Investigation note

Identification of the mite and pathogen associated with mango floral malformation in Gabriel Zamora, Michoacán

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Abstract

Among the factors that limit mango production, mites are one of the most important due to the association they have with pathogens that damage the crop. The objectives of this work were to identify the mites and pathogens associated with the floral malformation of the mango, as well as the mites in foliage in an orchard of Gabriel Zamora, Michoacán. Samples of foliage and malformations of mango inflorescence were taken in an orchard in the municipality of Gabriel Zamora from November 2015 to January 2016, which were taken to the laboratory to dissect the plant matter and assemble the mite species collected; in the same way, the mites associated with the malformation were sown in PDA medium and the fungal colonies that germinated in the medium were separated, to finally identify them with taxonomic keys. *Aceria mangiferae* and *Fusarium mexicanum* were identified as the mite and fungus associated with the malformation of mango inflorescence, as well as *Oligonychus mangiferus* as the species of mite associated with foliage in Gabriel Zamora, Michoacán.

Keywords: Michoacán, mite-pathogen determination, witch's broom.

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Mango (*Mangifera indica* L.) is a fruit tree native to Southeast Asia and its cultivation is present in more than 100 countries around the world, covering most of America, Australia, South Asia, Southeast Asia, East Africa, Africa Western and part of East Asia (Galan 1999; FAO, 2019). Mexico ranks as one of the leading mango production countries with a production of 1 958 491 t and has positioned itself as one of the top five producers of said fruit, only below powers such as India, China, Thailand and Indonesia according with data from the Food and Agriculture Organization (FAO, 2019).

In Mexico, mango production is headed by six of the twenty-two producing states, which are Guerrero, Sinaloa, Nayarit, Chiapas, Michoacán and Oaxaca, which together contribute around 85% of national production (SIAP, 2019). In Michoacán, mango is produced in 30 municipalities led by the municipalities of Lazaro Cárdenas and Gabriel Zamora, the latter producing 21 800 t, which reached a market value of 135 million pesos in 2017 (SIAP, 2019).

The Haden and Tommy Atkins cultivars that occupy almost 90% of the planted area stand out on the surface set with mango in Michoacán. In smaller proportions are other cultivars such as Ataulfo, Kent and Keitt. Among the factors that limit mango production in the state of Michoacán, pests and diseases are one of the most important factors and the malformation of the floral and vegetative tissue known as 'witch's broom' is the most important phytosanitary problem of the crop since it is estimated that it causes reductions in production of between 40 and 90% in the state.

The symptomatology is: shortened and thickened primary and secondary axes with many ramifications that are compressed. They appear mainly in the months of January, February, March, April and May months in which they continue to grow, after these, the malformations withered and became attached to the tree, to subsequently dehydrate or dry and acquire the peculiar form of 'witch's broom' (Vega and Miranda, 1993).

It has long been associated with the mites of the family Eriophyidae and fungi of the genus *Fusarium* as the causative organism of the malformation in the vegetative and floral tissue of mango, however it has not deepened in the study of such association in the region, which is why the following objectives are proposed: identify the mite and the pathogen associated with the malformation in the vegetative and floral tissue of the mango known as 'witch's broom' in an orchard of Gabriel Zamora, Michoacán, as well as identify the species of mite of the family Tetranychidae associated with mango foliage in said orchard.

The collections were made in a mango orchard (*Mangifera indica* L.) with 10-year-old trees and conventional management, called 'La Antorcha' at coordinates 19° 10' 35.96'' north latitude, 102° 02' 57.16'' west longitude, in the town of Lombardy, belonging to the municipality of Gabriel Zamora, Michoacán from November 2015 to January 2016.

Sample collection and processing: it was carried out using the direct collection method, for which 10 trees were chosen at random. From each tree 4 young leaves and 4 senescent leaves (one of each of the cardinal points) were cut with the help of pruning shears and placed separately, in addition to collecting inflorescences with malformations of floral and vegetative tissue known as 'witch's broom' that will be in good condition (without dehydration) and similarly placed in plastic bags to be taken to the laboratory and analyzed. Once in the laboratory, the leaves were checked under a

stereoscopic microscope by beam and reverse and in the malformations, cuts were made with the help of a knife, needle and dissection forceps. The mites were taken with a 'fisherman' (piece of wood with a fine metal bristle adapted at one end) to later be mounted.

Assembly and identification of the mites: the preparation was done by means of assembly in lamellae according to Acuña (2012) and for the identification the taxonomic keys Amrine *et al*. (2003); NAPPO (2014), procedures that were performed in the Faculty of Agrobiology 'Presidente Juarez' of the Michoacana University of San Nicolas de Hidalgo.

Isolation and identification of the pathogen: Once the dissection of the plant material was performed, copies of *A. mangiferae* PDA were placed in the culture medium, in each petri dish five mites were placed, one in each of the cardinal points and one more in the center. When mycelial growth was observed, the different colonies were separated, which was done by cutting with a punch of 1 cm in diameter, and then passing them to Petri dishes with the same culture medium.

Once the pathogen was grown, fixed preparations were carried out in the holder and covers objects for identification. For the identification, the synoptic keys of Leslie and Summerell (2006) were used, by morphological comparison and description of the growth, color and shape of the colony, as well as the microscopic characteristics of the reproductive structures, which were observed in a compound microscope.

The species *Aceria mangiferae* (Hassan) (Acari: Eriophyidae) was identified as the mite associated with the malformation of mango floral tissue. The morphological characteristics observed were females with a vermiform body and little yellowish curve. Gnatosoma directed downwards, prodorsal shield of subtriangular shape, with a small lobe which is the base of the chelycer, leg I with bv silk, silk l", tarsal with tarsal solenidium w strongly curved down. Leg II, bv silk, coxas I am touching the margins of the rings. Opistosoma with 72-82 dorsal rings and the number of these is reduced in ventral view to 70 completely microtuberculated, genitalia of the visible female, covering plate has 10 to 12 ribs (Sayed, 1946).

Aceria mangiferae is a cosmopolitan species belonging to the Eriophyidae family, has always been associated with mango and is widely distributed, has been reported in the United States of America, Spain, Central America, Brazil, Pakistan, South Africa, Sudan, Uganda, Israel, Malaysia, India. Australia, Egypt and Cuba (Narayanan and Ghani, 1963; Peña and Ferragut 1994; Ploetz and Prakash 1997; Rodríguez and Estébanez, 1998; Peña *et al*., 2005; Mesa-Cobo *et al*., 2010; Sarwar, 2015).

In Mexico this species has been registered by Rodriguez and Estébanez (1998); Espinoza *et al*. (2007) who collected it in mangoes of Morelos and Michoacán respectively. In Michoacán it was registered in the Balsas-Tepalcatepec depressions, which are close to the location of the present investigation. Several studies mention that there is a high correlation between *A. mangiferae* populations in the buds and the incidence of 'witch's broom' mango trees, in addition to demonstrating that the application of acaricides can reduce the incidence of these malformations (Mora *et al.*, 2003).

However, other authors report that *A. mangiferae* is not directly involved in the appearance of the 'witch's broom', as happens in Australia where trees do not show malformations even when the mite is present (Ploetz and Prakash 1997). From the total of Petri boxes sown, 20 isolates of the genus *Fusarium* were obtained, of which at least five different growths were observed and *Fusarium mexicanum* was identified.

The aerial mycelium was dense, abundant and with a cottony appearance, it presented shades of white to cream, with pink, purple or cherry color halos, it is important to point out that *Fusarium* species are sensitive to light which causes their colorations to change widely (Leslie and Summerell, 2006).

This work coincides Pinkas and Gazit (1992) who suggest the theory that *Aceria mangiferae* is not the causative agent of the witch's broom, but that it acts as the vector of the disease carrying on the body the spore of the fungus *Fusarium*, agent Cause of the disease (Pinkas and Gazit, 1992). *Oligonychus mangiferus* (Rahman and Sapra) (Acari: Tetranychidae) was identified as the species associated with the foliage in mangoes of Gabriel Zamora, Michoacán, this species is known as 'red spider of the mango' and the main damages in leaves are attributed, In addition to that it can affect the quality of the fruit.

The characteristics observed were: female has elongated dorsal mushrooms, extended in the back, beyond the base of the following mushrooms; tibia I with seven tactile mushrooms plus a solenidium, tarsus I with four tactile mushrooms plus a solenidium close to the duplex mushrooms, tibia 2 with 5 tactile mushrooms, tarsus 2 with 3 plus a solenidium also close to the duplex mushrooms. Genital flange with transverse striae and pregenital area with longitudinal stretch marks.

Oligonychus mangiferus is the most common Tetranychidae species in mango foliage and is present in the main mango-producing countries in the world, in Egypt it is widely studied just like its natural enemies, while in Taiwan and Israel it is the mite more damaging of this crop, it is also present in Mauritius, Thailand, El Salvador, Hawaii, India, United States of America, Pakistan and Mexico (Ben *et al*., 2007; NAPPO, 2014; Mohamed and Nabil, 2014; Sarwar, 2015). In Mexico it is not specified in the places where it is present, so it is the first time that this species is associated in the cultivation of mango in the state of Michoacán.

Although *O. mangiferus* is considered as a pest of economic importance for the cultivation of mango worldwide, no obvious damage was observed due to this pest, this is probably due to the fact that this pest has not yet been established in the producing area from Michoacán; however, it is important to monitor this species because it is a latent danger and can take advantage of the conditions that exist and become a plague of importance not only in Gabriel Zamora, but also in the state of Michoacán.

Conclusions

Based on the objectives set forth, the methodology used and the conditions under which this research was conducted, the following conclusions were reached: *Aceria mangiferae* and *Fusarium mexicanum* were identified as the mite and fungus associated with the inflorescence malformation of mango in the cultivation of Gabriel Zamora, Michoacán.

Oligonychus mangiferus was identified as the mite species associated with mango foliage in Gabriel Zamora, Michoacan. *Oligonychus mangiferus* is a new record for the cultivation of mango in Mexico, this pest did not show obvious damage to the crop during the duration of the investigation.

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