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Effects of Temperature on the Development of Calliphorid fly of forensic importance *Chrysomya megacephala* (Fabricius, 1794)

KEYWORDS: forensic entomology, Chrysomya megacephala, constant temperature and life cycle.

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ABSTRACT *Chrysomya. megacephala (Fabricius, 1794), one of the Calliphorid flies with forensic and medical importance has been studied for the effect of temperature on its life cycle duration and morphological parameters of different developmental stages.*

In room temperature during rainy season, the duration of life cycle was completed in 265 ± 2 hrs; 11.04 ± 0.08 days. But in low constant temperature 10 °C life cycle was completed in 609 ± 4 hrs; 25.38 ± 0.16 days, which means the completion of life cycle was delayed by 14.37 ± 0.13days.

In the rainy season when the temperature and the humidity are high the duration of life cycle is short andsize of maggots, pupae and adult are large, but in low temperature the duration wasprolonged and the size was small in each stage.

Introduction

Medico-legal entomology is the study of insects associated with a human corpse in an effort to determine elapsed time of death (post-mortem interval). More recently, studying the life cycle development of insect species helps forensic specialists to determine time since death (Byrd & Castner, 2001; Sam 2006). Insects recovered from human cadavers, predominantly blowfly larvae, can provide information on the conditions experienced by a body following death (Donovan, et. al. 2006).

Blowflies of the genera Chrysomya (Diptera: Calliphoridae) are of considerable medical and sanitary importance since they cause myiasis in animals and humans.These flies are also important inforensic entomology since they can be used to determine the post mortem interval (Gomes, et. al. 2003; 2005; 2006 and 2009).

To determine time since death, considerations of the critical factors affecting the rate of decomposition are important. These factors include location of the body, temperature, general climate, time of year, insect activity, animal activity in the area, and the amount of rainfall (Nafte, 2000). Temperature is the most important factor affecting developmental rate (Myskowiak & Doums, 2002). In this study the effect of two different temperatures on the life cycle duration and the morphological parameter of different stages of Callophoridae fly *Chrysomya megacephala* have been carried out.

Materials and Methods

C. megacephala were collected from dead Dog in Padegaon, Aurangabad, (M.S)-India and reared in the laboratory in the rearing box feeding daily on fresh liver of buffalo and water sweetened with honey. About 80 eggs were collected with the help of fine brush and 40 eggs were reared at the laboratory condition in rainy season to find out the duration of life cycle of this species, and 40 eggs were reared in low constant temperature 10°C and humidity 19 % by using cooling incubator. The life cycle and the duration of different stages were determined. The temperature and the humidity were recorded by Hygro-thermometer clock.

Observation and results

C. megacephala (Fabricius, 1794), a Holometabolus insect (complete metamorphosis) the life cycle stages are eggs, maggots, prepupa, pupae and adult. In the rainy season when the temperature and the humidity were high the duration of life cycle was short but in the low constant temperature the duration was prolonged.

In rainy season the duration of life cycle was completed in 265 ± 2 hrs, 11.04 ± 0.08 days (Table. 1) when the maximum and minimum temperature were 29 and 26 °C and maximum and minimum humidity were 50% and 35 % respectively, but at constant low temperature 10 ± 0.5 °C life cycle was completed in 609 ± 4 hrs, 25.38 ± 0.16 day (Table. 3) indicating delay in life cycle by 14.37 ± 0.13days.

Low temperature not only delays the duration of life cycle but also have impact on the morphological parameters like length, width and weight. At normal room temperature in rainy season the length, width and weight of second instar were 8.4 ± 0.16 mm 1.8 ± 0.66 mm and 23.2 ± 0.37 mg respectively (Table. 2). While at low temperature, 10 ± .05 °C the length, width and weight of second instar larvae were 6.8 ± 0.16 mm 1.4 ± 0.08 mm and 18.5 ± 0.67 mg. (Table .4). Thus in rainy season the duration required from laying of eggs to reaching the second instar was 77 hrs (3.21 days), but at constant low temperature same period was 153 hrs (6.38 days). In rainy season the total larval duration was 143 hrs (5.96 days) at room temperature, while at low temperature it was 343 hrs (14.29 days). The pupal stage remained for 122 hrs (5.08 days) at room temperature in rainy season while at low temperature (10 °C) it was 266 hrs (11.08 days).

The larval movement was very vigorous at normal temperature in rainy season but was very slow to non active at low temperature. At low temperature majority of maggots failed to pupate and died and those pupated rarely hatched. But in room temperature in rainy season there was no mortality in maggots and very few pupae died.

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At 9°C there is no development of larvae and all larvae were died as a result of this we can consider the 10°C as a minimum ambient temperature of this species.

Discussion

C. megacephala also known as the Oriental latrines fly; is a species of medical importance (Sukontason, et. al. 2003) and playing an important role in forensic cases (Smith, 1986). This species, formerly Australasian and Pacific in distribution, is now recorded in Africa and the Americas (Wells, et. al. 1994). In Malaysia, *C. megacephala* is now the predominant species infesting human corpses (Lee, et. al. 2004).

Effect of fluctuation of temperature on development of Calliphoridae, flies *Protophormia terraenovae* was reported at 4-28 and 9-23°C to their mean constant temperature, 16°C and found that generally development at the greater fluctuation was fast and at the constant temperature was slow and found similar percentages of development time in each stage. The effect of summation rate is suspected to have caused this difference in development rate because fluctuations above the mean enhance the rate comparatively more than temperatures below the mean can lower the rate (Warren & Anderson, 2013).

Entomological evidences found in criminal scenearound the corpse should be collected and preserved according to medico-legal standardprocedures (Haskell, et. al. 1997). Also microclimatic temperatures existing in the maggots' immediate environment at criminal site should be established and linked retrospectively with the air temperature records. Assuming an average constant temperature, as is the case with corpses found indoors, maggots or pupae which recovered from the scene should be stored at a constant temperaturetill they pupate or the first adults emerge out. Their age can then be used for PMI determination (Grassberge& Reiter, 2002).

Table: 1) Life cycle duration of C. megacephala in Rainy season at room temperature

(PMI) In Hours	Developmental Stages		Temperature(°C)			Humidity (%)		
	From	To	Max	Min	Average	Max	Min	Average
23	Eggs	1st Instar	29	26	27.5	50	42	46
26	1st Instar	2nd Instar	28	26	27	50	42	46
28	2nd Instar	3rd Instar	28	26	27	50	42	46
30	3rd Instar	Prepupae	29	26	27.5	45	35	40
36	Prepupae	Pupae	28	26	27	45	35	40
122	Pupae	Adult	28	26	27	43	35	39

Table: 2) Morphology parameters of different stages of C. megacephala in Rainy season at room temperature.

Developmental Stages	Length (mm)	Width (mm)	Weight (mg)
Eggs	2 ± 0.05	0.4 ± 0.04	0.57 ± 0.021
1st Instar	4.8 ± 0.23	1.2 ± 0.22	4.8 ± 0.11
2nd Instar	6.8 ± 0.16	1.4 ± 0.08	18.5 ± 0.67
3rd Instar	12.5 ± 0.75	2.2 ± 0.25	42.4 ± 0.44
Prepupae	13.2 ± 0.75	3.8 ± 0.20	78.5 ± 0.52
Pupae	9 ± 0.22	4.2 ± 0.14	46.1 ± 0.16
Adult	8.6 ± 0.24	4.4 ± 0.19	32.4 ± 0.33

(±) Standard Deviation of five values

Table: 3) life cycle duration of C. megacephala at low constant temperature.

(PMI) In Hours	Developmental Stages		Temperature (°C)	Humidity (%)
	From	To		
29	Eggs	1st Instar	10 ± 0.5	19
48	1st Instar	2nd Instar	10 ± 0.5	19
76	2nd Instar	3rd Instar	10 ± 0.5	19
98	3rd Instar	Prepupae	10 ± 0.5	19
92	Prepupae	Pupae	10 ± 0.5	19
266	Pupae	Adult	10 ± 0.5	19

Table: 4) Morphological parameter of different stages of C. megacephala at low constant temperature.

Developmental Stages	Length (mm)	Width (mm)	Weight (mg)
Eggs	2 ± 0.05	0.4 ± 0.04	0.57 ± 0.02
1st Instar	6.5 ± 0.42	1.4 ± 0.25	6.2 ± 0.14
2nd Instar	8.4 ± 0.16	1.8 ± 0.66	23.2 ± 0.37
3rd Instar	15.5 ± 0.08	3.5 ± 0.15	67.4 ± 0.67
Prepupae	14.2 ± 0.15	4.2 ± 0.20	109.5 ± 0.52
Pupae	10 ± 0.22	4.5 ± 0.14	65.1 ± 0.16
Adult	9.4 ± 0.45	4.2 ± 0.67	43.4 ± 0.12

(±) Standard Deviation of five values

Conclusion

It is observed that constant low temperature increases the duration of complete the life cycle, reduce the activity and causes mortality and hence it should be considered during determination of PMI. The minimum ambient temperature for the development of *C. megacephala* is 10 °C

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