

## ECOLOGY, BEHAVIOR AND BIONOMICS

### Life Cycle of *Retracrus johnstoni* Keifer (Acari: Phytoseptidae)

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#### Ciclo de Vida de *Retracrus johnstoni* Keifer (Acari: Phytoseptidae)

**RESUMO** - Os ácaros Eriophyoidea estão comumente associados a palmeiras, entretanto poucas espécies têm sido relatadas causando danos econômicos nessas plantas. Uma exceção é *Retracrus johnstoni* Keifer, praga de *Bactris gasipaes* Kunth, planta utilizada na produção de palmito. *R. johnstoni* tem sido encontrado em grande número de areáceas no Sudeste do Brasil. O objetivo deste trabalho foi estudar a biologia deste ácaro em laboratório. Seções de folhas da palmeira *Syagrus romanzoffiana* (Cham.) Glassman com cerca de 15 folíolos foram conservadas mantendo suas bases em água destilada. Aproximadamente 20 adultos de *R. johnstoni* foram transferidos para cada folíolo para oviposição. Após 24h, os ácaros foram removidos, deixando-se apenas um ovo por folíolo. Diariamente os ovos e os estágios subsequentes foram examinados para determinação do ciclo de vida, taxa de oviposição e sobrevivência. Cada estágio imaturo de *R. johnstoni* teve duração de aproximadamente sete dias, totalizando aproximadamente 20,5 dias para o desenvolvimento de ovo a adulto. A razão sexual foi de aproximadamente duas fêmeas para cada macho. A fecundidade total foi de cinco ovos por fêmea. Formas imaturas e adultos eram cobertos por uma camada de material branco secretado por eles. O espermatóforo de *R. johnstoni* é semelhante ao de outras espécies da superfamília, e consiste em uma cabeça de aproximadamente 6 x 6 µm e uma base de aproximadamente 6 µm de comprimento. Os danos apresentam-se como manchas escuras na superfície inferior e manchas amareladas nas regiões correspondentes da superfície. As manchas foliares aumentam progressivamente, coalescem e a folha morre e cai prematuramente.

**PALAVRAS-CHAVE:** Biologia, Eriophyoidea, Areaceae

**ABSTRACT** - Eriophyoid mites are commonly associated to palm trees, although few of them have been reported causing economic damage to those plants. One exception is *Retracrus johnstoni* Keifer, a pest of *Bactris gasipaes* Kunth, plant used for palm heart production. *R. johnstoni* is frequently found in large numbers on Areaceae in southeast Brazil. The biology of this mite was studied under laboratory condition. Sections of leaves of the palm tree *Syagrus romanzoffiana* (Cham.) Glassman, with ca. 15 leaflets, were kept alive by maintaining their bases in distilled water. Ca. 20 field collected adults of *R. johnstoni* were transferred onto each leaflet for oviposition. After 24h, mites were removed, leaving only one egg laid. Once a day, the eggs and the subsequent stages were examined to determine the life cycle, oviposition rate and survivorship. Each immature stage of *R. johnstoni* lasted ca. seven days, corresponding to ca. 20.5 days for immature development. The sex ratio was ca. two females per male. Total fecundity was slightly over five eggs per female. Immature and adult mites secreted a layer of white material, which covered their bodies. Spermatophores of *R. johnstoni* resemble those of other species in the same superfamily, and consist of a head of ca. 6 x 6 µm onto a base ca. 6 µm long. Leaflets show dark spots on the lower surface and yellowish spots on the corresponding regions of the upper surface. Leaf spots become progressively larger and coalescent, and the leaf dies and falls prematurely.

**KEY WORDS:** Biology, Eriophyoidea, Areaceae

Eriophyoid mites of the family Phytoseptidae are commonly associated to palm trees, although few species have been reported as pests of economic importance. Two exceptions correspond to species in the genus *Retracrus* (Ochoa *et al.* 1991). *Retracrus johnstoni* Keifer was described from the palm *Chamaedorea* sp. collected in Mexico, causing dark spots on both leaf surfaces (Keifer 1965). *Retracrus elaeis* Keifer was described from the oil palm, *Elaeis guineensis* N.J. Jacquin, collected in Colombia, causing yellowish or orange spots on the leaves (Keifer 1975). The latter species was reported as an important pest in that country (Genty & Reyes 1977) and in Central America (Ochoa *et al.* 1991). *R. johnstoni* was reported as a "palm tree pest" in Central America (Ochoa *et al.* 1991) and a pest of *Bactris gasipaes* Kunth (palm heart tree) in Brazil (Ferreira 1997), where it was reported on *Cocos nucifera* L. (coconut) and on *Syagrus romanzoffiana* (Cham.) Glassman (Santana & Flechtman 1998). *R. johnstoni* was the most frequent and abundant eriophyoid found by Gondim Jr. (2000) on leaves of different species of Arecaceae in Southeastern Brazil, causing considerable damage to leaves of *S. romanzoffiana*, a plant widely used as ornamental in that region.

The biology of *Retracrus* species is known only from the work conducted by Genty & Reyes (1977) on *R. elaeis* reared on *E. guineensis*. The present work was conducted due to the noticeable increase of the area cultivated to Arecaceae in Brazil, especially coconut and heart palm trees, and because of the frequency with which *R. johnstoni* has been recently found on *S. romanzoffiana* in an ongoing study in Southeast Brazil.

### Material and Methods

The study was conducted at  $25.8 \pm 2.0^\circ\text{C}$ ;  $56 \pm 5\%$  RH and 14h photophase. Sections of the proximal region of young leaves of *S. romanzoffiana* were used as substrate for the mites. The leaflets on each section were thinned to ca. 15 per leaf section. The base of the rachis of those sections was kept immersed in distilled water, which was changed weekly to maintain the physiological characteristics of the substrate during the study.

Mites used for the work originated from specimens obtained on leaves of *S. romanzoffiana* collected at the campus of Escola Superior de Agricultura/ Universidade de São Paulo, in Piracicaba County, State of São Paulo. Ca. 20 *R. johnstoni* adults were transferred to each of 50 leaflets. Twenty-four hours later, adults and most of the eggs laid were removed, leaving a single egg per leaflet. Because of the observed low tendency to move around, there was no need to use any sort of barrier to refrain the mites from escaping; they always remained very close to the chorion of the egg from which they emerged. Upon reaching adulthood, mites were transferred to new leaflets, because the original leaflets started to show signs of deterioration. Because of the type of insemination of the eriophyoids (Manson & Oldfield 1996) and the type of setup employed in this study, preliminary attempts to promote female fertilization resulted in considerable mortality. Such attempts involved moving the females to areas previously visited by males, where

spermatophores could be found. Thus, it was decided that no attempt to promote fertilization would be done in this study. Observations of immatures and adults were done daily at 2 PM, under a dissecting microscope to determine the duration of each stage, oviposition rate and survivorship.

Leaves containing mites that did not oviposit (probably males) were examined under scanning microscopy for the possible presence of spermatophores. Samples of immatures and adults were observed in the same way, to confirm the overall form of the putative immature stages observed in the study. Fragments of the leaflet with mites were fixed for one day in osmium tetroxid, mounted on stubs and coated with gold for 210 s before observation.

### Results and Discussion

Each immature stage of *R. johnstoni* lasted ca. seven days, corresponding to a total of ca. 20.5 days for immature development of males and females. Judging from the total number of individuals reaching adulthood, sex ratio was ca. two females per male. Females showed a pre-oviposition period of almost five days, followed by an oviposition period of ca. 12 days and a post-oviposition period of ca. two days. Adult longevity reached ca. 19 days for females and 16 days for males. Total fecundity was slightly over five eggs per female (Table 1). Only males were obtained from the eggs laid, indicating that *R. johnstoni* undergoes an arrhenotokous type of parthenogenesis.

Table 1. Duration (days) of developmental stages, adult phases and fecundity of *R. johnstoni* on *S. romanzoffiana* at  $25.8 \pm 2^\circ\text{C}$ ,  $56 \pm 5\%$  RH and 14h photophase.

Developmental stages	Mean $\pm$ D (m)	Minimum	Maximum	n
Immature (female + male)				
Egg	$6.9 \pm 0.30$	6	9	20
Larva	$7.1 \pm 0.40$	6	8	20
Nymph	$6.5 \pm 0.40$	5	8	20
Egg-adult	$20.5 \pm 0.70$	18	23	20
Adults (female or male)				
Pre-oviposition	$4.8 \pm 1.70$	2	10	9
Oviposition	$12.3 \pm 3.80$	4	21	9
Post-oviposition	$2.0 \pm 1.80$	1	8	9
Longevity of female	$19.1 \pm 3.60$	14	26	9
Longevity of male	$16.0 \pm 5.40$	8	25	4
Fecundity	$5.4 \pm 2.10$	3	12	9

Spermatophores of *R. johnstoni* were observed on the leaflets containing mites that did not oviposit and on additional infested leaf pieces taken from the field. They have a subquadrangular head ( $6 \times 6 \mu\text{m}$ ), using the terms employed by Oldfield *et al.* (1970), attached to a peduncle ca.  $6 \mu\text{m}$  long whose base is stuck to the leaf surface (Fig. 1). Oldfield (1969) was the first to demonstrate that the fertilization of female eriophyoid mites is indirect, with the deposition of spermatophore on the substrate and subsequent uptake by females. Until now, spermatophores of ca. 20 eriophyoid species have been described (Oldfield 1969, Oldfield *et al.*

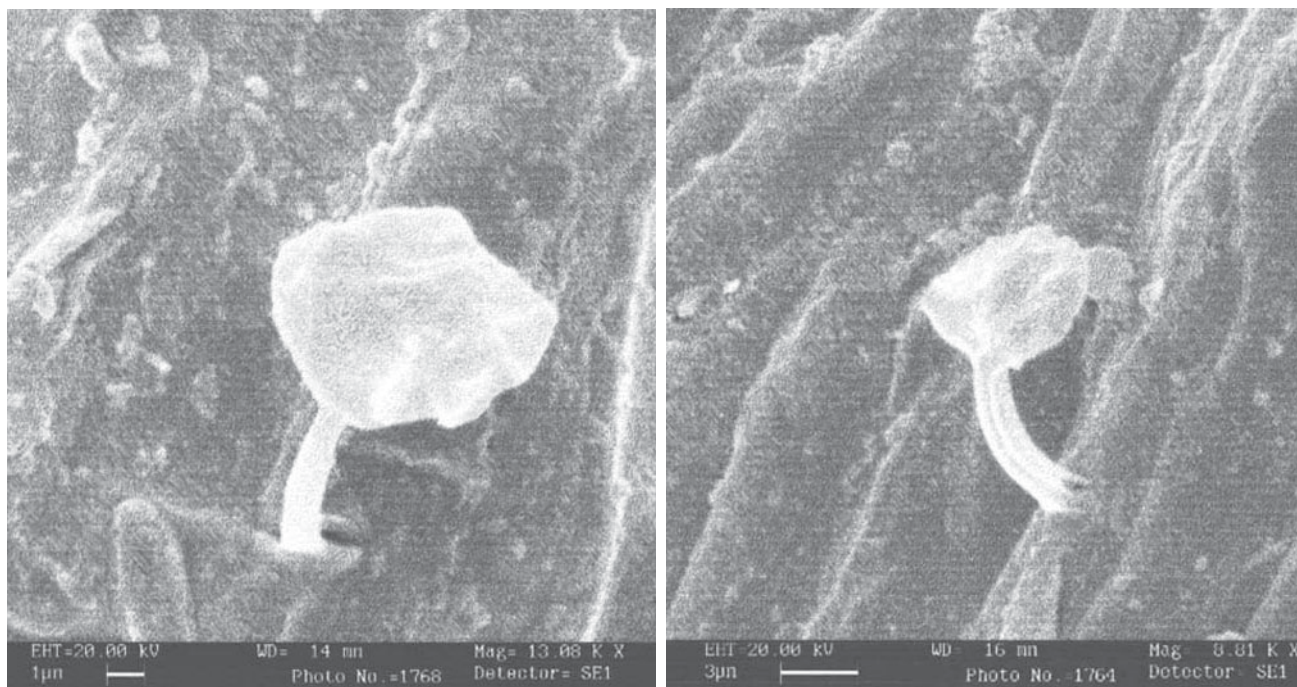


Figure 1. Spermatophore of *Retracrus johnstoni* Keifer.

1970, Oldfield 1973, Oldfield & Newell 1973, Oldfield & Michalska 1996). It has been observed that the sperm reservoir is set onto the head of the spermatophore. Although several spermatophores of *R. johnstoni* were observed in this study, it was never possible to detect the presence of sperm reservoirs.

Each developmental stage of *R. johnstoni* is shown in Fig. 2. Translucent and lentil-shaped eggs are ca. 50 µm in diameter and often covered by a layer of a white material that other authors have considered to be wax (Manson & Gerson 1996). Larvae, nymphs and adults are ca. 100, 120 and 180 µm long, respectively. Immediately after eclosion of the larva or after molting of later stages, the mites are nude. Ca. 24h later, a white material is observed covering their lateral and the dorsal surfaces. Genty & Reyes (1977) reported that a dense wax layer also covers the eggs of *R. elaeis*. They stated that after oviposition the females move over the eggs and produce the wax that covers them. Such behavior was not observed in this study, and the origin of the material covering the eggs could not be determined.

How to explain the apparent potential of *Retracrus* species to cause damage to palm plants? Genty & Reyes (1977) observed an incubation period of ca. 11 days and a total life cycle of 60 to 70 days for *R. elaeis*. It is difficult to compare those results with the findings of the present study, because of the different methods used and because of the unknown temperature, humidity and light conditions used by those authors. Similarly to *R. elaeis*, the life cycle of *R. johnstoni* seems long, and its oviposition rate seems low as compared to other eriophyids (Jeppson *et al.* 1975). Yet, considerable damage of *R. johnstoni* to *S. romanzoffiana* seems common in Piracicaba (Gondim Jr. 2000). Infested regions on the ventral surface of the leaves of *S. romanzoffiana* become dark,

contrasting with a number of white specks that correspond to live mites and mite exuviae. On the top leaf surface, yellowish areas appear in the region opposite to the infested areas on the ventral surface. The yellowish areas grow and coalesce progressively, taking up large areas of the infested leaves, and causing its ultimate death and premature fall. These damages are similar to those reported by Genty & Reyes (1977) for *R. elaeis* on *E. guineensis*.

The extended damage on the leaves of *S. romanzoffiana* observed in the field may be due to different causes. Because palm trees can maintain their leaves for extended periods, i.e., over a year, it may be possible that noticeable, extended damage to leaves is the result of summed small damages through time, and not the result of outbreaks of *R. johnstoni*. However, high populations at given times may actually occur, because of the absence of effective natural enemies in some instances. In addition, it is not known whether higher oviposition rates could occur, had the females been inseminated as they do in the field.

Just the importance of *S. romanzoffiana* as ornamental would justify more detailed studies on *R. johnstoni* in the future. However, because of the potential of this mite to cause damage to other important cultivated palm plants, such studies seem even more justified. Information is mostly needed in relation to the population dynamics of *R. johnstoni*, with special attention to the natural enemies associated with it under natural and disturbed conditions, with a view to their eventual use in future biocontrol efforts.

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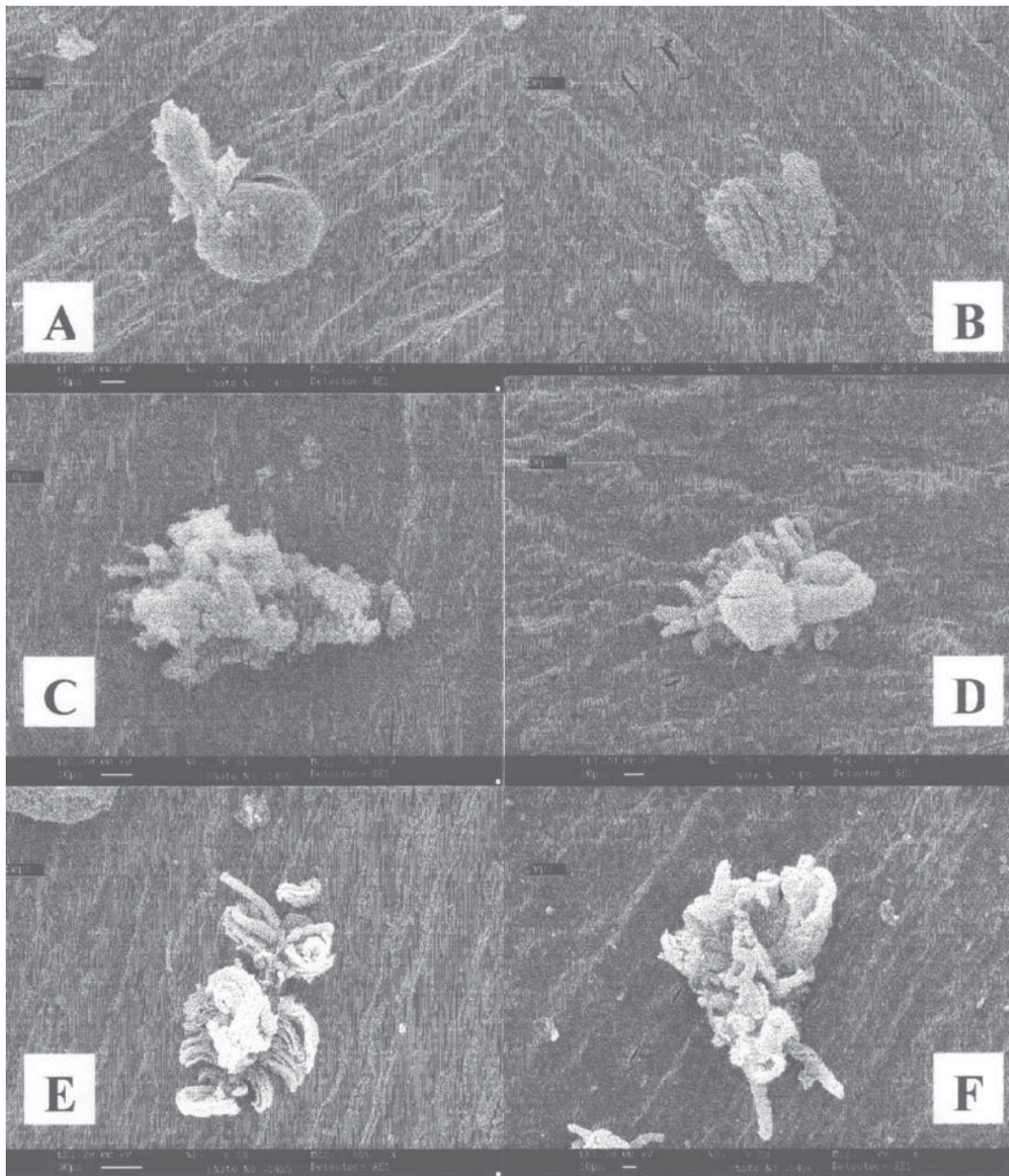


Figure 2. *Retracrus johnstoni* Keifer. A - egg with wax removed, B - egg with wax, C - larva, D - nymph, E - exuviae and F - adult, with wax cover.

observations under scanning microscopy. To R.R. Rodrigues and V.C. Souza, Departamento de Botânica (USP-ESALQ) for their help with the identification of the host plants. To J.L.L. Pereira for his suggestions at the final phase of the work. To PRONEX and CAPES for the financial support. This work is part of the BIOTA/FAPESP – The Biodiversity Virtual Institute Program ([www.biotasp.org.br](http://www.biotasp.org.br)).

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