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Study on the efficacy of ladybird beetle as a biological control agent against aphids (*Chaitophorus spp.*)

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Abstract

The Present study was carried out in laboratory of Entomology Department (28 °C, 65% RH) at PMAS-Arid Agriculture University Rawalpindi during the year 2012. Fully matured ladybird beetles and aphids (*Chaitophorus spp.*) were collected from the willow trees in front of PMAS-Arid Agriculture University Rawalpindi on April 2, 2012. These natural enemies were reared on the aphids for the collection of larvae of ladybird beetles. The results from the current study show that there was significant control of *Chaitophorus spp.* by the ladybird beetles. The efficacy of ladybeetle from 1st to 3rd instars against *Chaitophorus spp.* was tested during the whole experiment. The immature stage of the beetles instars when feed on aphids have more survival rate and grows very fast. So the efficacy of ladybird beetle against the *Chaitophorus* species is very good. Plants can be saved from the attack of aphid by using the ladybird beetles.

Keywords: Ladybird beetles, aphids, natural enemy

1. Introduction

Ladybird beetles are the member of class insecta and belong to family Coccinellidae. As all other insects, beetles have an outer skeleton known as exoskeleton (Minks, a. k. & harrewijn, p. 1988) [11]. This outer skeleton gives protection and provides the attachment places for muscles. Body of these insects is consisting of three main regions: head, thorax and abdomen (white, r. E. & Peterson, r. T. 1998) [18]. Ladybird beetles have very distinctive shape and can be easily identified. Some species of ladybird beetles are judged as pests due to their attack on the vegetative parts of plants (Watts, B. 2004) [17]. But the larval and adult stages are very good predators of aphids and other small insects and mites (Hangay, g. & zborowski, p. 2010) [7]. Beetles act as biocontrol agent that feed very rapidly on aphids. When there is fine excess of aphids fed to beetles they always lay little or vast bunches of eggs (Dixon, a. F. G. 2000) [3]. The insects of Coccinellidae family are very gracious and valuable. These are predators of many other insects that help farmers in controlling the crop damaging insects below threshold level (Vincent, c., goettel, m. S. & lazarovits, g. 2007) [16].

Almost 4000 species of aphids are there worldwide; mostly occur in temperate areas (Sexton, c. 2008) [13]. Aphids have small bodies and are plant sucking insects which suck the sap from plant body (Dixon, a. f. g. 1998) [2]. Generally most of the aphid species can increase their generations by both sexual and asexual reproduction (Minks, a. k. & harrewijn, p. 1988) [11]. Due to this capability of asexual reproduction these insects are thought to be very successful on zoological point of view. In temperate regions aphids are very harsh pests on the growing crops. Aphids are present around the world but mostly these insects are present in the temperate regions (Van emden, h. f. & harrington, r. 2007) [15]. Body of the aphids is very delicate in nature. These insects may be green, black, brown, pink are about colorless (Heymann, g. & nanao, j. 1986) [9]. The mouthparts of the aphids are sucking called stylets formed by the modification in the maxilla and mandible. (Miller, f. P., vandome, a. F. & mcbrewster, j. 2010) [10] *Chaitophorus* specie of aphids mainly attack on willow tree (*Salix spp.*) which can be controlled by natural enemies of aphids like beetles. To achieve the integrated control of insect pests of willow tree by natural enemies a few studies have been done (Hangay, g. & zborowski, p. 2010) [7]. This study was undertaken to check the effectiveness of ladybird beetle against the *Chaitophorus* species.

Experiments were conducted by rearing the beetle instars on the aphids collected from the willow tree.

Biological control is very famous for controlling the insect pests to the threshold level. Biological control is the policy for the integrated pest management (Turnbull and Chant, 1961) [14]. Biological control is the lowering of insect pest population by natural enemies and also involves the human role (Dreistadt, s. H., Clark, J. K. & Flint, M. L. 2004) [4]. Natural enemies of insect pests are known as biocontrol agents; include parasitoid, predator and pathogens (Sathe, T. V. & Margaj, G. S. 2001) [12]. Many predators such as ladybird beetle are free living insects that attack on the large number of prey during their whole life. Ladybird beetles of many species act as biocontrol agents of many pests like aphids. Ladybird beetles are very common for controlling many insects like aphids and many studies have been done on them (Dreistadt, s. H., program, U. O. C. I. P. M., agriculture, U. O. C. D. O. & resources, n. 2001) [5]. There are lots of methods to control the aphid's population, the most famous and effective method is through ladybird beetles. Aphids are very common plant pests that attack on both ornamental plants as well as garden crops. There are so many different species that are specific to the host plants and attack on the particular plant. Aphids are very destructive insects because they attack in colonies (Dixon, A. F. G. 1998) [2]. Clusters of aphids can be found on the young leaves, twigs, new branches and succulent shoots. Huge feeding on the plant by aphids causes leaves curl and dry out. As the aphids nourish on the host plant, they deposit a residue on the leaves that are commonly called as honey dew (Gossard, H. A. & Walton, R. C. 1922) [6]. There are many species of willow tree occur in the wide range of habitat. There is large range of insects attack on the willow tree. Several species of aphids feed on this tree. Among these the *Chaitophorus* species is the most common (Alford, D. V. 2012) [1].

Objective

- To determine the control of aphids (*Chaitophorus spp.*) through Lady bird beetle.

Materials and Methods

The Present study was carried out in laboratory of Entomology Department (28 °C, 65% RH) at PMAS-Arid Agriculture University Rawalpindi during the year 2012.

Insects

Fully matured ladybird beetles and aphids (*Chaitophorus spp.*) were collected from the willow trees in front of PMAS-Arid Agriculture University Rawalpindi on April 2, 2012. These natural enemies are reared on the aphids for the collection of larvae of ladybird beetles. Collected beetles were sorted out in the laboratory and pairs were kept in the three jars named as jar A, jar B and jar C to get the eggs and then larvae. Mother ladybird beetles laid eggs and after about a week the eggs hatched and became small black larvae with orange and white markings. Then these larvae were collected for this study.

Methods

After the collection of larvae the study was carried out up to the 3rd instars of beetle's larvae.

The experiment was conducted according to the Complete Randomized Design (CRD) with three treatments and nine replications and data was analyzed by ANOVA at 5% level of significance.

From each jar A, B and C three larvae were taken in to the three separate petri dishes. It means three groups of petri dishes were made classified as group 1, group 2 and group 3.

Each group was comprised of three petri dishes with one larva in each petri dish. So there were total 9 petri dishes. Group 1 contained larvae from the jar A, group 2 contained larvae from jar B and group 3 contained larvae from the jar C like (T1 in Jar A, T2 in Jar B and T3 in Jar C). From each jar there were three replications. So there were total 9 replications in the form of petri dishes in this experiment. Then aphids were placed in each petri dish of every group. Five aphids in each petri dish were increased after every two days. In first 2 days five aphids were placed daily in each of the replication. In next two days ten aphids were fed to each of the larvae daily and so on. Reading was taken after every 24 hours for couple of weeks that how many numbers of aphids consumed by each instars.

Results

The results from the current study show that there is significant control of *Chaitophorus* species by the ladybird beetles.

The efficacy of ladybeetle from 1st to 3rd instars against *Chaitophorus* species was tested during the whole experiment. The instars is immature stage of the beetles have more survival rate and grows very fast when fed on the aphids (Haug, G. W. 1938) [8]. The data obtained from this experiment at homogenous environment on the daily basis. The prey-predator relations of each day were intended and their data is recorded in the table 1 and table 2. The average value of consumed aphids by the 1st to 2nd instars and from 2nd to 3rd instars is written in the table 1 and table 2 of each replication respectively.

Table 1.1 shows the mean value of consumed aphids by the 1st to 2nd instars by each treatment and similarly table 2.1 shows the means of aphid consumption by 2nd to 3rd instars. Table 1.1 and 1.2 are also shown in the form of Graphs in the figure 1 and 2. From all the mean values of treatments in the tables and graphs shows that there is large number of aphid consumption by the natural enemy. All the treatments have almost same number of aphid consumption at the homogenous environment and number of aphids placed in the each replication at same developmental stage. Data shows that if feed is increased the number of aphid consumption by the beetle's larvae also increased little bit. More feed is given more consumption will be there and rapid growth will be achieved.

From ANOVA tables it is cleared that our calculated values does not fall in the critical region so automatically our null hypothesis will be accepted. Therefore we will say that all treatment effects are equal for the both 1st to 2nd and 2nd to 3rd instars.

Table 1: Number of aphids consumed by larvae/day from 1st to 2nd instars

Treatments	R1	R2	R3
T1	12.9	11.8	11.2
T2	13.2	10.5	12.2
T3	11.08	9.9	12.05

Table 2: Number of aphids consumed by larvae/day from 2nd to 3rd instars

Treatments	R1	R2	R3
T1	14.7	16.8	13.8
T2	15.2	11.2	16.2
T3	13.5	12.5	14.4

Table 1.1: Means of aphid consumption from 1st instars to 2nd instars

Treatments	Average Aphids/day
T1	11.96
T2	11.96
T3	11.01

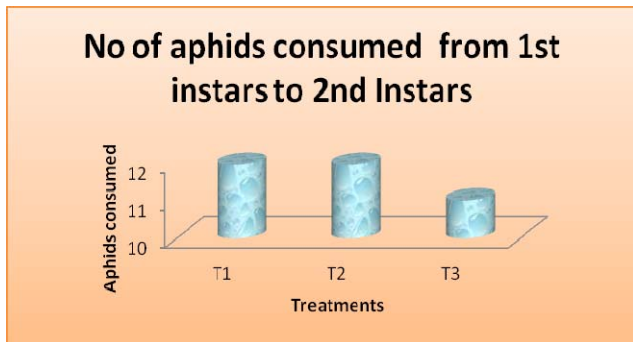


Fig 1: Showing number of aphids consumed by larvae/day

Table 2.1: Means of aphid consumption from 2nd instars to 3rd instars

Treatments	Average Aphids/day
T1	15.1
T2	14.2
T3	13.46

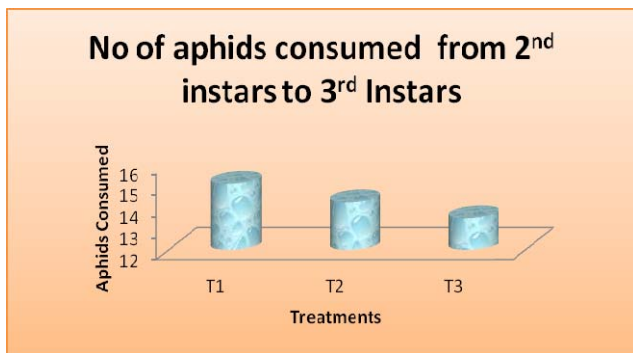


Fig 2: Showing number of aphids consumed by larvae/day

ANOVA of Table 1 (For 1st to 2nd Instars) at 5% Level of Significance

S.O.V	D.O.F	S.S	M.S	F-Value
Treatments	2	1.83	0.915	1.07
Error	6	5.11	0.851	
Total	8	9.36		

ANOVA of Table 2 (For 2nd to 3rd Instars) at 5% Level of Significance:

S.O.V	D.O.F	S.S	M.S	F-Value
Treatments	2	4.04	2.02	0.59
Error	6	20.57	3.42	
Total	8	24.61		

For both tables we will formulate null and alternative hypothesis as:

H₀: All treatment effects are equal.

H₁: All treatment effects are not equal.

The critical region is $F \geq F_{0.05}(2, 6) = 5.14$

Conclusion

From calculations it is cleared that mean consumption of aphids by the larvae of ladybird beetles in all treatments is almost equal.

So the efficacy of ladybird beetle against the *Chaitophorus* species is very good. The aphids can be controlled by the ladybird beetles very effectively and plants can be saved from the destruction.

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