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Cannibalism behaviour of a ladybird beetle, *Cheilomenes sexmaculata* Fabricius (Coleoptera: Coccinellidae) due to its densities

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India has an incredible affluent assortment of both flora and fauna. The fauna is extremely distinctive establishing the ecosystem steadiness in a drastic comportment. Ladybird beetles are cosmopolitan in distribution. They diminutive insects ranging in size from 1-10 mm, vibrantly clad with shades of red, yellow or orange with spots on their elytra, belonging to the order Coleoptera and family Coccinellidae. North India has an exceedingly loaded population of ladybird beetles together with both the herbaceous and aphidophagous species. They are elected as farmer's friends as they prey upon a number of insect pests like aphids, mealybugs, thrips other soft bodied insects and phytophagous mites. They are persuasive biocontrol agents and indispensable gears of integrated pest management. They have already been time-honored as successful biocontrol agents against coccids, diaspids and other pest infestations. Present work spotlights on the effect of density on cannibalism by different larval stages of the zigzag ladybird beetle, *Cheilomenes sexmaculata*.

Key words : Ladybirds beetles, Coccinellidae, Biocontrol agents, Integrated pest management, Cannibalism

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INTRODUCTION

Cannibalism reviewed by Fox (1975) is an extensive phenomenon in the animal kingdom that is generally considered to be an adaptive survival strategy (Church and Sherratt, 1996). It engrosses interactions between animals with analogous predatory abilities, and this may amplify the jeopardy of injury or even reciprocal predation. Cannibalistic feeding carries several prospective costs, counting loss of inclusive fitness if relatives are devoured (Agarwala and Dixon, 1993; Pfennig *et al.,* 1994) and menace of grievance or disease transmission during assault (Pfenning, 1997). The rate of cannibalism augments when the food is infrequent but many predators are cannibalistic even when food is copious (Wagner *et al.,* 1999). When other prey is plentiful but of low quality, conspecifics might be a expensive food source by acting as bio-accumulators, concentrating valuable resources, or as bio-filters, abolishing toxic or low-quality compounds. So, cannibalism may be regarded as a food-mixing tactic with conspecifics representing a moderately high quality food.

Cannibalism in the ladybird beetles (Coleoptera: Coccinellidae) is of pervasive occurrence both in the laboratory as well in the fields. Cannibalism in coccinellids is mainly due to paucity of aphid prey and predator starvation so eggs, lower and same stage larvae, pre-pupae and pupae are very recurrently devoured (Dixon, 2000). Larval cannibalism is a function of relative susceptibility and incidence of encounters (Maurice and Ramteke, 2012).

Cheilomenes sexmaculata Fabricius also known as the six-spotted or zigzag ladybeetle is very well-liked in the oriental region, effortlessly accessible in the environment and prefers to feed on an extensive variety of aphids (Omkar *et al.,* 2005). The larvae of this ladybird beetle are known to partake in cannibalism of both conspecifics eggs as well as larvae when the aphid availability declines (Maurice and Kumar, 2011). The experiment was designed in order to study the effect of

density on cannibalistic behaviour of this ladybird beetle under aphid scare conditions in the field and present results spotlight that with increasing density the incidence of cannibalism increases. The cannibalism incidence was found to be lowest among the early instars but highest among the older ones.

RESEARCH METHODOLOGY

Animal culture:

For the maintenance of the stock culture, adults of *C. sexmaculata* were unruffled from the agricultural fields neighboring Allahabad region and brought to the laboratory. Mating pairs were parted and kept in plastic Petri dishes (9.0x 2.0 cm) in the environmental test chamber (27±1^{0}C; 65±5% RH; 14:10 LD) and allowed to feed on different species of aphids *viz., Aphis craccivora* (Koch), *Aphis gossypii* (Glover), *Lipaphis erysimi* (Kaltenbach) and *Hysteroneura setariae* (Thomas) infested on *Dolichos lablab*, *Lagenaria vulgaris*, *Raphanus sativus* and *Cynodon dactylon*. The mated females laid eggs daily which were separated and observed for hatching. Hatched larvae were used for the commencement of the experiment. The dried twigs and leftover aphids were replenished after every 24 hour in order to avoid the microbial onslaught. All the experimental trials were performed in the plastic Petri dishes of the same size and replicated 20 times.

Experimental protocol:

The experiment was designed to study role of density on cannibalism by different larval stages of *C. sexmaculata*. To study this different density of conspecific first instars of *C. sexmaculata* along with 40 individuals of *Aphis craccivora* were taken together in a Petri dish. The neonates were taken from the egg clusters of unrelated mothers and kept in the groups of 2, 3, 4,5,6,7 and 8 per Petri dish. Daily observations were made and the prey was replenished daily. The quantity of the prey was later on increased to 60, 80 and 100 with the moulting of the instars. Data on mortality, cannibalism, moulting and pupation was recorded daily. The number of larvae was corrected and the incidence of cannibalism was compared with χ^2 test. The relationship between density, mortality and adult emergence was also analyzed by χ^2 test. (Minitab13.2, 2003).

RESEARCH FINDINGS AND ANALYSIS

The incidence of cannibalism was found to increase as the larval density increases (χ^2=126.838; P<0.0001; df=1) (Fig.1). The cannibalistic behaviour was found to be more prominent for the first instars than other larval stages. Cannibalism in the high density treatment was for the third instars were also observed but the intensity was low (Fig. 2). Effect of density on larval mortality was found to be statistically non-significant (χ^2=0.216; P>0.05; df=1) (Fig. 3). The total number of adults emerged when compared with density was also found to be statistically significant (χ^2=30.567; P>0.0001; df=1) (Fig. 4).

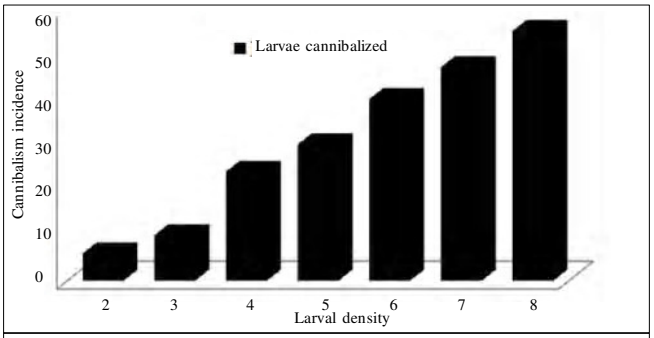

Fig. 1 : Effect of density on cannibalism incidence by larvae of *Cheilomenes sexmaculata*

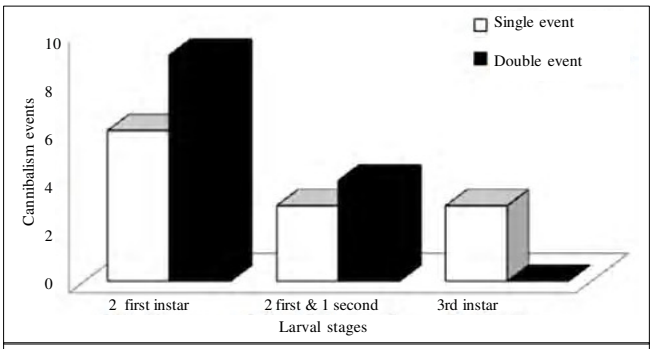

Fig. 2 : Cannibalism events (single and double) by larvae of *Cheilomenes sexmaculata*

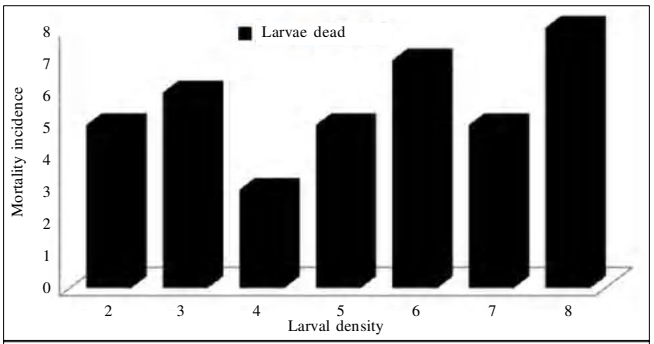

Fig. 3 : Effect of density on mortality of different larvae of *Cheilomenes sexmaculata*

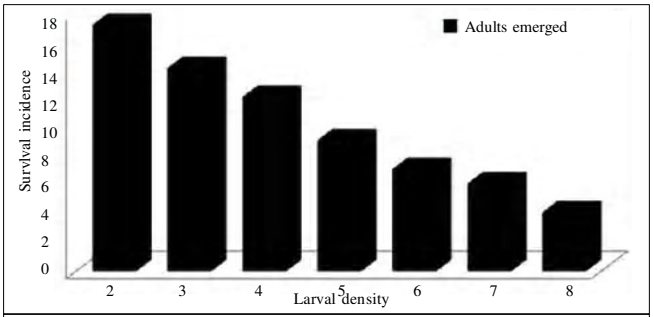

Fig. 4 : Effect of density on adult emergence of *Cheilomenes sexmaculata*

Present study indicates that density acts as an important factor in cannibalism and the incidence of cannibalism increases as the larval density is increased. So, it can be cleared out that cannibalism follows the density-dependent effect. This might be predicted that with increase in the larval density the rate of encounter between the cannibals and the victims increases so cannibalism increases. Findings are in agreement with the findings of Dimetry (1976) who concluded that larval overcrowding increased the rate of cannibalism among all instars of *Adalia bipunctata* and the studies carried out by Pervez *et al.* (2006) on *Propylea dissecta* and *Coccinella transversalis*. Similar observations have been found in other animals also for example in spiders, land crabs, fishes, salamanders and other vertebrates (Klemetsen *et al.,* 2003).

Cannibalism comes into play when the aphid availability declines and predator starvation occurs. Cannibalistic feeding appears as a means of preserving the race in case of shortage of natural diet (Brown, 1972). In general the eggs and young larvae of coccinellids are at greater risk of being cannibalized in comparison to the older larvae (Agarwala and Dixon, 1992) and present study is in greater confirmation with this fact. Although studies have indicated that the larvae of ladybirds cannibalize eggs in the presence of aphids but the intensity is lower and it increases when the availability of aphids declines this intensity increases. Cannibalism offers nutritional benefits which may be of two kinds. First, it means access to an energy source that is not available for the non-cannibals and thus, increases the food availability for the cannibals (Fox, 1975). Second, conspecifics may have a different 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). Our study also gets support from the studies carried out by McClure (1987) that rate of cannibalism increases up to 50 per cent among the larvae of *Harmonia axyridis* when larval density increases and aphid availability decreases.

Present results indicate that incidence of cannibalism was higher for the first instars followed by the second instars but lesser for the third instars and least for the fourth instars and this finding is in strong agreement with the studies carried out by Kindlmann and Dixon (1993) and Pervez *et al.,* (2006). This can be suggested by the fact that the survival of the neonates of ladybirds is strongly dependent on the availability of aphids and they must complete the development before the aphid population collapses. When the aphid population collapses, the larvae are under tremendous pressure to survive and the alternate food and the unhatched food as well as the tender younger instars are the easy targets. In this way a cannibalizing larva not only improves its chances of survival but also eliminates potential competitors and similar findings have been noted by Agarwala (1991) in *A. bipunctata*. Most empirical tests confirm that conspecifics are the high-quality food for predatory animals often even better food than heterospecific prey, Wildy *et al.* (1998) also reported in the graminivorous beetle *Tribolium castaneum* (Herbst). Snyder *et al.* (2000) also found that conspecifics of low quality in a lady beetle when given as a monotypic diet but cannibalism gave a positive contribution in mixed diets so the beetles were able to complete development when a low-quality food type was supplemented with cannibalism and this type of result is possible if conspecifics are nutrient rich but unbalanced compared with the predator's intake needs.

Conclusion:

Thus, it can be concluded from studies that:

– Cannibalism is an important survival strategy when aphids are scarce.
– Ladybirds first located aphids to ensure adequate food availability for their own reproductive needs and their offspring and when the food availability declines and population density increases they switched over to cannibalism for survival.

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LITERATURE CITED

Agarwala, B.K. (1991). Why do ladybirds (Coleoptera: Coccinellidae) cannibalize? *J. Biosciences,* **16**(3): 103-109.

Agarwala, B.K. and Dixon, A.F.G. (1992). Laboratory study of cannibalism and interspecific predation in ladybirds. *Ecologia Enotmologia.,* **17**: 303-309.

Agarwala, B.K. and Dixon, A.F.G. (1993). Kin recognition: egg and larval cannibalism in *Adalia bipunctata* (Coleoptera: Coccinellidae). *European J. Entomol.,***90**:45-50.

Brown, H.D. (1972). The behaviour of newly hatched coccinellid larvae (Coleoptera: Coccinellidae). *J. Entomol. Soc. South Africa,* **35**: 149-157.

Church, S.C. and Sherratt, T.N. (1996). The selective advantages of cannibalism in a Neoptropical mosquito. *Behaviour & Ecological Soc.,***10**: 298-303.

Dimetry, N.Z. (1976). The consequences of egg cannibalism in *A. bipunctata* (Coleoptera: Coccinellidae). *Entomophaga,* **19**: 445-451.

Dixon, A.F.G. (2000). *Insect predator-prey dynamics, ladybird beetles and biological control*. Cambridge University Press, CAMBRIDGE, 257 pp.

Fagan, W.F., Siemann, E., Mitter, C., Denno, R.F., Huberty, A.F., Woods, H.A. and Elser, J.J. (2002). Nitrogen in insects: implications for trophic complexity and species diversification. *American Naturalist,* **160**: 784-802.

Fox, L.R. (1975). Cannibalism in natural populations. *Ann. Rev. Ecol. & Systematics,* **6**: 87-106.

Kindlmann, P. and Dixon, A.F.G. (1993). Optimal foraging in ladybird beetles (Coleoptera: Coccinellidae) and its consequences for their use in biological control. *European J. Entomol.,* **90**:443-450.

Klemetsen, A., Amundsen, P.A., Dempson, J.B., Jonsson, B., Jonsson, N., O'Connell, M.F. and Mortensen, E. (2003). Atlantic salmon *Salmo salar* L., brown trout *Salmo trutta* L. and Arctic charr *Salvelinus alpines* (L.): a review of aspects of their life histories. *Ecol. Freshwater Fishes,* **12**: 1-59.

Maurice, N. and Kumar, A. (2011). Effect of food quantity and food consumed on the body weight and the developmental duration of two species of ladybirds (Coleoptera: Coccinellidae), *Ann. Plant Protect.*, **19**(1): 59-62.

Maurice, N. and Ramteke, P.W. (2012). Size disparity affects degree of cannibalism in two species of aphidophagous ladybird beetles (Coleoptera: Coccinellidae), *Internat. J. Advance Pharmaceutical & Biological Sci.,* **2**(2): 128-134.

McClure, M.S. (1987). Potential of the Asian predator, *Harmonia axyridis* Pallas (Coleoptera: Coccinellidae) to control *Matsucoccus resinosae* Bean and Godwin (Homoptera: Margarodidae) in the United States. *Environ. Entomol.,***16**: 224-230.

Minitab (2003). MINITAB Statistical Software, Minitab Release 13.2. Minitab, Inc., Pennsylvania (U.S.A).

Omkar, Pervez, A., Mishra, G., Srivastava, S., Singh, S.K. and Gupta, A.K. (2005). Intrinsic advantages of a ladybird, *Cheilomenes sexmaculata* over the relatively bigger two co-occurring Coccinella species. *Insect Sci.,* **12**: 179-184.

Pervez, A., Gupta, A.K. and Omkar (2006). Larval cannibalism in aphidophagous ladybirds: influencing factors, benefits and costs. *J. Biological Control,* **38**: 307-313.

Pfennig, D.W., Sherman, P.W. and Collins, J.P. (1994). Kin recognition and cannibalism in polyphenic salamanders. *Behavioural Ecol.,* **5**: 225-232.

Pfenning, D.W. (1997). Kinship and cannibalism. *Bioscience,* **47**: 667-675.

Snyder, W.E., Joseph, J.B., Preziosi, R.F. and Moore, A.J. (2000). Nutritional benefits of cannibalism for the lady beetle *Harmonia axyridis* (Coleoptera: Coccinellidae) when prey quality is poor. *Enivron. Entomol.,* **29**: 1173-1179.

Wagner, J.D., Glover, M.D. Mosely, J.B. and Moore, A.J. (1999). Hatchability and fitness consequences of cannibalism in larvae of ladybird beetle *Harmonia axyridis. Evolution Ecol. & Res.,* **1**: 375-388.

Wildy, E.L., Chivers, D.P., Kiesecker, J.M. and Blaustein, A.R. (1998). Cannibalism enhances growth in larval long-toed salamanders (*Ambystoma macrodactylum*). *J. Herpetol.,* **32**: 286-289.