

SUSTAINABLE IPM FOR IRRIGATED COTTON

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Integrated Pest Management for Cotton

In India about 48,000 metric tons of technical grade chemical pesticides are used annually to protect crops from pests which cause losses of about 18 % of the crop yields worth more than Rs. 60000 crores annually. Insecticides constitute almost 60 % of the total pesticides used, followed by fungicides and herbicides. Among the crops, cotton, rice and horticultural crops account for more than 80% of total pesticides used. Excessive and indiscriminate use of chemical pesticides in a few crops particularly cotton has created several adverse problems such as development of pest resistance, pest resurgence, outbreak of secondary pests, destruction of beneficials & non-target organisms, environmental pollution and crop failures leading to socio-economic problems including suicides by cultivators. In the National Agricultural Policy, Government of India has laid special emphasis on Integrated Pest Management (IPM) to overcome these problems and also to minimize the dependence on chemical pesticides by encouraging use of non-chemical methods of pest management. IPM is a holistic system approach combining a wide array of crop production and protection practices to reduce the economic losses caused by the pests. It emphasizes on careful monitoring of pests, conservation of beneficial and need based critical intervention with appropriate tactics of pest management.

Most of the IPM activities emphasize heavily on the preventive measures especially before the crop is sown. Agronomic practices such as summer ploughing, cleaning of crop residue, crop rotation, water management, weed management, intercropping, trap and border cropping, nutrition management and use of pest resistant / tolerant varieties etc., are some of the major tools for significant reduction of pest incidence.

Pest scouting, assessment of ETL and regular pest monitoring programme pay rich dividends in reducing the pest control costs. Analytical interpretation of population dynamics of pests, defenders, abiotic factors and farmers' past experiences are also major tools for decision making and timing of IPM interventions to obtain maximum efficiency from pest control tactics. Various IPM interventions such as mechanical, biological, cultural, botanical and less hazardous chemical measures are applied individually or harmoniously blended to achieve maximum benefit in pest management and thereby to increase the crop yields.

Diversity of cotton cultivation has critical bearing on plant protection efforts. In India, cotton crop is grown under three distinct agro-climatic regions in North zone, Central zone and South zone varying with respect to irrigation, rainfall and soil type. All the four cultivated species of cotton are grown besides several inter and intra-specific hybrids, with no apparent systematic control over their development.



The rainfed areas of Central zone and parts of South zone (about 5.7 m.ha) are repeatedly exposed to uncertainties of monsoon pattern and farmers have little control over executing sowing, inter-cultivation and crop protection operations in ideal time. The highly intensive and remunerative irrigated North zone has turned totally ‘inorganic’ and cotton is grown round the year in the South zone and the pest problem have thus aggravated.

First major village level effort in cotton IPM was made by CICR, Coimbatore in the late seventies and practical successful IPM implementation had been experienced in the early eighties in several villages of Coimbatore region. Later on multi-location trials on IPM started in all the three zones under AICCIP programme. Various modules had been tried in different regions, and location specific IPM Module has been identified for each of the various cotton growing regions of India.

In Coimbatore district, intensive cotton cultivation is being taken up in Annur of Avinashi blocks. The farmers were not aware of improved cultivation practices including plant protection. They were in the habit of applying pesticides indiscriminately and inappropriately. Over use of pesticides is a very common practice in cotton cultivation in this region. Synthetic pyrethroids especially fenvalerate, cypermethrin and lambda-cyhalothrin were liberally applied on cotton pest control which more often created problems like resistance and resurgence resulting in crop failure. An average of 8 – 11 rounds of sprays were given for cotton during the preadoption of this region for IPM.

Adoption of IPM measures in this region of Annur and Avinashi blocks of Coimbatore District helped to manage the major pests of cotton especially sucking pests and bollworms with reduced number of sprays (58 % spray reduction) and plant protection cost Rs. 5960 to Rs. 2080 /ha over control village. Besides, there was an yield increase of 15.85 % and a net profit of Rs. 9475 /ha over control village farmers. Higher cost-benefit ratio of 1:1.9 was obtained by the project farmers as against 1:1.3 by the control village farmers.

Guidelines for IPM Programme in Cotton

Village selection

Village (or) a cluster of villages will be useful for effective implementation of IPM strategies through farmers' participation. The following criteria may also be considered while selecting the village(s).

Majority of the farmers of the village(s) growing cotton

- i. Insect pests as the major problem (or) major set back in cotton production
- ii. Excessive use of pesticides
- iii. Farmers co-operation and willingness for adoption of new and improved scientific technologies



Convening farmers group meetings

After the selection of suitable village(s), farmers group meeting will be convened to prepare the list of farmers growing cotton and this exercise has to be completed at least one month before commencement of sowing. The choice of variety/hybrid having more or less uniform duration has to be selected. Genuine certified seeds may be arranged through reliable sources. Soil samples have to be collected along with previous crop details. The collected soil samples will be sent for testing major, minor and micronutrients. Based on soil testing results nutrient recommendation for the ensuing cotton crop needs to be obtained from concerned specialists.

Two or three group meetings of farmers have to be arranged and cotton production technology with special emphasis on plant protection will be highlighted with the help of audio visual aids. The active participation of the farmers will be insisted and encouraged in the group discussions.

Adoption of improved practices

Cotton sowing will be supervised along with the farmers and improved recommended practices have to be followed. The farmers may be apprised on all recommended agronomic practices which they have to adopt in their fields. Special efforts will be taken to maintain optimum spacing so that normal crop canopy will be ensured for good pest management. Excess nutrients especially nitrogenous fertilizers and excessive irrigation are to be avoided. Manuring has to be done based on the results of soil testing.

Seed treatment

Past experiences have shown that seed treatment with systemic insecticide like imidacloprid (7 g/kg seed) or Thiamethoxam (5 g/kg of seed) has protected the crop upto 40 to 50 days against sucking pests viz., aphid and jassid. It also helped to avoid or reduce (substantially) the early season insecticide application and thus enabled to conserve the beneficials of the ecosystem. Dust formulation(s) and Broad-Spectrum insecticide(s), which are detrimental to the beneficials are totally discouraged.

Bund crop and Trap crop

Cowpea grown as "Bund Crop" in cotton fields increased the build up of coccinellid predators. Marigold or okra or pigeon pea planted as "Trap Crops" helped to divert oviposition of *Helicoverpa* from main crop to trap crop which will be monitored and the pests can be destroyed periodically. Castor as trap crop can help to detect and destroy the egg masses and early instar larvae of *Spodoptera* at the initial stage itself.



Bio-rationals in IPM

Use of bio-rationals viz., Neem product and bio-pesticides (Parasites, Predators and Pathogens) will help to sustain the natural enemies as long as possible especially during the early fruiting period. Neem seed kernel extract @ 5% or neem products at 0.5% or Pongamia oil emulsion at 0.2% act as a strong oviposition deterrent and these can be used when there is low egg load of *H. armigera*. One or two releases of *Trichogramma chilonis* @ 1.5 lakhs/ha help to reduce bollworms to a greater extent if it is synchronized on the egg population of *H. armigera* and other bollworms. Spray application of HNPV @ 500 LE/ha will help to reduce the infestation of early instar larvae of *H. armigera*. Release of *Chrysoperla carnea* @ 0.5 lakh/ha will also help to check the sucking pests and to some extent, bollworms also.

Cultural Methods of Control

Clipping of terminals "Topping" of main stem of cotton crop at 80 – 90 days of growth will reduce *Helicoverpa* oviposition on new growth and also encourage sympodial branching which bears more fruiting bodies. Hand picking and destruction of big bollworms (large sized larvae) and egg masses of *Spodoptera*, flared up squares, rosette flowers, shed floral bodies etc. during the peak fruiting phase (80 – 120 DAS) will go a long way in reducing bollworm build up to a greater extent. Setting up of bird perches @ 25/ha encourages predation by insectivorous birds.

Pest monitoring and Pest scouting

Pest Monitoring

Monitoring the activities of pests and their natural enemies is very useful for considering various options in pest management and decision making. Use of pheromone traps @ 5/ha is highly useful to monitor the moth activity of all the bollworms, so as to synchronize the pesticide application on the vulnerable stage of the pests. Use of yellow pan traps and sticky traps @ 25/ha is useful to reduce the population of migrating adult whiteflies.

Pest scouting and sample size

Economic Threshold Level (ETL) is the best known and the most widely used yardstick in making pest management decisions. Crop and pest sampling provides a direct measure of pest population and economic damage potential, besides indicating the ETL level. Sampling may be carried out in randomly selected 10% of the plants (in small plots) or 20-25 plants/ha of a farm. The infestation in shed fruiting bodies may be observed in unit area of 5 square meter replicated thrice or four times in a farm. The total number of farms in a village may be subdivided into small groups of 20-25% and each group may be effectively managed by one farmer trainer (FTr) who will be available at all the times in the village besides carrying out pest scouting along with the farmers. The fields of farmers will have to be inspected at weekly intervals regularly during the cropping season along with the farmers. Assessment on pest population and damage will be made from randomly selected plants. The assessment



of density of pests and natural enemies is useful for quantitative comparisons and also to make pest management decisions. The gathered results have to be discussed in the farmers group meetings and the spray decisions will be taken by farmers themselves with the help of project staff and farmer trainers.

ETL for need based application

Aphid	15-20 % infested plants / 10 aphids per leaf
Jassid	50 nymphs in 25 terminal leaves
Thrips	15-20 % infested plants / 10 thrips per leaf
Mite	10 per square cm
Whitefly	10 adults and / or nymphs per leaf
Spotted bollworm	10 % infested fruiting bodies
Cotton bollworm, <i>H. armigera</i>	
Egg	1 per plant
Larva	1 per 2 plants
Fruiting bodies damage	5 %
Pink bollworm	10 % infested flowers and or bolls with live larvae.

Proper method of application of insecticides

Use correct dose of right insecticide, synchronize with the weak stage of the pest (early instar larvae) and ensure uniform coverage with small spray particles of uniform size. Use of selective insecticides will be relatively safe to the natural enemies. The following spray fluid volume may be used for effective management of insect pests of cotton.

Crop Age	Quantity of Spray Fluid/ha
Upto 45 days	200-250 litres in High Volume Sprayer
46-80 Days	100-150 litres in Low Volume Sprayer
81-120 Days	180-220 litres in Low Volume Sprayer
121-165 Days	250-300 litres in Low Volume Sprayer

Alternation of various chemical groups (Cyclodine, Organophosphate, Carbamate, Insect growth regulators, Pyrethroids *etc.*) preferably based on resistance monitoring data will be useful for obtaining maximum effectiveness and also to reduce the chances of development of resistance in insects.

Suggestions to organize farmers' participatory programme on IPM for a self sustaining system in cotton

For successful implementation of the sustainable IPM it needs the compliance of the following criteria by farmers, researchers and developmental agencies.

Farmers education

Proper monitoring of cotton pests and beneficial is essential and this in turn will help to apply the right type of pesticide in right quantity in right time. This



important task can be better achieved and/or facilitated by training farmers through "Farmer trainers"/extension staff of Agricultural department/NGOs. These agencies could well be trained intensively for three to four weeks in ICAR institutes/State Agricultural Universities on various aspects of cotton cultivation in general and on IRM in particular.

Village adoption for IPM implementation

ICAR institutes/SAUs/CCI/Department of Agriculture/NGOs/Pesticide and fertilizer industry etc. can well adopt a suitable region of cotton area for two to three years and implement the IPM strategy intensively.

Pesticide dealers education and involvement

A training course on identification of pests, natural enemies, diseases, pesticide recommendation and proper application technology is the need of the hour. Hence, it should be mandatory for issuing pesticide licenses to pesticide dealers like drug inspectors for human health care. ICAR institutes and SAUs can run this type of short training courses on charge basis.

