IOSR Journal Of Pharmacy And Biological Sciences (IOSR-JPBS)
e-ISSN:2278-3008, p-ISSN:2319-7676. Volume 15, Issue 5 Ser. V (Sep. –Oct. 2020), PP 05-09
www.Iosrjournals.Org

Study of the effect of temperature on the hatching of eggs in the ladybird Beetle, *Coccinella septempunctata* (family coccinellidae; order – Coleoptera)

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Abstract
Coccinella septempunctata is a carnivorous and predaceous insect, feeding on aphids, coccids and other soft bodied insects but in absence of the carnivorous food, it feeds on the leaves of plants belonging to the family Solanaceae, viz, potato, tomato, brinjal, etc. The mated female lays eggs on the upper surface of the leaves of host plants. The eggs were kept in petri dishes and exposed to different temperature levels to note down the duration and percentage of hatching of eggs. It was found that the optimum temperature for the hatching of eggs is 30-32^{0}C. There is a negative co-relation between temperatures (25 to 36^{0}C) and hatching periods of eggs. The mean weight of 1stinstar grub is maximum at optimum temperature of 30^{0}C & goes on reducing till 36^{0}C after which the egg did not hatch.

Key Words: *Coccinella septempunctata, Carnivorous , Predaceous, Eggs, Hatching, Correlation, Optimum temperature, Regression.*

Date of Submission: 07-10-2020 Date of Acceptance: 22-10-2020

I. Introduction

Coccinella septempunctata commonly called ladybird beetle, belongs to family-Coccinellidae of the insect order Coleoptera. It is a very beneficial group of insects, being natural enemies of many agricultural pests, especially aphids and other creatures that damage plants by feeding on their sap. A single ladybird beetle can consume vast number of aphids in its lifetime, perhaps as many as 5,000 or more. *C. septempunctata*, the seven spotted ladybird beetle, sometimes called 'C-7' is a medium sized, orange coloured beetle with seven black spots dorsally on elytra. Both adults and larvae are known primarily as predators of aphids (plant lice), but they prey also on other pests such as soft scale insects, mealy bugs, spider mites, etc. A few feed on plant and pollen mildews. *C. septempunctata* may be a more effective predator than some active ladybird beetle species, displacing them in some areas.

The adults are comparatively large (7-8 mm) with a white or pale spot on either side of the head. The body is oval and dome shaped. The spot pattern is usually 1-4.2, black on the orange or red forewings. Eggs are spindle shaped and small, about 1 mm long.

II. Material & Methods

Coccinella septempunctata is found in abundance as a pest on the leaves of vegetable plants belonging to the family Solanaceae e.g. brinjal (*Solanum melongena*), potato (*Solanum tuberosum*), tomato (*Lycopersicum esculentum*), etc. The insects were collected from brinjal plants grown in Saidpur areas of Patna, brought to the laboratory and kept in special Plastic Jars. Their tops were covered by fine mosquito net which prevents the escape of the insects, allows ventilation and permits observation from outside. Every morning the insects were provided with fresh leaves and tender shoots of the host plants. To prevent entry of the ants into the plastic jar, the bottom of the plastic jar was always kept in water.

During unfavourable conditions of temperature and humidity, when field becomes scarce of these beetles, the temperature of the plastic jar was raised in winter months by providing a lighted electric bulb of 40 watt inside the plastic jar and in the months of Feb. and early part of April, when humidity was quite low, water in a pot or water soaked cotton was kept in the plastic jar.

Collection of eggs.

A strict vigilance was kept on the mated females to know the exact time of egg laying. The eggs were collected with the help of brush and kept in a Petri dish of 4 cm diameter. The Petri dish was kept moist by putting wet cotton balls in the Petri dish. The number of eggs laid by each female was counted and recorded.

Determination of duration of hatching of eggs, percentage of hatching and weight of the 1st instar larva or grub

In order to study the hatching of eggs, the eggs were transferred to a number of Petri dishes so as to expose them to different temperature levels of 20^{0}C, 25^{0}C, 30^{0}C, 32^{0}C, 33^{0}C, 35^{0}C, 36^{0}C, 37^{0}C and 38^{0}C at 100% RH. The different temperature were maintained in incubators. The eggs were incubated under various temperatures and hatching time, percentage of hatching and wt. of 1st instar larvae were noted.

III. Observation

In *Coccinella septempunctata* the female after mating lays 120-140 yellow eggs at a time. The eggs are laid vertically on the leaves of host plants, viz. potato, brinjal, tomato, etc. At optimal condition of 30^{0}C and 100% RH, the eggs hatched into grubs in 3-4 days. The larva or the grub was gray coloured with yellow or white spots.

The eggs were exposed to temperature levels of 25^{0}C, 30^{0}C, 32^{0}C, 33^{0}C, 35^{0}C, 36^{0}C, 37^{0}C and 38^{0}C at 100% RH and the data regarding the relationship between the temperature and Incubation period of eggs for hatching, percentage of hatching and mean weight of 1st instar grub were recorded as shown in Table-I and graphically represented in fig-1.

(i) It is found that there is negative correlation between temperature and hatching period of eggs (Table-1).

(ii) There is no hatching of eggs at or below 20^{0}C and at or above 38^{0}C.

(iii) Any temperature above 32^{0}C has adverse effects on the percentage of hatching of eggs, although there is reduction in hatching period.

(iv) The time taken by freshly laid eggs in hatching into 1st instar grub was 96 hrs. at 25^{0}C, 72 hrs. at 30^{0}C, 70 hrs. at 32^{0}C, 68 hrs. at 33^{0}C, 66 hrs. at 35^{0}C and 64 hrs. at 36^{0}C. The regression line for the relationship between temperature and hatching time of eggs conforms to the regression equation, Y = 240.034-5.433 x amd r = -0.794 ($P < 0.01$). As such the observed difference is **statistically significant.** The maximum percentage of hatching was 96% at 30^{0}C and 32^{0}C, and minimum was 20% at 36^{0}C. Mean wt. of 1st instar grub was maximum i.e. 0.37 mg at 30^{0}C, and minimum of 0.32 mg at 36^{0}C. All the data & calculations are given in **Table-I** and graphically presented in Fig.-1.

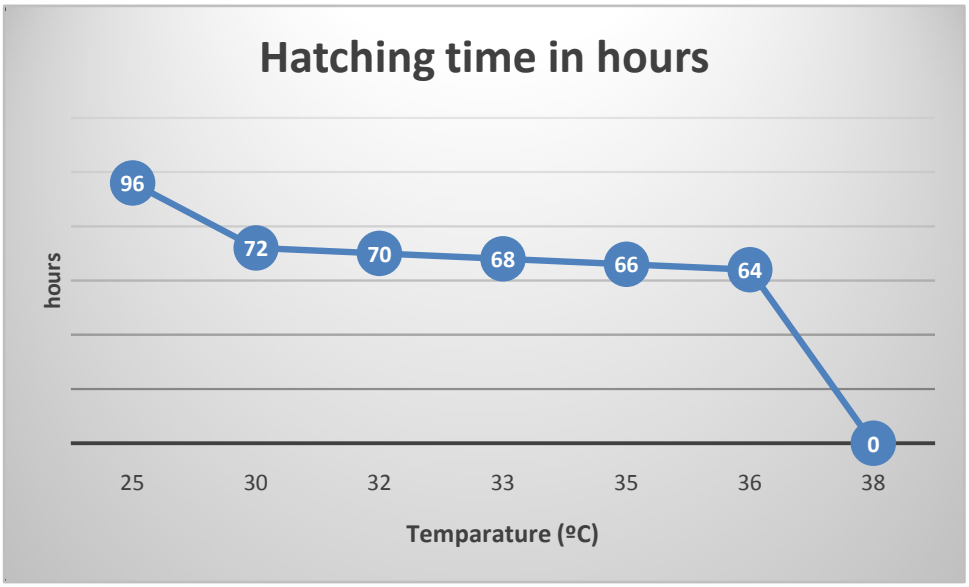
Table-1

Effect of temperature on hatching time of eggs, percentage of hatching and mean weight of 1st instar larva (grub) of *Coccinella septempunctata* (Each figure is based on 4 observations on 20 eggs).

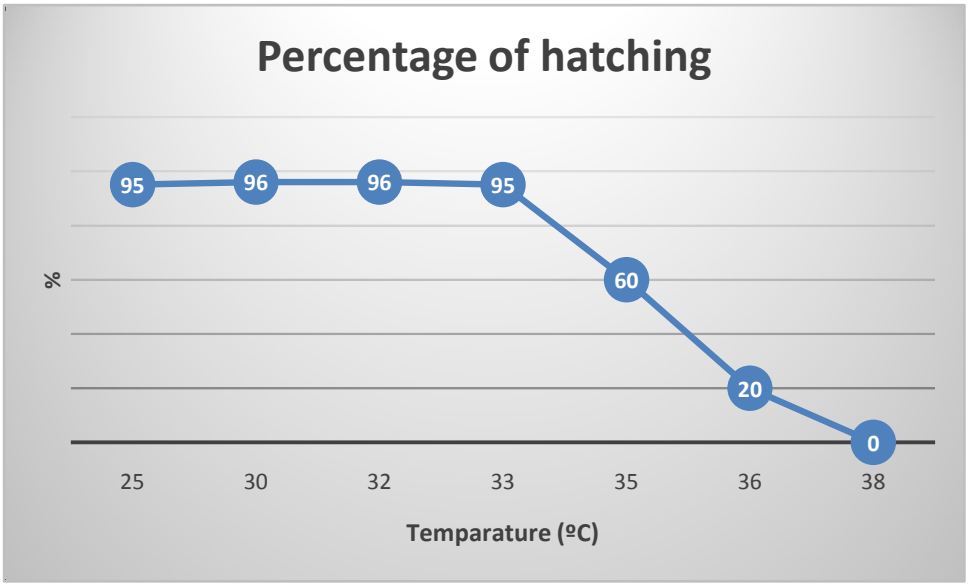
Temp. ^{0}C	Hatching time in hours	Percentage of hatching	Mean wt. of 1st instar grub in mg
25	96	95	0.36
30	72	96	0.37
32	70	96	0.36
33	68	95	0.35
35	66	60	0.33
36	64	20	0.32
38	No hatching	0	X

Temp./Hatching time : Y = 240.034-5.433 x r = -0.794 (P < 0.01)

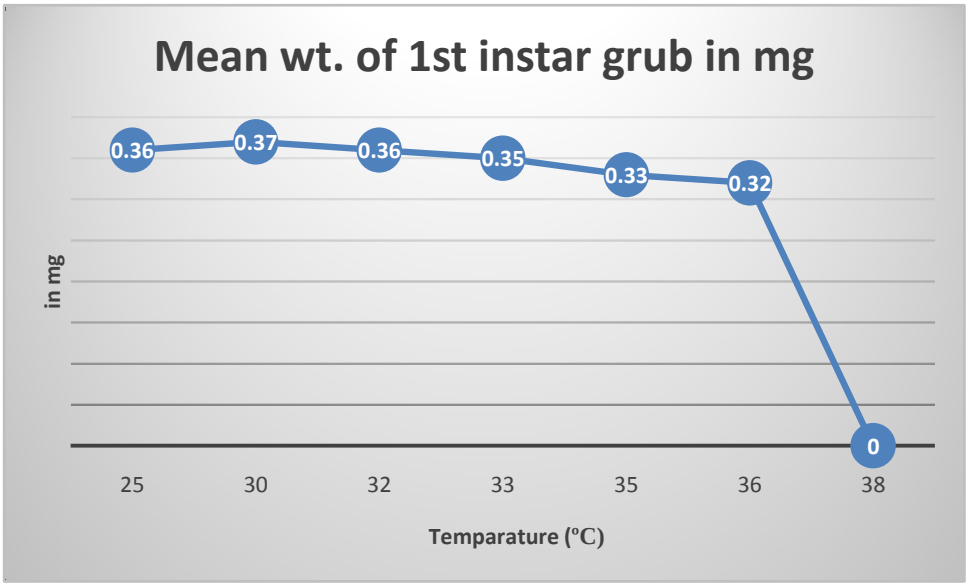
(a)



(b)



(c)



Relationship between temperature &
(a) Hatching Time.
(b) % of Hatching &
(c) Mean wt. (mg) of 1st instar grab of *Coccinella septempunctata*

IV. Results And Discussion

The temperature has great effects on the behaviour, metabolism, growth reproduction and development of insects. But it acts in association with other environmental factors viz. humidity, photoperiod, light etc. Seasonal variations in these parameters are reflected in the corresponding variation in population density of insects. The range of temperatures in which an insect can survive and the various stages of life cycle can develop varies from species to species. Temperature has sterilizing effects on certain species of insects.

Bursell (1964) has reported that the female of *Anopheles quadrimaculatus* stops egg laying if the temperature of environment falls below 12^0C. He has further reported that a population of *Drosophila* males were rendered permanently sterile if kept at 32^0C and males of *Musca domestica* became sterile if exposed to 34^0C for more than 24 hours.

Pathak (1990) has observed in her Ph.D. thesis that in red cotton bug, *Dysdercus koenigii* there is negative co-relation between temperature and time required for hatching of eggs. The present study conforms to the above observation. Chapman (1971), has also made similar observations.

Pandey (1993) studied the optimum levels of temperature of hatching of eggs and subsequent development upto adult stages in *Chrysocoris stollii* and he found most suitable temperature range for development of eggs and nymphs is 25^0C-30^0C. The present observation is in full agreement to the observation of Pandey (1993).

Verma (2009) observed the influence of temperature on the growth, metabolism and survival of *Aedes aegypti*. She observed that this species required the temperature of 28^0C for perfect hatching of eggs in 72 hrs. In the present study the optimum temperature for the perfect hatching is 30-32^0C which is higher than 28^0C which is optimum temperature for perfect hatching of eggs in *Aedes aegypti* as observed by Verma (2009).

Bui Minh Hong et al. (2013) observed that with increase in temperature the durations of the life cycle is decreased i.e. the temperature and period of development is indirectly proportional within a certain range of temperature but above that the higher temperature is detrimental to growth. Our observation is in full agreement with this work.

Kun Xing, Chun-Sen Ma et al. (2015) Observed that large temperature fluctuation had great effect pm hatching of eggs and subsequent development of diamondback moth (Lepidoptera : Plutellidae) and the duration of hatching was reduced with rise in temperature, which is in full agreement with our work.

Xiao D. et al. (2019) observed that development duration along with hatching of eggs was shortened. Our observation is in full agreement with their work.

Acknowledgement

The authors are thankful to Prof. (Dr.) Nandipati Tiwari, Head of the Department of Zoology, College of Commerce, Patna for providing laboratory facilities for the present work.

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Reena Bahan, et. al. "Study of the effect of temperature on the hatching of eggs in the ladybird Beetle, Coccinella septempunctata (family coccinellidae; order – Coleoptera)." *IOSR Journal of Pharmacy and Biological Sciences (IOSR-JPBS)*, 15(5), (2020): pp. 05-09.