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# **I**ntegrated **P**est **M**anagement Practice for Cotton



**IPM Package No. 25**

**Source: Ministry of Agriculture, Department of Agriculture & Cooperation, Directorate of Plant Protection, Quarantine & Storage, Government of India, 2003-04**

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## **IPM PACKAGE FOR COTTONS**

### **I. MAJOR PESTS**

#### **A. Pests of National Significance**

##### **1. Insect Pests**

- 1.1 American bollworm – (*Helicoverpa armigera*)
- 1.2 Whitefly (*Bemisia tabaci*) – Vector for CLCuV
- 1.3 Jassid (*Amrasca bigutella bigutella*)
- 1.4 Tobacco caterpillar ( *Spodoptera litura* )
- 1.5 Spotted bollworm ( *Earias vittella* )
- 1.6 Thrips (*Thrips tabaci*)
- 1.7 Pink bollworm ( *Pectinophora gossypiella* )

##### **2. Diseases**

- 2.1 Cotton Leaf Curl Virus (CLCuV)
- 2.2 Blackarm / Angular leaf spot ( *Xanthomonas campestris p.v. malvacearum* )
- 2.3 Fusarium wilt ( *Fusarium oxysporum f.sp vasinfectum* )
- 2.4 Root rot ( *Rhizoctonia spp* )

##### **3. Weeds**

###### **Monocots**

- 3.1 Burmuda grass (*Cynodon dactylon*)
- 3.2 Barnyard grass (*Echinochloa spp*)
- 3.3 Cowfoot grass (*Dactyloctenium aegyptium*)
- 3.4 Signal grass (*Brachiaria spp*)
- 3.5 Torpedo grass (*Panicum spp*)
- 3.6 Purple nut sedge (*Cyperus rotundus*)

###### **Dicots**

- 3.7 Coclebur (*Xanthium strumarium*)
- 3.8 Wild jute (*Corchorus spp*)
- 3.9 Cox comb (*Celosia argentea*)
- 3.10 Carpet weed (*Trianthema spp.*)
- 3.11 Purselane (*Portulaca oleracea*)
- 3.12 Netamundia (*Tridax procumbens*)
- 3.13 Field bind weed (*Convolvulus arvensis*)

- 3.14 Velvet leaf (*Abutilon sp.*)
- 3.15 Sida (*Sida sp.*)
- 3.16 Spurge (*Euphorbia spp.*)

## **B. Pests of Regional Significance**

### **1. Insect Pests**

- 1.1 Termites (*Odentotermes obesus*) - Haryana , Punjab, M.P, Gujarat and Rajasthan
- 1.2 Aphid (*Aphis gossypii*) A.P., Karnataka, Tamil Nadu, Maharashtra  
M.P., Gujarat
- 1.3 Spinny Bollworm (*Earias insulana*) - Punjab, Haryana, Rajasthan, Maharashtra
- 1.4 Shoot weevil (*Alcidodea affaber*) - Tamil Nadu , Karnataka , Gujarat
- 1.5 Stem Weevil (*Pemphras stimis*) - Tamil Nadu

### **2. Diseases**

- 2.1 Grey mildew - T.N., Maharashtra, M.P., Gujarat
- 2.2 Alternaria leaf spot - Punjab, Haryana, A.P., Karnataka
- 2.3 Verticillium wilt (*Verticillium dahliae*) - A.P., Karnataka and Tamil Nadu.

### **3. Nematodes**

- 3.1 Reniform Nematode ( *Rotylenchulus reniformis* ) – Haryana, Punjab, Rajasthan,  
Gujarat , M.P., & Maharashtra.

## **II PESTS MONITORING**

### **A. Agro Eco system Analysis ( AESA )**

AESA is an approach, which can be gainfully employed by extension functionaries and farmers to analyze field situations with regard to pests, defenders, soil conditions, plant health, the influence of climatic factors and their interrelationship for growing healthy crop. Such a critical analysis of the field situations will help in taking appropriate decision on management practices. The basic components of AESA are:-

- 1. Plant health at different stages.
- 2. Built – in – compensation abilities of the plants.
- 3. Pest and defender population dynamics.
- 4. Soil conditions.
- 5. Climatic factors.

## **B. Survey / Field Scouting**

The objective of surveys through roving surveys is to monitor the initial development of pests and diseases in endemic areas. Therefore, in the beginning of crop season survey routes based upon the endemic areas are required to be identified to undertake roving surveys. Based upon the results of the roving surveys, the State extension functionaries have to concentrate for greater effort at Block and village levels as well as through farmers to initiate field scouting. Therefore, for field scouting farmers should be mobilized to observe the pest and disease occurrence at the intervals as stipulated hereunder. The plant protection measures are required to be taken only when pests and disease cross ETL as per result of field scouting.

➤ **Roving survey** :- Undertake roving survey at every 10 km distance initially at weekly intervals and thereafter at 10 days intervals (depending upon pest population). Record incidence of bollworms on all host crops of the locality. Observe at each spot diagonally criss cross 20 plants/acre at random. Record the population potential of different biocontrol fauna. Record the major disease and their intensity.

➤ **Field scouting** :- Field scouting for pests and biocontrol fauna by extension agencies and farmers once in 3 – 5 days should be undertaken to workout ETL. For sucking pests, population should be counted on three leaves (top & middle portion) per plant. For whitefly, third and seventh leaves from the top of the plant should be observed for nymphs and adults. For bollworm eggs terminal leaves should be observed. Observe larvae on fruiting bodies and leaves per plant. For percent bollworm incidence count total and affected fruiting bodies on the plant and also in the shed material and work out the percent infestation.

The State Departments of Agriculture should make all possible efforts by using different media, mode and publicity to inform the farmers for field scouting in the specific crop areas having indication of pest or disease build up.

## **C. Pest Monitoring through Pheromones / Yellow Pan / Sticky Traps etc.**

Certain pests require positioning of various kinds of traps like pheromones, yellow pan, sticky traps to monitor the initial pest build up. Therefore, the State Department of Agriculture is to initiate action for positioning of different kinds of traps based upon the results of roving surveys at the strategic location at village level. While the concept needs to be popularized amongst farming community, the State Department of Agriculture is to

take greater initiatives for pest monitoring through specific pheromone trapping methods as per following details.

**Pheromone trap – monitoring** :- Use pheromone traps for monitoring of American bollworm, spotted bollworms, pink bollworm and Spodoptera. Install pheromone traps at a distance of 50 m @ five traps per ha. for each insect pest. Use specific lures for each insect pest species and change it after every 15 – 20 days. Trapped moths should be removed daily. ETL for pink bollworm is 8 moths per days per trap consecutively for 3 days. ETL for American bollworm is 4 – 5 moth per day per trap.

**Yellow pan / sticky traps** :- Set up yellow pan / sticky traps for monitoring whitefly @ 25 yellow pans / sticky traps per ha. Locally available empty yellow palmoline tins coated with grease / vasline / castor oil on outer surface may also be used.

#### **D. Economic Threshold Levels ( ETLs )**

Based upon the result of survey / field scouting etc., the extension functionaries are to determine the ETLs for different pests to advice farmers to initiate pest management practices accordingly. The ETLs for major pests are as under :-

<b>Insect pest</b>	<b>ETL</b>
1. American & Spotted bollworm	5 % damaged fruiting bodies or 1 larva per plant or total 3 damaged square / plant taken from 20 plants selected at random for counting.
2. Pink bollworm	8 moths / trap per day for 3 consecutive days or 10 % infested flowers or bolls with live larvae.
3. Spodoptera	1 egg mass or skeletized leaf / 10 plant.
4. Jassids *	2 jassids or nymphs per leaf or appearance of second grade jassid injury. (yellowing in the margins of the leaves )
5. Whitefly *	5 – 10 nymphs or adults 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

#### **E. Insecticide Resistance Management ( IRM ) of Helicoverpa**

For the last few years, incidences of insecticide resistance in Helicoverpa have been reported on important crops like cotton and pigeon pea in some parts of the country. Extension functionaries should get in touch with the experts of respective State Agricultural Universities for mapping such areas. Wherever the scientific input is available about occurrence of

insecticide resistance in Helicoverpa the areas should be very clearly demarcated. During the course of surveys and also in advising farmers about Helicoverpa management strategies, utmost care need to be taken “NOT TO ADVOCATE” the pesticide for which resistance has been reported in specific areas. Most of the cases of such resistance have been recorded from Andhra Pradesh, Tamil Nadu, Haryana and Punjab against synthetic pyrethroids, especially Cypermethrin. The best – bet Insecticide Resistance Management (IRM) window strategy for cotton pests including Helicoverpa is given in Annexure – IV.

## **II. INTEGRATED PEST MANAGEMENT STRATEGIES**

### **A. Cultural Practices**

- Summer deep ploughing to expose soil inhabiting / resting stages of insects, pathogen and nematode population.
- Growing cotton after cotton should be avoided. Adopt proper crop rotation.
- Select healthy seeds of resistant / tolerant varieties ( Annexure – II )
- Only certified seeds should be used.
- Acid delinting treatment should be followed before sowing @ one litre commercial sulphuric acid for 10 kg. seeds.
- Seed treatment to control soil and seed borne diseases should be followed. Trichoderma spp. @ 4 g / kg . or Captan 3 g / kg of seed or carbendazim 2 g / kg seed. In North Zone dipping of seeds in streptomycin 0.01 % in black arm endemic areas is recommended.
- Seed treatment with imidachloprid 70 WS \* @ 5 g / kg of seed in case of non – hybrid variety and 10 g / kg in case of hybrid or Thiomethoxam 5 g / kg seed or carbofuran 25 DS @ 50 gms / kg of seeds for early sucking pests. After insecticide seed treatment Trichoderma or fungicide treatment can be undertaken.
- Sowing should be done timely within 10 to 15 days in a village or block in the season. Early sowing in Northern region sowing should be completed by first week of May.
- Adopt proper spacing, irrigation and fertilizer management. Avoid application of high nitrogenous fertilizers to boost the crop. Use neem cake with oil content @ 5 quintal / ha in termite / nematode infested fields.
- The crop should be maintained weed free for at least 8 – 9 weeks after sowing till canopy starts closing in by timely inter – culture. A hoeing in between crop rows is to be given 18 – 20 days after emergence of cotton seedlings to control primary perennial weeds.
- Remove and destroy weeds as alternate hosts viz. Sida sp., Abutilon sp., Logascae mollis and other malvaceous plants in the cultivated area.

- The following inter – cropping system is recommended for Central and South Zone to colonize the bioagents fauna such as lady bird beetles, chrysopa and syrphid flies :
  - Cotton + Cowpea,
  - Cotton + Soybean.
  - Cotton + Groundnut
  - Cotton + Pulses ( Green gram / Black gram )
- Use of trap crops like okra, Canabinus, castor, marigold (Tagets), early Pigeon pea, coriander, jowar, maize crops is recommended. Insects feeding on these crops must be removed and destroyed.
- Do not extend the normal crop period and avoid rationings.
- Grazing by animals after last picking is recommended for checking the carry over population of bollworms.
- Remove and make use of crop residues after last picking as FYM or in Paper Industry.
- Staking the cotton stalks near the field should be avoided. Destroy opened bolls on the plant.
- Crushing of cotton seeds should be completed by early April in North Zone. Otherwise fumigate the seeds by the end of May under expert supervision.
- Clean the gin thrashers for checking of carry over population of pink bollworm. Install pink bollworm pheromone traps in the premises of ginning factories to trap emerging pink bollworm moths.

## **B. Mechanical Practices**

- Hand picking and destruction of various insect stages, affected plant parts and rosetted flowers.
- Clipping of terminal shoots on 90 – 110 days of crop growth depending upon cultivars.

## **C. Biocontrol Practices**

### **1. Seed treatment :**

- Seed treatment with Trichoderma spp. @ 4 gm per kg. of seed after acid delinting for soil and seed borne diseases.

### **2. Conservation :**

- Conservation of predators (lacewings, lady bird beetles, staphy linids, predatory wasps, surface bugs like Geocoris, Anthocorid, Nabids, Reduviids, Spiders, parasitoids like Apanteles, Bracon, Rogas, Agathis, Campoletis, Eriborus,

- Trichogramma, Telenomus by growing two rows of maize / sorghum or cowpea along the border
- Collection of Spodoptera egg masses and putting them in perforated cage.
  - Install 8 – 10 bird perches per ha. for the benefit of predatory birds after 90 days of crop growth like black drongo, king crow, orange Myna and Blue jay.

### 3. Augmentation :

- Monitor the incidence of sucking pests and release eggs or first instar larvae of Chrysoperla @ 10,000 eggs / grubs / ha. Observe the incidence of bollworms either by visual observation or by using pheromone @ 5 traps/ha. specific for each bollworm species. Release Trichogramma chilonis (cotton strain) immediately after the appearance of bollworm eggs (when moth activity is observed) @ 1,50,000/ - ha / week (2–3 releases) 40 – 50 days after sowing. Avoid spraying with insecticides for at least one week before and after the release of biocontrol agents.
- Apply Spodoptera NPV 250 – 500 LE/ha (1LE = 2X10 POBs) (1LE /lit of water) on observing 1st Instar larvae. HNPV @ 250 LE can be applied in the early infestation of Helicoverpa. However, HNPV is found to be more effective in Ravi hosts and its application on rabi crop is advisable to minimize the carry over population.
- Entomopathogenic fungi such as *Metarhizium anisopliae*, *Beauveria bassiana* and *Nomurea rileyi* can be used against *Helicoverpa*.

### D. Chemical Control Measures

- Need based, judicious and safe application of pesticides are the most vital tripartite segments of chemical control measures under the ambit of IPM. It involves developed IPM skills to play safe with environment by proper crop health monitoring, observing ETL and conserving natural biocontrol potential before deciding in favour of use of chemical pesticides as last resort. Therefore, it is necessary to rely upon pesticides as per the list in Annexure – II.

Following suggestions have important bearings for the success of control measures in the context of IPM strategy:

- Avoid mixing of two or more insecticides / tank mixing.
- Repeated application of same insecticide should be avoided.
- Avoid using insecticides such as pyrethroids which result in resurgence of sucking pests.
- Use neem based formulations.
- Use selective insecticides (Endosulfan) during early fruiting phase of crop growth.
- Alternate with various chemical groups (Cyclodine, Organophosphates, Carbamates, Pyrethroids and insect growth regulator).



- Pyrethroids usage should be restricted to twice (1-2) in the cropping period depending on the incidence of spotted and pink bollworms.
- Proper spray equipments should be used :
  1. Knapsack sprayer in the early stage of crop growth. Tractor mounted sprayers are recommended in the North Zone in early vegetative and fruiting phase of crop.
  2. Power sprayer in the later stages of crop growth.
  3. Discourage using undescriptive and inefficient sprayers and also CDA sprayers.
- Use proper spray volume for unit area :

#### **E. Cotton Leaf Curl Virus Disease Management**

- Cultivation of susceptible varieties in the established endemic area should be immediately discouraged.
- Quarantine measures must be implemented to restrict movement of diseased plants and its parts.
- Removal of weeds, which are alternate host of *B. tabaci* from the fields.
- Avoid growing bhindi, cucurbitaceous, solanaceous and other alternate host crops in cotton growing tracts.
- Avoid growing cotton crop near citrus orchards. Grow resistant varieties near orchards.
- Select any of the following resistant varieties such as RS – 875, LHH – 144, RS – 810, RS 2013, F – 1861, H – 1098, Ankur – 651 and whitegold. All desi cotton varieties are resistant to leaf curl virus. Grow desi cotton varieties in the host spot / endemic areas.
- Excessive use of nitrogenous fertilizers should be avoided.
- Use yellow traps for mass trapping of whitefly populations.
- Following insecticides may be used to manage the whitefly populations.
  1. Seed treatment as given in the Annexure – II
  2. Acetamiprid 30 – 40 gram a.i. / ha ; Thiomethoxam 25 gram a.i / ha
  3. Imidachloprid 25 gram ai / ha.
  4. NHKE 5 % or Neem formulation ( 1500 ppm ) 2.5 lit / ha.
  5. Triazophos 40 EC 1.5 litre / ha.
- Avoid use of synthetic pyrethroids when whitefly population exists.
- While spraying, ensure thorough coverage of the lower surface of cotton leaves for effective control of whitefly.

## F. Weed Management practices :

### Preventive Measures

- Summer deep ploughing during May / June to expose and destroy the underground vegetative parts of the deep rooted perennial weeds. The field should be kept exposed to sun at least for 2 – 3 weeks.
- Follow recommended agronomic practices for land preparation, stubble management, seed rate, sowing time, fertilizer and irrigation management etc. so as to have a desirable crop stand.
- The crop should be maintained weed free initially for 8 – 9 weeks after sowing by resorting timely inter – culture and hand weedings.

### Control Measures

- Smoothening of weeds by mulching with straw / plastic sheets etc.
- Use power of hand operated implements for maintaining crop weed free for initial 8 – 9 weeks DAS.
- Pre – emergence application of pendimethalin (0.75 to 1.25 kg a.i./ha) or alachlor ( 2.0 – 2.5 kg a.i./ha) or diuron ( 0.75 to 1.5 kg a.i./ha ) or trifluralin ( 0.96 to 1.2 kg a.i./ha) or pre – plant incorporation of fluchloralin ( 0.9 to 1.2 kg a.i./ha) control both types of weeds effectively.
- At post emergence stage (1.5 to 30 DAS ) Paraquate @ 0.3 – 0.5 lit. a.i./ha may be applied as direct spray.

## G. Nematode management practices for endemic areas :

- Deep summer ploughing to expose inhabiting nematodes.
- Remove and destroy crop residues.
- Application of neem cake.

## H. Other Precautions :

### 1. Seed Treatment

- For seed dressing, use either metal seed dresser / earthen pots or polythene bags.
- After seed treatment, do not open lid / cover of the polybag / earthen pot immediately to avoid inhalation of pesticide / fungicide.
- Do not use left over treated seeds either for human consumption or as animal feed.

## 2. Cautions during spraying

- If operator feels giddiness, uneasy, he must discontinue spraying / dusting at once.
- Operator should not spray / dust more than 4 hours at a stretch in a day.
- Operator should not take upon spray / dusting work with empty stomach.

### IPM for Bt. Cotton

- For sucking pest control seed treatment with insecticides already identified may be given
- If the hybrids are susceptible to sucking pests spray should be given on ETL.
- Spray against Spodoptera should be given as and when ETL crossed with the identified insecticides. Egg masses and gregarious larvae should be picked and destroyed.

## IV. STAGE WISE IPM PRACTICES TO BE ADOPTED AGAINST COTTON PESTS & DISEASES

S.No	Crop stage / pest	Method	Stage-wise IPM Practices
<b>1.</b>	<b><u>Pre-sowing</u></b>		
			1. Deep plough in summer. 2. Removal of alternate hosts. 3. Avoid cotton after cotton. 4. Adopt crop rotation.
<b>2.</b>	<b><u>At sowing</u></b>		
	Soil & seed borne diseases	Cultural practice	1. Select tolerant / resistant cultivars. 2. Use certified seeds.
		Chemical practices	3. Acid delinting treatment for seeds. 4. Seed treatment with fungicides. 5. Seed dipping in antibiotic in black arm endemic areas.
	Sucking pests	Cultural practice	1. Early sowing 2. Adopt recommended spacing & fertilization
		Chemical practice	1. Seed treatment with insecticides.
	Weeds	Chemical practice	1. Use pre-emergence/post emergence herbicides.
<b>3.</b>	<b><u>Vegetative growth stage (20 – 50 days)</u></b>		
	Weeds	Cultural practice	1. Gap filling and thinning. 2. Inter culture and hand weeding.
	Sucking pest	Cultural practice	1. Check population on trap crops & inter crops.
		Biological control	1. Release of Chrysoperla grubs @ 10,000/ha. 2. Spray <i>neem</i> products for whitefly.
		Chemical control	3. If pest persists spray recommended insecticides.
	Shoot borer (Earias sp.)	Mechanical control	1. Crushing of larvae in the shoots mechanically.
	Bollworms	Monitoring	1. Set pheromone traps.
	Whitefly	Monitoring	1. Fix yellow sticky traps.
	Diseases	Cultural practices	1. Remove & destroy root rot affected plants.

<b>4.</b>	<b>Early fruiting stage (50 – 80 days )</b>		
	Weeds	Mechanical practice	1. Inter culturing & hand weeding.
	Sucking pest	Cultural practice	1. Management of trap crops & inter crops.
		Biological practice	2. Release Chrysoperla @ 10,000 /ha.
	Bollworms	Monitoring	1. Use pheromone traps and change lures.
		Cultural practice	2. Management of population in trap crops.
		Biological practice	3. Release of Trichogramma @ 1.5 lac/ha.
		Mechanical practice	4. Set up bird perchers.
		Chemical practice	5. Window strategy of IRM should be followed.
	Whitefly	Monitoring	1. Use yellow sticky traps
		Biological practice	2. Use neem products.
	CLCV Disease	Mechanical practice	1. Destroy affected plants.
		Chemical practice	2. Spray recommended chemical for vector control.
<b>5.</b>	<b>Peak flowering &amp; fruiting stage (80 -120 days )</b>		
	Whitefly	Monitoring	1. Use yellow sticky traps.
		Biological practice	2. Spray neem products.
		Chemical practice	3. Spray triazophos/acephate/acetamprid.
	Bollworms	Monitoring	1. Use pheromone traps
		Mechanical practice	2. Collection & destruction of damaged floral bodies.
			3. Collection of grown up larvae under destruction.
		Biological control	4. Use Ha. NPV @ 250 – 500 LE/ha.
			5. Use neem products.
		Cultural practice	6. Removal of terminals (topping) is to be done.
		Chemical practice	7. Recommended window strategy of IRM should be followed.
	Spodoptera	Monitoring	1. Use pheromone traps.
		Mechanical practices	2. Hand collection & destruction of egg masses & early instar larvae.
		Biological practice	3. Spray Spodoptera NPV in evening hours.
		Chemical practice	4. Spray recommended insecticides.
	Whitefly		5. Adopt poison baiting technique.
		Monitoring	1. Yellow sticky traps.
		Biological practice	2. Spray neem products.
		Chemical practice	3. Spray recommended insecticides.
	CLCV disease	Mechanical practice	1. Destruction of CLCV affected plants.
		Chemical practice	2. Spray recommended insecticides for vector control.
	Black arm disease	Chemical practice	1. Spray recommended chemical (antibiotics)
<b>6.</b>	<b>Boll opening stage (120 -150 days)</b>		
	Whitefly	Monitoring	1. Use yellow sticky traps.
		Biological practice	2. Spray neem products.
	Bollworms	Chemical practice	3. Need based application of recommended insecticides.
		Cultural practice	1. Don't extend the crop period.
			2. Use monitoring device.
		Mechanical practice	3. Collection and destruction of damaged parts & grown up larvae.

		Chemical practice	4. Spray recommended insecticide alternatively using different groups with power sprayers.
	Mites	Chemical practice	1. Use recommended acaricides.
	CLCV disease	Mechanical practice	1. Destruction of CLCV infected plants.
	Black arm	Chemical practice	1. Spray recommended chemicals.
	Wilt	Chemical practice	1. Spot application of chemicals.
<b>7.</b>	<b>After last picking of cotton</b>		
			<ol style="list-style-type: none"> <li>1. Allow grazing by animals.</li> <li>2. Remove and destroy crop residue.</li> <li>3. Avoid stacking of the cotton stalks near the fields. Destroy the opened bolls if any on the plant before stacking.</li> <li>4. Crushing of cotton seeds to be completed by April end.</li> <li>5. Fumigation of seeds may be undertaken with expert supervision.</li> <li>6. Clean the Gins thrashers to check PBW population. Install PBW traps in ginneries.</li> </ol>

## V. DO'S AND DON'TS IN COTTON PEST MANAGEMENT

Do's	Don'ts
<ul style="list-style-type: none"> <li>▪ Grow only recommended variety / hybrid.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Do not grow under script materials which vary greatly in fruiting pattern and pest susceptibility.</li> </ul>
<p><b>Agronomic Practices</b></p> <ul style="list-style-type: none"> <li>▪ Sowing time : Prefer to sow the crop from mid May for North Zone and up to 30<sup>th</sup> June for South and Central Zone.</li> <li>▪ Judicious use of fertilizers : Always use recommended NPK fertilizers in balanced proportion based on soil testing report.</li> <li>▪ Uproot and destroy the weeds like Sida sp., Abutilon indicum and Xanthium sp. Before sowing of the cotton crop to reduce the initial build up of bollworm, whitefly and CLCV disease.</li> <li>▪ Rouge the plants infested with CLCV regularly during vegetative phase.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Avoid late sowing of the crop because yields are considerably reduced in late sowings.</li> <li>▪ Avoid overuse of Nitrogen fertilizer as crop becomes more susceptible to pest and diseases.</li> <li>▪ Do not use under, over or imbalanced fertilizer application which might result in poor plant health and reduced resistance to various insect pests and diseases.</li> </ul>
<p><b>Pest Management</b></p> <ul style="list-style-type: none"> <li>▪ Regular Surveillance : Ensure regular scouting / monitoring for timely detection of economic threshold values which are required for need based application of control measures against different insect pests.</li> <li>▪ Selection of effective pesticides and its dosages at right stage :</li> <li>▪ Use only recommended pesticides at the recommended dosages for the control of various pests.</li> <li>▪ Spray technology : Always follow the recommended spray technology using adequate spray of material.</li> <li>▪ Use recommended pesticides</li> </ul>	<ul style="list-style-type: none"> <li>▪ Do not keep the CLCV infested plants in the field to check the further spread of the disease.</li> <li>▪ Do not go for blanket sprays without field roving.</li> <li>▪ Do not use un recommended mixtures of various insecticides in any case.</li> <li>▪ Do not use insecticide at lesser / over dosages than the recommendation All these can lead to :               <ol style="list-style-type: none"> <li>a) Chemical control failure</li> <li>b) Quick development of resistance among insect pests to various insecticides</li> <li>c) Resurgence of pests like whitefly.</li> <li>d) Induction of secondary pest problems like leaf spots.</li> <li>e) Economical waste and contamination of the environment.</li> </ol> </li> <li>▪ Do not use substandard nozzles with high discharge rate which lead to poor coverage of the target site.</li> <li>▪ Do not use those pesticides which are not recommended. The date expired pesticides should not be used.</li> <li>▪ Do not purchase insecticides without bills and this information on batch number.</li> </ul>
<p><b>Weed Management</b></p> <ul style="list-style-type: none"> <li>▪ A deep ploughing is to be done on bright sunny days during the months of</li> </ul>	<ul style="list-style-type: none"> <li>▪ Do not plough or irrigate the field after ploughing, at least for 2-3 weeks to allow</li> </ul>

<p>May or June. The field should be kept exposed to sun light at least for 2 – 3 weeks.</p> <ul style="list-style-type: none"> <li>▪ Maintain optimum and healthy crop stand which would be capable of competing with weeds at a critical stage of crop – weed competition.</li> <li>▪ Pre – emergence herbicides should be applied immediately after sowing before emergence of weeds and crop.</li> <li>▪ Herbicides like fluchloralin should be incorporated in to soil immediately after spraying to avoid its photodegradation.</li> <li>▪ Apply only recommended herbicides at recommended dose, proper time, appropriate spray solution with standard equipment along with flat fan or flat jet nozzles.</li> </ul>	<p>desiccation of weed's bulbs / or rhizomes of perennial weeds.</p> <ul style="list-style-type: none"> <li>▪ Less seed rate of crops should not be used.</li> <li>▪ Crops should not be exposed to moisture stress at their critical growth stages.</li> <li>▪ Pre emergence herbicides should not be applied after emergences of crop and / or weeds as they will not control the germinated weeds as well as may cause phytotoxicity to the crop.</li> <li>▪ Soil incorporation of fluchloralin should not be delayed or avoided for achieving effective weed control.</li> <li>▪ Pre – emergence as well soil incorporated herbicides should not be applied in dry soils.</li> <li>▪ Herbicides should not be applied along with irrigation water or by mixing with soil, sand or urea.</li> <li>▪ The spray equipment including nozzles used for herbicides application should not be used for insecticides or fungicides application to avoid possible phytotoxicity to crop.</li> </ul>
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**RESISTANT / TOLERANT VARIETIES OF COTTON****Zone wise**

North Zone	Bikaneri Nerma, LH 900, F 414, F 505, H 777, RST– 9, LD–327, RG–8, LH –1134, LH–886, F–846, F–1054, RS–875, LRA –5166, LRK–516, LHH–144, RS–875, RS–810, RS–2013
Central Zone	Eknath, Purnima, Y -1, Malgari, Khandwa–2, Badnawar–1, G-cot –12, Jaydhar, NHH–1, NHH– 44, AKO–81, LRK 516
South Zone	MCU– 5VT, Supriya, Abhadita, LK–861

**Pest / Disease – Wise**

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
Nematode	Bikaneri Nerma, Khandwa 2
Verticillium wilt	MCU – 5T, Surabhi
Fusarium wilt	DB – 3 – 12, Ak – 145, Sanjay, Digvijaya, G.cot – 11, G.cot -13 , LD – 327, PA – 32
Bollworms	LH – 900, F – 414, Abadita, RS – 2013
Root rot	LH – 900
Leaf curl virus	All desi cottons, RS – 875, RS 810, RS 2013 LHH – 144, LRA – 5166, LRK – 516, Gk - 515



**RECOMMENDED PESTICIDES IN COTTON PEST MANAGEMENT**

	<b>Dosage (g a.i/ha )</b>	<b>Stage of Crop</b>
<b>Jassids / Aphids / Thrips</b>		
Neem products (1500 ppm )	2.5 lit / ha	Early phase of crop growth
Oxydemeton methyl 25 EC	300	Early phase of crop growth
Phoshamidon 85 WSC	200	Early phase of crop growth
Acephate 75 SP	290	Above 60 days
Monocrotophos 36 SL	350-600	Above 60 days
Acetamiprid	15	
Imidacloprid	25	
Thiomethoxam	25	
<b>Whitefly</b>		
Neem products (1500 ppm )	2.5 lit	
Triazophos 40 EC	600 – 800	
Acetamiprid	30 – 40	
Imidacloprid	25	
Thiomethoxam	25	
<b>Bollworms</b>		
Neem products ( 1500 ppm )	2.5 lit	40 – 60 day
Endosulfan 65 EC 35 EC	875 – 1050	40 – 60 day
Phosalone 65 EC 35 EC	700 – 900	40 – 60 day
Quinalphos 20 A F	500 – 700	During fruiting stages
Chlorpyriphos 20 EC	500 – 700	During fruiting stages
Profenofos 50 EC	1000 – 1250	During fruiting stages
Thiodicharb 75 SP	500	During fruiting stages
<b>Pyrethroids</b>		
Deltamethrin 2.8 EC	10 – 12.5	
Alphamethrin 10 EC	15 – 25	Above 75 days only
Cypermethrin 10 EC	40 – 60	once or twice in the
Fenvalerate 20 EC	75 – 100	cropping period
Indoxcarb	75	
Deltamethrin tablet 0.5	25 tablet / ha (12.5g a.i / ha)	
Lambdacyhalothrin 5 EC	15 g a.i / ha	
Spinosad 48 SC	50 – 75	
Trizophos 40 EC	600 – 800	
Novaluron	609 g / ha	

### Spodoptera & Others

Chlorpyrifos 20 EC	500	
Quinalphos 20 AF	500	
Diflubenzuron 50 WP	75	For early instars only
Poison bait using Monocrotophos 36 SL	250 – 500	Early & grown up larvae

### Seed Dresser

Imidacloprid 70 WS	5 – 10 g /kg of seed	Early sucking pests
Carbosulfan 20 SP	20 gm / kg of seed	Early sucking pests
Thiomethoxam 70 WS	5 g / kg	
Acetamiprid 20 SP	20 g / kg	

### Soil Insecticides

Carbofuron 3 G	750	Early sucking pests
Phorate 10 G	1000	Early sucking pests

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(+) as and when registered.

*Source: Ministry of Agriculture, Department of Agriculture & Cooperation,  
Directorate of Plant Protection, Quarantine & Storage, Government  
of India, 2003-04*

*Information Compiled by M. Sabesh, CICR, Coimbatore*