AGRI MAGAZINE
(International E-Magazine for Agricultural Articles)
Volume: 02, Issue: 11 (November, 2025)
Available online at http://www.agrimagazine.in

Insect Pest Management in Maize (*Zea mays* L.):A Short Review

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Maize (*Zea mays* L.) is a principal cereal cultivated across diverse agro-climatic regions and is vulnerable to a complex of insect pests that can substantially reduce yield and grain quality. Recent invasions and range expansions (notably fall armyworm, *Spodoptera frugiperda*) have intensified management challenges and highlighted the need for integrated pest management (IPM) strategies that combine host resistance, cultural tactics, biological control, and judicious pesticide use. This review summarizes the major maize pests in South Asia (with emphasis on India), practical IPM components, recent advances in host resistance and tolerant hybrids, and recommendations tailored to field-level implementation. Key actionable recommendations emphasize monitoring, synchronization of agronomy with pest biology, use of tolerant hybrids (including recently developed FAW-tolerant lines), conservation of natural enemies, and targeted chemical or biopesticide applications as last-resort options.

Keywords: Maize, insects, integrated pest management (IPM), fall armyworm, stem borer, host resistance, biocontrol

Introduction

Maize is cultivated over a wide range of environments and seasons (*kharif*, *rabi*, and *spring*) in India and globally. Its adaptability and high biomass productivity make it central to food, feed and industrial uses. However, insect pests remain a primary biotic constraint, causing both direct yield losses and post-harvest damage. While a large number of insect and mite species are associated with maize, a relatively small subset regularly causes economic loss - stem borers, shoot flies, ear feeders and storage pests being the most important in many production zones. The recent incursion and establishment of invasive species such as fall army worm (FAW) have increased management complexity and underlined the urgency for sustainable, farmer-friendly IPM strategies.

Major insect pests and damage symptoms

The principal field pests affecting maize in South Asia include:

1. Stem borers (e.g., *Chilo partellus*, *Sesamia inferens*): Cause pinholes, "dead hearts", stem tunneling and lodging; infestation at early vegetative stages can kill growing points and lead to significant yield loss. C. partellus is a perennial problem in kharif maize while S. inferens is more prevalent in winter crops.
2. Shoot fly (*Atherigona* spp.): Attacks seedlings in spring-sown crops; maggots damage the growing point producing dead hearts and reduced plant stands.
3. Ear and cob feeders (e.g., *Helicoverpa armigera*, *Spodoptera litura*): Damage silks, kernels and tassels, affecting seed set and grain quality.

4. Fall Army worm (*Spodoptera frugiperda*): An invasive, polyphagous defoliator now established across many Asian and African maize-growing regions; it attacks all crop stages and can cause rapid, localized crop failure.
5. Storage pests (e.g., *Sitophilus zeamais*, *Prostephanus truncatus*): Cause direct post-harvest losses, create conditions favorable to fungal contamination, and reduce seed viability.

Seasonality, cropping system and local climatic conditions modulate pest incidence. Farmers should be familiar with the key damage signs (dead hearts, shot-holing, whorl damage, ear tip feeding, frass accumulation) and link these to practical thresholds for action (monitoring + threshold-based response). Recent assessments indicate that while traditional stem borers and shoot fly continue to cause chronic yield loss, FAW's rapid outbreaks have become the most acute management challenge in several regions.

Integrated Pest Management (IPM) framework — practical components

A resilient IPM program blends preventive and responsive tactics. For on-farm implementation, these elements are actionable and cost-conscious:

Preventive measures (farm planning)

Crop planning and sowing windows: Synchronize sowing over large contiguous areas where possible to reduce prolonged host availability and escape peak pest pressure. Early sowing can reduce shoot fly damage in spring sowings.

Crop rotation and intercropping: Rotate maize with non-host crops and use intercrops (e.g., legumes) to disrupt pest cycles and enhance natural enemy populations. Napier grass rows as trap crops can reduce borer pressure.

Field sanitation: Destroy stubbles, remove and bury infested residues to reduce overwintering pest populations. Summer ploughing can reduce borer survival.

Host plant resistance and tolerant hybrids

Use of tolerant/resistant germplasm: Host resistance is the most sustainable long-term strategy. International and national breeding programs (CIMMYT, ICAR, national research centers) have identified/are deploying FAW-tolerant lines and borer-resistant germplasm; several non-Bt tolerant hybrids have been evaluated and fast-tracked for deployment in Africa and Asia. Incorporating tolerant or tolerant–high-yielding dual-purpose hybrids into seed planning is a high-priority recommendation for farmers.

Monitoring and decision support

Trapping and scouting: Pheromone traps for borers and scouting of whorls/ears helps detect early infestation. Action thresholds (e.g., percent plants with whorl damage, moth catches, percent FAW-infested plants) should be used to time interventions.

Advisory services & mobile alerts: Extension networks and advisories that translate monitoring data into farmer-friendly action advice are highly effective at reducing inappropriate pesticide use and improving timeliness.

Biological control and conservation

Conserve natural enemies: Parasitoids (e.g., Cotesia spp., Trichogramma spp.), predators and entomopathogens play a central role. Habitat management (flowering strips, reduced broad-spectrum insecticide use) increases biological control.

Microbial and bio-insecticides: *Bacillus thuringiensis* (Bt) formulations, entomopathogenic fungi (*Metarhizium*, *Beauveria*), and entomopathogenic nematodes are effective for whorl-feeding and early-instar control when applied in a timely manner.

Chemical control (judicious use)

Targeted insecticide sprays: Reserve synthetics for when thresholds are exceeded. When necessary, use selective chemistries (e.g., Emamectin benzoate, chlorantraniliprole, spinetoram) with attention to label rates, spray volume, and pre-harvest intervals. Rotate modes of action to manage resistance.

Safety and environment: Emphasize applicator safety, correct dosage, spray timing (evening application to spare pollinators), and integrated use with biological measures to reduce non-target impacts.

Recent advances (2020–2025):

Host resistance, tolerant hybrids and breeding progress:

International breeding programs have accelerated identification and deployment of FAW-tolerant germplasm and hybrids, emphasizing native genetic resistance rather than sole reliance on Bt traits. CIMMYT and partners have released FAW-tolerant hybrids in several African countries and have ongoing screening and deployment pipelines for Asia; national programs (ICAR, IIMR) are evaluating tolerant lines and regionally suited hybrids for deployment in India. These efforts confirm that partial genetic tolerance combined with agronomic practices can substantially lower crop losses and pesticide dependence. Farmers should engage with local extension to obtain recommended tolerant hybrids for their agro-ecology.

Biological technologies and reduced-risk tools:

There has been growing adoption of microbial biopesticides (Bt, fungal products) and conservation biocontrol in smallholder systems. Entomopathogens applied as seed treatments or foliar sprays demonstrate promising results when integrated with scouting-based application timing. Push–pull and trap cropping approaches continue to provide localized suppression of borers and FAW in certain cropping systems.

Digital scouting, sensing and decision support:

Remote sensing, smartphone-based pest reporting and advisory systems have matured, enabling faster detection of outbreaks and more precise pesticide recommendations. Imaging and spectral tools are also being evaluated to distinguish pest damage from abiotic stressors, aiding rapid, cost-effective field diagnosis.

Resistance management and policy:

Resistance management - rotating chemistries, preserving natural enemies, and limiting prophylactic insecticide use - is now a cornerstone of extension messaging, particularly given FAW's high propensity to develop resistance under repeated chemical selection pressure. National-level recommendations promoting IPM packages and farmer training are increasingly common.

Practical, field-focused recommendations (for extension agents and farmers)

- Monitor early and regularly. Install pheromone traps after sowing; scout whorls, plants and ears at least weekly during vulnerable stages.
- Choose tolerant hybrids. When available for your zone, plant FAW- or borer-tolerant hybrids recommended by national trials or research stations. These reduce damage and the need for emergency sprays.
- Implement cultural controls. Practice synchronous sowing where feasible, remove stubbles, use trap crops (Napier grass), and avoid consecutive maize-only cycles.
- Use biocontrol and biopesticides first. Apply *Bacillus thuringiensis* based products, entomopathogenic fungi, or neem extracts at low/early infestations. These are effective on neonates and conserve beneficials.
- Apply selective insecticides only when thresholds exceed recommendations. Use recommended chemistries, adhere to label rates and withholding periods, and avoid unscheduled blanket spraying.
- Preserve and encourage natural enemies. Plant flowering strips, avoid broad-spectrum sprays during beneficial activity windows, and time sprays to reduce impact on parasitoids.
- Post-harvest care. Employ improved storage methods (e.g., metal silos, hermetic bags), timely drying and cleaning to reduce storage pest losses.

Research gaps and priorities

Region-specific tolerant hybrids: Continued screening and release of regionally adapted FAW- and borer-tolerant hybrids for South Asia is a high priority. Breeding pipelines need to integrate yield, grain quality, and pest tolerance simultaneously.

Operationalizing decision support: Scalable farmer-level decision-support tools (mobile advisories, localized thresholds) need strengthening so that monitoring translates into timely action.

Biocontrol efficacy under field conditions: More multi-location trials to validate and standardize dosage/formulation/timing of microbial agents and entomopathogens.

Resistance management research: Long-term studies on pesticide resistance dynamics in FAW and other major pests to inform rotational strategies and stewardship.

Post-harvest and storage solutions: Wider dissemination and subsidy for hermetic storage to reduce grain losses from storage pests.

Conclusion

Managing maize insect pests in today's dynamic pest landscape requires a pragmatic combination of prevention, monitoring, host resistance, biological conservation and the careful, threshold-based use of pesticides. The recent recognition and spread of FAW have underscored the relevance of tolerant hybrids, rapid monitoring and extension-linked advisory systems. For smallholder and commercial farmers alike, the highest benefit comes from integrating tolerant varieties, good agronomy (synchronous sowing, residue management), biological tools and targeted chemicals only when necessary. Strengthened breeding pipelines, improved extension delivery, and farmer training on IPM will be critical to sustainably reduce yield losses and pesticide dependence in maize systems. Practical extension guides and national recommendations (e.g., Ministry of Agriculture advisories, ICAR-IIMR bulletins) provide locally adapted spray lists, thresholds and safe-use practices and should be consulted for region-specific chemical choices and dosages.

References

1. CIMMYT Repository. (2025). Assessment of fall armyworm tolerant maize hybrids for sustainable maize production. CIMMYT technical report. CIMMYT Repository
2. CIMMYT. (2023). Fall army worm research, development and extension — progress on FAW-tolerant hybrids. CIMMYT news release. CIMMYT
3. Dash, S. (2024). *Spodoptera frugiperda* in India: distribution, biology and management — a summary review. Regional Entomology Reports. environmentandecology.com
4. Kumar, R. M. (2022). Sustainable management of invasive fall army worm: Practical options and policy implications. Agronomy Review, 12, 2150.
5. Peterson, R. K. D. (2024). Insect pest management and environmental risk: A review. Annual Review of Entomology, 69: 1–24.
6. Prasanna, B. M. (2022). Host plant resistance for fall armyworm management in maize. Theoretical and Applied Genetics, 135, 1123–1140.