REPRODUCTIVE BIOLOGY AND FEEDING CONSUMPTION OF *ORIUS ALBIDIPENNIS* (REUTER) (HEMIPTERA: ANTHOCORIDAE) REARED ON FOUR DIFFERENT PREYS

ISLAM S. SOBHY, AWAD A. SARHAN, AHMAD A. SHOUKRY, GAMAL A. EL-KADY AND NASSER S. MANDOUR

Department of Plant Protection, Faculty of Agriculture, Suez Canal University, 41522 Ismailia, Egypt

ABSTRACT

The reproductive biology and feeding consumption of *Orius albidipennis* Reuter fed on eggs of *Anagasta kuehniella* Zell., *Tetranychus urticae* Koch., *Trialeurodes vaporariorum* Westwood and nymphs of *Gyniakothrips ficorum* Marchal were investigated under 26±1°C, 60±10 % RH and 16:8 L/D photoperiod in laboratory. Results indicated that type of prey had profound effect on all investigated bioparameters. The highest survival rate of 87.14 % was recorded when nymphs fed on *A. kuehniella* eggs, meanwhile the lowest one (51.93 %) was observed for those fed on *T. vaporariorum* eggs. On the contrary, the shortest nymphal period (10.60 days) was recorded for nymphs fed on *A. kuehniella* eggs, while the longest one (15.99 days) was for those fed on *T. urticae* eggs. For feeding capacity during the nymphal period, the greatest number of consumed preys was 209.46 eggs of *T. urticae*. *O. albidipennis* females showed the highest fecundity (148.00 eggs/female) when fed on *A. kuehniella* eggs, and the lowest (54.42 eggs/female) when fed on *T. vaporariorum*. Feeding on *G. ficorum* nymphs significantly extended the life span of *O. albidipennis* females and males over that of other preys. For adult feeding consumption, females consumed more preys than males. The greatest means of consumed preys for adult females and males were 127.50 and 42.57 *T. urticae* eggs, respectively. So, *A. kuehniella* eggs seem to be most suitable alternative prey for mass rearing of *O. albidipennis*.

INTRODUCTION

Orius species are generalist predators that attack a variety of arthropods such as eggs and small larvae of springtails, leafhoppers, fly larvae, scale insects, grain beetles, leaf-roller larvae, aphids, thrips and other small soft-bodied arthropods (Riudavets, 1995; Lee *et al.*, 1996). Recently, *Orius* spp. are considered as promising and effective bioagents and have been used successfully in biological control programs in greenhouses and row crop agricultural systems (Nagai, 1991; van den Meiracker & Ramakers, 1991; Jacoboson, 1993; Kawai, 1995). Moreover, a number of *Orius* spp. are mass produced and commonly available in European and North American commercial insectary markets (Cranshaw *et al.*, 1996; van Lenteren *et al.*, 1997). Due to their effectiveness in different agricultural ecosystems, several species have received considerable attention as biological control agents like *O. albidipennis* (Reuter), which is frequently found in large numbers in various agricultural habitats in the Mediterranean basin and the Atlantic zone of Western Europe (Salim *et al.*, 1987; Chyzik *et al.*, 1995; Cocuzza *et al.*, 1997; Fritsche and Tamo2000).

In Egypt, *O. albidipennis* is very common, all over the country, south to Wadi Halfa, in the desert and in the cultivated areas especially in corn and cotton fields. It is usually found in flowers and on plants infested with thrips, lepidopteran eggs and other small insects (Tawfik & Ata, 1973). It is considered as polyphagous predator and its prey range includes thrips (*Gynaikothrips ficorum, Thrips tabaci*), aphids (*Aphis gossypii, A. maidis*), lepidopteran eggs and their early larval instars (*Earias insulana, Spodoptera littoralis* and *Heliothis armigera*) and mites (*Tetranychus urticae, T. telarius*) (Tawfik & Ata, 1973; Awadallah *et al.*, 1977; El-Haidari & Georgis, 1977; Zaki, 1989; van de Vire & Degheele, 1995; El-Husseini *et al.*, 2000). This broad prey range may indicate the possibility of using *O. albidipennis* as an effective bioagent especially in greenhouses.

The suitability of different prey diets for *O. albidipennis* is the main obstacle regarding its mass production. Therefore, in the current study we initially attempted to determine the effect of different types of preys; *i.e.* eggs of *Anagasta kuehniella*, *Tetranychus urticae*, *Trialeurodes vaporariorum* and nymphs of *Gyniakothrips ficorum* on the development, reproduction, longevity and the feeding consumption of this predator under laboratory conditions.

MATERIAL AND METHODS

1. Rearing of *O. albidipennis*

Colony of *O. albidipennis* was established from field-collected nymphs and adults found on sunflower plants (*Helianthus annuus*) in the Experimental farm, Faculty of Agriculture, Suez Canal University at Ismailia. Adults and nymphs were housed in one liter plastic jar of 10 cm (diameter) × 20 cm (height) covered with muslin and held in place by means of rubber bands. Each jar was provided with sufficient quantities of *A. kuehniella* eggs as food supply for the enclosed predators

(Cocuzza *et al.*, 1997). A piece of bean pod (*Phaseolus vulgaris*) was provided in each jar as an ovipositional substrate (Isenhour & Yeargan, 1981). Colonies were maintained at 26±1°C, 60±10 % RH and 16L:8D. photoperiod. Bean pods with newly deposited eggs were removed and kept in the previously described plastic jars. Jars were examined daily until hatching. Soon after hatching, newly-hatched nymphs were carefully transferred to plastic jars and provided with of *Anagasta* eggs and small balls of white foam to reduce cannibalism (Sobhy *et al.*, 2005). Field collected adults and nymphs were added periodically to strengthen the colony and to increase its genetic diversity. Upon emergence, adults were sexed and kept in plastic jars provided with the same preys as food to investigate its bio-activity.

2. Rearing of investigated preys

Anagasta kuehniella: Eggs of this prey were taken from the mass rearing line in the Center of Biological Control, Faculty of Agriculture, Suez Canal University.

Trialeurodes vaporariorum: The stock was maintained on eggplants seedling reared in glasshouse under controlled conditions of 25±1°C, 70±10 % RH.

Tetranychus urticae: The stock culture was maintained on sweet potato plants in glasshouse under controlled conditions of 25±1°C, 70±10 % RH.

Gyniakothrips ficorum: Nymphs of this prey were collected directly from ficus trees (*Ficus nitida*) cultivated in the Experimental farm.

3. Effect of different preys on nymphal stage

In this experiment, the effect of preys on the nymphal developmental periods was estimated at 26±1°C, 60±10 % RH and 16L:8D photoperiod. Newly hatched nymphs (0-6 hrs/ old) were separated by small fine-hair brush into small petri dishs (9 cm) and provided with one of the four investigated preys (eggs of *A. kuehniella*, *T. urticae*, *T. vaporariorum* or nymphs of *G. ficorum*). Eggs of *A. kuehniella* were glued onto pieces of paper (Cocuzza *et al.*, 1997) and placed on moistened filter paper disc. As for the other preys, they were provided to the predators on small leaf discs from host plants used in their maintaining colonies.

Fifteen newly-hatched nymphs were used in each experiment. Preys were renewed and examined on daily basis till the completion of the nymphal stage. Data were recorded in the forms of developmental periods, mortality and feeding consumption for each nymphal instar (El-Husseini *et al.*, 1993).

4. Effect of different preys on adult stage

After adult eclosion, sex ratio was determined and estimated as female %. Each couple of newly emerged adults was placed separately in petri dish (9 cm diameter) for copulation without feeding to stimulate mating occurrence. Twelve hours later, males were removed and separated to another petri dishes. These insects were supplied daily with enough preys and bean pods as oviposition sites till death. Preys were renewed daily and the number of consumed preys and deposited eggs were recorded daily under binocular microscope (20 X). Experiments were conducted under the previously mentioned laboratory conditions.

5. Statistical analysis

Data were statistically analyzed using analysis of variance ANOVA (SPSS, 2000). When F-test was significant, means were separated using Duncan Multiple Range Test (DMRT) at the 0.05 level of significance.

RESULTS AND DISCUSSION

1 Effect of different preys on the immature stages of *O. albidipennis*

As shown in Table 1, type of prey had profound effect on the duration of *O. albidipennis*. Significant differences were found between different prey diets in case of first ($F=7.08$; $df= 3,53$; $P< 0.0001$), second ($F=42.40$; $df= 3,53$; $P< 0.0001$), third ($F=4.74$; $df= 3,53$; $P< 0.005$), fourth ($F=21.39$; $df= 3,53$; $P< 0.0001$) and fifth ($F=30.56$; $df= 3,53$; $P< 0.0001$) nymphal instar, with subsequent significant differences in the total nymphal period ($F= 45.81$; $df= 3,53$; $P< 0.0001$).

O. albidipennis nymphs completed their development on all tested diets. The lowest overall survival rate (51.93 %) among nymphal stage was recorded for nymphs fed on *T. vaporariorum* eggs, while highest rate (87.14%) was reported for those fed on *Anagasta* eggs. Intermediate records were reported for those fed on *T. urticae* (59.62 %) or on *G. ficorum* (72.31 %).

As depicted in Table 2, types of prey had significant effect on the feeding consumption of *O. albidipennis* nymphs ($F=57.68$; $df=3,53$; $P< 0.0001$ for the 1st instar; $F=68.92$; $df=3,53$; $P< 0.0001$ for the 2nd instar; $F=65.60$; $df=3,53$; $P< 0.0001$ for the 3rd instar; $F=80.24$; $df=3,53$; $P< 0.0001$ for the 4th instar and $F=92.72$; $df=3,53$; $P< 0.0001$ for the 5th instar). The nymphal feeding consumption increased significantly and steadily as *O. albidipennis* aged. The greatest overall nymphal feeding capacity was 209.46 eggs of *T. urticae* and the lowest was 61.85 eggs of *A. kuehniella*.

TABLE (I)

Effect of four different preys on the development and survival of nymphal stage of *Orius albidipennis* at 26±1 °C, 60±10 % RH and 16 :8 L/D photoperiod

Preys	No. of replicates	The nymphal period (Mean±SE)					Total nymphal period (Mean±SE)	Survival rate %
		1st instar	2nd instar	3rd instar	4th instar	5th instar		
A. kuehniella	14	2.50±0.15b	1.20± 0.69c	2.70± 0.25a	2.00± 0.24b	2.20± 0.23c	10.60±0.48c	87.14a
G. ficorum	15	2.90±0.10b	1.70±0.65b	1.80± 0.81b	1.20± 0.99c	3.13± 0.13b	10.73±0.23c	72.31b
T. urticae	15	3.50±0.20a	2.76±0.10a	2.13± 0.12b	2.40± 0.17b	5.20± 0.23a	15.99±0.40a	59.62c
T. vaporariorum	13	2.76±0.16b	1.61±0.15b	2.23± 0.19ab	3.46± 0.26a	4.61± 0.36a	14.69±0.49b	51.93c

Means in the same column followed by different letters are significantly different (DMRT, P < 0.05)

TABLE (II)

Effect of four different preys on the nymphal feeding consumption of *Orius albidipennis* at 26±1 °C, 60± 10 %RH and 16 :8 L/D photoperiod

Preys	No. of replicates	The nymphal period (Mean±SE)					Total nymphal consumption (Mean±SE)
		1st instar	2nd instar	3rd instar	4th instar	5th instar	
A. kuehniella	14	5.20±0.34d	7.71±0.41c	9.58±0.61c	16.09±0.87c	23.27±1.03c	61.85±1.95d
G. ficorum	15	27.13±1.35a	23.00±1.12b	35.40±1.52a	36.13±1.47b	52.33±1.30b	174.00±3.48b
T. urticae	15	23.40±1.41b	28.53±1.27a	25.86±1.08b	46.86±1.52a	84.80±2.32a	209.46±3.47a
T. vaporariorum	13	19.15±1.61c	24.15±1.45b	28.15±2.02b	36.53±1.77b	49.46±1.94b	158.23±3.69c

Means in the same column followed by different letters are significantly different (DMRT, P < 0.05)

TABLE (III)

Effect of four different preys on sex ratio, longevity, fecundity and feeding consumption of *Orius albidipennis* adults at 26±1°C, 60±10 % RH and 16 :8 L/D photoperiod

Preys	Sex ratio (females%) (Mean±SE)	♀			♂	
		Fecundity (Mean±SE)	Longevity (Mean±SE)	Feeding consumption (Mean±SE)	Longevity (Mean±SE)	Feeding consumption (Mean±SE)
A. kuehniella	57.16ab	148.00±5.69a	18.50±2.07b	123.50±3.47a	3.83±0.35c	24.66± 2.67c
G. ficorum	60.00a	93.22±2.33b	26.66±1.16a	113.55±1.47b	8.55±0.42a	31.33±1.35b
T. urticae	53.34b	62.37±1.73c	14.25±0.92c	127.50±2.56a	7.14±0.73a	42.57±1.90a
T. vaporariorum	53.84b	54.42±1.65c	18.57±0.84b	98.28±2.90c	5.66±0.51b	29.83±1.01bc

Means in the same column followed by the same letters are not significantly different (DMRT, P > 0.05)

2 Effect of different preys on the adult stage of *O. albidipennis*

Females generally over numbered males, with slightly higher female sex ratios in all treatments (Table 3). The lowest female sex ratio was 53 % for individuals fed on eggs of *T. urticae* and *T. vaporariorum*. When nymphs fed on eggs of *A. kuehniella*, female sex ratio increased to 57.16 %. The highest female sex ratio was 60.00 % when *G. ficorum* nymphs were supplied as preys.

Longevity of *O. albidipennis* was prey-dependent and females lived longer than males (Table 3). Significant differences in adults longevity were observed among different preys ($F= 15.45; df= 3, 28; P< 0.0001$ for females; $F=12.75; df=3, 21; P< 0.0001$ for males). Moreover, the tested preys differed significantly in their effect on fecundity of *O. albidipennis* (Table 3). The greatest fecundity (148.00 eggs /female) was recorded when fed on *A. kuehniella* eggs. When females fed on *G. ficorum* nymphs, fecundity dropped to 93.22 eggs/female. No significant difference in female fecundity was observed between eggs of *T. vaporariorum* or *T. urticae*.

O. albidipennis females differed significantly in their feeding consumption on the four tested preys ($F= 22.54; df=3, 28; P< 0.0001$), being greatest (127.50 eggs) when fed on *T. urticae* eggs and lowest (98.28 eggs) in case of *T. vaporariorum*. However, feeding capacity of adult males was less pronounced, but significant difference existed between tested preys ($F=17.43; df=3, 21; P< 0.0001$).

It is well known that, type of diet/prey used for insect rearing may have tremendous effect on predator performance and highlights the role of behavioral studies in quality control of mass-reared predators released for biological control. The use of different arthropod prey diets could greatly affect *Orius* reproduction and development (Kiman & Yeargan, 1985; Chyzik *et al.*, 1995; Richard & Schmidt, 1996). It is clear that, *O. albidipennis* developed faster when fed on eggs of *A. kuehniella* compared to other tested preys. These results are in harmony with those reported earlier for *O. albidipennis* by Cocuzza *et al.* (1997) and van den Meircker (1999).

In the current study, *O. albidipennis* nymphal stage completed their development on the four tested preys. However, nymphs consumed fewer numbers of *Anagasta* eggs to reach maturity. This indicates that this prey appears most suitable for development of this anthocorid; the phenomenon that may be attributed to the good food quality that led to short developmental time, high survival rate, protracted adults female longevity, and maximal fecundity for the predator. These results are also similar to the findings reported in earlier studies by (Honda *et al.* (1998) and Yano *et al.* (2002). With regard to the recorded bioparameters, a whitefly immature stage generally was the poorest prey because of the absence of some essential amino acids which may cause high mortality and extended immature development of the predator.

It is widely accepted that, diets containing nymphs of thrips are preferred to the generalist bugs *Orius* spp. (Nagi, 1991; Yano, 1996; Kohono & Kashio, 1998). Also, results by Chyzik *et al.* (1995) confirmed this hypothesis. In their studies, they found that the fecundity and survival rate of *O. albidipennis* on thrips were higher (217.2 eggs/female and 98.7%, resp.), compared to pyralid eggs (184.1 eggs/female and 84.6%, resp.). However, our study differed from their conclusion. The possible explanations for this difference could be attributed to the different species of thrips, protected microhabitat of *G. ficorum* inside the rolled leaves and also nymphs of *G. ficorum* may resist attack by *O. albidipennis*. This may need high time and energy cost for catching and handling the prey, leaving less time and energy available for oviposition.

It could be conclude that, *O. albidipennis* develop successfully and laid eggs when fed on all tested preys. Moreover, *A. kuehniella* was the most suitable preys for both development and oviposition for *O. albidipennis* that could ease the mass production of this predatory bug under laboratory conditions.

ACKNOLEDAGEMENTS

The authors would like to thank all technicians of the Public Service Center of Biological Control (PSCBC), Faculty of Agriculture, Suez Canal University for their assistance and the supplement of *A. kuehniella* eggs.

REFERENCES

AWADALLAH, K. T.; M. S. LEL- DAKROURY; A. H. EI-HENEIDY and M. S. T. ABBAS (1977): A study of the efficiency of *Orius albidipennis* when fed on either eggs or newly hatched larvae of *Heliothis armigera* (Hemiptera :Anthocoridae, Lepidoptera: Noctuidae). *(Agric. Res. Rev. Cairo, 55: 79-85).*

CHYZIK, R.; M. KLEIN and Y. BEN-DOV (1995): Reproduction and survival of the predatory bug *Orius albidipennis* on various arthropod preys. *(Entomol Exp. Appl., 75: 27-31).*

COCUZZA, G. E.; P. DE CLERCQ; M. VAN DE VIERE; A. DE COCK; D.

DEGHEELE and V. VACANTE (1997). Reproduction of *Orius laevigaatus* and *Orius albidipennis* on pollen and *Ephestia kuehniella* eggs. *(Entomol. Exp. Appl., 82: 101-104).*

CRANSHAWE, W.; D. C. SCLAR and D.COOPER (1996): A review of 1994 pricing and marketing by suppliers of organism for biological control of arthropods in the United States. *(Biol. Contr., 6: 291-296).*

EL-HAIDARI, H. S. and R. GEORGIS (1977): Predation of *Orius albidipennis* (Reuter) (Hemiptera: Anthocoridae) on *Tetranychus atlantiticus* (McGregor) (Acariformes: Tetranychidae) in Iraq. *(Z. Angew. Entomol, June., 83: 257-260).*

EL-HUSSEINI, M.; K. SCHUMANN and H. SERMANN (1993) Rearing immature feeding stage of *Orius majusculus* Reut. on the acarid mite *Tyrophagus putriscentiac* Schr. as a new alternative prey. *(J. Appl. Entomol., 116: 113-117).*

EL-HUSSEINI, M., E. AGAMY and S. M. H. SAYED (2000): Comparative biological studies on immatures of *Orius albidipennis* and *O. laevigatus* (Heteroptera :Anthocoridae) reared on two different preys. *(Egy. J. Biol. Pest Contr., 10: 81-88).*

FRITSCHE, M. E. and M. TAMO (2000): Influence of thrips prey species on the life history and behaviour of *Orius albidipennis*. (*Entomol. Exp. Appl., 96: 111-118).*

HONDA, J.; Y. NAKASHIMA and Y. HIROSE (1998): Development, reproduction and longevity of *Orius minutus* and *Orius sauteri* (Heteroptera: Anthocoridae) reared on *Ephestia kuehniella* eggs. *(Appl. Entomol. Zool., 33: 449-453).*

ISENHOUR, D. J. and K. V. YEARGAN (1981): Predation by *Orius insidiosus* on the soybean thrips, *Sericothrips varialilis*; Effect of prey stage and density. *(Environ. Entomol., 10: 496- 500).*

JACOBSON, R. (1993): Control of *Frankliniella occidentails* with *Orius majusculus*: experiences during the first full season of commercial use in the UK. *(IOBC/WPRS Bull., 61: 81-84).*

KAWAI, A. (1995): Control of *Thrips palmi* Karny (Thysanoptera: Thripidae) by *Orius* spp. (Heteroptera: Anthocoridae) on green house eggplant. *(Appl. Entomol. Zool., 30: 1-7).*

KIMAN, Z. B. and K. V. YEARGAN (1985): Development and reproduction of the predator *Orius insidiosus* (Hemiptera: Anthocoridae) reared on diets of selected plant material and arthropod prey. *(Ann. Entomol. Soc. Am., 78: 464-467).*

KOHONO, K. and T. KASHIO (1998): Development and prey consumption of *Orius sauteri* (Poppius) and *Orius minutus* (L.) (Heteroptera: Anthocoridae) fed on *Frankliniella occidentalis* (Pergande) (Thysanoptera: Thripidae). *(Appl. Entomol. Zool., 33: 227-230).*

LEE, G. H; M. Y. CHOI and D.H. KIM (1996): Predatory characteristic of *Orius sauteri* on two prey species of *Myzus persicae* and *Tetranychus urticae.* RDAJ. *(Agric. Sci. Crop., 38: 501-506).*

NAGAI, K. (1991): Predatory characterizes of *Orius* sp. on *Thrips palmi* Karny *Tetranychus kanzawai* Kishida and *Aphis gossypii* Clover. Jpn. *(J. Appl. Entomol. Zool., 35: 283-290).*

PERICART, J. (1972): Hemipteres, Anthocoridae, Cimicidae Et Microphysidae. (Text book, 157-195, Masson et Cie Editeurs, Paris).

RICHARD, P. C. and J. M. SCHMIDT (1996): The effects of selected dietary supplements on survival and reproduction of *Orius insidiosus* (Say). *(Can. Entomol., 128: 171-176).*

RIUDAVETS, J. (1995): Predators of *Frankliniella occidentails* (Per.) and *Thrips tabaci* Lind. : a review. Wageningen. *(Agric. Univ. Pap., 95:43-87).*

SALIM, M.; S. A. MASUD and A. M. KHAN (1987): *Orius albidipennis* (Reut.) (Hemiptera: Anthocoridae), a predator of cotton pests, Philipp. *(Entomol., 7: 37-42).*

SOBHY, I. S.; A. A. SARHAN; A. A. SHOUKERY; G. A. EL-KADY and N. S. MANDOUR (2005): Effect of different types of ovipositional substrates and shelters on the mass rearing parameters of *Orius albidipennis* (Reuter) (Hemiptera: Anthocoridae). *(J. Agric. Res., Suez Canal Univ., 5: 115-118).*

SPSS. (2000): SPSS for Windows, release 11. User's guide. SPSS, Chicago.

TAWFIK M. F. S. and A. M. ATA (1973): The life history of *Orius albidipennis* (Reut.) (Hemiptera: Anthocoridae). *(Bull. Soc. Entomol. Egypt, 57: 117-126).*

VAN DE VEIRE, M. and D. DEGHEELE (1995): Comparative laboratory experiment with *Orius insidiosus* and *Orius albidipennis* (Heteroptera: Anthocoridae), two candidates for biological control in glass house. *(Entomophaga, 40: 341-344).*

VAN DEN MEIRACKER, R. A. F. (1999): Suitability of *Ephestia kuehniella* eggs for rearing *Orius* predatory bugs. *(Ph.D. Thesis, University of Amsterdam. 33-44).*

VAN DEN MEIRACKER, R. A. F. and P. M. J. RAMAKERS (1991): Biological control of the western flower thrips *Frankliniella occidentalis*, in sweet pepper with the anthocorid predator *Orius insidiosus*. (*Mededelingen, van de faculteit. Landbouwweten schappen, Rijksuniversiteit. Gent, 56: 241-249).*

VAN LENTEREN, J. C.; M. M. ROSKAM and R. TIMMER (1997): Commercial mass production and pricing of organisms for biological control of pests in Europe. *(Biol. Contr., 10: 143-149).*

YANO, E. (1996): Biology of *Orius sauteri* (Poppius) and its potential as a biological agent for *Thrips palmi* Karny. *(IOBC/WPRS Bull., 19: 203-206).*

YANO, E.; K. WATANABE and E. YARA (2002): Life history parameters of *Orius sauteri* (Poppius) (Heteroptera: Anthocoridae) reared on *Ephesita kuehniella* eggs and the minimum amount of the diet for rearing individuals. *(J. Appl. Entomol. 126: 389-394).*

ZAKI, F. N. (1989): Rearing of two predators, *Orius albidipennis* (Reut.) and *Orius laevigatus* (Fieber) on some insect larvae. *(J. Appl. Entomol., 107: 107-109).*