

Functional Response of the Local Predator Larvae to Tomato Moth Eggs

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Abstract
This study was conducted at College of Agriculture /University of Baghdad ,. This study 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 2[ed] larvae stage and the lowest attack rate was1.509 cages for 3[rd] larva stage. However, the highest handling time was 23.274 minutes for 2[ed] larva stage and the lowest handling_time was 10.651 minutes for 1[st] larva stage .
Keywords: *Chrysoperla carnea*, *Tuta absoluta* , attack coefficient

INTRODUCTION

The tomato moth, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae),is a pest of tomato *Solanum lycopersicum* L. (Solanales :Solanaceae), causes significant economic loss economic loss to tomato cropping in many countries in South America (Magalhaes *et al*..,2001) , at present it is an important invasive species in the Mediterranean Basin.

The larval stadium mines leaves, stems, and fruits, and chemical control is the most used control method in both its original range and the invaded distribution regions. Since current *T. absoluta* control strategies seem limited, biological control is a prominent tool to be applied abroad, Although this is an endemic Neotropical pest, it has acquired a wider geographical distribution after its unintended introduction in other tomato production regions, such as southern Europe and northern Africa, during the last decade (Speranza *et al*..,2009);. In its new regions, *T. absoluta* has spread extremely fast, becoming a potential threat to the world tomato production (Desneux *et al*..,2011) .*T. absoluta* damage is caused by the feeding activity of larvae. All larval stadia feed on the mesophyll of the leaf and produce mines and galleries that reduce the photosynthetic capacity of the plant. At high density levels, it can affect mature fruits and stems, and indirectly generate an entrance way for pathogens, thus severely degrading crop commercial value.Several strategies are commonly used to control *T. absoluta* in its original and invaded distribution regions: pest monitoring ,agricultural practices, chemical control ,management by means of semiochemicals (mating disruption and mass trapping), and to a lesser extent, biological control using *Bacillus thuringiensis*, the egg parasitoid *Trichogramma pretiosum*, and the predators *Nesidiocoris tenuis* and *Podisus nigrispinus* (Molla *et al*..,2011).

Since *T. absoluta* has a widespread distribution, the current control techniques seem to be limited. The green lacewings, *Chrysoperla carnea* (stephens)is voracious predators of wide variety of soft -bodied arthropods including aphids ,scales ,mealybug .caterpillars ,leafhoppers, psyllids, white flies, thrips, insect eggs ,spiders, mites and others (Canard and Principi , 1984). Biological control by using *C.carnea* has gained importance in pest management because of its ability to control a host range soft bodied pests, having high searching ability ,vast geographical distribution ,ease of mass production ,wide adaptability in field than other predators and its tolerance to the wide ranges of ecological factors (Tauber *et al*..,2000).It has received much attention from researcher as well as farmers as potential biological pest control agent (Gitonga *et al*..,2002).

Functional response has received much attention in the entomological and ecological literature since Holling(1959). They showed the functional response as the change in the number of prey consumed by each predator in response to the change in density of prey within a specific time .Also ,they divided it into three main types expressed graphically by the relationship between density of prey and the consumed number from each predator at a specific time .the objective of the present study was to find out functional response of *C.carnea* to The tomato moth, *Tuta absoluta* as a biological agent.

Materials and Methods

1. pry rearing technique:

Insects used in the experiments were obtained from laboratory stock culture at plant protection Department of Agricultural collage . This culture which was renewed each year with a field collection of infested tomato with tomato moth .Rearing protocol was described elsewhere (Luna *et al*..,2007). Briefly, *T.absoluta* larvae were fed with fresh and water-rinsed tomato leaves ,extracted from potted tomato plants maintained in an experimental greenhouse at the Agriculture collage . The newly emerged adult were collected and kept in 40x40x40 cm, voile-meshed cages and provided a honey solution (10%sucrose solution) was presented as a food source and potted tomato plants (three fully expanded leaves) as substrate for oviposition .Cages were checked every two days to replace plants, which were then placed individually in plastic boxes (20× 20× 30 cm) to allow for egg hatching and first-instar larvae strolling to construct mines . Thereafter ,infested leaves were cut and placed in plastic containers(40-25-10cm). and maintained until pupation. colony was maintained in a walk - in room at 25±2 C,16 hour day-length, and 70±10% relative humidity and a photoperiod of 14:10 h (L:D).

2- Predator Rearing Technique:

Colony of *C.carnea* was established using adult collected from clover plantations at Agriculture collage gardens .Adult insect were Kept in glass jars 8 cm in diameter and 20 cm in height .Jars were covered with black cloth screen and fed on artificial diet consisted of 4g brewer's yeast . 7g honey and 5 ml water . The mixture forms a paste that was smeared on transparent plastic tapes and placed in rearing containers . Extra water was provided using wet cotton placed on the screen on top of the jar .Eggs deposited on the walks of rearing jars and cloth screens were removed with a brush on daily basis . Newly hatched larvae were reared on *Sitroroga cerealella* (Olivier) (Lepi. :Gelechiidae) egg (Hagen *et al*..,1976 ; Ashfaq and cheema,2004) .Rearing conditions were 27± 1^0 c , 65±5% R.H. and a photoperiod of 14:10 h(L:D).The rearing was carried out for six months to obtain sufficient number of the predators.

3- Experimented procedures :

The experiment was performed at the same laboratory conditions used for rearing the predator to calculate the functional responses of each instar larva of *C.carnea* to *T. absoluta* eggs. eight densities with of *T. absoluta* eggs were tested .The densities were increased gradually to be synchronized with the developmental stage of the larvae (i.e. 5,10,20.40,60,80,100and 120 eggs for first; 10,20,40,80,120, 160,180 and 200 eggs for second ;20,40,80,120,160,200,220 and 250 eggs for third larval instars).Each larval instar of predator was used once and discarded. The experimental arena was a9 cm diameter glass Petri dish. Each larvae was starved for 12 hours before tested .Starved predators were transferred to the experimental arena using smooth hair brush and left for 24h. The number of dead or alive eggs was counted .Ten replicates of each pry density were performed for larval instar each of *C.carnea* .Control with no predator as also replicated 10 times for each prey density to consider natural mortality of the prey. They were assessed with a binocular microscope.

4- Data Analysis:

The functional response of predators to different prey densities was expressed by fitting the data to Holling, s disc equation (Holling ,1959): $N_a = a' TN/(1+aT_bN)$ Where N_a defines the number of prey attacked by a predator per time unit, a' is search rate of a predator .T is the total time of exposure time (1 day in this experiment). N is the original number of prey items offered to each predator at the beginning of the experiment. And T_b is handling time for each prey caught (proportion of the exposure time that a predator spends in identifying. pursuing ,killing consuming and digesting prey). Search rate , handling time and their standard errors were calculated from liner regression of disc equation . The relationship between the mean number of consumed prey versus original number of prey item offered to each predator at the beginning of the experiment (prey consumed) /(prey density x 100) for all larval instars were estimated. Obtained results were fitted to regression lines SAS (1987).

RESULT AND DISCUTIONS

Obtained results in Fig.(1) indicated increasing in the number of consumed prey at decreasing rate of increasing prey density where curve slop consumption decreased gradually until leveling off . these specifications concurred with type II functional response that predators appear towards varied densities of its prey which is determined by consumption of predator and handling time.

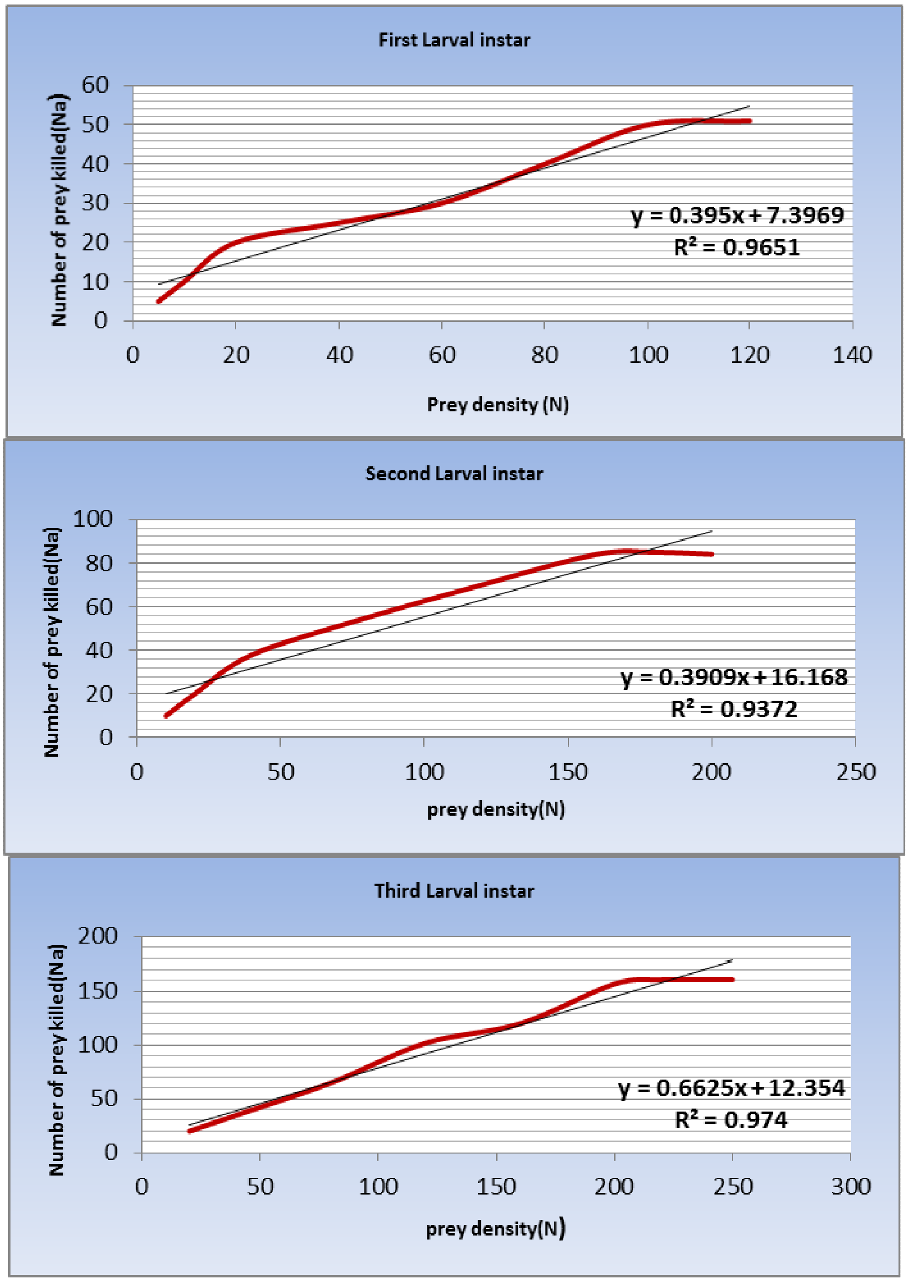
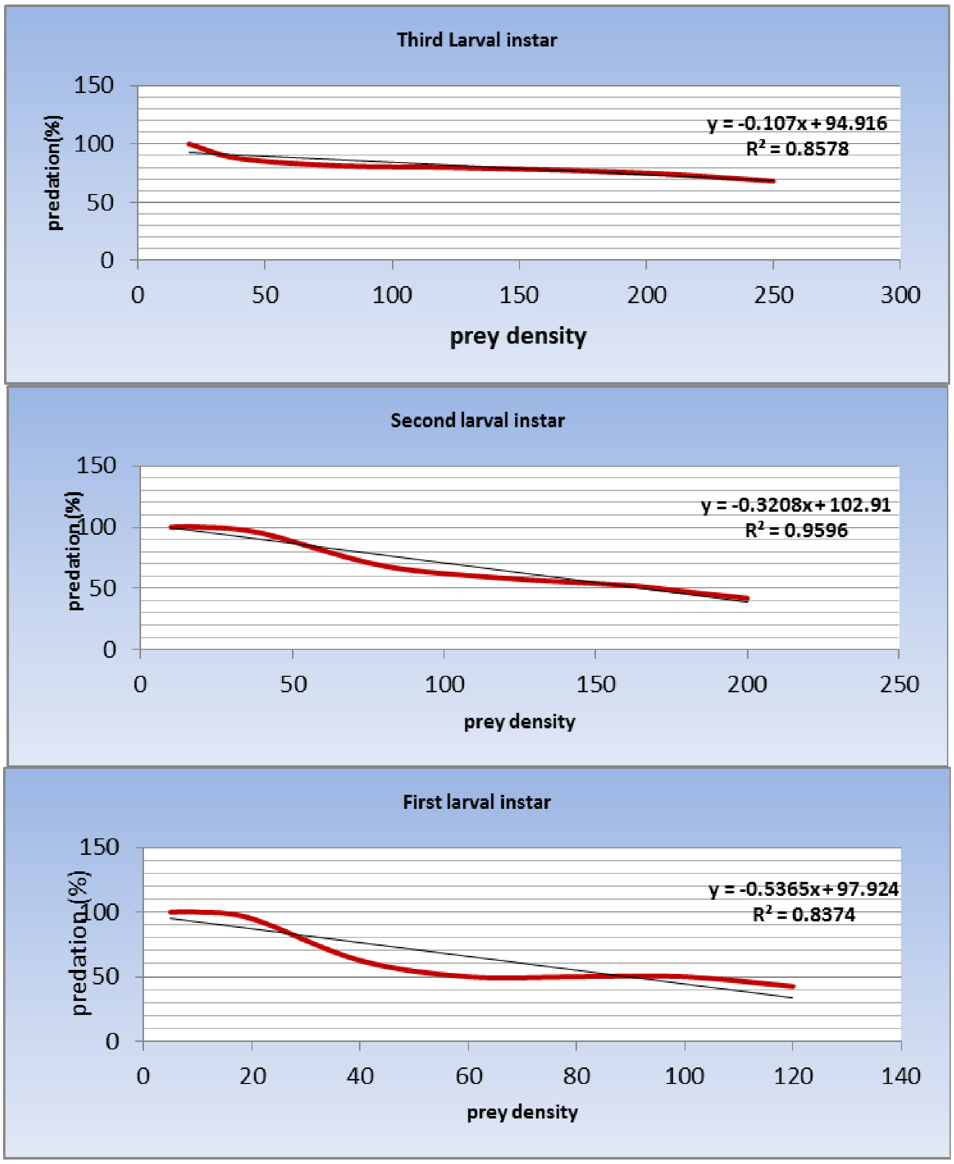


Fig. 1:Type II functional response of *C.carnea* to *T. absoluta* egg under laboratory conditions .

The number of prey eggs consumed by the three larval instars of predator increased significantly as predator development . The percentage of prey consumed of each larval instar was negatively correlated with the offered prey densities (Fig.2) .Obtained results were fitted to second degree of polynomial . Results presented in Table (1) showed the rate of successful search (a·) was the highest value of 2.585 occurred at the second larval instar, following the first larval instar ,while the shortest search rate was 1.509 for the Third larval instar.



Fig,2: Percentages of predation of *C,carnea* to *T. absoluta* egg under laboratory conditions .

Table 1: The attack rate (a),Handling time (T_b), and the maximum predation rate (pr)describing type II functional response parameter of *C.carnea* at different of *T. absoluta* eggs.

instars	a'	T_b	pr	R^2
First larval instar	2.531	10.651	28.875	0.765*
Second larval instar	2.558	23.274	55.75	0.937*
Third larval instar	1.509	17.789	103.25	0.974*

* Significant at 0.05

It is obvious that the handling time (T_b) per prey was shortest at first larval instar (10.651 min.)than that at each of second (23.274 min.)and third (17.789)larval instars .Obtained results were fitted to second degree of polynomial with R^2 value of 0.765 ,0.937 and 0.974 for first ,second and third larval instar respectively. The greatest Maximum predation rate was estimated for the third larval instar reaching 103.25 eggs/day followed by second and first larval instars being 55.75 and 28.875eggs/day, respectively. Estimated. Obtained results were fitted to regression lines SAS (1987).

The results demonstrated the calculation of attack rate(a') and handling time (T_b) significantly declined as stages reseed . Those values have been associated with the change on the prey and predator through their developmental stage. It has revealed generally increasing in the attack rate and decreasing in handing time with developing predator when fed on a particular stage of the prey . It should be noted that the search rate and handling time value from the functional response curves represent the mean value of these parameters for 24 hour exposure time which the predator was starved before lead to decreasing of starvation levels throughout the duration of the experiment at different rate of prey density .

This change in the starvation level carries on secondary components affects the values of the attack rate and handling time (Holling ,1959). It has been observed in similar studies to increase the speed of movement of starved individuals compared with individuals less starved giving it an increase in cases of convergence with the prey (Jevis,2005).For the type II response consumed prey is not density dependent (i.e. intensity of consumed prey does not increase with prey density. Stark and Witford,(1987) referred to similar type of functional response of *C.carnea* feeding on *phthorimaea operculella* eggs.

The parameters estimated for functional response are accurate measurement by laboratory tasting .In conclusion , these results are critical in order to develop a *T. absoluta* biological control program ,whether alone or combined in an integrated pest management scheme .It is suggested that interested in the control of tomato moth by means of the predator should pay more attention to this specie as a biocontrol agent and so enhancing our natural enemies potential.

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