**FORENSIC IMPORTANCE AND SEASONAL VARIATION OF TEMPERATURE IN DEVELOPMENTAL STAGES OF LIFE CYCLE IN THE FAMILY SARCOPHAGIDAE, *SARCOPHAGA DUX FLY* IN POLADPUR TEHSIL.**

 Bhosale P.A.

 Department of Zoology, Sundarrao More Arts, Commerce, and Science College Poladpur Dist- Raigad. – 402 303.

Email- bhosale\_popat@rediffmail.com

**Abstract**

 Sarcophaga dux is a species of flesh fly that belongs to the Sarcophagidae family. One particular group of organisms that has adapted to feed on meat carrion, and dead and decaying matter, is the scavengers which is the useful for post mortem interval (PMI). Determination plays a significant role in forensic investigations, as it is essential to uncover the truth behind crimes and bring justice to those involved The actual life cycle hours and days are calculated due to the inherent and intricate process involved in the growth and development of living organisms. The concept of a life cycle refers to the various stages of Sarcophaga dux were studied in different seasons; The life cycle began with the rainwater   in 270± 1.25 hrs (11.25 ± 0.40 days), when the maximum temperature was 27.02°C and the minimum temperature was 26.4°C; in summer season when the maximum temperature was 36.6°C and the minimum temperature 33.2°C, the life cycle was completed in 220± 1.17 hrs (6.16. ± 0.10 days), while in cycle was completed in 310 ± 1.35hrs (12.91 ± 0.21 days) when the maximum and minimum winter season life cm temperatures were 27.4°C and 17.2°C respectively. The temperature is an important role to determine the development and growth of life cycle of Sarcophaga dux which should be considered during PMI determination. Another important external parameter that varies stages on differ season to season. larvae are healthier and bigger in size in rainy regions due to the availability of water and the improved quality of their habitat but in summer were short and small sized. The size of larvae in winter season was also smaller than the size in both summer and rainy seasons.

***Keywods*** Forensic entomology *,PMI Season , lifecycle Temp change.*

**INTRODUCTION**

Forensic entomology deals with entomological evidence that is crucial in solving criminal investigations related to corpses. The use of morphological characteristics for identification is especially Similarly, entomologists also heavily rely on morphological characteristics to identify different insect species. Insects have a wide variety of physical features, such as the structure of their wings, the shape and color of their body segments, the presence or absence of certain appendages, and more. By closely examining and comparing these morphological traits (Smith, 1986, Gennard, 2007, Wells & Stevens, 2010).

 Flesh flies, belonging to the genus Sarcophaga, are a diverse group of insects that play an essential role in nature's cleanup crew and considerable medical and economic importance, used to determine the post mortem interval (Gomes et. al., 2003). The development stage of insect species plays a crucial role in assisting forensic experts in solving criminal investigations. Insects, specifically blowflies, beetles, and ants, are of immense importance in forensic entomology due to their lifecycle patterns and behavior.  (Nafte, 2000). Temperature is the most important factor affecting development as it plays a crucial role in determining the growth and survival. Insect succession and temperatures generally reduce the developmental period of Diptera.(Campobasso et al., 2001).

**Materials and Methods**

 Sarcophaga dux larvae were collected from dead dog at katetali village of Poladpur tehsil on Raigad district (M.S)-India and reared in the laboratory in the rearing box by feeding daily on fresh liver of sheep and goat and water sweetened with honey. Morphological identification was done in the laboratory using the identification keys (Sukontason et al., 2003).About 80 eggs were collected in indifferent seasons (rainy, summer and winter) with the help of fine brush and 50 eggs each were reared at the laboratory condition and the duration of different developmental stages and their morphological parameters (length, width and weight) were determined. The temperature and the humidity were recorded by Hygro-thermometer clock OPTILAB Model THC-20.

 **Observation and results**

 Sarcophaga dux , one of the fleshflies known as hairy maggot fleshflies, adult has face and cheeks with dense silvery hairs, anterior spiracle of the adult is open and proepisternal seta (stigmatic bristle) present, The larvae have tubercles hence called hairy maggot, these tubercles along the body segment are knobs encircling mostly half of lower surface, spines are round-knob turned spirally three times around the base of each tubercle; absence of hairy like structure at the base of tubercles in the caudal region; anterior spiracles always with 09 papillae and very rear 08 papillae. Life cycle duration of Sarcophaga dux in rainy season was completed in 270 ± 1.25 hrs (11.25 ± 0.40 days),Table.1) when the maximum temperature was 27.02°C and the minimum temperature was 26.4°C, but in summer season when the maximum temperature was 36.6°C and the minimum temperature 33.02°C, the life cycle was completed in 220± 1.17 hrs (06.16.04 ± 0.10 days), (Table. 2)while in winter season cycle was completed in 310 ± 1.35hrs (12.91 ± 0.21 days)when the maximum and minimum temperatures were 27.4°C and 17.2°C respectively (Table. 3). Size of the different developmental stages varied from season to season; in summer season, the size of different stages was smaller than same stage in rainy season and bigger than the same stage in winter season.

**Table: 1) Duration of different life cycle stages of** **Sarcophaga dux** in **rainy** **season**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Hours**  | **Developed stage**  | **Length (mm)**  | **Width (mm)**  | **Weight (mg** | **Temperature (°C)**  | **Humidity (%)** |
| **Max.**  | **Min.**  | **Average**  | **Max.**  | **Min.**  | **Average**  |
| 15  | Eggs  | 1.2 ± 0.08  | 0.4 ± 0.07 | 0.29 ± 0.02  | 28.1  | 26.3  | 27.2 | 70 | 46 | 56.5 |
| 39 | 1st Instar  | 4.4 ± 0.11  | 2.1 ± 0.25  | 9.6 ± 0.9  | 28.1  | 26.3  | 27.2  | 70 | 40  | 55 |
| 72 | 2nd Instar  | 8.5 ± 0.15  | 3 ± 0.02  | 26.2 ± 0.05  | 28.2  | 26.2  | 27.2 | 75 | 41  | 58 |
| 104 | 3rd Instar  | 11.2 ± 0.26  | 3.5 ± 0.28  | 55.4 ± 0.32 | 27.6  | 26.4  | 27.00 | 75  | 41  | 58 |
| 150  | Prepupae  | 10.6 ± 0.14  | 4.2 ± 0.9  | 46.4 ± 0.05  | 27.2  | 26.2  | 26.7  | 76  | 39.00 | 57.5 |
| 270  |  Pupae  | 8.2 ± 0.36  | 3.2 ± 0.219  | 39.5 ± 0.13  | 27.3  | 26.5  | 26.4 | 70  | 43.42  | 56.71 |
|  | Adult  | 8.3 ± 0.27  | 3.6 ± 0.11  | 32.3 ± 0.19  | 27.5  | 26.5  | 27.00  | 75  | 38 | 56.5 |

±) Indicate SD of five values

**Table:2) Duration of different life cycle stages of Sarcophaga dux** **in summer season**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Hours**  | **Developed stage**  | **Length (mm)**  | **Width (mm)**  | **Weight (mg** | **Temperature (°C)**  | **Humidity (%)** |
| **Max.**  | **Min.**  | **Average**  | **Max.**  | **Min.**  | **Average**  |
| 11  | Eggs  | 1.00 ± 0.05  | 0.2 ± 0.04 | 0.25 ± 0.01 | 35.1  | 33.3  | 34.2 | 71 | 50 | 60.50 |
| 30 | 1st Instar  | 4.1± 0.09  | 1.1 ± 0.24  | 8.6 ± 0.9  | 35.1  | 33.3  | 34.2  | 71 | 48  | 59.50 |
| 62 | 2nd Instar  | 7.5 ± 0.13  | 2± 0.02  | 22.2 ± 0.04 | 35.2  | 33.2  | 34.2 | 76 | 47  | 61.50 |
| 84 | 3rd Instar  | 10.2 ± 0.24  | 2.5 ± 0.26  | 49.4 ± 0.29 | 36.6  | 34.4  | 35.50 | 76 | 49  | 62.50 |
| 130  | Prepupae  | 9.6 ± 0.12 | 3.2 ± 0.5  | 41.4 ± 0.2  | 36.2  | 34.2  | 35.2  | 77 | 49.00 | 63.00 |
| 220  |  Pupae  | 7.2 ± 0.36  | 2.2 ± 0.27  | 32.5 ± 0.09  | 36.3  | 34.5  | 35.4 | 72  | 53.42  | 62.71 |
|  | Adult  | 7.3 ± 0.27  | 2.4 ± 0.10  | 27.3 ± 0.13  | 36.5  | 34.5  | 35.00  | 78 | 58 | 68 |

 ±) Indicate SD of five values

**Table: 3) Duration of different life cycle stages of Sarcophaga dux in winter season**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Hours**  | **Developed stage**  | **Length (mm)**  | **Width (mm)**  | **Weight (mg** | **Temperature (°C)**  | **Humidity (%)** |
| **Max.**  | **Min.**  | **Average**  | **Max.**  | **Min.**  | **Average**  |
| 20  | Eggs  | 1.43 ± 0.02 | 0.4 ± 0.05 | 0.22 ± 0.02 | 27.4  | 21.1 | 24.3 | 31 | 26 | 28.50 |
| 48  | 1st Instar  | 4.5 ± 0.12  | 1.4 ± 0.11  | 8.2 ± 0.15 | 23.6 | 20.1 | 22.4 | 31 | 30 | 30.50 |
| 80 | 2nd Instar  | 7.2 ± 0.21  | 2.8 ± 0.12  | 24.3 ± 0.27 | 23.2 | 21.2 | 22.8 | 29 | 27 | 28.00 |
| 120 | 3rd Instar  | 9.6 ± 0.07  | 3.5 ± 0.26  | 47.7 ± 0.20 | 21.6 | 19.2 | 21.1 | 26 | 25 | 25.50 |
| 170  | Prepupae  | 8.4 ± 0.20  | 4.4 ± 0.21  | 47.2 ± 0.21  | 21.6 | 18.2 | 20.5 | 25 | 24 | 24.50 |
| 310 |  Pupae  | 8 ± 0.31  | 4. ± 0.14  | 42.4 ± 0.34  | 21.8 | 17.6 | 20.1 | 25 | 23 | 24.00 |
|  | Adult  | 8.1 ± 0.22  | 3.7 ± 0.24  | 45.1 ± 0.03  | 21.6 | 17.2 | 19.8 | 24 | 20 | 22.00 |

 ±) Indicate SD of five values

**Discussion**

Sarcophaga dux is a species of fly that holds a significant degree of both medical and economic importance. Commonly known as the American carrion fly, it plays a crucial role in forensic entomology for determining the time of death in forensic investigations.  (Smith, 1986;) The flesh fly, scientifically known as Sarcophaga, is one of the first insects to colonize a corpse. As a member of the forensically important insects, these flies play a crucial role in determining the time of death in forensic investigations. With a keen olfactory sense, they are attracted to the odor of decaying flesh, which serves as a reliable food source for their life cycle. Due to their quick reproductive cycle, they arrive at the corpse within hours, laying their eggs on the decaying tissues. This early colonization by flesh flies helps scientists estimate the postmortem interval and contributes significantly to forensic entomology. Larvae were healthy and bigger in size in rainy season but in summer season life cycle duration was short and the size of different stages was small while in winter season the life cycle duration was longer than rainy season but the size in winter season also smaller than the size in rainy season. Study on the effect of temperature on the different developmental stage of Sarcophaga dux and life cycle duration in rainy season and low constant temperature 10 °C reported that in rainy season life cycle duration completed in 11.04 ± 0.08 days when the maximum and minimum temperature were 29°C and 26°C respectively. But in low constant temperature 10 °C life cycle was completed in 25.38 ± 0.16 days (AbdAlgalil and Zambare, 2015), they reportedimpact of temperature on the morphological parameters in rainy season and low constant temperature. Effect of fluctuation of temperature on development of sarcophagid flies Protophormia terraenovae was reported at 4-28°C 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. 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 and Anderson, 2013).For forensic investigations, entomological evidences found in criminal scenearound the corpse are collected and preserved according to medico-legal standard procedures. Alsomicroclimatic temperatures obtainable in the maggot’s immediate environment at criminal site is 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 are stored at a constant temperature till they pupate or the first adults emerge out. Then their age can be used for PMI determination (Grassbergeand Reiter, 2002).

**Conclusion**

 In this article temperature was fluctuate in differrnt seasons which is the adverse effect on physiology of insects of *Sarcophaga dux in various seasons*  So, here's the deal with those "Its" indicating life cycle duration in the rainy season being completed in  11.25 ± 0.40 days, but in summer season was 6.16. ± 0.10 days, days while in winter season was completed in 12.91 ± 0.21 days. The maximum temperature which is increased the growth in summer and delayed the growth in winter season by about 3 days. Larvae were healthy and strong in size inmonsoon season and small in summer season, while in winter season larvae were smaller than summer and rainy season. Temperature plays an important role in period of life cycle stages and hence correct temperature changes should be considered for PMI determination after the life cycle stages of *Sarcophaga dux* are collected from corpse.

**Acknowledgement:**

 My gratitude towards my research guide, former Zambare S.P. Prof.& B.C.U.D.director, Dept. of Zoology, Dr. B. A. M.University, Aurangabad He has been an invaluable resource throughout the entire research process, providing me with guidance and support.

 **References:**

1) **Smith KGV. (1986):** Annual report of Forensic Entomology. *Trustees of the British Museum). London. 1987.*

**2). Gennard D. (2007**): Forensic Entomology. An Introduction. *John Wiley, Sons Ltd, England. 2008.*

**3). Wells JD, Stevens JR. (2010):** Molecular methods for Forensic Entomology. In: Forensic entomology: entomological insect investigations 2nd edition (JH Byrd JH, *Castner JL, eds.) CRC Press, 2010. pp. 438-4534*

**4) Gomes, L., Augusto, W., Godoy, C. and Zuben, C.V. (2003**): A Review of post feeding larval dispersal in fleshflies: implications and benefits of for forensic entomology. *Naturwissenschaften. 93: 207-216.*

***5)* Nafte, M. (2000):** Flesh and Bone: An Introduction to Forensic Anthropology. *Durham, NC: Carolina Academic Press, MNM.C.*

6)**Campobasso C.P., Di Vella G.and Introna, F. (2001):** characters affecting which is decomposition & Diptera Colonization. *Forensic insect Sci. Int. 120: 18-27.*

**7) Sukontason, K., and Methanitikorn, J.K.(2003):** Clearing technique to which is examine to the cephalic skeletons of carrion fly larvae. *J .Vector Ecol. 29: 193-196.*

**8) Smith, K.G.V. (1986):** A manual of forensic entomology, London, UK: *C.University london*

**9) Abd Algalil, F.M. and Zambare S.P. (2015):** Effects of Temp. on the Development of sarcophagid fly of forensic imp. *Sarcophaga dux*.*Indian J.l of Applied Research, 5: 768- 770.*

**10) Warren, J.A. and Anderson, G.S. (2013):** Effect of various Temperatures rang on the growth of a Forensically Important Blow Fly, Protophormia terraenovae (Diptera: sarcophagidae) Environmental Entomology. 42:167- 173.

**11) Grassberger, M. and Reiter C. (2002):** Effect of temperature on physiology of the forensically important insect blow fly Protophormia terraenovae (Robineau-Desvoidy) (Diptera: sarcophagidae) *Forensic insect Science International.127: 178-183.*

………………………………………………………………………………………………