# Fall Armyworm

Volume 01, Issue-02

## A Destructive Pest in Maize Crops- Latest Control Measures and Biological Solutions

August 2025
Digital AgriNews e-Magazine

**Abstract**

Fall Armyworm (Spodoptera frugiperda) is an invasive pest that poses a serious challenge to maize cultivation worldwide. Native to the America, it has rapidly spread to Asia and Africa, causing significant yield losses in maize, a staple crop in many countries. This article reviews the pest's biology, its economic impact, and the most recent advances in control strategies. Emphasis is placed on integrated pest management, particularly biological solutions such as parasitoids, predators, and microbial biopesticides. As chemical pesticides lose effectiveness and environmental concerns mount, biological control offers a safer and more sustainable way forward.

**Introduction**

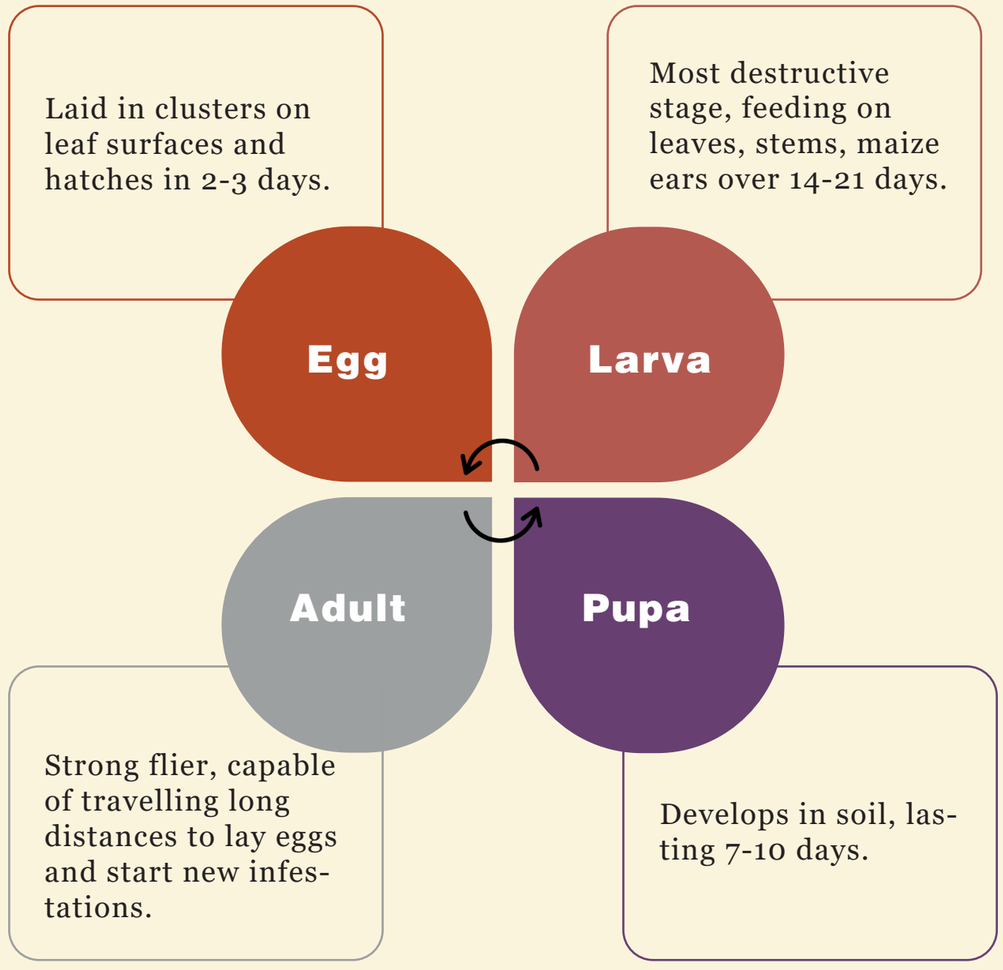
Maize (Zea mays L.) is a vital cereal crop grown across the globe for food, fodder, and industrial uses. In recent years, farmers in Asia and Africa have faced serious losses due to the emergence of Fall Armyworm (FAW), an insect pest that attacks multiple crop stages and is notoriously hard to manage. Since its first detection in India in 2018 in Karnataka (Sharanabasappa et al., 2018), the pest has rapidly spread to major maize-growing regions, raising alarm among scientists, farmers and policymakers alike.

Traditional pest control strategies, largely dependent on chemical insecticides have proven inadequate due to rapid resistance development and negative ecological consequences. As a result, researchers and extension agencies are now focusing on integrated strategies combing chemical. Cultural, mechanical and especially biological measures to reduce the pest burden.

## 1 BIOLOGY AND LIFECYCLE OF FALL ARMYWORM

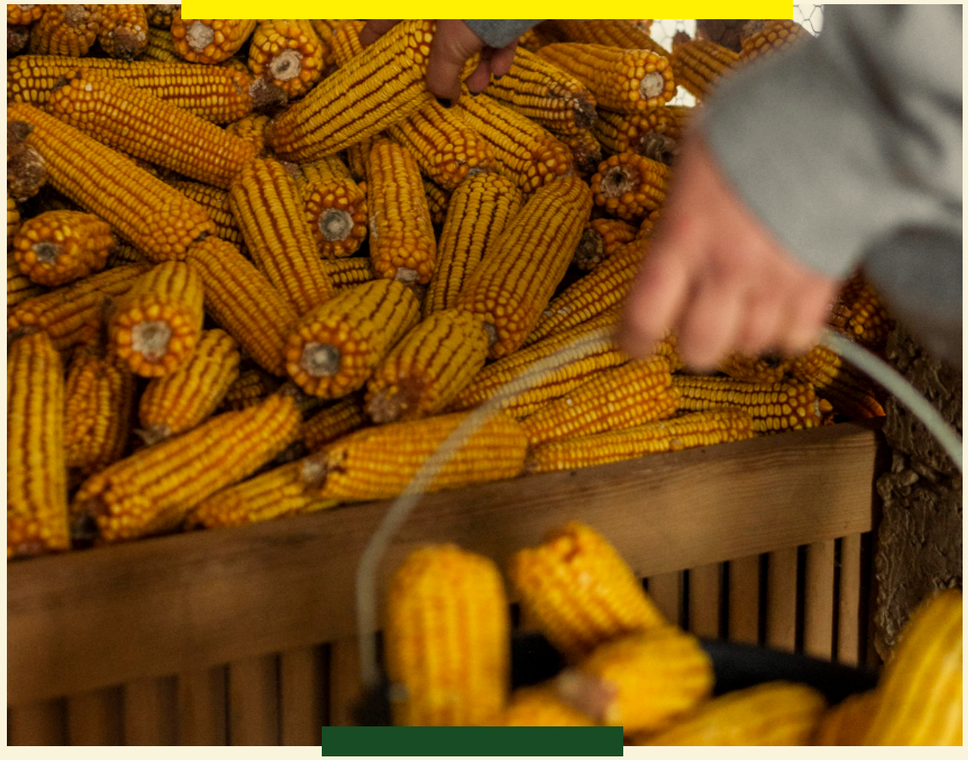


Fall armyworm is a moth species belonging to family Noctuidae. It thrives in warm climates and does not undergo diapause, allowing it to reproduce continuously throughout the year in suitable conditions. The pest goes through four developmental stages (Fig. 1). Each female can lay over 1500 eggs in her lifetime, contributing to population explosions under favorable conditions (Neelima et al., 2020).




The developmental stages of Fall Armyworm

# 2 Economic
## IMPACT ON MAIZE CROPS



FAW is highly polyphagous, but maize is one of its preferred hosts. It can lead to leaf skeletonization, whorl damage, and ear destruction, drastically lowering crop yields. In India, yield losses due to FAW have ranged from 20% to over 45%, especially in areas where early control was not implemented (ICAR-NBAIR, 2020). A study by the Food and Agriculture Organization (FAO, 2022) estimated annual losses of $2.5-6.2 billion in African maize production due to FAW. In India, beyond yield losses, farmers also face rising input costs from repeated pesticide applications and labor for manual removal and monitoring.



## Recent advances in management strategies

Chemical insecticides such as spinosad, emamectin benzoate and chlorantraniliprole are widely used for early-stage larval control. However, repeated use has led to development of pesticide resistance, harm to beneficial insects, environmental pollution and increased costs for smallholders. For effective results, experts recommend threshold-based spraying and alternating insecticides with different modes of action to delay resistance (Prasanna et al., 2018).

Cultural approaches play a vital role in reducing pest populations and delaying outbreaks:

- Crop rotation with non-host crops like legumes.
- Intercropping with crops such as cowpea to disrupt pest colonization.
- Timely planting to escape peak pest periods.
- Removal of crop residues to destroy overwintering pupae.

Farmers are also encouraged to use pheromone traps (15/ha) for mass trapping and early monitoring.

Mechanical methods are simple are particularly useful for small and organic farms aiming to avoid chemical usage. The effective physical methods include- hand removal of egg masses and larvae in small-scale fields, dusting maize whorls with wood ash or lime to suffocate larvae and bird perches to attract predatory birds that feed on caterpillars.

## 3 Biological Control: Nature's Answer to FAW

*Biological control involves deploying natural enemies such as parasitoids, predators, and microbial agents to keep pest populations under control. This method is eco-friendly, cost-effective, and poses no risk to human health.*

Egg and larval parasitoids such as Telenomus remus parasitizes FAW eggs. Field releases of 50,000 adults per hectare have shown up to 70% egg parasitism (ICAR-NBAIR, 2020). Trichogramma spp. is widely used in biocontrol programs, they are known to target a range of lepidopteran eggs, whereas Chelonus insularis attacks larval stages, reducing their survival rate. These parasitoids can be mass-reared and released at regular intervals during the cropping season.

Several beneficial insects naturally prey on FAW including- Ladybird beetles (Coccinella spp.) which feed on eggs and early larvae, Lacewings (Chrysoperla spp.) attack soft-bodied insects, while Predatory earwigs (Euborellia spp.) consume eggs and pupae. Farms can encourage predator populations by planting flowering border crops and minimizing pesticide usage.

Microbial biopesticides are gaining attention for their specificity and safety.



Some examples include- Bacillus thuringiensis (Bt) which is highly effective against young FAW larvae when applied as a foliar spray; Nucleopolyhedrovirus (SfNPV) is a naturally occurring virus that infects and kills larvae without harming other organisms (Walther et al., 2022); Beauveria bassiana and Metarhizium anisopliae are fungal biopesticides that invade larvae and kill them within days. These agents can be incorporated into IPM programs and are available through agricultural input centers and KVKs.

## 4 Integrated Pest Management: The Ideal Approach

Integrated pest management combines preventive and curative methods to reduce reliance on chemicals while maintaining crop health. A typical IPM strategy for FAW includes:

- Weekly field scouting and monitoring.
- Use of pheromone traps for early detection.
- Cultural methods like crop rotation and timely sowing.
- Release of biocontrol agents at recommended dosages.
- Judicious use of chemical pesticides when infestations exceed the economic threshold level.

## 5 Emerging Technologies and Innovations

Ongoing research and technological innovation are expanding FAW management options:

- RNA interference (RNAi): Gene-silencing technology to disrupt essential pest genes.
- CRISPR-edited maize lines: Under trial for improved pest resistance.
- Drone spraying: Enables precise application of biopesticides, especially in inaccessible or hilly terrain.

- Digital apps and AI models: Help farmers identify pest stages, predict outbreaks and follow location-specific advisories.

## Challenges and Way Forward

Despite advancements, some barriers remain:

- Limited access to quality biological products in remote regions.
- Inadequate training for farmers in IPM techniques.
- Lack of financial incentives for adopting eco-friendly methods.
- Rapid pest adaptation and resistance evolution

Addressing these issues require coordinated efforts between research institutions, policymakers, agribusinesses, and farmers. Incentivizing biocontrol usage, investing in rural agri-infrastructure, and enhancing extension services will be key to long term FAW control.

## Conclusion

Fall Armyworm continues to pose a significant threat to maize production globally. While chemical control offers short-term relief, it cannot serve as the foundation of sustainable pest management. Biological control, backed by informed cultural and mechanical strategies, holds the key to long-lasting, eco-friendly protection. Through integrated pest management, technological innovation and farmer education, the agricultural community can turn the tide against this invasive pest.

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