

RESEARCH ARTICLE :

Biology of cotton pink bollworm, *Pectinophora gossypiella* (Saunders) Lepidoptera: Gelechiidae

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SUMMARY : The biology of *Pectinophora gossypiella* was studied at three different temperature regimes of viz., 25±1, 30±1 and 35±1 °C. The study revealed that the time taken for developmental stages was less with increase in temperature. At 25±1 °C, the incubation period, larval period and pupal period were 3.77 ± 0.78 days, 23.15 ± 3.23 days and 8.75 ± 0.55 days, respectively. While at 35±1 °C, the incubation period, larval period and pupal period were comparatively low (1.95 ± 0.51 days, 12.8 ± 1.96 days and 5.20 ± 0.47 days, respectively). The longevity of adult male was 9.00 ± 0.5 days at 25 ± 1 °C and 3.57 ± 0.4 days at 35 ± 1 °C, whereas female longevity was 9.5 ± 1.0 days at 25 ± 1 °C and 3.45 ± 0.6 days at 35 ± 1 °C. The total life cycle from egg to adult emergence was high at 25 ± 1 °C (52.3 ± 6.51 days) and low at 35 ± 1 °C (29.8 ± 4.28 days). The oviposition period was ranged from 1.5 to 2.5 at different temperature but the fecundity was high (112.85 ± 16.1 eggs/female) at 25 ± 1 °C and less (49.80 ± 8.69 eggs/female) at 35 ± 1 °C. The influence of decreasing in temperature was evident in extending the duration of the life cycle.

KEY WORDS :

Pink bollworm,
Biology, Varied
temperature regimes

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BACKGROUND AND OBJECTIVES

Cotton (*Gossypium hirsutum* L.) is one of the principal commercial crops. The insect pests spectrum of cotton is quite complex and more than 1326 species of insect pests have been reported on this crop throughout the world (Atwal, 2004) and nearly 130 different species of insect pests and mites are reported to cause damage to cotton crop in India among which a complex of sucking pests viz., green leafhoppers, *Amrasca devastans* (Dist); thrips, *Thripstabaci* (Linnman); aphids, *Aphis gossypii* (Glover); whitefly, *Bemisia tabaci*

(Gennadius); red cotton bug *Dysdercus cingulatus* (Fabricius) and dusky cotton bug, *Oxycarenus hyalinipennis* (Costa) and nevertheless bollworms viz., american bollworm, *Helicoverpa armigera* (Hubner); spotted bollworm, *Earias vittella* (Fabricius); the spiny bollworm *Earias insulana* (Biosdual); pink bollworm, *Pectinophora gossypiella* (Saunders) and tobacco caterpillar, *Spodoptera litura* (Fabricius) (Jaleel *et al.*, 2004).

P. gossypiella is an endemic pest of cotton in central and south zones of India. Larvae found to infest flowers, feeding on the

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anthers, pollens by living in a sort of web. Such flowers are characteristically twisted in the form of rosette. Later, larvae bore into the bolls, burrow through lint penetrating deep into immature seeds. When one seed is destroyed, larvae make the tunnel through the developing lint and migrate to another seed and similarly to the locules. In North Karnataka, pink bollworm is considered to be a key pest of cotton and known to cause 2.81 to 61.87 per cent loss in seed cotton yield, 3.44 to 37.83 per cent loss in germination, 2.12 to 47.13 per cent loss in oil content and 10.66 to 59.15 per cent loss in normal opening of the bolls under unprotected condition (Patil *et al.*, 2003). Though much of the information is available on its incidence and damage levels, information on its biology is very scarce and hence the studies on its biology at three different temperature regimes were undertaken.

RESOURCES AND METHODS

Insect culture:

Initially culture of *P. gossypiella* was obtained from the population maintained at Bio control Laboratory, Main Agricultural Research Station, Raichur. Healthy pupae procured were sexed and stored in plastic vials (4 cm diameter and 5 cm height) with a filter paper disc at the bottom and a lid with a mesh window. These vials were retained in an incubator at $25 \pm 1^\circ\text{C}$ until adult emergence which served as the starter culture and was used for further studies.

Rearing:

Adult pink bollworm of ten mating pairs of pink bollworm moths were released into an oviposition jar (transparent plastic container of 28 cm height and 24 cm diameter) Adults were fed with honey and distilled water (1:3 ratio) delivered in a ball of absorbent cotton placed in a small glass dish inside the oviposition jar. Another cotton ball dipped in distilled water was also be placed in each jar containing a small twig of non Bt cotton bearing a few leaves and squares, which was served as a substratum for adults to rest and oviposit. The cut end of the twig was kept in water and inserted through a hole in the cap of a small plastic vial. The opening of the oviposition jar was covered with white cotton cloth fastened with rubber bands. Oviposition jars were maintained in an environmental chamber and adults will be transferred to a fresh jar every third day. Eggs laid by them were transferred to plastic container with twig

containing eggs and were counted every day till the death of female moth. After egg hatching the larvae were reared on the semi synthetic artificial diet cube in each plastic vial releasing single larva and the lid is provided with holes for aeration and covered with tissue paper to avoid escape of larvae.

These vials with larvae were placed in an incubator at three temperature points, *i.e.* $25 \pm 1^\circ\text{C}$, $30 \pm 1^\circ\text{C}$ and $35 \pm 1^\circ\text{C}$ with constant relative humidity of 70 per cent to study the biology. At regular interval biological parameters like pre-oviposition, oviposition, fecundity and developmental period were recorded.

OBSERVATIONS AND ANALYSIS

The biological parameters on developmental periods of egg, larvae, pupae and adult were recorded at different temperature regimes (Table 1)

Egg:

Newly laid eggs were whitish and turn yellowish and become orange red after one day before hatching and were flattened oval sculptured with longitudinal lines, which were laid in axils of petioles or peduncles, undersides of young leaves, under old leaves at junction of veins or on buds or flowers before boll formation. After boll formation eggs were laid in suture near the boll tip or under the bracteoles at the base of bolls and measures 0.43 mm lowest incubation period was 1.95 days on $35 \pm 1^\circ\text{C}$ while highest incubation period was 3.77 days on $25 \pm 1^\circ\text{C}$ (Table 1). Where, Shah *et al.* (2013) reported 4.00 days incubation period of *P. gossypiella*. While Syed and Rahman (1960) reported incubation period was 7.37 days at $25 \pm 1^\circ\text{C}$.

Larvae:

The newly hatched larva of *P. gossypiella* was whitish with pale brown head measures about 0.48 to 0.54 mm, second and third instar larva was creamy white in color with dark spots on the dorsal side of the body, the head was dark brown in color. The full grown larvae were pink in color with dark brown head and measures from 6.15 to 11.42 mm. Young larvae of *P. gossypiella* preferred to eat young bolls but mature larvae feeds on fully mature boll and specially cotton seeds. The lowest larval period was 12.8 and highest 23.15 days at $35 \pm 1^\circ\text{C}$ and $25 \pm 1^\circ\text{C}$, respectively (Table 1). Similar findings were also made by Syed and Rahman (1960) who reported

larval duration was 23.1 days on $25 \pm 1^\circ\text{C}$.

Pupae:

Pupa of *P.gossypiella* was dark brown in colour, length of male and female were 4.1 to 4.54 mm and 4.5 to 4.71mm, respectively. Full grown larvae of *P. gossypiella* pupate mostly very near to bolls, because

the adult larva of pink bollworm feeds mostly on seed portion of mature bolls so it has not much time to go in debris or other places like *armigera* species. The pupal stage was resting stage, in which development of moth took place. The highest pupal period was 8.75 days at $25 \pm 1^\circ\text{C}$ and lowest was 7.9 days at $35 \pm 1^\circ\text{C}$, (Table 1) Syed (1960) reported 16.7 days on $25 \pm 1^\circ\text{C}$, while Shah

Table 1 : Biological parameters of pink bollworm *P. gossypiella* (Saunders) on cotton at varied temperature regimes

Stage	Temperature					
	$25 \pm 1^\circ\text{C}$		$30 \pm 1^\circ\text{C}$		$35 \pm 1^\circ\text{C}$	
	Mean \pm SD	Range	Mean \pm SD*	Range*	Mean \pm SD*	Range*
Egg incubation period	3.77 \pm 0.78	2.5- 4.5	3.2 \pm 0.47	2.5- 3.5	1.95 \pm 0.51	1.5-2.5
Total larval period	23.15 \pm 3.23	19.5-27.5	15.77 \pm 1.92	13-17.5	12.8 \pm 1.96	11-15
Pre-pupal period	3.95 \pm 0.51	3.5-4.5	1.77 \pm 0.523	1.5-3.5	1.85 \pm 0.48	1.5-2.5
Pupal period	8.75 \pm 0.55	7.5-9.5	5.70 \pm 0.41	5.5-6.5	5.20 \pm 0.47	4.5-5.5
Pre-oviposition period	8.75 \pm 0.55	7.5-9.5	5.70 \pm 0.410	5.5-6.5	5.20 \pm 0.47	4.5-5.5
Oviposition period	2.05 \pm 0.53	1.5-2.5	2.15 \pm 0.49	1.5-2.5	1.80 \pm 0.47	1.5-2.5
Fecundity	112.85 \pm 16.1	100-175	102.60 \pm 9.96	85-125	49.80 \pm 8.69	43-82
Adult longevity						
Male	9.00 \pm 0.51	8.5-9.5	6.80 \pm 0.57	6 -7.5	3.58 \pm 0.49	3.0-4.5
Female	9.52 \pm 1.01	8.5-11.5	8.6 \pm 0.45	8 - 9.5	3.45 \pm 0.60	4.5-6.5
Total life cycle	52.31 \pm 6.51	45-61	40.59 \pm 4.54	35-46.75	29.83 \pm 4.8	27-37.75

*Means of 20 observations

Table 2 : Morphometry of egg, larval and pupal stages of pink bollworm, *P. gossypiella* (Saunders)

Stage	Length(mm)*		Breadth(mm)*	
	Mean \pm SD	Range (mm)	Mean \pm SD	Range(mm)
Egg	0.43 \pm 0.02	0.39-0.47	0.181 \pm 0.01	0.19-0.16
Larval stages				
I instar	0.52 \pm 0.01	0.48-0.54	0.16 \pm 0.02	0.11-0.21
II instar	0.89 \pm 0.02	0.85-0.91	0.18 \pm 0.05	0.17-0.18
III instar	5.38 \pm 0.29	4.92-5.92	0.16 \pm 0.03	0.12-0.21
IV instar	9.14 \pm 1.65	6.15-11.42	0.46 \pm 0.36	0.31-1.51
Pre pupa	4.33 \pm 0.11	4.18-4.52	1.54 \pm 0.04	1.48-1.61
Pupa				
Male	4.22 \pm 0.13	4.1- 4.54	1.32 \pm 0.13	1.17-1.61
Female	4.61 \pm 0.07	4.5-4.71	1.22 \pm 0.10	1.09-1.39

*Means of 10 of observations

Table 3 : Morphometry of adult pink bollworm, *P. gossypiella* (Saunders)

Adult wing expansion	Length(mm)*		Breadth(mm)*	
	Mean \pm SD	Range	Mean \pm SD	Range
Female (Fore wing)	4.27 \pm 0.09	4.14-4.44	1.21 \pm 0.07	1.11-1.35
Female(hind wing)	3.38 \pm 0.22	3.08-3.77	1.44 \pm 0.22	1.21-1.99
Male (Forewing)	3.13 \pm 0.03	3.08-3.19	0.8 \pm 0.07	0.71-0.92
Male (hind wing)	3.16 \pm 0.25	2.84-3.48	0.51 \pm 0.01	0.39-1.23
Body length				
Male	3.40 \pm 0.32	3.21-4.05	2.35 \pm 0.21	2.11-2.77
Female	4.38 \pm 0.12	4.21-4.6	1.24 \pm 0.31	1.01-1.43

*Means of 10 of observations

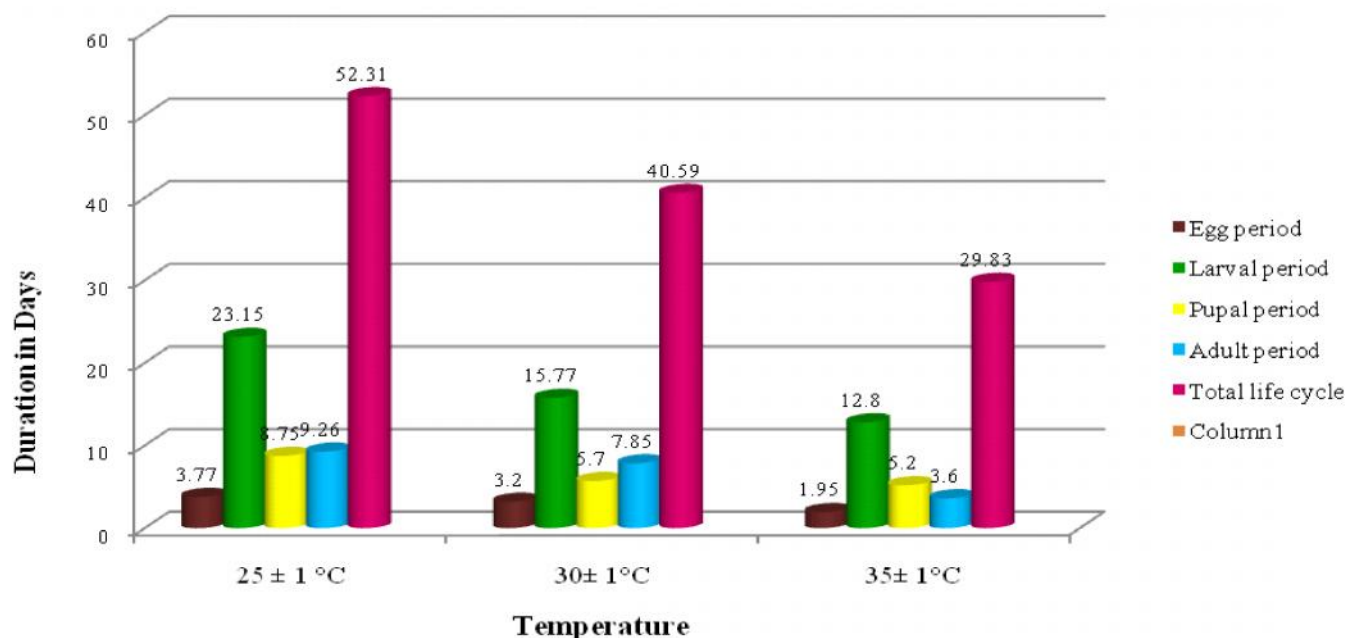


Fig. 1 : Biological parameters of *P. gossypiella* at varied temperature regimes

et al. (2013) reported 16 days at $25 \pm 1^\circ\text{C}$.

Adult:

The adult moth is small moth having dark brown, with irregular black markings on the forewing and hind wing are silvery grey with no distinct markings, both wings are elongated, fringed with long hairs posterior margin and tip of hind wing is sharply pointed. The length and breadth of adult male was ranged from 3.21 to 4.05 and 2.11 to 2.77 mm with an average of 3.40 ± 0.32 mm and 2.35 ± 0.21 mm, respectively (Table 2) and breadth at wing span was ranged from 3.08 to 3.9 and 0.71 to 0.92 mm with a mean of 3.13 ± 0.02 mm and 1.44 ± 0.22 mm, respectively (Table 3). While the body length and breadth of female were ranged from 4.21 to 4.6 and 1.01 to 1.43 mm with a mean of 4.38 ± 0.12 mm and 1.24 ± 0.31 mm, respectively (Table 2) and breadth at wing span were ranged from 3.08 to 3.77 and 1.21 to 1.99 mm with a mean of 3.38 ± 0.22 mm and 1.44 ± 0.22 mm, respectively (Table 3). Adult longevity was 9.26 and 3.6 at 25 and $35 \pm 1^\circ\text{C}$, respectively (Table 1). Syed and Rahman (1960) reported the adult longevity was 9.23 and 3.45 days at 25 and $35 \pm 1^\circ\text{C}$, respectively. Shah, *et al.* (2013) reported highest longevity (18 days) at $27 \pm 1^\circ\text{C}$ and lowest was 10 days at $35 \pm 1^\circ\text{C}$.

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