

BIOLOGICAL CONTROL

Influence of Photoperiod on *Orius thyestes* Herring (Hemiptera: Anthocoridae) Reproduction and Longevity

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Influência do Fotoperíodo na Reprodução e Longevidade de *Orius thyestes* Herring (Hemiptera: Anthocoridae)

RESUMO - Várias espécies de *Orius* Wolff são utilizadas no controle biológico de tripses em cultivos protegidos em regiões temperadas, entretanto algumas delas apresentam diapausa reprodutiva, comprometendo a atuação desses agentes de controle biológico. Não existem relatos sobre a biologia da espécie neotropical *Orius thyestes* Herring em diferentes condições ambientais. Este trabalho objetivou verificar a influência do fotoperíodo na reprodução e longevidade desse predador. Ninfas foram individualizadas em placas de Petri e mantidas em câmaras climatizadas a $28 \pm 1^\circ\text{C}$, UR de $70 \pm 10\%$ e nos fotoperíodos de 12L:12E, 11L:13E, 10L:14E e 09L:15E. Os adultos foram acasalados em placas de Petri contendo inflorescência de *Bidens pilosa* L. Asteraceae como substrato de oviposição e ovos de *Anagasta kuehniella* (Zeller) (Lepidoptera: Pyralidae) como alimento. Foram avaliados os períodos de pré-oviposição e oviposição, fecundidade e longevidade de fêmeas e machos. Em nenhuma das condições de fotoperíodos avaliadas *O. thyestes* apresentou diapausa reprodutiva. O número médio de ovos por fêmea diminuiu proporcionalmente ao número de horas de luz, com diferença ($P < 0,05$) entre os valores obtidos em 12h e 9h de luz. A longevidade de fêmeas e machos do predador sob fotofase de 9h foi menor ($P < 0,05$) que as longevidades observadas nos demais fotoperíodos testados. O conhecimento sobre a biologia do inimigo natural em diferentes condições permite otimizar a criação massal e prever o desempenho do predador em diferentes fotoperíodos que podem ocorrer ao longo do ano e no interior das casas de vegetação.

PALAVRAS-CHAVE: Predador, fecundidade, fotofase, comportamento, controle biológico

ABSTRACT - Several species of *Orius* Wolff are used in biological control of thrips in protected cultivations in temperate regions, but some of them show reproductive diapause, compromising the efficiency of these agents of biological control. There are no reports on the biology of the neotropical species *Orius thyestes* Herring under different environmental conditions. The purpose of this work was to investigate the influence of photoperiod on reproduction and longevity of this predator. Nymphs were kept in petri dishes in climatic chambers at $28 \pm 1^\circ\text{C}$, $70 \pm 10\%$ RH and under the photoperiods of 12L:12D, 11L:13D, 10L:14D e 09L:15D. The mating adults were kept in petri dishes with *Bidens pilosa* L. Asteraceae inflorescences as oviposition substrates and eggs of *Anagasta kuehniella* (Zeller) (Lepidoptera: Pyralidae) as food. The pre-oviposition and oviposition periods, fecundity and longevity were evaluated and *O. thyestes* did not show reproductive diapause in all photoperiod conditions established. The mean number of eggs obtained per female decreased with the reduction of the photophase, with a difference ($P < 0.05$) between the values obtained in 12h and 9h of photophase. Longevity of females and males under 9h photophase was shorter ($P < 0.05$) than in all other photoperiods tested. The knowledge of the biology of the natural enemy under different conditions allows to optimise the mass rearing and to predict the performance of the predator in different photoperiods which may occur along the year and in greenhouses.

KEY WORDS: Predator, fecundity, photophase, behavior, biological control

To understand the mechanisms that influence diapause induction is important for rearing procedures and storage of natural enemies and for inoculative and inundative releases (Ruberson *et al.* 1991).

Insects react in several ways to photoperiod according to its geographical location, and examples are known for those of the Heteroptera. In general, the critical day length for diapause induction declines with latitude (Beck 1980, Danks 1987). Musolin & Numata (2003) found influence of day length on the life-cycle of *Nezara viridula* (L.): short days induces diapause, changes in adult coloration from green to brown and increase of pre-mating and pre-oviposition periods.

In protected cultivation, photoperiod variation is a common and necessary practice to induce flowering on several ornamental plants where thrips are of economic importance (Arruda *et al.* 1996), and may affect their natural enemies on site. Under this system of cultivation, heteropterous of genus *Orius* Wolff are widely used on biological control of thrips in Europe, United States and Canada (van den Meiracker 1994, van Lenteren 2000), where reproductive diapause studies are made. Gillespie & Quiring (1993) found a decrease of approximately 3h in the critical day length when comparing *Orius tristicolor* (White) from Canada (49°N) and from California (38°N).

Tommasini & Nicoli (1996) found that strains of *Orius laevigatus* (Fieber) from North Italy tend to enter reproductive diapause while southern strains of this species can be used on thrips control in autumn and winter. Thus, low latitude strains may be of great value to biological control in greenhouses on high latitude regions (van den Meiracker 1994).

In Brazil, Argolo *et al.* (2002) did not detect diapause in *Orius insidiosus* (Say) when submitted to constant photophases from 9h to 14h. Silveira & Bueno (2003) did not observe sensibility of this predator to alternate photoperiods between pre-imaginal and adult phases. On the other hand, *O. insidiosus* has its reproduction altered by short photoperiods in temperate countries, resulting in reproductive diapause (Kingsley & Harrington 1982, Ruberson *et al.* 1991, van den Meiracker 1994).

There are no known studies referring to the influence of photoperiod on *Orius thyestes* Herring, since it was previously found only in Colombia and Mexico and more recently in Brazil (Silveira *et al.* 2003). Thus, this study aimed to know the influence of several constant photoperiods in the reproduction and longevity of *O. thyestes* under laboratory conditions, in order to optimize its mass rearing and utilization in biological control programs of thrips on crops in greenhouses.

Material and Methods

Rearing of *O. thyestes* was carried out in the Laboratório de Controle Biológico of the Departamento de Entomologia da UFLA with field collected specimens on amaranth (*Amaranthus* sp.) in Lavras, MG, Brazil (21°14'S, 44°59'W). Eggs of *Anagasta kuehniella* (Zeller) (Lepidoptera: Pyralidae) were placed every other day as food

and farmer's friend inflorescence (*Bidens pilosa* L.) as oviposition substrate.

Single fourth- and fifth-instar nymphs of *O. thyestes* were placed in petri dishes (5 cm diameter) containing eggs of *A. kuehniella* and wet cotton, and sealed with plastic film. All specimens used in this study originated from a laboratory rearing maintained over six generations. After emergence and mating of the adults, they were placed in petri dishes containing farmer's friend inflorescence surrounded by wet cotton using distilled water and *A. kuehniella* eggs. The inflorescence used as oviposition substrate was disinfected with $\pm 0.12\%$ sodium hypochlorite solutions to avoid the occurrence of fungi and bacteria which could interfere with the development of the eggs and nymphs; the upper part of the inflorescences were removed to prevent individuals from feeding on pollen which could interfere on their biology (Kiman & Yeargan 1985). Food and oviposition substrates were substituted daily. Experiments were conducted in climatic chambers at $28 \pm 1^\circ\text{C}$ and $70 \pm 10\%$ RH. Thirty replicates of the following photoperiods were evaluated: 9L:15D, 10L:14D, 11L:13D e 12L:12D.

Each oviposition substrate was carefully evaluated every day under stereoscopic microscopy for egg counting until female death. Death males were not replaced as females oviposit even at their absence (Askari & Stern 1972). Females and males were evaluated for pre-oviposition and oviposition periods, fecundity and longevity.

Data were submitted to the homogeneity variance test and transformed to \sqrt{x} before the analyses of variance. Means were compared using the Tukey's test at 5% of probability.

Results and Discussion

Females of *O. thyestes* found in Lavras did not show reproductive diapause in all tested photoperiods, since 100% oviposited before the eight day of life. According to Ruberson *et al.* (1991) and van den Meiracker (1994), species of *Orius* enter reproductive diapause when the pre-oviposition period exceeds 14 days. For Tommasini (2003), the pre-oviposition period is an indicator on how adult populations react to external stimuli.

The tested photoperiods did not interfere ($P < 0.05$) with the pre-oviposition and oviposition periods of *O. thyestes* when compared to each other (Table 1). Argolo *et al.* (2002) observed a longer pre-oviposition period of *O. insidiosus* submitted to 11h of photophase and found a direct relation between the number of hours of light and the oviposition period of the predator.

The pre-oviposition (1.4 days) and oviposition (9.1 days) of *O. thyestes* under 12h-photophase (Table 10) were shorter than the periods reported by Carvalho *et al.* (2005), (3.5 e 17 days, respectively). This difference may be explained by the presence of males together with females for 15 min only per day, as compared to this experiment where they were kept together with the females until death.

A significant ($P < 0.05$) reduction on the mean number of eggs/female/day under 10h (4.6) was observed as compared to 12h (5.9) (Table 1), with no significant differences among the remaining values obtained.

Table 1. Mean fecundity and longevity (\pm SE) of *O. thyestes* under different photoperiods. Temp.: $28 \pm 2^\circ\text{C}$ and RH: $70 \pm 10\%$

Biological parameters	Photoperiods			
	12L:12D	11L:13D	10L:14D	09L:15D
Pre-oviposition period (days)	1.4 \pm 0.09a	1.9 \pm 0.25a	1.4 \pm 0.09a	1.5 \pm 0.10a
Oviposição period (days)	9.1 \pm 0.64a	8.3 \pm 0.83a	9.2 \pm 1.16a	6.4 \pm 0.62a
Number of eggs/ female/ day	5.9 \pm 0.25a	5.6 \pm 0.28ab	4.6 \pm 0.22b	4.7 \pm 0.41ab
Number of eggs/ female	52.8 \pm 4.09a	48.5 \pm 6.14ab	43.4 \pm 5.66ab	32.5 \pm 4.14b
Female longevity (days)	11.2 \pm 0.69a	11.4 \pm 0.83a	11.4 \pm 1.12a	8.8 \pm 0.57b
Male longevity (days)	6.5 \pm 0.50a	7.3 \pm 0.69a	7.4 \pm 0.56a	4.5 \pm 0.34b

Means followed by the same letter in lines are not different from each other by the Tukey's test at 5% significance.

As for the 12L:12D photoperiod, the results are similar to those obtained by Carvalho *et al.* (2005), where *O. thyestes* deposited a mean of 5.8 eggs/female/day. Significant difference ($P < 0.05$) was found for egg number/female between 9h and 12h of light only. Argolo *et al.* (2002) also found no influence of different photofases on *O. insidiosus* fecundity, but the number of eggs/female was higher than the observed for *O. thyestes* (Table 1), varying from 162.0 eggs at 09L:15D to 195.2 eggs at 12L:12D.

Mean female and male longevity of *O. thyestes* was similar among the 12L:12D, 11L:13D and 10L:14D photoperiods, but was significantly shorter ($P < 0.05$) at 09L:15D (Table 1). In general, males live from 36% to 49% less than females (Table 1). These results confirm those of Mendes *et al.* (2003) who found a significant reduction of 6.7 days on *O. insidiosus* females when kept full time with males. But Carvalho *et al.* (2005) found no difference between male and female longevity of *O. thyestes* when mated every seven days, with longevity equal to 20.5 and 20.9 days for males and females, respectively. According to Askari & Stern (1972), females of *O. insidiosus* are always receptive to males but may become stressed and have their life span reduced.

Comparing *O. thyestes* to *O. insidiosus* (Argolo *et al.* 2002), longevity of *O. insidiosus* is greater than in *O. thyestes* in both sexes (Table 1) on all tested photoperiods, longevity varying from 53 to 41 days in adults of *O. insidiosus*.

Results indicate that *O. thyestes* found in Lavras have no reproductive diapause and the tested photoperiods do not interfere with longevity, but fecundity may be reduced. These data may be used to optimize mass rearing of the predator and predict its performance under the several photoperiods that may occur during the year in different localities and in greenhouses. Further studies should focus on photoperiod and temperature interactions.

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