

**Pistachio Psylla, *Agonoscena pistaciae* Burck. And Laut.
(Hom.: Psyllidae) Stages Preference by *Chrysoperla carnea* Steph. (Neuro.: Chrysopidae)**

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Abstract: The host-stages preference of pistachio psylla, *Agonoscena pistaciae*, by green lacewing larvae *chrysoperla carnea*, was studied in two experiments in growth chamber conditions ($40\pm 5\%$, R. H., L: D 14:10. H. and Tem. $26\pm 2^\circ\text{C}$). To identify the most preferred stage of psylla in the first experiment, all stages of psylla in equal ratios and in the second, variable ratios of 15:45, 45:45 and 45:15 of 4th and 5th nymphal instars were used. The results showed that 4th nymphal instars of green lacewing were the most preferred stage with 17.33% of predatism. Whereas 5th nymphal instars had 16.8% predatism. Other stages, the 3rd and 2nd and 1st nymphal instars had 13.6% and 10% and 6.8% predatism, respectively. In the second experiment with variable ratios of 4th and 5th instars of pistachio psylla, predatism of 4th instars in ratios 25, 50 and 75 percent of total population were 25.66, 52.63 and 79.82 %, respectively, while those for 5th instars nymphs were 20.18, 47.37 and 74.34%, respectively. So there was a positive preference for 4th instars and a negative preference for 5th instars nymphs.

Key words: Pistachio psylla % *Agonoscena pistaciae* % Predator % *Chrysoperla carnea* Host preference

INTRODUCTION

Agonoscena pistaciae Bruck. and Launt. is one of the most important pests of pistachio orchards in Iran. This species causes the most damage to pistachio in Greece and causes great economical lost [1]. This pest that is known as jumping psylla has 1.2 to 1.7 mm length and 5 nymphal instars. The nymphs and adults by sucking plant sap immediately after opening the pistachio buds and causes interruption of forming the Kernels [2]. This pest was first reported by Keriokhin (1946) from domesticated pistachio and wild pistachio *Pistacia mutica* in Iran [3]. There are difference natural enemies for this pest which control its population such as *Chrysoperla carnea* Steph. which is cosmopolitan species [4]. This species because of having desired character has been more attracted as a natural biological control [5]. The green lacewings adults are identified by characters like 15 mm length with a green color transparence rainbow wings and filiform antenna and shiny eyes [6]. The adults lay eggs individually on a silky stalk. First the eggs are green then turn to gray. The insect has three larval stages. The larva has long mandibles in front of head which look like sickle by penetrating mandibles into the host body and sucking its content. The most predatism of this insect is at the 3rd

larval stage [7]. This insect has two to three generation per year and is omnivorous [8] but this species prefers insect of Homoptera order as food [5]. The species and stages of the host is an essential factor in succeeding the natural enemy. When there are many hosts available for polyphage parasitoids and predators the natural enemy may prefer special species or prefer one of growth stages to the others [9]. Preferring on one host or pray to the others is usually due to be more available comparing to other hosts and in this regards Murdoch [10] offered his switching theory. Based on his theory, as the availability of special host increases the chance of being hunted is more than expected. If the predator or parasitoid lay eggs or feed from more available host, it is said that showing switching character [11]. And when a rare type relatively is more accepted or preferred it is said negative [12].

Monje *et al.* [13] studied the host preference of *Trichogramma galloi* Zucchi. the egg parasitoid of *Diatraea rufescens* Box. and *D. saccharalis* F. and reported that parasitoid wasp showed a positive preference for larger eggs of *D. rufescens* compare to smaller eggs of *D. saccharalis* [13]. The study of Blackwood *et al.* [14] on two species of phytosoid mites which are the predators of *Tetranychus urticae* Koch. showed that *Phytoseiulus macropilis* Banks. has a kind of positive preference for the eggs of *Tetranychus urticae*

while *Euseius finlandicus* Oudemans has a positive preference for the larval stage of *Tetranychus urticae*.

Usually the preference of a special stage is measure based on the ratio of attacked prey to the available prey in measuring space [15]. But this preference is not conclusive and is influenced by many factors such as experimental conditions and biological specificity of the host [16]. The aim of this experiment was to determine growth stage preference of *Pistachio psylla* for the third instars larva of *Chrysoperla carnea* as feed.

MATERIALS AND METHODS

This experiment was carried out to determine life stage preference of host by two methods.

A: To determine life stage preference of psylla with equal number of host in each growth stage.

In this experiment 15 nymph from each instars of psylla (instar I, II, III, IV and V) totaling 75 nymphs were selected and placed on 30 cm² pistachio leaves. The petiole of leaf was covered by moist cotton in order to keep the leaves freshness for longer time. Then this leaf was placed in the petry dish with 7.5 cm diameter and 1.5 cm height.

And a 3rd instar larva of *Chrysoperla carnea* which about 6 hours after molted was released in petry dish. The entire selected larva for all replicate was at the same growth stage. The psylla nymphs were introduced to third instars larva for hours. Then the larva was omitted and remaining nymphs of different instars was separated based on morphological characters such as, size of body and wing buds. Immediately after hatching or emerge of exuvia the size of body was measured by stereomicroscopy and indicated that the 1st instars length was 0.29 to 0.41mm and the color was bright orange, the 2nd instars was 0.5 to 0.59mm long and orange color, the 3rd instars was 0.66 to 0.71 mm long and the color was orange, the 4th instars was 0.84 to 0.93 mm long and the color was orange with dark shadow spots on the body and the 5th instars was 0.95 to 1.15 mm long and orange color with black spots on the wings and end of the abdomen. The 1st instars didn't have any wing bud and in the 2nd instars the wing buds was 0.02 to 0.04 mm, the 3rd instars was 0.09 to 0.13 mm, the 4th instars was 0.15 to 0.21 mm and the 5th instars had 0.3 to 0.32 mm wing bud. The experiment was carried out in ten replicate in a growth chamber with 26±2°C and relative humidity of 40±5 % and L: D 14:10. hr. The number of hunted nymphs from each growth stage was determined and the percent age of predatism was evaluated and compared with each other.

B: Evaluation of stage preference of 4th instars and 5th instars of psylla with varied ratios.

In this experiment based on the finding of previous experiment following ratio of 4th instars to 5th instars, 15:45, 45:45 and 45:15 was selected and placed on pistachio leaf which petiole was covered with moist cotton and placed in a Pettry dish and a 3rd instar larvae of *Chrysoperla* was released in each Pettry dish. For all replicates and treatments the larva was 6 hours old. The psylla was exposed to 3rd instar larva for 24 hours. After omitting the larva, the two remaining nymph instars were separated and were counted. The experiment was carried out in six replicate. The results were analyzed using Murdoch switching theory as follow and drawn the figures.

$$Y = 100 CX / (100-Y + CX)$$

Where; X = percentage of first type of host present in experimental condition. Y = percentage of first type host which has been hunted and C = coefficient of equal impact ratio of first and second type hosts which can be calculated as

$$C = Na_1 / Na_2$$

Where; Na₁ = the number of hunted first type host and Na₂ = the number of hunted second type host.

RESULTS AND DISCUSSION

The results indicated that using all growth stages of pistachio psylla with equal numbers. The 3rd instar larva of *Chrysoperla carnea* preferred the 4th nymphal instars of psylla with a mean predatism of % 17.33 ± 0.6 SE to other instars. Also *Chrysoperla carnea* larva ate the 5th instars with a mean predatism of % 16.8 ± 0.7 SE and there was no significant difference between preference for 4th and 5th instars (P<0.58) but there was a significant difference for preferring 4th and 5th instars (F=23.35, df =4, 45, p<0.00). In the next stage there were 3rd instars with a mean predatism % 13.6±1.05 SE and second instars with a mean predatism % 10±1.3 SE and first instars with a mean predatism % 6.8±0.9 SE respectively.

The data obtained by variable ratio of two growth stages of pistachio psylla nymphs are shown in Table 1.

Results indicated that 3rd instar larvae of *Chrysoperla carnea* at the same density of 4th and 5th instars had 52.63 and 47.39 percent predatism respectively. The mean of observed percent of predatism in 4th instars with the ratio of 25, 50 and 75 percent of total population 4th and 5th

Table 1: The number of 4th and 5th nymphal instars of *Agonoscena pistaciae* which are preyed by 3rd nymphal instars of *Chrysoperla carnea*

No. and ratio of investigated nymphs 4 th : 5 th instars	Number of preyed nymphs at 6 replicate 4 th instars: 5 th instars						Mean of age±SE
	4 th instars		5 th instars		6 replicates		
15:45	11:40	7:37	9:42	5:38	13:31	13:37	9.33±1.20:37.5 ±1.52
45:45	31:36	36:39	26:35	28:30	34:40	34:30	31.5±1.59:35±1.75
45:15	35:13	30:9	43:14	42:14	37:13	33:13	36.67±2.08:12.67±0.76

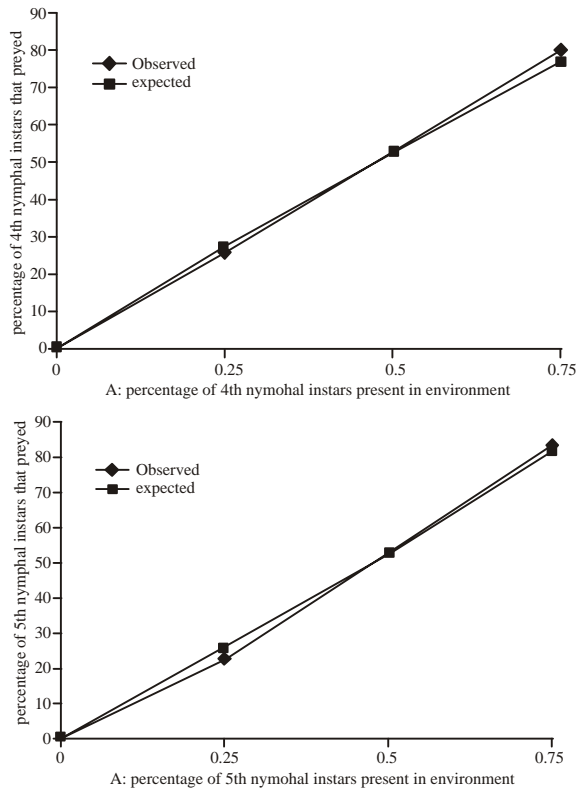


Fig. 1: Percentage of observed and expected predatism 4th instars (A) and 5th instars (B) of *Agonoscena pistaciae* by 3rd larval instar of *Chrysoperla carnea* in various ratios of 4th and 5th instars

instars were 25.66, 52.63 and 79.84 percent respectively. In order to calculate the percentage of predatism the Murdoch formula were used. To calculate the percentage of predatism for 4th instar the value of C in equal density of 4th and 5th instar was calculated as follow.

$$C = N_{a1} / N_{a2} = 1.11$$

Then percentage of predatism of 4th instars at variable density was calculated based on Murdoch formula. Also the rate of predatism of 4th instars at three density of 25, 50, 75 percent showed to be 27.01, 52.61, 76.91 percent (Figure 1-A).

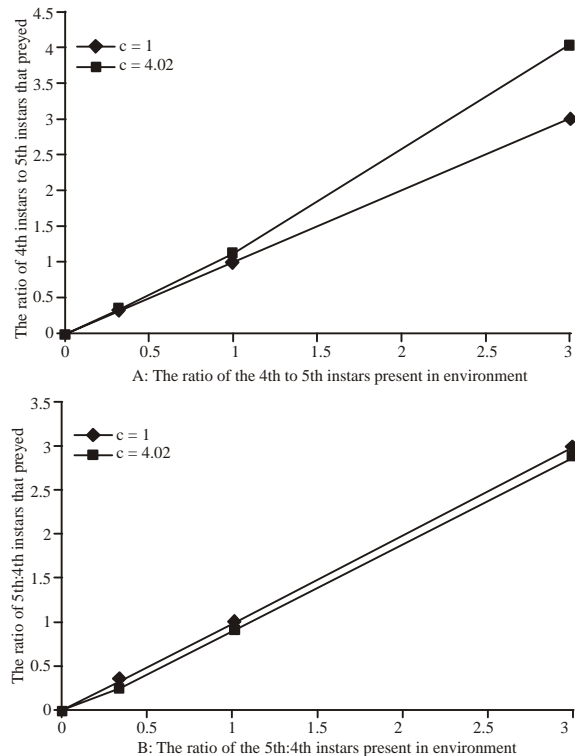


Fig. 2: The preference 4th instar (A) and 5th nymphal instar(B) of *Agonoscena pistaciae* by 3rd larval instar of *Chrysoperla carnea* at various ratio of 4th and 5th nymphal instars (C=1 indicated no preference)

The mean of observed percentage of predatism in 5th instars with the ratio of 25, 50, 75 percent of total population 4th and 5th instars were 20.18, 47.27, 74.34 percent respectively. The percentage of predatism of 5th instars was calculated the same as 4th instars.

$$C = N_{a1} / N_{a2} = 0.9$$

The mean calculated percentage of predatism based on Murdoch formula at ratio 25, 50, 75 percent were 23.08, 47.37, 72.97 percent respectively (figure 1-B).

To determine if there is a preference or no preference for 3rd larval instar to 4th and 5th nymphal instars of

pistachio psylla, different ratio of attacked host population (N_{a1}/N_{a2}) V.S initial ratio host (N_1/N_2) was plotted. The ratio of N_{a1}/N_{a2} at population density of 25, 50 and 75 percent were calculated for both 4th to 5th instars and 5th to 4th instars. The result showed that the ratio of 4th to 5th instars at population density of 25, 50 and 75 percent were 0.35, 1.11, 4.02 and the ratio of 5th to 4th instars at population density of 25, 50, 75 percent were 0.25, 0.9 and 2.89 accordingly. The results are shown in figure 2-A and 2-B. And indicates that 3rd instar of *Chrysoperla carnea* has a negative preference for 5th instars (C=0.9) and showed positive preference for 4th instars (C=1.11) by altering the ratios it didn't change predator preference for 4th instars. When the slope of line is equal to one (C=1) indicates there is no preference.

Jaafari *et al.* [17] investigated the host preference of *Hippodamia variegata* Goez to some species of aphid and reported that adults of ladybeetles preferred locust tree aphid (*Aphis craccivora* Koch) to *Aphis nerii* B.D.F. and *Aphis spiraeicola* Patch. and also *Hippodamia variegata* preferred *Aphis fabae* to *Aphis craccivora* and *Aphis nerii*.

Mirabzadeh *et al.* [15] reported that the 3rd instar larva of *Chrysoperla carnea* highly prefers *Aphis nerii* and *Brevicoryne brassicae* L. compare to other species of aphids. Also reported that 5th larval instar of *Chrysoperla carnea* has a positive preference for 2nd instars nymph compare to adult aphid of *Aphis craccivora* Koch.

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