols
RLA/5/045	Preparation for Pilot Fuit Fly-free Areas using the Sterile Insect Technique in Central America	Walther Enkerlin
SAF/5/007	Expanding the Use of the Sterile Insect Technique against Fruit Pests in the Western and Northern Cape	Jorge Hendrichs
THA/5/046	Area-wide Integrated Control of Fruit Flies	Walther Enkerlin
Projects started in 2005		
BGD/5/025	Studying the Feasibility of the Sterile Insect Technique in Sun-dried Fish Industry Project	Udo Feldmann

BRA/5/057	Establishment of Medfly, Fruit Fly Parasitoids and Codling Moth Rearing Facility	Walther Enkerlin Carlos Caceres
BKF/5/004	Feasibility Study on Applying the Sterile Insect Technique to Create a Tsetse-free Zone	Marc Vreysen
CHI/5/047	Upgrading Release Systems for Mediterranean Fruit Fly Containment in the Arica Region	Walther Enkerlin
INT/5/149	Interregional Training Course on the Use of the Sterile Insect Technique and Related Techniques	Jorge Hendrichs
ISR/5/011	Strengthening the Capacity for the Area-wide Control of the Mediterranean Fruit Fly Using the Sterile Insect Technique	Jorge Hendrichs
JOR/5/010	Stengthening the Capacity for the Area-wide Suppresion of the Mediterranean Fruit Fly Using the Sterile Insect Technique	Jorge Hendrichs
MAL/5/020	Feasibility Study for the Creation of a Zone Free of Tsetse	Marc Vreysen
MEX/5/029	National Prevention Campaign against the Cactus Moth	Walther Enkerlin
MOR/5/028	Assessing the Feasibility of Medfly Suppression through the Sterile Insect Technique	Udo Feldmann Walther Enkerlin
PAL/5/003	Strengthening the National Capacity for the Area-wide Suppression of the Mediterranean Fruit Fly	Jorge Hendrichs
PAK/5/043	Development of Biological Control for Cotton Pest Management Using Nuclear Techniques	Jorge Hendrichs
SAF/5/009	Preparation for the Creation of Zone Free of G. *brevipalpis and* G. *austeni*	Marc Vreysen
SEN/5/029	Feasibility Study to Create a Tsetse-free Zone Free Using the Sterile Insect Technique	Marc Vreysen
TUN/5/022	Implementation of the Pilot Programme Using Sterile Insect Technique Against the Mediterranean Fruit Fly, Phase II	Walther Enkerlin
URT/5/022	Assistance to a Feasiblity Study for the Use of the Sterile Insect Technique	Marc Vreysen
UGA/5/024	Integrated Area-wide Tsetse Eradication Programme in the Lake Victoria Basin	Marc Vreysen

In keeping with our policy to highlight activities of a few of our Technical Cooperation Projects, the following projects are discussed in this issue:

Exports of Non-traditional Crops from Selected Areas Under Fruit Fly Control in Central America. IAEA Technical Cooperation project RLA/5/045.

Central America, which is a predominantly agricultural region, has been suffering for the past almost 20 years the effects of the coffee, banana and sugarcane crisis. There is no indication that the conditions in the international markets for these products will improve in the near futu-

Bell peppers produced in Central America for exports to the USA.

re. Thus feasible alternatives to overcome this problem, among the roots of poverty in the region, need to be developed.

Since 2001, the Joint FAO/IAEA Programme of Nuclear Techniques in Food and Agriculture, and the Technical Cooperation Department of the International Atomic Energy Agency (IAEA), have been implementing in Central America a regional project aimed at developing fruit fly free and low prevalence areas with the ultimate goal of facilitating the export of fruits to lucrative markets such as the USA. The Member States in the region have been strongly committed to this project which has had substantial extra-budgetary contributions, financial and in kind, from other national and international organizations such as FAO, IICA, OIRSA and USDA, integrating in this way what has been called a regional inter-institutional project alliance.

Four years of project implementation have resulted in significant measurable achievements. As an example, a

Infrastructure available in Nicaragua for production of bell pepper.

fruit fly free area has been officially declared in each of the Central American countries. The Member States have developed the regulatory, human and physical infrastructure to be able to maintain the areas free or at low fruit fly prevalence, and fruits are already being exported to Mexico and the USA from fruit fly free areas in Guatemala.

A number of "pest risk assessments (PRA)" have been conducted for fruits which are considered to be hosts of fruit flies and that have potential for commercialization in the US market. The objective is to develop a basket of fruits that can be produced in these areas and exported to the USA or other markets without quarantine restrictions. This would have a very significant impact on the development of the horticultural industry in the region with its resulting economic and social benefits.

The risk assessments have already been prepared for mangosteen and lychee and are currently being reviewed by the authorities of the importing country, in this case, the USDA. The rule for exports of papaya from Central America to the USA has already been published in the US Federal Register and countries in the region are already benefiting from this. More recently, the proposed rule for exports of peppers from approved sites throughout Central America, except for Panama and Belize, has been published in the US Federal Register. The initial amount of peppers expected to be exported from these countries into the USA is 31,000 metric tons which is quite significant for the region, in which the industry has already invested over 100 million dollars for the export of this commodity. The proposed rule for exports of tomatoes to the USA is expected to be published at the end of 2005. Thus the basket of fruits and vegetables for export from Central America is gradually being completed under the framework of this Regional Project.

The visible results of this project have recently encouraged Honduras and Belize to also join the IAEA, looking at benefiting from this Regional TC Project and the other many benefits that FAO and IAEA provide to Member States.

The Status of Cactus Moth (*Cactoblastis cactorum,* Lepidoptera: Pyralidae) in the Caribbean and the Likelihood of its Spread to Mexico Technical Cooperation Project MEX/5/029.

Report to the International Atomic Energy Agency (IAEA), and the Plant Health General Directorate, Mexico (DGSV-SAGARPA) as part of the Technical Cooperation Project MEX/5/029 project.

This text summarizes the main findings of an expert mission conducted in August 2005 to the Caribbean Islands to Assess the Status of the cactus moth, *Cactoblastis cactorum* (Berg).

Consolea spinosissima (photo) and C. rubescens are endemic to the Caribbean and both species (and other species of Consolea) could be threatened by continuous attacks of C. cactorum.

The cactus moth, *C. cactorum,* which has become the textbook example of successful biological weed control of invasive *Opuntia* species in many countries, including Australia and South Africa, is now threatening not only the lucrative cactus pear industry in Mexico, but also the rich diversity of all *Opuntia* species in most of the North American mainland. Already otherwise threatened species in Mexico could go extinct. The moth is now present on most Caribbean islands as a consequence of mostly deliberate or accidental introductions by man, or through natural spread.

Although there is convincing evidence that *Cactoblastis* reached Florida inadvertently conveyed by the nursery trade, there also exists the slight possibility of natural spread and by means of cyclonic weather events. The role of the some nurseries in the Dominican Republic in facilitating rapid spread of the cactus moth with infested plant material within the Caribbean and to the USA during the seventies to nineties must have been substantial because of the high incidence of *Cactoblastis* presence in the nurseries and because of their ignorance regarding the importance of this insect at that time.

The different pathways that could result in the arrival of the moth to Mexico are analyzed. The most likely route of entry from the Caribbean is probably by means of importation of infested plant material, e.g. through the nursery trade, through local tourism or by plant exchanges. But the chances of the moth's arrival via these pathways are now small, partly because of the overall low *Cactoblastis* populations encountered throughout the Caribbean as a consequence of the diminishing availability of suitable host plants, and because of improved awareness regarding the threat of the insect to mainland North America. There is no doubt that *C. cactorum* was highly successful in controlling rampant O*puntia* infestations in many Caribbean islands and that the outcome of this project is praised by retired agricultural officers and land-users affected at that time. The infestations of cacti in the Caribbean resulted from large scale plantings of mainly three introduced species during the first three centuries after colonization, compounded by large scale deforestation and followed by overgrazing.

Remaining clumps of Opuntia dillenii were confined to coastal areas of Antigua and Montserrat. All sampled plants were infested by Cactoblastis during the expert mission in August 2005.

Nevertheless, the long-term impact of the cactus moth on most small size *Opuntia* species is severe and the status of several cactus species on the islands may now be regarded as "threatened" (according to the 1994 IUCN categories), including the species that were originally targeted for biological control, namely, *O. dillenii* and *O. triacantha*. The direct impact of the cactus moth on the larger species, including some of the rare *Consolea* species, is less drastic but the moth is devastating to recruitment, mainly the seedlings of some of the species including *C. rubescens* and *C. spinosissima*. *Nopalea cochenillifera* is the most common species found in the Caribbean and the only species utilized by some of the local people, mainly as an ornamental. It is a suboptimal host for *Cactoblastis* despite the fact that up to 20% of the plants investigated were infected. The plant easily recovers from attacks.

The Caribbean offers unique possibilities for further research on *Cactoblastis* including testing of the (SIT) and biological control under island situations, host preferences, bio-ecological studies, monitoring techniques and dispersal of the cactus moth. Officials in the Caribbean are willing to assist in this research and to put measures in place to prevent the arrival of *Cactoblastis* in Mexico. It is therefore essential for Mexico to retain the contact and to provide training and information material on a continuous basis to foster and maintain interest. Similar surveys are also recommended for Cuba, Haiti, the Bahamas, Belize and Guatemala.

With the exception of Puerto Rico, none of the quarantine and plant health officers on the other islands surveyed were aware of the presence and impact of *Cactoblastis* on their islands prior to this survey. This ignorance can partly be attributed to the general lack of interest in *Opuntia* species and because they are not actively utilized nor cultivated. The same could apply to Guatemala and Belize where *Opuntia* species are of little or no importance from a commercial point of view, however, a major component of arid and semiarid habitats especially along the coast.

Development and Application of the Sterile Insect Technique (SIT) for Fruit Pests in South Africa.

Summary of progress made under the IAEA Technical Cooperation Project (SAF/5/007).

The increasing importance of quarantine pests in international fruit trade, the mounting demand from international clients for healthy fruit produced under ecologically compatible conditions, the development of pest re-

sistance to chemical pesticides, and a diminishing arsenal of acceptable chemical products for their control provided the impetus for research on and implementation of the SIT addresses all of these factors and is increasingly regarded by fruit growers as essential for survival on the international market.

SIT for Medfly: Eight years ago a pilot project to investigate the viability of SIT for control of Mediterranean fruit fly on table grapes was initiated at ARC Infruitec-Nietvoorbij in Stellenbosch, in collaboration with the International Atomic Energy Agency IAEA in Vienna. Dr Brian Barnes and David Eyles ran the pilot project, with sterile Medflies being produced in a mass-rearing facility at the Pest Management Division.

Following the successful 10 000 ha Hex River Valley fruit fly SIT pilot project, sterile Medflies (Ceratitis capitata) have also been routinely released in the Elgin and Villiersdorp areas and in the Riebeek Valley area. Three other production areas, including one across the border in Namibia, have expressed an interest in fruit fly SIT. All fruit fly SIT rearing and release activities are now carried out by a commercial company, SIT Africa (Pty) Ltd. The company contracts the technical expertise on SIT from the Pest Management Division. At present approximately 6 million sterile male Medflies are produced per week for ground release in the various areas. The estimated maximum output of the current rearing facility is 10 million sterile males per week.

In SIT, the sterile males are the active agent and sterile females play no part in the success of the programme. Due to the existence of a genetic sexing strain of Medfly developed by the IAEA, it is possible to kill the female eggs in the release stream with a thermal treatment. This enables the release of only males, significantly reducing rearing costs and also ensuring that no sterile females, which can still sting the fruit (but only laying sterile eggs), cause damage to the fruit which can result in infection by pathogens and resultant crop loss.

Update: The South African Government, through the National Department of Agriculture, has recently (November 2005) pledged financial support for the Medfly SIT programme with a proposed R4 million (US$615,000) grant. This signals a major change in the Government's stance on SIT. It is hoped that this will become an anual grant, and will go a long way towards widening the area-wide use of SIT in the deciduous fruit industry. Another significant boost is expected to come through the introduction of a dedicated SIT levy on fruit growers, which willl widen the funding base of the fruit fly SIT programme.

SIT for Codling Moth: Codling moth (*Cydia pomonella*) is a key pest on deciduous fruit. A two-pronged approach is being followed as far as SIT for codling moth is concerned. The first focuses on mass-rearing of CM locally for release. A pilot project, funded by the Deciduous Fruit Producers' Trust and the IAEA, is currently being run by Matthew Addison (University of Stellenbosch) and Daleen Stenekamp (DFPT Research). The aims are to create a workable and realistic demonstration of the SIT programme and to establish the economic viability of the programme. Moths are reared in a facility on the Infruitec campus, Stellenbosch, iradiated at 150 Gy, and up to 2000 sterile moths are being released per per ha in the orchards of the 140 ha release site in Elgin. The release period will extend over 26 weeks from mid-September to March.

Results to date indicate that sterile moths should be released evenly over the whole treatment area and that laboratory moths should be released twice weekly rather than once a week, because they are not as fit (competitive) as the wild moths. Ongoing research includes refining of culture methods and diet, investigating competitiveness of sterile males, determining the optimum radiation dose, effects on SIT of CM mating disruption, and compiling an electronic database from the monitoring data.

Another research focus is the ongoing import of sterile moths from the codling moth rearing facility in Osoyoos, British Columbia for the codling moth SIT programme in South Africa. Canada has an established SIT suppression programme for codling moth, that has succesfuly been operating for over ten years, and the Osoyoos facility could provide a rapid back-up, should problems at the local facility result in a shortage of moths during release periods. In collaborative work between Drs Tom Blomefield (ARC), Stephanie Bloem and Jim Carpenter (both from the USA), the mating compatibility of moths from Canada and South Africa have been evaluated in South Africa in the laboratory and in the field. Male Canadian codling moths were equally attracted to calling Canadian and wild South African females, indicating that the moths are sufficiently compatible to allow their use for SIT studies and even for sterile releases in South Africa.

A season-long trial in which sterile Canadian moths are shipped weekly to Stellenbosch and released immediately in an apple orchard was started in October 2005. One of the main objectives is to establish an international protocol for the long-distance shipping of sterile codling moths which will ensure high quality and competitive moths after 48 to 72 hours in transit.

SIT for False Codling Moth: False codling moth (FCM), *Cryptophlebia leucotreta*, is a key pest of citrus in South Africa and a serious invasive threat to many countries including the United States. An SIT program could be used both as an area-wide pest management tactic in South Africa, and as an eradication tool should FCM be introduced into other countries.

Hendrik Hofmeyr (Citrus Research International), Stephanie Bloem and Jim Carpenter have been doing research on the radiation biology of FCM and the documentation of inherited sterility in this species. The research was continued with field-cage evaluations of different release ratios of treated FCM on the incidence of fruit damage and on the competitiveness of FCM by examining the proportion of matings that involved the treated insects released into each field-cage. Compared with the control cages, all treatments involving the release of irradiated FCM significantly reduced the number of larval injuries to the fruit and the number of damaged fruit. There was a corresponding reduction in damaged fruit of up to 39% despite the artificially induced severe infestations, with a corresponding reduction in fruit drop of up to 39%. The suitability and acceptibility of eggs produced by irradiated FCM to parasitization by Trichogrammatoidea cryptophlebiae under choice and no-choice situations were also investigated.

The results suggest that *T. cryptophlebiae* would accept, successfully develop in, and emerge from FCM eggs laid by the different crosses that would theoretically be present in the field under an SIT programme for FCM and suggest that further evaluations combining releases of irradiated moths and parasitoids are warranted. This finding might lead to the simultaneous field application of FCM-SIT and augmentative releases of egg parasitoids for synergistic suppression of FCM.

These results create a firm foundation for the continuation of SIT research on FCM, and support the use of sterile insect releases for the control of FCM on a semi-commercial scale in a pilot study in an isolated citrus orchard.

Source: Updated from ROSTRUM Newsletter number 65 of the Entomological Society of South Africa.

Reporting on On-going and Planned Coordinated Research Projects (CRPs) and RCMs

The Third RCM of the CRP on Improvement of Codling Moth SIT to Facilitate Expansion of Field Application was held in Mendoza, Argentina from 16-20 September 2005.

The 'Instituto de Sanidad y Calidad Agropecuaria Mendoza' (ISCAMEN) hosted this RCM of the Joint FAO/IAEA Programme of Nuclear Techniques in Food and Agriculture. The CRP aims to carry out research that will contribute to the reduction of insecticides in orchards through the development of pest management techniques like the sterile insect technique (SIT) that are efficient but friendly to the environment.

The meeting was opened by Dr Miguel Ruggeri, president of ISCAMEN, who highlighted the need for alternative, efficient control tools for the management of codling moth in Argentina. Mr Mario Sevilla of ISCAMEN presented a brief overview of the SIT and codling moth in Argentina. Argentina has high expectations with respect to codling moth control through the integrated use of the SIT and there is great confidence in the SIT technology as a result of the success of the Mediterranean fruit fly SIT programme.

All CRP participants (Armenia, Brazil, Canada, Chile, Czeck Republic, the Syrian Arab Republic, Switzerland, USA and South Africa) attended the meeting with the exception of Mr Howard Thistlewood of Canada and Ms Lisa Neven of USA. A total of 16 observers of ISCAMEN, SENASA and INTA likewise attended the presentation sessions and participated in some of the discussions.

The following highlights some (but not all) of the achievements of the CRP to date:

- An evaluation was made of several morphological and physiological attributes that may be used to distinguish adult F_1 progeny of irradiated males from wild males captured in traps. Preliminary results suggest that the chromatin material in the mature eupyrene sperm bundles stains differently for F_1 progeny of irradiated males than for wild males.

- In Brazil, considerable progress was made with the control of the confined outbreaks of codling moth in the urban areas. A trapping survey determined the spread of the codling moth only in the municipalities of Vacaria, Bom Jesus, Caxias do Sul and Lages. The replacement of host trees in the urban areas with non-host trees and the application of lure-and-kill were continued in the infested areas. In addition, a benefit-cost analysis, taking into account different control scenarios highlighted the significant benefits that would accrue from eliminating the codling moth from these urban areas using an integrated approach that includes the SIT.

Participants and observers of the 3rd RCM on 'Improvement of Codling Moth SIT to facilitate expansion of field application', held in Mendoza, Argentina, 16-20 September, 2005.

- The effects of diapause-rearing and irradiation on codling moth dispersal were investigated. In addition, various traits were correlated with mobile and sedentary characteristics of codling moth.

- Initial small-cage and field trials, undertaken in South Africa revealed no mating barriers between moths originating from Canada and South Africa. The trials likewise demonstrated that Canadian and South African female moths did not differ in their ability to attract both Canadian and South African males over a wide range of environmental differences.

- Additional mating compatibility trials were conducted at Seibersdorf by scientists from ISCAMEN. Diapausing larvae were obtained from collaborators in Canada, Armenia, the Syrian Arab Republic, New Zealand, Switzerland, Argentina and Chile. Results revealed the absence of mating barriers between the codling moth populations collected from the different geographical locations tested.

- Four trial packages of moths and pupae were shipped via commercial freight routes from the Sterile Insect Release (SIR) codling moth rearing facility in Canada to Stellenbosch, South Africa during 2004. Quality assessments were undertaken both pre- and post-transit to confirm the preservation of moth quality following long-distance transport. Based on the success of these initial freighting trials, an additional four consignments of increased quantity of moths were initiated in August 2005. These trials preclude the season-long shipments for field release in Stellenbosch for the 2005 growing season.

- In the Czech Republic, a detailed analysis of the karyotype of the codling moth has been carried out and a ribosomal DNA probe has been developed for use as the positive control in Fluorescence In Situ Hybridization (FISH) experiments to localize a transgene in codling moth. The probe is universal for Lepidoptera and it can be easily used in any other lepidopteran pests.

- Genomic In Situ Hybridization (GISH) and Comparative Genomic Hybridization (CGH) methods were used to identify and differentiate the sex chromosomes of codling moth and a W-chromosome specific painting probe has been developed.

- In the Syrian Arab Republic, work has continued to develop a new approach for detecting radiation-induced aberrations of the W chromosome using alterations of the sex chromatin, which has been used as a cytogenetical marker instead of a visible marker, which is not available in the sex chromosomes of codling moth.

- In Armenia, work continued on the identification and characterisation of ecological parameters of codling moth populations from different altitudes.

- In the USA, an efficient DNA delivery system, based on embryo injection, has been developed. In preliminary experiments, successful transformations of codling moth with *piggyBac/EGFP* or with *piggyBac/EGFP/Notch60G11* have been achieved. Several transgenic lines were obtained and tested for the stability and expression of the transgene. A cold-sensitivity trial confirmed that the *Notch60G11* lethal gene is expressed in codling moth embryos at 12°C and causes their deaths.

Most CRP participants will continue with their research activities and will attempt to finalise their work in the remaining 18 months of the CRP (expected to end in mid-2007). In addition to that, plans were made to conduct a summer-long release trial to assess the efficiency of male-only releases versus bi-sexual releases of codling moth. It was agreed that the SIR programme in Canada would be the most suitable place to implement this challenging experiment.

In Argentina, the production of codling moths will start soon and it is anticipated to produce 60,000 moths per week in the first 6 months. As of mid-2006, this production level is expected to increase to 200,000 moths per week. A replicated SIT trial, using the release of 150 Gy irradiated moths, is planned for the spring of 2006 and evaluation will be done by trapping (pheromone lures), by fruit damage assessment and by the evaluation of overflooding ratios and induced sterility.

The Second RCM of the CRP on Molecular Technologies to Improve the Effectiveness of SIT was held at the Vienna International Center, Vienna, Austria from May 14-17, 2005.

This CRP was initiated as a consequence of a recommendation from a Consultants Meeting in Capri, Italy, in May of 2003. The consultants recommended that the Joint FAO/IAEA Programme of Nuclear Techniques in Food and Agriculture re-examine its activities on the impact that transgenic insect technology can have on the efficiency and further development of the SIT so that it can take advantage of "its position as the ideal coordinating and implementation agency for SIT technology transfer".

Twenty-three scientists from Australia, China, Germany, Greece, India, Italy, New Zealand, Thailand, United Kingdom and the United States of America, attended this second RCM. The attendees represented countries that both develop technologies for SIT and countries that apply it to insect pests of agricultures. Scientists actively working on fruit fly pests, tsetse, mosquito pests, lepidopteran pests of crops and others were present. The breadth of the field of transgenic insect technology as applied to pest insect species was well represented, with all attendees being considered world experts in their respective areas.

The current RCM convened at the conclusion of a successful FAO/IAEA International Conference on Area-Wide Control of Insect Pests: Integrating the Sterile Insect and Related Nuclear and Other Techniques held in Vienna, Austria, from 9-14 May 2005. In this forum several RCM participants reported on the rapid and substantial advances in transgenic technology in pest insects that are, or soon can be, targets of the SIT and participated in discussions how these developments can be translated into practical applications in the field.

It needs to be clearly stated here that recent developments, many involving RCM members and observers,

now mean that transgenic insects in species that are targets of the SIT can be generated and tested in quality control programmes. This is the aim of this RCM and of the two CRPs that preceded it. It is imperative that these insects be generated and laboratory tested now and this is one of the three general recommendations of this second RCM.

The IAEA is an ideal position to do this and to determine whether genetic engineering technology can, in reality and practicality, be applied to the SIT. The IAEA has been at the forefront of fostering the development of this technology for SIT, and it now is in a position to generate and test this technology. Successful augmentation of the SIT through contemporary genetic technologies may increase the efficacy of the SIT and may lead to increases in agricultural productivity and, in the case of insect vectors of human disease, decreased incidence of debilitating diseases such as malaria and dengue.

The Second RCM of the CRP on Improved and Harmonized Quality Control for Expanded Tsetse Production, Sterilization and Field Application was held in the Vienna International Centre, Vienna from 4-7 May, 2005.

The meeting brought together 11 contract holders, two agreement holders and two observers from the following countries: Austria, Burkina Faso, Costa Rica, Ethiopia, Kenya, Slovakia, Uganda, United Republic of Tanzania, Republic of South Africa, Belgium and Mali. The presentations covered three main areas, fly quality measurement, both in the colony and after release, blood diet collection, processing and decontamination, and control of vectorial capacity.

Fly quality measurements covered ranged from colony performance characteristics such as fecundity, survival and pupal size, to a detailed video analysis of mating behaviour and recording and analysis of sound production. These latter two indicate that the behaviour of tsetse during mating is much more complex than previously thought, and the studies will continue to try to determine which components are critical to mating success of the released sterile flies in the wild. A study of flight muscle development looked at the rate of muscle development, changes in the proportion of actin to myosin and enzyme activity, and will look at methods to enhance muscle development in the males destined for irradiation and release.

Under blood diet, presentations were made on the effect of season and host condition on blood quality, and the potential of high temperature, short time pasteurization for bacterial decontamination of blood. Whilst variation in blood quality could be observed with season, the effect was small. The influence of donor condition is likely to be more important, and the method for assessing this was discussed. Pasteurization was shown to be feasible, at a temperature in excess of 70°C for 1-3 seconds, but difficulties had been experienced in controlling the conditions to achieve the correct holding time and post treatment cooling rate.

In the final group of presentations, the control of vectorial capacity through feeding trypanocidal drugs in the blood diet of sterile males was presented. Two contract holders have been working on this issue, and presented very similar results in two different tsetse species with different trypanosome isolates. Both showed that isometamidium chloride (Samorin®) at 10µg/ml substantially reduces the rate of establishment and of maturation of trypanosome infections, particularly of *Trypanosoma brucei* over a period of 7-10 days. The mode of action of the isometamidium chloride was discussed, and two possible mechanisms were identified: direct toxicity of the drug with residual action, and persistent modification of the midgut environment influencing the parasites ability to invade the host. Further work to elucidate this was planned.

The Third RCM of the CRP on Enabling Technologies for the Expansion of SIT for Old and New World Screwworm was held at Facultad de Ciencias Tecnicas Nucleares Aplicadas, Igua 4225, 11400, Montevideo, Uruguay, from 30 May to 3 June, 2005.

The meeting was attended by 9 participants and 9 observers from: Uruguay, Brazil, the Islamic Republic of Iran, Indonesia, United Kingdom, USA and Venezuela. The opening session was very well attended and included faculty staff, representatives from various ministries, the private sector and the FAO representative.

There are two main components of the CRP, the first on population genetics of Old World screwworm, *Chrysomyia bezziana* (OWS) and the New World screwworm *Cochliomyia hominivorax* (NWS) and the second on genetic sexing for NWS. The population work aims to uncover the genetic variation present over the distribution of the two species in order to establish population structure and the degree of isolation between different populations. The use of a genetic sexing strain for NWS could reduce the costs of SIT programmes especially in the case of the permanent 300km barrier system that is now in operation in Panama and which has an annual budget of US $10 million.

For NWS, several DNA molecules are being used in the analysis of an increasing number of populations although there are still large areas of the distribution that have not yet been sampled. This should improve with the recruitment of a consultant who is making collections in the

Caribbean. Analysis of samples from Brazil and Uruguay has shown low levels of population variability indicating low levels of population structure.

Using mitochondrial DNA, samples of OWS from various islands in Indonesia, The Islamic Republic of Iran and Oman have been analysed. Although there are some haplotypes unique to Indonesia the samples so far analysed do not indicate any great degree of genetic differentiation. Samples from the Horn of Africa are proving impossible to obtain, despite repeated attempts.

Work on genetic sexing of NWS has been seriously hampered by the closure of the ARS Midwest Livestock Insects Laboratory in Lincoln, Nebraska, where much of this work was planned to be carried out. The staff has now moved to Panama. Nevertheless, before the move, genetic transformation was successfully completed and fitness studies carried out on the transformed lines. These lines have not been lost, as cryopreservation techniques have been developed for this species.

Significant studies on mating incompatibility between sterile and wild NWS strains were presented. These incompatibilities resulted in wild males choosing not to mate with sterile females when given the option to do so in cages also containing wild females and sterile males. The sterile males showed no discrimination. These results are very important in terms of the effectiveness of sterile insect release and plans were made to extend these studies.

Developments at the Entomology Unit Seibersdorf

FRUIT FLIES

Transgenic fruit flies

Transgenesis offers the possibility to generate sexing strains or other strains improving the SIT even in pest species where genetic knowledge is minimal or even lacking completely. Many species have been transformed already but many questions related to the applicability of such strains in SIT are still unanswered. Especially, the performance of such strains under mass rearing conditions has not been tested. For example, the stability of the transgene in large colonies maintained for extended periods of time cannot be predicted with the data available today.

In the continuing effort to generate and evaluate transgenic sexing strains a new set of transformation experiments was performed. In collaboration with Al Handler (USDA, Gainesville, USDA) six different constructs, all based on the mobile element *piggyBac*, were injected into medfly embryos. In total, ca 3600 embryos were injected and between 33% and 65% survived to the larval stage. Additional injections were done with the Mexican fruit fly, *Anastrepha ludens*. Unlike in the experiments with medfly, the survival of the injected embryos was here very low, i.e. of ca 400 injected embryos only 30 (= 4%) survived to the larval stage. The survival of later stages was within the values observed for medfly. All surviving G0 flies were crossed with flies from an appropriate strain, i.e. 20-25 G0 females in middle cages and 5-6 G0 males in small cages. G1 eggs were collected every second day in total 9 times.

In one of these experiments, an attempt was made to generate strains that carry a deleted transformation vector lacking one of the terminal inverted repeats. This is in the context of generating stable strains, i.e. strains where the inserted transgene is fixed to its original position in the genome. All transformation vectors in use today are based on mobile elements that are members of families of related elements. It follows that one potential cause for instability could be the cross mobilization of the integrated transgene by related endogenous elements present in the target species. Such a process would require an interaction between the transposase produced by the endogenous element and the two inverted repeats of the *piggyBac* transformation vector. These two repeats are initially required to allow *piggyBac* transposase-mediated integration of the construct into the target genome. However, after integration they are dispensable and could be removed without negative consequences.

For this purpose Handler et al. have generated, and tested successfully in *Drosophila*, a construct that carries three inverted repeats: two left (L) and one right (R) in the order L_1-L_2-R. Two fluorescent marker genes are inserted, EGFP (green fluorescence) between L_1 and L_2 and DsRed (red fluorescence) between L_2 and R.

As a first step this construct (plus the required helper plasmid providing the *piggyBac* transposase activity) was injected into medfly embryos and the resulting offspring was screened for individuals that express both markers. Such a phenotype would indicate that the entire construct, and not only the fragment L_2-R which in itself would be sufficient for integration, was integrated into the genome. This was achieved successfully, i.e. several lines were generated with varying intensities of the two types of fluorescence.

In a second step, one of these lines was re-injected with only the helper plasmid to provide transposase activity to mobilize, and thereby eliminate, the subfragment flanked by L_2 and R. If successful, offspring is generated that show the green but lack the red fluorescence. This was achieved successfully and several individuals with only green fluorescence were detected. Further experiments will be required to analyse the genetic and molecular constitution of these lines.

South American Fruit Fly

The South American fruit fly, *Anastrepha fraterculus*, in contrast to most other fruit flies that have been adapted to mass rearing, show low levels of egg viability when adult flies are fed with the conventional diet based on sugar and yeast hydrolysate. To overcome this problem several products such as corn extract protein have been used as additional supplements to improve egg viability for A. *fraterculus* in other facilities (e.g. Argentina and Brazil). However this corn protein extracts it is not a standard industrial product and therefore alternatives are needed. Recent preliminary experiments have been conducted to evaluate the possibility of using wheat germ as a supplement for the feeding adults. Preliminary results have indicated that the diet formulation of 3:1:1 (sugar: yeast hydrolysate: wheat germ) can increase the egg hatch from 60% to 85% when compared with standard adult diet 3:1 (sugar and yeast hydrolysate). Additional experiments are ongoing to determine optimal diet formulation to measure the effect on egg production and on the quality of the subsequent generations.

Olive fly

Three colonies of the olive fly, *Bactrocera oleae*, are maintained in Seibesdorf. One from Democritus, Greece (more that 30 years old colony), a colony from California (3 years old colony) and a hybrid strain established from crossing females from the Greek colony with wild males from Valencia, Spain (one year old). As reported in the previous Newsletter, these different colonies will be used in field cage compatibility experiments with wild populations from Crete, Greece in December.

Medfly

During the 2 months fellowship of Mr. Luciano Arnolds from South Africa several types of brewer's and torula yeast were evaluated as a source of protein for medfly larval diet. This evaluation is important since the identification of good quality yeasts that can be obtained locally can result in a significant reduction of rearing cost given that the local market can offer cheaper products than those imported from abroad. The conclusion from these experiments was that at least one type of locally available brewer's yeast in South Africa can be used in the medfly rearing facility. This will result in significant savings in production costs if the current torula yeast, imported from Europe, is replaced by the locally produced yeast.

During the 3 months of the fellowship of Mr. Nathan Vermeulen and Mr. Hilton Asia from South Africa, experiments were conduced to reassess mass rearing protocols for the genetic sexing strain, Vienna-8. Medfly GSS generate individuals that carry unbalanced chromosomes and these can die during the embryo, larval, pupal or adult stage depending on the chromosome segments involved in the translocation responsible for the genetic mechanisms. This means that different mass rearing protocols should be used for each specific strain. The objective of the evaluation was to assess the effect on pupal production and adult quality of different egg density rates as well as different amount of diet per larval tray. The main conclusion of the experiment was that a density of 1ml of eggs/kg of diet and trays loaded with 4 kgs of larval diet using wheat bran will be the optimal choice for colony maintenance of Vienna-8 strain in South Africa.

TSETSE FLIES

Colony status

The envisaged reorganization of the tsetse colonies has now been completed with the transfer of the *Glossina morsitans morsitans* colony to Bratislava and the return of the *G. m. centralis* colony to Seibersdorf. This latter colony is now held at about 3,000 females. With the expiration of the three year contract in Bratislava, we are discussing the future arrangement. Depending on the outcome of these discussions further changes to the colonies may be necessary.

TPU3.2

Testing of the TPU3.2 (Tsetse Production Unit) has continued, with alternate week's units being set up on the TPU3.2 and the conventional system. The main problem encountered has been the alignment and leveling of the cages, caused in large part by the irregularity of our old cages. A new holding system has been designed to hold the cages level and we are awaiting the new red, foam-core PVC pipe cages and holding system, due at the end of the year. Once the new cages are in place we will continue to work with the designer and supplier to resolve the alignment problems and future issues.

Alternative processing of blood

As reported in the last newsletter, we are continuing to work on the UV treatment of blood. One of the UV treatment machines has been installed in Seibersdorf, and we are starting to test the effect of UV irradiation on the nutritional quality of the blood, and to test the effect of the irradiation on the bacteria normally encountered during blood collection.

Work on the effect of freeze-dried blood has recommenced. Freeze-dried blood has been dialysed through a 6-8000 k Dalton membrane and the dialysate collected and concentrated by freeze-drying to isolate a compound, named yellow factor (YF), due to its light yellow to orange appearance. Freeze-dried blood that has been dialysed can not support reproduction in tsetse, and the females show various reproductive abnormalities. Work is continuing to demonstrate the necessity of YF for tsetse reproduction, and to identify the components of YF.

Work is also just starting, jointly with the mosquito group, to look at the effect of storage on blood quality, and various additives to minimize the effect of storage. This will continue earlier work on citrate as an anticoagulant reported in the 2002 Annual Report

(http://www.iaea.org/programmes/nafa/d4/public/ent-ann-rep-02.pdf)

Salivary gland hyperplasia

As reported in earlier newsletters, some tsetse species carry a virus that, in a certain proportion of individuals, leads to hyperplasia of the salivary gland and these individuals also show reproductive abnormalities. The problem seems to be more serious in *G. pallidipes*. This virus is present in natural population at a low level (0.5-5%), but in Seibersdorf colonies the virus is widespread and can result in some of them in significant decrease in colony production.

PCR analysis has confirmed that the virus infection were 100% in *G. pallidipes* colony originated from Uganda. By the same method, the virus was also detected at a very

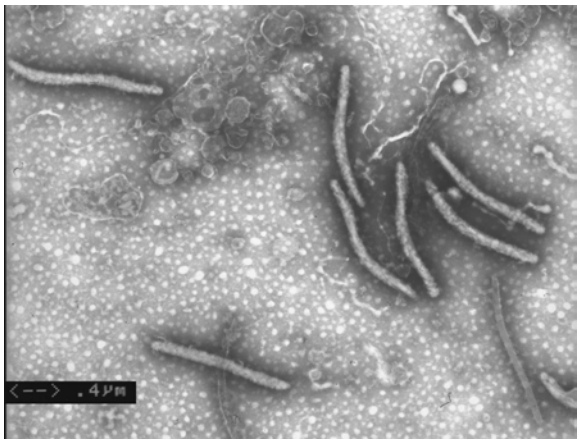
high level (93%) in the *G. pallidipes* colony originated and established in Ethiopia.

Due to the negative impact of the virus on colony productivity under certain stressful condition it is important to understand more about the virus with the goal to develop a management strategy for the virus. The most effective way to begin this study is to obtain the nucleotide sequence of this virus as recommended during a consultancy by Max Bergoin (Montpellier). Last July Drion Boucias (Univ. Florida, Gainesville) visited the Unit to develop collaborative work on this topic as he is working on a very similar virus in house fly.

To obtain the nucleotide sequence of this virus, it was necessary to obtain sufficient quantity of the purified virus. This was done by injecting the virus into 3rd instar larvae as previously described in the literature. Using this approach sufficient virus could be purified and confirmed under the electron microscope (see figure).

Due to the long life span of tsetse, attempts to produce this virus in an alternative host such as house fly are being undertaken. The small quantity of viral DNA prepared from hypertrophied salivary gland by Francois Cousserans in 2003 was used to construct two viral genome libraries. The first uses small insert fragments as these can be easily cloned and sequenced. The second is construction of a library from large insert fragments in order to facilitate sequence assembly. Using the first approach we obtained more than 800 recombinant colonies and 681 colonies were analysed to estimate the insert length and 415 colonies were sequenced totaling 60-90kpb. The attempts to assembly this sequence and to compare it with the data bank and to complete the genome sequence are ongoing.

Another important aspect to study is the impact of anti-



SGHV particles

viral drugs on SGHV infection and for this a cell culture susceptible for this virus is very important. Primary attempts to establish a cell culture from hypertrophied salivary gland of tsetse were initiated. While, neither bacterial nor fungal contamination was observed, the cells did not multiply in the tested media. The attempts to use another cell culture media and also try to establish cell culture from other tissues such as ovaries and imaginal discs have been initiated.

MOTHS

Codling moth

In the previous newsletter, it was reported that Mr. Gustavo Taret from Argentina carried out field cage mating compatibility studies between different geographical populations of the codling moth, *Cydia pomanella,* in support to a CRP to "Improve Components of Codling Month SIT to facilitate the Expansion of Field Application". Both wild and laboratory populations from most of the regions of the world were included in the tests. The crosses that were assessed were: Argentina wild x Canada colony; Argentina wild x the Syrian Arab Republic wild; Argentina wild x New Zealand colony; Armenia wild x Canada colony; Armenia wild x New Zealand wild; the Syrian Arab Republic wild x Canada colony; the Syrian Arab Republic wild x New Zealand colony and New Zealand wild x Canada colony. The protocol used for the field cage evaluation was based on that described in the FAO/IAEA-USDA 2003 Fruit Fly QC Manual. In the majority of cases the Isolation Index (ISI) was not different from zero essentially indicating random mating; however in 3 cases the ISI exceeded 0.2 which may indicate a very limited degree of assortative mating.

Additional tests are being carried out to confirm these results. Results of these experiments will help to plan and implement codling moth SIT programmes in terms of the ability to ship sterile moths from a rearing facility to a prgramme in another region.

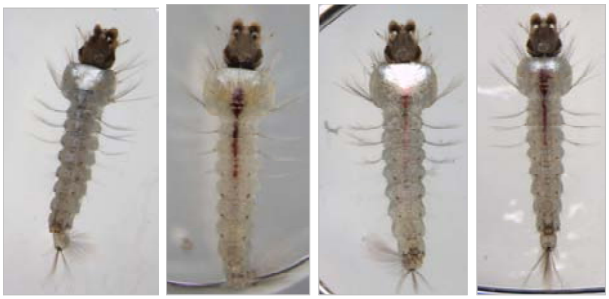
MOSQUITOES

Radiation Biology

Following completion of the dose-sterility curve for the pupal stage of *Anopeheles arabiensis* in 2004, a similar curve for the adult stages was developed. The KGB strain of *An. arabiensis* was used in all experiments. Adult males were irradiated within 24 hrs post emergence and were immobilized prior to the irradiation process by cooling. Doses tested varied from 25-100 Gy, and in each series a control was included. Each dose was repeated 2-3 times. Normal virgin females were introduced in the cages and a human blood meal (through insertion of an arm in the cage for 10 min), was offered twice. Egg laying occurred *en masse* in the cage and eggs were examined for hatch. As expected sterility levels increased with dose, reaching 90% at a dose of 70 Gy. As dose-sterility curves for both pupae and adults have now been established, future experiments will focus on the impact of radiation on mating competitiveness of male *An. arabiensis*. A protocol for these studies is currently being drafted.

Strain quality control

An intern, Mr. Wolfang Schmied, undertook to study the phenotypic variation in three colonies of *An. arabiensis* present in Seibersdorf. Some unique phenotypes were found that can distinguish KGB from Dongola mosquitoes, albeit that the frequency of these are rather low (<15%). The same intern then focused on the development of a PCR based method to separate the colonies and was successful. The primers developed can now be used as a quality control method to safeguard against unwanted hybridization between strains in laboratory or mass rearing settings. Some of the phenotypes are shown in the figure below.



Individual egg laying

A large constraint in the laboratory is the difficulty to get individual females to lay eggs. After obtaining encouraging results, experiments were initiated to study the individual ovipositing behaviour in the KGB and Dongola strains. Females were allowed to mate for a number of nights after which a blood meal was offered. The non-fed females were discarded and the fed females individually tubed some days later. In the KGB strain, it was possible to achieve up to 75% of the tubed females laying eggs. No correlation was found between number of eggs laid and hatch rate of the batch. There is a large variation in the hatch rate of individual batches, with a high proportion of batches yielding low to zero hatch. This happens even though all females that laid eggs were positive for insemination. For the Dongola strain, it was more difficult to have a high number of females ovipositing. On average, around 50% of the females laid eggs when tubed individually. It was observed that far fewer batches of eggs yielded low or no hatch as observed in the KGB strain.

Methylparaben

Adult mosquitoes are routinely fed on 10% sucrose solution. Methylparaben (MP), a chemical compound with anti-oxidizing capabilities, can be added to the sugar water to increase its shelf life. In the KGB strain, the effect of MP on female fecundity was studied in comparison to normal sugar water without MP. Adding MP to the sugar diet does not affect the fecundity of the females. Average batch size is larger but not significantly different ($F_{1,171}$: 3.42, p = 0.074) from the females that received normal sugar water. Egg hatch was also similar between both groups (results not shown).

Larval nutrition and automation

Work on the optimisation of larval nutrition, which was initiated by Ms. Safia Saddig continued after her retun to Sudan. Work is under way to determine a standard quantity of larval food per tray. Concomitantly, a method is being developed to homogenize egg and larval density per tray. With the assistance of the Instrumentation and Workshop Units in Seibersdorf, a larval counter was developed and preliminary tests have been carried out; further tests are on schedule to refine the accuracy of the counter, particularly for the younger (L1) stages. Earlier experiments by Franz Markowicz, a former intern in the mosquito project, demonstrated that a system of automating egg counting is feasible. But this too requires improvement to be able to handle high densities of eggs.

Heating plates for temperature-controlled larval rearing

Temperature is one of the key parameters influencing larval development. To obtain an optimal water temperature and induce daily temperature fluctuation patterns in larval trays, heating plates have been developed and introduced in the laboratory. The installation of these aluminium plates has taken place earlier this year. Experiments to assess the impact of various temperature regimes on larval growth and adult energy reserve accumulation have been conducted by Ms Ali (Sudanese fellow).

A new cage for adult maintenance

A new cage for maintenance of large numbers of mosquitoes was developed. This new design has special resting sites, and has so far been loaded with up to 15 thousand mosquitoes. Novel sugar and bloodfeeding systems are currently being designed to minimize interference with the mosquitoes in the cage and maximizing holding capacity.

Stable isotopes for mosquito marking

Stable isotopes are naturally abundant in the environment safe and nonradioactive. Therefore they do not decay, and in general are chemically identical to the more common isotopes which makes them useful natural tracers. We have been investigating the use of the stable isotope of carbon ^{13}C as a marker for mosquitoes and it is added in minute quantities to the mosquito larval diet.

Initial tests showed that the label was retained throughout the adult mosquito life (up to 21 days post emergence) and that there were no detrimental effects on the mosquito's growth or behaviour. It was also possible to determine the turnover of carbon in the male mosquitoes as they were fed with unlabelled sugar diets in their adult

stage, demonstrating the power of the isotope in resource acquisition and allocation studies. Results showed that around 50% of the adult carbon in the mosquito is "structural" and turns over very slowly and that the remaining 50% is metabolically active with a turnover time of less than 14 days.

Stable isotopes also proved useful in determining diet preference. Methyl paraben (methyl 4-hydroxybenzoate; see above) is a common anti fungal-bacterial agent used widely in cosmetics and food and has been shown to increase shelf life of sugar water in the laboratory and therefore useful from a mass rearing perspective. Classical studies had shown that the mosquitoes lived longer if offered methyl paraben amended sugar water only, but there was no effect if offered a choice. By labelling the sugar water with ^{13}C it was possible to show that the mosquitoes avoided the methyl paraben amended sugar water by up to 30%.

ANNUAL REPORT 2004

For more detailed information on the 2004 R&D activities conducted by the Entomology Unit, Seibersdorf, see Annual Report 2004:

www.iaea.org/programmes/nafa/d4/index.html

Special News and Reports

The Story of the First Private Sterile Insect Production in Europe: *de Groene Vlieg* Company Producing Sterile Onion Flies.

Since 1981, the de Groene Vlieg Company in the Netherlands has been mass rearing and sterilizing onion fly (*Delia antiqua*) for release in commercial production areas. According to Loosjes (2000), the operation is entirely private but received some support from the Dutch Government for the first two years as part of its promotion of environmental businesses.

Onion fly is present throughout the region and eradication cannot be maintained easily. It is more economical to routinely release sterile onion fly for suppression than to create a quarantine barrier to monitor and control new invasions. Because the onion flies do not disperse much beyond a particular field, it has worked to a certain degree for this SIT service to be purchased on an individual grower basis.

As of 1996 the de Groene Vlieg facility capacity was over 400 million pupae per year, providing for treatment of 2,600 ha of onions, which represents approximately 16 percent of the Dutch onion production area (Loosjes, 2000). Releases are done weekly during the growing season and adjusted based on monitoring and rapid feedback.

SIT for onion fly suppression is profitable and it compares to the cost of insecticide based control. The area treated is on the average increasing by 5% per year and investment to increase the rearing capacity is under way. Around 50% of the farmers in the area where SIT is being used are applying SIT and the other half continue using chemical control and some use a low input chemical control or do nothing.

As a private facility, difficulties encountered include the Dutch Government decommissioning of the irradiation source initially used by the company, forcing it to send pupae for sterilization in Belgium, which is more costly and inconvenient. Some of the challenges initially faced by Loosjes, 2000, are gradually being solved such as:

Farmer doubts about effectiveness of SIT compared to insecticides are gradually disappearing as the benefits of SIT technology become more apparent.

With the trend of increasing area managed under a SIT based programme, cost-effectiveness of SIT is also increasing and losses to neighbours' fields are substantially decreasing, together with the free rider effect.The unique positive contribution of SIT to the region, however, has been the reduction of pesticides used and continued management of populations that might develop pesticide resistance. The SIT approach for onion fly also has been below cost or competitive with costs of chemicals. This suggests that the use of SIT for onion fly in the Netherlands could increase more rapidly if the government recognized the public benefit of this approach and maintained a policy that encouraged its adoption by more individual farmers to pay for the service.

More information on the Groene Vlieg company can be found in www.degroenevlieg.nl

Cited Reference:

Loosjes, M. 2000. The sterile insect technique for commercial control of the onion fly. *In* Keng-Hong Tan, ed. *Area-wide control of fruit flies and other insect pests*, pp. 181-192. Penerbit Universiti Sains Malaysia.

The Second Meeting of the International Organisation for Biological and Integrated Control of Noxious Animals and Plants West Palaearctic Regional Section Group on Integrated Protection of Olive Crops was held at the Polo Scitifico of Sesto Fiorentino, Florence, Italy, from 26 – 28 October, 2005.

Around 70 participants from Italy, France, Greece, Spain, other countries from the Mediterranean and the USA attended.

There was much discussion regarding the previous attempts to develop SIT for olive fly control. During the 1970 and 80s researchers in Greece conducted basic research on biology, mass rearing, quality control and irradiation protocols. It was concluded that very good progress on the development of the SIT technology package was achieved. Nevertheless improvements are still needed to reduce costs of mass rearing and ensure mating compatibility of mass reared and wild insects.

Current control of olive fly is based on the conventional application of pesticides or utilization of mass trapping. The utilization of pesticides is becoming more restricted and consumers are demanding organic vegetables and fruit production. Mass trapping is an expensive method of control due to high labour costs.

It was strongly recommended to reassess SIT technology and fine tune the rearing, quality control and irradiation protocols for olive fly. Olive oil and table olive production is an important economic activity in the Mediterranean Basin and in the USA, specifically in California.

Why is the SIT not an appropriate tool for desert locust management? (prepared in conjunction with FAO's Desert Locust Control staff).

The SIT has been successfully used to suppress or eradicate major key pests such as screwworm, tsetse fly, and various fruit flies and moths. Consequently, Member States, the press and the public have been regularly asking the Joint FAO/IAEA Programme of Nuclear Techniques in Food and Agriculture why this technique is not part of the arsenal to control locusts. The 2003-2005 desert locust emergency prompted donors and Member State to request that SIT be developed to manage locusts.

The Joint Programme's response now, as in the past, has been that it cannot justify SIT R and D (i.e. rearing, sterilisation, release systems etc.) on locusts and related Orthopterans and currently has no plans to do this since:

a) SIT is unlikely to provide effective locust control, especially against the desert locust during emergencies, and

b) Other control methods, already available or under development, are much more appropriate to deal with the locust problem.

It has been emphasised that SIT can be effectively implemented against insect pests only when certain preconditions or situations apply. These include:

1. that the large numbers of sterile insects released do not cause major damage;

2. that the SIT can be applied during periods when the target population is at low density;

3. that an effective suppression method is available for high pest population densities;

4. that the target pest population is not migratory over large distances and remains confined to a circumscribed area; and

5. that SIT can be applied on a cost-effective basis against key pests that each year cause damage above the economic threshold.

Consequently, applying the SIT to desert locust management has at least six major problems:

1. the released sterile locusts would themselves feed on crops, thus causing additional damage, and so could not be released on a large scale;

2. the numbers of locusts during emergencies are much larger than any potential capacity to produce sterile locusts, and thus the released sterile insects would have little if any effect;

3. as the SIT does not cause immediate mortality but only reduces reproductive potential, it would not provide the immediate pest suppression that is required once large swarms have formed;

4. locusts swarms move over very large distances during plagues;

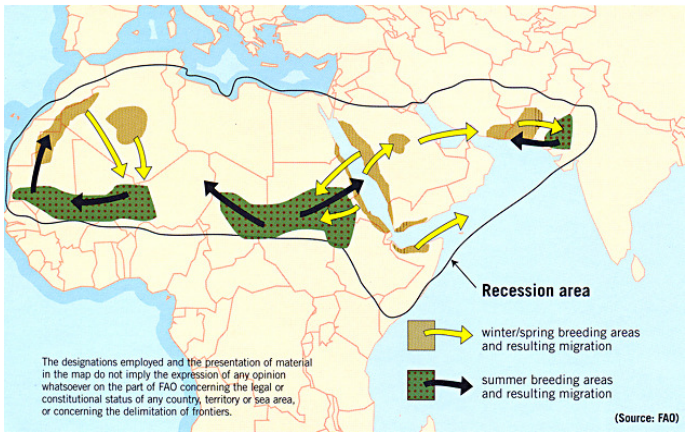
5. locusts such as the desert locust, that have no permanent outbreak areas, also migrate seasonally within relatively large areas during recessions and,

6. plagues occur only every 7-15 years, leaving the mass rearing capacity idle for long periods (sterile locusts cannot be stockpiled), which would not be cost-effective. Neither would it be possible to produce large numbers of sterile insects at short notice in response to an emergency.

In addition, industrial methods to mass-produce desert locusts and procedures to release them would need to be developed and are unlikely to be cost-effective in view of the biology of this locust. Furthermore, Orthopteran insects are generally more radio-resistant than Diptera and other insect orders, and so a detailed assessment of locust radiobiology would be needed to develop procedures that do not damage the reared locusts or alter their behaviour while still assuring their sterility.

Based on the above, together with relevant sister Divisions at FAO, Rome, it has been concluded that SIT has no role to play in desert locust control whether in preventing outbreaks or involving immediate remedial action during emergencies to control large migrating swarms that threaten agriculture in Member States.

What control strategies and tools are being used and developed to control locusts and where are these policies formulated? FAO's mandate includes monitoring desert locust activities and providing technical advice and coordinates the work of national and regional locust organizations. The FAO desert locust Control Committee is a fo-



Desert locust regions, invasion and recession areas

rum for locust-affected Member States and donors to discuss programmes and policies with FAO. Affected Member States and FAO jointly operate an early warning system, initiated in the 1930s and the resulting monthly bulletin and forecast alerts countries to incipient outbreaks.

The desert locust control strategy has always aimed to prevent plague development, but recessions were too short, control capacity too limited and finance too scarce for its implementation until the 1960s. Subsequently, countries have monitored the seasonal breeding areas in the central arid recession area (see Figure). During recessions, low density desert locust populations pose no threat to crops or grazing. As numbers and densities increase, locusts gregarize. At first, they cluster into groups and later swarms form. Swarms migrate farther than individual adults and during plagues may invade up to 20% (28 million km^2) of the earth's surface (Figure 1). Each desert locust region contains migration circuits that take solitarious adults between summer, winter and spring breeding areas. In years with unexceptional rains, a few small outbreaks occur which often disperse without control. On rare occasions, rains support population increases in all three seasons for one or more years and an upsurge starts that will develop into a plague unless checked by control, drought, or migration to unsuitable habitats.

Successful implementation of plague prevention requires an inter-related complex of national, regional and international inputs each of which depends on accessing reserve funds at short notice. Countries in the recession area need to maintain sufficient control teams to locate and control outbreaks as locusts gregarize and this is beyond the financial capacity of some. These teams are expected to organize early upsurge campaigns, which entails mobilizing and financing national and regional reserve teams. International assistance is sought through FAO later when the Early Warning Service at FAO predicts that large scale aerial campaigns are needed because a plague is imminent.

Currently infestations are sprayed with ULV formulations of contact pesticides and control begins when locusts aggregate into dense targets (swarms and bands)[1] to maximise kill per unit of pesticide to minimise the scale of later interventions. As an upsurge begins, these targets form only a small proportion of the locusts and spraying them fails to stop further developments. More of the population becomes gregarious and sprayable with each successive season of good rains and successful breeding but the infested area rapidly becomes too large for the permanent teams and they must mobilize local and regional reserves. Later, only aircraft can spray all infested areas before swarms emigrate, which for most countries requires donor assistance. Field evidence indicates that control can destroy the final upsurge stage, preventing plagues from developing and expanding. No upsurge since 1964 has reached the full plague stage typical of earlier years. Most managers believe, however, that with earlier assistance upsurges could be ended more economically and sooner. To date, this assumption remains untested.

Successful plague prevention depends on timely control and an effective early warning system. Both systems improve during and shortly after plagues but teams are seldom re-equipped and trained to use the new techniques before the next emergency. Recent improvements include using computers, GPS and GIS tools nationally and at FAO to collect, map and exchange locust survey and control records. Consequently, the new products based on satellite imagery that can distinguish sparsely vegetated locust habitats from bare soil with reasonable reliability are transferred electronically from FAO to national locust units to help direct surveys. Long-term experimental seasonal rainfall forecasts would enable upsurge warnings to be made earlier if shown to predict upsurge generating rains reliably.

Changes in anti-locust techniques deliver control that is more effective and improved safety for operators, inhabitants, livestock and the environment. Correct application techniques allow dose rates to be lowered to minimize adverse side-effects but further training is required to ensure the universal uptake of such best practices. Barrier spraying requires persistent chemicals and as well as being work-efficient, it leaves unsprayed refuges for non-target species. Trials with insect growth regulators suggest that they have acceptably low non-target impact for barrier spraying to be reintroduced. Multi-donor funding in the 1990s, developed an environmentally safer but slower acting biopesticide, "Green Muscle" based on a fungal disease *Metarhizium anisopliae* var. *acridum*. Its non-target impact is slight since infectivity is specific to locusts and grasshoppers. Currently, large-scale field trials are setting parameters for its operational use.

Four actions would improve responses to future emergencies:

- a mechanism to release funds rapidly as an upsurge begins;
- training that ensures improved early warning and control techniques are fully implemented in all desert locust regions;
- the implications of agriculture developments in areas infested during upsurges incorporated into control tactics and practices;
- reduced reliance on chemical control to safeguard environmentally sensitive areas, and those prac-

[1] Swarm densities range from 20-150 million/km^2 and their sizes vary from <1km^2 ->500km^2

ticing integrated pest management and organic agriculture.

Workshop on Pest and Weed Control in Sustainable Fruit Production, organized by the Research Institute of Pomology and Floriculture in Skierniewice, Poland, 1-3 September 2005.

The Research Institute of Pomology and Floriculture, a centre of excellence in sustainable pomology employs more than 200 scientific staff and research is conducted on a wide variety of topics such as genetics, traditional breeding for pest-resistant cultivars, integrated orchard management, biotechnology to develop new methods of pathogen identification and genome mapping with the aim to develop resistance to pests and diseases using transgenesis. Approximately 50 scientists attended the workshop and papers were presented on a variety of topics such as the pro's and cons of weed control, bio-control in orchards by increasing food web biodiversity, IPM and pesticides residues in Europe, midge control against raspberry cane, etc. Of particular interest was the report on resistance of the codling moth to organophosphates and insect growth inhibitors in some parts of the Czech Republic, which highlighted again the need for alternative control tools for this most important pest of pears and apples in Europe. In another interesting presentation, the limitations of new sprayable pheromone formulations for codling moth mating disruption and the need to supplement mating disruption programmes with insecticide spraying in orchards with high population pressure were highlighted. It was interesting to note that drastic improvements of 'mating disruption' trials were observed, when a 'whole farm' (i.e. area-wide) approach was used. Staff of the Insect Pest Control Subprogramme presented a paper on the 'The SIT as a component of Sustainable Area-wide Management of Selected Insect Pests of Fruits'.

VI Argentine Entomological Congress organized by the Entomological Society of Argentina in San Miguel de Tucuman, Tucuman, Argentina, 12 to 15 September 2005.

More than 450 scientists, mainly from Argentina attended the congress. Several parallel sessions were organized dealing with insect ecology, behaviour, control and eradication of insect pests, integrated pest management, phylogeny, biodiversity, genetics, insecticide resistance, medical and veterinary entomology, biological control, systematics, bio-geography etc. One session was entirely devoted to the area-wide pest management of codling moth. In this session, the members of the codling moth Coordinated Research Project of the Joint FAO/IAEA Programme presented oral papers on codling moth control in Brazil, the effect of diapause and irradiation on mobility of codling moth, codling moth management in the USA and in Canada, the development of genetic sexing strains and how to genetically engineer insects. Staff of the Insect Pest Control Subprogramme of the Joint FAO/IAEA Programme was invited to present a keynote lecture on 'Prospects for area-wide integrated management of tsetse and trypanosomosis in sub-Sahara Africa'.

Second Meeting of the Fruit Fly Technical Panel of the IPPC, 19-23 September 2005, San Jose, Costa Rica.

The Technical Panel on Fruit Flies of the International Plant Protection Convention (IPPC), reviewed the comments made by Member States to the draft International Standard (IS) on Fruit Fly Free Areas which was drafted by the Panel in the first meeting conducted in September 2004 in Bangkok, Thailand. Approval of this standard by the Interim Commission of Phytosanitary Measures (ICPM) is expected in the next meeting of the Commission which will take place in Rome, Italy, in April 2006.

Members of the Fruit Fly Technical Panel. From left to right: Keng-Hong Tan, Jane Chard, John Stewart (observer), Jaime Gonzalez, Jose Luis Zavala, Magda Gonzalez, Odilson Ribeiro , Jose Fernandez, Alise van Sauers-Muller, Walther Enkerlin and Jesus Reyes (invited expert).

In addition the Panel drafted an IS on Fruit Fly Low Prevalence Areas (FF-ALPP). The draft standard was presented to the Standards Committee in November 2005 and will be sent out for country consultation. The Panel also reviewed a discussion paper on an IS for Fruit Fly Systems Approach. This IS will be developed by the Panel during its next meeting to be held in September 2006 in Bahia, Brazil, the week before the International Fruit Fly Symposium. The Panel drafted the specifications for the IS on Fruit Fly Free Places of Production and Sites of Production and the reference documents on Fruit Fly Trapping Guidelines and Suppression and Eradication Procedures, which will be annexed to the IS on Fruit Fly Free Areas and Low Prevalence Areas. The specifications

were presented in November to the Standards Committee of the ICPM and approved. The Technical Panel will subsequently develop this draft IS and technical documents.

The use of available FAO-IAEA International Guidelines such as the "Trapping Guidelines for Area-Wide Fruit Fly Programmes" and the "Product Quality Control and Shipping Procedures for Sterile Mass-Reared Tephritid Fruit Flies" as reference documents in support of IPPC International Standards was agreed by the IPPC Secretariat. However, final decision will be subjected to approval from the ICPM.

Guest Article

Effect of Larval Crowding on Mating Competitiveness of *Anopheles gambiae* Mosquitoes.

Kija R Ng'habi[1,2], Bernadette John[1,2], Gamba Nkwengulila[2], Bart GJ Knols[3,4], Gerry F Killeen[1,5] and Heather M Ferguson[1,4]

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Malaria Journal 2005, 4:49 doi:10.1186/1475-2875-4-49

This article is available from:
http://www.malariajournal.com/content/4/1/49

Abstract

Background: The success of sterile or transgenic *Anopheles* for malaria control depends on their mating competitiveness within wild populations. Current evidence suggests that transgenic mosquitoes have reduced fitness. One means of compensating for this fitness deficit would be to identify environmental conditions that increase their mating competitiveness, and incorporate them into laboratory rearing regimes.

Methods: *Anopheles gambiae* larvae were allocated to three crowding treatments with the same food input per larva. Emerged males were competed against one another for access to females, and their corresponding longevity and energetic reserves measured.

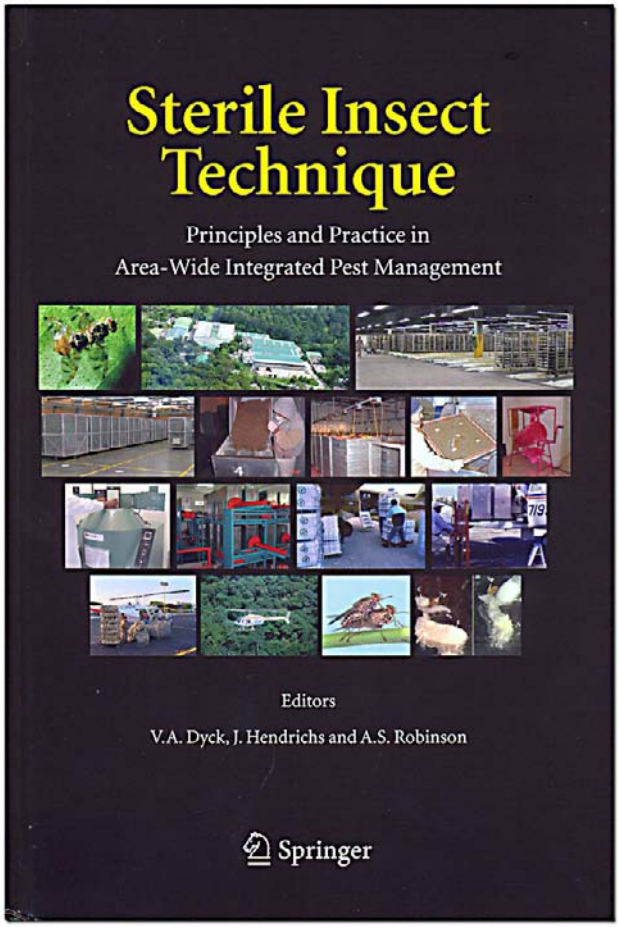
Results: Males from the low-crowding treatment were much more likely to acquire the first mating. They won the first female approximately 11 times more often than those from the high-crowding treatment (Odds ratio = 11.17) and four times more often than those from the medium-crowding treatment (Odds ratio = 3.51). However, there was no overall difference in the total number of matings acquired by males from different treatments ($p = 0.08$). The survival of males from the low-crowding treatment was lower than those from other treatments. The body size and teneral reserves of adult males did not differ between crowding treatments, but larger males were more likely to acquire mates than small individuals.

Conclusion: Larval crowding and body size have strong, independent effects on the mating competitiveness of adult male *An. gambiae.* Thus manipulation of larval crowding during mass rearing could provide a simple technique for boosting the competitiveness of sterile or transgenic male mosquitoes prior to release.

Announcements

New Book on the Sterile Insect Technique Available since November 2005.

The first comprehensive book on the sterile insect technique (SIT) has now been published:



Sterile Insect Technique. Principles and practice in area-wide integrated pest management.

The 28 chapters of this book, written by 50 authors from around the world, review all aspects of the SIT. The book covers a wide variety of topics written from a generic perspective: History and principles of the SIT, Technical components of the SIT, Supportive technologies to improve the SIT, Economic, environmental and management considerations, Application of the SIT, Impact of area-wide IPM programmes that integrate the SIT, and Future development of the SIT.

The book can be purchased from Springer.

http://www.springer.com/sgw/cda/frontpage/0,11855,5-10027-22-91829290-0,00.html?changeHeader=true

FAO/IAEA Regional Training Course on Principles of Base-line Data Collection for Integrated Area-wide Tsetse and Trypanosomosis Inervention Projects with a Sterile Insect Technique Component, Nairobi, Kenya, 13 March to 7 April. Deadline for nominations 16 January 2006.

The training course will aim at exposing the participants to the principles of entomological and other baseline data collection, as needed in preparation of integrated area-wide national and / or sub-regional tsetse and trypanosomosis intervention campaigns, which may involve a tsetse SIT component. Other national / international partners, such as international institutions of the CGIAR system based in Nairobi, may contribute relevant components of standardised baseline data collection, particularly regarding veterinary, environmental and socio-economic information.

The course will be open for 26 participants from IAEA and / or FAO Member States in the region of Africa, which are affected by the tsetse and trypanosomosis problem and intend to initiate a national or sub-regional intervention project along the overall objectives of the AU-PATTEC initiative. The participants should be researchers or tsetse control personnel, who are or will likely be involved as key personnel in the planning and / or implementation of national or sub-regional integrated area-wide PATTEC projects against the T&T problem. The participants should hold at least a bachelor's degree in biology, entomology, human or veterinary medicine, parasitology or a related discipline. Participating countries are encouraged to submit more than one application to provide scope for IAEA final selection. The training course will be conducted in English and, consequently, participants should be capable of freely expressing themselves and following lectures in this language.

Nominations should be submitted in duplicate on the standard IAEA application form for training courses/workshops (downloadable from: http://www-tc.iaea.org/tcweb/participation/astrainee/default.asp). Completed forms should be endorsed by and submitted through the official channels established (namely the Ministry of Foreign Affairs, the National Atomic Energy Authority, the Office of the United Nations Development Programme, the office of the FAO Resident Representative or the Ministry of Agriculture). The completed forms must be received by the International Atomic Energy Agency, P.O. Box 100, A-1400 Vienna, Austria, not later than **16 January 2006**. Nominations received after this date or applications which have not been routed through one of the aforementioned channels cannot be considered.

Advance nominations by facsimile (+43-1-26007), or email (Official.Mail@IAEA.ORG) are welcomed. The facsimile / email should contain the following basic information about the candidate: name, age, academic qualifications, present position including exact nature of duties carried out, proficiency in English and full working address including telephone / facsimile numbers and email address.

Special issue of the International Journal Insect Biochemistry and Molecular Biology (IBMB) entitled: Insect Transgenesis and its Potential Role in Agriculture (Insect Mol. Biol. and Biotech. Volume 34, 2004).

The issue contains six working papers of the final Research Coordinating Meeting (RCM) on "Enhancement of the SIT through Genetic Transformation of Arthropods using Nuclear Techniques" held in Capri in 2002. The journal IBMB is widely read and has an impact factor of 2.358. Two additional papers, written by observers attending the RCM, and a review paper by A.S. Robinson, G. Franz and P. Atkinson are also included. The papers address technical constraints to the use of transgenesis as a tool to improve components of operational SIT programmes. Special emphasis is given to mechanisms that can be used to decrease any potential risk associated with the technology. The special value of this publication lies in the compilation of several papers, written by the leading experts in the various areas of insect transgenesis, into one publication. Therefore, the reader can obtain an immediate and complete overview of the current state of the art in the field insect transgenesis as applied to the improvement of the SIT.

Environmental Benefits of Medfly Insect Technique in Madeira and Their Inclusión in a Cost-Benefit Analysis.
IAEA-TECDOC Series No. 1475

This study was funded by the Joint FAO/IAEA Programme of Nuclear Techniques in Food and Agriculture. It presents an economic model and the methods selected for the valuation of environmental benefits of the Mediterranean fruitl fly sterile insect technique (SIT) in Madeira (Madeira-Med). It quantifies the key costs and benefits of Madeira-Med to carry out an economic analysis to assess the economic returns of SIT use in Madeira, including the benefits obtained from environmental savings. Recent cost-benefit analyses for proposed insect pest eradication or suppression programmes have included some environmental factors; however, a systematic valuation of these factors, as developed in this study, had not been carried out in previous analyses.

IAEA-TECDOC Series No. 1475, 2005, ISBN 92-0-110505-3. English € 15.00. Date of Issue: 8 December

Irradiation As Post-Harvest Phytosanitary Treatment

Arved Deecke, Director General of PHYTOSAN S.A. de C.V. is very pleased to announce that as of November 16, 2005 PHYTOSAN has received its nuclear license for construction of a gamma facility in Matehuala, San Luis Potosi, Mexico, from the Mexican Commission of Nuclear Safety and Safeguards (CNSNS). The permit covers the installation of a MDS Nordion irradiator with 2MCi maximum cobalt-60 activity.

Conceived jointly with the National Plant Protection Organization (DGSV) of the Mexican Ministry of Agriculture, this facility will primarily serve as phytosanitary treatment for fruits and vegetables destined for restricted fruit fly-free areas in northern Mexico and for export to the United States. Expect this facility to be operational in 2006. Plans are under way for another irradiator in the State of Jalisco to be commissioned early in 2007.

The World's Worst Invasive Species

The Invasive Species Specialist Group (ISSG) updated and reprinted the booklet 100 OF THE WORLD'S WORST INVASIVE SPECIES, and also recently produced Spanish and French versions of the same publication as: 100 DE LAS ESPECIES EXOTICAS INVASORAS MAS DAÑINAS DEL MUNDO, and 100 DES PIRES ESPECES EXOTIQUES ENVAHISSANTES DU MONDE. Species were selected for the list based on: 1) their serious impact on biological diversity and/or human activities; and 2) their illustration of important issues of biological invasion. Files for the English and Spanish versions can be downloaded respectively from: http://www.issg.org/booklet.pdf and http://www.issg.org/Spanish.pdf. Hard copies of any of the three are available through ISSG. ISSG, School of Geog. and Environ. Sci., Univ. of Auckland, Pri. Bag 92 019, Auckland, NEW ZEALAND. Fax: 64-9-373-7042. E-mail: mailto:issg@auckland.ac.nz.

Recent web sites

IAEA website relating to tsetse flies:

http://www.iaea.org/worldatom/Press/Focus/Tsetse/

IAEA website for Zanzibar tsetse fly video:

http://www.iaea.org/worldatom/Press/Multimedia/Videos/tsetse.shtml

IAEA website on Food Security video [also talks about tsetse and SIT]:

http://www.iaea.org/worldatom/Press/Multimedia/Videos/GC45Movies/sf-food.shtml

Map of Africa showing tsetse fly zone:

http://www.iaea.org/worldatom/Press/Focus/Tsetse/images/tsetse_map500x448.jpg

Agriculture Research Council (ARC) / Institutes / Infruitec-Nietvoorbij / Divisions / SIT Division. www.arc.agric.za

In Memoriam

Barbara Dueben

Bob Heath wrote:

Dear All:

As many of you know I had the privilege to work with Barbara while at CMAVE and continued working with Barbara and Peter Teal after moving to Miami. At this time of sadness it is difficult to recall all the positive aspects and contributions that Barbara made to CMAVE, science and me. Her willingness and organizational skills were superb and helped lead our group in Gainesville to be a premier research group. As an example, several weeks ago I called Barbara to ask if she had any information from the early 80's on who synthesized the sweet potato weevil pheromone. Within a day she called and reviewed the history of this pheromone and said she had it all available in her notebook. As Peter mentioned, she was a stalwart mentor for summer interns, high school students, graduate students and Post doctoral associates. In addition to her scientific skills Barbara shared an unprecedented enthusiasm for horses, cats and the Florida Gators. Barbara was a significant asset to science and a great friend. Having known and worked with her for more than 25 years I realize that will miss her tremendously. Barbara would want us to continue and we have been fortunate to have had the singular opportunity to know her.

For Barbara - GO GATORS

Robert Heath. USDA, ARS,

Subtropical Horticulture Research Station Miami, Florida, USA.

Peter Teal wrote:

It is with great sadness that I have to tell you that Barb Dueben passed away last night after a brief illness. Barb began working in the Chemistry Unit of CMAVE in 1979 and was a fantastic help to many of us. Among the very important projects that she was involved with were the identification of the Sweet Potato Weevil sex pheromone, the Velvet Bean Caterpillar sex pheromone and new highly effective attractants and traps for Tephritid Fruit Flies including the most effective trapping system ever developed for the Mediterranean fruit fly. In my view she was the most knowledgeable person in the world on the chemical ecology of Tephritid fruit flies. In addition to her tremendous abilities to conduct science Barb was a wonderful mentor and during her time with us she trained many summer interns, high school students, graduate students and post doctoral associates. She was also a great manager and essentially ran the day to day operations of both my laboratory and that of Bob Heath before he moved to Miami. In fact, during my time as Centre Director, Barb took on most of my responsibilities in the laboratory and made many wonderful contributions. Barb also stepped up when our Safety Officer was called to active duty and took on the majority of his responsibilities to ensure that CMAVE was one of the most safety conscious Centres in ARS. Barb was a fantastic asset to CMAVE and a great friend. I consider it an honour to have known her for 25 years and will miss her tremendously.

Sincerely,

Peter Teal. Research Leader Insect Chemistry Research Unit. USDA, ARS, Gainesville, Florida, USA.

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