BIOLOGICAL MANAGEMENT OF APHIDS BY COCCINELLID SPECIES

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ABSTRACT

*A laboratory study was conducted using four aphid species viz; Myzus persicae (Sulzer), Lipaphis erysimi (*Kaltenbach), *Aphis craccivora (*Koch) *and Brevicorynae brassicae (*Linn) *and two coccinellid species, i.e.Coccinella septumpunctata* (Linn) *and Adonia variegata* (Goeze). *Predatory activity of C. septumpunctata was the highest on L. erysimi (feeding 183 aphids) and the lowest on A. craccivora (feeding 126 aphids), while, that of A. variegata was the highest on L. erysimi(feeding 155.4 aphids) and the lowest on B. brassicae (feeding 112 aphids) during larval stages. Fourth instar individual larval weight of C. septumpunctata was recorded the highest (26.82 mg) when fed on A. craccivora and the lowest (13.9mg) when fed on B. brassicae, while the 4th instar larval weight of A. variegata was only 12.82 mg and 11.34mg. Hence, it can be concluded that C. septumpunctata seems better promising species of predators of aphids, especially beneficial in biological control of aphid species.*

Keywords: Aphid species, biological control, coccinellid species, predator

INTRODUCTION

Insect pests have always been a threat to agriculture productivity in Nepal resulting in lower productivity as compared to advanced agricultural countries of the world. Various chemicals/pesticides are applied against different insect pests (Pearson, 2004). Due to the intensive and indiscriminate use of many pesticides, people suffer from many diseases, and some of these are chronic for human beings. Besides contaminating food and food products, pesticides have been accumulating in the soil, air and water to a critical stage. This calls for a safe and cheap control method sentence not complete. This can only be achieved by the practice of Integrated Pest Management (IPM); a pest control management which ensures environmental safety (Solangi, 2004).

Ladybird beetles are considered important agents in biological control helping to regulate the population of pests in many economically important crops (Obrycki and Kring, 1998).They are predators in both adult and larval phases,

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presenting an intense search for food and predatory capacity (Vandenberg, 2002; Olkowski *et al.*, 1990; Oliveira *et al.*, 2004). Ladybird beetles or coccinellids have significant importance as a biological control agent because of they extend to control many soft-body insect pests especially aphids on which larvae as well as adultsboth feed vigorously.

In the world, aphids are very severe pests of agriculture. Aphid attacks on variety of plants and both nymphs and adults suck the cell sap and reduce the plants vigour and growth. Aphids are responsible of transferring about 60% of all type of plant viruses in the whole world. They also produce honey dew which results in sooty mold development (Gilkeson and Kelin, 2001).

OBJECTIVES

The general objective of the experiment was to select ladybird beetle as effective bio-control agents.

Specific objectives

- To study biology of two coccinellid beetle species on four aphid species
- To evaluate the feeding efficiency of two ladybird beetle species on four aphid species
- To select the effective ladybird beetle as bio-agent for the bio-control of four aphid species

MATERIALS AND METHODS

The experiment was conducted in the Mass-rearing Laboratory of Entomoloyg Division, Nepal Agricultural Reasearch Council (NARC), Khumaltar, Lalitpur (27.6644° N latitude and, 85.3188° E longitude). For the experiment, two coccinellid species; *Coccinella septumpunctata* (Linn) and *Adonia variegata* (Goeze) each was fed on four different aphids; *Aphis craccivora* (Koch) and *Brevicorynae brassicae* (Linn), *Lipaphis erysimi* (Kaltenbach) and *Myzus persicae* (Sulzer). The comparative biology and feeding behavior of beetles was studied for evaluating their efficacy as effective bio-control agent.

COLLECTION AND STOCK CULTURE OF TWO COCCINELLID SPECIES

The adults of *C. septumpunctata* and *A. variegata* was collected from premises of Nepal Agricultural Research Council, Khumaltar, Lalitpur (From

field of Agriculture Botany Division and Entomology Division) and reared in mass-rearing Laboratory of Entomology Division within 27.6644° N latitude and 85.3188° E longitude. The beetle pairs of both species was kept in separate ventilated plastic container (18cm × 12cm × 8cm) and offered fresh and live aphids available in the field. The observation on egg laying was carried out twice a day (9am and 5pm). The corrugated papers were provided to each plastic container for influencing egg laying on the paper for easy collection of eggs. The eggs laid by females was collected and subjected for further observations.

For stock culture of aphids, *A. craccivora* was reared on faba bean, *B. brassicae* on cabbage, *L. erysimi* on mustard and raddish and *M. persicae* on tomato plants.

LABORATORY EXPERIMENT

The collected egg mass of each species of coccinellid beetle was kept in a separate ventilated plastic container (6.5cm × 7.5 cm) and observed twice a day (9am and 5pm) for hatching. After hatching of the eggs, the larva was kept in four different ventilated plastic containers (5 larvae per container) each replicating five times. This experimental set up was same for both species of coccinellids, i.e. feeding two species of coccinellids on four species of aphids, which were replicated five times.

The larva in each plastic container was provided with counted number of aphids each day. Ten aphids were given initially and aphid number was increased by five after every two days. This process continued till all the larvae pupated. Pupae were kept undisturbed for emergence of adults. The adults were then paired in male and female and kept in ventilated plastic container (6.5cm × 7.5 cm) for observation of egg laying capacity and longevity of adults. The weight of each instar of larvae and adult within 12hr of emergence and just after death was recorded. Maximum and minimum temperatures of the laboratory throughout the experiment were recorded daily.

DATA ANALYSIS

The information collected from the laboratory experiment was coded, tabulated and analyzed by using R-Studio and Microsoft Excel in the computer. Both descriptive and analytical methods were used to analyze the data.

RESULTS

PREDATORY PERFORMANCE BY LARVAE OF TWO SPECIES OF LADYBIRD BEETLES ON FOUR APHID SPECIES

Experiment showed that among four different aphids viz; M. *persicae* reared on tomato plant, *L. erysimi* reared on mustard plant, *A. craccivora* reared on faba bean *and B. brassicae* reared on cabbage plant, consumption of *L. erysimi* was recorded the highest (183 aphids by *C. septumpunctata L.* and 155.4 aphids by *A. variegata* duirng larval period) followed by *M.* persicae (165.6 aphids by *C. septumpunctata L.* and 147.4 aphids by *A. variegata* during larval period), *B. brassicae L.*(135.2aphids), *A. craccivora* (126 aphids), respectively by *C. septumpunctata L.* and *A. craccivora* (122 aphids), *B. brassicae* (111.8 aphids), respectively by *A. variegata* as shown in Table 1. This finding is supported by previous findings of Jonathan and Lundgren(2014).

Table 1: Predatory performance by larvae of two species of ladybird beetle on four different aphids in laboratory condition at NARC, Khumaltar, 2016

Aphid spp.	*C. septumpunctata* (Mean± SE)	*A. variegata* (Mean± SE)	Sig.(2-tailed)	
Myzus persicae (Sulzer)	165.6 ± 2.821	147.4± 5.446	0.003	**
*Lipaphis erysimi (*Kaltenbach)	183 ± 6.519	155.4± 5.582	0.059	*
Aphis craccivora (Koch)	126 ± 2.949	122 ± 1.483	0.082	ns
Brevicorynae brassicae L.	135.2 ± 0.969	111.8± 1.067	0.000	***
CV	**7.105**	**8.057**		
LSD	**17.261**	**16.227**		

ns = non-significant. *, ** and *** significant at 0.1, 0.05 and 0.01 level, respectively by t-test.

LARVAL WEIGHT OF TWO SPECIES OF LADYBIRD BEETLES ON CONSUMING FOUR DIFFERENT APHIDS

Laboratory analysis showed almost similar effect on each four aphid species on larval weight gain of *C. septumpunctata* in first, second and third instars. There was visible difference in weight gain by fourthinstar larvae of *C. septumpunctata* as shown in Figure 1.

In case of *A. variegata,* similar effects of each four aphid species on weight gain by larvae was observed infirst and second instars, while there was difference in weight gain by larvae of *A. variegata* in third and fourth instars, which are presented in Figure 2.

The results shown in Figures 1 and 2 are very similar to the finding of Ali and Rizwi (2009).

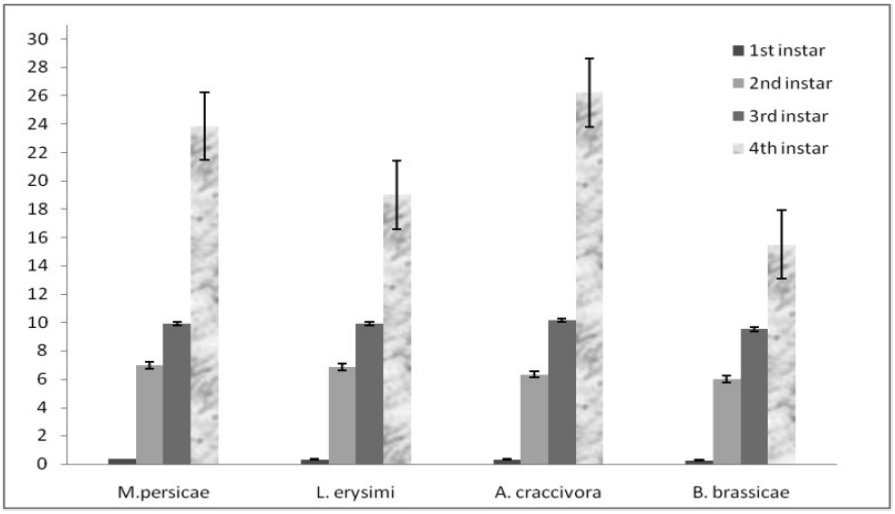

Figure 1. Larval weight (mg) of *C. septumpunctata* fed on four different aphids in laboratory condition at NARC, Khumaltar, 2016.

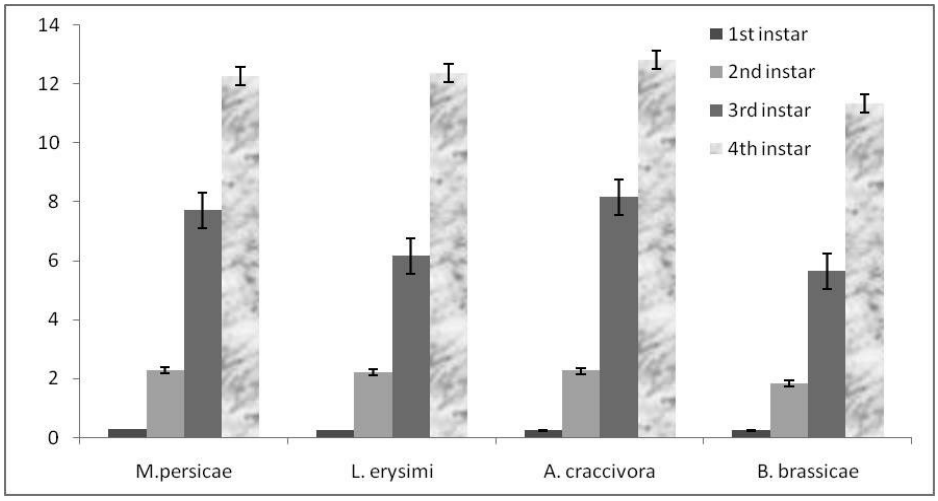

Figure 2. Larval weight (mg) of *A. variegata* fed on four different aphids in laboratory condition at NARC, Khumaltar, 2016.

EGG LAYING CAPACITY OF TWO SPECIES OF LADYBIRD BEETLES ON CONSUMING FOUR DIFFERENT APHIDS

According to laboratory study, the highest egg laying (53.7 eggs per day by *C. septumpunctata* and 40.0 eggs per day by *A. variegata*) was recorded feeding on *A. craccivora* which was followed by feeding on *M. persicae* (50 eggs per day by *C. septumpunctata* and 32 eggs per day by *A. variegata*), *L.* erysimi (46 eggs per day by *C. septumpunctata* and 27 eggs per day by *A. variegata*) and *B. brassicae L.* (45 eggs per day by *C. septumpunctata L.* and 25.7 eggs per day by *A. variegata*).

Table 2 shows the significant difference in egg laying capacity of two species of beetles when fed with four species of aphids. This means different aphid species have different influence on egg laying capacity in the test beetles.

Table 2: Egg laying capacity of two species of ladybird beetles fed with four different aphids in laboratory condition at NARC, Khumaltar, 2016

Aphid spp.	*C. septumpunctata* (Mean± SE)	*A. variegata* (Mean± SE)	T-test	
Myzus persicae (Sulzer)	50.548 ± 3.564	32.769± 2.389	0.004	***
*Lipaphis erysimi (*Kaltenbach),	46.723 ± 3.673	27.303± 2.201	0.000	***
Aphis craccivora (Koch)	53.728 ± 3.382	40.031± 3.305	0.000	***
Brevicorynae brassicae L.	45.881 ± 3.681	25.740± 2.130	0.000	***

CONCLUSION

Comparing the feeding efficiency of two species of beetle, *C. septumpunctata* was found to consume higher number of aphids than *A. variegata*. This clarified the effectiveness of former as effective bio-control agent of aphid providing better management of aphid than later one.

Larval weights of beetle species were recorded the highest when fed on *A. craccivora*. Although the consumption rate was observed the least for *A. craccivora* and the highest for *L. erysimi*, development was found to be better with *A. craccivora*. Therefore, on the basis of this study, supported by several previous findings, *A. craccivora* seemed to be better choice of host insect for laboratory rearing of beetles for mass production.

Fecundity is a good indicative parameter to judge the rate of multiplication of a predator. The highest egg laying capacity observed in female beetle fed on *A. craccivora* and followed by *M. persicae*, *L. erysimi* and recorded least while

fed with *B. Brassicae* to both beetle species. Eggs laid by two beetle species differred significantly while fed on all types of aphid. *C. septumpunctata* was superior in terms of fecundity too. Therefore, *C. septempunctata* performs better in progeny development as well as for consumption of prey offering economic significance in biological control of aphid.

From the results of this experiment, it can be concluded that *C. septumpunctata* is superior and effective bio-control agent in comparison to *A. variegata*. The overall development of two species of predators was recorded better when fed on *A. craccivora*. Thus, for mass rearing purpose, predators can be given the same aphid species. *M. persicae* and *L. erysimi* can be given on unavailability of *A. craccivora* for quick and satisfactory development as performance of these beetles was satisfactory on feeding with these species.

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