Development and emergence patterns of the tobacco cutworm *Spodoptera litura* (Lepidoptera: Noctuidae)

Yan-Ying Li \(^1\), Jin-Feng Yu \(^1\), Qin Lu \(^2\), Jin Xu \(^1\)*, Hui Ye \(^2\)*

\(^1\)Yunnan key laboratory of international rivers and transboundary ecosafety, Yunnan University, Kunming 650091, P.R. China
\(^2\)Laboratory of biological invasion and ecosafety, Yunnan University, Kunming 650091, P.R. China

*Correspondence: Jin Xu, E-mail: xujin2798@126.com; Hui Ye, E-mail: yehui@ynu.edu.cn

These authors contributed equally

Abstract— Study of lifecycle patterns and rhythms is important to understand the ecology and evolution of insects. The tobacco cutworm *Spodoptera litura* (Lepidoptera: Noctuidae), is a serious polyphagous pest in Asia, Oceania and the Indian subcontinent. The laboratory investigations of development patterns and circadian rhythms described in this paper have shown that the development duration from egg to pupae is 21.5 ± 0.7 d in which the pupation peak took place in the 21st day after eggs being laid. The development duration from egg to adult is 33.0 ± 0.8 d and 35.0 ± 0.7 d for female and male moths, respectively. Adult emergence showed a circadian rhythm in both sexes where adults start to emerge in the afternoon and increased quickly and peaked at dusk and then declined gradually in a few hours into the night. The present study suggests that *S. litura* is a protogynous species. Protogyny may be a mechanism that has evolved to reduce inbreeding because early emerged females are less likely to mate with their brothers. In *S. litura*, eggs are laid in clusters with a cluster contain 50-300 eggs, from which inbreeding risks are increased due to offspring live together with high population density. Therefore, females emerge earlier than males should be extremely important in *S. litura*, and inbreeding avoidance should be the main forth behind the evolution of protogyny in this insect.

**Keywords**— The tobacco cutworm; *Spodoptera litura*; Emergence; Larval development; Circadian rhythms

INTRODUCTION

The tobacco cutworm *Spodoptera litura* (Fabricius, 1775) (Lepidoptera: Noctuidae) is a serious polyphagous pest in Asia, Oceania and the Indian subcontinent [1]. Importantly, its larvae and adults are widely utilised for behavior, physiology and molecular biology study due to its large size and extremely easy to rearing [e.g. 2,3-6]. The sexual maturation and reproductive rhythms of *S. litura* have been studied in detail [6-8]. However, larval development pattern and adult emergence rhythms in laboratory rearing condition of this insect have not been thoroughly investigated. Such knowledge is vital to appraising prospects for further investigation of the behavior, physiology and molecular biology in this increasingly important insect.

In the present study, therefore, the details of larval development and emergence patterns of *S. litura* were investigated. This data will provide vital information for further investigations in this insect.

MATERIALS AND METHODS

Insects

*S. litura* colonies were maintained in separate rearing rooms: normal photoperiod room, lights on from 7:00 to 21:00 and off from 21:00 to 7:00, and reversed photoperiod room, lights on from 19:00 to 9:00 and off from 9:00 to 19:00. Larvae were reared on an artificial diet [9] and adults were fed on a 10% honey solution at 26 °C, RH 60–80% and under a 14:10 h L:D photoperiod regime.

DOI: 10.5176/2251-3140_3.1.46
Larval development and adult emergence

To determine larval development and adult emergence of this insect, newly laid eggs (< 10 h old) were set up as outlined above in separate rearing rooms (500 eggs per room) set with either. For each room, egg hatch, pupation and adult emergence were recorded daily.

To detect the circadian emergence on an hourly basis, the number of emerged adults was recorded hourly during the photopase in the normal photoperiod room and the scotophase in the reversed photoperiod room. Data were pooled and presented.

RESULTS

Black dots (larval heads) in eggs were observed after two days of incubation and eggs hatched in the fourth and fifth day after being laid. The development duration from egg to pupae is 21.5 ± 0.7 d in which the pupation peak took place in the 21st day after eggs being laid (Fig.1). The pupae stage is about 8 days.

The development duration from egg to adult is 33.0 ± 0.8 d and 35.0 ± 0.7 d for female and male moths, respectively. The emergence peak of females happened one day earlier than that of males (Fig. 2).

Adult emergence showed a circadian rhythm in both sexes (Fig. 3) where adults start to emerge in the afternoon and increased quickly and peaked at dusk and then declined gradually in a few hours into the night. The emergence peak of males happened one hour earlier than that of females (Fig. 3).

DISCUSSION

Study of lifecycle patterns and rhythms is important to understand the ecology and evolution of insects [10].

Egg hatching and larval development are influenced by diet and environment conditions [9,11]. Observations in the wild found that the larval development duration from egg to adult ranges from 25 to 58 days in S. litura [11]. In the present study, using an artificial diet [9] and at 26 °C, RH 60–80% and under a 14:10 h L:D photoperiod regime, the shortest development duration obtained is 30 days (Fig. 2).
These results suggest that the laboratory rearing condition used in the present study still can be optimized for *S. litura*.

The present study also found females emerged a few days earlier than males (Fig. 2) and both females and males can mate the first time in the subsequent night after emergence, suggesting that *S. litura* is a protogynous species. Protogyny may be a mechanism that has evolved to reduce inbreeding [12] because early emerged females are less likely to mate with their brothers. In *S. litura*, eggs are laid in clusters with a cluster contain 50-300 eggs [13], from which inbreeding risks are increased due to offspring live together with high population density. Therefore, females emerge earlier than males should be extremely important in *S. litura*, and inbreeding avoidance should be the main forth behind the evolution of protogyny in this species.

Elosion of *S. litura* also showed a circadian rhythm in which most males and females eclosed at dusk and the emergence peak of males happened one hour earlier than that of females (Fig. 3), which may facilitate for mate searching and benefit them from predation avoidance.

ACKNOWLEDGEMENTS

Research reported here was supported by projects from the National Natural Science Foundation Program of China (31160434), the Department of Education of China (2013-46), the Department of Science and Technology of Yunnan Province of China (2011Z110). These results suggest that the laboratory rearing condition used in the present study still can be optimized for *S. litura*.

REFERENCES


Yan-Ying Li

2009-2013 BSc in Plant protection, Yunnan Agriculture University, China

2013 to date, MSc in Entomology, Yunnan University, China