INSECT AND PEST CONTROL NEWSLETTER

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

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A. TO THE READER

Alien invasive insect pests are increasingly threatening agriculture and the environment. In the context of the rapidly growing international travel and trade, the potential for moving dangerous pest species to new geographic regions and locations has been drastically increasing. APHIS-USDA reports that the expanding flow of passengers and cargo is far outdistancing the inspection capabilities of its quarantine system despite increases in funding, staffing and use of technology. The potential threat of bioterrorism also adds to the complexities of excluding major foreign pest species.

Under the Convention of Biodiversity, the International Plant Protection Convention and other binding international treaties that also address alien invasive species (inconsistently also referred to as exotic, foreign, or non-indigenous), prevention is recommended as being far more cost effective and environmentally desirable than measures that have to be taken once introduction of an alien invasive species has occurred. Offshore pest risk mitigation at the point of origin is therefore recommended as the most viable approach to prevention and pest exclusion. This approach provides a means of identifying potential high risks so that appropriate preventive and preparedness, strategies can be developed to avoid invasive pest introductions.

Nevertheless, in reality the safeguarding systems are often breached and major alien invasive pests continue to spread, even entering countries such as Australia, Japan, New Zealand or the U.S.A., which are supposed to have the best quarantine systems in operation. In case the establishment of an alien invasive species has been detected, the above international conventions urge countries to give priority to eradication over containment or management measures. Of course the best opportunity for eradicating introductions of alien invasive species is in the early stages of invasion, when populations are small and localized. However, appropriate response strategies and tools are unfortunately not available to eradicate outbreaks of most invasive pest introductions, thus often condemning countries to only containment or mitigation measures. Alternatively, some existing eradication methods are controversial or may be phased out in the USA for example as a result of the Food Protection Quality Act (FQPA).

SIT, being environment-friendly and acting inversely density dependent and therefore optimally suited to deal with invasive pest population up to the last individuals, is the ideal tool to complement efforts to eliminate beach-heads of alien insect invasions. Examples of successful integrated application of SIT in such a context include the eradication of the New World Screwworm from Libya, and of medfly in California and Florida. Australia has invested considerable efforts in developing the SIT for the Old World Screwworm to be able to address potential outbreaks of this pest insect, which would cause major economic damage to its livestock industry in case it became established. California has stand-by contracts in place for the provision of sterile flies of various *Anastrepha* fruit fly species, and New Zealand, being fruit fly-free, has considered a similar approach to be able to procure sterile flies in case of fruit fly outbreaks.

Unfortunately, however, SIT methodologies have not been developed for many of the major potential invasive pest species for which it could play an important role in eradicating incipient outbreaks. Among the USDA-APHIS Exotic Pest Arthropod List for the USA,

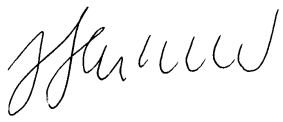
which highlights 100 high-risk pests, ca. fifty percent of this "worst of the worst" list are from the order Lepidoptera. Many of these Lepidoptera are not only a threat to the US but also to many other regions of the world. Nevertheless, research to develop SIT for these high risk, exotic lepidopteran pests is lacking in most cases (Asian gypsy moth being an exception). Cooperative efforts are needed to develop appropriate response strategies that would include eradication technologies in advance of invasive lepidopteran pest introductions.

In collaboration with USDA scientists James Carpenter, Ken Bloem and Stephanie Bloem, FAO/IAEA has been supporting research and facilitating co-operation among scientists of different countries to develop F_1 Sterility as a proactive approach for dealing with two such potential invasive lepidopteran pests. Because F_1 Sterility produces competitive insects and has been reported in all lepidopteran species investigated, these studies should serve as useful models for half of the species on the "Worst of the Worst" list.

One is the false codling moth, *Cryptophlebia leucotreta*, which features prominently on the "Worst of the Worst" list. It is a polyphagous key pest in South Africa and many regional plant protection organizations have expressed concern of the spread of this damaging pest as a direct result of increased international trade. Under a multi-country and multi-agency effort mass rearing methods are being improved in South Africa, and radiation biology studies are being refined to determine the optimum dose of radiation to induce F_1 Sterility for use in an SIT programme as an eradication tool should this pest be introduced into a foreign country.

Another good example of our ill-preparedness to deal with invasions of exotic Lepidoptera is the cactus moth, *Cactoblastis cactorum* (Pyralidae). Once the best example of successful classical biological control of weeds, solving a major cactus problem in Australia, it invaded Florida in 1989 and has been spreading along the Atlantic and Gulf of Mexico coasts. There is grave concern that this pest will eventually reach the cactus-rich Western U.S.A., Mexico, and Central America, threatening the biodiversity of the *Opuntia*-based native ecosystems and adversely impacting the important food and fodder *Opuntia* industry. Currently, the pheromone is being developed as a monitoring tool, mass rearing methods are being refined in South Africa and the radiation biology of the cactus moth is being studied to determine the optimum dose of radiation. An SIT programme is being considered to prevent further geographical expansion of this moth, but the use F_1 sterility is also being assessed as a tool to determine the eventual host and geographical range and to study the rate of spread of this invading insect.

To raise awareness of this major environmental threat and the potential of SIT to address alien species, the Joint FAO/IAEA Division recently hosted a planning and co-ordination meeting, that included representatives of some environmental organizations, to assess the role SIT/F_1 Sterility can play in addressing the cactus moth invasion as a model of invasive pests affecting not only agriculture, but that are also of environmental concern (see report of a cactus moth Consultants Meeting on page 28). We foresee an increased role in developing SIT for potential alien invasive species to help FAO and IAEA Member States deal with incipient outbreaks of such pest species.



Jorge Hendrichs
Head, Insect Pest Control Section

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C. FORTHCOMING EVENTS (2003)

I. Research Co-ordination Meetings (RCM's)

"Use of nuclear techniques for the colonization and production of natural enemies", 23-27 February 2003, Damascus, Syria. 3rd RCM.

"Quality assurance of mass produced and released fruit flies" 19-23 May 2003, Perth, Australia. 3rd RCM.

"Application of genetics to improve the SIT for tsetse" 23-27 June 2003, Edmonton, Alberta, Canada. 4th and final RCM.

New CRP on "Improved and harmonized quality control for expanded tsetse production, sterilization and field application" (in conjunction with IOBC meeting on QA of Mass Reared Arthropods), 15-19 September 2003, Montpellier, France. 1st RCM.

"Genetic sexing and population genetics of screwworms" 22-26 September 2003, Jakarta, Indonesia. 2nd RCM.

New CRP on "The use of molecular tools to improve the effectiveness of SIT" 6-10 October 2003, Vienna, Austria. 1st RCM.

"Development of improved attractants and their integration into fruit fly SIT management programmes" (in conjunction with Western Hemisphere Meeting on Fruit Flies of Economic Importance). October 2003, Miami, Florida, USA. 3rd RCM.

II. Consultants and Other Planning Meetings

Third semi-annual meeting of the management committee for the use of the USAID-MERC funds in the fruit fly projects in the Near East", 29-30 January, 2003, Vienna, Austria.

Consultants meeting on "Use of hormones and kairomones to enhance the effectiveness of sterile fruit fly males", 1-5 April 2003, Vienna, Austria.

Consultants meeting on "Codling moth genetic sexing", 5-9 May 2003, Vienna, Austria.

Consultants meeting on "Development of guidelines for verification of tsetse fly free areas" August 2003, Vienna, Austria.

III. Other Meetings/Events

Tenth International Citrus Congress will be held on 15-20 February 2004 in Agadir, Morocco, under the auspices of the International Society of Citriculture.

Regional East Africa Training Course on Establishing National GIS Capacity for Ongoing and Planned Tsetse/Trypanosomosis Intervention Campaigns, February/March 2003, Addis Ababa, Ethiopia.

Fruit fly workshop organized by the Australian-Asian International Fruit Fly Centre. Kuala Lumpur, Malaysia, March 2003.

Interregional Training Course on the "Use of the Sterile Insect and Related Techniques for the Integrated Areawide Management of Insect Pests", Gainesville, Florida, USA, April-May 2004.

Tenth workshop of the IOBC global working group on arthropod mass rearing and quality control Montpellier, France, 21-24 September 2003.

Twenty seventh ISCTRC in Pretoria, South Africa from 29 September - 3 October 2003.

D. PAST EVENTS (2002)

I. Research Co-ordination Meetings (RCM'S)

"Improvement of codling moth SIT to facilitate expansion of field application" 19-13 August 2002, Kelowna, British Columbia, Canada. 1st RCM.

"Enhancement of the SIT through genetic transformation of arthropods using nuclear techniques" 8-12 July 2002, Capri, Italy. 4th and Final RCM.

"Development of Improved Attractants and their integration into Fruit Fly SIT Management Programmes" 30 April – 3 May 2002, Stellenbosch, South Africa; 2nd RCM. Held in conjunction with 6th International Symposium on Fruit Flies of Economic Importance, 6-10 May 2002.

"Improved attractants for enhancing the efficiency of tsetse fly suppression operations and barrier systems used in tsetse control/eradication campaigns" 18 – 23 March 2002, Kampala, Uganda, Final RCM.

"Enabling Technologies for the Expansion of SIT for Old and New World Screwworm" 28 January- 5 February 2002, Campinas, Brazil. 1st RCM.

II. Consultants and Other Planning Meetings

Consultants meeting on "Identification of improved rearing techniques for *Anastrepha* and *Bactrocera* species" 23-27 September 2002, Vienna, Austria.

Consultants meeting on "Mitigating the threat of *Cactoblastis cactorum* to international agriculture and ecological systems and biodiversity" 14-18 July 2002, Vienna, Austria.

Second semi-annual meeting of the management committee for the use of the USAID-MERC funds in the fruit fly projects in the Near East. 15-16 July, 2002, Vienna, Austria.

Consultants meeting on "Identifying and establishing molecular technologies to improve the effectiveness of SIT" 8-12 July, 2002, Capri, Italy.

Co-ordination meeting on the Central America Fruit Fly Regional Project RLA5045, 8-9 July 2002, Panama City.

Consultants meeting on "Developing product and process quality control for standardization of tsetse mass production, sterilization and SIT release", 10-14 June 2002, Vienna, Austria.

Third Meeting of the National Coordinators of Fruit Fly Projects in the Near East. 30 April – 3 May 2002, Stellenbosch, South Africa.

FAO and IAEA meeting on "Risk Assessment of Transgenic Arthropods. 8 - 12 April 2002, Rome, Italy.

AOAD/FAO/IAEA harmonization meeting on intervention against Old World Screwworm Fly in Regional West Asia, 18-20 February 2002, Cairo Egypt.

First semi-annual meeting of the management committee for the use of the USAID-MERC funds in the fruit fly projects in the Near East, 28-29 January 2002, Vienna, Austria.

III. Other Meetings/Events

Technical and steering meeting on the screwworm project in Jamaica. Kingston, Jamaica, 4-5 December, 2002.

Seventh meeting of the PAAT Programme Committee, WHO, 25-26 November 2002, Geneva, Switzerland.

Entomological Society of America (ESA) Annual Meeting. November 17-20, 2002, Fort Lauderdale, Florida, USA.

Conference on "*Cactoblastis cactorum* in North America: Issues and Action" as part of the Entomological Society of America (ESA) Symposium. 18 November, 2002, Florida, USA.

Planning meeting on "Eradication and Control Programs for Pests and Diseases of Animals and Plants". November 15, 2002 Washington, D.C., USA.

Presentation on Tephritid fruit flies of economic significance for citrus production at the CIRAD-CLAM Professional Meeting on "The Quality of Fresh and Processed Citrus Fruits: New Responses to the Expectations of Professionals". 10-11 October 2002, Montpellier, France.

Regional Latin America Training Course on "Fruit Fly Management with Emphasis in the Sterile Insect Technique (SIT)", Retalhuleu, Guatemala, 22 September to 9 October 2002.

DFID-AHP meeting on "Tsetse Control – The Next 100 Years", Edinburgh, Scotland, 9-10 September 2002

Regional West Asia Workshop on "Tephritid Fruit Flies Trapping and Fruit Sampling", 2-6 September 2002, Chios, Greece.

International Symposium on Screwworm. 28-29 August 2002, Tuxtla Gutierrez, Chiapas, Mexico.

Interregional Training Course on the "Use of the Sterile Insect and Related Techniques for the Integrated Areawide Management of Insect Pests", Okanagan University College, 6-29 August 2002, Kelowna, British Columbia, Canada.

Regional training course on establishing national GIS capacity for ongoing and planned tsetse/trypanosomosis intervention campaigns, 6-24 May 2002, Ouagadougou, Burkina Faso.

Scientific tour with journalists in Africa regarding the sleeping sickness and tsetse fly problem, 12-20 May 2002, Uganda, Ethiopia and Tanzania.

Sixth International Symposium on Fruit Flies of Economic Importance. 6-10 May 2002, Stellenbosch, South Africa.

"FAO/IAEA/OAU/WHO workshop to harmonise joint international activities against tsetse and trypanosomoasis under the Programme Against African Trypanosomoasis (PAAT) and the Pan-African Tsetse and Trypanosomoasis Eradication Campaign (PATTEC)". 2-3 May 2002, FAO, Rome.

Workshop on fruit fly control – Cooperation in the Asia-Pacific Region" 18-23 March 2002, Okinawa, Japan.

"Workshop on arthropod pest problems in pome fruit production (IOBC/OILB). Bundesanstalt fuer

Pflanzenschutz. 10-14 March 2002, Vienna, Austria.

Presentation on SIT at the 2nd International Conference on "Alternative control methods against plant pests and diseases" 4-7 March 2002, Lille, France.

Presentation of the status of the peach fruit fly in the Near East at the "EPPO workshop on peach fruit fly". 5-6 March 2002, Paris, France.

Expert consultation in Brazil to assess the "Feasibility of building a medfly mass rearing and sterilization facility in the North east of Brazil". 19 February – 1 March 2002, Brasilia, Brazil.

WHO/PATTEC meeting to explore public-private sector interaction on tsetse and trypanosomosis, 23-25 January 2002, WHO, Geneva.

E. TECHNICAL CO-OPERATION PROJECTS (HIGHLIGHTS OF SOME OF THE TCP'S)

The New World Screwworm Eradication Project on Jamaica (JAM/5/007)

The New World Screwworm (NWS) *Cochliomyia hominivorax* has been a major pest of livestock on the island of Jamaica (see map of the island) with annual economic losses estimated between US$ 5 to US$ 7 million (figures from 1998). Most of the reported NWS cases originated from dogs (47%) and cattle (21%) and to a lesser extend from goats (17%) and pigs (14%). The first human casualty as a result from a NWS infestation was reported in 1983, and over 100 cases have been reported since.

An areawide NWS eradication programme was launched in 1998 using the release of sterile insects in combination with suppression of the NWS population through the treatment of wounds, epidemiological surveillance and quarantine measures. The Ministry of Agriculture of Jamaica is executing the programme and the collaborating organizations include the United States Department of Agriculture – Animal and Plant Health Inspection Service (USDA-APHIS), USDA-ARS (Agricultural Research Service), the Mexico-US Screwworm Commission, FAO and the IAEA.

The aerial dispersal of sterile insects over the island was initiated in August 1998 using the weekly shipments of 20 million sterile NWS pupae, air shipped from the production plant in Tuxtla Gutiérrez, Mexico to Jamaica. At the dispersal centre, located at the Norman Manley International Airport in Kingston, the emerging flies were collected and immobilised for dispersal using 2 twin-engine aircraft. The sterile insects were released over the entire island at a density of 3,000 insects per square mile. Epidemiological surveys and animal wound treatment with insecticides relied very strongly on the collaboration of the farmers and the private veterinarians. The number of screwworm samples received by the veterinarians and the veterinary clinics were therefore strongly influenced by the effort of the farmers and the public to report infestations.

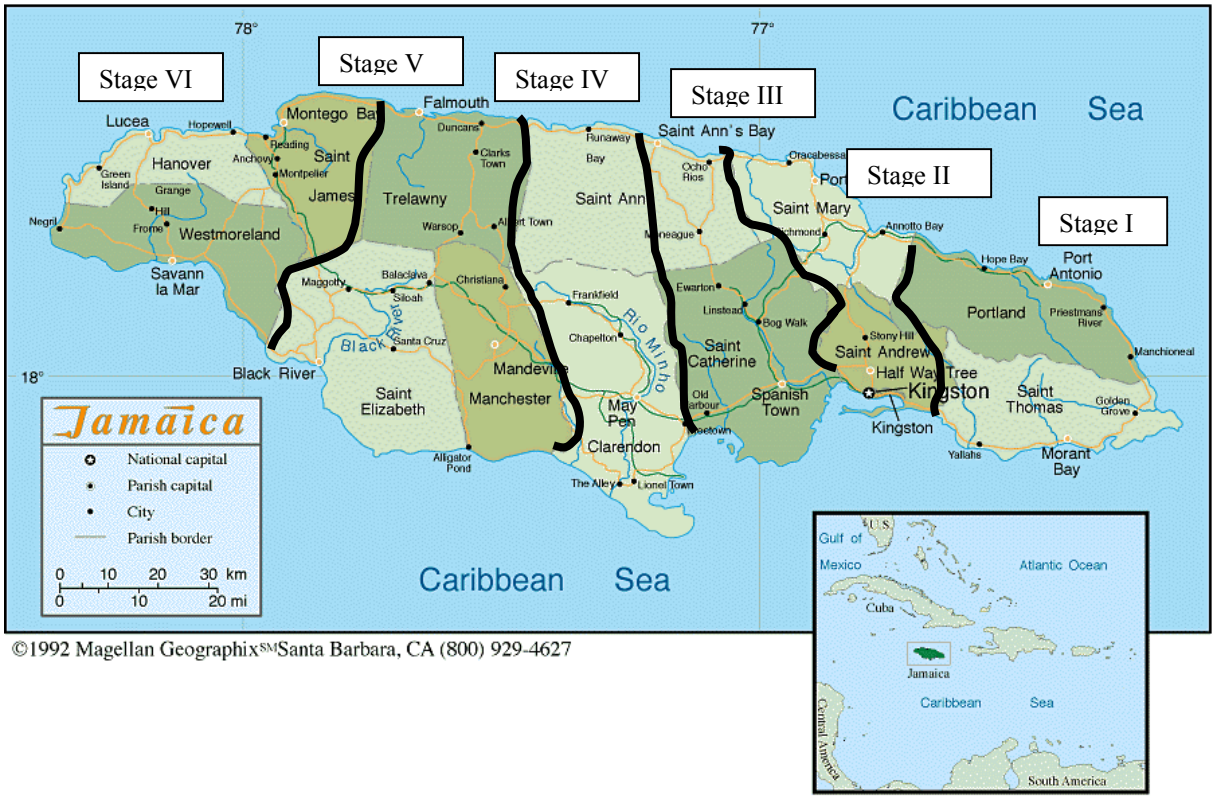
Unfortunately, the programme has already twice experienced major interruptions in the dispersal of sterile insects, due to strikes at the production facility in Mexico. As a consequence, the fly dispersal was interrupted for 3 weeks in November-December 1999 and for 38 days in June-July 2001. Due to the short life cycle of the NWS (21 days under optimal conditions), and their high reproductive capacity (one female may lay 1,000 eggs during her lifetime) most of the progress made during the first 2 years of the programme was lost due to the second interruption in fly releases.

The releases of sterile insects were re-initiated on 1st August 2001 and the following provides a summary of the significant changes made in the programme strategy since then and the progress achieved during the last 9 months:

- The total number of sterile pupae shipped each week to Jamaica was increased from 20 to 30 million in January 2002, and to 36 million in April 2002.

- Rather than attempting to eradicate the screwworm from the whole island at once, a 6-phase East-West eradication strategy was developed and has been implemented since July 2002. This implies that most of the resources are being concentrated in only 2-3 parishes at one time. (See map).
- The sterile insect dispersal patterns and densities were re-designed in July 2002, and the following weekly release densities were adopted for each parish i.e. 7,500-9,000 sterile insects per square mile (SISM) in Portland and St Thomas, 12,000 SIQM in St. Mary and Eastern St. Ann , 21,000 SISM in Kingston-St. Andrew and St. Catherine, 7,500 SISM in Western St. Ann and Clarendon and 3,000 SISM for the remaining parishes of Jamaica.
- The field monitoring and wound treatment has been significantly intensified through the implementation of a more systematic farm-to-farm and house-to-house surveillance programme in the eastern parishes. These so called 'sweeps' have been implemented with the assistance of 25 additional field inspectors. Rather than relying on the farmers to inspect their animals and send the screwworm samples to the clinics, the inspectors now actively inspect each animal and treat each wound, whether infested with screwworm or not.
- The major NWS 'hot-spot' area i.e. the town of Kingston, has received an additional 6 million sterile pupae, which are released each week using 'ground release chambers' (as of April 2002).

Map of Jamaica showing East-West eradication strategy



The field data of the last months indicate that the newly adopted East-West strategy is giving excellent results (Figure 1). The very high sterile insect population density over Kingston/St Andrew/St. Mary obtained by both aerial and ground releases of sterile insects, combined with a more intensified field surveillance, have resulted in a drastic decline of screwworm cases in these parishes i.e. whereas in January 2002, the weekly reported cases of NWS fluctuated between 21 and 30, only 9 and 10 cases were reported during the month of September 2002 for Kingston/St. Andrew and St. Mary, respectively. The city of Kingston has been one of the screwworm 'hot spot' areas and the high population of stray dogs has made screwworm control very cumbersome and difficult. In the light of this, the decline in positive screwworm cases in Kingston becomes very significant.

The 'sweeps' in the eastern parishes have highlighted the shortcomings of the 'passive way' of screwworm surveillance i.e. 30 to 40% of farmers visited had never seen a field officer from the programme. The efficiency of the more 'active surveillance' is shown by the data of the July – August sweep in St. Thomas and Portland i.e. a total of 9,667 livestock holders were contacted and 33,877 animals were inspected. This resulted in the detection of 1,047 wounds on the animals of which 81 were infested with screwworm. This observed increase in number of screwworm cases during these 'sweeps' was expected due to the physical inspection of each animal in the parish by the field inspectors (Figure 1). During the second sweep in September 2002, only very few screwworm cases have been found.

With the current progress achieved, and if current levels of project support are maintained, it is expected that the parishes of Portland and St. Thomas will be free of NWS by mid-November 2002 and St. Mary-Kingston-St. Andrew is expected to be NWS-free by February 2003. During the remaining phases, it is expected that Eastern St. Ann-St. Catherine will be free of NWS by May 2003, Western St. Ann-Clarendon by August 2003, Manchester-St. Elisabeth-Trelawny: by November 2003 and the Western Parishes of Hanover, Westmoreland and St. James by early 2004. Of course, this progress in phases will also depend on reducing the movement of animals from East to West. By December 2003, it should be possible to reduce the sterile pupae requirements to 20 million per week and from March 2004 to 15 million a week. In case no NWS case is reported by mid-2004, Jamaica can be declared free from screwworm.

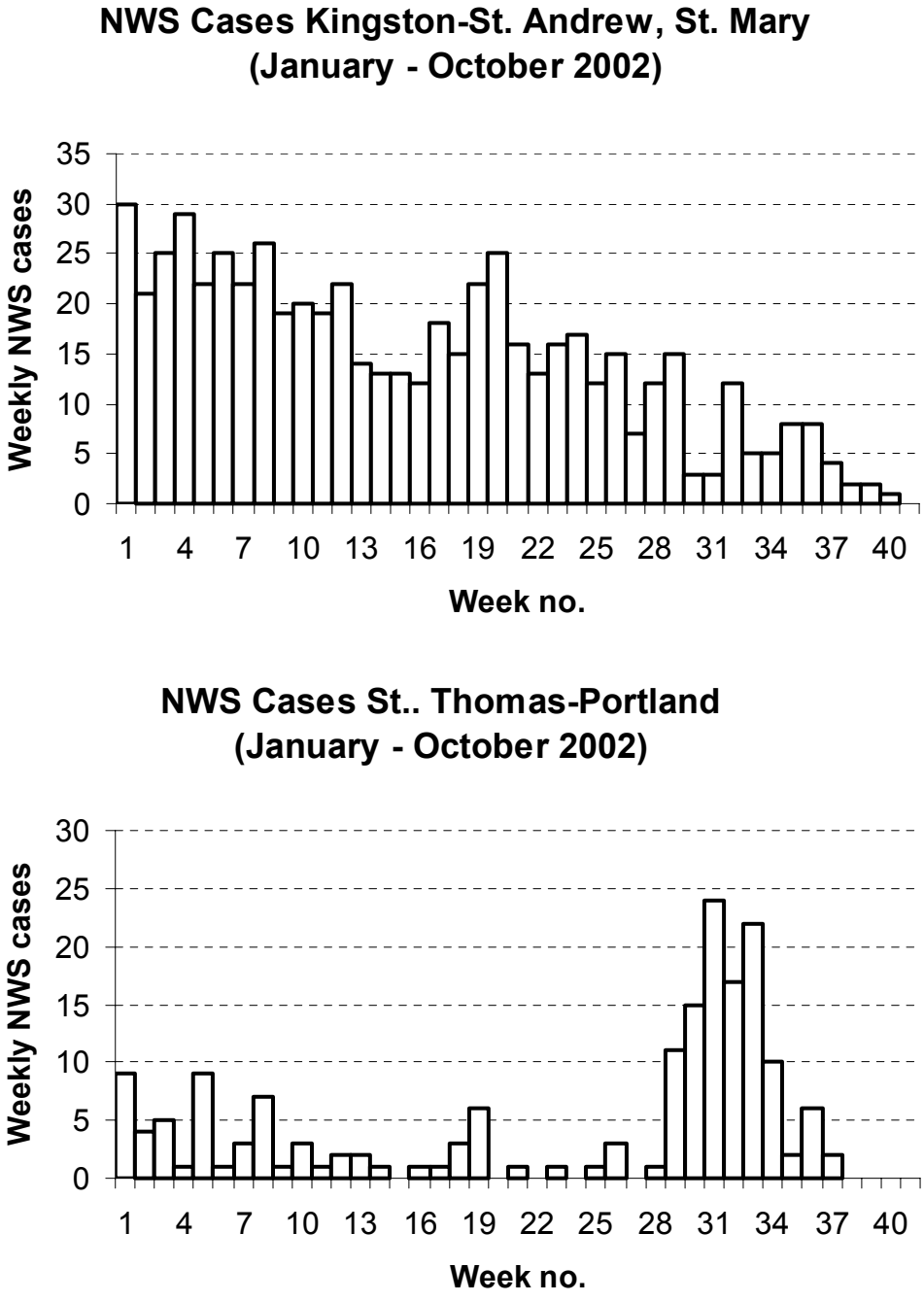


Figure 1. The number of reported NWS cases in the parishes of Kingston/St. Andrew and St. Mary (top graph) and in the parishes of St. Thomas and Portland (bottom graph) from January to October 2002.

The Date Moth SIT Project in Tunisia (TUN5019)

The date moth (*Ectomyelois ceratoniae*), also know under the name of carob moth, is a devastating pest of dates in Morocco, Algeria, Tunisia, Libya, Iran, Iraq, Saudi Arabia and Israel. The other hosts of the date moth include pomegranates, pigeon pea, locust bean, oranges, carobs, pistachios, etc. In Tunisia, the economic damage inflicted by the date moth on the agricultural sector is staggering with infestation rates as high as 90% in pomegranates (in the south), 75% in pistachios and 20% in dates.

About 103,000 metric tons of high quality dates were produced in the year 2,000 on the 27,000 ha of date palm plantations in Tunisia. The annual export of 29,000 metric tons of dates generates a revenue of US$ 70 million. The Government of Tunisia has established a maximum infestation level of 5% for dates destined for the export market. The use of organochlorine insecticides to control the date moth was banned completely several years ago. Since then, the control of date moth relies solely on the use of nets and plastic bags to physically protect the dates, the spraying of *Bacillus thuringiensis* (Bt), various sanitation measures (removal of fallen dates and other host trees in the date plantations) and the post harvest treatment (fumigation) of the dates with methyl bromide. Each of these control measures has its own limitations and therefore, there is an urgent need to develop alternative techniques, friendly to the environment.

A research project, aiming at the development of the Sterile Insect Technique (SIT) for date moth suppression, was initiated in 1999 with technical support from the IAEA under TC project TUN5019. The uniqueness of this project is demonstrated by the fact that it is the only programme in the world developing the SIT technology as part of an Integrated Pest Management approach against the date moth. The isolated locations of most of the date palm plantations in the southern part of Tunisia, offer an ideal opportunity to apply area-wide control efforts.

In the past 2 years, considerable progress has been made with the rearing of the date moth and more sophisticated and efficient rearing methods have been developed at the experimental production unit of the 'Institut National Agronomique de Tunisie (INAT)' located in Tunis. Only a few years ago, date moth was still reared on dates and other host fruits, but the development of a very efficient artificial larval diet has been the major breakthrough enabling the shift from 'individual moth rearing' to a stage of 'mass production'. The main achievements in this respect, some representing adaptations from the Canada codling moth programme, are the following:

Efficient oviposition in specially designed cages: In the first step of the production process, virgin female moths are placed together with fertile male moths in locally constructed oviposition cages. The wall of the cylindrical oviposition cages consists of removable paper sheets, which are highly suitable for the deposition of the eggs. A series of these cages is kept in an acclimatised room, where the cages are slowly rotating on rails to ensure an equal light distribution. The system is highly efficient as shown by the excellent fecundity of the female moths and the random distribution of the eggs on the paper sheets.

The development of an efficient artificial diet: After several days, the female moths have deposited sufficient eggs, and the paper sheets of the ovi-position cages can be removed. The sheets are cut in appropriately sized pieces, each containing approximately 2,500 eggs,

which are deposited on the trays with the larval diet. Up to 85 of these larval trays can be stacked in locally constructed trolleys. With an excellent average emergence rate of 80%, it is estimated that between 160,000 and 170,000 adult moths are emerging from pupae held in each trolley.

The marking of the moths: In any sterile insect release programme it is desirable to have information on the ratio of sterile to fertile insects. Sterile released insect can be discriminated from native insects through the marking of the released insects (e.g. tsetse flies, medfly) or by dissecting the female insects for examination of their reproductive system (e.g. in screwworm flies). In the date moth rearing system, a dye (Calco-Red) is mixed with the larval diet, colouring the internal organs of the released moths red. Moths trapped in pheromone-baited traps are simply squashed and the red internal organs will distinguish the released from the native insects (native moths have yellow internal organs). The marking with CR has now been optimised and previously experienced problems with high mortalities of the larvae, attributed to the colorant, have been solved.

The development of an automatic adult moth collecting system: After emergence from the pupae, the adult moths have to be collected for sterilisation. The previously used system consisted of a dark container (holding the larval/pupae trays) with transparent tubes to attract and collect the moths. This 'manual' adult moth collection system is very suitable for research purposes but in view of the labour involved, inappropriate for large scale operational rearing. The system has therefore been abolished and was replaced by a more sophisticated and efficient 'automatic' adult moth collection system. The unit, which is now fully operational, consists of a large, fully acclimatised emergence room, where the trolleys with the pupae are kept in complete darkness. After emergence from the pupae, the moths are attracted to a light source and sucked into a duct system leading to an adjacent cold room, where the adult moths are immobilized. This elegant system not only reduces significantly the labour requirements, but it also eliminates weak moths or poor flyers and ensures the selection of high quality insects for release.

Research is continuing to further optimise several components in the rearing, such as the development of methods to induce diapause in date moth. With other moths e.g. the codling moth, there is evidence that diapaused moths are more competitive after release as compared to normally reared moths. This needs to be verified for date moth and field trials are scheduled for next spring, to evaluate the competitiveness of diapaused versus normally reared moths. Although rearing moths in diapause requires additional space to store the larvae, it offers the opportunity of accumulating large numbers of moths over the winter months, which can be released in early spring, when the natural moth population is still low.

In conclusion, it is obvious that the programme has advanced considerably and the research attention can therefore be shifted to the next important phase of the programme i.e. the development of the field component. This will entail radiation dose-response studies (to accurately identify the radiation dose required to sterilise the moths) followed by field studies on the behaviour, the competitiveness, the longevity and the dispersal characteristics of the released sterile moths. Upon completion of this field component, the counterparts are planning to implement a field pilot trial to evaluate the technology under operational conditions.

Top left: the oviposition cages (with the removable paper sheets), slowly rotating on rails.
Top right: trolleys with the trays containing the artificial larval diet with the colorant
Bottom left: the collecting device in the cold room of the automatic adult moth collecting unit.
Bottom right: the immobilised adult moths in the bottom part of the collecting device.

F. REPORTING ON ONGOING AND PLANNED CO-ORDINATED RESEARCH PROJECTS AND RCM'S

Improvement of Codling Moth SIT to Facilitate Expansion of Field Application, 19-23 August, 2002, Kelowna, British Columbia, Canada (CRP D4.10.18)

The first Research Co-ordination meeting of this new CRP was held at the Okanagan University College in Kelowna, British Columbia, Canada from 19 to 23 August 2002. During the RCM, the participants developed the work plans and research activities for the coming 18 months. The main research topics are related to i.) the better understanding of codling moth genetics (with the eventual goal of developing a genetic sexing strain), ii.) the development of quality criteria and technologies for optimum rearing and quality management and iii.) improved field implementation.

The second RCM will be held in February 2004 and the venue will soon be defined.

The meeting was attended by seven Contract Holders from Argentina (2), Armenia, Brazil, Chile and Syria (2); four Agreement Holders from Canada, USA, South Africa and Switzerland and two Technical Contracts from Canada and Czech Republic.

Enhancement of the Sterile Insect Technique Through Genetic Transformation Using Nuclear Techniques, 8-12 July 2002, Capri, Italy (CRP D4.10.12)

The fourth and final RCM of this CRP (duration 1996-2002) was held in Capri in conjunction with a Consultants Group Meeting entitled: "Transgenic technology and its application in the SIT". The participants of both groups reviewed the results obtained during the last years in the field of insect transgenesis and made recommendations for future research that will be required to move this technology towards the application in SIT projects.

The objectives of the CRP were:

To identify, analyze and engineer mobile elements so that they can be used as transformation vectors in insect pests of economic importance.

To clone and analyze genes and promoters which have relevance for the improvement of SIT strains.

In summary the following results were obtained:

Progress in this field since 1996 has been extraordinary. Four transposable element gene vectors have been developed that transform pest insect species. Counting only initial published reports, to date there are 14 examples of genetic transformation of pest insect species covering three orders of insects. Of special note is that at least six of them, *Ceratitis capitata, Bactrocera dorsalis*, *Anastrepha suspensa*, *Lucilia cuprina*, *Anopheles stephensi* and *Pectinophora gossypiella*, are, or have been, the focus of vigorous genetic control programs using the SIT or, in case of *Lucilia cuprina,* a related technology. Based on these results it is reasonably safe to assume that most, if not all insect pest species can be genetically transformed with one or more of the four available vector systems and, based on the

current knowledge, all four systems are in principle useful as transformation vectors.

The ability to place genes into pest insect species, such as for example *C. capitata* and *Ae. aegypti*, has led to the rapid testing of a number of promoters in these species in order to determine if they are effective in driving the expression of strategic genes of genetic markers in these species. These have included two male specific promoters from *C. capitata*, the *hsp70* promoters from both *Drosophila melanogaster* and *C. capitata*, the synthetic 3xP3 promoter, the *polyubiquitin* promoter from *D. melanogaster*, the apyrase, maltase, carboxypeptidase and vitellogenin promoters from *Ae. aegypti*, the actin5C promoter from *D. melanogaster*, the actin promoter from *Bombyx mori*, and the *Minos* and *piggyBac* transposase promoters. Once again, published reports of the testing and use of these promoters have all occurred during the tenure of this CRP and CRP participants have played significant roles in these studies. It is concluded that although most of the promoters can also be used outside of the original species, their ability to drive high levels of expression in a controllable fashion may be restricted. This is compounded by severe position effects, i.e. either the level of transgene expression is modulated by the nature of the surrounding chromatin or the transgene is expressed in a variety of different patterns probably due to the influence of neighboring control elements.

Initial reports of the genetic transformation of pest insect species such as *C. capitata* and *Ae. aegypti* utilized eye pigmentation genes as genetic markers to efficiently identify transgenic individuals. However, it was clear from the beginning that this would probably not be a practical approach, e.g. the eye color mutation is usually not rescued completely leaving the vision of the insect impaired. Since 1999, the use of fluorescent protein genetic markers such as GFP, enhanced GFP, CFP, YFP and dsRed has greatly facilitated the generation of transgenic pest insect strains through both the ease of their identification and the elimination of the requirement to have recessive, mutant strains as the recipient. Indeed 15 of the first published examples of insect transformation have utilized these fluorescent protein marker genes. In conclusion, fluorescent protein markers can be applied universally across many or even all species and, in addition it was shown that the fluorescence can be detected several weeks after the death of the insect, which is of course an essential prerequisite for a marker to be useful to distinguish released and wild flies in the field.

Strategic genes that have, or are being tested, for specific use in the development of transgenic genetic sexing strains of *C. capitata* are the *transformer*, *transformer 2*, *doublesex*, *alcohol dehydrogenase*, and *inaZ* ice nucleation genes. Research into using the *Sex lethal*, transformer and *doublesex* genes of *C. capitata* has indicated that genes located downstream (referring to the *Drosphila* pathway) from the *Sex lethal* gene are suitable candidates for the engineering of genetic sexing strains in *C. capitata*. Research into these sex determination genes continues to be intense with the now added possibility that RNA inhibition technology might be useful in silencing the activity of these important genes.

New genetic sexing strategies using the tetracycline repressible system have been developed for insects and, as proof of principle, have been demonstrated to lead to the efficient elimination of females in transgenic strains of *D. melanogaster* containing this system. These systems have yet to be extended into pest insect species, however it is clear, based on the *D. melanogaster* research, that, provided sex specific promoters and appropriate cell death genes can be efficiently utilized in these species, and provided the repressor molecule can be delivered to the

developing embryo or early larvae, these approaches to genetic engineered genetic sexing are valid and offer a glimpse into how future genetic sexing strains may be constructed.

Based on the results of this CRP and the worldwide developments in the area of insect transgenesis the participants made the following recommendations:

The use of genetic engineering technologies for the improvement of the SIT should be further facilitated with the objective now being to push it toward field application. We therefore recommend that the Joint FAO/IAEA Division initiates support for research and action in the:

Optimization, improvement and refinement of gene vectors, genes, genetic markers and promoters for use in genetic sexing strategies with particular attention devoted to their effects on the mass rearing and strain stability. This includes the development of insulator sequences and sequences that can stabilize transgenes.

Assessment of the genetic fitness and stability of transgenic strains under the necessary containment guidelines.

The establishment of clear guidelines for the laboratory testing of genetically engineered pest insect strains before they are moved from the laboratory to field cage or field trials. Such guidelines would best be developed through the convening of a meeting of experts. Directly related to this is the need for IAEA and FAO to become involved with the formulation of international guidelines for determining calculations of risk associated with the applications of these technologies and with working towards increasing public acceptance of the use of transgenic technologies for the betterment of human welfare.

The establishment of intellectual property policies consistent with the rules of participating institutions.

Agreement holders (8) from: Australia, Italy (3), UK, USA (3)

Contract holder (1) from Greece

Technical contract (1) from New Zealand

New CRP on "Improved and Harmonized Quality Control for Expanded Tsetse Production, Sterilization and Field Application" (D4.20.10)

A new CRP has been approved in the field of tsetse quality control. Increasing interest in tsetse SIT is leading to increased demand for sterile flies. Little systematic work has been done specifically on the quality of mass reared and sterilized tsetse, and there is now an urgent need to harmonize and improve the existing ad hoc measures. The result of the CRP should be a quality control manual similar to the one already produced for tephritid fruit flies.

The Consultants Group Meeting that advised us on the need for this research identified seven main areas: quality control protocols for reproductive behaviour; colony maintenance; tsetse fly diet; irradiation of tsetse flies; fly handling, transporting and release; field quality control protocols for released flies; and standardized facilities, equipment, and materials for quality control. It is planned to hold the first RCM in conjunction with IOBC meeting on "QA of Mass Reared Arthropods", 15-19 September 2003, Montpellier, France.

Expected duration: 5 years (2003-2007).

We invite colony managers and researchers from tsetse affected countries and other laboratories to participate in this CRP, and research proposal in any of the above topics or related field will be welcome. Details of the IAEA Research Co-ordination Programme and the necessary application forms can be found at the IAEA web site (http:www.iaea.or.at/programmes/ri/uc.html*)*

***New CRP on* "Molecular Technologies to Improve the Effectiveness of SIT" (D4.10.19)**

The past ten years have seen an explosion in the use of molecular biology in all biological sciences; especially in the fields of medicine and agriculture and particular emphasis has been placed on gene transfer technology. The recognition that the development of gene transfer techniques in pest insects may lead to improvements in the SIT, encouraged the Joint FAO/IAEA Division to support and co-ordinate activities in this field by funding two CRPs. Scientific progress in the field is now such that transgenic technology in pest insects can be moved from the laboratory to initial evaluations of strains under operational conditions of large scale rearing and in contained field-cage situations to assess mating competitiveness of the transgenic strains. The new CRP will address these areas with the objective of delivering improved transgenic strains for eventual use in SIT programmes.

The two previous CRPs have provided the groundwork for this new proposal that will facilitate moving the field of the use of transgenic insects from the laboratory towards field application. During the implementation of the previous CRP highly efficient vectors for pest insect transformation have been developed and widely applicable transformation markers have been identified. These developments have made the screening of putative transgenic individuals in any pest species extremely efficient and have led to the creation of transgenic strains in more than 10 pest insect species. In many pest insects molecular analyses of important gene systems have produced useful biological reagents for the development of transgenic strains. The project will involve transfer of transgenic strains to larger rearing situations, evaluation in contained field-cage conditions and initial model studies on the impact of transgenic insects on the environment.

The new CRP will also begin the first major studies on the biological fitness of transgenic insects. Whilst not directly focused on risk assessment issues, the data produced will be of considerable importance to the development of a regulatory framework for any eventual open field release of transgenic insects. In order to maximize the chance that transgenic technology can be effectively transferred to field programmes, participation of operational SIT managers, regulators, ecologists and other stakeholders will be encouraged.

Overall objectives of the CRP:

To move transgenic insect technology from the laboratory gradually towards the field for the eventual management of insect pests through the improvement of the SIT.

Specific objectives:

- To improve gene transfer technology for the safe and effective use of transgenic or paratransgenic insects in pest management.
- To assess the performance of transgenic strains in large-scale rearing and under contained field-cage conditions.

- To define ecological and population concepts and models associated with the release of transgenic insects for pest management.

Expected research outputs:

- A collection of characterized molecular reagents and promoters/regulatory elements to be used for the expression of effector genes or selectable markers in pest insects.

- Increased knowledge of molecular mechanisms of sex determination and dosage compensation in pest insects.

- Data on the interaction between the transgene and the whole host genome in target pest insects.

- Development and definition of systems to maintain stability and strain integrity under large scale rearing.

- Transgenic strains of pest insects including: a) genetically marked strains, b) male producing strains and c) refractory strains.

- Data on transgene stability and fitness of transgenic strains during large scale rearing and contained evaluation.

- Mathematical models to predict the interactions between transgenic and wild type populations in the environment.

- Knowledge and data to support risk assessment analysis for the eventual release of transgenic insect strains.

Expected duration: 5 years (2003 – 2008); first RCM is planned for 6-10 October 2003, in Vienna, Austria.

Applications for contracts/agreements to participate in research on the above topics are invited. Deadline: 2003-1-31. Details of the IAEA Research Co-ordination Programme and the necessary application forms can be found in the IAEA web site (http:www.iaea.or.at/programmes/ri/uc.html).

G. DEVELOPMENT AT THE ENTOMOLOGY UNIT SEIBERSDORF

TSETSE R & D

Field Cage Compatibility Studies

Mating compatibility tests were conducted in a field cage set up in a greenhouse between *G. pallidipes* strains from Ethiopia and Uganda. The Ethiopia strain was received as pupae at the end of July 2002 and the Uganda strain has been colonised at Seibersdorf for several generations. This was a repeat of an earlier trial (Newsletter 57) when both strains were maintained at Seibersdorf. A similar proportion of Ethiopia strain females mated with Uganda strain males as reported earlier although the absolute number was lower. There is no indication of any mating incompatibility between these two populations and shipments of *G. pallidipes* flies of the Uganda strain from Seibersdorf to Tanga have been initiated to enable a large colony to be built up for future transfer to Ethiopia.

Mating compatibility tests were also carried out between *G.palpalis gambiensis* strains from Bobo-Dioulasso and the Niger River Basin in Mali. The tests were conducted in a walk-in cage in the open at CIRDES, Bobo-Dioulasso in Burkina Faso. The strain from Bobo-Dioulasso exhibited behaviour that allowed it to compete very well for females of the Niger River Basin (NRB). During one week of daily tests it was concluded that there is mating compatibility between males of the Bobo-Dioulasso strain and females of the NRB strain. The mating activity in the field cage was similar to that observed when the cage was set up in a greenhouse for other species (Newsletter 59).

Reproductive response to irradiation

Irradiation in the absence of oxygen reduces the amount of induced biological damage and in some insects, a net advantage has been demonstrated when using nitrogen atmosphere during irradiation. Anoxia induced by sealing puparia in a plastic bag before irradiation after the exhaustion of oxygen is routinely used when irradiating Medfly puparia and nitrogen has been used experimentally for some *Glossina* species. The effect of a range of different irradiation doses under nitrogen atmosphere on reproduction was investigated. Thirteen days after emergence, male *Glossina pallidipes* were irradiated at 70, 85, 100, 120, 145, 170, 180 and 210 Gy in a nitrogen atmosphere. The males were mated with 8 days old virgin females the day following irradiation. The production and survival of females was then followed for each individual fly for six weeks after mating. Irradiation at all levels caused expulsion of eggs and abortion of larvae. There was more than 97% induced sterility for flies irradiated at 145 Gy and above. Previous work has shown that when males are irradiated in air similar sterility levels are obtained at a lower dose of 120 Gy. Females that mated with irradiated males started their ovulation cycles about a week earlier than those that mated with fertile males. There was an increase in expulsion of eggs as the dose was increased. A batch of 7 days old females was also irradiated at 120 Gy in air and mated with mature fertile males the following day. Complete sterility was induced on the whole batch since no viable larvae were produced. At most only two eggs were extruded by any one female

through the more than sixty days observation period after mating.

Rearing Developments

Cage development

Developments are proceeding to replace the netting cages with an injection-moulded cage. Following testing of the hexagonal grid design to replace the use of netting, we are now proceeding to the production of 16 prototype cages. The detailed design of the cages is being finalised. The cages will incorporate lugs to interconnect between the cages, to ensure that the cages are stable individually and also that the combination of four cages in one frame will be stable during feeding of the flies. These prototypes will be available early next year for testing and are specifically adapted for use in the Tsetse Production Unit 3 (TPU 3).

The Entomology Unit has now received the prototype reefer container for tsetse rearing. The container incorporates an integral cooling/heating and humidification system, and skylights and equipment support bars have been installed. A door has been inserted near the main cargo door end to provide easy foot access. The system will first be tested for temperature and humidity control, and then will be tested with *G. pallidipes* for fly performance. In the final stage the TPU 3 rearing system will be installed. If the system proves satisfactory it will form the basis for a relocatable fly rearing system that can be manufactured in advance, and quickly installed wherever needed.

Salivary gland hypertrophy virus (SGHV)

The presence of the SGHV in *G. pallidipes* can have significant consequences for fly fertility and fecundity. The Uganda strain held in Seibersdorf has the virus, but without significant impact on the fecundity, whereas the Arba Minch (Ethiopia) strain, which shows a very high infection rate, has collapsed as a result of it. Infection results in salivary gland hypertrophy, but it is not known if asymptomatic infection occurs, nor if the virus occurs (asymptomatically) in any of our other colonies.

In an attempt to resolve this a consultant, Max Bergoine (Montpellier), has visited the Unit. Flies were dissected and infected salivary glands collected. These were examined under an electron microscope and the large rod-like virus particles identified. DNA has been extracted and sequenced from the samples, and specific primers sequenced. A student from Dr Bergoine's laboratory is due to visit the Unit to test the primers. Once shown to be effective, they will be used to study transmission and distribution of the virus and hopefully a virus free strain of *G. pallidipes* can be established.

Video and sound recording of mating behaviour

In order to improve the quality control procedures for mass produced tsetse detailed studies on mating behavior of *G. pallidipes* have been initiated in collaboration with Dr. Daniel Briceno (Costa Rica). Recordings of premounting behavior and copulatory courtship behavior were carried out as well as sound recordings. As has been previously recorded males frequently produced high frequency sounds. These sounds were produced in the presence of the female usually several minutes after the males were introduced into the cage; the females do not produce sound. The copulatory courtship of this species is rather elaborate. The female needs to co-operate with the male so that copulation can occur. There is no evidence at this moment of rape behavior in this species. Apparently many of the male's behaviors observed during the copulation have a stimulatory function and his performance during the copulation

probably has a direct effect in the final result i.e. the successful insemination of the female. Further studies will be carried out on wild and laboratory G. pallidipes and the studies expanded to other species. Phonotaxis experiments will be carried out in collaboration with Dr. Kratochvil (Univ. Vienna).

Remating

A consideration with the sterile insect technique is that if multiple mating takes place, sperm precedence or sperm selection by the female could have an impact on the effectiveness of released sterile males. Sperm selection will only be a problem if remating is frequent, and sperm precedence if remating is more likely after a sterile mating than a fertile one and the second mating takes precedence. It has been suggested that remating may take place if the first mating does not provide sufficient sperm, or some other component of the ejaculate is inadequate.

In an attempt to elucidate the factors controlling the incidence of remating in tsetse, females of three species were mated either with fertile or sterile males in small cages, and then two days later given the opportunity to mate with the other type of male in the field cage (to reduce the incidence of artificially forced remating). Immediately following the second mating (or at the end of the experiment if no second mating occurred) the females were dissected to check for the presence of a spermatophore, and the quantity of sperm in the spermathecae from the first mating recorded. However in the trials the rate of remating was so low that no significant results were obtained. The results are being prepared for publication.

Fruit Fly R & D

Cryopreservation of medfly embryos

Through the services of a consultant (Dr. Roger Leopold, USDA, Fargo, ND, USA) work has been initiated on using cryopreservation to maintain medfly strains. There are two main reasons to do this, firstly to reduce the work load in maintaining the many different and genetic and transgenic lines that are currently reared at Seibersdorf and secondly, in relation to field programmes, to provide a back-up in case of the loss of a colony. For field programmes using genetic sexing strains, it would be necessary to preserve sufficient eggs so that the filter could be replaced.

Using protocols that have already been used for other species, and for initial work on medfly in Hawaii, cryopreservation of medfly eggs was successful. However, further work will need to be done to enable this technique to be carried out on genetic sexing strains carrying the *tsl* mutation. It appears that the difference in developmental times between male and female embryos compromises the success of cryopreser-vation.

Induction of a translocation based on the balancer chromosome

Two strategies were investigated to improve stability in genetic sexing strains. Firstly, by inducing an inversion on the *wp* (*white pupae*) *tsl* (*temperature sensitive lethal*) chromosome. Only one inversion (D53) was so far obtained and cytological analysis showed that it included *wp* but not the *tsl* mutation. Nevertheless, recombination is significantly reduced even in the *wp-tsl* interval. This inversion is used in the latest genetic sexing strain called VIENNA 8.

Secondly, an attempt was made to induce new translocations utilizing a 5th chromosome balancer chromosome that consists of three overlapping inversions.

Furthermore, this balancer chromosome carries the marker *Sergeant* (Sr^2) and is lethal in a homozygous condition. Out of 100 single pair crosses, carrying chromosomes irradiated at 40Gy, a single family was detected that showed the appropriate genetic behaviour, i.e. pseudo-linkage between the markers *w* (*white*), *wp* and Sr^2 and sex. To determine the translocation breakpoint, polytene chromosomes from trichogen cells (male sub-orbital bristles) were analysed by Dr. A. Zacharopoulou (University of Patras). The breakpoint was mapped to position 49C. Due to the multiple inversions this position is located on the balancer chromosome on the right arm close to the centromere. Analysis of mitotic chromosomes will be required to determine the structure of the Y chromosome in this translocation. In addition, parallel test crosses with *w wp*, *wp tsl* and D53 (*wp tsl*) have been initiated to determine the genetic behaviour of this strain. Preliminary data show that a) the sex ratio is close to 50% and b) the balancer seems to be compatible with the inversion D53.

Generation and analysis of strains carrying either the markers GFP or DsRed

In collaboration with USDA-ARS and Dr. A. Handler (University of Gainesville) several sets of transgenic medfly strains were generated using the mobile element *piggyBac* as transformation vector. As host strains we used either the wild type strain Egypt II (EgII), the *w wp* strain or the inversion strain D53. Several different constructs either carrying EGFP or DsRed as marker, were micro-injected. So far a total of ca 150 transgenic lines was recovered out of which roughly 77% appeared to be independent insertions as judged by Southern analysis. The degree of multiple versus single insertions varied from experiment to experiment. The analysis of some of these transgenic lines is on-going. In particular, the visual expression patterns of the two fluorescent markers is determined and used to group the different lines. Depending on the marker used, four classes can be distinguished in case of EGFP and six in case of DsRed. The DsRed marker produces generally a stronger fluorescence and even allows detection of very unique expression patterns in some lines. For both markers strongly expressing lines will show fluorescence even several weeks after death. This is obviously a prerequisite if these markers are to be used to distinguish released sterile flies from wild flies in an operational programme. Additional investigations are on-going to determine the viability of the transgenic lines. Of particular interest are two EGFP and six DsRed lines because they seem to carry an insertion on the inversion D53. With respect to the fluorescence pattern they fall at least into 5 different classes that is corroborated by preliminary results of Southern analyses. Currently, Dr. A. Zacharopoulou is determining the exact chromosomal location of the insertions by *in situ* hybridisation on polytene chromosomes.

Medfly Shipments Between El Pino, Guatemala and Seibersdorf, Austria

Six shipments of medfly, *Ceratitis capitata,* eggs from the genetic sexing strain (GSS) VIENNA 7-Toliman were air-freighted from the "El Pino" medfly mass rearing facility in Guatemala to the Entomology Unit, FAO/IAEA Agriculture and Biotechnology Laboratory, Seibersdorf, Austria. Prior to shipment the eggs were bubbled for 24hr. The eggs were then shipped either in water or in a 0.1% solution agar to prevent settling. The length of the transportation time fluctuated between 48 to 82hr. Each shipment consisted of two metallic thermos flasks containing approximately 250ml of eggs in 500ml of the transportation media. Upon arrival in Seibersdorf, the eggs from each flask were divided in two aliquots with one aliquot being incubated at 24°C for 24hr

whilst the other aliquot was incubated at 24°C for 12hr followed 12hr at 34°C. The latter is the standard treatment necessary to kill the female embryos. Following each type of incubation, 5 larval trays with 5kg of wheat bran based larval diet were set up to assess production parameters. For the heat-treated eggs, 8ml of eggs were used and for the non heat-treated 3.2ml were used. Pupal yield and standard QC test were performed to determine any effect of the long distance shipment on the quality and quantity of insects recovered.

The major conclusions of this first trial are as follow:

- There was a slight difference in pupal production depending on the transportation media; the eggs transported in an agar suspension gave the better value.
- Egg hatch was reduced as consequence of the shipment but the total number of good flying adults was unaffected.
- Larvae production was not affected despite the use of a different larval diet in El Pino and Seibersdorf.
- Further trials are required in order to confirm these initial positive results and it is necessary to assess if eggs can be heat-treated prior to shipment.

Initial Activities on *Anastrepha fraterculus*

In order to help stimulate the development of the SIT for other important fruit flies a colony of *Anastrepha fraterculus* colony, that was adapted to artificial rearing conditions in 1997 in Tucuman, Argentina, was established in the Entomology Unit. *A. fraterculus* is one of the most important pests for temperate and tropical fruit in South and Central America and an important quarantine species for the USA as well the rest of the continent. It is a good candidate to be controlled with SIT but efficient rearing technology has not yet been developed. The Entomology Unit will initiate studies in this area.

A major concern for the use of the SIT for *A. fraterculus* is the apparent existence of different sub-species throughout its distribution. In order to address this situation a consultant (Dr. T. Vera, see page 44, Section I) has been recruited to carry out mating compatibility studies. These studies cannot be carried out in South America because of quarantine regulations preventing the movement of this species into different countries. Field colonies from different altitudes and climatic extremes are being established at Seibersdorf and comparative studies carried out in field cages. In addition, the degree and extent any post-zygotic compatibility in hybrid crosses will be assessed.

H. SPECIAL NEWS AND REPORTS

Consultants Meetings

Consultants meeting on "Mitigating the Threat of *Cactoblastis cactorum* to International Agriculture and Ecological Systems and Biodiversity" July 2002, Vienna, Austria.

The cactus moth *Cactoblastis cactorum* has become a serious threat to the high diversity of *Opuntia* (cactus pear) species throughout the world, both native and cultivated. Its presence in the Caribbean and its rapidly expanding range in the southeastern USA, is an imminent threat to the southwestern USA, Mexico, and Central and South America and eventually to other regions of the world where *Opuntia* cacti are regarded as extremely important plants, especially in arid and semi-arid regions where few plants can be grown. They have a valuable role in subsistence and commercial agriculture, in maintaining the ecological balance of unique ecosystems, and in soil conservation and combating desertification. Increasing areas in *Opuntia* cultivation and reliance on food and income from products means that invasion by *C. cactorum* has the potential to impact large regions and thousands of subsistence farmers in Central and South America, the Mediterranean, North Africa and in other countries. This impact would result in serious social and economic problems. Impacts on biodiversity and ecosystems where *Opuntia* are dominant components of the vegetation, including the centre of *Opuntia* radiation, Mexico, also loom large. The critical nature of this threat, and timing and scale of the likely response needed, requires immediate action.

A Cactus Moth Consultants Meeting held 15-19 July 2002 reviewed and evaluated the threat of *C. cactorum* to international agriculture and ecological systems and biodiversity. The consultants came to the following conclusions and recommendations: (1) The establishment of *C. cactorum* in cactus-growing areas will be devastating. Irreparable ecological and economical damage as well as irreparable social effects are still to be avoided providing that further spread is curtailed; (2) An immediate containment/ eradication programme of *C. cactorum* in the southeastern USA, Cuba and other Caribbean islands and particularly along the leading edge must be launched while the chances of containment and control are still possible; (3) The Sterile Insect Technique (SIT) approach is the most promising eradication tool and a critical element of any containment and eradication programme. Sufficient know-ledge is available to launch the programme; (4) The threat of *C. cactorum* is not fully appreciated by decision makers, and therefore, effective national and international awareness and regulatory programmes should be immediately implemented; (5) More research and development is needed to refine and increase efficacy of the control and prevention methods; (6) Although the emphasis may initially focus on Mexico, Cuba, other Caribbean islands and the USA, this does not mean that the threat is less important in other countries (see Table). Any effective contingency /eradication programme developed under the proposed project will be available for application in any other country; and (7) A collaborative effort among several countries and all available expertise on *C. cactorum* should be mobilized in this programme; 8) The IAEA is encouraged to approve an interregional Technical Co-operation project for the cycle 2003-2004

to facilitate and support the collaboration among countries immediately and practically at risk to prepare for and establish the capacity to deal with invasions of C. *cactorum*.

Table of countries that cultivate cactus pear and which are threatened by *Cactoblastis cactorum* invasions.

COUNTRY	SPECIES CULTIVATED	ESTIMATED AREA HA UNDER CULTIVATION	PRODUCTS	REMARKS
Brazil	*O. ficus-indica* *O. robusta* (many cultivars)	400 000	Mainly fodder, Also fruit	Cultivations are expanding
Chile	*O. ficus-indica* (many cultivars)	10 000	Cochineal Fruit	Export fruit and high income cochineal production
Peru	*O. ficus-indica* (many cultivars)	35 000	Cochineal Fruit, Fodder	90% of world cochineal production
Mexico	*O.ficus-indica* *O. streptacantha* *O. robusta* *O. amyclaea* *O. tomentosa* *O. megacantha* And others	360 000	Fruit Fodder Vegetable (nopalitos) Many other by products	3 million ha of natural populations are also utilized
Bolivia	*O. ficus-indica* (several cultivars)	1 000	Fruit, Cochineal Fodder	Becoming increasingly important
Italy	*O. ficus-indica* (several cultivars)	30 000	Fruit (export) Fodder, Medicinal	Mayor industry in Sicily
Spain	*O. ficus-indica*	1 000	Fruit	Mainly non-commercial
Canary slands	*O. ficus-indica*	1 000	Cochineal Fruit	Major income from cochineal
Israel	*O. ficus-indica*	300	Fruit	Intensive fruit production
Egypt, Portugal Turkey, Jordan Pakistan, Namibia	*O. ficus-indica*	unknown	Fruit Fodder	Starting with production
Tunisia	*O. ficus-indica* (various cultivars)	80 000	Fruit Fodder	Increasing in importance
Other North African countries such as Algeria and Morocco	*O. ficus-indica* (many cultivars)	120 000	Fruit Fodder	Increasing importance in Morocco and Algeria
Ethiopia, Eritrea Yemen	*O. ficus-indica* (many cultivars)	31 000 ?	Fruit Fodder	Serious conflicts of interest

The recommendation of the potential use of SIT for dealing with this problem was based on the following assessment:

Potential of Applying the Sterile Insect Technique to *C. cactorum*

SIT progammes have been successful against a number of pest Diptera (including the screwworm fly, *Cochliomyia hominivorax*, tsetse flies, the Mediterranean fruit fly, *Ceratitis capitata* and various other fruit fly pests), and numerous mass rearing facilities have been constructed worldwide to support these programmes. However, compared to dipterans, lepidopterans (moths) generally are more expensive to rear and often have a propensity to fly greater distances. Additionally, moths are more radio-resistant than dipterans. As a consequence, the larger dose of radiation required to completely sterilize moths reduces their competitiveness and performance in the field. Nevertheless, two SIT programmes are currently operating against moth pests, namely the pink bollworm programme in the USA, and the codling moth programme in Canada, and both of these have been very successful.

Inherited Sterility in Moths

One approach to reduce the negative effects of radio-resistance in Lepidoptera has been the use of inherited or F1 sterility. F1 sterility was first documented in studies on the codling moth. Subsequently, investigators have reported F1 sterility in many Lepidopteran species of economic importance. Like SIT, F1 sterility involves the mass rearing and release of genetically altered insects to insure that when matings occur in the field, a significant proportion of matings involve a treated, released insect. However, F1 sterility takes advantage of two unique genetic phenomena in Lepidopetera. First, Lepidopteran females generally are much more sensitive to radiation than are males of the same species. This allows the dose of radiation to be adjusted so that the treated females are completely sterile and males are partially sterile. Second, when this partially sterile males mate with fertile females, the radiation-induced deleterious effects are inherited by the F1 generation. As a result, egg hatch is reduced and the resulting F1 offspring are highly sterile and predominantly male. The lower dose of radiation used in F1 sterility increases the quality and competitiveness of the released insects. In addition, because F1 sterile progeny are produced in the field, the release of partially sterile insects offers greater suppressive potential than the release of fully sterile insects and is more compatible with biological control and other non-chemical pest control mechanisms or strategies.

Field release of partially sterile insects have demonstrated the potential of using F1 sterility to control many Lepidopterans, including the cabbage lopper, *Trichoplusia ni*, the corn earworm, *Helicoverpa zea*, the gypsy moth, *Lymantria dispar* and the codling moth, *Cydia pomonella.* In addition many studies have shown that F1 sterility can be effective combined with other biological control such as pheromone mating disruption, entomopathogens, host plant resistance and natural enemies. As a result of these studies, F1 sterility is regarded as the most favourable genetic method for most applications against Lepidoptera.

Nuclear Component

Sterilization is accomplished by exposing insects to a specific dose of gamma radiation emitted by radioisotopes (Cobalt 60 or Caesium 137). No other methods are available or appropriate to provide achieve sterilization. Chemo-sterilants carry a high risk for environ-mental contamination and pose serious health concerns. Linear accelerators have not shown sufficient applicability and

reliability in consistently achieving the desired level of sterility.

Nuclear technology has not only a comparative advantage in sterilizing mass reared insects, but is, at present, the only technology available for this purpose. As every single insect used in SIT activities must be sterilized, irradiation is a central and indispensable part of the total process.

Development of Inherited Sterility for *C. cactorum*

Although the cactus moth has been mass reared for use as a biological control agent in the past, use of sterility to control it is still untested in the field. Inherited (F_1) sterility could be a valuable tool to predict and manage the expanding populations of *C. cactorum*.

The use of F_1 sterility for control would be most appropriate for:

- Elimination of *C. cactorum* from areas of new introductions, or from isolated and/or environmentally sensitive areas.

- Establishment of a barrier through the release of irradiated moths along the leading edge of the *C. cactorum* geographical range.

- Provisioning sterile *C. cactorum* to assess the host range and potential geographic distribution.

- Provisioning sterile *C. cactorum* as hosts in the field to assess its potential natural enemy complex.

Studies on the radiation biology of *C. cactorum* have been carried out at the USDA-ARS laboratory in Tifton, GA., in collaboration with USDA-APHIS in Tallahassee, FL and the Joint FAO/IAEA Division in Vienna. Further collaboration with the Joint Division could facilitate the involvement of international experts to accelerate the refinement of inherited sterility procedures for this pest. South Africa is probably the best location for rearing and irradiating large numbers of *C. cactorum* for use in an action program in the immediate future. Since parts of the Caribbean have been infested with *C. cactorum* since the 1960's, some of the field testing could also take place there.

The meeting report is available upon request.

Consultants Meeting on "Improved Rearing Techniques for *Anastrepha* and *Bactrocera* Fruit Flies", September 23-27 Vienna, Austria.

The group of experts reviewed the state of the art of SIT applied to fruit flies of major international economic significance including those species that are potentially invasive. The rapid spread of several prominent fruit fly species was considered, along with the increased costs for quarantine treatments required for international trade. Major fruit fly species were grouped into 3 categories according to their level of development of SIT.

Level I. Species with advanced rearing technology available and in use with successful SIT.

Level II: Species for which rearing methodologies do exist but not to the stage of low cost, high quality production.

Level III: Species for which little or no rearing methodology has been developed.

The group agreed unanimously to recommend that a future CRP focused on mass-rearing be established for certain exotic fruit fly species of international significance with emphasis on those in Level II. The assumption was that by focusing the effort on a few species on

which considerable effort has been already directed, would elevate them to Level 1. It was assumed that knowledge acquired so far by species of Level I status e.g. medfly, melon fly and Mexican fruit fly would greatly benefit the effort on species in Level II. Member States with Level III fruit flies are encouraged to participate in the CRP to develop basic R&D for rearing certain of these species that threaten global agriculture. The group also recommended that additional CRPs be established to enhance fruit fly male effectiveness and genetic sexing, two areas of research that are distinct but closely related to mass rearing.

Workshops and Co-ordination Meetings

Eighth meeting of the Panel of PAAT Advisory Group Co-ordinators

The 8th Meeting of the PAAT Advisory Group was organised at ILRI, Nairobi, Kenya, on 24/25 September 2002 and was attended by 32 participants from 16 countries, 5 regional and international organizations and 11 national and international research institutions. The representatives from the mandated regional and international organizations made brief presentations on the respective activities since the last PAG meeting in Ouagadougou, September 2001. FAO informed the meeting participants that, in response to a request for assistance by AU, FAO intends to initiate a TCP in support of PATTEC. Presentations were made on GIS support to the planning of T&T intervention programmes and on other T&T-relevant research and methods development. Representatives from Botswana and Ethiopia were given the floor for detailed presentations on their progress and national plans regarding tsetse and trypanosomosis (T&T) intervention. An additional brief presentation was made on the T&T situation in Sudan and the anticipated transboundary co-operation between Ethiopia and Sudan on T&T intervention. The PAAT Chairman and members of the PAAT Secretariat provided information about the PAAT-PATTEC harmonisation process, initiated in early May 2002, and the joint press release by the four mandated organizations (AU, FAO, IAEA, WHO) in early June 2002, which received the support of the PAG participants. In view of the growing consensus on the approach for T&T intervention, observed already at a DFID-AHP workshop in Edinburgh, UK, 9-10 September 2002, the 8th PAG meeting undertook an effort to develop a joint statement, which brings "on-board" further international research institutions that were previously not fully supportive of PATTEC goals and activities:

At the 8th PAG Meeting the "T&T community", including mandated international organizations (AU/IBAR, FAO, IAEA, WHO), tsetse-affected countries, NARS, ARIs and relevant international institutes (ILRI, ICIPE, CIRAD and IFAD), underlined that it is united in its resolve to reduce and ultimately eliminate the constraint of tsetse-transmitted trypanosomosis in man and animals.

The meeting participants concluded that progress is best achieved through sequential concerted intervention efforts with an initial focus on those areas where the disease impact is most severe and where control provides the greatest benefits to human health, well-being and sustainable agriculture and rural development (SARD). As the scale and impact of trypanosomosis varies between African countries in man and animals, also the approaches towards the ultimate objective, as defined in the respective Heads of States and Government Decisions, will also vary.

In the case of human trypanosomosis, disease management - in the foreseeable future - will continue to depend on disease surveillance, detection and treatment as the principal priority. Strategies for vector intervention strategies need to be developed as a component of longer-term human trypanosomosis prevention measures, particularly in view of the increasing evidence of resistance to available trypanocidal drugs for treating sleeping sickness.

Regarding African animal trypanosomosis tsetse intervention has an immediate key role to play in the effective control and eventual elimination of the disease. A significant stage in achieving this objective is the creation of tsetse-free zones through the integration of appropriate and environmentally acceptable technologies, including the Sequential Aerosol Technique (SAT, sequential aerial spraying of ultra-low volume formulations of non-persistent insecticides) and SIT, as economically justified.

The PAAT community supports the outcome and the associated joint press release resulting from the PAAT-PATTEC harmonization workshop, Rome, 2/3 May 2002. T&T affected Member States, international organizations / institutions and funding agencies are encouraged to apply the criteria identified at this workshop in their process of planning, fund raising and implementing of T&T intervention campaigns and related development initiatives.

DFID-AHP meeting on "Tsetse Control – The Next 100 Years", 9-10 September 2002, Edinburgh, Scotland

Following controversial articles in the international press media on the declared objectives of PATTEC and a relevant statement made by the British Secretary of State for International Development, Ms. Claire Short, on the U.K. position regarding the objectives of this campaign and support to its implementation, the AHP of DFID was given the assignment to organise a workshop for exploring the key technical, scientific, socio-economic and environmental arguments 'for' and 'against' a programme to eradicate tsetse from Africa. The workshop was structured in three parts, namely a) a session with two relevant introductory presentations in the evening of 9 September 2002; b) a second session on 10 September 2002 a.m. titled "Is tsetse eradication feasible or desirable?" with six keynote speakers; and c) a discussion session on 10 September p. m. carrying the workshop title "Tsetse control – the next 100 years", which was expected to provide an outline as to how Africa's tsetse and trypanosomosis problem should be dealt with over the next decades.

The meeting was a good opportunity to share with the approximately forty participants from seven African and five non-African countries, representing international/regionalorganizations, universities, government institutions, the private sector and press media, information on the recently (FAO Rome, 2/3 May 2002) initiated harmonisation process between on PATTEC[1], PAAT[2] and the mandated international organizations (AU, FAO,

[1] Pan-African Tsetse and Trypanosomosis Eradication Campaign, an AU initiative, geared taking all necessary steps that will enable and lead to applied field intervention against tsetse and trypanosomosis;

[2] Programme Against African Trypanosomiasis, a forum that the four mandated organizations (AU, FAO, IAEA and WHO) and other partners use in an effort to streamline and harmonise their efforts and resources for tsetse and trypanosomosis research and control.

IAEA and WHO). This harmonisation workshop confirmed that the mandated organizations and PAAT support PATTEC.

Thanks to the good preparations and professional scene setting by the organisers, the debate was balanced, nevertheless partially lively, and it was necessary to correct some false statements such as "Zanzibar is a fake" or "something like areawide IPM does not exist".

Written conclusions of the meeting are currently being prepared by the organisers. In addition Wren media already placed a few citations from participants on their webpage (see http://www.new-agri.co.uk/02-6/pov.html). The meeting highlighted that the large majority of participants reached general consensus on various decisive issues, namely:

1. The initial opposition against "eradication" was overcome with the concurrence that this basically stands for the long-term political vision and that the strategy for implementation will aim at initiating tsetse and trypanosomosis intervention in identified priority areas with high potential for sustainable agriculture and rural development.

2. It was agreed that initial "small"-scale (20,000 to 35,000 km^2) efforts of creating tsetse fly free zones in the PAAT/PATTEC identified priority intervention areas, will likely result in highest possible benefits and should, therefore, be supported.

3. Although a few participants criticised (mainly the cost of) SIT, its availability in the "tool box" for application, when needed and feasible, was appreciated by the large majority of the meeting participants, and some, particularly African colleagues, even insisted that they are assured operational access to tsetse SIT. The two unique features of SIT as a component of areawide Integrated Pest Management (AW-IPM) are meanwhile widely recognised, namely that it is the only technique with a) no known adverse effects on non-target organisms; and b) an inverse (target population) density efficiency pattern and that it is, therefore, best applied in a phased manner, following other intervention techniques.

Regional Workshop on "Tephritid Fruit Flies Trapping and Fruit Sampling", 2-6 September 2002, Chios, Greece

The regional West Asia workshop on "Tephritid Fruit Flies Trapping and Fruit Sampling" was held on the Island of Chios, Greece on September 2-6, 2002. The workshop was attended by 8 participants from the three IAEA fruit fly projects in the Near East region, namely from Israel, the Hashemite Kingdom of Jordan and the Territories Under the Jurisdiction of the Palestinian Authority. Hands-on-training and lectures, provided by Prof. Byron Katsoyannos and Dr. Nikos Kouloussis from the Department of Agriculture of the Aristotle University of Thessaloniki, Greece, focused on: (i) biology, ecology and management of the medfly and of the olive fly, *Bactrocera oleae*; (ii) principles of Tephritid fruit fly trapping (attractant, type of traps, trap location and maintenance); (iii) principles of fruit sampling; (iv) data interpretation. The workshop has been successful in that it provided a common training to field personnel of the three projects that share

some financial and technical resources. As a result, trapping and fruit monitoring data will now be largely comparable throughout the region.

Workshop on "Arthropod Pest Problems in Pome Fruit Production (IOBC)" 10-14 March 2002, Vienna, Austria

The International Organization for Biological and Integrated Control of Noxious Animals and Plants (IOBC) is an organization that promotes the use of sustainable, environmentally safe, economically feasible and socially acceptable control-methods of pests and diseases of agricultural and forestry crops. The activities of the IOBC are carried by various working groups, study groups and commissions. The IOBC working group on "Integrated Plant Protection in Orchards" organized a workshop on 'Arthropod Pest Problems in Pome Fruit Production' from 10 to 14 March 2002 at the Bundesanstalt fuer Pflanzenschutz, in Vienna, Austria. The working group deals with all aspects of integrated, biological, and organic plant protection in fruit production, with the exception of grapes, citrus and olives. In the workshops, specialized subjects are discussed and technical guidelines for various fruit crops are formulated and strategies for integrated plant protection in orchards developed.

A presentation was made on the activities of the Insect Pest Control Subprogramme and on the goals and expected outputs of the newly started CRP on 'The improvement of Codling Moth SIT to facilitate field expansion'. The opportunity was taken to distribute the newly produced video on SIT and to promote the areawide concept and SIT through discussions with the participants.

Summary of Meetings of the Management Committee for the Use of the USAID-MERC Funds in Support of the SIT Projects in the Near East

The Management Committee of the Fruit Fly Projects in the Near East (Israel, the Hashemite Kingdom of Jordan, and the Territories Under the Jurisdiction of the Palestinian Authority) has been created following the award of a USAID-MERC grant to those three projects, for which the IAEA is the Prime Grantee and the Executing Agency. The Managing Committee, composed of 4 members (one representative of each of the three parties and of the IAEA) is responsible for: (i) coordination among the parties, (ii) setting priorities and approval of project work plans, (iii) tracking project's progress and use of budget; (iv) financial analysis of activities; (v) preparation of project reports and (vi) identification of fund-raising opportunities from additional sources. Two meetings of the Committee (scheduled on a semi-annual basis) took place in January and July 2002 at the IAEA Headquarters in Vienna, Austria. During those meetings, the following major conclusions were reached:

Under the prevailing situation, regional co-operation acquired through these projects is essential. This regional cooperation has already been successful in leading to a better control of Tephritid fruit flies in the region, and most notably in maintaining the three project areas free of the Peach Fruit Fly, *Bactrocera zonata*.

Considering that the Peach Fruit Fly is established in Egypt, it is foreseen that this Tephritid pest of economic significance will remain for the coming years a permanent threat to the neighbouring countries and the medfly SIT projects. Successfully controlling the medfly would be of little value unless the

three projects are maintained free of Peach Fruit Fly.

The environment-friendly control of Tephritid fruit fly species of economic significance throughout the region is of major importance. The three parties expressed their strong willingness and the need for continuing those activities in the long-term.

Numbers of good quality sterile medfly adults to supply the region in the long-term are not available. This issue is of major importance for the long-term sustainability of the projects in the region.

To date, effective regional co-operation has resulted in the control of the medfly in the Arava/Araba Valley making exports of horticultural products to high value "medfly free" markets a reality.

Based on the above conclusions, the Management Committee recommended:

- To strengthen regional action against introduction of Tephritid fruit fly species by, for example, setting-up a permanent "Exotic Fruit Fly National Task Force" within each project, that would react to new detected outbreaks on an emergency basis. These three national task forces should jointly agree upon emergency action plans to be made available and applied throughout the region.

- To make any efforts needed to involve neighbouring countries to meetings, trainings and discussions regarding the peach fruit fly situation.

- To investigate the relative cost effectiveness of various possibilities to supply the region with suitable numbers of good quality sterile medfly male adults. The three options to be investigated include: a) purchase of pupae from a foreign rearing facility, b) purchase of heat-treated (male) eggs from a foreign facility and building a facility for larval rearing and sterilization in the region, and c) building a complete mass-rearing and sterilization facility in the region.

- To prepare budgets and allocate adequate resources for the sustainable medium-term use of SIT for the areawide control of the medfly.

- To promote joint Israeli/Jordanian ventures in the Arava/Araba Valley for exporting commodities to high value "medfly-free" export markets.

Training Courses and International Conferences

Interregional Training Course on the "Use of the Sterile Insect and Related Techniques for the Integrated Areawide Management of Insect Pests", Okanagan University College, Kelowna, British Columbia, Canada, 6-29 August 2002.

The training course included participants from 22 countries and 20 lecturers and laboratory instructors. A wide variety of subjects, and pre and post-harvest pest control activities in many parts of the world, were discussed during the lectures, audio-visual presentations, laboratories and field excursions. The local Okanagan Kootenay Sterile Insect Release (SIR) Program to control the codling moth in apple and pear orchards was featured, and students had the opportunity to observe the large-scale rearing of moths, sterilization and release of the moths, and Integrated Pest Management activities related to pest

control in orchards. The course was co-ordinated by Dr. Stephanie Bloem.

After students returned home, a survey was taken to answer two questions:

1. What did you learn about the SIT?

2. How could the SIT be applied in your country?

The following are excerpts of the responses obtained:

- For the first time in my country a pest control project using the SIT will be initiated, releasing parasitoids and sterile male medflies.

- The SIT can be used to eradicate the screwworm in my country, a pest important for both human health and animal production.

- Participate in already approved programmes to control tsetse flies or medflies using the SIT.

- Insure that large-scale pest control projects include the co-operation of adjoining countries so that transboundary pests are treated on a regional basis.

- Conduct a pilot programme to control the codling moth in apple and pear orchards using an IPM system that includes the SIT.

- Initiate new SIT programmes as experience is gained with ongoing programmes.

- Establish a national committee to assess the feasibility of including the SIT in IPM programmes, and make plans accordingly.

- Make presentations to scientists, government planners and policy makers about the potential to control selected agricultural and human health insect pests by using the SIT along with other control methods.

- Write an article about the feasibility of implementing the SIT in my country, and make the technology known to the community by being interviewed on television and by a newspaper reporter.

- Provide liaison between scientists and farmers about the benefits of using the SIT.

- Evaluate pest control systems being using in my country so that opportunities to make the control methods more environment friendly are known and considered for implementation.

- Assess the potential to use the SIT against pests of vegetables in greenhouses.

- Request an expert on the SIT to visit my country and assess the feasibility of applying the SIT in our particular situation, including the control of vectors of malaria.

- Prepare a project proposal on insect control, including costs, where the SIT is included. Discuss the proposal with the IAEA.

- Prepare a budget for research on the SIT, and include SIT work in future research on pests.

- Develop a module to train staff on the principles of applying the SIT, and arrange for more staff to be trained.

- Obtain training on methods of mass rearing insects.

- Conduct research to develop a genetic sexing strain for the codling moth.

- Conduct surveys to ascertain the distribution of a pest.

It is evident that the students learned much about IPM and the SIT, and they are trying to use that new knowledge to improve pest control practices in their countries.

The next interregional training course will be held in Florida in 2004. Information about the next course is provided in this newsletter.

Regional Latin America Fruit Fly Training Course Held in Retalhuleu, Guatemala, Under the Framework of Project RLA5045.

The second international fruit fly course under the framework of the IAEA Technical Cooperation Project RLA5045 and FAO's Technical Co-operation Project RLA/0/172 aimed at assisting the Central American countries in developing pilot areas for fruit exports, was held in Retalhuleu, Guatemala, from 22 of September to 11 of October 2002. The objective was to train staff from the Plant Protection Organizations of the Central American countries as well as other Latin American countries in the basic techniques for areawide management of fruit fly pests including SIT. The course included the basic topics on monitoring and control techniques as well as biology, ecology and taxonomy of the main fruit fly pests. Managerial and operational aspects of large scale programmes was also addressed. Special attention was provided to the elements required to develop low prevalence and fly free areas and how this elements fit together in a systems approach combining pre and post-harvest treatments, for fruit exports. The course included visits to the El Pino mass rearing and sterilization facility, the holding, emergence and release facility in Retalhuleu, quarantine checkpoints and mango hot water treatment facilities. Twenty-three participants from 9 countries attended the course. Apart from the IAEA, the course was supported by the Ministry of Agriculture and Livestock of Guatemala (MAG), the Guatemala Moscamed Program, the University of San Carlos, the Food and Agriculture Organization of the United Nations (FAO) and other private firms. This course will no doubt contribute to the objectives set by the combined FAO and IAEA project and, in general, to the need for effective fruit fly control in the region.

International Symposium on Screwworm

The thirtieth anniversary of the establishment of the Mexico-US Screw-worm Commission was commemorated with the organization of an International Symposium on Screwworm in Tuxtla Gutiérez, Chiapas, Mexico on 28 and 29 August 2002. The Commission was instrumental for the successful eradication of the New World Screwworm (NWS) from Mexico and Central America.

On Aug. 28, 1972, the Mexican-American Commission for the Eradication of Screwworm was formed at the request of Mexican livestock producers, to continue with the successful screwworm eradication programme in the US, and push the screwworm back south to the Isthmus of Tehuantepec. The Commission was made up of an equal number of members from Mexico and the United States. The Commission was capable of establishing a barrier at the Isthmus of

Tehuantepec in 1984, but screwworm eradication from all of Mexico was achieved in 1991. The Mexican-US Screwworm Commission has collaborated with other commissions formed with each Central American country to eradicate the NWS from most of Central America. Today a permanent sterile fly release barrier is maintained in Panama between the Panama Canal and the Colombian border with sterile flies provided by the Commission's facility in Tuxtla, Mexico. The annual benefits for the livestock sector, resulting from the eradication of the NWS have been estimated at US$ 853 million, US$ 314 million and US$ 87.8 million for the USA, Mexico and the rest of Central America (Belize, Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica and Panama), respectively.

The symposium was opened and addressed by numerous officials such as the Constitutional Governor of Chiapas (Mr P.S. Mendiguachia), the US ambassador in Mexico (Mr J. Davidow), the US Agriculture Secretary (Ms. A. Veneman), the Mexican Secretary of Agriculture, Livestock, Rural Development, Fishery and Food (Mr. J.Usabiaga Arroyo) and Mr E.B. Knipling, the son of E.F. Knipling, who together with R. Bushland conceived the idea of the Sterile Insect Technique. Other speakers included Dr. G. A. Rodriguez Heres and Dr. J. B. Welch, current Directors of the Commission.

The symposium was attended by numerous US and Mexican officials, active and retired screwworm scientists and representatives of numerous national and international organizations. The Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture was represented by M. Vreysen who, as invited speaker, presented a paper on 'The activities of the Joint FAO/IAEA Programme of Nuclear Techniques in Food and Agriculture in support of New- and Old World Screwworm eradication programmes'.

Other Important News and Reports

Surveys in 2002 Confirm that the Island of Unguja (Zanzibar) remains free of the tsetse fly (*Glossina austeni*) and of the Disease Trypanosomosis

During an areawide eradication campaign (1994-1997), the weekly releases of gamma sterilised male tsetse flies was integrated with conventional suppression techniques such as the use of insecticide pour-on on livestock and the deployment of insecticide impregnated screens. This campaign culminated in the elimination of the only tsetse species present on the island of Unguja i.e. *Glossina austeni*. The last native *G. austeni* fly was trapped in September 1996 and the incidence of the parasite *Trypanosoma congolense* and *T. vivax* dropped to zero after 1995 and 1997, respectively.

No tsetse intervention activities have been undertaken since the dispersal of sterile males was terminated in December 1997, nor have any trypanocidal drugs been administered to the native domestic livestock on the island. Post-tsetse eradication entomological monitoring activities were initiated in early 1998 and to date, 'sticky panel' traps (suitable for the sampling of *G. austeni*) have been deployed in more than 200 sample sites during more than 300 trapping days. The sites for sampling were mainly selected in areas of previously known high fly density (tsetse 'hot-spot' areas such as the Jozani forest) and in those areas where cattle is imported from Tanzania mainland (e.g. the cattle quarantine station of Kisakasaka). No tsetse fly was trapped during the entire monitoring campaign.

During the same post-eradication period (1998-2002), the blood of almost 5,000 cattle, older than 6 months, born on the island and selected at random, was screened for the presence of trypanosomes. Not a single animal was found infected with trypanosomes.

An independent expert from South Africa reviewed the entire post-eradication monitoring programme in October 2002. His conclusion unequivocally confirms the results of the 5-year post-eradication monitoring programme on the island i.e. six years after the last native tsetse fly was trapped on Unguja Island, all scientific evidence indicates that the island is still a 'tsetse-free zone' and the native livestock population has remained free of trypanosomes.

It is obvious that the island has already experienced a substantial increase in livestock and agricultural productivity and a study will be implemented in the coming months with the specific aim to quantify the socio-economic benefits resulting from the removal of the tsetse fly and the disease trypanosomosis from the Island of Unguja.

The Peach Fruit Fly, *Bactrocera zonata* Saunders, on the A1 List of Quarantine Pests for the European Plant Protection Organization (EPPO)

The peach fruit fly, *Bactrocera zonata* Saunders, which attacks the main fruit varieties grown in the Mediterranean Basin, is a major threat for agriculture trade and exports.

Following its introduction and spread in Egypt, and the several detections which occurred in some countries of the Near East region, the EPPO organized a workshop on this pest on 5 March 2002 in Paris, France (see Newsletter 59) to assess the risk of its introduction in an EPPO Member State.

Following the conclusions of the workshop, the EPPO Working Party on Phytosanitary Regulations, whom met on 18-21 June in Vilnius, Lithuania, recommended ranking *B. zonata* as A1 Quarantine Pest. Based on the recommendation of the Working Party, the EPPO Council added the peach fruit fly on the A1 list of quarantine pests for the EPPO Member States. Additional information and useful links can be found on the EPPO website at www.eppo.org.

Similarities in the Areawide Control of African and American Trypanosomiases.

African and American trypanosomiases seem to share many parallel problems. Both are widespread and serious in their respective continents. Both are mainly problems of the rural poor and major obstacles to efforts aiming at poverty reduction and overall economic improvements. Both are difficult to treat, but vulnerable to control of their slowly-reproducing insect vectors. In both cases there would appear to be a substantial range of proven techniques for eliminating the insect vectors, so that the key problems seem to be operational and political rather than technical. In this respect, it may be that the experience of very large-scale control of American trypanosomiasis (Chagas disease) could provide useful guidance for similar large-scale interventions against African trypanosomiasis.

The underlying rationale of the Southern Cone Initiative against Chagas disease and American trypanosomiasis– subsequently accepted for other multinational initiatives – is that the vector control interventions need to be continued until a sustainable end-point can be reached. And while continuity of

intervention can be facilitated by international agreements, those same agreements can also provide for area-wide coverage of the interventions. The operational argument is that although small areas may be successfully controlled, they cannot be indefinitely protected against immigration of vectors from untreated areas. Consequently, to protect the investment in control within one area, it becomes necessary to control all other areas from which immigrant vectors may arrive. The Southern Cone Initiative was targeted specifically against domestic populations of the main vector, *Triatoma infestans*, and includes the 7 countries that together encompass the entire geographic distribution of this species. Similarly, the Central American and Andean Pact Initiatives are initially targeted against their main domestic vector, *Rhodnius prolixus*, and now include all countries where this species has been reported. In each case, surveillance and selective action against secondary vectors is included, but this can generally be effected at a much more localised level.

But the concept that exercises some commentators is that of the sustainable end-point. For Chagas disease, this is the point at which all domestic populations of Triatominae have been eliminated, and community-based surveillance systems are developed to monitor and treat any new cases of transmission that may occur – for example due to adventitious silvatic species of Triatominae. This point has already been reached in Uruguay, Chile, most of central and southern Brasil, and at least 4 previously endemic provinces of Argentina. For tsetse in Africa, a similar end-point has been reached for Zanzibar, although some would argue that recolonisation of this island may occur if *Glossina austeni* is not also eliminated from the mainland. In economic terms, the benefits of progressive elimination of tsetse accrue not just within the areas that are treated, but also from the protection accorded to previously treated areas. Recrudescence of tsetse in treated areas – due to lack of treatment of neighbouring areas – may entirely abnegate all accrued benefits.

(Contribution by: **C.J.Schofield** ECLAT Coordinator, LSHTM (ITD), London WC1 E7HT, UK)

New database: World-Wide Directory of SIT Facilities (DIR-SIT)

As part of IDIDAS, (International Database forInsects Disinfestation and Sterilization) *DIR-SIT* is being developed with the objective of aiding the retrieval of information on all mass rearing facilities of sterile pest insects. The database compiles information on production size, radiation process, quality control parameters, dosimetry, programme objective, trans-boundary shipment, field release data, and the facility full address. The content of the directory is under the responsibility of editors from the respective facilities whose task is to regularly update the information over the Internet in accordance with the developments in their programme. The old version of the Directory, *World-wide Directory of SIT Facilities*, which is a pdf file, can be consulted until the DIR-SIT development is completed.

The long-term aim of DIR-SIT database is to enable Member States to share technical, operational and safety information and contribute to the harmonization of the production and quality control process so that SIT can be implemented based on international standards and guidelines.

How to get to DIR-SIT:

Through IDIDAS (*http://www-ididas.iaea.org/ididas/*)

For editors: click on Editor's workshop and then click on *Add a new SIT facility*. Enter your data in the form. If you access any DIR-SIT editor functions you will be asked to enter the respective User Name and Password.

For users, click on DIR-SIT and get DIR-SIT Search Form: it is possible to search by Species, Strain, Taxonomy (Class /Order/ Family /Genus/ Species), Programme objective (any/Containment /Eradication /Parasitoids production/ Research /Suppression), Irradiation Source (any/Caesium /Co60 /Fast electrons/ X-rays), Irradiated Stage (any/Adult /Egg /Larva, /Nymph /Pupa), Radiation Dose, Country (*select from the window*), City, Director/Manager, Operating Authority, Year of Operation, Shipment (any/National /International), Production/ week (any /<1M /<20M /<100M /<1000M /1000000/>>1000M), and Dosimetry.

Call for contribution:

In order to have the web site of your mass rearing facility on the internet hosted by the Joint FAO/IAEA Division, please contact Dr. A. Bakri (*a.bakri@iaea.org*) for registration and to get your username and password.

Example of South Africa, Infruitec Facility

I. ANNOUNCEMENTS

STAFF CHANGES

Mark Benedict Joins the Entomology Unit at Seibersdorf

In October, 2002, Mark Benedict joined the Entomology Unit. He will be working at Seibersdorf and will initiate activities on the malaria transmitting mosquito, *Anopheles arabiensis* in relation to a new Agency activity which aims to evaluate the feasibility of using SIT for mosquitoes. Mark is a cost-free expert provided by the USA and comes from the CDC in Atlanta. He has much experience in mosquito biology and molecular biology and was involved in the *Anopheles albimanus* SIT pilot programme implemented in the 1970's in El Salvador. In Seibersdorf he will be involved with the development of genetic sexing strains in *Anopheles arabiensis*. We wish Mark and his family a pleasant and fruitful stay in Austria.

Teresa Vera doing research at the Entomology Unit in Seibersdorf

Teresa will spend six months in Seibersdorf conducting mating compatibility tests between South American fruit fly *(Anastrepha fraterculus)* populations from as many geographic locations as possible in Latin America. The post-zygotic compatibility in hybrid crosses will also be tested. These aspects are of major importance for the future use of the sterile insect technique (SIT) against this major fruit fly pest. She obtained her PhD at the National Institute of Agricultural Technology (INTA) studying the reproductive compatibility, mating behaviour and sexual selection of different populations of the Mediterranean fruit fly (*Ceratitis capitata*). She also extended some of these studies to *A. fraterculus* in collaboration with colleagues in Argentina. Recently she started working at the Experimental Station of Agriculture and Industry, Obispo Colombres (EEAOC) in Tucumán, Argentina, where she is conducting studies on the biology of *A. fraterculus* aimed to improve the rearing conditions and to determine the feasibility of implementing the SIT against this species. We wish Teresa a very successful work in Seibersdorf addressing this very interesting biological aspect of the South America fruit fly.

Brian Barnes, Chairman of the International Fruit Fly Steering Committee

Brian Barnes, who chaired the local South African Organizing Committee for the 6th International Symposium on Fruit Flies of Economic Importance now also holds the reigns of the International Fruit Fly Steering Committee. He has replaced Pat Gomes, who has stepped down after 2 terms.

Brian is currently manager of the Mediterranean fruit fly SIT Programme at the ARC Infruitec-Nietvoorbij Research Institute in Stellenbosch. He has been promoting the Hex River Valley pilot project, the expansion of SIT to codling moth, false codling moth and to other fruit production areas, and initiatives to

commercialize the production of sterile medflies and moths.

As Chair-person of the International Fruit Fly Steering Committee he will chair the 7th International Symposium of Fruit Flies of Economic Importance to be held in 2006 in Bahia, Brazil.

A New President for the Comité de Liaison de l'Agrumiculture Méditerranéenne (CLAM)

The delegates of the Member States of the CLAM, during its General Assembly held on 9-10 October 2002 in Montpellier, France, have elected Mr. Mena Davidson, General Manager of the Citrus Marketing Board of Israel, as the new President. Mr Davidson is taking over his duties from Mr. Octavio Ramón Sales, President of the Comité de Gestión de Cítricos of Spain.

IN MEMORIAN

Entomology Emeritus Professor **D. Elmo Hardy** passed away on October 20, 2002. He was born in 1914, and retired from the University of Hawaii in 1981, although he has remained quite active through the past two decades. Elmo published 235 papers and books on dipteran systematics, described over 1900 new species, and received numerous awards, including the ESA Excellence in Research Award in 1976, and the University of Hawaii Board of Regents Medal of Distinction in 1998. He had also been a Research Associate with the Bishop Museum for almost 20 years.

Elmo is survived by his grown children and his wife, Illse.

(contribution by Neal Evenhuis)

MEETINGS, SYMPOSIA, CONFERENCES

Interregional Training Course on the "Use of the Sterile Insect and Related Techniques for the Integrated Areawide Management of Insect Pests"

University of Florida, Gainesville, Florida, USA, April-May 2004. This course is co-funded by the US Government, FAO and IAEA. Applications must be submitted through Atomic Energy Authorities, Ministries of Agriculture or the FAO before the application deadline of 9 January 2004.

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22nd International Congress of Entomology "Strength in Biodiversity", Brisbane, Australia, 15-21 August 2004 (www.ccm.com.au/icoe/index.html)

The XXII International Congress of Entomology 2004 (ICE2004) will be held in Brisbane, Australia.

The theme of the Congress, Strength in Diversity represents the diverse nature of Entomology and will be reflected in the many symposia, presentations and sessions to be held during ICE2004.

The Australian Entomological Society will host ICE2004 and looks forward to welcoming colleagues from around the world to this important event.

First Announcement of the 10th International Citrus Congress

The 10th International Citrus Congress will be held on 15-20 February 2004 in Agadir, Morocco, under the auspices of the International Society of Citriculture.

Information about the Congress and the First Announcement can be found at www.lal.ifas.ufl.edu/isc_citrus_homepage.htm.

10th Workshop of the IOBC Global Working Group On Arthropod Mass Rearing and Quality Control, 21-24 September 2003, Montpellier, France

The 10th Workshop of the AMRQC Working Group will be held at Montpellier, France, from 21 to 24 September 2003. The venue of this meeting will be Agropolis International, 5km to the north of the city centre.

The workshop will focus on all issues related to the rearing of entomophagous and phytophagous insects and mites, and to principles and practices of quality control. The programme will consist of invited papers presenting an overview of selected topics (to be announced later) and contributed presentations on the different aspects of arthropod rearing as it relates to quality control. Papers will serve as a basis for discussion and exchange, with the final aim of improving collaboration among scientists and practitioners (e.g., biocontrol companies).

Estimated conference fees are in the range of 200 Euro. The fees will cover the registration, welcome reception, lunches, coffee breaks, shuttle between Agropolis and hotels, and proceedings. The banquet will be an extra charge. Those who are interested in attending the workshop or in presenting an oral or poster paper are requested to complete the enclosed pre-registration form and send it to Ms. Mireille Montes de Oca at the IOBC Permanent Secretariat, Agropolis, France (see the form for the full address).

Institutes or companies that wish to sponsor events or reserve display space should also contact Ms. Montes de Oca.

All upcoming information on the programme, registration and accommodation will be available on the AMRQC website (www.AMRQC.org). A circular for final registration will be sent in spring 2003 to all who have pre-registered.

Patrick De Clercq, Simon Grenier and Norm Leppla Co-chairmen AMRQC

OTHER ITEMS

Australian-Asian International Fruit Fly Center

The Tropical Fruit Fly Research Group at Griffith University Queenland, Australia has embarked on an exciting new initiative to establish an **Australian-Asian International Fruit Fly Center** to meet the current and future needs of horticultural industries in the Asian region. Fruit flies are well recognized as major pests that cause extensive losses to fruit and vegetable cultivation in this region.

For developing economies, the proposed Center can be viewed as a new concept to increase household food security, reduce poverty and facilitate international trade.

For more information please contact the: *Tropical Fruit Fly Research Group at Australian School of Environmental Studies Nathan Campus, Griffith University Brisbane, Queensland 4111 Australia.*

The IAEA Technical Co-operation Booklet "Science Serving People" is Available

The booklet presents a report on the tsetse problem on pages 11 to 15. Ethiopia is the main story, but Tanzania, Zanzibar and PATTEC are also mentioned. The book is now also on line at: http://www.iaea.org/worldatom/Press/Booklets/Ssp/index.html.

J. PUBLICATIONS

In Press

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