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BIOLOGY AND MORPHOMETRICS OF *Helicoverpa armigera* (HUBNER) ON MARIGOLD UNDER LABORATORY CONDITIONS

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ABSTRACT

The present investigation was carried out during *kharif* 2025 at the Biocontrol Laboratory, Department of Entomology, N.M. College of Agriculture, Navsari Agricultural University, Navsari. The eggs of *H. armigera* were creamy white, hemispherical and measured 0.55 ± 0.02 mm in length and 0.53 ± 0.02 mm in width. The incubation period ranged from 2 to 4 days (2.66 ± 0.63 days), while the average hatching percentage was 59.05 ± 4.05 per cent. The larva passed through six instars. The average body length and width increased from 1.44 ± 0.02 mm and 0.55 ± 0.02 mm, respectively, in the first instar to 40.22 ± 1.41 mm and 6.21 ± 0.38 mm, respectively, in the sixth instar. The total larval period ranged from 19 to 25 days with an average of 21.00 ± 0.71 days. The pre-pupal and pupal periods averaged 1.48 ± 0.50 days and 12.22 ± 1.42 days, respectively. The pre-pupa measured 26.53 ± 0.65 mm in length and 4.85 ± 0.02 mm in width, whereas the pupa measured 21.21 ± 0.51 mm in length and 6.12 ± 0.04 mm in width. The average body length of male and female moths was 18.02 ± 0.53 mm and 22.45 ± 0.39 mm, respectively, while the average wing expanse was 36.43 ± 0.42 mm and 38.79 ± 0.42 mm, respectively. The fecundity averaged 452.25 ± 35.89 eggs per female. The longevity of male and female moths averaged 5.88 ± 1.24 days and 8.70 ± 1.31 days, respectively. The total life cycle ranged from 38 to 44 days in males (40.34 ± 1.70 days) and 42 to 49 days in females (45.54 ± 1.91 days).

Key words: Marigold, *Helicoverpa armigera*, biology, morphometrics

Introduction

India's diverse agro-climatic conditions provide an excellent opportunity for the cultivation of a wide range of ornamental crops throughout the year. The floriculture industry in the country comprises both cut flowers such as rose, carnation, gladiolus and gerbera, as well as loose flowers like marigold, jasmine, chrysanthemum and china aster. Among these, marigold holds a unique position due to its adaptability, ease of cultivation and wide range of uses (Arora, 2013). Marigold (*Tagetes erecta* L.) belongs to the family Asteraceae, which are most prevalent in the domain and are commonly referred to as "Gada" or "Genda" flowers in Bangladesh. It originated in Mexico and South America and was brought to other areas of the world by the Portuguese in the early 16th century. It has accepted so well in India so that it is now considered native to India (Bhagat *et al*., 2018). The area under marigold cultivation in India was about 103.99 thousand ha with a production of 1115.85 thousand MT of loose flowers and 13.57 thousand MT of cut flowers during 2025–26 (Anon., 2026). The area under cultivation of marigold in Gujarat is 10,293 ha with 95,685 MT production and productivity 9.30 MT per ha (Anon., 2025). The area under cultivation of marigold is concentrated in the vicinity of Vadodara, Gandhinagar, Ahmadabad, Anand, Navsari, Valsad, Bharuch, Kheda and Surat in Gujarat. In addition to its ornamental value, marigold possesses considerable phytochemical and pharmacological properties. The flowers are rich in carotenoids, especially lutein and zeaxanthin, which are widely used as natural colorants in the food and feed industries. These compounds also play an important role

in human health, particularly in preventing age-related macular degeneration and improving vision (Wahab *et al*., 2015). Marigold planted in-between rows of onion crop have shown to promote the reduction of aphid, nematode, whitefly and virus diseased plants (Zavaleta-Mejia and Gomez, 1995). Marigold faces challenges from several insect pests such as aphids, mites, miners, mealybugs, thrips and Helicoverpa armigera (Hubner) (Chivde *et al*., 2011). Among these, the gram pod borer or American bollworm (*H. armigera*) is the most destructive pest. It is a highly polyphagous insect pest with a wide host range, attacking more than 200 plant species including cotton, tomato, pigeon pea, maize, sunflower and several vegetable crops (Ganai *et al*., 2017). *H. armigera*, a highly polyphagous capitulum borer, severely damages marigold crops producing crop loss up to 20 per cent (Margal, 1990). It is a polyphagous pest and attacks many other crops, including cotton, pigeon pea, maize, tomato, sunflower, sorghum, a variety of vegetables, fruit crops and tree species (Devi *et al*., 2011). In severe cases, the pest can cause yield losses of up to 90 per cent, depending on the insect density and susceptibility of the host crop (Mahmood *et al*., 2021).

Materials and Methods

The initial culture of *H. armigera* larvae were collected from the marigold field at floriculture farm, ASPEE College of Horticulture and biological study was carried out at Biocontrol Laboratory, Department of Entomology, Navsari Agricultural University, Navsari.

Rearing Technique

For individual rearing of larvae, marigold leaves/ flowers were provided in a Petri dish (90 mm). Full-grown larvae were provided with moist soil for pupation in one-liter glass jars and the top of the jar was covered with a piece of muslin cloth held in position with the help of a rubber band. After pupation, it was sorted out and kept in a glass jar for the emergence of adults. The newly emerged male and female moth separated based on morphological characters. They were paired and were kept in a rearing cage for mating. Marigold plant was placed in a cage for oviposition. The rearing cage was covered with black coloured muslin cloth. The adults were fed with honey solution (5%) soaked on a cotton swab in small plastic container placed inside the cage and replaced daily. Eggs were collected daily in the morning from the leaves, flower, muslin cloth and also from the bottom of the cage with the help of a camel hair brush and kept in a petri dish for hatching. The size of eggs, initial instar larvae and head capsules were measured under a trinocular stereo zoom microscope (MPT/MKT/2025/SEP), while later instar larvae, pupae and adults were measured with a ruler (scale) or microscope. Then, 50 eggs were taken for study of biology during the present investigation.

Method of Recording Observations

Egg: For determine the incubation period, 50 freshly laid eggs were collected individually using a fine camel hair brush and transferred to separate Petri dishes. In order to determine the length and breadth of eggs, 25 eggs were observed. To study the incubation period, counted numbers of freshly laid eggs were observed daily till hatching. Hatching percentage was calculated from the data on number of eggs hatched out of the total number of eggs kept for hatching. When the larva hatched, it was provided with sufficient number of leaves/flowers of marigold.

Larva: Each larva was reared individually in a Petri dish and observed daily throughout its development. Fresh marigold leaves and flowers were provided every morning. The larval instars were identified based on the occurrence of moulting, which was confirmed by the presence of shed exuviae and cast head capsules. The duration of each larval instar was determined by recording the time interval between successive moults. Morphometric observations, including body length and width, were recorded for each larval instar. The length and width of the first and second instar larvae, as well as their head capsules, were measured using a trinocular stereo zoom microscope, whereas the later instars were measured using a ruler. The total larval period was calculated from egg hatching until the initiation of the pre-pupal stage.

Pre-pupa and pupa: The developing larvae were examined daily to determine the onset of the pre-pupal stage. Full-grown larvae ceased feeding, became sluggish, contracted their bodies and gradually turned greenish before entering the pre-pupal stage. The larvae subsequently constructed earthen cocoons in moist soil for pupation. The period between the formation of the pre-pupa and the appearance of the pupa was recorded as the pre-pupal period. The pupal period was determined as the duration from pupal formation to adult emergence. The length and width of freshly formed pre-pupae were recorded. After completion of pupation, the earthen cocoons were carefully broken open to remove the pupae and their morphometric measurements were recorded using a microscope or scale.

Adult: Adults emerged from pupae were observed for their colour, shape, size and sex difference. The male and female moths were measured across their expanded

wings with the help of a ruler or microscope. The female was distinguished from the male by various morphological characters viz., the female moth was bigger than the male and forewings of the male moth were greenish-gray in colour, whereas the forewings of the female moth were orange-brown and the female also had broad abdomen with a tuft of creamish scales at the tip of the abdomen.

Pre-oviposition, oviposition and post-oviposition period: For 3 determine the pre-oviposition, the newly emerged pairs of adults (male and female) were kept separately in a rearing cage. Period between the emergence of an adult female and commencing the egg-laying was recorded as the pre-oviposition period. The period between commencing the egg-laying and ceasing of egg-laying by an individual female was recorded as the oviposition period and the period between ceasing of egg-laying to death of the female was considered as post-oviposition period.

Fecundity: Eggs laid by female moths were collected and counted daily in the morning. The total number of eggs laid during the life span of a female moth was considered as its fecundity.

Adult longevity: The male and female longevity were calculated separately from the date of emergence to the death of adults.

Sex ratio: In order to determine the sex ratio (male: female), emerged males and females were identified on the basis of morphological features and sex ratio was the sex ratio was calculated.

Total life cycle: The duration of the entire life span was considered as the period between the date of egg-laying and the date of adult's death.

Results and Discussion

Egg

Eggs were laid singly on flowers, tender leaves and stems of marigold. The results on site of egg laying of *H. armigera* made during present study are similar to the results of Patel *et al*., (2012) who revealed that the eggs of *H. armigera* were laid singly on buds as well as on tender leaves on rose (Plate 2). Freshly laid eggs were creamy white, hemispherical with a flattened base and



Plate 1: Egg of *H. armigera.*

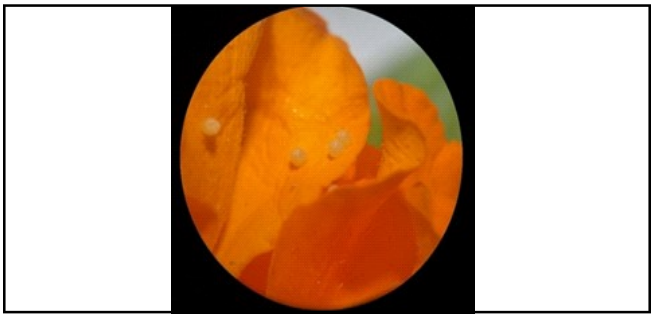


Plate 2: Eggs laid on flower of marigold.

became dark brown before hatching (Plate 1). The present findings are more or less similar from the results of Patel *et al*., (2012) who reported that the freshly laid egg of *H. armigera* on rose was yellowish white which changed to deep yellow after one day and became dark brown prior to hatching. Eggs were hemispherical with flat base and prominently sculptured with ridges running from one polar end to another. These ridges persisted until hatching. The average egg length and width were 0.55 ± 0.02 mm and 0.53 ± 0.02 mm, respectively. The present findings are more or less similar from the results of Patel *et al*., (2012) who reported that the eggs, measuring from 0.45 to 0.51 mm with an average of 0.49 ± 0.04 mm in length and 0.50 to 0.58 mm with an average of 0.54 ± 0.02 mm in width on rose. Purabiya *et al*., (2024) recorded that the incubation period of *H. armigera* was 50 51 2.84 ± 0.58 days and hatching percentage of *H. armigera* was 58.39 ± 4.22 per cent on chick pea. The results of present study are similar with the observations of above workers.

Larvae

H. armigera has six different larval instars. The duration of first larval instar of *H. armigera* varied from 2 to 3 days with average 2.50 ± 0.50 days (Table 1). The result of present findings is strongly supported by Herald and Tayde (2018), who reported that the duration of first instar larvae was 2.50 ± 0.52 days on tomato. The freshly emerged larvae were semi translucent, yellow in colour with small hairs on the dorsal surface of the body and black head (Plate 3). Almost similar observations were



Plate 3: First instar larva of *H. armigera.*

Table 1: Duration of different life stages of *Helicoverpa armigera* on marigold.

Sr. no.	Particulars	Min.	Max.	Mean ± SD
1	Incubation period (days)	2	4	2.66 ± 0.63
2	Hatching percentage	50.82	65.22	59.05 ± 4.05
3	Larval period (days)			
	1st instar	2	3	2.50 ± 0.50
	2nd instar	2	4	2.78 ± 0.76
	3rd instar	2	5	3.18 ± 0.98
	4th instar	3	5	3.58 ± 0.75
	5th instar	3	6	3.86 ± 0.92
	6th instar	3	6	5.10 ± 0.95
	Total	19	25	21.00 ± 0.71
4	Pre- pupal period (days)	1	2	1.48 ± 0.50
5	Pupal period (days)	10	15	12.22 ± 1.42
6	Pre-ovipositional period (days)	2	4	2.8 ± 0.75
7	Ovipositional period (days)	3	6	4.42 ± 1.05
8	Post-ovipositional period (days)	1	2	1.34 ± 0.47
9	Sex Ratio (Male : Female)	1:0.73	1:0.93	1:0.79
10	Adult longevity (days)			
	Male	3	8	5.88 ± 1.24
	Female	6	11	8.70 ± 1.31
11	Total life cycle (days) (egg to adult mortality)			
	Male	38	44	40.34 ± 1.70
	Female	42	49	45.54 ± 1.91
12	Fecundity (No. of eggs/female)	360	520	452.25 ± 35.89

done by Patel *et al*., (2012), who reported that the freshly emerged larvae were semi translucent, yellowish white on rose. The body length of first instar larva varied from 1.42 to 1.48 mm with an average 1.44 ± 0.02 mm while the width varied from 0.52 to 0.60 mm with an average 0.55 ± 0.02 mm (Table 2). Purabiya *et al*., (2024) recorded that the length and width of first instar larvae

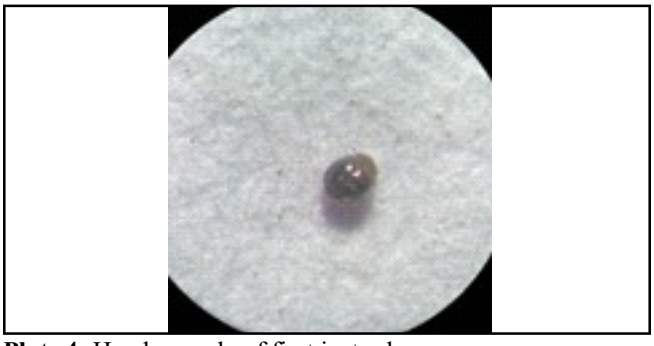


Plate 4: Head capsule of first instar larva.



Plate 5: Second instar larva of *H. armigera.*

on chickpea were 1.56 ± 0.12 mm and 0.46 ± 0.03 mm, respectively. The results of present study are similar with the observations of earlier workers. The head capsule length and width of first instar larvae of *H. armigera* ranged from 0.18 to 0.23 mm and 0.21 to 0.26 mm, respectively, with mean values of 0.20 ± 0.01 mm and 0.24 ± 0.01 mm (Table 2). Similarly, Purabiya *et al*., (2024) observed that the length of the head capsule was 0.23 ± 0.01 mm while the breadth of the head capsule was 0.26 ± 0.01 mm on chickpea.

The second instar larva of *H. armigera* lasted for 2 to 4 days with mean of 2.78 ± 0.76 days (Table 1). The present results are almost in accordance with results of the Chauhan *et al*., (2018), who recorded that larval duration were 2.76 ± 0.72 days on pearl millet. The colour of second instar larvae of *H. armigera* was reddish yellow with dark brown hairs with brown head (Plate 5). Patel *et al*., (2012) observed that the larva was yellowish brown in colour with somewhat darker head than the general body colour on rose. The results of present study are more or less similar with the observations of above workers. The body length of second instar larva of *H. armigera* varied from 3.81 to 3.88 mm with an average 3.84 ± 0.02 mm while the width varied from 0.76 to 0.84 mm with an average 0.81 ± 0.02 mm (Table 2), respectively. The present findings are more or less similar to those reported by Patel *et al*., (2012), who recorded that the length and width of *H. armigera* larvae on rose were 3.52 ± 1.08 mm and 0.82 ± 0.01 mm, respectively.



Plate 6: Head capsule of second instar larva.

Table 2: Morphometrics of different life stages of *Helicoverpa armigera* on marigold.

Sr. no.	Stage	Length			Width		
		Min.	Max.	Avg. ± SD	Min.	Max.	Avg. ± SD
1	Egg	0.61	0.47	0.55 ± 0.02	0.58	0.48	0.53 ± 0.02
Larva							
2	1st instar	1.42	1.48	1.44 ± 0.02	0.52	0.60	0.55 ± 0.02
	Head capsule	0.18	0.23	0.20 ± 0.01	0.21	0.26	0.24 ± 0.01
	2nd instar	3.81	3.88	3.84 ± 0.019	0.76	0.84	0.81 ± 0.021
	Head capsule	0.38	0.42	0.40 ± 0.01	0.44	0.48	0.46 ± 0.01
	3rd instar	8.52	10.48	9.42 ± 0.53	2.70	2.76	2.72 ± 0.02
	Head capsule	0.55	0.60	0.58 ± 0.02	0.67	0.71	0.69 ± 0.01
	4th instar	21.82	23.66	22.49 ± 0.45	3.16	3.20	3.17 ± 0.014
	Head capsule	1.02	1.08	1.06 ± 0.01	1.14	1.18	1.16 ± 0.01
	5th instar	30.26	32.90	31.52 ± 0.70	4.87	5.07	4.97 ± 0.05
	Head capsule	1.79	1.85	1.81 ± 0.02	1.89	1.94	1.92 ± 0.02
	6th instar	34.43	42.39	40.22 ± 1.41	5.39	6.91	6.21 ± 0.38
	Head capsule	2.30	2.34	2.32 ± 0.02	2.42	2.48	2.45 ± 0.02
3	Pre-pupa	25.41	27.61	26.53 ± 0.65	4.81	4.88	4.85 ± 0.02
	Pupa	20.48	22.31	21.21 ± 0.51	6.06	6.21	6.12 ± 0.04
Adult							
4	Male	16.2	18.55	18.02 ± 0.53	35.02	37.00	22.45 ± 0.39
	Female	21.60	23.00	36.43 ± 0.42	38.10	39.80	38.79 ± 0.42

The head capsule length and width of second instar larvae of *H. armigera* ranged from 0.38 to 0.42 mm and 0.44 to 0.48 mm, respectively. The mean values were 0.40 ± 0.01 mm for length and 0.46 ± 0.01 mm for width (Table 2). The present findings were consistent with Purabiya *et al*., (2024), who reported that the length of the head capsule was 0.45 ± 0.01 mm while the breadth of the head capsule was 0.50 ± 0.01 mm on chickpea.

The duration of third instar larvae of *H. armigera* varied from 2 to 5 days with average 3.18 ± 0.98 days (Table 1). The result of present findings is strongly supported by the results of Chauhan *et al*., (2018) who revealed that the duration of third instar larvae was 3.08 ± 1.08 days on pearl millet. The colour of third instar larvae of *H. armigera* was reddish orange in colour and body surface was cover with brown hairs (Plate 7). The present observations are slightly differing with Patel *et al*., (2012) who reported that the body colour turned to yellowish brown in third instar on rose. The variation in the results may be due to difference in host plant. The body length of third instar larva of *H. armigera* varied from 8.52 to 10.48 mm with an average 9.42 ± 0.53 mm while the width varied from 2.70 to 2.76 mm with an average 2.72 ± 0.02 mm (Table 2). The results are more or less confirmed with Patel *et al*., (2012) who revealed that the length and width of larvae on rose was 9.74 ± 0.66 mm and 2.81 ± 0.02 mm, respectively. The length and width of head capsule of third instar larva of *H. armigera* ranged from 0.55 to 0.60 mm and 0.67 to 0.71 mm, with mean values of 0.58 ± 0.02 mm and 0.69 ± 0.01 mm, respectively (Table 2). Purabiya *et al*., (2024) observed that the length of the head capsule was 0.63 ± 0.02 mm while the breadth of the head capsule was 0.73



Plate 7: Third instar larva of *H. armigera.*



Plate 8: Head capsule of third instar larva.



Plate 9: Forth instar larva of *H. armigera.*

± 0.01mm on chickpea. The results of present study are similar with the observations of above workers.

The duration of fourth instar larvae of *H. armigera* ranged from 3 to 5 days with an average of 3.58 ± 0.75 days (Table 1). The result of present findings is more or less similar with Sharma *et al*., (2019) who reported that the fourth instar larva lasted for 3.60 ± 0.57 days on tomato. The fourth instar larvae of *H. armigera* were greenish yellow in colour. Chaudhary *et al*., (2016) observed that the fourth instar larvae on okra were greenish yellow and the narrow dark bands with varying colour appeared on the middle of the back (Plate 9). The results of present study are similar with the observations of above workers. The body length of fourth instar larva of *H. armigera* varied from 21.82 to 23.66 mm with an average 22.49 ± 0.45 mm while the width varied from 3.16 to 3.20 mm with an average 3.17 ± 0.01 mm (Table 2). The present observations are in close agreement with those of Patel *et al*., (2012), who reported that the length and width of *H. armigera* larvae reared on rose were 23.02 ± 1.36 mm and 3.24 ± 0.01 mm, respectively. The head capsule length and width of fourth instar larvae of *H. armigera* ranged from 1.02 to 1.08 mm and 1.14 to 1.18 mm, respectively. The mean values were 1.06 ± 0.01 mm for length and 1.16 ± 0.01 mm for width (Table 2). Purabiya *et al*., (2024) observed that the length of the head capsule was 1.12 ± 0.01 mm while the breadth of the head capsule was 1.28 ± 0.01 mm on chickpea. The results of present study are more or similar with the



Plate 10: Head capsule of forth instar larva.



Plate 11: Fifth instar larva of *H. armigera.*

observations of above workers.

The duration of fifth instar larvae of *H. armigera* ranged from 3 to 6 days with average 3.86 ± 0.94 days (Table 1). The present findings are strongly supported by the results of Chauhan *et al*., (2018) who revealed that the duration of fifth instar larvae was 3.72 ± 0.94 days on pearl millet. The fifth instar larvae of *H. armigera* were greenish orange in colour with brown broken line on dorsal side (Plate 11). The result of present findings is differed from all reviews. The variation in the results may be due to difference in host plant. The body length of fifth instar larva of *H. armigera* varied from 30.26 to 32.90 mm with an average 31.52 ± 0.70 mm while the width varied from 4.87 to 5.07 mm with an average 4.97 ± 0.05 mm (Table 2). The present observations are slightly different from those reported by Patel *et al*., (2012), who recorded the length and breadth of *H. armigera* larvae on rose as 34.50 ± 1.29 mm and 5.11 ± 0.07 mm, respectively. The variation in the results may be due to difference in host plant. The head capsule length and width of fifth instar larvae of *H. armigera* ranged from 1.79 to 1.85 mm and 1.89 to 1.94 mm, with mean values of 1.81 ± 0.02 mm and 1.92 ± 0.02 mm, respectively (Table 2). The result of present findings is slightly differed from the results of Purabiya *et al*., (2024), who reported that the length of the head capsule was 2.19 ± 0.02 mm while the breadth of the head capsule was 2.22 ± 0.01 mm on chickpea. The variation in the results may be due to difference in host plant.

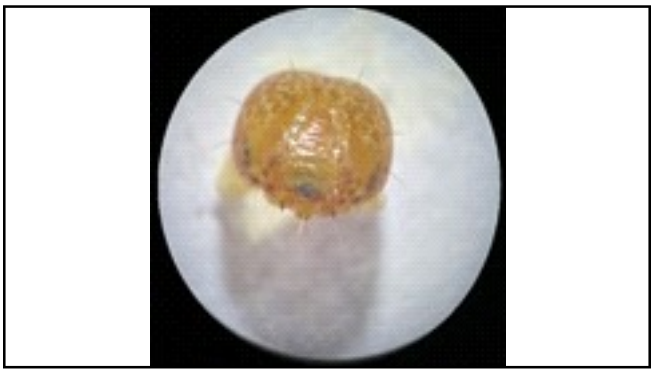


Plate 12: Head capsule of fifth instar larva



Plate 13: Sixth instar larva of *H. armigera.*

The duration of sixth instar larvae of *H. armigera* varied from 3 to 6 days with average 5.10 ± 0.95 days (Table 1). The present findings are slightly differed from the results of Sharma *et al*., (2019) who reported that the duration of sixth instar larvae was 4.84 ± 0.74 days on tomato. The sixth instar larvae of *H. armigera* were reddish-yellow in colour with dark broken brown lines along the side of the body. The head was reddish brown in colour (Plate 13). The present findings are differed from all reviews. The variation in the results may be due to difference in host plant. The body length of fourth instar larva of *H. armigera* varied from 34.43 to 42.39 mm with an average 40.22 ± 1.41 mm while the width varied from 5.39 to 6.91 mm with an average 6.21 ± 0.38 mm (Table 2). The present findings are slightly differed from the results of Patel *et al*., (2012) who reported that length and breadth of larvae was 43.89 ± 1.24 mm and 6.59 ± 0.56 mm, respectively. The third instar larvae of *H. armigera* recorded head capsule lengths ranged from 2.30 to 2.34 mm and widths from 2.42 to 2.48 mm, with mean values of 2.32 ± 0.02 mm and 2.45 ± 0.02 mm, respectively (Table 2). The present findings are slightly differed from the results of Purabiya *et al*., (2024), who reported that the length of the head capsule was 2.61 ± 0.04 mm while the breadth of the head capsule was 2.70 ± 0.05 mm on chickpea. The variation in the results may be due to difference in host plant.

The total larval period of *H. armigera* varied from 19 to 25 days with an average of 21.00 ± 0.71 days. Gami *et al*., (2025) reported that the total larval period was 20.86 ± 3.90. Gusain *et al*., (2023) also reported that the total larval period, from the first instar to the end of the sixth instar, lasted for 20.00 ± 3.21 days on pea. The results of present study are similar with the observations of above workers.



Plate 14: Head capsule of sixth instar larva.



Plate 15: Exuva of 6th instar larva.

Pre-pupa

The duration of pre-pupa of *H. armigera* ranged between 1 to 2 days with an average of 1.48 ± 0.50 days (Table 1). similar observation recorded by Sharma *et al*. (2019) who observed that the pre-pupal period was 1.48 ± 0.50 days on tomato. The sixth instar full grown larvae became less active, contracted their body and suspended feeding considered as pre-pupal stage (Plate 16). The present findings agree with the results of Chaudhary *et al*., (2016) who reported that the sixth instar full grown larvae became sluggish, ceased feeding, contracted their body and suspended feeding and movement considered as pre-pupal stage on okra. The length of pre-pupa was varied from 25.41 to 27.61 mm with an average of 26.53 ± 0.65 mm while the width of the body varied from 4.81 to 4.88 mm with an average of 4.85 ± 0.02 mm (Table 2). The present findings are more or less similar from the results of Patel *et al*., (2012) who reported that the length and breadth of pre-pupa was 25.01 ± 1.56 mm and 4.96 ± 0.02 mm, respectively.

Pupa

The newly formed pupa of *H. armigera* was greenish in colour later change to yellowish green in colour and



Plate 16: Pre-pupa of *H. armigera.*



Plate 17: Dorsal view of pupa.

after finally gains reddish brown in colour. Pupa was rounded interiorly and tapering at posteriorly (Plate 17). The present findings are more or less similar from the results of Patel *et al*., (2012) who reported that the pupa was broadly rounded interiorly but tapering posteriorly. The newly formed yellowish green pupa became light brown within 24 hours and further darkened prior to emergence of moth on rose. The length and width of pupal stage varied from 20.48 to 22.31 mm (Avg. 21.21 ± 0.51 mm) and 6.06 to 6.21 (Avg. 6.12 ± 0.04 mm), respectively (Table 2). The present findings similar with the results of Patel *et al*., (2012) who reported that the length and breadth of pupa was 20.93 ± 1.09 mm and 6.09 ± 0.08 mm, respectively.The duration of pupal stage of *H. armigera* varied from 10 to 15 days with an average 12.22 ± 1.42 days (Table 1). Chauhan *et al*., (2018) observed the pupal duration was 12.48 ± 1.58 days on pearl millet, which was similar to present study.

Adult

The moth was medium size with broad thorax. The fore wing has circular black dot in middle of wing. The hind wing is lighter in colour with black to brown border at apical end of wing. The male and female were distinguished by colour. The male was greenish grey in colour and female was yellowish brown in colour (Plate 19 and Plate 20). The present findings are in agreement with the reports cited in the review of literature. The



Plate 18: Lateral view of pupa.



Plate 19: Female adult of *H. armigera.*

average length of male and female varied from 16.20 to 18.55 mm (Avg. 18.02 ± 0.53 mm) and 21.60 to 23.00 mm (Avg. 22.45 ± 0.39 mm), respectively (Table 2). The average width (with expanded wings) of male and female was varied from 35.20 to 37.00 mm (Avg. 36.43 ± 0.42 mm) and 38.1 to 39.80 mm (Avg. 38.79 ± 0.42 mm), respectively (Table 2). The present findings are slightly differed from the results of Patel *et al*., (2012) who reported that length and breadth of male was 17.09 ± 0.77 mm and 36.20 ± 1.55 mm, respectively and for female 20.57 ± 1.22 mm and 41.61 ± 2.86 mm, respectively.

Pre-ovipositional, oviposition and post-oviposition periods

The pre-oviposition period of *H. armigera* varied from 2 to 4 days (Avg. 2.80 ± 0.75 days) (Table 1). The oviposition period ranged from 3 to 6 days (Avg. 4.42 ± 1.05 days) (Table 1). The post-oviposition period ranged from 1 to 2 days (Avg. 1.34 ± 0.47 days) (Table 1). Chaudhary *et al*., (2016) recorded that the average pre-oviposition, oviposition and post-oviposition periods were 2.86 ± 0.70 days, 6.22 ± 1.41 days and 1.40 ± 0.70 days, respectively. The variation in the results may be due to difference in host plant.



Plate 20: Male adult of *H. armigera.*

Fecundity

The number of eggs laid by female varied from 360 to 520 with an average 452.25 ± 35.89 (Table 1). The present findings are slightly differed from the results of Herald and Tayde (2018) who reported that the single female of *H. armigera* was laid an average 412.00 ± 5.24 eggs over an oviposition period.

Adult longevity

The longevity of male and female of was 3 to 8 days (Avg. 5.88 ± 1.24 days) and 6 to 11 days (Avg. 8.7 ± 1.31 days), respectively (Table 1). The present findings similar with the results of Patel *et al*., (2012) who reported that the longevity of male and female of *H. armigera* was 5.40 ± 1.04 days and 8.84 ± 1.91 days, respectively.

Sex ratio

The sex ratio of male to female reared was 1:0.79 (Table 1). Baikar and Naik (2016) observed that the sex ratio of male to female was 1:0.78. Purabiya *et al*., (2024) and Gami *et al*., (2025) also observed that the sex ratio of *H. armigera* was 1:0.76. The results of present study are similar with the observations of above workers.

Total life cycle

The total life cycle of male was ranged from 38 to 44 days with an average of 40.34 ± 1.70 days and in case of female it was 42 to 49 days with an average of 45.54 ± 1.91 days (Table 1). The present findings are similar with the results of Patel *et al*., (2012) who reported that the total life cycle of male *H. armigera* was 39.40 ± 2.33 days and in case of female it was 42.96 ± 2.47 days on rose.

Conclusion

H. armigera successfully completed its life cycle on marigold under laboratory conditions. The eggs were laid singly on flowers, tender leaves and stems and hatched after 2 to 4 days with an average hatchability of 59.05 per cent. The larva passed through six distinct instars, completing its larval development within 19 to 25 days. During its growth, noticeable changes in colour, body size and head capsule dimensions were observed. The fully grown larva entered into pre-pupal stage lasting about 1 to 2 days, followed by a pupal period of 10 to 15 days. Adult moths emerged from pupae and exhibited sexual dimorphism with females being larger and longer-lived than males. The pre-oviposition, oviposition and post-oviposition periods averaged 2.80, 4.42 and 1.34 days, respectively. The fecundity ranged from 360 to 520 eggs per female with an average of 452.25 eggs per female. The successful completion of its life cycle and high fecundity proves the pest's ability to multiply rapidly on marigold, emphasizing the need for timely and effective management practices.

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References

Anonymous (2025). Area – Production - Horticulture – 2024 - 25; Available https://doh.gujarat.gov.in /Home/Horticulture Cultivation (Accessed from: on: 21 June 2026).

Anonymous (2026). Area and Production of Floriculture Crops in India, 2025-26. National Horticulture Board (NHB), Ministry of Agriculture and Farmers Welfare, Government of India. Available from: https://dataful.in /datasets (Accessed on: 21 June 2026.)

Arora, J.S. (2013). *Introductory ornamental horticulture*. Kalyani Publishers.

Baikar, A.A. and Naik K.V. (2016). Biology of fruit borer, *Helicoverpa armigera* (Hubner)on chilli under laboratory conditions. *Plant Archives*, **16(2)**, 761-769.

Bhagat, V.P., Painkra G.P., Bhagat P.K. and Painkra K.L. (2018). Insect pests and its natural enemies on marigold in northern hill region of Chhattisgarh. *Journal of Entomology and Zoology Studies*, **6(2)**, 2659-2662.

Chaudhary, M.G., Chaudhary H.K. and Chaudhary R.J. (2016). Biology of *Helicoverpa armigera* (Hubner) Hardwick on okra under laboratory condition. *Advances in Life Sciences,* **5(12)**, 5032-5037.

Chauhan, N.N., Chaudhary F.K., Patel H.N. and Kachhadiya N.M. (2018). Biology of pearl millet ear head worm, *Helicoverpa armigera* under laboratory condition. *International Journal of Current Microbiology and Applied Sciences,* **7(1)**, 2958-2969.

Chivde, B.V., Kumar V.K. and Shiramane R.S. (2011). Evaluation of hepatoprotective activity of flowers of tagetes erecta L. *International Journal of Pharmaceutical and Biological Archive*, **2**, 692-695.

Devi, V.S., Sharma H.C. and Rao P.A. (2011). Interaction between host plant resistance and biological activity of Bacillus thuringiensis in managing the pod borer *Helicoverpa armigera* in chickpea. *Journal of Crop Protection*, **30(8)**, 962-969.

Gami, K.N., Gadhiya V.C., Mordiya A.D., Patel S.R. and Ghelani M.K. (2025). Biology of earhead worm, *Helicoverpa armigera* (Hubner) on pearl millet. *International Journal of Advanced Biochemistry Research,* **9(12)**, 433-439.

Ganai, S.A., Ahmad H., Sharma D., Khaliq N., Sharma S., Kaur R. and Norboo T. (2017). Effect of abiotic factors on the populations of pod borer, Helicoverpa armigera (Hubner) on marigold, Tagetes erecta in Jammu, India. *International Journal of Current Microbiology and Applied Sciences*, **6(9)**, 181-185.

Gusain, A., Semwal A., Maheshwari S., Nautiyal P., Rai D., Raghav D. and Singh T. (2023). Evaluation of life cycle of gram pod borer *Helicoverpa armigera* (Hubner) on vegetable pea. *International Journal of Plant and Soil Science,* **35(22)**, 731-735.

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)1**, 734-1737.

Mahmood, M.T., Akhtar M., Ahmad M., Saleem M., Aziz A., Rasool I., Ali Z. and Amin M. (2021). An update on biology, extent of damage and effective management strategies of chickpea pod borer (*Helicoverpa armigera*). *Pakistan Journal of Agricultural Research*, **34(1)**, 91-101.

Margal S.M. (1990). Studies on estimation of losses in sunflower cultivars due to *Helicoverpa armigera* Hub. (Lepidoptera: Noctuidae) and possible occurrence of biotypes *PhD thesis*, submitted to University of Agricultural Sciences, Bangalore.

Patel, R.S., Patel K.A., Patil K.S. and Toke N.R. (2012). Biology and management of bud borer (*Helicoverpa armigera* Hub*.)* on rose in South Gujarat. *Madras Agricultural Journal*, **99(10-12)**, 824-828.

Purabiya, P.N., Patel P.B. and Jena M.K. (2024). Biology and morphometry of gram pod borer *Helicoverpa armigera* Hubner infesting gram *Cicer arietinum* L. *Journal of Advances in Biology and Biotechnology*, **27(1)**, 13-28.

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.

Wahab, S., Ahmad I. and Irfan M. (2015). Phytochemical profile of Tagetes. *IJPP Sciences*, **7(11)**, 1-5.

Zavaleta-Mejía, E. and Gomez R.O. (1995). Effect of Tagetes erecta L.-tomato (*Lycopersicon esculentum* Mill.) intercropping on some tomato pests. *Fitopatologia Brasileira*. **30**, 35-46.