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Reproductive Performance of *Spodoptera frugiperda* on Diverse Host Plants: A Comparative Study

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Authors' contributions

This work was carried out in collaboration among all authors. Author SG carried out the lab experiment, Author RV contributed to manuscript preparation. Author SB helped in editing the manuscript. All authors read and approved the final manuscript.

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Short Research Article

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ABSTRACT

Aims: In this study, we investigated the reproductive performance of *Spodoptera frugiperda* on seven economically important host plants (maize, soybean, French bean, green gram, castor, sorghum, groundnut) under laboratory conditions.
Study Design: The design of the experiment was completely randomized with seven treatments, which replicated thrice.
Place and Duration of Study: The present research work was carried out at entomology laboratory, SVIAg, SVVV, Indore during 1 July 2024 to 31 June 2025.
Methodology: Laboratory reared 1 instar larvae were kept in petri dishes with each plant species leaves until they pupated. After emergence, seven pairs of moths were

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placed in plastic containers, after oviposition observation on all reproductive parameters were observed.
Results: All reproductive parameters were significantly affected by all tested host plants. The preoviposition period shortest and longest on maize and French bean (2.08 and 3.33 days, respectively). However, Oviposition period of FAW inversely correlated with preoviposition period. Significantly highest fecundity, egg masses and fertility were found on maize (816.67 eggs/ female, 7.17 egg masses/ female and 95.46 %, respectively), while lowest on French bean (311.33 eggs/ female, 2.83 egg masses/ female and 79.42 %, respectively). Further, incubation period was shortened on maize (2.20 days), conversely prolonged on French bean (2.93 days).
Notably, Maize was found to be most preferred and nutritious host for *S. frugiperda* larval development as compared to other host plants.

Keywords: Spodoptera frugiperda; reproductive parameters; host plants; eggs.

1. INTRODUCTION

The fall armyworm (FAW), *Spodoptera frugiperda* (J.E. Smith, 1797), a pest native to tropical and subtropical regions of the Americas, has recently invaded several Asian countries, including India (Sharanabasappa *et al*., 2018). This highly polyphagous insect is known to infest over 350 plant species, including cereals, vegetables, weeds, and ornamental plants (Russianzi *et al*., 2021). In maize, one of its primary hosts, FAW infestation can lead to yield losses ranging from 11.57% to complete crop failure, depending on the crop growth stage and severity of infestation (Naganna *et al*., 2020). The insect has developed resistance to several commonly used insecticides, often rendering chemical control strategies ineffective. Despite this, chemical control remains a widely adopted management practice among farmers due to its immediate efficacy, provided that appropriate timing, dosage, and application methods are employed (Bayu & Krishnawati, 2016).

Host plant quality plays a critical role in influencing the fecundity and reproductive performance of herbivorous insects, affecting parameters such as egg size, oviposition preference, resource allocation, and even egg or embryo resorption under suboptimal conditions (Refsnider & Janzen, 2010; Caroline & Simon, 2022). Therefore, investigating the effects of different host plants on the reproductive traits of FAW is vital for understanding host preference and suitability. Such knowledge is essential for developing predictive models of pest population dynamics and estimating potential crop damage. Furthermore, these insights can inform the optimization of integrated pest management (IPM) strategies, including the timing of pesticide applications, deployment of pheromone traps, implementation of sterile insect techniques, and the use of trap crops (Shahout *et al*., 2011).

Several studies have investigated the reproductive potential of FAW on various host plants under diverse environmental conditions across regions such as Brazil (Carvalho *et al*., 2022), Africa (Konan *et al*., 2023), Egypt (El-Shannawy *et al*., 2022), and China (Wu *et al*., 2024), where the pest poses a major threat to agricultural productivity. However, limited research has been conducted on the influence of different host plants on the reproductive biology of FAW under Indian agro-climatic conditions, necessitating further investigation. Therefore, this study aims to assess the reproductive performance of *S. frugiperda* on selected host plants.

2. MATERIALS AND METHODS

2.1 Insect Culture

The present research work was carried out at entomology laboratory, SVIAg, SVVV, Indore during 1 July 2024 to 31 June 2025. Initially, sixth instar larvae of *S. frugiperda* were collected from an unsprayed maize field at SVIAg, SVVV, and were kept in petri dishes with fresh maize leaves until they pupated. After emergence, seven pairs of moths were placed in plastic containers, each provided with a cotton swab soaked in 50% honey solution for nourishment. For each host plant, three such containers were maintained. Additionally, five plants of each host species were placed in 250 ml conical flasks filled with water to serve as an oviposition substrate (Firake & Behere, 2020).

2.2 Procurement of Host Plant Seeds

Seeds of various host plants used in the study were procured from SVIAg, SVVV, Indore,

Madhya Pradesh. These seeds were stored in airtight containers until needed for experimentation.

2.3 Raising of Test Host Plants

The six different host plants selected for the study were grown in pots measuring 20 cm in diameter, containing a mixture of suitable soil and vermicompost. The plants were raised following recommended cultivation practices, with the exception that no insecticidal sprays were applied. Leaves of seven host plants namely Maize (*Zea mays*), Soybean (*Glycine max*), French bean (*Phaseolus vulgaris*), Green gram (*Vigna radiata*), Castor (*Ricinus communis*), Sorghum (*Sorghum bicolor*), Groundnut (*Arachis hypogaea*).

2.4 Method of Observation

The design of the experiment was completely randomized with seven treatments, which replicated thrice and kept at room temperature as per methodology suggested by Bankar (2020).

Pre-oviposition, oviposition and post-oviposition periods: The time span from the day a female insect emerged until the day it began laying eggs was defined as the pre-oviposition period. The duration during which the female actively laid eggs was referred to as the oviposition period. The post-oviposition period was the time between the end of egg laying and the female's death.

Fecundity: The total number of eggs laid/ female was counted under the stereomicroscope after removing the hairy covering with camel hairbrush from the marked spots.

Adult longevity: The interval between the emergence of the adults and its death was taken as the adult longevity.

Eggs: 50 eggs were examined on each host plant and kept at room temperature. The data on hatching percentage and incubation periods were recorded.

Incubation period: It was calculated from the time of egg laying to the time of hatching.

Hatching percentage: It was calculated from the data on number of eggs hatched out of total number of eggs under observation.

2.5 Statistical Analysis

The data of various parameters were suitably transformed wherever required and statistically analysed in CRD according to the method described by Gomez and Gomez (1984). All the data analysis by using MS-Excel -2010.

3. RESULTS AND DISCUSSION

3.1 Reproductive Parameters of *S. frugiperda*

Pre-oviposition period: The data presented in Table 1 revealed that significant difference was observed in the mean pre-oviposition period on different host plants. The shortest pre-oviposition period was observed on maize (2.08 days), which was at par with sorghum (2.19 days) and castor (2.33 days). These were followed by soybean, groundnut and green gram (2.50, 2.67 and 2.83 day, respectively), but they did not differ significantly with each other. Prolonged pre-oviposition period was recorded on french bean (3.33 day). The present finding is comparable with those of Bankar (2020), Nandhini *et al*., (2023) and Gebretsadik *et al*., (2024), as they also reported it to be range 2.75- 4.22 days on various host plants, However, Xie *et al*., (2021), as they claimed it to be range from 5.8-8.80 days on tested host plants.

Oviposition period: Perusal of the data in the Table 1 showed that the mean oviposition period exhibited significant differences on various host plants and were lowest on french bean and green gram (both were registered 2.00 day). These followed by groundnut and soybean (both were recorded 2.33 days, respectively), which were at par with castor (2.50 days). The longest oviposition period was noticed in maize (2.92 days) but was at par with sorghum (2.69 days). The present findings agree with those of Nandini *et al*., (2023), as they also observed it to be between 2.38- 3.56 days on different host plants. Whereas, Wang *et al*., (2020) and Gebretsadik *et al*., (2024) reported it to be varied from 4.58 – 7.22 days on tested host plants which is slightly higher in comparison to the present findings. Similarly, Jadhav (2020) reported that the pre oviposition and oviposition periods of *Spodoptera spp*. were inversely correlated on different soybean genotypes.

Post-Oviposition period: Data in Table 1 showed that significant difference was observed in the mean post-oviposition period in the

different host plants. It was shortened on maize (3.67days) which exhibited non-significant differences with sorghum and castor (both were registered 3.83 days, respectively). Soybean (4.33 days) and groundnut were next in the series with non-significant differences between them. Extended post-oviposition period was recorded in green gram (5.33 day) and french bean (5.67 days), but they did not differ significantly with each other.

Egg: The eggs were flattened from top to bottom. At first, they appeared pale green for a day, then changed to a golden yellowish color, and eventually turned black just before hatching.

Egg masses /♀ : According to Table 2, the minimum number of egg masses were deposited on french bean (2.83 egg masses/♀), followed by green gram (3.67 egg masses/♀) and groundnut (5.33 egg masses/♀), but significant differences were observed among them. Soybean (5.83 egg masses/♀) and castor (6.17 masses/♀) were followed the series, but non-significant differences were observed between them. Maximum egg masses were recorded on sorghum (6.83 egg masses/♀) and maize (7.17 egg masses/♀). The present finding deviates from the finding of Nandhini *et al*., (2023), as they observed that the number of egg masses ranged from 1.20 (marigold) to 3.00 egg masses/♀ (maize) (Table 2)**.**

Fecundity/ ♀: The *S. frugiperda* fecundity/ female on different host plants showed significant differences and it was lowest on french bean (311.33 eggs/♀) followed by green gram (354.00 eggs/ ♀), groundnut (515.178 eggs/ ♀) and castor (756.50 eggs/♀). While, highest on maize (816.67 eggs/♀) and was at par with sorghum (779.17 eggs/♀) (Table 2). The present findings agree with those of Li- mei *et al*., (2021), as they also reported it to be ranged from 525.58 (Sorghum) to 699 (Maize) eggs/♀. However, the results contradict the findings of Firake & Behere (2020), Carvalho *et al*., (2020), Gebretsadik *et al*., (2024) and Ahmad *et al*., (2025), as they claimed it to be lasted from 778.93 to 17.06 eggs/♀ on different host plants, which is longer than the present findings. The variation may be attributed to the host plants included in the study which might have more preferred by the pest.

Hatching percent: The lowest mean egg hatching percent of *S.frugiperda* was noticed on french bean and green gram (both were registered 79.92%). These were followed by groundnut and soybean (82.14 and 86.58% respectively). On the other hand, it was highest on maize and sorghum (both were registered 95.46%) (Table 2). It confirms the findings of Bankar (2020) and Nandhini *et al*., (2023), as they reported it to be in the range of 72.60 to 94 .00 % on selected host plants.

Table 1. Influence of different host plant species on reproductive parameters of *S.frugiperda*

Different host plant species	Pre oviposition period*	Oviposition period*	Post-oviposition period*
Maize	2.08 (1.76)^{b}	2.92 (1.98)^{a}	3.67 (2.16)^{c}
Sorghum	2.19 (1.79)^{b}	2.69 (1.92)^{ab}	3.83 (2.2)^{c}
Castor	2.33 (1.82)^{b}	2.50 (1.87)^{abc}	3.83 (2.19)^{c}
Groundnut	2.50 (1.87)^{ab}	2.33 (1.82)^{bc}	4.33 (2.31)^{bc}
Soybean	2.67 (1.91)^{ab}	2.33 (1.82)^{bc}	4.67 (2.38)^{abc}
Green gram	2.83 (1.95)^{ab}	2.00 (1.73)^{c}	5.33 (2.51)^{ab}
French bean	3.33 (2.08)^{a}	2.00 (1.73)^{c}	5.67 (2.58)^{a}
SEm±	0.073	0.045	0.080
CD at 5%	0.220	0.137	0.244

The means followed by the same letters in each column are non-significant (P<0.05, DMRT)
**= Figures in parentheses are square root transformed values*
 # = Figures in parentheses are arcsin transformed values

Table 2. Influence of different host plant species on egg development of *S.frugiperda*

Different host plant species	Egg mass*	Fecundity /Female*	Egg hatching (%) #	Incubation period*
Maize	7.17 (2.86)^{a}	816.67 (28.59)^{a}	95.46 (79.35)^{a}	2.20 (1.79)^{e}
Sorghum	6.83 (2.8)^{ab}	779.17 (27.93)^{ab}	95.46 (79.35)^{a}	2.33 (1.83)^{de}
Castor	6.17 (2.68)^{bc}	756.50 (27.52)^{b}	91.02 (72.79)^{ab}	2.51 (1.87)^{cd}
Groundnut	5.83 (2.61)^{cd}	620.50 (24.92)^{c}	86.58 (68.63)^{bc}	2.58 (1.89)^{bc}
Soybean	5.33 (2.52)^{d}	515.17 (22.71)^{d}	82.14 (65.09)^{bc}	2.71 (1.93)^{ab}
Green gram	3.67 (2.16)^{e}	354.00 (18.84)^{e}	79.92 (63.41)^{c}	2.84 (1.96)^{a}
French bean	2.83 (1.96)^{f}	311.33 (17.67)^{f}	79.92 (63.38)^{c}	2.93 (1.98)^{a}
SEm±	0.039	0.287	2.701	0.010
CD at 5%	0.119	0.872	3.820	0.030

The means followed by the same letters in each column are non-significant (P<0.05, DMRT)
**= Figures in parentheses are square root transformed values*
 # = Figures in parentheses are arcsin transformed values

Incubation period: The mean incubation period on different host plants exhibited significant differences and was shortest value observed on maize (2.20 day), which was at par with sorghum (2.33 days). Castor (2.51 days) and soybean (2.58 days) were next in the series, but both were at par each other. Whereas prolonged incubation period was observed on french bean (2.93 day), and it did not differ significantly with green gram and groundnut (2.84 and 2.71 day, respectively) (Table 2). The present findings confirm the findings of Bankar (2020), Wang *et al*., (2020), Mohanta (2021), Nandhini *et al*., (2023), Vishwakarma (2023), Gebretsadik *et al*., (2024), and Ahmad *et al*., (2025), as they also observed it to be range between 2.00 to 3.00 days on various host plants.

4. CONCLUSION

This study shows that *S. frugiperda* can Survive and reproduce on maize, soybean, French bean, green gram, castor, sorghum and groundnut, though maize remains its preferred host. Differences suggest French bean may help to reduce pest population. Results vary by population and host plants, highlighting the need for further research on crop rotation, off season refuges, and FAW dispersal patters, especially in India.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

I hereby declare that generative AI technologies such as Large Language Models (ChatGPT), have been used during the writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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