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AN OVERVIEW ON THE LIFE CYCLE OF SPODOPTERA FRUGIPERDA

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ABSTRACT

The fall armyworm (FAW), or Spodoptera frugiperda, (J.E. Smith, 1797) is a significant pest affecting global maize production and other economically important crops. It is an invasive and extremely damaging insect that affects maize and other crops all over the world. S. frugiperda is the most notorious, rapidly dominating as a major pest.

This species is also widely distributed in Rajasthan. Its life cycle, including the egg, larval instars, pupa, and adult stages, is thoroughly and methodically examined in this work. The host plants and environmental factors have a significant impact on the lifespan, which usually takes 32 to 45 days to complete. FAW poses a significant threat to agriculture due to its high fecundity and adaptability, with the larval stage being the most destructive.

Keywords: Life Cycle, Larval Instars, Invasive Pest, Metamorphosis

INTRODUCTION

Spodoptera frugiperda (J.E. Smith, 1797) is a significant pest affecting global maize production and other economically important crops. It is an invasive and extremely damaging insect that affects maize and other crops all over the world. Madali (2025). It is the most notorious pest native to the Americas but now widely distributed across Africa and Asia, including India since 2018. It affects crops like Maize (primary host), Sorghum, Rice, Sugarcane and vegetables. Key morphological characteristics are polyphagous-feeding behaviour Kumar et al. (2024), High dispersal ability, Rapid-reproduction. The insect undergoes complete metamorphosis (holometabolism): Egg → Larva → Pupa → Adult

Severe infestations can lead to up to 70% crop loss, making lifecycle understanding essential for pest management. S. frugiperda can grow and reproduce normally on both hosts, although maize is more suitable. It is important for crop-specific life cycle modeling.

Global climate change may substantially affect the diverse geographical distributions of organisms, alter biodiversity, and influence the interactions between species and ecosystems.

Understanding the life cycle of Spodoptera, particularly S. frugiperda, is crucial for developing effective integrated pest management (IPM) strategies. Detailed knowledge of stage-specific biology and developmental thresholds enables precise timing of control measures, such as biological control agents, pheromone traps, and selective insecticides. Moreover, life table analyses and phenological models derived from life cycle studies provide valuable tools for predicting population outbreaks and minimizing crop losses. It is known as the "fall armyworm" because it wreaks havoc and damages crops by skeletonising leaves and burrowing through the stems of maize leaves. Pathak (2024), Indian Council of Agricultural Research. (2023)

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the S. frugiperda feeds on over 80 host plant species, with a strong preference for cereal crops such as maize, rice, sorghum, and wheat. Panigrahi et al. (2025)

RESEARCH GAP

The following gaps persist despite substantial research:

Differences in life cycle length between climates and host plants

Inadequate incorporation of developmental models based on temperature

Absence of stage-specific mortality information in the field

Inadequate knowledge of the ecological significance of larval cannibalism

Instars length is not well standardized between locations.

OBJECTIVES

The present research paper throws light on the following aspects. It focuses on brief study of S. frugiperda's whole life cycle, developmental stage's duration and form, assessment of infestation on the effects of the host plant and the environment and will also determine crucial phases for pest management tactics

MATERIALS AND METHOD

Conditions of the Experiment: The temperature will be maintained between 25oC and 30°C, 60–75% relative humidity and Photoperiod: 12–14 hours of light

METHODOLOGY (STEP-BY-STEP)

Step 1: Collection of Eggs

Eggs extracted from gravid females and kept in damp filter paper-lined petri-dishes in the laboratory.

Step 2: Rearing Larvae

Transferring hatch larvae to fresh maize leave. To prevent cannibalism, larvae are raised separately.

Step 3: Monitoring Instar

Every day, moulting is noticed, measurements of the head capsule is done on regular basis.

Step 4: Pupation

Mature larvae moved to the soil medium. Observation of pupation done under controlled circumstances.

Step 5: Emergence and Reproduction of Adults

Adult moths are fed with honey solution. Oviposition behaviour is also recorded.

The data was recorded and analysed carefully.

OBSERVATIONS

1) Egg Stage

Eggs: laid in clusters (100–200 eggs per mass) Sagar et al. (2020)

Total fecundity: ~1000 eggs/female

Incubation period: 2–3 days

Characteristics:

Dome-shaped

Covered with scales from female abdomen

2) Larval Stage (Most Destructive Stage)

Key Findings:

6 instars

Total duration: 13–14.5 days Rakshit (2022)

Instar-wise duration:

1st: ~2.6 days

2nd: ~2.7 days

3rd: ~2.5 days

4th: ~3.1 days

5th: ~3.3 days

6th: ~4.5–6.8 days

Characteristics:

Greenish to dark brown

Inverted "Y" mark on head Xie (2021)

Cannibalistic behaviour in later instars

3) Pupal Stage

Occurs in soil at 2–8 cm depth

Duration: 7–11 days

Characteristics:

Reddish-brown

Non-feeding stage

4) Adult Stage

Nocturnal moth

Lifespan:

Male: ~8 days

Female: ~12 days

Reproductive Period:

Pre-oviposition: ~4 days

Oviposition: ~3–4 days

5) Total Life Cycle Time

32–35 days, depending on the surroundings

RESULT AND DISCUSSION

Results indicated average egg duration of 2-3 days, with larval stages comprising six instars.

It takes 2.6 days for the first instars to moult and 4.5–6.8 days for the sixth instars, characterized by aggressive feeding behaviour on maize foliage. The total larval period averaged 13 to 14.5 days, while the pupal stage took 7-11 days. Adult longevity was recorded of Male- 8 and Female around 12 days. In total, life cycle duration ranged between 32-35days. Significant sexual dimorphism was observed in adult morphology.

Environmental Impact:

Increased temperature leads to quicker growth.

Ideal: 25–30°C

Effect of the Host Plant:

Compared to other hosts, it develops on Maize more quickly. Fecundity is influenced by nutritional quality. It shows adaptations in behaviour, Competition is diminished due to cannibalism. Feeding at night helps it avoid predators.

Pest Importance: Quick reproduction that results in several generations annually, High capability for dispersal stage of critical control. The first three larval instars are the most susceptible. They are climate-driven displaying biological impacts, specifically regarding range expansion and phenological shifts. Walther et al. (2022).Due to its high pest status and polyphagous nature, this insect poses a significant economic threat to numerous crops. Darshan et al. (2024)

CONCLUSION

The life cycle of Spodoptera frugiperda demonstrates high adaptability, rapid development, and strong ecological fitness. Its short generation time, high fecundity, and destructive larval stage make it a major global pest Bhat and Bajracharya (2022). Understanding each life stage is crucial for effective integrated pest management (IPM).The disruption of pest colonization and larval development through these diversified cropping systems, often combined with pheromone traps. Rajashekhar et al. (2024)

Introducing natural enemies of Spodoptera frugiperda in the field of maize could also help in reducing the threat of the pest in an eco-safe way. Shylesha et al. (2018)

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