Pest management by modifying insect development and behaviour
Insect growth regulators (IGR’s)

- Synthetic compounds possessing the activities of juvenile and moulting hormone of insects are called as IGR’s/ JH mimics/ JH analogues/ Juvenoids.
- Retard the development of pest species particularly inducing effects from sterility to death.
- Effective only on immature insects.
Invention of paper factor

- Discovered by Slama and Williams, 1967

- In *Pyrrhocoris apterous*

- Paper towel was developed from Balsam fir tree

- Mimic the JH- kills the insects without reaching to adult stage
Affects the insects in different ways

1. Antimetamorphic effect
2. Larvicidal effect
3. Ovicidal effect
4. Diapause disrupting effect
5. Embryogenesis inhibiting effect
Chitin synthesis inhibitors

Chemicals which interfere with the biosynthesis and deposition of chitin.

Acts on chitin synthase.

Acts as stomach poisons and kills insects at the time of moulting and also suppress the fecundity and exhibit ovicidal and contact activity.

Causes improper attachment of the new cuticle during moulting and produces a cuticle that lacks some of the layers.

Larvae die from rupture of the new malformed cuticle, starvation desiccation and predation.

Benzyl phenyl urea analogues - affects the larval stage.
Practical IGR’s found in market

1. Methoprene (Altosid)- Homopterans and Dipterans
2. Kinoprene (Enstar-IGR)- mosquitoes, flies
3. Hydroprene (Altozar)- Lepidopterans, coleopterans, Homopterans and for few stored pests
4. Pyriproxifen (Admiral)- flies, beetles, midges and mosquitoes.
5. Diflubenzuron (Dimilin)- flies, midges and mosquitoes.
Other chitin synthesis inhibitors

- **Diflubenzuron (Dimilin)** - used in cotton, soybean, citrus, vegetables and also medical pests (mosquitoes).
- **Lufenuron (Match)** - lepidoptera and coleoptera on cotton, corn and vegetables.
- **Buprofezin (Applaud)** - produces weakened exoskeleton in moulting immatures both insecticides and acaricides. Used against hemipterans in rice.
- **Novaluron (Rimon)** - used for whiteflies on tomato and lepidopterans.
Anti-juvenile hormones

- Tested plant extracts for antagonistic activity of JH.
- Discovered anti JH activity from bedding plant, *Ageratum houstonianum*.
- Identified 2 compounds- Precocene I and Precocene-II.
- As they induce precocious form of metamorphosis and their chemical structure.
- Induce premature metamorphosis.
- Lethal activation within the corpora allata, thus destroying the glands.
- Azadirachtin- liquid and dust formulations from neem seeds- disrupts molting process.
Advantages

- Effective in minute quantities and hence are economical
- Highly species specific; so non-target organisms are spared
- Affects more than one aspect of insect development and hence effective against insects which are resistant to insecticides.
- Non-toxic to plants and animals.
- Suitable for insects which are living in concealed environments.
Disadvantages

- They have a narrow physiological windows; hence cannot be applied at all times.
- Effective only for last larval instars and hence stages will continue to feed.
- Slow mode of action
- Chances of resistance development
- Few are unstable in environment
- High cost of chemicals
Push-Pull Strategy or Stimulo-deterrent diversion

A strategy where a host-plant attractant(s) and a repellent(s) are used in combination.

Tested using a repellent intercrop and an attractant “trap” plant.

Insects are repelled by volatiles emitted from the intercrop (push) and simultaneously attracted by volatiles from the trap plant (pull).

The most successful work on push-pull to date has been conducted in Africa to control stem borers in maize and sorghum (Cook et al., 2007).

Works not only by decreasing stem borer damage to maize, but also by enhancing the efficacy of natural enemies.
‘Pull’
Volatile chemicals from Napier border attract moths to lay eggs

‘Push’
Volatile chemicals from Desmodium intercrop repel moths
## Attractants

- Chemicals which elicit oriented movements by insects towards their source.
- Also called as Food lures

### Important food lures includes

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Lure</th>
<th>Insect</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sugar + Molasses</td>
<td>House fly</td>
</tr>
<tr>
<td>2</td>
<td>Geraniol</td>
<td>Japanese beetle</td>
</tr>
<tr>
<td>3</td>
<td>Trimed lure</td>
<td>Mediterranean fruit fly</td>
</tr>
<tr>
<td>4</td>
<td>Melon fruit fly</td>
<td>Cue lure</td>
</tr>
<tr>
<td>5</td>
<td>Methyl eugenol</td>
<td>Oriental fruit fly</td>
</tr>
<tr>
<td>6</td>
<td>Sinigrin</td>
<td>Cabbage butterfly</td>
</tr>
<tr>
<td>7</td>
<td>Cinnamaldehyde</td>
<td>Spotted cucumber beetle</td>
</tr>
</tbody>
</table>
Antifeedants

• Chemicals which inhibit feeding when present in a place where insects in its absence would feed.
  
  OR

• Chemical compound which prevent feeding of insect or animal on a treated material without necessarily killing or repelling.

• 1st antifeedant – Zinc salt of Dimethyl dithiocarbonic acid against rodents and trees- to prevent feeding on bark of trees.
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Antifeedant</th>
<th>Target insects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Azadirachtin</td>
<td>Desert locust and other insects</td>
</tr>
<tr>
<td>2</td>
<td>Baygon</td>
<td>Cotton boll weevil</td>
</tr>
<tr>
<td>3</td>
<td>Brestan</td>
<td>Cut worms and potato tuber moth larvae</td>
</tr>
<tr>
<td>4</td>
<td>Chlorinated triphenyl methane and triphenyl sulfonium salts</td>
<td>Phytophagous insects</td>
</tr>
<tr>
<td>5</td>
<td>Organotins</td>
<td>Grasshoppers, Agrotis sp.</td>
</tr>
<tr>
<td>6</td>
<td>Phlorizin</td>
<td>Myzus persicae</td>
</tr>
<tr>
<td>7</td>
<td>Pyrethrum</td>
<td>Glossina sp.</td>
</tr>
<tr>
<td>8</td>
<td>Solanine</td>
<td>Potato leaf hopper</td>
</tr>
<tr>
<td>9</td>
<td>Thiocarbamates and phenyl carbamates</td>
<td>Beetles</td>
</tr>
<tr>
<td>10</td>
<td>Triazines</td>
<td>Cockroaches and beetles</td>
</tr>
</tbody>
</table>
Repellents

• Chemicals that cause insects to orient their movements away from a source.

• Allied materials that do not cause movement away but do prevent feeding or oviposition by insects- deterrents.

• Repellents- volatile chemicals- activity in the vapour phase.

• Plants- unattractive, unpalatable or offensive.
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Repellents</th>
<th>Insect</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Benzyl benzoate</td>
<td>Mites</td>
</tr>
<tr>
<td>2</td>
<td>Bordeaux mixture</td>
<td>Foliage feeders</td>
</tr>
<tr>
<td>3</td>
<td>Creosote</td>
<td>Chinch bugs</td>
</tr>
<tr>
<td>4</td>
<td>Diacetyl pthalate</td>
<td>Cattle fleas</td>
</tr>
<tr>
<td>5</td>
<td>Dimethyl pthalate</td>
<td>Mosquitoes</td>
</tr>
<tr>
<td>6</td>
<td>N, N, diethyl m-toulamide (DEET)</td>
<td>Mosquitoes, fleas, flies</td>
</tr>
<tr>
<td>7</td>
<td>Naphtalene balls</td>
<td>Cloth moths</td>
</tr>
<tr>
<td>8</td>
<td>N-butylacetanilide</td>
<td>Ticks, fleas</td>
</tr>
<tr>
<td>9</td>
<td>Pentachlorophenol</td>
<td>Termites</td>
</tr>
<tr>
<td>10</td>
<td>Pine tar oil</td>
<td>Screw worm flies</td>
</tr>
</tbody>
</table>
Advantages

• Low toxicity-safe to humans, plants and domestic animals.
• Protects the desired plants and insects are not killed.
• Resistance development- low.

Disadvantages

• The need to completely cover all susceptible surfaces with repeated applications
• Possibility of increasing infestations on near by untreated surfaces.
Thank you