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Chunni Kumari
Ph.D. Scholar, Department of Entomology, College of Agriculture, IGKV, Raipur, Chhattisgarh, India

Jayalaxmi Ganguli
Professor, Department of Entomology, College of Agriculture, IGKV, Raipur, Chhattisgarh, India

Nivedita Shah
Ph.D. Scholar, Department of Entomology, JNKVV, Jabalpur, Madhya Pradesh, India

Rashmi Gauraha
Ph.D. Scholar, Department of Entomology, College of Agriculture, IGKV, Raipur, Chhattisgarh, India

Corresponding Author
Chunni Kumari
Ph.D. Scholar, Department of Entomology, College of Agriculture, IGKV, Raipur, Chhattisgarh, India

Life cycle and morphometrical parameters of *Coccinella transversalis* Fabricious on cowpea aphid, *Aphis craccivora* Koch

Chunni Kumari, Jayalaxmi Ganguli, Nivedita Shah and Rashmi Gauraha

Abstract
Life cycle and morphometric parameters of different stages of *C. transversalis* was undertaken in the Bio-control Laboratory, Department of Entomology, IGKV, Raipur, Chhattisgarh during the year 2019-20 and 2020-21 on nymphs of cowpea aphid, *A. craccivora* as host. The average incubation period was3.00±0.775 days, larval mean period of 1st, 2nd, 3rd and 4thinstar was 1.60±0.490, 2.10±0.300, 1.90±0.831 and 2.50±0.500 days respectively and pupal mean duration was 2.50±0.671 days. The average life cycle duration of male and female beetle was 21.00±1.000 and 35.00±0.975 days. Longevity of male and female beetle was 31- 40 and 44-54 days. The average length and breadth of eggs was 1.22±0.228 and 0.47±0.013 respectively. The average length of 1st, 2nd, 3rd and 4th instar larvae/ grubs was 1.93±0.058, 4.29±0.282, 5.31±0.252, and 7.30±0.245 respectively. The corresponding breadth of the larvae were 0.85±0.091, 1.55±0.369, 2.13±0.078, and 2.62±0.185 respectively. The length and breadth of male and female beetle were 5.43±0.303, 4.08±0.061 and 6.51±0.156, 5.10±0.168 respectively.

Keywords: *Coccinella transversalis*, incubation period, morphometrical, larval period, pupal period

Introduction
Most of ladybirds (Coleoptera: Coccinellidae) are generalist predators and are economically important insects, having wide prey ranges, including sternorrhynchan hemiptera, thysanoptera, phytophagous mites, young instars of holometabolous insects (Evans, 2009) [7] and even fungi (Hodek *et al.*, 2012) [8], which has resulted in their categorization as either aphidophagous, coccidophagous, acarophagous or mycophagous. It may be assumed that aphidophagous ladybirds grow better when fed on aphids rather than on non-aphid prey as they are best at exploiting aphids (Evans, 2008)[6]. They have been successfully used as biocontrol agents and frequently branded as "Farmers' Friends" as they predate on numerous phytophagous pests, especially scale insects (Omkar and Pervez, 2003) [11]. *Coccinella transversalis* Fab. is a potential predator on many soft bodied insects (Omkar and James, 2003) [10]. It has significant potential and use against a variety of crop pests in combination with other insect pest management tactics. Biology is an important parameter for every predator in order to efficiently maintaining of laboratory culture. The knowledge of biology plays an important role in mass production and its utilization in pest management programmes. Morphometry of the predator is also important from taxonomic point of view. Being a predator, the knowledge of its biotic potential is helpful in formulating the strategy of biological control of insect pests. Information on life cycle and morphometry of *C. transversalis* is meager and therefore the present investigation s on such aspects were carried out in laboratory conditions.

Material and Methods
The stock culture of *Coccinella transversalis* was collected from the cowpea crop from the horticultural field of IGKV, Raipur, Chhattisgarh and reared under laboratory condition in the Biocontrol Laboratory, Department of Entomology, IGKV, Raipur, Chhattisgarh, during the year 2019-20 and 2020-21, at 27±2 ºC; 65±5%RH, in glass petri-dishes of 9.0 cm diameters. Cowpea aphid, *Aphis craccivora* was used as host /food for feeding and completion of life cycle of the beetles. The adult beetles were paired in the petri-dishes with the cowpea leaf infested with cowpea aphids. After laying of eggs by the adult female beetles, the beetles were separated into other petri-dishes. The eggs laid by the beetle on the periphery of the petri-plates and leaves were counted and noted.

Newly hatched ten grubs were kept separately in petri plates and reared until the adult emergence. These petriplates were observed regularly and the required number of nymphs of aphids were provided daily. The incubation period and hatching of eggs were recorded along with the number of instars and duration of each life stages of coccinellids were recorded and confirmed on the basis of exuvae casted-off by the grubs. Date of transformation of each instars, pupation and date of adult emergence, longevity of male and female beetles was also documented. During the life cycle study, size of different stages was measured with the help of microscope scale/venier caliper/ and graph paper.

Results and Discussion

The life cycle and morphometric parameters have been analyzed under following sub heads:

Eggs

Freshly laid eggs of *C. transversalis* were yellowish orange which gradually became black before hatching. Eggs were spindle shaped, laid in groups containing 15– 31 eggs per group.

The results presented in Table 1 revealed that the incubation period varied from 2 to 4 days with an average of 3.00±0.775 days. This finding is in contradiction with the report of Debaraj and Singh, 1990 [4] who reported the incubation period of 8 to10 days which is more than the present study.

Length of eggs varied from 1.10 to 1.90 mm with a mean of 1.22±0.228 mm and the breadth ranged from 0.45 to 0.49 mm with a mean of 0.47±0.013 mm (Table 1 and Fig. 1). This is in close agreement with the findings of Debaraj and Singh, 1990[4]and Chakraborty and Korat, 2014 [3].

Grub (larvae)

During the present study, *C. transversalis* was observed to pass through four larval instars.

First Instar grub/ larva

The duration of development of first instar larvae of *C. transversalis* ranged from 1 to 2 days with a mean of 1.60±0.490 days. Length of larvae varied from 1.80 to 2.00 mm with average length of 1.93 ± 0.058 mm and breadth of larvae varied from 0.67 to 0.90 mm with mean breadthof 0.85 ± 0.091 mm,respectively. (Table 1 and Fig. 1)

Second instar grub/larva

The duration of second instar larvae was 2 to 3 days with mean of 2.10±0.300 days. The average length and breadth of larvae were 4.29±0.282 and 1.55±0.369 mm, respectively.

Third Instar grub/larvae

The duration of the third instar larvae ranged from 1 to 3 days with a mean of 1.90±0.831 days. Average length and breadth of larvae were 5.31±0.252 and 2.13±0.078 mm, respectively.

Fourth Instar grub/larvae

Fourth instar larvae were also black in colour, the duration of fourth instar larvae of *C. transversalis* ranged from 2 to 3 days with a mean of 2.50±0.500 days. Average length and breadth of larvae were 7.30±0.245 and 2.62±0.185 mm, respectively.

Mean duration of first, second, third and fourth instar larvae were 1.60±0.490, 2.10±0.300, 1.90±0.831and 2.50±0.500 days respectively. The duration of individual instars noticed in present study agrees with Lyla *et al.* 2008 [9] who recorded 1, 1.8± 0.13, 2.7± 0.15 and 4.8± 0.13 days of duration for the first, second, third and fourth larval instars of *C. transversalis* respectively when reared on *A. craccivora*. Slight discrepancy in duration of different instars was observed by Deho, 2009 [5] who observed total larval period ranging from 8 to 13 days, when reared on *Aphis gossypii* Glover of marigold.

Pupal period

Average pupal stage lasted for 2.50±0.671 (2 to 3 days). Mean length and breadth of pupae was 5.02±0.035 mm and 2.16±0.095 mm, respectively. Duration of pupae (*i.e.* 2.48 days) for *C. transversalis* has been recorded by Patro and Sontakke, 1994 [12] which is in accordance with the present study.

Table 1: Biometrics and duration of different stages of *C. transversalis* on cowpea aphid (*Aphis craccivora*)

Sl. No	Stage	Length (mm)		Breadth (mm)		No. of insect stages observed	Duration (days)	
		Range	Mean	Range	Mean		Range	Mean
1	Egg	1.10-1.90	1.22±0.228	0.45-0.49	0.47±0.013	10	2-4	3.00±0.775
	Grub							
2	1st instar	1.80-2.00	1.93±0.058	0.67-0.90	0.85±0.091	10	1-2	1.60±0.490
3	2nd instar	3.90-4.80	4.29±0.282	1.16-1.98	1.55±0.369	10	2-3	2.10±0.300
4	3rd instar	5.00-5.80	5.31±0.252	2.00-2.33	2.13±0.078	10	1-3	1.90±0.831
5	4th instar	6.94-7.60	7.30±0.245	2.33-2.96	2.62±0.185	10	2-3	2.50±0.500
6	Pupa	4.97-5.08	5.02±0.035	2.10-2.34	2.16±0.095	10	2-3	2.50±0.671
	Total development period from egg to adult						11-18	
7	Male	5.19-5.77	5.43±0.303	4.01-4.13	4.08±0.061	03	20-22	21.00±1.000
8	Female	6.30-6.70	6.51±0.156	4.90-5.33	5.10±0.168	07	33-36	35.00±0.975
9	Longevity of Male and Female					03 07	31-40 44-54	

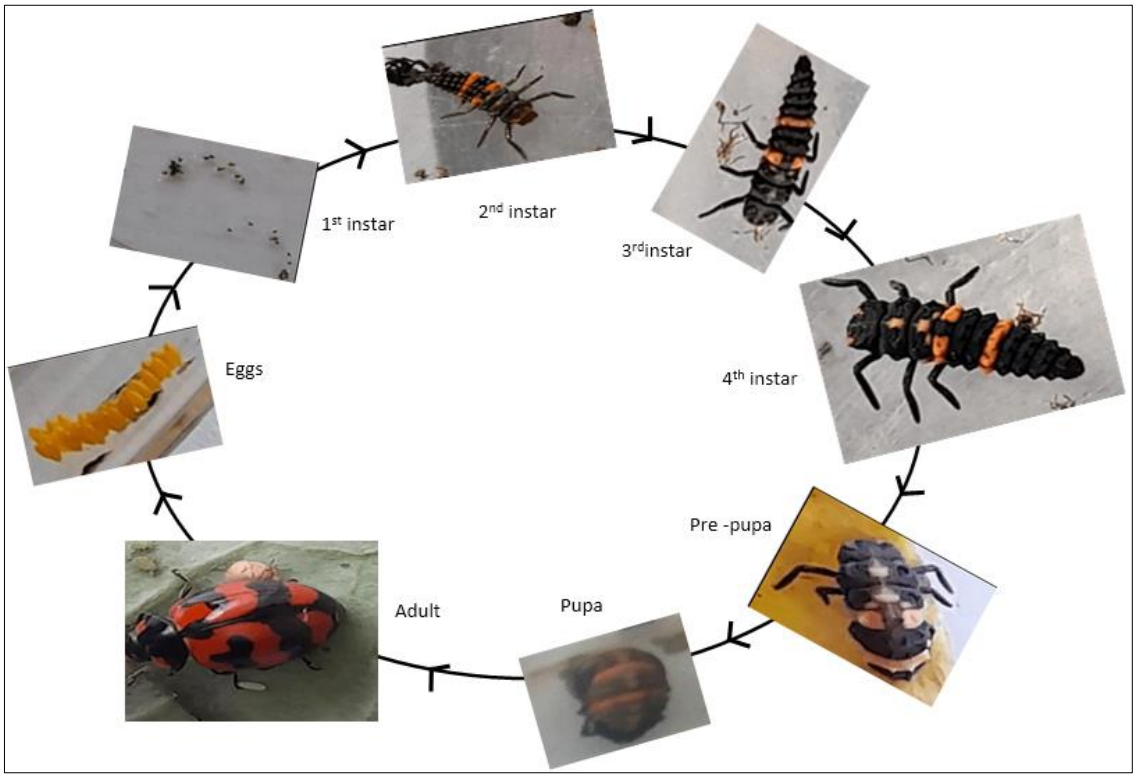

Fig 1: Life cycle of *C. transversalis*

Adult

Average longevity of male and female was 21.00±1.00 and 35.00±0.975 days, respectively. The report of Debaraj and Singh, 1990 [4] slightly deviated from the present finding as they reported that the adult longevity of *C. transversalis* ranged from 38 to 45 days. This variation may be due to effect of food and climatic conditions where the study was carried out.

Measurements of adults revealed that the length and breadth of male beetles ranged from 5.19 to 5.77 and 4.01 to 4.13 mm with an average of 5.43±0.303 and 4.08±0.061 mm, respectively.

The corresponding values for females were 6.30 to 6.70 and 4.90 to 5.33 mm with an average of 6.51±0.156 and 5.10±0.168 mm, respectively. These measurements are in accordance with Ali *et al.* 2012 [1] who mentioned that the length and width of adults were 6.0 to 7.5 and 4.5 to 5.0 mm, respectively. These data clearly indicated that the females were relatively larger in size than males. Body size of beetles as revealed in the present study is also in agreement with the findings of Chanmamla, 2009 [2] who stated more or less similar measurements of males and females of *C. transversalis*. Further, she also showed that the body size of females was larger than males which are in accordance with the present study.

Conclusion

Thus, in the present studies, it was observed that, the average incubation period was 3.00±0.775 days, larval mean period of 1st, 2nd, 3rd and 4thinstar was 1.60±0.490, 2.10±0.300, 1.90±0.831, and 2.50±0.500 days, respectivelyand pupal mean duration was 2.50±0.671 days. Duration of entire life-span for male and female adult beetles of *C. transversalis* was 31-40 and 44-54 days. Mean length and breadth of eggs of *C. transversalis* were 1.22±0.228 and 0.47±0.013. The average length of 1st, 2nd, 3rd and 4th instar larvae/grubs was 1.93±0.058, 4.29±0.282, 5.31±0.252, and 7.30±0.245 respectively. The corresponding breadth of the larvae were 0.85±0.091, 1.55±0.369, 2.13±0.078, and 2.62±0.185 respectively. The length and breadth of male and female beetle were 5.43±0.303, 4.08±0.061 and 6.51±0.156, 5.10±0.168 respectively. Longevity of male and female beetle was 31- 40 and 44-54 days.

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