



POPULATION DYNAMICS OF THE RICE LEAF FOLDER *CNAPHALOCROCIS MEDINALIS* GUENEE: A LIFETABLE STUDY

P S ARYA^{1,2}, SUBHASH CHANDER^{3*}, S RAJNA¹, PRABHULINGA TENGURI³ AND YOGESH YELE⁴

¹Division of Entomology, ICAR-Indian Agricultural Research Institute (IARI), New Delhi 110012, India

²Chaudhary Chhotu Ram (Post Graduate) College, Muzaffarnagar 251001, Uttar Pradesh, India

³ICAR-National Research Centre for Integrated Pest Management, New Delhi 110012, India

⁴ICAR-Central Institute for Cotton Research, Nagpur 440010, Maharashtra, India

⁵ICAR-National Institute of Biotic Stress Management, Raipur 493225, Chhattisgarh, India

*Email: schanderthakur@gmail.com (corresponding author): ORCID ID 0000-0003-0741-4276

ABSTRACT

The rice leaf folder *Cnaphalocrocis medinalis* Guenee has become a major concern, causing outbreaks in various parts of India. A lifetable study was conducted to analyze the growth, survival, reproduction, and mortality of *C. medinalis*, aiming to determine the weakest lifestages and unravel its population dynamics. The study observed the highest survival rate at the fourth-instar larval stage and the lowest during the egg and first-instar larval stages. A population trend index of 5.9 was observed, indicating significant population growth.

Key words: *Cnaphalocrocis medinalis*, rice, lifetable, developmental stages, survival, mortality, k value, weakest lifestage, population trend index, population dynamics, IPM, larval instars, population trend index

Rice (*Oryza sativa*) is one of the important cereal crops in India, cultivated over an area of 46.4 m ha with a production of 130.29 mt during 2021-22 (DAC, 2023). However, rice cultivation is prone to substantial environmental stresses, with biotic stress causing 52% of annual production loss, of which 21% is caused by insects (Tenguri et al., 2023). Amongst the insect pests attacking rice, the rice leaf folder *Cnaphalocrocis medinalis* Guenee (Lepidoptera: Pyralidae) is a predominant defoliator and perhaps one of the most debilitating pests (Luo, 2010). From the second instar onwards, the larvae build their shelter by folding the leaf longitudinally and attaching its margins with silk strands. The larvae feed on the mesophyll tissue of the leaf, resulting in longitudinal white streaks. Even a single larva can harm multiple rice leaves, and this damage can add up and reduce photosynthesis. Ultimately, this can result in decreased crop yield. The rice leaf folder, formerly considered a minor pest, has attained major pest status, causing population outbreaks in recent decades in various parts of India (Singh et al., 2017). The infestation often lasts throughout the crop cycle, severe during the reproductive and ripening stages. Understanding the insect behavioral ecology and the various mortality factors influencing their population will enhance our abilities to effectively manage pest populations. However, studying the rice leaf folder has proven challenging due to difficulties in its laboratory breeding (Jian et al., 2012).

A lifetable is an effective tool for comprehending the growth, development, mortality, and survival of insects for ecological studies. It divides the insect life cycle into several time periods or developmental stages and provides an extensive overview of its birth, death, and dispersal under varying conditions (Schowalter, 2016). The parameters used in the lifetable help in detecting fluctuations in insect populations at various stages of development and throughout their lifecycles (Kakde et al., 2014). A cohort lifetable or an age-dependent lifetable takes account of the mortality experience of a particular cohort from its time of birth till the death of the last individual (Carey, 2001). Along with the lifetable analysis, the population trend index is invaluable for understanding, analyzing, and predicting population dynamics. Hence, a lifetable study was undertaken to elucidate the mechanisms of population change of *C. medinalis* and to determine their weakest lifestages.

MATERIALS AND METHODS

The culture of *C. medinalis* was initiated with field collected adults and maintained at the climate control facility at the Division of Entomology, Indian Agricultural Research Institute (IARI), New Delhi, India (28°38'N, 77°09'E). The relative temperature and humidity were maintained at 27± 1°C and 70± 5% respectively. The rearing method and culture maintenance were followed as per Chintalapati et al. (2015). Study was conducted

indicated that the population would increase 5.9 times after one generation. A population trend index can be considered as a measure to forecast the population size, wherein an index value of >1 indicates the growth of the population, and a value of <1 points toward its suppression as opined earlier (Cui et al., 2018). Similar to our study, the population trend index study on the *C. medinalis* population was conducted by researchers like Jian et al. (2012) and Padmavathi et al. (2013) and both of them revealed an index value >1, which shows the potential for the buildup of the population in the upcoming generation. Life table analysis, coupled with population trend indices, provide valuable insights into the growth, survival, reproduction, and mortality patterns of the rice leaf folder population. It can aid in predicting the potential population buildup as well as in identifying the weakest life stage for implementing targeted control measures.

ACKNOWLEDGEMENTS

The authors acknowledge the Entomology Division and ICAR-Indian Agricultural Research Institute, New Delhi, for providing facilities.

AUTHOR CONTRIBUTION STATEMENT

APS and SC conceived and designed the research. APS, SR, PT, and YY conducted experiments. APS, SC, and SR analyzed data. APS and SC wrote the manuscript. All authors read and approved the manuscript

CONFLICT OF INTEREST

No conflict of interest

REFERENCES

- Ali A, Rizvi P Q. 2010. Age and stage-specific lifetable of *Coccinella septempunctata* (Coleoptera: Coccinellidae) at varying temperatures. *World Journal of Agricultural Sciences* 6(3): 268-273.
- Ankit K, Maan S, Ram S, Banvir S. 2016. Life cycle of rice leaf folder, *Cnaphalocrocis medinalis* (Guenee) on rice cultivar HKR-47. *International Journal of Agriculture Sciences* 8(52): 2488-2490.
- Carey J R. 2001. Insect biodemography. *Annual Review of Entomology* 46(1): 79-110.
- Chintalapati P, Gururaj K, Vallabuni S, Yenumulag P. 2015. Physiological age status of female adults and off-season survival of rice leaf folder *Cnaphalocrocis medinalis* in India. *Rice Science* 22(5): 237-244.
- Cui J, Zhu S Y, Bi R, Xu W, Gao Y, Shi S S. 2018. Effect of temperature on the development, survival, and fecundity of *Heliothis virescens* (Lepidoptera: Noctuidae). *Journal of Economic Entomology* 111(4): 1940-1946.
- Cuthbertson A G, Mathers J J, Blackburn L F, Korycinska A, Luo W, Jacobson R J, Northing P. 2013. Population development of *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) under simulated UK glasshouse conditions. *Insects* 4(2): 185-197.
- DAC, 2023. Annual report 2022-23. <https://agricoop.nic.in/en/Annual#gsc.tab=0>
- Hasan F, Ansari M S. 2011. Population growth of *Pieris brassicae* (L.) (Lepidoptera: Pieridae) on different cole crops under laboratory conditions. *Journal of Pest Science* 84: 179-186.
- Jian X U, Li C M, Yang Y J, Qi J H, Zheng X S, HU R L, Zhong X L U, Qin L I U. 2012. Growth and reproduction of artificially fed *Cnaphalocrocis medinalis*. *Rice Science* 19(3): 247-251.
- Kakde A M, Patel K G, Tayade S. 2014. Role of lifetable in insect pest management-A review. *IOSR Journal of Agriculture and Veterinary Science* 7(1): 40-43.
- Luo S. 2010. Occurrence of rice leaf roller in China and its identification and prevention. *Plant Diseases and Pests* 1(2): 13-18.
- Manikandan N, Kennedy J S, Geethalakshmi V. 2023. Stage specific lifetable of rice leaf folder, *Cnaphalocrocis medinalis* (Guen.) at different temperature regimes. *International Journal of Environment and Climate Change* 13(3): 200-205.
- Marina R, Nur Azura A, Lau W H, Yaakop S. 2019. Life table and demographic parameters of rice leaf folder, *Cnaphalocrocis medinalis* Guenee (Lepidoptera: Pyralidae). *Serangga* 24(2): 49-60.
- Padmavathi C, Katti G, Sailaja V, Padmakumari A P, Jhansilakshmi V, Prabhakar M, Prasad Y G. 2013. Temperature thresholds and thermal requirements for the development of the rice leaf folder, *Cnaphalocrocis medinalis*. *Journal of Insect Science* 13(1): 96.
- Park H H, Park C G, Ahn J J. 2014. Oviposition model of *Cnaphalocrocis medinalis* Guenee (Lepidoptera: Pyralidae). *Journal of Asia-Pacific Entomology* 17(4): 781-786.
- Pereira E J G, Picanço M C, Bacci L, Della Lucia T M C, Silva É M, Fernandes F L. 2007. Natural mortality factors of *Leucoptera coffeella* (Lepidoptera: Lyonetiidae) on *Coffea arabica*. *Biocontrol Science and Technology* 17(5): 441-455.
- Schowalter T D. 2016. *Insect ecology: an ecosystem approach*. 4th edition. Academic Press, San Diego.
- Singh P, Chander S, Husain M, Pal V, Singh P. 2017. Development of a forewarning model to predict rice leaf folder (*Cnaphalocrocis medinalis* Guenee) incidence in Punjab, India. *Proceedings of the National Academy of Sciences, India Section B: Biological Sciences* 87: 201-206.
- Soufbarf M, Fathipour Y, Karimzadeh J, Zalucki M P. 2010. Development and age-specific mortality of diamondback moth on Brassica host plants: pattern and causes of mortality under laboratory conditions. *Annals of the Entomological Society of America* 103(4): 574-579.
- Southwood T R E, Henderson P A. 2000. *Ecological methods*. 3rd edition. Blackwell Science, Oxford.
- Tenguri P, Chander S, Nebapure S, Arya P S, Madhu T N, Yele Y. 2023. Effect of silicon amendment on herbivore-induced plant volatiles of rice plant infested by brown planthopper *Nilaparvata lugens* (Stål). *Indian Journal of Entomology* 85(2): 385-388.

(Manuscript Received: June, 2023; Revised: August, 2023;
Accepted: September, 2023; Online Published: October, 2023)
Online First in www.entosocindia.org and indianentomology.org Ref. No. e23335