

Role of the IAEA in the Development & Application of the Sterile Insect Technique against Fruit Flies

Patrick Gomes ✓
Insect & Pest Control Section
International Atomic Energy Agency

Outline of Presentation

- **IAEA involvement & basic functions**
- **Fruit fly problem**
- **Current control methods used**
- **Early efforts to develop & promote area-wide SIT against fruit flies**
- **Recent SIT Projects**
- **R&D Breakthroughs**
- **Prospects for Applying SIT against fruit flies in the Future**

IAEA's Involvement

- **Joint FAO/IAEA Division & Insect & Pest Control Section formed in 1964**
- **R&D efforts aimed at control fruit flies using SIT began immediately**
- **First targets: Medfly, Mexican fruit fly, Oriental fruit fly, Olive fly, Queensland fruit fly**
- **Early trials were conducted on several islands in the Mediterranean**

Research & Development

- **Developing & improving area-wide SIT technologies by the FAO/IAEA Entomology Unit at the Seibersdorf Laboratory.**
- **Implementation of focused & result-oriented Coordinated Research Projects (CRPs) and individual Technical Research Contracts.**

Normative Functions

- **Publish scientific findings of research & convene conferences, working groups, scientific panels, etc.**
- **Disseminate technical information via the Internet on the application of the SIT to control fruit flies.**
- **Promote area-wide application of the SIT for fruit fly control through development of generic models aimed at assessing costs, economic and environmental benefits, etc.**

Technology Transfer & Field Application

- **Assist Member States to implement area-wide SIT control programmes against fruit flies**
- **Training personnel from Member States on basic concepts, principles and practices of area-wide control using the SIT**
- **Promote the commercialization & sustainability of area-wide SIT**

Key Services Provided

- **Maintaining different strains of fruit flies for use in research & development.**
- **Supplying new/improved strains of fruit flies for use in operational programmes.**
- **Technical advise/consultation on facility design & rearing methodology**
- **Assist Member States in project planning.**

Fruit Fly Problem

- **Rose to prominence during the last 100 years**
- **All Temperate, Subtropical, Tropical Areas of the World Affected**
- **Significant losses each year**
- **Pesticides used to avoid severe crop losses**
- **Environmental & economic costs incurred**
- **Development & diversification limited**
- **Market access/trade limited**

Weaponry Available

- **Insecticides**
- **Protein Bait Sprays**
- **Male Annihilation Technique (MAT)**
- **Sterile Insect Technique (SIT)**
- **Biological Control (BC)**
- **Cultural Control**
- **Others**

Common Methods of Control

SCENARIO A

- **Conventional cover sprays using OPs**
- **Farm-by-farm basis with no central coordination**
- **Treat on a calendar basis**
- **Financed by grower**
- **Direct damage averages > 29%**

SCENARIO B

- **Bait sprays - Malathion or Fenthion**
- **Centrally organized - all commercial citrus treated**
- **Treat based on trap findings**
- **Financed by grower assessments**
- **Direct damage - less than 1%**

Shortcomings of Chemical Approaches

- Residues, pollution, contamination
- Broad spectrum effects
- Environmental costs incurred
- Resistance
- Regulatory trend - reduction in use
- Costly registration & re-registration
- Litigation
- Unpopular

Pesticide Approach vs. Area-wide SIT

- | | |
|---|---|
| • Independently applied <u>farm-by-farm</u> by the grower or licensed PCO | • Applied over an entire geographic area by <u>centrally organised team</u> |
| • <u>Remedial</u> action | • <u>Preventative</u> action |
| • Objective = <i>crop protection</i> below economic threshold | • Objective = pest population reduction wherever it occurs |
| • Applied only to commercial hosts | • Applied on area-wide basis to all commercial & non-commercial hosts |
| • Applications cease when harvest complete | • Applications seldom cease |

SIT provides options to users

- **Prevention/Exclusion**
 - ◆ Biological barrier to establishment or spread
- **Control/Suppression**
 - ◆ Low Prevalence
- **Eradication**
 - ◆ Pest free areas

SIT projects to control Medfly

<i>LOCATION</i>	<i>TYPE</i>
<i>Argentina (Mendoza)</i>	<i>Eradication</i>
<i>Argentina (Patagonia)</i>	<i>Eradication</i>
<i>Mexico - Guatemala</i>	<i>Eradication + SIT Barrier + Suppression</i>
<i>Chile – Peru</i>	<i>Eradication + SIT Barrier + Suppression</i>
<i>USA (California/Florida)</i>	<i>Preventive + Eradication</i>
<i>Israel - Jordan</i>	<i>Eradication (pilot test)</i>
<i>Madeira Island</i>	<i>Control</i>
<i>South Africa</i>	<i>Control (pilot test)</i>

Value Added Attributes of SIT

- **Efficacious**
- **Target specific**
- **Sterile insects seek out its target in all available niches**
- **Environmentally benign**
- **Non-polluting/Leaves no residues**
- **Reduces pest population over entire geographic area**
- **Application not limited to commercial crops**

Early Efforts to Control Fruit Flies Using the SIT

- **Tenerife Island, Spain - 1965-68**
- **Capri Island, Italy - 1967**
- **Costa Rica 1968-69**
- **Procida Island, Italy - 1969**
- **Alhama de Murcia, Spain – 1969**
- **Okinawa, Japan - 1969**
- **Porto-Farina, Tunisia - 1970-72**
- **Cyprus – 1971**
- **Procida Island, Italy - 1971-75**
- **Southern coast, Israel - 1972-73**
- **Okinawa, Japan - 1974**
- **Guatemala - 1975-76**
- **Santa Cruz de Tenerife, Spain - 1975-77**
- **California, USA - 1975**
- **Chiapas, Mexico 1978-82**
- **Egypt - 1982-86**

Results of Earlier Efforts

- **Successfully demonstrated use of SIT on a limited scale.**
- **Mass-rearing & release methods developed & refined.**
- **Methods of sterilisation devised.**
- **Methods of assessing fruit fly populations improved.**
- **Biological and ecological information gained.**
- **Many operational aspects tested & improved.**

SIT is available for the following fruit fly species

- **Medfly, *Ceratitis capitata***
- **Melon Fly, *Bactrocera cucurbitae***
- **Oriental Fruit Fly complex, *Bactrocera dorsalis* & *B. philippinensis***
- **Mexican Fruit Fly, *Anastrepha ludens***
- **Caribbean Fruit Fly, *Anastrepha suspensa***
- **West Indian Fruit Fly, *Anastrepha obliqua***

R&D Underway on Mass-Rearing & SIT for Other Fruit Flies

Species of Fruit Flies:

- South American Fruit Fly, *Anastrepha fraterculus*
- Zapote Fruit Fly, *Anastrepha serpentina*
- Oriental Fruit Fly complex, *Bactrocera carambolae*
- Natal Fruit Fly, *Ceratitis rosae*

Constraints Identified

- Availability of sterile fruit flies for use over large areas
- Cost must be competitive with pesticides
- Demand for high quality and efficiency
- Eliminate potential damage from female stings
- Capability to ship sterile insects long distances
- Strategies needed for dealing with multiple species

Recent IAEA Projects - Medfly

- Gvulot, Israel - 1989-90
- North Africa Regional Programme for Medfly Control & Eradication (MAGHREB) 1990-94 Phase I
- Tozeur, Tunisia - 1993-94
- Crete, Greece - 1995-98
- Madeira, Portugal 1995 - 2000
- Lebanon 1995-99
- Arava Valley, Israel 1996 - 2000
- Jordan Valley, Jordan 1996 - 2000
- Gaza, Palestinian Authority 1999 - 2002

IAEA Projects to Develop SIT for Other Fruit Flies

LOCATION	SPECIES
<i>Pakistan</i>	<i>Bactrocera zonata</i>
<i>Philippines</i>	<i>Bactrocera philippinensis</i>
<i>Thailand</i>	<i>Bactrocera dorsalis</i>

Successful SIT Projects Against Fruit Flies

- **Chile - Medfly Free**
- **Argentina**
 - ◆ **Patagonia - Medfly Free**
 - ◆ **Mendoza - Low Prevalence**
- **Guatemala-Mexico Border**
 - ◆ **Barrier in place for 20 years**
- **Japan – Melon fly Free**
- **USA – Continental areas Medfly Free**
 - ◆ **Preventative Release Program**

Elements of Successful Projects

- **Strong government and grower support**
- **Strong plant health infrastructure exists & regulations in place**
- **Economic assessments conducted**
- **Work plan developed**
- **Well-trained and dedicated staff present**

Recent Breakthroughs/Changes

- **Development of Genetic Sexing Strains**
- **Improvement in Rearing & Release Methods**
- **Improvement in Assessment of Fruit Fly Quality & Behaviour**
- **Development of a Female Attractant**
- **Better Decision Tools for Assessing Economic Aspects & Impacts**
- **New International Standards for Phytosanitary Measures**

Current Assumptions

- **Further improvements will be made in genetic sexing strains reducing SIT cost and increasing effectiveness**
- **Commercial production & sale of sterile fruit flies for control and/or eradication purposes**
- **Expanded use of SIT will lead to lower costs in the future**
- **Major operational components of the SIT could be combined and managed by the private sector as “turn key” operations**

Current Assumptions(2)

- **Additional Refinements in Mass-Rearing**
 - ◆ **Quality Control**
 - ◆ **Diets**
 - ◆ **Automation**
- **Better supportive tools**
 - ◆ **assessing inducement of sterility**
 - ◆ **monitoring pest populations**
 - ◆ **suppressing target pest populations particularly in urban areas**

Whole “package” is available for Medfly

- **Technology available for use by Member States**
- **R&D for refinement and optimization**
- **Commercialisation of various aspects possible**

Prospects for applying SIT in the Future

- **Which technologies are most developed and ready for use?**
- **Which fruit fly species should be targeted?**
- **What additional R&D will be needed?**
- **What areas of the globe have the greatest prospect for impact and/or success?**
- **Where are investments being made that might offer opportunities for partnerships?**

Mexico & Central America

- **National fruit fly campaign underway in Mexico against 4 species.**
- **Renewed interests and investments now being made by US for eradication of Medfly.**
- **Strong interest in SIT & food irradiation expressed by Costa Rica Minister.**
- **Investments to be made in plant health with hurricane relief funds.**
- **Feasibility study completed on food irradiation facility in Central America.**
- **Honduras to become a Member State.**

South America

- **Successful eradication of Medfly in Chile.**
- **Co-operative Program underway between Chile & Peru.**
- **Peru received IDB funds for plant health & fruit fly activities.**
- **Advances made in fruit fly control in Argentina.**
- **Sub-Regional Proposal for fruit fly control developed.**
- **Carambola fruit fly eradication & exclusion in Guyana, Suriname & French Guiana funded by IFAD & IICA.**

Mediterranean Basin

- **Medfly production facility built in Madeira and control programme initiated.**
- **Algarve, Portugal conducting feasibility study on future use of SIT for Medfly.**
- **Interest recently expressed in the use of SIT for Medfly control by citrus producers (CLAM).**
- **Medfly proposal developed for MAGHREB region along with economic assessment.**
- **North African countries trained on area-wide use of the SIT for Medfly control.**
- **Tunisia recently submitted project proposal.**

West Asia/Near East

- National TC Projects underway in Israel, Jordan and the Palestinian Territories
- Progress made toward eradication
- Cooperation achieved among parties
- Operational plan and economic assessment completed for EASTMED Sub-Region
- Operational plan also exists for Cyprus and Egypt

Asia & Pacific

- Oriental fruit fly eradicated from Japan using MAT.
- Melon fly eradicated from Okinawa Islands of Japan.
- Japanese continue to produce Melon fly for preventative releases.
- FAO Regional Project on Fruit Fly Management underway in Pacific.
- IAEA-funded projects aimed at control of *Bactrocera* spp. underway in Philippines & Thailand.

***Thank you for your kind
attention***