Acta Scientific MEDICAL SCIENCES (ISSN: 2582-0931)

Volume 7 Issue 6 June 2023

Research Article

Functional Response of the Local Predator Larvae *Chrysoperla carnea* (Stefens (Neuroptera:Chrysopidae)) to Tomato moth *Tuta absoluta* (Lepidoptera:Gelechiidae) Eggs

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Received: March 16, 2023

Published: May 15, 2023

Abstract

This study was conducted at College of Sciences/Al- Mustansiyriah University,aimed to examine the functional response of local predator *Chrysoperla carnea* (Stefens ((Neuroptera:chrysopidae) The predator is one of the important natural enemies of (Gelechiidae) family eggs. Result showed that the Carves of functional response of the predator green lacewing *Chrysoperla carnea* (stephens) (Neuroptera:chrysopidae) larvae to various densities of tomato moth *Tuta absoluta* (Lepidoptera:Gelechiidae) eggs showed that the larvae of predator belongs to second type (Cyrtoid) of functional response. The rate of attack coefficient (a) was increased while the handling time (T_h) was reduced the highest attack coefficient was 2.558 cages for 2ed larvae stage and the lowest attack rate was 1.509 cages for 3rd larva stage. However, the highest handling time was 23.274 minutes for 2ed larva stage and the lowest handling time was 10.651 minutes for 1st larva stage.

Keywords: Handling Time; Attack Coefficient; *Chrysoperla carnea*; *Tuta absoluta*

Extracted

This experiment was conducted in the laboratories of the College of Science/University of Baghdad with the aim of testing the functional response of the larvae of the local predator *Chrysoperla carnea* (Neuroptera: chrysopidae) (Stefens), which is an important and efficient natural enemy of the eggs of the family (Gelechiidae) of the order (Lepidoptera) The results showed that the functional response curve of the larvae of the predator *C. carnea*) On different densities of tomato leafworm eggs, the *Tuta absoluta* was of the second ring pattern of functional response. The attack coefficient increased while the processing time decreased, as the highest attack coefficient was 2.558 for the second larval phase, the lowest attack coefficient was 1.09for the third larval phase, the highest treatment time was 23.274 minutes for the second larval phase, while the first larval phase took the least time to treat the eggs of the insect, reaching 10.651 minutes.

Introduction

The tomato leafworm (Lepidoptera: Gelechiidae) *Tuta absoluta* (Meyrick), a pest on the tomato Solanum *lycopersicum* L. Solanaceae: Solanales, causing significant economic losses to this crop in many countries in South America) is currently an important economic pest in the Mediterranean basin [16]. Larvae cause tunnels in leaves, stems and fruits, Chemical control is the most commonly used method of controlling the pest in its original habitat and areas where it has recently spread. The strategies to control this pest seem limited, despite being a new endemic tropical pest, spread in the wide geographical areas that invaded the tomato crop production areas in southern Europe and North Africa, in the last decade, integrated control techniques have emerged that have been applied to control it on a large scale in the areas of New Spread [19]. *T. absoluta* has spread rapidly, becoming a serious pest that threatens global tomato production [6]. Causing severe damage as a result of feeding their larvae. All larval ages feed on the mesophil middle tissue layer in the leaf, forming tunnels that reduce plant photosynthesis. High insect density levels affect stems and fruit ripening processes, as these tunnels are entry points for plant pathogens, which will gradually reduce the commercial value of the tomato crop. Several *T. absoluta* pest control strategies have been used in their native habitat and new areas of infestation. Such as pest prediction, agricultural control, chemical control, use of semiochemicals in mating and pheromone traps, biological control using *Bacillus thuringiensis*, *Trichogramma pretiosu* parasitizer, *Podisus nigrispinus* and *Nesidiocoris tenuis* [17]. Despite the widespread spread of *T. absoluta*, strategies to control this pest are limited. The predator *Chrysoperla carnea* (stephens) is a predator that feeds on a wide range of micro-bodied arthropods such as aphids, scale insects, mealybugs, worm larvae, tunnel makers, biscids, whiteflies, thrips, insect eggs, spiders, mites and others [5]. Biological control using *C. carnea* has gained wide importance in pest management because of the predator's ability to control the group of pests with small bodies, these predators have a great ability to search for their prey, their wide spread, ease of breeding and production in large quantities, their ability to adapt to different environments and their ability to withstand extreme environmental conditions [22]. This predator has received more attention from researchers and farmers as an important and effective factor within biological pest control techniques [9]. The functional response has received great attention by ecologist and entomalogists [13]. They showed that functional response means a change in the number of prey consumed by a single predator in response to a change in prey density for a specified period of time. They are divided into three main types, which are graphically expressed in the relationship between the density of the prey population and the number of prey consumed by each predator at a given time. The aim of this study is to find out the functional response of the predator *C. carnea* to the tomato moth *T. absoluta*, and its use as a biological agent.

Materials and Methods of Work

Prey breeding technique

The insects used in the experiment were obtained from a colony in the laboratories of the College of Agriculture, University of Baghdad, the insect was diagnosed at the Natural History Museum in Baghdad. The predator breeding technique is described by [15]. The larvae of *T. absoluta* were fed on fresh tomato leaf juice from tomato plants grown in the greenhouse at the College of Agriculture, University of Baghdad. Newly emerging adults were collected and placed in cages of dimensions ((40x40x40 cm covered with fidget cloth and equipped with a hole in which a piece of cotton saturated with sugar solution (10%) is placed) for feeding adults. Plants containing three leaves were used for the purpose of laying eggs replaced every two days, as they are transferred individually to other cages dimensions (20x20x30) cm for the purpose of hatching eggs into larvae that work tunnels for feeding in the silting leaves. The affected leaves are removed and placed in plastic containers with dimensions (40-25-10) cm until it is not possible under a temperature of 25 ± 2°C^0 and relative humidity 70 ± 10% and a period of illumination 10:14 Light: Darkness.

Predator breeding technique

The colony of the predator *C. carnea* was built from adults collected from citrus gardens and orchards at the College of Agriculture/University of Baghdad. It was used to supplement the study with the numbers required for subsequent testing on insects used in the experiments. The adults were placed in glass containers with a diameter of 8 cm and a height of 20 cm, covered from the top with a black cloth and fed with artificial food consisting of 4 g brewer's yeast, 7 g honey, 5 ml distilled water. Mix to make a paste and place on transparent plastic strips that are attached to breeding containers. Cotton swabs impregnated with distilled water were also placed to provide adults with water. Eggs laid by females on the black cover are removed daily with a soft brush. The newly hatched larvae are raised on the eggs of *Sitroroga cerealella* (Olivier) (Lepi: Gelechiidae) [3,11] at a temperature of 27 ± 1 °C0, relative humidity 65 ± 5% and a luminous period of 10:14 Light: Dark. To obtain the required feed from predators, the breeding process lasted six months [2,8].

The functional response of the predator *C. carnea* to its prey

The experiment was conducted under the same laboratory conditions used in predator breeding to calculate the functional responses of all larval ages of the predator C. *carnea* on the eggs of prey *T. absoluta.* Eight prey egg densities were selected, the prey numbers were gradually increased according to the larval ages of the predator, they were 5, 10, 20, 40, 60, 80, 100 and 120 eggs for the first larval age of the predator and 10, 20, 40, 80, 120, 160 And180 and 200 eggs for the second larval age and 10, 20, 40, 80, 120, 160, 200, 220 and 250 eggs for the third larval age. One larval age of the predator is used once and then neglected. The larvae are placed in a glass dish with a diameter of 9 Cm is equipped with blotting paper and slightly moistened with distilled water. The larvae starve for 12 hours, then transfer to the dishes with a soft brush and leave for 24 hours. The eggs consumed by the predator larvae were counted. 10 replicates were used per egg density of the studied prey and according to the larval age of the predator, 10replicates were used per egg density without exposing them to the predator larvae as a control treatment. The phases were examined by electron microscopy.

Data analysis

The functional response of the predator was studied at different densities of prey eggs according to the Holling disc equation [13]: $N_a = a, TN/(1 + aT_b N)$ where where: N a = number of prey consumed by one predator, a = with the hope of attack, N = density of prey, T = total time of search, T_b = processing time, α = slope of the straight line, β = point of intersection. The relationship between the average number of prey consumed and the original number provided for each age promoted to the predator at the beginning of the experiment. Prey consumed/prey density 100x for all larval ages of the predator [15].

Results and Discussion

The functional response in Figure (1) of the larvae of the mentioned predator indicated an increase in the number of prey consumed (the number of eggs) at a rate commensurate with the increase in the population density of the prey, where the slope of the consumption curve gradually decreases until it is even, thus consistent with the second type of functional response, which is the most common pattern for insect predators [14,23], which is the pattern shown by many predators towards a variety of prey densities that are determined by the predator's satiety and processing time. It was also noted that the aphid lion's response to the increase in population density, that is, an increase in the chances of the aphid lion facing its prey at high densities, so the number of consumed prey increased compared to the low densities, and then the predation rates decreased with the high density of prey, which supports the results that the functional response pattern of the aphid lion is of the type dependent density (Inverse density dependent [12], which shows that the lion aphid possesses a good predation trait, which is the search for prey at low and high densities, which enables it to reduce the population of its prey. These results are consistent with what Abd-El-Gawad., *et al*. [1] reported on the aforementioned predator and its response to various densities of potato tuber moth larvae *Phthorimaea operculella Zeller*, where the results showed a high predatory ability of this species on the larvae of the said insect, and the study of Stewart., *et al*. [21] whose results showed The predator *Chrysoperla rufilabris* represents the same pattern of response to its prey embroidered bug *Stephanitis pyrioides*.

Figure 1: Shows the pattern of the functional response of the larval phases of the C aphid lion. carnea towards different numerical densities of the eggs of the tomato leafworm T. absoluta at 27 ± 1 °C0 and RH 65 ± 5% and illumination period 10:14 Light: Dark.

It was also noted that the response of the aphid lion to increase the population density, that is, to increase the chances of the aphid lion facing its prey at high densities, so the number of prey consumed increased compared to the low densities, and then the predation rates decreased with the high density of prey, which supports the results that the functional response pattern of the aphid lion is of the type dependent density [12], which shows that the aphid lion possesses a good predation characteristic, which is the search for prey at the density of It slow and high, enabling it to reduce the population of its prey. These results are consistent with what Abd-El-Gawad., *et al*. [1] reported on the aforementioned predator and its response to various densities of potato tuber moth larvae *Phthorimaea operculella Zeller*, where the results showed a high predatory ability of this species on the larvae of the said insect [20]. The values of the attack coefficient and processing time calculated from the functional response curves represent the average values of these criteria for 24 hours multiplied by60 minutes, as the results of calculating the attack coefficient (a) and processing time (T_h) showed an increase in the attack coefficient (a) and a decrease in processing time (T_h) for the larvae of the third phase of the aphid lion, the highest attack coefficient (A) was 1.509 while 2.531 for the larvae of the first aphid. The processing time (T_h) was reduced, with the shortest treatment time (T_h) being 10.651 minutes for the larvae of the first phase, the longest treatment time (T h) was 23.274 minutes for the larvae of the second phase, and the treatment time (T_h) was 17.789 minutes for the larvae of the second phase. Lth. The change in attack values (a) and processing time (T_h) when the size of the prey and predator varies is related to changes that occur in the secondary components of the two criteria, as the small prey is generally easier to chase, prey and digest compared to the larger prey [7]. Similarly, large predators usually search faster and have greater success in hunting than small predators that encounter the same size of prey [4,10]. The results showed that the rebound equation was 0.765, 0.937 and 0.974 for the first, second and third larval ages of the predator respectively. The highest predation rate was by third age nymphs with 103.25 eggs/day, followed by the second and third larval ages with predation rates of 55.75 and 28.875 eggs/day respectively [18].

Figure 2: Shows the relationship between the pedigree of the eggs of the tomato leafworm *T. absoluta* consumed (Ha/H) by *C. carnea* aphid larvae and number of processed eggs (H) at 27 ± 1 °C0, 65 ± 5% RH and 10:14 Light Light: Dark.

Larval phases	(a׳)معامل الهجوم	(Tb) Processing time	(Pr) Predation rate	(R^2)معادلة الارتداد
Alomar Aliraqi I	2.531	10.651	28.875	0.765
Second larval age	2.558	23.274	55.75	0.937
Third larval age	1.509	17.789	103.25	0.974

Table 1: Criteria for the functional response of *C. carnea* lion to different densities of *T. absoluta* eggs Attack coefficient (a׳), processing time (T_b), predation rate (Pr) and reflux equation (R^2).

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