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Comparative Biology of *Helicoverpa armigera* (Hubner) Reared on Different Hosts

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ABSTRACT

The data on comparative biology of H. armigera on different hosts inferred that the eggs length and breadth (0.51 ± 0.02 and 0.53 ± 0.02 mm) and hatching (90.00 per cent) were noted maximum when reared on chickpea and minimum (0.48 ± 0.02 and 0.50 ± 0.02 mm) (80.00 per cent) on cabbage host. The incubation period was minimum on chickpea with 3.73 ± 0.64 days and maximum with 4.27 ± 0.83 days on cabbage. Six larval instars were observed on all three hosts under study. The colour of larvae varied in different instars and was observed light brown initially, later to greenish brown, yellowish-brown, light black brown and pale green with longitudinal stripes. Measurement of larval instars was recorded maximum (1.52 ± 0.04 and 0.49 ± 0.01 mm to 41.21 ± 1.59 and 5.90 ± 0.13 mm length and breadth) when larvae reared on chickpea, while minimum (1.43 ± 0.05 and 0.45 ± 0.02 mm to 37.03 ± 3.00 and 5.00 ± 0.25 mm length and breadth) when larvae reared on cabbage host. The minimum larval developmental period of 22.97 ± 1.10 days was noted on chickpea, whereas, it was maximum (27.10 ± 1.60 days) on cabbage. Similarly, the length and breadth of pre-pupae (25.60 ± 1.23 and 5.92 ± 0.23 mm) and pupae (21.04 ± 1.17 and 6.59 ± 0.29 mm for male and 21.54 ± 1.49 and 7.10 ± 0.21 for female) was maximum when H. armigera reared on chickpea host and minimum of 23.13 ± 1.64 and 5.34 ± 0.44 mm for pre pupa, 19.04 ± 1.20 and 5.57 ± 0.35 mm for male pupa and 19.36 ± 1.91 and 6.04 ± 0.18 mm for female pupa was measured on cabbage. The minimum pre pupal (1.93 ± 0.69 days) and pupal periods (8.07 ± 0.98 and 11.17 ± 1.05 days for male and female) were recorded on chickpea host, while maximum (2.27 ± 0.45 days pre pupal and 9.13 ± 0.94 and 12.70 ± 1.26 days male and female pupal periods) on cabbage host. The length and breadth of adult moths measured as 17.42 ± 0.85 and 34.18 ± 1.57 for male and 20.36 ± 0.83 and 40.78 ± 1.26 mm for female on chickpea host which was maximum as compared to cabbage recorded 14.35 ± 0.67 and 31.36 ± 1.56 mm for male moth and 18.33 ± 0.85 and 34.48 ± 1.51 mm for female, which was minimum. Among three hosts the longevity of male and female was recorded maximum with a mean of 5.70 ± 0.97 and 9.20 ± 1.32 days on chickpea and minimum with a mean of 5.30 ± 0.95 and 8.30 ± 1.42 days, respectively on cabbage. The mean pre-oviposition, oviposition and post-oviposition periods of H. armigera female were observed as 2.40 ± 0.52, 5.90 ± 0.88 and 0.90 ± 0.74 days on chickpea, while 2.50 ± 0.71, 5.10 ± 1.10 and 0.60 ± 0.70 days on cabbage host, respectively. The maximum mean fecundity was 229.10 ± 16.26 eggs per female on chickpea, whereas, minimum with 191.70 ± 10.76 eggs per female on cabbage host. The sex ratio of male to female was observed as 1: 0.87, 1: 0.85 and 1: 0.81 on chickpea, tomato and cabbage, respectively. On the basis of growth index, chickpea (3.59) was most preferred host, while tomato (3.42) was intermediate and cabbage (3.09) the least preferred host for H. armigera.

Key words: *Helicoverpa armigera, biology, host, Gujarat.*

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is an important profitable crop and gives higher yield to the growers. Due to its relative short duration, tomato crop has become economically attractive to the farmers and the area under cultivation is increasing day by day around the world. However, all the stages of tomato crop right from nursery to maturity are attacked by a large spectrum of insect pests. Among these insect pests of tomato, fruit borer, *H. armigera* is very important which causes 40-50 per cent damage to the crop[12]. *H. armigera* is a charismatic insect pest in agriculture accounting for the consumption of over 55 per cent of total insecticides used in India[14]. The problem of pest is magnified due to its direct attack on fruiting structures, voracious feeding habits, high mobility, fecundity and multivoltine overlapping generations. Losses solely due to this pest up to Rs. 10000 million have been reported in crops like cotton, pigeonpea, groundnut, sorghum, pearlmillet, tomato and other crops of economic importance[15]. It is one of the most dominant insect-pests infesting agricultural crops and accounting for the consumption of over 55% of the total insecticides used in the country[14]. The outbreak of *H. armigera* on crops has been attributed to the development of insecticide resistance to broad spectrum of insecticides used in the agriculture and are known to have detrimental effect on the populations of its natural enemies[11]. Exposure of successive generations while moving from one crop to another, has made this pest highly resistant to the pesticides i.e. cyclodiene, pyrethroids, organophosphates, carbamates etc[6]. *H. armigera* has become threat to the intensive agriculture. Alternative management approach to this pest could be host plant resistance, which can play major role in management of *H. armigera*[18]. It is economically reliable, ecologically safe and compatible with other IPM strategies[8,10,18]. HPR helps in developing cultivars that give stability is important in terms of growth, development and behavior of herbivorous insects. A thorough knowledge of the biology of the insect provides an important basis for developing efficient pest management strategies. Therefore the present investigation was undertaken to study the comparative biology of *H. armigera* reared on different tomato varieties

MATERIALS AND METHODS

Detailed studies were carried out in the laboratory of Department of Entomology, C. P. Collage of Agriculture, S.D.A.U., Sardarkrushinagar on comparative biology of *H. armigera* on chick pea, tomato and cabbage. During the study period the average temperature and relative humidity was 20.73 ± 2.55 ^{0}C and 65.77 ± 7.65 per cent, respectively.

Rearing of *H. armigera:*

Fruit borer, *H. armigera* larvae were collected from the unsprayed tomato field of Horticulture Instructional farm, C.P.C.A, SDAU, Sardarkrushinagar. The collected larvae were reared in the laboratory on leaves and fruits of tomato. The larvae were kept individually in plastic tubes (3.8 cm diameter x 5 cm height) to avoid cannibalism. The plastic tubes were closed with lid having small aeration holes. Tomato leaves, fruits and plastic tubes were changed daily to maintain sanitation. The larvae pupated in the tubes were taken out and kept in Petri dish. The in the pupal stage was determined by examining the location of genital slit in relation to anal slit with the help of binocular microscope. The male and female pupae were kept in separate rearing cages (30 cm x 30 cm x 30 cm) for emergence of adults. Male and female adults emerging out from pupae were collected with the help of plastic tube.

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The pairs of male and female were released in separate rearing cage for mating and egg laying. The tomato plant with young leaves and fruits were placed inside the cage for egg laying. Absorbent cotton dipped in 5 per cent honey solution was served as food for the adults. The freshly laid eggs on leaves and fruits were used for further studies.

Larva

To determine the number and duration of different larval instars and total larval period, the larvae were reared in separate plastic tubes by providing tender and fresh leaves or fruits as the food. The food and plastic tubes were changed daily in the morning. The molting was confirmed by casted off exuvia and increased size of larvae of subsequent instars. The larvae in each instar were studied for their colour, shape and size. The length and breadth of all larval instars were measured with the help of stage and ocular micrometer. Observations on number of instars, duration of each instar and total larval period were recorded separately. The total larval duration was calculated from the date of hatching of egg to the end of final instar.

Pre-pupa

When full grown larvae ceased feeding, turned darker, wrinkled and sluggish, it was considered as pre-pupal stage. The length and breadth of all the pre-pupae formed were measured by using stage and ocular micrometer. The period between formation of pre-pupa and pupa was taken as pre-pupal period and recorded.

Pupa

The individual pupa was examined for their morphological characters, colour and size. The length and breadth of the pupae were also measured by using stage and ocular micrometer. The male and female sex was determined by examining the distance between the genital slit and anal slit of the pupa. Pupal period was calculated from the date of formation of pupa to the date of emergence of adult from the pupa.

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Table 1: Measurement of various life stages of *H. armigera* reared on different hosts

Sr. No.	Life Stage	Measurement (mm)	Tomato			Cabbage			Chickpea		
			Min.	Max.	Mean ± S.D.	Min.	Max.	Mean ± S.D.	Min.	Max.	Mean ± S.D.
	Egg	Length	0.46	0.53	0.49 ± 0.02	0.44	0.51	0.48 ± 0.02	0.47	0.54	0.51 ± 0.02
		Breadth	0.46	0.55	0.51 ± 0.03	0.47	0.54	0.50 ± 0.02	0.49	0.57	0.53 ± 0.02
2	Larvae										
	I instar	Length	1.42	1.51	1.48 ± 0.02	1.34	1.49	1.43 ± 0.05	1.42	1.58	1.52 ± 0.04
		Breadth	0.44	0.49	0.47 ± 0.01	0.42	0.50	0.45 ± 0.02	0.47	0.52	0.49 ± 0.01
	II instar	Length	3.21	3.49	3.32 ± 0.07	3.18	3.29	3.24 ± 0.03	3.33	3.48	3.41 ± 0.03
		Breadth	0.66	0.74	0.70 ± 0.02	0.56	0.64	0.61 ± 0.03	0.70	0.81	0.75 ± 0.03
	III instar	Length	9.16	9.42	9.27 ± 0.06	8.44	8.97	8.72 ± 0.14	9.55	9.86	9.69 ± 0.08
		Breadth	2.54	2.68	2.60 ± 0.04	2.24	2.56	2.43 ± 0.09	2.68	2.82	2.75 ± 0.04
	IV instar	Length	17.84	24.20	20.83 ± 1.36	17.24	23.00	19.90 ± 1.65	19.43	23.15	21.43 ± 1.03
		Breadth	2.94	3.24	3.09 ± 0.07	2.61	3.10	2.80 ± 0.13	3.15	3.30	3.21 ± 0.04
	V instar	Length	25.49	33.39	29.34 ± 1.98	24.55	33.74	28.17 ± 2.37	28.00	34.22	30.80 ± 1.47
		Breadth	4.67	4.92	4.84 ± 0.07	4.20	4.56	4.34 ± 0.09	4.85	5.20	4.93 ± 0.07
	VI instar	Length	36.22	41.56	39.00 ± 1.55	29.00	40.75	37.03 ± 3.00	37.89	44.22	41.21 ± 1.59
		Breadth	4.90	6.09	5.36 ± 0.26	4.36	5.88	5.00 ± 0.25	5.65	6.18	5.90 ± 0.13
3	Pre-pupa	Length	21.36	26.53	24.19 ± 1.29	21.03	26.92	23.13 ± 1.64	23.22	28.16	25.60 ± 1.23
		Breadth	4.46	6.52	5.56 ± 0.59	4.57	5.96	5.34 ± 0.44	5.64	6.46	5.92 ± 0.23
4	Pupa										
	Male	Length	18.22	22.12	20.14 ± 1.04	17.23	21.83	19.04 ± 1.20	17.45	23.11	21.04 ± 1.17
		Breadth	5.16	6.72	5.81 ± 0.41	5.00	6.24	5.57 ± 0.35	6.00	7.20	6.59 ± 0.29
	Female	Length	18.56	22.85	20.66 ± 0.97	15.84	22.68	19.36 ± 1.91	19.20	26.37	21.54 ± 1.49
		Breadth	5.32	7.49	6.45 ± 0.49	5.78	6.44	6.04 ± 0.18	6.78	7.56	7.10 ± 0.21
5	Adult										
	Male	Length	15.62	17.90	16.92 ± 0.74	13.75	16.08	14.35 ± 0.67	16.24	19.56	17.42 ± 0.85
		Breadth	30.48	36.58	32.64 ± 1.55	29.11	34.11	31.36 ± 1.56	31.48	37.45	34.18 ± 1.57
	Female	Length	17.28	21.69	19.53 ± 1.38	16.76	19.58	18.33 ± 0.85	18.26	21.66	20.36 ± 0.83
		Breadth	36.20	41.27	38.65 ± 1.23	31.25	37.54	34.48 ± 1.51	36.21	42.26	40.78 ± 1.26

Table 2: Comparative biology of *H. armigera* on different hosts

Sr. No.	Life stage	Tomato			Cabbage			Chickpea		
		Period (Days)								
		Min	Max	Mean ± S.D.	Min	Max	Mean ± S.D.	Min	Max	Mean ± S.D.
1	**Egg**	2	5	3.97 ± 0.85	3	6	4.27 ± 0.83	2	5	3.73 ± 0.64
2	**Larva**									
	I instar	2	4	2.43 ± 0.68	2	4	2.57 ± 0.57	2	4	2.37 ± 0.61
	II instar	2	4	2.70 ± 0.65	2	4	2.93 ± 0.69	2	4	2.67 ± 0.66
	III instar	2	5	3.87 ± 0.68	3	5	4.03 ± 0.76	2	5	3.30 ± 0.75
	IV instar	4	6	4.63 ± 0.63	4	7	4.97 ± 0.81	3	5	3.97 ± 0.72
	V instar	4	6	5.60 ± 0.81	4	7	5.83 ± 0.91	4	6	4.93 ± 0.69
	VI instar	5	9	6.37 ± 1.07	5	9	6.77 ± 1.07	5	7	5.67 ± 0.66
	Total	23	29	25.53 ± 1.53	25	31	27.10 ± 1.60	20	26	22.97 ± 1.10
3	**Pre-pupa**	2	3	2.20 ± 0.41	2	3	2.27 ± 0.45	1	3	1.93 ± 0.69
4	**Pupa**									
	Male	7	10	8.83 ± 0.95	7	11	9.13 ± 0.94	7	10	8.07 ± 0.98
	Female	9	14	12.47 ± 1.25	9	14	12.70 ± 1.26	7	12	11.17 ± 1.05

N=30

Table 3: Pre-oviposition, oviposition, post-oviposition periods, fecundity, longevity, growth index, hatching percentage and sex ratio of *H. armigera* on different hosts

Sr. No.	Life stage	Tomato			Cabbage			Chickpea		
		Period (Days)								
		Min	Max	Mean ± S.D.	Min	Max	Mean ± S.D.	Min	Max	Mean ± S.D.
1	**Adult**									
	Pre-oviposition	2	4	2.60 ± 0.70	2	4	2.50 ± 0.71	2	3	2.40 ± 0.52
	Oviposition	5	7	5.60 ± 0.84	4	7	5.10 ± 1.10	5	8	5.90 ± 0.88
	Post oviposition	0	2	0.80 ± 0.92	0	2	0.60 ± 0.70	0	2	0.90 ± 0.74
2	**Longevity**									
	Male	4	7	5.50 ± 1.08	4	7	5.30 ± 0.95	4	7	5.70 ± 0.97
	Female	7	11	8.80 ± 1.40	6	11	8.30 ± 1.42	7	12	9.20 ± 1.32
3	**Fecundity**	174	222	203.50 ± 13.44	168	204	191.70 ± 10.76	188	243	229.10 ± 16.26
4	**Growth index**	3.42			3.09			3.59		
5	**Hatching (%)**	83.33			80.00			90.00		
6	**Sex ratio (M:F)**	1: 0.85			1: 0.81			1: 0.87		

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