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Integrated Pest Management in Cotton

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ARTICLE ID: 28

Abstract

Utilizing every method possible to control pest populations, integrated pest management (IPM) for cotton aims to minimise the need for pesticides while preserving crop viability, productivity, and fibre quality. IPM is a practise for enhancing environmental quality, and the effectiveness of an IPM programme is based on how environmentally friendly it is. Good integrated crop management would inevitably follow from a good IPM programme. The IPM framework is extremely flexible in terms of aims and objectives and embraces holistic thinking by continuously upgrading the technical inputs in addition to fixing the flaws in existing plant protection techniques.

Introduction

In India, cotton takes up 5% of the total cropped land that is divided among three different agro climatic zones. Cotton uses 55% of the nation's pesticides, which accounts for 40% of all production expenditures. This information illustrates how pesticide use has increased and how insect pests have an impact on cotton production.

Since the 1980s, concern over the effects of agrochemicals on human health, the environment, and insect resistance to pesticides has been a cornerstone. IPM has been in use for almost 15 years, but aside from the realization that natural controls are already in place, their conservation and augmentation, better cultural practices, the use of resistant cultivars, established monitoring and scouting based economic threshold levels (ETLs), and alternative pest control methods like matting disruption through pheromones, use of botanicals, and insect pathogens, there hasn't been much of a drop in pesticide use.

The Status of Cotton Insect Pest

The uncertain growth characteristics of the cotton crop, both directly and indirectly, provide a wider class of Insects with food and shelter. If higher cotton yields are to be attained, management of the more than 130 insect pest species that affect Indian cotton is

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necessary. Alliances between already existing insect pest species appear to both limit competition between one another and to accord with the phenology of cotton growth. Sucking pests like jassid (*Amrascabiguttulabiguttula* Ishida), aphids (*Aphis gossypii* Glover), whiteflies (*Bemisiatabaci* Gennadius), and thrips (*Thrips tabaci* Lindeman) have a negative impact on the growth and development of cotton. All of these pests have the potential to grow to dangerous proportions due to the cotton plant.

The abundance of alternative hosts, particularly the ongoing production of vegetables in addition to wild hosts, makes it easier for them to survive without cotton. While poor crop stand and yield reduction are the direct effects of sucking pests during the early season, their attack in the late season (particularly from aphids and whiteflies) indirectly lowers the quality of cotton fiber due to honey dew deposits on lint. Whiteflies also spread the sickness caused by the leaf curl virus in addition to lint contamination.

Damage from the*Earias*, *Helicoverpa*, and*Pectinophora* bollworm complex, which consists of three bollworm taxa, is incurred on the reproductive period of cotton crop growth. Two species of the former genera, *E.insulana (Boisd) and E.vittella* (F), and one species of the last two genera, *H.armigera* (Hubner) and *P.gossypiella*, are associated with cotton (Saunders). *Malvales* are the primary alternate host plants of *Earias* and*Pectinophora*, whereas*Helicoverpa* is polyphagous and has emerged as a significant cotton bollworm due to the increased intensity of attack in virtually all cotton-growing regions of the nation. Lepidopterans, particularly the semilooper *Anomis flava* (Fabricius), *Spodoptera litura* (Fabricius), and leaf roller *Syllepte derogate* (Fabricius), are significant leaf feeders, however grasshoppers and ash weevils also eat or notch off the leaves.

Major Insect Pests of Cotton and Their Damage Symptoms

S.No	Insect Pest	Scientific Name	Damage Symptoms
1	Jassids	*Amrascabigutullabigutulla*	Downward curling of leaves, yellowing and hopper burn symptoms
2	Aphids	*Aphis gossypi*	Downward curling of leaves and sticky bolls due to honey dew deposition

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3	Whiteflies	*Bemisia tabaci*	Distorted and wrinkled leaves with shiny white patches
4	Spotted and spiny bollworm	*Eariasvitellla and Eariasinsulana*	Boremark in the main shoot, feeding holes in floral buds and bolls blocked by excrement
5	American bollworm	*Helicoverpaarmigera*	Little webbing on squares, squares flare up, excessive shedding of bolls and buds.
6	Pink bollworm	*Pectinophoragossypiella*	Rosseted bolls with inter loci movement
7	Semi looper	*Anomis flava*	Significant loss of leaf area

Current Practices in IPM of Cotton

Cotton pest management strategies must deal with a complex of pests, so the choice of insecticides and other tactics will be determined by the pests in question and their relative importance as members of the complex. Sucking pests during the early stages of crop growth and bollworms during the mid and late seasons are the most important pests to control for good cotton crop production. IPM is a necessary component of a sustainable cotton production system that consists of two essential elements. The first consists of a series of measures that aid in keeping insect pests below economic threshold levels (ETL). Natural control agents, host plant resistance, manipulation of agronomic factors such as rotations, spacings, time of sowing, and fertilizer applications, in addition to biological control and botanical use, are examples of such control methods.

Natural Control

Chilomenessexmaculatus (Fab.) and *Chrysoperlacarnea* (Steph.) are two naturally occurring native predators that provide significant control of early season sucking pests. In the presence of coccinellids and chrysopids, a predatory prey ratio of 1.5 for jassids and 0.1 for aphids was found to be optimal for natural control. Because the use of broad-spectrum insecticides such as organophosphorus components for sucking pest control eliminates these natural enemies, a strategy of using sucking pest tolerant genotypes in combination with natural enemy exploitation is advocated.

Resistance of Host Plants

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Cotton's insect resistance is relative. Cotton cultivar differences can thus be used to growers' advantage. The most valuable contribution of host plant resistance is pest avoidance or escape by early maturing and rapid fruiting cultivars. Jassid resistance is achieved by using hairy cultivars (e.g., PKV 081, NHH 44, PKV Hy2, etc.). Glabrous plant types are resistant to aphids, whiteflies, and *Helicoverpa*; fregobract plants are resistant to *Helicoverpa* and pink bollworm.

Cultural Control

Cotton stubbles should be removed and destroyed as soon as possible, followed by deep ploughing to expose the carry-over population of bollworms, crop rotation with cereals or pulses, and early sowing of cotton on ridges and furrows. The best times to plant in each zone are as follows: northern zone-mid May; central zone-15th to 25th May (irrigated), 25th June-8th July (rainfed); southern zone-August. For effective pest management, varieties and hybrids should be spaced at least 60 x 30 cm and 90 x 60 cm, respectively.

Biological Management

The use of mass-produced bio agents is widely regarded as a supplement to IPM aimed at reducing over-reliance on insecticides and their negative consequences. Trichogrammachilonis @ 1,50,000 six times starting after six weeks of germination at weekly intervals supplemented with two to three releases Braconbrevicornis @ 15000 starting after second release of T.chilonis against spotted bollworm, continuing weekly releases of T.chilonis against pink bollworm, and release of T.chilonis Bio C1 or C3 @ 1,50,000 six to eight times after 60 days of germination.

Botanical management

Antifeedent / deterrent properties of neem seed kernel extract at 5%, neem formulations at 21/ha, and neem or karanj oil at 1% are recommended against sucking pests and bollworms. All botanicals serve similar functions as bio control agents in terms of conservation of native as well as augmented bio agents and reduction in insecticide use in relation to pest population selection pressure. Their high photo instability, suspect quality, and inconsistent pest control efficiency are serious issues that require research and demonstration before they can be used as an effective component of IPM.

Chemical control

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In areas where H.armigera is a major pest with resistance, strategies for efficient insecticide use are imposed, with a strong emphasis on insecticide resistance management, in addition to IPM technologies involving other methods of control. Growing sucking pest tolerant genotypes to allow for no spray situation up to 60 days followed by endosulfan against H.armigera populations is recommended when resistance levels are lower (i.e., up to 90 days after sowing). Later, the recommended insecticide sequence includes biorationals such as HaNPV, Bt, and neem. Based on economic thresholds of insect pests, organophosphorus insecticides and pyrethroids are recommended at 80-90, 90-110, and 110-130 days of crop growth. As a result, insecticide use is restricted to windows associated with crop development stages.

Conclusion

The history of cotton production will be difficult to integrate. The impact of IPM programmes varies due to regional, time, and crop type heterogeneity. While IPM can be successful when applied over a large area, Indian farm holdings are fragmented, making it difficult to measure the benefits of IPM. The success of IPM is also dependent on research programmes. IPM practices currently in use include making control decisions based on ETL of single pests. However, in order to address multiple pest problems and benefit from computer decision models through quantification of pest interactions, estimation of ETLs for concurrent multiple pests is required and holds promise for the future. Also increasing understanding of the biology and population dynamics of the pests and beneficials, improves our ability to introduce preventive measures to keep pests below damage thresholds- but this work proceeds at a much slower pace than development of control techniques. Pest management options should be arrived in consonance with weed and alternate hosts of pests, in addition to climatic factors. Further, forewarning systems are a must for effective decision making in pest management. With improved information technologies, regional advisory services should gear up to guide farmers for situations ranging from “spray or no spray” to “grow or don’t grow cotton” decisions.

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