

Failure of survival of two species of aphidophagous ladybird beetles (Coleoptera: Coccinellidae) on conspecific larvae

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SUMMARY

Cannibalism is a natural phenomenon occurring among the biological communities and is considered beneficial as it provides energy to survive in conditions of food scarcity. It has been frequently observed in the predatory ladybird beetles. Our study spotlights on the comparative development of two species of aphidophagous ladybirds viz., *Coccinella transversalis* and *Cheilomenes sexmaculata* on aphids and frozen conspecific larvae. The results point out that larvae failed to survive on the frozen conspecific larvae resulting in total declination of the population while good population build up was obtained on aphids with shorter developmental duration.

Key Words : *Coccinella transversalis*, *Cheilomenes sexmaculata*, Cannibalism, Development

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The interaction among natural-enemy species can be complex and embrace cannibalism and intraguild predation (IGP). Cannibalism has been extensively noticed among ten orders of insects and is considered adaptive. Nutritional profits of cannibalism are of two kinds. First it means entrée to an energy source not available for non-cannibals and second, conspecifics may have an unrelated composition of nutrients than alternative prey types and cannibalism may provide nutrients in proportions that are more optimal than heterospecific diets (Fagan *et al.*, 2002). Cannibalism in coccinellids is mainly due to paucity of aphid prey and predator starvation and cannibalistic feeding

materializes a mean of preserving their race in case of dearth of natural diet. Cannibalism of eggs, lower and identical stage larvae, prepupae and pupae by ladybird larvae is frequent in the laboratory as well as fields. Larval cannibalism is a function of virtual vulnerability and incidence of encounters (Dixon, 2000).

Coccinella transversalis and *Cheilomenes sexmaculata* are the most admired ladybird beetles of India, easily traced out in the gardens and feed on an extensive assortment of aphids. Both these aphidophagous species are known to partake in cannibalism when aphid population begs off (Maurice and Kumar, 2011). Our study limelights the behaviour of these ladybeetles when presented with aphids and frozen conspecific larvae indicating a unbeaten survival on aphids and 100 per cent mortality on frozen conspecific larvae.

Adults of *C. sexmaculata* and *C. transversalis* were unruffled from agricultural fields adjoining Allahabad and brought to the laboratory. Mating pairs were separated and kept in plastic Petri dishes (9.0 x 2.0 cm) at 27±1°C; 65±5% RH; 14:10 LD in the environmental test chamber, feed on aphids and the mated females laid eggs which were divided and used for conducting the experiment.

The development of two species was worked out by feeding on frozen conspecific larvae as well as aphids. The neonates hatched from unrelated mothers were taken, divided

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into two groups and kept singly in Petri dishes and weighed (in mg). They were fed on equal quantity of frozen larvae conspecific larvae (24 hr) as well as fresh aphids (*A. gossypii*) and development was noted. It was planned that the number of conspecific larvae and aphids will be increased at every moult. The data obtained on 'body weight' and 'developmental duration' were analyzed by two-way ANOVA by taking 'stages' and 'species' into account and data on the 'survival' and 'mortality' was calculated by chi-square test with ten replications by using the statistical software Minitab 13.2 (2000).

The data analyzed by two-way ANOVA on 'body weight' show a non-significant effect (L_1 : $F=16.04$; $P>0.05$; L_2 : $F=2.47$; $P>0.05$; L_3 : $F=2.10$; $P>0.05$; L_4 : $F=2.23$; $P>0.05$; adult: $F=1.22$; $P>0.05$) (Fig. 1) and also a non-significant effect of 'food' on the 'developmental duration' on different life stages was

observed (L_1 : $F=0.23$; $P>0.05$; L_2 : $F=4.25$; $P>0.05$; L_3 : $F=1.78$; $P>0.05$; L_4 : $F=0.08$; $P>0.05$; Prepupa: $F=0.22$; $P>0.05$; Pupa: $F=0.22$; $P>0.05$). Chi square test showed a significant effect of the 'survival' and 'mortality' when aphids were presented as food ($\chi^2=90.42$; $P<0.05$; $DF=1$) but a non-significant effect when conspecific larvae were taken into account ($\chi^2=46.05$; $P>0.05$; $DF=1$) (Fig. 2).

Our results specify that the body weight gained by the larvae after the consumption of aphids was superior enough for adult emergence but the larvae failed to survive when presented with frozen conspecific larvae and this can be suggested by the fact that aphids are the essential food with all the vital elements sufficient enough to carry out growth and development while frozen conspecific larvae possessed shrunken bodies with all the body fluid condensed so failing to afford nourishment to first instars. Cannibalism is flawlessly

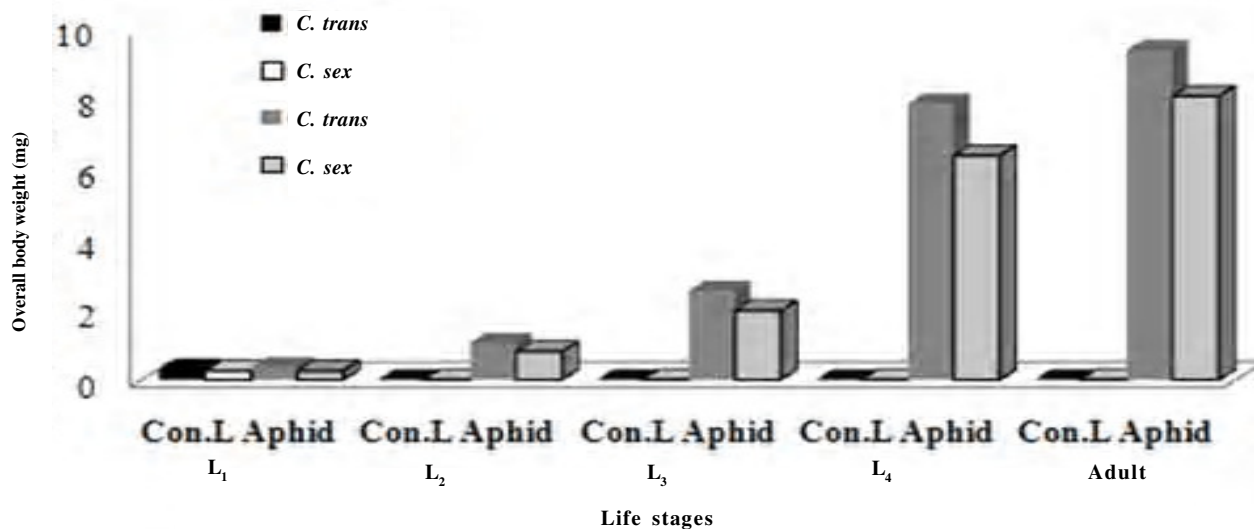


Fig. 1: Graph showing body weight gained by different life stages of *C. transversalis* and *C. sexmaculata*

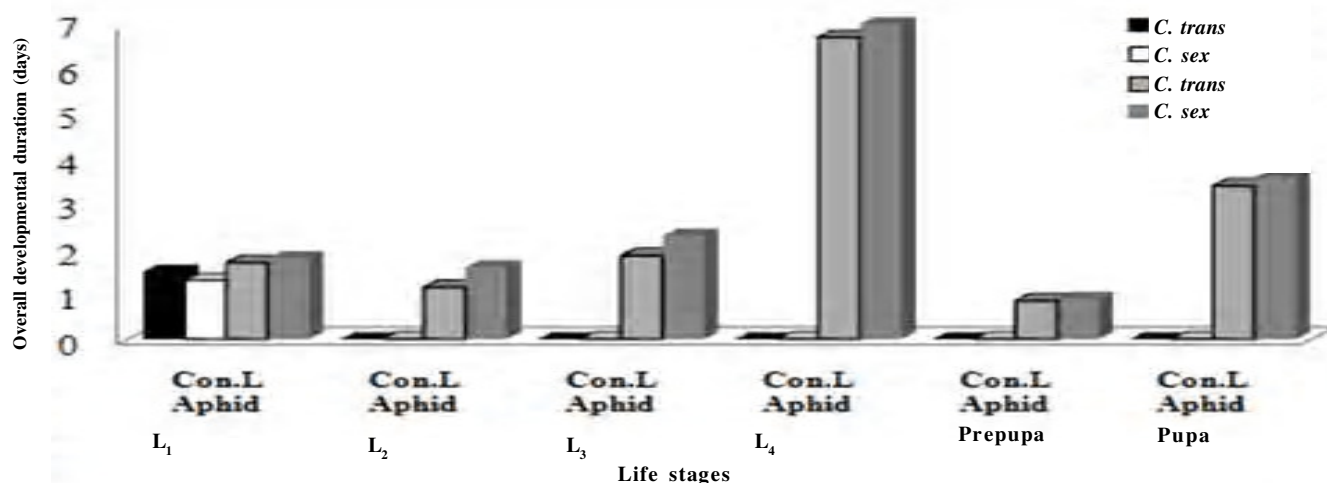


Fig. 2: Graph showing developmental duration of different life stages of *C. transversalis* and *C. sexmaculata*

a natural behaviour familiar in predaceous ladybirds conferring nutritional and competitive advantages to the cannibals as it evolves if evolutionary costs are less than the benefits. The likely costs are: (i) risk of injury, (ii) reduction in inclusive fitness if relatives are attacked and (iii) risk of disease transmission (Gagne *et al.*, 2002). Larval cannibalism represents a survival strategy for the larvae under prey sparse conditions as it enables the fittest survivors to thrive on conspecifics and complete their development. It has been reported that eggs and young larvae are more vulnerable to cannibals as compared to older larvae and adults (Dixon, 2000).

The whole set up of larvae preordained to feed on the conspecific larvae failed to survive showing 100 per cent mortality while the other group fed on the aphids showed short developmental duration with good survival ratio and this happened as ladybirds are austere predators of aphids and desire to complete their development till the aphid accessibility turns down. When food availability declines rate of cannibalism increases and they feed on whatever is available whether an egg or conspecific larvae. Thus, cannibalism can be designated as a food mixing strategy with conspecifics representing a relatively high quality food. Most empirical tests confirm that conspecifics are high quality food for predatory animals often even better food than heterospecific prey (Wildy *et al.*, 1998). However, contradictory results have also been obtained supporting our work. Oelbermann and Scheu (2002) found poor survival and very low growth rates in two different species of wolf spiders fed on cannibalistic diets.

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