

**Biological and behavioral studies of
an ovoviparous earwig, *Marava arachidis* (Yersin, 1860)
(Dermaptera; Forficulidae)**

by

P. N. Patel* and M. E. M. Habib*

(Received for publication May 24, 1978)

Abstract: The biology of *Marava arachidis*, probably a tropical species, was studied under normal laboratory conditions of temperature and relative humidity in Southeastern Brazil. The behavior of ovoviviparity as well as maternal care were observed. The embryo developed fully before the egg was laid. Hatching was facilitated by the mother eating away the chorion soon after the egg was deposited. The nymphal stage, containing four instars, lasted an average of 49 ± 0.33 days, with a maximum of 57 and a minimum of 41 days. The unmated adults showed greater longevity than the mated ones. The total life cycle of unmated individuals reached an average of 282 ± 6.95 days, while that of the mated ones 200 ± 9.16 days. Adults reached sexual maturity on an average of 8.4 ± 0.5 days.

Marava arachidis has a world-wide distribution, but nothing is known about its exact origin (Herter, 1965). Among Dermaptera, *M. arachidis* is the only ovoviparous earwig whose maternal care has been studied (Herter, 1943, 1965). Parental behavior among other earwigs was studied by Lamb (1976). The general lack of knowledge in earwig biology and behavior is probably due to three reasons: the group is largely tropical, secretive in habit and of little economic importance (Lamb, 1976).

Concerning *M. arachidis*, very little is known about its food habits and bionomy particularly in neotropical regions. Moreover, it has not been previously recorded in Brazil. Due to the significant occurrence of this species in different stored animal rations, the present study was undertaken with the purpose of revealing some of its biological and behavioral aspects.

MATERIAL AND METHODS

To obtain the culture of *Marava arachidis*, adults were collected from the rabbit vivarium (Dept. of Parasitology, UNICAMP) and reared in the laboratory of Entomology, Dept. of Zoology, UNICAMP. The study was carried out from the end of 1975 up to the end of 1976, under normal laboratory conditions of temperature and relative humidity, those of its natural habitat.

* Departamento de Zoologia, Instituto de Biologia, Universidade Estadual de Campinas (UNICAMP), Campinas, SP, 13100, Brasil.

The insect was reared during its entire life cycle on an animal ration containing corn, soybean, sun-flower, wheat flours, fish, meat, blood, bones, bone meal, vitamins and minerals, of the same type fed on by natural populations.

The breeding technique adopted by Habib & Patel (1977) was slightly modified to serve the present study. As this insect species is negatively phototropic, dark glass containers were used. The ration was offered in powder form during the first two nymphal instars and in pellets during the rest of the life cycle. In each bottle, a piece of cotton soaked with water was offered.

During the immature stages, 100 individuals were used for each experiment. For the adult stage, 20 pairs were utilized in the observations of sexual and reproductive activities, and 60 unmated adults were used for the other observations. Temperature and relative humidity were recorded daily. Normal biostatistical tests were applied to analyse the results.

RESULTS AND DISCUSSION

Embryonic development and hatching: As *Marava arachidis* is an ovoviviparous species, it was necessary to determine the duration of embryonic development. The time from the first mating until the first oviposition was between 12 and 14 days. Since the newly deposited egg contained a fully developed embryo, the minimum time necessary for the embryonic development (within the mother's body) was 12 days. Anatomical examinations of the reproductive system showed that embryonic development of the eggs of the same oviposition occurred uniformly at the same time.

The time interval between successive egg depositions averaged 9.0 minutes, with a maximum of 18 and a minimum of 2.10 minutes.

The average laboratory conditions during these observations were T = 29 C (max.), 22 C (min.) and R. H. = 75%

The first step in maternal care was demonstrated by the manner in which the nymphal emergence was facilitated by the mother eating away the membranous chorion. This behavior was also observed by Herter (1965). The present data showed that the time between egg deposition and nymphal emergence lasted an average of 9.35 minutes, with a maximum of 21.5 and a minimum of 4.3 minutes.

Nymphal stage: The young nymphs, during the first 2-4 days received another type of maternal care. Soon after emergence, the mother began to clean the young ones with its mouth parts, described by Lamb (1976) as licking. When a nymph tried to leave the others, the mother brought it back in her mandibles, also observed by Lamb (1976) and Herter (1965). The newly hatched nymphs were white except for the two black compound eyes and required an average of 1.12 hours to acquire the natural shiny black color, with a maximum of 1.20 and a minimum of 1.05 hours.

Cannibalism was observed during the present study, principally among adults. The mother eats nymphs, but never the young ones under maternal care. Only on one occasion was a female observed to eat two eggs. On this occasion the female examined the eggs with her antennae for more than an hour, but the eggs did not hatch. It is probable that these eggs were unfertilized or unviable.

The whole nymphal stage, including four instars, lasted an average of 49.08 days, with a maximum of 57 and a minimum of 41 days. The duration of each nymphal instar is presented in Table 1. The average laboratory conditions during these observations were of 28 C (max.), 23 C (min.) and 75% R. H.

TABLE 1

Duration, in days, of the different nymphal instars as well as of the whole nymphal stage of M. arachidis

Phase	$\bar{x} \pm s.d.$	Duration	
		Maximum	Minimum
1 st. instar	11.13 \pm 0.164	16	8
2 nd. instar	9.00 \pm 0.113	14	7
3 rd. instar	12.20 \pm 0.187	17	6
4 th. instar	16.75 \pm 0.222	23	11
Nymphal stage	49.08 \pm 0.327	57	41

Herter (1943) presented data for *M. arachidis*, when reared under controlled conditions (25 C), in which the total nymphal development time as well as those for the different instars are relatively less than the data of Table 1.

Adult stage: Like the majority of the univoltine insects, *M. arachidis* showed a very long adult life. Unmated adults lived longer than the mated. At the same time, unmated females presented a significantly longer life span than unmated males. In the case of mated adults, no significant differences were noted between the longevity of the two sexes. These results show that female reproductive activities reduced their life cycle. The effect of reproductive activities on adult longevity has been observed among other types of insects (Habib, 1976; Habib & Vasconcellos Neto, 1978). Detailed results for adult longevity of *M. arachidis* are presented in Table 2. The average laboratory conditions during these observations were T = 26 C (max.), 21 C (min.) and R. H. = 74%.

TABLE 2

Longevity, in days, of unmated and mated adults of the two sexes of M. arachidis

Type of adult	$\bar{x} \pm s.d.$	Longevity	
		maximum	minimum
Unmated (both sexes)	233.32 \pm 4.598	301	163
Unmated females	243.27 \pm 5.476	301	184
Unmated males	216.90 \pm 6.874	265	163
Mated (both sexes)	151.86 \pm 7.639	254	68
Mated females	152.00 \pm 12.064	254	68
Mated males	151.72 \pm 9.732	204	89

Sexual and reproductive activities: The sex ratio among adults of *M. arachidis* was calculated as 1:1. In spite of the long adult longevity, the maximum number of matings observed was 4/pair, with an average of 2.43. As mentioned before, it seems the male sexual activities did not affect longevity as much as reproduction in the females.

The time per mating averaged 114 minutes, with a maximum of 350 and a minimum of 11 minutes.

Concerning reproductive activities, it is of interest here to mention that the total number of nymphs per female is relatively small, which is common in ovoviviparous animals. Table 3 shows some results relating to sexual and reproductive activities in *M. arachidis*.

TABLE 3

Attainment of sexual maturity, pre-oviposition, oviposition and post-oviposition periods, and number of nymphs per female

Phase	$\bar{x} \pm s.d.$	Time in days	
		Maximum	Minimum
Sexual maturity	8.40 \pm 0.505	12	4
Pre-oviposition	21.53 \pm 0.609	25	13
Oviposition	52.89 \pm 7.307	105	12
Post-oviposition	82.00 \pm 12.329	158	16
No. of nymphs/female	24.56 \pm 1.214	33	15

Total life cycle: The total life cycle of *M. arachidis* is prolonged because of the high adult longevity. The life cycle of unmated females lasted longer than that of the unmated males, and no significant differences of life cycle duration were observed between mated individuals of different sexes. Detailed results are presented in Table 4.

TABLE 4

Total life cycles of mated and unmated individuals of M. arachidis

Form	$\bar{x} \pm s.d.$	Time in days	
		Maximum	Minimum
Unmated (both sexes)	282.44 \pm 6.245	348	213
Unmated females	291.36 \pm 5.592	348	232
Unmated males	267.70 \pm 6.948	315	213
Mated (both sexes)	200.58 \pm 7.629	299	113
Mated females	200.39 \pm 12.099	299	113
Mated males	200.78 \pm 9.161	254	141

Finally, it is important to mention here that the dermapterous species deserve special attention and more study in order to clarify their interesting biological and behavioral aspects and their possible economic importance, principally in stored products.

ACKNOWLEDGEMENT

Our sincere thanks to Dr. Seiroku Sakai, Daito Bunka University, Japan, for helping us in identifying the specimens.

RESUMEN

La biología de *Marava arachidis*, probablemente una especie tropical, fue estudiada bajo condiciones de humedad relativa y temperatura normales de laboratorio, en el sudeste del Brasil. Fueron observados tanto el comportamiento de ovoviviparidad como los cuidados maternos.

El embrión se desarrolló completamente antes de la postura del huevo. La madre ayuda la salida del embrión del huevo al comer el corión. La fase ninfal, conteniendo cuatro estadios, duró un promedio de $49 \pm 0,33$ días, con un máximo de 57 y un mínimo de 41 días. Los adultos no fecundados presentaron mayor longevidad que los fecundados. El ciclo total de vida de los individuos no fecundados alcanzó un promedio de $282 \pm 6,95$ días, mientras que los fecundados $200 \pm 9,16$ días. Los adultos alcanzaron la madurez sexual en promedio de $8,4 \pm 0,5$ días.

LITERATURE CITED

- Habib, M. E. M.
1976. Estudos biológicos sobre *Zelus leucogrammus* Perty, 1834 (Hemiptera, Reduviidae). *An. Soc. Ent. Bras.*, 5: 120-129.
- Habib, M. E. M., & P. N. Patel
1977. Biology of *Heliothis virescens* (Fab., 1781) (Lepidoptera, Noctuidae) on two host plants in the laboratory. *Indian J. Agric. Sci.*, 47: 537-539.
- Habib, M. E. M., & J. Vasconcellos Neto
1978. Biological studies on *Botanochara impressa* (Coleoptera, Chrysomelidae). In Press.
- Herter, K.
1943. Zur Fortpflanzungsbiologie eines lebendgebärenden Ohrwurmes (*Prolobia arachidis* Yersin). *Z. Morph. Okol. Tiere*, 40: 158-180.
- Herter, K.
1965. Vergleichende Beobachtungen und Betrachtungen über die Fortpflanzungsbiologie der Ohrwürmer. *Z. Naturforsch.*, 20: 365-375.
- Lamb, J.
1976. Parental behavior in the Dermaptera with special reference to *Forficula auricularia* (Dermaptera, Forficulidae). *Can. Ent.*, 108: 609-619.