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RESEARCH PAPER

Efficacy of Ladybird Beetle Over Multi-species of Aphids in Chitwan Condition of Nepal

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ABSTRACT

Purpose: The capacity of ladybird beetles in consuming different aphid species was not clear in Chitwan district. Therefore, a study to understand the efficacy of ladybird beetle *Coccinella septempunctata* on different species of aphids was carried out. **Methods:** A laboratory analysis for three species of aphids namely, black bean aphid *Aphis fabae*, cucurbit aphid *Aphis gossipii*, and mustard aphid *Lipaphis erysimi* (Kalt.) based on feeding capacity of ladybird beetle *Coccinella septempunctata* was conducted at Agriculture and Forestry University, Chitwan, Nepal during November 2014 to November. Interrelationship between fluctuating temperature and aphid consumption rate of ladybird beetles was also observed. **Results:** At average temperature between 17 and 23°C the maximum feeding of aphids by the beetle was analyzed, and the ladybird beetle consumed highest numbers of mustard aphid *Lipaphis erysimi* (Kalt.) followed by black bean aphid *Aphis fabae* and cucurbit aphid *Aphis gossipii* during 5-35°C temperature. All the three species of aphids were consumed highest by the adults of the ladybird beetle compared with its larval instars. At any adult stage of adult ladybird beetle the consumption rate of aphid species was highest for mustard aphid *Lipaphis erysimi* (Kalt.) followed by black bean aphid *Aphis fabae* and cucurbit aphid *Aphis gossipii*. With increase of the age of adult ladybird beetles the capacity of aphid consumption also increased. **Conclusion:** Therefore, ladybird beetle *C. septempunctata* have variable efficacy of aphid consumption based on the temperature parameter and species of aphids.

HIGHLIGHTS

- The study concentrates efficacy of ladybird beetle *C. septempunctata* in different species of aphids.
- This research focuses on temperature parameters in relation with predatory frequency and potentiality of ladybird beetles on aphid species.

Keywords: Adult, aphid, beetle, consumption, temperature

The lady bird beetles are considered as the good fortune in many myths and legends. They have been prayed through the centuries as they vernacular indicates that the term 'Lady' is in reference to biblical Mother Mary (Roache, 1960). The coccinellids, generally called as lady bird beetles and are famous known as a predator for huge number of insects. Lady beetles, often called ladybug or coccinellids. They are the most known of all beneficial insects. In Europe such beetles are known as ladybirds (William, 2002). They play significant role to reduce the loss and damage of crops especially by controlling the population of soft bodied insects such as aphids, coccids, etc. (Hippa *et al.* 1978; Kring *et al.* 1985), while the species *M. discolor* consume various pests like brown plant hopper, corn borer, mealybugs, whiteflies, etc. (Rao *et al.* 1989; Mani, 1995). Predaceous coccinellids are observed linked with those insects that damage bean, wheat, chilli, sorghum, potato, lathyrus, soyabean, sweet potato, lentil, mustard,

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maize, brinjal, groundnut, sunflower and cabbage. (Duffieded, 1995; Gautam *et al.* 1995).

The negative effect of insecticides and pesticides in the environment, soil, plant, and other ecological components greatly reduce by the activities of biological control agents especially to decrease the population of aphid pest (Bellows, 2001). *Coccinella septempunctata* showed a close association with their prey species (especially aphids). When the prey population are decreasing the reproduction and activities of predator (ladybird beetle) also decreases simultaneously (Kenneth and Hagen, 197). Coccinellids have been largely applied for the control of aphid by mass rearing, augmentation by translocation and release (Saharia, 1982). The huge destruction has been analyzed at the global level and has been increasing regularly (Begum *et al.* 1991). Bean aphid, *Aphis craccivora* Koch. attacks the bean plant and other leguminous crops which are fed by the nymphs and the adults of aphid that hamper destruction by sucking the sap from the flowers, buds, pods, tender shoots and reduce the market value (Srivastava and Singh, 1986). Yield loss could be found to be 20-40% which initially fails in flowering and pods setting due to the infestation of such pests (Islam, 2007). The mechanisms of the aphid attack consist of sucking the cell sap and check the plant growth, development and yield by both nymphs and adults. The adults of aphids re considered to transfer 60% of virus diseases in different crops and produce honey dew that creates sooty mold development (Gilkeson and Kelin, 2001).

The efficiency that biological control agents have reflected thus have increased the interest of policy makers, researchers, and scientists to recognize the biocontrol method of IPM as one of the significant strategies to reduce and control the effect of aphid pest population in crop field (Minks and Harrewijn, 1987). Ladybird beetles are highly sensitive in consuming aphid population intensively and controlling the damage of crops thereby. The consumption of aphids by the beetle are influenced by climatic and environmental factors. Katsarou *et al.* (2005) investigate that some species of lady bird beetle including *C. septempunctata* have direct and indirect effect of temperature in their predatory capacity and growth in turn.

With respect to the importance of predator, *C. septempunctata* in agroecosystem as an efficient predator for phytophagous insect pests, this study deals to investigate the efficacy of ladybird beetle *C. septempunctata* in consuming different species of aphids such as black bean aphid *Aphis fabae*, cucurbit aphid *Aphis gossipii*, and mustard aphid *Lipaphis erysimi* (Kalt.) for the growth of *C. septempunctata.*

MATERIALS AND METHODS

The study was conducted during November 2014 to November 2015 in the laboratory condition of Entomology department in Agriculture and Forestry University, Chitwan Nepal. Plant twigs and sample species of insects [both ladybird beetle *Coccinella septempunctata* and species of aphids namely black bean aphid *Aphis fabae*, cucurbit aphid *Aphis gossipii*, and mustard aphid *Lipaphis erysimi* (Kalt.)] were collected and reared in the lab condition. Regularly the data were collected and recorded.

The recorded data were all tabulated and systematically arranged treatment wise under three replications using MS- Excel which were subjected to Analysis of Variance (ANOVA) and Duncan's Multiple Range Test (DMRT-0.05 level) for mean separations using Gen stat software.

RESULTS AND DISCUSSION

Effect of temperature in aphid feeding efficiency of ladybird beetle

It was recorded that the average numbers of cucurbit aphid *Aphis gossipii* consumed by single ladybird beetle (per day) found to be 28, 30, 40, 46, 48, 50, 50, 48, 45, 37, 30 at 5, 8, 11, 14, 17, 20, 23, 26, 29, 32 and 35°C respectively. Similarly, the average numbers of black bean aphid *Aphis fabae* consumed by single ladybird beetle (per day) found to be 31, 32, 42, 47, 50, 50, 50, 48, 47, 40, 33 at 5, 8, 11, 14, 17, 20, 23, 26, 29, 32 and 35°C respectively. Finally, the average numbers of mustard aphid *Lipaphis erysimi* (Kalt.) consumed by single ladybird beetle (per day) found to 35, 37, 45, 49, 50, 50, 50, 49, 48, 43, 34 at 5, 8, 11, 14, 17, 20, 23, 26, 29, 32 and 35°C respectively (Fig. 1).

After certain point of temperature, the average numbers of aphid's consumption potentiality by lady bird beetle *C. septempunctata* (seven-spotted) decreases gradually. At average temperature between 17 and 23°C maximum feeding of aphids by the beetle were recorded, and the ladybird

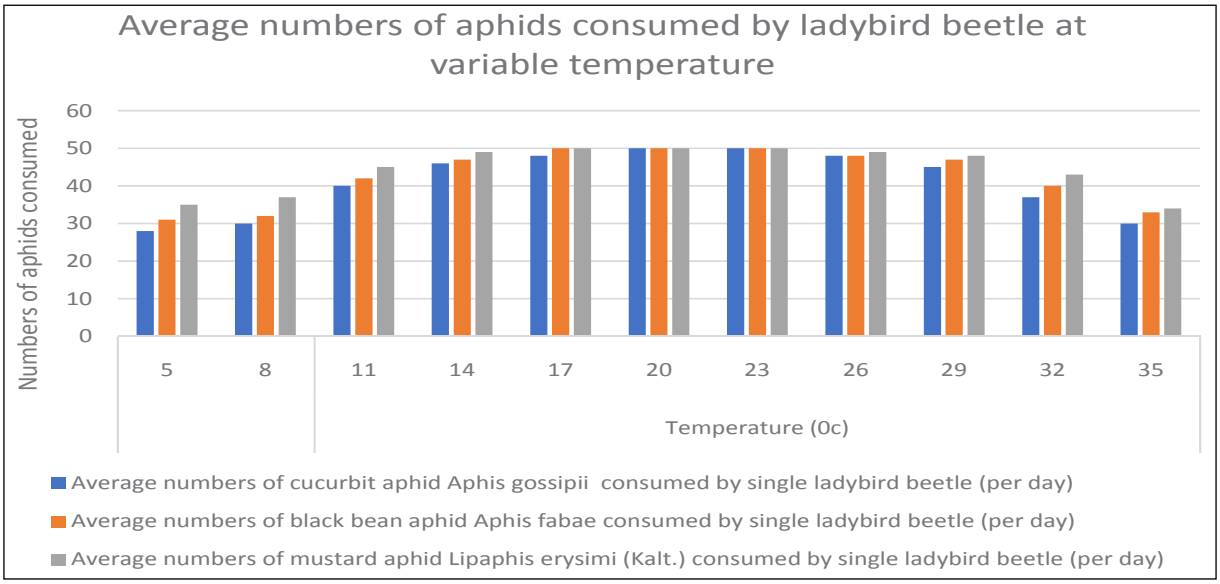

Fig. 1: Feeding efficiency of ladybird beetle in different species of aphids at variable temperature

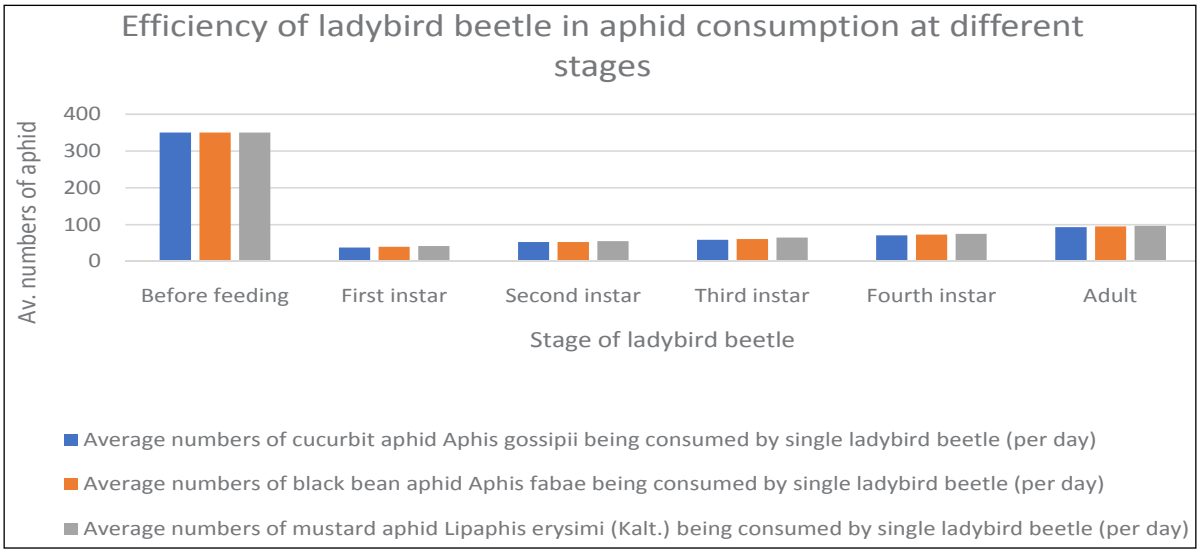

Fig. 2: Population of aphids consumed by different stages of ladybird beetle

beetle consumed maximum numbers of mustard aphid *Lipaphis erysimi* (Kalt.) followed by black bean aphid *Aphis fabae* and cucurbit aphid *Aphis gossipii* within the mentioned temperature. Soares *et al.* (2003) observed increasing aphid consumption by *H. axyridis* larvae and adults between 10 and 25 °C. Thus, the difference in adult consumption can be explained by a higher demand for energy due to higher metabolism activity caused by higher temperature (Brown *et al.* 2004). Investigation of Rizwi (2009) and Ahmad (2015) revealed that the mustard aphid *Lipaphis erysimi* (Kalt.) were intensively consume ladybird beetle in comparison with other species of aphids.

Population of aphid species influenced by ladybird beetle

It was found that 38, 40, and 42 average numbers of cucurbit aphid *Aphis gossipii*, black bean aphid *Aphis fabae* and mustard aphid *Lipaphis erysimi* (Kalt.) were consumed by single ladybird beetle (*C. septempunctata*) at its first instar of larvae respectively. Similarly, 2nd, 3rd and 4th instar of ladybird beetle consumed 53, 53, 55; 59, 61, 65; 71, 73, 75 average numbers of cucurbit aphid *Aphis gossipii*, black bean aphid *Aphis fabae* and mustard aphid *Lipaphis erysimi* (Kalt.) respectively. The adult ladybird beetle consumed 93, 95, 97 average

numbers of cucurbit aphid *Aphis gossipii*, black bean aphid *Aphis fabae* and mustard aphid *Lipaphis erysimi* (Kalt.) respectively. Initially before feeding each species of aphids were 350 in numbers (Fig. 2).

The adult stage of *C. septempunctata* consumed more aphids in comparison with the larval stages. Similar results were reported by (Srivastiva *et al.* 1987; Dixon *et al.* 1997; Sattar *et al.* 2008) who investigated that with increase of growth stage the consumption frequency of ladybird beetle *C. septempunctata* increases accordingly. The study of Muzammil *et al.* (2008) and Sarmad *et al.* (2015) found that *C. septempunctata* feeds highest population of mustard aphid *Lipaphis erysimi* (Kalt.) in comparison with cucurbit aphid *Aphis gossipii* and black bean aphid *Aphis fabae.*

Effect of ladybird beetle in different species of aphids

It was recorded that at 15 days adult one ladybird beetle *C. septempunctata* consumed 70, 87 and 90 average numbers of cucurbit aphid *Aphis gossipii*, black bean aphid *Aphis fabae* and mustard aphid *Lipaphis erysimi* (Kalt.) respectively in a single day. There were 50 av. Number of each aphid species before their initiation of consumption. Similarly, it was found that 60 days adult one ladybird beetle *C. septempunctata* consumed 85, 98 and 100 average numbers of cucurbit aphid *Aphis gossipii*, black bean aphid *Aphis fabae* and mustard aphid *Lipaphis erysimi* (Kalt.) respectively in a single at the laboratory status (Fig. 3).

Ladybird beetle *C. septempunctata* consumed highest population of mustard aphid *Lipaphis erysimi* (Kalt.) followed by black bean aphid *Aphis fabae* and cucurbit aphid *Aphis gossipii* at its all-time adult duration. Many studies have found that mustard aphid *Lipaphis erysimi* (Kalt.) as an essential prey for ladybird beetles, viz. *C. septempunctata* (Hodek, 1960; Omkar and Mishra, 2005). Dixon (2000) and Omkar and Srivastava (2001) found the frequency of feeding aphid by ladybird beetle were observed highest in the population of mustard aphid *Lipaphis erysimi* (Kalt.) in comparison with bean aphid *Aphis fabae* and cucurbit aphid *Aphis gossipii.* Our evaluation was supported by the observation of Sarmad *et al.* (2015) and Debaraj and Singh (1990). Ladybird beetles have close relationship with the mass of mustard aphid *Lipaphis erysimi* (Kalt.) than other species of aphids.

CONCLUSION

In the laboratory of Entomology, Agriculture and Forestry University, Chitwan, Nepal a study during

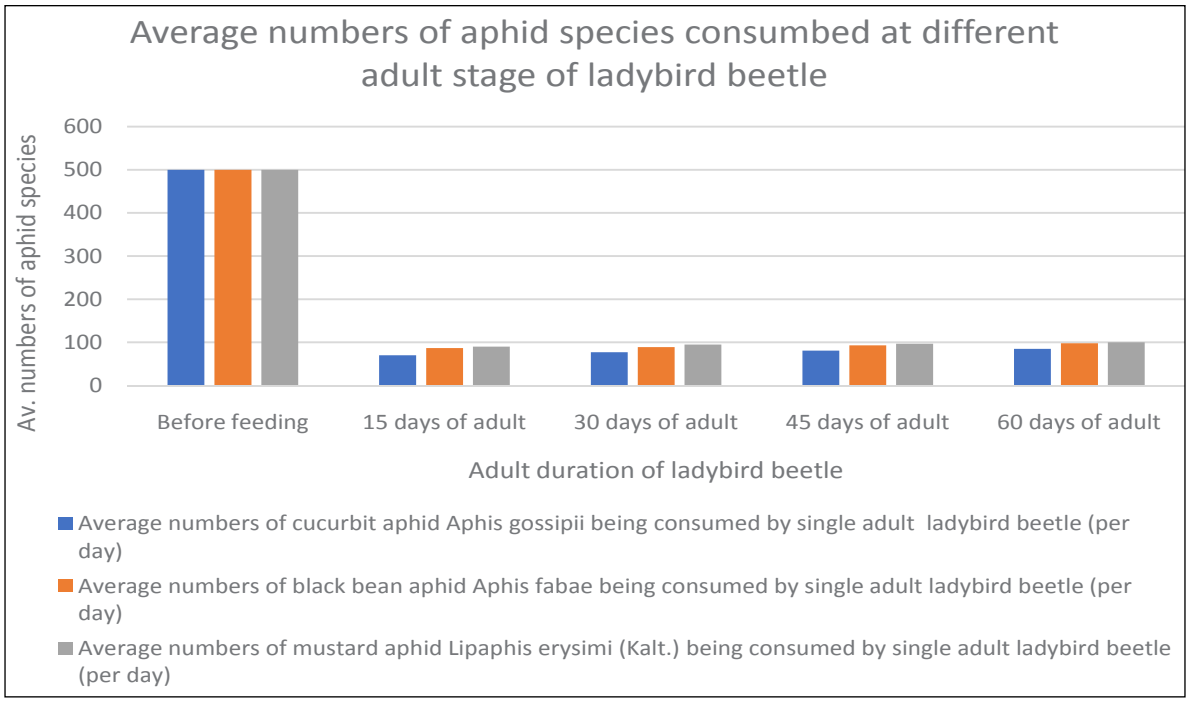

Fig. 3: Average numbers of aphid species consumed by different adult days ladybird beetle

November 2014 to November 2015 was carried out to understand the capacity of ladybird beetles on three different aphid species. Plant twigs and sample species of insects [both ladybird beetle *Coccinella septempunctata* and species of aphids namely black bean aphid *Aphis fabae*, cucurbit aphid *Aphis gossipii*, and mustard aphid *Lipaphis erysimi* (Kalt.)] were collected and reared in the lab condition. At average temperature between 17 and 23°C the maximum feeding of aphids by the beetle were recorded, and the ladybird beetle consumed highest numbers of mustard aphid *Lipaphis erysimi* (Kalt.) followed by black bean aphid *Aphis fabae* and cucurbit aphid *Aphis gossipii* during 5-35°C temperature. All the three species of aphids were consumed highest by the adults of the ladybird beetle compared with its larval stage. It was observed that at any adult stage of ladybird beetle the consumption rate of aphid species were highest for mustard aphid *Lipaphis erysimi* (Kalt.) followed by black bean aphid *Aphis fabae* and cucurbit aphid *Aphis gossipii.* With increase of the age of adult ladybird beetles the capacity of aphid consumption also increased. Thus, ladybird beetle *C. septempunctata* have different efficacy of aphid consumption as per the changing temperature and species of aphids.

Further, the researcher could study the efficacy of various species of ladybird beetle in multi-species of aphids at variable climatic factors.

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