CHAPTER 2
SURVEY AND PHENOLOGY OF NATURAL POPULATIONS OF THE INVASIVE MITE *PHYLLOCOPTES FRUCTIPHILUS* IN NORTHERN FLORIDA

2.1 Introduction

Phyllocoptes fructiphilus is a microscopic plant-feeding eriophyid mite. Eriophyoid mites are very host specific (Oldfield 1996b, Skoracka et al. 2009) and *P. fructiphilus* only feeds on plants in the genus *Rosa* (Amrine Jr 1996). *P. fructiphilus* is the vector of Rose Rosette Virus (RRV). RRV infection is commonly associated with the following symptoms: witches' brooms/rosetting, deformed flowers, increased prickle density, elongated shoots, reddened leaves and stems, and increased die-back which ultimately kills the rose host (Amrine Jr 1996). This disease is known as Rose Rosette Disease (RRD). and is the most serious disease of roses. Florida is the largest producer of roses with a total value exceeding $30 million, and stands to lose millions of dollars if RRD and *P. fructiphilus* become established. There are few options available to control RRD, prevention of disease spread by quarantine and rouging infected roses is key to controlling the spread of this disease into Florida. Rose Rosette Disease and the mite have invaded the southeastern united states as they followed the range expansion of the non-native *Rosa multiflora* (Thunb) towards the coast (Amrine Jr 2002, Otero-Colina et al. 2018). In 2018, a group of researchers conducted a series of surveys for *P. fructiphilus* and RRD in the southeastern United States (Solo 2018, Solo et al. 2020). They encountered *P. fructiphilus* in Thomas County and Lowndes County, GA (*2-1*), less than 20 miles from the northern border of Florida. RRD has been detected in previously in southern (Babu et al. 2014), no mites were detected at that time, and no disease spread has been documented in those areas since.

2.2 Surveying for *P. fructiphilus*, RRD and predatory mites in northern Florida

A key part of *P. fructiphilus* control is vector and disease monitoring. Previous surveys of the southeastern United States did not survey for *P. fructiphilus* in Florida, so

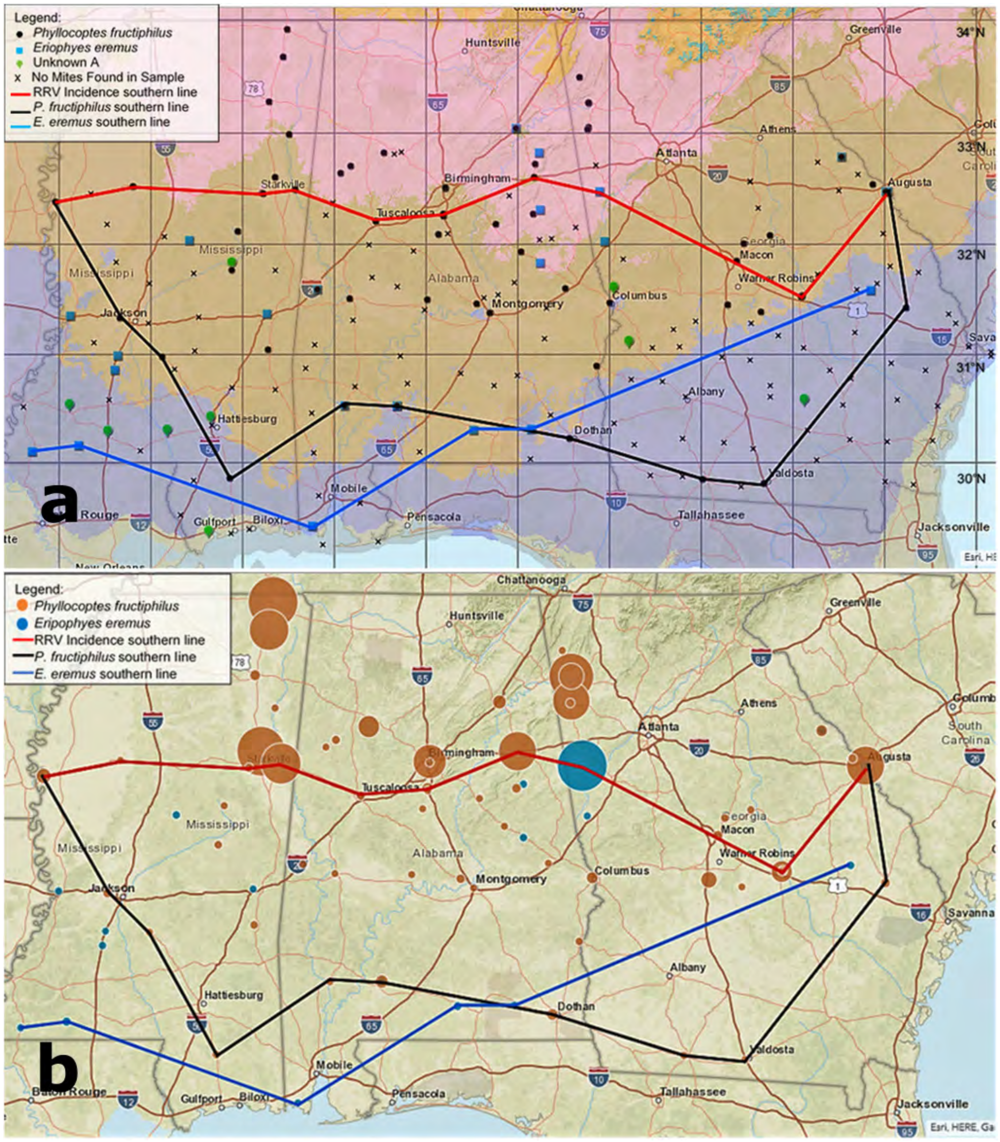

Figure 2-1. From Solo et al. 2020: a) 'Map of the southern incidence line of Rose rosette virus (RRV) and eriophyid mites in Alabama, Georgia, and Mississippi in 2017. Plant hardiness Zone 7b is in pink, Zone 8a is brown, Zone 8b is blue, and Zone 9a is in gray. Note that there are five locations in which two mite species were found on the same rose sample' b) 'Map of the southern incidence line of Rose rosette virus (RRV), southern distribution of *Phyllocoptes fructiphilus* and *Eriophyes eremus*, and the population densities of eriophyid mites found on rose samples in Alabama, Georgia, and Mississippi in 2017. The larger the circle, the more mites found in the sample.' Citation: HortScience horts 55, 8; 10.21273/HORTSCI14653-20

it is possible that *P. fructiphilus* and/or RRV are present in other parts of the state. In 2017, the entomology lab at the North Florida Research and Education Center (NFREC) in Quincy, FL, began a series of surveys of roses along the borders of northern Florida and southern Georgia. Our purpose was to estimate the distribution and populations levels of *P. fructiphilus*, as well as recording any RRD incidence in northern Florida. An additional goal of the rose surveys was to detect other predatory mites present on roses: there are many species of predatory phytoseiid mites present in Florida with potential to control agricultural pests such as *P. fructiphilus* (Muma and Denmark 1970). Encountering predatory mites native to the Florida landscape may help in the development of biological control methods for *P. fructiphilus*: native predatory mites sometimes have an advantage for bio-control because native mites have adapted to the environment where they will be released (Gerson 2014). Our results should help identify areas with greater risk for invasion of *P. fructiphilus* and/or RRD.

2.2.1 Phenology of natural populations of *P. fructiphilus* in northern Florida

As a result of these surveys, populations of eriophyoid mites suspected to be *P. fructiphilius* were encountered on roses in Tallahassee, Leon County, Florida, on February 14, 2019 (Fife et al. 2020). Accordingly, the NFREC reported the find to the Florida Department of Agriculture and Consumer Services, who were able to confirm the mite species as *P. fructiphilius*. Researchers at the NFREC monitored the phenology of *P. fructiphilus* in that area from 2020-2021.

2.3 Materials & Methods

2.3.1 Mite Survey

A survey of roses in the landscape was conducted following a transect of northern Florida from west to east, Pensacola to Jacksonville. Cities with populations over 1,000 were visited along this route and cuttings were taken from various roses in each city *(see 2-1)*. Rose cultivar/species, sun exposure and GPS coordinates were recorded to map out sites which had predatory mites, eriophyoid mites, or possibly symptoms of RRD.

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 which were routinely sanitized with 70% ethanol between cuts. Samples were stored in 500 mL Nalgene™ Wide-Mouth Polypropylene Copolymer bottles (ThermoFisher Scientific, Waltham, MA, USA) with ~10 mL of 95% ethanol. The rose samples then were gently shaken to coat the rose tissues sampled with ethanol. Doing so made sure that the sampled mites were killed and acted to preserve both mites and rose tissues until samples could be processed further and checked for mites. Samples were processed using a washing method derived from Monfreda et al. (2007) used to detect eriophyoid mites such as *P. fructiphilius*: The sampling bottles with ethanol and rose tissues were vigorously shaken to dislodge any mites, then the ethanol in the container was poured over a stack of sieves with decreasing screen sizes: 180 µm, 53 µm, and 25 µm. The bottle and rose pieces were then further rinsed with 95% ethanol over the sieve stack to dislodge any remaining mites. The 53 µm and 25 µm sieves were processed separately; the 53 µm sieve retained larger mites while the 25 µm sieve retained smaller mites, including *P. fructiphilus*. The sieves were then backwashed from the underside of their screen with a 95% ethanol-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 observations. The ethanol solutions of mites and plant debris were stained with a derivative of McBride's acid fuchsin stain to enhance contrast (Backus et al. 1988). Solutions were allowed to settle until excess ethanol could be siphoned off, making it possible to then pour this concentrated plant-mite mixture into a thin, small petri dishes or a glass plate for observation under a dissecting microscope. Mites found among the plant debris were counted, then siphoned off with a glass pipette and subsequently stored in micro-centrifuge containers with 95% ethanol as a preservative. 5-10 unstained specimens from each sample were made into prepared microscope slides:

Mites were cleared and mounted using the methods of Faraji and Bakker (2008): mites were simultaneously cleared and stained with Faraji and Bakker's modified clearing solution and heated on a hot plate until the specimens were clear. Subsequently, these mites were moved with an eyelash tool into an iodine-modified Hoyer's slide mounting media (Hempstead Halide®, Inc., Galveston, Texas, USA), underneath a 12 mm glass coverslip. The prepared slide was then dried at 90°C before sealing the slide by painting a ring of alkyd insulating enamel (Red Glyptal® 1201, Chelsea, MA, USA) over the edges of the coverslip to seal the slide, to protect it from damage by air incursion and moisture. These slides could then be observed under a compound microscope with phase-contrast objectives to identify the mite families and species if necessary. After mite quantities and species were recorded, a representative sample of eriophyoids putatively identified as *P. fructiphilus* had their identity verified with the acarologist, Dr. Sam Bolton of the Florida Department of Agriculture and Consumer Services, Division of Plant Industry (FDACS-DPI) to ensure accuracy. Roses which appeared to show symptoms of RRD, or which had populations of *P. fructiphilus* present were tested by the Plant Disease Diagnostic Clinic at the NFREC. Plant tissues were tested for RRV by Dr. Fanny Iriarte using the currently accepted molecular methods described in Babu et al. (2016), Babu et al. (2017a), and/or Babu et al. (2017b).

2.3.2 Phenology

Rose cuttings were collected periodically from four plots in the landscape of a church in Leon County, FL from 2020-2021: The site had two plantings of 2-3 years old Double Pink Knockout roses, with open sun exposure, ~0.3 m spacing, and natural watering. Blocks were divided into 24 plots of ~3 m^2, with approximately 12 roses per plot. Samples were processed as previously described in 2.3.1. After washing, plant tissues were placed into in paper bags and put into a drying oven for ~48 hrs at 50 °C, after which dry weight was recorded. Mites were counted and recorded to track changes in the mite populations. Roses were pruned once on the beginning of July 2020 by a professional landscaping crew.

2.4 Results

2.4.1 Survey

425 samples were taken from 33 sites from an east to west transect along the border northern Florida. Eriophyoid mites were recovered in rose samples from six cities. The first samples of *P. fructiphilus* were first encountered in Tallahassee during 2019; subsequent sampling efforts found in more eriophyoids in Jacksonville, Baldwin, Gainesville and Defuniak Springs in 2020, and Lake City in 2021. Other mites were collected from 68% of the cities visited. The largest populations of *P. fructiphilus* were seen in Tallahassee, with over 8,400 eriophyoid mites from 260 samples collected during 2019-2021 (*see 2-1*). No evidence of RRD was observed in northern Florida during the surveys, even in areas where abundant *P. fructiphilus* were found. Over 4,600 non-eriophyoid mites were collected from various cities during 2019-2021 *2-1*. Other non-eriophyoid mites collected primarily belong to the family Tetranychidae, but a small number of phytoseiidae and other predatory mites were recovered as well. These other mites currently await curation and expert identification.

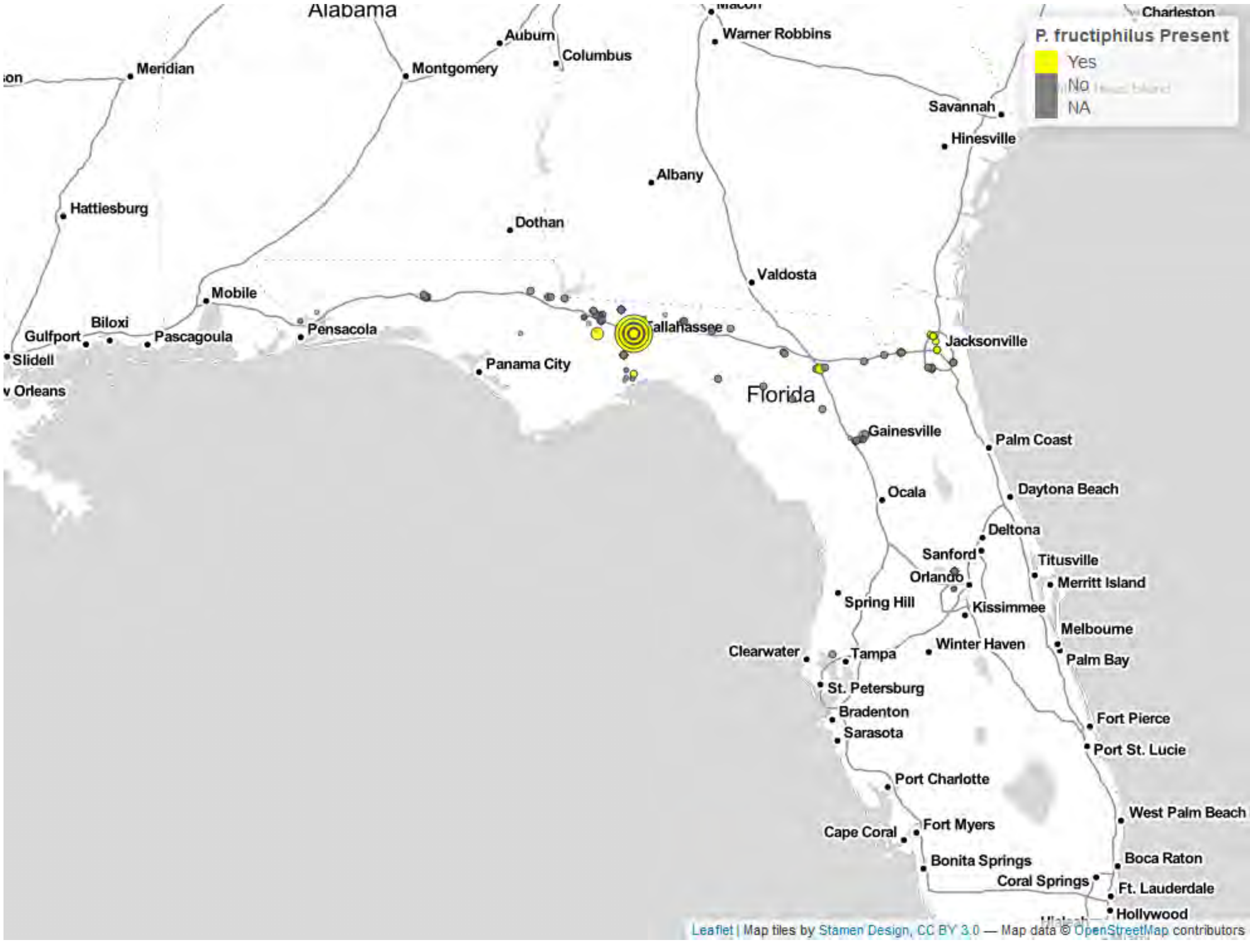

Figure 2-2. *P. fructiphilus* mites recovered during surveys of roses in Florida, 2017-2021.

2.4.2 Phenology

Populations of *P. fructiphilius* showed seasonal fluctuations in mite numbers, with highest populations achieved during June 2020. Rose pruning in July reduced the numbers of *P, fructiphilus* collected for 3 months, populations began to recover that November. Mite numbers remained relatively lower during 2021 compared to the previous year. None of the mite-infested roses have shown symptoms of RRD to date.

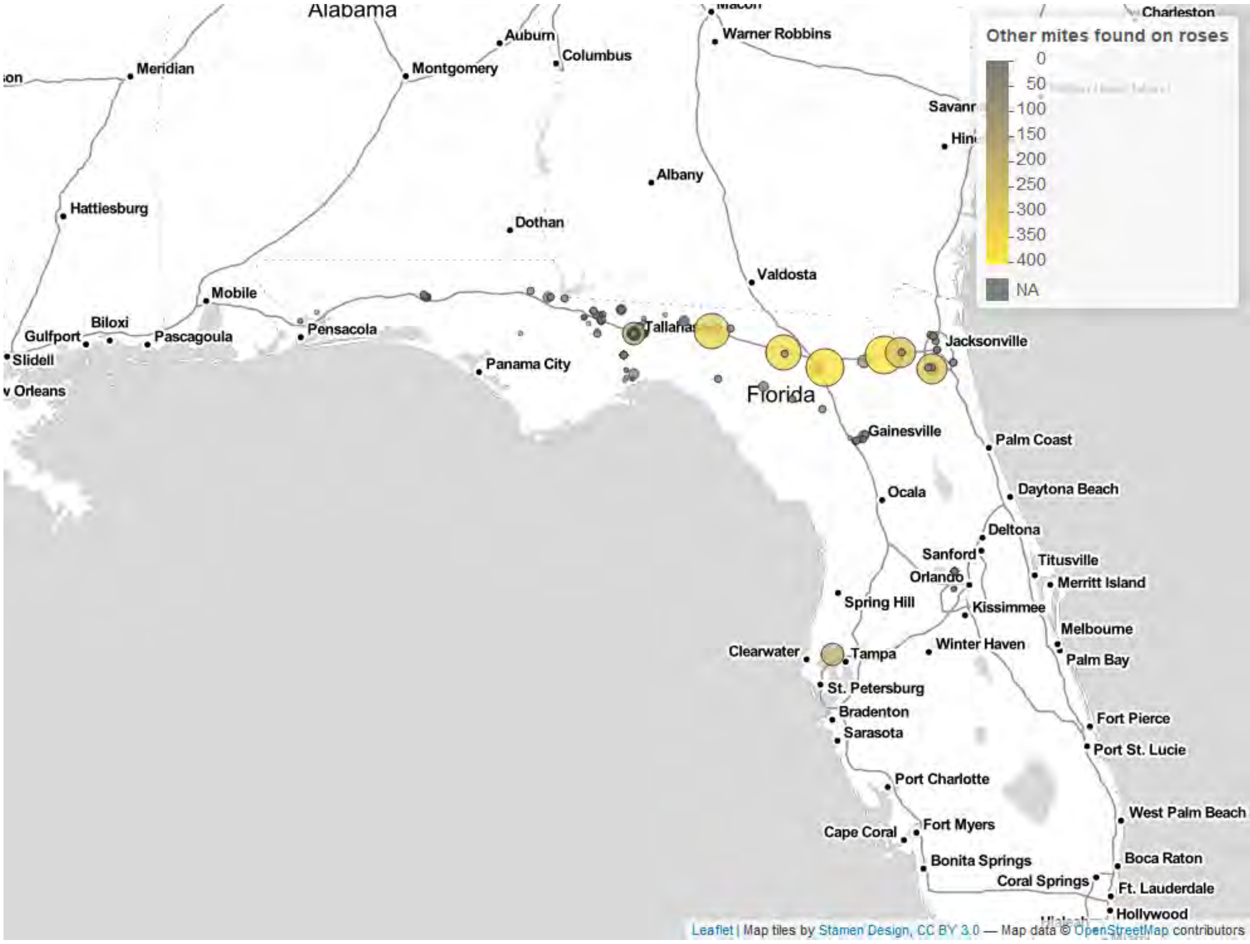

Figure 2-3. Other mites recovered during surveys of roses in Florida, 2017-2021.

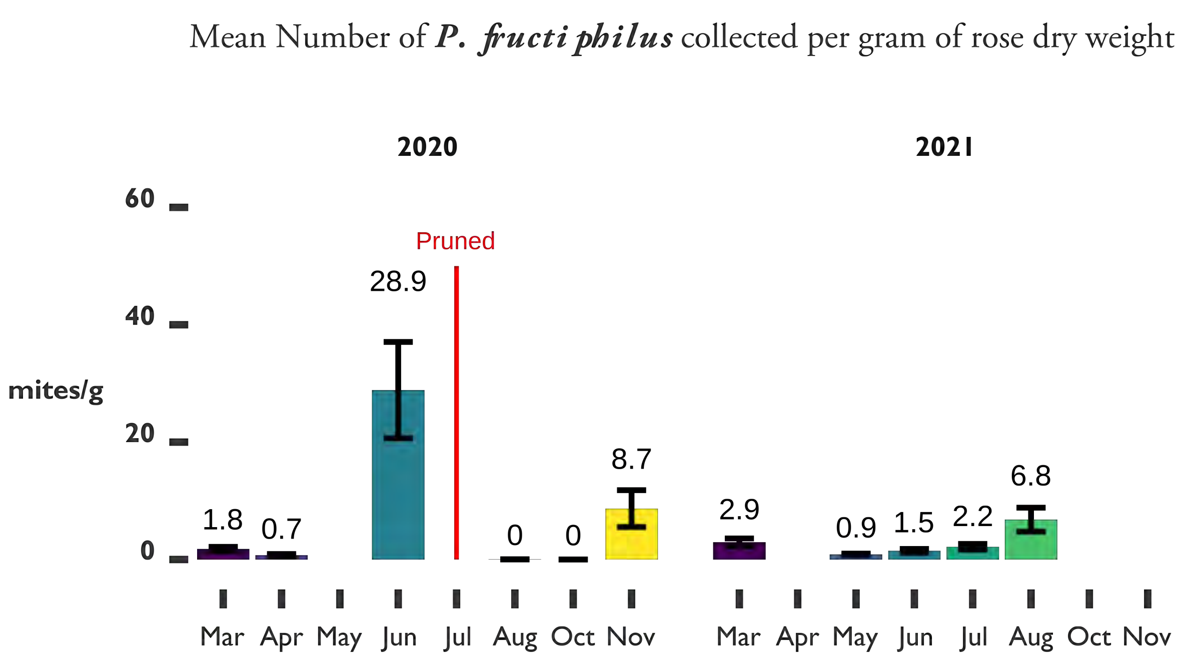

Figure 2-6. Phenology of *P. fructiphilus* mite populations on roses in Leon County, Florida 2020-2021. Roses were pruned back heavily on July 9, 2020.

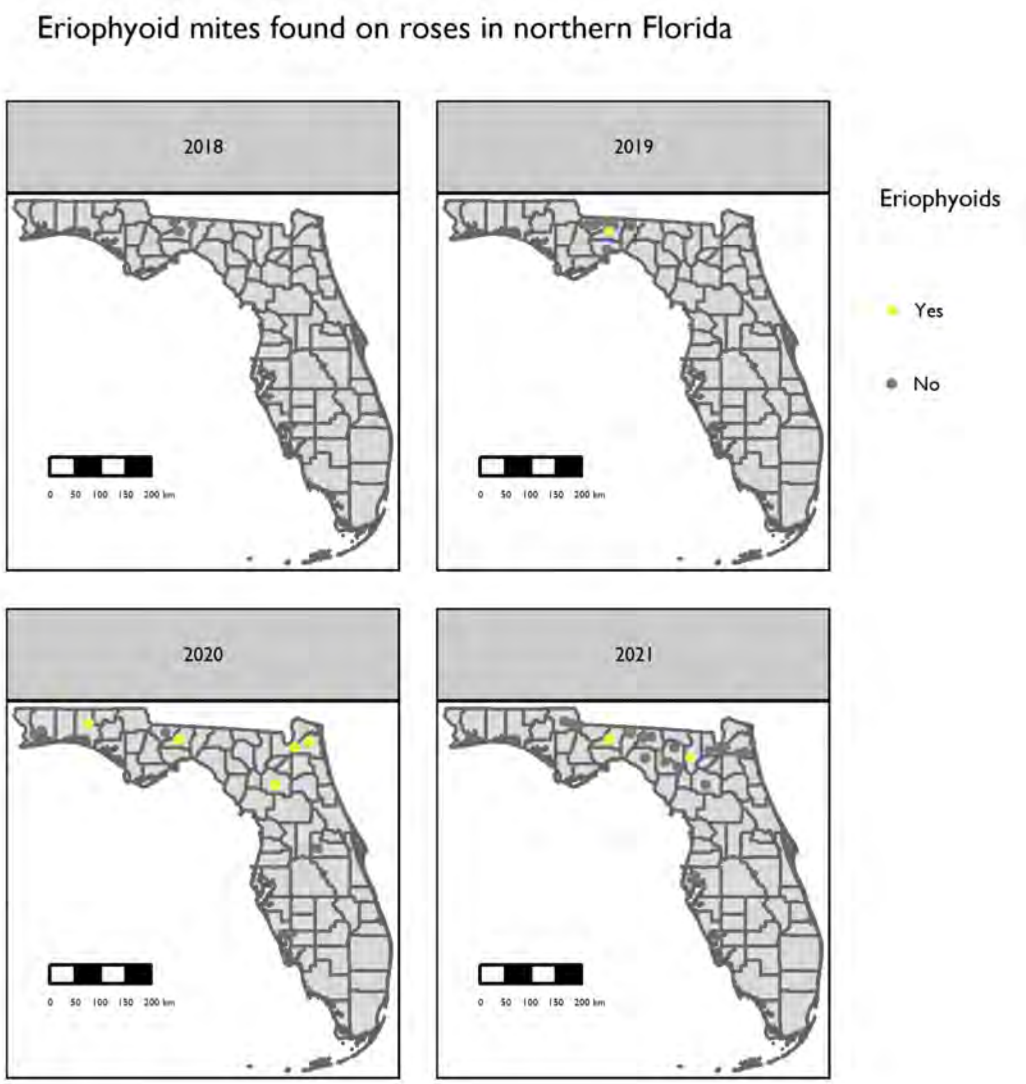

Figure 2-4. Location of populations of eriophyoid mites found on roses in northern Florida 2018-2021.

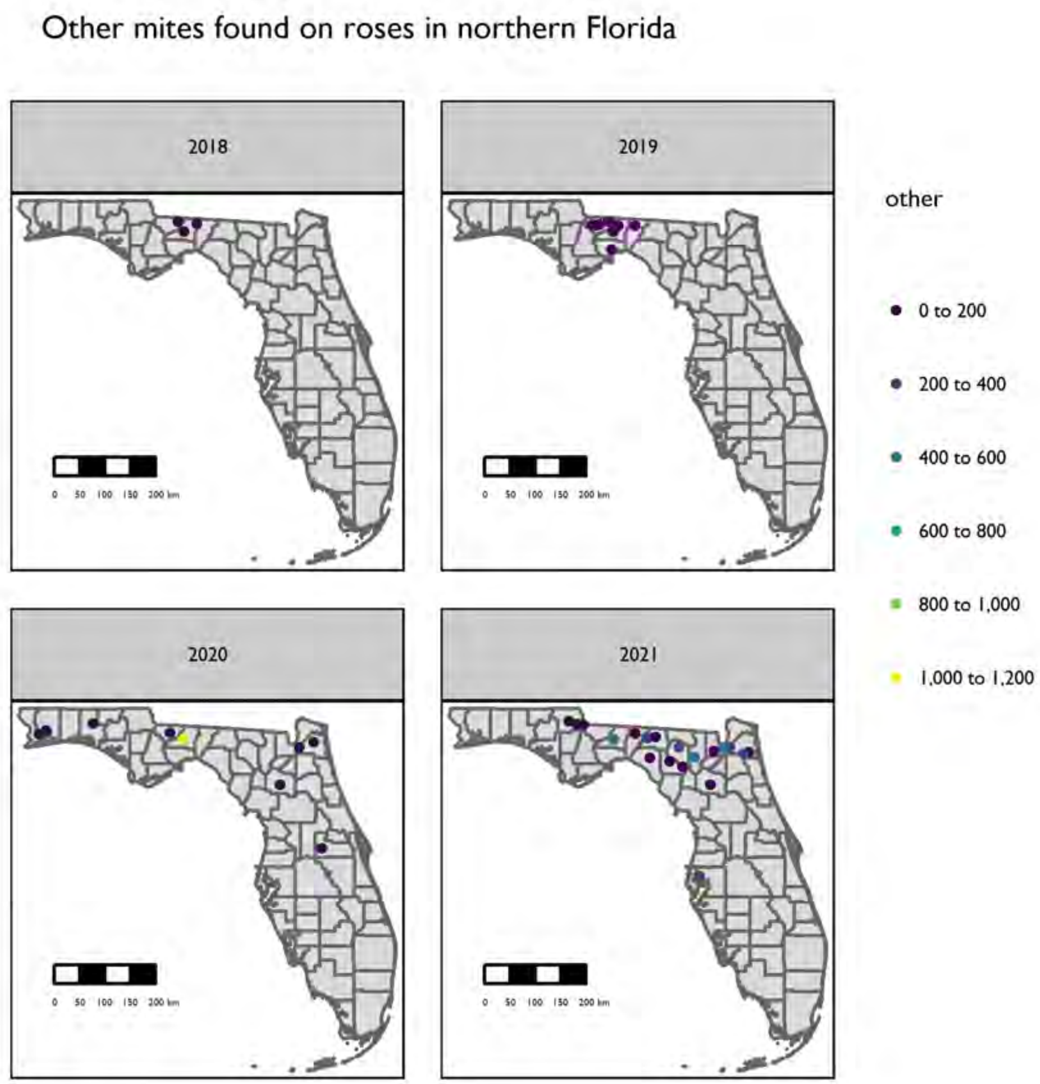

Figure 2-5. Locations of other mites recovered during surveys of roses in Florida, 2018-2021.

Table 2-1. Eriophyids and other mites recovered during surveys of roses in Florida, 2017-2021.

City	Year	Eriophyoids	Std. Error	Other Mites	Std Error	Samples per city	Eriophyoids per sample	Totals	Longitude	Latitude
Havana	2018	0	NA	0	NA	9	0.0	0	-84.41461	30.62618
Miccosukee	2018	0	NA	0	NA	1	0.0	0	-84.03900	30.59406
Tallahassee	2018	0	NA	0	NA	7	0.0	0	-84.29692	30.44227
Bradfordville	2019	0	NA	0	NA	2	0.0	0	-84.21892	30.54678
Crawfordville	2019	0	NA	0	NA	7	0.0	0	-84.35288	30.12877
Greensboro	2019	0	NA	0	NA	5	0.0	0	-84.74333	30.56824
Gretna	2019	0	0.00	5	1.77	4	0.0	5	-84.66470	30.55817
Havana	2019	0	0.00	49	6.08	5	0.0	49	-84.41501	30.62601
Midway	2019	0	0.00	0	0.00	2	0.0	0	-84.32201	30.44610
Monticello	2019	0	NA	0	NA	7	0.0	0	-83.87824	30.54454
Quincy	2019	0	0.00	9	1.13	7	0.0	9	-84.60175	30.56986
Tallahassee	2019	4704	9.86	47	0.29	79	59.5	4751	-84.30902	30.44618
Baldwin	2020	27	1.31	15	1.55	4	6.8	42	-81.97352	30.30268
Defuniak Springs	2020	20	2.06	29	0.70	6	3.3	49	-86.12718	30.72614
Ferry Pass	2020	0	NA	0	NA	2	0.0	0	-87.21893	30.54415
Gainesville	2020	25	3.23	55	4.60	20	1.2	80	-82.36118	29.64316
Jacksonville	2020	66	1.13	41	1.67	8	8.2	107	-81.68811	30.39848
Milton	2020	0	NA	0	NA	1	0.0	0	-87.07610	30.60700
Orlando	2020	0	NA	0	NA	4	0.0	0	-81.51605	28.50670
Quincy	2020	0	NA	0	NA	1	0.0	0	-84.57331	30.55638
Tallahassee	2020	3364	4.82	1150	0.79	157	21.4	4514	-84.30878	30.44297
Baldwin	2021	0	0.00	309	145.50	2	0.0	309	-81.97613	30.30260
Branford	2021	0	NA	12	NA	1	0.0	12	-82.92316	29.95685
Gainesville	2021	0	0.00	6	1.00	2	0.0	6	-82.36566	29.63691
Grand Ridge	2021	0	0.00	30	11.00	2	0.0	30	-85.04182	30.71944
Greenville	2021	0	NA	356	NA	1	0.0	356	-83.63092	30.46842
Greenwood	2021	0	NA	200	NA	1	0.0	200	-82.57149	28.00751
Jacksonville	2021	0	0.00	12	2.65	3	0.0	12	-81.59286	30.21992
Lake City	2021	49	9.80	472	77.72	5	9.8	521	-82.67590	30.12273
Live Oak	2021	0	0.00	376	182.00	2	0.0	376	-82.99862	30.30259
Macclenny	2021	0	NA	400	NA	1	0.0	400	-82.11797	30.28349
Madison	2021	0	NA	14	NA	1	0.0	14	-83.46405	30.48829
Marianna	2021	0	NA	11	NA	1	0.0	11	-85.20554	30.76829
Mayo	2021	0	NA	32	NA	1	0.0	32	-83.18075	30.05482
Monticello	2021	0	NA	20	NA	1	0.0	20	-83.87114	30.54514
Orange Park	2021	0	0.00	363	90.28	3	0.0	363	-81.70203	30.18646
Perry	2021	0	NA	3	NA	1	0.0	3	-83.57833	30.11150
Sanderson	2021	0	NA	78	NA	1	0.0	78	-82.29722	30.24098
Sneads	2021	0	NA	1	NA	1	0.0	1	-84.91279	30.71067
Tallahassee	2021	424	2.78	579	8.68	24	17.7	1003	-84.30731	30.44491
Grand Totals	2021	8679	NA	4674	NA	425	127.9	13353	-83.71379	30.25158

2.5 Discussion

The presence of *P. fructiphilus* in northern Florida over multiple years and seasons provides evidence against a putative southern limit for the species (Solo et al. 2020). Our survey efforts were severely hampered by the COVID-19 pandemic, which limited opportunities to travel and collect mites. We expect that further investigations of roses in other Florida cities will reveal more site with *P. fructiphilus*. The arrival of a competent vector is not a guarantee that its associated disease will follow suit, but it does provide a necessary component of the disease triangle: if the environmental conditions are suitable, and the rose host is sufficiently abundant, there is potential for disease to occur (Francl

2001). We did not see any signs of RRD in roses in northern Florida, but it is important to note that the delayed onset and difficulty of identifying symptoms makes it likely to miss detection until late stages of the disease. It is not known how *P. fructiphilus* have arrived in northern Florida, and unfortunately our observations are not sufficient to describe a mechanism of invasion. Eriophyoid mites are known to disperse in a variety of ways: they may be windblown, transported with infected plants, move on contaminated equipment or clothes, or rarely, through phoresy (Sabelis and Bruin 1996). The short distances between mite infested roses in Georgia, Alabama and Florida suggest the possibility of multiple routes of introduction, but the mechanisms of dispersal require further investigation for *P. fructiphilus.* In addition, the movements of plant pathogens such as RRD is thought to be partially driven by socioeconomic factors and the movement of plants by people (Nelson and Bone 2015). Inspections and quarantines of mite-infested roses by wholesalers and larger growers is predicted to slow the spread of plant pathogen epidemics (Nelson and Bone 2015). A large number of other non-eriophyoid mites have been collected as well, but it is beyond our ability to identify many of them. Phytoseiid and other predatory mites require expert identification by mite taxonomists, and many species have been misidentified by amateurs either through carelessness or ignorance (Demard et al. 2021). The large reductions of *P. fructiphilus* seen post pruning suggests its potential as a method of cultural mite control. It may be possible to combine pruning with acaricide treatments for improved control of *P. fructiphilus*, but this hypothesis requires further study. Tracking populations for longer periods of time with additional climatic data could be used to determine the best times to prune to reduce mite numbers. The presence of *P. fructiphilus* in Florida necessitates the development of mite control practices to prevent mite populations from surging, and to hopefully prevent the spread of RRD.

First Report of Phyllocoptes fructiphilus Keifer (Eriophyidae), the Vector of the Rose Rosette Virus, in Florida, USA

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First report of *Phyllocoptes fructiphilus* Keifer (Eriophyidae), the vector of the rose rosette virus, in Florida, USA

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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* feeds only on plants in the genus *Rosa* (Amrine 1996). *Phyllocoptes fructiphilus* is associated with the rose rosette emaravirus (rose rosette virus) and acts as the only known vector of rose rosette virus. Infection is associated commonly with the following symptoms: witches' broom, rosetting, deformed flowers, increased thorn density, elongated shoots, reddened leaves and stems, and increased die-back that ultimately kills the rose host (Amrine 1996) (Fig. 1A, B). This disease is known as rose rosette disease and is the most serious illness of roses, affecting the US commercial rose industry which is worth millions of dollars. Rose rosette disease and *P. fructiphilus* have invaded the southeastern US as they followed the range expansion of the non-native *Rosa multiflora* (Thunb.) (Rosaceae) towards the east coast (Amrine 2002; Otero-Colina et al. 2018).

In 2013, a nursery in Quincy, Gadsden County, Florida, USA, detected witches' brooms and other rose rosette disease symptoms on 15 knockout roses that had been imported from out of state. Eight symptomatic plants were tested and found to be positive for rose rosette disease, but *P. fructiphilus* was 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, Florida. 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. The average sample contained 26.8 ± 1.5 g of undried plant tissue. Samples were trimmed with bypass pruners, dried plant tissue with 70% ethanol between cuts and stored in quart sized plastic bags (Ziploc®, S.C. Johnson & Son, Racine, Wisconsin, USA). Rose cultivars, species, and coordinates were recorded to map out sites that had predatory mites, eriophyid mites, or possible rose rosette disease.

Samples were processed using a washing method derived from Monfreda et al. (2007); cut roses were soaked in a 500 mL beaker with a solution of 1:1 bleach:water with a few drops of concentrated liquid dish washing 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 retained larger mites while the 25 µm sieve retained 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, Texas, USA), dried at 90 °C, then a ring of nail polish was painted over the edges of the coverslip to seal the slide.

On 14 Feb 2019, we found a total of 42 eriophyid mites from 6 samples obtained from Pink Double Knock Out® roses while surveying roses in the landscape in Tallahassee, Leon County, Florida, USA (Fig. 2A). The mites were sent to the Florida Department of Agriculture and Consumer Services, Division of Plant Industry and were identified as *P. fructiphilus* based, among other characters, on the distinctive pattern of ridges on the prodorsal shield (Bauchan et al. 2019) (Fig. 1C, D). Whereas 2 other eriophyid mites *Eriophyes eremus* Druciarek & Lewandowski and *Phyllocoptes adalius* Keifer (both Acari: Eriophyoidea) are found in roses in the central and eastern US, neither of them were found in the samples analyzed. The roses did not show signs or symptoms of rose rosette disease.

On 16 Jul 2019, 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 detected originally (Fig. 2B). Each sample contained more than 50 eriophyid mites, with some samples containing over 300 mites. We compared the samples collected during Feb and Jul in the same locations with a paired *t*-test and found a significant increase in the *P. fructiphilus* population between the 2 sampling dates (see Fig. 1C; $P = 0.001$; $\alpha = 0.05$; df = 4). Mites that were slide mounted were confirmed subsequently as *P. fructiphilus*.

This is the first record for *P. fructiphilus* in Florida. None of the mite-infested roses showed symptoms of rose rosette disease and none tested positive for rose rosette virus based on detection tools devel-

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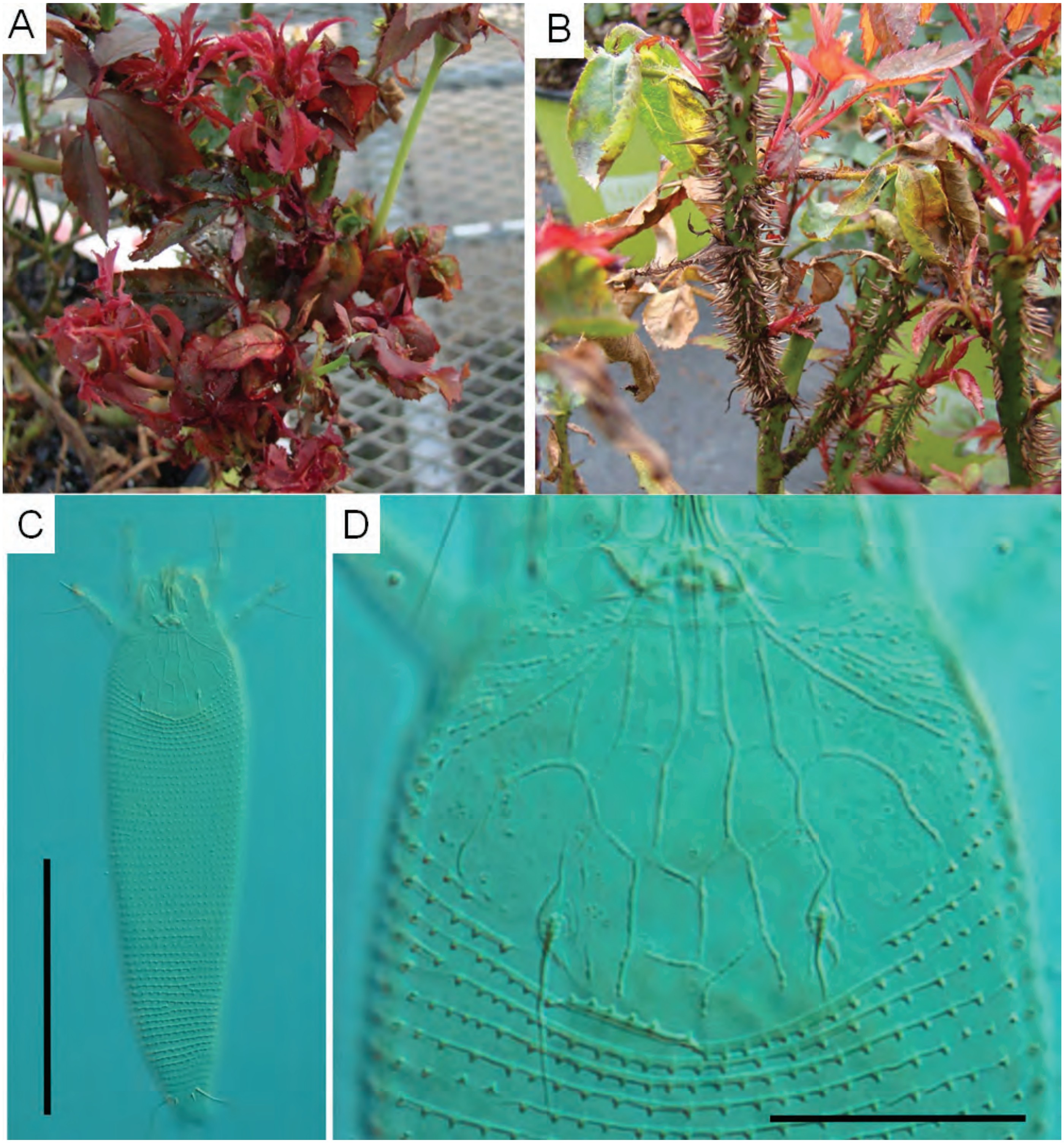

Fig. 1. (A) Symptoms of rose rosette disease: witches' broom, and (B) excessive thorn proliferation; (C) *Phyllocoptes fructiphilus* Keifer (female) from Leon County, Florida, USA: body (scale bar = 100 µm); (D) enlargement of *P. fructiphilus* prodorsal shield to show detail (scale bar = 20 µm).

oped to date. However, the presence of *P. fructiphilus*, along with past detections of rose rosette virus 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 rose rosette virus, or homeowners, commercial landscapers, and the US rose industry stands to lose millions of dollars and established plantings in the coming yr.

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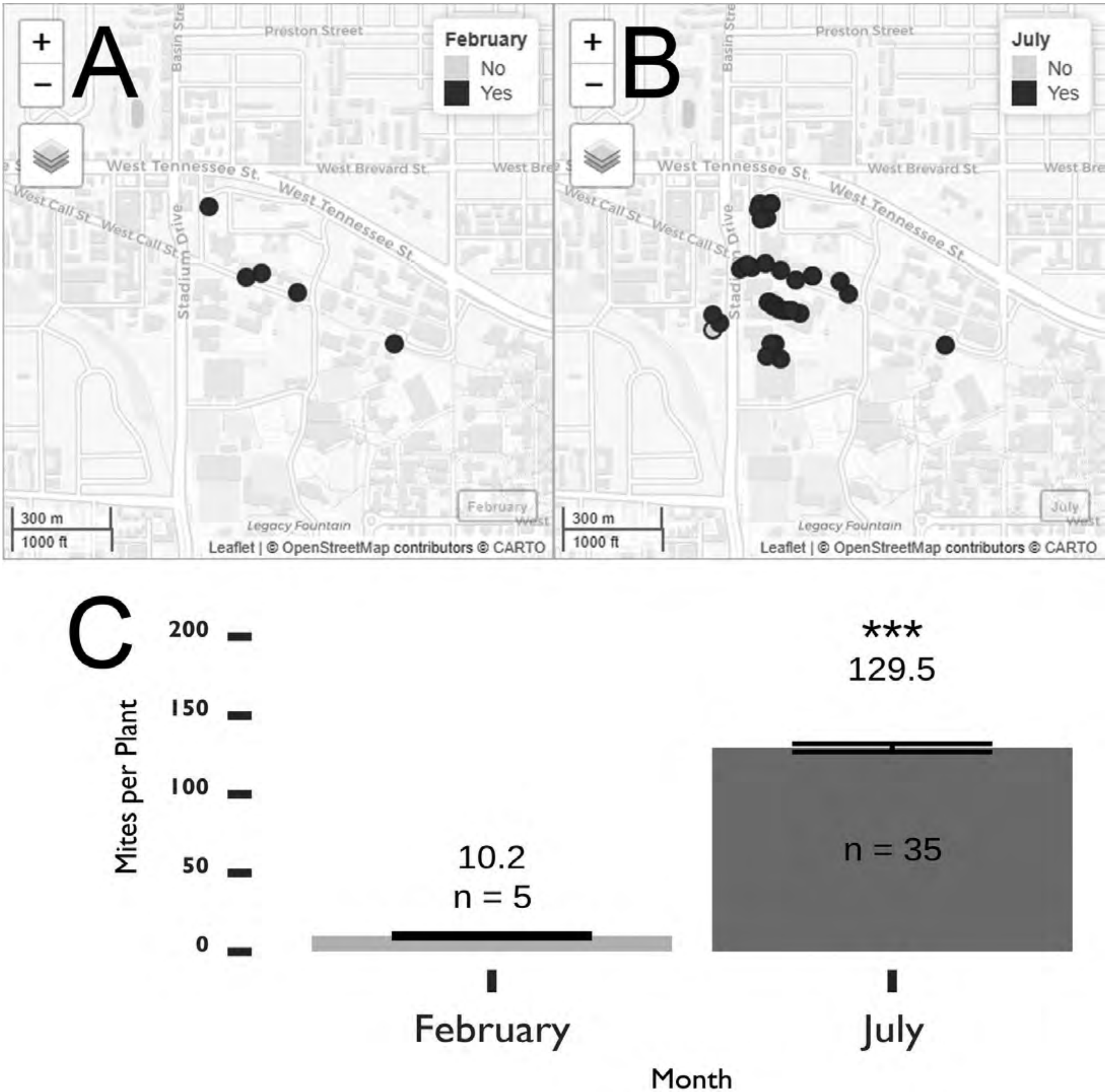

Fig. 2. Presence of *Phyllocoptes fructiphilus* in Leon County, Florida, USA, in (A) Feb 2019 and (B) Jul 2019. Orange dots indicate sites sampled that had *P. fructiphilus*. Gray dots indicate surveyed areas where no *P. fructiphilus* were found. (C) Average number of *P. fructiphilus* per rose sample. Samples were taken from sites in Leon County, Florida, on 14 Feb and 16 Jul 2019. Asterisks represent significant differences as calculated by pairwise *t*-tests of the 5 sites tested for *P. fructiphilus* during both mo. *P*-value < 0.001.

Summary

The invasive mite *Phyllocoptes fructiphilus* Keifer (Acari: Eriophyidae) feeds on plants in the genus *Rosa*. *Phyllocoptes fructiphilus* is associated with the rose rosette emaravirus (rose rosette virus) and acts as the only known vector of rose rosette virus, the causal agent of rose rosette disease (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. *Phyllocoptes fructiphilus* represents a potential threat to the Florida rose industry if rose rosette disease becomes established.

Key Words: rose rosette disease; rose rosette virus

Sumario

El ácaro invasivo *Phyllocoptes fructiphilus* Keifer (Acari: Eriophyidae) se alimenta sobre plantas del género *Rosa. Phyllocoptes fructiphilus* se asocia con rose rosette emaravirus (virus del arrosetamiento de la rosa), es reconocido principalmente como vector de la virus del arrosetamiento de la rosa, el agente causal de la enfermedad del arrosetamiento de la rosa (Emaraviridae). 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. *Phyllocoptes fructiphilus* representa una amenaza potencial para la industria de la rosa en la Florida si Emaraviridae se llega a establecer.

Palabras Clave: virus del arrosetamiento de la rosa; enfermedad del arrosetamiento de la rosa; emaravirus

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