Reproductive potential of the predator *Supputius cincticeps* (Heteroptera: Pentatomidae) affected by female body weight

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ABSTRACT. The reproductive potential of *Supputius cincticeps* (Stal) (Heteroptera: Pentatomidae) females of two weight classes was evaluated with males and females of this predator obtained from nymphs fed on *Tenebrio molitor* L. (Coleoptera: Tenebrionidae) pupae. Females of *S. cincticeps* weighing less than 45 mg (light females) and more than 60 mg (heavy females) constituted the treatments. Pre-oviposition, oviposition and post-oviposition periods besides adult longevity were similar between treatments while number of egg masses, eggs, eggs/egg mass and number of nymphs hatched were higher for heavier females. Periods between egg mass laying and egg incubation were shorter for insects of the last treatment. These results are discussed in relation to the use of heavier females of *S. cincticeps* to improve mass rearing of this predator in laboratory.

Key words: Asopinae, mass rearing, weight classes.

RESUMO. Potencial reprodutivo de *Supputius cincticeps* (Stal) (Heteroptera: Pentatomidae) influenciado pelo peso do corpo da fêmea. O potencial reprodutivo de fêmeas de *Supputius cincticeps* (Stal) (Heteroptera: Pentatomidae) de duas classes de peso foi avaliado. Machos e fêmeas desse predador foram obtidos de ninfas alimentadas com pupas de *Tenebrio molitor* L. (Coleoptera: Tenebrionidae). Foram analisadas fêmeas com peso inferior a 45 mg (fêmeas leves) e superior a 60 mg (fêmeas pesadas). A longevidade e os períodos de pré-oviposição, oviposição e pós-oviposição foram semelhantes entre fêmeas das duas classes de peso, enquanto aquelas mais pesadas apresentaram maior número de posturas, ovos, ovos/postura e ninfas. Períodos entre posturas e de incubação dos ovos foram menores para fêmeas com peso superior a 60mg. Esses resultados são discutidos em relação ao uso de fêmeas mais pesadas de *S. cincticeps* para aumentar a produção em criação massal desse predador.

Palavras-chave: Asopinae, criação massal, classes de peso.

Introduction

Defoliator caterpillars are important pests because they can reduce production in crops of economic relevance including eucalyptus (Zanuncio *et al.*, 1994). *Supputius cincticeps* (Stal) (Heteroptera: Pentatomidae) and other Asopinae species can be used to control eucalyptus defoliator caterpillars and its biology, behavior and insecticide. The impact on these organisms has been studied (Zanuncio *et al.*, 1992a, 1993, 1996/1997, 1998; Molina-Rugama *et al.*, 1998; Torres *et al.*, 1998; Assis Junior *et al.*, 1999).

Males and females of *S. cincticeps* are heavier when fed on *Tenebrio molitor L.* (Coleoptera: Tenebrionidae) pupae than with *Musca domestica* L. (Diptera: Muscidae) larvae (Zanuncio *et al.*, 1992a). Intraspecific competition also affects weight, body size, fecundity, development period and behavior of insects and Zanuncio *et al.* (1993) obtained heavier females of *S. cincticeps* when rearing a maximum of 20 nymphs of this predator per 500 mL container. Body weight as a quality control parameter for stinkbug predators should be used with caution especially when compared individuals reared in laboratory with those ones collected in the field (Mohaghegh-Neyshabouri *et al.*, 1996).

Fecundity of insects can be affected by female body weight (Honek, 1993) such as reported for *Podisus maculiventris* (Say) (Heteroptera: Pentatomidae) by Evans (1992) and *Podisus nigrispinus* (Dallas, 1851) (Heteroptera: Pentatomidae) by Zanuncio *et al.* (1992b) with better reproductive performance of heavier females including higher number of egg masses, eggs and nymphs. *S. cincticeps* has been presenting individuals

of different body weight in the same population. For this reason it is necessary to study the effect of this parameter on reproductive capacity of this predator. Thus, the purpose of this study was to evaluate the reproductive performance of *S. cincticeps* females of two weight classes when fed with *T. molitor* pupae.

Material and methods

This research was conducted by the Laboratory of Biological Control of Insects (Núcleo de Biotecnologia Aplicada à Agropecuária - BIOAGRO) of the Federal University of Viçosa (UFV), in Viçosa, State of Minas Gerais, Brazil. *S. cincticeps* was maintained at constant temperature of 25 ± 2ºC, relative humidity of 60 ± 5% and 13 h photoperiod. Males and females of *S. cincticeps* were obtained from nymphs fed with *T. molitor* pupae from a rearing facility maintained according to the procedures described by Zanuncio *et al.* (1992a) at UFV.

Newly emerged males and females of *S. cincticeps* were weighted after 24 hours of starvation. Females of treatment T_1 weighed less than 45 mg (light females) while their males weighted less than 35 mg. Those of treatment T_2 weighed more than 60 mg (heavy females) and its males more than 35 mg. Thirty pairs were formed per treatment with a total of 10 replications being each one constituted by three pairs of *S. cincticeps.* Each pair of this predator was placed in a 500 ml plastic cup with two holes in its cover**.** One had a plastic cup (40 ml) with its bottom substituted by a nylon mesh where *T. molitor* pupae were placed *ad lib*. A 2 mm cylindrical plastic tube filled with water was placed in the other hole (Zanuncio *et al.*, 2001; Torres and Zanuncio, 2001). Males and females of this predator were weighed after their first mating. Pairs of *S. cincticeps* were observed every hour for the determination of mating duration.

Egg masses of *S. cincticeps* were daily collected and placed in Petri dishes (9.0 x 1.2 cm) with a moistened cotton ball (Zanuncio *et al.*, 2001).

Duration of first mating, pre-oviposition, oviposition and post-oviposition periods, interval between egg mass laying, number of eggs/female, nymphs hatched/ female, egg masses, egg viability and female longevity were evaluated.

Number of egg masses, eggs/female, nymphs/female and female longevity were analyzed for all females including those which laid no eggs while pre-oviposition, oviposition, post-oviposition, and egg incubation periods were considered only for females that laid eggs.

Adults of *S. cincticeps* that died before the tenth day after their emergence were replaced. Dead insects were maintained in 70% alcohol and used to obtain their body length (from the head to the end part of the abdomen) and body wide (pronotum wide), parameters used as indicative of body size for Pentatomidae (Barcelos *et al.*, 1994).

Data were submitted to Cochran and Bartlett and Lilliefors tests to determine variance homogeneity and normality, respectively, while period between egg laying was transformed to log x. All data were submitted to the F test with a significance level of 5%.

Results

Males and females of *S. cincticeps* of treatment T_2 showed higher body size and width than those of T_1 (Table 1).

Table 1. Length and width (mean ± sd) of body size of *Supputius cincticeps* of two weight classes maintained at 25 ± 2 °C, 60 ± 5% relative humidity and 13 hours photoperiod

	Weight class (mg)			
	Male		Female	
Biological parameters	T_1(<35)	T_2(> 35)	T_1(<45)	T_2(>60)
Length (mm)⋆	8.92 ± 0.06	9.21 ± 0.05	10.24 ± 0.06	10.88 ± 0.03
Width (mm)⋆	4.88 ± 0.02	5.20 ± 0.02	5.53 ± 0.04	6.05 ± 0.02

⋆ Significant at 1% probability level by the F test

Duration of first mating, pre-oviposition, oviposition and post-oviposition periods, percentage of nymph hatched and longevity of *S. cincticeps* were similar (F, $p > 0.05$) for females of both weight classes (Table 2).

Table 2. Reproductive parameters and longevity (mean ± sd) of females of *Supputius cincticeps* (Heteroptera: Pentatomidae) of two weight classes maintained at 25 ± 2 °C, 60 ± 5% relative humidity and 13 hours photoperiod

Biological parameters	Weight class (mg)	
	T_1(<45)	T_2 (>60)
Duration of first mating (min.)^{ns}	813.56 ± 48.79	839.06 ± 45.58
Pre-oviposition period (days)^{ns}	13.20 ± 1.91	8.86 ± 0.80
Oviposition period (days)^{ns}	25.61 ± 6.79	29.10 ± 3.56
Post-oviposition period (days)^{ns}	5.16 ± 0.76	5.09 ± 1.22
Number of egg masses⋆⋆	4.73 ± 1.21	12.50 ± 1.84
Interval between egg laying (days)⋆	6.01 ± 1.51	2.41 ± 0.16
Total number of eggs⋆⋆	44.58 ± 13.15	128.27 ± 14.19
Eggs/egg mass⋆	8.62 ± 0.81	10.71 ± 0.41
Egg incubation (days)⋆⋆	6.48 ± 0.10	5.89 ± 0.16
Nymphs hatched (%)^{ns}	65.27 ± 5.78	49.93 ± 6.07
Nymphs hatched/egg mass⋆	30.60 ± 9.90	64.76 ± 11.40
Longevity (days)^{ns}	36.03 ± 4.51	42.07 ± 3.93

^{ns} non significant at 5% probability level by F test. ⋆ significant at 5% probability level by F test. ⋆⋆ significant at 1% probability level by F test

Heavier females presented higher number of egg masses (F, $p<0.05$) and shorter egg incubation period (F, $p<0.001$) and interval between laid

periods (F, $p<0.05$). Total number of eggs (F, $p<0.01$), eggs/egg mass and nymphs hatched/egg mass (F, $p<0.05$) were higher for females in T_2 than in T_1 (Table 2), although lower percentage of nymph hatched occurred in the last egg masses (Figure 1).

Higher number of egg masses and nymphs/egg mass were found for females of treatment T_2 (Figure 1). Mean number of eggs/day/female and nymphs/day/female were higher for heavier females (Figures 2, 3, 4, 5).

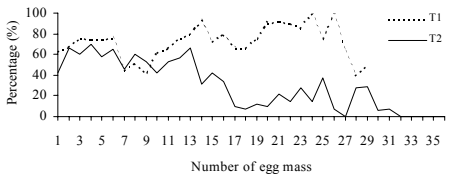

Figure 1. Percentage of nymphs hatched/day for *Supputius cincticeps* females with weight below 45 mg (T1) and above 60 mg (T2) maintained at 25 ± 2 °C, 60 ± 5% relative humidity and 13 hours photoperiod

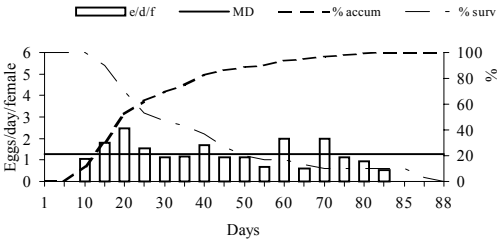

Figure 2. Daily egg production per alive female (e/d/f), accumulated egg production (% accum.) and female survival (% surv.) every five days for *Supputius cincticeps* females with weight below 45 mg maintained at 25 ± 2 °C, 60 ± 5% relative humidity and 13 hours photoperiod. MD = mean

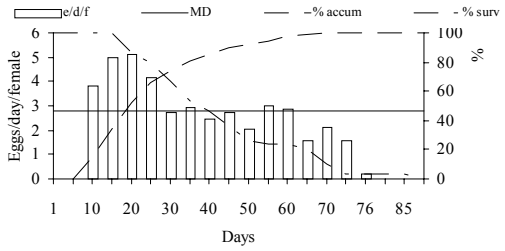

Figure 3. Daily egg production per alive female (e/d/f), accumulated egg production (% accum.) and female survival (% surv.) every five days for *Supputius cincticeps* (Heteroptera: Pentatomidae) females with weight above 60 mg maintained at 25 ± 2 °C, 60 ± 5% relative humidity and 13 hours photoperiod. MD = mean

Nine females of the treatment T_1 and two of T_2 died before the tenth day after emergence and they were replaced by other ones. Nine females laid no eggs in treatment T_1 while all those of T_2 laid eggs. A total of 142 egg masses were obtained in treatments T_1 with 29 (20.42%) of them being infertile and 25 (86.20%) were laid after the death of the respective male. From a total of 113 fertile egg masses, 42 (37.16%) were laid after the death of their males. Heavier females (T_2) produced 375 egg masses being 126 of them (33.6%) infertile from which 64.28% were laid after male death. Besides 66.40% of the 249 egg masses were fertile, with a total of 76 (30.52%) being laid in the absence of the respective male.

One male of treatment T_1 and four of treatment T_2 were substituted, because they died before the tenth day after emergence. After death of the respective male, one female produced two egg masses without nymph hatching in treatment T_1, while all females of treatment T_2 laid eggs, with two of them producing five and 23 infertile egg masses. Twelve females laid 17 fertile egg masses in treatment T_1 after male death. However, the last nine ones were laid by only one female which might have been due to a higher mating success of this female (Figure 4).

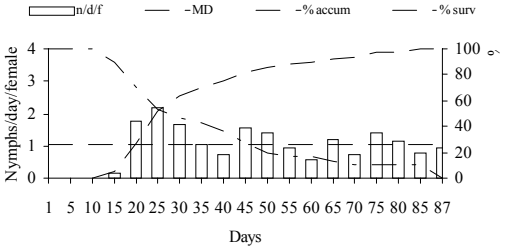

Figure 4. Daily nymph production per alive female (n/d/f), accumulated nymph production (% accum.) and female survival (% surv.) every five days for *Supputius cincticeps* (Heteroptera: Pentatomidae) females with weight below 45 mg maintained at 25 ± 2 °C, 60 ± 5% relative humidity and 13 hours photoperiod. MD = mean

Heavier females of *S. cincticeps* reached 50% of their egg production 20 days after emergence (Figure 3). These females had higher accumulated production of eggs and nymphs per day than lighter ones whose egg production reached 25 days after their emergence (Figures 2, 3, 4, 5).

Nymph hatching began between the 10th and 15th days (Figures 4, 5) and extended to the 50th day after adult emergence for heavier females of *S. cincticeps*, followed by a sharp decline on this parameter.

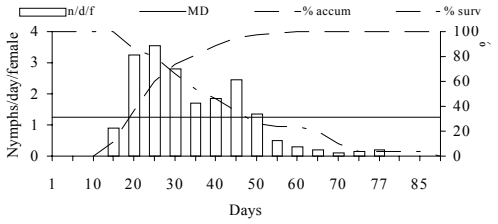

Figure 5. Daily nymph production per alive female (n/d/f), accumulated nymph production (% accum.) and female survival (% surv.) every five days for *Supputius cincticeps* (Heteroptera: Pentatomidae) females with weight above 60 mg maintainded at 25 ± 2 °C, 60 ± 5% relative humidity and 13 hours photoperiod. MD = mean

Daily production of eggs and nymphs per female of *S. cincticeps*, on each five days, was higher in the treatment T_2, with egg production starting before the 10th day and extending to the 35th day (Figure 3).

Discussion

Reproductive capacity of insects can be affected by many variables such as the positive correlation between body size and longevity, fecundity and development for *Nezara viridula* L. (Heteroptera: Pentatomidae) (McLain, 1991).

Larger or heavier *S. cincticeps* females showed higher number of egg masses and nymphs than the lighter ones which agrees with Evans (1982) and Zanuncio *et al.* (1992b) who found similar results for *P. maculiventris* and *P. nigrispinus*, respectively. Therefore, weight, length and width of the body are parameters that can be used to evaluate reproductive capacity of *S. cincticeps* because heavier females of this predator showed higher number of eggs. However, duration of the oviposition period was similar between light and heavy *S. cincticeps* females. This fact suggests that the predator concentrates its reproductive effort at the beginning of the adult period for both groups of females, without reproductive delay along its adult lifespan.

Heavier and lighter females of *S. cincticeps* showed similar longevity but McLain (1991) found different results for other Pentatomidae species. Barcelos *et al.* (1994) found higher number of eggs, egg masses, eggs/egg mass and longer oviposition period for heavier females of *Brontocoris tabidus* (Signoret) (Heteroptera: Pentatomidae) fed with *Bombyx mori* but similar longevity for heavy and light females which agrees with this research.

Differences in reproductive capacity of females of *S. cincticeps* of both weight classes showed that heavier females produced higher numbers of egg masses and total number of eggs. In spite of their similar longevity, heavier females laid egg masses more frequently than the lighter ones. Egg incubation was shorter and number of nymphs produced was higher for heavier *S. cincticeps* females. Although the quantity of stored reserves of *S. cincticeps* females was not measured, we can suggest that lighter females of this predator have lower amount of reserves, such as that found by Legaspi *et al.* (1996), what could reduce oviposition rate of these females.

Nourishment has been a constant subject matter in systems of insect rearing and studies have shown correlation between number and prey type with growth of predators. Generalist predators can feed on different prey in the field, but in the laboratory they are usually fed with a single prey type what can affect their reproductive performance such as found for *P. maculiventris* (Mukerji and LeRoux, 1969) and *Geocoris puncticeps* Say (Heteroptera: Lygaeidae) (Cohen and Urias, 1988). Therefore, Zanuncio *et al.* (2000), Beserra *et al.* (1995) and Azevedo and Ramalho (1999) recommended the use of *T. molitor* for rearing *S. cincticeps* because this predator presented higher body weight when fed with this prey. Our results reinforce the use of *T. molitor,* because heavier females of *S. cincticeps* showed better reproductive performance than the lighter ones.

S. cincticeps nymphs well fed and of good genetic potential can produce heavier females. They can present better reproductive capacity what may be due to higher quantity of stored resources and energy for reproduction besides shorter time for egg maturation. Shorter intervals between egg laying and period of egg incubation indicate that heavier females of *S. cincticeps* should be used to mass rear this predator.

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