Biological Forum – An International Journal **14(2a): 603-607(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Biology of Pod Borer, *Helicoverpa armigera* (Hubner) on Chickpea Leaves and pods under Laboratory conditions

Pawan Kumar[1*], D.N. Mishra[2], D.V. Singh[2], Sushant Kumar[1], Ravi Shanker[1] and Aditya Patel[1]
[1]Research Scholar, Department of Entomology, S.V.P.U.A & T, Meerut (Uttar Pradesh), India.
[2]Professor, Department of Entomology, S.V.P.U.A & T, Meerut (Uttar Pradesh), India.

(Corresponding author: Pawan Kumar)*
(Received 17 April 2022, Accepted 24 June, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: The biology of gram pod borer *Helicoverpa armigera* (Hubner) was studied in the biological control laboratory of SVPUA&T, Meerut on chickpea leaves and pods as a food source. The observation on biology of pod borer recorded the average pre-oviposition, oviposition and post oviposition on chickpea leaves and pods lasted 2.60 ± 0.08, 5.00 ± 0.15 and 1.40 ± 0.04, respectively. The pod borer female lays on an average 409.20 ± 12.28 eggs. The incubation periods of eggs were ranges 3.60 ± 0.11 days. The average time duration of first, second, third, fourth, fifth and sixth instars varied 2.60 ± 0.08, 3.40 ± 0.10, 4.40 ± 0.13, 3.80 ± 0.11, 4.40 ± 0.13 and 5.40 ± 0.16 days, respectively. The average pre-pupal and pupal duration ranged 1.80 ± 0.05 and 13.60 ± 0.41 days, respectively. The average male and female adult period ranged 10.40 ± 0.31 and 12.40 ± 0.37 days, respectively. The average length and breadth of eggs ranged 0.47 ± 0.01 and 0.50 ± 0.02 mm, respectively. The average length of first, second, third, fourth, fifth and sixth instars was ranged 1.53 ± 0.05, 3.42 ± 0.10, 10.04 ± 0.30, 22.13 ± 0.66, 30.82 ± 0.92 and 40.95 ± 1.23 mm, respectively. The average breadth of first, second, third, fourth, fifth and sixth instars was ranged 0.50 ± 0.02, 0.72 ± 0.02, 2.76 ± 0.08, 3.23 ± 0.10, 5.04 ± 0.15 and 6.04 ± 0.18 mm, respectively. The mean length and breadth of pre-pupa was ranged 24.75 ± 0.74 mm and 6.25 ± 0.19mm, respectively. The average male and female length ranged 21.86 ± 0.66, 22.50 ± 0.67 mm and breadth ranged 7.06 ± 0.21, 7.37 ± 0.22 mm, respectively. The average length of adult male and female ranged 19.34 ± 0.58, 22.66 ± 0.68 mm and breadth was ranged 35.62 ± 1.07, 40.00 ± 1.20 mm, respectively.

Keywords: Biology, instars, duration, length and breadth and pod borer.

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is an important pulse crop of India and also known as king of pulses. Chickpea belongs to Fabaceae family. It is native to India, Afghanistan and Ethopia. It is also called as Ceci bean, Bengal gram, Garbanzo bean, Chana and Sanagalu bean. Pulses are the main source of protein among the food crops grown in India. Indiais the largest producer and consumer of pulses and is considered as "poor man's meat"because they are the cheapest source of protein, which constitutes about 27 per cent of Indian diet. It is most important pulse crop of the world, cultivated in an area of 13.84 million hectares with a production of 13.65 million tonnes. In India chickpea, is grown in an area of 9.85 million hectares with production of 11.99 million tonnes. In India, Rajasthan is the largest chickpea growing state with an area of 2.46 million hectares with production of 2.66 million tonnes followed by Maharashtra and Madhya Pradesh. Uttar Pradesh is the 4th largest producer with an area of 0.62 million hectares with production of 0.85 million tonnes (Anonymous, 2021).

Chickpea pods in raw form are consumed as both whole fried or boiled and salted. It is made into split pulse (Chana dal) which is cooked and eaten and as flour (Besan) out of which a variety of dishes like snacks and sweets are made. Fresh green leaves and grains are used as vegetables (Chhole). It is being used increasingly as a substitute for animal protein.The straw of chickpea is an excellent source of fodder for cattle besides both husk and bits of the 'Dal' serve as valuable cattle feed. Chickpea seed contains 18.22 per cent protein, 16-62 per cent total carbohydrate, 47 per cent starch, 5 per cent fat, 6 per cent crud fibre, 6 per cent soluble sugar and 3 per cent ash (Jukanti *et al*., 2012). Although pulses have been consumed for thousands of years for their nutritional qualities (Kerem *et al*., 2007). Besides being rich in protein, its ability to enrich the soil fertility by fixing large quantities of atmospheric nitrogen with the help of symbiotic bacteria mainly *Rhizobium* species is economically sounder and environmentally acceptable which are capable of fixing 40 kg nitrogen per hectare and reduce the requirement of other synthetic chemical fertilizer. The adult moths of Gram pod borer, *Helicoverpa armigera* are typically dull light brown in color with a wing expanse of 30-45 mm. Fore wings of the moth are with a series of irregular, a pale band near the margin. Hind wings are pale with a dark broad outer margin with a pale patch in it. Lifecycle of *H. armigera* take 4-6 weeks from egg to adult in summer and 8-12 weeks in spring or autumn. The *Helicoverpa armigera* lifecycle stages are egg, larva, pupa and adult. The female moths lay eggs on tender parts of the plant, a single moth can lay up to

500-890 eggs. The freshly laid eggs of *H. armigera* are yellowish-white in colour. The apical area of egg is smooth and the rest of the surface sculptured in the form of longitudinal ribs. Larva of *H. armigera* had six distinct instars in chickpea (Ali *et al*., 2009).

MATERIALS AND METHODS

Rearing of *Helicoverpa armigera* was managed in Biological Control Laboratory, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut.

Rearing of *H. Armigera.* Pod borer larvae were gathered in great numbers from the chickpea crop in order to research the biology of the *H. armigera*. To prevent cannibalism, each larva was raised separately in a plastic jar at ambient temperature. The larvae were given fresh chickpea leaves or pods to eat. Muslin fabric served as the cover for each plastic container. The plastic jar's third section was filled with moist sand, which creates the ideal environment for pupation. In the plastic jar, the mature larvae pupated. In order to capture the eggs, the newly emerging moths were released in pairs. A piece of muslin cloth secured with a rubber band kept the top of the jar closed. For egg laying, fresh chickpea leaves or pods were employed. Adults were given nourishment in the form of a 10% honey solution that was applied to cotton swabs. The female moths placed their eggs on muslin fabric, foliage, or seed pods. Using a wet camel comb, these eggs were gently retrieved.

Fecundity: Each mated female moth was housed in a plastic jar to evaluate the fecundity. To encourage egg laying, chickpea leaves or pods were placed in each jar. Fresh leaves or pods were added daily to replace the old ones containing the eggs. Every day, the eggs on each leaf or pod were counted. This practice was carried out till the female passed away. Eggs were occasionally placed on the muslin fabric and the jar's walls. In such circumstances, these will be directly numbered without being taken off of these surfaces.

Duration of larval instars: Larvae between 0 and 24 hours old were used to calculate the length of the six larval instars. Individual larvae were raised in plastic jars. The muslin cloth served to keep each jar closed. Every day, fresh leaves or pods from the field were brought in to replenish the food in each jar. By using an ocular micrometre, daily observations were made of things like length, breadth, the length of the larval instar, and moulting. The last instar's exuviae were visible to the naked eye. As a result, the length and width of various larval instars were noted.

Pre-pupal and pupal duration: Pre-pupal and pupal durations, which measure the intervals between the last larval skin being shed and the end of eating, were calculated. We collected the freshly emerged larvae for investigation.

Adult. When the moths emerged, their size and colour were evaluated. The difference between male and female moths was based on whether the female had a tuft of hairs at the end of its abdomen while the male did not. To examine the pre-oviposition, oviposition, and post-oviposition periods as well as adult longevity and fecundity, five male and female moths of the same age group were paired independently in an oviposition cage. With the use of an ocular micrometre, their length and width with spread wings were also measured.

Pre-oviposition, oviposition, post-oviposition period and fecundity. The pre-oviposition period was calculated from the day the female became an adult to the day the egg-laying process started. Similar to this, the time from the beginning of egg laying to the end of egg laying was referred to as the oviposition period, and the time from the end of egg laying to the death of the female was referred to as the post-oviposition period.

RESULTS AND DISCUSSION

The biology of gram pod borer *Helicoverpa armigera* (Hubner) was studied in the biological control laboratory on chickpea leaves and pods as a food source from January to February during *Rabi*, 2021. The biology studied of *Helicoverpa armigera* were carried out with five sets of plastic jar 1/3 filled with soil. The average maximum and minimum temperature during the study period was 23.46 ± 0.70°C and 8.76 ± 0.26°C, morning and evening relative humidity was 86.76 ± 2.60 and 54.4 ± 1.63 percent, respectively. The obtained results are obtained as follows.

Egg. Before hatching, the freshly placed eggs of *H. armigera* were sculptured yellowish-white and shimmering at first. The eggs' incubation time was 3.60 ± 0.11 days, and their sizes ranged from 0.47 ± 0.01 mm in length to 0.50 ± 0.02 mm in breadth (Tables 1 and 2). Infertile eggs were those that did not hatch after four to five days and were discarded. After 3 – 4 days, the infertile eggs went from being yellow to being more yellow and shrivelled. The findings made it clear that the incubation time was between three and four days.

Larvae. The newly hatched larvae of *H. armigera* were raised on chickpea leaves and pods in order to evaluate the size, shape, colour, and duration of several larval instars. Six larval instars were discovered throughout the current study. The observations regarding the larval instars are shown in Table 1. Larvae underwent five moults throughout that time.

First instar. The colour and form of first instar larvae were not significantly different over the Rabi seasons. The newly hatched larva was semi-translucent, yellowish white in colour, and had longitudinal lines that were orange-yellow on its dorsal side. First instar larvae were found to have an average body size of 1.53 ± 0.05 mm and 0.50 ± 0.02 mm, respectively (Table 1). The information in Table 2 showed that during the Rabi season, the initial instar's development lasted between two and four days, with a mean time of 2.60 ± 0.08 days.

Second instar. The second instar larvae were seen to grow in size, change colour to a brownish yellow, have black thoracic legs, and had very fine hairy structures on their body surfaces. According to the findings (Table 1), second instar larvae had average body length and breadth measurements of 3.42 ± 0.10 and 0.72 ± 0.02 mm, respectively.

Larvae in their second instar developed on average for 3.40 days with a standard deviation of 0.10 days (Table 2).

Third instar. Larvae in their second instar moulted into their third instar, which is longer than the first instar and has longitudinal lines on its body and a brownish head. The outcomes followed a similar pattern, and during the study period, average body length and breadth of 10.04 ± 0.30 and 2.76 ± 0.08 mm, respectively, were noted (Table 1).

The third instar larvae had a mean developmental time of 4.40 ± 0.13 days, according to Table 2's data.

Fourth instar. The fourth instar larvae showed no discernible alteration. The larvae showed, however, differ in terms of colour and the amount of longitudinal stripes. Larvae in their fourth instar were measured, and their average body length and breadth were 22.13 ± 0.66 and 3.23 ± 0.10 mm, respectively (Table 1).

The fourth instar's developmental stage lasted between three and five days. A fourth instar larval phase of 3.80 ± 0.11 days on average was noted.

Fifth instar. The fifth instar larva's colour and form were described as being light brown with continuous dorsal stripes and brown lateral stripes. The head was a rusty brown colour. The average body length and breadth of fifth instar larvae were 30.82 ± 0.92 and 5.04 ± 0.15 mm, respectively, according to the results shown in Table 1.

The information in Table 2 showed that it typically took 4-5 days for fifth instar larvae to mature into sixth instar larvae.

Sixth instar. Larvae in the sixth instar had small hairs scattered here and there on their pale green and greenish yellow bodies. The thoracic and anal shields, as well as the thoracic legs, were all brown in colour, yet the larvae's reddish brown head was visible. The sixth instar larva has a convex dorsal form but a flattened ventral shape. Larvae in their sixth instar were measured and found to have an average size of 40.95 ± 1.23 mm and 6.04 ± 0.18 mm (Table 1). The information in Table 2 makes it evident that larval development followed a similar pattern, with the minimum developmental duration of the sixth instar being reported as 5–6 days and the average developmental period being 5.40 ±0.16 days.

Pre-pupa. After being fully nourished, the sixth instar larvae stopped feeding, stopped moving, changed colour, crumpled, and slenderized their bodies. Before the pupa formed, the colour later became darker. Pre-pupae had an average length and breadth of 24.75 ± 0.74 and 6.25 ± 0.19 mm, respectively (Table 1).

The information in Table 2 showed that *H. armigera* pre-pupal period ranged from one to three days. The average number of days in the pre-pupal phase was 1.80 ± 0.05, it was found.

Pupa. The pupae were clearly visible to be widely spherical internally but tapering posteriorly. Within 24 hours, the freshly formed yellowish green pupa turned light brown and then darkened even more before the moth emerged. The information in Table 1 demonstrated that there were differences in the measurements of male and female pupae. Female pupae measured 22.50 ± 0.67 mm in length and 7.37 ± 0.22 mm in width. Similar to female pupae, male pupae measured 21.86 ± 0.66 mm in length and 7.06 ± 0.21 mm in width (Table 1).

According to results on pupal period (Table 2), the pupal period spans from 12 to 16 days. 13.60 ± 0.41 days on average were needed to emerge as adults.

Adult. The forewings of the medium-sized adults were yellowish brown with rows of dots along the edge. Each forewing's underside bore a black mark in the shape of a kidney. The apical portion of each of the light-colored hind wings had a black colour patch. Male and female morphologically resembled one other quite closely, with the exception of the female's tuft of hairs on the tip of the abdomen. In terms of body length and breadth, it was found that females were larger than males. But the average body length and breadth of male and female moths were measured to be 19.34 ± 0.58 mm and 35.62 ± 1.07 mm and 22.26 ± 0.68 mm and 40.00 ± 1.20 mm (Table 1), respectively. The average time period for male and female was recorded as 10.40 ± 0.31 and 12.40 ± 0.37 days, respectively. The adult period of male and female ranged from 10–11 days in male and 12–13 days in female (Table 2).

Pre-Oviposition. According to the information in Table 3, the female had a pre-oviposition period of two to four days. The average pre-oviposition period, however, was noted to be 2.60 ± 0.08 days.

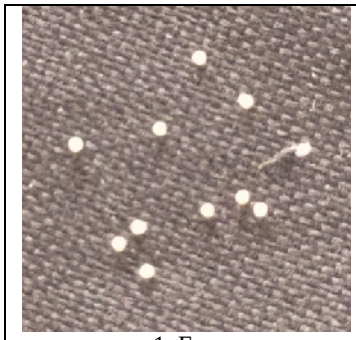
Oviposition. Table 3 clearly shows that females oviposited for 4–6 days. However, it was noted that the mean oviposition period was 5.00 ± 0.15 days.

Post-Oviposition. After finishing egg laying, female moths were found to live for one to two days. The average post-oviposition period was 1.40 ± 0.04 days (Table 3).

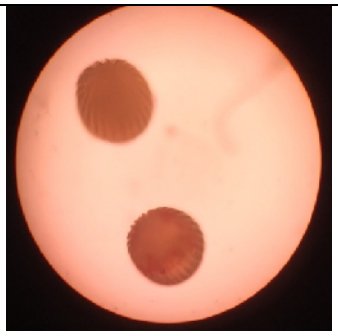
Fecundity. Table 3 makes obvious that there were significant variations in the amount of eggs laid by females raised throughout the seasons. The average fecundity was 409.20 ± 12.28 eggs.

The present result is in agreement with the finding of Dahegaonkar and Mohite (2014). The present finding is almost similar to the finding by Raberi *et al*. (2017) because the measurement of the immature stages are generally same, the average egg length and breadth was recorded 0.51 ± 0.02 mm. The length and breadth of larval instar, pre-pupa, pupa and adult are generally more or less same. The finding are in accordance with Herald and Tayde (2018) they reported that the fecundity of female moth ranges 405-420 eggs with the average fecundity 412.00 ± 5.24. The finding is according to Sharma *et al*. (2019) reported that the egg, larval and pupal duration are almost similar. The duration of larval instar and total larval period ranges 20-26 with an average mean of 23.20 ± 1.73.

Different stages of pod borer



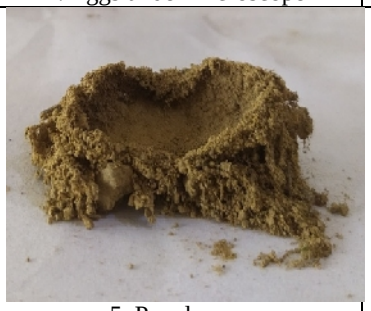
1. Eggs



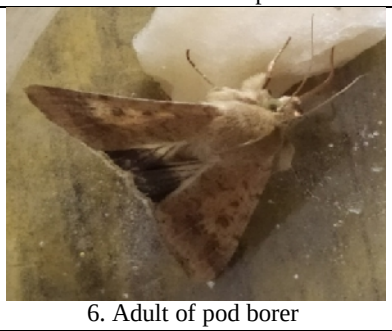
2. Eggs under microscope

3. Different instars of pod borer

4. Pupa



5. Pupal case



6. Adult of pod borer

Table 1: Measurement of various life stages of *Helicoverpa armigera* reared on chickpea leaves and pods during *Rabi*, 2020-21.

Sr. No.		Length (mm)			Breadth (mm)		
		Minimum	Maximum	Mean ± S.D.	Minimum	Maximum	Mean ± S.D.
1.	**Egg**	0.45	0.52	0.47 ± 0.01	0.47	0.55	0.50 ± 0.02
2.	**Larva**						
	1st Instar	1.44	1.60	1.53 ± 0.05	0.48	0.53	0.50 ± 0.02
	2nd Instar	3.36	3.51	3.42 ± 0.10	0.69	0.82	0.72 ± 0.02
	3rd Instar	9.95	10.16	10.04 ± 0.30	2.70	2.83	2.76 ± 0.08
	4th Instar	20.11	24.20	22.13 ± 0.66	3.20	3.28	3.23 ± 0.10
	5th Instar	28.52	34.44	30.82 ± 0.92	4.92	5.17	5.04 ± 0.15
	6th Instar	38.10	45.34	40.95 ± 1.23	5.72	6.34	6.04 ± 0.18
3.	**Pre-pupa**	22.72	27.96	24.75 ± 0.74	5.73	6.84	6.25 ± 0.19
4.	**Pupa**						
	Male	18.10	24.42	21.86 ± 0.66	6.37	7.82	7.06 ± 0.21
	Female	20.22	24.11	22.50 ± 0.67	7.00	7.84	7.37 ± 0.22
5.	**Adult**						
	Male	18.15	20.24	19.34 ± 0.58	32.67	39.16	35.62 ± 1.07
	Female	21.11	24.25	22.66 ± 0.68	36.34	43.32	40.00 ± 1.20

Table 2: Developmental period of different life stages of *Helicoverpa armigera* on chickpea leaves and pods during *Rabi*, 2020-21.

Sr. No.	Stage	Developmental period (Days)		
		Minimum	Maximum	Mean ± S.D.
	Egg period (3-5) days			
1.	**Incubation**	3	5	3.60 ± **0.11**
2.	**Larval period (21-29) days**			
	1st Instar	2	4	2.60 ± **0.08**
	2nd Instar	3	4	3.40 ± **0.10**
	3rd Instar	4	5	4.40 ± **0.13**
	4th Instar	3	5	3.80 ± **0.11**
	5th Instar	4	5	4.40 ± **0.13**
	6th Instar	5	6	5.40 ± **0.16**
3.	**Pre-pupal period (1-3) days**			
	Pre-pupa	1	3	1.80 ± **0.05**
4.	**Pupal period (12-16) days**			
	Pupa	12	16	13.60 ± **0.41**
5.	**Adult period (22-24) days**			
	Male	10	11	10.40 ± **0.31**
	Female	12	13	12.40 ± **0.37**

Table 3: Developmental period of *Helicoverpa armigera* in days on chickpea leaves and pods during *Rabi*, 2020-21.

Stage	Developmental period (Days)		Mean ± S.D.
	Minimum	Maximum	
Pre-Oviposition	2	4	2.60 ± 0.08
Oviposition	4	6	5.00 ± 0.15
Post-Oviposition	1	2	1.40 ± 0.04
Egg laying	**No. of Eggs**	**No. of Eggs**	**Mean ± S.D.**
Fecundity	392	423	409.20 ± 12.28

CONCLUSION

The identification of the pest and its treatment are aided by observations of lifecycle factors. The findings of these investigations could be useful in estimating the field population of *H. armigera.* The current study of *H. armigera* biological features provides extensive information on development, survival, and reproduction/fecundity, which is a necessary first step in implementing any control measures. This allows us to identify the venerable stages of *H. armigera* as well as build chemical, biological, and integrated chickpea control methods.

Acknowledgements. I would like to acknowledge and thank to whole faculty of Department of Entomology and I specially wants to thank to the officer in charge of biocontrol laboratory of Sardar Vallabhbhai University of Agriculture & Technology, Meerut, Uttar Pradesh, India, for providing me all the necessary facilities for my research work.
Conflict of Interest. None.

REFERENCES

Ali, A., Choudhury, R. A., Ahmad, Z., Rahman, F., Khan, F. R. and Ahmad, S. K. (2009). Some biological characteristics of *Helicoverpa armigera* on chickpea. *Tunisian. Journal of Plant. Protection*, *4*: 99-106.

Anonymous (2021). Directorate of Economics & Statistics, Department of Agriculture & Farmers Welfare (DAC&FW), Govt. of India; Agriculture statistics at a glance, pp 42-43.

Dahegaonkar, J. S. and Mohite, A. S. (2014). Studies on the life stages and external morphology of gram pod borer, *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae). *International journal of Researches in Bioscience, Agriculture & Technology*, Special Issue.pp. 226-235.

Herald, K. P. and Tayde, A. R. (2018). Biology and morphology of tomato fruit borer, *Helicoverpa armigera* (Hubner) under Allahabad conditions. *Journal of Entomology and Zoology Studies*, *6*(4): 1734-1737.

Jukanti, A. K., Gaur, P. M., Gowda, C. L. L. and Chibbar, R. N. (2012). Nutricinal quality and health benefits of chickpea (*Cicer arietinum* L.). *British Journal of Nutrition*, *108*S11- S26.

Kerem, Z., Yadun, L. S., Gopher, A., Weinberg, P. and Abbo, S. (2007). Chickpea domestication in the Neolithic Levant through the nutritional perspective. *Journal of Archaeological Science*, *34*, 1289-1293.

Rabari G. N., Pareek A. and Patel B. R. (2017). Comparative Biology of *Helicoverpa armigera* (Hubner) Reared on different hosts. *International Journal of Pure and Applied Bioscience*, *5*(1): 849-856.

Sharma, V. G., Kumar, S. and Srinivas, G. (2019). Biology of *Helicoverpa armigera* (Hubner) on tomato in South Gujarat, *Journal of Entomology and Zoology Studies*, *7*(5): 532-537.

How to cite this article: Pawan Kumar, D.N. Mishra, D.V. Singh, Sushant Kumar, Ravi Shanker and Aditya Patel (2022). Biology of Pod Borer, *Helicoverpa armigera* (Hubner) on Chickpea Leaves and pods under Laboratory Conditions. *Biological Forum – An International Journal*, *14*(3): 603-607.