

Presence of *Raoiella indica* Hirst (Acari: Tenuipalpidae) at an unexpected altitude: in Mexico City.

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Short note

ABSTRACT

>*Raoiella indica* or red palm mite, is reported for the first time from Mexico City. It has now been found at 2244 masl which is the highest elevation documented for the species. Most of the specimens were collected from the underside of Canarian palms (*Phoenix canariensis* Chabaud) fronds, however it is registered for the first time on the upper side as well. Some specimens were collected also from robellini palms (*Phoenix roebelenii* O'Brien).

Keywords Central Mexico; high elevation; landscaping; ornamental palms; red palm mite

Introduction

The red palm mite, *Raoiella indica* Hirst, was originally described from coconut palms in India (Hirst 1924). It was first detected in the Americas on the Caribbean Island of Martinique in 2004 (Flechtman & Etienne 2004), being considered a risk species since its arrival (Castilho *et al.*, 2004). Its progressive dispersion after reaching the New World is spectacular, spreading at an average rate of 400 km a year, so that it is now found from Florida in the North to Paraguay in the south (Rodrigues *et al.*, 2020).

The number of countries where this pest was registered increased from 33 in 2010 to 46 in 2022 [Africa (9), Asia (13), North America (17), South America (7)] but there are currently no confirmed records in Europe (Taylor, 2022). Although it was officially reported for the first time in Mexico in 2009 (Estrada-Venegas *et al.*, 2010), it was intercepted in the same locality (in the southern part of Mujeres Island, Quintana Roo), in 2007 (foreign interception), from a cruise liner on a palm frond hat (Ochoa, personal communication). Since its establishment, the species has been moving along the coasts of the country and currently it is found on both borders, with the United States to the north as well as with Guatemala-Belize to the south (SENASICA 2021).

In this paper, following the examination of several palm trees, we report the presence of *R. indica* in Mexico City.

Material and methods

Sampling activities in search of mites were conducted from March to June 2022 in Mexico City, in Alcaldía Cuauhtémoc along Oaxaca Avenue (19°25'16.8"N 99°09'54.7"W; 2234 m asl), and Alcaldía Gustavo A. Madero, in the General Miguel Miramón Street (19°29'19.5"N 99°06'37.7"W; 2244 m asl), 510 Avenue (San Juan de Aragón 4° section) (19°27'53.8"N

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99°05'09.6"W; 2231 m asl), where a large number of 3-10 m high Canary palms (*Phoenix canariensis* Chabaud) with severe chlorosis were observed (Figure 1A, B). A few samples from chlorotic robellini palm (*Phoenix roebelenii* O'Brien) were collected from Oaxaca Avenue (19°28'50.1"N 99°07'35.1"W; 2234 m asl).

The collected mites were mounted in Hoyer's medium for identification and were identified under a Carl Zeis Axioskop 2 plus phase contrast microscope using available taxonomic mite keys. Voucher specimens were saved in the synoptic collection of the Forest Entomology Collection at Colegio de Postgraduados, Montecillo, Mexico.

Results and discussion

From samples of fronds of Canary palms with chlorosis taken in March from Mexico City, the damage appeared characteristic of *R. indica*, but the mites were not found initially. Only in a second examination they were located in protected sites, at the base of the fronds. Live adults, nymphs and eggs were collected from samples from Oaxaca Avenue (Figure 1C, D). Exuviae of all stages of development were also observed. They were collected from the underside and, contrary to what was suggested by Di Palma *et al.*, (2022), for the first time, they were also collected from the upper side of green fronds (Figure 1D, E), near the rachis, where the populations find protection. Live adult and immature mites were also collected on the underside of green fronds of chlorotic robellini palms in this study but they had already been found on the upper and lower sides of fronds in Yucatan, Mexico (Unpublished data). Both palm species were registered as hosts of the red palm mite in Mexico (SENASICA 2015).

Under the existing landscaping conditions, the total number of mites collected was limited. However, the successful finding of *R. indica* under the prevailing circumstances, demonstrating its adaptative ability, is surprising. Indeed, Mexico City was not considered suitable given its altitude, temperature and humidity are not optimal for this mite based on its biology (Martínez *et al.*, 2019) even though some host plants are documented there. Many sites in Latin American countries and the USA from where *R. indica* has been reported are in the range of 0 to 500 meters above sea level, where tropical or sub-tropical conditions prevail [according to the CABI's map revision (CABI, 2022)], while in Mexico City the climate is mainly temperate sub-humid (87%) and the remainder is a dry and semi-dry climate (7%) and temperate humid (6%) (Weatherspark 2022).

Checking the distribution and dispersion of the species over time in Mexico (Figure 2), suggests that it was well spread on the east coast by 2010 and that it reached the west coast in 2012 and then moved to north and south (Estrada-Venegas, 2014). Although this species is currently reported from the east and west coasts of Mexico, given the conditions in which the species is able to develop (see Martínez *et al.*, 2019), the central states of Mexico (Morelos, State of Mexico, Hidalgo, Tlaxcala, Puebla, San Luis Potosi, Aguascalientes, Nuevo Leon, Zacatecas and Chihuahua) and some of the coastal states (Tamaulipas and Baja California Norte) have appropriate conditions for the establishment of the species.

Based on our findings, we believe that this species will continue to disperse, adapt and settle further. More species of host plants used as ornamentals, such as Washingtonia palm (*Washingtonia robusta* H. Wendl) and other species present in and around Mexico City could facilitate the survival of the mite. The red palm mite is spreading into the interior of the country and is established in Mexico City in low numbers, due to the environmental conditions, on the foliage of the host plants. It is considered that this species may already be present in other parts of Mexico City where a large number of chlorotic or dying host palms are found.

The presence of the species close to the USA border is an important concern to the states of California and Arizona as similar conditions and host plants exist for the establishment of the mites (Figure 2). The results of this work may be an early indication of the effects of climate change that are forecast to continue to grow allowing red palm mite and other species into areas which were not considered appropriate for their survival, not only in Mexico but in other places to which where the species is dispersing.

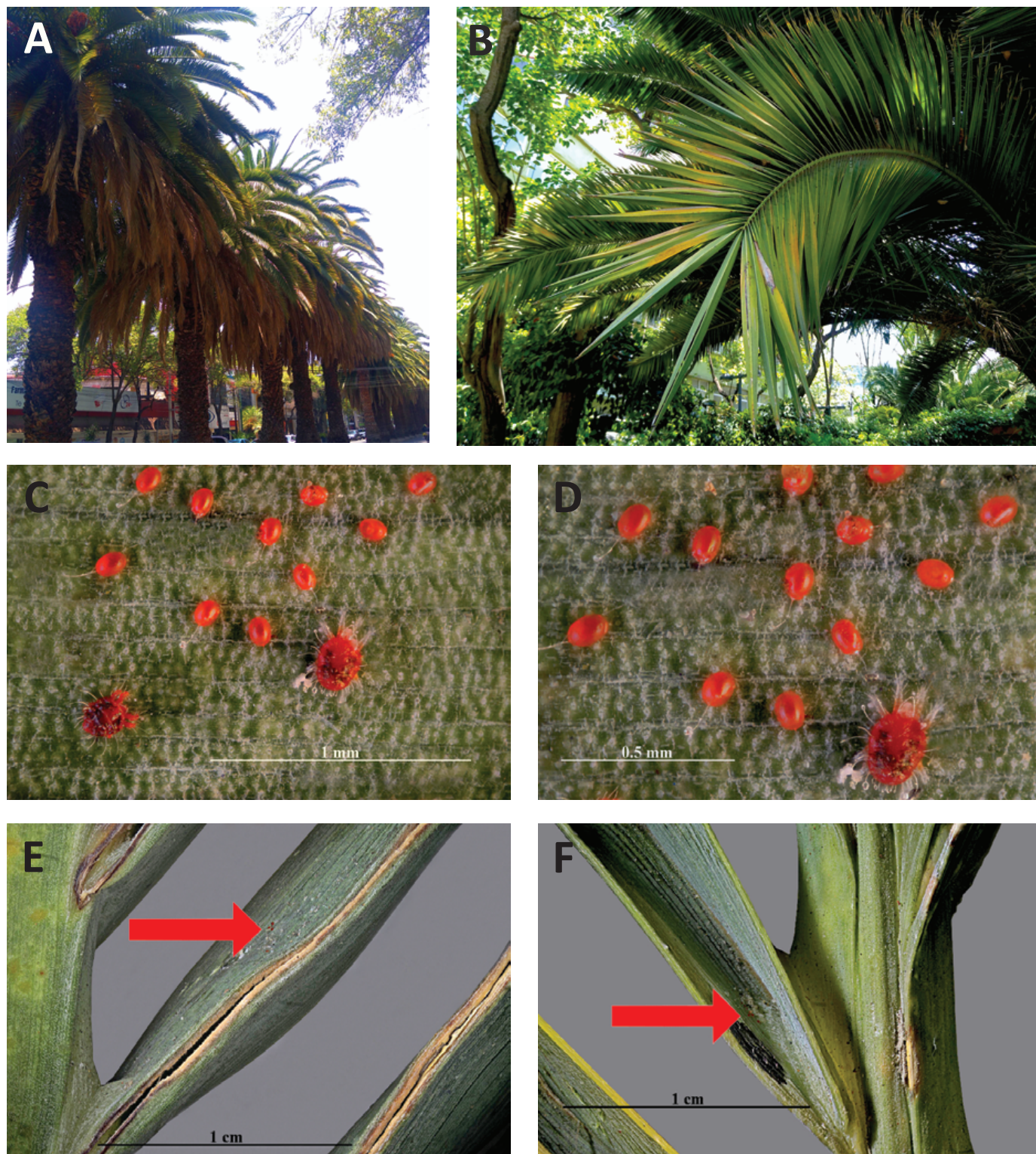


Figure 1 A and B – Canary palms (*Phoenix canariensis* Chabaud) with severe damage ; C and D – *Raoiella indica* Male and female and eggs; D and E – Population underside and upside of green fronds, respectively.

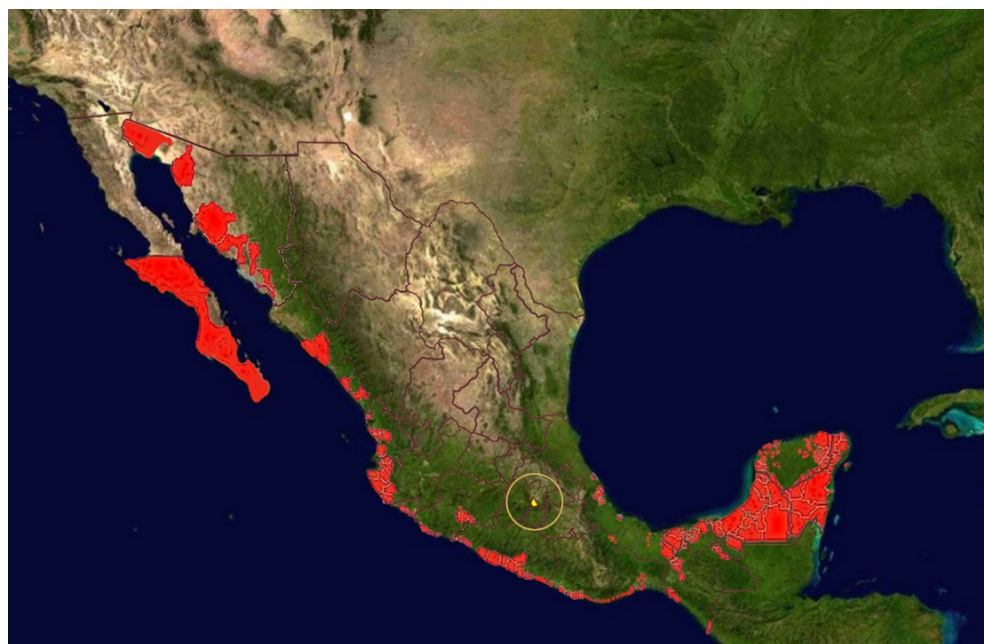


Figure 2 Distribution of *Raoiella indica* in Mexico (modified from SENASICA, 2021). Mexico City is indicated by a yellow point in the center (Drawing by Diana Montoya).

The study of the natural enemies of *R. indica* (insects, mites and pathogens) should be a priority in order to keep the species under control. Likewise, a similar analysis of landscaping plants should be carried out to ensure that some of them may not be possible substitutes for the known susceptible host plants. Similar occurrences of other mite pests have been described (Migeon *et al.*, 2009) underling the impact a climate in state of flux. Development of new weather modeling could play a critical role in predicting potential future occurrences of adventive or invasive plant feeding mites moving into previously intemperate areas.

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