Feeding, Defecation, and Development Times of *Meccus longipennis* Usinger, 1939 (Hemiptera: Reduviidae: Triatominae) under Laboratory Conditions

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Aspects related to hatching, time-lapse between presenting the blood-meal and beginning of feeding, feeding time, postfeed defecation delay, mortality, and fecundity for each stage of Meccus longipennis *life-cycle were evaluated. The bugs were maintained in a dark incubator at 27 ± 1ºC and 80 ± 5% rh, were fed weekly and checked daily for ecdysis or death. The hatching rate observed for 300 eggs was 76.7% and the average time of hatching was 19.8 days. Mean time-lapse between presentation of the blood meal and the beginning of feeding was under 5 min in nymphal stages and postfeed defecation delay was under 10 min in most stages, except in fourth and fifth stages. Mean feeding time was longer than 10 min in most stages, except in fourth stage. One hundred thirty-one nymphs (N) (65.5%) completed the cycle and the average time from NI to adult was 192.6 ± 34.8 days. The average span in days for each stage was 18.1 for NI, 21.4 for NII, 29.5 for NIII, 45.5 for NIV and 55.9 for NV. The number of bloodmeals at each nymphal stage varied from 1 to 5. The mortality rate was 3.29 for NI, 6.8 for NII, 2.92 for NIII 3.76 for NIV, and 10.16 for NV nymphs. The average number of eggs laid per female in a 9-month period was 615.6. Based on our results, we conclude that* M. longipennis *has some biological and behavioral characteristics which influence its capacity of becoming infected and transmitting* Trypanosoma cruzi *to human populations in those areas of Mexico where it is currently present.*

Key words: *Meccus longipennis* - biology - ethology - laboratory conditions - Mexico

Meccus longipennis Usinger, is one of the most important vectors of Chagas disease in Mexico, because of the current presence of its populations in both domestic and wild ecotopes (WHO 2002, Martínez-Ibarra et al. 2003a), high capacity to colonize human dwellings (Martínez-Ibarra 2000, Espinoza-Gómez et al. 2002), its frequent contact with man as a blood meal source, and high infection rates with *Trypanosoma cruzi* (Magallón-Gastélum et al. 1998, Ibáñez-Bernal & Paz-Rodríguez 1999, Guzmán-Bracho 2001, Martínez-Ibarra et al. 2001a, Espinoza-Gómez et al. 2002). This species usually occurs in houses, chicken coops in villages, and sylvatic foci of Western Mexico (Magallón-Gastélum et al. 1998, Martínez-Ibarra et al. 2001a, 2003a, Espinoza-Gómez et al. 2002). In spite of the important role of *M. longipennis* in the transmission of *T. cruzi* to human populations in an extensive area of Mexico, the biology and behavior of this species is not documented.

As a part of a larger study on the ecology of *M. longipennis*, studies of the biology of this species under experimental conditions are described.

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MATERIALS AND METHODS

A laboratory colony of *M. longipennis* was established in 2001 from 134 specimens collected in Xalisco, Nayarit. The specimens were identified according to the taxonomic key of Lent and Wygodzinsky (1979). The colony was maintained at 27 ± 1ºC and 75 ± 5% relative humidity (rh) and fed weekly on immobilized leghorn hens.

Eggs were grouped by date of oviposition to initiate a cohort of 200 eggs. After eclosion, first-instar nymphs were separated individually into plastic containers (10.5 cm diameter x 20.5 cm height), with an upcenter support of absorbent cardboard. Three days after eclosion, nymphs were individually offered a feed on hens during a 1 h period until the first blood meal, after that they were offered feed weekly. Nymphs were observed from beginning feeding through 1 h postfeeding for recording feeding and defecation behaviors. The bugs were maintained in a dark incubator at 27 ± 1ºC and 80 ± 5% rh, and were checked daily for ecdysis or death.

From the insects that completed development to the adult stage, 10 adult couples were placed in individual containers (10.5 cm diameter x 20.5 cm height) and maintained as previously described to determine oviposition patterns.

The variables that showed a normal distribution were compared by Student t-test or analysis of variance (ANOVA). In the case of ANOVA tests, post hoc comparisons were made using the Scheffé test. The Wilcoxon nonparametric test was used for variables with a non-normal distribution. The chi-square test was used

for comparison of frequencies. The differences were considered to be significant when $P < 0.05$.

RESULTS

Egg eclosion rate was 76.9% with an average incubation period of 19.4 days (range 17-22 days). One hundred thirty-one nymphs completed development to the adult stage (39 males and 59 females) (Table I), taking an average of 1.7 blood meals per nymphal stage (range 1-5) (Table II). The average egg-to-adult development time was 192.6 days (range 146-241) (Table I).The average number of eggs laid per female was 615.33 (range 115-950).

Mean elapsed time between presentation of the blood meal source and the beginning of feeding was under 5 min for nymphal stages. Mean feeding time was longer than 10 min in most stages, except fourth stage (Table III). Postfeed defecation delay was under 10 min in most stages, except in fourth and fifth stages (Table IV).

TABLE I

Egg to adult development cycle of *Meccus longipennis* fed weekly on hens

		Duration in days		
Stage	Nr	Min.	Max.	Mean ± SD
Egg -NI	152	17	22	19.4 ± 0.45
NI-NII	147	14	32	18.1 ± 3.63
NII-NIII	137	13	39	21.4 ± 3.6
NIII-NIV	133	17	49	29.5 ± 7.45
NIV-NV	128	26	79	45.5 ± 11.61
NV-AD	131	27	86	55.9 ± 12.42
Total	131	146	241	192.6 ± 34.80

TABLE II

Number of blood meals and stage mortality for *Meccus longipennis*

		Nr bloodmeals			
Stage	Nr nymphs	Min.	Max.	Mean ± SD	% mortality
I	152	1	2	1.05 ± 0.23	3.3
II	147	1	2	1.49 ± 0.5	6.8
III	137	1	3	1.42 ± 0.51	2.9
IV	133	1	4	1.87 ± 0.66	3.8
V	128	1	5	2.82 ± 0.74	10.2
Total	125	-	-	-	27

A partial life table analysis, following the methods of Southwood (1978), indicates a net reproductive rate (Ro) of 221.4 times per generation under these conditions, with an instantaneous daily reproductive rate (r) of 0.011 (Table V).

TABLE IV

Postfeed defecation delay in *Meccus longipennis* fed on hens

		Postfeed defecation delay (min)		
Stage	Nr nymphs	Min	Max	Mean ± SD
I	152	0.1	20	3.47 ± 2.09
II	147	0.1	20	3.37 ± 4.01
III	137	0.5	22	5.03 ± 5.93
IV	133	0.5	28	12.15 ± 8.33
V	128	0.5	30	10.67 ± 8.55
Female	72	1	60	7.21 ± 8.34
Male	43	1	60	8.32 ± 9.75

TABLE V

Partial stage specific life table for *Meccus longipennis* (notation following Southwood 1978)

Stage	lx	Dx
Egg	200	48
I	152	5
II	147	10
III	137	4
IV	133	5
V	128	13
Adult	115	115

$$Ro = \frac{\text{Nr of females produced by cohort x mean eggs laid per female}}{\text{Nr of eggs beginning a cohort}} = 221.40$$

$r = \log(Ro)$/ egg-to-egg generation time = 0.011
Lx = No entering stage x; dx = No dying in stage x

DISCUSSION

The development cycle of a triatomine varies according to species, the specific environmental conditions and it is greatly influenced by the availability of blood sources (Schofield 1985); many species are also influenced by the kind of these sources (Guarneri et al. 2000a, b, Martínez-Ibarra et al. 2003b).

TABLE III

Mean time-lapse for beginning feeding and mean feeding times in *Triatoma longipennis* fed on hens

		Mean time (min) for starting a blood meal			Mean feeding time (min) Mean ± SD		
Stage	Nr nymphs	Min.	Max.	Mean ± SD	Min.	Max.	Mean ± SD
I	152	0.5	15	1.27 ± 2.55	4	25	15.82 ± 4.27
II	147	0.5	15	1.50 ± 1.59	4	29	13.56 ± 5.73
III	137	0.5	15	1.62 ± 2.15	4	19	11.52 ± 3.16
IV	133	0.7	17	3.32 ± 4.53	4	23	7.86 ± 3.69
V	128	0.9	20	4.57 ± 4.88	4	29	12.24 ± 6.30
Female	72	2.5	22	6.35 ± 4.52	4	25	11.83 ± 5.94
Male	43	2.5	25	10.74 ± 7.54	4	20	5.37 ± 4.71

The most important biological factors that are necessary to understand the populations dynamics of any species include: development time and mortality of immature stages; number of female progeny emerged, onset of sexual maturity, fertility and fecundity, mating habits; longevity, and rate of oviposition with respect to feeding frequency (Perlowagora-Szumlewicz 1953).

The average development time of the cohort of *M. longipennis* fed on hens (196.6 ± 15.8 days) was shorter than the average development time of some other Mexican Triatominae species, like the 897.5 days for *T. nitida* feeding weekly on mice and maintained at 28 ± 1ºC and 80 ± 5% rh (Galvão et al. 1995), than the development time of 240 days (range 180-336 days) for *T. dimidiata* feeding fortnightly on rabbits and maintained at 26.5 ± 0.5ºC and 50 ± 5% rh (Zeledón et al. 1970) and than the development time of 235.77 days for *M. mazzottii* feeding weekly on rabbits and maintained at 27 ± 2ºC and 70% rh (Malo et al. 1993). The average development time in our study was similar to development times of 196.8 ± 15.8 and 189.5 ± 22.9 days for *M. picturata* feeding weekly on hens and rabbits, respectively, and maintained under similar laboratory conditions (Martínez-Ibarra et al. 2003b). The average development time in our study was also longer than development times for other Mexican Triatominae species. Novelo-López and Martínez-Ibarra (2002) recorded an average development time of 185.6 days (range 148-226 days) for *M. pallidipennis* fed weekly on rabbits and maintained at 27 ± 1ºC and 75 ± 5% rh. Martínez-Ibarra and Katthain-Duchateau (1999) reported an average development time of 168 days (range of 131-199 days) also for *M. pallidipennis* fed weekly on rabbits and maintained at 27 ± 2ºC and 60 ± 5% rh. Martínez-Ibarra et al. (2001b) reported an average development time of 161.7 days (range of 88-325 days) for *T. dimidiata* fed weekly on rabbits and maintained at 27 ± 3ºC and 65 ± 5% rh. Zárate (1983) reported an average development time of 143.7 days for females and 205.3 for males of *T. barberi* fed every 4.2 days on rabbits and maintained at 27ºC and 60 ± 10% rh.

Egg hatching rates in Mexican triatomines are around 80% and under, as *M. longipennis* in this study (76.9%), *M. picturata* (75% and 72%) fed on rabbits and hens, respectively (Martínez-Ibarra et al. 2003b), *M. pallidipennis* (72% and 60%) fed on rabbits and hens, respectively (Martínez-Ibarra & Katthain-Duchateau 1999, Novelo-López & Martínez-Ibarra 2002), *T. dimidiata* (66.7%) (Martínez-Ibarra et al. 2001b), *T. gerstaeckeri* (65.9%) (Galaviz-Silva et al. 1991), and *M. mazzottii* (58.7%) (Malo et al. 1993). High egg hatching rates reflects how favorable were those present laboratory conditions for the development of *M. longipennis* in this study.

The lowest mortality rate was in the molt from third to fourth stage. As recorded in some other studies (Zárate 1983, Martínez-Ibarra & Katthain-Duchateau 1999, Novelo-López & Martínez-Ibarra 2002, Martínez-Ibarra et al. 2003b, Paredes et al. 2003), in the youngest nymphs (first, second and third stadia), mortality appeared to be due mainly to an incapacity to feed, since dead bugs were generally without significant intestinal content. Meanwhile, the highest mortality was between the fifth to adult, similar to *T. dimidiata* (Zeledón et al. 1970), *T. infestans* (Rabinovich 1972), *T. barberi* (Zárate 1983), *M. pallidipennis* (Martínez-Ibarra & Katthain-Duchateau 1999, Novelo-López & Martínez-Ibarra 2002), *Rhodnius neglectus* (Rocha et al. 2001a), *M. picturata* (Martínez-Ibarra et al. 2003b) and *T. rubida sonoriana* (Paredes et al. 2003). In contrast to younger nymphs, mortality in the older nymphs occurred mainly during their molting. Accumulative mortality rate in this study was significantly ($P < 0.05$) higher than those for *M. mazzottii* (Malo et al. 1993) and *T. barberi* (Zárate 1983), similar to that for *T. r. sonoriana* (Paredes et al. 2003), and lower to those for most studied Mexican triatomine species, such as *M. pallidipennis* (Martínez-Ibarra & Katthain-Duchateau 1999, Novelo-López & Martínez-Ibarra 2002), *T. dimidiata* (Martínez-Ibarra et al. 2001b) and *M. picturata* (Martínez-Ibarra et al. 2003b). On average, approximately 70% of I-IV stages, and 30% of V stage of both cohorts required one and a half meals in order to molt to the next stages.

Mean elapsed time between presentation of the blood meal and the beginning of feeding was under 5 min in nymphal stages. These shorter mean time for beginning feeding were similar to those for *R. pictipes, R. neglectus* and *R. robustus* (Rocha et al. 1994, 2001a, b) similar to those for *T. dimidiata, T. infestans* and *R. prolixus* (Zeledón et al. 1977), considered some of the most important Chagas disease vectors in America (WHO 2002) and similar to *T. barberi* (Zárate et al. 1984), *M. pallidipennis* (Novelo-López & Martínez-Ibarra 2002) and *M. picturata* (Martínez-Ibarra et al. 2003b) considered some of the most important Chagas disease vectors in Mexico (Ibáñez-Bernal and Paz-Rodríguez 1999, Guzmán-Bracho 2001, WHO 2002).

Mean feeding time was similar to *R. prolixus* (Pippin 1970), *T. barberi* (Zárate et al. 1984), *M. pallidipennis* (Martínez-Ibarra & Novelo-López 2002) and *T. picturata* (Martínez-Ibarra et al. 2003b), species considered as some of the most important vectors of transmission of *T. cruzi* to human populations in Mexico.

According to Zeledón et al. (1977), those species of triatomines that defecate during first 5-10 min after feeding could be considered potentially effective transmitters of *T. cruzi* to humans, since the assumption of contact with their victim along that period. In consequence, the youngest nymphal stadia and females of *T. longipennis* in this study could be considered as effective transmitters as *T. infestans, R. prolixus* (Pippin 1970, Zeledón et al. 1977), the most important Chagas disease vectors in America (WHO 2002).

The average net reproduction rate (Ro) for the cohort of *M. longipennis* was 221.4, significantly ($P < 0.05$) higher to that for some related Mexican triatomine species, as *M. pallidipennis* (145.4) (Martínez-Ibarra & Katthain-Duchateau 1999), *M. picturata* fed on rabbits (148.5) and fed on hens (114.7) (Martínez-Ibarra et al. 2003b) and *T. barberi* (Ro = 89.1) (Zárate 1983), all of these four species reared under similar controlled conditions. The average net Ro was higher also than that calculated for *T. infestans* reared under different controlled conditions (Ro = 25) (Rabinovich 1972).

According to most of the studied parameters on this research, the youngest stadia of *M. longipennis* could be considered as those with higher vectorial capacity. Similar results have been recorded for some correlated species, as *M. pallidipennis, T. dimidiata* and *M. picturata* (Martínez-Ibarra & Katthain-Duchateau 1999, Martínez-Ibarra et al. 2001b, 2003b, Novelo-López & Martínez-Ibarra 2002).

Most of the studied parameters could reflect the current association of *M. longipennis* to birds in wild and domestic ecotopes, as suggested by previous field studies (Magallón-Gastélum et al. 1998, Martínez-Ibarra et al 2001a, Espinoza-Gómez et al. 2002), which could facilitate their colonization of human dwellings in their distribution area. Results on the studied parameters added to above facts, lead us to conclude that *M. longipennis* could be considered an important potential vector of *T. cruzi* to human population in those areas of Mexico where is currently present.

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