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Insect Pest Control Newsletter

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Participants to the Second International Conference on Area-Wide Insect Pest Control from 9 to 13 May 2005 in Vienna, Austria

Contents

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To Our Readers

The concept of Area-wide Integrated Pest Management (AW-IPM) is defined as IPM applied against an entire pest population within a delimited geographic area. Area-wide intervention strategies require more planning and ecological understanding, longer-term commitment, a minimum infrastructure and a coordinated implementation by farmers and all other stakeholders. The spatial distribution of the pest population has to be considered not only in surrounding cultivated areas, but also in non-cultivated areas. It also involves considering the temporal distribution of the pest to determine the periods when the pest is most susceptible to preventive, rather than remedial, interventions.

In 1998 FAO and the Agency sponsored the *First International Conference on"Area-Wide Control of Insect Pests, Integrating the Sterile Insect and Related Nuclear and other Techniques"* in Penang, Malaysia. This Conference greatly increased the interest and awarness concerning the AW-IPM approach to insect pest control. Since then, many new technical innovations

have been introduced; a better regulatory framework is being developed to encourage the involvement of the private sector, and more FAO and Agency Member States are integrating insect pest control methods on an area-wide basis.

Over the past months we have been heavily involved in preparing for the *Second FAO/IAEA International Conference on "Area-Wide Control of Insect Pests: Integrating the Sterile Insect and Related Nuclear and Other Techniques"*, which was held from 9-13 May in Vienna. The response and interest of scientists and governments, as well as the private sector and sponsors were once more very encouraging. The conference took place with the participation of over 300 delegates from 86 countries, nine international organization, and eight exhibitors. It covered the area-wide approach again in a very broad sense, including the development and integration of many non-SIT technologies, as well as genetic research on cytoplasmic incompatibility and other alternatives to sterilization.

Area-wide insect pest control programmes are logistically complex and managerially intensive. They require an effective management and a broad coalition of stakeholders committed to ensure success. These critical, but largely non-technical, operational issues, often determine success or failure of area-wide programmes: whereas the integration of various technologies is effective in some countries, it runs into major problems when implemented against the same pest insect in others. Therefore the main focus of this second conference was to review lessons learned in implementation, addressing both the technical and managerial components of operational AW-IPM programmes.

Thus, in addition to oral and poster presentations on programmes and new technologies relevant to improving the implementation of operational programmes, managers, scientists and decision-makers at the conference debated a number of relevant questions during eight discussion sessions and four discussion panels. These included: Why is the area-wide approach not more widely applied in view of its obvious effectiveness, favourable economics and better sustainability? What are the major factors limiting its acceptance and implementation? How do we assure effective management in these complex programmes? Why do so few university curricula tech area-wide principles? Is the area-wide application of SIT a solution to eliminate outbreaks of invasive species, which as a result of increased trade, travel, and tourism, are increasing their movement and establishment in new locations? Does the area-wide approach have to involve government participation? What is the potential for commercialisation?

A majority of area-wide programmes have so far been carried out by governmental organizations, with or without some financial participation from the direct beneficiaries. Although they often address a public good, in the long run this may not be sustainable. Continued expansion of the area-wide approach will require the involvement of commercial enterprises. This could involve the delivery of a complete package or more likely be partitioned into different components depending on the type of programme. Obviously this is more feasible where producers are organized into associations, or governments are willing to contract such operations to deal with pest of animal or public health importance.

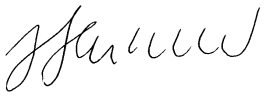
The potential role of modern biotechnology, including transgenic crops, in AW-IPM programmes was another topic debated. It is now possible to routinely introduce genes into the germ line of many pest species and much of this development has been predicated on using sterile transgenic insects as one of the lowest risk strategies. Will genetic engineering of insects improve the SIT or will it compete with it? Will it be acceptable to stakeholders? Up to now there has been much speculation in this area, but as yet no transgenic strains of pest insects have been produced that could be effectively used in a programme integrating the SIT. It was concluded that a critical and informed, case by case, analysis of the possible advantages and disadvantages of using genetically modified or paratransgenic insects in future area-wide programmes is needed, together with the development of a framework that regulates their use.

I would like to thank all conference participants and government delegates for their enthusiastic participation and the high quality of oral and poster presentations, as well as the IAEA Conference Services staff, the Joint FAO/IAEA Programme staff, and sponsors, for the effective organization and support, contributing to a very fruitful and enjoyable event. We hope that a third conference on this theme can be held in ca. 5-6 years.

Another major development we would like to share relates to the 7th Session of the Interim Commission for Phytosanitary Measures (ICPM) for the International Plant Protection Convention (IPPC), held in April 2005 at FAO headquarters in Rome. The IPPC is the international treaty under which the international standards for phytosanitary measures (ISPM) that protect plant health are agreed. These standards are recognized by the WTO's Agreement on Sanitary and Phytosanitary Measures (SPS). The use and transboundary shipments of sterile insects was previously outside the scope of ISPM No.3 entitled *Code of Conduct for the Import and Release of Exotic Biological Control Agents.* Since the implementation of the SIT was largely dominated by the public sector, this did not represent a problem for the transboundary shipment of sterile insects. However, the lack of an international standard covering sterilization did discourage private investment in the production and shipment of sterile insects.

Over the last three years ISPM No.3 has undergone a major revision to update and broaden its scope. We have been involved in explicitly including sterile insects as *beneficials* in the revised standard to facilitate the application of SIT. The revised ISPM No.3 *Guidelines for the Export, Shipment, Import, and Release of Biological Control Agents and Other Beneficial Organisms* was drafted in 2004, reviewed by the Standards Committee and submitted for country consultation. It was then submitted to the 7th ICPM in 2005. After having dealt satisfactorily with all country comments, the revised standard was adopted by the plenary ICPM in 2005. In addition, the terms *sterile insect* and *sterile insect technique* were submitted to the Glossary Working Group for inclusion in the ISPM Glossary of Phytosanitary Terms. This revision of ISPM No.3, to include sterile insects, should help facilitate their use, especially in terms of commercialization of the SIT.

Finally I would like to inform you that the Director of the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, James Dargie, is retiring on July 31st, after leading the Division for ten years (1995-2005). This has been a very intensive and productive decade for the Insect Pest Control subprogramme, with rapid technological development, and many successes and some failures against a background of much internal and external change. All staff of the Insect Pest Control subprogramme, both in Vienna and Seibersdorf, would like to thank Jim for his guidance and support to the subprogramme during these critical years. We wish him many healthy years and an active and happy retirement. We would also like to inform you that the Directors General of FAO and IAEA have appointed Mr. Liang Qu as the new Director of the Joint FAO/IAEA Division. Mr. Qu will take up his duties on 1 August 2005. He is only the fourth Director of the Joint FAO/IAEA Division in its forty-one year history (1964-2005). Mr. Liang Qu is from the People's Republic of China (originally from Fujian Province) and holds a M.Sc. in Agronomy from the Chinese Academy of Agricultural Sciences. His former positions include Deputy Director General of the Institute for Application of Atomic Energy, Beijing; Director General of the Department of International Cooperation and Industrial Development of the Chinese Academy of Agricultural Sciences; Permanent Representative of China to FAO and, his most recent position, Director General, Dept. of International Cooperation in the Chinese Academy of Agricultural Sciences. We all welcome Mr. Liang Qu to the Division and wish him much success in his new position.



Jorge Hendrichs, Head
Insect Pest Control Section

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Forthcoming Events

I. Research Coordination Meetings (RCMs)

RCM on Improvement of Codling Moth SIT to Facilitate Expansion of Field Application. 14-18 November 2005, Mendoza, Argentina. Second RCM.

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

RCM on Development of mass rearing for New World (Anastrepha) and Asian (Bactrocera) fruit fly pest in support of SIT. 4-8 September 2006, Bahia, Brazil. Second RCM.

II. Consultants and Other Planning Meetings

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

Consultants Meeting on Handling and Release of Fruit Flies, September 2005, Vienna, Austria.

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

III. Other Meetings/Events

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

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

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

Nominations should be submitted on the standard IAEA application form for training courses available on the web site: (http://www-tc.iaea.org/tcweb/participation/astrainee/default.asp). Completed forms should be endorsed by and returned through the official channels (Ministry of Foreign Affairs, Ministry of Agriculture, National Atomic Energy Authority, Office of the United Nations Development Programme or Office of the FAO). Nomination forms must be received by the IAEA, P.O. Box 100, A-1400, Vienna, Austria not later than 29 December 2005. A course prospectus is available upon request.

Past Events

I. Research Coordination Meetings (RCMs)

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

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

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

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

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

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

II. Consultants and Other Planning Meetings

Ninth Meeting of the Programme Against African Trypanosomiasis (PAAT), 5-6 May 2005, Vienna, Austria.

III. Other Meetings/Events

Second International Conference on Area-Wide Insect Pest Control, 9-13 May 2005, Vienna, Austria.

First Meeting of the regional fruit fly scientific group TEAM (Tephritidae of Europe, Africa and the Middle East) 11 May 2005, Vienna, Austria.

Note: Reports available upon request.

Technical Cooperation Projects

Ongoing Technical Cooperation Projects are:

ALG/5/019 Control of Date Moth Using the Sterile Insect Technique.

BOT/5/002 Support of Tsetse Eradication from Ngamiland.

EGY/5/025 Area-Wide Fruit Fly Control in Eastern Egypt.

ETH/5/012 Integrating SIT for Tsetse Eradication.

INT/5/145 Promotion of Insect Pest Control Using the Sterile Insect Technique.

IRQ/5/016 Field Monitoring and Rearing of Old World Screwworm.

KEN/5/022 Integrated Area-Wide Tsetse and Trypanosomosis Management in Lambwe Valley.

MAG/5/011 Feasibility Study of SIT-Based Integrated Pest Management of Fruit Flies.

MAR/5/015 Feasibility Study For Integrated Use of the Sterile Insect Technique for Area-Wide Tephritid Fruit Fly Control.

MEX/5/027 Transfer of Genetic Sexing Mass Rearing Technologies for Fruit Fly Production.

RAF/5/051 SIT for Tsetse and Trypanosomosis Management in Africa.

RAF/5/052 SIT Development for Control of Anopheles Mosquito.

RLA/5/045 Preparation for Pilot Fruit Fly-Free Areas using the Sterile Insect Technique in Central America.

SAF/5/007 Expanding the Use of the Sterile Insect Technique against Fruit Pests in the Western and Northern Cape.

THA/5/046 Area-Wide Integrated Control of Fruit Flies.

UGA/5/024 Integrated Area-Wide Tsetse Eradication Programme in the Lake Victoria Basin.

New Technical Cooperation Projects for 2005-2006 cycle are:

BGD/5/025 Studying the Feasibility of the Sterile Insect technique in Sun-dried Fish Industry Project.

BRA/5/057 Establishment of Medfly, Fruit Fly Parasitoids and Codling Moth Rearing Facility.

BKF/5/004 Feasibility Study on Applying the Sterile Insect Technique to Create a Tsetse-Free Zone.

CHI/5/047 Decresing the Population of the Mediterranean Fruit Fly in the Arica Region.

INT/5/149 Interregional Training Course on the Use of the Sterile Insect Technique and Related Techniques.

ISR/5/011 Strenghening the Capacity for the Area-Wide Control of the Mediterranean Fruit Fly Using the Sterile Insect Technique.

JOR/5/010 Strenghening the Capacity for the Area-wide suppression of the Mediterranean Fruit Fly Using the Sterile Insect Technique.

MALI/5/020 Feasibility Study for the Creation of a Zone Free of Tsetse.

MEX/5/029 National Prevention Campaign against the Cactus Moth.

MOR/5/028 Assessing the Fesibility of Medfly Suppression Through the Sterile Insect Technique.

PAL/5/003 Strenghening the National Capacity for the Area-wide Suppression of the Mediterranean Fruit Fly.

PAK/5/043 Development of Biological Control for Cotton Pest Management Using Nuclear Techniques.

SAF/5/009 Preparation for the Creation of Zone Free of *G. brevipalpis* and *G. austeri*.

SEN/5/029 Feasibility Study to Create a Tsetse-Free Zone Free Using the Sterile Insect Technique

TUN/5/022 Implementation of the Pilot Programme Using Sterile Insect Technique against the Mediterranean fruit fly, Phase II.

URT/5/022 Assistance to a Feasibility Study for the Use of the Sterile Insect Technique.

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

Establishment of Medfly Mass Rearing and Sterilization Facility In The Rio San Francisco Valley (BRA5057)

The establishment of a medfly mass rearing facility in Brazil, is an idea that was born within the Empresa Brasileira de Pesquas Agropecuaria (Embrapa) and consolidated inside the Ministry of Agriculture. It has been formally constituted as a social organization in 2002 for the implementation of mass rearing of insect pests of the horticulture industry.

Sketch of Medfly Mass Rearing Facility in Brazil

In 2003, the first contacts were established with federal, two state organizations, the private sector and international organizations including the IAEA and the FAO. As a result, cooperative agreements and technical cooperation contracts were established.

The Government of Bahia, through its Secretary of Agriculture, Irrigation and Agriculture Reform donated 60,000 m^2 of land with 5,500 m^2 of buildings available for the mass rearing facility. In late 2004, refurbishment of two existing modular buildings started with financial resources from the Ministry of Science and Technology that were allocated to the Ministry of Agriculture and to the Plant and Animal Health Agency of the State of Bahia (ADAB).

Given that this is a pioneer project in Brazil and to allow for an adequate design of the facility and a more rational use of the financial resources, engineers and arquitects, and technical staff from EMBRAPA, the University of Sao Paulo (USP) and ADAB visited large-scale facilities abroad, including the El Pino facility in Guatemala. It is expected that by the end of 2005 the production modules, fully equipped with a centralized air-conditioning, will be ready.

The *tsl* –thermal sensitive lethal- only male strain was transferred from the Entomology Unit of the FAO/IAEA Agriculture and Biotechnology laboratory at Seibersdorf, Austria, to the Embrapa quarantine laboratories and then to the Centre of Nuclear Energy for Agriculture (CENA-USP), where the colony has been successfully established.

Strengthening the Capacity for the Area-Wide Control of the Mediterranean Fruit Fly Using the Sterile Insect Technique (SIT) in Israel (ISR5011), Jordan (JOR5010) and The Palestinian Territories (PAL5003).

A cooperative programme between Israel, Jordan and the Palestinian Authority for medfly control using area-wide SIT was established in 1997 under IAEA Technical Cooperation Projects. Achievements resulted in a 50-fold increase in bell pepper export revenue. Now growers target a much larger potential export market. The successful regional cooperation within this programme has also served as a peace-promoting platform for the region.

Exports of bell peppers from the Arava Valley to high value markets.

The Mediterranean fruit fly (*Ceratitis capitata*) (or Medfly) is a key pest of fruits and vegetables throughout the Mediterranean Basin including Israel, Jordan and the Territories Under the Jurisdiction of the Palestinian Authority (TUJPA). During the past 40 years, farmers have attempted to control this pest by using conventional insecticide cover sprays in Jordan and insecticide bait sprays in Israel and the TUJPA. However, despite an average of 10 annual insecticide applications, fruit loss was significant, secondary pest outbreaks frequent and export markets accessible only through the use of costly postharvest treatments. An economic feasibility study conducted in 1997 showed that in Israel, Jordan and the TUJPA the total annual losses from Medfly amounted to nearly US $300 million, including loss of markets that discriminate against Medfly and pesticide residues.

Given the seriousness of the problem, Israel and Jordan in 1997, and the TUJPA in 1999 requested support from the IAEA to integrate the sterile insect technique (SIT) as part of an area-wide approach in this region. The necessary technology was transferred through Technical Cooperation Projects (TCPs) subscribed by the Ministries of Agriculture. Through these TCPs, the SIT technology for Medfly population suppression was transferred to Israel and Jordan and capacity generated in the TUJPA for

adoption of this technology. These projects have equally served as a peace-promoting platform, bringing together these countries and territories in a joint collaboration and partnership to solve a shared problem.

Since 1998, sterile male Medflies have been imported form the El Pino mass rearing and sterilization facility in Guatemala to an emergence and release facility in Israel. Sterile flies have been released on a continuous basis in pilot areas located in the Arava Valley on both sides of the Israeli and Jordanian borders. By integrating SIT with other suppression methods, reduction in fruit infestation and insecticide use has been significant. Moreover, on the Israeli side of the Arava, the export of Medfly-free produce, mainly bell peppers, has increased from less than US $1 million in 1998, to US $50 million in 2004, as a result of effective Medfly population suppression integrating the SIT on an area-wide basis.

The positive impact that application of this technology has had in the region has recently encouraged the Israeli company BIO-FLY, a subsidiary of the biocontrol company BIO-BEE, to build a pilot Medfly mass rearing facility at Sde Eliahu in the Beit She'an Valley to supply local farmers in the Arava Valley pilot areas with 15 million sterile male Medflies per week. This is the first privately run facility of its kind in the Mediterranean region.

Demand for sterile male Medflies will continue to increase as the programme expands to commercial horticultural production areas in the Northern Negev and Upper Galilee in Israel, the upper Jordan Valley in Jordan and the Palestinian Authority areas. To cover this increased demand BIO-FLY is currently planning to enlarge its present Medfly rearing capacity. This programme contributes significantly to the improvement of the agricultural sector in the Middle East and also forms a sound basis for increased cooperation within the region.

Status of Coordinated Research Projects (CRPs) and RCMs

New Coordinated Research Project

A new CRP was initiated this year entitled *Development of Mass Rearing Procedures for* Anastrepha *(New World) or* Bactrocera *(Asia/Pacific region) fruit fly pests. T*he first RCM was attended by 20 scientists from 17 countries and held in Manila Philippines, from 28 March to 1st April 2005. Fruit flies are of major economic importance in nearly all tropical, subtropical and some temperate countries worldwide. In this group of fruit flies of economic importance, several polyphagous species infest a broad range of fruit and/or vegetable crops and damage their production (e.g. Medfly, Queensland fruit fly, *Bactrocera zonata*, *Anastrepha spp*). Other, monophagous species (e.g. olive fly) are key pests of individual crops of international importance. The SIT as an area-wide environmentally clean technique to control insect pests, has become an important part of many of the integrated fruit fly management programmes. The high degree of sophistication in SIT technology in some programmes and progress in its application has encouraged interest in developing the SIT for additional fruit fly species of major international/regional importance. Considerable research on artificial rearing on some of these species was conducted in earlier years, but there is need now to solve specific problems of mass production for some of the species, or initiate research for those species that currently became economically important. Such candidate species for future concerted action include key *Bactrocera* and *Anastrepha* species, which are of economic importance to many FAO and IAEA Member States.

The overall objective of this project is to develop and improve rearing technology for selected *Anastrepha* and *Bactrocera* fruit flies of economic importance for SIT application. Thus, the focus will be from basic biology studies and colonization process through the establishment/improvement of mass rearing protocols. The proposed CRP will focus on twenty two tephritid fruit fly species (including some African *Ceratitis* species). For some of the species there is, currently, a total lack or little knowledge about colonization and mass rearing, while for other species with ongoing SIT programmes, there is a requirement and demand to improve mass rearing protocols and control processes.

Development of Improved Attractants and Their Integration into Fruit Fly SIT Management Programmes

RCM participants, Vienna, Austria, May 2005

The fourth and final Research Coordination Meeting (RCM) was carried out in Vienna, Austria, from 5 to 8 May 2005. Twenty-one participants from Argentina, Brazil, Colombia, Costa Rica, France (Corsica and Reunion), Honduras, Greece, Israel, Italy, Kenya, Mauritius, Mexico, Pakistan, Portugal (Madeira), Spain, United Kingdom and United States of America presented results from the last year experiments and a summary of the five year research. The meeting had a number of observers including representatives from private companies that supplied trapping materials to conduct the experiments throughout the five years of research. Networking of scientists from 17 countries with commercial companies proved to be a very fruitful association and a very effective way of bridging the gap between science and the use of the technology in the field.

Different trap, lures and bait stations were tested in a wide range of environmental conditions to measure the response of a number of fruit fly species of economic importance including, in Latin America: Mediterranean Fruit Fly (*Ceratitis capitata*), Mexican Fruit Fly (*Anastrepha ludens*), West Indian Fruit Fly (*A. obliqua*), South American Fruit Fly (*A. fraterculus*), Guava Fruit Fly (*A. striata*) and Sapote Fruit Fly (*A. serpentina*). In Africa and the Mascarene: Oriental Fruit Fly (*Bactrocera dorsalis*), Melon Fruit Fly (*B. cucurbitae*), Peach Fruit Fly (*B. zonata*), and Ethiopian Fruit Fly (*Dacus ciliatus*).

In the Mediterranean: Mediterranean Fruit Fly (*C. capitata*) and Olive Fruit Fly (*B. oleae*).

As a result of the five-year Research Coordinated Project important progress was made in improving some of the trapping systems currently being used against these fruit fly species. In general, response of some of the most important *Anastrepha* species to a two-component synthetic food lure was equal or better compared with the conventional but less practical protein baits. Likewise, the *Bactrocera* species responded much better to combinations and different concentrations of the synthetic food lures than to the conventional protein baits. It was observed that the level of female response of some species of *Ceratitis*, in particuluar, *C. rosa* and *C. cosyra,* to the female biased three component lure (Biolure), is the same as *C. capitata*. On the other hand, species which are more host specific such as the Guava Fruit Fly, (*A. striata*) and the Olive Fruit Fly (*B. oleae*) had poor response to the synthetic food lures as compared with the conventional protein baits. For these species research needs to be focused at basic biology and ecology studies and at evaluating volatiles or crude extracts of primary host plants.

Substantial amount of research was done in trying to develop a cost-effective bait station as a population suppression method for fruit fly control in backyard hosts and in difficult to access sites. Preliminary results indicate the significant potential use of bait station techniques for suppressing *C. capitata* populations and some species of *Anastrepha*, such as internally baited yellow spheres with Ammonium Acetate and Trimethylamine and coated with sugar and methomyl. Nevertheless, at this time it is not possible to recommend a specific bait station for use in action programmes. More work on the implementation of the bait stations technology to control fruit flies should be conducted. Standard research protocols for bait station evaluation need to be further developed, including fruit sampling procedures to measure infestation levels.

Detailed results, conclusions and recommendations from this CRP will be soon published in an IAEA Technical Document.

New CRP Development of Standardized Mass Rearing Systems for Male Mosquitoes 2005-2010

Successful application of the Sterile Insect Technique against many pest species has lead to resurgence in interest to develop this area-wide control/elimination strategy against mosquito vectors. Autocidal control of mosquitoes to curb disease transmission is not new, and has been applied with varying degrees of success. SIT was successfully implemented in a pilot project against the malaria mosquito *Anopheles albimanus* in El Salvador in the 1970s. Since then, scientific advances in the fields of molecular biology, mosquito ecology and behaviour, as well as GIS technology, have improved prospects for mosquito SIT development. This CRP will focus on key gaps in knowledge on mosquito mass rearing and adult maintenance, and includes aspects of aquaculture, aquatic microbiology, colonization and mosquito genetics. The ultimate goal of the CRP is to develop and standardize cost-efficient mass production procedures for male mosquitoes with fitness and competitiveness levels that match their wild counterparts. The first research coordination meeting is planned for late 2005 and research proposals are still being accepted.

Developments at the Entomology Unit Seibersdorf

TSETSE
Pupal sexing

As indicated in our last newsletter, we have now taken delivery of a near infrared spectrometer for sexing tsetse pupae. In order to standardize pupal development for this sexing system *G. pallidipes* pupae were collected daily and placed in an incubator. During a consultancy by Dr Floyd Dowell, USDA-ARS, Grain Marketing and Production Research Center, Manhattan, Kansas the machine was tested using pupae of a known number of days before emergence. Excellent results were obtained with pupae 4 to 5 days before emergence with a sexing accuracy of about 96%. Tests were also carried out on *G. fuscipes* and *G. brevipalpis* but the data for these species has not yet been analysed. The system will now be further evaluated and used in the routine maintenance of the laboratory colonies so that sexing of adult flies using chilling will no longer be necessary. The system will also be used in operational programmes to provide male pupae for irradiation and release.

Salivary gland hyperplasia

As reported in earlier Newsletters, some tsetse species carry a virus that, in a certain proportion of individuals, leads to hyperplasia of the salivary gland and these individuals also show reproductive abnormalities. The problem seems to be most serious in *G. pallidipes*. Salivary gland hypertrophied virus was first reported by Jenni in 1973. This virus is present in natural population of tsetse at a low level (0.5-5%), but in the Seibersdorf colonies the virus is widespread and can result in significant decrease in colony reproduction. PCR analysis has confirmed that virus infections were 100% in *G. pallidipes* colony originated from Uganda. Due to the negative impact of the virus on colony productivity under certain stressful conditions it is important to understand more about the virus with the goal to develop a management strategy for the virus. The most effective way to begin this study is to obtain the nucleotide sequence of this virus as recommended during a consultancy by Max Bergoin (Montpellier). In July, Drion Boucias (USDA, Gainesville) will visit the Unit to develop collaborative work on this topic as he is working on a very similar virus in the house fly.

To obtain the nucleotide sequence of this virus, it was necessary to obtain sufficient quantity of the purified virus to extract the viral nucleic acid for a genomic library for sequencing. Two methods to produce virus in tsetse flies were investigated, the first by injecting the virus into 3rd instar larvae as previously described in the literature. The second is through infection during blood feeding. The small quantity of viral DNA prepared from hypertrophied salivary gland by Francois Cousserans in 2003 was used to construct a viral genome library. Two strategies to obtain the library were used; the first uses small insert fragments as this leads to easy cloning and sequencing. The second is the construction of a library from large insert fragments in order to facilitate sequence assembly. Using the first approach we obtained more than 800 recombinant colonies and 395 colonies were analysed to estimate the insert length and 12 are currently being sequenced. The second genomic library from large insert fragment will be initiated after having at least 50% of DNA sequence from the small fragment library. Another important aspect to study the impact of anti-viral drugs on SGHV infection is the availability of a cell culture susceptible for this virus. Primary attempts to establish a cell culture from hypertrophied salivary gland of tsetse was initiated. While, neither bacterial nor fungal contamination was observed, the cells did not multiply in the tested media. Attempts to use another cell culture media and also try to establish cell culture from another tissues such as ovaries have been initiated.

Colony status

Continuing reduction in the staff and resources available to the tsetse section has forced us to reconsider the number of species and size of colonies held. Up to now we have supplied tsetse pupae free of charge to both Member States' Technical Cooperation projects and to research institutes, but following the review of the Agency's tsetse SIT activities it has been agreed that future supply of pupae to TC projects will be charged back to the project.

A second development also influences the maintenance of colonies. As reported in the last Newsletter (64), under an Interregional Project a tsetse rearing facility has been established in Bratislava, Slovak Republic, to supplement and support the colonies in Seibersdorf. Early in 2005 the total colony size in Bratislava of three species, *Glossina pallidipes*, *G. fuscipes fuscipes* and *G. morsitans centralis* exceeded 100,000 females and is now stabilized at about 130,000. The *G. pallidipes* and *G. f. fuscipes* colonies will be progressively expanded and balanced by a reduction in the *G. m. centralis* colony until the final holding is approximately 50,000 each of *G. pallidipes* and *G. f. fuscipes* and about 20,000 *G. m. centralis* by the middle of 2005. The *G. m. centralis* colony in Seibersdorf has already been reduced as projected demand for this species is limited, and the *G. f. fuscipes* colony will also be minimized by the middle of the year. As the highest anticipated demand is for *G. pallidipes* we will ex-

pand our colony to fill the TPU3 (see below) in addition to the colony held in Bratislava to give an aggregate colony of 100,000 females.

For the research community the principal species of interest is *G. m. morsitans*. Demand for this species is higher than Seibersdorf can easily supply so we will transfer the *G. m. morsitans* colony to Bratislava later in the year, and take back from them the *G. m. centralis* colony. *G. m. morsitans* will then be held at a level of some tens of thousands in Bratislava, while Seibersdorf will maintain only a minimum colony of *G. m. centralis*. Collaborators needing *G. m. morsitans* are requested to contact Peter Takac in Bratislava, e-mail: uzaetaka@savba.sk

TPU3 installation

The installation of the TPU3 (Tsetse Production Unit) in Seibersdorf was completed in February this year. A number of minor problems have been identified and corrected in the construction, and we are now testing the equipment with a number of fly units. Currently 117 cages are on the system since 28 March.

The principle problems identified relate to mounting cages in cage frames (trays). The cages currently used in Seibersdorf are constructed from 200mm diameter grey PVC pipe with netting glued on. During washing these cages distort due to the heat. The tray system for the TPU3 holds nine cages together in an aluminium frame by compressing the cages in the frame with a screw system and when the cages are distorted they are no longer stable. Two solutions are being investigated. The first is to use identical sized cages made from a different material, a red, foam-core PVC pipe. Cages made from this material are both lighter and more stable, so that they can be held in the tray with much less pressure. The second possibility is a large, 300 x 300mm square cage, consisting of a collapsible frame covered with netting. The cage frame can be held in the aluminium moulding of the tray, potentially making them very secure. A number of minor issues of alignment and fitting have been identified, and we will continue to work with the designer and supplier to resolve these and future issues.

Alternative processing of blood

The work on alternative blood processing is continuing with work on pasteurization and UV treatment. For the pasteurization work, initial tests with a semi-commercial milk pasteurization apparatus gave disappointing results with coagulation at too low a temperature (72 °C). Work is now progressing with a laboratory simulation, at temperatures up to 80 ºC. It has been found that one of the most important parameters is the time taken for the blood to cool down from the pasteurization temperature to below 20 ºC. If this cooling is rapid, pasteurization temperatures near 80ºC may be used for several seconds without coagulation. To achieve this in a conventional pasteurising machine will require a change to the system, to replace the heat regenerator with a specific cooling system.

In the second line of investigation, a commercial UV (254 nm) blood product virus inactivation system is being investigated. This system is used to reduce the risk of virus transmission, specifically hepatitis viruses and HIV, by blood products such a serum and plasma. For these products the system is very efficient, achieving high log reductions with no damage to the product, but the system had never been used for whole blood. The absorption of UV by whole blood is very high (A 1cm 254nm = 44), such that the UV penetrates only some tens of micrometers into the blood. So far two stages of testing have been completed. Following a successful proof of principle using an artificial feedstock of similar viscosity and absorbance to blood, the second stage tested defibrinated horse blood spiked with a representative bacterium (*E. coli* 9481) and virus (PhiX 174). For the test a one litre sample of spiked blood was recirculated through the UV apparatus at 25ml/s and samples taken to measure the log reduction at various times. The reduction curves for both bacteria and virus were similar, with about a 5-log reduction in 15 minutes of recirculation. In these initial tests it was demonstrated that there was a measurable increase in met-haemoglobin after 45 minutes treatment, but it is not known if this is significant in terms of tsetse nutrition.

The equipment manufacturer has done all the work to this stage under contract. This has demonstrated the principle, but a number of issues remain. One of the UV treatment machines will be installed in Seibersdorf to allow us to test the effect of UV irradiation on the nutritional quality of the blood, and to test the effect of the irradiation on the bacteria normally encountered during blood collection.

FRUIT FLIES

Hormonal supplements for *Anastrepha fraterculus* and *Bactrocera dorsalis*.

Previous studies conducted with *Anastrepha ludens*, *A. suspensa* and *C. capitata* have shown that either topical application or feeding with juvenile hormone during the early adult stage can speed up sexual maturity and increase sexual activity of sterile males of these species. For operational programmes with an SIT component, the utilization of this novel therapy could lead to savings of space and energy in the holding and emergency facilities, since more sterile males reach sexual maturity before dying due to predation or other causes. In addition, it is expected that SIT efficiency can be increased since the treated males are more sexually competitive than the untreated males.

Peter Teal (USDA, Gainesville) is conducting some basic studies in the Unit to assess this technology for South American fruit fly *Anastrepha fraterculus* and Oriental fruit fly *Bactrocera dorsalis*. In both cases the objective is to shorten the sexual maturity time especially for Oriental fruit fly were around three weeks are necessary for the males to reach sexual maturity. The activities are: determine the age at which wild and sterile males become sexually mature, assess effects of application of methoprene on acceleration of reproductive development, determine the formulation and optimal dose required, establish the application period and method and compare mating success of sterile treated and untreated males.

A new *Bactrocera oleae* colony

A new colony laboratory strain of olive fruit fly was received from Mark Roberts USDA-ARS laboratory in California. This strain was colonized from wild material collected from infested olives in California. This strain will be used to carry out strain compatibility studies between olive flies from different origins and these are planned in the autumn. The original strain from Greece is now being maintained at levels of about 50,000 and collaboration with colleagues working on biological control of this species is ongoing.

Transfer of VIENNA 8 medfly GSS to Israel.

Biofly is a company that is working with the Inspection and Plant Protection Service (IPPS) of Israel to supply sterile medfly males to the current SIT programme in the Arava Valley. Biofly recently constructed a small medfly mass-rearing facility with capacity to produce 20 million male medfly pupae per week and they will begin to deliver sterile insects to the SIT project in Arava Valley in August. In order to establish the VIENNA 8 medfly GSS colony in the new facility, the IPPS requested, though the IAEA Technical Cooperation project ISR5011, the transfer of a fertile colony from Seibesdorf. To accomplish this transfer eight shipments of one million fertile pupae per week will be sent. Local production of sterile insects in Israel is important to increase the efficiency of the SIT projects since currently the source of sterile flies is "El Pino" facility located in Guatemala. Long shipment time significantly reduces the quality of the sterile flies that finally arrive in Israel.

Transgenic medflies

The generation of transgenic insects has two goals in relation to SIT: a) to incorporate a marker gene that would allow to discriminate between released and wild flies, and b) to incorporate genes that allow either the separation of the sexes, the elimination of the females or the conversion of the females into males. In the past the very first step, the genetic transformation of non-drosopholid insects, was the practical bottleneck. This has been solved to a point where many different species have been transformed successfully. However, in many cases the efficiency of transformation or, more precisely, the number of transformants obtained was relatively low. This means that the procedure is still rather labour intensive and due to the small number of transgenic strains available no general conclusion can be obtained with respect to the expression of the transgenes, their impact on the fitness (from viability to behaviour) and their stability, especially in large scale rearing. All these issues are, however, very important for the practical application of such strains within the SIT.

For the direct practical application as marker for released medflies in a sexing strain the transgene should be integrated on chromosome 5 that carries the mutations *white pupae* and *temperature sensitive lethal*. In the VIENNA 8 sexing strain chromosome 5 also carries an inversion (D53, *wp tsl*). With respect to the stability it would be ideal if the marker gene would be located within the inverted region (the sexing strain males are heterozygous for the inversion chromosome). In collaboration with Al Handler (USDA, Gainesville) nearly 25000 embryos have been injected with various constructs and over 300 transformants were detected. All transgenic strains derived from injecting the inversion line D53 with a *DsRed* construct were crossed with the wild type strain EgII followed by inbreeding to determine whether the marker (i.e. the fluorescence) co-segregates with *wp*. In five strains the marker appears to be inserted on chromosome 5. In collaboration with Antigone Zacharopoulou (University of Patras) these strains have been analysed by *in situ* hybridization. As corroborated by Southern analyses, the strains fall into two classes, i.e. two different integration sites were detected. Four strains have an insertion at 66B/C and one strain carries an insertion at 77A. This means unfortunately that all insertions are outside of the inversion. For all lines temperature tests were performed to show that the *tsl* mutation was not lost during the various crossing steps. The results showed that these strains are temperature sensitive as expected.

Two of these *DsRed* marked chromosomes were used to generate a sexing strain by backcrossing females of these transgenic lines twice with males from the translocation strain T(Y;5)101. The level of rearing was raised to the standard evaluation level (34ml of pupae per generation) to obtain data comparable to the other sexing strains. However, it became immediately apparent that neither of the two transgenic lines is optimal for practical application. The expression of the transgene is too weak or too variable. When larger numbers of flies were screened it became apparent that even among the homozygous females with two copies of the *DsRed* marker, a certain percentage of flies show only very weak fluorescence. This effect becomes more pronounced when the heterozygous males with only one copy of the *DsRed* are analysed. Here a considerable percentage shows either

very weak fluorescence or no fluorescence at all. With respect to the temperature-based elimination of the females these lines behave normally as was shown by standard temperature tests. Originally it was planned to introduce these lines into mass rearing. However, with these results this does not seem appropriate. Fortunately, among the lines from a more recent injection experiment with the D53 strain one line with a very strong fluorescence, even in a heterozygous condition, was detected where genetic tests show that the insertion is located on the chromosome 5. After verifying the location via *in situ* hybridization this chromosome will be evaluated as a component of a sexing strain.

Bactrocera spp genetic sexing strains

In Hawaii, Don McInnis and his group have succeeded in isolating potential genetic sexing strains based on white pupal mutations for *Bactrocera dorsalis* and *B. cucurbitae*. In a collaborative project these strains have now been transferred to Seibersdorf for further studies on stability and competitiveness. In Thailand, an SIT programme is being implemented in areas where *B. dorsalis* and *B. correcta* are present and both species are being reared and released. There is obviously great interest in improving efficiency by introducing a genetic sexing strain. In order to assess this possibility, pupae from a field population of *B. dorsalis* were sent to Seibersdorf from Thailand and field cage compatibility studies have been carried out by D. McInnis. *B. correcta* were also found in the pupal shipment and the possibility of hybrid mating between the two species will also be assessed. It has also been confirmed that feeding on methyl-eugenol (ME) can significantly improve the mating success of *B. dorsalis* males. Preliminary results have show that the genetic sexing strain is compatible with populations from Thailand and that feeding with ME one or two days before the tests doubled the mating performance of the treated males in comparison to the non-treated males.

Codling moth mating compatibility

The codling moth, *Cydia pomonella*, is a major pest of many agricultural commodities in many parts of the temperate world and it has shown the predictable capacity to develop resistance to insecticides. In support of a CRP to "Improve Components of Codling Moth SIT to Facilitate the Expansion of Field Application" (D4.10.18), field cage mating compatibility studies between different geographical populations are being carried out in Seibersdorf. This type of activity is facilitated in this species as wild populations of codling moth can be collected in diapause for shipment to Seibersdorf and the diapause can be broken as required to carry out the field cage mating compatibility tests. The rationale for this work is to assess the feasibility of using sterile codling moths from a few facilities for programmes with an SIT component in different parts of the world. Also included in the study will be laboratory colonies from Canada and New Zealand. Shipments of diapausing larvae of wild and laboratory populations have already been received in Seibersdorf and preliminary work by Mario Sevilla from Argentina has revealed interesting differences in some larval behavioural components. During June the field cage evaluations are being carried out by Gustavo Taret from Argentina.

MOSQUITOES R&D

A framework of activities and processes for the development of automated or semi-automated mosquito production systems is under preparation. These activities encompass all components of an SIT programme beginning with colonisation, and continuing through mass-rearing, female elimination, sterilization, quality control and eventual release. The framework will help provide expert advice most immediately for the development of a future mosquito mass-rearing facility for *Anopheles arabiensis* in Sudan. However, the design components are generally conceived for any location and mosquito species.

An Excel spreadsheet was recently developed to estimate the number of adults needed to produce 100,000 sterile males per day, a number representing a modular subunit to target the release of one million sterile males per day. Based on these parameters, the construction of a modular cage for both colonization and production cage was initiated. Several characteristics such as biological suitability, portability, and cost of construction were considered in the design of this first prototype. The cage design includes several innovations such as the use of pipes for sugar and blood feeding and collection of eggs, thereby limiting the necessity for intervention inside the cage. All components of the mosquito project are being jointly developed with instrumentation and mechanical workshop units in Seibersdorf.

Mark Benedict is designing and testing experimental systems for development of larval diets. The design goal is to create a novel system in which the effects of tactile interaction, waste accumulation, and diet abundance and quality can be clearly controlled. As a test diet, he is using the protist *Tetrahymena*.

Radiation biology

Ms Helinski has conducted a wide range of experiments, gathering valuable data relating to the appropriate dose and impact of irradiation applied to mosquitoes at the pupal stage. Overall, her results show that pupal irradiation at a dose of 100 Gy results in 99% male sterility without impacting adult emergence and longevity. Male mating ability is still under investigation. Preliminary results show the negative correlation between dose and % of insemination. Further activities for this year include the establishment of irradiation curves for adult mosqui-

toes. The construction of a large greenhouse is also foreseen to allow the testing of irradiated male competitiveness in field cages.

Genetic sexing

Mark Benedict followed a conventional scheme for the generation of a genetic sexing strain and these activities were resumed upon his return in May. *White* and *scarlet* irradiation-induced mutations on the X chromosome will also be screened for using the color change method. These mutants might result in a useful marker for the X chromosome and germline transformation. In addition, the linkage relationship of the candidate marker *dieldrin resistance* was determined to be similar to that in the sibling species *An. gambiae* – very loose linkage on chromosome 2.

Microinjections of Anopheline embryos are now performed routinely in the laboratory using a method develop at the Seibersdorf laboratory by Herve Bossin and Mark Benedict. The newly developed injection method can be found on the Malaria Repository website at:

http://www2.ncid.cdc.gov/vector/Tech%20Tips/Microinjection%20Method%20for%20Anopheles%20Embryos%20V2.pdf

Using this protocol, consistent hatch rates (8-14%) are obtained and transient somatic expression observed in more than 20% of the larvae following injection using a *piggybac* construct carrying a 3xP3-EGFP expression cassette. Current efforts are focused on improving the mating efficiency of small families to increase the chances of recovering G1 transgenic individuals. In parallel, Ms Labbé is developing the molecular tools necessary to conduct excision and transposition assays and confirm the functionality of *piggybac*-based germline transformation in *A. arabiensis*. Once the first germline transformation of *A. arabiensis* is achieved, the testing of conditional sexing systems will take place immediately.

SIT support for Sudan

The commitment of the Sudanese authorities to the feasibility study has further increased at the beginning of this year with the provision of additional funding, vehicles, equipment, and recruitment of staff. Field larval surveillance is ongoing, performed at monthly intervals in the Dongola and Merowe test sites. Safia Siddig and Osama Seidhamed, two Sudanese fellows joined the mosquito group in Seibersdorf earlier this year for training on mosquito mass-rearing. Both are actively contributing to the R&D effort, Ms Siddig focusing more specifically on larval rearing conditions with the optimisation of larval nutrition and Mr Seidhamed investigating the potential role and importance of specific volatile organic compounds (VOCs) in mosquito male mating behaviour.

Feasibility study on the island La Reunion

Following the recommendations of the scientific advisory committee during its meeting in Vienna last December, a project document was produced which provides background information and describes the 2005-2008 preparatory research programme for the eventual elimination of *A. arabiensis* from the island of La Réunion using an integrated area-wide approach with and SIT component. Specific objectives such as colony establishment, study of population genetics and dynamics, evaluation of trapping methods, and ecological and socio-economics impact studies are included in the programme. The document presented to the French permanent mission (Mr Albert and Mr Perrin) and the CEA (Mr Mousseigne, French Atomic Energy Commission) was received very favourably and is being disseminated to the relevant national and local French authorities as well as scientific institutions likely to provide their support to the project.

ANNUAL REPORT 2004

For more detailed information on the 2004 R&D activities conducted by the Entomology Unit, Seibersdorf, see Annual Report 2004:
www.iaea.org/programmes/nafa/d4/index.html

Special News and Reports

The Second FAO/IAEA International Conference on Area-Wide Control of Insect Pests

The Second FAO/IAEA International Conference on Area-Wide Control of Insect Pests was convened at the IAEA Headquarters in Vienna, Austria from 9–13 May 2005. A total of 305 participants attended the conference, representing 86 countries (of which 63 were developing) and nine international organizations (AOAD, CIP, CIRDES, CIRAD, FAO, IAEA, ICIPE, IICA and IITA,). The participants presented a total of 49 oral presentations in eight sessions and 143 posters in two sessions. During the last day of the conference, panel discussions were held on themes including *potential barriers to the commercialization of SIT, the reasons for the absence of area-wide principles in university curricula, the spread of invasive species with globalization and the role area-wide pest management can play, the importance of efficient management in the implementation of area-wide pest programmes* and *the role biotechnology is likely to play in future area-wide IPM programmes*.

The main theme of the conference was the "Lessons Learned from the "Implementation of Operational Programmes", and three oral sessions were devoted to the various lessons that can be learned from area-wide programmes. The topics of the oral presentations were not restricted to the use of SIT and included high quality lectures on non-SIT area-wide management programmes against ticks, boll weevils, desert locusts, mountain pine beetles, pests of wheat storage, tarnished plant bug and termites.

One session was devoted to the ever-increasing threat of a multitude of invasive pests. The role of the SIT as part of the area-wide integrated pest management was highlighted for invasive species such as the painted apple moth in New Zealand, the cactus moth in the USA and the false codling moth in South Africa. Other area-wide approaches were discussed in papers on invasive weeds, invasive fire ants and the golden apple snail as an invasive exotic pests of rice.

Other sessions dealt with commercialization and regulatory issues, animal and human health and modern biotechnology and genetics. The last session of the conference contained some interesting papers on new developments for the area-wide management of insect pests and exciting topics such as *Wolbachia*-induced cytoplasmatic incompatibility, cold storage techniques to extend the shelf life of insects strains, new advances in dispersal and navigation techniques for sterile insects, hormone therapy to improve the efficiency of fruit fly SIT, and the use of insects as dispensers for mating disruption.

The successful completion of the conference can mainly be attributed to the excellent quality of the many papers and posters that were presented, the variety and diversity of the topics that were offered, the professional guidance of the moderators of the various sessions, the keen interest displayed by the participants as evidenced by the many interactions during the discussion sessions and the skilled assistance provided by Conference Services of the IAEA, which resulted in a flawless completion of the Conference.

The proceedings of the conference will be published by an outside publisher and will be available as of mid-2006.

Tephritid Workers Database (TWD) News! (Source A. Bakri, University Cadi Ayyad, Morocco)

Launched one year ago on May 7th, 2004, TWD has already reached 321 members from 65 countries. During this first year, more than 800 tephritid workers were contacted by e-mail. A reminder to update input or to join TWD was sent six months later. Members are also encouraged to update their list of publications.

To promote TWD, a poster was presented in the 5th Meeting of the Working Group on Fruit Flies of the Western Hemisphere on May 16-21, 2004 in Fort Lauderdale, Florida. Another poster was presented in the Second FAO/IAEA International Conference on Area-Wide Control of Insect Pests: Integrating the Sterile Insect and Related Nuclear and other Techniques. 9-13 May 2005, Vienna, Austria.

During the first assembly meeting of **Tephritidae of Europe Africa and the Middle East (TEAM)** in Vienna on 11th May 2005, there was a good response and appreciation of TWD (see "First Meeting" in Announcements). Participants suggested to piggy back the website of TEAM to TWD and use it as a platform for communication between their members. At the end of the meeting the participants elected a Steering Committee and the Governing Board. For more information, please contact:

Dr. Nikos Papadopoulos (University Thessaly, Greece) – Chairperson (npapadop@agro.auth.gr)

Prof. Abdeljelil Bakri (University Cadi Ayyad, Marrakech, Morocco) – 1st Vice Chairperson (bakri@ucam.ac.ma)

Dr. Yoav Gazit (Institute of Biological Control, Israel) – 2nd Vice Chairperson (yoav@jaffa.co.il)

TWD in numbers

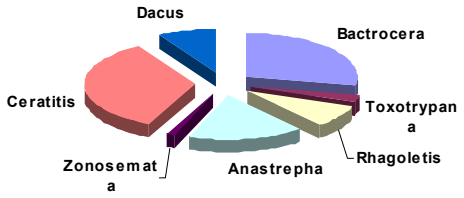

Figure 1. Tephritid workers per genera

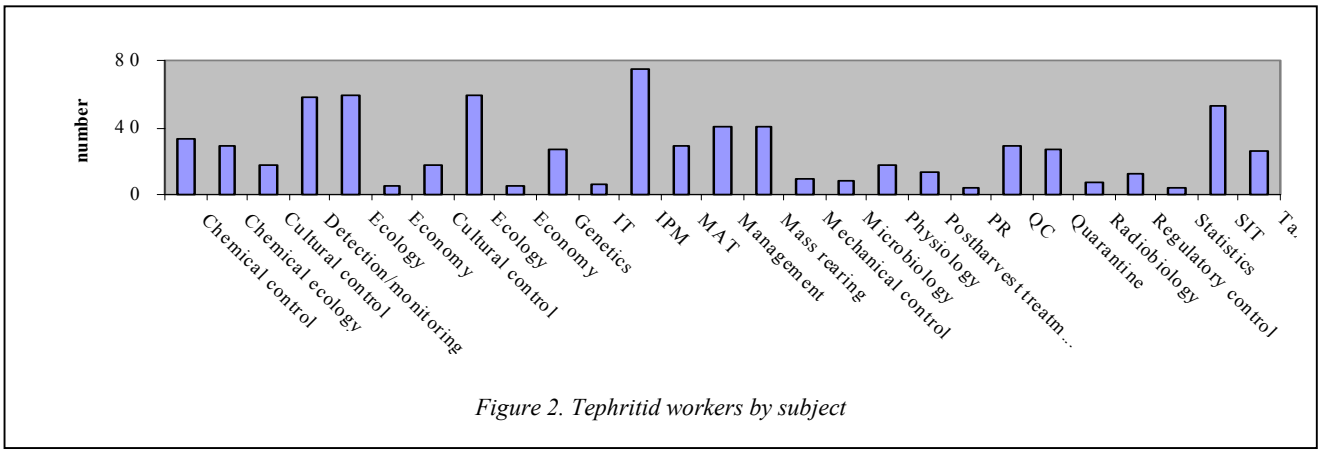

Figure 2. Tephritid workers by subject

Alert notice USDA-APHIS:

Elevated Risk of Peach Fruit Fly (*Bactrocera zonata)* from Egypt

Pests: Bactrocera spp.
Pathways: Fruits and Vegetables
Grower / Producer / Importer:
Countries: Egypt
Regions: Northern Africa
Date: May-09-2005
Current Pest Population Level: Outbreak
Report Reliability: Written, Unofficial Report
Report Type : NEWS

Background

The geographical range of *Bactrocera zonata* (peach fruit fly, guava fruit fly) extends from Southeast Asia west to India, Iran, Arabia, Israel and Egypt. Its primary hosts include mango, peach and guava. Citrus is a secondary host. (CABI 2004). Only *B. cucurbitae* and *B. tryonii* are OPIS Target Pests (A). Other species in the genus are OPIS Non-priority Target Pests (B).

Current Status

The increase in detections at the port facilities in Valencia, Spain of *B. zonata* from Egypt has prompted the Valencian Association of Growers (AVA) to request more rigorous inspection of all citrus from that country. According to the AVA, the economic damage to citrus crops in North Africa caused peach fruit fly amounts to approximately $188 million annually. Crop losses in northern Africa are reportedly between 30% to 100%.

Unless peach fruit fly has spread to other countries in northern Africa, all references to crop damage in North Africa probably refers to Egypt. Annual economic losses of $188 milllion and 30%-100% crop loss reflect a very serious infestations within the country. The OPIS non-priority Target Pest list (B) for Egypt should be amended to include *Bactrocera* spp. to indicate the occurrence of *B. zonata* in the country.

The New Invasive *Bactrocera* species

New invasive *Bactrocera invadens* officially named as it extends its distribution and host range across Africa.

Background:

The new invasive *Bactrocera* species is now rapidly extending its distribution and host ranges across Africa as predicted in previous OPIS reports (9734, 9948, 9952, 10040, 10170) dating back to June 2004, because it is highly invasive and polyphagous habits. These predictions are now being substantiated as more and more countries and commercial fruit hosts are invaded.

Current status:

The fly, first reported in Kenya in 2003 (Lux et al. 2003) and then Tanzania (Mwatawala et al. 2004) has now been

formally named. In a paper just published, Drew, Tsuruta & White (2005) have described the species as *Bactrocera (Bactrocera) invadens – invadens* on the basis of its rapid invasion of the African continent. The description is based on specimens from several African countries, as well as Sri Lanka.

Bactrocera invadens is morphologically very similar to *Bactrocera (Bactrocera) dorsalis* (Hendel) from South-east Asia and *B. (B.) kandiensis* (Drew & Hancock) from Sri Lanka. *Bactrocera (B.) invadens* belongs to the *Bactrocera dorsalis* complex, which comprises more than 50 species, all from the oriental region. According to Drew et al. (2005), the origin and identity of the invading species was originally unknown, although it was recognized as belonging to an Asian species complex. The species appears to have invaded Africa from the Indian subcontinent, and was only discovered in Sri Lanka after it was found in Africa, when large numbers of specimens were identified from a collection of Dacini made in Sri Lanka by K. Tsuruta, thereby confirming its provenance.

It is of great economic significance in Africa (Mwatawala *et al.* 2004) where the rapid spread across tropical Africa and growing records in fruit crops are strongly indicative of its potentially devastating pest status. *Bactrocera invadens* may initially have been overlooked in some areas and its place of first discovery should not be assumed to be its point of invasion into Africa, but rather due to the vigilance of the African Fruit Fly Initiative (AFFI) programme at ICIPE (International Centre of Insect Physiology and Ecology), Nairobi. The species was first found in Kenya soon after completion of an extensive programme of monthly fruit collections carried out from February 1999 to January 2003 by Dr R.S. Copeland (Texas A&M University and ICIPE) (Copeland *et al*. 2004). This was followed by further collections by Bob Copeland, one of which yielded the first reared specimen on 9.ii.2003, a male from fruit of *Strychnos mellodora* from the Shimba Hills, Kenya. The first recorded specimen was a female collected on 2.ii.2003 at Tiwi, Coastal Province, Kenya by A. Manrakhan (ICIPE) from a McPhail trap baited with NuLure protein, during a routine survey. The species was subsequently found as a serious pest of mangoes, and the first specimens from Tanzania were obtained from mangoes collected from a market place in Matombo on 25 July 2003 (Mwatawala *et al.* 2004)

The species has already spread rapidly across Africa and, according to Drew et al. (2005), has now been recorded from the following countries in sequence: Kenya (February 2003 – reared from fruit (fruit), Tanzania (December 2003 (confirmed) - fruit), Sudan (May 2004 – fruit), Benin (June 2004 – Methyl eugenol trap (ME), Uganda (July 2004 – ME), Cameroon (August 2004, fruit), Togo (October 2004 – ME), Senegal (October 2004 – torula liquid trap), Ghana (January 2005 – ME) and Nigeria (January 2005 – ME). It is also known from the Democratic Republic of Congo and Sri Lanka. This adds three more African countries (Ghana, Nigeria and Sudan) and Sri Lanka to its geographical range since the most recent OPIS report (10170).

A characteristic of *Bactrocera invadens* is that it is strongly attracted to Methyl Eugenol - contrary to African Dacini species, which are attracted by Cue Lure (White & Elston-Harris 1992). Although Methyl eugenol had not been widely used, it was deployed at sites in Kenya and other African countries (including Tanzania) during 1999-2000 by ICIPE's AFFI programme. Samples from the programme examined by Dr I.M. White (a leading authority on dacine fruit flies) did not contain the species, suggesting that it was not yet established in 2000, or present in very low numbers. This is a further indication of its burgeoning invasion of Africa.

The host plant list is also growing at a rapid rate and *Bactrocera invadens* has now been recorded from Guava, Citrus, Papaya, Tandam, Tomatoes and, especially Mango, and a number of wild hosts including *Strychnos.*

This new species is of high phytosanitary risk, especially to the countries of southern Africa (where it is not yet present), and ultimately to trading partners including the U.S.A.

It should be of great concern to PPQ and any PRA's being developed on vulnerable fruits in affected countries should be re-assessed. This especially, as there is currently no scientific basis to assume that it will be susceptible to normal cold treatment procedures. Trapping in mitigation of preclearance programmes should also be extended to include Methyl Eugenol traps to monitor the presence of this invasive pest. Cold treatment experiments are also strongly advised.

Bactrocera invadens now poses a considerable threat to the agriculture and exports of the countries of southern Africa, although it is not yet recorded from South Africa, Botswana, Namibia, Lesotho, Swaziland, Mozambique, Malawi, Zambia, Zimbabwe or Angola. These countries and their trading partners should consequently institute immediate measures to prevent the introduction of *B. invadens* from infected countries.

Finally, in a recent circular from the Inter-African Phytosanitary Council (No. UA/CPI/2005/01), it is rated as "a devastating quarantine pest".

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Source:
Cheryl French, D.V.M
USDA-APHIS-IS
Dakar, Senegal

Irradiation Treatment Against *Rhagoletis pomonella* (from: EPPO Reporting Service 2005/045)

Studies were done in USA on the efficacy of irradiation against *Rhagoletis pomonella* (Diptera: Tephritidae – EPPO A1 list) in apples under storage conditions (hypoxic atmosphere and low-temperatures). The efficacy of irradiation was assessed by measuring the failure of adult emergence from puparium, after treatment of third larval instars. The irradiation treatment was not significantly affected by cold temperatures but its efficacy was reduced by hypoxia. It was also found that a dose of 50 Gy completely prevented development into full pupae when apples were irradiated in ambient and hypoxic atmospheres. It is noted that apples and pears can tolerate doses 300-900 Gy, depending on cultivar. It is concluded that a dose of 57 Gy could be recommended for a phytosanitary treatment of host fruits of *R. pomonella*.

Source: Hallman GJ (2004) Irradiation disinfestation of apple maggot (Diptera: Tephritidae) in hypoxic and low-temperature storage. Journal of Economic Entomology, 97(4), 1245-1248.

Irradiation treatment against Bactrocera dorsalis, Ceratitis capitata and B. cucurbitae (from: EPPO Reporting Service 2005/046)

In USA, the currently approved doses for irradiation treatments for *Bactrocera dorsalis, Ceratitis capitata* and *B. cucurbitae* (Diptera: Tephritidae –A1 list for *Bactrocera* spp., A2 list for *C. capitata*) are respectively 210, 225 and 250 Gy. Irradiation may be required as a phytosanitary treatment for exporting fruits and vegetables from Hawaii to continental USA. Further laboratory studies on third larval instars irradiated at different doses, in artificial diet or in fruit, showed that lower doses could be used. No adult survival was obtained with irradiation at 150, 100 and 125 Gy for *B. cucurbitae, C. capitata* and *B. dorsalis*, respectively. It was concluded that a common dose of 150 Gy could be proposed as a phytosanitary treatment against these fruit flies.

Source: Follett PA, Armstrong JW (2004) Revised irradiation doses to control melon fly, Mediterranean fruit fly, and oriental fruit fly (Diptera: Tephritidae) and a generic dose for Tephritid fruit flies. Journal of Economic Entomology, 97(4), 1254-1248.

Proposed Rules

United States Department of Agriculture (USDA)
Animal and Plant Health Inspection Service
7 CRF Parts 301, 305, 318, and 319
[Docket No.03-077-1]

Treatments to Fruits and Vegetables

Agency: Animal and Plant Health Inspection Service, USDA
Action: Proposed rule.

SUMMARY: We are proposing to amend the regulations to revise the approved doses for irradiation treatment of imported fruits and vegetables. This proposal would establish a new minimum generic dose of irradiation for most arthropod plant pests, establish a new minimum generic dose for the fruit fly family, reduce the minim dose of irradiation for some specific fruit fly species, and add nine pests to the list of pests for which irradiation is an approved treatment. These actions would allow the use of irradiation to neutralize more pests and to neutralize some pests at lower doses.

Generic Minimum Dose for Fruit Flies and Minimum Dose Reductions for Individual Fruit Fly Species

Although a generic minimum dose could be used to treat many arthropod plant pests, it is important that required irradiation doses for plant pests be set at the lowest effective level. Higher doses of irradiation treatment cost more to administer, and irradiation causes many fruits and vegetables to undergo changes in colour and texture that increase at higher doses.

Accordingly, the Agriculture Research Service (ARS) of the USDA has undertaken research to determine whether fruit flies currently approved to be treated with irradiation in the regulations can be neutralized at lower doses than are presently required and whether species of fruit flies that are not currently listed in the regulations can be neutralized at a lower dose than the proposed 400 gray ge-

neric minimum dose for arthropod pests other than pupae and adults of the order *Lepidopera*.

This research demonstrated that all fruit flies of the family *Tephritidae* would be neutralized by a dose of 150 gray. Therefore, we are proposing to add the entire family *Tephritidae* to the list of pests for which irradiation is an approved treatment, and to set the required irradiation dose for those fruit flies at 150 gray. This change would reduce the required dose for the Oriental fruit fly (*Bactrocera dorsalis*), for which a 250 gray does is currently required' the Mediterranean fruit fly (*Ceratitis capitata*), for which a 225 gray dose is currently required; and the melon fly (*B. curcubitae*), for which a 210 gray dose is currently required. It would also set a dose for irradiation treatment for any fruit fly that is lower than the proposed generic minimum dose of 400 gray for arthropod pests other than pupae and adults of the order *Lepidoptera*.

The research ARS undertook also demonstrated that the proposed 150 gray generic minimum fruit fly dose would be higher than necessary to neutralize certain fruit flies.

Specifically, the research found that the Mexican fruit fly (*Anastrepha ludens*) and the Caribbean fruit fly (*A. suspense*) are neutralized at 70 gray and that the West Indian fruit fly (*A. obliqua*), the sapote fruit fly (*A. serpentina*), the Jarvis fruit fly (*Bactrocera jarvisi*), and the Queensland fruit fly (*B. tryoni*) are neutralized at 100 gray. Accordingly, we are proposing to allow those fruit flies to be treated at those lower doses rather than at the proposed generic fruit fly minimum of 150 gray.

To submit or view public comments before 9 August 2005:

EDOCKET: Go to http://www.epa.gov/feddocket, access the index listing of the contents of the official public docket, and to access those documents in the public docket that are available electronically. Once you have entered EDOCKET, click on the "View Open APHIS Dockets" link to locate this document.

Postal Mail/Commercial Delivery: Please send four copies of your comment (an original and three copies) to Docket No.03-077-1, Regulatory Analysis and Development, PPD, APHIS, Station 3C71, 4700 River Road Unit 118, Riverdale, MD 20737-1238. Please state that your comment refers to Docket No.03-077-1.

Guest Article

Development of Genetic Sexing Strains in Lepidoptera: from Traditional to Transgenic Approaches

J. Economic Entomology 98:248-259.

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The sterile insect technique (SIT) is currently being used for the control of many agriculture pests, including some lepidopteran species. The SIT relies on the rearing and release of large numbers of genetically sterile insects into a wild population. The holokinetic chromosomes of Lepidoptera respond differently to radiation than do species where there is a localized centromere. This difference has enabled a variation of the SIT to be developed for Lepidoptera where a substerilizing dose of radiation is given to the insect before their release with the result that a certain level of sterility is inherited by the F1 offspring. The development of genetic sexing strains for fruit flies, enabling the release of males only, has resulted enormous economic benefits in the mass rearing and has increased the efficacy of field operations several fold. This article outlines Mendelian approaches that are currently available to separate large numbers of males and females efficiently for different lepidopteran species and describes their difficulties and constraints. Successful transgenesis in several lepidopteran species opens up new possibilities to develop genetic sexing strains. The proposal to develop genetic sexing strains described in this article takes advantage of the fact that in Lepidoptera, the female is the heterogametic sex, with most species having a WZ sex chromosome pair, whereas the males are ZZ. This means that if a conditional lethal gene can be inserted into the W chromosome, then all females should die after the application of the restrictive condition. The assumption made to accommodate this model are discussed, and the advantage to be gained for control programmes are elucidated.

Announcements

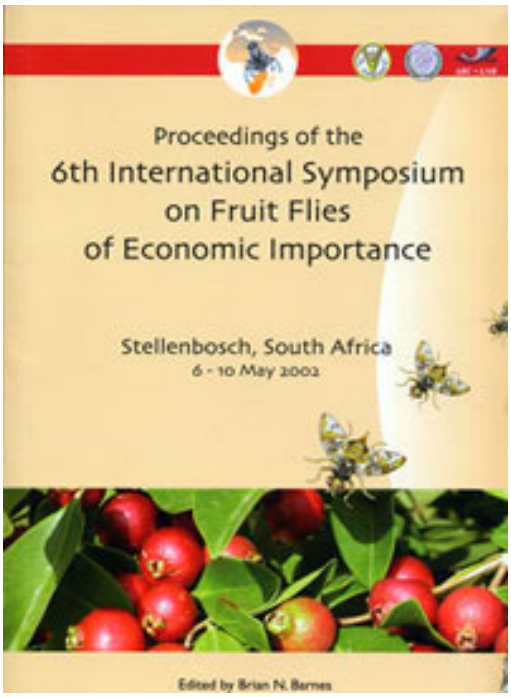
New Book on the Sterile Insect Technique Available in 2005

The camera-ready copy of the first textbook on the Sterile Insect Technique has been delivered to the publisher and will be published soon. The 29 chapters, written from a generic perspective by more than 50 authors from around the world, review all aspects of the SIT. The book is divided into eight sections: Introduction, Principles of the SIT, Technical Components of the SIT, Supportive Technologies to Improve the SIT, Economic, Environmental and Management Considerations, Application of the SIT, Impact of AW-IPM Programmes that Integrate the SIT, and Future Development of the SIT.

When the book is published, information can be obtained from the publisher: Springer Distribution Center, Haberstrasse 7, 69126 Heidelberg, Germany.
Website:
http://www.springeronline.com/sgw/cda/frontpage/

Information will also be available on the website of the Insect Pest Control Section:
http://www.iaea.org/programmes/nafa/d4/index.html

Proceedings of the 6th International Symposium on Fruit Flies of Economic Importance, 6-10 May 2002, Stellenbosch, South Africa, organized by the International Steering Committee



In May 2002, over 200 scientists and fruit fly workers from 42 countries gathered in Stellenbosch, South Africa to present 55 oral and 110 poster presentations on topics ranging from fruit fly ecology and behaviour to molecular biology and genetics; from attraction and trapping to natural enemies and cost-benefit analyses, to mention a few. Dr. Brian Barnes from the Agricultural Research Council and the reviewers made an excellent work in editing and preparing the proceedings which was published by Isteg Scientific Publications, 9 Clifford Road, Irene, 0062 South Africa. ISBN 1-86849-298-2.

The FAO/IAEA Joint Division of Nuclear Techniques in Food and Agriculture was one of the sponsors of this International Symposium.

First Meeting of TEAM (Tephritidae of Europe Africa and the Middle East)

The first organizational meeting of the fruit fly scientific group TEAM (Tephritidae of Europe, Africa and the Middle East) was held in Vienna on 11th of May 2005. Sixty scientists from around 25 countries and more than 30 institutes participated. The first part of the meeting dealt with the activities carried out by other regional fruit fly organizations, and especially with their organization, format and general structure. The aim and the objectives of the proposed TEAM group was covered in the second part of the meeting. Discussion focused on the following topics:

1. Reasoning of Establishing TEAM
2. Format of TEAM
3. Administration of the Group
4. First Scientific Meeting

Subsequent discussions led to the following decisions: (a) to establish TEAM as an independent scientific group that deals with questions regarding fruit flies in Europe, Africa and the Middle East, (b) to organize TEAM as a scientific group open to every individual who wants to become member of this group, (c) the potential members of TEAM need only to submit a registration form to the Chair of the steering committee of TEAM; no registration fees are required, (d) TEAM should provide a platform for interaction promoting collaboration and communication among scientists of Europe, Africa and the Middle East, (e) to create a website, (f) to issue a newsletter once or twice a year, (g) to organize a scientific meeting every 2–3 years. Efforts should be made to keep the meeting as inexpensive as possible, and to increase participation of scientists from African countries, (h) the administration

of TEAM will be conducted by a chair person, two vice-chair persons plus a steering committee of six members. The nine members of the administration group (chair, two vice chairs and six members of the steering committee) were elected from the participants of the first organizational meeting of TEAM. The steering committee elects the chair and the two vice-chair persons, (f) the decision for the next (first scientific) meeting (time and place) of TEAM will be made by the steering committee of TEAM based on an analysis of economic and other factors. There was one suggestion – an offer from participants from Spain to organize the next meeting in Mallorca, Spain, in 2007.

Figure 2. Participants TEAM meeting, Vienna, Austria 11 May 2005

The third part of the meeting focused on the election of the steering committee of TEAM. There were 46 participants who voted and they elected a steering committee consisting of the following 10 persons: Nikos Papadopoulos (Greece), Bakri A. (Marocco), Serge Quilici (France), Mariangela Bonnizoni (Italy), Brian Barnes (S. Africa), Yoav Gazit (Israel), Slawomir A. Lux (Kenya), David Nestel (Israel), Massimo Cristofaro (Italy), Rui Pereira (Portugal).

The steering committee was elected out of 14 candidates. The steering committee decided to assign Nikos Papadopoulos as the Chairman of the committee and A. Bakri and Y. Gazit as vice chairmen.

Insect Dieting and Rearing Institute

The Insect Diet and Rearing Institute, LLC, offers continuing education and workshops, offers consultation services, and conducts on-going research for the advancement of insect diet and rearing science and technology. Browse throughout the website to learn more: www.insectdiets.com.

October 2005 Workshop

Special Features:

- Tour of the USDA, APHIS Pink Bollworm Rearing Facility in Phoenix, Arizona
- Alan Bartlett, world renowned rearing facility geneticist
- Study at University of Arizona's Imaging Center
- Visit Carl Hayden Bee Research Facility
- Optional Saturday tour of Tucson's major features

Learn directly from Allen Cohen:

- How diets work and why they sometimes fail to work.
- How to develop a data-based diet quality control system in your insectary.
- How to detect & prevent diet deterioration from microbial sources.
- How to detect & prevent diet deterioration from microbial sources.
- How to detect and prevent other forms of diet deterioration (oxidative stresses, physical deterioration-such as separation of components-failure of gelling agents, and many other common diet problems).
- How the insectary environment can contribute to colony health and well being.
- How to use artificial diet-based bioassays for testing toxins and nutrients.
- Diet processing equipment, how they work & how they may fail.
- Handling & storage of diet ingredients from procurement to use in diets.
- Hands-on experiences illustrating workshop principles.
- Group & individual activities directed at solving problems specific to participants laboratory/rearing situations.
- Workshop fee: $1,100 for the week.

Registration: Visit www.insectdiets.com for on-line registration for workshop.

Contact them at idri@insectdiets.com or (+) 1 520 577-6536 to find out more about the workshop, special hotel rates. Hotel across the street from university.

2nd. European Meeting of the IOBC/WPRS Working Group

"Integrated Protection of Olive Crops"

First announcement

Dear Colleagues,

On behalf of the International Organization for Biological Control of Noxious Animals and Plants, West Palaearctic Regional Section we are pleased to announce to you the forthcoming 2nd European Meeting of the IOBC/WPRS Study Group: "Integrated Protection of Olive Crops" that will be held in Florence, Italy, from October 26 to October 28, 2005.

The meeting is aimed at updating the knowledge of pest and diseases of olive grove.

The main topics of the meeting are:

- Biology, ecology and behaviour of arthropods associated to the olive grove
- Population detection and assessment of pests and their natural enemies
- Monitoring systems: attractants and traps
- Integrated control strategies
- Biological and biotechnical control methods
- Chemical control: efficacy, selectivity, resistance and side effects
- New problems in integrated pest and disease management of olive crops
- Spatial and data analysis of pests and diseases
- Pathogens (viruses, bacteria, phytoplasma, and fungi) of olive grove
- Epidemiology of olive diseases
- New strategies in olive diseases control
- Diagnosis and certification

The meeting will include oral presentations and poster sessions. Proceedings of the meeting will be published in the IOBC/WPRS Bulletin.

Detailed information about accommodation is available on the Website of the Meeting. For further information, please, contact Dr. Chiara Tagliavini (E- mail: segrpolo@polosci.unifi.it).

Deadline for registration: 10 September 2005

For information on registration fee and more consult the Meeting web page: www3.unifi.it/ipoc
On behalf of the Local Organizing Committee,

Sincerely yours,

Prof. Antonio Belcari, Chairperson.

New Versions of the Pest Fruit Fly Adult and Larval interactive Identification Keys

New versions of the pest fruit fly adult and larval interactive indentification keys have been posted to the web on the delta site (see http://delta-intkey.com/ffl/www/_wintro.htm). The keys include Intkey, Lucid 2, and Lucid 3 versions for both the adult and larval systems, so users can choose whichever one they prefer. Both systems are updates of the keys produced by Thompson et alia (1999), which became obsolete (they used a DOS based program). The adult system, which includes the 193 species that are most significant as pests or most commonly intercepted at ports of entry, has been available on the web since 2003, but we have added new or improved images for many species. The larval system, largely produced by Lynn Carroll, is available via the internet for the first time. It includes data and images for about 80 species

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Visit the Diptera site at www.diptera.org and see the fruit fly web pages at
http://www.sel.barc.usda.gov/Diptera/tephriti/tephriti.htm

In Memoriam

George Berg

George Herman Berg, was born in Milwaukee, Wisconsin, USA, on 26 September 1916. He was the second son of Frank and Victoria Berg, whose ancestors came from Germany and Poland, respectively.

Since George was six years old, he showed a deep interest in butterflies and started to collect them. He studied zoology at the University of Wisconsin and in 1981 received an award as a distinguished ex-student. Before finishing his studies, he was appointed Director of the Museum of Milwaukee and President of the State Society of Entomology. Afterwards, he finished his masters degree in Entomology at the University of Kansas.

For several years George worked with the USDA and then with the Food and Agriculture Organization (FAO) of the United Nations, training staff on vegetal quarantine in more than 64 countries around the world, producing more than 80 related publications.

In 1979, the FAO honoured him with the B.R. Sen Prize, the most prestigious award granted by this organization to professionals of agriculture at worldwide level.

George came to the Central American region around 1956 as one of the FAO experts assigned to the regional plant protection organization (OIRSA) in whose Member States he developed various projects related to quarantine.

When he retired from the FAO, he settled down in El Salvador and worked with OIRSA during 16 years. He retired in 2001 after suffering a cerebral stroke while carrying out an official mission in Honduras. He went back to the USA but unfortunately underwent two more cerebral strokes that were deadly to his life that was so valuable to the protection of plants in the countries where he worked in Central America. George was married to Norma Jean Berg for 45 years. She died in El Salvador in 1997. George passed away on 31 January 2005 in Austin, Texas, surrounded by his beloved children Terry, Michele and Marlene.

By: Ms Dinora Villeda

Ronald J. Prokopy

The late Ronald J. Prokopy will be honored with the Agriculture Day Award today at the Massachusetts Statehouse in recognition of his work in promoting integrated pest management throughout the world.

Prokopy was a professor of entomology at the University of Massachusetts for 29 years before he unexpectedly died in his sleep May 14, 2004, at his home in Conway. He was 68. Prokopy spent the day before his death visiting orchards in New England to talk to fruit farmers about insect control. In his obituary, his family requested donations be sent to the Massachusetts Fruit Growers Association.

"It's (the award) very much deserved," said Wesley R. Autio, a professor of pomology at UMass who worked with Prokopy for nearly 20 years. "He really is the father of integrated pest management."

Prokopy researched ways of controlling insect pests on small fruit, especially apples, but his findings were used to protect all sorts of crops. He traveled the world to collaborate on projects and was given numerous awards, grants and honors throughout his career.

"His contribution is something we won't even understand the scope of for many more years," Autio said. "He was very intense about the subject (of integrated pest management). He really cared about the farmers. He wanted to push them to the greatest level of pest management."

Prokopy will be the sole award recipient this year. Usually, the Massachusetts Agriculture Promotion Board gives the award to three to five people, and many are usually state legislators.

"We could not have chosen a better person," said Kenneth J. Nicewicz, chairman of the board, president of the Massachusetts Fruit Growers Association and an apple grower from Bolton. "He was one of us. He was always looking at ways for us to lessen our reliance on chemicals and rely more on traps."

The award will be given to Prokopy's widow, Linda L. Prokopy of South Deerfield, at 11:30 a.m. on the Grand Staircase.

He'd be very pleased, Ms Prokopy said. *He felt very close to the fruit growers in the state. I think it's an award he would really, really like*.

Prokopy and the Massachusetts Fruit Growers Association have established a memorial endowment in Ronald Prokopy's name to fund an entomological research and extension position at UMass.

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Ph.D., C.C.A.
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Publications

In Press

BAKRI, A., K. MEHTA and D. R. LANCE. Sterilizing insects with ionizing radiation. Chapter 3.3. In: Sterile Insect Technique: Principles and Practice in Area-Wide Integrated Pest Management. V. A. Dyck, J. Hendrichs and A. S. Robinson (eds.). *Springer Verlag.* (in press).

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