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Growth and development of *Earias vittella* (Fabricius) on cotton cultivars

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ABSTRACT : Studies on biology of *Earias vittella* (Fabricius) on different cotton cultivars *viz.,* Parbhani Turab, Paras Brahma and NHH 44 were conducted at 26 ± 3^{0}C temperature under laboratory condition. The larva of *E. vittella* passed through four instars when reared on three different cotton cultivars. Incubation period of *E. vittella* when reared on Parbhani Turab, Paras Brahma and NHH-44 was 3.07, 3.63 and 3.33 days, respectively. Whereas larval period of *E. vittella* when reared on Parbhani Turab, Paras Brahma and NHH 44 was 9.26, 15.72 and 12.26 days, respectively. Pupal period of *E. vittella* was 8.39, 10.22 and 9.28 days on Parbhani Turab, Paras Brahma and NHH 44, respectively. Longevity of male (9.26 days) and female moths (11.10 days) found to be maximum on Paras brahma followed by NHH 44 (8.84 and 9.60 days) and Parbhani Turab (7.48 and 8.30 days). Shortest total life cycle duration of *E. vittella* male and female observed to be 29.24 and 30.06 days, respectively on Parbhani Turab. Longest total life cycle duration of *E. vittella* male and female noticed to be 40.60 and 42.08 days, respectively on Paras Brahma. Amongst different cotton cultivars Parbhani Turab exhibited most favourable host for growth and development of *E. vittella* as compared to Paras Brahma and NHH 44**.**

Keywords: Biology, cotton cultivars, development period, *Earias vittella*,

Cotton provides the most important natural fiber or vegetable wool which has been in the cultivation commercially for domestic consumption and export needs in many countries worldwide and hence called “King of Fibers” or “White Gold”. Cotton is found to harbour 1326 species of insects from sowing to maturity in different cotton growing areas of the world and 162 species have been reported on cotton crop in India. The bollworm complex causes severe damage to the cotton in which the spotted bollworm (*E. vittella*) causes damage to the crop in various life stages of development, it causes 6.45 to 13.20 per cent damage at square development stage, 1.27 to 8.35 per cent damage at flowering stage and 2.44 to 8.48 per cent damage during boll development period. The food plants play a vital role in development, survival and reproductive potential of insect. The food may influence the chance of insect to survive and multiply by modifying its growth, fecundity and longevity. Preferred hosts have a great influence on oviposition, fecundity, developmental period and longevity of adults of *E. vittella* (Fab.) and *E. insulana* (Boisd.). Keeping all this in view, the present investigation was conducted to study the biology of *E. vittella* (Fab.) on different cultivars of cotton.

Rearing technique: The laboratory culture of spotted boll worm, *Earias vittella* Fabricius (Noctuidae : Lepidoptera) was initiated by collecting infested cotton bolls having large larvae from Research Farm. The collected larvae were reared individually in round clean plastic containers. These containers were cleaned every day. Daily larvae were fed on fresh field collected green cotton bolls in the morning hours till pupation. After pupation, the sexes of pupae were determined on the basis of distance between the two apertures. In case of male, the distance between genital and anal aperture is less, while it is more in case of female. The adults that

emerged on the same day were sexed and one male and one female were paired together for copulation and egg laying in oviposition cage. Cotton swab dipped in 5 per cent honey solution was provided as a food to the adults. The bouquet of fresh cotton shoot with tender leaves whose one end was dipped in water contained in small vial was provided as a substrate in each oviposition cage for egg laying. After every 24 h, cotton twigs were examined for presence of egg and replaced with fresh one.Thus, the freshly laid eggs were used for investigation on biology of *E. vittella* on different cotton cultivars. During the course of investigation, the ambient room temperature was 26 ± 3^{0}C.

Biology of *E. vittella* : Three cotton cultivars *viz.,* Parbhani Turab, Paras Brahma (non *Bt* refugia) and NHH 44 were grown at the Research Farm, Department of Agril. Entomology, College of Agriculture, Latur during *kharif* 2012. Each cultivar was grown on gross plot size of 5x5 sq. m at the spacing of 45x20 cm.

The studies on biology of *E. vittella* were carried out in a completely randomized design with five replications under laboratory conditions. Hundred freshly laid eggs in a group of 20 per replication were kept in petri dish for recording observations in respect of incubation period and per cent egg hatching. The newly hatched larvae were reared individually in the plastic containers on cotton bolls of respective cotton cultivars. While rearing due care was taken to transfer the larvae into clean plastic container. Fresh food (green cotton bolls) was provided daily and old food was removed. The observations on the larval duration, per cent pupation, growth index, pre pupal duration, pupal duration, per cent adult emergence and total development period were recorded on respective cotton cultivars. The adults that emerged on the same day were sexed and one male and one female were paired together for copulation and egg laying in oviposition cage. Cotton swab dipped in 5 per cent honey solution was provided as a food to the adults. The bouquet of fresh cotton shoot with tender leaves whose one end was dipped in water contained in small vial was provided as a substrate in each oviposition cage for egg laying. The number of eggs laid by each female was counted daily till the death of female moth. The observations on emergence, initiation of oviposition, last oviposition and death of female were recorded. From these pre-oviposition, oviposition and post-oviposition period were worked out on respective cotton cultivars. Longevity of male and female was calculated separately from the date of emergence and death. Finally duration of life-cycle was worked out on respective cotton cultivars.

The growth index was calculated

$$\text{Growth index} = \frac{\text{Per cent larvae pupated}}{\text{Mean larval duration (days)}}$$

The results in respect of growth and development of *Earias vittella* (Fabricious) on different cotton cultivars *viz.*, Parbhani Turab, Paras Brahma and NHH 44 are presented in Table 1.

The data on incubation period of egg showed to be statistically significant difference on different cotton cultivars. Incubation period varied from 3.07 to 3.63 days. Parbhani Turab recorded shortest incubation period (3.07 days) followed by NHH-44 (3.33 days) and Paras Brahma (3.63 days). These results are in close conformity with the findings of Rehman and Ali (1981) and Suryawanshi *et al.,* (2001) who recorded incubation period of *E. vittella* eggs on cotton ranged from 3-4 days. Dhillon and Sharma (2004) noticed shortest incubation period on *G. arboreum* (2.8 days) and *G. hirsutum* (2.8 days) varieties than on the hybrids (3.5 days). While, Shitole and Patel (2010) revealed incubation

period was 2.97 ± 0.71 days on cotton. Further, Syed *et al.* (2011) noticed varying incubation period as 3.0 ± 0.0 and 3.87 ± 1.3 days at 32.6 and 34.12^{0}C, respectively. Similarly, Shah *et al.,* (2012) noted incubation period of 4, 3 and 2 days at 27, 31 and 35±1°C temperatures, respectively.

The significantly maximum egg hatching (85%) was observed on Parbhani Turab followed by NHH 44 (78 per cent). However, lowest egg hatching was noticed on Paras Brahma (72 per cent).These findings are supported with the work of Shitole and Patel (2010) who reported 74.80 ± 4.64 per cent eggs hatching. Syed *et al.,* (2011) observed 71.68 per cent fertility of eggs. While, Shah *et al.,* (2012) recorded 90 per cent egg hatchability during the experimentation.

Larval duration also recorded considerable variation when larvae fed on different cotton cultivars. The significantly lowest larval instar duration of I, II, III and IV instars was recorded when the *E. vittella* fed on Parbhani Turab (2.50, 2.30, 2.05 and 2.41 days) followed by NHH 44 (3.15, 3.06, 2.93 and 3.01 days). The highest larval instar duration of I, II, III and IV instars was recorded when the *E. vittella* fed on Paras Brahma (4.43, 3.79, 3.52 and 3.98 days). Thus, the overall range tallies with those reported by Shitole and Patel (2010) who recorded mean duration of first, second, third and fourth instars of *E. vittella* to the tune of 2.51 ± 0.61, 1.48 ± 0.50, 2.17 ± 0.62 and 3.40 ± 0.77 days, respectively, on cotton.

The significantly shortest total larval duration (9.26 days) was recorded when larvae fed on bolls of Parbhani Turab followed by NHH-44 (12.20 days) and Paras Brahma (15.72 days). These results are parallel to the findings of Suryawanshi *et al.,* (2001) who documented larval period of *E. vittella* ranged from 5-16 days on cotton. Significantly shortest larval period was noted on *G. arboretum* (8.7 days) than on the *G. hirsutum* hybrid (10.8 days) by Dhillon and Sharma (2004). Shitole and Patel (2010) reported larval period as 9.74 ± 1.54 days. While, Syed *et al.* (2011) observed larval period of 12.4 ± 1.4 and 11.5 ± 1.1 days at 32.6 and 34.12^{0}C, respectively. However, Shah *et al.,* (2012) reported larval period of 14, 12 and 8 days, at 27, 31 and 35 ± 1°C temperature, respectively. This could be because of the variations in the nutritional status of bolls.

The significantly highest pupation of *E. vittella* was recorded when larvae fed on bolls of Parbhani Turab (94.48%) followed by NHH-44 (89.71 per cent) and Paras Brahma (83.30 per cent). These findings do find support from the work of Kate (2005) who examined 97.77 to 100 per cent pupation. On the contrary, Dhillon and Sharma (2004) noted significantly lowest pupation on *G. arboreum* (23.2 %) than *G. hirsutum* (36.0 %).

The growth index values varied from 10.28 to 6.52. The significantly highest growth index was observed in the case of larvae which fed on Parbhani Turab (10.28) over NHH 44 (8.25) and Paras Brahma (6.52). These observations are in agreement with the results of Kate (2005) who reported the growth index values ranged from 10.56 to 12.95. Nevertheless, the growth index values varied from 2.7 to 3.8, being minimum on *G. arboreum* and maximum on *G. hirsutum* (Dhillon and Sharma, 2004).

The significant differences were observed in respect of pre pupal duration. Among different cotton cultivars, Parbhani Turab recorded shortest pre pupal period (1.03 days) followed by NHH 44 (1.16 days). Whereas, Paras Brahma reported extended pre pupal duration (1.40 days). However, it ranged from 19.8 to 23.7 h on different cotton genotypes (Dhillon and Sharma, 2004). Similarly, Shitole and Patel (2010) revealed pre pupal duration of *E. vittella* was 1.48 ± 0.50 days.

Significantly longest pupal duration was observed to be 10.22 days when larvae fed on the bolls of Paras Brahma followed by NHH 44 (9.28 days) and Parbhani Turab (8.39days). The trend

of results found in present studies coincides with that reported by Suryawanshi *et al.*, (2001) who demonstrated pupal period ranged from 4 to 14 days. Likewise, Dhillon and Sharma (2004) noticed pupal period of 8.0 to 8.8 days and it was significantly longer on *G. hirsutum* variety, as compared to *G. hirsutum* hybrids. According to Shitole and Patel (2010), average duration of pupa destined to be male and female was 7.40 ± 0.91 and 7.58 ± 1.61 days, respectively. However, Syed *et al.* (2011) indicated pupal period lasted for 10.7 ± 3.1 and 9.84 ± 0.7 days at 32.6 and 34.12^{0}C, respectively. Analogously, Shah *et al.,* (2012) reported pupal period to extent of 15, 11 and 7 days at 27, 31 and 35 ± 1°C temperature, respectively.

Significantly highest adult emergence was observed in the case of larvae which were reared on the bolls of Parbhani Turab (91.36%) followed by NHH 44 (85.69%). However, lowest adult emergence was recorded on Paras Brahma (72.47%). The results obtained are in close agreement with the findings of Kate (2005) who reported adult emergence to extent of 73.76 to 95.55 per cent.

Significantly shortest developmental period was exhibited on Parbhani Turab (21.76 days) as compare to NHH 44 (25.97 days) and Paras Brahma (30.98 days). More or less similar results were obtained by Kate (2005) who showed total developmental period varied from 21.76 to 30.98 days. Syed *et al.,* (2011) recorded total developmental period on cotton as 26.1 and 25.21 days at 32.6 and 34.12^{0}C, respectively.

Statistically significant differences were observed in respect of longevity of male and female of *E. vittella* when reared on different cotton cultivars. The significantly utmost longevity of male and female of *E. vittella* was recorded on Paras Brahma (9.62 and 11.10 days). It was followed by NHH 44 (8.84 and 9.60 days) and Parbhani Turab (7.48 and 8.30 days). Overall results indicated that irrespective of the cotton cultivars longevity of female was significantly longer than male. Dhillon and Sharma (2004) reported male life span ranged from 5.9 to 7.3 days and female 8.5 to 11.2 days which was significantly longer on *G. hirsutum* hybrids as compared to that on the variety of *G. arboreum*. Shitole and Patel (2010) reported adult longevity male and female to the of 9.20 ± 2.30 and 11.40 ± 2.91 days, respectively. Syed *et al.,* (2011) noted adult longevity (male and female) as 9.0 ± 0.0 and 9.84 ± 0.7 days at 32.6^{0}C and 34.12^{0}C, respectively. Shah *et al.,* (2012) recorded adult life span of male as 12, 9 and 6 days and female as 14, 12 and 9 days at 27, 31 and 35 ± 1°C temperatures, respectively.

Significantly shortest life cycle duration of *E. vittella* male and female was observed to be 29.24 and 30.06 days, respectively when larvae fed on cotton bolls of Parbhani Turab followed by NHH 44 (34.81 and 35.57 days) and Paras Brahma (40.60 and 42.08 days). These results are analogous to the findings of Suryawanshi *et al.*, (2001) who noticed duration of life cycle ranged from 18 to 45 days on cotton. Shitole and Patel (2010) reported total life cycle of male and female was as 28.20 ± 3.42 and 30.70 ± 2.50 days, respectively. While, duration of life cycle was noticed as 35.1 and 36.7 days on cotton at 32.6 and 34.12^{0}C, respectively by Syed *et al.,* (2011). Similarly, Shah *et al.,* (2012) recorded duration of life-cycle as 45-47, 35-38 and 23-26 days at 27, 31 and 35±1°C temperature, respectively.

Among different cotton cultivars, longest pre oviposition period (1.46 days) was observed on Paras Brahma which was followed by NHH 44 (1.28 days) and Parbhani Turab (1.0 day). Dhillon and Sharma (2004) showed pre-oviposition period of 1.4 to 2.4 days and concluded that pre oviposition period on *G. arboreum* variety was significantly more than on *G. hirsutum* cultivars. However, Shitole and Patel (2010) reported pre oviposition period of *E. vittella* was 1.50 ± 0.71 days. Syed *et al.,* (2011) recorded pre-oviposition

Table 1. Growth and development of *Earias vittella*on different cotton cultivars

Biological parameters or Life stages of *E. vittella*	Different cotton cultivars			S. E. +	C.D. (p=0.05)	C.V. (%)
	Parbhani Turab	Paras Brahma	NHH 44			
Incubation period (days)	3.07	3.63	3.33	0.09	0.27	6.09
Per cent egg hatch/hatchability	85.00 (61.62)*	72.00 (46.91)	78.00 (52.08)	5.61	17.28	23.46
I Instar larval duration (days)	2.50	4.43	3.15	0.10	0.31	6.64
II Instar larval duration (days)	2.30	3.79	3.06	0.15	0.45	10.91
III Instar larval duration (days)	2.05	3.52	2.98	0.09	0.27	7.00
IV Instar larval duration (days)	2.41	3.98	3.01	0.11	0.33	7.73
Total Larval duration (days)	9.26	15.72	12.20	0.27	0.83	4.88
Per cent larvae pupated	94.48 (75.47)	83.30 (56.49)	89.71 (64.43)	4.10	12.64	14.03
Growth index	10.28	6.52	8.25	0.19	0.59	5.21
Pre-pupal duration (days)	1.03	1.40	1.16	0.03	0.12	7.32
Pupal duration (days)	8.39	10.22	9.28	0.19	0.60	4.72
Per cent adult emergence	91.36 (66.25)	72.47 (46.71)	85.69 (59.62)	2.37	7.30	9.24
Total developmental period	21.76	30.98	25.97	0.47	1.46	4.04
Longevity of male (days)	7.48	9.62	8.84	0.16	0.50	4.23
Longevity of female (days)	8.30	11.10	9.60	0.14	0.43	3.27
Life cycle duration of male (days)	29.24	40.60	34.81	0.54	1.66	3.46
Life cycle duration of female (days)	30.06	42.02	35.57	0.55	1.70	3.45
Pre-oviposition period (days)	1.00	1.46	1.28	0.05	0.16	9.82
Oviposition period (days)	6.30	8.14	6.92	0.20	0.61	6.28
Post Oviposition Period (days)	1.00	1.50	1.40	0.05	0.17	9.93
Fecundity	333.40	281.60	305.80	2.69	8.09	1.91

*Figures in parentheses indicate arcsine transformed values

period as 1.0 ± 0.0 and 1.33 ± 0.5 days at 32.6 and 34.12^{0}C, respectively. Shah *et al.,* (2012) recorded pre oviposition period of 2 to 3 days.

The significant differences were observed in respect of oviposition period of *E. vittella*. Shortest oviposition period of 6.3 days was observed on Parbhani Turab followed by NHH 44 (6.92 days) and Paras Brahma (8.14 days). The oviposition period varied from 4.2 to 5.3 days and revealed significantly shorter on the *G. arboreum* variety than on the *G. hirsutum* cultivars (Dhillon and Sharma, 2004). However, Shitole and Patel (2010) found oviposition period of *E. vittella* to the tune of 5.80 ± 1.69 days. According to Syed *et al.,* (2011), oviposition period was 6.0 ± 0.0 and 8.0 ± 0.0 days at 32.6 and 34.12^{0}C, respectively. Analogously, oviposition period was reported as 6 to 8 days by Shah *et al.,* (2012).

Significantly shortest post-oviposition period (1.0 day) was recorded on Parbhani Turab followed by NHH 44 (1.4 days) and Paras Brahma (1.5 days) However, Dhillon and Sharma (2004) reported significantly longer post oviposition period (1.9 to 5.2 days) on the *G. hirsutum*. Shitole and Patel (2010) found post oviposition period of 3.9 ± 1.29 days. Studies conducted by Syed *et al.,* (2011) noted post-oviposition period as 1.0 ± 2.0 and 3.0 ± 2.82 days at 32.6 and 34.12^{0}C, respectively.

The significant differences were observed in respect of fecundity of *E. vittella* on different cotton cultivars. Parbhani Turab exhibited highest fecundity as 334.4 eggs/female followed by NHH 44 (305.8 eggs/female). However, lowest fecundity was observed on Paras Brahma (281.8 eggs/female). Dhillon and Sharma (2004) observed fecundity to the extent of 269.2 to 344.6 eggs per female. Shitole and Patel (2010) reported 265 ± 93.98 eggs/female on cotton. Syed *et al.,* (2011) reported 276.3 ± 37.7 eggs/female. Similarly, Shah *et al.,* (2012) recorded 150-250 eggs per female at 27, 31 and 35±1°C temperatures.

CONCLUSION

Parbhani Turab was found to be most suitable host for growth and multiplication of *E. vittella* while, Paras Brahma was observed to be less suitable for the development of spotted bollworm, *E. vittella* under laboratory conditions. This data can be very well utilized in the pest management programme.

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