INSECT PEST CONTROL NEWSLETTER

No. 58 January 2002

A. TO THE READER

The year 2001 has again been a very intense and interesting period for all of us at the Insect Pest Control Sub-programme of the Joint FAO/IAEA Division. As you can see from the content of this newsletter, there are many exciting things to report in terms of normative, development and application aspects of SIT.

I would like to take this opportunity to highlight a few aspects. In terms of normative activities the development of a draft international standard to facilitate the transboundary shipment of sterile insects stands out. This was developed in response to requests from Member States and the private sector for regulation of the shipping of sterile insects. The draft standard will be considered, reviewed and hopefully endorsed over the next years by the Interim Commission on Phytosanitary Measures (ICPM), the governing body of the International Plant protection Convention (IPPC). Also of significance are the Fruit Fly Trapping Guidelines that have been developed to support the harmonization of monitoring procedures for these pest insects in view of the increasing fruit fly related transboundary interactions resulting from the rapidly growing trade in agricultural commodities, as well as travel, transport and tourism.

An upcoming event also in the normative area is an FAO/IAEA Expert Meeting on "Risk Assessment of Transgenic Arthropods" to be held at FAO, Rome from 8-12 April, 2002. The objective of the meeting are to a) assess current status of transgenesis in pest arthropods; b) to assess biosafety concerns for transgenic arthropod release; c) to provide guidance for future risk assessment protocols for case by case analysis; and d) to assess the possibility of establishing a working group under IPPC for setting guidelines for development and use of transgenic insect technology. Transgenic technology is now almost routine in many insect species and improvements are continually being made. Genetic vectors are functional in many insect orders and there is no technical reason why this technology cannot be applied for any pest or biocontrol agent. However, a major technical concern is the genotypic and phenotypic stability of the transgenic strains and their ability to express the transgene in a reliable and predictable way. A second area of concern is the biological fitness of transgenic strains. In addition to these technical questions, the whole area of trangenesis and the release of transgenic organisms will require a thorough risk assessment protocol, moving from the laboratory through field cages to open field release. There are currently four main areas where transgenic arthropod technology is being developed: a) improving strains for SIT; b) developing refractory disease vectors; c) improving strains for biocontrol; and d) using insects as vaccinators.

An important event at the end of 2001 was the Resolution on the Pan African Tsetse & Trypanosomosis Eradication Campaign (PATTEC) adopted by the FAO Conference held in Rome, 2-13 November 2001 (for the full text of the resolution see page 39).. The resolution acknowledges the severity of the trypanosomosis problem in sub-Saharan Africa, and the potential benefits of tsetse elimination, and calls upon affected member nations to include tsetse eradication in their Poverty Reduction Strategy Papers and for the FAO to support them in their efforts to combat the diseases and their vectors, and in particular to support the OAU initiative of PATTEC. A subsequent meeting attended by representatives of interested countries and FAO staff was held to explain the role of PAAT (Program Against African

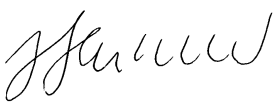
Trypanosomosis) and the efforts to harmonize the roles of PAAT and PATTEC. The country representatives recognised the relevance of both PAAT and PATTEC, and the priority attached by FAO to harmonizing their activities.

Looking forward into the coming year, we are starting the new programme cycle for 2002-2003. Some of the main programme changes involve a realignment to reduce research and development on medfly mass rearing since other facilities are better able to address large scale mass rearing; increase focus on regional programmes in order to address transboundary issues; target other key insect pests, such as *Anastrepha* and codling moth; and increase emphasis on quality assurance in order to improve efficiency. Additionally, increasing effort will be made to examine commercialisation of some components of SIT.

I would like to call your attention to two moth related events that we are organizing for 2002: the start of a new CRP on "Improvement of Codling Moth SIT to Facilitate Expansion of Field Application", and an interregional training course to take place at the codling moth SIT suppression programme in British Columbia, Canada. For both events, which are tentatively planned for August 2002, we are encouraging applications. For another new CRP on "Genetic Sexing and Population Genetics of Screwworms", which is holding its first Research Coordination Meeting in early February in Brazil, we are still receiving additional applications to achieve a good geographic distribution of participants working on the different screwworm populations in the world.

On the staff side there have been some changes. We are fortunate to have Dr. Marc Vreysen joining the team as Technical Officer for the tsetse programme and to support the growing activities related to moth SIT. Marc has great experience in tsetse SIT and an extensive publication record in this field. Without doubt he will contribute greatly to the Insect Pest Control Sub-programme. We also welcome our new secretary Magali Evrard and trust she will provide support to the Section for many years. Dr. James Novy has replaced Wendell Snow in Jamaica as International Advisor of the ongoing screwworm eradication project on the island. We sincerely thank Wendell Snow for his commitment and dedication during his years in Jamaica to establish this project. We all wish him many years of happy retirement. Dr. Abdeljelil Bakri has returned for a 12-month spell to continue his work on the development of the IDIDAS database on radiation doses for arthropod disinfestations and sterilization.

On behalf of all of us at the Sub-programme, I would like to thank those of you who are involved in one way or another in SIT-related R&D and action programmes, for your collaboration and hard work. We look forward to another fruitful year and wish you a very successful 2002.



Jorge Hendrichs
Head, Insect Pest Control Section

B. STAFF

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C. FORTHCOMING EVENTS

I. Research Co-ordination Meetings (RCM)

"Genetic Sexing and Population Genetics of Screwworms", 5 – 14 February 2002, Campinas, Brazil; 1st RCM and Workshop.

"Improved Attractants for Enhancing the Efficiency of Tsetse fly Suppression Operations and Barrier Systems Used in Tsetse Control/Eradication Campaigns". 18 – 22 March 2002, Entebbe Uganda, 4th and Final RCM.

"Development of Improved Attractants and their Integration into Fruit Fly SIT Management Programmes" 29 April – 3 May 2002, Stellenbosch, South Africa, 2nd RCM

"Enhancement of the Sterile Insect Technique through Genetic Transformation Using Nuclear Techniques", 8 – 12 July 2002, Capri, Italy, 4th and Final RCM. (See p. 28)

"Improvement of codling moth SIT to facilitate expansion of field application", 19-23 August 2002, Kelowna, British Columbia, Canada, 1st RCM.

II. Consultants and other Planning Meetings

FAO/IAEA Experts Meeting on "Risk Assessment of Transgenic Arthropods", FAO, Rome, Italy, 8 – 12 April 2002.

Consultants meeting on "Identification and establishment of molecular technologies to improve the effectiveness of SIT", Capri, Italy, July 2002,

Consultants meeting on "Identification of improved rearing techniques for *Anastrepha* and *Bactrocera*", Vienna, Austria, July/August 2002.

Consultants meeting on "Developing product and process quality control for standardization of tsetse mass production, sterilization and SIT release", Vienna, Austria, June 2002.

III. Other meetings

Meeting of the National Counterparts of IAEA Fruit Fly Projects in the Middle East. Stellenbosch, South Africa, April 30 May 3, 2002.

Interregional Training Course on the "Use of the Sterile Insect and Related Techniques for the Area wide Management of Insect Pests", Okanagan Valley, British Columbia, Canada. 5 – 30 August 2002.

This course will include field visits related to the Okanagan Kootenay Sterile Insect Release (SIR) Program[1], a program that releases sterilized codling moths as part of an area wide strategy of Integrated Pest Management in apple and pear orchards. Applications should be submitted through FAO, Atomic Energy Authorities or Ministries of Agriculture before the application deadline of 5 May 2002.

[1] http://www.oksir.org/

The 6th International Symposium on Fruit Flies of Economic Importance, 6 – 10 May 2002, Stellenbosch, South Africa.

The Meeting

The 6th International Symposium on Fruit Flies of Economic Importance, will be based on the same successful formula of the previous symposia. Paper and poster sessions will be presented, without parallel sessions. Poster presenters will have designated opportunities to share their findings with fellow delegates. There will also be opportunities for breakaway meetings.

Topics for the symposium will be wide-ranging as before: biosystematics and biodiversity; molecular biology, genetics and biotechnology; biochemistry and physiology; semiochemicals, behaviour and ecology; post-harvest and quarantine; management and action plans; natural enemies and beneficial fruit flies – and anything relevant that is not mentioned above. Suggestions for additional topics and possible workshops are welcome.

For more information consult the Symposium's web site[2].

Regional Training Course on GIS Under RAF/5/051

Under the umbrella of OAU's Pan-African Tsetse and Trypanosomosis Eradication Campaign, FAO/IAEA intend to organise a course on the "Use of Geographic Information Systems (GIS) for planning and implementing tsetse / trypanosomosis intervention campaigns and for monitoring responsible utilisation of natural resources."

Venue: Ouagadougou, Burkina-Faso.
Date: April or May 2002.
Duration: probably 3 weeks.
Candidates: Number: 12 from up to 10 tsetse infested West African Member States.
Academic qualifications: BSc or MSc in Biology, Entomology, Parasitology, Veterinary Sciences or a related field.
Working experience: experience in entomological, veterinary and ecological surveys relevant to tsetse / trypanosomosis intervention.
Skills: proven ability to work with MS-Excel, MS-Access and related computer programmes.

Eligible candidates need to provide evidence from relevant Government authorities that after the training they **will** be working as GIS specialists in tsetse / trypanosomosis intervention projects.

Applicants should complete the Training Course Nomination Form that can be downloaded from our web site[3] and submit it to IAEA referring to *RAF/5/051 – GIS course*. **Closing date 22 February 2002.**

A subsequent course will be organized for candidates from East Africa.

[2] http://www.fruitflysymposium.co.za/
[3] http://www-tc.iaea.org/tcweb/participation/astrainee/default.asp

D. PAST EVENTS (2001)

I. Research Co-ordination Meetings (RCM)

"Genetic Application to Improve the SIT for Tsetse Control/Eradication Including Genetic Sexing" 19 – 23 March 2001, Rome, Italy.

"Evaluating the Use of Nuclear Techniques for the Colonisation and Production of Natural Enemies", 18 – 23 June 2001, Tapachula Mexico; 2nd RCM.

"Automation in Tsetse Mass-rearing for Use in Sterile Insect Technique Programmes", 7 – 13 July 2001, Addis Ababa, Ethiopia; 4th and Final RCM.

"A Molecular and Genetic Approach to Develop Sexing Strains for Field Application in Fruit Fly SIT Programmes", 10 – 14 July 2001, Sydney, Australia; Final RCM.

"Quality Assurance of Mass Produced and Released Fruit Flies", 19 – 23 November 2001, Mendoza, Argentina; 2nd RCM. Held in conjunction with the Western Hemisphere Working Group of Fruit Flies of Economic Importance, 25 – 29 November 2001.

II. Consultants and other Planning Meetings

"Consultants Meeting on Developing Guidelines for Fruit Fly Trapping" 20 – 24 August 2001 – IAEA, Vienna, Austria

"Consultants Meeting on Trans-boundary Shipment of Sterile Insects" 30 July – 3 August 2001; IAEA, Vienna, Austria.

"First Planning Meeting on Development of the Sterile Insect Technique for Control of Malaria-Transmitting Mosquitoes", 5 – 8 June 2001; IAEA, Vienna, Austria.

"Second Meeting of the National Project Counterparts for the Fruit Fly SIT Projects in the Middle East", 26 – 28 March 2001; IAEA, Vienna, Austria.

"Consultants Meeting on Tsetse Suppression", 5 – 8 February 2001; IAEA; Vienna, Austria

"Thematic Planning Meeting on Establishing Tsetse Fly Free Zones through Area-wide Tsetse Intervention Involving the SIT", 29 January – 2 February 2001; IAEA; Vienna, Austria.

"Preparatory Meeting on the Central American Regional Fruit Fly SIT Project", 16 – 19 January 2001; IAEA, Vienna, Austria.

III. Regional Workshop on Using GIS for Data Management for Fruit Fly SIT

The regional workshop on "Using GIS for Data Management" took place in Vienna on July 2 – 6 2001. The workshop was attended by 8 participants from 4 fruit fly projects of the Near East region, namely Egypt, Israel, the Hashemite Kingdom of Jordan and the Territories under the Jurisdiction of the Palestinian Authority. Hands-on training and lectures, provided by the experts Mr. Patrick Akers

(CDFA), Ms. Anita Erkelens (FAO/IAEA) and Mr. Zowinde Koudougou (FAO/IAEA), focused on using GIS, working with GPS units and managing data using MS Access 2000 and ESRI Arcview 3.2 computer programs. All the participants agreed that fruit fly trapping, fruit monitoring and host location data will now be shared on a regional basis through the Joint Division, using as a common basis the Access and Arcview applications developed for the Arava Medfly Eradication Project (AMEP) in Israel. In that perspective, it was recommended that: (i) background geographical information would be made available to each project based on digitised maps or aerial photographs; (ii) a mechanism for transferring fruit fly monitoring data from 4 national to a single regional coordinate system be set-up; and (iii) support be provided to further improve the applications developed for the AMEP for the benefit of the regional activities. The use of GIS for fruit fly monitoring data management will provide easy access to regional information by all the participating projects and will allow a more regional approach to the fruit fly problem through transboundary technical communication.

IV. Consultants Meeting on Transboundary Shipments of Sterile Insects

A Consultants Group Meeting was held to review the transboundary shipment of sterile insects for plant pest control programmes. This meeting took place in Vienna at the Joint FAO/IAEA Division from 30 July through 3 August 2001. The group of consultant was called together in response to questions from national plant protection organizations (NPPO's) in light of the growing demand for alternatives to pesticide use as an exclusive control measure and the increasing interest from the private sector to invest in the Sterile Insect Technique (SIT).

The aim of the meeting was to facilitate the transboundary shipment of sterile insects for SIT programmes and to reach conclusions regarding the level of risk. In the process of this analysis, the group identified some routinely applied procedures, including best practices for shipment that have been shown in nearly 50 years of SIT application to reduce the risk to a negligible level. However, currently there are no internationally recognized guide-lines for regulating the shipment of sterile insects.

This analysis has been the basis for the development of a draft international standard for consideration by the Interim Commission on Phytosanitary Measures (ICPM), the governing body for the FAO based International Plant Protection Convention (IPPC), at their annual meeting in March 2002. International Standards on Phytosanitary Measures can take three to five years to be developed, reviewed and endorsed. The proposed standard integrates new versions of FAO/IAEA standard operating procedures for product quality control and shipping of sterile insects. The Consultants Group hopes that this effort will reduce the demand on the IPPC resources and promote adoption of a full standard in a timely manner. Harmonized guidance regarding regulation of the shipment of sterile insects will facilitate trade, while addressing any concerns about shipment of what could be quarantine pest species.

In the interest of harmonization, similar discussions may be needed at the Office International des Epizooties (OIE) and the World Health Organization (WHO) regarding the use of sterile insects for control of vectors of human or animal diseases.

V. Consultants Meeting on Fruit Fly Trapping Guidelines

Accurate methods for fruit fly population surveys are a prerequisite for effective decision-making in area-wide control programmes aimed at pest suppression, as well as those attempting to establish fruit fly free or low prevalence areas. The Joint FAO/IAEA Division, as part of its mandate to support the implementation of integrated area-wide fruit fly control programmes involving the use of the Sterile Insect Technique, has carried out two coordinated research projects over the last decade with the objective of developing and validating in the field fruit fly attractants and traps. As a result, improved fruit fly trapping systems have been developed that are being adopted by operational fruit fly control programmes.

At the 3rd Western Hemisphere Meeting on Fruit Flies of Economic Importance, held July 1999 in Guatemala City, representatives of National Plant Protection Organizations (NPPOs) of 21 participating FAO and IAEA Member States expressed trade-related difficulties as a result of a lack of uniformity in the application of the various trapping methodologies to survey fruit flies of economic importance. They recognized the acute need for some harmonization of trapping procedures in view of the increasing fruit fly-related trans-boundary interactions resulting from the rapidly growing travel, transport, tourism and trade. Thus they requested FAO and IAEA to develop in support of their fresh fruit trade some guidelines on fruit fly survey activities for the various fruit fly pests.

To address this problem a Consultants Group Meeting was held to prepare trapping guidelines in response to the IAEA Member States request. This meeting took place in Vienna at the Joint FAO/IAEA Division, from 20 to 24 of August 2001.

The resulting draft FAO/IAEA Trapping Guide-lines for Fruit Flies of Economic Importance, provide strategic guidance and harmonized direction on where and how to implement surveys in support of fruit fly control and quarantine activities. This draft document is the summation of recommendations put forth by a multi-national group of fruit fly workers that has the aim of providing objective information on fruit fly survey tools to NPPOs and industry in FAO and IAEA Member States. These Trapping Guidelines are to be considered as a "working" document to be regularly updated as survey techniques continue to improve and experience in fruit fly control programmes evolves.

Application of these recom-mendations, however, will not guarantee access to trade in fruit and vegetable commodities by an exporting country with an importing country. The use of information in this working document does not preclude the need for early contact of the exporting country's NPPO with the respective NPPO of the importing country to negotiate the specific trapping protocols that will be needed to fulfil the quarantine requirements of the importing country.

VI. Regional Fruit Fly Course in Support of the Regional Project on Development of Pilot Low Prevalence and Fly Free Areas for Fruit Exports (RLA5045)

With the aim of preparing a specialized group on control of fruit flies in Central America and Panama a regional course on fruit fly area-wide management was carried out from 7 to 26 of October 2001, at the International Fruit Fly Training Centre of the Moscamed Program

located in Metapa de Dominguez, Chiapas, México.

The course was financed by the IAEA through project RLA5045 by means of a contract with the Moscamed Program. Seventeen professionals from Central America participated in the course from the following countries: Belize (1), Costa Rica (4), El Salvador (3), Honduras (2), Nicaragua (3) and Panama (4). The IAEA financed participants from Costa Rica, El Salvador, Nicaragua and Panama. Participants from Belize were financed through the existing FAO Fruit Fly Technical Co-operation Project and participants from Honduras by IICA and the OIRSA-USDA/FAS Fruit Fly Project.

The course focused mainly on topics related to the planning and execution of detection and control activities for the Mediterranean fruit fly and various fruit fly species of economic importance of the *Anastrepha* genus endemic to the American continent.

The specific subjects covered were: organization of fruit fly control programmes, establishment and operation of detection and monitoring systems for different trap types and under different pest levels and programme objectives, use of fruit sampling as a detection and monitoring tool, utilization of chemical control (bait sprays) for suppression of populations on agroecosystems, areas of organic agriculture, and for forest areas, biocontrol through the use of parasitoids and the integration of all these methods with the SIT. Other topics included in the training programme were related to quarantine programmes established to allow fruit exports such as economic and technical feasibility studies, pest risk assessment, post-harvest treatment and the implementation and operation of a systems approach programme. These subjects were focused on the development of low prevalence and fly-free areas.

Over 30 lecturers participated in the training course from USA, Guatemala and Mexico. The duration of the course was three weeks, with 120 hours of effective training with 30% of the time dedicated to hands on training in the field. The course included visits to the medfly and *Anastrepha spp*. mass rearing and sterilization facilities and to the parasitoids mass rearing facility. Other visits included quarantine stations and to the State of Chiapas growers fruit fly control programme and research centres.

With this course an important and firm step towards the formation of a specialized fruit fly working group has been taken. This will constitute the basis for the efforts towards developing pilot fruit export areas in the Central America and Panama region.

VII. IAEA Scientific Forum on Nuclear Technology's Role in Serving Human Needs

A two day Scientific Forum was held 18 – 19 of September, 2001, Vienna, Austria, in conjunction with the IAEA's annual General Conference at the Austria Centre.

Science and technology's critical role in eradicating famine and disease, among the root causes of global instability, was address by some of the worlds leading experts including: Jeffery Sachs, Director of the Centre for International Development at Harvard University in the USA (via video-conference), Jose Vargas, former Minister of Science and Technology in Brazil, and Margaret Catley-Carlson, who chairs the Global Water Partnership.

The meeting underlined the contribution of nuclear science and technology to sustainable development and the betterment of human welfare and

stressed the need for the world's wealthiest nations to give it more support.

In the developing world, nuclear science and technology applied at the village level is providing for some of the world's poorest people with alternatives to suffering. In Africa it promises to eradicate the tsetse fly, carrier of sleeping sickness and nagana, a disease that binds millions of rural people to poverty by killing their livestock, the source of draught power. In Asia isotope hydrology techniques are helping to relieve the plight of millions of people in Bangladesh, whose drinking water is contaminated by arsenic. In Latin America isotopic and nuclear techniques are being used as tools in the fight against malnutrition.

In the last 10 years the IAEA has contributed nearly US $60 million towards expanding radiotherapy treatment for cancer, the use of isotopes in managing fresh water resources, and in the fight against the tsetse fly. The Agency places considerable emphasis on assisting partner countries to adopt new technologies and use them to the best effect by providing training and continued support.

VIII. 26th Meeting of the OAU International Scientific Council for Trypanosomiasis Research and Control (ISCTRC)

PAAT Advisory Group Meeting (26 – 28 September 2001)

A joint meeting of the Programme Against African Trypanosomiasis (PAAT) Advisory Group and the European Union funded Concerted Action on Integrated Control of Pathogenic Trypanosomes and their Vectors (ICPTV) was held in Ouagadougou from 26 – 28 September 2001. Several papers were presented on environmental monitoring, use of Geographic Information Systems (GIS), the activities at different national, regional and international institutions and on the tsetse / trypanosomosis situation and intervention measures in selected African countries. The presentation on the completion of an aerial spraying campaign in the northern half of the Okavango delta, Botswana, which eventually is anticipated to be complemented by an SIT component, received particular attention by the participants.

A special working group elaborated specific recommendations relevant to the implementation of the OAU Assembly of Heads of State and Government approved PATTEC Plan of Action, which was submitted to subsequent forums and meetings held in Ouagadougou.

PAAT – PATTEC Harmonisation Meeting (28 September and 4 October 2001)

In the presence of the Co-ordinator of the Pan-African Tsetse and Trypanosomosis Eradication Campaign (PATTEC), the Chairman of PAAT, the chairman of the OAU Pan-African SIT Forum and representatives of OAU/IBAR, FAO, WHO and IAEA various issues relevant to the required further harmonisation and concerted action between PAAT and PATTEC were discussed.

Besides confirming the respective roles of PAAT and PATTEC it was agreed that a) PAAT will assist PATTEC to mobilise resources for its activities; b) efforts be made as soon as possible to meet again and further advance the PAAT-PATTEC harmonisation; and c) the four mandated organisations (FAO, IAEA, OAU and WHO) should meet as soon as possible at high level to approve the outcome of the harmonisation discussions for implementation.

Directors' of Veterinary Services Meeting (29 – 30 September 2001)

OAU-IBAR organised a meeting of Directors of African Veterinary Services, with the key intention to formally brief the officials on PATTEC and the Heads' of State and Government approved action plan. The Directors of Veterinary Services came up with recommendations, urging Member States to take specific concerted steps in support of joint intervention against the tsetse and trypanosomosis problem under the PATTEC umbrella.

26th ISCTRC Meeting (1 – 5 October 2001)

More than 230 researchers, decision makers and tsetse control personnel from 44 countries and various regional and international organisations participated in the 26th meeting of the ISCTRC. Reports from international organisations and tsetse/ trypanosomosis affected countries were followed by papers on protozoology/ immunology and diagnosis, Human African Trypanosomosis (HAT), animal trypanosomosis, entomology and vector control. Participants furthermore exhibited numerous scientific posters, on which there was ample time for discussions during session breaks. Remarkable was that private companies involved in tsetse/ trypanosomosis management present at the meeting elected a spokesperson, who presented a specific resolution in support of the PATTEC objectives.

Launching of PATTEC

In response to a Summit decision by the African Heads of State and Government in Lomé, Togo, July 2000, regarding the ultimate eradication of tsetse flies from the African continent, the OAU Secretary General established a task force of African specialists, who met in Nairobi in December 2000 and developed a plan of action for the Pan-African Tsetse and Trypanosomosis Eradication Campaign, PATTEC. This plan of action was approved by the subsequent African Summit in Lusaka, Zambia, in July 2001 for implementation. The Prime Minister, on behalf of the President of Burkina Faso, launched PATTEC in the presence of about 250 meeting participants and representatives of the diplomatic corps. As a symbol of commitment to co-operate and contribute towards the achievement of PATTEC goals, the Prime Minister handed over the PATTEC flag to delegates from 32 African countries and 17 international, regional and national institutions.

E. TECHNICAL CO-OPERATION PROJECTS

Establishment of a Medfly Mass-Rearing Facility and Introduction of a Pilot Sterile Insect Technique Control Programme (TUN/5/020)

Tunisia is considering the use of SIT to suppress, in a more environment-friendly way, the medfly from the Cape Bon Region where important commercial fruit production, mainly citrus, takes place.

A small pilot control programme, which has been in preparation since 2001, aims to demonstrate the technical feasibility of the method, train local personnel in rearing, field and aerial release operations and convince the private fruit industry to invest in this environment-friendly method on a larger scale.

As a first step, a rearing facility capable of a weekly production of 12 million sterile *tsl* males has been built in Sidi Thabet in the outskirts of Tunis. The facility should be fully equipped and ready to initiate rearing as from early 2002. A trapping network has been set-up recently to monitor the population of medfly throughout the year in the Cape Bon Region, and a pilot area of about 5,300 ha has been selected around the city of Hammamet.

The project will be jointly operated by the Ministry of Agriculture (Direction Générale de la Protection, et la Qualité des Produits Agricoles, DGPQPA) for the field activities, the fruit industry (Groupement Interprofessionnel des Agrumes et des Fruits, GIAF) for the conditioning and aerial release activities, and by the Atomic Energy Authority (Centre National des Sciences et Technologies Nucléaires, CNSTN) for operating the rearing facility.

For increased effectiveness and economies of scale the area wide control project of medfly will have to expand in the future to the entire Cape Bon Peninsula. There would be a need for about 200 millions sterile males a week to be released over a 1000 sq. km area in the Cape Bon. The Tunisian authorities are considering the possibility of building a large rearing facility capable of producing not only the required numbers of sterile medfly males but also additional numbers to supply future SIT projects in the Mediterranean Basin.

Integrated Control of Animal Trypanosomosis to Create a Tsetse Fly Free Zone (MAL/5/017)

On October 5, 2001, the Governments of Mali and Burkina Faso signed a 'programme development document', outlining a strategy to create tsetse free zones in their respective countries. The document was co-signed by the IAEA as the first international organisation to endorse this initiative and to provide sound technical support to this tsetse intervention effort. Most of the people in Mali and Burkina Faso live in a rural environment and depend heavily on agriculture for their income. Livestock productivity, however, is extremely low due to the presence of the tsetse fly and the disease (African Animal Trypanosomosis (AAT) it transmits. Both Governments have realised that the elimination of AAT is a key factor in the elimination of hunger and the alleviation of poverty. The most

efficient way of containing this disease is through the removal of the vector (the tsetse fly) using an area-wide integrated pest management approach (IPM). Area-wide is defined here as the management of *entire* tsetse populations within a target area. To attain this goal, the programme intends to integrate the release of sterile male insects (SIT) with efficient tsetse fly population suppression methods such as traps, insecticide impregnated targets, pour-on application of insecticide on livestock and the Sequential Aerosol Technique (SAT) in a phased and dynamic way.

The distribution of the most economically important tsetse species in Mali and Burkina Faso (*G. palpalis gambiensis* and *G. tachinoides*) is restricted during most seasons to the riparian vegetation bordering rivers. The geographical 'unit area' of operation will be the 'primary river basin', which fits well within the concept of area-wide IPM. The degree of isolation of tsetse fly populations residing in adjacent river basins will be determined using a combination of high resolution satellite imagery, field data on tsetse fly population dynamics, distribution patterns and genetics. Consequently, zones of close contact where there is potential for immigration/ emigration of flies between populations of adjacent river systems can be identified and temporary fly barriers erected.

To date, operational field teams have been established in Mali and the entomological and veterinary base-line data collection has started in the periurban area of Bamako. In addition, an agreement has been signed between the Government of Burkina Faso and the regional research centre 'Centre International de Recherche-Développement sur l' Élevage en zone Subhumide' (CIRDES) located at Bobo Dioulasso in Burkina Faso, to use and expand their existing *G. palpalis gambiensis* colony to an operational capacity of 30,000 excess males for release every week in Mali. Refurbishment of the existing facilities has been initiated and new rearing and handling techniques such as the semi-automated feeding and holding system TPU-3 will be installed in the near future.

The creation of a tsetse free zone in the Niger River Basin will be a model for future expansion of the eradication zone to other river basins under the umbrella of the newly created Pan African Tsetse and Trypanosomosis Eradication Campaign (PATTEC). The joint Mali-Burkina Faso programme is a fine example that demonstrates the determination of African Governments to take the lead and the ownership in this battle against the disease and the tsetse fly. It is anticipated that the international community through advisory bodies such as the Programme Against African Trypanosomosis (PAAT) and international organisations such as FAO, WHO, IFAD, OAU etc. will endorse this initiative and provide their long-term support.

Sterile Insects Technique for Area-Wide Tsetse and Trypanosomosis Management (RAF/5/051)

In line with the Organisation of African Unity (OAU)-IAEA framework agreement for strategic co-operation and in support of the plans for the implementation of the Decisions by the African Heads of State and Government on the eventual eradication of the tsetse fly and the PATTEC Plan of Action, the project seeks to assist Member States by contributing to the PATTEC objectives by:

- developing a strategy for creating and subsequently expanding tsetse free areas;

- assisting in the design and implementation of action plans for integrated area-wide tsetse/trypanosomosis intervention;

- delivering concepts and designs for, assistance in construction and equipping and in managing of tsetse mass production factories;

- contributing to relevant capacity building efforts for tsetse SIT and related components of an area-wide tsetse / trypanosomosis intervention campaign and of preparations for sustainable and environmentally responsible utilisation of natural resources;

Utilising IAEA TC funds and extra budgetary contributions by Norway and the U.S.A., the project will support PATTEC and related Member States' efforts in planning and executing integrated area-wide campaigns for the creation of tsetse fly free zones in internationally agreed priority intervention areas in Eastern, Southern and Western Africa. The creation of an increasing number of tsetse fly free zones is expected to be a key contribution to poverty reduction by generating opportunities for agricultural and livestock development that, as the Zanzibar exercise demonstrated, are almost autonomously realised by the previously tsetse/ trypanosomosis affected rural poor.

Area wide Integrated Control of Fruit Flies (THA/5/046)

Mango (*Mangifera indica*) is a traditional crop in Thailand with more than 300,000 hectares cultivated throughout the country. The area is divided into small mango plantations belonging to thousands of farmers each having an average of two hectares. Unfortunately most of the mango production is low input and considered to be subsistence agriculture. Most of the mango produced in Thailand is sold in the domestic market although a small fraction is exported to markets that do not discriminate against the presence of Oriental fruit fly (*Bactrocera dorsalis*) such as Canada, Hong Kong, Malaysia, Singapore, etc. Small volumes of mango are also exported to Japan after compliance with a postharvest treatment (i.e. vapour heat) and after a fruit fly free federal phytosanitary certificate is issued by an inspector of the importing country.

Although the mango has a number of economically important pests, the key pest is by far the Oriental fruit fly (OFF). At least 50% of the mango is lost every year due to poor control practices.

In 1991, the IAEA and the government of Thailand through the Office of Atomic Energy for Peace (OAEP) and the Department of Agriculture Extension (DOAE) embarked on a pilot integrated project to control the OFF in mango orchards in the Ratchaburi Province, southwest of Bangkok. The SIT technology including field activities and mass rearing, sterilization and release of flies has been transferred through expert missions, fellowships and scientific visits. In 1992 the government of Thailand decided to adapt some facilities of the Centre for Irradiation of the DOAE into an OFF mass rearing and sterilization facility. Since that date the facility has been producing an average of 10 million sterile flies per week for the project. The IAEA Board of Governors recently approved an extension of the SIT Pilot Project for three more years under project THA/5/046. The technology transfer has not been an easy task; however, after years of effort, it has paid good dividends to a large number of small scale mango growers in the District of Paktor, Ratchaburi Province.

According to the information provided by the DOAE and confirmed by one of the farmers' associations in the District of Paktor, the OFF damage

decreased from over 80% in 1987, before the implementation of the SIT project, to 30, 26, 21, 18, 17 and 9% in the following six years (i.e. 1988 to 1993) respectively. From 1994 to 2001 the damage has been reduced further to an average of less than 4% per year.

The economic benefits of the integrated application of the SIT for the mango growers of Paktor has been substantial. Farmers claim that mango has become a profitable business since the integrated use of SIT for control of the key pest (OFF) and that mango growers in the neighbouring areas are eager to join the SIT project.

This project has reached a stage where it could be scaled up to a regional level with proper support from the government and mango industry. However, currently, without economies of scale the project operates at a high per hectare cost for the government. Furthermore, this project is one of only a few examples of using the SIT for effective insect pest suppression, and techniques need to be substantially improved. Despite the project's success, no serious effort has been made to promote the project with the fruit industry at national level. Scaling up of the project would require improvements in field operations and management activities through the following basic actions:

- Definition of a project management structure and clear identification and assignment of responsibilities for the mass production and sterilization facility and for the field operations.
- Shift from an orchard by orchard control strategy to an area wide control strategy. Such an approach is not only effective, but also permits achieving economies of scale in the application of SIT.
- Adoption of new and better technologies:
  - Aerial release.
  - Chilled adult release system.
  - GPS and GIS information systems for trapping and fruit sampling networks and for sterile fly release.
  - Bait spray applications based on protein hydrolysate and Spinosad.
  - Incorporation of female traps in the trapping network.
- A scheme for effective technology transfer from Ratchaburi to other provinces where mango is produced such as Phitchit has to be developed and implemented.
- If the project will expand in the near future to a second area, production will need to be scaled up considerably (at least by 10 fold) and careful planning of sterile fly production must be made in order to be able to supply the required amounts of good quality sterile flies for the two areas (Ratchaburi and Phitchit).
- Data management is vital for effective application of the SIT under an area wide and large-scale approach. A computerized data management network should be developed for record keeping, data analysis and decision making. The network has to connect the district offices to the headquarters in Bangkok.
- Technology transfer to another area would be part of a national strategy and would be done mainly by the government of Thailand in close collaboration with the mango growers and exporters.

F. ONGOING AND PLANNED CO-ORDINATED RESEARCH PROJECTS

Improvement of Codling Moth SIT to Facilitate Expansion of Field Application (CRP D4.10.18)

The objective of this **NEW CRP** is to improve the application of the sterile insect technique (SIT) and inherited sterility (IS) for codling moth control and its integration with other environmentally friendly control methods to expand its use in field control applications and reduce insecticide use.

Codling moth (*Cydia pomonella* (L.)) (CM) is a serious pest of pome fruit and some walnut orchards in the temperate regions of all major continents. Between 60-80% of apples and pears can be infested on neglected apple and pear trees. Control of the CM has relied mostly on the intensive use of organophosphate and other broad-spectrum insecticides. The need for 4 to 5 spraying cycles in each growing season has led to the development of resistance and cross-resistance to most of the traditionally used insecticides and to the disruption of natural controls of the secondary pest complex. Alternative methods such as the use of insect growth regulators, mating disruption, attract and kill, biological control agents have only proven to be effective under certain conditions. Environment friendly methods which show great potential for integration with these other methods for the control of Lepidoptera (including CM) are the SIT and IS. Considerable R&D and field evaluation are still required however, before the implementation of operational projects will be feasible. Several aspects of both the rearing and field application will be addressed through a co-ordinated research approach:

1) research to improve the cost-effectiveness of rearing, sterilisation, release and distribution of sterile moths,

2) research to develop production and product quality control tests and standards to ensure consistent production of high quality moths,

3) research on the genetics of CM in order to facilitate the development of genetic sexing strains,

4) research on the genetics of CM populations in different regions,

5) research on the improvement of monitoring techniques,

6) research to better understand the combination of SIT with other techniques such as parasitoids, mating disruption etc.

Expected duration 5 years (2002-2006).

Applications for contracts to work on the above topics, to be received as soon as possible, preferably before 28 February 2002, are invited from researches in the field of integrated area-wide control of Lepidoptera, and in particular codling moth. Details of the IAEA Research Co-ordination Programme and the necessary application forms can be found in the IAEA web site[4].

[4] http://www.iaea.or.at/programmes/ri/uc.html

A) REARING

1. Artificial Diet Sterilization: Use, Storage and Table Life Extension

Problem:

Artificial diet often has a limited shelf life and table life.

How Nuclear Techniques Can Help Us Solve the Problem:

Gamma radiation, as well as X-rays, can provide a non-destructive means of killing microbial contaminants in artificial diets that may degrade the diet and/or impair insect growth and development.

i. -may eliminate the need for other preservatives

ii. -may simplify procedures in diet preparation (e.g., eliminate autoclaving)

iii. -allows for "terminal stage" sterilization (e.g., after packaging)

Progress:

Artificial diet often has a limited shelf life. Gamma radiation and X-rays can provide a non-destructive means of killing microbial contaminants that may degrade the diet or impair insect growth. Initial research has indicated that for situations where prolonged shelf life is not required, freezing or ultra low freezing may be simpler and more efficacious. However, situations during rearing where longer shelf life is required still need to be further explored.

2. Suppression of Host Immune Reactions

Problem:

Host immune reactions may reduce rearing efficiency or prevent the use of a factitious host that is easier or more economical to rear.

How Nuclear Techniques Can Help Us Solve the Problem:

Exposure to radiation has been shown to suppress host immune system responses. This may make irradiated larvae of older instars more suitable for parasitoid development and thus increase rearing efficiency and parasitoid quality.

Progress:

Initial data showed that irradiation of *Galleria mellonella* larvae with doses from 60 to 80 Gy allowed normal development of the endoparasitoid *Venturia canescens* while no development was possible in the non-irradiated larvae. Irradiation of *Plodia interpunctella* larvae with a dose of 60 Gy increased emergence of *V. canescens* compared to non-irradiated controls. This might be due to suppression of host immune response to the parasitoid.

3. Storage Extension of Hosts or Prey

Problem:

Normal host/prey development limits storage of host/prey material.

How Nuclear Techniques Can Help Us Solve the Problem:

Use of radiation may be used to arrest insect development and thus facilitate the development of procedures that would allow for storage and stockpiling of hosts or prey.

Progress:

Studies on *Ephestia kuehniella, Spodoptera litura, Sitotroga cerealella*, and *Musca domestica* showed that irradiation caused a protraction in the development of host stages suitable for parasitization, thus facilitating the use of these hosts under mass rearing conditions.

4. Host Suitability Extension

Problem:

Normal host development limits the time interval when a host is suitable for parasitization.

How Nuclear Techniques Can Help Us Solve the Problem:

Use of radiation may be used to delay normal insect development and thus extend the time interval when a particular host stage is available for use by the parasitoid or help to regulate (slow-down or synchronize) parasitoid development within the irradiated host.

Progress:

Results have shown that radiation can be used to delay normal insect development and extend the time when a given host stage is suitable for use by parasitoids. These examples are related to the use of parasitoids in poultry production to control *Musca domestica*, to control *Anastrepha* spp. in mixed fruit orchards, and to control *Ephestia kuehniella* in mills and warehouses. In addition, radiation has been used to extend the time *Sitotroga cerealella* as factitious host is available for *Trichogramma chilonis* to control *Chilo infuscatellus*.

5. Use of Sub-Products of SIT Mass-Rearing

Problem:

Insect mass-rearing programs often produce relatively large numbers of substandard material or have excess production of particular life stages that are discarded.

How Nuclear Techniques Can Help Us Solve the Problem:

Sub-products of insect mass-rearing programs (e.g., excess or "off" season production or products that do not meet minimum quality standards) may be irradiated and used to support the production of natural enemies and thus improve the overall (cost) efficiency of a mass-rearing (SIT) system.

Progress:

Insect mass-rearing programs often have excess production of particular life stages or produce significant amounts of substandard material that is discarded. These may be irradiated and used to support the production of natural enemies. Research has shown that this approach is in fact viable. Examples include the use of excess egg production in *Ceratitis capitata* and *Anastrepha ludens* mass-rearing facilities to produce egg parasitoids, as well as the use of remnant larvae and pupae to produce larval and pupal parasitoids.

6. Stimulation Effects of Very Low Doses of Radiation to Natural Enemies

Problem:

Field performance of laboratory-reared parasitoids and predators is a concern.

How Nuclear Techniques Can Help Us Solve the Problem:

Very low doses of radiation may stimulate a variety of physiological (e.g., pesticide tolerance) and behavioural (e.g., increased longevity and searching ability) processes in insects that may be beneficial. As such, very low doses of radiation may be useful in improving field performance of laboratory-reared parasitoids/predators.

Progress:

In *Trichogramma evanescens* and *Habrobracon hebetor* low dose of irradiation (20 and 40 Gy for *T. evanescens* and 7.5 to 15 Gy for *H. hebetor*) had a stimulating effect on adult longevity and oviposition. In *Trichogramma chilonis* low dose irradiation (100 to 200 mGy) altered the sex ratio in favour of females.

7. Use of Radiation as a Tool to Study Host-Natural Enemy Interactions

Problem:

Behavioural and physiological inter-actions between host and parasitoids are complex, often difficult to study and not well understood.

How Nuclear Techniques Can Help Us Solve the Problem:

Use of nuclear techniques may be used to selectively modify certain physiological processes in the host (e.g., host "odours") thereby facilitating the study of particular host-parasitoid interactions. Nuclear techniques may be also used to modify or terminate certain parasitoid processes that affect host physiology and behaviour (e.g., sterilizing the parasitoid egg).

Progress:

Irradiation of *Glyptapanteles liparidis* wasps (24 to 96 Gy) caused temporary sterilization and a reduction in oviposition. Effects of parasitization of *Lymantria dispar* larvae by irradiated female wasps indicate that this method can be used to study the influence of parasitoid associated factors.

B) HANDLING-SHIPMENT RELEASE AND TRADE

1. Reproductive Sterilization of Host/ Factitious Hosts/ Prey

The Problem:

Continued development and emergence of non-parasitized fertile hosts, factitious hosts, as well as of unused prey (pest) insects during rearing of natural enemies can require additional steps in handling, thereby decreasing the efficiency of rearing systems.

How Can Nuclear Techniques help us to solve the problem:

Radiation can be used to reproductively sterilize hosts, factitious host or prey, thereby inhibiting further development and preventing the emergence of unused individuals. This application of nuclear techniques would:

a) allow for the earlier shipping of hosts together with natural enemies without the need to wait for emergence unused hosts;

b) reduce the handling procedures required during rearing of natural enemies, thereby increasing the cost effectiveness of the rearing process and the quality of the natural enemy product;

c) facilitate the preservation of purity of host, prey and/or natural enemy strains;

d) provide a cleaner product for customers purchasing/using natural enemies produced in this fashion.

Progress:

During the rearing of natural enemies it is often the case that not all of the host material is parasitized or consumed, requiring additional steps in handling prior to shipment to prevent the release of pest insects. Radiation has been successfully

used to reproductively sterilize the host insects used to produce parasitoids of *Musca domestica* , the stored grain pests, *Ephestia kuehniella* and *Plodia interpunctella*, and to control a complex of sugar cane borers and *Bactrocera oleae*. The use of sterilized hosts is also being implemented on a large scale for the mass production of two larval fruit fly parasitoids, *Diachasmimorpha longi-caudata* and *Doryctobracon crawfordy,* being shipped to a number of countries. These uses of natural enemies, without the simultaneous release of pest insects, have only been made possible by the application of radiation. In addition, the application of radiation to the production of natural enemies has reduced handling costs, allowed for earlier shipping, and provided a cleaner product to the customer.

2. Provisioning Natural Enemy Shipments with Sterilized Artificial Diets

The Problem:

Artificial diets have a short table-life and, as such, are problematic to use for rearing and shipment of natural enemies.

How Can Nuclear Techniques help us to solve the problem:

Radiation can be used to preserve the quality of the diet by delaying the process of diet degradation and, thereby, extending the acceptability and suitability of the artificial diet to the natural enemies. In this way, the system also becomes more cost effective, as diets have longer table-life.

Progress:

Artificial diets often have a short table-life and, as such, can be problematic for use in provisioning shipments of natural enemies. Research has not been carried out in this area. However, it is envisioned that radiation can be used to preserve the quality of the diet over longer time periods, thereby extending the acceptability and suitability of the artificial diet to the natural enemies during shipments.

3. Provisioning Natural Enemy Shipments with Sterilized Host/Prey

The Problem:

There exists a real or perceived risk that shipping natural enemies with host/prey material will lead to introduction of non-native, pesticide resistant or new strains of pest insects into new areas or countries. This may exacerbate the ever stricter quarantine regulations required to obtain permits for natural enemy shipment.

How Can Nuclear Techniques help us to solve the problem:

Use of radiation has the potential of:

a) killing or reproductively sterilizing host/prey to provide the required quarantine security to overcome regulatory barriers, and thereby facilitating and encouraging national and international trade;

b) reducing the risk of inadvertently shipping hitch-hiking arthropods with host/prey;

c) extending the period of suitability of host or prey (as food) during shipping;

d) allowing the addition of safe, nutritional supplements (in the form of host/prey) to shipments of natural enemies that will improve/maintain their quality; allowing more timely delivery of natural enemies by eliminating the time required to allow non-parasitized hosts to emerge, and eliminating the need to separate emerged adult host from parasitized hosts allowing the customers more flexibility in release timing of natural enemies

Progress:

There exists a risk that shipping natural enemies with viable host/prey

material will lead to the introduction of non-native, pesticide resistant or new strains of pest insects into new areas or countries. Research on the use of pest mite eggs to provision shipments of predatory mites has confirmed that radiation can be used to eliminate the risk of introducing fertile pest insects, or other hitch-hiking arthropods, and at the same time allow the inclusion of nutritional supplements in the form of host material to maintain quality. This application of radiation will help facilitate and encourage the national and international trade of natural enemies.

4. Shipping of Sterilized Pests/ Factitious Hosts or Prey (in the Absence of Natural Enemies):

The Problem:

There exists a real or perceived risk that shipping fertile hosts or prey material will lead to accidental introduction of non-native, pesticide resistant or different strains of pest insects into new areas or countries. This may exacerbate the ever stricter quarantine regulations required to obtain permits for shipment of insects.

How Can Nuclear Techniques help us to solve the problem:

The use of radiation will allow for the commercial shipment of sterilized host individuals, from one laboratory or insectary to another, both within and between countries, Thus, commercial laboratories will be able to rear the same strain of natural enemy using the same host material, insuring a standardized quality of the product for the customer.

Progress:

There are commercial needs and opportunities to ship sterile host/prey material in the absence of natural enemies for use and redistribution by smaller rearing facilities and to standardize host material to insure product quality. No research has been carried out in this area, however, it is known that some commercial biological control companies are making use of this technology. One potential example is the shipment of sterile *Musca domestica* pupae to rear their parasitoids in other locations.

C) SIT/F1 STERILITY + BIOLOGICAL CONTROL

1. Combination of Augmentative Releases : SIT/F1 + Natural Enemies

The Problem:

Agricultural and forest production is adversely affected by many insect pests which have traditionally been controlled with a heavy emphasis on chemical pesticides. Resistance to most insecticides has been documented, leading to increased use rates, which in return can exacerbate the adverse affects of pesticides on the environment.

How Nuclear Techniques Can Help Us Solve the Problem:

Nuclear techniques (SIT/F1 sterility) and augmentative releases of natural enemies (parasitoids, predators, nematodes, and insect pathogens) can significantly reduce insect pests populations. Combining these tactics can yield both additive and synergistic effects. These combined augmentative releases would be compatible with traditional IPM programmes that could include resistant plant varieties, biopesticides, cultural practices, and mating disruption.

Progress:

Nuclear techniques (SIT/F1 sterility) and augmentative releases of natural enemies are compatible strategies that can yield both additive and synergistic effects. Laboratory studies and field trials with *Helicoverpa armigera*, *Helicoverpa zea*, *Phthorimaea operculella, Lymantria dispar, Spodoptera litura, Spodoptera exigua,* and *Plutella xylostella* indicated that progeny from irradiated moths were acceptable as hosts for egg and larval parasitoids. In addition, *L. dispar* larvae

that were reproductively sterilized by irradiation were found to be suitable carriers for the transmission of nuclear polyhedrosis virus to field pests populations.

2. Supplement Hosts for Natural Enemies Prior to Pest Population Outbreak

The Problem:

Many insect pests have demonstrated cyclic population outbreaks. Although these outbreaks may be predicted, effective and environmentally friendly control strategies are needed to reduces the effects of these economically damaging events.

How Nuclear Techniques Can Help Us Solve the Problem:

An increase in the number of host insects available for natural enemies can increase the population density of natural enemies before a cyclic pest outbreak begins. In this way, an optimum level of natural enemies can be available to prevent expected pest outbreaks. Nuclear technique can be used to produce sterile host insects or host insects with inherited sterility (F1). Releasing sterile insects as hosts for the natural enemies can increase the number of host insects available for natural enemies without increasing the risk that the released insect pest will cause economic damage in the future.

Detail objectives:

a. Suitability of irradiated host for parasitoids [lab and field tests].

b. Optimum methods for releasing the sterile hosts.

c. Optimum methods for measuring the effects the natural enemies following the releases of sterile hosts.

Progress:

Pests with demonstrated cyclic population outbreaks may be controlled if the number of natural enemies could be increased prior to the outbreak. Releasing sterile insects as hosts for the natural enemies could increase the number of natural enemies without increasing the risk that the released pest will cause economic damage in the future. Doses of radiation required to reproductively sterilize pest eggs and larvae were determined. Irradiated *Lymantria dispar* and *Helicoverpa armigera* eggs were studied in the field and found to be acceptable and suitable as host for natural enemies.

3. Supplemental Hosts for Seasonal Maintenance of Natural Enemies

The Problem:

Pest populations can vary greatly from generation to generation. During periods of low pest densities, population levels of their natural enemies can be reduced to very low levels. The low population levels of natural enemies are then unable to effectively respond in a timely manner to the next outbreak in the pest population.

How Nuclear Techniques Can Help Us Solve the Problem:

The use of SIT or F1 sterility could provide supplemental hosts in the form of sterile eggs, larvae, and pupae. These supplemental hosts could sustain higher population levels of natural enemies so that future pest population increases would be moderated. An example of this application would be the release of an egg parasitoid during a SIT program so that sterile eggs deposited by irradiated insects could be used by the parasitoid.

Progress:

During periods of low pest densities, population levels of natural enemies can be very low and unable to respond to an increase in the pest population. Irradiated *Helicoverpa armigera* and *Plutella xylostella* moths released in the field laid eggs that served as host for feral egg

parasitoids and caused the parasitoid population to increase.

4. SIT Against Natural Enemy Pests

The Problem:

In certain cases where an insect provides a useful service, natural enemies of the useful insect are considered to be a pest. Examples of this relationship would include parasitoids of the silkworm, *Bombyx mori*, Varroa mites that attack honeybees, or natural enemies of weed herbivores.

How Nuclear Techniques Can Help Us Solve the Problem:

In this relationship, the natural enemies could be sterilized with nuclear techniques and released in an SIT program to reduce the detrimental effects of the natural enemies on the useful insect.

Progress:

In certain cases where an insect provides a useful service, natural enemies of the useful insect are considered to be a pest (example: parasitoid of *Bombyx mori*, the uzi fly). Radiation biology studies were conducted to determine the optimum dose required to sterilize the natural enemy pest (Uzi fly).

D) FACILITATION OF CLASSICAL BIOLOGICAL CONTROL AND NATURAL ENEMY MONITORING

1. Use of Reproductively Inactivated Agents for Final Confirmation of Host Specificity of Potential Exotic Biological Control Agents

Problem:

The importation of exotic natural enemies, particularly insect herbivores of plant pests, is becoming increasingly difficult due to concerns over the possibility that imported natural enemies may shift and become pests of beneficial or protected species. In some cases, despite extensive and positive pre-release studies, promising biological control agents are ultimately rejected because of remaining doubts about their host specificity.

How Nuclear Techniques Can Help Us Solve the Problem:

Radiation may be used to reproductively inactivate natural enemies so that they can be released and studied under actual field conditions without the risk of establishing breeding populations. The use of reproductively inactivated forms would allow one to further assess and confirm oviposition behaviours and host (acceptability) associations. The use of F1 sterile larvae of herbivores, being considered for release against plant pests, also would allow field-testing larval feeding preferences and the ability of these larvae to develop and survive on related plants that are of concern.

Progress:

The importation of exotic natural enemies, particularly insect herbivores of plant pests, is becoming increasingly difficult due to concerns over the possibility that imported natural enemies may shift and become pests of beneficial or protected species. A model system including *Opuntia* spp. and the cactus moth (*Cactoblastis cactorum*) has been developed to study the host range of an exotic herbivore. Radiation biology studies have been initiated to determine the optimum dose at which females are sterilized and males remain partially fertile and produce sterile progeny.

2. Use of Sterilized Hosts for Exploration of New Natural Enemies and for Monitoring Natural Enemy Field Populations

Problem:

The collection of new exotic natural enemies or the monitoring of field populations of native natural enemies is

sometimes complicated by the fact that hosts are rare or difficult to locate.

How Nuclear Techniques Can Help Us Solve the Problem:

Reproductively inactivated host insects may be placed in the field in strategic locations as sentinels to aid in the exploration and collection of new natural enemies. These sentinels may also be used to monitor natural enemy populations. Furthermore, the use of live but reproductively inactivated hosts will eliminate the risk of increasing pest populations.

Progress:

Monitoring of field populations of natural enemies is sometimes complicated by the fact that hosts are rare or difficult to locate. Radiation biology studies were conducted to determine appropriate doses to reproductively inactivate certain life stages. Reproductively inactivated eggs or larvae of *Lymantria dispar, Ephestia kuehniella* and *Plodia interpunctella* were released in the field to monitor the number and type of natural enemies (parasitoids and pathogens).

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

The final RCM of this CRP was held at the Fruit Fly Research Center, in the University of Sydney, Australia from 9 – 13 July 2001. The objectives of the CRP were to:

1) optimize genetic sexing strains as regards their genetic composition, productivity and application;

2) develop third generation genetic sexing strains using nuclear and molecular methods, and

3) develop genetic sexing strains in fruit flies other than medfly.

Results presented at the meeting and elsewhere have shown that for the current genetic sexing strains (GSS) the first objective has been achieved as almost all medfly rearing facilities now use these strains. Progress to achieve the second objective has been very positively influenced by advances made in a related CRP on genetic transformation (D4.10.12) where genetic transformation for several fruit fly species has now been demonstrated. Some of this work has been carried out in the Entomology Unit at Seibersdorf and it represents a major breakthrough in the development of third generation GSS. Data was also presented on the development of GSS in *B. dorsalis* and *B. tryoni*.

The use of the filter rearing system (FRS) and the introduction of improved GSS, have had significant impacts on the use of medfly GSS. The meeting focussed on a) the use of inversions to improve GSS and isolation of useful genes, b) the use of microsatellite analysis to better understand incursions of fruit flies into new areas and c) the use of ginger oil to increase the mating success of male fruit flies.

The CRP consisted of 8 research teams and representatives of 6 were present at this last meeting together with a large number of observers. The results of the CRP will be published in a special issue of the journal Genetica.

Automation in tsetse mass rearing for use in sterile insect technique programmes (CRP D4.20.06)

The final RCM took place from 9 to 13 July 2001 in Addis Ababa Ethiopia and was attended by all 5 participants. The CRP lasted 6 years and achieved its objective of improving and upgrading tsetse mass rearing by the development and utilization of automated and other methods. Simple, efficient, flexible and affordable systems and procedures able to meet requirements for large scale tsetse mass rearing were developed. Mating regimes appropriate for automated mass rearing and direct loading of production cages (self-stocking of production cages, SSPC) were developed. Adult sex separation based on differences in eclosion time was demonstrated and tested in Ethiopia, Burkina Faso and Tanzania. The automated sex separation and direct loading of production cages may be used for production of male pupae only for sterile male production. Procedures developed have been adopted by rearing facilities in member states paving the way for the standardization of tsetse mass rearing. Prototypes of tsetse production units, TPU were produced and evaluated and verification took place in target countries. TPU 3 is a production unit in which cages are held stationary in a frame and blood in the feeding system is moved to them and then raised to make contact with the cages.

The systems and procedures can be adopted to meet the need for large-scale production of sterile males for tsetse eradication in Africa. The design of future sterile male production facilities will be based on systems and procedures developed during this CRP. However the participants identified areas that need further development namely; cage design/size for maximum use of feeding surface; automation of pupal collection and SSPC and non manual filling of blood feeding system for large colonies, facility design and environment control particularly light and heating system for blood.

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

The CRP focuses research on the population genetics of tsetse as a tool in the management of tsetse SIT programmes, using a range of modern techniques, with emphasis on the requirements of the tsetse eradication project in the Southern Rift Valley of Ethiopia.

The second RCM was held from 3 - 7 October 1999, in Mombasa, Kenya in conjunction with the 25th OAU/STRC ISCTRC Meeting and the 3rd RCM was held 19-23 of March 2001, at FAO, in Rome, Italy.

The recent declaration of the African Heads of State and Government on the eradication of tsetse from the African continent has resulted in the planning of extensive tsetse intervention programmes incorporating the SIT. A key component in the identification of target populations is to delimit the degree of their isolation from other populations; a very powerful tool to aid in this decision making is population genetic analysis. A second component of target population identification is the use of GIS mapping technology.

Results so far from the CRP confirm previous analyses that showed there is a surprisingly high level of population structuring in tsetse, even over quite small geographic distances. However, adequate sampling has not been carried out over a sufficiently wide geographic area and this

remains a major constraint to understanding fully tsetse population structure.

Polytene chromosome maps are now available for *G. austeni*, *G. pallidipes* and *G. morsitans submorsitans*. Banding pattern analysis has revealed the presence of many inversion differences between the species. So far no field populations have been analysed to see if there are floating inversions as there are in mosquitoes and black flies. A sex-distorter phenotype in *G. m. submorsitans* was shown to be associated with complex inversions on an X chromosome.

The frequent occurrence of hybrid sterility, when tsetse from different taxa are crossed, may provide an additional component to SIT. Data from many different crossing schemes illustrate the complexity of the hybrid phenotype but identify several situations in which females could be permanently sterilized following mating with a male from a different taxon.

The 4th and final RCM will tentatively be held in Edmonton, Canada, in early 2003.

Expected duration: 6 years (1997-2003).

Contract Holders (3) from: Greece, Kenya and Burkina Faso.

Agreement Holders (7) from: Greece, Kenya, Belgium, Canada, United States (2) and Italy.

Genetic Sexing and Population Genetics of Screwworms (CRP D4.20.09)

A very successful area-wide programme for the eradication of the New World Screwworm (NWS) has been carried out in North and Central America. A Thematic Plan for both NWS and OWS (Old World Screwworm) identified several technical constraints for the further expansion of SIT for these two species and these form the core of this new CRP. Any expansion of the NWS programme into the Caribbean and South America will require information on the target populations in that large area where very little is known concerning the distribution and levels of population isolation. In addition, the size of the populations to be targeted and the area over which they are distributed will require that economies be made in fly production and release costs. One way to achieve this would be to develop a genetic sexing strain for NWS.

For SIT to be effectively developed for the OWS much data is needed on distribution and the genetic relationships of populations from S. E. Asia to the Middle East and Sub-Saharan Africa. The CRP will address these high priority areas.

1st RCM and Workshop: 28 January – 5 February 2002, Campinas, Brazil.

Expected duration: 5 years (2002 – 2006).

Contract Holders (5) from: Brazil, Indonesia, Iran, Uruguay, Venezuela.

Agreement Holders (5) from: Sweden, UK (2), USA (2).

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

The third RCM was held in São Paulo, Brazil on 14 – 18 August 2000. The meeting was attended by 8 participants of this CRP and three observers. The group presented the results of the research conducted over the last 18 months and discussed the developments and opportunities for future work.

Since the last RCM, the participating laboratories have been very successful in generating a range of novel vectors, genes, regulatory elements and approaches which have the potential for incorporation into the SIT. Medfly remains the essential model for the development of the transgenic technology for the SIT. However, it is foreseen that the major impact and opportunities for exploiting this technology will be the development of genetic sexing systems for other key pest species that are the target for SIT and where the background knowledge in genetics/cytology is lacking.

Over the forthcoming period, the participating laboratories will be well placed to begin the move from laboratory-based research to consider the more applied aspects of using transgenic technology to the benefit of the SIT. This will include studies on the genetic behaviour of transgenic insects, e.g. stability of transgenic strains over extended periods of time and under less favourable rearing conditions.

It is planned to hold the last RCM in Capri, from 8-12 July 2002.

Expected duration: 7 years (1995-2002).

Contract Holders (2) from: Greece and from New Zealand

Agreement Holders (8) from: United Kingdom, United States (4) and Italy (3).

Development of Improved Attractants and their Integration into Fruit Fly SIT Management Programme (CPR D4.10.17)

The first Research Coordination Meeting (RCM) for development of improved attractants for female fruit flies and their integration into fruit fly SIT management programmes took place from August 28 to September 1, 2000, in São Paulo, Brazil. Eighteen professionals from 13 countries and 4 subregions participated in the meeting, most of them as contract holders and some as observers. A consensus was reached on a standard protocol for the core experiments and on the side experiments that will be carried out during the first phase of this CRP following protocols developed by the participants. Lists of materials required for the first year experiments and delivery schedules for supplying them were prepared. Participants will be presenting the results of the first experiments as well as a progress report of the second year experiments by April 2002 in the next RCM to be held in Stellenbosch, South Africa. All the relevant documents and papers that were presented during the meeting have been compiled in the working document for consultation. Technical details including the standard research protocol, fruit fly conditions in each country, species being addressed, list of participants and material requirements can be found in this report.

Expected duration: 5 years (1999-2003).

Contract Holders (15) from: Argentina, Brazil (2), Colombia, Costa Rica, Greece, Honduras, Israel, Mauritius, Mexico, Pakistan, Spain, USA (2).

Agreement Holders (4) from: United Kingdom, Portugal, France and Spain.

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

This CRP aims at alleviating the shortcomings in attractants for a number of important tsetse species where the standard odours used for *Glossina morsitans* and *G. pallidipes* are poor or ineffective, and in general to try to improve attractant

effectiveness for a) entomological monitoring, b) tsetse population suppression and c) barrier maintenance.

The 3rd Research Co-ordination Meeting took place in Bamako, Mali, 21 – 25 February 2000 and was attended by 8 participants and numerous observers. In the months preceding the meeting, molecules that are stereo-isomerically related to known natural tsetse kairomones have been synthesised and tested in laboratory experiments and field trials. In addition, an effort was made to identify locally available inexpensive sources of visual and chemical attractants.

Among the odours tested in the coastal region of Kenya for *G. austeni, G. pallidipes* and *G. brevipalpis*, octyl formate and decyl formate proved attractive. Preliminary studies reveal that racemic octenol increases the capture rate of *G. brevipalpis* males. Coconut oil increases the capture rate of *G. austeni* and *G. pallidipes*.

Preliminary field studies placing electrified grids close to pyramidal traps on Buvuma islands, Lake Victoria, Uganda, revealed that of the synthesised attractants decylformate and racemic octenol significantly increased the number of attracted (but not trapped) female *G. fuscipes fuscipes*. Alternative trap designs for *G. f. fuscipes* (e.g. the H-trap) will be explored in combination with different odour combinations, in order to combine increased attractiveness with a higher rate of trap entry.

The antennal chemoreceptors of *Glossina brevipalpis* and *G. pallidipes* show responses to plant secondary products, as indicated by electroantennogramme assays of essential oils. Preliminary wind tunnel experiments indicate that some plant secondary products also evoke behavioural responses from tsetse.

As conventional PVC or fibreglass leg panels are expensive and heavy to carry, efforts were undertaken to develop lighter and less expensive leg panels for trapping *G. austeni.* The leg panel made from a wire framework and royal blue polyethylene (150 μm) appears to meet these requirements and holds Temoocid® (the sticky substance) for a sufficiently long placement period (> three months).

Gas-chromatographic and mass-spectrometric analyses of the oxidative degradation process of methyl linoleate, a model for linoleic acid containing vegetable oils, revealed the formation of (±) 1-octen-3-ol, suggesting the use of these oils as low-cost octenol sources in field traps.

The 4th and Final RCM is scheduled for Kampala, Uganda 18 – 22 March, 2002.

Expected duration: 6 years (1995-2002).

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

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

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

This CRP was established after a Consultants Group Meeting on the International Standardization of Quality Control Procedures for Mass Reared and Released Fruit Flies, held in May 1997 in Vienna. This meeting produced an updated international manual of standard QC procedures (available for downloading from the internet[5]) and recommended implementing this CRP to address those

[5] http://www.iaea.org/programmes/nafa/d4/public/d4_pbl_5_1.html

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.

The objective of the CRP is to improve and standardise international quality control procedures for mass produced fruit flies. There are now more than 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. This CRP, involving behaviourists, physiologists and mass rearing specialists allows us to fine-tune the internationally accepted quality control procedures as well as develop new tests measuring more representative parameters.

The first Research Co-ordination Meeting, to plan and co-ordinate the research, was held 1 – 5 November 1999 in the IAEA, Vienna, Austria. Proceedings of this meeting are available from the Section. The 2nd RCM was held in Mendoza, Argentina from 26 – 30 November 2001. (This RCM coincided with the preparation of this Newsletter; a report will be presented in the next Newsletter).

Expected duration: 6 years (1999-04).

Contract Holders (12) from: Argentina (2), Chile, Costa Rica, Guatemala, Israel (2), Lebanon, Mexico (2), Peru, Philippines and Portugal.

Agreement Holders (5) from: Australia, France, Japan, South Africa and the United States.

G. DEVELOPMENT AT THE ENTOMOLOGY UNIT SEIBERSDORF

TSETSE R & D

Storing male *Glossina pallidipes* at low temperature

For large scale tsetse SIT programmes it will be necessary to develop a chilled adult release system for aerial release of sterile males. To assess the effect of low temperature a series of studies on male *Glossina pallidipes* has been carried out where adult males were stored for different amounts of time at 7°C and at 4°C. First day mortality among flies exposed to low temperature was significantly higher than the control group depending on the length of time the adult flies were exposed to 7°C. Females that mated with males that had been stored at low temperature had significantly lower spermathecal values than females mated with males from the normal colony. Storage of adults for longer than 24 hours is extremely damaging to the flies. The exact protocol in terms of temperature and time will depend on the production and release logistics developed during the field programmes. However it was concluded that storage of adult males at low temperature invariably reduces survival and insemination potential of the males. Therefore the time spent in the low temperature has to be as short as possible. A prototype chilled adult release machine is now at Seibersdorf and will be evaluated shortly.

Rearing Developments

The TPU 3 fly holding and feeding system has been expanded on the basis of very positive results during the initial evaluation. The system will be installed in a large tsetse rearing facility in Burkina Faso. The cages used in the TPU 3 are the standard cages and although they function well in the system, they have some serious problems in terms of construction and maintenance. Developments are taking place to assess whether injection moulded cages can be produced. A prototype has been produced and tested and though improvements are still needed, in principle an injection-moulded cage is a serious possibility for large scale tsetse rearing.

The use of a high radiation dose to reduce the bacterial load of large volumes of blood collected in an abattoir is a major technical constraint to tsetse mass rearing in Africa and elsewhere. In an effort to provide a solution to this problem, collaboration was started with the Food Technology Department of the University in Vienna to assess whether pasteurization technology could be used. Initial results following different treatments of blood with a pasteurizer in the University were not successful. A machine was subsequently loaned to the Unit and a series of experiments were carried out. Although not conclusive, the bioassay results were encouraging and they need to be followed up.

Re-mating among female tsetse flies

Experiments were conducted to determine re-mating among tsetse flies and the effect of re-mating on production when females are first mated to irradiated males. The preliminary results indicate that re-mating is less frequent when females are first mated by normal males followed by irradiated males. More females accept second mating when first mated to irradiated males. Although the number of flies observed is small, it would appear that when

females are mated to normal males followed by irradiated males, their production is not affected whereas when females are first mated to irradiated males followed by normal males more than 50% produce normal pupae. Having established that re-mating takes place among female *G. pallidipes* and *G. brevipalpis*, it is important to determine its frequency and the influence of re-mating on induced sterility/sperm usage using the field cage.

MEDFLY R & D

Induction of new translocations

Over the last years, a significant amount of data was gathered on the genetic behaviour of different Y-autosome translocations and their usefulness for the construction of operational genetic sexing strain (GSS), i.e. strains that are not only stable at the required mass rearing level but also show the maximum benefit for the economics of mass rearing. The structure of the translocation determines the stability of the GSS. Two aspects are here of relevance: firstly, type 1 recombination which determines how closely linked the selectable markers are to the translocation breakpoint and secondly, type 2 recombination which involves intra-Y-chromosomal recombination related to the different types of sequences on this chromosome. In addition, the structure of the translocation determines the sex and the viability of the progeny generated by adjacent-1 segregation during male meiosis. In all cases observed so far adjacent-1 segregation occurs with the same frequency as alternate segregation, i.e. all simple Y-autosome translocations show 50% sterility due to the inviability of the genetically unbalanced adjacent-1 genotypes. This lethality represents a problem for mass rearing because the productivity of the colony is reduced by 50% and as the lethality does not necessarily occur at the embryo stage rearing efficiency is reduced and some QC parameters are affected negatively.

The challenge for the construction of improved strains is to identify translocations where the sterility is reduced (e.g. reduced frequency of adjacent-1 segregation, or other modes of linking selectable markers to the male lineage) or, if that is not possible, to at least find strains where the adjacent-1 genotypes die as early as possible. It is obvious that "construction of improved strains" in essence means selection of appropriate strains from a large number of candidates. Based on this we have started several experiments to find better translocations:

a) Irradiation treatment of males with a very short Y chromosome

b) Re-irradiation of existing Y-autosome translocations

c) Irradiation treatment of males carrying a balancer chromosome

So far, 200 single pairs with irradiated males were screened for experiment a) and 6 new translocations were detected which we are currently analysing genetically and cytologically, in collaboration with A. Zacharopoulou (University of Patras). For experiment b) 100 single pairs have been screened while experiment c) is about to start.

Medfly Transgenics

In collaboration with Al Handler (USDA-ARS Gainesville) new medfly transgenic lines were generated. In total 5292 medfly embryos were injected with three different *piggyBac* constructs carrying as marker either EGFP or DsRed, both are fluorescent proteins (GFP). Two different strains, D53 (inversion, white pupae, temperature sensitive lethal) and EgII (wild type), were used. The recovery of viable G0 flies was significantly higher in case of EgII (26.7%) than with D53 (0.9%). The experiment with DsRed was unsuccessful but will be repeated shortly. In total, 70 G1 flies displaying GFP were recovered, out of

which at least 12 should represent independent events. These flies were initially crossed with *w wp* flies. Later, 57 lines were made homozygous and, currently, these families are being analysed with respect to the expression of GFP in adults and after death. The results obtained so far indicate that a significant variability between different lines can be observed while the respective patterns of fluorescence are stable within each line. No obvious correlation between the pattern/intensity and the promoters used in the two different constructs can be seen. The analysis/classification of the different lines will be extended using molecular techniques.

Storage and Transport of Eggs

The possibility of shipping medfly eggs to rearing and release centres is being considered as a way to increase the efficiency of large operational SIT programmes. This would enable large facilities producing eggs from genetic sexing strains to ship eggs to satellite facilities where only male insects need to be reared, sterilized and released. In order to test this system experimentally, it was decided to carry out some initial laboratory studies on egg storage to provide protocols for test shipments between the El Pino facility in Guatemala and Seibersdorf.

Initially, the effect on egg viability of egg storage for different periods of time followed by storage at different temperatures was assessed using eggs collected 0-6 hours after oviposition. The eggs were initially stored for different periods of up to 36 hours at 24°C followed by treatment at different temperatures for different amounts of time. Egg hatch was then measured. Egg hatch decreased with the length of the egg storage for all temperatures. Increasing the length of the temperature treatment also decreased the egg hatch, independent of the temperature used. The similarity in the pattern of egg hatch for all the treatment temperatures suggests that storage of eggs in water at 24°C before treatment stops development. The viability of the embryos decreased in relationship to the length of the treatment period for all temperature treatment. It was concluded that storage of eggs in water at 24°C without bubbling stops development. In almost all treatments where the eggs were exposed to any temperature for longer than 24 hours there was an unacceptable loss in viability.

In a second experiment, eggs were collected 0-1 hour after oviposition. Young embryos are very sensitive to storage. However, storage of embryos 24 hours and older can be carried out at different temperatures and for periods up to 72 hours at 20ºC without affecting egg hatch. It was concluded that egg shipment will indeed be possible but eggs need to be at least 24 hours old when transported. Experimental shipments will now be initiated between Seibersdorf and El Pino, Guatemala.

Olive Fly Rearing

The olive fly (*Bactrocera oleae*) is the primary pest for olive plantations in the Mediterranean basin and elsewhere, including a recent introduction into California and northwestern Mexico. Many years ago extensive studies were carried out on the development of SIT for this species and a recent review of these studies is now available from the sub-programme. Current rearing technology is not appropriate for any area-wide SIT approach for this species. The laboratory will initiate studies on this species to try to improve mass rearing technology and bring down the cost of fly production. Olive fly pupae were obtained from a colony maintained by Dr. E. Economopoulos, University of Crete, Greece and a small colony has been established. The R and D activities to be carried out are part of a wider European project that has been submitted to the EU for funding.

H. SPECIAL NEWS AND REPORTS

Member of the Order of Canada awarded to Arnold Dyck for his lifetime achievements in insect pest control and agriculture.

Victor Arnold Dyck, C.M., was distinguished by the Government of Canada with the *Member of the Order of Canada (C.M.)*. Dr. Dyck is a respected entomologist whose life's work has had an important effect on insect pest control practices in various parts of the world. A specialist in agricultural research and the use of the Sterile Insect Technique, he led the Agriculture Canada codling moth research project in the Okanagan Valley, which had a major impact on the fruit tree industry of British Columbia. He directed the Zanzibar project that helped to eliminate the tsetse fly population. Currently working for the International Atomic Energy Agency, he has contributed, through his enthusiasm, his research abilities and his leadership skills, to the development of the agricultural and economic sectors of many countries.

Sterile Insect Technique for Medfly in Adelaide

For many years the area of Adelaide has experienced incursions of medfly brought in from Western Australia, despite a very aggressive quarantine policy. These outbreaks, if allowed to become established, would threaten very important commercial fruit growing areas in the fruit fly exclusion zone (FFEZ) to the east. These outbreaks have been traditionally dealt with using a combination of cover and bait sprays. This year the programme has run into very serious technical and political problems. Firstly, the incursions have been very difficult to deal with and in some cases the traditional technology has simply failed to contain them. Secondly, there has been a vociferous and well-organised public campaign against the use of cover sprays that caused the Governor to take a decision to ban their use this year. Fortunately, Western Australia has just completed a feasibility study for medfly eradication and has a small rearing facility in Broom producing about 10 million males/week using a *tsl*-GSS. The eradication programme in South Australia is now purchasing sterile flies from the facility for weekly releases to deal with incursions into the state.

Shipments to Israel

The Entomology Unit will produce and ship 5 million sterile male medfly pupae per week to Israel in support of IAEA/TC project ISR/5/010 "Upgrading the Area-Wide Control of the Mediterranean fruit fly using the Sterile Insect Technique". Male flies from a trial shipment of the strain were evaluated in Israel and shown to be competitive for the wild female medflies. These shipments are a stopgap measure to support the programme in the absence of medflies from other rearing facilities. This clear imbalance in supply and demand suggests that commercialisation of medfly production should be a viable business.

Pilot use of SIT to Control the Sweet Potato Weevil on Kume Island, Japan.

The Sweet Potato Weevil (SPW), *Cylus formicarius*, first described in India in 1792, is a serious pest of sweet potato. SPW spread from its origin in India and it

is now present throughout Asia, some countries in Africa and in the American continent. The larvae develop in the tuberous roots of sweet potato causing irreversible damage to the plant.

In 1994-95, the Department of Agriculture, Forestry and Fisheries of the Okinawa Prefectural Government in Japan, launched a pilot project to control the pest on Kume Island.

Until 1998, the control method included the use of a specific sexual attractant developed by R. Heath (USDA/ARS). As in the case for the Male Annihilation Technique used against some tephritid flies, blocks impregnated with a mixture of the attractant and an insecticide were released over the entire island. Unfortunately and unlike *Bactrocera* fruit flies, SPW adults do not feed on the attractant and consequently do not ingest the insecticide. This method alone was not successful in efficiently controlling the SPW populations.

In parallel, "mass-rearing" of the pest was being developed in Okinawa. SPW is reared on sweet potato roots. The attractiveness of the synthetic lure was used as a sexing tool to select males only for release. SPW adults are then exposed to an irradiation dose of 200 Gy which induces a nearly 100% sterility in the population [until September 2001, an irradiation dose of 100 Gy was applied which resulted in a 90% sterility rate].

As from early 1999, an SIT component was then successfully integrated into the control strategy. The aerial release is done by helicopter from which paper bags (9x20.5cm) containing 1,000 SPW adults of both sexes are released at a rate of 500 to 2,000 individuals per hectare. Initially, 100,000 sterile SPW adults were released weekly over Kume Island. As from 2001, following the increase in production capacity, a total of 1 million adults are released weekly. From 1999 until the first semester of 2001, these operations resulted in a ten-fold decrease in the wild population of the SPW on Kume Island.

Cylus formicarius (Photo courtesy of R. Burns, Texas Agricultural Extension Services)

In order to lead to a wider use of SIT against the SPW, research is needed in the following fields: (i) development of a high yield artificial diet and of an effective egg-collection process. The actual larval rearing on sweet potatoes strongly limits the number of eggs produced; (ii) improvement of survival of sterile SPW. The survival of sterile SPW is actually limited to one week in the field against over three weeks for the wild individuals. In addition, research is already being done to develop small size (about the size of SPW), round-shaped lure-toxicant blocks which are foreseen to be more efficient in attracting and thus killing SPW adults by contact. These "MAT" blocks would be needed to artificially decrease wild SPW population prior to large scale SIT operations.

A pilot project was also initiated to control the West Indian Sweet Potato Weevil (WISPW), *Euscepes postfasciatus*, in a 30 ha area of Kume Island. An unsuccessful attempt was made to rear the WISPW on artificial diet. In order to use SIT against the WISPW on a larger scale, research would be needed: (i) to develop an effective egg collection method; (ii) to

evaluate the adverse effects of sterilization on adult longevity; (iii) to synthesize an effective attractant for this pest as available for the SPW in order to set-up effective population monitoring and suppression methods.

These pilot projects run in the Okinawa Archipelago are promising and show that some R&D can make the technique available for large scale area-wide SIT-based integrated control of sweet potato weevils.

(Information provided by Dr. Tadashi Teruya, Research Institute for Subtropics, Okinawa, Japan).

Work to start on R & D for mosquito SIT

Malaria is the most important insect transmitted disease. It causes approximately two million deaths a year and there are about 300–500 million cases of clinical malaria annually. Over 90% of the world's malaria cases occur in Africa, and in many countries it consumes a major portion of the national health budget. The disease constitutes a major obstacle to poverty reduction in Africa; according to some estimates, it has slowed economic growth in African countries by 1.3% per year. The burden that malaria places on societies and economies was recognized when 48 African Heads of State and Government met in Nigeria in April 2000 and adopted the Abuja Declaration on Roll Back Malaria (RBM) in Africa.

Early treatment for malaria requires affordable and effective drugs but there are growing problems of drug resistance. Insecticide treated bed nets have proved a valuable control tool in seasonal transmission areas, but they are ineffective in hyperendemic areas and resistance to pyrethroid insecticides, already reported from several countries in Africa, could limit the efficacy of bed nets if it were to become more widespread. In recent trials of candidate malaria vaccines, none have proved sufficiently protective against malaria to warrant use in malaria control. Even when one is available, the belief is that a vaccine should be deployed alongside other control methodologies.

The Sterile Insect Technique has been shown to be an effective technology for the suppression and/or eradication of certain key insect pests including the vector of animal trypanosomosis, tsetse fly. These factors have led to renewed interest by Member States in the potential of the SIT for the suppression of mosquito vectors in suitable areas.

Previous attempts to develop the SIT against *Anopheles* mosquitoes took place mainly in the 1960's and 1970's and a number of field trials were conducted. Over the last decade there have been repeated requests from Member States to evaluate SIT for application against vectors of malaria. As a result of these requests, two consultants meetings - in 1993 and 1996 - advised on the possible use of SIT for the control of malaria mosquitoes. Both Consultant Reports commissioned by the IAEA recognized the potential of SIT for area-wide control of mosquitoes, but stressed that important technical constraints relating to several key components of SIT technology must first be removed. They recommended candidate *Anopheles* species for SIT together with potential target sites for initial field trials. However they noted that the technology for large-scale field application does not exist and substantial R&D is needed to develop the methods required.

Now, following IAEA General Conference Resolution (GC-44/24), the Sub-programme has been instructed to embark on a feasibility study of the use of SIT for one important vector of malaria. To implement the above resolution, a meeting was convened involving national experts from 8 African countries, international experts and a representative from WHO. Emanating from this June

2001 meeting was a detailed definition of a five-year R&D project aimed at developing and evaluating SIT technology for *An. arabiensis*, a major malaria-transmitting species that is the only vector in large parts of its distribution in Africa. A project document has been prepared that would guide future work and would be used by the Agency and Member States to solicit donor support. The funding requirements for the 5-year project amount to $4.64 million. The scope of this initial project is limited to: (a) laboratory R&D of SIT technology for *An. arabiensis;* (b) the collection of baseline data from field site(s); (c) training and capacity building in a network of centres in Africa. The project will also involve establishing an improved network of centres in Africa, together with strengthened collaboration with centres of excellence elsewhere.

The feasibility study will start in 2002 and will focus on the following technical constraints:

a) Development of efficient methods of mass rearing *Anopheles* mosquitoes.

b) Improvement of sterilization, handling and release methodology.

c) Design of genetic and molecular methods for the production of male mosquitoes.

d) Integration of the SIT with other *Anopheles* control approaches.

The following resolution in support of PATTEC was passed at the recent FAO General conference. The application of this resolution will give strong additional support to PATTEC, to complement that provided by the IAEA.

FAO GENERAL CONFERENCE RESOLUTION 4/2001

Plan of Action for the Pan African Tsetse and Trypanosomiasis Eradication Campaign (PATTEC)

THE CONFERENCE,

Acknowledging that tsetse flies which affect 37 African countries and cause an estimated annual loss of US$ 4.5 billion were one of Africa's greatest constraints to socio-economic development, severely affecting human and livestock health, limiting land use, causing poverty and perpetuating underdevelopment on the African continent,

Realizing that elimination of tsetse flies would significantly contribute to increased productivity of crops and livestock and reduce rural poverty on the African continent,

Recognizing decisions AHG/Dec. 156 (XXXVI) of 12 July 2000 and AHG/Dec. 169 (XXVI) of 11 July 2001 by the Heads of State and Government of the Organization of African Unity (OAU) to free Africa of tsetse flies, and their endorsement of and commitment to the OAU's Plan of Action for the Pan African Tsetse and Trypanosomiasis Eradication Campaign (PATTEC),

Taking note that the PATTEC was officially launched in Ouagadougou, Burkina Faso, during the Second Orientation Workshop for the Directors of Animal Resources and Veterinary Services on Policy and Strategy for Tsetse Eradication held on 29-30 September 2001,

Noting the recommendations made by the FAO Liaison officers meeting for West and Central Africa, in Ouagadougou, Burkina Faso on 29 September 2001, inviting the international community to fully support the PATTEC initiative,

Recalling that the *World Food Summit Plan of Action* of 1996, adopted in Rome on 13 November 1996, recommended that Governments, in partnership with all actors of civil society, and with the support of international institutions, seek to ensure effective prevention and progressive control of plant and animal pests and disease, including those which are of transboundary nature,

Considering the acknowledgement of the problem by the Secretary-General of the United Nations in his recent report to the United Nations Economic and Social Council, and the Resolution E/2001/L.34 adopted by the United Nations Economic and Social Council on 25 July 2001, calling upon all Member Nations, organizations of the United Nations System and the international community to fully support the Organization of African Unity's Pan-African Tsetse and Trypanosomiasis Eradication Campaign,

Acknowledging the Resolution GC(45/RES/12, adopted on 21 September 2001 by the Forty-fifth Session of the Conference of the International Atomic Energy Agency, welcoming the OAU's Plan of Action of the eradication of tsetse flies from Africa and calling upon Member Nations to provide technical, financial and material support to African Member Nations in their efforts to eradicate tsetse flies,

Considering that the Twenty-ninth Session of the FAO Conference in adopting Resolution 5/97 on the Programme against African Trypanosomiasis (PAAT) endorsed the objectives and structures for PAAT in recognition of its concern over the considerable adverse impact of Trypanosomiasis on agricultural production and human welfare, and for PAAT's potential to contribute to the objectives of the *World Food Summit Plan of Action*,

Supporting the significant joint efforts undertaken by FAO, IAEA, OAU and WHO through PAAT,

Recognizing the important contribution that FAO was making in the fields of pest and disease control and in food and agricultural production,

1. **Welcomes** the OAU initiative for the progressive control and ultimate eradication of tsetse flies from Africa as an important tool to increase animal and agricultural production in affected countries,

2. **Urges** affected Member Nations to include tsetse flies eradication in their Poverty Reduction Strategy Papers,

3. **Requests** FAO, in cooperation with Member Nations and relevant international organizations, to support African Member Nations in their efforts to effectively combat the human and animal diseases and their vectors, and in particular to support the OAU's initiative of PATTEC,

4. **Requests** the Director General to report on the progress made in the implementation of this Resolution to the Council and the Conference at its Thirty-second Session.

(Adopted on 12 November 2001)

I. ANNOUNCEMENTS

STAFF CHANGES

Marc Vreysen joins the Insect Pest Control Section

Marc Vreysen joined the Section as a tsetse expert in July 2001. He has lived and worked in the Congo, Tanzania, Zanzibar and Ethiopia. Previous work with the IAEA include 3 years as a research scientist at the Entomology Unit (tsetse group) in Seibersdorf, engaged in research on radiation biology and hybridisation of tsetse flies. From 1990 to 1993, he worked as an IAEA expert in Zanzibar and Tanzania. During this time he was involved in methods development on tsetse trapping, monitoring techniques and sterile male release methods. From 1994 to 1997, he was responsible for the field operations of the tsetse SIT project in Zanzibar, which culminated in the eradication of the pest from the island. From 1998 to 2000, he was the IAEA regional expert for the tsetse project in Africa based in Addis Ababa, Ethiopia.

Marc holds a Ph.D. in Veterinary Entomology from the Agricultural University of Wageningen, The Netherlands. The FAO and the IAEA will greatly benefit from Marc's expertise in tsetse, considered to be a one of the main root problems of poverty in Africa and a priority for the IAEA's Technical Cooperation Programme.

Abdeljelil Bakri rejoins the Insect Pest Control Section as Visiting Scientist

Abdel Bakri has previously worked in the Section in 1999 on the EcoPort pages[6] for medfly and the South American fruit fly and in 2000 on the IDIDAS database (International Database for Insect disinfestation and Sterilization) which has been established jointly with the Food & Environmental Protection Section of the Joint FAO/IAEA Division. He rejoined the Section on July for 12 months to continue his valuable work on the IDIDAS database and to assist in updating the manual on Nuclear Techniques in Entomology.

Abdel holds a Ph.D. in chemical ecology from the University of Southampton in the United Kingdom. His expertise in the development of databases and knowledge of SIT technology will be of great benefit to the Section.

Magali Evrard joins the Section

Magali Evrard joined the Section as a Secretary in November 2001. She has worked previously in the IAEA for 22 years in the Medical Service and the Division of Human Health.

We welcome Magali and wish her a fruitful time at the section.

[6] http://www.ecoport.org/

Wendell Snow leaves Jamaica

Wendell Snow has left the Jamaica screwworm SIT project on retirement after several years as the IAEA expert there. Wendell has guided the counterparts through many problems, and although he leaves before the project is complete significant progress has been recorded. Wendell has been involved with SIT for much of his professional career has been associated with the Sub-programme through many projects, including the Zanzibar tsetse eradication.

He will be missed by this project and the Sub-programme. We wish him a happy and long retirement, and hope that we shall continue to see him.

OTHER ITEMS

Recent SIT video now available in Spanish and French versions.

The English teaching video "The Sterile Insect Technique. An environment-friendly method of insect pest suppression and eradication" is now also available in Spanish (**La Técnica del Insecto Estéril**) and in French (**La Technique de l'Insecte Stérile**). Copies, in PAL, NTSC and SECAM formats, are available on request from the section. Contact one of the secretaries to obtain a free copy.

CD-ROM publication, STOP Screwworms from the Special Collection of the National Agricultural Library

The Special Collections of the National Agricultural Library (NAL) documents on eradication programs in North America and Central America from the 1930s through 2000, is offering a recent published CD-ROM, "STOP Screwworms: Selections from the Screwworm Eradication Collection". The content of this CD is currently available on the web[7]. We believe that you will find these materials interesting and informative.

The Moscamed Program website now available in the internet.

The Moscamed Program website[8] is now available with interesting information on historical and current information on the efforts that the Mexican and US governments have been doing for the past 22 years to prevent the Mediterranean fruit fly (*Ceratitis capitata*) from spreading beyond its current distribution in Central America. The Moscamed Program very much appreciates suggestions and comments to improve the website which can be e-mailed to:

direccion@moscamed.org.mx

[7] http://www.nal.usda.gov/speccoll/collect/screwworm
[8] http://www.moscamed.org.mx

Corrigendum

In our Newsletter No. 56, on page 9, there is an article about "Date moth (*Ectomyelois ceratoniae*) SIT in Tunisia". Unfortunately the specimen pictured is not the date moth but a picture of the Indian meal moth, *Plodia interpunctella*, a notorious stored products pest. We apologize for this error and request you to make a note in your copy of the Newsletter 56 to prevent confusion. The correct photograph is shown on the right.

Ectomyelois ceratoniae

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