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Orius albidipennis (Hemiptera : Anthocoridae) adults and nymphal voracity on different prey species in relation to biology of the predator

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Abstract

This study aimed to evaluate the effect of three different prey species on some biological aspects of the minute pirate bug *Orius albidipennis* . The third nymphal instar of two aphid species ; *Aphis craccivora* and *Schizaphis graminum* , and also the first instar larvae of *Spodoptera litoralis* were chosen as preys and offered to nymphs and adults of the predator *O. albidipennis* under laboratory conditions of at 26 ± 1°C and 60 ± 5% RH. Males lived shorter than females. While, the shortest development period (12.00±0.35 days) was achieved when predatory insect was fed 1st instar larvae of *S. litoralis* . Feeding on *S. litoralis* or *S. graminum* shortened pre-oviposition period and prolonged the oviposition which resulted in a higher rate of fecundity. *S . litoralis* was the most suitable food source where it caused the highest rate of net reproduction (187.60 ±5.51 eggs / female) . Throughout the whole nymphal stage ,'a single *O. albidipennis* is nymphal fed on total number of 243.40±14.90 *S. graminum* , 211.90±12.95 *A . craccivora* or 110.70±11.90 individuals of 1st instar larvae of *S. litoralis* . The mean total number of prey individuals was, significantly, higher in case of *S. graminum* than *A . craccivora*. These results should contribute to the development of mass rearing programs for biological control.

Key Words: *Orius albidipennis*, Biology, *Schizaphis graminum*, *Aphis craccivora*, *Spodoptera litoralis* .

Introduction

Generalist predatory insects are capable of attacking a diverse spectrum of prey species (Eubanks and Denno, 2000), because they have the necessary phenotypical plasticity to adjust their biology to different food sources (Mendes *et al.*, 2002). However different types of prey can substantially alter the development and reproduction of predators, which in turn affect population dynamics. Species of the genus *Orius* (Hemiptera : Anthocoridae) are generalist predators that attack eggs and freshly emerged immature stages of various arthropods, or small soft-bodied arthropod adults, including numerous important agricultural pest species (Bush *et al.* 1993 and Reitz *et al.* 2006). Although these predatory species are polyphagous, *Orius* spp. show a preference for attacking nymphal and adult thrips (Thysanoptera) over other available prey species (Kakimoto *et al.*, 2006 and Arno *et al.*, 2008). While, certain *Orius* spp. are mass produced for augmentative biological control, growing concerns over the introduction of non-native species (Van Lenteren *et al.* 2003 and Louda *et al.* 2003). This interest is reinforced by the recognition that biological control agents ara better to be well acclimatized to environments where they would be released. One species of *Orius* of particular interest as a biological control agent is *O. albidipennis* (Reuter), which is frequently found in large numbers in various agricultural habitats throughout the Mediterranean basin, the Atlantic zone of Western Europe, and East Africa (Salim *et al.*1987; Hernandez and Stonedahl 1999 and Fritsche and Tamo 2000). Chyzik and Ucko (2002) reported that *O. albidipennis* could control thrips in pepper fields in Israel. In Egypt, *O. albidipennis* is very common through wide area of the country, south to Wadi Halfa, in the desert, and in cultivated areas, especially in corn and cotton fields. It is usually found in flowers of plants infested with thrips, lepidopteran eggs or other small arthropods (Tawfik and Ata 1973 and Zaki 1989). *Orius albidipennis* is well adapted to high temperatures and does not have a photoperiod induced reproductive diapause (Chyzik *et al.* 1995) as do other species of *Orius* . Rather, its abundance and activity is only limited by low temperatures (Chyzik *et al.* 1995). However, its use as a biological control agent has been hindered by a relative lack of information on its interactions with different prey species and in determining the suitability of different prey diets for *O. albidipennis* is an obstacle in its mass production. Therefore, the aim of the current study was to determine the effect of a range of three prey types including two aphid species, *Aphis craccivora* and *Schizaphis graminum* and first instar larvae of *Spodoptera litoralis* on the development, reproduction, longevity, and prey consumption by this predator .

Materials and methods

1- Rearing of *Orius albidipennis* :

Rearing of *O. albidipennis* took place in laboratory at 26 ± 1°C and 60 ± 5% RH. Egg-laying females were isolated in a plexiglas cylinders (4 cm height and 4 cm diameter), with a fine gauze lid on the top . Then, 50 newly emerged adults of the same

species were placed together in larger plexiglass cylinders (9 cm height and 9 cm diameter) covered with fine cotton gauze to start pilot rearings (the so-named adult unit). To prevent cannibalism, some paper strips were added to each cylinder, and water was supplied by adding moistened cotton. Frozen eggs of the flour moth *E. kuehniella* , gently glued on paper with Arabic gum, were used to feed both nymphs and adults. This prey was successfully used for other Anthocoridae also by, Alauzet *et al.* (1990 and 1992). Fresh bean pods were used as oviposition substrates as reported by Isenhour and Yeargan (1981) and Riudavets (1993). Bean pods with *Orius* eggs were removed from the adult units three times per week to be placed in a new cylinder (the so-named nymphs unit) to start the pre - imaginal rearing. Food and water were supplied daily until adults emergence. Study was to determine the effect of the mentioned prey types on the development, reproduction, longevity, and prey consumption of this predator.

2- Source and rearing of prey species :

The first stock of *A . craccivora* and that of *S . litoralis* were supplied from Syngenta Laboratory , Kaha district , while that of *S. graminum* was obtained from the Dept. of Biological Control , Plant Protection Research Institute , A.R.C. Giza . The three species were reared in the laboratory of the Plant protection Dept., Faculty of Agriculture at Moshtohor , Benha University . *A . craccivora* was reared on faba bean plants while *S. graminum* reared on wheat plants and *S. litoralis* was reared on castor leaves.

3- Some biological studies on *Orius albidipennis* :

For determining the nymphal duration of *O. albidipennis* reared on three prey species ; *A . craccivora* , *S. graminum* and first instar larvae of *S . litoralis* ; 15 replicates were used . Each nymph was placed in a plastic cup (7 x 6 cm) . Each cup had its cover which had fine pores that do not permit scape of *Orius* immatures fixed by melted wax . Each nymph was daily provided with enough numbers of prey individuals preparation to the nymphal instar . All experiments were carried out on the 3 rd nymphal instar of *A . craccivora* and *S. graminum*. Numbers of the consumed prey individuals by a predator were daily counted and recorded. Duration of each nymphal instar and total nymphal durations of the predator were recorded.

4- Longevity and fecundity of *Orius albidipennis* on different preys :

Thirty freshly emerged adults (15 males and 15 females), representing 15 couples (replicates) of the predator were used in these experiments. Every couple was placed in a plastic cup (7 x 6 cm). Each cup had its cover which has a piece of fine pores, that do not permit scape of *Orius* immatures , fixed by melted wax . Each adult was daily provided with enough numbers of prey. Numbers of the predator under investigation were daily counted and recorded . This cage was provided with a piece of clean and fresh bean pods *(Phaseolus vulgaris)* for deposition of eggs . Longevities for both of two sexes (males and females) were recorded . Fecundity per female (Preoviposition , Oviposition and Postoviposition Period) of *O. albidipennis* were recorded .

Statistical Analysis:

All data were analysed by using ANOVA with three factors at 0.05 significance level for the whole results using SPSS (ver. 22). Data were treated as complete randomization design according to Steel *et al.* (1997). Multiple comparisons of significance were carried out applying LSD values .

Results and Discussion

Data in Table (1), indicated that the 1st instar nymphal period was, nonsignificantly different between means from three prey species. While, this period varied significantly, among the 2nd , 3rd , 4th and 5th instars nymphal period by rearing on different prey species . In all cases, the shortest period was obtained when the predator was fed on *S . litoralis* , 1st instar larvae . As for the total nymphal period it was the shortest (12.00±0.35 days) by rearing on 1st instar of *S . litoralis* and the longest (14.90±0.50 days) when rearing took place on *A . craccivora.*

Table 1. Effect of rearing on three prey species on durations of *O . albidipennis* nymphal instars and total nymphal period :

Nymphal instar	preys		
	A . craccivora	*S. graminum*	*S . litoralis*
1st	2.5±0.17^{bA}	2.3±0.15^{dA}	2.3±0.15^{bA}
2nd	2.7±0.26^{bA}	2.8±0.13^{cA}	2.0±0.00^{cB}
3rd	3.3±0.21^{aA}	2.9±0.10^{bcB}	2.1±0.10b^{cC}
4th	3.3±0.21^{aA}	3.5±0.22^{aA}	2.8±0.13^{aB}
5th	3.1±0.18^{aA}	3.1±0.10^{bA}	2.8±0.13^{aB}
Total	14.90±0.50	14.60±0.40	12.00±0.35

a, b & c: There is nonsignificant difference (P>0.05) between any two means, within the same column having the same superscript small letter.

A, B &C: There is nonsignificant difference (P>0.05) between any two means for the same attribute, within the same row having the same superscript capital letter.

Feeding capacity throughout the whole nymphal stage:

As shown in Table (2) throughout the whole nymphal stage period of *O. albidipennis* , a single nymph fed on total number of 243.40±14.90 *S. graminum*, 211.90±12.95 *A. craccivora* or 110.70±11.90 to *S . litoralis* . The mean total number of prey individuals was, significantly, higher in case of *S. graminum* than *A. craccivora.* The present results agree with El – Bolok *et al* (2010) who recorded low predation capacity of *O. albidipennis* nymphs occurred when fed on *A. craccivora.*

Table 2. Feeding capacity and mean / day of five instars of *O. albidipennis* reared on *A . craccivora, S. graminum* and 1st instar larvae of *S . litoralis*

Nymphal instar	preys		
	A . craccivora	*S. graminum*	*S . litoralis*
1st	16.8±1.82^{dA}	19.7±1.65^{dA}	6.55±0.31^{dB}
2nd	35.2±3.30^{cA}	37.2±2.43^{cA}	13.24±0.95^{cA}
3rd	50.0±4.22^{bA}	50.0±1.71^{bA}	14.96±0.39^{bB}
4th	53.9±3.56^{abB}	66.9±4.45^{aA}	16.34±0.35^{aB}
5th	56.0±4.17^{aB}	69.6±1.98^{aA}	17.93±0.43^{aB}
Total	211.90±12.95	243.40±14.90	110.70±11.90

a, b & c : There is nonsignificant difference (P>0.05) between any two means, within the same column having the same superscript small letter.

A, B &C: There is nonsignificant difference (P>0.05) between any two means for the same attribute, within the same row having the same superscript capital letter.

The Ovipositional periods and total deposited eggs / female are shown in Table (3):

- **Preoviposition period :**

The preoviposition period was 2.7±0.21 , 2.5±0.17 and 2.6±0.16 days at 26 ± 1°C and 60 ± 5% RH. when *O. albidipennis* adults were fed on *A . craccivora , S. graminum* and *S . litoralis* , respectively (Table 3) . Nonsignificant difference was detected between any means of preoviposition period by feeding on either of the three prey species.

- **Oviposition period :**

The oviposition period lasted 13.1±0.50, 14.2 ±0.71 and 13.7 ±0.37 days at 26 ± 1°C and 60 ± 5% RH. when was *O. albidipennis* adults were fed on the mentioned three prey species , respectively . Nonsignificant difference was detected between any means of oviposition period to three prey species .In similar studies, Sayed (1999) reported that the oviposition Period of *O. albidipennis* was 12.1 days after rearing on *A . craccivora* nymphs.

- **Postoviposition period :**

The postoviposition period lasted 0.9±0.28, 0.8±0.29and 1.0±0.30 days at 26 ± 1°C and 60 ± 5% RH. when *O. albidipennis* adults were fed on *A. craccivora, S. graminum* and 1st instar larvae of *S. litoralis* , respectively . Nonsignificant difference between any means to three prey species was detected by changing the prey species.

Eggs reproductively of *O. albidipennis* female by feeding on three different prey species:

From data in table (3), it is clear that the 1st instar of larvae *S . litoralis* and *S. graminum* may be considered as the highest suitable food for rearing *O. albidipennis* . An adult female deposited 187.60±5.51 and 187.50±4.16 eggs , respectively, being , significantly , higher than feeding on *A . craccivora* from which the adult female laid 150.60±6.11 eggs .

Table 3. Ovipositional periods and eggs reproductively / female of O. *albidipennis* recorded means by rearing on *A . craccivora, S. graminum* and 1st instar of *S . litoralis*

Preys	Period (days)			Count of egg			
	Preoviposition	Oviposition	Postoviposition	Total count	Minimum	Maximum	Average
A . craccivora	2.7±0.21^{a}	13.1±0.50^{a}	0.9±0.28^{a}	150.60±6.11^{b}	128	180	15.06
S. graminum	2.5±0.17^{a}	14.2 ±0.71^{a}	0.8±0.29^{a}	187.50±4.16^{a}	128	203	18.74
S . litoralis	2.6±0.16^{a}	13.7 ±0.37^{a}	1.0±0.30^{a}	187.60±5.51^{a}	165	210	18.75

Longevity of *O. albidipennis* adults when fed on different prey species :

Data in table (4) show that *O. albidipennis* adults female lived , significantly , for a longer period than male when feeding took place on the same prey species .The longevity of *O. albidipennis* female was the longest (17.00±0.41 days) when fed on 1st Instar larvae of *S . litoralis* , being , significantly , longer than the 14.67±0.71 and 15.00±1.00 days when the females of this predator were fed on *A . craccivora* and *S. graminum.*

As for the *O. albidipennis* males , it lived for a , significantly , shorter period than female (10.33±0.21 , 9.00 ± 0.38 and 7.75±0.25 when feeding took place on 1st instar of *S . litoralis, S. graminum* and *A . craccivora* respectively ; table , 4) .The present results agree with Wafaa (2013) who found that *O. albidipennis* males lived a shorter period (25.8 days) than females (31.07 days) when adults were fed on *A . craccivora.* It is clear that the longevities of *O. albidipennis* adults recorded by Wafaa (2013) were , generally longer than those recorded in the present study . This may be attributed to differences in the laboratory conditions of the two experiments.

Table 4. Longevity of *O. albidipennis* adults fed on *A . craccivora, S. graminum* and *S. litoralis* neonate larvae:

Sex	Longevity (days)		
	A . craccivora	***S. graminum***	***S. litoralis***
Female	**14.67±0.71^{aB}**	**15.00±1.00^{aB}**	**17.00±0.41^{aA}**
Male	**7.75±0.25^{bC}**	**9.00±0.38^{bB}**	**10.33±0.21^{bA}**

a, b & c : There is nonsignificant difference (P>0.05) between any two means, within the same column having the same superscript small letter.

A, B &C: There is nonsignificant difference (P>0.05) between any two means for the same attribute, within the same row having the same superscript capital letter.

Feeding capacity of *O. albidipennis* adults reared on the three prey species :

As shown in table (5), throughout the whole longevity of *O. albidipennis* adults , a single male fed on 179.17±2.06 individuals of *A . craccivora* or 176.43 of *S. graminum* nymphs , opposed to 84.75±1 individuals 1st instar larvae of *S . litoralis* . As for females , a single adult fed on 319.75±10.98 individuals of *A . craccivora*, 299.67±23.90 of *S. graminum* or 170.33±17.18 1st instar of *S . litoralis* larvae .

The obtained data may provide important information for understanding predator population dynamics and estimating population level effects of predators on prey species.

Table 5. Feeding capacity of *O. albidipennis* adults resulted by rearing on *A . craccivora, S. graminum* and 1st instar of *S . litoralis.*

Sex	prey		
	A . craccivora	*S. graminum*	*S . litoralis*
Female	319.75±10.98^{aA}	299.67±23.90^{aA}	170.33±17.18^{aB}
Male	179.17±2.06^{bA}	176.43±7.30^{bA}	84.75±1.31^{bB}

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الطاقة الإفتراسية للحشرات الكاملة والحوريات لبق الأوريس (آوريس ألبيديبنس) على ثلاث فرائس مختلفة وعلاقته ببيولوجي المفترس.

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هدفت هذه الدراسة إلى تقييم تأثير تغذية وتربية المفترس الحشرى آوريس ألبيديبنس على ثلاث فرائس مختلفة و على البيولوجي ودورة الحياة لهذا المفترس . كفرائس تم اختيار الطور الثالث من الحوريات لنوعين من المن هما من البقوليات *Aphis craccivora* ومن القمح *Schizaphis graminum* والعمر اليرقي الاول لدودة ورق القطن *Spodoptera litoralis* . وقد تمت التربية لكلا من الحوريات والحشرات الكاملة من بق الأوريس في المعمل علي درجة حرارة ٢٦ ± ١ درجة مئوية ورطوبة نسبية ٦٠ ± ٥٪. أظهرت الدراسة أن الذكور عاشت لفترة أقصر من الإناث . كما بلغت أقصر فترة لطور الحورية ١٢.٠٠ ± ٠.٣٥ أيام عند التغذية علي يرقات العمر اليرقي الاول لدودة ورق القطن . كما اظهرت الدراسة ان التغذية علي كلا من يرقات العمر الاول لدودة ورق القطن ومن القمح أدت الي قصر فترة ما قبل وضع البيض وطول فترة وضع البيض مما ادي لزيادة العدد الكلى للبيض الذى تضعه الأنثى حيث كان أعلي معدل لوضع البيض عند التغذية علي يرقات العمر الاول لدودة ورق القطن (١٨٧.٦٠ ± ٥.٥١ بيضة / للأنثى) . وكان العدد الإجمالي الذى تتغذى عليه الحورية الواحدة من بقه الأوريس هو ٢٤٣.٤٠ ± ١٤.٩٠عند التغذية علي حوريات من القمح *Schizaphis graminum* ، ٢١١.٩٠ ± ١٢.٩٥ حورية لمن البقوليات *Aphis craccivora* و ١١٠.٧٠ ± ١١.٩٠ يرقة عمر أول من دودة ورق القطن *Spodoptera litoralis* .