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Research Article

Functional response of *Anthocoris nemoralis* (Hemiptera: Anthocoridae) to the pear psylla, *Cacopsylla pyricola* (Hemiptera: Psyllidae): effect of pear varieties

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Abstract: *Anthocoris nemoralis* (F.) (Hemiptera: Anthocoridae) is one of the most prominent predators of the pear psylla, *Cacopsylla pyricola* (Forster) (Hemiptera: Psyllidae) and is considered as a biological control agent against this pest. In order to investigate the effects of plant varieties on predation of *C. pyricola* by *A. nemoralis*, the functional response of both the sexes of *A. nemoralis* to pear psylla nymphs was studied on three pear varieties including 'Shahmiveh', as a susceptible host plant and 'Sebri' and 'Coscia', as partially-resistant host plants. Different densities of *C. pyricola* nymphs were offered to single *A. nemoralis* and predation proceeded for 24 h. The experiments were carried out under constant environmental conditions (27 ± 1 °C, 70 ± 5% RH and L: D 16: 8 h). Logistic regression and nonlinear least-squares regression were used to determine the type of functional response and to estimate attack rate (a) and handling time (T_h), respectively. The results showed a type II functional response on all varieties. The asymptotic 95% confidence intervals, estimated by the model with indicator variable revealed that there was no significant difference between either the attack rates or between handling times of same sex of the predator on the tested varieties. However, when sexes were compared, the females of *A. nemoralis* had a shorter handling time and higher searching efficiency than the males on all varieties. The maximum predicted daily prey consumption by a female predator (T/T_h) was the highest on the susceptible variety**.** Based on the type of functional response and its parameter values, the effectiveness of *A. nemoralis* was not affected by plant resistance; these findings may be promising for the integration of the partially-resistant varieties and *A. nemoralis* in sustainable pest management programs against the pear psylla. The implications of the results for biological control of pear psylla are discussed in a tritrophic context.

Keywords: *Anthocoris*, host plant resistance, pear psylla, predation, *Cacopsylla*, functional response

Introduction

The pear psylla, *Cacopsylla pyricola* (Forster) (Hemiptera: Psyllidae), is the most serious and a major economic pest of pear trees (*Pyrus communis* L., Rosaceae) worldwide (Burts, 1968; Behdad, 1984; Radjabi, 1989; Brown *et al*., 2009; Guedot *et al*., 2009). Serious damage is caused by feeding of both nymphs and adults on the phloem sap and injecting a toxic saliva as they feed, causing stunted growth, leaf necrosis, wilting, defoliation, fruit drop, yield reduction, transmission of phytoplasma causing pear decline and death of

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trees, vulnerability to winter injury and reduced fruit set the following year (Radjabi, 1989; Carraro *et al*., 2001; Shaltiel and Coll, 2004). Current control of the pest in Iran relies mainly on pesticides (Emami, 2012). In other parts of the world, however, integrated pest management strategies are operated (Civolani, 2012).

Due to continuous use of pesticides, the pest has developed resistance to most of the available pesticides (Emami, 2008; Civolani, 2012). Therefore, there has been an increasing interest in controlling the pest with biological control agents. Pear psyllids are commonly consumed by several species of generalist predators (Anthocoridae, Chrysopidae, Coccinellidae, Miridae and Aranae) (McMullen and Jong, 1967; Daugherty *et al*., 2007). The more important ones are anthocorid bugs (Hemiptera: Anthocoridae), such as *Anthocoris nemoralis* (F.) (McMullen and Jong, 1967; Brunner and Burts, 1975; Horton *et al*., 1997). *A. nemoralis* has a strong preference for pear psyllids, especially *C. pyricola* (Hodgson and Aveling, 1988; Solomon *et al*., 2000). *A. nemoralis* is the most abundant type of Anthocoridae in Isfahan pear orchards (Emami and Taheri, 2013). *Anthocoris* adults and nymphs feed on both eggs and nymphs of pear psyllids and effectively reduce their numbers (Sigsgaard *et al*., 2006; Emami, 2010).

Determining the effects of predations on prey populations is most commonly done through the analysis of functional responses (Huffaker and Messenger, 1976). Functional responses relate changes in the prey consumption rate by predators with changes in prey density (Solomon, 1949). For a predator, it is a key factor regulating population dynamics of predator-prey systems (Jeschke *et al*., 2002). Many factors influence the functional response of a predator, including biotic and abiotic agents. The biotic such as host plant may influence functional responses either directly by plant structures (Price *et al*., 1980; Skirvin and Fenlon, 2001) or indirectly through effects on the prey (Messina and Hanks, 1998; Sabelis *et al*., 1999; Stenberg *et al*., 2011). To our knowledge, no data have been published in the literature concerning the functional response of *A. nemoralis* to *C. pyricola*. Present study aimed to examine the effects of host plant resistance on the predation efficiency of *A. nemoralis*. The type and the parameter values of functional response and the maximum predation of *A. nemoralis* on pear psylla fed on different pear varieties (susceptible and partially-resistant) were used as a measure for the predation efficiency.

Materials and Methods

Plant and insect rearing protocol

A nursery of three pear (*Pyrus communis* L.) varieties, including 'Shahmiveh', as a susceptible host plant, 'Sebri' and 'Coscia', as partially-resistant host plants, were established in a 1000 m^2 field in Isfahan Research Center for Agriculture and Natural Resources (Isfahan, central Iran) in February 2013. Pear psylla, *C. pyricola*, was separately reared on each pear variety in sleeve cages under field condition (Emami *et al*., 2010). The initial population of *A. nemoralis* was collected from pear orchards in Isfahan (central Iran) during May 2013. There was no pesticide application in these orchards. The colony of *A. nemoralis* was maintained in the laboratory at constant environment (27 ± 1 °C, 70 ± 5% RH and L: D 16: 8 h). Adult *A. nemoralis* were reared on shoots of pear trees var. 'Pasculmar', a different variety from those that were used in the experiments (to remove any effects of rearing history), as described previously (Emami and Taheri, 2013).

Functional response

Before starting the experiments, 3-day-old *A. nemoralis* adults were starved for 24 h. The experimental arena consisted of a fresh pear leaf of each variety that was placed in a 9-cm-diameter Petri dish. The dishes were ventilated through a hole (3 cm diam.) in the lid that was covered by a fine mesh cloth. Different prey densities were separately offered to the males or females of *A. nemoralis*. The dishes were sealed with a plastic paraffin film to prevent insects from escaping. The densities tested were 10, 20, 40, 80 and 160 preys, consisting of the same number of the first and second nymph instars of *C. pyricola*. In order to check the survival of the psylla nymphs in the absence of the predator, the same number of replications without the predator was set up for each prey density. After 24 h, the predators were removed and the number of killed and live prey was recorded. Each treatment was replicated ten times. Preys were not replaced during the experiment. All the experiments were conducted in constant environmental conditions (27 ± 1 °C, 70 ± 5% RH and L: D 16: 8 h).

Data analysis

The data were analyzed in two main steps: model selection and parameters estimation. The data were first subjected to a logistic regression analysis of the proportion of prey eaten (N_a/N_0) in relation to prey offered (N_0) (Trexler and Travis, 1993). In details, the following polynomial function describes the relationship between N_a/N_0 and N_0 (Juliano, 2001):

$$\frac{N_a}{N_0} = \frac{\exp(P_0 + P_1 N_0 + P_2 N_0^2 + P_3 N_0^3)}{1 + \exp(P_0 + P_1 N_0 + P_2 N_0^2 + P_3 N_0^3)} \quad (1)$$

where, N_a/N_0, is the probability a nymph is eaten by a predator. P_0, P_1, P_2 and P_3, are the intercept, linear, quadratic and cubic coefficients, respectively. The parameters were estimated using the CATMOD procedure of SAS software version 9.1. A criterion for separating type II and type III functional responses is to test for significant positive or negative linear coefficients in the expression fit by the method of maximum likelihood to data on proportion eaten vs. offered (Juliano, 2001). If $P_1 < 0$, the proportion of prey eaten declines monotonically with the initial number of prey offered, thus describing a type II functional response. If $P_1 > 0$ and $P_2 < 0$, the proportion of prey eaten is initially positively density-dependent, thus describing a type III functional response (Juliano, 2001). Once the type of functional response was determined, because the experiments were conducted with prey depletion, the 'random predator' equation (2) (Rogers, 1972) was used to estimate handling time (T_h) and searching efficiency or attack rate (*a*). For a Type II functional response, the following model was used to fit the experimental data:

$$N_a = N_0\left[1 - \exp\left(a\left(T_h N_a - T\right)\right)\right] \quad (2)$$

where, N_a, is the number of prey eaten by the predator, N_0, the initial prey density, a, the attack rate, T, the time that predator and prey are exposed to each other (24 h) and, T_h, the handling time associated with each prey eaten. The attack rate, a, shows an instantaneous rate of encountering host and proportion of the arena searched when multiplied by searching time (T). The handling time, T_h, measures the time spent capturing, subduing, killing and eating a prey and then perhaps cleaning and resting before moving on to search for more prey. Handling time can be used to predict the maximum number of prey consumed in a given time period (T/T_h). Parameters were obtained by fitting observed data to the model above using nonlinear least-square regression with iterative application of Newton's method in SAS software (PROC NLIN SAS Institute Inc., 2004). This step is needed because N_a is on both sides of the expression (Juliano, 2001). The values of the coefficient of determination (R^2), (R^2 = 1 - (RSS / TSS) and Akaike Information Criteria (AIC) (Ding-Xu *et al.*, 2007), [AIC = n log (MSE) + 2q, where n is sample size, MSE is mean square error and q is number of parameters; the smaller the value of AIC, the better the fit] and residual sum of squares (RSS) were used to fit the model on the data. To compare predator functional response parameters on two pear varieties, the following equation with indicator variables were used:

$$N_a = N_0\left\{1 - \exp\left[\left(a + D_a(j)(T_h + D_{Th}(j)N_a - T\right)\right]\right\} \quad (3)$$

where, j, is an indicator variable that takes value 0 for variety 1 and the value 1 for variety 2. The parameters, D_a and, D_{Th}, estimate the differences between the varieties in the value of the parameter a and, T_h, respectively. If these parameters are significantly different from 0 then functional response of predator on two varieties differ significantly in the corresponding parameters. For variety 1, $\hat{a}$ and, $\hat{T}_h$, are the estimates of the parameters a_1 and, T_{h1}, For variety 2, $\hat{a}+\hat{D}_a$ and, $\hat{T}_h+\hat{D}_{th}$, are the estimates of the parameters a_2 and T_{h2} (Juliano, 2001). Nonlinear least square regressions were again used to obtain parameter estimates. The difference between the number of eaten preys on different host plants were analyzed using the one-way ANOVA (SAS Institute Inc., 2004).

Results

No mortality occurred during the experiments in the control. When female predator was tested, a significant difference was found between the number of prey eaten on different prey densities on all the varieties (Shahmiveh: $F_{4,45} = 83.87$, $P < 0.0001$; Sebri: $F_{4,45} = 61.53$, $P < 0.0001$; Coscia: $F_{4,45} = 57.57$, $P < 0.0001$). Similarly, there was a significant difference between the number of prey eaten on different prey densities by the male predator (Shahmiveh: $F_{4,45} = 59.06$, $P < 0.0001$; Sebri: $F_{4,45} = 52.82$, $P < 0.0001$; Coscia: $F_{4,45} = 56.14$, $P < 0.0001$).

Parameter estimates form the logistic regressions model (model 1) for the adults of *A. nemoralis* showed that the linear terms of the model were negative and significantly different from 0 for both the female and male (Table 1). The proportion of *C. pyricola* killed by both sexes of *A. nemoralis* declined with increasing prey density on all pear varieties. This suggested a Type II functional response of both the female and male *A. nemoralis* on all of the three varieties (Fig. 1). This means that the functional responses are linear at low prey densities, curvilinear at moderate prey densities and approximately asymptotic at high prey densities. Significant quadratic terms were derived for females and males on varieties tested, indicating that asymptotically declining proportions of pear psylla were killed by *A. nemoralis* (Table 1). The values of the coefficient of determination (R^2), Akaike Information Criteria (AIC) and residual sum of squares (RSS) indicated the model 2 adequately described the functional response of *A. nemoralis* on all varieties (Table 2). Estimates of attack coefficients (a) and handling times (T_h) by model showed that females of *A. nemoralis* had a shorter handling time and higher searching efficiency than the males on all varieties (Table 2). The 95% confidence intervals for searching rate and handling time on each host plant were overlapping, indicating no significant influence of the tested varieties on the searching behaviour of *A. nemoralis* (Table 2). The maximum number of pear psylla nymphs eaten by a female predator (T/T_h) using the model (2) were 40.57, 37.45 and 37.45 nymphs per day on 'Shahmiveh', 'Sebri' and 'Coscia', respectively (Table 2). The asymptotic 95% confidence intervals, estimated by the model (4), for D_a and D_{Th} at all comparisons include 0, (Table 3), which means that there were no significant differences of attack rate or handling time for either sex of the predator between the varieties tested.

Discussion

In many cases, functional response is measured to assess the suitability (Waage, 1990) and effectiveness (Hassell, 1978) of a natural enemy as a biological control agent. The P_1 value (Table 1) indicates how well the type II non-linear model fits the data from each test for both sexes of *A. nemoralis* on both susceptible and partially resistant pear varieties. This shows that the numbers of host attacked per predator increase with an increase in prey density for low prey densities, when the population of the pest is not beyond some median levels.

Although three types of functional response have been described by Holling (1959), most of the arthropod predators indicated a type II functional response (Holling, 1961; Royama, 1971; Oaten and Murdoch, 1975; Hassell, 1978; Luck, 1985). In most studies it has been shown that a predator, given varying densities of a single prey species, eats more prey at higher prey densities but with a decelerating rate; *i.e.*, prey mortality would be under a process of inverse density dependent. This deceleration may occur because when more prey become available and get eaten, the predator spends more time dealing with and therefore less time hunting for prey (Murdoch, 1973). Similarly, a type II functional response has been reported by several authors for different species of anthocorids to various preys, such as *Orius insidiosus* (Say) to *Panonychus ulmi* (Koch) (McCaffrey and Horsburgh, 1986), *Xylocoris flavipes* (Reuter) to bruchid pests (Sing and Arbogast, 2008), *X. flavipes* to *Tribolium confusum* Duval (Rahman *et al*., 2009), *O. albidipennis* (Reuter) to *Tetranychus urticae* (Zamani *et al*., 2009), *O. sauteri* (Poppius) to *Thrips palmi* Karny (Hemerik and Yano, 2010) and *O. albidipennis* to barely aphid (Gholami Moghadam *et al*., 2012).

Functional response experiments can provide a relatively rapid way to estimate the effects of plant characteristics on the efficiency of a natural enemy through prey (Messina and Hanks, 1998). The present study showed that the susceptible and partially resistant pear varieties had the same type of functional response of *A. nemoralis* to *C. pyricola* nymphs.

Some factors such as environmental conditions and previous situation of predator may influence the effectiveness of predators (Emami *et al*., 2000). Hofsvang (1976) noted increased voracity when *Anthocoris sibericus* Reuter was maintained under fluctuating (8-28 °C) rather than constant (18 °C) temperatures. Here, in contrast, the experiments were performed under less variable temperature. In present study, prior to starting the experiments, the predators were starved for 24 hours. Some authors reported that starvation of anthocorids increased their chances of encountering prey by searching areas (Hodgson and Aveling, 1988). Additionally, predators are rarely found in nature as single individuals; various life stages of a single prey species as well as several prey species may appear simultaneously on a single leaf and/or plant. This has definitely paramount influences on the functional responses of predators (Hoddle, 2003).

Table 1 Maximum likelihood estimates from logistic regression of proportion of prey eaten as a function of initial prey densities by female and male of *Anthocoris nemoralis* on Pear varieties.

Variety	Sex	Parameters	Estimate	S. E.	$\chi^{2(1)}$	P^2
'Shahmiveh'	Female	Constant (P_0)	3.0328	0.44320	46.82	0.0001
		Linear (P_1)	-0.0833	0.02330	12.83	0.0003
		Quadratic (P_2)	0.0007	0.00030	5.08	0.0242
	Male	Constant (P_0)	0.7128	0.30380	5.50	0.0190
		Linear (P_1)	-0.0499	0.01780	7.85	0.0051
		Quadratic (P_2)	0.0005	0.00030	3.50	0.0613
'Sebri'	Female	Constant (P_0)	1.8434	0.17470	111.32	< 0.0001
		Linear (P_1)	-0.0376	0.00430	76.80	< 0.0001
		Quadratic (P_2)	0.0001	0.00002	32.15	< 0.0001
	Male	Constant (P_0)	0.4186	0.30290	1.91	0.1670
		Linear (P_1)	-0.0367	0.01780	4.26	0.0389
		Quadratic (P_2)	0.0003	0.00020	1.30	0.0254
'Coscia'	Female	Constant (P_0)	1.3441	0.16330	67.77	< 0.0001
		Linear (P_1)	-0.0293	0.00410	51.11	< 0.0001
		Quadratic (P_2)	0.0001	0.00002	17.04	< 0.0001
	Male	Constant (P_0)	0.0931	0.15580	0.36	0.5504
		Linear (P_1)	-0.0193	0.00416	21.50	< 0.0001
		Quadratic (P_2)	0.0001	0.00002	5.99	0.0144

[1] Chi squared; [2T]he probability level.

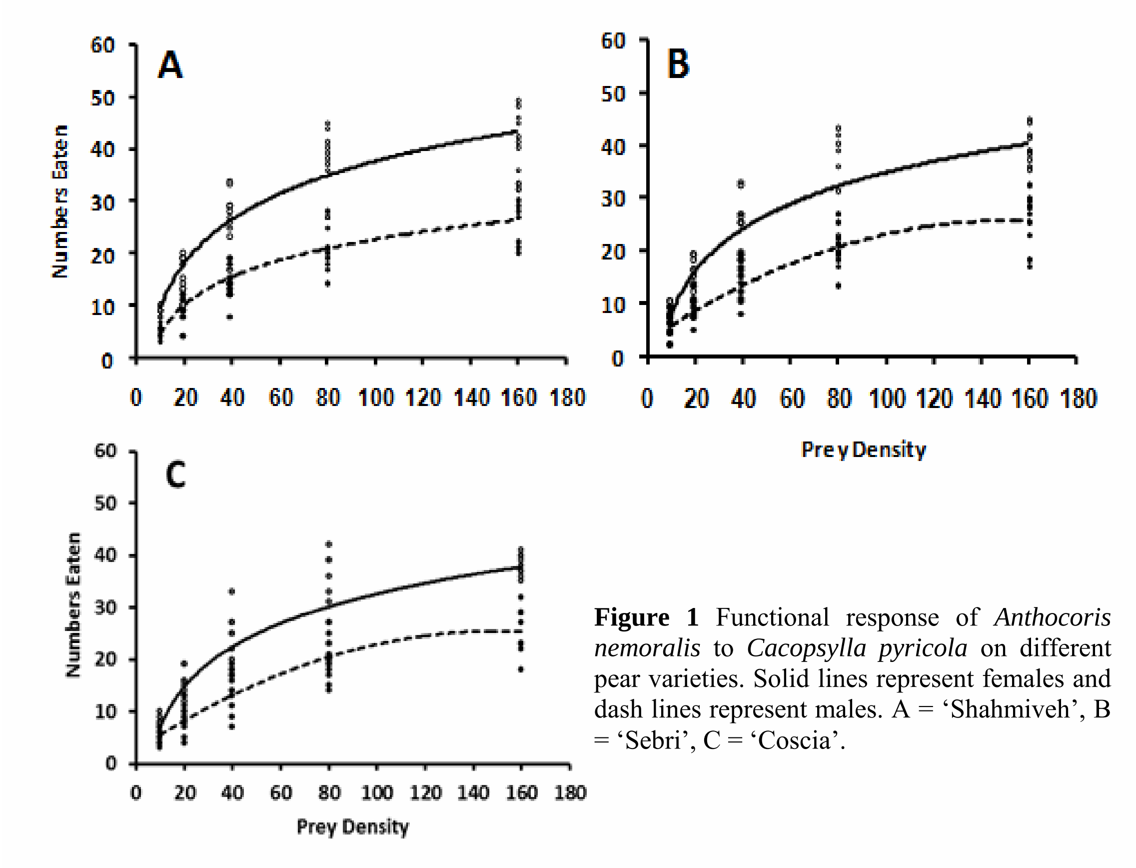

Figure 1 Functional response of *Anthocoris nemoralis* to *Cacopsylla pyricola* on different pear varieties. Solid lines represent females and dash lines represent males. A = 'Shahmiveh', B = 'Sebri', C = 'Coscia'.

It is clear that the handling time (T_h) is a good indicator of the predation rate (Athan and Guldal, 2009). Here, it was demonstrated that there was no significant effect of host-plant resistance on the handling time and attack rate of the predator; the intensity of predation on the partially resistant varieties was as high as the susceptible one.

The handling times of the predator (Table 2) on all pear varieties were shorter than handling times reported for other anthocorids, such as *O. majusculus* (Reuter) and *O. laevigatus* (Fieber) to *Trialeurodes vaporariorum* (Westwood) on cucumber (T_h = 0.78 and 1.55 h, respectively; Montserrat *et al*., 2000) and *O. albidipennis* (Reuter) to adult female of *Tetranychus urticae* Koch on cucumber (T_h = 0.94; Jalalizand *et al*., 2012). According to Nordlund and Morisson (1990), the handling time influences the type of functional response; *i.e.*, the shorter the handling time, the faster the curve reaches the asymptote. Thus, predators with low handling time will encounter prey more quickly and thereby would be more efficient at foraging behaviour. In the present study the values obtained for attack rates were similar on all three pear varieties. Therefore, the predator had similar abilities to find psylla nymphs on partially resistant as well as susceptible varieties. Low attack rate revealed that the predator spent a larger amount of time with non-searching activities (e.g., resting or feeding on plant juice). Evans (1976) showed that anthocorid adults had the ability to modify their searching behavior following a successful attack such that they remained in close proximity to the prey encountered.

The functional response can also predict the maximum number of prey attacked

(T/T_h), which can be used to determine some life-history parameters (*e.g.*, development, survival and reproduction) of the predator (Oaten and Murdoch, 1975). Here, female predators had the same type of functional response to psyllid nymphs on three pear varieties, but the maximum number of prey attacked was greater on the susceptible variety (40.57 nymphs per day) than the partially resistant ones (37.45 nymphs per day). This could be due to the resistance mechanisms; such that plants may increase or decrease natural enemy feeding rate via effects on herbivore quality (Price *et al.*, 1980; Stadler and Mackauer, 1996; Holton *et al.*, 2003; Singh, 2003). Anthocorids have been reported to feed on plant juices, so plant sap may form a significant part of the food (Hodgson and Aveling, 1988; Stenberg *et al.*, 2011). It has been documented that *A. nemoralis* also feed directly on plant juices (Daugherty *et al.*, 2007; personal observation). Thus, apart from indirect influences via the prey, the nutritional quality of the plants can directly affect *A. nemoralis*. As demonstrated in other studies (Donnelly and Phillips, 2001; Rahman *et al.*, 2009), our results also showed that the females of *A. nemoralis* killed more prey than the males in all tested varieties. This is likely due to the additional energy requirement of females for the production of eggs (Omkar, 2004).

Table 2 Parameter values for the model describing the functional response of *Anthocoris nemoralis* females and males fed on *Cacopsylla pyricola* nymphs on three Pear varieties.

Variety	Sex	Parameters[1]	Estimate	S. E.	95% CI[2]		T/T_h (day^{-1})	RSS[3]	$R^{2(4)}$	AIC[5]
					Lower	Upper				
'Shahmiveh'	Female	a (h^{-1})	0.0050	0.0009	0.0031	0.0069	40.57	1145.0	0.97	72.88
		T_h (h)	0.5916	0.0187	0.5540	0.6293				
	Male	a (h^{-1})	0.0015	0.0003	0.0009	0.0020	26.02	781.3	0.95	64.58
		T_h (h)	0.9223	0.0417	0.8384	1.0062				
'Sebri'	Female	a (h^{-1})	0.0040	0.0008	0.0023	0.0057	37.45	1416.2	0.96	77.49
		T_h (h)	0.6409	0.0247	0.5914	0.6905				
	Male	a (h^{-1})	0.0014	0.0003	0.0009	0.0020	24.66	757.2	0.94	63.9
		T_h (h)	0.9731	0.0454	0.8819	1.0643				
'Coscia'	Female	a (h^{-1})	0.0033	0.0007	0.0019	0.0046	37.45	1346.7	0.96	76.4
		T_h (h)	0.6719	0.0270	0.6176	0.7263				
	Male	a (h^{-1})	0.0013	0.0003	0.0008	0.0016	24.66	704.9	0.95	62.34
		T_h (h)	0.9772	0.0446	0.8875	1.0668				

[1]a: Attack rate, T: Searching time, T_h: Handling time. [2]CI: Confidence interval; [3]RSS: Residual sum of squares; [4] R^2: Coefficient of determination; [5]AIC: Akaike's information criterion.

Table 3 Comparison functional response parameters of *Anthocoris nemoralis* between pear varieties.

Sex	Variety	Parameters[1]	Asymptotic 95% confidence interval	
			Lower	Upper
Female	'Shahmiveh'-'Sebri'	$\hat{a}$	0.0759	0.1604
		$\hat{T}_h$	0.4637	0.5661
		D_a	-0.0821	0.0203
		D_{Th}	-0.0590	0.0996
	'Shahmiveh'-'Coscia'	$\hat{a}$	0.0763	0.1601
		$\hat{T}_h$	0.4641	0.5656
		D_a	-0.0936	0.0023
		D_{Th}	-0.0497	0.1197
	'Sebri'-'Coscia'	$\hat{a}$	0.0572	0.1173
		$\hat{T}_h$	0.4723	0.5980
		D_a	-0.0535	0.0240
		D_{Th}	-0.0799	0.1095
Male	'Shahmiveh'-'Sebri'	$\hat{a}$	0.0249	0.0434
		$\hat{T}_h$	0.5904	0.7972
		D_a	-0.0150	0.0109
		D_{Th}	-0.1198	0.1878
	'Shahmiveh'-'Coscia'	$\hat{a}$	0.0251	0.0433
		$\hat{T}_h$	0.5918	0.7958
		D_a	-0.0157	0.0093
		D_{Th}	-0.1215	0.1862
	'Sebri'-'Coscia'	$\hat{a}$	0.0232	0.0411
		$\hat{T}_h$	0.6153	0.8403
		D_a	-0.0136	0.0112
		D_{Th}	-0.1627	0.1594

[1]a: Attack rate, T_h: Handling time; D_a and, D_{Th}: Estimate the differences between the varieties in the value of the parameter a and T_h respectively.

Here, it was shown that host-plant resistance had no adverse effect on the predation efficiency of *A. nemoralis* to the pear psylla in terms of both searching efficiency and handling time. Given this and the high search efficiency (Brunner and Burts, 1975), strong numerical response (Fauvel and Atger, 1981; Trapman and Blommers, 1992) and ability to detect psylla infestations based on plant volatiles (Drukker *et al.*, 1995; Scutareanu *et al.*, 1997), it might be useful to combine *A. nemoralis* with partially-resistant varieties for integrated pest management of pear psylla. Future field studies are needed to examine how the responses of predator found in the laboratory would be reflected in nature, where systems are likely to be more complex.

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واکنش تابعی سنک شکارگر *Anthocoris nemoralis* (Hemiptera: Anthocoridae) به پسیل گلابی *Cacopsylla pyricola* (Hemiptera: Psyllidae): تأثیر رقم گلابی

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چکیده: سنک شکارگر، *Anthocoris nemoralis* (F.) (Hemiptera: Anthocoridae)، یکی از شکارگران غالب پسیل گلابی، *Cacopsylla pyricola* (Forster) (Hemiptera: Psyllidae)، است و به‌عنوان عامل کنترل بیولوژیک این آفت مورد توجه است. به‌منظور بررسی اثر رقم گلابی روی میزان شکار *A. nemoralis*، از *C. pyricola*، واکنش تابعی هر دو جنس نر و ماده *A. nemoralis* نسبت به پوره‌های پسیل گلابی روی سه رقم گلابی شامل 'شاه‌میوه' به‌عنوان رقم حساس و 'سبری' و 'کوشیا' به‌عنوان ارقام نیمه مقاوم مورد مطالعه قرار گرفت. تراکم‌های مختلف پوره‌های *C. pyricola*، به‌طور جداگانه به‌مدت ۲۴ ساعت در اختیار حشرات کامل *A. nemoralis*، قرار گرفت و روند شکارگری بررسی شد. آزمایشات در شرایط محیطی ثابت استاندارد (دمای ۱ ± ۲۷ درجه سلسیوس، رطوبت نسبی ۵ ± ۷۰ درصد و دوره نوری ۱۶ ساعت روشنایی، ۸ ساعت تاریکی) انجام شد. برای تعیین نوع واکنش تابعی و تخمین نرخ حمله (a) و زمان دستیابی (T_h)، به‌ترتیب از رگرسیون لجستیک و رگرسیون غیرخطی روش least square استفاده شد. نتایج نشان داد واکنش تابعی سنک شکارگر روی ارقام مورد آزمایش از نوع دوم بود. بین نرخ حمله و یا زمان دستیابی جنس‌های مشابه شکارگر در ارقام آزمایش شده اختلاف معنی‌داری وجود نداشت. حشرات ماده *A. nemoralis* نسبت به حشرات نر، دارای نرخ حمله بیشتر و زمان دستیابی کمتری روی همه ارقام بودند. حداکثر میزان شکار مصرف شده در روز (T/T_h) توسط حشره ماده، در رقم حساس برآورد شد. براساس نوع واکنش تابعی و مقدار آماره‌های برآورد شده، کارآیی *A. nemoralis* تحت تأثیر مقاومت گیاه میزبان قرار نگرفت. یافته حاضر نویدبخش تلفیق ارقام نیمه‌مقاوم و سنک شکارگر *A. nemoralis* در برنامه مدیریت تلفیقی پسیل گلابی است. کاربرد نتایج جهت کنترل بیولوژیک پسیل گلابی در سیستم سه سطح تغذیه‌ای مورد بحث قرار گرفته است.

واژگان کلیدی: *Anthocoris*، مقاومت گیاه، پسیل گلابی، شکارگری، *Cacopsylla*، واکنش تابعی