



Study on biology of lesser grain borer (*Rhyzopertha dominica*) on wheat

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Abstract

Study on "Biology of lesser grain borer (*Rhyzopertha dominica*) on wheat" was carried out in PG laboratory, Department of Entomology, N. M. College of Agriculture, Navsari Agricultural University, Navsari during 2022-23 on the wheat variety Lok-1 Study was carried out at ambient temperature of $30\pm 1^\circ\text{C}$ and $70\pm 5\%$ relative humidity. The eggs were laid on grain surface, nearly oblong shaped with round ends and glued singly over the grain. Average fecundity of *R. dominica* was 46 ± 6.43 eggs/female. The average incubation period of eggs was 5.58 ± 0.79 days. The average hatching percentage was 94.08 ± 1.75 per cent. The entire development of larval stage was completed inside the grain. Pupation takes place inside the hollow shell of the seed. The average development period was 46.94 ± 2.58 days. The average pre-oviposition period was of 5.64 ± 1.93 days. The upper and lower limits of oviposition were 25 days and 20 days, respectively. The post-oviposition period varied from 2 to 6 days with an average of 4.2 ± 1.11 days. The average adult longevity of male and female were 14.91 ± 0.99 days and 21.88 ± 1.86 days, respectively. Sex ratio of (male: female) was 1.23:1.04. An average life cycle of male adult beetle was 60.52 ± 2.87 days and female were 69.96 ± 2.02 days.

Keywords: Biology, *Rhyzopertha dominica*, Wheat

Introduction

Wheat (*Triticum aestivum* L.) belongs to family Poaceae, is a staple food in the world and said to be originated from South Western Asia. In India, it has occupied an area of 341.57 lakh hectares with an annual production of 112.18 million tonnes (Anon., 2023). However, Gujarat occupied 6416.93 hectares area with an annual production of 15384.80 MT (Anon., 2022). Among the wheat growing countries, India ranked second both in terms of area and production.

Lesser grain borer inflicts colossal loss to grains and grain products during storage. The amount of damage in quality, quantity and health due to insect infestation could account for a huge monetary loss to the country's economy. researchers for effective management of lesser grain borer and have some knowledge regarding the basis of resistance of different wheat varieties to the pest.

Wheat cultivation has been undergoing a marked change over the past few decades, as per as variety complex is concern and new varieties are coming up every year. With such an enormous change the insect pest complex is also expected. The laboratory studies in recent years established that varieties have some resistance to *R. dominica*. With a view to test the relative resistance of some newly developed varieties.

Generally, for the management of stored wheat pests' knowledge about the different stages or life cycle of lesser grain bore is needy. It is helpful to find out various alternatives to the chemicals that can effectively prevent storage losses, are easily available, affordable, safer and least detrimental to the environment. There has been little emphasis to study biology of *Rhyzopertha dominica*. on wheat under laboratory was useful.

Material and Methods

The required quantity of wheat was collected, cleaned, sieved to remove the undesired foreign materials and

utilized for rearing of *R. dominica*. The grain was incubated at 70°C in a BOD incubator for 4 hours to kill any hidden *R. dominica* infestation before use.

The initial culture of *R. dominica* was collected from wheat variety Lok-1 and maintained at $30 \pm 2^\circ\text{C}$ in BOD incubator. A single pair of *R. dominica* was obtained from the stock culture and sterilized at the temperature of 50°C for 4 hrs. in the oven to eliminate the hidden infestation and were conditioned. Twenty-five pairs of one- or two-days old beetles from the initial culture was released in cylindrical glass jar measuring 20×15 cm containing 250 g grains. Subsequently adults emerged from this culture were used for further study.

The biological studies of *R. dominica* were undertaken in open environmental condition in the laboratory by taking undamaged grain and a pair of adults in glass jar covered with muslin cloth. Time to time observations on egg laying, hatching of eggs, larval-pupal period and adult emergence and longevity were recorded. Finally, developmental period, life span and sex ratio were worked out.

In order to facilitate the observations for egg period one egg was kept on each grain, while the others were removed with the help of needle. Such 50 grains were kept individually in plastic container (6×4 cm) under laboratory conditions. Incubation period was recorded as the duration of time taken from egg laying to hatching.

To calculate hatching per cent total number of eggs laid by female and number of hatched eggs were recorded. Eggs were observed daily in the morning and evening for hatching of eggs.

$$\text{Hatching percentage} = \frac{\text{Number of eggs hatched out}}{\text{Total number of eggs laid by female}} \times 100$$

The duration of larval pupal period was calculated as the number of days taken from hatching of egg till the adult emergence. The pre-oviposition period was calculated from the date of emergence of female and the date of starting of

egg laying. The oviposition period was calculated from the date of starting of egg laying and the date of stopping of egg laying by the female. Post oviposition period was calculated from the date of stopping of egg laying and the date of female death. To know the adult longevity the male and female were kept in plastic container (6 x 4 cm) separately after mating. The longevity was calculated from emergence of adult to death of the adult. Sex-ratio was worked out by dividing the number of females by number of males emerged during biological study.

Developmental period was recorded from egg laying to emergence of adult. For this purpose, 50 individuals were taken separately in a small container with 10 ml capacity. The duration of entire lifespan was considered as the period between date of egg laying and date of death of adults. The measurement of length and width of egg, abdomen, antennae and total body length (from head to posterior tip of abdomen) of each of 25 male and female were recorded with the help of stereo trinocular microscope (Make: Olympus-SZ 61) fitted with Brand Catcam-130 camera having software power Scope photo (version 3.1). The recorded observations were computed and expressed in range and mean with standard deviation.

The fecundity was carried out by taking ten pairs of newly emerged adults in specimen glass vials (15×5 cm) containing 500g of grains. The eggs laid were counted every day and the total number of eggs laid during the lifespan of the adult female was taken into consideration. Fecundity was recorded by totaling the number of eggs laid during the oviposition period for each female. The observations were taken from such 10 sets.

Results and Discussion

1. Biology of lesser grain borer, *Rhyzopertha dominica* on wheat under laboratory

Fecundity

The number of eggs laid by female of *R. dominica* were recorded daily till the female stops the laying of eggs. The fecundity of female *R. dominica* ranged from minimum of 36 to maximum of 54 eggs/female with an average of 46±6.43 eggs/female during its entire life span.

Egg Period

The average incubation period of *R. dominica* was 5.58 ± 0.79 days. The duration of egg period under laboratory condition were obtained in the range of 4 to 7 days. The result of study is almost similar to that of Abdul-matin (1974) [1] who observed 5.7 days on wheat and flour of incubation period.

Hatching Percentage

After observing 460 eggs, 433 eggs were found to hatch. The hatchability ranged from 91.11 to 96.15 per cent. The average hatching percentage observed was 94.08±1.75 per cent.

Larval Pupal Period

Results about the larval-pupal period was varied from a

minimum duration of 32 days to maximum of 40 days with an average period of 35.28±2.14 days. The results are corroborated with those of Win and Rolania (2020) [8] who have reported an average larval and pupal period of 42 to 53 days.

Developmental Period

The duration of developmental period was ranged from 41 to 52 days and the average development period was 46.94±2.58 days. This finding is supported by Win and Rolania (2020) [8] who reported an average development period was 42 to 53 days.

Pre-oviposition Period

The result indicated that the duration of pre-oviposition ranged from 3 to 9 days and the average pre-oviposition period was of 5.64±1.93 days.

Oviposition Period

The average ovipositional period was 21.84±1.62day and upper and lower limits were 20 days and 25 days, respectively. The results is confined with findings of earlier works of Win and Rolania (2020) [8] who reported an average oviposition period of 23 to 27 days.

Post-oviposition

The post-oviposition period varied from 2 to 6 days with an average of 4.2±1.11 days. The results obtained agreed with the finding of Win and Rolania (2020) [8] observed an average post oviposition period of 4-5 days.

Adult Longevity

The duration of adult longevity of male ranged from 13 to 16 days and that of female from 18 to 24 days. The average adult longevity of male and female were 14.91±0.99 days and 21.88±1.86 days, respectively. The results were in close conformity with the findings of Win and Rolania (2020) [8] who recorded an average male longevity of 13-15 days and that of female longevity with an average period of 14-29 days.

Sex Ratio

Among the 388 emerged adults during the biological study of *R. dominica* on wheat, 204 were males and 184 were females the present finding revealed a sex ratio of (male: female) 1.04:1.23 indicating the dominance of male over female. Similar results were obtained by Kumawat (2007) [6] in wheat, 1: 1.08.

Life Span

The life span of male beetle varied from 56 to 67 days with an average of 60.52±2.87 days. While, in case of female it varied from 67 to 75 days with an average duration of 69.96±2.02 days.

Table 1: Life stages of *Rhyzopertha dominica*

Sr. No	Stage / period	Minimum	Maximum	Average
1	Fecundity (No)	36	54	46.0±6.43
2	Egg period (day)	4	7	5.58±0.79
3	Hatching per cent	91.11	96.15	94.08±1.75
4	Development period	41	52	46.94±2.58
5	Pre-Oviposition period	3	9	5.64±1.93

6	Oviposition period	20	25	21.84±1.62
7	Post-Oviposition period	2	6	4.2±1.11
8	Adult longevity			
	Male	13	15	14.91±0.99
	Female	18	24	21.88±1.86
9	Sex Ratio			
	Male (No.)	204	1.04:1.23	
	Female (No.)	184		
10	Life Span (days)			
	Male	56	67	60.52±2.89
	Female	67	75	69.96±2.02

2. Measurement of different stages of *R. dominica* Egg

The average length of egg was 0.71±0.04 mm which ranged from 0.63 to 0.85 mm. Whereas, the average width of egg was 0.27±0.03 mm which ranged from 0.23 to 0.38 mm.

I instar

The length of I instar larva ranged from 0.61 to 0.84 mm with an average of 0.70±0.06 mm and width ranged from 0.2 to 0.36 mm with an average of 0.2±0.06 mm. These observations are in contrasting with the results of Ajaykumar *et al.* (2018) [2] who found average length of larva 0.65 to 0.82 mm and width 0.27 to 0.36.

II instar

The II instar larva length ranged from 0.83 to 1.21 mm with an average of 0.99±0.13 mm and width ranged from 0.42 to 0.68 mm with an average of 0.55±0.07 mm. Morphological observations were found similar to the results obtained by Potter (1935) [7] who visualised the second instar was similar in shape to the first instar with 1.1 mm long and Gururaj (2005) [5] reported the 1.024 mm length and 0.315 mm width in second instar grub.

III instar

The III instar larva length was 1.68 to 2.15 mm with an average of 1.91±0.13 mm and the width were recorded in the range of 0.63 to 0.84 mm with an average of 0.74±0.06 mm. These observations are in contrasting with the results of Ajaykumar *et al.* (2018) [2] who found average length of larva 1.69 to 2.15 and width 0.69 to 0.85.

IV instar

The IV instar larva length ranged from 2.31 to 2.94 mm with average of 2.61±0.18 mm and width ranged from 0.81 to 1.12 mm with an average of 0.93±0.09 mm. Morphometric measurements are found in close confirmation with the results of Gururaj (2005) [5] who recorded the mean length of 2.900 mm and width of 0.826 mm.

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Abdomen

The average length of female abdomen was 2.71±0.23 mm which ranged from 2.5 to 3.58 mm. Whereas, the average width of female abdomen was 0.71±0.11 mm which ranged from 0.54 to 0.96 mm. In case of male the average length measured was 2.24±0.12 mm which ranged from 2 to 2.46 mm and the average width of male abdomen was 0.35±0.04 mm which ranged from 0.3 to 0.42 mm.

Body Length

The total body length of female (from head to posterior tip of abdomen) was ranged from 3.15 to 3.91 mm with an average of 3.46±0.18 mm. While, in case of male the body length was ranged from 2.41 to 3.08 mm with an average of 2.71±0.15 mm. The body length was found higher in female as compared to male. The observations were in line with the findings by Ajaykumar *et al.* (2018) [2] who reported that male adult length ranged from 2.91 mm to 3.48 mm and width ranged from 1.12 mm to 1.45 mm while in case of female adult length ranged from 3.01 mm to 3.79 mm and width 1.21 mm to 1.75 mm.

Table 2: Measurement of life stages of *Rhyzopertha dominica*

Sr. No	Measurement	Minimum (mm)	Maximum (mm)	Average (mm)
1	Eggs			
	Length	0.63	0.83	0.71±0.04
	Width	0.23	0.38	0.27±0.03
2	1 st Instar			
	Length	0.61	0.84	0.70±0.06
	Width	0.2	0.36	0.2±0.06
3	2 nd Instar			
	Length	0.83	1.21	0.99±0.13
	Width	0.42	0.68	0.55±0.07
4	3 rd Instar			
	Length	1.68	2.15	1.91±0.13
	Width	0.63	0.84	0.74±0.06
5	4 th Instar			
	Length	2.31	2.94	2.61±0.18
	Width	0.81	1.12	0.93±0.09
6	Abdomen Female			
	Length	2.5	3.58	2.71±0.23
	width	0.54	0.96	0.71±0.11
7	Abdomen Male			
	Length	2.0	2.46	2.24±0.12
	Width	0.3	0.42	0.35±0.04
8	Body Length			
	Female	3.15	3.91	3.46±0.18
	Male	2.41	3.08	2.71±0.15



Photo 1: Rearing of general culture of *R. dominica*



Photo 2: Screening of different wheat varieties against *R. dominica*



Photo 1: Rearing of general culture of *R. dominica*

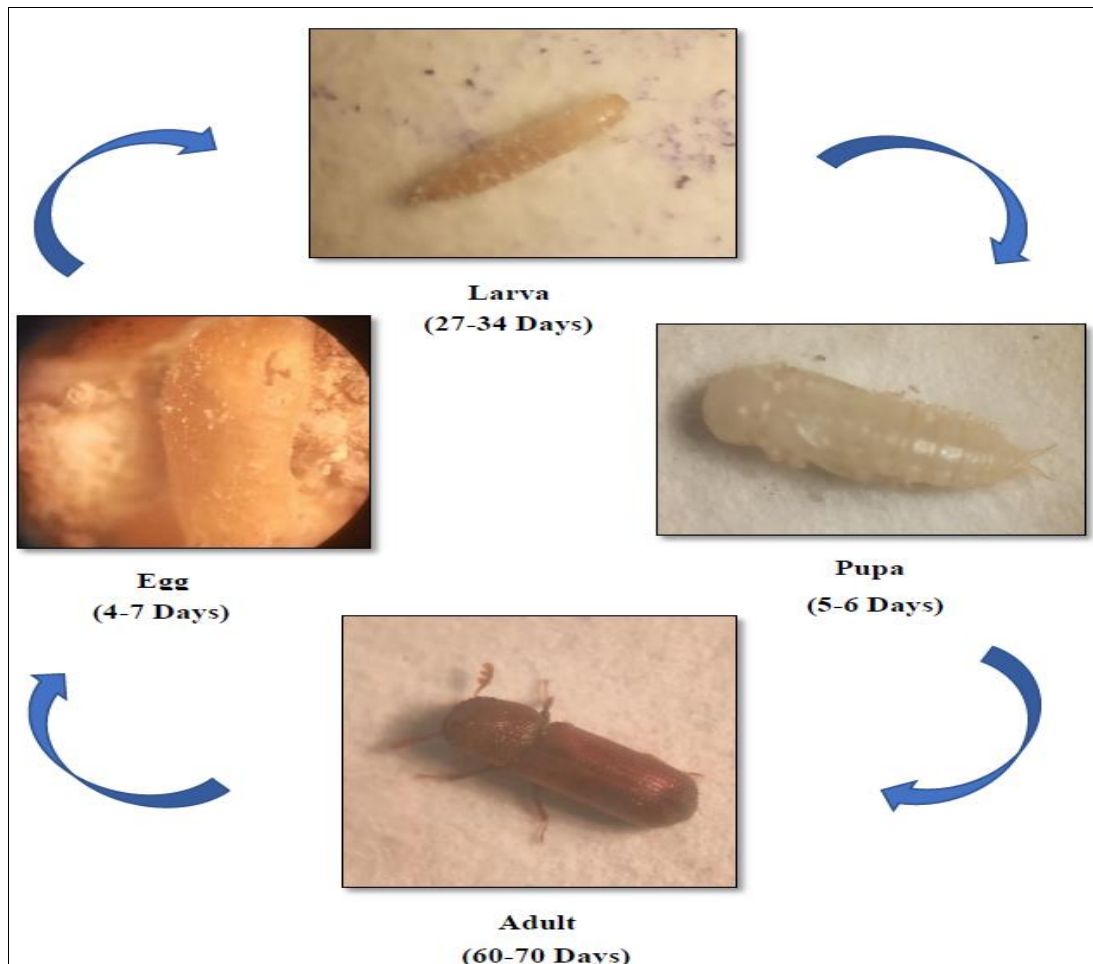


Photo 2: Life cycle of *R. dominica*

Conclusion

It is concluded from the experiment that average fecundity of *R. dominica* was 46 ± 6.43 eggs/female, average incubation period was 5.58 ± 0.79 days. The average hatching percentage was 94.08 ± 1.75 per cent. The average development period was 46.94 ± 2.58 days and average pre-oviposition period was of 5.64 ± 1.93 days. The upper and lower limits of oviposition were 25 days and 20 days, respectively. The post-oviposition period varied from 2 to 6 days with an average of 4.2 ± 1.11 days. The average adult longevity of male and female were 14.91 ± 0.99 days and 21.88 ± 1.86 days, respectively.

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