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BIOLOGY OF *HELICOVERPA ARMIGERA* (HUBNER) ON CHICKPEA UNDER LABORATORY CONDITION AT AMBIENT TEMPERATURE

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ABSTRACT

The biology of *H. armigera* was studied at ambient temperature under laboratory conditions. The eggs of *H. armigera* were spherical in shape with a flattened base which looked like dome shaped. The colour of eggs in the beginning was yellow – white, which became dark brown before hatching. The egg was 0.45-0.48 mm X 0.42-0.45 mm in size. The fecundity per female was 453.50 and 357.80 eggs in two the generations respectively. The per cent viability of eggs varied from 77 to 92 per cent during different periods of study. The longevity of male and female moths were 7.90-9.00 and 10.10-10.90 days respectively. The larvae passed through six instars with 32.70 and 40.20 days of total larval period in the both generation. The mean pre-pupal period in case of the Ist and IInd generation were 4.10 and 4.60 days, respectively. The average pupal period during the Ist and IInd generation were 22.20 and 24.00 days, respectively. *H. armigera* took 59.50 and 69.80 days in completing the Ist and IInd generation, respectively. The *H. armigera* completed two generations in Semi-Arid region of Rajasthan from November to March in semi arid region of Rajasthan.

Key words: Biology, *Helicoverpa armigera*

Chickpea, *Cicer arietinum* (L.) is an important pulse crop grown in temperate as well as in sub-tropical regions of the World. The insect pest's damage is a major limiting factor in getting the good yield. Out of three species of gram pod borer, *viz*. *Helicoverpa armigera* (Hubner), *H. assuita* (Guenec) and *H. peltigera* (Denis and Schiffermullar) prevailing in India. *H. armigera* (Lepidoptera: Noctuidae) is the most common. Commonly called as gram pod borer, tomato fruit borer or American boll worm. It is a typical polyphagous pest of sporadic nature and inflicts serious losses to chickpea, pigeonpea, tomato, cotton, sorghum, maize, okra, lucerne, sunflower, linseed, safflower, pea and castor (Singh and Bains, 1986, Saini and Mehla, 1991). The early stage larvae (first to third instar) prefer to feed on green leaves, while the late instars prefer pods, whenever available.

The attack of this pest is a major constraint in the production of chickpea and has been reported to cause losses ranging from 20 to 80 per cent in different parts of the country (Sithananthan *et al.,* 1989). In Rajasthan, *H. armigera* caused 19-20 per cent reduction in grain yield of gram (Ameta and Thakar, 1988). Therefore, present studies were undertaken on the Biology of the pest which in turn will help in the management of the pest.

MATERIALS AND METHODS

Studies on biology of gram pod borer, *H. armigera* were conducted in the laboratory at ambient temperature in the Department of Entomology, College of Agriculture, Bikaner. The biology of gram pod borer was conducted under laboratory conditions using chickpea leaves as host plant. For conducting life cycle a large number of moths of *H. armigera* were collected with the help of light trap from the field during October 2005. These moths were used for the raising of culture and studying its life cycle. After mating the female moths laid eggs in the petri plates. Soon after hatching the larvae were transferred on fresh leaves of chickpea. Since larvae were cannibalistic, each larva was reared in separate petri dish (7 cm diameter). The diet of larvae was changed every alternate day. The larvae stopped feeding just before pre-pupal stage and started wandering in search of a site for pupation. Ten pairs of moths which emerged from pupae were released in ten jars of 25 × 25 cm (diameter × height). The jars were covered on the top with muslin cloth and contained a strip of black muslin cloth for oviposition. The oviposition started a day after mating and continued for 6-8 days. The freshly laid eggs were surface sterilized with 1 per cent sodium hypochlorite solution after which they were washed with distilled water and placed in a humid place in the laboratory.

The size of the egg, larva, pupa and adult were measured with the help of stage and ocular micrometer and the development duration of each stages were reared as and when the stage was changed from one stage to the another one. The longevity of moth and total life cycle starting from hatching till the mortality of the adults were

also recorded. For studying the fecundity each mated female moth was kept in a glass jar. Each glass jar was provided with a 10 cm long black muslin cloth to facilitate egg laying. The muslin cloth bearing the eggs were replaced daily by another strip of muslin cloth. The eggs on each muslin cloth were counted daily. This process was continued till the female died. Some times eggs were also laid on the walls of the jar. In such cases these eggs were counted directly without removing them from their surface. Eggs obtained from females were placed in a Petri dish (7 cm dia) to study their viability in terms of per cent egg hatching and incubation period in days.

RESULT AND DISCUSSION

Measurement of different stages of *H. armigera*

Egg: The eggs of *H. armigera* (Hub.) were spherical in shape with a flattened base which looked like dome shaped. The colour of eggs in the beginning was yellow-white, which became dark brown before hatching. The egg was 0.45–0.48 mm x 0.42–0.45 mm in size.

Larva : The first instar larvae were 2.0–3.0 mm in length and 0.44–0.48 mm in breadth. The second instar larvae were 5.0–8.0 mm in length and 0.72–0.76 mm in breadth. The body colour of the larva was creamy white to pale greenish. The feeding behaviour slightly changed as minute holes in the leaves were made due to food consumption. The third instar larvae were 12–17 mm in length and 2.90–2.95 mm in breadth. The body colour became greenish yellow with brown head. The fourth instar larvae were 23–29 mm in length and 3.00–3.05 mm in breadth. The change in body colour was apparent, from dorsal side, it was pale- yellow with greyish longitudinal lines. The larva was very active and moved swiftly. The fifth instar larvae were 30–34 mm in length and 4.80–4.85 mm in breadth. Body colour of this instar was pale green with one broken stripe along each side of the body and one line on the dorsal side. Prothorax was slightly darker than mesothorax and metathorax. This instar larva was found voracious feeder.The sixth instar larvae were 35–39 mm in length and 5.10–5.18 mm in breadth. There larvae were light greenish in colour with broken strips. They were slightly sluggish in nature. The head was dark brown and body colour varied from individual to individual (Table-1).

Pre-pupal stage : The body length was reduced from the original size of the last larval instar and became 22–26 mm in length and 4.82–4.87 mm in breadth. Before moulting, the full grown larvae of sixth instar became sluggish, stopped feeding and movement and moved away from the food (Table-1).

Pupa : The pupa of *H. armigera* (Hub.) was obtect and measuring 18–21 mm in length and 5.85–5.90 mm in breadth in males while in females it was 20-22 mm in length and 6.38-6.43 mm in breadth. Pupation generally occurred during night. The colour of freshly formed pupae were reddish green and later changed to reddish brown and got further darkened prior to the emergence of moth (Table-1).

Table 1: Measurement of different stages of *H. armigera* (Hub.)

S..No.	Life stages	Length (mm)	Mean (mm)	Breadth (mm)	Mean (mm)
1.	Egg	0.45-0.48	0.47	0.42-0.45	0.43
2.	Larva				
	Ist instar	2.0-3.0	2.64	0.44-0.48	0.46
	IInd instar	5.0-8.0	6.56	0.72-0.76	0.73
	IIIrd instar	12-17	15.04	2.90-2.95	2.92
	IVth instar	23-29	26.43	3.00-3.05	3.03
	Vth instar	30-34	32.51	4.80-4.85	4.82
	VIth instar	35-39	37.17	5.10-5.18	5.15
3.	Pre-pupa	22-26	24.45	4.82-4.87	4.84
4.	Pupa				
	(A) Male	18-21	19.73	5.85-5.90	5.87
	(B) Female	20-22	20.84	6.38-643	6.40
5.	Adult				
	(A) Male				
	Body length	17-20	18.63	_	_
	Wing Expanse	34-38	36.34	_	_
	(B) Female				
	Body length	18-22	20.50	_	_
	Wing Expanse	37-42	39.95	_	_

Data based on measurement of 10 individuals.

Adult : The male moth of *H. armigera* (Hub.) was smaller than female and brownish gray colour. The male adult had 17-20 mm body length and 34-38 mm wing expanse while female had 18-22 mm body length and 37-42 mm wing expanse (Table-1).

Biological parameters of *H. armigera*

Fecundity : The fecundity was maximum during Ist generation (3rd week of November to 2nd week of January) average 453.50 eggs/female followed by IInd generation (3rd week of January to 2nd week of March) average 357.80 eggs/female (Table-2).

Viability of eggs : The per cent viability of eggs varied from 77 to 92 per cent during different periods of study. The maximum per cent viability was found during Ist generations (averages 88.87 per cent) followed by IInd generations (average 82.65 per cent) Table-2 .

Longevity of adult : The longevity of both male and female moths was higher (average 9.00 days in male and 10.90 days in female) during 3rd week of January to 2nd week of March, followed by 7.90 days in male and 10.10 days in females in 3rd week of November to 2nd week of January. In both generation, females generally lived more than the males (Table-2).

Table 2: Biological parameters of *H.armigera* (Hub.)

S. No.	Parameters	3rd week of November to 2nd week of January	3rd week of January to 2nd week of March
1.	Fecundity (Number of eggs/female)	385-540 (453.50)	280-420 (357.80)
2.	Viability of eggs (Percentage)	85-92 (88.87)	77-87 (82.65)
3.	Longevity of adults (days)		
	I. Male	7-9 (7.90)	8-10 (9.00)
	II. Female	8-12 (10.10)	9-13 (10.90)

Data based on 10 pairs of individuals.
Figures in Parenthesis indicate mean.

Viability of eggs : The per cent viability of eggs varied from 77 to 92 per cent during different periods of study. The maximum per cent viability was found during Ist generations (averages 88.87 per cent) followed by IInd generations (average 82.65 per cent) Table-2.

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Durations of different developmental stages of *H. armigera*

Incubation period : The incubation period of the eggs ranged from 4-5 days (average 4.60 days), 5-6 days (average 5.60 days) in Ist and IInd generation, respectively (Table-3). The variations in the incubation periods were due to variations in the atmospheric temperature prevailing under the laboratory conditions at ambient temperature during these months.

Durations of larval instars : *H. armigera* (Hub.) completed 6 larval instars from hatching to the pupation (Table-3). In the Ist generation, the I, II, III, IV, V and VI larval instars took 6.50, 6.40, 5.40, 5.50, 4.50 and 4.40 days, respectively and the total larval duration under these conditions was 32.70 days. In the IInd generation it was 7.70, 8.10, 6.60, 6.70, 5.50 and 5.60 days in I, II, III, IV, V and VI larval instars, respectively and the total larval duration was 40.20 days.

Pre-Pupal period : The full grown larvae stopped feeding and remained inactive for 3-5 days in the both generations. The mean pre-pupal period in case of Ist and IInd generations was 4.10 and 4.60 days, respectively. (Table-3).

Pupal period : The average pupal period in case of Ist and IInd generations was 22.20 and 24.00 days, respectively (Table-3).

Total life cycle : The life cycle of *H. armigera* (Hub.) took minimum of 59.50 days for completing the life cycle in its Ist generation which occurred between 3rd week of November to 2nd week of January and maximum of 69.80 days in its IInd generation which completed from 3rd week of January to 2nd week of March.

Egg : It was spherical in shape with a flattened base. The colour in the beginning was yellowish - white, which became dark brown before hatching. It was measured as 0.45-0.48 mm X 0.42-0.45 mm in length and breadth, respectively. The above observations are in agreement with the findings of Singh and Singh (1975).

Larva : The larva passed through six instars before becoming pupa and the size of first, second, third, fourth, fifth and sixth instar larva was 2.0-3.0 mm X 0.44-0.48 mm, 5.0-8.0 mm X 0.72-0.76 mm, 12-17 mm X 2.90-2.95 mm, 23-29

Table 3: Developmental period of different stages of *H.armigera* (Hub.) under laboratory condition at ambient temperature

Generations	Study period	Incubation period (days) Range (Av.)	Larval duration in days					Total Larval duration in (days) Range (Av.)	Pre-pupal stage (days) Range (Av.)	Pupal duration in (days) Range (Av.)	Total life cycle duration in Range (Av.)
			I instar Range (Av.)	II instar Range (Av.)	III instar Range (Av.)	IV instar Range (Av.)	V instar Range (Av.)	VI instar Range (Av.)			
I	3rd week of November to 2nd week of January	04-05 (4.60)	06-07 (6.50)	06-07 (6.40)	05-06n (5.40)	05-06 (5.50)	04-05 (4.50)	04-05 (4.40)	30-36 (32.70)	03-05 (4.10)	20-24 (22.20)	54-65 (59.50)
II	3rd week of January to 2nd week of March	05-06 (5.60)	07-09 (7.70)	07-09 (8.10)	06-07l (6.60)	06-07 (6.70)	05-06 (5.50)	05-06 (5.60)	36-44 (40.20)	04-05 (4.60)	22-26 (24.00)	63-76 (69.80)

Data based on 10 individuals
Figures in parenthesis indicate Average

mm X 3.00-3.05 mm, 30-34 mm X 4.80-4.85 mm and 35-39 mm X 5.10-5.18 mm in length and breadth, respectively. The newly hatched larva was semi-translucent and creamy in colour with dark brown head. It was very active and moved swiftly in search of food. These finding are similar to those of Singh and Singh (1975) and Verma and Kakar (2001). The second instar larva was creamy white to pale greenish in colour. In the third instar, the colour turned greenish yellow with brown head. In the forth instar the change in body colour was apparent having dorsal side pale yellow with greyish longitudinal lines. The head became dark in the fifth instar with pale green body and broken stripe along each side of the body. The sixth instar larvae was light greenish in colour with broken stripes. These findings are in conformity with those of Singh and Singh (1975) and Verma and Kakar (2001).

Pre-pupal stage : The fully grown larva stopped feeding before entering into pupal stage. The pre-pupa measured 22-26 mm in length and 4.82-4.87 mm in breadth, however, the colour became darker with less prominent stripes.

Pupa : The male pupa measured 18-22 mm in length, 5.85-5.90 mm in breadth while in females it was 20-22 mm in length and 6.36-6.43 mm in breadth. The freshly formed pupa was reddish green and later changed to reddish brown and got further darkened prior to the emergence of moth. The abdomen was distinctly divided into 10 dark brown segments. Spiracles were present on 4th to 9th segment of the abdomen. These findings are in conformity with those of Singh and Singh (1975) and Bhatt and Patel (2001).

Adult : The adult was brownish grey in colour. The body of the male measured 17-20 mm in length with 34-38 mm wing expanse, while female had 18-22 mm body length with 37-42 mm wing expanse. The fore wings were pale brown with marginal series of dots and black kidney shaped mark was present on the underside of the fore wing. The hind wings were lighter in colour with dark coloured patches at the apical end. A tuft of hair was present on the tip of the abdomen of female only. These findings are similar to those of Singh and Singh (1975) and Bhatt and Patel (2001).

Biological parameters of *H. armigera*

Fecundity : The number of eggs laid per female ranged from 280-540 during present investigation. Dhandapani and Balsubramanian (1980 a) also recorded similar fecundity per female, which support the present findings.

Viability of eggs : The per cent viability of eggs varied from 77 to 92 per cent during the study period. Present findings are in accordance with Singh and Singh (1975) and Gopali and Lingappa (2001), who also reported similar viability of eggs 63 to 90 per cent in their investigations.

Longevity of adult : The longevity of male was 9.00 days while 10.90 day in case of female during 3rd week of January to 2nd week of March (IInd generation), followed by 7.90 days in male and 10.10 days in female in 3rd week of November to 2nd week of January (Ist generation). In both the generations, females generally lived more than the males. Similar results were also obtained by Singh and Singh (1975), and Sujalata and Singh (2004), who reported the longevity of male 7.52 days and in case of female it was 10.93 days.

Durations of different developmental stages of *H. armigera*

Incubation period : The incubation period ranged from 4-5 days and 5-6 days in Ist and IInd generations, respectively. These findings are in agreement with those of Singh and Singh (1975).

Larval period : *H. armigera* (Hub.) completed six larval instars from hatching to the pupation. In the Ist generation, the I, II, III, IV, V and VI larval instars took 6.50, 6.40, 5.40, 5.50, 4.50 and 4.40 days, respectively and the total larval duration under these conditions was 32.70 days. In the IInd generation it was 7.70, 8.10, 6.60, 6.70, 5.50 and 5.60 days in I, II, III, IV, V and VI larval instars, respectively and the total larval duration was 40.20 days. Similar observations were recorded by Singh and Singh (1975).

Pre-pupal period : The mean pre- pupal period in case of Ist and IInd generations were 4.10 and 4.60 days respectively. These findings are in agreement with those of Singh and Singh (1975).

Pupal period : The average pupal period in case of Ist and IInd generations were 22.20 and 24.00 days, respectively. The observations of Singh and Singh (1975) reporting the pupal period of 16.21 $\pm$ 1.40 days are in close proximately to present findings.

Total life cycle : The life cycle of *H. armigera* (Hub.) took minimum of 59.50 days for completing the life cycle in its Ist generation which occurred between 3rd week of November to 2nd week of January and maximum of 69.80 days in its IInd generation which completed from 3rd week of January to 2nd week of March. The present findings are in agreement with those of Singh and Singh (1975), and Verma and Kakar (2001).

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