

Biology of *Triatoma flavida* Neiva, 1911 (Hemiptera: Reduviidae) under Laboratory Conditions

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The complete life cycle of Triatoma flavida, weekly fed on hens, was studied at 28±2°C and 80±10% RH. Aspects related to hatching, life span, mortality and feeding behavior for each stage of its life cycle were evaluated. The hatching rate observed for 100 eggs was 93% with an average incubation period of 27.2 days. Sixty-two nymphs completed the cycle and the mean egg to adult development time was 230.4 days. Mean duration of 1st, 2nd, 3rd, 4th and 5th instar nymphs was 22.1, 25.3, 36.7, 49.7 and 69.4 days, respectively. The number of blood meals on each nymphal stage varied from 1 to 7. The mortality rate was 6.5% for NI, 23% for NIII and 7.5% for NV nymphs. Mean number of laid eggs per female was 283.1. Adult survival rates were 344.8±256.4 days for males and 285.3±201.8 days for females.

Key words: *Triatoma flavida* - population biology - Triatominae - life cycle

Triatoma flavida Neiva, 1911 has a restricted distribution in the countryside of Cuba, where it is the most abundant triatomine species (Jiménez-Ozete & Fuentes 1981). It has been found in human habitations (Lent & Wygodzinsky 1979, Jiménez-Ozete 1981), but there is no any record indicating that it actually colonizes in houses (Lent & Wygodzinsky 1979). It is considered a sylvatic species that is eventually attracted to houses by lights (Jiménez-Ozete 1981). The natural host of this triatomine is not known with certainty, but there are indications that it is associated with the rodent *Capromys pilorides* (Lent & Wygodzinsky 1979, Lent & Jurberg 1981) and with dogs, pigs and the bat *Artibeus jamaicensis* (Jiménez-Ozete 1981).

Up to the present, the biology and natural history of this species is almost unknown, there is only some information on the duration of its life cycle under environmental temperature (Jiménez-Ozete 1981) and the biometry of the 1st instar nymphs (Jiménez-Ozete & Fuentes 1981). As a part of a larger study on the comparative ecology of the genus *Triatoma*, the life cycle of *T. flavida* under experimental conditions is described for the first time.

MATERIALS AND METHODS

The population of *T. flavida* used in this experiment was obtained from a laboratory colony established in 1995 from triatomines captured in Cuba. The colony is maintained at the Institute

Herman Lent of the University de Los Andes, Mérida, Venezuela, where bugs are kept at 26±3°C and 85±10% RH, and fed weekly on immobilized white leghorn hens.

The life cycle described in this work is based on a cohort constituted by 100 recently laid eggs (0 to 48 h old), these were kept in 150 cm³ glass containers until all viable eggs hatched. After hatching, all 1st instar nymphs were separated individually into plastic containers (10.5 cm diameter x 20.5 cm height) lined with white filter paper and closed with cotton netting. Three days after egg hatching, the nymphs were individually offered a feed during a 3 h period each day until the first blood meal; after that they were offered a weekly feed. Specimens were maintained in a climatic chamber at 28±2°C and 80±10% RH, and were checked daily for ecdysis or death.

From the insects that completed development to the adult stage, 15 couples were placed in individual containers (10.5 cm diameter x 20.5 cm height) and kept as indicated before to determine adult survivorship and oviposition patterns.

A partial life table analysis, following Southwood (1978) was developed for the cohort.

RESULTS

Egg hatching rate was 93% with an average incubation period of 27.2 days (range 21-32 days) (Table I). Sixty-two 5th instar nymphs completed development to adult (25 males and 37 females), taking an average of 3.0 blood meals per nymphal stage (range 1-7) (Table II). The mean egg to adult development time was 230.4 days (range 182 to 272 days). Adult survival ranged from 31 to 608 days for males (mean 344.8±256.4) and from 49 to 584 days for females (mean 285.3±201.8). Mean

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number of laid eggs per female was 283.1 (range 129-402).

Mortality showed an irregular pattern. There were no mortality in the molt from 2nd to 3rd and from 4th to 5th stages; the highest mortality rate was registered in the molt from 3rd to 4th stage (Table II).

The life table analysis indicated a net reproductive rate (R_o) of 104.7 times per generation under these conditions, with an instantaneous reproductive rate (r) of 0.058 (Table III).

TABLE I

Egg to adult development cycle of *Triatoma flavida* fed weekly on hens

Stage	N	Duration in days		
		Min.	Max.	Mean±SD
Egg-NI	93	21	32	27.18±3.26
NI-NII	87	19	32	22.11±2.41
NII-NIII	87	23	40	25.29±3.01
NIII-NIV	67	33	60	36.71±4.38
NIV-NV	67	30	82	49.67±7.53
NV-AD	62	62	87	69.40±7.19
Total	62	182	272	230.36±16.89

TABLE II

Number of blood meals and stage mortality for nymphal *Triatoma flavida*

Stage	N	Number of blood meals			% mortality
		Min.	Max.	Mean±SD	
I	93	1	3	1.96±0.65	6.4
II	87	1	3	2.07±0.38	0
III	87	2	5	3.37±0.91	22.9
IV	67	2	6	3.54±0.96	0
V	67	3	7	3.79±1.07	7.4

TABLE III

Partial stage specific life table for *Triatoma flavida* (notation following Southwood 1978)

Stage	lx	dx
Egg	100	7
I	93	6
II	87	0
III	87	20
IV	67	0
V	67	5
Adult	62	62

$$R_o = \frac{\text{Number of females produced by cohort} \times \text{mean eggs laid per female}}{\text{number of eggs beginning cohort}} = 104.7$$

$$r = \log(R_o) / \text{egg-to-egg generation time} = 0.058$$

lx = number entering stage x

dx = number dying in stage x

DISCUSSION

The development cycle of triatomines is different according to species and environmental conditions, and is deeply influenced by the accessibility of adequate blood sources (Schofield 1985). Biological data are available for many species, however comparisons among studies are difficult due to large differences in experimental design, particularly with respect to temperature, humidity, feeding frequency, blood meal sources, density of insects per container, number and stage of specimens, and frequency of observations (Zárate 1983).

In this work, rearing conditions were optimized with absence of intra-specific competition during their development. Under these conditions, mean development time of *T. flavida* (230.4±16.9 days) was longer than most species of *Triatoma*. So Rabinovich (1972) registered an average development time of 141 days for *T. infestans* fed weekly on hens, and kept at 26±1°C and 60±10% RH. Feliciangeli and Rabinovich (1985) found a life cycle of 178.9 days in *T. maculata* kept at 28±1°C, 60±10% rh and fed weekly on hens. Braga et al. (1998) indicated that the life cycle of *T. rubrofasciata* fed on Swiss mice varied between 83-246 days (at 29°C, 80% RH) and 115-677 days (at 20.5 to 33°C, 91.3±4.3% RH). Martínez-Ibarra and Kathain-Duchateau (1999) reported a life cycle of 168.0±11.7 days in *T. pallidipennis* fed every three days on hens. Few studies on species of *Triatoma* have showed life cycles longer than this one; for example, Zeledón et al. (1970) observed a life cycle ranging from 257 to 411 days (mean: 320-330 days) at room temperature (22.8-24.4°C) and from 180 to 336 days (mean: 233-275 days) at 26.5°C for *T. dimidiata* fed on rabbits; and Mena-Segura et al. (1994) indicated for *T. pallidipennis*, fed every 10-12 days on hens, a mean duration of the life cycle of 411 days (range 261-581 days).

It seems evident from the data on the life cycle of *T. flavida* that in general, there is an increase in time between molts as the insect grows. This is in agreement with the data from the literature for the life cycle of other species of *Triatoma* (Lucena 1960, Zeledón et al. 1970, Jiménez-Ozete 1981, Zárate 1983, Feliciangeli & Rabinovich 1985, Martínez-Ibarra & Kathain-Duchateau 1999).

Among triatomine species molting takes place on a range of days, even for groups of insects fed to repletion simultaneously. For any species, the range from first to last molt increases with age, decreases with rising temperature, and varies greatly with blood source (Zeledón et al. 1970). For *T. flavida*, the ranges of molting from first to last individual were very long in all instars, in spite of the abundant occasions to feed, suggesting that factors as

well as physiologic variation could be implicated. Such factors might include individual rates of feeding, behavioral responses to the environment during feeding or to the host animal itself.

The average incubation period, 27.2 ± 3.3 days was very close to the registered by Jiménez-Ozete (1981) with *T. flavida* (28.7 ± 0.3 days) in the summer months (at 30°C) and higher than that found (21.0 ± 0.4 days) in the winter months (at 24°C) in Cuba. In other species of *Triatoma* the mean duration of the egg stage ranges between 17 and 29 days, so our results are one of the longest for *Triatoma* species.

Egg hatching rates in *Triatoma* species also vary. They are usually above 80% (Zeledón et al. 1970, Rabinovich 1972, Feliciangeli & Rabinovich 1985, Braga et al. 1998), although lower average hatch rates of 61.9% (Mena-Segura et al. 1994) and 60% (Martínez-Ibarra & Katthain-Duchateau 1999) have been recorded in colonies of *T. pallidipennis*. The 93% hatch rate showed here may reflect the good conditions in which the colony is kept in our laboratory.

The irregular pattern registered in the mortality rate was similar to those observed in other *Triatoma* species. The lowest mortality rate is often in the molt from third to fourth or from 4th to 5th stages (Zeledón et al. 1970, Rabinovich 1972, Feliciangeli & Rabinovich 1985, Martínez-Ibarra & Katthain-Duchateau 1999) and it is occasionally detected in the first molting (Mena-Segura et al. 1994, Braga et al. 1998). In the youngest nymphs, mortality seems to be due to failure to feed, since dead insects were usually without significant intestinal contents. On the contrary, mortality in the oldest nymphs came about essentially in the course of their molting.

The development time and the high reproductive rate could represent close to the maximum achievable for this species under optimum conditions. The calculated net reproductive rate (R_0) was considerably higher than those determined for *T. infestans*: 25.04 (Rabinovich 1972) and for *T. maculata*: 86.2 (Feliciangeli & Rabinovich 1985); although lower than the registered for *T. pallidipennis* (Martínez-Ibarra & Katthain-Duchateau 1999).

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