

Studies on developmental biology of lesser grain borer, *Rhyzopertha dominica* (F.) (Coleoptera, Bostrichidae) at different seasons on paddy

V. Ramalakshmi*, Deepayan Padhy, T. Mounika, Manish Kumar Yadav and
Goutam Hosamani

Department of Entomology, M.S. Swaminathan School of Agriculture, Centurion University of
Technology and Management, Paralakhemundi Campus, Gajapati, R Sitapur 761211, Odisha, India.
Email: ramalaxmiv06@gmail.com; deepayan28@cutm.ac.in; tumma.mounika@cutm.ac.in;
manish.yadav@cutm.ac.in; goutam.hosamani@cutm.ac.in

ABSTRACT: Developmental biology of *Rhyzopertha dominica* (F.) (Coleoptera, Bostrichidae) was conducted using the paddy variety RNR-15048 across three seasons: the rainy season, winter season and summer season. The results indicated that the highest and lowest fecundity was observed during the rainy season and summer seasons 200-220 eggs and 46-57 eggs per female, respectively. The longest egg period was found in winter with a mean of 7.80 ± 0.77 days, while the shortest duration was observed with a mean of 4.53 ± 1.33 days in summer. The grub and pupal period were longest in winter with an average of 75.33 ± 7.00 days, and shortest in summer with an average 35.23 ± 1.74 days. The data showed that adult male lesser grain borers take about 69-74 days for egg laying to adult emergence in the winter, and 31-37 days in summer, while adult females require long time of 81-93 days in winter, and 33-39 days in summer.

© 2025 Association for Advancement of Entomology

KEY WORDS: Adult longevity, fecundity, life cycle, seasonal effect, sex ratio

Rice (*Oryza sativa* L.) is a vital cereal crop worldwide, serving as a staple food for more than half of the global population. Its significance is emphasized by the economic and qualitative aspects of rice production, distinguishing it from other cereals. Unlike other grains, rice is typically consumed as whole grains. However, when stored for over three months, rice becomes highly susceptible to insect infestations, leading to both quantitative and qualitative losses (Manandhar *et al.*, 2018). In India, these losses range from 5 to 25 per cent due to storage insects (Prakash and Rao, 1995). *Rhyzopertha dominica* (F.) (Coleoptera,

Bostrichidae) is one of the most significant pests affecting stored cereals, including rice, the adult female lays eggs outside the grain kernel, and the newly hatched larvae feed voraciously inside, developing within the grain until they emerge as adults (Sola *et al.*, 2017). Notably, *R. dominica* causes damage at both grub and adults stages. Adult beetles exhibit migratory behaviour between storage facilities, leading to substantial losses in both quantity and quality of grain and its derivatives (Arthur *et al.*, 2012; Ramalakshmi *et al.*, 2024). Moreover, infestation by *R. dominica* diminishes essential amino acid levels in wheat, maize, and

* Author for correspondence

sorghum, as well as the germination capacity and vigour of seeds (Jood *et al.*, 1996). Infested grains become vulnerable to further damage by secondary pests and fungi, amplifying the overall detriment to stored grains (Subramanyam *et al.*, 1996). Common strategies to minimize insect infestation during storage include altering the abiotic components of storage, such as grain moisture content, temperature conditions, and the type of storage structure, to prevent insect development. Given the pest's importance, laboratory studies were conducted to understand its biology better.

The biology of *R. dominica* was studied using the paddy variety RNR-15048, sourced from the seed production unit of Centurion University of Technology and Management, during the rainy season (July-October 2022), winter season (November 2022-February 2023), and summer season (March-June 2023) at the Entomology laboratory, M.S. Swaminathan School of Agriculture, Centurion University of Technology and Management. Grains were disinfected (Kumawat, 2007) and equilibrate moisture content

in grains (Solomon, 1951). This pre-conditioned seed material was then used for the biology studies. Ten pairs of 1- to 2-day old *R. dominica* adults were introduced into Petri dishes (10 cm diameter, 1.5 cm depth), covered with black paper (21 cm × 15 cm), and containing 50 paddy grains for egg-laying. Eggs were collected and transferred to glass vials (9.5 cm long × 2.5 cm diameter) containing 10 grams of grains. Each vial was inoculated with 30 eggs, with ten replications maintained to observe the total developmental period from egg to adult and to assess the sex ratio. Additionally, 50 eggs were placed in separate Petri dishes, with five dishes serving as replications. These setups were provided with a few sound grains to study the incubation, larval, and pupal periods, as well as adult longevity, pre-oviposition, oviposition, and post-oviposition periods, and fecundity.

The findings revealed significant seasonal variations in developmental periods, fecundity, and longevity (Table 1). The egg period ranged from 5-8 days (mean 6.70 ± 0.94 days) in the rainy season, 7-9 days (mean 7.80 ± 0.77 days) in winter, and 3-7

Table 1. Developmental period and biological attributes of *R. dominica* on rice (Var. RNR-15048)

Life Stages and attributes	Developmental period (days) and fecundity (no) during different seasons					
	Rainy season		Winter season		Summer season	
	Range	Mean±SD	Range	Mean ±SD	Range	Mean ±SD
Egg period (n=60)	5-8	6.70±0.94	7-9	7.80±0.77	3-7	4.53±1.33
Grub and pupal period (n=60)	31-45	40.2±4.05	62-83	75.33±7.00	32-37	35.23±1.74
Total development period -male (n=30)	37-42	40.06±1.63	69-74	71.16±1.86	31-37	34.16±1.63
Total development period –Female (n=30)	39-46	42.16±2.29	81-93	87.70±4.49	33-39	37.07±1.93
Sex ratio		1.27:1		1.08:1		0.72:1
Pre-oviposition period (n=30)	4-6	4.77±0.80	5-8	6.37±1.14	6-13	9.1±1.98
Oviposition period (n=30)	22-28	24.73±2.06	15-24	22.23±3.18	10-18	12.5±2.24
Fecundity (eggs/female) (n=30)	200-220	211.16±6.28	89-134	113.03± 16.01	46 -57	52.3±2.97
Post-oviposition period (n=30)	7-9	8.03±0.87	6-7	6.50±0.50	4-7	5.33±0.78
Longevity of Adult Male (n=30)	25-38	35.20±3.96	33-41	38.03±2.81	13-27	19.63±5.6
Longevity of Adult Female (n=30)	35-41	38.50±1.66	37-45	39.26±1.94	16-29	24.63±3.31

Note: Rainy season (July-Oct, 2022; mean min temp-17.4°C; mean max temp-29.0°C; Avg. RH -87.89%); Winter season (Nov, 2022-Feb, 2023; mean min temp- 7.3°C; mean max temp-28.9°C; Avg. RH -75.51%); Summer season (March-June, 2023; mean min temp- 15.63°C; mean max temp-36.05°C; Av.RH-69.2%); n= Number of individuals observed

days (mean 4.53 ± 1.33 days) in summer, indicating the shortest duration during summer. The grub and pupal period also varied considerably, being 31-45 days (mean 40.20 ± 4.05 days) in the rainy season, 62-83 days (mean 75.33 ± 7.00 days) in winter, and 32-37 days (mean 35.23 ± 1.74 days) in summer.

From egg-laying to adult emergence, males required 37-42 days (mean 40.06 ± 1.63 days) in the rainy season, 69-74 days (mean 71.16 ± 1.86 days) in winter, and 31-37 days (mean 34.16 ± 1.63 days) in summer. Females took a slightly longer duration, ranging from 39-46 days (mean 42.16 ± 2.29 days) in the rainy season, 81-93 days (mean 87.70 ± 4.49 days) in winter, and 33-39 days (mean 37.07 ± 1.93 days) in summer. Notably, the sex ratio (female: male) varied across seasons, being 1.27:1 in the rainy season, 1.08:1 in winter, and 0.72:1 in summer, indicating a male-biased emergence during summer.

The pre-oviposition period was shortest in the rainy season (4-6 days, mean 4.77 ± 0.80 days) and longest in summer (6-13 days, mean 9.10 ± 1.98 days). Similarly, the oviposition period was longest during the rainy season (22-28 days, mean 24.73 ± 2.06 days), followed by winter (15-24 days, mean 22.23 ± 3.18 days) and summer (10-18 days, mean 12.50 ± 2.24 days). Correspondingly, fecundity was highest in the rainy season (200-220 eggs, mean 211.16 ± 6.28 eggs per female) and lowest in summer (46-57 eggs, mean 52.30 ± 2.97 eggs per female). Post-oviposition periods varied across seasons, being longest in the rainy season (7-9 days, mean 8.03 ± 0.87 days) and shortest in summer (4-7 days, mean 5.33 ± 0.78 days).

Adult longevity also showed seasonal differences. Males lived 33-41 days (mean 38.03 ± 2.81 days) in winter, 25-38 days (mean 35.20 ± 3.96 days) in the rainy season, and 13-27 days (mean 19.63 ± 5.60 days) in summer. Females exhibited longer lifespans than males in all seasons, with 37-45 days (mean 39.26 ± 1.94 days) in winter, 35-41 days (mean 38.50 ± 1.66 days) in the rainy season, and 16-29 days (mean 24.63 ± 3.31 days) in summer.

These findings align with earlier studies. Kumawat (2007) reported that fecundity peaked at moderate temperatures ($30 \pm 10^\circ\text{C}$) with relative humidity

($75 \pm 5\%$), similar to the present study's observations during the rainy season. Conversely, fecundity was reduced under unfavourable conditions, such as higher temperatures and lower humidity, consistent with the observed trends in summer. Win *et al.* (2020) demonstrated significant seasonal differences in fecundity and developmental durations, with higher egg counts and shorter developmental periods during the rainy season. Kumar *et al.* (2017) also reported comparable developmental trends, highlighting the influence of temperature and humidity on insect biology. Ajaykumara *et al.* (2018) noted seasonal impacts on the life cycle of *R. dominica*, with shorter durations in summer and kharif seasons. The present study corroborates these findings, emphasizing the influence of seasonal variations on the life history traits of *R. dominica*.

ACKNOWLEDGEMENT

The authors would like to thank Department of Entomology, M.S. Swaminathan School of Agriculture, Centurion University of Technology and Management for providing the laboratory facilities for the conduct of these experiments.

REFERENCES

- Ajaykumara K.M., Thirumalaraju G.T. and Anjali A.S. (2018) Seasonal variations in the biology of lesser grain borer *Rhyzopertha dominica* (F.) (Coleoptera: Bostrychidae) on stored maize under laboratory conditions. *Journal of Entomology and Zoology Studies* 6(1): 516–522.
- Arthur F.H., Ondier G.O. and Siebenmorgen T.J. (2012) Impact of *Rhyzopertha dominica* (F.) on quality parameters of milled rice. *Journal of Stored Products Research* 48: 137–142.
- Jood S., Kapoor A.C. and Singh R. (1996) Effect of infestation and storage on lipids of cereals. *Journal of Agriculture and Food Chemistry* 44: 1502–1506.
- Kumar P.S., Maheswari T.U. and Padmakumari A.P. (2017) Comparative biology of *Rhyzopertha dominica* (Fab.) in major cereals. *International Journal of Current Microbiological Application Science* 6(7): 2205–2210.
- Kumawat K.C. (2007) Effect of abiotic factors on biology of *Rhyzopertha dominica* (fab.) on wheat. *Annals*

- of Plant Protection Sciences 15(1):111–115.
- Manandhar A., Milindi P. and Shah A. (2018) An overview of the post-harvest grain storage practices of smallholder farmers in developing countries. *Agriculture* 8: 57.
- Prakash A. and Rao J. (1995) Insect pest management in stored-rice ecosystems. D G Jayas, N D G White, W E Muir (eds.) *Stored grain ecosystem*. New York. Basel. Hongkong: Marcel Dekker. pp1–10.
- Ramalakshmi V., Satapathy C.R., Shimantini B., Ray S., Gaikwad D. and Yadav M.K. (2024) Influence of rice grain traits to their susceptibility to the lesser grain borer, *Rhyzopertha dominica* (F.) (Coleoptera, Bostrichidae). *ENTOMON* 49(1): 109-116.
- Sola M., Lundgren J.G, Agusti N. and Riudavets J. (2017) Detection and quantification of the insect pest *Rhyzopertha dominica* (F.) (Coleoptera: Bostrichidae) in rice by qPCR. *Journal of Stored Products Research* 71: 106–111.
- Solomon M.E. (1951) Control of humidity with potassium hydroxide, sulphuric acid, or other solutions. *Bulletin of Entomological Research* 42: 543–554.
- Subramanyam B. and Hagstrum D.W. (1996) Resistance measurements and managements. Subramanyam B, Hagstrum D W (eds.), *Integrated management of insects in stored products*. Marcel Dekker, NewYork. pp 331–389.
- Win N., Rolania K. and Yadav S.S. (2020) Effect of seasonal variation on the biology of lesser grain borer, *Rhyzopertha dominica* (Fabricius) on paddy. *Journal of Entomology and Zoology Studies* 8(3): 694–699.

(Received May 06, 2025; revised ms accepted August 13, 2025; published September 30, 2025)