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**First report of *Phyllocoptes fructiphilus* Keifer, the vector of the *Rose Rosette Virus*, in Florida**

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*Phyllocoptes fructiphilus* Keifer (Acari: Eriophyidae) is a microscopic eriophyid mite. Eriophyid mites are very host specific (Oldfield 1996; Skoracka et al. 2009) and *P. fructiphilus* only feeds on plants in the genus *Rosa* (Amrine 1996). *Phyllocoptes fructiphilus* is associated with the *Rose rosette emaravirus* (rose rosette virus, RRV) and acts as the only known vector of RRV. Infection is commonly associated with the following symptoms: witches’ broom, rosetting, deformed flowers, increased thorn density, elongated shoots, reddened leaves and stems, and increased die-back which ultimately kills the rose host (Amrine 1996). This disease is known as Rose Rosette Disease (RRD) and is the most serious illness of roses, affecting the U.S. commercial rose industry which is worth millions of dollars. Rose Rosette Disease and *P. fructiphilus* have invaded the southeastern U.S. as they followed the range expansion of the non-native *Rosa multiflora* (Thunb.) towards the east coast (Amrine 2002; Otero-Colina et al. 2018).

In 2013 a nursery in Quincy, Gadsden County, FL detected witches’ brooms and other RRD symptoms on 15 knockout roses which had been imported from out of state. 8 symptomatic plants were tested and found positive for RRD. *P. fructiphilus* were not detected on the roses at that time (Babu et al. 2014). In 2018 we began a series of surveys along the borders of northern Florida and southern Georgia to determine if this mite was present and acting as a vector for the disease.

Survey efforts initially focused on counties around Leon County, FL. Rose tissue samples were taken from the periphery of various roses in the landscape: sampling was focused on the flowering tips of roses and included a mixture of flowers, fruits, buds and short lengths of rose cane. Samples were trimmed with bypass pruners, sanitized with 70% ethanol between cuts and stored in quart sized plastic bags. The average sample contained 26.8 ± 1.5 g of undried plant tissue. Rose cultivar/species and coordinates were recorded to map out sites that had predatory mites, eriophyid mites, or possibly RRD.

Samples were processed using a washing method derived from Monfreda et al. (2007): 10 cm cut roses were soaked in a 500 mL beaker with a solution of 1:1 bleach:water with a few drops of dishwasher detergent. The solution was stirred vigorously with a glass rod to dislodge any mites, then poured over a stack of sieves with decreasing screen sizes: 180 μm, 53 μm and 25 μm. The beaker and rose pieces were further rinsed with tap water over the sieve stack to dislodge any remaining mites. The 53 μm and 25 μm sieves were processed separately; the 53 μm sieve retains larger mites while the 25 μm sieve retains smaller mites, including *P. fructiphilus*. The sieves were then backwashed from the underside of their screen with a water-filled wash bottle, starting from the highest point of a sieve and working to the bottom to flush any trapped debris and mites into a 50 mL centrifuge tube for storage and future observation. Samples were observed under a dissecting microscope. Mites found among the plant debris were siphoned off with a glass pipette and subsequently stored in micro-centrifuge containers with 95% ethanol as a preservative. Some specimens were mounted directly into Hoyer’s slide mounting media (Hempstead Halide, Inc. Galveston, TX), dried at 90°C, then ringed with nail polish.

On February 14, 2019, we found a total of 42 eriophyid mites from six samples obtained from Pink Double Knock Out® roses while surveying roses in the landscape in Tallahassee, Leon County, Florida (see Fig. 1A). The mites were sent to the Florida Department of Agriculture and Consumer Services - Division of Plant Industry (FDACS-DPI) and were all identified as *P. fructiphilus* based, among other characters, on the distinctive pattern of ridges on the prodorsal shield (Bauchan et al. 2019) (Fig. 2). The roses did not show signs or symptoms of RRD.

On July 16th we conducted an additional survey of 33 sites with Pink Double Knock Out® roses near the initial site of discovery, including the rose sites where *P. fructiphilus* was originally detected (Fig. 1B). Each sample contained more than 50 eriophyid mites, with some samples containing over 300 mites. We compared the samples collected during February and July with a paired t-test and we found a significant increase in the *P. fructiphilus* population between the two sampling dates (seeFig. 1C; p-value = 0.001, α = 0.05, df = 4). Mites that were slide mounted were subsequently confirmed as *P. fructiphilus*.

This is the first record for *P. fructiphilus* in Florida. None of the mite-infested roses showed symptoms of RRD and none tested positive for RRV based on detection tools developed to date. However, the presence of *P. fructiphilus*, along with past detections of RRV in Florida warrants increased monitoring for the mite and virus in Florida. There is a critical need to develop methods to manage *P. fructiphilus* and RRV, or homeowners, commercial landscapers, and U.S. rose industry stands to lose millions of dollars and established plantings in the coming years.

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**Summary**

The invasive mite *Phyllocoptes fructiphilus* Keifer (Acari: Trombidiformes, Eriophyidae) feeds on plants in the genus *Rosa*. *P. fructiphilus* is associated with the *Rose rosette emaravirus* (rose rosette virus, RRV) and acts as the only known vector of RRV, the causal agent of Rose Rosette Disease (*Bunyavirales: Fimoviridae, Emaravirus*). The mite *P. fructiphilus* is reported for the first time in the state of Florida, USA. No roses showed signs or symptoms of viral infection, and current molecular methods were unable to detect the virus. *P. fructiphilus* represents a potential threat to the Florida rose industry if Rose Rosette Disease becomes established.

Key Words: Rose rosette disease; *Rose rosette virus*; *Virus del arrosetamiento de la rosa*; Enfermedad del arrosetamiento de la rosa; Emaravirus

**Resumen**

El ácaro invasivo *Phyllocoptes fructiphilus* Keifer (Acari: Trombidiformes, Eriophyidae) se alimenta sobre plantas del género *Rosa.* *P. fructiphilus* se asocia con *Rose rosette emaravirus* (virus del arrosetamiento de la rosa, VAR), es reconocido principalmente como vector de la VAR, el agente causal de la enfermedad del arrosetamiento de la rosa (*Bunyavirales: Fimoviridae: Emaraviridae,* EAR). El ácaro *P. fructiphilus* se reporta por primera vez para el estado de la Florida, USA. Ninguna rosa mostró señales o síntomas de una infección viral, y ningun virus fue detectado con el uso de métodos moleculares de hoy en día. *P. fructiphilus* representa una amenaza potencial para la industria de la rosa en la Florida si EAR se llega a establecer.

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**Figure Caption**

**Fig. 1:** Presence of *Phyllocoptes fructiphilus* in Leon County, Florida in (A) February 2019 and (B) July 2019. Orange dots indicate sites sampled which had *P. fructiphilus*. Gray areas indicate surveyed areas where no *P. fructiphilus* were found. (C) Average number of *P. fructiphilus* per rose sample. Samples were taken from sites in Leon County, Florida on February 14th and July 16th, 2019. Asterisks represent significant differences as calculated by pairwise t-tests of the 5 sites tested for *P. fructiphilus* during both months. P-value < 0.001.

**Fig. 2:** *Phyllocoptes fructiphilus* Keifer (Female) from Leon County, Florida: (A) Body (scalebar = 100 µm); (B) Enlargement of prodorsal shield to show detail (scalebar = 20 µm).

A close up of a map

Description automatically generated

**Figure 1**

A picture containing animal

Description generated with very high confidence

**Figure 2**