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Farmers Shield Against Fall Armyworm: A Maize-Focused Defensive Strategies in Punjab

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Introduction

The fall armyworm (FAW), scientifically known as *Spodoptera frugiperda*, is an insect belonging to the Lepidoptera order and Noctuidae family. This pest is native from tropical and sub-tropical regions of the Americas. FAW was dispersed from Africa in 2016 and was officially documented in India in May 2018, specifically within the state of Karnataka. It exhibits polyphagous feeding behavior, demonstrating the ability to feed on diverse range of plants. Notably, it poses a significant threat to major crops such as maize, sweet corn, and sorghum, as well as minor crops including sugarcane and rice. This adaptability underscores its status as a prominent agricultural pest, leading to substantial crop damage.

Life Cycle

The fall armyworm undergoes holometabolous metamorphosis, characteristic of insects with distinct larval and pupal stages. This process involves four stages: egg, larva, pupa, and adult. The egg stage is identified by dome-shaped structures. Females exhibit an egg-laying capacity ranging from 1500 to 2000, and the incubation period spans 2–3 days. Eggs are deposited in clusters on both sides of leaves. In the larval stage, FAW show distinct behaviors, such as cannibalism. This phase consists of six instars, each marked by shedding the old skin and developing a larger exoskeleton. As they move through these instars, their feeding intensifies, posing a significant threat to various crops. The fall armyworm undergoes a vital pupal stage in its life cycle after completing the larval instars. Larvae burrow into the soil for pupation, where a transformative process occurs, converting the larva into an inactive, non-feeding pupa. Metamorphosis unfolds during this phase, culminating in the emergence of the adult moth. This pupal stage is a crucial component influencing the fall armyworm's development and eventual contribution to its reproductive cycle. Adult stage, following the

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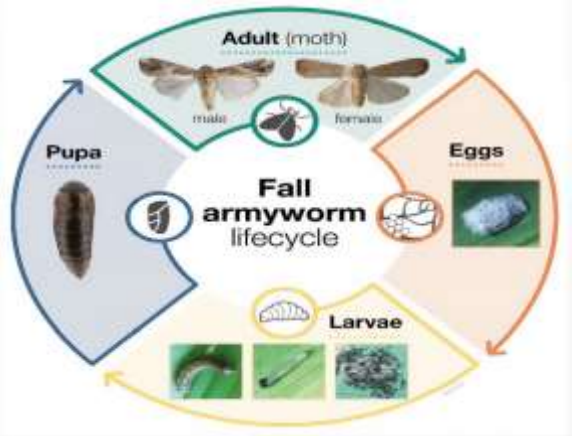
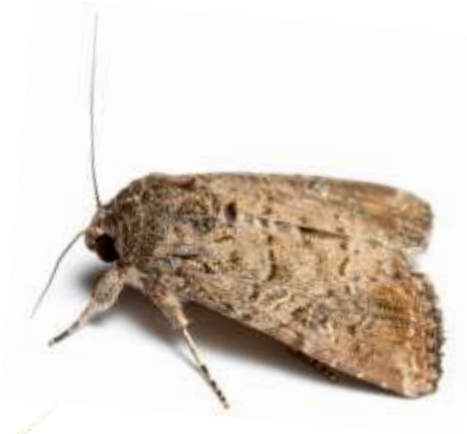
pupal phase, is marked by the emergence of nocturnal moths. During this phase, the primary activities involve mating and egg-laying, contributing to the initiation of a new generation.





Source: Tay *et al* (2022)

Symptoms and Nature of Damage

The different larval stages of the fall armyworm pose a threat to maize crops. The larvae, in their different instars, exhibit voracious feeding behavior, causing damage to the leaves, whorls, and sometimes even the reproductive structures of the maize plants. This feeding activity can lead to defoliation, reduced photosynthesis, and overall yield loss. The symptoms and nature of damage caused by Fall Armyworm (FAW) infestation include:

1. **Ballooning in larvae:** Earlier larvae exhibit a behavior termed ballooning, utilizing silken threads for wind-assisted dispersal. This unique behavior facilitates the rapid spread of the pest across extensive distances, posing challenges for effective pest management.
2. **Typical 'window pane' damage:** Distinct feeding pattern, involves scrapping the epidermis of leaves, resulting in a transparent layer resembling a window pane. This characteristic damage serves as a clear indication of fall armyworm infestation in crops.
3. **Damage by older larvae:** Older larval instars create irregular, large holes in the leaves. this stage is correlated with substantial defoliation, as the larvae systematically strip leaves and other plant components, posing a considerable threat to overall crop yields.

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Ballooning in larvae

Window pane

Damage by older larvae

Source: https://www.cabi.org/wp-content/uploads/FAW-pocket-guide.pdf

Optimizing Fall Armyworm Management: Practical and Proven Strategies

1. **Agroecological Approaches**: Incorporating Push-Pull Technology, involves intercropping with pest-repellent (push) plant species, such as *Desmodium* spp., surrounded by a border of pest-attractive trap (pull) plant species, such as *Brachiaria* spp.
2. **Cultural Approaches**: Crop rotation with non-host crops (sunflower and beans), good quality seeds, removal of weeds, adjustment of sowing date, installation of bird perches.
3. **Biological approaches**: Include natural enemies, pathogens, and biopesticides.
    - Natural Enemies: Encouraging the presence of natural enemies, such as predators like the predatory earwig and parasitoids such as parasitoid wasps, can help regulate fall armyworm populations.
    - Baculoviruses as Biopesticides: Baculoviruses, particularly nucleopolyhedro viruses, are used as biopesticides against fall armyworm larvae, providing an environmentally friendly option for control.
4. **Chemical approaches**: Spinetoram 11.7 % SC @ 0.5 ml/l, Chlorantraniliprole 18.5 SC @ 0.4 ml/l, Thiamethoxam 12.6 % + Lambda cyhalothrin 9.5% ZC @0.25 ml/l. (Recommended by Central Insecticide Board and Registration Committee)

Recommendation by PAU (Punjab Agricultural University, Ludhiana):

1. **Cultural control:** Sow the crop at recommended time only and avoid staggered sowing of maize in adjacent fields to minimize spread of this pest.
2. **Chemical control:** Coragen 18.5 SC (Chlorantraniliprole) @ 0.4 ml per litre water, Delegate 11.7 SC (Spinetoram) @ 0.5 ml per litre

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3. **Prepare soil–insecticide mixture**, add 5 ml of Coragen 18.5 SC (Chlorantraniliprole) or Delegate 11.7 SC (Spinetoram) or 5 g of Missile 5 SG (Emamectin benzoate) in 10 ml of water and mix well in one kg of soil. Apply soil-insecticide mixture (about half gram) in the whorls of the infested plants to manage fall armyworm.

Recommendation by IIMR (India Institute of Maize Research): Controlling larval instars at different stages

a. **1 and 2 instars:** Azadirachtin 1500ppm @ 5ml/1 water, *Bacillus thuringiensis* variety *kurstaki* commercial formulations @ 2g/l water and Entomopathogenic fungi *Metarhizium anisopliae* (1×10^6cfu/g) @ 5g or *Nomuraea rileyi* rice grain formulation (1×10^6 cfu/g) @ 3 g/l water.

b. **3 and 4 instars:** Spinetoram 11.7 % SC @ 0.5 ml/l, Chlorantraniliprole 18.5 SC @ 0.4 ml/l, Thiamethoxam 12.6 % + Lambda cyhalothrin 9.5% ZC @0.25 ml/l.

c. **5 and 6 instars:** Poison baiting formulation by mixing 10 kg rice bran and 2 kg jaggery in 2-3 litres of water and keep the mixture for 24 hours to ferment. Add 100g Thiodicarb 75% WP and roll into balls of 0.5- 1 cm diameter, bait should be applied into the whorl of the plant in the evening.

Conclusion

In summary, the temperature range of 26-30°C and higher humidity significantly contribute to the rapid multiplication of Fall Armyworm (FAW) in tropical and sub-tropical climates. Effective monitoring using the W-pattern technique is crucial for timely pest management. Implementing control measures at each larval stage is essential to mitigate crop damage and sustain agricultural productivity. In Punjab, a proactive defense strategy for maize farmers involves integrating pest-resistant practices like crop rotation and using quality seeds, along with innovative techniques like bird perches. This approach aims to empower farmers, enhance resilience in maize farming, and ensure a secure agricultural yield. A comprehensive, tailored integrated pest management plan is vital for minimizing FAW impact, ensuring sustainable crop production, and safeguarding food security. Regular monitoring, timely interventions, and community collaboration are key elements for successful implementation and adaptation of this defensive strategy in maize crops.