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Degree-days constancy of common lady bird beetle, *Coccinella septumpunctata* reared in the lab condition in different season

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Abstract- Degree-days constancy is mathematical representation of product of variable temp. Lifecycle completed in different seasons of a year surprisingly, the product value exhibits feature of constancy with negligible variation in any insect. As a matter of fact, the life cycle of insect is greatly governed by the prevailing temperature which is measure of heat energy expressed in either degree C or F. *Coccinella septumpunctata*, lady bird beetles are basically of visible size with brilliant colours and less motility. Starting from agriculture field to the economic crops of vegetables and cereals, varieties of lady bird beetle populations can be easily found thriving on the wide range of floristic leaves & twigs having aphid pest infestation. In the present research work it has been observed by closed monitoring of the life cycle duration of *Coccinella septumpunctata*, reared in the lab throughout the year 2019 & 2020 that the value of degree days constancy is 580±5.

Key words: Seasonal temperature, RH, Lifespan, Degree days product

INTRODUCTION

Coccinella septempunctata, the seven-spot ladybird (or, also called as seven-spotted ladybug in North America). It is the most common ladybird in Europe. Its wings are reddish in colour, with black spots on each wing and the spots are often overlapping. There are a total of seven spots.

A body length of 7.6-12.7 mm (0.3-0.5 in) is seen in an adult seven-spot ladybird. The species can secrete a fluid from joints in their legs which gives them a foul taste. Toxic alkaloids like N-oxide coccinelline are synthesized by the seven-spot ladybird. Such toxic secretions are controlled by the sex of the insect as well as the diet it consumes. These spots and alkaloids make them undesirable for predators. The spot size and coloration indicate the toxicity of the individual insect to potential predators. It can also act dead in order to protect itself.[1-3]

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Life cycle

Adult female's lay about 200 to 800 eggs usually near aphids which serve as food for the hatching larvae. The hatched larvae are about 1mm long. If the supply of aphids is abundant, the larvae grow upto 7 mm in 30 days. After a period of 30 days, larvae enter the pupal stage, which lasts from 3-12 days. The period of pupal development largely depends on temperature.[4,5] Life span

of adults varies from weeks to months. Their life span is affected by food availability, predators and the time left for onset of winters. Winter hibernation is seen in adults.

This species can be used as biological pest control, as it actively feeds on aphids. It has a diverse habitat preference.

Degree-days constancy is the mathematical representation of product of variable temperature.

A degree day is calculated as the fundamental of a function of time which generally varies with temperature. The function is reduced to upper and lower limits that vary by organism, or to limits that are suitable for climate control.[6,7] In the present research work it has been observed by closed monitoring of the life cycle duration of *Coccinella septumpunctata*, reared in the lab throughout the year 2019 & 2020.

MATERIALS & METHODS

Few live adult individuals of both male & female lady beetle were collected from the field along with their host plant, leaves & twigs and brought in the culture lab of Department of Zoology, Ranchi University, Ranchi. Three pairs of male and female beetles were transferred in three sets of small glass jars along with their host plants to be renewed periodically for their free propagation. Each culture experiment was started in the beginning of all the four seasons of the year 2019. Adequate precautions were taken to avoid random mortality of the beetle due to shortage of food resources, ventilation and space for free movement of adult beetles. These parameters were kept in standards for all the sets of culture jar in all the four seasons. However, the seasonal variation in the temperature of culture room was not controlled in order to observe the trend of variation and its corresponding impact on the duration of the life cycle of the propagating beetle. The varying temperature of the lab was also recorded in combination with RH carefully (Table I) to examine the trend of variation. Along with this, the number of days taken by the starters producing the new young ones was also recorded simultaneously to observe the temperature dependent flexibility in the life span. A mathematical correlation between the varying monthly temperatures of the season and related stretching and shrinking of the lifespan of the lady birds was obtained by simple analysis (Table II).

RESULTS & OBSERVATION

Table I- Record of seasonal variation in the lab temperature and relative humidity (RH) of the year 2019 (in %)

Sl. No.	Name of the season & months involved		Average room Temperature	RH (In %)
1.	Spring	Feb	20±2	65
		Mar	24±2	66
		April	26±2	65
2.	Summer	April	28±2	67
		May	34±2	68
		June	37±2	70
3.	Monsoon	June	35±2	70
		July	33±2	71
		Aug	30±2	75
4.	Autumn	Aug	29±2	76
		Sep	25±2	72
		Oct	22±2	71
5.	Winter	Oct	21±2	71
		Nov	18±2	68
		Dec	16±2	68
		Jan	12±2	69
		Feb	19±2	65

Table II – Seasonal variation in the values of room temperature (culture lab) in degree C & life span in days showing degree days constancy in *Coccinella septumpunctata.*

Sl. no.	Name of the season & months involved		Average room Temperature (in $^{o}C/D_1$)	No. of days involved in completion of life cycle (D_2)	Product of D_1& D_2(degree days)	Value of DD constancy for *C.septumpunctata*
1.	Spring	Feb	20±2	29	580±2	560.76±2
		Mar	24±2	24	576±2	
		April	26±2	22	572±2	
2.	Summer	April	28±2	21	588±2	
		May	34±2	17	578±2	
		June	37±2	16	592±2	
3.	Monsoon	June	35±2	17	595±2	
		July	33±2	18	594±2	
		Aug	30±2	19	570±2	
4.	Autumn	Aug	29±2	20	580±2	
		Sep	25±2	23	575±2	
		Oct	22±2	25	550±2	
5.	Winter	Oct	21±2	26	546±2	
		Nov	18±2	28	504±2	
		Dec	16±2	32	512±2	
		Jan	12±2	36	432±2	
		Feb	19±2	31	589±2	

CONCLUSION

After the onset of winters, this is marked by food shortage and low temperatures, adults usually aggregate near the ground. In laboratory conditions, when females were exposed to 12°C, diapause which was caused by winters was terminated. Temperatures play a vital role in maintaining the life cycle of *Coccinella septumpunctata.* High temperatures favour the life cycle completion in shorter time span, like in the month of May and June, where average temperature is more than 30°C, the life cycle takes 17-18 days to complete.

During the months of January and February, with daily average temperature of 19°C or less, the life cycle extends upto 31 days. Degree-day requirements for *Coccinella septumpunctata* development decrease as the lower temperature threshold increases.[8] Similar relationship has been also found by Frazer and McGregor (1992)[9] for different Coccinellidae egg development. Mortality of *Coccinella septumpunctata* increases in low temperature. The value of degree days constancy for *Coccinella septumpunctata* is observed 580±5.

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