

Consumption and Utilization of *Triticum aestivum* Standing Crop by *Mythimna separata*, (Lepidoptera: Noctuidae): Migratory Insect

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Abstract

The armyworm, *Mythimna separata* (Walker, 1865) (Lepidoptera: Noctuidae), is a global migratory pest of crops. This migratory pest's details study has been continuously followed by different researchers for a long history, factors that affecting the wingbeat frequency (WBF), as the insect is migratory, which mainly related to flight activity of the armyworm, remain Mistry and unclear. During the study, the WBFs of cultured and migrating moths both were observed carefully and tested under different natural and created conditions in the laboratory using the stroboscope. With the observation the study indicated efficiency of conversion of ingested food. These findings about the armyworms provide a deeper and useful understanding of factors that mainly affect conversion of ingested food in *M. separata*, which will be helpful for the researcher and other investigators to developing a regional migratory monitoring system through which they can develop a warning system of the pest, which can help in identifying target insect species based on.

Keywords: *Triticum aestivum*, *Mythimna separata*, Lepidoptera:Noctuidae.

INTRODUCTION

Orientially *Mythimna separata* known as armyworm, *Mythimna separata* Walker (Lepidoptera: Noctuidae), a long-distance, seasonal, migratory agricultural pest (Zhang *et al.* 2018a, (Liu and Zhang 2018) the pest generally distributed in Europe, Asia and Oceania (Sharma *et al.* 2002, Wang *et al.* 2006, Li *et al.* 2019). The larva of armyworm is polyphagous, which can feed more than 100 species of host plants belonging to 16 families, mainly feed on leaves, young stems

and fruits, and greatly effect on the productions of wheat, maize and other crops (Wang *et al.* 2021). It is estimated that alone in China, control costs and the yield losses amount calculated to more than 2 billion Chinese RMB (US\$274 million) every year (Zhang *et al.* 2012; Jiang *et al.* 2014a, b). *Mythimna separata* is not very much cold hardy, therefore In most of northern and northeastern China, it cannot overwinter (Li *et al.* 1965). For survival strategy, *M. separata* develop migratory behavior and they able to adapt different environments and with this they are able to extends their habitat (Southwood 1962). *M. separata* has been confirmed and studied

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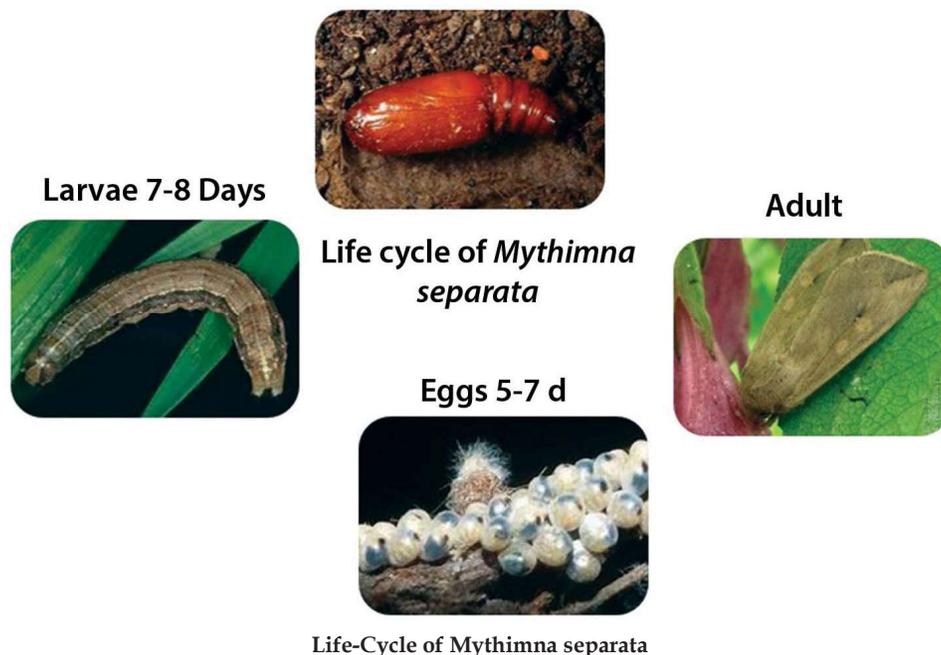
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by various methods includes a round-trip, long-distance migrant and in which they migrates or relocate from south to north in summer and spring and observed back relocate from north to south in the autumn in China (Li *et al.* 1964, Chen *et al.* 1989, Feng *et al.* 2008, Fu 2015, Zhang *et al.* 2018b). Large-scale mark–release–recapture experiments done to study the survival and migration indicated that this insect able to migrate 600–1400 km (Li *et al.* 1964). Tethered laboratory studies and found that these

moths could fly continuously 40 hr and can cover a noted distance of 430 km (Jiang *et al.* 2003). The radar used to observe their speed i.e., Scanning entomological observed and indicated that the pest flew with a noted speed of 4 to 12 m/s and 10 hr of continuous flight at an altitude between 50 to 500 m (Feng *et al.* 2008). In general, the adult migration of *Mythimna separata* is important factor that generally causes these pests outbreaks or attack for multiple crops in a large region (Zhang 2006, Jin *et al.* 2013).



Temperature treatments Eggs masses laid on folded paper within a 24 h period was randomly selected. The five plastic cups were used for eggs in which eggs were transferred for each temperature treatment. And in the experiments three constant while three stage-specific alternating temperature treatments.

MATERIAL AND METHODS

Insect rearing Larvae of *Mythimna separata* collected for study from wheat fields in Bichpuri, India in early July, 2022 and 2023. The population of the *Mythimna* was then reared for over to fifteen generations in a laboratory for prior to conducting temperature experiments. The rearing conditioned in different temperature were set for a photo-period of 14 hrs. L:10 h D, and different relative humidity (RH) in growth chambers.

Observation the given data collected and data analyzed by using different statistical observations.

RESULT & DISCUSSION

Crawlers of *Mythimna separata* were reared at 15-30 °C with alternating 12 hours photoperiodism. At each temperature 75±5 relative humidity was also maintained. Some basic growth parameters like larval periods, increasing body weight, consumption index, growth rate, efficiency with which the ingested and digested food is converted to body substance (E.C.I. and E.C.D) were computed to understand the growth behaviour as mention above temperatures. Observation indicate that larvae develop rapidly at lower temperature required longer duration as compared to higher temperature but food consumption increase with the rise of environmental temperature.

First instar larvae indicate high C.I which decrease with the fifth larval stage. In general C.I gradually increase as the temperature increase. Similarly, at low temperature G.R was very slow which indicate poor utilization of food. A.D also varied considerably at different stages of development.

Usually, fourth instar larvae digested less food but no definite correlation between A.D, larval instar and environmental temperature was observed except in

third, fourth and fifth instar during which gradually there is decreasing of A.D recorded with the rise in temperature.

$$\text{Efficiency of conversion of ingested food to body substances} = \frac{\text{Wt. gained by animal during feeding period}}{\text{Wt. of ingested food}} \times 100$$

Table 1: Consumption and utilization of *Triticum aestivum* by various larval instars of *Mythimna separate* at 15°C

Instar	Larval period (in days)	Food eaten (in mg)	Faeces produced	E.C.I
I	5.1	0.73	0.31	13.8
II	6.4	2.41	0.65	9.2
III	4.6	3.02	1.21	18.8
IV	6.1	10.4	3.90	21.3
V	5.0	26.3	16.7	21.0
VI	6.7	125.2	68.5	17.8
VII	7.2	465.3	297.1	8.1
Total	41.1	633.63	388.37	110.0

Table 2: Consumption and utilization of *Triticum aestivum* by various larval instars of *Mythimna separate* at 20 °C

Instar	Larval period (in days)	Food eaten (in mg)	Faeces produced	E.C.I
I	4.1	0.94	0.47	13.8
II	4.2	1.35	0.82	12.5
III	4.6	3.61	1.83	25.9
IV	5.0	15.71	7.2	25.6
V	6.0	54.7	35.5	23.7
VI	9.6	114.3	69.6	16.00
Total	33.5	190.61	115.33	117.5

Table 3: Consumption and utilization of *Triticum aestivum* by various larval instars of *Mythimna separate* at 25°C

Instar	Larval period (in days)	Food eaten (in mg)	Faeces produced	E.C.I
I	3.0	0.97	0.47	15.6
II	3.2	2.20	1.04	13.2
III	4.0	6.2	3.2	30.3
IV	3.50	13.5	7.5	28.4
V	4.9	52.4	31.7	28.8
VI	9.5	152.8	18.98	14.1
Total	28.10	228.07	62.89	130.4

Table 4: Consumption and utilization of *Triticum aestivum* by various larval instars of *Mythimna separate* at 30°C

Instar	Larval period (in days)	Food eaten (in mg)	Faeces produced	E.C.I
I	3.1	1.1	0.5	17.9
II	2.8	5.1	3.8	10.7
III	4.02	10.5	6.4	30.6
IV	3.76	42.6	25.6	12.9
V	5.01	141.2	72.0	13.2
VI	8.59	304.3	213.2	5.2
Total	27.30	504.8	323.3	90.5

**Fig. 1:** Larva of *Mythimna separata*

The Efficiency of conversion indigested food for entire larval life at 15, 20, 25 and 30°C were noted 110.0, 117.5, 130.4 and 90.5 respectively during the study.

Temperature Influence on Development: Larval development was accelerated at higher temperatures (25-30°C) compared to lower temperatures (15-20°C). This is evident from the shorter larval periods observed at higher temperatures in *Tables 2.2* and *2.3*.

Temperature and Food Consumption: Food consumption increased with rising environmental temperature. This is evident in the "Food Eaten" column across *Tables 2.1, 2.2,* and *2.3*. First instar larvae exhibited the highest C.I. (Efficiency of Conversion of Ingested Food), which gradually decreased in subsequent instars. This trend is consistent across all temperature conditions. C.I. generally increased with rising environmental temperature.

Growth Rate (G.R.): G.R. was significantly slower at lower temperatures (15°C), indicating

less efficient food utilization. This is supported by the longer larval periods and lower C.I. values in *Table 1*.

Apparent Digestibility (A.D.): A.D. varied considerably across different larval instars. Fourth instar larvae generally exhibited lower A.D. A negative correlation between A.D., larval instar, and environmental temperature was observed in the third, fourth, and fifth instars, with A.D. decreasing as temperature increased. This is evident in the decreasing A.D. values in these instars across *Table 1 to 3*.

CONCLUSION

This study investigated the influence of temperature on the growth and development of *Mythimna separata* crawlers. The findings demonstrate a clear temperature-dependent effect on various growth parameters. Higher temperatures significantly accelerated larval development while lower temperatures prolonged

the larval period. Increased temperature generally led to higher food consumption. Growth rates were significantly impacted by temperature, with slower growth observed at lower temperatures. Apparent digestibility exhibited complex patterns, with variations across instars and a negative correlation with temperature in later instars. These findings suggest that temperature plays a crucial role in regulating the growth and development of *M. separata*. Understanding these temperature-dependent relationships is crucial for predicting population dynamics, developing effective pest management strategies, and optimizing rearing conditions for this insect species.

REFERENCES

1. Attisano, A., J. T. Murphy, A. Vickers, and P. J. Moore.2015. A simple flight mill for the study of tethered flight in insects. *J. Vis. Exp.* 106: e5337.
2. Carne, P.B. 1966. Growth and food consumption during larval stage of *Paropsis atomaria* (Coleoptera:Chrysomelidae).
3. Chlodny, J. 1967. The amount of food consumed and production output of larvae of *Colorado beetle* (*Leptinotarsa decemlineata* say). *Ekologia Polska-Seria A*, 15:531-541.
4. Fu, X. W. 2015. Study on the community structure and population dynamics of migratory insects across the Bohai strait. Doctoral dissertation. Chinese Academy of Agricultural Sciences, Beijing.
5. Guo, J. L., X. K. Li, X. J. Shen, M. L. Wang, and K. M. Wu.2020. Flight performance of *Mamestra brassicae* (Lepidoptera: Noctuidae) under different biotic and abiotic conditions. *J. Insect Sci.* 20: 2.
6. Hu, C. Y., and L. P. Hu.2022. How to use analysis of variance correctly—the multiple comparisons among the multiple means. *Sichuan Mental Health.* 35: 21–25.
7. Institute of Plant Protection Chinese Academy of Agricultural Sciences, Chinese Plant Protection Society. 2015. *Crop pests and diseases in China*, 3rd ed. China Agriculture Press, Beijing, pp. 1430–1440
8. Liu, H., and Z. Y. Zhang.2018. Occurrence regularity and control technology of maize armyworm. *Mod. Agric. Sci. Technol.* 4: 36–37.
9. Li, M. M., B. L. Li, S. X. Jiang, Y. W. Zhao, X. L. Xu, and J. X. Wu.2019. Microsatellite based analysis of genetic structure and gene flow of *Mythimna separata* (Walker) (Lepidoptera: Noctuidae) in China. *Ecol. Evol.* 9: 13426–13437.
10. Li, G. B., H. X. Wang, and W. X. Hu.1964. Hypothesis of damage caused by seasonal migration of oriental armyworm and mark-recovery experiment. *Acta Phytophyl. Sin.* 3: 101–109.
11. Li, M. C., R. L. Chen, T. Y. Liu, and C. S. Leo.1965. Studies on the source of the early spring generation of the armyworm, *Leucania separata* Walker in Kirin Province: I. Studies on the hibernation and problems of source. *Acta Entomol. Sin.* 14: 21–31.
12. Prasad, J. 1973. Growth and development of the tobacco caterpillar, *Spodoptera litoralis* (Boisduval) (Lepidoptera:Noctuidae) on several host plants, M.sc. thesis, G.B.P.U.A. & T. Pantnagar, India.
13. Sharma, H. C., D. J. Sullivan, and V. S. Bhatnagar.2002. Population dynamics and natural mortality factors of the Oriental armyworm, *Mythimna separata* (Lepidoptera: Noctuidae), in South Central India. *Crop Prot.* 21: 721–732.
14. Wang, Y. R., J. S. Zhang, R. Wang, Y. M. Hou, H. A. Fu, Y. Xie, S. J. Gao, and J. D. Wang.2021. Unveiling sugarcane defense response to *Mythimna separata* herbivory by a combination of transcriptome and metabolic analyses. *Pest Manage. Sci.* 77: 4799–4809.
15. Zhang, Y. H., Z. Zhang, Y. Y. Jiang, J. Zeng, Y. B. Gao, and D. F. Cheng.2012. Preliminary analysis of the outbreak of the third-generation armyworm *Mythimna separata* in China in 2012. *Plant Prot.* 38: 1–8.
16. Zhang, Z., Y. H. Zhang, J. Wang, J. Liu, and Q. B. Tang.2018b. Analysis on the migration of first-generation *Mythimna separata* (Walker) in China in 2013. *J. Integr. Agric.* 17: 1527–1537.

