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Major Insect Pests of Maize

and Their Sustainable Management

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Introduction

Maize (*Zea mays* L.) is one of the most important cereal crops cultivated worldwide and serves as a staple food, feed and industrial raw material. It occupies a significant position in global agriculture due to its high productivity, adaptability to diverse agro-climatic conditions and wide range of uses. In India, maize is cultivated across various states under rainfed and irrigated conditions and contributes substantially to food security and agricultural income. Despite its economic importance, maize production is severely constrained by several biotic and abiotic factors. Among the biotic stresses, insect pests are one of the major causes of yield reduction. More than 250 insect species have been reported to infest maize at different growth stages, although only a few cause significant economic losses. These insect pests attack maize from seedling emergence to grain storage, affecting plant growth, grain quality and overall productivity. Effective pest management is therefore essential for sustainable maize production.

Major Insect Pests of Maize

1. Fall Armyworm (*Spodoptera frugiperda*)

The fall armyworm (FAW) is currently the most destructive insect pest of maize worldwide. Native to the Americas, it was first reported in India in 2018 and has rapidly spread across maize-growing regions. The larval stage causes severe damage by feeding on leaves, whorls, tassels and developing ears.

Nature of Damage

- Young larvae scrape leaf tissues, creating transparent patches.
- Older larvae feed voraciously and produce large irregular holes in leaves.
- Larvae hide within the whorl and deposit large quantities of frass.
- Severe infestation may result in complete destruction of the growing point.

Economic Importance

Yield losses due to FAW may range from 15 to 70 percent depending on crop stage, pest population and management practices.

Management

- Timely sowing and field sanitation.
- Installation of pheromone traps for monitoring.
- Conservation of natural enemies such as *Trichogramma pretiosum*, *Telenomus remus* and predatory insects.
- Application of biopesticides such as *Bacillus thuringiensis* (Bt) and Nuclear Polyhedrosis Virus (NPV).
- When infestation exceeds 5–10% damaged plants during the early crop stage, one of the following insecticides may be applied:

Insecticide	Formulation	Dose/ha
Emamectin Benzoate	5 SG	220 g/ha
Chlorantraniliprole	18.5 SC	150 ml/ha
Spinetoram	11.7 SC	450 ml/ha
Thiamethoxam + Chlorantraniliprole	12.6% + 9.5% ZC	250 ml/ha

Spray in the whorl region using 500–600 litres of water per hectare.

The spotted stem borer, *Chilo partellus*, is a major pest of maize in Asia and Africa. It attacks the crop during vegetative growth stages.

Nature of Damage

- Larvae initially feed on leaf surfaces and later bore into stems.
- Infested plants exhibit characteristic "dead heart" symptoms.
- Tunneling within stems weakens plants and reduces nutrient translocation.

2. Stem Borer (*Chilo partellus*)

- Grain formation and cob development are adversely affected.

Management

- Removal and destruction of crop residues.
- Early sowing to escape peak infestation.
- Release of egg parasitoids such as *Trichogramma chilonis*.
- Application should be made at 20–30 days after germination when early symptoms appear.

Insecticide	Formulation	Dose/ha
Chlorantraniliprole	18.5 SC	150 ml/ha
Emamectin Benzoate	5 SG	220 g/ha
Fipronil	0.3 G	25 kg/ha
Carbofuran*	3 G	33 kg/ha

- Use only where legally permitted and registered.

Helicoverpa armigera is a highly polyphagous pest attacking maize during reproductive stages.

Nature of Damage

- Larvae feed on silks, kernels and developing grains.
- Entry holes on cobs facilitate secondary infection by pathogens.

3. Corn Earworm (*Helicoverpa armigera*)

- Damaged grains become unfit for consumption and storage.

Management

- Monitoring through pheromone traps.
- Conservation of predators and parasitoids.
- Use of biological control agents such as NPV.

Insecticide	Formulation	Dose/ha
Emamectin Benzoate	5 SG	220 g/ha
Indoxacarb	14.5 SC	500 ml/ha
Spinosad	45 SC	75 ml/ha
Chlorantraniliprole	18.5 SC	150 ml/ha

Apply during silk emergence and early cob formation if infestation reaches ETL.

4. Shoot Fly (*Atherigona spp.*)

Shoot fly is particularly important during the seedling stage.

Nature of Damage

- Maggots bore into the central shoot.
- Drying of the central leaf leads to "dead heart" formation.
- Damaged plants exhibit poor growth and reduced yield potential.

Management

- Early sowing and optimum plant population.
- Seed treatment with recommended insecticides.
- Removal of infested seedlings.

Seed Treatment

Insecticide	Dose
Imidacloprid 48 FS	10 ml/kg seed
Thiamethoxam 30 FS	10 ml/kg seed

Foliar Application

Insecticide	Formulation	Dose/ha
Thiamethoxam	25 WG	100 g/ha
Imidacloprid	17.8 SL	125 ml/ha

5. Aphids (*Rhopalosiphum maidis*)

Aphids are sap-sucking insects that infest leaves, tassels and cobs.

Nature of Damage

- Direct sap extraction weakens plants.
- Honeydew secretion promotes sooty mold development.
- Aphids act as vectors of viral diseases.

Management

- Conservation of ladybird beetles and lacewings.
- Avoid excessive nitrogen fertilization.
- Application of botanical pesticides and selective insecticides when required.

6. White Grubs (*Holotrichia spp.*)

White grubs are soil-dwelling pests that feed on roots.

Nature of Damage

- Root feeding causes wilting and drying of plants.
- Damaged plants can be easily uprooted.
- Severe infestations lead to significant stand reduction.

Management

- Deep summer ploughing.
- Collection and destruction of adult beetles.
- Seed treatment and soil application of recommended insecticides.

Insect Pest Dynamics in Maize Ecosystems

The occurrence and abundance of insect pests in maize fields are influenced by various environmental and agronomic factors. Temperature, relative humidity, rainfall, cropping pattern, planting date and host plant availability significantly affect pest population dynamics. Climate change has altered pest behavior, distribution and survival rates. Rising temperatures and changing rainfall patterns have increased the incidence of invasive pests such as fall armyworm. Continuous maize cultivation and monocropping systems also favor pest multiplication by providing uninterrupted food sources. Understanding seasonal incidence and pest ecology is crucial for developing effective management strategies. Regular field scouting and pest surveillance enable timely intervention and reduce unnecessary pesticide use.

Role of Natural Enemies in Maize Pest Management

Natural enemies play an important role in regulating insect pest populations in maize ecosystems. Predators, parasitoids and entomopathogenic microorganisms contribute significantly to biological control.

Predators

- Ladybird beetles (*Coccinellidae*)
- Green lacewings (*Chrysoperla spp.*)
- Spiders
- Predatory bugs

Parasitoids

- *Trichogramma chilonis*
- *Telenomus remus*
- *Cotesia flavipes*

Entomopathogens

- *Bacillus thuringiensis*
- *Beauveria bassiana*
- *Metarhizium anisopliae*
- Nuclear Polyhedrosis Virus (NPV)

Conservation of these beneficial organisms through reduced pesticide use and habitat management enhances natural pest suppression.

Integrated Pest Management (IPM) in Maize

Integrated Pest Management (IPM) is an environmentally sound approach that combines multiple pest management tactics to maintain pest populations below economic injury levels.

Cultural Methods

- Timely sowing.
- Crop rotation.
- Removal of crop residues.
- Balanced fertilizer application.
- Field sanitation.

Mechanical Methods

- Hand collection and destruction of egg masses and larvae.
- Use of light traps and pheromone traps.
- Destruction of infested plant parts.

Biological Methods

- Release of parasitoids and predators.
- Use of microbial biopesticides.
- Conservation of natural enemies.

Host Plant Resistance

Development and cultivation of insect-resistant maize varieties provide an economical and eco-friendly management option. Resistant varieties reduce pest establishment and damage.

Chemical Methods

Chemical control should be used only when pest populations exceed economic threshold levels. Selective and recommended insecticides should be preferred to minimize adverse effects on beneficial organisms and the environment.

Future Prospects

Advances in entomological research are contributing to the development of sustainable maize pest management strategies. Emerging technologies such as precision agriculture, remote sensing, artificial intelligence-based pest detection and molecular approaches are improving pest monitoring and decision-making. Biological control, biopesticides and host plant resistance are expected to play increasingly important roles in future maize production systems. Strengthening farmer awareness, pest surveillance networks and integrated management programs will be essential for addressing emerging pest challenges and ensuring sustainable maize productivity.

Conclusion

Insect pests remain one of the major constraints to maize production worldwide. Among them, fall armyworm, stem borer, shoot fly, aphids and corn earworm are particularly important due to their widespread occurrence and economic impact. Sustainable management of these pests requires a comprehensive understanding of their biology, ecology and population dynamics. Integrated Pest Management, which combines cultural, biological, mechanical and chemical approaches, offers the most effective and environmentally responsible strategy for protecting maize crops. Continued research and adoption of eco-friendly pest management practices will be crucial for enhancing maize productivity and ensuring long-term agricultural sustainability.