



Red Palm Mite, *Raoiella indica*:
a bibliography
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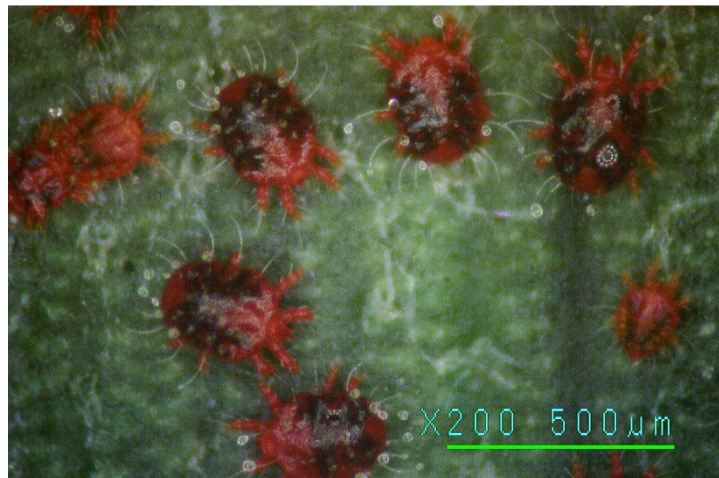


Photo courtesy Farzan Hosein

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BIOLOGY

Biological studies on Raiiella indica Hirst and Phyllotranychus aegyptiacus Sayed infesting date palms in U.A.R. (Acarina-Tenuipalpidae)

M. A. Zaher, A.K, Wafa, A. A Yousef

1969. Zeitschrift fur Angewandte Entomologie, 63:406-411

<http://onlinelibrary.wiley.com/doi/10.1111/j.1439-0418.1969.tb04395.x/abstract>

Biology and Control of the Red Palm Mite, Raiiella indica. Special issue of Experimental and Applied Acarology, August 2012, Volume 57, Numbers 3-4

<http://link.springer.com/journal/10493/57/3/page/1>

Biology of Raiiella indica Hirst (Acari: Tenuipalpidae) on Areca catechu L./ Biología de Raiiella indica Hirst (Acari: Tenuipalpidae) sobre Areca catechu L./

G. Flores-Galano*, A. Montoya*, H. Rodríguez**

2010. Revista de Protección Vegetal v.25 n.1 La Habana ene.-abr.

Lang: Portuguese

Abstract

The development and reproduction of *Raiiella indica* on *Areca catechu* were studied under laboratory conditions at $25,42 \pm 1,21^\circ\text{C}$ and $57,54 \pm 6,54\%$ HR. The experimental units were leaf discs of *A. catechu* in Petri dishes (10,5 cm diameter) with water-saturated cotton. Gravid females were transferred to experimental unit and allowed to lay eggs for five hours. The duration of each life cycle stages were registered. The larvae that emerged were transferred to individual arenas and observed until adult appearance. The average duration of the life cycle was 31 days. The egg stage was the longest, while that of protonymphs was the shortest. The preoviposition period averaged 4 days, while the oviposition period can last 17 days, with an average of 11 days and a female longevity of 30 days. Sex ratio was 56% females. The mortality of immature stages was: 14,6% for larvae; 7,3% for protonymphs, and 17,1% for deutonymphs, with 39% total mortality.

Key words: *Raiiella indica*; *Areca catechu*; red palm mite; development duration

http://scielo.sld.cu/scielo.php?pid=S1010-27522010000100004&script=sci_arttext

Detection and identification of the red palm mite Raiiella indica Hirst (Acari:Tenuipalpidae).

E. Kane and R. Ochoa

2006. Beltsville, MD: USDA, ARS. 6 pp.

<http://www.sel.barc.usda.gov/acari/PDF/indicaGuide.pdf>

Development and ecology of Raiiella indica Hirst (Acari: Tenuipalpidae) on coconut

B.K. Nageshachandra and G.P. Channabasavanna. 1984.

1984. IN: Griffiths, D. A. & Bowman, C.E. (eds). Proceedings: Acarology VI, Vol. 2. Sussex, England:

Ellis Horwood, pp.785-790

Effect of coconut palm proximities and Musa spp. germplasm resistance to colonization by Raoiella indica (Acari: Tenuipalpidae)

J.C.V. Rodrigues and B.M. Irish

2012. Experimental and Applied Acarology 57:309-316

Abstract

Although coconut (*Cocos nucifera* L.) is the predominant host for *Raoiella indica* Hirst (Acari: Tenuipalpidae), false spider mite infestations do occur on bananas and plantains (*Musa* spp. Colla). Since its introduction, the banana and plantain industries have been negatively impacted to different degrees by *R. indica* infestation throughout the Caribbean. Genetic resistance in the host and the proximity of natural sources of mite infestation has been suggested as two of the main factors affecting *R. indica* densities in *Musa* spp. plantations. Greenhouse experiments were established to try to determine what effect coconut palm proximities and planting densities had on *R. indica* populations infesting *Musa* spp. plants. Trials were carried out using potted *Musa* spp. and coconut palms plants at two different ratios. In addition, fourteen *Musa* spp. hybrid accessions were evaluated for their susceptibility/resistance to colonization by *R. indica* populations. Differences were observed for mite population buildup for both the density and germplasm accession evaluations. These results have potential implications on how this important pest can be managed on essential agricultural commodities such as bananas and plantains.

Keywords: *Musa*; Banana; Germplasm; Red palm mite; Acari; Tenuipalpidae

<http://www.springerlink.com/content/503724377m7286u4/>

Evaluation of some pesticides against Raoiella indica Hirst on coconut palm in West Bengal.

P. K. Sakar and A. K. Somchodhury.

1988. Pesticides. 22: 21-22.

External mouthpart morphology in the Tenuipalpidae (Tetranychidae): Raoiella a case study

J.J. Beard, R. Ochoa, G.R. Bauchan, W.C. Welbourn and C. Pooley, et al.

2012. Experimental and Applied Acarology 57: 227-255

Abstract

The use of low-temperature scanning electron microscopy (LTSEM) to study external mouthpart morphology in the Tenuipalpidae, in particular the genus *Raoiella*, has brought some aspects of the mechanics of feeding in this group into question. In addition, an LTSEM study on the specialized feeding behaviour of *Raoiella indica* Hirst (Tetranychidae: Tenuipalpidae) revealed host plant use in this species could be affected by stomatal complex morphology.

Keywords: External morphology; Functional morphology; Palmetto; *Sabal*; Spider mite; Stomata; Tetranychidae

<http://www.springerlink.com/content/p417762567008knm/>

Feeding, reproduction, and development of the Red Palm Mite (Acari: Tenuipalpidae) on selected palms and banana cultivars in quarantine

A. Cocco and M. A. Hoy

2009. Florida Entomologist 92:276-291.

Abstract

The red palm mite, *Raoiella indica* Hirst, an important pest of coconut, banana, and date palms is a new invasive pest in the Western Hemisphere. The red palm mite (RPM) has been observed attacking bananas and plantains in Dominica and in Florida (M. A. Hoy, A. Cocco, personal observation). In order to develop an efficient method to rear the RPM in quarantine for a classical biological control project, several banana and plantain varieties were tested as hosts for the RPM. Bananas are more desirable than coconut (a favored host plant) because bananas are easier to rear in small cages and will produce new shoots quickly after pruning. Red palm mite females did not establish on the banana and plantain varieties (Dwarf Cavendish, Dwarf Nino, Gran Nain, Dwarf Zan Moreno, Dwarf Green, Truly Tiny, *Musa sumatrana* × Gran Nain, Dwarf Puerto Rican, Rose, Nang Phaya, Misi Luki,

Manzano, Lady Finger, Glui Kai, and Eburn Musak) of leaf discs tested, but they established on coconut leaf discs. The mites could not be reared on potted banana trees (Glui Kai, Dwarf Green, and Nang Phaya varieties), but a multigenerational colony has been maintained on coconut trees and leaf discs. No RPM females survived on native palms tested (saw palmetto, cabbage palm, and dwarf palmetto), but RPM completed a generation on needle palm, with longer development time, higher mortality, and lower fecundity than when reared on coconut discs. Our results indicate that coconut leaf discs and trees are better hosts for rearing RPM in quarantine than banana, plantain varieties, or native palms tested. Quarantine tests and field observations suggest that the host range of RPM may not be as broad as some reports indicate because plants from which RPM adults and/or eggs have been collected might not be suitable for establishment of a multigenerational colony. More studies under natural conditions need to be conducted to evaluate the ability of *R. indica* to establish and spread on native and ornamental palms in natural landscapes in Florida.

<http://www.bioone.org/doi/abs/10.1653/024.092.0212>

Full text PDF <http://www.bioone.org/doi/pdf/10.1653/024.092.0212>

Herbivore Exploits Chink in Armor of Host

R. Ochoa, J.J. Beard, G.R. Bauchan, E.C. Kane, A.P.G. Dowling, E.F. Erbe

2011. *American Entomologist* 57:26-29

Abstract

Knowledge of plant-feeding mite diversity, their interactions with host plants, and their ecological impact are not clear or have been too narrowly studied in the past. The mite superfamily Tetranychoidae has been identified around the world feeding on almost every plant known. Spider mites (Tetranychidae) are the most common mite recognized by farmers, researchers, and any person with an ornamental plant at home. On the other hand, flat mites (Tenuipalpidae) are also common on plants, but are often overlooked due to their small size and camouflaging colors. Mites in the flat mite genus *Raoiella* Hirst are obligate plant parasites that feed via stylet-like mouthparts adapted to pierce plant tissues. A species of particular interest in this genus, the red palm mite, *R. indica* Hirst, is currently spreading aggressively throughout the Americas on species of palm (Arecaceae). How they feed on the plant and how they are able to multiply into huge populations on one host plant have only recently been studied. Here, using low-temperature scanning electron microscopy, *R. indica* and several other species in this genus were captured and observed for the first time feeding via the stomatal aperture of host plants in several different families. These findings on their different host plants challenged our common belief that all plant-feeding mites feed by piercing the epidermis. Stomatal feeding could negatively affect the plant's ability to regulate gas and water exchange. Further examination of feeding methods for other herbivorous mites is necessary.

<http://www.ingentaconnect.com/?jsessionid=3wg7gc9cbse0d.victoria>

PDF

<http://docserver.ingentaconnect.com/deliver/connect/esa/10462821/v57n1/s7.pdf?expires=1354568256&id=71799312&titleid=4100023&accname=Guest+User&checksum=5A0B035AD2B1829DD4A040654AA4DCEF>

Host plant range of Raoiella indica (Acari: Tenuipalpidae) in areas of invasion of the New World

D. Carrillo, D. Amalin, F. Hosein, A. Roda and R.E. Duncan, et al.

2012. *Experimental and Applied Acarology* 57: 271-289

Abstract

Raoiella indica has spread rapidly through the Neotropical region where the mite damages economically and ecologically important plants. Three studies were conducted to determine the host plant range of *R. indica*, using the presence of colonies containing all life stages as an indicator of reproductive suitability. Periodic surveys at the Fairchild Tropical Botanic Garden (Miami Dade County, FL, USA) and the Royal Botanical Gardens (Port of Spain, Trinidad and Tobago) identified 27 new reproductive host plants. The reproductive suitability of two dicotyledonous species and three native Florida palm species was examined. An updated list of reproductive host plants of *R. indica* is presented. All reported reproductive hosts (91 plant species) of *R. indica* are monocots from the orders Arecales (Arecaceae), Zingiberales (Heliconiaceae, Musaceae, Strelitziaceae, Zingiberaceae) and Pandanales (Pandanales).

Most are palms of the family Arecaceae that originated in areas of the Eastern Hemisphere; about one fourth of the reported hosts are native to the New World and could be considered new host associations of *R. indica*. Six years after the initial detection in the Caribbean, *R. indica* has expanded its host plant range. Here we report 27 new reproductive host of *R. indica* that represent 30% of increase on previous host plant records. As this mite continues spreading in the Neotropical region a great diversity of plants is potentially affected.

Keywords: *Raoiella indica*; Invasive species; Neotropics; Reproductive hosts; Monocotyledons; Arecaceae; Palms
<http://www.springerlink.com/content/v646635q3x832682/>

Influence of major abiotic factors on the seasonal incidence of Raoiella indica and Tetranychus fijiensis on coconut.

P.K. Sarkar, A.K. Somchoudhury

1989. In: [Channabasavanna, G. P. Viraktamath, C. A. (eds)] Progress in Acarology, 2. Chap 9.2, 59-65.

http://books.google.tt/books?id=188UAAAIAAJ&pg=PA60&lpg=PA60&dq=Progress+in+Acarology,+Vol.+2++Raoiella+indica+a&source=bl&ots=XHXgEM-HTa&sig=0x81mNu_GLMZBHO7-e9w-ZcxTBo&hl=en&sa=X&ei=dbu_UMjiO4Tq9ATHvYDoCA&ved=0CDYQ6AEwAw#v=onepage&q=Progress%20in%20Acarology%2C%20Vol.%202%20%20Raoiella%20indica%20a&f=false

Interrelationship between plant characters and incidence of Raoiella indica Hirst on coconut.

P. K. Sakar, and A. K. Somchodhury.

1989. Indian Journal of Entomology 51: 45-50.

Invasive pest species Red Palm Mite

Jamaica. Ministry of Agriculture and Lands. Bodles Research Station

http://www.rada.gov.jm/articlepdfs/red_palm_mite.pdf

Look out... for the Red Palm Mite

United States Department of Agriculture. Animal and Plant Health Inspection Service

2007.

Program Aid No. 1935. 2p.

http://www.aphis.usda.gov/publications/plant_health/content/printable_version/RedPalmMite_6-20-7.pdf

Mite diversity in coconut habitat in West and East Africa

I.D. Zannou, K. Negloh, R. Hanna, S. Houadakpode & M.W. Sabelis

2010. 13th International Congress of Acarology August 23-27, 2010, Recife-PE, Brazil: Abstract book:295

Abstract

Evaluation of side effects is necessary in all classical biological control programs. This necessitates adequate knowledge of the diversity of arthropods and plants associated to the target pest or crop before the introduction of the exotic natural enemies in a target region. Several surveys were conducted in coconut orchards in Benin and Tanzania from 2004 to 2010 to determine mite diversity in coconut (*Cocos nucifera* L.) habitats in both countries in preparation to the introduction of exotic predatory mites to control the eriophyid mite *Aceria guerreronis* in these countries. During these surveys, mites were collected from leaves, flowers, and surface and beneath bracts of coconut fruits. Mites were also collected from the five most common plants found in the plantations. Twenty and 15 families of mites were recorded in coconut habitats in Benin and Tanzania, respectively. Of the phytophagous mites,

Aceria guerreronis was the most common (more than 90% of the total number of mites found beneath bracts) mite pest encountered beneath bracts in Benin and Tanzania. This pest mite was found in all surveyed coconut plantations in both countries and was only encountered beneath bracts of nuts, where it was sometimes associated with very low densities of *Steneotarsonemus furcatus*. *Raoiella indica* was the most common (more than 70% of the total number of pest mites recorded on coconut leaves) and one of the most important mite pests (in term of damage) recorded on coconut leaves in both countries. Phytoseiids were the most common (about 80%) predators recorded. On coconut tree, *Neoseiulus baraki* (2-13% in Benin, 23-41% in Tanzania), *N. neobaraki* (0-2% in Benin, 37-59% in Tanzania) and *N. paspalivorus* (84-98% in Benin, 15-18% in Tanzania) were the most common predators found in association with *A. guerreronis* beneath bract of nuts. *Amblyseius largoensis* was the most abundant (more than 25%) on leaflets and nut surfaces not covered by bracts. On non-Arecaceae plants, the Phytoseiidae was mostly represented by *Phytoseius amba* followed by *Paraphytoseius horrifera* or *A. largoensis*. Among the other mites, *Neocyphophylax* sp. of the family Ameroseiidae was the most common and was mostly found on coconut flowers and nut surface. Densities of *A. guerreronis* and its predators (phytoseiids) showed seasonal variability. The abundance of *N. paspalivorus*, *N. baraki* and *N. neobaraki* beneath bracts is largely due to their smaller size relative to other predatory mite species encountered in coconut habitat. Potential factors affecting distribution and relative abundance of these three species of predatory mites in West and East Africa will be discussed.

Abstract book: http://www.acarology.org/ica/ica2010/docs/0910_15_abstractBookCapa.pdf

On some new species of red spider

S. Hirst

1924. Annals and Magazine of Natural History, Ser. 9, vol. 14: 522-527.

Pest Alert: Red Palm Mite Raoiella indica Hirst (Acari: Tenuipalpidae)

C. Welbourn

2009. Florida Department of Agriculture and Consumer Services, Division of Plant Industry, Gainesville, FL, US. USDA, United States Department of Agriculture. Page created 15-June-2006 | Updated 1-May 2009

<http://www.freshfromflorida.com/pi/pest-alerts/raoiella-indica.html>

Phylogenetic investigation of the genus Raoiella (Prostigmata: Tenuipalpidae): diversity, distribution and world invasions

A.P.G Dowling, R Ochoa, J.J. Beard, W.C. Welbourn and E.A. Ueckermann

2012. Experimental and Applied Acarology 57: 257-269

Abstract

The genus *Raoiella* is best known because of the red palm mite, *R. indica*, a major pest of palms spreading aggressively throughout the Americas. Not much was known about the biology, geographic origins, or evolutionary history of the genus when *R. indica* emerged as a major invasive pest. This paper attempts to address some of the basic historical questions regarding the palm mite as well as the genus. Molecular characters from COI and 28S regions were used to produce a phylogenetic hypothesis for the genus in an effort to understand its geographic origin. It also uses COI barcode data to delimit several potentially new species discovered by the authors in Australia. Results show a basal split between *R. indica* and all other *Raoiella* species, which indicates Africa or the Middle East as the most probable origin of the genus. Additionally, COI data suggests that at least eight new species are represented among the 20 Australian populations included in this study.

Keywords: *Raoiella*; Phylogenetics; Invasive; Australia

<http://www.springerlink.com/content/56x61k034h186913/>

***Raoiella indica* Hirst (Red Palm Mite)**

2006. CariPestNet

Contents: Identity, Morphology, Biology & Ecology, Dispersal, Management, Host Notes, Distribution

Available at: http://www.caripestnetwork.org/vtt/docs/datasheets/acarina/raoiella_indica.pdf

***Raoiella indica* (Acari: Tenuipalpidae): a rapidly expanding generalist among specialist congeners**

A.P.G. Dowling, R. Ochoa, W.C. Welbourn & J.J. Beard

Presented at 13th International Congress of Acarology August 23-27, 2010, Recife-PE, Brazil

Abstract

The red palm mite, *Raoiella indica* (RPM), is a major invasive pest spreading aggressively throughout the Americas. The mite is originally known as a pest of palms, but upon arriving to the neotropics, it has rapidly spread to numerous unrelated host plants. Unfortunately, very little has been known about the red palm mite or the genus *Raoiella*. Until this study, the mite was thought to be one of only three species known for the genus and knowledge of the origin of species, dispersal methods, and native predators, was completely lacking. Our research uses molecular data from several gene regions (COI, 16S, and 28S) to study the phylogenetic history and population genetics of the genus and species, respectively. Sequences of 27 populations from 15 different countries have been obtained and collections in Australia have discovered at least seven new species of *Raoiella*.

Molecular results indicate that the most primitive RPM haplotypes tend to be in the Middle East and then has spread throughout the Old World and eventually into the Neotropics. Additionally, *R. indica* appears to be a host generalist whereas all other known species have only been found on a single type of plant host. The red palm mite is also the only species that is not restricted to a small geographic area.

Abstract Book http://www.acarology.org/ica/ica2010/docs/0910_15_abstractBookCapa.pdf

***Raoiella indica*, new pest of palms in the Carribean. (Un nouvel acarien ravageur des palmiers: en Martinique, premier signalement de *Raoiella indica* pour les Caraïbes.)**

C.H.W. Flechtmann and J. Étienne

2005. Phytoma, No.584:10-11.

***Red Palm Mite, Raoiella indica* Hirst (Arachnida: Acari: Tenuipalpidae)**

M.A. Hoy, J. Peña and R. Nguyen

2010. Florida, USA: Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida.

Published November 2006. Revised April 2010. Reviewed December 2012.

This document is EENY-397 (IN711), one of a series of Featured Creatures from the Entomology and Nematology Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida

Introduction

The red palm mite, *Raoiella indica* Hirst, a pest of several important ornamental and fruit-producing palm species, has invaded the Western Hemisphere and is in the process of colonizing islands in the Caribbean, as well as other areas on the mainland.

<http://edis.ifas.ufl.edu/pdf/IN/IN71100.pdf>

***Raoiella indica* (Acari: Tenuipalpidae): an exploding mite pest in the neotropics**

E.C. Kane, R. Ochoa, G. Mathurin, E.F. Erbe and J.J. Beard

2012. Experimental and Applied Acarology 57:215-225

Abstract

Major infestations of the flat mite species *Raoiella indica* Hirst affecting bananas, palms and other ornamental plants have been reported from the Caribbean islands, Mexico, FL (USA), Venezuela, Colombia and Brazil. Specimens from these localities were examined using traditional light microscopy and low-temperature scanning electron microscopy techniques. While little is known about the biology of this mite, its recent appearance in the Americas in both commercial coconut and banana plantations has raised concerns about its economic impact as an invasive pest.

Keywords: Flat mite; Light microscopy; Low-temperature scanning electron microscopy; LTSEM; Feeding damage; Stomata feeding; Taxonomic review; Symptomatology

<http://link.springer.com/article/10.1007/s10493-012-9541-1>

***Raoiella indica* Hirst (Acari: Tenuipalpidae): an island-hopping mite pest in the Caribbean**

E.C. Kane, R. Ochoa, G. Mathurin, and E.F. Erbe

2005. Entomological Society of America, Annual Meeting, Florida- poster. Available at:

Poster: http://www.sel.barc.usda.gov/acari/PDF/Raoiella_indica-Kane_et_al.pdf

Handout also available <http://www.sel.barc.usda.gov/acari/PDF/TrinidadHandout.pdf>

***Raoiella indica* (Prostigmata: Tenuipalpidae): The Red Palm Mite: a potential invasive pest of palms and bananas and other tropical crops of Florida**

J. E. Peña, C. M. Mannion, F. W. Howard and M. A. Hoy

2006. Florida, USA: IFAS Extension, Institute of Food and Agricultural Sciences, University of Florida

This document is ENY-837 (IN681), Published: November 2006.

Excerpt:

The red palm mite, *Raoiella indica* Hirst, also known as the coconut mite (A species of eriophyid mite, *Aceria guerreronis* Keifer, is also known by the common name coconut mite. It is a serious pest of the fruits (coconuts) of the coconut palm in many countries in the tropics of the Eastern and Western hemispheres.), coconut red mite, red date palm mite, leaflet false spider mite, frond crimson mite, or scarlet mite, is an important pest of coconuts, date palms and other palm species, as well as a pest of bananas, beans, and durian in different parts of the world. Previous to its arrival in the New World, the mite was found in India, Philippines, Mauritius, Reunion, Malaysia, Israel and Egypt. *Raoiella indica* was found in Martinique and St. Lucia in 2004. During 2005, the mite was found in Dominica and during 2006 on the islands of Trinidad and Tobago, Guadeloupe, and Saint Martin (Kane et al., 2005; Etienne and Fletchmann, 2006). Kane and Ochoa (2006) reported widespread distribution of *R. indica* throughout St. Lucia on coconuts, observing that most of the lower leaves had high infestations ranging from 20-300 individuals. During 2005, *R. indica* was found infesting bananas on the island of Dominica (N. Commodore, pers. obs.). During 2006, Etienne and Fletchmann (2006) found *R. indica* infesting palms, banana, ginger, bird of paradise and other plants within the Musaceae ([Table 1](#)).

Keywords: Damage ; Description of Stages; Life Cycle; Seasonality; Dispersal; Host Plants; Chemical Control; Natural Enemies; Pathogens; Detection

<http://edis.ifas.ufl.edu/pdf/IN/IN68100.pdf>

<http://edis.ifas.ufl.edu/IN681>

Studies on seasonal fluctuation of the population of Raoiella indica Hirst (Acari:Tenuipalidae) on coconut with reference to weather parameters.

B.K Nageshachandra, G.P,ChannaBasavanna

1984. Indian Journal of Acarology, 8:104-111

Taxonomic research in acarology

Eddie A. Ueckermann

2004. Editors: Stéphane Baret, Mathieu Rouget, Ingrid Nänni, Thomas Le Bourgeois

Proceedings of a Workshop on biodiversity dynamics on La Reunion Island - 29th Nov. to 5th Dec. 2004:
12-13

<http://reunion-mayotte.cirad.fr/en/news/biodiversite>

The Tetranychid mites of Africa

E.W. Baker and A.E. Pritchard.

1960. Hilgardia, 29:455-574

CONTROL

Alternatives for the chemical control of the red palm mite, *Raoiella indica* (Acari: Tenuipalpidae) on palms and bananas

J.E. Peña and J.C.V. Rodrigues

2010. 13th International Congress of Acarology August 23-27, 2010, Recife-PE, Brazil: Abstract book: 202-203

Abstract

Several insecticides were tested for efficacy against the red palm mite on potted coconut palms and banana kept inside of a greenhouse in Rio Piedras, Puerto Rico and on field grown coconut palms in Broward County, Florida. Mite populations were recorded before infestation and regularly every week after treatment for approximately 3-4 weeks after treatment. In Florida, all treatments (Pylon, Sanmite, Shuttle, Tetrasan, Thiolutax, Ultiflora, Avid + oil and Avid + Silwet) were statistically low in mite density compared to the untreated control for 42 days after spray. Avid treatments, which were applied twice, were statistically lower than the control 28 days after the second spray. In general, Sanmite and Avid + Glacial had the lowest mite densities throughout the experiment. During the second test, 28 days after treatment, all Tetrasan treatments and sulfur had the lowest density compared to the control. In Puerto Rico, the acaricides, Ultiflora, Tetrasan, Floramite, Shuttle, Kelthane and Forbid were significantly different from the untreated control. Seven pesticides, SorbiShield, SucraShield, Floramite, Hexygon, Shuttle 15 SC, Oberon and Tetrasan were applied to bananas planted in one five-gallon pot. Trials were conducted 4 times. During the first trial, Tetrasan (Etoaxole) reduced mite densities up to 14 d after application, while during the second trial Shuttle (Acequinocyl) provided control 14 d after treatment. The mixture of Sorbishield plus Oberon and Sorbishield alone and Sorbishield + Shuttle provided satisfactory control 3 through 12 d after treatment.

http://www.acarology.org/ica/ica2010/docs/0910_15_abstractBookCapa.pdf

Biology and Control of the Red Palm Mite, *Raoiella indica*. Special issue of *Experimental and Applied Acarology*, August 2012, Volume 57, Numbers 3-4

<http://link.springer.com/journal/10493/57/3/page/1>

Biology and predatory habits of the lady bird beetle *Stethorus keralicus* Kapur (Coleoptera: Coccinellidae), predatory on the palm mite

M. Daniel

1976. Journal of Plantation Crops, 4:7-9

Development and reproduction of *Amblyseius largoensis* (Acari: Phytoseiidae) feeding on pollen, *Raoiella indica* (Acari: Tenuipalpidae), and other microarthropods inhabiting coconuts in Florida, USA

D. Carrillo, J.E. Pena, M.A. Hoy, J.H. Frank

2010. Experimental and Applied Acarology 52:119-129

Abstract

The red palm mite, *Raoiella indica* (Acari: Tenuipalpidae), is an important pest of palms (Arecaceae) and other species within the Zingiberaceae, Musaceae and Strelitziaceae families. *Raoiella indica* was discovered in the USA (Palm Beach and Broward counties, Florida) late in 2007, and it subsequently spread to other Florida counties. The predatory mite *Amblyseius largoensis* (Acari: Phytoseiidae) has been found associated with *R. indica* in Florida. In order to verify whether *A. largoensis* can develop and reproduce when feeding exclusively on *R. indica*, the biology of this predator was evaluated on various food sources, including *R. indica*. Five diets [*R. indica*, *Tetranychus*

gloveri, *Aonidiella orientalis*, *Nipaecoccus nipae*, oak (*Quercus virginiana*) pollen] and a no-food control were tested to determine the predators' development, survivorship, oviposition rate, sex ratio and longevity at 26.5 ± 1 °C, $70 \pm 5\%$ RH and a 12:12 L:D photophase. *Amblyseius largoensis* was able to complete its life cycle and reproduce when fed exclusively on *R. indica*. The development of immature stages of *A. largoensis* was faster and fecundity and survivorship were higher when fed on *R. indica* or *T. gloveri* compared to the other food sources. The intrinsic rate of natural increase of *A. largoensis* was significantly higher when fed on *R. indica* than on other diets. These results suggest that, despite earlier assessments, *A. largoensis* can play a role in controlling *R. indica*.

Keywords: Mites; Invasive species; Biological control; *Cocos nucifera*; *Raoiella indica*; *Amblyseius largoensis*
<http://link.springer.com/content/pdf/10.1007%2Fs10493-010-9360-1>

Chemical control of red palm mite Raoiella indica, on ornamentals

J. Peña, C.M. Mannion, L. Osborne, F.W. Howard

2007. [USDA National Invasive Species Information Centre.] 2p.

<http://mrec.ifas.ufl.edu/iso/RPM/RPM%20Chem%20Managment-2.pdf>

Chemical control of the red palm mite, Raoiella indica (Acari: Tenuipalpidae) in banana and coconut

J.C.V. Rodrigues and J.E. Pena

2012. *Experimental and Applied Acarology* 57:317-329

Abstract

The red palm mite (RPM), *Raoiella indica* Hirst, is a predominant pest of coconuts, date palms and other palm species, as well as a major pest of bananas (*Musa* spp.) in different parts of the world. Recently, RPM dispersed throughout the Caribbean islands and has reached both the North and South American continents. The RPM introductions have caused severe damage to palm species, and bananas and plantains in the Caribbean region. The work presented herein is the result of several acaricide trials conducted in Puerto Rico and Florida on palms and bananas in order to provide chemical control alternatives to minimize the impact of this pest. Spiromesifen, dicofol and acequinocyl were effective in reducing the population of *R. indica* in coconut in Puerto Rico. Spray treatments with etoxanole, abamectin, pyridaben, milbemectin and sulfur showed mite control in Florida. In addition, the acaricides acequinocyl and spiromesifen were able to reduce the population of *R. indica* in banana trials.

Keywords: Chemical control; Tenuipalpidae; Coconut palm; Banana; *Cocos nucifera*; *Musa*

<http://www.springerlink.com/content/d1436qr81hp2m036/>

Classical biological control of the red palm mite (Raoiella indica): area of origin and preliminary surveys

B. Taylor

2009. [IOBC/WPRS Bulletin](#) 50:103-105

This issue of bulletin has Proceedings of the IOBC/WPRS Working Group "Integrated Control of Plant-Feeding Mites", Florence, Italy, 9-12 March 2009.

Abstract

Red palm mite (RPM) has recently become a serious pest of palms and other ornamentals in the Caribbean and eastern USA. A classical biological control project has been set up to examine the potential of using specialised natural enemies. The first stages of the project have focussed on the assessment of host plant relations as a basis to understand likely area of origin and on the design of preliminary surveys for natural enemies. The centre of diversity for the majority of the host plant families points towards the floristic province known as Malesia, which encompasses the Malay peninsula, Indonesia, New Guinea and The Philippines. Based on this, preliminary surveys for the RPM and natural enemies have been set up in Indonesia, Malaysia and Papua New Guinea. Surveys for natural enemies have also been set up in India where the commonly reported hosts *Cocos nucifera* and *Areca catechu* have been naturalised for over 1000 years.

http://www.iobc-wprs.org/pub/bulletins/bulletin_2009_50_table_of_contents_abstracts.pdf

<http://www.iobc-wprs.org/pub/bulletins/#2009>

Comparison of two populations of the pantropical predator Amblyseius largoensis (Acari: Phytoseiidae) for biological control of Raoiella indica (Acari: Tenuipalpidae)

Cleiton A. Domingos, Leandro O. Oliveira, Elisângela G. F. de Moraes, Denise Navia, Gilberto J. de Moraes, Manoel G. C. Gondim Jr.

2012. Experimental and Applied Acarology. Published online 26 October 2012. DOI 10.1007/s10493-012-9625-y.

Abstract

The red palm mite, *Raoiella indica* Hirst (Acari: Tenuipalpidae), was recently introduced in the Americas. It spread quickly throughout coconut palm growing areas, expanding considerably its host range. The invasion of this species has caused high economic impact in several countries. In Brazil, extensive areas are expected to be affected. For logistical reasons and other concerns, chemical control does not seem desirable for the control of this pest in most Latin American countries. Biological control of *R. indica* by introducing exotic natural enemies seems to be an important control measure to be considered. Surveys in many countries have shown that *Amblyseius largoensis* (Muma) (Acari: Phytoseiidae) is a very common predator on coconut palms. This study compared the biology of a population of *A. largoensis* found for a long time in association with *R. indica* in La Reunion Island (Indian Ocean) with a population from Roraima State (northern Brazil), where *R. indica* was first found about two and a half years ago. No significant differences were observed between populations in relation to the duration of different immature stages or total survivorship. However, the oviposition period, prey consumption and net reproductive rate were significantly higher for the La Reunion population, warranting further investigation to determine whether that population should be released in Roraima to control the pest.

Keywords: Coconut palm, Red palm mite, Phytoseiid, Biological control, Arecaceae, Quarantine pest

http://download.springer.com/static/pdf/470/art%253A10.1007%252Fs10493-012-9625-y.pdf?auth66=1354464486_ac56de9918d94f82262247b05edf8352&ext=.pdf

<http://link.springer.com/article/10.1007%2Fs10493-012-9625-y?LI=true#page-1>

Control of Raoiella indica Hirst (Tenuipalpidae: Acari) on coconut with pesticides

J. Jayaraj, K. Natarajan, G. Ramasubramanian

1991. Indian Coconut Journal (Cochin) 22:7–9

Control of the red coconut mite Raoiella indica Hirst (Tenuipalpidae: Acari) in the nursery

S.M. Jalaluddin and M. Mohanasundaram

1990. Indian Coconut Journal (Cochin) 21:7–8

Development and reproduction of Amblyseius largoensis (Acari: Phytoseiidae) feeding on pollen, Raoiella indica (Acari: Tenuipalpidae), and other microarthropods inhabiting coconuts in Florida, USA

D. Carrillo, J.E. Pena, M.A. Hoy, J.H. Frank

2010. Experimental and Applied Acarology 52:119–129

Abstract

The red palm mite, *Raoiella indica* (Acari: Tenuipalpidae), is an important pest of palms (Arecaceae) and other species within the Zingiberaceae, Musaceae and Strelitziaceae families. *Raoiella indica* was discovered in the USA (Palm Beach and Broward counties, Florida) late in 2007, and it subsequently spread to other Florida counties. The predatory mite *Amblyseius largoensis* (Acari: Phytoseiidae) has been found associated with *R. indica* in Florida. In order to verify whether *A. largoensis* can develop and reproduce when feeding exclusively on *R. indica*, the biology of this predator was evaluated on various food sources, including *R. indica*. Five diets [*R. indica*, *Tetranychus gloveri*, *Aonidiella orientalis*, *Nipaecoccus nipae*, oak (*Quercus virginiana*) pollen] and a no-food control were tested to determine the predators' development, survivorship, oviposition rate, sex ratio and longevity at 26.5 ± 1°C, 70 ± 5% RH and a 12:12 L:D photophase. *Amblyseius largoensis* was able to complete its life cycle and reproduce when

fed exclusively on *R. indica*. The development of immature stages of *A. largoensis* was faster and fecundity and survivorship were higher when fed on *R. indica* or *T. gloveri* compared to the other food sources. The intrinsic rate of natural increase of *A. largoensis* was significantly higher when fed on *R. indica* than on other diets. These results suggest that, despite earlier assessments, *A. largoensis* can play a role in controlling *R. indica*.

Keywords: Mites, Invasive species, Biological control, *Cocos nucifera*, *Raoiella indica*, *Amblyseius largoensis*

<http://link.springer.com/article/10.1007%2Fs10493-010-9360-1?LI=true#page-1>

Full article http://download.springer.com/static/pdf/972/art%253A10.1007%252Fs10493-010-9360-1.pdf?auth66=1354736794_63cd2a50d2829ced7fd55d1104c4620&ext=.pdf

Efficacy of some pesticides against Raoiella indica Hirst. (Tenuipalpidae) on arecanut seedlings in Terai region of West Bengal

S.K. Senapati and A.K. Biswas

1990. Environment and Ecology 8:763-765

Evaluation of some pesticides against Raoiella indica Hirst on coconut palm in West Bengal

P.K.Sakar and A.K. Somchodhury

1988. Pesticides 22:21–22

Evaluation of toxicity of some pesticides to the red mite on coconut, Raoiella indica (Hirst) (Phytoseiidae)

K. Saradamma

1973. Agricultural Research Journal of Kerala 10:61–62

Feeding behavior of Amblyseius largoensis (Muma) on Raoiella indica (Hirst) / Conducta alimentaria de Amblyseius largoensis (MUMA) sobre Raoiella indica Hirst

H. Rodríguez, A. Montoya, G. Flores-Galano

2010. Revista de Protección Vegetal v.25 n.1 La Habana ene.-abr.

Lang: Portuguese

Abstract

Feeding behavior of *Amblyseius largoensis* on *Raoiella indica* was determined on excised *Areca catechu* leaves infested with all the stages of the prey. The studies were carried out under laboratory conditions at $25,42 \pm 1,21$ °C and $57,54 \pm 6,54$ % RH. Gravid females of the predatory mites were previously kept in starvation in hermetic plastic boxes for 24 hr. The starving females were then placed on experimental arena: *A. catechu* leaves infested with all the stages of *R. indica* were placed on water-saturated cotton layer in Petri dishes. The leaves were surrounded with wet cotton. The activity of the phytoseiid mite was observed continuously under a dissecting microscope for 30 min. The number of prey killed was 1,30; the percentage of successful attacks, 39,39 %; and the mean time spent on feeding on each prey was 74,65 seg. *A. largoensis* fed on egg, larva, nymph and female stages. Most of the time was spent on prey foraging, grooming and resting. Results showed, for the first time, that *A. largoensis* can feed on *R. indica*, what supports its possible use in the management of this exotic mite.

Key words: *Amblyseius largoensis*; *Raoiella indica*; palm red mite; biological control; feeding behavior

http://scielo.sld.cu/scielo.php?pid=S1010-27522010000100006&script=sci_arttext

Feeding potential of Lasioseius sp. (Acari: Mesostigmata), a promising predator of the red palm mite, Raoiella indica Hirst (Acari: Prostigmata) ecosystem.

U. M Sheeja, N.Ramani,

2009. Karnataka Journal of Agricultural Sciences 22: 698-700

Abstract www.cabdirect.org/abstracts/20103004331.html

The feeding potential and feeding preference of *Lasioseius* sp. reared on *R. indica* were studied. A larva, protonymph, deutonymph, adult male and adult female of *Lasioseius* was given a leaf disc with 100 individuals of *R. indica* consisting of 30 eggs, 30 larvae, 20 protonymphs, 10 deutonymphs and 10 adults. The individual stages of the predator showed considerable variation in feeding potential, although all the developmental stages could feed on all stages of *R. indica*. The mean number of *R. indica* eggs, larvae, protonymphs, deutonymphs and adults consumed by a single larva were 7.95 (26.5%), 3.55 (17.75%), 2.45 (12.25%), 0.0875 (0.875%) and 0.05 (0.5%), respectively. The protonymphs of *Lasioseius* sp. fed an average number of 15.6 (52%) eggs, 13.3 (44.33%) larvae, 6.75 (33.75%) protonymphs, 0.36 (3.6%) deutonymphs, and 0.1 (1.0%) adults of *R. indica* per day. The respective feeding rates of the deutonymph of *Lasioseius* sp. on the egg, larva, protonymph, deutonymph and adult of *R. indica* were 21.3 (71%), 19.3 (64.33%), 11.2 (56%), 2.05 (20.5%) and 1.55 (15.5%). A single adult predator female consumed an average of 25.15 (83.83%) eggs, 19.97(66.5%) larvae, 2.2(61%) protonymphs, 3.05(30.5%) deutonymphs and 1.8(18%) adults. The total consumption rate of the male predator (40.5%) was lower than that of the deutonymph and female predator. Predation potential was greatest for larvae, followed by protonymphs, male adults, deutonymphs and female adults. Among the different life stages of the prey mites, the eggs were the most preferred while the adults were the least preferred.

Full article <http://pub.uasd.edu/ojs/index.php/kjas/article/viewFile/1227/1172>

Field trials to determine the efficacy of three chemicals in the control of the Red Palm Mite (Raoiella indica Hirst) on coconut (Cocos nucifera) in Saint Lucia

G. Mathurin, G. George, B. Lauckner

2010. CARDI Review 10:12-19

Abstract

Field trials were conducted at several sites in St. Lucia with the aim of investigating the efficacy of four readily available chemicals (GC-Mite, Kumulus, Lime Sulphur and Safe Oil) in the control of the Red Palm Mite (*Raoiella indica* Hirst). The trials were conducted from mid 2007 to the end of 2008. Results demonstrated that Safe Oil gave the best control for the first half of the experimental period with GC-Mite being the least effective, but in the final 3 months Kumulus and Lime Sulphur seemed to give the best control.

Keywords: Red Palm Mite, St. Lucia, GC-Mite, Kumulus, Lime Sulphur, Safe Oil

<http://www.cardi.org/wp-content/uploads/2011/09/CARDI-Review-Issue-10.pdf>

Investigations into palms (indigenous, native and exotic) in the Nariva Swamp, Trinidad to establish their susceptibility to the Red Palm Mite, Raoiella indica

F. Hosein and P. Siew

2010. In: Ministry of Food Production, Land and Marine Affairs. Research Division. Annual Report

2010. Centeno, Trinidad and Tobago: Ministry of Food Production, Land and Marine Affairs, pp.119-121

Management strategy of Raoiella indica Hirst in Cuba, based on biology, host plants, seasonal occurrence and use of acaricide

M. Ramos Lima, A.I. González and M. González

2010. 13th International Congress of Acarology August 23-27, 2010, Recife-PE, Brazil: Abstract book: 218-219

Abstract

Raoiella indica is a bright red mite that attacks many important plant species, mainly palm and banana species. Significant infestations have been found damaging *Musa* species in Cuba, where it can become a key pest because of

the greater economical importance of bananas compared to coconuts. To establish the real potential of this mite as a pest, the following activities were performed: a) a survey to find out its range of host plants in the country; b) its development and reproduction parameters were studied on coconut and banana leaves as host plants; c) its seasonal variation on *Musa* sp. and the associated predatory mites; d) a mathematic model was built to represent the observed seasonal variation on *Musa* sp.. In addition, the miticide effect of Mitigan (Dicofol 18% emulsifiable concentrate, EC) and the line 13 of *Bacillus thuringiensis* on females and eggs were evaluated. Twenty one plant species were found as host, of which 13 were Arecaceae, five were Musaceae and one was Strelitziaceae and one was Zingiberaceae. *Mycrocycas calocoma* and *Cycas* sp. are reported as new host plants for this mite. Eggs hatched after an average of 8.5 and 8.1 days on coconut and banana, respectively. The larvae developed to protonymphs in 8.7-8.8 days. Deutonymphs developed to adults in 6.6-9.2 days. The whole period from egg to adult lasted 31.4±3.31 days on coconut and 33.4±4.76 on banana leaves. Female oviposition period, longevity and total oviposition were higher on coconut than on banana. The red palm mite population showed an exponential increase, reaching a peak in the dry season. *Amblyseius largoensis* Muma was the only predator species recorded in association with the red palm mite. In general, there was a correspondence between prey and predator population trends; a forecasting model helped to conceptualize how the various processes affected mite population. The acaricide Mitigan showed the best control of *R. indica*. Data obtained in the study made possible the design of a management strategy for *R. indica* in Cuba, but until now, the best recommendation is to maintain the surveillance system.

http://www.acarology.org/ica/ica2010/docs/0910_15_abstractBookCapa.pdf

Molecular discrimination of phytoseiids associated with the red palm mite *Raoiella indica* (Acari: Tenuipalpidae) from Mauritius and South Florida

H.M. Bowman and M.A. Hoy

2012. *Experimental and Applied Acarology* 57:395-407

Abstract

Phytoseiid populations imported from Mauritius for evaluation for a classical biological control program in Florida, USA, were morphologically identified as *Amblyseius largoensis* Muma, a species associated with the red palm mite in south Florida and the Caribbean. Bayesian analysis and sequence divergences of the mitochondrial *12S* rRNA and nuclear *Elongation factor—1 alpha* (*EF-1 α*) genes and Neighbor-Joining analysis of High-fidelity-RAPD-PCR markers were used to discriminate between the south Florida and Mauritius populations. High-fidelity-RAPD-PCR markers in addition to Bayesian and sequence divergence analyses of the *12S* rRNA sequences suggest that the Mauritius and south Florida populations are genetically different but whether these are species or population differences is unknown. The degenerate *EF-1 α* primers used to survey the phytoseiids amplified two different elongation factor sequences with distinct amino acid translations, the putative *EF-1 α* and an unknown elongation factor. Variability within the *12S* gene was used to develop population-specific primers for identifying the Mauritius phytoseiids in the event they are released in south Florida.

Keywords: *Amblyseius largoensis*; Bayesian analysis; Classical biological control; *Elongation factor*; *1 alpha*; High-fidelity PCR; Red palm mite; *Raoiella indica*; Phytoseiidae; Population-specific primers; *12S* rRNA; RAPD-PCR

<http://www.springerlink.com/content/n401u21vm68r4082/>

Natural Enemies of Red Palm Mite in India (Final Report of the Project KFRI 558/08)

(September 2008-December 2010)

V.V. Sudheendrakumar , K.V. Sankaran, P. Mujeeb Rahman

July 2011. Kerala Forest Research Institute , Peechi- 680 653, Kerala, India. 54p. KFRI Research Report No. 408

Excerpt from Executive summary pp.2 -3.

Along with RPM, various predators were also recorded. The majority of predators collected during the surveys were phytoseiid mites belonging to the genus *Amblyseius*. Apart from this coccinellids were also recovered which were relatively low in number. Two different genera of coccinellids including *Stethorus keralicus* were observed. Other predators recorded belonged to the orders, Thysanoptera, Neuroptera, Hemiptera and Diptera.

The influence of local weather parameters and predators on RPM population were investigated. It was found that there was a significant positive effect of site temperature on RPM population. It was also found that there was a

significant effect of host plant species on population levels of RPM. Even though there was no significant effect of site humidity on RPM number ($F=0.37$, $p=0.56$) there was a trend whereby higher humidity levels were related with lower RPM numbers.

Predator (phytoseiid) number was not related to site temperature, but it was slightly related with site humidity. There was, however, a very significant correlation between average phytoseiid number and rainfall of the previous month ($F=23.49$, $p<0.01$), although no correlation was seen between phytoseiid number and rainfall in the current month ($F=0.37$, $p=0.55$). These results indicate that the increase in populations of RPM is not only linked to temperature, but also to the host plant, number of predatory mites present, humidity and rainfall. Laboratory studies proved that phytoseiid feeds red palm mite, but rearing and bioassay was difficult because phytoseiids always showed escaping behaviour from the arena.

The rapid spread of RPM throughout the other parts of the world (New World) demonstrates the ability of the mite to disperse effectively between plants. However, the method of transfer between plants is unknown, along with the factors that trigger the dispersal of the mite between plants. To address this problem, wind-dispersal traps were installed in the field to study the mechanism of dispersal of RPM. Tailor made traps were set up in the field and periodic observations were made. Besides, to assess the mite density on each trap site, four coconut palms were randomly sampled each month (different trees were selected each month), from which three leaflets were collected from a lower frond and mite density was estimated. RPM was caught in April and May. RPM density was also high during that time. The study indicated that RPM dispersed through the wind current. Aerial dispersal occurred when the populations were dense on the tree canopy. Results also showed that the number of solitary females found increased throughout the season. Leaf nutrient analysis revealed that Phosphorus content of the leaves and RPM numbers were related.

To summarise, the results showed that the most abundant predator associated with RPM is the phytoseiid mite. There were high numbers of phytoseiid mites during the months of December and January but there was a significant drop in numbers in the later period. Phytoseiid mites were highly correlated to rainfall of the previous month, and negatively correlated to RPM populations, even though laboratory data has shown that these mites do feed on RPM. From this information it could be postulated that the predator is indeed adapted to feeding on RPM but it is poorly synchronised. RPM on the other hand, has an abundance of suitable host plants and ideal weather conditions for population expansion.

<http://docs.kfri.res.in/KFRI-RR/KFRI-RR408.pdf>

A new species of Stethorus Weise S. keralicus (Coleoptera-Coccinellidae), feeding on arecanut palm mites Raiiella indica Hirst. in Kerala, southern India

A.P. Kapur

1961. Entomophaga 6:35–38

Observations on natural enemies found in association with coconut mite, Raiiella indica Hirst.

A.K. Somchoudhury and P.K. Sarkar

1987. Bulletin of Entomology (New Delhi) 28:104–107

Overview of a classical biological control project directed against the red palm mite in Florida.

M.A. Hoy

2012. Experimental and Applied Acarology 57:381-393

Abstract

Information is provided on the steps involved in classical biological control programs, with an outline of the steps achieved in the classical biological control of the red palm mite, *Raiiella indica* (Acari: Tenuipalpidae), in Florida. An overview is provided of the results and an accompanying paper by Bowman and Hoy (2012) describes the

molecular analyses conducted to characterize phytoseiid predators of the red palm mite collected from Mauritius. The Mauritius phytoseiids were identified as *Amblyseius largoensis*, using morphological criteria, and compared to four populations of *A. largoensis* from Florida. The difficulties encountered in the systematics, rearing, and evaluation of the Mauritius phytoseiids are described. A method was tested for obtaining DNA from single mites without destroying the body so that voucher specimens can be maintained. Ultimately, the project was terminated due to constraints expected in obtaining permission to make releases.

Keywords: Classical biological control; Red palm mite; *Raoiella indica*; Phytoseiidae; *Amblyseius largoensis*; Risk assessment

<http://www.springerlink.com/content/t321346164214332/>

Predator-prey dynamics and strategies for control of the red palm mite (Raoiella indica) (Acari: Tenuipalpidae) in areas of invasion in the Neotropics

J. E. Peña, J.C.V. Rodrigues, A. Roda, D. Carrillo and L.S. Osborne

2009. [IOBC/WPRS Bulletin](#) 50:69-79. This issue of bulletin has [Proceedings of the IOBC/WPRS Working Group "Integrated Control of Plant-Feeding Mites"](#), Florence, Italy, 9-12 March 2009.

Abstract

The red Palm mite, *Raoiella indica* (Acari: Tenuipalpidae) invaded the new world around 2004 and is now reported from the Caribbean islands, Florida, USA and northern South America (Venezuela). Surveys to determine generalist fauna prior to its arrival during the end of 2007 in Florida, reported the predators *Amblyseius largoensis*, *Stethorus utilis*, *Chrysoperla* spp., *Aleurodothrips fasciapennis* and *Bdella distincta* in association with diaspidids, aleyorids and tetranychids. Predator density increase was not observed until 6 months after the arrival of *R. indica* in Florida. Studies on predator composition after the initial detection in 2006 of *R. indica* in Trinidad and Tobago, indicated that the predaceous mite, *A. largoensis* increased its densities as the red palm mite grew and spread to new locations. Other reported predators were *A. fasciapennis*, *Bdella* spp., *Cheletomimus* sp., and species of the families Cecidomyiidae and Chrysopidae. *Amblyseius largoensis*, while preying on the red palm mite in Puerto Rico, has not substantially reduced the high numbers of *R. indica*. Studies to find exotic and more effective predators of the red palm mite should be intensified.

http://www.iobc-wprs.org/pub/bulletins/bulletin_2009_50_table_of_contents_abstracts.pdf

<http://www.iobc-wprs.org/pub/bulletins/#2009>

Prey-stage preferences and functional and numerical responses of Amblyseius largoensis (Acari: Phytoseiidae) to Raoiella indica (Acari: Tenuipalpidae)

D. Carrillo and J.E. Peña

2012. *Experimental and Applied Acarology* 57:361-372

Abstract

Raoiella indica Hirst (Acari: Tenuipalpidae) is a phytophagous mite that recently invaded the Western Hemisphere. This mite is a multivoltine and gregarious species that can reach very high population densities and cause significant damage to various palm species (Arecaceae). The predatory mite *Amblyseius largoensis* (Muma) (Acari: Phytoseiidae) has been found associated with *R. indica* in Florida. This study evaluated *A. largoensis* for potential to control *R. indica* by (1) determining predator preferences among developmental stages of *R. indica*, and (2) estimating predator functional and numerical responses to varying densities of its most preferred prey-stage. Under no-choice conditions *A. largoensis* consumed significantly more eggs than other stages of *R. indica*. In choice tests *A. largoensis* showed a significant preference for *R. indica* eggs over all other prey stages. *Amblyseius largoensis* displayed a type II functional response showing an increase in number of prey killed with an increase in prey population density. Consumption of prey stabilized at approximately 45 eggs/day, the level at which oviposition by the predator was maximized (2.36 ± 0.11 eggs/day; mean \pm SEM). Results of this study suggest that *A. largoensis* can play a role in controlling *R. indica* populations, particularly when prey densities are low.

Keywords: Mites; Invasive species; *Cocos nucifera*; *Raoiella indica*; *Amblyseius largoensis*; Prey-stage preference; Functional response; Numerical response

<http://www.springerlink.com/content/1207x23221447113/>

Protecting Florida Palms. Effectively managing red palm mite in nursery environments.
Nursery industry update May 15, 2009

C.H. Bronson

2009. Florida, USA: Florida Department of Agriculture and Consumer Services. 2p.

http://www.freshfromflorida.com/pi/enpp/ento/images/rpm_nursery_industry_update_051509.pdf

***Raoiella indica* Hirst (Acari: Prostigmata: Tenuipalpidae), The Red Palm Mite - A Threat to Palm Trees in the Americas**

R.S. Mendonga, D. Navia, and C.H.W. Flechtmann.

2006. Brasilia: Embrapa Recursos Geneticos e Biotecnologia

Lang: Portuguese

Available at: <http://www.cenargen.embrapa.br/publica/trabalhos/doc146.pdf>

The Red Palm Mite, Raoiella Indica: effect of resident and commercially produced predators against a recently introduced pest in Florida, USA

J. E. Peña, J. C. Rodrigues, L. Osborne & A. Roda

2008. In: Proceedings of the Third International Symposium on Biological Control of Arthropods, Christchurch, New Zealand. Peter G. Mason, David R. Gillespie & Charles Vincent (2008)

Abstract.

The red palm mite, *Raoiella indica* Hirst invaded the Caribbean in 2004 and Florida, USA during the last month of 2007. Previous to the arrival of *R. indica* in Florida, surveys were undertaken to determine the current beneficial fauna inhabiting plant hosts of *R. indica*. Predators present included, *Amblyseius largoensis* (Acari:Phytoseiidae), *Bdella distincta* (Acari: Bdellidae), *Stethorus utilis* (Coleoptera: Coccinellidae) and *Chrysoperla* spp. (Neuroptera: Chrysopidae) among others. After the arrival of *R. indica*, predaceous fauna have been dominated by *A. largoensis* representing 77.2% of the total predators collected, followed by *Aleurodothrips fasciapennis* (Franklin) (Thysanoptera: Phlaeothripidae) (20%), while other predators (i.e., *B. distincta*, *S. utilis* and *Chrysoperla* spp.), have been found less frequently. No significant correlations have been determined until now between the population levels of natural enemies and population levels of *R. indica* (F1, 3 = 2.36; P = 0.21; F1,2 = 1.3; P = 0.49) for Broward and Palm Beach, respectively. Preliminary tests of the efficacy of the predator, *Amblyseius swirski*, show some promise, but further tests are necessary to determine its role for the management of the red palm mite.

<http://www.cabi.org/ISC/FullTextPDF/2009/20093074188.pdf>

A review of the natural enemies of the red palm mite, Raoiella indica (Acari: Tenuipalpidae)

D. Carrillo, J.H. Frank, J.C.V. Rodrigues and J.E. Peña

2012. Experimental and Applied Acarology 57:347-360

Abstract

A review of all the available information about the natural enemies reported in association with the red palm mite, *Raoiella indica* is presented. Twenty-eight species of predatory arthropods, including mites and insects, have been reported in association with *R. indica* in Asia, Africa and the Neotropics. In addition, pathogenic fungi associated with *R. indica* in the Caribbean have been reported. The available literature indicates that each site has a different natural enemy complex with only one predator species, *Amblyseius largoensis* (Acari: Phytoseiidae), present in all the geographical areas. The phytoseiids, *Amblyseius caudatus* Berlese, *Amblyseius channabasavanni* Gupta and *A. largoensis*, were regarded as important natural enemies of *R. indica*, and their predatory efficiency was studied in some detail. Among the predatory insects the coccinellids *Stethorus keralicus* Kapur and *Telsimia ephippiger* Chapin were reported as major predators of *R. indica*. The known distribution, abundance and relative importance of each species reported in association with *R. indica* are discussed.

Keywords: *Raoiella indica*; Invasive species; Biological control; Natural enemies; Predatory mites; Predatory insect; Pathogenic fungi; *Amblyseius largoensis*

<http://www.springerlink.com/content/fw73h23k48rg8382/>

Studies on the biology of native predators associated with Raiiella indica (Acari: Tenuipalpidae) in Florida, USA: implications on their potential as biological control agents of this exotic species

D. Carrillo and J.E. Peña

2010. 13th International Congress of Acarology August 23-27, 2010, Recife-PE, Brazil: Abstract book: 45

Abstract

In Florida, some predatory natural enemies including *Amblyseius largoensis* (Muma) (Acari: Phytoseiidae), *Ceraeochrysa claveri* Navas (Neuroptera: Chrysopidae), *Stethorus utilis* (Horn) (Coleoptera: Coccinellidae), *Bdella distincta* (Barker and Bullock) (Acari: Bdellidae) and *Aleurodothrips fasciapennis* (Franklin) (Thysanoptera: Phlaeothripidae) have been observed feeding on the invasive species *Raiiella indica* Hirst (Acari: Tenuipalpidae). Among these, *A. largoensis* increased in numbers after the arrival of *R. indica* in south Florida. We evaluated the development and reproduction of *A. largoensis* feeding on pollen, *R. indica*, and other microarthropods inhabiting coconuts in Florida. The intrinsic rate of increase (rm) of *A. largoensis* fed with *R. indica* was significantly higher than those fed with the other food sources (F = 34.18; df = 2, 58; P<0.001). *Amblyseius largoensis* showed higher survival and reproductive rates, and shorter developmental times when fed solely on *R. indica* compared with single other food sources. Other Florida native predators develop and reproduce poorly or cannot complete development feeding on the invasive species. Results of these studies suggested that *A. largoensis* can play a role in controlling *R. indica* in Florida.

http://www.acarology.org/ica/ica2010/docs/0910_15_abstractBookCapa.pdf

Survey of the indigenous predators of arecanut phytophagous mites

M. Daniel

1979. In: Venkata CS (ed). Proceedings of the second annual symposium on plantation crops: plant protection (entomology, microbiology, nematology, plant pathology and rodentology), pp 227–236

Testing prey DNA fingerprinting on Amblyseius largoensis (Acari: Phytoseiidae) predation of Raiiella indica (Acari: Tenuipalpidae).

C. Rivera-Rivera, A. Galindo-Cardona and J.C.V. Rodrigues

2012. Experimental and Applied Acarology 57:373-379

Abstract

Molecular detection of predation by identifying prey markers in the digestive tract of predators has developed into a powerful tool to assess predator–prey systems in which diet identification is too time consuming or impossible. Here we explore its utility for detecting predation of the pest mite *Raiiella indica* Hirst by the predatory mite *Amblyseius largoensis* Muma, taking advantage of the color the predator acquires after eating this mite to cross-reference our results. For this, a ~410 bp segment of the cytochrome c oxidase subunit I (COI) mitochondrial gene marker specific for the subfamily Tetranychoidae was used. *Amblyseius largoensis* that had recently eaten were collected from greenhouse colonies containing both mites, and isolated from any other food source. Predator mites were taken for fingerprinting at 24, 48, 72 and 96 h of starving after collection, and the same process was repeated a second time, offering pollen as an alternative food source to see whether detection changed. Lastly, a sampling trial was conducted in the greenhouse, in which mites were collected regardless of their color and frozen immediately for fingerprinting. *Raiiella indica* DNA was detected for 48 h on starving predators, and for 96 h on those who had eaten pollen. The segment was detected in 26 % of the samples collected on the trial. This technique needs refinement specific for this system, but the results obtained here confirm that it could turn into a very useful tool for assessing aspects of this predator–prey system.

Keywords: Red palm mite; DNA fingerprinting; Prey-predator relationship; Biocontrol

<http://www.springerlink.com/content/4182g731g7427t3g/>

Variability in response of four populations of Amblyseius largoensis (Acari: Phytoseiidae) to Raoiella indica (Acari: Tenuipalpidae) and Tetranychus gloveri (Acari: Tetranychidae) eggs and larvae

D. Carrillo, M.E. de Coss, M.A. Hoy, J.E. Peña

2012. Biological Control 60:39–45

Abstract

Raoiella indica (Acari: Tenuipalpidae) is a phytophagous mite that recently invaded the Neotropical region. A predatory mite *Amblyseius largoensis* (Acari: Phytoseiidae) has been found associated with *R. indica* in Florida. This study evaluated *A. largoensis* by determining its likelihood of consuming eggs and larvae of *R. indica* and *Tetranychus gloveri* (Acari: Tetranychidae) under no-choice and choice conditions. To detect variations in the response of *A. largoensis* to *R. indica*, four populations of predators were examined: (1) predators reared exclusively on *R. indica* in the laboratory for 2 years, (2) predators reared on *T. gloveri* in the laboratory for 2 months but reared on *R. indica* for 2 years previously, (3) predators collected from a field infested with *R. indica*, and (4) predators collected from a field that had never been infested with *R. indica*. Results of this study suggest that *A. largoensis* is likely to accept and consume high numbers of *R. indica* eggs regardless of their previous feeding experience. In contrast, all populations consumed relatively fewer *R. indica* larvae than the other prey tested. Predators previously exposed to *R. indica* were more likely to consume *R. indica* larvae. By contrast, predators not previously exposed to *R. indica* showed the lowest likelihood of choosing to feed on this prey item. Plasticity in the response of *A. largoensis* to *R. indica* larvae could be associated to selection, learning, or a combination of both. The possible implications of the observed differences in terms of biological control of *R. indica* are discussed.

Keywords Invasive species; *Raoiella indica*; *Amblyseius largoensis*; Learning; Selection

<http://www.sciencedirect.com/science/article/pii/S1049964411002520>

Within-season dynamics of red palm mite (Raoiella indica) and phytoseiid predators on two host palm species in south-west India

B. Taylor, P. M. Rahman, S. T. Murphy and V. V. Sudheendrakumar

2012. Experimental and Applied Acarology 57:331-345

Abstract

Field surveys were conducted monthly between December 2008 and July 2009 in Kerala, south-west India to compare the population dynamics of the red palm mite *Raoiella indica* (RPM) on two host plants *Areca catechu* and *Cocos nucifera* during one non-monsoon season when, in general, RPM populations increase. The aim was to examine the effects of host plant, host plant locality and the impact of climatic factors on RPM and related phytoseiid predators. There were significantly higher RPM densities on areca in peak season (May/June) compared to coconut; although significantly more coconut sites were infested with RPM than areca. Although no one climatic factor was significantly related to RPM numbers, interactions were found between temperature, humidity and rainfall and the partitioning of host plant locality showed that where conditions were warmer and drier, RPM densities were significantly higher. Specifically on coconut, there was a significant relation between RPM densities and the combined interaction between site temperature, site humidity and phytoseiid densities. There was a marked difference in the density of phytoseiids collected between areca and coconut palms, with significantly more on the latter, in several months. *Amblyseius largoensis* was the most commonly collected phytoseiid in association with RPM, although *Amblyseius tamatavensis* species group and *Amblyseius largoensis* species group were collected in association with RPM also. There was also evidence of a weak numerical response of the combined phytoseiid complex in relation to RPM density the previous month on coconut but this was not observed on areca.

Keywords: *Raoiella indica*; *Areca catechu*; *Cocos nucifera*; Biological control; Phytoseiids; Within-season dynamics

<http://www.springerlink.com/content/r54717616m433130/>

DISTRIBUTION

2007 Florida CAPS Red Palm Mites survey 2nd interim report, October 2006– January 2008

T.R. Smith and W.N. Dixon

2008. Gainesville, Florida: Florida Department of Agriculture and Consumer Services
Florida Cooperative Agricultural Pest survey Programme Report No. 2007-02-RPM-02
http://www.freshfromflorida.com/pi/caps/images/pdf_rpm_report_2nd_interim_2007_small.pdf

Climate Factor Comparison Analysis for Red Palm Mite, *Raoiella Indica*

D. Borchert and D. Fieselmann

2008. In: Proceedings of the Caribbean Food Crops Society Forty Fourth Annual Meeting 2008, Miami Beach, Florida, USA. San Juan Puerto Rico: Caribbean Food Crops Society 44(2):581

Poster #60

Abstract

The red palm mite, *Raoiella indica* was first detected in the Western Hemisphere in Martinique in 2004. It has rapidly spread through the Caribbean Basin causing extensive foliar damage, especially on young coconuts, other palms and bananas. Red palm mite has been reported in Israel and Egypt for over 25 years without causing significant damage. The aim of this study is to investigate the climatic factors that might explain the difference in pest status between the Mediterranean Region as opposed to the Caribbean Basin. The web based NAPPFAST (North Carolina State University- Animal and Plant Health Inspection Service Plant Pest Forecasting) system was used to compare various climatic factors that may determine red palm mite populations. Three climatic factors utilized in the analysis are present in the countries where *R. indica* is reported to be a pest. This NAPPFAST model may be useful for predicting areas at high risk for red palm mite. This model may also be useful to assess the risk from other pest species based upon climatic factors.

Keywords: *Raoiella indica*, Climate matching, NAPPFAST

<http://cfcs.eea.uprm.edu/sites/default/files/proc/CFCS%202008%20Vol.%2044%20No.%201.pdf#page=205>

Current status and distribution of *Raoiella indica* (Acari: Tenuipalpidae) in Brazil

D. Navia, G.J. de Moraes, A.L. Marsaro Jr., M.G.C. Gondim Jr., F.R. da Silva and T.M.M.G. de Castro

2010. 13th International Congress of Acarology August 23-27, 2010, Recife-PE, Brazil: Abstract book: 173

Abstract

The red palm mite, *Raoiella indica* Hirst, is a notable example of an invasive phytophagous mite to the New World. It was first found in the Caribbean in 2004, disseminating and extending its host range widely within a very short time. Its detection in Venezuela in early 2007 alerted Brazilian researchers about the risk of its entry in Brazil. The State of Roraima was considered as the most probable region where it could first be found in this country, because of its border with Venezuela, and because of the frequent trade of goods and movement of people between those countries. Surveys in this State were initiated in May 2007 and intensified in 2008 in three municipalities: Pacaraima (at the border with Venezuela), Boa Vista (the capital of Roraima, about 220 km south of the border with Venezuela) and Cantá (about 100 km southwest of the capital). The red palm mite was not found in those surveys. In July 2009, *R. indica* was found on coconut leaves in the urban area of Boa Vista; immediately subsequent samplings showed the mite to be spread over extensive areas of Boa Vista municipality and neighboring southern municipalities, infesting coconut, banana and other host plants. Probably, the dispersal of the red palm mite from Venezuela was not natural, but transported by man. An immediate impact of the introduction of *R. indica* in Brazil was social, due to the restriction of movement of bananas from Roraima, where it is widely grown by large and small farmers, to the State of Amazonas. Until now, the distribution of *R. indica* in Brazil is restricted to Roraima,

north of the large Amazonian forest. While little can be done in terms of reducing the possible natural spread of the mite, given the common occurrence of palm trees in the natural vegetation, efforts have been dedicated to delay the dispersal by man to other parts of the country. Mitigation efforts should be put in place to allow the control of the pest. A biological control project has been initiated, to evaluate the role played by local predators and the possible introduction of exotic, prospective natural enemies.

First record of *Raoiella indica* (Hirst, 1924) (Acari: Tenuipalpidae) in Guadeloupe and Saint Martin, West Indies.

J. Etienne and C.H.W. Flechtmann

2006. International Journal of Acarology 32: 331-332.

<http://www.tandfonline.com/doi/abs/10.1080/01647950608684476>

First report of *Raoiella Indica* (Acari: Tenuipalpidae) in Amazonas State, Brazil

J.C.V Rodrigues and L.M.K. Antony

2011. Florida Entomologist 94:1073-1074

Summary

The occurrence of *Raoiella indica* Hirst, the red palm mite, found infesting coconut plants in Aug 2011, is reported for the first time in the urban area of Manaus, state of Amazonas, central region of the Amazon Basin. Additional hosts found infested were Dwarf Royal Palm, *Veitchia merrillii* (Becc.) H. E. Moore and Fishtail Palm Tree, *Caryota mitis* Lour. Despite quarantine efforts this mite has become established in the Southern Hemisphere in the Americas. The mite presents an imminent threat to coconut palm and banana plantations, as well as natural trees, located in the Northeast and Central regions of Brazil.

<http://www.bioone.org/doi/pdf/10.1653/024.094.0452>

First report of *Raoiella indica* Hirst (Acari: Tenuipalpidae) and its damage to coconut palms in Puerto Rico and Culebra Islands

J. C.V. Rodrigues, R. Ochoa and E. Kane

2007. International Journal of Acarology 33: 3-5

Abstract

This is the first report of the occurrence of the red palm mite, *Raoiella indica* Hirst, and its damage in Puerto Rico and Culebra Island. *Raoiella indica* is a new invasive pest threatening ornamental palm, coconut, and banana plantations. The mite was observed in eastern Puerto Rico and on Culebra Island infesting and causing damage to coconut, *Cocos nucifera* L., and *Veitchia merrillii* L.

<http://www.tandfonline.com/doi/abs/10.1080/01647950708684493>

First Report of *Raoiella Indica* (Acari: Tenuipalpidae) in Colombia

D. Carrillo, D. Navia, F. Ferragut and J.E. Peña

2011. Florida Entomologist 94:370-371

Summary:

In January 2010, high populations of *Raoiella indica* were reported for the first time in Colombia attacking coconut, banana, and heliconia plants in the Tayrona National Park. The predatory mite, *Amblyseius largoensis*, was found associated with *R. indica* in Los Naranjos, Magdalena. Strict sanitary strategies and other management tactics should be implemented to minimize the damage caused by *R. indica* in the Americas.

<http://journals.fcla.edu/flaent/article/view/76356>

First report of the presence of red palm mite

International Plant Protection Convention (IPPC)

2010. Rome, Italy: FAO.

IPPC Official Pest Report, No. BRB-02/2

[https://www.ippc.int/index.php?id=1110879&no_cache=1&frompage=118&tx_pestreport_pi1\[showUid\]=217019](https://www.ippc.int/index.php?id=1110879&no_cache=1&frompage=118&tx_pestreport_pi1[showUid]=217019)

First report of the red palm mite, *Raoiella indica* Hirst (Acari: Tenuipalpidae), in Brazil.

D. Navia, A.L. Marsaro Jr., F.R. da Silva, M.G.C. Gondim Jr. and G.J. de Moraes

2011. Neotropical Entomology 40:409–411

Abstract

The presence of the red palm mite, *Raoiella indica* Hirst, is reported for the first time in Brazil. This invasive mite was found in July 2009 infesting coconut palms and bananas in urban areas of Boa Vista, State of Roraima, in northern Brazil. Comments on the possible pathways of *R. indica* into the country, present and potential impact of its introduction and mitigating measures to prevent or to delay the mite spread in Brazil are presented.

Keywords: Plant protection, invasive species, coconut, banana

http://www.scielo.br/scielo.php?pid=S1519-566X2011000300018&script=sci_arttext

First report of *Raoiella indica* Hirst (Acari: Tenuipalpidae) in South America

Carlos Vásquez; Magally Quirós de G., Orlando Aponte; D. María F. Sandoval

2008. Neotropical Entomology 37(6)

Abstract

The presence of the red palm mite, *Raoiella indica* Hirst is recorded for the first time in South America. High populations and severe damages caused by this new invasive mite were found on coconut and banana leaves in Sucre (10° 27' 47" N and 64°10' 38" W) and Monagas (9°46'60" N and 63°12'0" W) states in northeastern Venezuela.

Keywords: False spider mite, coconut, *Musa*, red palm mite

http://www.scielo.br/scielo.php?pid=S1519-566X2008000600019&script=sci_arttext&tlng=es

Impact of the invasion of the red palm mite, *Raoiella indica*, in Puerto Rico

J.C.V. Rodrigues, J. Peña, and A. Roda

2007. In: Proceedings of the Caribbean Food Crops Society 43rd Annual Meeting September 16 - 22, 2007, Radisson Europa Hotel & Conference Center San José, Costa Rica. San Juan Puerto Rico: Caribbean Food Crops Society 43:22.

Abstract

The mite *Raoiella indica* Hirst (Acari: Tenuipalpidae) was first detected on the eastern coast of Puerto Rico and on Culebra island in October 2006 (Inter. J. Acarol. 33:3-5, 2007). While tracking the spread of the mite on coconut and banana plants, we observed that it is spreading faster through the southern part of the island than through the north side. Since June 2007 the mite has been observed in the southwestern corner of the island and in the north extending about halfway across the northern coast of the island, about 100 and 50 km, respectively, from the original detection sites. Because the coconut palm is common in all coastal areas of the island, the occurrence of this susceptible host is probably not responsible for the mite's pattern of distribution. The southern part of the island is markedly drier than the north side and this difference would likely affect natural enemies as well as the pest. Severe damage associated with high number of mites has been observed in coconut palms and in banana, which are the most common hosts found in the coastal areas. Mite infestations are killing young coconut palms, all of which may lead to a decrease in natural reseeding and consequently a decrease in palm densities in natural areas. Coconut palms around two years old have been found severely infested and appear to have had vigor and growth compromised. Adult plants show twisted, drooping lower leaves and premature loss of young immature fruits. There is great

variability in palm (species and varieties) and banana susceptibility to mite infestation. Complex groups of natural enemies have been observed attacking red palm mite colonies in the field, including predatory mites, thrips, ladybeetles, chrysopids, Diptera larvae (probably Cecidomyiidae), and fungi. First trials with acaricides were conducted in order to select products that could protect young nursery plants.

Keywords: Invasive species, coconut, banana

<http://cfcs.eea.uprm.edu/sites/default/files/proc/CFCS%202007%20Vol.%2043.pdf>

National Invasive Species Strategy for Saint Lucia PATHWAYS: carried out under the project Mitigating the Threats of Invasive Alien Species in the Insular Caribbean. Project No. GFL / 2328 – 2713-4A86, GF-1030-09-03

Guy Mathurin, NISS Pathways Specialist

2010. September 2010. 46p.

Introduction

This document is produced as part of the development of a National Invasive Species Strategy (NISS) which is being formulated for Saint Lucia under the project “Mitigating the Threat of Invasive Alien Species in the Insular Caribbean”. This project is funded by the Global Environment Facility (GEF) and implemented by CABI Bioscience. The aim of this report is to identify possibly pathways by which Invasive Alien Species (IAS) could arrive into Saint Lucia and recommend measures which may be taken to mitigate against them

<http://www.ciasnet.org/wp-content/uploads/2012/09/NISS-Pathways-final-2010.pdf>

Un nouvel acarien ravageur des palmiers. En Martinique, premier signalement de Raoiella indica pour les Caraïbes

C.H.W Flechtmann and J. Etienne

2005. Phytoma 584:10-11

<http://www.phytoma-ldv.com/article-23428->

[Un nouvel acarien ravageur des palmiers En Martinique premier signalement de Raoiella indica pour les Caraïbes](http://www.phytoma-ldv.com/article-23428-)

The presence and distribution of the Red Palm Mite, Raoiella indica Hirst (Acari: Tenuipalpidae) in Trinidad

C. Shripat, F. Hosein, P. Siew and Y. Ali

2008. In: Proceedings of the 44th Annual Meeting Caribbean Food Crops Society, July 13-17, 2008, Miami Beach, Florida, USA. Vol. XLIV – Number 2. San Juan, Puerto Rico: CFCS 44(2):235-248

Abstract

The red palm mite, *Raoiella indica* Hirst (Acari: Tenuipalpidae) is an Invasive Alien Species (IAS), which was first detected in the Western Hemisphere in the island of Martinique in 2004. It has since spread to Dominica (2005), Dominican Republic (2006), Puerto Rico (2006), Trinidad (2006), St. Vincent (2007), Jamaica (2007), and Grenada (2007). The pest has the potential to quickly spread to new locations by wind currents or human activities. *Raoiella indica* was first detected in Trinidad in March 2006. Surveillance activities revealed that the pest was rapidly dispersing to new areas. From July-September 2007, a survey was conducted to detect the presence and distribution of red palm mite and native natural enemies in Trinidad. Ten coconut farms were randomly selected from each of the eight counties and two trees were sampled from each farm. In each case, samples were collected from the 3rd and 9th fronds and examined in the laboratory for red palm mite and natural enemies. The data were analyzed using the Statistical Package for Social Science (SPSS), Version 7.5. Red palm mite was present in all counties, but the numbers observed in each county were varied. Nariva/Mayaro and St. Andrew/St. David had significantly ($p < 0.05$) more mites than the other counties. The predominant natural enemy was *Amblyseius largoensis* (Acari: Phytoseiidae); however, predatory mite populations were low ranging from only nine in the St. Patrick East samples to 81 in St. George West. Counties with higher populations were those with large coconut farms >20.0 hectares.

Because the red palm mite was found to be widespread, surveys should also be conducted in the dry season and long term population dynamics studies should be initiated. *Amblyseius largoensis* should be reared and mass produced in the laboratory for augmenting field populations, and classical biological control also should be investigated to manage the pest.

Keywords: *Raoiella indica*, natural enemy, Trinidad

<http://cfcs.eea.uprm.edu/sites/default/files/proc/CFCS%202008%20Vol.%2044%20No.%201.pdf#page=205>

***Raoiella indica*. [Distribution map]**

CABI

2007. Wallingford, UK: CABI

Distribution Maps of Plant Pests, 2007, June, Map 210 (1st Revision)

Description

A new distribution map is provided for *Raoiella indica* Hirst. Acari: Tenuipalpidae. Hosts: betelnut palm (*Areca catechu*), coconut (*Cocos nucifera*), date palm (*Phoenix dactylifera*) and ornamental palm (*Vietchia merrillii*). Information is given on the geographical distribution in Asia (India, Goa, Karnataka, Kerala, Madhya Pradesh, Tamil Nadu, West Bengal, Iran, Israel, Oman, Pakistan, Philippines, Saudi Arabia, Sri Lanka, United Arab Emirates), Africa (Egypt, Mauritius, Reunion, Sudan), and Central America and Caribbean (Dominica, Dominican Republic, Guadeloupe, Martinique, Puerto Rico, St Lucia, Trinidad and Tobago).

<http://www.cabi.org/dmpp/default.aspx?site=164&page=4049&LoadModule=Review&ReviewID=80164>

***Raoiella indica* Hirst (Acari: Tenuipalpidae): a threat for Cuba. (*Raoiella indica* Hirst (Acari: Tenuipalpidae): una amenaza para Cuba.)**

H. Rodríguez, A. Montoya and M. Ramos

2007. Revista de Protección Vegetal, 22:142-153

Lang: Spanish

Abstract

The red palm mite, *Raoiella indica* Hirst (Acari: Tenuipalpidae) is a serious pest for coconut, date and areca palms in many countries in the tropics of the Eastern and Western hemispheres. It was described on coconut leaves from India in 1924, being disseminated in several countries including Pakistan, Sri Lanka, Malaysia, Mauritius, Egypt, Sudan, Iran, Oman, Israel, Reunion, Saudi Arabia, United Arab Emirates and Philippine. This mite was recently reported in the Caribbean region, in Martinique, in 2004. It has spread rapidly throughout this region and has been found in Dominica, Guadeloupe, St. Martin, Saint Lucia, Trinidad and Tobago, Puerto Rico, St. Thomas, Dominican Republic and Jamaica, where it has been observed also affecting other plant species not belonging to Arecaceae family such as *Musa* spp. (Musaceae), *Heliconia rostrata* (Heliconiaceae), *Alpinia purpurata* (Zingiberaceae) and *Eucalyptus* spp. (Myrtaceae). Considering the risk of introduction of this invasive species, the present review was carried out to provide updated technical information about the biology, geographic distribution, detection, damage and management of *R. indica*. The incidence of this pest in Cuba might have serious consequences for coconut and plantain crops and to the tourism industry for the damage on the attractive gardens surrounding the hotels and to the Real Palm, national tree, with social and cultural implications. For this reason, the development of a management strategy to mitigate the possible impact of red palm mite and of a comprehensive public awareness programme for farmers and the public in general is very important.

Keywords: *Raoiella indica*; red palm mite; coconut; plantain; Arecaceae; ornamental plants.

http://scielo.sld.cu/scielo.php?script=sci_abstract&pid=S1010-27522007000300002&lng=en&nrm=iso&tlng=en

***Raoiella indica* Hirst (Acari: Tenuipalpidae): first record and threat in Mexico**

E.G. Estrada-Venegas, H.J. Martínez-Morales and J. Villa Castillo

2010. 13th International congress of Acarology August 23-27, 2010, Recife-PE, Brazil: Abstract book:77
Abstract

The red palm mite, *Raoiella indica* Hirst, 1924, is a serious threat to coconut (*Cocos nucifera*) and other palms, as well as to *Musa* spp. (Musaceae), *Heliconia rostrata* (Heliconiaceae), *Alpinia purpurata* (Zingiberaceae), *Eucalyptus* spp. (Myrtaceae), among others. This pest is widespread in Pakistan, Sri Lanka, Malaysia, Mauritius, Egypt, Sudan, Iran, Oman, Israel, Reunion Island, Saudi Arabia, United Arab Emirates and the Caribbean, Philippines. Reported in Martinique, and from there has spread to Dominica, Guadeloupe, St. Maarten, St. Lucia, Trinidad and Tobago, Puerto Rico, St. Thomas, U.S. Virgin Islands, Dominican Republic and Jamaica. In Mexico, it was first detected in Isla Mujeres, Cancun, Quintana Roo (southwestern Mexico), on October 19, 2009, probably present at low population levels. It was recently detected in Lazaro Cardenas, Benito Juarez, Solidaridad and Tulum counties, all in the State of Quintana Roo. It was collected attacking coconut plants. Collected material was sent to the Acarology Laboratory for identification. All states of development were found in the samples. Surveys were conducted in those sites, looking for the mite on other plant species (ornamental palms and banana). Different activities through the Mexican government (Sanidad Vegetal) were done to control the dispersal of the population.

http://www.acarology.org/ica/ica2010/docs/0910_15_abstractBookCapa.pdf

Red menace on the horizon!

Barbados. Ministry of Agriculture

2010. The Agriculturalist:29-31

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The red palm mite, *Raoiella indica* Hirst, a threat to palms in the Americas (Acari: Prostigmata: Tenuipalpidae)

C.H.W. Flechtmann and J. Etienne

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Risk analysis and potential consequences associated with the introduction of the red palm mite *Raoiella indica* into the United States

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Spatial distributions of the red palm mite, *Raoiella indica* (Acari: Tenuipalpidae) on coconut and their implications for development of efficient sampling plans

A. Roda, G. Nachman, F. Hosein, J.C.V. Rodrigues and J.E. Pena

2012. Experimental and Applied Acarology 57:291-308

Abstract

The red palm mite (*Raoiella indica*), an invasive pest of coconut, entered the Western hemisphere in 2004, then rapidly spread through the Caribbean and into Florida, USA. Developing effective sampling methods may aid in the timely detection of the pest in a new area. Studies were conducted to provide and compare intra tree spatial distribution of red palm mite populations on coconut in two different geographical areas, Trinidad and Puerto Rico, recently invaded by the mite. The middle stratum of a palm hosted significantly more mites than fronds from the upper or lower canopy and fronds from the lower stratum, on average, had significantly fewer mites than the two other strata. The mite populations did not vary within a frond. Mite densities on the top section of the pinna had significantly lower mite densities than the two other sections, which were not significantly different from each other. In order to improve future sampling plans for the red palm mite, the data was used to estimate the variance components associated with the various levels of the hierarchical sampling design. Additionally, presence-absence data were used to investigate the probability of no mites being present in a pinna section randomly chosen from a frond inhabited by mites at a certain density. Our results show that the most precise density estimate at the plantation level is to sample one pinna section per tree from as many trees as possible.

Keywords: *Raoiella*; Red palm mite; Tenuipalpidae; Invasive mite; Spatial distribution; Dispersion; Taylor's power law

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Update on invasive species work in the region with specific reference to recent incursions

Litta Paulraj

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Excerpt

pp.19 Coconut Red Palm Mite

Coconut Red Palm Mite, *Raoiella indica* is a pest of coconut, areca palm, and date palms in tropical and subtropical regions. In the Western Hemisphere it was first reported in Martinique (Flechtmann and Etienne 2004). It has since been confirmed in St Lucia (2005), Dominica (2005), Trinidad (2006) (Wellbourne 2005). Infestation was observed on banana plants (*Musa* spp., Musaceae) in Dominica and Trinidad with additional infestations observed on heliconias and gingers. This pest is a possible threat to the entire Caribbean region, North and South America.

CARDI provided the technical assistance in the identification of the pest and biometric support for the survey for the pest in Dominica. CARDI has set up an e-mail list server to enable the researchers in these three countries to talk to each other and to experts from the United States Department of Agriculture Animal and Plant Health Inspection Service and from CAB International.

<http://www.cardi.org/wp-content/themes/default/files/cardireview/CARDIReview-2006-06.pdf>

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European and Mediterranean Plant Protection Organization (EPPO)
<http://www.eppo.int/>

- Global database *Raiiella indica* <http://gd3.eppo.int/organism.php/RAOIIN>