

Evaluation of life cycle of gram pod borer *Helicoverpa armiger* (Hubner) on vegetable Pea

Abstract

Pulse crops are faced with a major biotic constraint globally, and they are attacked by *Helicoverpa armigera* (Hübner) (Noctuidae), also known as the pod borer, across various regions including Asia, Europe, Africa, Australia, and South America. It is widely recognized as a key agricultural pest. Study of their life cycle revealed that total larval period were recorded (20.00±3.21) days from 1st instar to 6th instar under laboratory conditions at 26° C with 65 % relative humidity revealed. The mean duration was (2.66±0.33), (2.66± 0.33), (2.33± 0.33), (3.66± 0.88), (4.33± 0.66), and (4.33±0.88) days of 1st, 2nd, 3rd, 4th, 5th and 6th larval instar respectively during April-May 2022. The average incubation period of egg ranged from (4.66±0.88) days. The pod borer passes through six larval instars to become an adult.

Key words- Pea Pod Borer, Life Cycle, *Helicoverpa armigera*, control condition

Introduction

Peas, which are grown virtually worldwide for their edible seeds, can be bought fresh, canned, or frozen, and dried peas are commonly used in soups. Edible pods are produced by some varieties, such as sugar peas and snow peas, and they are eaten raw or cooked like green beans, particularly in East Asian cuisines. The plants are relatively easy to grow, and the seeds are a good source of protein and dietary fiber (Sachanet *et al.*, 2016). Pea pods have high nutritive value for human consumption and contain 7.2% carbohydrate, 19.2% mineral matters, 80% phosphorus, and 1.8% iron in fresh pea. In dried pea, they contain 19.7% protein, 56.6% carbohydrate, 2.1% mineral matters, and 4.4% iron. Pea is an important vegetable grown all over the country and serves as an off-season vegetable and a significant source of income for farmers. During the growth period, pea plants are susceptible to attacks from a variety of insect pests. The major insect pests of peas, such as *Helicoverpa armigera* from the order Lepidoptera and family Noctuidae, are known to be polyphagous in nature. The pod borer is responsible for causing up to 90% damage in peas, as it regularly occurs from vegetative growth to pod formation. It has been observed that the pod borer feeds on 300 species belonging to 68 plant families worldwide. These pests are highly destructive and can significantly reduce crop yield and economic value. They cause severe damage to both the crop and the field, resulting in decreased yield and quality of peas. The larva, particularly in its second instar stage, poses a significant threat as a single

larva can destroy multiple fruits by creating borers. The months of March to June are particularly prone to higher chances of damage.

Material and method

The biology of *Helicoverpa armigera* were carried out under lab conditions in year 2021-2022 at Department of Entomology as well as in Plant Protection Laboratory, College of Horticulture, Bharsar, Pauri Garhwal, Uttarakhand. The standing crop was carefully scanned, and *Helicoverpa armigera* was identified as one of the serious pests. The eggs were collected from the crop fields and were incubated in petri dishes under lab conditions. The newly hatched larvae were then transferred to other petri dishes lined with moist filter paper and provided with fresh pea pods. The filter paper and food were changed every second day. The larva was observed daily, and data was recorded regarding the moulting, duration, and size of each larval instar. The life stages were observed and recorded. The incubation period was measured as the time between egg laying and the emergence of the first instar larva from the egg.

Results and Discussion:

Biology of *H. Armigera* was studied on vegetable pea under laboratory condition during April-May. The description of various stages namely egg, larval instar, pupa and adult are detailed as under. The freshly laid eggs were collected from the Vegetable Research and Demonstration Block Department of Vegetable Science, College of Horticulture, VCSG UHF, Bharsar. The experiment on biology of vegetable pea pod borer (*H.armigera*) was conducted at laboratory of Entomology, College of Horticulture.

Incubation period (in days): The eggs were laid by the female in masses on various parts of the plants and on the upper and lower sides of the pea leaves. The eggs are commonly laid singly and in close proximity to each other. The freshly laid eggs had a spherical shape and a creamy white color with a ribbed surface. Just before hatching, the color of the eggs turned dark brown. During hatching, the egg shell opened at one end, leaving a cap-like flap loosely attached to it. The average incubation period of the eggs ranged from (4.66±0.88) days during April-May. The larval instar molted five times to reach maturity. The newly hatched larva was bright orange with red eyes. As it developed, the color changed to reddish brown, and just before molting, it turned red. The incubation period ranged from 3-6 days, with an average of (4.66±0.88) days. The

results of our experiments are consistent with the studies conducted by Chakarvarty *et al.* (2018), who also reported an incubation period ranging from 3.26 ± 0.15 days.

Larval stage: During the *Zaid* season in the hills, the first instar lasted for (2.66 ± 0.33) days. Table 1 represents the duration. The second instar lasted for (2.66 ± 0.33) days, and it had a reddish-brown color with dark brown hair and scarlet red eyes. The third instar had a pale brown color with blackish markings on the abdomen. The fourth instar had a greenish-yellow color with narrow dark bands on the back. It lasted for about (3.66 ± 0.88) days. The body color of the fifth instar larva was similar to that of the fourth instar larvae. The head had a reddish-yellow or light brown color. This instar lasted for about (4.33 ± 0.66) days. The fully grown sixth instar larva had a greenish color with dark broken grey lines along the side of the body. These lines varied in width and intensity of color. The color of the larvae could vary, including green, straw-colored, yellow, reddish-brown, or black. The head was greenish yellow. On each segment, there were a number of inconspicuous tubercles from which short hairs arose. The sixth instar lasted for about (4.33 ± 0.88) days. The total larval period, from the first instar to the end of the sixth instar, lasted for (20.00 ± 3.21) days, and the total pupal period ranged from (14.00 ± 0.57) days. The duration of the 1st instar was found to last for 2-3 days, with an average of (2.66 ± 0.33) days, under laboratory conditions. Similarly, the 2nd instar lasted for 2-3 days, with an average of (2.66 ± 0.33) days. The 3rd instar had a duration of 2-3 days, with an average of (2.33 ± 0.33) days. The 4th instar lasted for 2-5 days, with an average of (3.66 ± 0.88) days. The 5th instar had a duration of 3-6 days, with an average of (4.33 ± 0.66) days. Finally, the 6th instar lasted for 3-5 days, with an average of (4.33 ± 0.88) days. The total larval period, from the birth of the first instar to the end of the sixth instar, lasted for 14-25 days, with an average of (20.00 ± 3.21) days. Our results are comparable to those reported by Chauhan *et al.* (2018), who found a total larval period of the pod borer to be 17-22 days, with an average of 19.20 ± 1.29 days. Baikar *et al.* (2016) also reported an average larval period of 19-25 days.

Total pre pupal and pupal period (days): The total pre-pupal period was found to last for 1-3 days, with an average of (2.22 ± 0.66) days. Similarly, the total pupal period ranged from 13-15 days, with an average of (14.00 ± 0.57) days. These results align with the studies conducted by Nasreen and Mustafa (2000), who observed that the total pre-pupal and pupal period under lab

conditions varied from 1-4 days and 14-17 days, with an average of 2.1 ± 0.158 and 15.4 ± 0.50 days, respectively.

Adult longevity: The adults of *H. armigera* exhibited a wide range of color and markings. The color of the adult varied from buff to brown, with a dark brown circular spot located halfway between the base and apex of the forewings, as well as a smaller spot near the base. The hind wings displayed white coloration with some dark spots, along with well-defined veins and a dark margin containing two lighter spots. The freshly emerged male moth had a deep olive-buff forewing with a dark brown spot, while the female adult had a reddish-brown forewing with a blackish-brown spot. The abdomen shape of the female moth was broad, while the male moth had a pointed abdomen. The male could be distinguished from the female by its smaller size. The female had a longer lifespan, ranging from (46.33 ± 1.76) days, while the male had a lifespan ranging from (44.00 ± 2.64) days. Our results align with the findings of Chauhan *et al.* (2018), who reported a total lifespan of 46.33 ± 1.76 days for females and 44.00 ± 2.64 days for males of *H. armigera*.

Total developmental period: Total developmental period range from 31-49 days with an average of 41.33 ± 5.36 days. Chakarvarty *et al.* (2018) also reported the total life span of male and female adult in 39-48 days and 42-51 days respectively with an average of 45.64 ± 1.49 and 48.76 ± 1.56 days respectively.

Conclusion:

The information generated out of this investigation are summarized and concluded as follows. The incubation period of egg ranged from (4.66 ± 0.88) days during (April- May). The pod borer passes through six larval instars to become an adult. The mean duration was (2.66 ± 0.33) , (3.00 ± 0.57) , (2.33 ± 0.33) , (3.66 ± 0.88) , (4.66 ± 0.88) , and (4.00 ± 0.57) days for the 1st, 2nd, 3rd, 4th, 5th and 6th larval instar respectively during April-May 2022. Total larval period was considered from birth of 1st instar to the end of 6th instar. The duration from birth of total larval period lasted for (20.33 ± 3.48) days. Total pre pupal period last for (2.33 ± 0.66) days. Total pupal period range for (21.33 ± 0.88) days. The adults of *H. armigera* can have such a wide range of colors and markings. From buff to brown, with that dark brown circular spot in the middle of the forewings and a smaller spot near the base. And those hind wings with their strongly marked veins and that

dark margin with two lighter spots on it. The female lived longer with ranged between (46.33±1.76) days and longevity of male ranged between (44.00±2.64) days. The period from egg to adult emergence is known to be total development period. Developmental period from egg deposition to adult emergence ranges from (25.00±4.35) days.

Table 1. Duration of life cycle of *Helicoverpa armigera* on vegetable pea crop in Zaid season in hills.

S.NO	STAGES	DURATION (Days)	MEAN ±SE(m)
01	Incubation period	3.0-6.0	4.66±0.88
02	Larval period		
(A)	1 ST instar	2.0-3.0	2.66±0.33
(B)	2 nd instar	2.0-3.0	2.66±0.33
(C)	3 rd instar	2.0-3.0	2.33±0.33
(D)	4 th instar	2.0-5.0	3.66±0.88
(E)	5 th instar	3.0-5.0	4.33±0.66
(F)	6 th instar	3.0-6.0	4.33±0.88
03	Total larval period	14-25	20.33±3.21
04	Pre –pupal period	1.0-3.0	2.33±0.66
05	Pupal period	13-15	14.00±0.57
06	Adults		
(A)	Male	39-48	44.00±2.64
(B)	Female	43-49	46.33±1.76
07	Total developmental period	31-49	41.33±5.36
	SE(d)	-	2.13
	C.D(0.05)	-	4.44

References:

- Ali, A., R.A.Choudhury, Z. Ahmad, F.Rahman, F. Khan, and S.K. Ahmad, 2009.**Some biological characteristics of *Helicoverpaarmigera* on chickpea.*TunisianJournal of Plant Protection*.4(7): 99-106.
- Baikar, A.A. andK.V.Naik, 2016.**Biology of fruit borer, *Helicoverpaarmigera* (Hubner) on chilli under laboratory conditions.*PlantArchives*.16(2):761-769.
- Bhatt, N. J. and R.K.Patel, 2001.**Biology of chickpea pod borer, *H. armigera*.*Indian Journal of Entomology*.63 (3): 255-259.
- Chakravarty, S., C.P. Srivastava, and R. Keval, 2018.** Biology of *Helicoverpaarmigera* (Hubner) on chick pea- based artificial diet under laboratory condition. *Annals of Plant ProtetioncSciences*.26 (2):265-269.
- Chauhan, N.N., F.K. Chaudhary, H.N. Patel. AndN.M. Kachhadiya, 2018.**Biology of Pearl Millet Ear Head Worm, *Helicoverpaarmigera* under Laboratory Condition.*International Journal of current Microbiology and Applied Science*.7(01): 2958-2969.
- Choudhary, R.A., P.O.Rizvi, A. Ali.and S.K. Ahmad, 2009.**Age specific life table of *Helicoverpaarmigera* on *Cicerarietinum* under natural condition.*Annual plant protection sciences*. 21(8):57-61.
- Fathipour, Y., F.Baghery, A. Baghery and B. Naseri, 2020.**Development , reproduction and life table parameters of *Helicoverpaarmigera* (lepidotera: Noctuidae) on five main host plants. *Journal of Crop Protection*.9(4) :551-561.
- Fitt, G. P. 1989.**The ecology of *Heliothis* species in relation to agroecosystems.*Annual Review of Entomology*.34(1):17-52.
- Herald, K.P. and A.R. Tayde, 2018.**Biology and morphology of tomato fruit borer, *Helicoverpaarmigera* (Hubner) under Allahabad conditions. *Journal of Entomology and Zoology Studies*.6(4):1734-1737.
- Lomash, K., R.S. Bisht, H. Singh and K. Mohit, 2017.**Studies on Growth and Development of *Helicoverpaarmigera* (Hub.) on Various Hosts and Artificial Diet under Laboratory Conditions.*International Journal of current Microbiology and Applied Science*.6(12): 1627-1637.
- Matthews, M. 1999.**Heliothine moths of Australia: a guide to pest bollworms and related noctuid groups. *Melbourne.CSIRO*.35(4):220-225.
- Mohan, N., T.S.Aghora, M.A. Wani, and B. Divya, 2013.**Garden pea Improvement in India.*Journal of Horticulture Sciences*.8(2):125-164.

- Narssen, A. and G. Mustafa, 2000.** Biology of *Helicoverpaarmigera* (Hubner) reared in laboratory on natural diet. *Pakistan journal of biological sciences*.3(7): 1668-1669.
- Peter, K. V. and P.T. Kumar, 2008.**Garden Pea. In: Genetics and Breeding of vegetable crops. DIPA, ICAR, New Delhi. 121(8):242-249.
- Rabari , G.N., A. Pareekand B.R.Patel, 2017.**Comparative biology of *Helicoverpaarmigera* (Hubner) Reared on different hosts.*International Journal Pure and Applied Bioscience*.5(1):849-856.
- Sachan V. K., R. Kumar and P Nautiyal, 2016.**Impact of hydropriming treatments on seed invigoration in vegetable pea (*Pisumsativum* L.).*Vegetable Science*. 43 (1): 70-72.
- Sharma, K.C., S.C.Bhardwaj, and G. Sharma, 2011.** Systematic studies, life history and infestation by *Helicoverpaarmigera*(Hubner) (Lepidoptera: Noctuidae) on tomato in semi-arid region of Rajasthan. *Biological Forum-An International Journal*.3(1):52-56.
- Sharma, V. G, S. Kumarand, G. Srinivas, 2019.**Biology of *Helicoverpaarmigera* (Hubner) on tomato in south Gujrat.*Journal of entomology and zoology studies*.7(5):532-537.
- Singh , S.Y., K. Nighthoujam, S. Nakambam, N.S. Thakur, T. Rajesh, R.K. Tombisana, and P. Balasubramanian, 2019.**Studies on the biology of *Helicoverpaarmigera* on different semi-synthetic diet.*Journal of entomology and zoology studies*.7(1):709-712.
- Singh, H. and G. Singh, 1975.**Biological studies on *Heliothisarmigera* (Hübner) in Punjab.*Indian Journal of Entomology*.34(2): 154–164.
- Torres V., L.M. Rodrigues, A. Lacasa, 1996.**An unusual behaviour in *Helicoverpaarmigera*Hubner (Lepidoptera: Noctuidae): pupation inside tomato fruits. *Journal of Insect Behaviour*.9(7):981-984.
- Tripathi, S.R. and R.Singh, 1993.** Seasonal bionomics of *Heliothisarmigera* (Hubner) (Lepidoptera: Noctuidae) in the Terai Belt of northeastern Uttar Pradesh.*G. it. Entomol.* 2(3): 215–222.
- Verma, M., T.Lal, and M.Devi, 2018.**Seasonal incidence of major insect pests infesting field pea.*Journal of Entomology and Zoology studies*.6(2):2213-2215.
- Wang, N.C. and Z.H. LI, 1984.**Studies on the biology of cotton bollworm (*Heliothisarmigera*Hübner) and tobacco budworm (*Heliothisassulta*Quenee).*Journal of the Shandong Agricultural University, Taian*.1-2(1): 13-25.
- Yadav,A., V.Singh, , A. Yadav, and H. Singh, 2019.**Studieson succession of insect pest complex associated with pea at Bikaner. *Journal of Entomology and Zoology studies*.7 (3):1606-1608.