Eco-friendly methods of pest management

INTEGRATED PEST MANAGEMENT

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Studies on Population Dynamics of the Insect Pest

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Uses all suitable Technologies and methods which are compatable

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Maintains Insect population at levels below causing Economic damage

Includes many technologies and methods which are called as

“components of IPM”

Legislative measures

- **First Act in the country was passed in 1906 under the *"Sea Customs Act of 1878"* to stop the entry of Maxican Cotton boll weevil**

- ***"Cotton Pest Act" – 1911* in Madras State-Cotton stalks had to be removed by 1st August every year to minimize the incidence of PBW**

- ***"Destructive Insects and Pests Act of 1914"* which also includes Plant Quarantine Act. This prevents prohibition of movement of any class of plants or plant products or pests from foreign country or Inter State or locally from one territory to another**

- ***"Insecticide Act of 1968"* Regulate the import, manufacture, Sales, transport, distribution and use of insecticides. This was enforced from April 1, 1971. Later amendments were made.**

- ***"The prevention of Food Adulteration Act of 1954"* Pesticide residues-Tolerance limits.**

Cultural practices

Alterations / Changes in cultivation Practices

- Habitat mgt.
- Tillage
- Inter cropping
- Trap cropping
- Border cropping
- Banker cropping
- Eco-feast / scarifice cropping
- Push-Pull poly cropping
- Vegetative trap
- Crop rotation
- Plant nutrition
- Water mgt.
- Sanitation
- Closed season
- Mulching

Host Habitat Management

- **Manipulation of crop production and management tactics**
- **Planting time-Early sowing decreases Gall midge, Shoot fly, earhead bug, white grub, aphid, podborer**
- **High seed rate- SF, SB in maize and sorghum - BND in g.nut**
- **Plant spacing**

  Closer - increases leaf hoppers, whitefly & bollworms in cotton.

  Increases plant hopper, BPH, WBPH, gall midge & leaf folder in paddy

  Decreases thrips, hoppers, leaf miners in groundnut

  Increases *Spilosoma, Melanoagromiza & Bemicia* in Soybean
- **Alley formation – (60 cm wide) for every 2mt planting decreases BPH**
- **Wider spacing – Decreases SWA, shoot internode & stalk borers**

Time of Sowing : Sorghum Shoot Fly

1.	Early sowing	up to June end	Less incidence
2.	Normal sowing	July 1st to July 15th	Medium incidence
3.	Delayed sowing	After July 15th	More incidence

DISRUPTING THE CONTINUITY OF THE FOOD SOURCES

a) Crop Spacing

b) Crop Location

c) Crop Rotation

d) Disrupting Crop and insect synchrony

a) Crop Spacing

- **Spacing can affect the relative growth rate of plants and development of environments favourable to insect population growth.**

- **Aphids were found to be less of a problem when plant spacing was less than 0.8m, whereas a spacing of 1.0–1.5 reduced flower thrips and the pod borer in cowpea.**

b) Crop Location

- **Fields with unmanaged habitats adjacent to it should not be selected for cultivation as it may lead to increased pest infestations which overwinter in the habitat.**

Crop Rotations

Not only creates discontinuity in pest life cycle but also improves soil structure and fertility.

Works best when

- **1)The pest has a narrow host range**

- **2)Eggs are laid before the new crop is planted**

- **3)The feeding stage is not very mobile.**

- **Rotations for soil dwellers like white grubs have been successful.**

- **Cereal –legume rotation scheme is quite popular.**

Disrupting crop and insect synchrony

- **If the crop phenology can be changed to be asynchronous with insect events like egg laying and larval development, insect numbers can be reduced drastically**
- **Modifying planting dates is a classical example**
- **Early sown sorghum escapes serious damage by the midge, *Contarinia sorghicola (Coq.) whereas the late sown crop usually suffers heavy loss.***
- **Late transplanted rice crop is severly affected by gall midge, while early sown one escapes the infestation.**

Alley formation in Paddy

Concepts and Principles of Pest Management

Landmarks in the history of agricultural insect pest management

ERA OF TRADITIONAL APPROACHES

Ancient :

- **The Chinese - chalk and wood ash - pests in enclosed spaces.**

- **Ants - biological control of stored grain as well as foliage insects.**

- **In India - neem leaves were placed in grain bins to keep away troublesome pests.**

- **In Middle and Near East- powder of chrysanthemum flowers as an insecticide.**

- **300 AD: First record of the use of biological control agents in citrus orchards in China.**
- **900 AD: The Chinese used arsenic to control garden pests.**

- **1690: The tobacco extract was used as a plant spray in parts of Europe.**

- **1762: Mynah bird from India was imported for the control of locusts in Mauritius.**

- **1782: "Underhill" variety of wheat reported resistant to Hessian fly in USA.**

- **1831: "Winter Majetin" variety of apple reported resistant to woolly apple in USA.**

- **1848: *Derris* (Rotenone) reported to be used in insect control in Asia.**

- **1858: Pyrethrum first used for insect control in the USA.**

- **1889: Biological control of cottony cushion scale on citrus in the USA by use of Vedalia beetle imported from Australia.**

- **1890: Control of grape *Phylloxera* in Europe by grafting of European grapevine scions to resistant North American root stocks.**

- **1898: The coccinellid, *Cryptolaemus montrouzieri* Mulsant from Australia was released against coffee green scale, *Coccus viridis* (Green) in India. It established but failed to control the scale.**

- **1931: The cottony cushion scale attacking wattle of commerce, *Acacia decurrens* was controlled in India by release of predatory beetle, *Rodolia cardinalis* Mulsant from California.**

- **1939: Insecticidal properties of DDT reported by Paul Muller in Switzerland.**
  First microbial insecticide- *Bacillus thuringiensis*

- **1941: Insecticidal activity of HCH- France**

- **1946: Organophosphate insecticide –parathion**

- **1948: Use of DDT and HCH on agricultural crops in India**
  "Doom" based on *Bacillus popilliae* and *B. lentimorbus* registered in USA against Japanese beetle larvae on turf.

Foundation of IPM

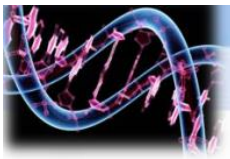
- **1959: concepts of integrated control involving integration of chemical and biological control introduced**
  Concept of EIL and ETL by V.M. Stern and coworkers.

Green Revolution era

- **1975: Elcar *(Heliocoverpa* NPV*)* against bollworm and tobacco budworm on cotton.**
  First Insect Growth Regulator (Methoprene) in USA.

Post-Green Revolution era

- **1987: Development of transgenic plant, tobacco for control of *Manduca sexta.***



Gene Revolution Era

- **2002:Bt cotton approved for commercialization in India.**
- **2005: First agreement to develop Bt Brinjal was signed.**
- **2006: Bt Brinjal approved for large scale field trials in India.**
- **2009: Bt brinjal for commercialization on 14 October in India.**

Series of Phases in the evolution of an IPM programme

i. **Single tactic phase:** Emphasis placed on a single pest utilizing a single tactic.

ii. **Multiple tactic phase:** Variety of tactics for manipulation pest population.

iii. **Biological monitoring phase:** monitoring of pest, natural enemies and host on timely basis.

iv. **Modeling phase:** Pictorial, flowchart and mathematical models to generate data in pest management systems.

v. **Management or optimization phase:** construction of a functional IPM system.

vi. **Systems implementation phase:** ultimate phase, optimal systems are delivery to and utilization by the farmers.

IPM..... Some definitions

- Integrated Pest Management (IPM) is a system that, in the context of associated environment and population dynamics of the pest species, utilizes all suitable techniques and methods in as compatible a manner as possible and maintains pest populations at levels below those causing economic injury.

-FAO (1967)

Kogan, 1988

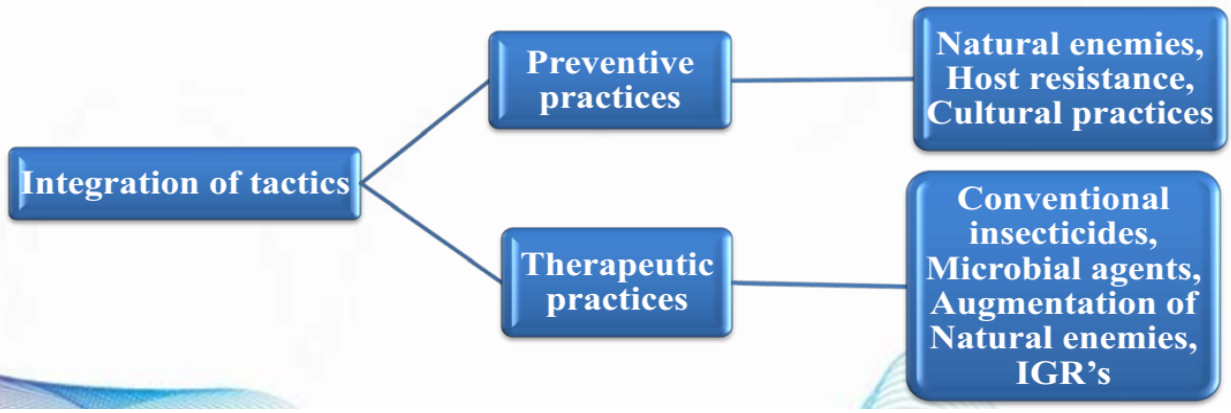
- **Integration:** the harmonious use of multiple methods to control single pest as well as the impacts of multiple pests.
- **Pest:** any organism detrimental to humans, including invertebrate and vertebrate animals, pathogens and weeds.
- **Management:** a set of decision rules based on ecological principles and economic and social considerations.

IPM is a Multidisciplinary Endeavour

Dhaliwal and Arora (2012):

Contd…,

- Evolving approach which utilizes all the suitable management tactics and available surveillance and forecasting information.
- To develop a holistic management programme as part of a sustainable crop production technology.
- Based on an understanding of pest ecology and begins with steps to accurately diagnose the nature and source of pest problems.
- Relies on a range of preventive and curative measures.



Objectives of pest management

1. To reduce pest status below economic injury level.

   Complete elimination of pest is not the objective……

2. To manage insects by not only killing them but by preventing feeding, multiplication and dispersal.

3. To use eco-friendly methods, which will maintain quality of environment (air, water, wild life and plant life)

4. To make maximum use of natural mortality factors, apply control measures only when needed.

5. To use component in sustainable crop production.