Effects of Different Temperature Levels on The Biological Attributes of *Orius Albidipennis* (Reuter) (Hemiptera: Anthocoridae)

Sobhy, I.S., Sarhan A.A., Shoukry, A.A., El-Kady, G.A. and Mandour, N.S.
Department of Plant Protection, Faculty of Agriculture, Suez Canal University, Ismailia, Egypt

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Abstract: *The effect of four degrees of temperature (22, 26, 30 and 34±1°C) on the bio-parameters of* Orius albidipennis *(Reuter) was studied under controlled conditions of 60±10 % RH and photoperiodic regime of 16 L/ 8 D. Eggs of* Anagasta kuheniella *(Zell.) were supplied as prey and bean* Phasolus vulgaris *(L.) pods were used as ovipositional substrate. Results indicated that temperature greatly affected the development and reproductive biology of* O. albidipennis. *For the immature stages, results showed that there was a negative correlation between temperature and the developmental period of* O. albidipennis. *The shortest developmental period (10.20 days) was recorded at 34°C and the longest (22.46 days) was recorded at 22°C. The same trend of relation was found in the adul longevityt; with temperature increasing adult longevity decreased. The optimum temperature for nymphal feeding consumption was found to be 26°C with an average of 61.00 eggs of* A. kuehniella. *Analogously, the greatest feeding consumption for both males (39.00 eggs) and females (325.89 eggs) were recorded at the same temperature regime. Also,* O. albidipennis *females showed the greatest fecundity of 163.00 eggs at 26°C. Thus, 26°C associated with above mentioned relative humidity and photoperiodic regime is considered the best temperature for rearing the predatory bug* O. albidipennis.

Key words: Orius albidipennis, *Temperature,* Anagasta kuehniella, *developmental period, feeding consumption, fecundity, longevity.*

INTRODUCTION

Flower bugs or minute pirate bugs (Anthocoridae: Hemiptera) are a large cosmopolitan predatory bugs (Hernández and Stonedahl, 1999). They feed upon harmful mites and other insects attacking crops and stored grains (Ghauri, 1980). Anthocorids are common insects in the Egyptian agricultural habitats and are typically among the most abundant predators in field cropping systems. Among anthocorids, many species of the genus *Orius* are considered to be very active bioagents in various agro-systems (Tawfik and Ata, 1973).

Orius spp. have already been used successfully for biological control or integrated control of thrips and other small arthropods in greenhouse crops, including sweet pepper, cucumber and some ornamentals (Nagi, 1991). A number of *Orius* spp. such as *O. albidipennis* (Carnero *et al.* 199٣); *O. insidoisus* (van den Meiracker and Ramakers, 1991); *O. laevigatus* (Tavella *et al.*,1991) are considered as potential control agents for *Francklinie lla occidentalis*.

Before using *O. albidipennis* in biological control program, it is essential to study its biological traits under various experimental conditions. Temperature has been considered the most crucial environmental factor that affects the success of biological control by *Orius* spp. in greenhouses. Therefore, the objectives of the current study were to determine the effects of four degrees of temperatures (22, 26, 30 and 34±1°C) on the development and reproductive biology and feeding consumption of *O. albidipennis* immature and adult stages to reach to the most idealistic and suitable temperature for *O. albidipennis* mass rearing.

MATERIALS AND METHODS

1. Prey rearing

The stock colony of Mediterranean flour moth (MFM), *Anagasta kuehniella* (Zell.), (Lepidoptera: Pyralidae) used in this study was taken from the stock colony kept in the Public Service Center of Biological Control (PSCBC), Faculty of Agriculture, Suez Canal University. Upon emergence, adults of MFM were collected and kept in glass chimneys covered with silk gauze from the two sides and held by rubber bands. Adults were provided with pieces of cotton wet with diluted honey solution 10 %. Moths laid eggs inserting in the silk gauze throw the other side. A petri dish was put under the chimney to receive the deposited eggs.

2. Predator Rearing

Nymphs and adults of *Orius albidipennis* were collected from sunflower plants, *Helianthus annuus* (L.) from the experimental farm, Faculty of Agriculture, Suez Canal University at Ismailia and kept in plastic jars of 10×20 cm covered with muslin and held by rubber bands. Each jar was provided with both small balls of white foam to reduce cannibalism and sufficient quantities of *A. kuehniella* loose eggs were provided as food for the enclosed predators (Alauzet *et al.*, 1994; Cocuzza *et al.*, 1997). *Phaseolus vulgaris* (L.) pod was provided in each jar as an ovipositional substrate (Isenhour and Yeargan, 1981). Eggs of *O. albidipennis* are inserted into bean pods tissues. Bean pods with newly deposited eggs were kept in plastic jars previously described. Jars were examined daily until hatching.

Soon after hatching, newly-hatched nymphs of *O. albidipennis* were removed and kept in the plastic jars

Correspondent author: Awad Ahmed Sarhan; E-mail: awad_sarhan@yahoo.co.uk

and provided with of *A. kuehniella* eggs and small balls of white foam till reaching the adult stage. Upon adult eclosion, adults were collected and kept in plastic jars provided with food and bean pods as ovipositional substrate. This procedure was repeated for several successive generations before carrying out the intended experiments.

3. Effect of temperature on the immature stages

Incubation period and nymphal development of *O. albidipennis* were investigated at 4 degrees of temperature ±1 °C: 22, 26, 30 and 34°C under 60±10 %RH and photoperiodic regime of 16 L / 8 D. To obtain *O. albidipennis* eggs, bean pods were put inside adult jars for oviposition. Six hrs later, bean pods having eggs of *O. albidipennis* were removed and number of eggs was counted. The hatched nymphs were placed individually in Petri dishes (7 cm diameter) at the tested temperature. Nymphs of *O. albidipennis* were provided with pieces of cotton moistened with diluted honey solution (10%) and eggs of *A. kuehniella* on a sticky paper sheet as food supply. Petri dishes were checked at 12 hrs intervals till adult eclosion. The duration and number of consumed eggs of *A. kuehniella* for the nymphal stage were observed daily till eclosion.

4. Effect of temperature on the adult stage

After emergence, couples of *O. albidipennis* adults (0-12hrs) were kept for 24 hrs in glass tubes (3×10 cm) covered with gauze and held by a rubber band to encourage mating. Each couple of *O. albidipennis* was kept starved for 12 hrs, then male and female were separated in Petri dish (7 cm diameter) and provided with sufficient mount of *A. kuehniella* eggs on a sticky paper sheet. Egg sheets were changed daily and bean pods as ovipositional substrate were supplied daily. The number of deposited eggs by adult females was counted under binocular microscope (20 ×). Longevity, feeding consumption and female fecundity were recorded till death.

5. Statistical analysis

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

RESULTS

1. Egg stage

Data in Table 1 showed that the shortest incubation period of 2.70 days was recorded at 34°C. At 30°C and 26°C, the incubation period increased to 3.10 days and 3.60 days, respectively. On the other hand, the longest mean incubation period (4.90 days) was found at 22°C. Statistical analysis (F-test) has shown that temperature has a significant effect on the incubation period.

The lowest hatchability rate of 73.75 % was recorded at 22°C. At 26°C and 30°C, the hatchability rate increased to 81.25 % and 86.25 %, respectively. On the other hand, the highest hatchability rate of 88.75 % was recorded at 34°C. Statistical analysis has shown that temperature has a significant effect on the hatchability rate (Table 1).

2. Nymphal stage

Table (1) shows that the longest nymphal developmental period (17.56 days) was attained at 22°C and the shortest (7.50 days) at 34°C. At 30°C and 26°C, the nymphal developmental period lasted 7.60 days and 12.79 days, respectively. The nymphal developmental periods differed significantly among the tested temperatures.

For the total developmental periods, while the shortest period of 10.20 days was found at 34°C, the longest total developmental period of 22.46 days was recorded at 22°C. The figures at 30 and 26°C were intermediate. Statistical analysis indicated that temperature has highly significant effect on the total developmental period.

The lowest mean of nymphal feeding consumption was 54.00 eggs at 22°C. While at 30 and 34°C, the mean feeding consumption of nymphal stage increased to 57.00 eggs and 58.00 eggs, respectively. In addition, the greatest mean of nymphal feeding consumption was 61.00 eggs at 26°C (Table 1).

Statistical analysis revealed that there were highly significant differences in nymphal feeding consumption among the investigated temperatures. Nevertheless, there was no significant effect between 30 and 34°C in terms of nymphal feeding consumption.

3. The adult stage

As shown in Table (2) females of *O. albidipennis* lived significantly longer (32.12 days) at the lowest tested temperature (22°C). With the increase of temperature, longevity was significantly shortened. For female fecundity, the lowest fecundity was 126.10 eggs/female at 34°C. While at 30°C and 22°C, the mean fecundity increased to 135.66 eggs/female and 149.37 eggs/female, respectively. On the contrary, the greatest fecundity of 163.00 eggs/female was recorded at 26°C (Table 2). Regarding female feeding consumption, it was negatively correlated with the highest temperatures (30 & 34°C), but reached greatest capacity of 325.89 eggs of *A. kuehniella* at 26°C (Table 2). Statistical analysis has shown that there were highly significant differences of females feeding consumption among tested temperatures. Meanwhile, there was no significant differences between 30 and 34 °C in terms of females feeding consumption.

Data in Table (2) indicated that temperature significantly affected the longevity of *O. albidipennis* males. The shortest male lifetime of 3.71 days was observed at 34°C. While at 30°C and 26°C, the mean male longevity increased to 3.83 days and 4.50 days, respectively. Besides, the longest mean male longevity was 5.93 days at 22°C. For feeding consumption, the smallest number of *A. kuehniella* consumed eggs by adult male was 22.42 eggs at 34°C. While at 30°C and 22°C, the mean males feeding consumption increased to 23.50 and 31.25 eggs, respectively. In addition, the greatest feeding consumption of 39.00 eggs/ male was recorded at 26°C. Statistical analysis indicated that temperature significantly affected male feeding consumption under tested temperatures.

Table 1. Effect of different temperature regimes on the development and feeding consumption of immature stages of *Orius albidipennis* at 60 ±10 % RH and 16 : 8 L/D photoperiod

Temperature °C	Incubation period (Mean±SE)	Hatchability rate (%)	Nymphal period (Mean±SE)	Total developmental period (Mean±SE)	Feeding consumption (Mean±SE)
22	4.90±0.08a	73.75c	17.56±0.22a	22.46±0.27a	54.00±1.34c
26	3.60±0.08b	81.25b	12.79±0.14b	16.39±0.15b	61.00±0.40a
30	3.10±0.13c	86.25a	7.60±0.13c	10.70±0.16c	57.00±1.20b
34	2.70±0.12d	88.75a	7.50±0.27c	10.20±0.29c	58.00±0.74b

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

Table 2. Effect of different ambient temperatures on the bioparameters of adult stage of *Orius albidipennis* at 60±10 % RH and 16: 8 L/D photoperiod

Temperature °C	♂		♀		
	Longevity (Mean±SE)	**Feeding consumption** (Mean±SE)	**Longevity** (Mean±SE)	**Feeding consumption** (Mean±SE)	**Fecundity** (Mean±SE)
22	5.93±0.17a	31.25±2.63b	32.12±0.27a	261.50±12.56b	149.37±1.22b
26	4.50±0.28b	39.00±2.09a	23.38±0.51b	325.89±18.42a	163.00±1.72a
30	3.83±0.33b	23.50±1.60c	16.00±0.70c	160.00±2.61c	135.66±2.76c
34	3.71±0.28b	22.42±0.99c	15.00±0.77c	145.50±3.02c	126.10±3.36d

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

DISCUSSION

In this study, the obtained data indicate that temperature has a profound influence upon the development of *Orius albidipennis* as it is the case with most insects. *O. albidipennis* develops satisfactorily with each increase of temperature. From 22 to 34 °C, the egg development rate was accelerated nearly 4 folds. Tawfik and Ata (1973) also found the same trend for incubation period in *O. laevigatus* at 27°C. Temperature also plays an important role in nymphal development. In the current study, from 22 to 34 °C development time declined from 17.56 to 7.50 days (Table 1). This specific nymphal development is relatively longer than that of *O. majusculus* (Alauzet *et al.* 1992). On the contrary, development of *O. albidipennis* was somewhat shorter than that of *O. insidious*, a well known northern American species at 22 °C (Isenhour and Yeagan, 1981). In our experiment, the duration of total developmental period (from egg to adult) was approximately 16.39 days at 26 °C. Cocuzza *et al.* 1997 reported similar developmental period (17.00 days) of *O. albidipennis* fed on the same prey at 25°C.

The average female longevity and life expectancy between 22 and 34°C was ranged between 32.25 and 15.00 days. The optimum temperature for oviposition was around 26°C. These important characteristics show how much temperature is determining and have to be taken into account when using these predators in biological control. The differences in fecundity and longevity in this study were in disagreement with those reported in the literatures (Tawfik and Ata, 1973; Chyzik *et al.* 1995; Cocuzza *et al.* 1997). This could be attributed to the different diets and thermic regimes used in the other studies.

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