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MORPHOMETRICS OF *PECTINOPHORA GOSSYPIELLA* (SAUNDERS) ON COTTON AS INFLUENED BY TEMPERATURE

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ABSTRACT

The morphometry of life stages of the pink boll worm *Pectinophora gossypiella* (Saunders) was evaluated at four temperature levels of 20, 25, 30 and 35ºC to assess the impact of temperature. Measurement of larval head capsule width, body length, body width and weight on cotton at 20ºC were 0.68, 0.87, 0.98 and 1.24 mm, 2.27, 5.80, 7.46 and 10.60 mm, 1.08, 1.58, 1.68 and 2.53 mm and 0.40, 2.84, 24.42 and 64.21 mg for I, II, III and IV larval instars, respectively. The mean pupal length and weight of male and female varied significantly when reared at different temperature levels.

Key words: *Pectinophora gossypiella*, morphometrics, temperature, head capsule, wing span, instars, body length, body weight, Dyar's rule

The pink boll worm *Pectinophora gossypiella* (Saunders) (Lepidoptera: Gelechiidae) is a pervasive and devastating pest that severely damages cotton. It is found across various cotton-growing areas and is notorious for causing extensive losses in seed cotton quantity and quality (Bhamare and Wadnerkar, 2018). Temperature variation has a significant impact on the morphometrics of life stages of insects. Various aspects like physical characteristics, such as body size, weight and developmental rates vary with temperature (Huang et al., 2018). Temperature variations can affect the growth and development of larvae and pupae, ultimately influencing their overall size and shape. Understanding the relationship between temperature and the morphometrics of *P. gossypiella* is crucial for developing effective IPM in cotton.

MATERIALS AND METHODS

The evaluation of morphometrics of *P. gossypiella* was conducted under laboratory conditions at 20, 25, 30 and 35ºC using a BOD incubator at the Department of Agricultural Entomology, College of Agriculture, Latur, during kharif 2019. Immediately after hatching 30 larvae for each instar were transferred into separate plastic containers. These were reared individually on cotton bolls. Every day fresh food was provided to the larvae. The observation of the casting of exuviae was made under a microscope. During each instar, immediately after each moulting head capsule width, body length & width, and weight of each larva were measured with an ocular and stage micrometer to the nearest value of 0.1053 mm. The application of Dyar's rule (1890) was tested for all the instars when fed on cotton at different temperature levels. The regression relationship between the instar and mean value of head capsule width, body length, body width and weight of larva over instars was calculated using the formula. Log10 Y = a + bx, where, Y = head capsule width/ head capsule length/ body length/ body width/ body weight of larva (mean), a= constant, b = logarithm of growth ratio, x = number of instars. The growth ratio was calculated by dividing the mean value of head capsule width/ head capsule length by the value of the mean of head capsule width/ head capsule length of the larva of the preceding instar.

RESULTS AND DISCUSSION

The larvae of *P. gossypiella* passed through four instars when reared on cotton at 20, 25, 30 and 35ºC. Table 1 reveals that the head capsule width exhibited variations; when reared at 20ºC, the widths for the first to fourth instars were 0.68± 0.02, 0.87± 0.01, 0.98± 0.03 and 1.24± 0.02 mm, respectively; at 25ºC, the corresponding measurements were 0.68± 0.02, 0.84± 0.02, 0.96± 0.07 and 1.21± 0.02 mm; similarly, at 30ºC, widths ranged from 0.63± 0.01 to 1.11± 0.02 mm for the respective instars; and at 35ºC these were 0.62± 0.01, 0.74± 0.02, 0.82± 0.01 and 1.08± 0.02 mm. More or less similar results were obtained by Dongarjal et al. (2016) with *Earias vitella*; and with varieties. Shitole

Table 1. Morphometrics of *P. gossypiella* on cotton as influenced by temperature

Larval head capsule width and length (mm)																
Temperature	20± 1°C				25± 1°C				30± 1°C				35± 1°C			
Larval instars	Width± SE	Growth ratio	Length± SE	Growth ratio	Width± S.E.	Growth ratio	Length± SE	Growth ratio	Width± S.E.	Growth ratio	Length± SE	Growth ratio	Width± S.E.	Growth ratio	Length± SE	Growth ratio
I	0.68± 0.02	-	2.27± 0.06	-	0.68± 0.02	-	2.52± 0.10	-	0.63± 0.01	-	2.30± 0.09	-	0.62± 0.01	-	2.10± 0.08	-
II	0.87± 0.01	1.28	5.80± 0.20	2.56	0.84± 0.02	1.24	5.66± 0.22	2.25	0.78± 0.02	1.24	5.00± 0.22	2.17	0.74± 0.02	1.19	5.00± 0.22	2.38
III	0.98± 0.03	1.13	7.46± 0.10	1.29	0.96± 0.07	1.14	7.53± 0.20	1.33	0.89± 0.02	1.14	6.80± 0.19	1.36	0.82± 0.01	1.11	6.26± 0.19	1.25
IV	1.24± 0.02	1.27	10.60± 0.30	1.42	1.21± 0.02	1.26	11.7± 0.30	1.55	1.11± 0.02	1.25	8.40± 0.01	1.24	1.08± 0.02	1.32	8.20± 0.01	1.31

Stages	20±1°C			25±1°C			30± 1°C			35±1°C		
	Length (mm) Mean± SE	Breadth (mm) Mean± SE	Weight (mg) Mean± SE	Length (mm) Mean± SE	Breadth (mm) Mean± SE	Weight (mg) Mean± SE	Length (mm) Mean± SE	Breadth (mm) Mean± SE	Weight (mg) Mean± SE	Length (mm) Mean± SE	Breadth (mm) Mean± SE	Weight (mg) Mean± SE
Larva												
I Instar	2.27± 0.06	1.08± 0.13	0.40± 0.06	2.52±0.10	1.03± 0.03	0.46±0.08	2.30±0.09	0.95± 0.02	0.48±0.06	2.10±0.08	0.86± 0.02	0.56± 0.09
II Instar	5.80± 0.20	1.58± 0.05	2.84± 0.07	5.66±0.22	1.48± 0.05	3.50±0.08	5.00±0.22	1.28± 0.29	3.84±0.08	5.00±0.22	1.20± 0.04	3.86± 0.08
III Instar	7.46± 0.10	1.68± 0.02	24.42± 0.04	7.53± 0.20	1.52± 0.02	24.80±0.07	6.80±0.19	1.38± 0.03	24.86±0.39	6.26±0.19	1.38± 0.03	24.90± 0.06
IV Instar	10.60± 0.30	2.53± 0.10	64.21± 0.07	11.7±0.30	2.40± 0.13	65.07± 0.04	8.40±0.01	2.30± 0.14	66.06± 0.40	8.20±0.01	2.39± 0.06	69.02± 0.18
Pupa												
Male	4.16± 0.11	1.18± 0.08	20.36± 0.28	4.24± 0.14	1.33± 0.13	22.55± 0.35	4.18± 0.16	1.28± 0.11	21.65± 0.20	4.10± 0.12	1.12± 0.11	18.42± 0.34
Female	4.53± 0.06	1.10± 0.07	21.22± 0.34	4.60± 0.04	1.27± 0.12	24.62± 0.31	4.56± 0.06	1.23± 0.11	22.18± 0.28	4.51± 0.08	1.08± 0.12	20.42± 0.31

Adults	Body length (mm)	Wing span (mm)	Body length (mm)	Wing span (mm)	Body length (mm)	Wing span (mm)	Body length (mm)	Wing span (mm)
Male	8.26± 0.61	15.31± 0.43	8.34± 0.45	16.49± 0.54	8.31± 0.52	16.21± 0.28	8.20± 0.49	15.17± 0.38
Female	8.27± 0.40	1± 0.41	8.37± 0.54	17.40± 0.58	8.33± 0.38	17.05± 0.57	8.21± 0.34	15.50± 0.51

and Patel (2010) with breadth. The body length ranged from 2.27± 0.06 to 10.60± 0.30 mm for the first to fourth instars. When the temperature increased to 25ºC these were 2.52± 0.10 to 11.7± 0.30 mm. At 30ºC the body lengths ranged from 2.30± 0.09 to 8.40± 0.01 mm, while at 35ºC they were measured as 2.10± 0.08 mm to 8.20 ±0.01 mm for the respective instars. The results of the present investigation are comparable with those of Shrinivas et al. (2019). Sapna et al., (2017) revealed that the length of first to fourth instar larvae of *P. gossypiella* ranged from 0.48-0.54 (0.52± 0.01) to 6.15-11.42 (9.14± 1.65) mm.

At 20ºC the body width of *P. gossypiella* varied from 1.08±0.13, 1.58± 0.05, 1.68± 0.02 and 2.53± 0.10 mm for the first to fourth instars, respectively. Similarly, at 25ºC the body widths were 1.03± 0.03, 1.48± 0.05, 1.52± 0.02 and 2.40± 0.13 mm for the respective instars; at 30ºC these ranged from 0.95± 0.02 to 2.30± 0.14 mm; and at 35ºC these were 0.86± 0.02, 1.20± 0.04, 1.38± 0.03, and 2.39± 0.06 mm. Shrinivas et al. (2019), observed similar variations at 27± 2°C varied Sapna et al. (2017) reported a breadth range of 0.16± 0.02 to 1.54± 0.04 mm.

At 20°C the recorded weights for the first to fourth instars were 0.40± 0.06, 2.84± 0.07, 24.42± 0.04 and 64.21± 0.07 mg, respectively. At 25°C the weights were 0.46± 0.08, 3.50± 0.08, 24.80± 0.07 and 65.07± 0.04 mg; 30°C, it ranged from 0.48± 0.06 to 66.06± 0.40 mg. Similarly, at 35°C these were 0.56± 0.09, 3.86± 0.08, 24.90± 0.06 and 69.02± 0.18 mg for the first to fourth instars. The present results correspond with the findings of Dhara Jothi et al. (2016). Mervat (2013) found that the larval weight of *E. vitella* was 0.004 and 0.003 g at 16 and 37ºC, respectively, while it was 0.066 g at 26ºC. The low and high temperatures caused a high reduction in the weight of larvae from 21 to 22 times which led to small in body size and caused failure in the adult's emergence.

Significant variations were observed in the mean pupal length, breadth and weight of male and female individuals reared on cotton at different temperature levels. In terms of pupal length, maximum length for males was recorded at 25°C (4.24± 0.14 mm), followed by 30°C (4.18± 0.16 mm), 20°C (4.16± 0.11 mm) and 35°C (4.10± 0.12 mm). Similarly, for females, it was observed at 25°C (4.60± 0.04 mm), followed by 30°C (4.56± 0.06 mm), 20°C (4.53± 0.06 mm) and 35°C (4.51± 0.08 mm). Regarding pupal breadth, males exhibited breadth (mm) at 25°C (1.33± 0.13), followed by 30°C (1.28± 0.11), 20°C (1.18± 0.08) and 35°C (1.12± 0.11). Conversely, female pupae were broadest at 25°C (1.27± 0.12), 30°C (1.23± 0.11), 20°C (1.10± 0.07) and 35°C (1.08± 0.12). In terms of pupal weight, males showed a maximum weight at 25°C (22.55± 0.35 mg), followed by 30°C (21.65± 0.20 mg), 20°C (20.36± 0.28 mg) and 35°C (18.42± 0.34 mg). Females, on the other hand, had the highest mean pupal weight at 25°C (24.62± 0.31mg), followed by decreases at 30°C (22.18± 0.28 mg), 20°C (21.22± 0.34 mg) and 35°C (20.42± 0.31 mg). The results are in accordance with those of Zinzuvadiya et al. (2017) on pupae. Akhtar et al. (2023) revealed that the average pupal weight of *P. gossypiella* when reared on cotton was 20.13± 0.05 mg.

Regarding adult body length, males were longest at 25°C (8.34± 0.45 mm), followed by 30, 20 and 35°C. Females, on the other hand, displayed the maximum mean body length at 25°C (8.37± 0.54 mm), followed by 30, 20 and 35°C. The mean male adult wing span varied significantly with temperature and it was significantly maximum at 25°C (16.49± 0.54 mm). Females also displayed the maximum mean wing span at 25°C (17.40± 0.58 mm), Zinzuvadiya et al. (2017), found that size of the adult moth (male) varied from 8.37± 1.20 mm in length and 16.60± 1.09 mm in breadth with wing expansion. Nagmandla and Maheshwari (2021) observed a maximum wing span of 14.6± 1.09 mm on non-*Bt* cotton, which was on par with okra (13.40± 0.54 mm) and *Bt* cotton (13.20± 1.27 mm) but significantly differed from abutilon (13.0± 0.17 mm). Morphometric analysis plays a crucial role in constructing life tables, assessing the impact of various rearing conditions on the physical fitness of predators, and determining the optimal developmental stage for their release. This study examines the growth and morphometrics when reared on cotton at four temperature levels.

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AUTHOR CONTRIBUTION STATEMENT

Deshmukh K V and Bhamare V K conceptualized and designed the study; Deshmukh K V conducted the study, analyzed the data, and authored the report under the supervision of Bhamare V K.

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CONFLICT OF INTEREST

No conflict of interest.

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