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A Greener Path to Chilli Protection: Sustainable Pest Management for Better Yields

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Chilli (*Capsicum annuum* L.) is one of the most important spice and vegetable crops cultivated in India. It is valued for its pungency, colour, flavour and nutritional properties. Fresh green chillies are widely used in daily cooking, while dried red chillies are an essential ingredient in the spice industry. Chilli also provides income and employment to farmers, traders and processors. However, chilli cultivation is often affected by insect pests and mites that damage leaves, flowers, tender shoots and fruits. Severe pest infestation can reduce plant growth, fruit quality and marketable yield. Repeated and indiscriminate pesticide applications may increase production costs, leave undesirable residues, harm beneficial insects and contribute to pesticide resistance. The solution lies in adopting Biointensive Integrated Pest Management (BIPM)—an approach that combines preventive, cultural, mechanical, biological and need-based chemical methods to keep pest populations below damaging levels. The objective is not to eliminate every insect from the field, but to protect the crop while conserving beneficial organisms and maintaining environmental health.

Major Pests of Chilli

1. Tobacco Caterpillar: A Leaf-Eating Menace:

The tobacco caterpillar (*Spodoptera litura*) is a destructive pest that feeds on chilli foliage. Young larvae usually feed together, scraping the leaf surface and leaving a characteristic skeleton-like appearance. As they grow, the caterpillars spread and consume larger portions of the leaves. Severe infestations can cause extensive defoliation and weaken plants.

Management Practices

a. Deep plough the field during summer to expose pupae and other soil-dwelling stages to predators and environmental conditions.
b. Regularly inspect the crop, particularly the undersides of leaves, for egg masses and young larvae. Collect and destroy infested leaves and caterpillars where practical.
c. Install pheromone traps at locally recommended densities to monitor adult moth activity and support timely management decisions.
d. Use suitable trap crops, such as castor, where locally recommended, and inspect them frequently for caterpillars.
e. Encourage natural enemies and use registered biological products, such as *Bacillus thuringiensis* or suitable nucleopolyhedrovirus (NPV) formulations, when recommended for the target pest and crop stage.
f. If infestation reaches a damaging level, use only a currently registered insecticide recommended for chilli and the target pest.

Early intervention is especially important because young larvae are generally easier to manage than larger, widely dispersed caterpillars.

2. Fruit Borer: Protecting the Marketable Harvest

The fruit borer, *Helicoverpa armigera*, attacks flowers and developing fruits. Caterpillars may feed on buds, flowers and fruits, leaving holes and internal feeding damage. Damaged fruits become unmarketable and may be vulnerable to secondary infections.

Management Practices

a. Monitor the crop regularly for eggs, young larvae and damaged fruits.
b. Remove and destroy infested fruits and caterpillars whenever feasible.
c. Use pheromone traps to monitor moth activity and help determine the need for further intervention.
d. Grow suitable trap crops, such as marigold, where recommended for the local cropping system, and monitor them for pest activity.
e. Conserve natural enemies, including parasitoids and predatory insects, by avoiding unnecessary broad-spectrum insecticide applications.
f. Consider registered microbial products, including suitable *B. thuringiensis* formulations, when appropriate for the pest's early larval stages.
g. Apply chemical control only when necessary and according to current agricultural recommendations.

Regular monitoring and timely removal of infested fruits can help prevent the pest from building up in the field.

3. Cutworm: A Threat to Young Plants

Agrotis ipsilon is a polyphagous pest that feeds on a wide range of host plants, particularly solanaceous crops, and can cause severe damage under favourable conditions. The adult moths are nocturnal and cosmopolitan in distribution, occurring widely across Asia and North America. The larval stage is responsible for crop damage. Early instars feed on tender leaves, creating holes in the foliage. Later instars cut young seedlings at night, causing them to wilt and lose vigour. During subsequent stages of plant growth, the larvae may also bore into plant tissues, causing further damage. The larvae remain concealed during the day and emerge at night to feed. Typical symptoms of infestation include holes and tunnels in shoots, as well as cut leaves and seedlings. The pest remains active from March to September in tropical regions and from March to October in subtropical and temperate regions. Its population generally peaks in May. In tropical regions, pest incidence begins to decline during September and October.

Management Practices

a. Prepare the field properly and remove weeds and crop residues that may shelter the pest.
b. Plough the field before planting, where appropriate, to expose soil-dwelling stages.
c. Inspect the soil around damaged seedlings, especially in the evening or early morning, and collect caterpillars when found.
d. Avoid excessive weed growth around the crop and maintain field sanitation.
e. Where cutworm damage is confirmed, follow locally recommended, registered control measures.
f. Protecting chilli plants during the early establishment stage helps ensure a uniform crop stand.

4. Thrips: Tiny Insects, Serious Damage

Thrips are among the most troublesome pests of chilli. Species such as *Scirtothrips dorsalis* and *Thrips parvispinus* may damage leaves, tender shoots, flowers and developing fruits. Feeding causes silvery patches, leaf curling, crinkling and distortion. Severe infestation may result in stunted plants, flower drop and poor fruit development.

Management Practices

- Use healthy seedlings and inspect them carefully before transplanting.
- Monitor the growing tips, tender leaves, flowers and undersides of leaves for thrips.
- Use blue or yellow sticky traps, as locally recommended, to monitor flying insects. Traps are useful for monitoring but may not provide sufficient control on their own.
- Remove heavily infested plant parts when practical and manage weeds that serve as alternative hosts.

- Maintain balanced nutrient application; excessive nitrogen can encourage tender growth that may favour certain sucking pests.
- Conserve predatory mites, lacewings and other beneficial organisms. Avoid unnecessary broad-spectrum sprays.
- If treatment is required, choose a registered product recommended for the identified thrips species on chilli and follow the label instructions.

Thrips can multiply rapidly under favourable conditions, so frequent field inspection is more useful than waiting for severe symptoms to appear.

5. Aphids: Sap-Sucking Pests That Weaken Plants

The green peach aphid (*Myzus persicae*) feeds on plant sap, often forming colonies on tender shoots and the undersides of leaves. Infested leaves may curl, become distorted and show reduced growth. Aphids also produce honeydew, which can encourage the growth of sooty mould. Some aphid species can transmit plant viruses. Because virus transmission may occur during brief feeding or probing, killing the insects after they arrive does not always prevent infection.

Management Practices

- Inspect young shoots and leaf undersides regularly for aphid colonies.
- Remove heavily infested plant parts where feasible.
- Manage weeds that harbour aphids and avoid excessive nitrogen fertilization.
- Conserve ladybird beetles, lacewings, hoverflies and parasitoids, which naturally suppress aphid populations.
- Use suitable neem-based or other registered botanical products when recommended and apply them according to the label.
- Where aphid populations become damaging, use a registered product recommended for chilli, while considering its effects on natural enemies.

Aphid management should be combined with measures to reduce virus sources and protect the crop from infection.

6. Whiteflies: Small Insects with Multiple Impacts

Whiteflies, including *Bemisia tabaci* and *Aleurothrixus trachoides*, feed on plant sap and may weaken chilli plants. Heavy infestations can cause leaf yellowing and honeydew accumulation. Certain whitefly species also transmit plant viruses, making their management important in virus-prone areas.

Management Practices

- Use healthy seedlings and avoid planting near heavily infested crops when practical.
- Monitor the undersides of leaves for adults, eggs and immature stages.
- Use suitable yellow sticky traps for monitoring adult activity.
- Remove weeds and volunteer plants that may harbour whiteflies or plant viruses.
- Conserve natural enemies, including parasitoids and predators, by limiting unnecessary broad-spectrum insecticide use.
- Use registered neem-based or other recommended products when appropriate.
- If chemical intervention is necessary, rotate insecticides with different modes of action in accordance with current recommendations to help delay resistance.

Because whiteflies can transmit viruses, pest suppression should be supported by clean planting material, weed management and timely removal of virus-infected plants where advised.

7. Broad Mite: The Hidden Cause of Leaf Distortion

The broad mite (*Polyphagotarsonemus latus*) is extremely small and often difficult to detect without magnification. It attacks tender leaves and growing points, causing downward curling, crinkling, bronzing and distortion. In severe cases, plant growth may be stunted, and flowers or young fruits may be affected.

Management Practices

- Examine tender leaves and growing points whenever leaf distortion is observed.
- Use healthy planting material and avoid moving infested seedlings between fields.
- Maintain suitable irrigation and crop nutrition to prevent unnecessary plant stress.

- Remove severely affected plant parts when practical.
- Conserve predatory mites and other beneficial organisms.
- If the pest is confirmed and intervention is required, use only a registered product specifically recommended for broad mites on chilli.

Correct identification is essential because mite damage can resemble injury caused by viruses, nutrient disorders or herbicides.

Build a Strong First Line of Defence

Successful IPM begins before the first pest appears. The following practices help create a field environment that is less favourable for pest outbreaks.

Start with healthy seedlings

Select healthy, vigorous seedlings from a reliable source. Inspect them for thrips, aphids, whiteflies, mites and disease symptoms before transplanting. Avoid introducing infested planting material into a clean field.

Keep the field clean

Remove weeds, volunteer chilli plants and crop residues that may shelter pests or act as alternative hosts for viruses. However, weed management should be selective and timely, because some flowering plants around field margins may also provide food and shelter for beneficial insects.

Use crop rotation and proper field preparation

Where feasible, rotate chilli with suitable non-host crops to disrupt pest life cycles. Summer ploughing may expose soil-dwelling pests to predators and unfavourable environmental conditions. Avoid repeatedly growing the same crop in the same field when this encourages persistent pest problems.

Apply balanced fertilizers and manage irrigation

Excessive nitrogen may encourage lush, tender growth that is attractive to some sucking pests. Apply fertilizers according to soil-test results and crop requirements. Ensure proper drainage and irrigation, as waterlogging and moisture stress can both weaken plants and affect crop performance.

Use traps intelligently

Pheromone traps help monitor selected moth pests, while sticky traps help monitor flying insects such as thrips and whiteflies. Trap type, placement and density should be selected according to the target pest and local recommendations. Traps are monitoring tools and should be used alongside other management measures.

Biological Control: Let Nature Help Protect the Crop

A healthy chilli field supports a range of beneficial organisms. Ladybird beetles, lacewings, predatory mites, spiders and parasitoid wasps feed on or parasitize different pests. Protecting these natural enemies is an important component of biointensive IPM. Biological control products can also play a useful role. Depending on the pest and product, options may include *Bacillus thuringiensis*, suitable NPV formulations and selected beneficial fungi such as *Beauveria bassiana* and *Metarhizium* species. Their effectiveness depends on correct identification, product quality, pest stage, weather conditions and proper application. Neem-based products and other approved botanical formulations may be useful components of a management programme. Nevertheless, botanical and microbial products should not be assumed to be harmless to all beneficial organisms; they must also be used according to their label directions. The key principle is to conserve the natural enemies already present in the field and use biological products strategically, rather than relying entirely on chemical sprays.

Responsible Pesticide Use: Treat Only When Necessary

Chemical pesticides may sometimes be required to prevent substantial crop damage. However, repeated spraying without monitoring can increase costs, encourage resistance, harm pollinators and natural enemies, and contribute to pesticide residues. Farmers should identify the pest correctly, assess its population and damage, and follow current local recommendations before deciding to spray. Only products registered for the particular pest and chilli crop should

be used, strictly according to the label. Observe the prescribed dose, protective equipment requirements, waiting period before harvest and other safety instructions. Do not mix products unless the label or an authorised agricultural adviser confirms that the combination is appropriate. Rotating products with different modes of action, when recommended, helps reduce the risk of resistance. Spraying during periods of pollinator activity should be avoided where relevant, and applications should be made in a manner that minimises exposure to people, livestock, water bodies and beneficial insects.

A Farmer-Friendly IPM Checklist

Before and during the chilli-growing season, farmers can follow these simple steps:

- **Before planting:** Prepare the field, manage weeds and crop residues, and select healthy seedlings.
- **During early growth:** Inspect plants regularly for cutworms, thrips, aphids and mites.
- **During flowering:** Monitor for thrips, fruit borers and other pests that may damage flowers and developing fruits.
- **During fruit development:** Check fruits for borer damage and inspect leaves for sucking pests.
- **Throughout the season:** Use suitable traps for monitoring, conserve beneficial organisms and maintain balanced crop nutrition.
- **Whenever damage increases:** Identify the pest, assess the need for intervention and select the safest effective option recommended for the situation.
- **Before harvest:** Follow the product-specific waiting period and all label directions for any pesticide used.

Conclusion: Protect the Crop, Preserve the Ecosystem

Biointensive integrated pest management offers a practical and environmentally responsible approach to chilli cultivation. By combining healthy planting material, field sanitation, crop rotation, balanced nutrition, regular monitoring, mechanical removal, biological control and need-based pesticide use, farmers can reduce pest pressure while protecting beneficial organisms. No single method can manage every chilli pest under all conditions. Success depends on timely observation, correct pest identification and the integration of suitable methods throughout the crop season. Healthy plants, regular field monitoring and judicious pest management are the foundations of a productive chilli crop. By working with nature rather than against it, farmers can move towards safer cultivation, better-quality produce and more sustainable farming.






Fruit Borer	Thrips	Whiteflies	Aphids

Fig1. Tiny Invaders, Big Threat: Pests of Chill