
INTEGRATED PEST
MANAGEMENT IN COTTON

Economic Threshold levels (ETLs)

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

*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**

Jassids	**Bikaneri Nerma, ABH-466, H-777, G.cot-12. G-cot-10, RS-875, RST-9, F-5-5, Fateh, RS-2063**
White fly	**Supriya, Kanchana, LK-861, RS-875, RS-2013,**
Bollworms	**LH-900, F-414, Abadita, RS-2013**
Leaf curl virus	**All desi cottons, RS-875, RS-810, RS-2013, LHH-144, LRA-5166, lRK-516, Gk-515**

Cultural Practices:

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

***Helicoverpa* & *Earias*:**	**Greengram, blackgram, soybean, castor, sorghum**
White fly:	**Sorghum, ragi, maize**

- **Removal and destruction of alternate weed hosts**

***Helicoverpa*:**	***Logascae mollis***
White fly:	***Abutilon indicum*, *Chrozophore*, *Rottlari*, *Solanum nigrum***
Mealy bug:	**Congress grass, Hibiscus, okra, custard apple, guava**

- **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* @ 10,000eggs 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 *Ha*NPV @ 250 and *Sl*NPV @ 250-500 LE /ha.**

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

- **Spray *V. lecanii* (2 x 10^8 CFU/gm (10gm/l)) and *Beayveria bassiana* (Potency 10^8 spores/ml) during high humid days.**
- **Releases of the predatory mite, *Neosellus (Amblyseius) barberi* (Phytoseiidae) (Mite pests).**
- **ULV spray of NPV at 3 x 10^{12} POB /ha with 10% cotton seed kernel extract, 10% crude sugar, 0.1% each of Tinopal and Teepol for effective control of *Helicoverpa*.**

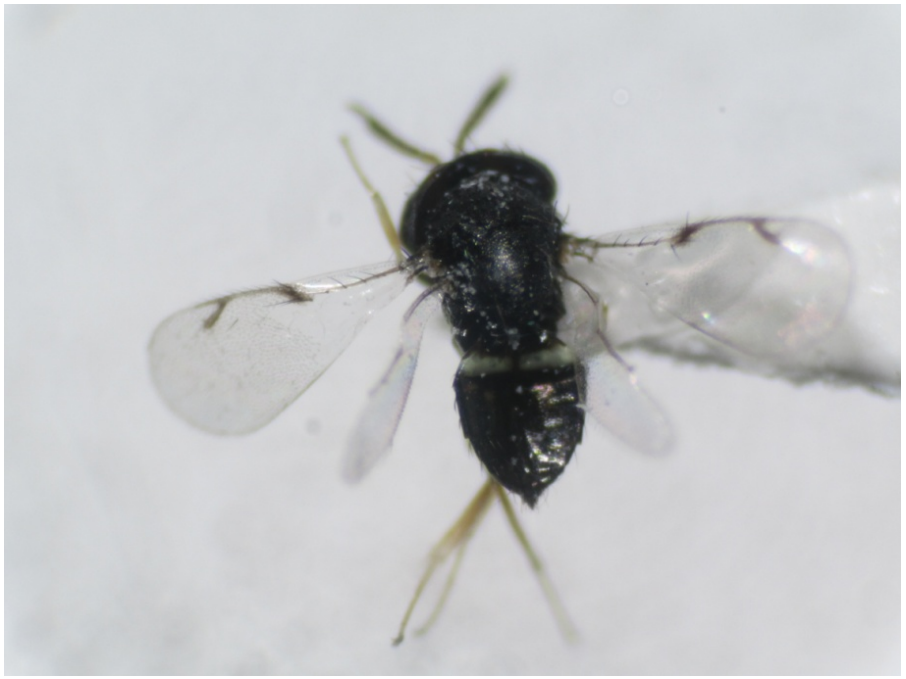
Parasitoid associated with whiteflies

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

Insect pests	Recommended Insecticides for management
SUCKING PESTS	
Thrips	**Seed treatment: Imidacloprid and Thiamethoxam @ 5g/kg.** **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**
Leafhoppers	
Aphids	
Whitefly	**Triazophos 40 EC @ 1.5 ml/l or Acetamiprid 20 SP @ 30-40 g/ha**
Red cotton bug	**Profenophos 50 EC @ 2 ml/l**
Dusky cotton bug	**Spray Profenophos 50 EC @ 2 ml/l or Chlorpyriphos 20 EC @ 2 ml/l or Acephate @ 1g/l**

Chemical control

Insect pests	Recommended Insecticides for management
SUCKING PESTS	
Flower midge	Imidacloprid 17.8 SL or Acephate 75 SP or Profenophos 50 EC @ 2ml/l + DDVP @ 0.25 ml/l Neem oil
Mirid bug	Fipronil 5 SC @1ml OR Acephate 75 SP @ 1g OR Profenophos 50 EC @ 2 ml OR Indoxacarb 14.5 SC @ 0.5 ml OR Imidacloprid 17.8 SL @ 0.3 ml per lit of water
Mealy bug	Colony destruction by drenching with Chlorphyriphos 20 EC @ 2.5 ml/l or Application Malathion dust @ 25 kg/ha. Spray Carbonate (Carboxyl 50 WP @ 2500 g/ha) OR thiodicarb 75 WP @ 5.0 g/l or Profenophos 50 EC @ 5ml/l, 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 rotation.
Mite pests	Fenpyroximate 5 SC @ 25 g a.i./ha or Dicofol, Abamectin or wettable sulphur.

Insect pests	Recommended Insecticides for management
LEPIDOPTERAN INSECT PESTS	
Bollworms	**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**
Pink bollworm	**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**
Tobacco caterpillar	**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.**
Cotton leaf roller	**Quinalphos or Cypermethrin**

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 0r 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 or

  Profenophos 50 EC @ 2 ml/l or

  Thiodicarb 75 WP @ 1 g/l