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Biometrics of *Helicoverpa armigera* (Hubner) on pigeon pea at different temperature levels

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Abstract

The investigation on biometrics of *H. armigera* (Hubner) reared on pods of pigeon pea at different temperature levels viz., 20, 25, 30 and 35°C revealed that the mean measurements of the head capsule width and larval body length, width and weight of *H. armigera* at 20°C varied from 0.10 to 1.19 mm, 1.25 to 16.73 mm, 0.18 to 2.82 mm and 0.74 to 194.18 mg for I, II, III, IV, V and VI instar, respectively. The corresponding values at 25, 30 and 35°C ranged from 0.21 to 1.34 mm, 1.455 to 18.23 mm, 0.31 to 3.09 mm, 0.81 to 195.12 mg and 0.11 to 1.35 mm, 1.45 to 21.33, 0.22 to 3.14 mm, 0.68 to 199.12 mg and 0.11 to 1.42 mm, 0.45 to 23.23 mm, 0.28 to 3.21 mm, 0.66 to 201.94 mg, respectively. The larvae of *H. armigera* passed through six instars on each of the temperature levels tested under present investigation.

Keywords: Biometrics, *Helicoverpa armigera*, pigeon pea, temperature levels

1. Introduction

Pigeon pea (*Cajanus cajan* (L.) Millspaugh) is important grain legume crop of tropical and subtropical countries in Asia, Africa and Latin America which revealed high potential in addressing human nutrition, soil health and crop productivity. It is the second most important pulse crop of India, after chickpea (Nene *et al.*, 1990)^[7]. It is used as *dhal* (split seed); green seeds are used as a vegetable. Crushed dry seeds are used as animal feed, green and dry leaves as fodder, stems as fuel wood and to make huts and baskets in tribal area etc. Indians, in general, prefer vegetarian food and one of the main sources of getting protein is the pulses. They are also rich in energy, dietary fiber, micronutrients such as vitamin B and a variety of anti-oxidants. Their nutrient density has also led many food processors to employ them in fortifying other foodstuffs, especially cereals^[4].

Helicoverpa armigera (Hubner) (Lepidoptera: Noctuidae) is a polyphagous insect-pest which attacks about 181 species of plants belonging to 45 families in India. However, it prefers to feed more on pulses, cotton, vegetables and oilseeds. It causes huge annual losses, especially to the poorest farmers who cannot afford chemical control. Damage to pods due to the borer complex was reported to be 20 to 72 per cent (Lateef and Reed, 1983)^[6]. The temperature plays a very important role in the development of the pest in different seasons. Insects' being poikilothermic, temperature is the most important factor affecting their distribution range, development, food consumption, multiplication and number of generations per year (Speight *et al.*, 2008; Arora and Dhawan, 2011)^[9, 2]. Temperature influences the rate of growth and development, the duration of life-cycle, the fecundity and the survival of insect species (Howe 1967, Andrewartha 1970)^[5, 1].

2. Materials and Methods

A biometrical study of *H. armigera* (Hubner) reared on pods of pigeon pea at different temperature levels was conducted during *kharif*-2017 at Entomological Research Laboratory, College of Agriculture, Latur, Maharashtra. The initial culture of *H. armigera* was developed by collecting large number of larvae from the field of pigeon pea and other crops. The collected larvae were reared individually in the round plastic boxes by feeding them on the pods of pigeon pea at different temperature levels viz., 20, 25, 30 and 35°C respectively every day till pupation. The adults emerged on the same day were placed in oviposition cage for the purpose of egg laying. The eggs laid by female moths were used for investigation on biometrics. Immediately after hatching fifteen larvae of *H. armigera* for each temperature level and each instar were transferred into separate small plastic containers. They were reared individually on pigeon pea pods. Every day fresh pigeon pea pods were provided to the larvae.

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They were reared individually on pigeon pea pods. Every day fresh pigeon pea pods were provided to the larvae. The observations on the casting of exuviae were made under microscope. During each instar immediately after moulting, the head capsule width and body length, width and weight of each larva was measured with the help of ocular and stage micrometer to the nearest value of 0.0091 mm. The regression relationship between the instar and mean head capsule width, body length, body width and body weight of larvae in different instars was calculated by using the following formula.

$$\text{Log}_{10} Y = a + bx$$

Where,

Y = Head capsule width / 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 / body length / body width / body weight of larval instar by the value of mean head capsule width / body length / body width / body weight of larva of

preceding instar. The progression factor is the average of growth ratio.

3. Results

3.1 Larval head capsule width

The results presented in Table 1 revealed that the larvae of *H. armigera* passed through six instars. The head capsule width was 0.10 ± 0.01 , 0.21 ± 0.01 , 0.35 ± 0.01 , 0.46 ± 0.01 , 0.73 ± 0.01 and 1.19 ± 0.01 mm for I, II, III, IV, V and VI instars, respectively when grown on pigeonpea at 20 °C temperature, 0.21 ± 0.01 , 0.26 ± 0.01 , 0.28 ± 0.01 , 0.51 ± 0.01 , 0.76 ± 0.01 and 1.34 ± 0.01 mm at 25 °C temperature, 0.11 ± 0.01 , 0.21 ± 0.01 , 0.35 ± 0.01 , 0.49 ± 0.01 , 0.76 ± 0.01 mm and 1.35 ± 0.01 mm reared on pigeonpea at 30 °C temperature and the head capsule width was 0.11 ± 0.10 , 0.17 ± 0.01 , 0.32 ± 0.01 , 0.53 ± 0.01 , 0.68 ± 0.01 and 1.42 ± 0.01 mm for I, II, III, IV, V and VI instars, respectively when grown on pigeonpea at 35 °C temperature.

The mean observed and calculated progression factors were 1.62 and 1.57, 1.46 and 1.42, 1.63 and 1.59, 1.73 and 1.61, at 20 °C, 25 °C, 30 °C and 35 °C temperature respectively. The regression equation was $\log_{10}y = -1.110 + 0.196x$, $\log_{10}y = -0.917 + 0.161x$, $\log_{10}y = -1.086 + 0.200x$ and $\log_{10}y = -1.148 + 0.210x$ at 20 °C, 25 °C, 30 °C and 35 °C temperature respectively.

Table 1: Comparison of observed and calculated values of mean measurements of larval head capsule width (mm) of *H. armigera* reared on pigeonpea at 20 °C, 25 °C, 30 °C and 35 °C temperature

Temperature levels	Parameters	Larval instars						Progression Factor
		I	II	III	IV	V	VI	
20 °C	Observed head capsule width (mm) \pm S.E.	0.10 \pm 0.01	0.21 \pm 0.01	0.35 \pm 0.01	0.46 \pm 0.01	0.73 \pm 0.01	1.19 \pm 0.01	--
	Growth ratio	--	1.81	1.80	1.63	1.23	1.65	1.62
	Calculated head capsule width (mm)	0.11	0.18	0.30	0.47	0.74	1.17	--
	Growth ratio	--	1.57	1.57	1.60	1.55	1.56	1.57
	Difference	-0.32	-0.23	-0.06	0.04	0.31	0.82	--
	Per cent difference	-143.2	-75.0	-12.0	8.03	38.71	62.81	--
25 °C	Observed head capsule width (mm) \pm S.E.	0.21 \pm 0.01	0.26 \pm 0.01	0.28 \pm 0.01	0.51 \pm 0.01	0.76 \pm 0.01	1.34 \pm 0.01	--
	Growth ratio	--	1.32	1.06	1.71	1.46	1.77	1.46
	Calculated head capsule width (mm)	0.17	0.23	0.36	0.52	0.76	1.12	--
	Growth ratio	--	1.37	1.46	1.44	1.42	1.42	1.42
	Difference	-0.28	-0.21	-0.17	0.04	0.29	0.89	--
	Per cent difference	-89.51	-57.1	-40.44	6.55	33.61	61.47	--
30 °C	Observed head capsule width (mm) \pm S.E.	0.11 \pm 0.01	0.21 \pm 0.01	0.35 \pm 0.01	0.49 \pm 0.01	0.76 \pm 0.01	1.35 \pm 0.01	--
	Growth ratio	--	1.81	1.66	1.26	1.82	1.62	1.63
	Calculated head capsule width (mm)	0.11	0.21	0.31	0.50	0.80	1.28	--
	Growth ratio	--	1.63	1.58	1.59	1.59	1.60	1.59
	Difference	-0.33	-0.22	-0.07	0.04	0.33	0.93	--
	Per cent difference	-148.57	-65.73	-13.95	7.29	37.84	63.03	--
35 °C	Observed head capsule width (mm) \pm S.E.	0.11 \pm 0.01	0.17 \pm 0.01	0.32 \pm 0.01	0.53 \pm 0.01	0.68 \pm 0.01	1.42 \pm 0.01	--
	Growth ratio	--	1.71	1.78	1.63	1.50	2.03	1.73
	Calculated head capsule width (mm)	0.11	0.18	0.31	0.49	0.80	1.31	--
	Growth ratio	--	1.58	1.63	1.61	1.62	1.62	1.61
	Difference	-0.31	-0.23	-0.10	0.11	0.23	1.05	--
	Per cent difference	-140.0	-80.99	-24.18	17.73	31.33	67.19	--

3.2 Larval body length

The mean observed larval body length of *H. armigera* for I, II, III, IV, V and VI instars reared on pigeonpea at 20 °C temperature was 1.25 ± 0.02 , 2.70 ± 0.04 , 5.73 ± 0.06 , 10.22 ± 0.07 , 13.38 ± 0.08 and 16.73 ± 0.10 mm, respectively. The mean observed and calculated progression factors were 1.44 and 1.39. The regression equation was $\log_{10}y = -0.0073 +$

$0.2233x$. While, the mean observed body length of larva of *H. armigera* for I, II, III, IV, V and VI instars reared on pigeonpea at 25 °C temperature was 1.45 ± 0.02 , 2.97 ± 0.04 , 6.80 ± 0.06 , 11.33 ± 0.07 , 13.76 ± 0.08 and 18.23 ± 0.10 mm, respectively. The mean observed and calculated progression factors were 1.42 and 1.41, respectively. The regression equation was $\log_{10}y = 0.0156 + 0.2298x$.

The larval body length of *H. armigera* for I, II, III, IV, V and VI instars reared on pigeonpea at 30 °C temperature was 1.45± 0.02, 3.23± 0.04, 8.12± 0.06, 12.11± 0.07, 16.21± 0.08 and 21.33± 0.10 mm, respectively. The mean observed and calculated progression factors were 1.48 and 1.46, respectively. The regression equation was $\log_{10}y = 0.0180 + 0.2426x$. As well as the larval body length of *H. armigera* for

I, II, III, IV, V and VI instars reared on pigeonpea at 35 °C temperature was 1.45± 0.02, 4.43± 0.04, 8.21± 0.06, 13.35 ± 0.07, 20.73± 0.08 and 23.23 ± 0.10 mm, respectively. The mean observed and calculated progression factors were 1.53 and 1.50, respectively. The regression equation was $\log_{10}y = 0.0314 + 0.2544x$ (Table 2).

Table 2: Comparison of observed and calculated values of mean measurements of larval body length (mm) of *H. armigera* reared on pigeonpea at 20 °C, 25 °C, 30 °C and 35 °C temperature

Temperature levels	Parameters	Larval instars						Progression Factor
		I	II	III	IV	V	VI	
20 °C	Observed body length (mm) ± S.E.	1.25 ± 0.02	2.70 ± 0.04	5.73 ± 0.06	10.22 ± 0.07	13.38 ± 0.08	16.73 ± 0.10	--
	Growth ratio	--	2.16	2.12	1.78	1.31	1.25	1.44
	Calculated body length (mm)	1.64	2.75	4.60	7.69	12.86	21.51	--
	Growth ratio	--	1.67	1.67	1.67	1.67	1.67	1.39
	Difference	-0.39	-0.05	1.13	2.53	0.52	-4.78	--
	Per cent difference	-31.55	-1.85	19.78	24.75	3.88	-28.56	--
25 °C	Observed body length (mm) ± S.E.	1.45 ± 0.02	2.97 ± 0.04	6.80 ± 0.06	11.33 ± 0.07	13.76 ± 0.08	18.23 ± 0.10	--
	Growth ratio	--	2.05	2.29	1.67	1.21	1.32	1.42
	Calculated body length (mm)	1.76	2.99	5.07	8.61	14.62	24.81	--
	Growth ratio	--	1.70	1.70	1.70	1.70	1.70	1.41
	Difference	-0.31	-0.02	1.73	2.72	-0.86	-6.58	--
	Per cent difference	-21.36	-0.58	25.42	24.01	-6.21	-36.10	--
30 °C	Observed body length (mm) ± S.E.	1.45 ± 0.02	3.23 ± 0.04	8.12 ± 0.06	12.11 ± 0.07	16.21 ± 0.08	21.33 ± 0.10	--
	Growth ratio	--	2.23	2.51	1.49	1.34	1.32	1.48
	Calculated body length (mm)	1.82	3.19	5.57	9.73	17.02	29.75	--
	Growth ratio	--	1.75	1.75	1.75	1.75	1.75	1.46
	Difference	-0.37	0.04	2.55	2.38	-0.81	-8.42	--
	Per cent difference	-25.65	1.39	31.43	19.62	-4.98	-39.47	--
35 °C	Observed body length (mm) ± S.E.	1.45 ± 0.02	4.43 ± 0.04	8.21 ± 0.06	13.35 ± 0.07	20.73 ± 0.08	23.23 ± 0.10	--
	Growth ratio	--	3.06	1.85	1.63	1.55	1.12	1.53
	Calculated body length (mm)	1.93	3.47	6.23	11.19	20.10	36.11	--
	Growth ratio	--	1.80	1.80	1.80	1.80	1.80	1.50
	Difference	-0.48	0.96	0.98	2.16	0.63	-12.88	--
	Per cent difference	-33.16	21.71	24.11	16.17	3.02	-55.46	--

3.3 Larval body width

The mean larval body width of *H. armigera* for I, II, III, IV, V and VI instars reared on pigeonpea at 20 °C temperature was 0.18± 0.02, 0.42± 0.03, 1.04± 0.04, 1.99± 0.05, 2.67± 0.06 and 2.82± 0.07 mm, respectively. The mean observed and calculated progression factors were 1.78 and 1.73, respectively. The regression equation was $\log_{10}y = -0.833 + 0.242x$. The larval body width of *H. armigera* for I, II, III, IV, V and VI instars reared on pigeonpea at 25 °C temperature was 0.31± 0.02, 0.62± 0.03, 1.26± 0.04, 2.16± 0.05, 2.23± 0.06 and 3.09± 0.07 mm, respectively. The mean observed and calculated progression factors were 1.64 and 1.58, respectively. The regression equation was $\log_{10}y = -0.592 + 0.195x$.

The mean observed larval body width of *H. armigera* for I, II, III, IV, V and VI instars reared on pigeonpea at 30 °C temperature was 0.22± 0.02, 0.43± 0.03, 1.28± 0.04, 2.49± 0.05, 2.98± 0.06 and 3.14± 0.07 mm, respectively. The mean observed and calculated progression factors were 1.84 and 1.77, respectively. The regression equation was $\log_{10}y = -0.785 + 0.245x$. The larval body width of *H. armigera* for I, II, III, IV, V and VI instars reared on pigeonpea at 35 °C temperature was 0.28± 0.02, 0.65± 0.03, 1.26± 0.04, 2.32 ± 0.05, 2.91± 0.06 and 3.21± 0.07 mm, respectively. The mean observed and calculated progression factors were 1.67 and 1.65, respectively. The regression equation was $\log_{10}y = -0.621 + 0.212x$ (Table 3).

Table 3: Comparison of observed and calculated values of mean measurements of larval body width (mm) of *H. armigera* reared on pigeonpea at 20 °C, 25 °C, 30 °C and 35 °C temperature

Temperature levels	Parameters	Larval instars						Progression Factor
		I	II	III	IV	V	VI	
20 °C	Observed larval body width (mm) ± S.E.	0.18 ± 0.02	0.42 ± 0.03	1.04 ± 0.04	1.99 ± 0.05	2.67 ± 0.06	2.82 ± 0.07	--
	Growth ratio	--	2.25	2.38	1.91	1.32	1.05	1.78
	Calculated larval body width (mm)	0.25	0.48	0.77	1.36	2.40	4.18	--
	Growth ratio	--	1.87	1.58	1.75	1.74	1.74	1.73
	Difference	-0.50	-0.35	0.20	1.02	1.13	1.07	--
	Per cent difference	-206.66	-63.10	14.78	42.11	39.39	33.14	--
25 °C	Observed larval body width (mm) ± S.E.	0.31 ± 0.02	0.62 ± 0.03	1.26 ± 0.04	2.16 ± 0.05	2.23 ± 0.06	3.09 ± 0.07	--
	Growth ratio	--	2.04	1.99	1.75	1.02	1.40	1.64
	Calculated larval body width (mm)	0.41	0.64	0.99	1.56	2.45	3.84	--
	Growth ratio	--	1.59	1.58	1.57	1.58	1.58	1.58
	Difference	-0.43	-0.34	0.09	0.86	0.57	0.91	--
	Per cent difference	-105.27	-50.49	6.44	36.16	23.67	28.99	--
30 °C	Observed larval body width (mm) ± S.E.	0.22 ± 0.02	0.43 ± 0.03	1.28 ± 0.04	2.49 ± 0.05	2.98 ± 0.06	3.14 ± 0.07	--
	Growth ratio	--	2.15	2.87	1.93	1.21	1.05	1.84
	Calculated larval body width (mm)	0.30	0.51	0.89	1.59	2.79	4.80	--
	Growth ratio	--	1.73	1.79	1.78	1.77	1.77	1.77
	Difference	-0.47	-0.46	0.21	1.21	1.39	0.91	--
	Per cent difference	-168.03	-95.63	14.86	45.14	43.05	28.30	--
35 °C	Observed larval body width (mm) ± S.E.	0.28 ± 0.02	0.65 ± 0.03	1.26 ± 0.04	2.32 ± 0.05	2.91 ± 0.06	3.21 ± 0.07	--
	Growth ratio	--	2.06	1.66	1.74	1.24	1.14	1.67
	Calculated larval body width (mm)	0.40	0.65	1.05	1.71	2.80	4.58	--
	Growth ratio	--	1.65	1.64	1.64	1.65	1.65	1.65
	Difference	-0.47	-0.25	0.04	0.74	0.89	0.76	--
	Per cent difference	-113.76	-29.34	3.10	30.72	30.07	22.95	--

3.4 Larval body weight

The mean observed larval body weight of *H. armigera* when grown on pigeonpea at 20 °C temperature its body weight was recorded to the tune of 0.74± 0.01, 2.52± 0.04, 19.75± 0.09, 50.24± 0.12, 161.32± 0.14 and 194.18± 0.18 mg for I, II, III, IV, V and VI instars, respectively. The mean observed and calculated progression factors were 3.59 and 3.24, respectively. The regression equation was $\log_{10}y = -0.488 + 0.510x$. While, the larvae of *H. armigera* when grown on pigeonpea at 25 °C temperature its body weight was recorded to the tune of 0.81± 0.01, 2.81± 0.04, 20.13± 0.09, 50.96± 0.12, 162.71± 0.14 and 195.12± 0.18 mg for I, II, III, IV, V and VI instars, respectively. The mean observed and calculated progression factors were 3.50 and 3.20, respectively. The regression equation was $\log_{10}y = -0.445 +$

0.502x.

The larvae *H. armigera* when grown on pigeonpea at 30 °C temperature its body weight was recorded to the tune of 0.68± 0.01, 2.96 ± 0.04, 14.20 ± 0.09, 44.20 ± 0.12, 111.82 ± 0.14 and 199.12 ± 0.18 mg for I, II, III, IV, V and VI instars, respectively. The mean observed and calculated progression factors were 3.35 and 3.21, respectively. The regression equation was $\log_{10}y = -0.523 + 0.503x$. The larvae of *H. armigera* when grown on pigeonpea at 35 °C temperature its body weight was recorded to the tune of 0.66± 0.01, 2.25± 0.04, 13.45± 0.09, 53.62± 0.12, 119.91± 0.14 and 201.94 ± 0.18 mg for I, II, III, IV, V and VI instars, respectively. The mean observed and calculated progression factors were 3.51 and 3.35, respectively. The regression equation was $\log_{10}y = -0.595 + 0.522x$.

Table 4: Comparison of observed and calculated values of mean measurements of larval body weight (mg) of *H. armigera* reared on pigeonpea at 20 °C, 25 °C, 30 °C and 35 °C temperature

Temperature levels	Parameters	Larval instars						Progression Factor
		I	II	III	IV	V	VI	
20 °C	Observed larval body weight (mg) ± S.E.	0.74 ± 0.01	2.52 ± 0.04	19.75 ± 0.09	50.24 ± 0.12	161.32 ± 0.14	194.18 ± 0.18	--
	Growth ratio	--	3.32	7.70	2.54	3.19	1.20	3.59
	Calculated larval body weight (mg)	1.04	3.39	10.99	35.57	115.14	372.72	--
	Growth ratio	--	3.26	3.24	3.24	3.24	3.24	3.24
	Difference	-1.07	-2.19	4.48	19.29	76.97	-29.77	--
	Per cent difference	-137.03	-83.14	40.13	36.84	47.09	-15.16	--
25 °C	Observed larval body weight (mg) ± S.E.	0.81 ± 0.01	2.81 ± 0.04	20.13 ± 0.09	50.96 ± 0.12	162.71 ± 0.14	195.12 ± 0.18	--
	Growth ratio	--	3.41	7.22	2.53	3.19	1.19	3.50
	Calculated larval body weight (mg)	1.16	3.65	11.55	36.59	116.32	369.85	--
	Growth ratio	--	3.18	3.21	3.21	3.20	3.20	3.20
	Difference	-1.09	-1.52	7.76	16.18	68.15	-57.20	--

	Per cent difference	-112.81	-39.00	35.97	30.36	41.22	-28.98	--
30 °C	Observed larval body weight (mg) ± S.E.	0.68 ± 0.01	2.96 ± 0.04	14.20 ± 0.09	44.20 ± 0.12	111.82 ± 0.14	199.12 ± 0.18	--
	Growth ratio	--	4.47	4.48	3.12	2.55	1.80	3.35
	Calculated larval body weight (mg)	0.97	3.06	9.72	30.96	98.62	314.72	
	Growth ratio	--	3.22	3.21	3.20	3.20	3.21	3.21
	Difference	-1.05	-0.99	3.04	14.87	41.91	-1.15	--
	Per cent difference	-121.62	-25.64	19.77	32.14	34.41	-0.57	--
35 °C	Observed larval body weight (mg) ± S.E.	0.66 ± 0.01	2.25 ± 0.04	13.45 ± 0.09	53.62 ± 0.12	119.91 ± 0.14	201.94 ± 0.18	--
	Growth ratio	--	3.50	6.04	4.1	2.25	1.70	3.51
	Calculated larval body weight (mg)	0.85	2.82	9.38	31.20	103.82	345.62	
	Growth ratio	--	3.37	3.34	3.35	3.34	3.35	3.35
	Difference	-1.07	-1.33	2.33	24.92	44.08	3.76	--
	Per cent difference	-144.87	-40.17	16.31	44.81	35.87	1.64	--

The biometrical observations of *H. armigera* when grown on pigeonpea at different temperature levels revealed that the highest larval head capsule width, body length, width and weight of *H. armigera* was observed when grown on pigeonpea at 35 °C temperature followed by at 30 °C temperature and 25 °C temperature. While, it was lowest at 20 °C temperature. This indicates that low temperatures are not favourable for the growth of *H. armigera* on pigeonpea.

4. Discussion

More or less similar results were observed by Deepa and Srivastava (2010) [3] according to them, the average length and breadth of first, second, third, fourth, fifth and sixth instar larvae of *H. armigera* was 1.23 ± 0.04 and 0.37 ± 0.01 mm, 2.88 ± 0.11 and 0.68 ± 0.01 mm, 6.90 ± 0.17 and 1.63 ± 0.03 mm, 11.73 ± 0.48 and 2.76 ± 0.04 mm, 19.97 ± 0.51 and 3.18 ± 0.04 mm and 30.50 ± 0.36 and 3.33 ± 0.01 mm, respectively on pigeonpea. Patel *et al.* (2012) [8] reported that the average body length and breadth of I, II, III, IV, V and VI instar larvae of *H. armigera* on tomato was found to be 1.47 ± 0.02 and 0.51 ± 0.02 mm, 3.52 ± 1.08 and 0.82 ± 0.01 mm, 9.74 ± 0.66 and 2.81 ± 0.02 mm, 23.02 ± 1.36 and 3.24 ± 0.01 mm, 34.50 ± 1.29 and 5.11 ± 0.07 mm and 43.89 ± 1.24 and 6.59 ± 0.56 mm, respectively.

5. References

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