



E-ISSN: 2320-7078

P-ISSN: 2349-6800

JEZS 2018; 6(2): 2145-2148

© 2018 JEZS

Received: 15-01-2018

Accepted: 16-02-2018

Jitender Yadav

Department of Entomology,
CCS Haryana Agricultural
University, Hisar, Haryana,
India

Jai Lal Yadav

Department of Entomology,
CCS Haryana Agricultural
University, Hisar, Haryana,
India

RK Saini

Department of Entomology,
CCS Haryana Agricultural
University, Hisar, Haryana,
India

Meenakshi Devi

Department of Entomology,
CCS Haryana Agricultural
University, Hisar, Haryana,
India

Correspondence**Meenakshi Devi**

Department of Entomology,
CCS Haryana Agricultural
University, Hisar, Haryana,
India

Biology of *Trogoderma granarium* Everts on wheat grain

Jitender Yadav, Jai Lal Yadav, RK Saini and Meenakshi Devi

Abstract

Studies on biology of *khapra* beetle, *Trogoderma granarium* Evert (Coleoptera: Dermestidae) on wheat grain (variety WH 711) were conducted during July-August, 2013 in the Department of Entomology, CCS Haryana Agricultural University, Hisar. Rearing of the pest was done in the incubator maintained at $30 \pm 2^\circ\text{C}$ and $65 \pm 5\%$ relative humidity. The results showed that a female laid 57.83 ± 4.31 eggs during its life span with 63.77 percent egg hatchability. The larva passed through five instars with mean duration of 3.9 ± 0.23 , 5.05 ± 0.20 , 5.75 ± 0.40 , 6.4 ± 0.41 , and 6.8 ± 0.25 days for 1st, 2nd, 3rd, 4th, and 5th instar, respectively. Mean total duration of the larva was 27.9 ± 0.57 days. Pupal period was 3-7 days with a mean duration of 4.85 ± 0.22 days, while adult stage lasted for 11-18 (mean: 14.75 ± 0.53) days. Pre-oviposition, oviposition and post oviposition periods were 2.93 ± 0.28 , 4.83 ± 0.41 and 2.33 ± 0.29 days, respectively.

Keywords: biology, hatchability, *Trogoderma granarium*, wheat grain

Introduction

Trogoderma granarium Everts (Coleoptera: Dermestidae), commonly known as *khapra* beetle, is a serious pest of stored wheat in Haryana. Post harvest losses due to stored product insects have been estimated to be up to 9 percent in developed countries to 20 percent or more in developing countries [9]. Beside the quantitative loss, the insect infestation in wheat grains reduce germination and produce unpleasant odour, dirty appearance and abhorrent taste due to contamination with insect fragments and excrement [5]. The insect first of all eats away the germ portion resulting in reduced viability as well as nutritive value of the grain. They can feed on dried products with as little as 2% moisture contents [2, 7]. In India, it is a serious pest of stored wheat [11]. The larval stage is generally responsible for damage and adults do not normally feed or feed very little, if at all. Young larvae feed on damaged grains, while older larvae are able to feed on whole grains [3, 1]. They can cause a weight loss between 5-30% and may be extent up to 70% in severe cases [2]. In addition, it is pest of health concern, its exuviae, hairs and other body parts may cause respiratory diseases and skin irritation [10, 8]. With increased infestation, the attacked grains stock is reduced to a mixture of weeviled grains and large number of larval exuviae. Infestation of the pest is more severe in the southern part of the state, thus, necessitating study of its biology on the currently grown popular wheat variety of the area as no such information is available. Study of biology would provide better insight into the pest's activity, its behavior and duration of different stages for efficient planning of its management. Keeping in view the above issues, the present studies were conducted.

Materials and Methods

Preparation of stock culture of *T. granarium*

The culture of *T. granarium* was prepared from the collections of larvae made from farmers' storage structures in different Blocks of Mahendergarh district and rearing them in glass jars (20 cm x 15 cm) for two generations in the laboratory of Department of Entomology CCS Haryana Agricultural University Hisar on wheat grain (variety WH 711) at room temperature ($32-35^\circ\text{C}$) during July-August (2013). From the stock culture, samples of adult insects were drawn for studying different aspects of insect biology. A pair of adults was released per rearing jar containing 500 g wheat grain keeping 6 replications. Open end of a jar was covered with muslin fastened with elastic bands. Before releasing the insect, the wheat grain was cleaned by removing broken/damaged grain, weeds seeds, dirt and other extraneous material, and kept in oven ($60 \pm 5^\circ\text{C}$) for eight hours to eliminate both apparent and hidden infestation, if any, as

suggested by Sharma (2013) ^[12]. Such jars were placed in an incubator kept at 30±2°C and 65±5% relative humidity to maintain uniform moisture level in the samples.

Pre-oviposition, oviposition, and post-oviposition period

Freshly emerged adults were used in these studies. To obtain fresh adults 30 pupae from the stock culture were isolated and put in a Petri-dish. These were kept under observation till the emergence of adults. As soon as the adult emerged, these were paired for mating and kept in separate vials (having 1g wheat flour) @ 1 pair per vial. These vials were kept in an incubator maintained at 30±2°C and 65±5% relative humidity. There were six replications each for pre-oviposition, oviposition, and post-oviposition period.

Fecundity

For recording fecundity, each adult pair was examined daily by placing the vial content in a Petri-dish. The vial content was sieved (mess sieve size 100) to separate out eggs. The eggs were counted under stereo microscope with 10 X magnification and put in separate vials with the help of wet camel hair brush. The vial content i.e. flour as well as insect pair were returned back to the vial and kept in the incubator for further observations. The process was repeated till the female died. Record of daily egg laying by the female was maintained. Total life span of the adult was recorded.

Incubation period

Period from egg laying to hatching of larvae was taken as incubation period. Samples of 300 eggs were observed for recording incubation period.

Egg hatchability

A part of powdered content of stock culture was removed and examined under the stereo microscope (10X) and put in Petri-dish. This content was examined under microscope to separate out eggs. These eggs were removed and collected with the aid of a microscope and a wet camel hair brush. A sample of 300 eggs were put into a Petri dish and kept under observation till hatching. This experiment was repeated six times examining 1800 eggs in all. Hatched and un-hatched eggs were counted and percent hatching was worked out.

Larval duration

To study duration of different larval instars, initially 30 first instar larvae was kept individually in separate 30 glass vials containing wheat flour @ one larva per vial. The criterion used for determining change of larval instar was the presence of exuvae in the vial. Duration of different larval instars was

recorded. During this period the larval food (i.e. wheat flour) was replaced with fresh food with the change of instar. Total larval duration was worked out on the basis of observation of 20 larvae which reached up to the final instar.

Duration of Pupa

Thirty glass vials were provided with freshly formed pupae @ one pupa per vial. Pupal duration was recorded from the day the larva transformed into the pupa till emergence of the adult from it. Data were recorded on daily basis and total pupal duration was worked out based on a sample of 20 pupae.

Adult Longevity

For recording the total adult duration freshly emerged adults were separated into different vials carrying the healthy grain of wheat and data were recorded daily till death of the adult.

Results and Discussion

Results of different biological parameters of *T. granarium* recorded under laboratory conditions are presented in Table 1 to 4. Fecundity of *T granarium* varied from 43-74 eggs per female with mean fecundity of 57.83 ± 4.31 eggs/female (Table 1). These finding were also supported by ^[4] who recorded a fecundity of 52.3 eggs/female. The egg hatchability of *T. granarium* ranged from 53.64 to 71.22 percent with mean hatchability of 63.77 percent. These findings are supported by ^[3] work who recorded 59.8% hatchability.

Observations on the larval instars and their duration revealed that the larva passed through five instars during the course of its development. The duration of different larval instars ranged from 23 to 32 days (Table 2). Mean duration of different instars was 3.9 ± 0.23, 5.05 ± 0.20, 5.75 ± 0.40, 6.4 ± 0.41, and 6.8 ± 0.25 days for 1st, 2nd, 3rd, 4th, and 5th instar, respectively. Mean total duration of the larva was 27.9 ± 0.57 days. Almost similar results were reported by ^[13] who recorded a larval duration of 29.3 days.

Duration of the pupae varied from 3 to 6 days with a mean duration of 4.85± 0.22 days (Table 3). The adult stage lasted for 14.75 ± 0.53 days with a range of 11 to 18 days. Similarly, pupal duration recorded by various worker was 4.01 ^[3], 4.6 ^[13] and 5 ^[6] days.

Data on pre-oviposition, oviposition and post oviposition period showed that the mean pre-oviposition, oviposition and post oviposition period of *T. granarium* was 2.93 ± 0.28, 4.83± 0.41 and 2.33 ± 0.29 days, respectively (Table 4). Similarly, ^[3] observed oviposition period of 4.92 days, while ^[4] recorded pre oviposition and post oviposition period of 3.1 and 4.82 days, respectively.

Table 1: Fecundity and eggs hatchability of *T. granarium* on wheat grain

Fecundity		Eggs hatchability			
Pair No.	No. of egg laid/female	Sample No.	Eggs observed (No.)	Eggs hatched (No.)	Egg hatchability (%)
1	63	1	300	161	53.66
2	43	2	300	170	56.66
3	51	3	300	207	69
4	59	4	300	203	67.66
5	74	5	300	214	71.33
6	57	6	300	193	64.33
Mean± S.E	57.83 ± 4.31	Mean			63.77

Table 2: Duration of different larval instars of *T. granarium* on wheat

Larva No.	Duration (Days) of different larval instars					Total larval duration
	1st	2nd	3rd	4 th	5th	
1	4	4	7	5	6	26
2	5	5	4	8	8	30
3	6	5	3	7	5	26
4	3	6	3	7	8	27
5	4	4	6	8	5	27
6	5	5	6	8	7	31
7	3	4	4	8	6	25
8	3	5	4	6	8	26
9	3	6	8	6	7	30
10	5	4	5	6	8	28
11	5	5	6	4	6	26
12	3	4	6	3	7	23
13	5	6	7	8	6	32
14	4	5	6	8	7	30
15	3	7	4	7	8	29
16	3	6	8	3	8	28
17	5	5	8	8	6	32
18	3	5	6	3	8	25
19	3	4	8	7	5	27
20	3	6	7	8	7	31
Mean±S.E.	3.9 ± 0.23	5.05 ± 0.20	5.8 ± 0.37	6.4 ± 0.41	6.8 ± 0.25	27.9 ± 0.57

Table 3: Duration of pupa and adult of *T. granarium* on wheat

Pupa No.	Pupal duration (Days)	Adult No.	Adult duration (Days)
1	6		15
2	4	2	17
3	5	3	11
4	5	4	18
5	6	5	12
6	5	6	13
7	6	7	16
8	6	8	14
9	5	9	17
10	3	10	12
11	6	11	14
12	5	12	18
13	4	13	12
14	3	14	16
15	4	15	14
16	5	16	16
17	6	17	14
18	5	18	17
19	4	19	11
20	4	20	18
Mean±S.E.	4.85 ± 0.22	Mean±S.E.	14.75±0.53

Table 4: Pre-oviposition, oviposition and post-oviposition period of *T. granarium* on wheat grains

Set No.	No. of adult pairs observed	Pre-oviposition Period (Days)		Oviposition Period (Days)		Post-oviposition Period (Days)	
		Mean±S.E.	Range	Mean±S.E.	Range	Mean±S.E.	Range
I	6	2.83 ± 0.31	2-4	5.17 ± 0.48	4-7	1.83 ± 0.31	1-3
II	6	3.33 ± 0.21	3-4	4.50 ± 0.43	3-6	2.50 ± 0.22	2-3
III	6	2.67 ± 0.33	2-4	4.83 ± 0.31	4-6	2.67 ± 0.33	2-4
Mean	6	2.93 ± 0.28	2-4	4.83±0.41	3-7	2.33 ± 0.29	1-4

Conclusion

From the above investigation, biology of *T. granarium* can be concluded that grub passed through five instars. Total larval and pupal period averaged of 27.9 ± 0.57 days and 4.85 ± 0.22, respectively. Mean pre-oviposition, oviposition and post-oviposition period was 2.93, 4.83 and 2.33 days, respectively.

References

1. EPPO. *Trogoderma granarium*. Data sheets on quarantine pests, Paris, France, 1997.
2. Global Invasive Species Database (GISD). Species profile: *Trogoderma granarium*. 2015; Available from: <http://www.iucngisd.org/gisd/species.phpsc;142>
3. Hadaway AB. The biology of the dermestid beetles,

- Trogoderma granarium* Everts and *Trogoderma versicolor* (Creutz). Bulletin of Entomological Research. 1956; 46: 781-796.
4. Jakhar BL. Bio-ecology and management of khapra beetle, *Trogoderma granarium* Everts on wheat. Ph.D. Thesis submitted to Rajasthan Agricultural University, Bikaner. 2004.
 5. Khare BP, Singh KN, Chaudhary RN, Sengar CS, Agrawal RK and Rai PN. Insect infestation and quality deterioration of grain germination, odour and palatability in wheat. Indian Journal of Entomology. 1974; 36(3): 194-199.
 6. Kulkarni NV, Gupta Seema, Kataria Ruchika and Sathyanarayana N. Morphometric analysis and reproductive system studies of *Trogoderma granarium* Everts (Coleoptera: Dermestidae). International Journal of Scientific and Research Publications. 2015; 5(8): 1-8.
 7. Lindgren DL, Vincent LE, Krohne HE. The khapra beetle, *Trogoderma granarium* Everts. Hilgardia. 1955; 24(1):1-36.
 8. Morison GD. The khapra beetle (*Trogoderma granarium* Everts). Pro. Royal Physical Society of Edinburgh. 1925; 21: 10-13.
 9. Phillips TW and Thorne JE. Bio-rational approaches to managing stored product insects. Annual Review of Entomology. 2010; 55: 375-397.
 10. Pruthi HS, Singh M. Pests of stored grain and their control, 3rd ed. Replaces Indian Journal of Agricultural Sciences. 1950; 18(4): 1-88.
 11. Rahman KA. Insect pests of stored grains in Punjab and their control. Indian Journal of Agricultural Sciences. 1942; 12: 564-587.
 12. Sharma R. Management of khapra beetle, *Trogoderma granarium* Everts on wheat. Ph.D. Thesis, submitted to Rajasthan Agricultural University, Bikaner, 2013.
 13. Vir S. Effect of food and temperature on the biology of *Trogoderma granarium* Everts, Khapra beetle (Coleoptera-Dermestidae). Bulletin of Grain Technology. 1980; 18(2): 100-104.