INSECT PEST MANAGEMENT

(in respect of current scenario)

Indiscriminate use of Chemical Pesticides

- **Insecticidal resistance**
- **Environmental residues**
- **Adverse health effects**

Need to develop strategies

- **Ecological Compatible**
- **Environmentally safe**
- **Reproductive suppression**
  (in lieu of Instant Mortality)

Most suitable alternative is to opt for

- **Non-chemical control**
- **Biological / Parabiological control**

Pest Management through Radiation Technology

- **Sterile Insect Technique (SIT)**
- **Other Radio-Genetic Tactics**

  (*F-1 sterility, Chromosomal aberrations*)
- **Biological control**
- **Radiation hormesis**
- **Dis-infestation of stored products & agro-commodities for quarantine/ phytosanitation**

Pest Management through Radiation Technology

Advantages of Nuclear Techniques

- **Ecologically Compatible**
- **Parabiological approach**
- **No transgenic**
- **Environmentally safe**
- **No radio-activity**
- **No residue**

Characteristics of Electromagnetic Spectrum

Types of EM radiation	Frequency	Wavelength	Quantum	Nature of chemical effect
Gamma rays	> 10^{20} Hz	< 10^{-12}m	> 1MeV	Ionising
X-rays	3×10^{16} Hz	100nm -10 nm	≥124 eV	Ionising
UV rays	7.5×10^{14} - 3×10^{16} Hz	400nm – 100nm	3.1-124 eV	Non-ionising
Visible rays	4-7.5×10^{14} Hz	750-400nm	1.65-3.1eV	Non-ionising
IR rays	0.003-4×10^{14} Hz	1mm – 750 nm	0.0012-1.65 eV	Non-ionising
Microwave	3×10^{9}-3×10^{11} Hz	10^{-3}-10^{-1}m	2×10^{-24}–2×10^{-22}J	Non-ionising
Radiowave	<3×10^{9}Hz	10^{-1} m	<2×10^{-24} J	Non-ionising

Estimated sterilization doses for insects from different taxonomic orders

Order	Sterlization Doses (Gy)
Coleoptera	13 - 200
Dictyoptera	5 - 120
Diptera	10 - 200
Hemiptera	10- 200
Hymenoptera	80 - 200
Lepidoptera	40 - 400

An Environment Friendly Pest Management Approach

Area-Wide Pest Management

- Population suppression
- Large area augmentation
- Sterile insects
- Parasitoids
- Synergistic

Sterile Insect Technique(SIT)

- **E. F. Knipling conceived an approach to insect control by SIT**

- **Screwworm fly** (*Cochliomyia hominivorax*) **eradication : Foremost successful example**

- **Sterile insects are** released into environment in large numbers **(10 to 100 x)**

- **Native female** mating with a **sterile male** produce **fertilized** but **sterile** eggs

- **Success of screwworm eradication** through **SIT** program led to investigations on this **radio-genetic technique** for control of many other pests.

- **IAEA runs Coordinated Research programmes & Technical projects to promote SIT**

Sterile Insect Technique(SIT)

DEFINITION: A genetic method of pest suppression involving mass release of compatible but **sterile insects into a wild fertile pest population to overwhelm & suppress its reproductive capacity,** often eventually to the **point of extinction.**

T-Male X N-female

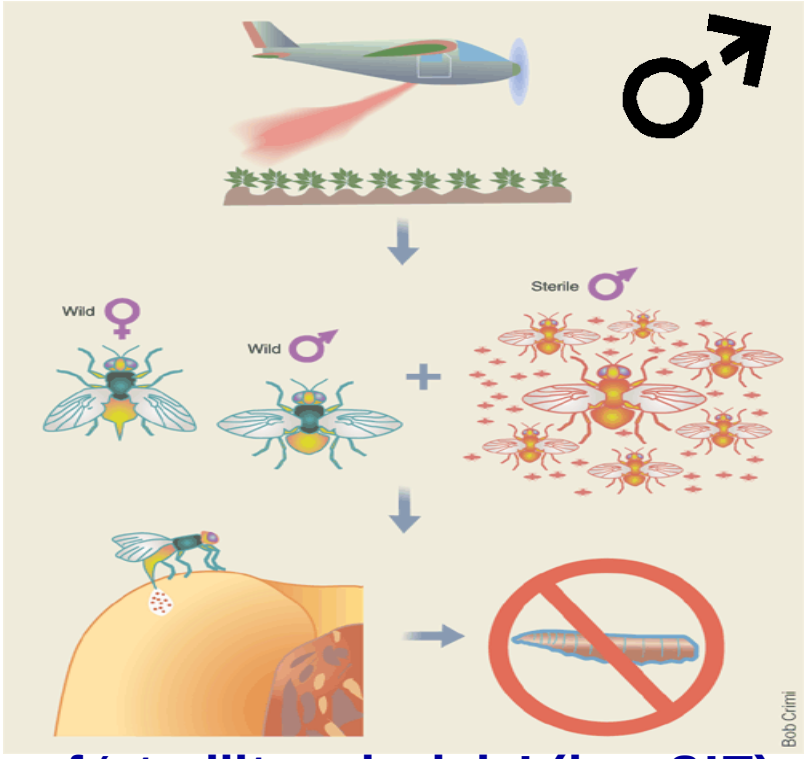
↓

Successful Mating

↓

ensures

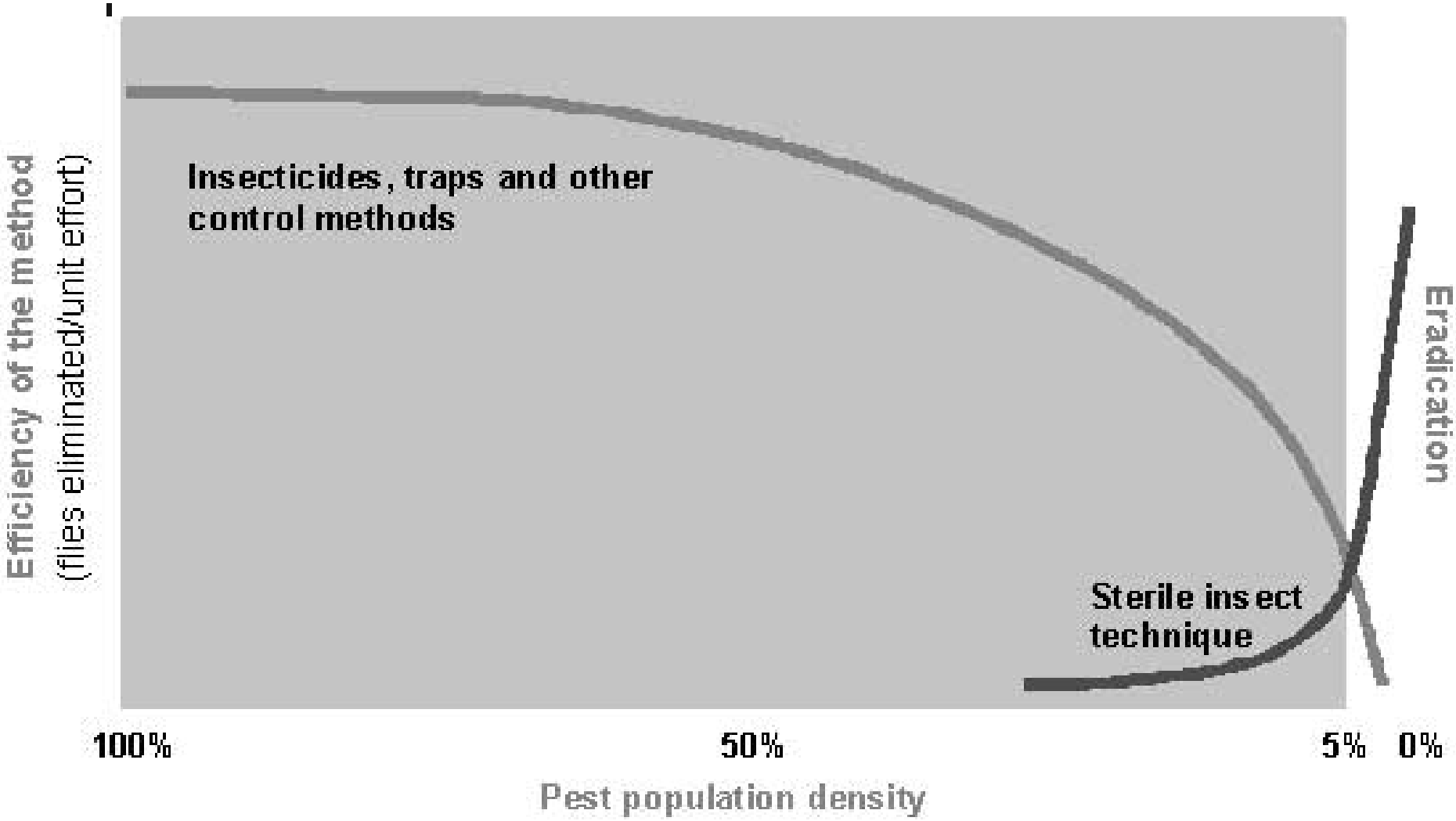
Success of SIT



Main components of employing of 'sterility principle' (i.e., SIT)

(i) Rearing
(ii) Treatment
(iii) Competitiveness
(iv) Release
(v) Evaluation
(vi) Re-infestation

Optimizing the efficiency of SIT in IPM



Optimizing the efficiency of an insect pest intervention campaign
by using conventional control and SIT in an integrated, phased approach

Some success stories…

- **Screwworm fly (***Cochliomyia hominivorax*)- eradicated from the United States (1950s-90s), Netherland (Curaçao, 1954) and Libya (1990-92)

- **Mexican fruit fly (***Anastrepha ludens*) eradicated from most of northern Mexico.

- **Tsetse fly** eradicated from Zanzibar (1970–1990s).

- **Medfly** (*Ceratitis capitata*)- eradicated from northern part of Chile and southern part of Peru and southern part of Mexico (1970s–80s)

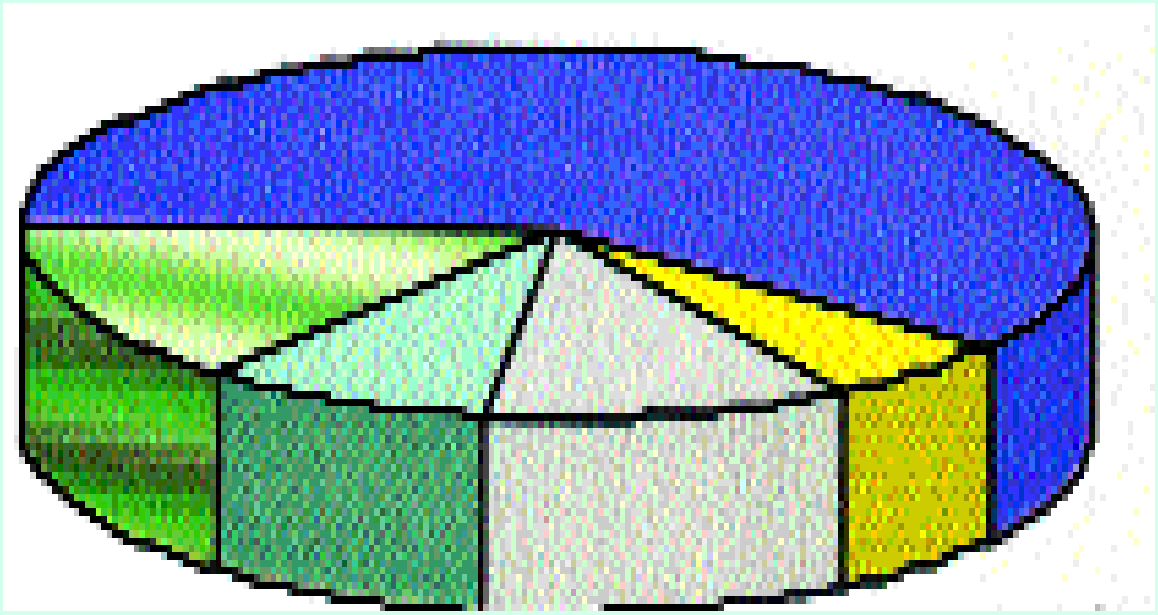
- **Sweet potato weevil (***Cylas formicarius)* eradicated from Kume Island, Okinawa, Japan (1994-99).

Etc….

Various Insect Species subjected to SIT

- **Screwworm fly** / **USA, Mexico, South America, Libya**
- **Mediterranean Fruit Fly**(*Ceratitis capitata* Wiedemann)/ **USA(Cal.), Mexico**
- **Melon Fly** (*Dacus cucurbitae* Coquillett)/ Japan, Taiwan
- **Pink Bollworm** (*Pectinophora gossypiella* Saunders)/ **USA (California)**
- **Tsetse Fly** (*Glossina* species)/ **Tanzania, Zimbabwe, Upper Volta**
- **Mosquitoes** (various spp.) **USA (Florida), East Africa, Venezuela**
- **Boll Weevil** (*Anthonomus grandis* Boheman)/ **Southeastern USA**
- **Mexican Fruit Fly**, (*Anastrepha ludens* Loew)/ **USA (Texas), Mexico**
- **Gypsy Moth** (*Lymantria dispar* Linn.)/ **Northeastern USA, Canada**
- **Stable Fly** (*Stomoxys calcitrans* Linn.)/ **USA (St. Croix, Virgin Islands** –exptl**)**
- **Horn Fly** (*Haematobia irritans* Linnaeus)/ **USA (Texas - experimental)**
- **Corn Earworm** (*Helicoverpa zea* Boddie)/ **USA (St. Croix, VI)**
- **Tobacco Hornworm** (*Manduca sexta* Linnaeus)/ **USA (St. Croix, VI)**

Continents adopting SIT



America 60%

Africa 14%

Europe 9%

Asia 11%

Australia 6%