



Life table of the red spider mite *Tetranychus bastosi* (Acari: Tetranychidae) on different host plants

R. Pereira de Lima, Marcello M. Bezerra, Gilberto J. de Moraes, Imelda Furtado

► To cite this version:

R. Pereira de Lima, Marcello M. Bezerra, Gilberto J. de Moraes, Imelda Furtado. Life table of the red spider mite *Tetranychus bastosi* (Acari: Tetranychidae) on different host plants. *Acarologia*, 2017, 57 (3), pp.601-605. 10.24349/acarologia/20174177 . hal-01535779

HAL Id: hal-01535779

<https://hal.science/hal-01535779>

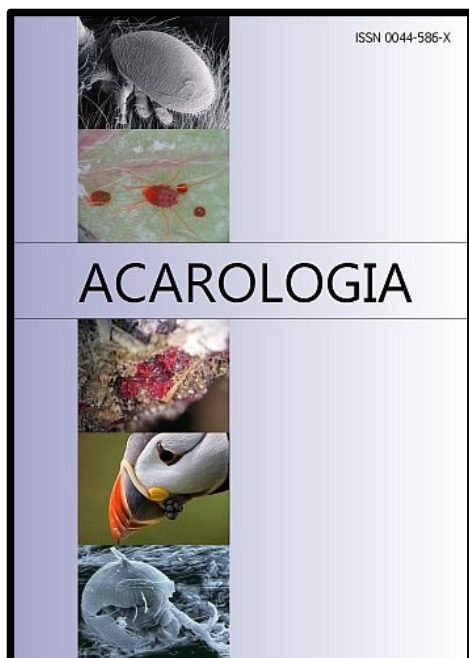
Submitted on 9 Jun 2017

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution - NonCommercial - NoDerivatives 4.0 International License



ACAROLOGIA

A quarterly journal of acarology, since 1959
Publishing on all aspects of the Acari

All information:



<http://www1.montpellier.inra.fr/CBGP/acarologia/>
acarologia@supagro.inra.fr



**Acarologia is proudly non-profit,
with no page charges and free open access**

Please help us maintain this system by
encouraging your institutes to subscribe to the print version of the journal
and by sending us your high quality research on the Acari.

Subscriptions: Year 2017 (Volume 57): 380 €

<http://www1.montpellier.inra.fr/CBGP/acarologia/subscribe.php>

Previous volumes (2010-2015): 250 € / year (4 issues)

Acarologia, CBGP, CS 30016, 34988 MONTFERRIER-sur-LEZ Cedex, France

The digitalization of Acarologia papers prior to 2000 was supported by Agropolis Fondation under the reference ID 1500-024 through the « Investissements d'avenir » programme (Labex Agro: ANR-10-LABX-0001-01)



Acarologia is under **free license** and distributed under the terms of the Creative Commons-BY-NC-ND which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original author and source are credited.

Life table of the red spider mite *Tetranychus bastosi* (Acari: Tetranychidae) on different host plants.

Renata PEREIRA DE LIMA¹, Marcello M. BEZERRA¹, Gilberto J. de MORAES² and Imeuda FURTADO^{1✉}

(Received 01 August 2016; accepted 03 January 2017; published online 16 May 2017; edited by Olivier BONATO)

¹Departamento de Ciências Biológicas, URCA, 63.100-000 Crato, CE, Brazil. renata.iguatu@bol.com.br, marcelomuniz.40@gmail.com,
(✉) ipfurtado@yahoo.com.br

²Departamento Entomologia e Acarologia, ESALQ-USP, 13.418-900 Piracicaba, SP, Brazil; CNPq. moraesg@usp.br

ABSTRACT — *Tetranychus bastosi* Tuttle, Baker & Sales was described from Ceará state, northeastern Brazil. It has so far been reported from 25 plant species, among which cassava (*Manihot esculenta* Crants), common bean (*Phaseolus vulgaris* L.) and papaya (*Carica papaya* L.). Although there is no information about its impact on crop yield, high population levels have been observed on some crops, leading to suppose that damage might occur in some occasions. In this study, fertility life table parameters were calculated for *T. bastosi* on cassava, common bean and papaya at 25 ± 2 °C, $70 \pm 5\%$ RH and photoperiod of 12/12 h. The best performance of *T. bastosi* occurred on *C. papaya* and *P. vulgaris*, on which the intrinsic rate of population increase reached 0.184 and 0.183 female/female/day, respectively. These results agree with the most common occurrence of this mite on papaya and on common bean than on cassava.

KEYWORDS — biology; phytophagous mite; performance; *Carica papaya*; *Phaseolus vulgaris*; *Manihot esculenta*

INTRODUCTION

Tetranychus bastosi Tuttle, Baker & Sales was originally described from specimens collected on red mulberry, *Morus rubra* L. (Moraceae), in Crato, Ceará state, Brazil (Tuttle *et al* 1977). It now seems to be widespread in that country, where it has been reported from the northern, northeastern and southeastern regions; it still has not been reported from other countries (Migeon & Dorkeld 2006). *Tetranychus bastosi* has been found on 25 plant species (Bastos *et al* 1979, Moraes & Flechtmann 1980, 1981, Bolland *et al* 1998, Santos *et al* 2010, Mendonça *et al* 2011, Sarmiento *et al* 2011, Cruz *et al* 2012, Lofego *et al* 2013, Rosado *et al* 2014). It has been mentioned as a potential pest of some crops (Moraes & Flechtmann 2008,

Santos *et al* 2010). Among the plants cultivated in northeastern Brazil, *T. bastosi* seems to reach particularly higher levels on bean (*Phaseolus vulgaris* L.) plants. The biology of this mite was studied on *Jatropha curcas* L. (Euphorbiaceae) (Pedro Neto *et al* 2013), which has been considered for cultivation in several tropical countries for biodiesel production (Openshaw, 2000).

Thus, the objective of this paper was to compare the biotic potential of *T. bastosi* on bean plants and two other plant species onto which it has been found, namely cassava (*Manihot esculenta* Crantz) and papaya (*Carica papaya* L.), all important crops in Brazil. Our hypothesis was that *T. bastosi* has a better biological performance on bean than on

those other plant species. Although there is no official information on the economic importance of this mite species, it has become increasingly common in northeastern Brazil and information about their biology are necessary for their management.

MATERIALS AND METHODS

Approximately 300 specimens of *T. bastosi* were collected from *Turnera subulata* Sm. (Turneraceae), in Crato (7°05'S – 39°40'W and 461 m altitude), Ceará state. These were used to establish stock colonies on cassava, common bean and papaya plantlets. The colonies were maintained separately for at least three months before the beginning of the evaluations, in a greenhouse, at ambient conditions. Tests were conducted at 25 ± 2 °C, $70 \pm 5\%$ RH and photoperiod of 12/12 h.

To obtain the eggs to start the evaluations, a group of 50 females was transferred from each stock colony to separate experimental units consisting of a piece (4 x 4 cm) of a leaf of the respective plant species onto which they had been held, placed with the abaxial surface up onto a disk of polyethylene foam mat in a Petri dish. The edges of the leaf piece were covered by a strip of cotton wool that contacted the polyurethane mat, which was maintained wet by daily addition of distilled water.

Eight hours later, the females were removed and the eggs laid were observed every 8 h to determine survivorship and duration of embryonic development. After hatching, each larva was isolated in an experimental unit similar to that described in the previous paragraph. Post-embryonic immatures were also observed every 8 h to determine survivorship and duration of each stage. After adult emergence, males were kept in isolation, whereas one male from the stock colony was transferred to each unit containing a recently molted female. When dead, males were replaced by new males from the same source. Oviposition level was determined by daily examination of each unit. The experimental units were replaced periodically (every third to fourth day) to ensure adequate physiological conditions of leaf piece. The progeny of each female was

reared separately to adulthood to determine sex ratio.

Data analysis was done within a completely randomized design, with three treatments, each corresponding to a plant species, and each replicate corresponding to one mite. The test was initiated with 142 eggs when the substrate was *P. vulgaris* and 125 eggs on each of the other substrates. Data were tested for normality and homogeneity of variance and subsequently subjected to variance analysis and compared by Tukey's HSD test (5% significance level), using the software GraphPad Prism 5 version.

Fertility life tables were prepared according to Birch (1948). Biological parameters and estimates for their variances were calculated by "LifeTable SAS" (SAS Institute 1999-2001), adapted by Maia *et al* (2000). Biotic parameters were compared by Student's *t* tests.

TABLE 1: Mean duration (\pm Standard Error) in days of the immature stages of *Tetranychus bastosi* on three different host plants, at 25 ± 2 °C, $70 \pm 5\%$ RH and 12h/12h photophase. Number in parenthesis below each host plant indicates respectively the number of females and males reaching adulthood.

Stage	Host Plants		
	<i>P. vulgaris</i> (122; 14)	<i>C. papaya</i> (93; 18)	<i>M. esculenta</i> (86; 20)
Females			
Egg	4.5 \pm 0.02 a	4.5 \pm 0.05 a	4.9 \pm 0.02 b
Larva	2.4 \pm 0.05 a	2.5 \pm 0.05 a	2.8 \pm 0.12 b
Protonymph	2.1 \pm 0.07 ab	1.8 \pm 0.10 a	2.3 \pm 0.14 b
Deutonymph	1.8 \pm 0.07 a	1.8 \pm 0.11 a	1.8 \pm 0.15 a
Egg – adult	10.5 \pm 0.29 a	11.2 \pm 0.18 a	12.3 \pm 0.24 b
Males			
Egg	4.5 \pm 0.08 a	4.8 \pm 0.20 a	4.9 \pm 0.05 a
Larva	2.4 \pm 0.11 a	2.3 \pm 0.09 a	3.1 \pm 0.23 b
Protonymph	1.6 \pm 0.11 a	2.0 \pm 0.09 a	2.3 \pm 0.15 b
Deutonymph	1.8 \pm 0.23 a	2.2 \pm 0.15 a	2.5 \pm 0.23 a
Egg – adult	10.3 \pm 0.81 a	11.7 \pm 0.25 a	13.4 \pm 0.32 b
Females and Males			
Egg	4.5 \pm 0.02 a	4.6 \pm 0.05 a	4.9 \pm 0.01 b
Larva	2.4 \pm 0.04 a	2.5 \pm 0.04 a	2.8 \pm 0.10 b
Protonymph	2.0 \pm 0.07 ab	1.9 \pm 0.08 a	2.3 \pm 0.12 b
Deutonymph	1.8 \pm 0.06 a	1.9 \pm 0.10 a	2.0 \pm 0.13 a
Egg – adult	10.5 \pm 0.28 a	11.3 \pm 0.16 a	12.5 \pm 0.21 b

Means followed by the same letters in each line do not differ by Tukey's test ($P < 0.05$).

TABLE 2: Mean duration (\pm Standard Error) in days of the different periods of *Tetranychus bastosi* adult female reared on three different host plants at $25 \pm 2^\circ\text{C}$, $70 \pm 5\%$ RH and 12h/12h photophase.

Host	Periods				
	N°	Pre-oviposition	Oviposition	Post-oviposition	Longevity
<i>P. vulgaris</i>	41	1.6 ± 0.1 a	8.2 ± 0.4 a	0.0 ± 0.0 a	16.9 ± 0.6 a
<i>C. papaya</i>	40	1.8 ± 0.1 a	9.5 ± 0.5 a	0.3 ± 0.2 b	18.5 ± 0.6 b
<i>M. esculenta</i>	40	2.0 ± 0.2 a	8.2 ± 0.5 a	0.7 ± 0.2 b	13.0 ± 0.6 a

Means followed by the same letters in each column do not differ by Tukey's test ($P < 0.05$).

RESULTS

For females and males, durations of each stage and of the whole immature phase were generally similar on the different host plants, although significant differences were observed for some developmental stages and in those cases the longest durations were observed on *M. esculenta* ($F_{(0.823)} = 772$, $P < 0.0001$) (Table 1).

Development from egg to adult female ranged from 10.5 days on *P. vulgaris* to 12.3 days on *M. esculenta*, whereas development from egg to adult male ranged from 10.3 days on *P. vulgaris* to 13.4 days on *M. esculenta*. Consequently, a similar pattern was observed when females and males were considered together, with durations from egg to adult ranging from 10.5 days on *P. vulgaris* to 12.5 days on *M. esculenta*.

No significant differences were observed for the durations of pre-oviposition and oviposition periods on the different host plants, but the duration of the post-oviposition period was significantly shorter on *P. vulgaris* ($F_{(2,118)} = 5.37$, $P < 0.0059$) and longevity was longer on *C. papaya* ($F_{(2,98)} = 1.54$, $P < 0.219$) (Table 2).

Total fecundity and daily oviposition rate were significantly higher on *C. papaya* (respectively $F_{(2,118)} = 14.16$, $P < 0.0001$ and $F_{(2,118)} = 56.60$, $P < 0.0001$) (Table 3).

These parameters were almost twice as high on *C. papaya* as on *M. esculenta*, and intermediate in *P. vulgaris*. Sex ratio (proportion of females) was high on the three host plants in both parental and F1 generations, ranging between 0.80 and 0.89.

TABLE 3: Oviposition (\pm SE) and sex ratio (% females) of *Tetranychus bastosi* on three different host plants at $25 \pm 2^\circ\text{C}$, $70 \pm 5\%$ RH and 12h/12h photophase.

Host plants	Eggs/female	Eggs/female/day	Sex ratio	
			Parental	F ₁
<i>P. vulgaris</i>	36.1 ± 2.5 a	1.5 ± 0.1 b	0.89	0.88
<i>C. papaya</i>	50.6 ± 4.4 b	2.1 ± 0.2 c	0.80	0.88
<i>M. esculenta</i>	26.5 ± 2.2 a	1.1 ± 0.1 a	0.81	0.86

Means followed by the same letters in each column do not differ by Tukey's test ($P < 0.05$).

Calculated life table parameters (Table 4) showed best performance of *T. bastosi* on *C. papaya* and *P. vulgaris*, which was compatible with the significant slower immature development and lower reproduction rates on *M. esculenta*.

TABLE 4: Biological parameters of *Tetranychus bastosi* reared on three different host plants, $25 \pm 2^\circ\text{C}$, $70 \pm 5\%$ RH and 12h/12h photophase.

Biological Parameters	Host Plants		
	<i>C. papaya</i>	<i>P. vulgaris</i>	<i>M. esculenta</i>
R_0	32.0 b (29.2 - 34.8)	25.4 b (23.6 - 27.2)	16.8 a (15.4 - 18.2)
T	18.9 a (18.4 - 19.1)	17.7 a (17.3 - 17.9)	22.1 a (21.5 - 22.3)
r_m	0.184 b (0.181 - 0.188)	0.183 b (0.180 - 0.186)	0.128 a (0.125 - 0.132)
l	1.20 b (1.19 - 1.21)	1.20 b (1.19 - 1.20)	1.13 a (1.13 - 1.14)
Dt	3.8 a (3.7 - 3.8)	3.8 a (3.7 - 3.8)	5.4 b (5.2 - 5.5)

Means (Confidence Interval- 95%) followed by the same letter in the same line, do not differ by comparisons of treatments two by two with confidence interval at 95% probability after estimating errors by the Jackknife method.

In summary, *T. bastosi* had higher net reproductive rates (R_0 respectively 32.0 and 25.4), intrinsic

rate of population increase (r_m 0.184 and 0.183) and finite rate of population increase (λ both 1.20), and shorter doubling time (Dt both 3.8) on *C. papaya* and *P. vulgaris*, respectively.

DISCUSSION

The results indicated that papaya and common bean were the best hosts for *T. bastosi*, allowing quicker development of the immature stages and higher oviposition rates. These partially confirmed our hypothesis. Biotic parameters determined on those hosts were lower than determined by Pedro Neto *et al* (2013) for the same mite species on *J. curcas*, but their study was conducted at slightly higher temperature (26 °C). Yet, the population growth was higher than determined for another world important tetranychid pest, the two spotted spider mite, *Tetranychus urticae* Koch, on several plant species (Modarres Najafabadi *et al* 2014; Riahi *et al* 2013; Silva *et al* 2009; Fazlul Hoque *et al* 2008). *Tetranychus urticae* is an important pest of papaya and common bean in Brazil. However, in the drier areas of northeastern Brazil, *T. bastosi* occurs more frequently on irrigated *C. papaya* than *T. urticae* and may cause significant damage to this crop (Moraes & Flechtmann 1980; Moraes & Flechtmann 2008).

In the urban area of Piracicaba, São Paulo state, in southeastern Brazil, *T. bastosi* has been found in large populations on *Amaranthus* sp. and *Turnera* sp. during the dry season, leaving other neighboring plant species untouched. Quite often, the phytoseiid mite *Neoseiulus idaeus* Denmark & Muma is found on those plants preying upon the different stages of *T. bastosi*, as reported by Moraes & McMurtry (1983) in northeastern Brazil. Preliminary trials conducted in greenhouses have shown that when infested leaves are transferred from those plants onto common bean plants, the mite attain high population levels. *Tetranychus bastosi* may actually be more widespread than presently known, given its great morphological similarity with other red species of tetranychid mites, from which they can be separated by the shape of the male aedeagus (Tuttle *et al* 1977).

ACKNOWLEDGEMENTS


This study was supported by a grant of Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – CAPES. We thank M. F. C. Barbosa for her help in the life table analyses and Programa de Pós-graduação em Bioprospecção Molecular – PPBM/URCA for the logistic support.

REFERENCES

- Bastos J. M., Flechtmann C. H. W., Figueredo R. W. 1979 — Subsídios para o conhecimento das pragas da maniçoba. — Fitossanidade, 3(1): 45-46.
- Birch L. C. 1949. — The intrinsic rate of natural increase of an insect population. — J. Anim. Ecol., 17: 15-26. doi:10.2307/1605
- Bolland H. R., Guterrez J., Flechtmann C. H. W. 1998. — World Catalogue of the spider mite family (Acari: Tetranychidae). — Leiden: Brill Publisher pp. 392.
- Cruz W. P., Sarmiento R. A., Teodoro A. V., Erasmo E. A. L., Marçal Neto P., Ignacio M., Fontenele Junior D. F. 2012. — Acarofauna em cultivo de pinhão-mansão e plantas espontâneas associadas. — Pesq. Agropec. Bras., 47(3): 319-327. doi:10.1590/S0100-204X2012000300002
- Fazlul Hoque M., Islam W., Khalequzzaman M. 2008. — Life table of two-spotted spider mite *Tetranychus urticae* Koch (Acari: Tetranychidae) and its predator *Phytoseiulus persimilis* Athias-Henriot (Acari: Phytoseiidae). — J. Bio-Sci., 16: 1-10.
- Lofego A. C., Rezende J. M., Verona R. L. C., Feres R. J. F. 2013. — Mites (Acari) associated with three species of the genus *Jatropha* (Euphorbiaceae) in Brazil, with emphasis on *Jatropha curcas*. — Syst. Appl. Acarol., 18(4):411- 423.
- Maia A. H. N., Luiz A. J. B., Campanhola C. 2000. — Statistical inference on associated fertility life table parameters using Jackknife technique: computational aspects. — J. Econ. Entomol., 93: 511-518. doi:10.1603/0022-0493-93.2.511
- Mendonça R. S., Navia D., Diniz I. R. 2011. — South American spider mites: new hosts and localities. — J. Insect. Sci., 11: 121. doi:10.1673/031.011.12101
- Migeon A., Dorkeld F. — Spider Mites Web: a comprehensive database for the Tetranychidae [Internet] -[15 June 2009]. Montpellier: INRA/CBGP; [25 Oct. 2015] Available from: <http://www1.montpellier.inra.fr/CBGP/spmweb/>
- Modarres Najafabadi S. S., Vafaei Shoushtari R., Zamani A. A., Arbabi M., Farazmand H. 2014. — Life parameters of *Tetranychus urticae* (Acari: Tetranychidae) on six common bean cultivars. — J. Econ. Entomol., 107(2): 614-622. doi:10.1603/EC11205

- Moraes G. J., Flechtmann C. H. W. 1980. — Paralelo entre dois complexos Euphorbiaceae – Tetranychidae (Acari) no Nordeste e Sudeste do Brasil. — An. Esc. Super. Agric. Luiz de Queiroz, 37(2): 743-745. doi:10.1590/S0071-12761980000200011
- Moraes G. J., Flechtmann C. H. W. 1981. — Ácaros fitófagos do Nordeste do Brasil. — Pesq. Agropec. Bras., 16: 177-186.
- Moraes G. J., Flechtmann C. H. W. 2008. — Manual de Acarologia: Acarologia Básica e Ácaros de Plantas Cultivadas no Brasil. — Holos Publisher, pp. 288.
- Moraes G. J., McMurtry J. A. 1983. — Phytoseiid mites (Acarina) of northeastern Brazil with descriptions of four new species. — Int. J. Acarol., 9: 131-148. doi:10.1080/01647958308683326
- Openshaw K 2000 — A review of *Jatropha curcas*: an oil plant of unfulfilled promise. — Biomass Bioenergy, 19:1–15. doi:10.1016/S0961-9534(00)00019-2
- Pedro Neto M., Sarmiento R. A., Oliveira W. P., Picanço M. C., Erasmo E. A. L. 2013. — Biologia e tabela de vida de ácaro-vermelho *Tetranychus bastosi* em pinhão-manso. — Pesq. Agropec. Bras., 48(4): 353-357. doi:10.1590/S0100-204X2013000400001
- Riahi E., Shishehbor P., Nemati A. R., Saeidi Z. 2013. — Temperature effects on development and life table parameters of *Tetranychus urticae* (Acari: Tetranychidae). — J. Agr. Sci. Tech., 15: 661-672.
- Rosado J. F., Sarmiento R. A., Pedro-Neto M., Galdino T. V. S., Marques R. V., Erasmo E. A. L., Picanço M. C. 2014. — Sampling plans for pest mites on physic nut. — Exp. Appl. Acarol., 63: 521-534. doi:10.1007/s10493-014-9804-0
- Santos H. O., Silva-Mann R., Boari A. J. 2010. — *Tetranychus bastosi* Tuttle, Baker & Sales (Prostigmata: Tetranychidae) mites on *Jatropha curcas* (Linnaeus) in Sergipe State, Brazil. — Comun. Sci., 1(2): 153-155.
- Sarmiento R. A., Rodrigues D. M., Faraji F., Erasmo E. A. L., Lemos F., Teodoro A. V., Kikuchi W. T., Santos G. R., Pallini A. 2011. — Suitability of the predatory mites *Iphiseiodes zuluagai* and *Euseius concordis* in controlling *Polyphagotarsonemus latus* and *Tetranychus bastosi* on *Jatropha curcas* plants in Brazil. — Exp. Appl. Acarol., 53: 203-214. doi:10.1007/s10493-010-9396-2
- SAS Institute. SAS/STAT User's guide, version 8.02, TS level 2MO. SAS Institute Inc., Cary, NC. 1999-2001.
- Silva E. A., Reis P. R., Carvalho T. M. B., Altoé B. F. 2009. — *Tetranychus urticae* (Acari: Tetranychidae) on *Gerbera jamesonii* Bolus and Hook (Asteraceae). — Braz. J. Biol., 69(4): 1121-1125. doi:10.1590/S1519-69842009000500016
- Tuttle D. M., Baker E. W., Sales F. M. 1977. — Spider mites (Tetranychidae: Acarina) of the State of Ceará, Brazil. — Fitossanidade, 2: 1-6. doi:10.1080/01647957708683070

COPYRIGHT

 Pereira de Lima R. *et al.* Acarologia is under free license. This open-access article is distributed under the terms of the Creative Commons-BY-NC-ND which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original author and source are credited.