

INSECT AND PEST CONTROL



NEWS LETTER

Joint FAO/IAEA Division
of Nuclear Techniques
in Food and Agriculture and
FAO/IAEA Agriculture and
Biotechnology Laboratory, Seibersdorf
International Atomic Energy Agency
Vienna



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A. TO THE READER

Letter from the Section Head

A seven-member multi-national external review team under the Chairmanship of Dr. Isi Siddiqui, Deputy Secretary of Agriculture, USDA, and with Dr. John Mumford, Deputy Director of the Centre for Environmental Technology, Imperial College, London as Rapporteur, carried out a thorough evaluation of the Insect and Pest Control Subprogramme of the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture during 18-22 January, 1999 as part of the regular IAEA Programme Performance Appraisal System (PPAS).

In addition to assessing extensive background material, covering the period 1990-1998 and assembled by an external reviewer, as well as a mid-term strategy prepared by Subprogramme staff for the six-year period 1999-2004, the team listened to the presentations made by the management and scientific staff of the Joint FAO/IAEA Division and the Subprogramme, and visited the Seibersdorf entomology laboratory. Also, the team met individually administrative and scientific staff of the Subprogramme, related Subprogrammes within the Joint FAO/IAEA Division, and management of the Departments of Nuclear Sciences and Application and the Department of Technical Co-operation, and held telephone interviews with representatives of FAO's Plant Production and Protection and Animal Production and Health Divisions in Rome.

We can report that the external review team has largely endorsed the work of the Subprogramme and the overall three-pronged approach based on a) normative work (information, decision support and other services), b) research and development (in Seibersdorf and through Co-ordinated Research Projects or CRPs) and c) technology transfer through technical co-

operation projects with Member States to implement SIT field programmes to address key pest problems. The complete summary of the evaluation report with these positive findings follows.

As we have started the 1999-2000 biennium, we are therefore secure in the knowledge that we have a programme with the appropriate focus. Thus we are initiating this year two FAO/IAEA Coordinated Research Projects on: "Evaluating the Use of Nuclear Techniques for the Colonization and Production of Natural Enemies of Agricultural Pests", and "Quality Assurance of Mass Produced and Released Fruit Flies", the commencement of which had been pending the review's outcome. In addition, recommendations made by the review are being taken into account for the 2001-2002 programme of work and budget, which is presently under elaboration.

Whilst we have only just started a new biennium (1999-2000), I would like to draw your attention to the fact that proposals for support under the 2001-2002 IAEA Technical Cooperation Programme have to be submitted this autumn through official national channels.

Findings and Conclusions of the External Review

"The review team fully endorses the rationale for area-wide control of insect pests. It is clear that radiation induced sterility of mass reared insects has played and for the foreseeable future will continue to play an important role in area-wide insect pest control. Additional enabling technology and management, which is being developed by this Subprogramme, is essential for the effective use of SIT based area-wide control. There is considerable evidence that the demand for area-wide insect pest management is increasing due to environmental, health and international trade requirements. Insect pest control, using the techniques developed in this Subprogramme, contributes directly to the missions of both FAO and IAEA and should be fully supported within both organizations.

“The overall assessment of the review team is that the Subprogramme has delivered exceptional technical achievements which have been implemented by many Member States with substantial impact on the effectiveness and efficiency of insect pest management, in both the fields of plant protection and animal health. Significant advances have been made in laboratory and rearing facility techniques that have made radiation induced sterility an economically feasible control technique for some key insect pests. The Subprogramme has contributed substantially to the awareness and operation of area-wide insect pest management.

“The review concludes that the staff in the Subprogramme are exceptionally talented and dedicated to the programme mission. They are internationally recognised leaders in their fields with clear visions to meet the needs of Member States. The Subprogramme is unique in providing international networking and expertise in the sterile insect technique (SIT), area-wide insect control, laboratory and mass-rearing facility management. It also serves as an international source of Medfly and tsetse fly genetic material, which is made available to scientific and governmental organizations. Furthermore, the co-ordinated research projects (CRPs) administered by the Subprogramme play a vital role in developing basic components essential for control operations, focusing international attention and fostering international co-ordination. Subprogramme publications and related materials, symposia and training courses provide easy access to the subject of area-wide control and SIT to both Member States of both FAO and IAEA, as well as non-governmental organizations.

“The review indicates that zero budget growth and recent budget reductions and retirements without replacements have created difficulties for the Subprogramme in meeting its objectives, especially in tsetse research and development activities. The budget situation is further exacerbated by legal inhibitions against accepting some forms of extra-budgetary funds, which have resulted in some external Medfly funding being refused. The relatively high proportion

of Technical Co-operation funding in the Subprogramme indicates high levels of Member State demand and it was felt that further external funding could be successfully sought.

“Socio-economic and environmental benefits of area-wide SIT projects are not fully documented in many cases and cannot be fully addressed by the entomologists who implement SIT programmes. This information is essential for planning and evaluating major insect control projects and would, in many cases, provide background support for additional internal and external funding

“There appears to be a risk averse attitude among some managers towards large projects such as area-wide insect control in which very high levels of performance are expected, particularly where eradication is the objective. Continued experience of success in such programmes should encourage greater confidence. However, it should be realised that while SIT has proven to be a highly effective eradication tool for a number of plant and animal insect pest species, it still remains an experimental tool for other insect pest species and much must still be learned by the study of sterile male-target female dynamics in the field. Other projects are developing in which insect suppression using SIT is the objective and these offer less risk and may result in greater opportunities for commercial uptake.”

With best wishes



Jorge Hendrichs

B. STAFF

The Subprogramme staff, consisting of those in the Joint FAO/IAEA Division located in the Vienna International Centre, those in the FAO/IAEA Agricultural and Biotechnology Laboratory in Seibersdorf Laboratory and field experts, are listed below.

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C. FORTHCOMING EVENTS

I. Research Co-ordination Meetings (RCM)

“Medfly Mating Behaviour Studies Under Field Cage Conditions”, 29 June - 3 July, 1999, Antigua, Guatemala. 4th and final RCM.

“Molecular and Genetic Approach to Develop Sexing Strains for Field Applications in Fruit Fly Sterile Insect Technique Programmes”, 12 - 16 July 1999, Tapachula, Mexico, 3rd RCM.

“Quality Assurance of Mass Produced and Released Fruit Flies”, 27 September - 1 October 1999, Vienna, Austria. 1st RCM.

“Genetics Application to Improve the SIT for Tsetse Control/Eradication including Population Genetics”, 3 - 7 October 1999, Mombassa, Kenya. 2nd RCM.

“Evaluating the Use of Nuclear Techniques for the Colonisation and Production of Natural Enemies”, 22 - 26 October 1999, Montpellier, France. 1st RCM.

“Improved Attractants for Enhancing the Efficiency of Tsetse Fly Suppression Operations and Barrier Systems used in Tsetse Control/Eradication Campaigns”, January 2000, Bamako, Mali. 3rd RCM.

“Enhancement of the Sterile Male Technique Through Genetic Transformation Using Nuclear Techniques”, August 2000, Iguazu, Brazil, 3rd RCM.

“Automation in Tsetse Mass-rearing for Use in Sterile Insect Technique Programmes”,

February 2001, Burkina Faso, 4th and final RCM.

II. Consultants Meetings

“Thematic Planning for Fruit Fly Control Activities”, 15 - 19 November 1999, Vienna Austria.

III. FAO/IAEA Training Courses

FAO/IAEA Regional Training Course on “Techniques Used for Area-Wide Control/Eradication of the Old World Screwworm Fly”, Screwworm Fly Laboratory, Institut Haiwan, Malaysia, 31 May to 12 June 1999

National Training Course on Integrated Fruit Fly Control, Arequipa, Peru, Autumn 1999.

FAO/IAEA Regional Training Course on “The Sterile Insect Technique as a Component for Integrated Area-wide Tsetse and Trypanosomosis Management”, 20 March to 14 April 2000, Tanga, Tanzania.

The course will last four weeks and will include lectures and practical work in the laboratory and the field. Emphasis will be placed on: principles of area-wide insect pest control / eradication; general introduction in the complexity of tsetse and trypanosomosis management; a refresher course in tsetse morphology and reproductive physiology, relevant to SIT programmes; introduction to tsetse mass-production; overview of epidemiology and methods for parasitological and serological monitoring techniques used in intervention programmes; methods for pre-release tsetse population suppression, fly population monitoring and maintenance of barrier systems; methods for sterile male releases; use of GIS and principles of decision taking in tsetse SIT eradication programmes; awareness of essential supportive and administrative aspects relevant to the operation of a tsetse SIT eradication campaign, including public relations activities; environmental appropriateness of tsetse control measures and of land use after intervention campaigns.

The course will be open to senior tsetse control staff, with preference to entomologists and veterinarians who are or will likely be involved in area-wide tsetse and trypanosomiasis management campaigns. Applications should be made on the standard Nomination for Training Course form (TA-3E) through one of the official channels (the National Atomic Energy Authority, the Ministry of Agriculture, the Ministry of Foreign Affairs or the Office of the United Nations Development Programme). Applications must be received by the IAEA **not later than 15 December 1999.**

Application forms for Training Courses can be obtained from the Agency, the national Atomic Energy Commission / Ministry of Energy, or from our web site (see address on front cover) under Meetings and Training Courses, Regional Workshops.

IV. Other meetings

Third meeting of the Working Group on Fruit Flies of the Western Hemisphere, Guatemala City, Guatemala, July 4-9, 1999 which is being co-funded by the Joint FAO/IAEA Division.

The XIVth International Plant Protection Congress, Jerusalem, Israel, July 25-30, 1999. The meeting includes a Symposium coorganized by the Joint Division entitled "*The Sterile Insect Technique (SIT), Past Present and Future*"

International Scientific Council for Trypanosomiasis Research and Control 25th meeting, 27 September - 1 October 1999, Mombasa, Kenya. The Joint Division will be organising a number of satellite meetings before and during the ISCTRC meeting.

IOBC Symposium on "Evaluating Indirect Ecological Effects of Biological Control", 17 - 20 October 1999, Montpellier, France. The 1st RCM of the CRP on "Evaluating the Use of Nuclear Techniques for the Colonisation and Production of Natural Enemies" will be held immediately following this meeting



D. PAST EVENTS (1998-1999)

I. Research Co-ordination Meetings (RCM)

"Evaluation of Population Suppression by Irradiated Lepidoptera and their Progeny", 26 - 30 May 1998, Penang, Malaysia. 3rd and final RCM. The final proceedings are being edited by F. Marec and J. Carpenter and will appear in *The Florida Entomologist*. (See page 13)

"Improved Attractants for Enhancing the Efficiency of Tsetse Fly Suppression Operations and Barrier Systems used in Tsetse Control/Eradication Campaigns", 26 - 30 May 1998, Penang, Malaysia. 2nd RCM

"Development of Female Medfly Attractant Systems for Trapping and Sterility Assessment", 26 - 30 May 1998, Penang, Malaysia. 3rd and final RCM. A TECDOC of the final proceedings will be available in July/August 1999. (See page 13)

"Enhancement of the Sterile Male Technique Through Genetic Transformation Using Nuclear Techniques", June 1998, Penang, Malaysia. 2nd RCM

"Automation in Tsetse Mass Rearing for Use in Sterile Insect Technique Programmes", 12-16 April 1999, Vienna, Austria, 3rd RCM.

Proceedings are available on request at the Insect & Pest Control Section's office.

II. Consultants and Other Meetings

"Standardisation of Quality Control in Fruit Fly Mass Rearing", 25-27 May, 1998, Penang, Malaysia.

“Co-ordination meeting for Mediterranean fruit fly SIT projects in the Near East”, 13-15 October 1998, Vienna, Austria.

“Thematic planning for Old and New-World Screwworm Control”, 10 - 12 November 1998, Vienna, Austria.

“Programme on African Animal Trypanosomosis”, 25-27 November 1998, Vienna, Austria.

“Formulating an Approach for Integrated Area-Wide Tsetse / Trypanosomosis Intervention in the Lambwe Valley, Kenya”, 6 and 7 April 1999, Vienna, Austria.

“Alternative Tsetse Suppression Techniques for Use before Sterile Male Releases”, 8 and 9 April 1999, Vienna, Austria.

Proceedings are available on request from the Insect & Pest Control Section’s office.

III. FAO/IAEA Training Courses

Seminar/workshop held in conjunction with INFRUITTEC on “Feasibility Assessment for Fruitfly Eradication using SIT”, Stellenbosch, Western Cape, Republic of South Africa, 28-29 April 1998.

National Training Course held in conjunction with DOAE and OAEP on “Integrated Area-wide Control of Fruit Flies”, 8-12 June 1998, Patum Thane, Thailand.

2nd National Workshop organised by SENASA/PROCEN in conjunction with FAO/IAEA on “Advances in Research Support for the National Fruit Fly Programme”, Buenos Aires, Argentina, August, 1998.

Group training course on “Plant Quarantine Procedures against Fruit Flies for Quarantine Inspectors and Supervisors”, 17 - 21 August 1998, Lima, Peru.

Group training course on “Integrated Control of Fruit Flies, with Emphasis on the Sterile

Insect Technique”, 30 November - 4 December 1998, Lima, Peru.

Second Workshop on Quarantine Procedures needed for the Creation of a Fruit Fly Free Zone in Tacna and Moquegua, Moquegua, Peru, 6 - 9 April 1999

The Interregional Training Course on the “Use of the Sterile Insect and Related Techniques for the Area-Wide Management of Insect Pests”, University of Florida, Gainesville, Florida, USA, 14 April - 19 May 1999. (Co-funded by the US Government, FAO and IAEA.)

As before this training course elicited considerable interest, and over 150 applications were received from more than 80 countries. 23 participants for the course were selected from 22 countries: Argentina, Botswana, Brazil, Burkina Faso, China, Costa Rica, Ethiopia, Guatemala, Jordan, Republic of Korea, Malaysia, Mali, Mexico, Portugal, Slovakia, South Africa, Syria, The Territories under the Jurisdiction of the Palestinian Authority, Thailand, Uganda, Tanzania and the USA.

IV. Other meetings

FAO/IAEA International Conference on “Area-Wide Control of Insect Pests, Integrating the Sterile Insect Technique and Related Nuclear and Other Techniques”, 28 May - 2 June 1998, Penang, Malaysia.

5th International Symposium on Fruit Flies of Economic Importance, 1-5 June 1998 Penang, Malaysia.

Combined proceedings of both events are being edited by Dr. Tan Keng Hong of the University of Sains, Malaysia (e-mail: khtan@usm.my) and are foreseen to be published in the autumn of 1999.



E. TECHNICAL CO-OPERATION PROJECTS

Over the last four years, the Section has had technical responsibility for over 35 technical co-operation projects. They fall under four major areas, namely:

- Tsetse
- Fruit Flies
- F-1 Sterility for the Control of Lepidopteran Pests
- Screwworm and Others

Current Operational Projects (1999-2000) are:

ALG/5/017 Control of the Date Moth using SIT/F-1 Sterility Principle
ETH/5/012 Integrating SIT for Tsetse Eradication
INT/5/145 Promotion and transfer of Sterile Insect Technology
IRQ/5/014 Field Monitoring and Laboratory Rearing of Old World Screwworm
ISR/5/009 Feasibility Study of SIT for Medfly Eradication
JAM/5/006 Eradication of the New World Screwworm: Preparatory Phase
JAM/5/007 New World Screw-worm Eradication
JOR/5/007 Feasibility of Area-wide Control of Medfly by SIT
LEB/5/013 Feasibility of Integrated Control of Medfly Using SIT
MAL/5/023 Feasibility of Old World Screw-worm Control through SIT
MAR/5/009 Control of Diamondback Moth by Sterile Insect Technique
PAL/5/002 Area-wide Application of SIT for Medfly Control
PHI/5/026 Integrated Control of Oriental Fruit Fly on Guimaras Island
POR/5/005 Mediterranean Fruit Fly Programme on Madeira
RAF/5/040 SIT for Tsetse and Trypanosomosis Management in Africa
RAW/5/008 Preparing to Combat the Old World Screwworm in West Asia.

RLA/5/039 Bi-national Project Chile-Peru: Eradication of the Fruit Fly in Southern Peru
RLA/5/044 Preparing Caribbean Eradication of New World Screwworm.
SAF/5/002 Feasibility Assessment for Fruit Fly Eradication Using SIT
SLR/5/002 Feasibility Study for a Mass Rearing Insect Facility
SYR/5/019 Controlling Codling Moth for Apple Crop Using SIT.
THA/5/044 Extension of Areas Under Integrated Fruit Fly Control
TUN/5/019 Control of the Date Moth using Radiation Sterilisation.
UGA/5/021 Integrated Tsetse Control in Buvuma Island - Phase II
URT/5/018 Post Eradication Entomological and Veterinary Monitoring on Zanzibar
URT/5/019 Support to National Tsetse and Trypanosomosis Management

In keeping with our policy to highlight activities in a few of our Technical Co-operation projects in each Newsletter the following projects are discussed in this issue.

Filter rearing system introduced in Madeira (POR/5/005)

Significant progress was made in implementing a filter rearing system at the mass-rearing facility located near Camacha. The system now extends to the release colony. Newly modified adult eggging cages that allow more light into the cage have been a factor in achieving greater egg production per female. Production currently stands at 32 million males per week in the release colony. Aerial releases were hampered by low clouds that diverted releases to other areas. After a recent review of the situation, it was decided to fly above the clouds to release the adults when possible. Aerial releases are being made over Madeira and Porto Santo Islands.

Middle East medfly projects (ISR/5/009, JOR/5/007, LEB/5/013, PAL/5/002)

The U.S. Agency for International Development (USAID) gave conditional approval to a 3-way project proposal submitted by Israel, Jordan and the Palestinian Authority, as part of the Middle East Regional Co-operation (MERC) Programme. USAID is willing to commit up to US \$ 2.5 million over

the next three years in support of area-wide medfly control using SIT. The funds would be split equally with each party receiving approximately US \$ 833,300. Final approval is pending submission of a revised proposal followed by contract negotiations. MERC funds will be used to expand SIT activities into new areas adjacent to and north of the Arava (Wadi Araba) valley.

The release of sterile temperature sensitive lethal (*tsl*) Medflies has continued over Israeli and Jordanian Territory. Trapping and fruit sampling provide evidence that native populations are declining and a number of settlements have not captured any wild flies for several months. Localized bait sprays are applied to those properties where adults are captured followed by intensive release of sterile flies by ground.

At the beginning of June an embargo on the movement of live animals that halted the delivery of *tsl* medfly male pupae from Guatemala to Israel was suddenly imposed. Attempts to find an alternative carrier and route met with little success. Three shipments were attempted, one never arrived, one was so late that it was not released, and the third was released despite having spent 72 hours in transit. An appeal from the IAEA to the CEO and general management of the airline resulted in a waiver of the embargo for the project, and shipments resumed in mid June.

The TC Project LEB/5/013 has taken steps to establish a colony of *tsl* medflies in Beirut. IAEA assisted these efforts by securing key equipment items including an irradiator. An expert mission was completed recently to train the staff on dosimetry practices and procedures for dose mapping. Radiation safety practices also were reviewed. A scientific visit to Guatemala by Ms. Najla Khoury was made during March/ April. Ms. Khoury participated in studies to assess sterile fly mating compatibility and competitiveness with wild flies in field cages. Flies irradiated at different dosages (0, 80, 100, 145 Gy) were compared. Another Lebanese scientist will travel soon to Guatemala to observe and learn how to mass-rear *tsl* medflies. These actions are preparatory to initiating mass-rearing at the agricultural research institute located in Fanar, Lebanon. The laboratory will have an initial production of 3 million *tsl* males per week. Flies that are produced will support small-scale

demonstration of SIT technology for control purposes to farmers and the general public. Eggs and pupae to start the new colony will come from Guatemala.

The Footnote a/ Proposal for the Territories Under the Jurisdiction of the Palestinian Authority (PAL/5/002) has been upgraded through a donation from the United States of America together with partial funding from IAEA Technical Co-operation. The objective of the project is to integrate SIT into the existing Medfly control programme in the Gaza Strip.

Old World Screwworm Projects (RAW/5/008, IRQ/5/016, MAL/5/023)

The Old World Screwworm (OWS) fly, *Chrysomya bezziana*, is an insect pest infesting warm blooded vertebrates and occurs in most of south-east Asia, throughout tropical and subtropical Africa and on the Indian subcontinent. OWS was probably absent from West Asia until recently and may have been introduced to the Gulf region only in the past 20 years. It causes widespread economic losses in livestock production as well as suffering to animals and to those people unfortunate enough to become infected. First results of recently initiated mitochondrial DNA comparisons carried out by FAO among different OWS strains indicate that the OWS population(s) in the Gulf States are less closely related to strains from Sub-Saharan Africa than to strains from Asia. The OWS population(s) of the Arabian peninsula may have been introduced through transit infestation via livestock shipments from Asia. Field surveys in the region, carried out during emergency assistance after a 1996 OWS outbreak in Iraq, confirmed that OWS already existed in several countries on the Arabian peninsula, including Iran, Iraq, Kuwait and Saudi Arabia. OWS has not yet been reported in Syria and Jordan, but it has been found in Iraq only a few kilometres away from the Iraqi-Syrian border. OWS is a major threat to livestock, wildlife, pets and humans in all countries in the West Asian region and potentially in the Mediterranean basin (North Africa and Southern Europe).

Three IAEA TC projects are currently supported by the Insect and Pest Control Sub-Programme:

- A regional project in West Asia (RAW/5/008) targets at a) entomological

surveying for OWS in the region; b) population genetic studies that are relevant to designing intervention strategies and appropriate quarantine measures; c) provision of OWS insect materials for various screening purposes (insecticides, larvicides, attractants); d) strain assessments, test transport and releases of sterile flies; and e) technical and economic feasibility assessment of an SIT component as part of an integrated area-wide approach to combat OWS in the region.

- A dramatic increase in incidence and a north-south expansion of OWS distribution in Iraq was observed in September-November 1997 (11,000 cases) compared to the same period in 1996 (2,000 cases). The largest (over 30-fold) increase was recorded in Babylon. Because of the severity of the OWS outbreak and its implications for adjacent countries, it is being treated as an emergency and the Agency initiated, in addition to the above regional project, a national project in Iraq on “Field Monitoring and Rearing of Old World Screwworm” (IRQ/5/016). This project deals primarily with a) laboratory rearing of OWS to provide flies for test releases (as part of SIT feasibility assessment) and b) entomological monitoring for improved seasonal information on OWS dispersal and population density.
- In view of the recent economic developments in Malaysia, the establishment of efficient agricultural systems, including livestock development, has been given high priority. The livestock sector in Malaysia experiences an OWS strike rate of 5.5%-32%, resulting in an annual loss of well over four million US dollars due to myiasis, especially in ruminants. A joint project is being undertaken by the Department of Veterinary Services of the Government of Malaysia and the Department of Agriculture, Fisheries and Forestry of the Government of Australia to develop a small OWS factory and initiate in September 1999 a demonstration release operation on the technical feasibility of the SIT against OWS. The Agency has been requested to provide additional assistance to this pilot release campaign, assist in economic assessments of OWS and

expected benefits from an area-wide intervention campaign (“Feasibility of Old World Screw-worm Control through SIT” MAL/5/023). As other countries in and outside the region are also affected by OWS, it was proposed that the Agency assume the role of co-ordinator between developing Member States and investigate the possibility of establishing a regional centre of excellence in Malaysia.

More Date Moths for SIT trials in Tunisia (TUN/5/019)

In Tunisia the date moth *Ectomyelois ceratoniae* (Zeller) causes substantial losses to the date crop in plantations and in storage. Research in Tunisia in recent years, conducted in conjunction with the Co-ordinated Research Project "Evaluation of Population Suppression by Irradiated Lepidoptera and their Progeny" (D4.10.11), showed that there is a potential to control this pyralid pest through the release of substerile male moths. However, before a pilot project can be conducted in the field, a mass rearing system must be developed to produce the large number of moths required.

Until now the date moth has been reared on dates or on a simple artificial diet. Other more nutritionally complete, but still relatively inexpensive, diets are currently being evaluated to improve larval survival, developmental rate and fecundity. To reduce cost, diets that do not require agar are being tested first.

To eliminate the handling of pupae, diets that slowly dry out and provide suitable cocooning/pupation sites in the diet are being assessed.

Major changes in the rearing protocol are under test: collecting adults directly from the diet using light traps, using one cage for both mating and oviposition, sterilising the surface of the paper egg sheets, and holding the diet in large open trays instead of closed containers. Temperature, relative humidity and photoperiod (with dusk and dawn periods to encourage mating) are strictly controlled in a newly constructed rearing facility. Precautions are being taken to prevent microbial contamination of the diet and insects.

It is anticipated that releasing certain volatile odours in the mating/oviposition cage will stimulate oviposition.

All of these changes should provide a rearing system that produces tens of thousands of moths with the same labour cost that earlier produced only thousands.

Two types of chemicals to mark moths will be tested -- Calco Red added to the diet to mark the internal organs of larvae which remain marked into the adult stage, and fluorescent dyes that can be applied to the adult moth.

The installation of a new gamma irradiator will, for the first time in Tunis, provide an irradiator that can accurately measure the dosage delivered to test insects. Both adults and pupae can now be treated quickly to select an optimum dose for sterility studies.

MODEL PROJECTS

Chile opens border to Argentinian fruit exports as a result of the successful SIT programme (ARG/5/005)

As a result of the Sterile Insect Technique model project in Argentina (ARG/5/005) on "Fruit Fly Eradication in the Southern Region", major economic benefits are now being achieved as a result of progress made in successfully applying the SIT against the Mediterranean fruit fly in the Provinces of Rio Negro, Neuquen and Mendoza. Not only have insecticide applications much decreased in fruit orchards since the start of the project, but also the quantity and quality of temperate fruit production has increased significantly.

In Mendoza Province alone the surface planted with new orchards just for fresh late-season peach production has been expanded 42% as a result of the absence of fruit fly damage, representing an annual added value of about \$US 5 million per year. In Patagonia, several fruit producing valleys (Bariloche, El Bolsón and Los Antiguas) have now been declared fruit fly free. Most importantly the neighbouring country of Chile, already recognised internationally as fruit fly free as the result of a previous FAO/IAEA SIT project, has allowed for the first time in March 1999 the fruit industries in Mendoza and Rio Negro Provinces to use Chilean ports for fruit export. Argentinian fruit exports amount already to US\$ 0.5 billion annually, and this opening of Chile to provide access to the export markets of Pacific Rim countries will represent major

future economic benefits to Argentina's fruit industry.

Argentina mass rearing facility is certified ISO 9001

In related news, the Mendoza medfly factory with a production of 300 million sterile males per week, has been externally certified to ISO 9001 by the Bureau Veritas Quality International. This is the first medfly factory to meet this high international standard.

New World Screwworm eradication programme gears up (JAM/5/007)

The National Screwworm Eradication Project (NSEP) on Jamaica is preparing for the first sterile fly releases in the middle of this year. The chilled fly emergence facility has been completed, and the equipment for it delivered, so they are ready to receive the first shipment of pupae, and the hangar for the release plane is complete. Training for the staff is underway, and trapping will start ahead of fly releases.

From the beginning of the year a public education campaign has been going on to raise awareness of the programme, with advertisements on radio and television and in the press. NSEP staff have also visited Agricultural Society shows around the country, and made presentations at various other functions. A seminar was given to standardise the presentations, and Eugenio Regidor Fernandez, a screwworm information specialist from Costa Rica, visited the island. An information corner was also developed for veterinary clinics.

The identification laboratory has been processing several samples per day, with the number having increased considerably since private veterinarians have been included. Up to March 1999 874 samples from all areas of the island had been checked, with 843 positive for screwworm. Highest numbers of positive samples have come from Kingston, Clarendon and St. Catherine parishes, with lower numbers from other areas.

With everything now set to start releases, prospects for eradication with two years of releases look very good. The feral dog population is not as large as at first thought, there are few wild animals to deal with, and the

sterile flies from Mexico are performing very well in Panama.

Baseline data collection well underway in Ethiopian tsetse project (ETH/5/012)

Baseline data collection for the tsetse model project in Ethiopia is now well under way. The second round of entomological monitoring in the first block (6,000 km²) of the project area was completed in March. More than 1,600 NG2G traps, baited with acetone and urine, were deployed in the surveyed area, which was divided into 102 10 x 10 km grids. The trap data confirmed that *G. pallidipes* is present at high density only in limited areas on the west side of Lake Abaya, and no flies were trapped in 55% of the surveyed area. It also confirmed that *G. fuscipes* is confined to the Deme River system, a tributary of the Omo River in the north-west of the first block. The network of trapping sites is now established, and fly trapping will continue for the rest of 1999 to monitor seasonal changes in fly distribution or density. So far flies have been reported up to 1992 meters above sea level, as measured by GPS units. More accurate digital altimeters have been received, and the altitude of all trap sites will be checked. The continuing discovery of tsetse at ever higher altitudes re-emphasises the importance of this project to protect the adjacent highland areas from encroachment.

A survey of cattle in the project area to record the prevalence of trypanosomosis has been initiated in May, and this survey will be repeated later in the year to compare wet and dry season prevalence. Direct parasitological examination is being done by the buffy coat technique, and sera are being collected for antibody ELISA. About 9,000 cattle, estimated to be around 1% of the cattle present, will be sampled each time in 61 sampling points, selected at random in 8 relevant strata.

A socio-economic survey is now organised for later this year, to record cattle holding, farming practices and area under cultivation both to provide a comparison with post eradication production, and as a basis for the early development of a sustainable post eradication land use plan.

A new field insectary was established at Arba Minch for the collection of pupae for establishing a colony at the Seibersdorf laboratories. Collection of wild flies and

rearing procedures were refined, resulting in a substantial increase of pupae being shipped to Seibersdorf. Work is now underway to convert the old building at Kaliti just outside Addis Ababa for tsetse fly production. An architect and structural engineer have been appointed to oversee the design of the main fly production factory, and they have recently visited Vienna for discussions on the design, and Central America to see the medfly factories at El Pino and Tapachula.

Zanzibar post eradication monitoring continued (URT/5/018)

Monitoring continues on Zanzibar to confirm the success of the eradication. In January 300 animals were bled in the south of the island, and a further 295 in the north in April. All animals were parasitologically negative for trypanosomosis. Antibody ELISA analysis of 700 serum samples also indicated no transmission (6% positive, the normal rate of false positives as the test is 94% specific). The last confirmed trypanosomosis case was in September 1997.

Tsetse fly monitoring continues to be negative throughout the island, with 33 months now since the last fly was caught in September 1996. Monitoring of other biting flies show substantial populations of *Stomoxys niger* in many locations on the island (apparent densities up to 360 flies per trap per day) with lower populations of *S. calcitrans* (10 flies per trap per day). Despite these high biting fly populations there is no indication that mechanical transmission can maintain trypanosomosis in the absence of tsetse.



F. EXISTING AND PLANNED CO-ORDINATED RESEARCH PROJECTS (CRP)

Evaluation of Population Suppression by Irradiated Lepidoptera and their Progeny (D4.10.11)

This CRP was concluded in June 1998. Drs. F. Marec and J. Carpenter are organizing the peer-review and editing of the final proceedings which will be published as a special issue of the Florida Entomologist, which is available on-line.

(<http://www.fcla.ufl.edu/FlaEnt/feissues.htm>)

Enhancement of the Sterile Insect Technique (SIT) through Genetic Transformation Using Nuclear Techniques (D4. 10.12)

The second RCM was held in Penang, Malaysia, 26-27 May 1998, in conjunction with the FAO/IAEA International Conference on "Area-wide control of insect pests integrating the sterile insect technique and related nuclear and other techniques". The participants reviewed the current status in the field of transformation of non-drosophilid insects and recommended research strategies for the remaining period of the CRP.

Since the initiation of this CRP in 1996, dramatic advances have been made in our ability to introduce genes into insects. Specifically, there are now multiple strategies available to routinely generate transgenic insects. So far, three different mobile element systems were used successfully to transform the medfly. Participating laboratories of the current CRP are therefore now in a unique position to incorporate this technology into the SIT and they will continue to develop vectors and identify strategic gene systems for use in the SIT.

It was proposed to hold the next RCM in 2000 in conjunction with the Entomology Congress in Brazil. Furthermore, the CRP was extended into 2001 and, consequently, there will be four RCMs.

Expected duration: 6 years (1995-2001)

Contract Holders (2) from Greece and New Zealand

Agreement Holders (6) from Australia, United Kingdom, United States (2) and Italy (2).

Development of Female Medfly Attractant Systems for Trapping and Sterility Assessment (D4.10.13).

This CRP was concluded in mid 1998 and has resulted in an effective female medfly attractant system that was tested in 16 countries and is now commercially available and being used in many operational projects including California and Florida. Dr. M. Heath has edited the final proceedings which will be available as a technical publication (TECDOC) from the IAEA in July/August 1999.

The TECDOC will be available from the Insect & Pest Control Section, or for details of how to obtain the document in electronic format or on microfilm contact the INIS clearinghouse (see the INIS web page at <http://www.iaea.org/programmes/inis/inis.htm> or e-mail chouse@iaea.org).

Medfly Mating Behaviour Studies under Field Cage Conditions (D4.10.14)

The last Research Co-ordination Meeting will be held from 29 June - 4 July in Antigua, Guatemala with 25 behaviourists and quality control experts participating. The peer-review and editing of final papers to be published in the Florida Entomologist will be coordinated by J. P. Cayol.

Slow motion video-recordings of the sexual behaviour of wild and/or mass-produced flies have been collected from Argentina, Costa Rica, Greece, Guatemala, Israel, Kenya, Madeira, Mexico and Reunion

for centralised analysis. A quantitative analysis (still in process) has shown that no consistent qualitative difference can be found between the courtship behaviour of males from the different wild populations.

Wild female flies exerting mate choice in field cage tests with host trees have been found to be the most reliable tool available to assess mating performance and sexual compatibility of mass-reared medfly males when competing with wild males for wild females. There is clear evidence from the tests and field assessment studies that some quantitative differences in terms of mating performance and sexual activity between mass-reared and wild flies can be detected.

Among the most important outcomes of the CRP it was shown that, for the countries represented in the CRP with the exception of some populations in Kauai, Hawaii, and Madeira, Portugal, no sexual incompatibility was encountered between mass-reared and wild medfly populations or among wild medfly populations from different geographic origins.

Expected duration: 5 years (1994 - 99)

Contract Holders (8) from Argentina, Costa Rica, Greece, Guatemala, Israel, Mexico, Reunion and Kenya.

Agreement Holders (1) from the United States.

A Molecular and Genetic Approach to Develop Sexing Strains for Field Application in Fruit Fly SIT Programmes (D4.10.15)

The first and second RCM's of this CRP have now been completed. The first was in Mendoza, Argentina (March 1996) and the 2nd in Guatemala City, Guatemala (July 1997). The venues were chosen as genetic sexing strains are being reared at facilities in both of these locations and this gives the participants the opportunity to appreciate the constraints associated with the introduction of genetic sexing strains into operational programmes.

During the course of the CRP genetic sexing strains have been introduced into mass rearing facilities in Argentina, Guatemala, Chile, Madeira and Crete. In addition Hawaii, South Africa, Peru and Western Australia are preparing to rear genetic sexing strains. The expertise developed in the CRP has been essential in order that this technology transfer meets the needs of the customer. In other fruit fly species, progress towards the development of genetic sexing strains has been made in the areas of polytene chromosome analysis and the isolation of genetic markers. There is also an increasing emphasis on the use of molecular techniques targeted to the cloning of sex determination genes.

A proposal has been made to extend the CRP for a further year into 2001. The next RCM will be held in Tapachula, Mexico from 12-16 July, 1999.

Expected duration: 5 years (1995-2001)

Contract Holders (6) from Argentina, Bangladesh, Brazil, Greece, Guatemala, Philippines and United States of America.

Agreement Holders (3) from Australia, Italy and the United States.

Genetic Applications to Improve the SIT for Tsetse Control/Eradiation including Population Genetics (D4.20.05)

The first RCM was held in Addis Ababa, Ethiopia in February, 1997. During the meeting detailed research goals were elaborated and they focused on the development of PCR based analytical tools which will be used to investigate the degree of population isolation of target populations in the Southern Rift Valley and Kenya, (*G. pallidipes*), around Lake Victoria (*G. fuscipes*), and Mali (*G. palpalis gambiensis*). It was also decided to develop polytene chromosome analysis for tsetse. Other work that will be carried out in the CRP includes the analysis of refractoriness in tsetse and the possible use of genetic incompatibilities

between different taxa of tsetse. A report of the meeting is available from the Section.

The next meeting will be held from 3 - 7 October 1999, in Mombasa, Kenya in conjunction with the 25th OAU/STRC ISCTRC Meeting

Expected duration: 5 years (1997-02)

Contract Holders (3) from Greece, Kenya and Italy.

Agreement Holders (5) from Greece, Kenya, Belgium, Canada, United States and Italy

Automation in Tsetse Fly Mass-rearing for Use in Sterile Insect Technique Programmes (D4.20.06)

Several stages in the mass production of tsetse have been addressed so far. Progress has been good in the automated stocking of production cages, where it is now possible to emerge flies under controlled conditions into production cages to give the desired female to male ratio of 4:1 with less than 0.5% females remaining in the un-emerged pupae, for *G. austeni*, *G. palpalis gambiensis* and *G. pallidipes*. The necessary conditions for other species remain to be determined. The next stage in this work is to institute large scale evaluation of the procedures, and to introduce the technique into the routine running of all the Seibersdorf colonies and then to other colonies.

After emergence of the females, the remaining male pupae have to be handled. Work is now underway on controlling the emergence of these males by manipulating the holding temperature to allow synchronous emergence, and on chill holding of the adult males in preparation for release.

The automated recognition of males and females has given mixed results. A transport system has been devised that moves the flies one at a time at emergence past a camera, where high quality images can be captured. So far though the variation in light intensity and orientation of the flies is too great for the image recognition software to reliably separate males and females.

Work on an improved system to handle cages for feeding is progressing well. A first fully automated prototype proved to be too complicated and a second prototype is now undergoing trials and shows good promise of reducing the effort of cage handling by approximately ten fold. The system holds 63 large cages on a single trolley that can be moved to feed all the cages simultaneously and then returned to the larval collecting unit. Prototypes of the new system will be transferred this year to TTRI, CIRDES, KETRI and Addis for field evaluation using existing cages, and the locally available tsetse species. The system is also being further modified to incorporate recommendations resulting from the recent 3rd RCM held in Vienna in April 1999.

Other work has looked at the handling factors affecting flight ability in irradiated males, increasing cage holding density by the use of inserts, energy saving and blood decontamination. This last is a very important factor in the running of large colonies, and the possibility of using pasteurization or UHT sterilization is being investigated.

The 4th and final RCM is scheduled for February 2001 in Burkina Faso.

Expected duration: 6 years (1995-01)

Contract Holders: (5) from Austria, Czech Republic, Burkina Faso, Tanzania and Kenya.

Improved Attractants for Enhancing the Efficiency of Tsetse Fly Suppression Operations and Barrier Systems Used in Tsetse Control/ Eradication Campaigns (D4.20.08)

This CRP was set up to address the shortcomings in attractants for a number of important tsetse species where the standard odours used for *G. morsitans* and *G. pallidipes* are poor or ineffective, and in general to try to improve attractant effectiveness and reduce cost.

So far the Nile monitor lizard has been confirmed to be the principal host of *G. palpalis gambiensis* and *G. f. fuscipes* by blood meal analysis, but odour experiments using live lizards have been inconclusive.

A number of natural kairomones and their analogues have been synthesised, and tested in laboratory experiments or in the field. Decylaldehyde increased caches of *G. austeni*, and linoleic acid, a possible precursor of 1-octan-3-ol also proved active.

Molecular modelling of the structure of known attractants has indicated possible new synthetic attractants, and several of these have proved active in laboratory tests. This approach could lead to the identification of not only more attractive and cheaper compounds, but also attractants for the current "difficult" tsetse species. Field investigations on these new potentially attractant compounds are underway.

Work is also going on to characterise the cuticular hydrocarbon sex pheromones of tsetse, for use in assessing population differences. Comparisons of conspecific populations have shown that the hydrocarbons mixtures are usually very similar.

Expected duration: 5 years (1995-2001)

Contract Holders (7) from Mali, Burkina Faso, Kenya, Uganda, Tanzania and Hungary.

Agreement Holders (2) from Switzerland and the United States.

Reports of the RCMs are available upon request from the offices of the Section.

The following two Co-ordinated Research Programmes are being initiated in the second half of 1999.

Quality Assurance of Mass Produced and Released Fruit Flies (D4.10.16)

Objective: To improve and standardise internationally quality control procedures for mass produced fruit flies. There are now over ten fruit fly mass rearing facilities in the world that produce sterile flies for SIT programmes. With international trade in sterile insects becoming a reality, it is important that producers and users apply standard international quality control

procedures. A CRP involving behaviourists, physiologists and mass rearing specialists will allow fine-tuning of the internationally accepted standards and procedures as well as developing new tests measuring more representative parameters. A Consultants Group Meeting on the International Standardization of Quality Control Procedures for Mass Reared and Released Fruit Flies was held in May 1997 in Vienna. It produced an updated international manual of standard QC procedures (available for downloading from the internet at http://www.iaea.org/programmes/nafa/d4/public/d4_pbl_5_1.html) and recommended implementing this CRP to address those technical issues that require fine-tuning and those that could not be resolved and therefore require a co-ordinated R&D approach to develop new or better QC tests.

Expected duration: 5 years (1999-04)

Thus far a total of 10 contract and 2 agreement proposals have been received. The first Research Co-ordination Meeting is scheduled for 27 September - 1 October 1999 in Vienna to plan and co-ordinate the research to be carried out under this CRP.

We encourage further proposals from behaviourists, physiologists and mass rearing specialists from rearing facilities and research institutions and universities for this co-ordinated research programme.

Evaluating the Use of Nuclear Techniques for the Colonisation and Production of Natural Enemies (D4.20.09)

Nuclear techniques have considerable potential for various uses in biological control. These applications should provide significant benefits to producing biological control agents and for using them to managing pests, facilitating trade, and protecting the environment. The First Co-ordination Meeting will focus on developing a research plan for the following

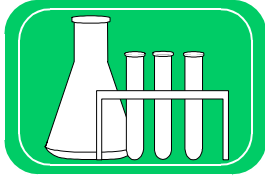
potential applications of nuclear techniques in biological control:

- a) to provide a non-destructive means for pasteurization/ sterilization of artificial diets. Using ionizing radiation to destroy micro-organisms in artificial media provides a viable method to sterilize media without the damaging effects associated with heat treatment, and allows sterilization to be accomplished after diet dispensing and packaging ("terminal sterilization").
- b) to provide non-reproductive supplemental hosts/prey for parasitoids and predator to build-up naturally occurring or augmentatively released natural enemies early in the season when pest populations are low. Non-parasitized hosts would be sterile, even further contributing to suppress the pest population.
- c) to sterile pests/hosts as food during commercial shipment of entomophagous insects/mites, thereby assuring quality during transport and that no new pest or pest race is introduced into the regions or countries of customers. Irradiation would also help fulfilling quarantine regulations by avoiding the transport of other hitchhiking pests.
- d) to improve the suitability of natural or factitious hosts/prey for use in parasitoid/predator mass rearing, by helping for example to overcome host resistance such as encapsulation of parasitoids. Radiation of hosts during mass rearing would also avoid the emergence of fertile adults of the pest, or the need for costly procedures to separate parasitized from non-parasitized insects.
- e) to reproductively sterilize exotic beneficial insects that are promising candidates for classical biological control, thus enabling safe field testing of their host or prey specificity on weeds or insect pests. In view that there are many reported cases of natural enemies becoming pests, and the fact that promising natural enemies are eventually not released because doubts persist as to their specificity after detailed assessments under quarantine conditions, safe field testing of specificity is a major

use of ionizing radiation not exploited to date.

Expected duration: 5 years (1999 - 04)

There have been over 30 proposals for this CRP and a number of proposals are under consideration. The first Research Co-ordination Meeting, to plan and co-ordinate the research, is scheduled for 22 - 26 October 1999 in Montpellier, France, in conjunction with the IOBC Symposium on "Evaluating Indirect Ecological Effects of Biological Control", 17 - 20 October 1999



G. DEVELOPMENTS AT THE ENTOMOLOGY UNIT, SEIBERSDORF

TSETSE

Mass Rearing Developments

Recently more emphasis has been placed on developing a system suitable for semi-industrial production of *Glossina pallidipes*. A tsetse production unit (TPU 2) was designed, constructed and is undergoing evaluation. It has already demonstrated that it has the basic requirements needed for holding a large number of cages with flies which can be easily transported for feeding and from which pupae can be collected. Based on this design, a basic module for tsetse mass rearing facilities in Africa has been proposed.

Different species of tsetse require different conditions for successful mating. Using *G. pallidipes* a number of important mating strategies were tested, these included: day 0 mating (introducing newly emerged flies directly into cages), sex ratio (number of males and females in the cage), resident males (leaving males permanently in the cage) and self stocking of production cages (allowing flies to emerge directly into the cage). It was also shown that alternate day feeding was not detrimental to performance of *G. morsitans* and *G. pallidipes* and this will go a long way to ease the logistics of mass rearing as only half a colony needs to be fed on any one day. Experiments with different diet components including freeze dried blood indicated the potential and limitations in the use of this type of blood for the maintenance of tsetse colonies.

Studies have continued on the effect of low temperature treatment on performance of male flies and have been extended to cover mature male pupae with the aim of manipulating the last few days of the pupal

period to have better control of male emergence. This study will be further extended to include the chilled adult release system for sterile tsetse.

Day 0 Mating and Sex Ratio

Experiments were set up to determine the effect of Day 0 mating and sex ratio on production and survival of *G. pallidipes*. Four production cages for each sex ratio were set up at the time of emergence together with a control group where 8 day old females were mated with 10 day old males for 3 days after which the flies were chilled and the males removed. Survival and production were monitored for 13 weeks. The goal of the experiment was to identify the lowest male to female ratio that would not compromise survival and production, and in so doing free more males for sterilisation and release. The male: female ratios used were 1:4, 1:5, 1:6 and 1:8 with a 1:1 ratio as a control. There was no significant difference in survival and pupal production of flies for all treatments. The results show that as with *G. austeni* it is possible to use Day 0 mating, resident males and a sex ratio in favour of females in production cages with *G. pallidipes*. This will impact positively on the efficiency of mass rearing the species.

Handling of *G. pallidipes* Male Pupae

By allowing adult female *G. pallidipes* to emerge before the males it is possible to produce a collection of pupae which are entirely male. These pupae can then be handled in such a way as to optimise male emergence in terms of operational efficiency for SIT releases. By holding the pupae at lower temperatures emergence can be delayed. Experiments were carried out to monitor the effects of reduced pupal incubation temperature on male emergence, mating and survival. At the temperatures used in the test no significant effects on these parameters were observed even though emergence could be delayed by up to two days. By using these procedures it will be possible to introduce a certain degree of flexibility into sterile male releases. These temperature experiments will be extended to

the adults in order to develop a chilled adult release system for tsetse.

Other Areas of Interest

- 1) *Freeze dried blood*: This can be used as a diet for adult tsetse on a short term basis. Using this product over a period of three generations led to a significant reduction in pupal production. Survival however was not affected and freeze dried blood could be used in an emergency or to feed males before release.
- 2) *Salivary gland infection*: A proportion of individuals from a colony of *G. pallidipes* from Uganda carries a salivary gland infection which impacts on the mating success of infected males. The recently colonised strain from Ethiopia does not carry the infection as is the case with the other species at Seibersdorf.
- 3) *Male specific DNA marker*: A PCR marker has been identified in *G. fuscipes* which can be used to differentiate males from females in the adult and pupal stages. The marker cannot be used to differentiate the sexes of the other tsetse species held at Seibersdorf. It will be used to develop a methodology to amplify DNA from sperm.
- 4) *New colonies*: A colony of *G. swynnertoni* has now been established and is being used to examine hybrid sterility in crosses with *G. m. centralis* from Botswana. Recently a sample of *G. brevipalpis* pupae has been received from South Africa and a colony will be established.

MEDFLY

Work has been continued on genetic transformation. Many lines are now being reared which have been generated using two different vector systems. Although the transformation efficiencies are still low it is now possible to induce medfly transgenics with a certain degree of reliability.

Max Scott from Massey University, New Zealand spent 4 months in the Unit working on the cloning of the Maleness gene in medfly.

The use of medfly genetic sexing strains (GSS) in operational programmes over the past 3-4 years has revealed some unexpected findings related to genetic recombination. In order to develop strategies to maintain the integrity of the strains it was necessary to analyse the basis of genetic recombination. A genetic and cytological analysis has revealed the cause to be a very rare recombination event that occurs in the male determining chromosome.

GSS are characterised under mass rearing conditions in Seibersdorf so that, following transfer to operational facilities, managers know what to expect of them and can make informed decisions relating to SIT implementation. A detailed study of the mass rearing of VIENNA 7-97, a temperature sensitive lethal GSS, was completed and the strain demonstrated excellent characteristics for the production of high quality males for field releases. After 12 months in mass rearing, VIENNA 7-97 remained genetically stable.

An extension of the Filter Rearing System (FRS) concept, called an "open filter", was explored to test the idea of maintaining flies under more natural conditions within a factory. Using VIENNA 7-97 an open filter rearing system was established and some production and behavioural traits documented.

Mating behaviour studies were continued on GSS Vienna 7-97 using a now standard experimental protocol. In a series of tests in Madeira the performance of the VIENNA 7-97 males with Madeiran flies was disappointing. These tests were repeated in Seibersdorf to try to confirm the unexpected results in Madeira.

A Second Type of Recombination in GSS

An analysis was completed of a second type of recombination in GSS. This type of recombination has now been identified in most GSS that are mass reared. The analysis demonstrated that a recombination event between segments of the Y chromosome was the cause of the instability. This event although extremely rare can rapidly

destabilise a GSS as it produces males with increased fitness. Using information from the genetic and cytological analysis, a new GSS was synthesised, VIENNA 7-97, incorporating a different Y chromosome and when mass reared this strain showed a much higher level of stability than previous strains. This particular strain has now been back-crossed into a highly heterogeneous genetic background and will be supplied during the year to various SIT facilities including South Africa and Australia.

The Open Filter Concept

The filter rearing system (FRS) developed at Seibersdorf, in collaboration with colleagues in Guatemala, has now been implemented in facilities in Argentina, Guatemala, Chile and Madeira, where GSS are being mass reared. The FRS, as well as maintaining stability in GSS, can also be used to improve the quality of mass reared insects and this was tested using an Open Filter. A VIENNA 7-97 fly colony was held in a large room in the middle of which was placed an oviposition cage and from which eggs were collected. After 7 generations of rearing, males were tested in a field cage for mating competitiveness with males of the same strain which had been held under standard colony conditions. The results were encouraging with a key mating index being significantly higher for the Open Filter males.

Field Cage Tests with Flies from Madeira

A mass reared GSS, VIENNA 7-97, was tested several times with wild flies from Madeira and in all cases a low mating compatibility was observed. However, when the same strain was tested with wild flies from South Africa it showed normal levels of mating compatibility. A test was also carried out with the same strain which had not been mass reared and in this case mating compatibility was normal. These experiments have been replicated several times with each time the same result and a convincing explanation for the data has not yet been provided. It is the first time that such a level of mating incompatibility has been

demonstrated between wild and laboratory strains of medfly.

Other Areas of Interest

- 1) *Mating compatibility*: A world-wide survey of mating compatibility between medfly populations and GSS has now been completed. It showed that there are no pre-mating isolation mechanisms in wild medfly populations and that a particular GSS can be used in many facilities.
- 2) *Heat treatment of GSS*: A generic heat treatment procedure has now been developed for GSS which ensures that all females are killed and males survive. Using this treatment on a specially constructed strain, a deeper insight was obtained into the behaviour of GSS during mass rearing.
- 3) *Inversions*: Inversions, when incorporated into GSS, will stabilise the strain and enable back-crossing to be carried out efficiently. Two of the 8 inversions isolated last year have now been made homozygous.

The 1998 Annual Report of the Entomology Unit is available on the Subprogramme's internet home page (see front cover) under Publications, Section Newsletters and Entomology Unit Annual Reports.



H. SPECIAL NEWS AND REPORTS

Fruit fly free zone in Baja California Sur, Mexico

The first infestations of fruit flies were detected in 1985 in the town of San Bartolo, La Paz municipality, Baja California Sur (BCS). The species was *Anastrepha ludens* commonly known as the Mexican Fruit Fly. Subsequently it spread into Los Cabos, Todos Santos zone as well as all the municipality of La Paz. Other species such as *A. obliqua* and *A. striata* have also been detected but at lower densities than *A. ludens*.

Sporadic captures caused by the movement of infested fruit in the south of the State were recorded in the municipalities of Comondú, Loreto and Mulegé though no established infestations were detected that caused damage to the host products.

The principal hosts of this pest in BCS are: all citrus with the exception of lime or Mexican lemon, mango, plums, guava, zapote, peach and nectarine.

In 1985 the first McPhail type traps were used for the capture of adults, but later on only sporadic actions took place without follow-up. It was only in 1992 that the Phytosanitary Campaign against Fruit Flies was established with the financial contributions from the Federal and State Government and producers, who organized themselves as the State Committee of Plant Health.

From that date phytosanitary inspection was instituted together with various control measures including the release of sterile *Anastrepha* flies and parasitoids (*Dia-chasmimorpha longicaudata*). Chemical control with extensive aerial spraying, including urban and agricultural zones in the most infested areas like Todos Santos, Pescadero and Elías Calles were intensified, as also were sampling activities, cultural control and mechanical control by means of destruction of host fruits that were not in commercial production such as zapote, extension activities and the training of technicians and producers.

As a result of these activities fruit fly numbers were drastically reduced from 1993. From 1992 to date a total amount of 11 million pesos have been invested; of this total 4.6 million pesos have been contributed by the Federal Government, 3.8 by the State Government and 2.6 by the producers.

As a result of the activities that were carried out under this Campaign, the official declaration of the municipalities of Mulegé, Loreto and Comondú as fruit fly free zones was published in the Diario Oficial de la Federación on 26 July 1995. Subsequently, on 26 February 1998, the declaration of all the municipalities of Baja California Sur as fruit fly free zones was published.

In 1996 steps were taken by the United States Department of Agriculture (USDA) to recognize the municipalities of Comonú, Loreto and Mulegé as a fruit fly free zone and removal of phytosanitary controls on exports from these municipalities to the US was published in the Federal Register on 20 January 1999.

It is calculated that the municipalities of Comondú and Mulegé, with a total area of

CAPTURES OF FRUIT FLIES AND EXPENDITURE PER ANNUM

YEAR	1992	1993	1994	1995	1996	1997	1998
Captured Flies	92,080	10,016	2,165	223	26	0	0
Mil. of Pesos	1.1	0.9	1.3	1.4	1.6	2.4	2.3

1890 and 160 ha respectively, can produce approximately 7,300 tonnes of export quality citrus with an estimated value of US\$3.3 million in the US market.

The municipalities of La Paz and Los Cabos have initiated steps to obtain similar recognition from the USDA.

A total of 1,220 producers at a State level and 745 in the municipalities of Comondú, Loreto and Mulegé will benefit from these activities.

Thematic Planning Meeting for the use of the Sterile Insect Technique for Old and New World Screwworm control, 10-12 November 1998

This thematic planning meeting attended by leading screwworm specialists from Australia, US, Mexico and Cuba as well as FAO and IAEA staff, reviewed best practices and experience gained in field operations, identified stakeholders and common objectives in new and old world screwworm control and outlined a strategy for implementing integrated pest control programmes at the regional, sub-regional and national level.

The New World Screwworm, *Cochliomyia hominivorax* (NWS) and the Old World Screwworm, *Chrysomya bezziana* (OWS) are major parasitic pests that profoundly affect the livestock sector in many countries and can also affect humans. The Office International des Epizooties classifies NWS and OWS myiases as List B diseases - transmissible diseases which can be considered to be of socio-economic and/or public health importance within countries and which are significant in the international trade of animals and animal products.

To effectively address this transboundary issue, regional strategies are required as well as active and sustained international co-operation. Important considerations in developing a strategy are:

- NWS and OWS are two distinct insects species with differing natural geographic ranges;

- there is a broader current knowledge base for NWS than for OWS where a major need for data exists;
- SIT is a mature technology for NWS having been instrumental in eradicating NWS from North and most of Central America, but needs to be validated for OWS. SIT is a key component of a technological package involving surveillance, suppression and regulatory measures required for control or eradication programmes;
- country commitment (from both the government and the livestock industries);
- favourable benefit/cost assessment;
- potential public health impact;
- potential threat to wildlife;
- if there is an expansion of the range of the pest, especially if this is into a new region (for example, the infestation of NWS into Libya in 1988, and OWS into the Persian Gulf and Iraq in the 1980's).

Technical solutions should ideally be used in the following scenarios to gain the most benefit from an investment:

- islands, including 'ecological islands' due to natural barriers or ones established with SIT at narrow interfaces between zones;
- at the edge of the distribution of the pest;
- as part of a regional approach.

Drawing on the considerations above, the strategic priorities for future programmes for each pest is as follows:

NWS

1. Caribbean
 - a) Cuba
 - b) Hispaniola (Dominican Republic and Haiti)
 - c) Trinidad and Tobago (in conjunction with control in Venezuela; subject to further experimentation and risk analysis of the reinfestation potential)
2. South America (subject to availability of additional rearing facilities; detailed field studies are essential before eradication programmes can be attempted)

- a) from the south upwards
- b) from north downwards
- c) west of the Andes

OWS

- 1. Middle East region;
- 2. South East Asia, preferably initially in infested nations with islands;
- 3. South Asia (Indian sub-continent);
- 4. Africa.

Fourth Meeting of the PAAT Programme Committee, 25 - 27 November 1998

The fourth meeting of the Programme Against African Animal Trypanosomosis (PAAT) Programme Committee was convened at the Headquarters of the International Atomic Energy Agency, Vienna, Austria, from 25 to 27 November 1998 and included representatives from OAU-IBAR, WHO, CIRDES, ICIPE, IFAD, CIRAD-EMVT, FAO and the IAEA and various national organisations. Discussions placed emphasis on the identification and endorsement of a five point action plan for trypanosomosis/tsetse control. This plan would then give the focus required for the investment of resources in accordance with the objectives of improving human welfare and facilitating the development of mixed farming and sustainable agriculture in areas offering the most promising potential.

The meeting was opened by J. Hendrichs who, on behalf of the Director of the Joint FAO/IAEA Division, welcomed participants whilst also recommending that the meeting consider a more aggressive area wide approach to tsetse control, based on the justification of the considerable constraint trypanosomosis continues to impose on rural development over much of sub-Saharan Africa. The meeting was Chaired by Professor P. Holmes with Mr. K. Katondo as vice Chairman.

The meeting considered a number of topics, and produced 26 recommendations and conclusions. Amongst these were:

- 4. The meeting notes the relevance of the Sequential Aerosol Technique (SAT) for application to sleeping sickness epidemics.
- 5. The meeting recognises two main approaches to tsetse and trypanosomosis management; one farmer/community based and the other area-wide. In considering these options it was recommended that within the context of the PAAT Plan of Action greater emphasis should be placed on the application of area wide pest management principles. It was noted that the area wide approach demands active support by the benefiting communities.
- 6. The meeting, based on the limited success of certain community based tsetse control schemes, concludes that not all technologies are appropriate to all situations and objectives, and recommends that further studies be undertaken to establish which mixes of techniques and modes of implementation best fit the different community and/or farmer based scenarios.
- 7. The meeting in recognition of the justification for area-wide pest management, recommends the consideration of SAT and SIT as techniques which both offer potential to make a significant contribution to the control and ultimate eradication of tsetse flies.
- 8. The meeting appreciates that the feasibility study for tsetse control in Ethiopia, using SIT, had already been initiated prior to a similar recommendation made in the PAAT assessment.
- 10. The meeting endorses the geographic demarcation of two priority areas; one in West Africa (the common cotton production areas of Burkina Faso/ Mali/ Côte d'Ivoire) and the other in East Africa (the western plus south-western parts of Ethiopia).
- 12. The meeting re-affirms the conclusion by the Scientific Environmental

Monitoring Group that SAT causes only minor direct negative environmental effects and, therefore, offers the potential for use in area wide programmes noting that criteria need to be developed to permit the safe use of this technique in different sets of circumstances.

20. The Committee endorsed the proposal that IAEA representation and participation within the PAAT secretariat should include not only the Joint FAO/IAEA Division but also the Agency's Technical Co-operation Department.
21. The meeting recommended that the IAEA, as a member of the secretariat, should nominate experts in order to ensure the availability of technical expertise in SIT at the level of PAAT Advisory Group Co-ordinators.

Sterile insect technique for suppressing and eradicating insect populations: 55 years and counting (E. S. Krafsur, J. Agric Entomol. 15 4 (1998) 303-317)

“The sterile insect technique (SIT) has a long, interesting, but controversial history. The concept, operation and outcomes of SIT programs have been criticized heavily and acceptance of this area-wide approach to insect management is minimal. These criticisms are examined in general and specifically with regard to Mediterranean fruit fly, *Ceratitidis capitata* (Wiedemann), and screwworm, *Cochliomyia hominivorax* Coquerel. The chief objections reviewed included evolutionary responses to SIT, the occurrence of sibling species, the role of weather in causing pest suppression and outbreaks during SIT programs, and the occurrence of undetected pest populations where eradication has been claimed. There is a paucity of data relating sterile fly releases to sterile mating rates in target populations and sterile mating to target population dynamics. The overkill strategy should be updated, especially in

experimental efficacy trials. Despite the carping, it is concluded that SIT is a highly effective method for insect population management. This environmentally benign method of insect pest suppression and eradication is under utilized even though using SIT has eradicated screwworm populations on a continental scale and many tephritid fruit fly infestations throughout the world. It would lend credibility to the efficacy of SIT if sterile mating frequencies were estimated in challenged populations and correlated with target population densities.”

Successful Restructuring of Tuxtla Screwworm Mass Rearing Factory

The Mexico-USA Screwworm Commission announced that on April 16-17, 1999 it successfully negotiated the termination of employment of all 635 employees of the Tuxtla Gutierrez screwworm mass rearing facility in Chiapas, Mexico. Despite the unions' and Government's efforts to modify the terms of “liquidation”, all employees accepted the Commission's generous severance package. Only one of the 115 employees that were selected to be re-contracted under the new salary schedule and working conditions declined the offer. Presently the facility is fully staffed, with about 300 employees (114 re-hires and the rest new), under Commission contract. This is a reduction of about 350 from the 635 employees previously working at the plant. Operations are running smoothly in all departments and employees are willingly performing multiple tasks, which was impossible to achieve before the “liquidation.” The friendly new atmosphere is very welcome and good news for the ongoing screwworm eradication activities in Costa Rica, Panama and Jamaica.

Use of nuclear techniques in biological control of insects and weeds (Nuclear News, February 1999 pp. 33 - 34)

Based on the report of a Consultants Group Meeting held in Vienna in 1997 ("Use of nuclear techniques in biological control: Managing pests, facilitating trade and protecting the environment") Patrick Greany and James Carpenter in their article in Nuclear News review the potential advantages of nuclear techniques in biological control. The potential improvements identified included:

- improvements in rearing media
- provision of sterilized natural prey to be used as food during shipment of natural enemies to remove the risk of the pest becoming established in a new area
- provision of supplemental food or hosts in the field, that are not themselves able to breed, to increase the initial survival and build up of a released natural enemy
- reproductive sterilisation of weed-feeding insects that are candidates for biological control of weeds, for use in open field trials

They discuss each of these points, and then ask "Why isn't this approach being used to greater advantage?" One reason is the shortage of irradiators, another the fear and misunderstanding of irradiation. The former may be ameliorated in the future with the development of accelerators and relatively low cost cabinet X-ray machines.

Control of fruit fly damage in chirimoya by mass trapping in Spain

In a two year experiment (1997/8) in southern Spain Dr. Pedro Ros has demonstrated the practicality of controlling medfly damage in a high value crop such as chirimoya (*Annona cherimollia*) orchards using trapping. In the first year conventional bait spraying was conducted in the orchard every 10 days (Buminal and malathion) from 1 August to 1 December, and in addition in half of the orchard one trap was

placed in each tree (145 traps). The traps were baited with the three component lure developed during the CRP D4.10.13 (see Newsletter 52, p23) (100 traps), Nulure (44 traps) and one with trimedlure for population monitoring. Throughout the period the fruit damage in the area with traps was reduced to one third as compared to the area treated with bait spray alone.

In the second year the bait spraying was restricted to the half of the orchard without traps, and traps were placed as before in the other half. Damage throughout the test period (1 August to 2 December) was lower in the trap area than in the bait spray area, averaging only two thirds the rate of damage. Mass trapping of medfly appears to be a promising alternative to insecticidal bait spray use in this high value crop, and would allow organic production with minimum loss through medfly damage. The trials will continue this year in a larger area which may permit the trap densities to be reduced.

Mission to assess peach fruit fly in Egypt

FAO and IAEA have arranged for three experts to travel to Egypt to assess the incidence and severity of peach fruit fly (PFF), *Bactrocera zonata*, that has been introduced accidentally into Egypt. Reports received thus far indicate that this pest is already wide-spread and causing serious damage to mango, guavas and citrus. However so far there are no reports from neighbouring countries in North Africa, the Near East or Southern Europe, so fortunately the pest may still be confined to Egypt.

The experts will arrive in June and spend two weeks to survey the extent to which it has spread from Alexandria, to determine measures to slow or halt its spread and to train local personnel how to apply male annihilation techniques (MAT) for pest suppression from the air or ground. MAT calls for mixing a small amount of insecticide with methyl eugenol, then

spraying small concentrated spots onto trees, telephone poles and other up-right surfaces along the roadway. To be effective, approximately 600 spots should be applied per square mile (231 spots per square kilometre). The team will also determine if eradication is feasible.

The South American Fruit Fly, *Anastrepha fraterculus* (Wied.); Advances in Artificial Rearing, Taxonomic Status and Biological Studies

Proceedings of a Workshop organized by the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture and held in Viña del Mar, Chile, 1 - 2 November 1996. IAEA-TECDOC-1064, 206pp.

Apart from the exotic Mediterranean fruit fly, *Ceratitidis capitata*, which is established throughout Central and much of Southern America other fruit fly species of the genus *Anastrepha*, which are native to the American continent, are also of considerable economic importance. In this group, of most economic importance are *A. obliqua* and *A. ludens* for Mexico and some Central American and Caribbean countries and *A. fraterculus* and *A. obliqua* for South America. In this publication, attention is focused on *A. fraterculus*, the South American fruit fly.

This species, as it is presently recognised, occurs from Mexico to Argentina and is reported from approximately 80 host plants, including commercial fruits of economic importance, such as mango, citrus, guava, apple and coffee. As *A. fraterculus* is considered to be of high economic and quarantine importance in many countries in South America, it is justifiable to recommend and promote the implementation of activities to strengthen knowledge of the species and develop techniques for its control and/or eradication. The development of the sterile insect technique (SIT) and other biological

control methods are very encouraging alternatives, as can be seen from examples in Mexico and the USA, where these approaches are in use against *A. ludens* and *A. obliqua*.

The Workshop on the South American Fruit Fly, *Anastrepha fraterculus* (Wied.), held in Viña del Mar, Chile in November 1996, was the first effort in Latin America to assemble fruit fly scientists and pest control programme managers from different countries in order that they could contribute with their experience and knowledge and at the same time acquire valuable information on the biology, behaviour, taxonomy and control methods of this important agricultural pest. Twenty three papers are presented, covering taxonomy, genetics, molecular biology, artificial rearing, ecology, biology, behaviour, control methods and a specific bibliography.

The IAEA-TECDOC-1064 can be obtained from the section, or in electronic format or on microfilm from the INIS document delivery service (see the INIS web page at http://www.iaea.org/programmes/inis/dd_srv.htm for details of local delivery services) for a fee.

Fourth annual exotic fruit fly symposium, Riverside, California

The fourth annual exotic fruit fly symposium will be held in Riverside, California, from 12 to 14 September 1999. The first two days will be a research meeting with an invited audience, to present the current progress and future plans by the various researchers funded to perform fruit fly research by the California Department of Food and Agriculture (CDFA) and the Citrus Research Board (CRB), and will end with a public session on 14 September. The CRB will continue with their regular autumn meeting 15 - 17 September.

Business plan for the production and sale of sterile insects by the Agricultural Research Council -

Fruit, Vine and Wine Research Institute *INFRUITEC/NIETVOORBIIJ*.

A business plan was completed in February under the "Model Project to Determine the Feasibility of Area Wide Control of Fruit Flies in the Western Cape Utilising the Sterile Insect Technique - Phase I: Hex River Valley Pilot Project" (SAF5002). The business plan presents the strategy, methodology, resource requirements, establishment of a trust in collaboration with the fruit industry, proposed sources of funding and other support required for *Infruitec/Nietvoorbij* to carry out its responsibilities in support of the Hex River Valley Pilot Project.

Design concept of HVAC-system for fruit fly mass rearing facilities.

Under a technical contract, Jiri Oborny of York (Austria) GmbH has produced a design concept for the heating, ventilation and air conditioning systems required for fruit fly mass rearing facilities. The report includes a study of several mass rearing facilities including the codling moth facility in Canada, with detailed recommendations for improvements. It then goes on to analyse the ventilation requirements of large scale medfly rearing, and presents a detailed design for a typical 100 million fly per week unit, under European conditions. The report is available to interested mass rearing facility managers.

ANNOUNCEMENTS

JP leaves

Jean-Pierre Cayol (JP to all his friends) left the IAEA at the end of April to take up a post with CIRAD in French Guiana, where he will be working on a multinational effort to eradicate the accidentally introduced carambola fruit fly, *Bactrocera carambolae* from South America.

After working for FAO for ten months in a pilot project in Southern Tunisia, JP spent almost four years in the Entomology Unit,

FAO/IAEA Agriculture and Biotechnology Laboratories, Seibersdorf, where he worked on medfly mating behaviour and sexual compatibility of different medfly populations and mass rearing strains. He published several papers on this subject and was responsible for the behavioural evaluation of genetic sexing strains. He was also much involved with the CRP on "Medfly mating behaviour studies under field cage conditions". He clearly showed that whereas there are behavioural differences between mass reared laboratory strains, wild medfly populations world-wide exhibit no mating incompatibility. This finding will greatly facilitate the application of medfly SIT with genetic sexing strains.

JP will be much missed by all colleagues in headquarters and in Seibersdorf, and we wish him all the best in his new position.

Arnold Dyck joins section

Arnold Dyck has joined the section on a five month contract to work on preparing outlines for a video and a book to be used as university level teaching material on the Sterile Insect Technique.

I. PUBLICATIONS

Special Items

INTERNATIONAL ATOMIC ENERGY AGENCY, Product Quality Control, Irradiation and Shipping Procedures for Mass-reared Tephritid Fruit Flies for Sterile Insect Release Programmes. http://www.iaea.org/programmes/nafa/d4/public/d4_pbl_5_1.html (1999)

INTERNATIONAL ATOMIC ENERGY AGENCY, The South American Fruit Fly *Anastrepha fraterculus* (Wied.); Advances in artificial rearing, taxonomic status and biological studies. IAEA-TECDOC-1064, IAEA, Vienna Austria (1999). 206pp. ISSN 1011-4289

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In Press

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GRANT, G. H., J. W. SNOW, M. VARGAS. "A screwworm eradication programme for Jamaica and other Caribbean nations", Area-Wide Management of Fruit Flies and Other Major Insect Pests (TAN, K. H. Ed.) (in press)

HEATH, R. R., et al. "Evaluation of female Mediterranean fruit fly (*Ceratitidis capitata*) synthetic attractant system for trapping and sterility assessment in thirteen countries", Area-Wide Management of Fruit Flies and Other Major Insect Pests (TAN, K. H. Ed.) (in press)

- KABAYO, J. P., U. FELDMANN. "Potential for area-wide control or eradication of tsetse in Africa", Area-Wide Management of Fruit Flies and Other Major Insect Pests (TAN, K. H. Ed.) (in press)
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