INTEGRATED PEST MANAGEMENT IN COTTON
## Economic Threshold levels (ETLs)

<table>
<thead>
<tr>
<th>Insect pest</th>
<th>ETL</th>
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</thead>
<tbody>
<tr>
<td>1. American and Spotted bollworm</td>
<td>5 % damaged fruiting bodies or 1 larva per plant or total 3 damaged squares/ plant taken from 20 plants select at random for counting</td>
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<tr>
<td>2. Pink bollworm</td>
<td>8 moths/ trap per day for 3 consecutive days or 10 % infested flowers or flowers or bolls with live larvae.</td>
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<tr>
<td>3. <em>Spodoptera</em></td>
<td>1 egg mass or skeletonized leaf / 10 plants</td>
</tr>
<tr>
<td>4. Leaf hopper*</td>
<td>2 leaf hopper per leaf or appearance of second grade leaf hopper injury (yellowing in the margins of the leaves)</td>
</tr>
<tr>
<td>5. Whitefly*</td>
<td>5-10 per leaf before 9 AM</td>
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<tr>
<td>6. Aphids</td>
<td>10 % affected plants counted randomly</td>
</tr>
<tr>
<td>7. Thrips*</td>
<td>5-10 thrips/leaf</td>
</tr>
<tr>
<td>8. Nematode</td>
<td>1-2 larvae per gm of soil</td>
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*3 leaves (top, middle, bottom) per plants from 10 plants
Integrated pest management

Cultural Practices:

- Deep summer ploughing.
- Field sanitation by destroying and removing the crop residues.
- Early and Timely sowing with recommended spacing.
- Use of Resistant varieties

<table>
<thead>
<tr>
<th>Jassids</th>
<th>Bikaneri Nerma, ABH-466, H-777, G.cot-12, G-cot-10, RS-875, RST-9, F-5-5, Fateh, RS-2063</th>
</tr>
</thead>
<tbody>
<tr>
<td>White fly</td>
<td>Supriya, Kanchana, LK-861, RS-875, RS-2013,</td>
</tr>
<tr>
<td>Bollworms</td>
<td>LH-900, F-414, Abadita, RS-2013</td>
</tr>
<tr>
<td>Leaf curl virus</td>
<td>All desi cottons, RS-875, RS-810, RS-2013,</td>
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<tr>
<td></td>
<td>LHH-144, LRA-5166, lRK-516, Gk-515</td>
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</tbody>
</table>
Cultural Practices:

- Collect shedded squares and bolls from cotton field.
- Crop rotation with non-preferred hosts

<table>
<thead>
<tr>
<th>Helicoverpa &amp; Earias:</th>
<th>Greengram, blackgram, soybean, castor, sorghum</th>
</tr>
</thead>
<tbody>
<tr>
<td>White fly:</td>
<td>Sorghum, ragi, maize</td>
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- Removal and destruction of alternate weed hosts

<table>
<thead>
<tr>
<th>Helicoverpa: Logascae mollis</th>
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<tr>
<td>White fly:</td>
</tr>
<tr>
<td>Abutilon indicum, Chrozophore, Rotllari, Solanum nigrum</td>
</tr>
<tr>
<td>Mealy bug:</td>
</tr>
<tr>
<td>Congress grass, Hibiscus, okra, custard apple, guava</td>
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</tbody>
</table>
• Border crop: Pigeonpea, bajra or maize for mealy bug

• Judicious application of recommended dose of fertilizers.

• Inter crop: Cowpea or Soybean (Leafhopper).

• Trap crop:

  1. *Helicoverpa*: Marigold, Okra, Castor, Pigeonpea, Jowar, Maize, canabinus

  2. Mirid bug: Lucerne

• Set up yellow pan traps and sticky traps @ 12/ ha.

• Pheromone traps @ 5 /ha (Pink bollworm and *Spodoptera*)
Mechanical practices

- Hand picking and destruction of various insects stages, affected plant parts and rossetted flowers.

- Clipping of terminal shoots on 90-110 days of crop growth depending upon cultivars.

- Wash equipments with a jet of water or spray with chemical insecticides before mixing to uninfected portion in a crop helps in minimizing the spread of mealy bug.

- Uproot severely affected cotton plants at early stage of infestation burry them in a pit and spray with any one of the recommended chemical insecticides to prevent the Mealy bug from carry over to the next crop.
Biological control

Conservation:

- **Predators:** Lacewings, Lady bird beetles, staphylinids, predatory wasps, surface bugs like Geocoris, Anthocorids, Nabids, Reduviids, Spiders, Damsel bugs, big eyed bugs, shield bugs and ants.

- **Parasitoids:** Apanteles, Bracon, Rogas, Agathis, Campoletis, Eriborus, Telenomus, Trichogramma.
• Naturally occurring fungi (*Beauveria bassiana*) also infect and kill mirids.

• Install 8-10 bird perches /ha for the benefit of Predatory birds- Black drango, King crow, orange Myna and Blue jay.
AUGMENTATION:

• Releasing predator *Chrysoperla carnea* @ 10,000 eggs or grubs/ha at 6th, 13th and 14th week after sowing.

• Release of *Trichogramma chilonis* @ 1,50,000 /ha/week (2-3 releases) 40-50 DAS (*Helicoverpa*).

• *Cryptolaemus montrouzieri* adults or grubs @ 10 per mealy bug infested plants.

• Spray *HaNPV* @ 250 and *SlNPV* @ 250-500 LE /ha.

• Entomopathogenic fungi – *Metarhizium anisopliae, Beauveria bassiana and Nomurea rileyi* against *H. armigera*. 

Contd…,
• Spray *V. lecanii* (2 x 10⁸ CFU/gm (10gm/l)) and *Beayveria bassiana* (Potency 10⁸ spores/ml) during high humid days.

• Releases of the predatory mite, *Neosellus (Amblyseius) barberi* (Phytoseiidae) (Mite pests).

• ULV spray of NPV at 3 x 10¹² POB /ha with 10% cotton seed kernel extract, 10% crude sugar, 0.1% each of Tinopal and Teepol for effective control of *Helicoverpa.*
Parasitoid associated with whiteflies

Nymph parasitized with *Encarsia* sp.

*Encarsia* sp. adult
Mealy bug-Parasitoid

Mummified mealy bug

Aenasius bambawali adult
Parasitoid associated with flower midge

_Ecrizotomorpha sp._
(Hymenoptera: Pteromalidae)
Botanical control

Spray:

• For Sucking pests: 5 % NSKE or 1 % crude neem oil + Detergent and soap powder @ 1 g/l.

• For White fly: Neem oil (1%), fish oil resin soap (2.5%) and NSKE 5%.

• Neem oil (3 %) and NSKE (5 %) against Mirid bug, mealy bug.
## Chemical control

**Recommended Insecticides for management of target pests**

<table>
<thead>
<tr>
<th>Insect pests</th>
<th>Recommended Insecticides for management</th>
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<tr>
<td><strong>SUCKING PESTS</strong></td>
<td></td>
</tr>
<tr>
<td>Thrips</td>
<td>Seed treatment: Imidacloprid and Thiamethoxam @ 5g/kg.</td>
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<tr>
<td>Leafhoppers</td>
<td>Spray: Clothianidin 50 WDG @ 0.075 g/l OR Imidacloprid 17.8 SL @ 0.25 ml/l OR Acetamaprid 20 WP @ 0.2 g/l OR Thiamethoxam 25 WP @ 0.2 g/l OR Dinotefuran 20SG 0.2g/l</td>
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<tr>
<td>Aphids</td>
<td></td>
</tr>
<tr>
<td>Whitefly</td>
<td>Triazophos 40 EC @ 1.5 ml/l or Acetamiprid 20 SP @ 30-40 g/ha</td>
</tr>
<tr>
<td>Red cotton bug</td>
<td>Profenophos 50 EC @ 2 ml/l</td>
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<tr>
<td>Dusky cotton bug</td>
<td>Spray Profenophos 50 EC @ 2 ml/l or Chlorpyriphos 20 EC @ 2 ml/l or Acephate @ 1g/l</td>
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# Chemical control

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<tr>
<td>Flower midge</td>
<td>Imidacloprid 17.8 SL or Acephate 75 SP or Profenophos 50 EC @ 2ml/l + DDVP @ 0.25 ml/l Neem oil</td>
</tr>
<tr>
<td>Mirid bug</td>
<td>Fipronil 5 SC @1ml OR Acephate 75 SP @ 1g OR Profenophos 50 EC @ 2 ml OR Indoxacarb 14.5 SC @ 0.5 ml OR</td>
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<tr>
<td></td>
<td>Imidacloprid 17.8 SL @ 0.3 ml per lit of water</td>
</tr>
<tr>
<td>Mealy bug</td>
<td>Colony destruction by drenching with Chlorphyriphos 20 EC @ 2.5 ml/l or Application Malathion dust @ 25 kg/ha.</td>
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<tr>
<td></td>
<td>Spray Carbonate (Carboxyl 50 WP @ 2500 g/ha) OR thiodicarb 75 WP @ 5.0 g/l or Profenophos 50 EC @ 5ml/l,</td>
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<tr>
<td></td>
<td>quinalphos 25 EC @5 ml/l, acephate 75 SP @ 1 g/l or Chlorphyriphos 25 EC @ 3 ml/l) 1-3 times as per need in</td>
</tr>
<tr>
<td></td>
<td>rotation.</td>
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<tr>
<td>Mite pests</td>
<td>Fenpyroximate 5 SC @ 25 g a.i./ha or Dicofol, Abamectin or wettable sulphur.</td>
</tr>
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<td>Recommended Insecticides for management</td>
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<td>----------------------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>LEPIDOPTERAN INSECT PESTS</strong></td>
<td></td>
</tr>
<tr>
<td>Bollworms</td>
<td>Profenophos 50 EC @ 2.0 ml/l OR Thiodicarb 75 WP @ 1.0 g/l OR Methomyl 40 SP @ 0.6 g/l (ovicidal spray) Indoxacarb 14.5 SC @ 0.5 ml/l OR Spinosad 45 SC @ 0.2 ml/l OR Emamectin benzoate 5 SG @ 0.25 g/l OR Chlorantraniliprole @ 0.2ml/l OR Fludendiamide 20 SG 0.2g/l</td>
</tr>
<tr>
<td>Pink bollworm</td>
<td>Lamdacyhalothrin @ 0.5 ml/l or Decamethrin 2.8 EC @ 0.5 ml/l or Cypermethrin 10 EC @ 0.5 ml or Profenophos 50 EC @ 2 ml/l or Thiodicarb 75 WP @ 1 g/l</td>
</tr>
<tr>
<td>Tobacco caterpillar</td>
<td>Lufenuron or Novaluron @ 1 ml/l Prepared with rice bran 12.5 kg, jaggery 1.25 kg, carbaryl 50 % WP 1.25 kg, and water 7.5 lit.</td>
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<tr>
<td>Cotton leaf roller</td>
<td>Quinalphos or Cypermethrin</td>
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</table>
Management of pink bollworm

Field sanitation:

• Remove unopened/partially opened bolls from cotton stalks and the ones fallen on the ground and destroy by burying them.

• Stalks without dried bolls can be stored for fuel purpose.

• Termination of the cotton, crop should be available for pest during February to may.

• Summer deep-ploughing to expose pupae and diapaused larvae of PBW.
• Plough the field to destroy the resting stage of PBW and pupae of all bollworms.

• Plant the non-Bt cotton “Refuge” seeds along with Bt seeds

• Gin sanitation:
  – Destroy PBW damaged seed trash by burying them in pits. PBW damaged seed lot should never be left in the open.
  – Install 4 pheromone traps to trap the emerging male moths.
• Scout the Bt cotton crop every week and determine if ETL has been reached by
  – Counting moths in the pheromone traps, or
  – Examining 60 flowers across the whole field, or
  – Cutting open 20 randomly collected mature bolls and counting the live PBW larvae.

• ETL has reached if you find
  (i) 8 moths every day for 3 successive days
  (ii) 2 or more live PBW larvae in 20 bolls. Take the decision to spray an effective insecticide if ETL has been crossed.
• Farmers in hot spot areas of PBW should opt for **early maturing Bt cotton** hybrids for cultivation.

• PBW pheromone traps @ 30 per ha

• **Recommended Insecticides:**
  Lamdacyhalothrin @ 0.5 ml/l or
  Decamethrin 2.8 EC @ 0.5 ml/l or
  Cypermethrin 10 EC @ 0.5 ml/l or
  Profenophos 50 EC @ 2 ml/l or
  Thiodicarb 75 WP @ 1 g/l