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BIOLOGY OF *TENUIPALPUS HEVEAE*
(ACARI, TENUIPALPIDAE) ON RUBBER TREE LEAVES

by Karine J.B. PONTIER *, Gilberto J. DE MORAES ** & Serge KREITER *

**SUMMARY:** The tenuipalpid mite *Tenuipalpus heveae* Baker has caused considerable damage to leaves of rubber tree, *Hevea brasiliensis* (Muell. Arg.), in parts of central and southern Brazil. The development and the reproduction of *T. heveae* were studied under laboratory condition at 28°C in the light phase (12 h), 25°C in the dark phase and 70±10% RH, on excised leaves of rubber tree clone PB 260. The egg stage was almost as long as the mobile immature stages combined, and the total duration of the pre-imaginal phase was ca. 30 days. This duration is comparable to the observations led on for other tenuipalpid species. The peak oviposition rate was ca. 1.4 eggs per female per day, and the average fecundity was 34 eggs per female. Females corresponded to ca. 85±0.4% of the population. The intrinsic rate of increase was 0.08 egg/female/day and the mean generation time, 44.5 days. The low value of rm and the high population levels observed in parts of the area of distribution of *T. heveae* indicate the absence of effective natural enemies of that species.

**RéSUMÉ:** Le tenuipalpide *Tenuipalpus heveae* Baker cause d'importants dégâts aux feuilles de l'Hévéa, *Hevea brasiliensis* (Muell. Arg.), dans certaines parties au Centre et au Sud du Brésil. Le développement et la reproduction de *T. heveae* ont été étudiés en conditions contrôlées de laboratoire, à 28°C durant la photophase (12 h), 25°C durant la scotophase et 70±10% RH, sur des feuilles d'Hévéa du clone PB 260. La durée du stade œuf est pratiquement aussi longue que la durée de développement de tous les stades immatures et la durée totale du développement pré-imaginal est de 30 jours. Cette durée de développement est comparable aux observations menées par d'autres auteurs sur d'autres espèces de tenuipalpides. Le taux maximum de ponte est de 1,4 œufs par femelle et par jour, et la fécondité moyenne est de 34 œufs par femelle. Les femelles représentent 85±0.4% de la population. Le taux intrinsèque d’accroissement rm est de 0,08 femelle par femelle et par jour et la durée moyenne d’une génération 44,5 jours. La faible valeur du rm et les niveaux de populations importants observés dans toute l’aire de distribution de *T. heveae* indiquent l’absence d’ennemis naturels efficaces de cette espèce.

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INTRODUCTION

The phytophagous mite *Tenuipalpus heveae* Baker is only known from leaves of rubber tree, *Hevea brasilensis* (Muell. Arg.) (Euphorbiaceae), in the Brazil. The original description by Baker (1945) was based on females collected in Belterra, State of Pará; Flechtmann (1979) reported it in Belém, in the same State; Flechtmann and Arleu (1984) reported it in Manaus, State of Amazonas. All of those places are located in northern Brazil. Later reports referred to its occurrence in central and southern Brazil. Thus, Feres (1998) reported a heavy defoliation caused by this species in São José do Rio Preto, State of São Paulo, whereas Pontier and Flechtmann (1999, 2000) reported it in Pontes e Lacerda, State of Mato Grosso and Barretos, State of São Paulo.

We observed heavy infestations by *T. heveae* in Pontes e Lacerda, causing considerable leaf rusting followed by plant defoliation, probably with a consequent reduction in yield. Nothing is known about the biology of this species. Thus, the objective of the present work was to study the development and reproduction of *T. heveae*.

MATERIALS AND METHODS

**Experimental conditions**

Healthy leaves of *H. brasilensis* clones GT1 and PB 260 were used as rearing substrates to maintain a stock colony initiated with mites collected by M. Tanzini in Pindorama, State of São Paulo, just before this study was initiated in April 1999. The leaves were kept in open PETRI dishes whose base was covered with a layer of cotton permanently soaked in distilled water. Preliminary observations resulted in heavy mite mortality when the leaves were maintained in closed PETRI dishes, possibly as an effect of high humidity. For this reason, all further observations were conducted in open PETRI dishes, kept in an incubator at $28^\circ$C in the light phase (12 h), $25^\circ$C in the dark phase (12 h) and $70\pm10\%$ RH.

**Immature development**

Approximately 40 adult females were put on an entire, mature, healthy rubber tree leaf maintained in a PETRI dish, similarly to what was reported previously. Six hours later, the females were transferred to a new leaf. The operation was repeated until enough eggs were obtained to start the observations on the life cycle. Preliminary observations indicated that the duration of the egg stage was over 10 days, and that excised rubber tree leaves could remain in apparently good physiological condition for at least that period. Thus, in this work, the leaf substrate around each egg laid was cut on the eleventh day of incubation, and the egg plus the adherent substrate were transferred to one of the 4-square-centimeter rearing arenas delineated with a sticky material on a new rubber tree leaf of clone PB 260. Preliminary trials had resulted in considerable egg mortality when eggs where handled otherwise. The leaf was also maintained in a PETRI dish, as previously reported. The mites were transferred to new rearing arenas upon the first sign of leaf deterioration. Two observations were conducted daily (at 8:00 a.m. and 4:30 p.m.), under a stereomicroscope.

**Reproduction**

Upon reaching adulthood, females were transferred to new arenas. A male was then added to each arena for one day. Daily observations were conducted to determine egg laying and survival.

Sex ratio was determined for periods of 5 days for each of the ovipositing females. Thus, females were maintained on each arena for such periods, after which they were transferred to new similar arenas, repeating the process until the death of the females. Immatures were reared to adulthood for sex determination, transferring them to new arenas whenever necessary.

**Life table**

The life table was constructed considering the females of the cohort studied.

This life table has permitted to calculate the parameters $R_0$, $T$, $r_m$ and $\lambda$.

- $R_0 = \Sigma (lx.mx)$,
- $T = \Sigma (x.lx.mx)/\Sigma (lx.mx)$,
- $r_m = \log R_0/0.4343T$
- $\lambda = \exp(r_m)$
with:
- \( x \), the age (with 0.5 for the day when eggs had been laid),
- \( lx \), the survival,
- \( mx \), the number of female descendants per female at \( x \),

**RESULTS**

**Immature development**

Eggs were deposited singly but because females were frequently found close together, the eggs were often clustered mainly along the mid rib or in other protected places. They seemed to be glued to the leaf surface, what was probably the reason why mortality increased when eggs were handled. During incubation, eggs are initially reddish, become pale-reddish just before hatching. Larvae are yellowish when newly emerged, becoming orange just before moult ing. Nymphs are reddish with black patches which can be seen through the integument of the idiosoma. HARAMOTO (1969) interpreted them as resulting from the accumulations of food and waste matter inside the body. Larvae, protonymphs and deutonymphs had an active phase followed by a quiescent phase, the latter consistently and slightly longer than the former. Immatures were apparently fastened to the substrate when in the quiescent phase; if moved from the place it became quiescent, many of the mites were malformed when moult ing to the following stage. Just before moulting, the skin became glassy and a transverse rupture between the propodosoma and the hysterosoma initiated dorsally and progressed to encircle the body.

Thirty five out of 107 individuals reached the adult stage, with a corresponding ca. 33% viability of immatures (Table 1). Mortality was higher in the larval stage, with only ca. 54% of the larvae reaching the protonymphal stage. Egg was the longest stage (ca. 14 days). Larvae and protonymphs had similar duration (ca. 5 days), whereas deutonymphal stage was slightly longer (ca. 6 days). The total duration of the immature phase was ca. 30 days.

**Reproduction**

Three observations of mating were led. The male moved underneath the female and bent the opisthosoma upward to contact the posterior end of the female's opisthosoma. The pair remained in copula for ca. 10 minutes. For unknown reasons, some of the adult females (ca. 45%) never oviposited. Females were bright orange immediately after reaching adulthood, turning black reddish after starting to oviposit or bright red if they never oviposited. Preoviposition, oviposition and postoviposition periods lasted ca. 4.4, 23.8 and 0.4 days (Table 1). Most of the females (87%) died during the oviposition period.

Average fecundity was ca. 34 eggs/female. Longevity was about the same for ovipositing and non-ovipositing females (Figure 1). Oviposition increased slowly to reach a peak ca. 5-10 days from the beginning, before starting to decrease again.

![Survival and oviposition of Tenuipalpus haveae on leaves of Hevea brasilienis clone PB 260, at 28°C in the light phase (12 h), 25°C in the dark phase (12 h) and 70±10% RH.](image)

The proportion of females obtained in this study was 85 ± 4%. The intrinsic rate of natural increase \((r_m)\) and the finite rate increase \((\lambda)\) were 0.08 and 1.085 ± 0.05, respectively, whereas the net reproductive rate was 4.46 ± 0.02.
TABLE 1: Development and reproduction of *Tenuipalpus heveae* on leaves of *Hevea brasiliensis* clone PB 260, at 28° C in the light phase (12 h), 25° C in the dark phase (12 h) and 70± 10% RH.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Duration (days)</th>
<th>n</th>
<th>Survival (%)</th>
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<tbody>
<tr>
<td><strong>IMMATURES</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Egg</td>
<td>11.5</td>
<td>13.7</td>
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<td>Larva</td>
<td>3.5</td>
<td>4.9</td>
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<tr>
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<td>1.9</td>
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<tr>
<td>Quiescent</td>
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<td>2.4</td>
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</tr>
<tr>
<td>Protonymph</td>
<td>4</td>
<td>4.6</td>
<td>48</td>
</tr>
<tr>
<td>Active</td>
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</tr>
<tr>
<td>Quiescent</td>
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<td>2.5</td>
<td></td>
</tr>
<tr>
<td>Deutonymph</td>
<td>5</td>
<td>5.8</td>
<td>44</td>
</tr>
<tr>
<td>Active</td>
<td>1.5</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>Quiescent</td>
<td>2</td>
<td>3.3</td>
<td></td>
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<tr>
<td>Egg to adult</td>
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<td>35</td>
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<td><strong>ADULT FEMALES</strong></td>
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<td>Preoviposition</td>
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<tr>
<td>Oviposition</td>
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<td>23.8</td>
<td>-</td>
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<tr>
<td>Postoviposition</td>
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<td>-</td>
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<tr>
<td>Longevity (ovipositing females)</td>
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<td>28.5</td>
<td></td>
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<td>Longevity (no ovipositing females)</td>
<td>4</td>
<td>23.6</td>
<td>15</td>
</tr>
<tr>
<td>Fecundity</td>
<td>8</td>
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</table>

**DISCUSSION AND CONCLUSION**

There are few reports in the literature in relation to the biology of mites of the family Tenuipalpidae. GONçIN Jr. and DE OLIVEIRA (personal communication) studied the biology of *Tenuipalpus pacificus* Baker and also observed a relatively long developmental period, as observed in this study for *T. heveae*. Long developmental periods have also been observed by HARAMOTO (1969), CHIAVEGATO (1986) and TRINDADE & CHIAVEGATO (1994) for *Brevipalpus* species. Mites in the family Tetranychidae, which as Tenuipalpidae belong to the superfamily Tetranychioidea, have developmental periods considerably shorter (JEPPSON et al., 1975; SABELIS, 1985). The long developmental period and the relatively high mortality of immatures are most probably the factors responsible for the low intrinsic rate of increase obtained in this study. Details about molting, observed in this study, are similar to what was also reported by HARAMOTO (1969), ZAHER et al. (1974) and WAHAB et al. (1974), for other species of Tenuipalpidae.

It is interesting that despite having a calculated low intrinsic rate of increase *T. heveae* be still found in high population levels on rubber tree leaves in areas of Goiás and Mato Grosso do Sul. This apparent discrepancy could be related to two factors. First, the low intrinsic rate of increase calculated in the present study could indicate that the experimental condition was not as favorable as that experienced by the mite in fields of those regions. Alternatively, or complementarily, the high population levels of *T. heveae* could indicate absence of efficient natural enemies of that mite in those places, to check its population during the 4-5 generations that could develop there between December and April, the period in which rubber tree leaves would be physiologically suitable for development of *T. heveae* in those field. High immature mortality has also been reported by CHIAVEGATO (1986) for *B. phoenicis*.

The actual economic importance of *T. heveae* is still under investigation. Determining its real impact to rubber trees is rather difficult task not only
because its host is a perennial plant, but also because of its usual co-occurrence with other mites and insects also found in high population levels on leaves of rubber tree. The results of the present study are being used for the establishment of experimental set ups to determine the effect of _T. heveae_ on physiological parameters of rubber tree under controlled condition.

**REFERENCES**


