N O T E

Impact of Pecan Leafroll Mite (Acari: Eriophyidae) on Pecan Foliage[1]

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The pecan leafroll mite, *Aceria caryae* (Keifer) (Acari: Eriophyidae), is a small cigar-shaped mite, normally measuring 0.1–0.2 mm long. The mite uses a ventral sucker located on its caudal end for attachment to the host plant while it feeds using piercing mouthparts that are short and thus limiting feeding to the epidermal cells (Grasswitz 2012, USDA Forest Service Proceedings, New Mexico). There are nearly 2,000 species of eriophyid mites (Davis and Beddes 2011, Utah Pests Fact Sheet, ENT-149-11) and most are host specific, which makes some species ideal for biological control of weed species (Skoracka et al. 2010, In E.D. Uekermann [ed.], Eriphyoid Mites: Progress and Prognoses, Springer, NY). Feeding symptoms vary, but can include galls, stunting, blisters, leaf curl, rust, silvering, fruit russeting, witches' broom, stunting and deformities of seedlings.

On pecan, *Carya illinoinensis* (Wangenheim) Koch, the adult pecan leafroll mite feeds on the lateral edge of the adaxial surface of young, expanding leaflets during the early spring (Davis and Beddes 2011). Feeding along the leaf edge causes cells on the adaxial surface to grow slower than those cells on the abaxial side, hence forming a gall-like deformation along the lateral leaf margin and causing the leaf edge to curl up in a tight roll. Although this distortion to the leaf occasionally turns brown, defoliation does not occur. For many host plant species, damage is generally cosmetic and not a significant problem, allowing control by pruning infested branches or removing damaged leaves (Grasswitz 2012). However, the large size of many infested pecan trees precludes this as an option.

During migration between plant tissues, the eriophyid mites are more exposed and vulnerable to natural enemies such as predaceous mite species (Stigmaeidae and Phytoseiidae), spider mite destroyer lady beetle, *Stethorus punctum* (LeConte) (Coleoptera: Coccinellidae), and predaceous midge larvae (Diptera: Cecidomyiidae)

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(Skoracka et al. 2010). In addition, plant defense mechanisms such as dense setae on leaves or buds, thicker plant cell walls, or secondary plant compounds may protect against mites feeding on the host plant (Skoracka et al. 2010). The objective of the study was to assess whether foliar feeding by the pecan leafroll mite negatively affects leaf area and leaf chlorophyll content and gas exchange parameters.

The experiment was conducted from July to September 2022 in an approximately 25-yr-old pecan orchard of cv. Desirable near Fort Valley, GA (32.55559 N, −83.82753 W). Three trees were randomly selected for data collection. Compound leaves, with or without pecan leafroll mite injury, were selected for examination of gas exchange parameters and leaf area. Leaf readings were taken from attached leaves with and without leafroll injury by using a LI-6800 portable meter (LI-COR, Lincoln, NE) and included net carbon assimilation rate (A), transpiration rate (E), and stomatal conductance to water vapor (g_{sw}). These measurements were taken between 9:00 a.m. and 12 p.m. under field conditions at 1,860 $\mu mol \cdot m^{-2} \cdot s^{-1}$ photosynthetic photon flux density and ambient atmospheric CO_2 levels (385 ± 23 $\mu mol \cdot mol^{-1}$). Gas exchange treatment effects were analyzed using full factorial analysis of variance (ANOVA) using PROC GLM procedure followed by a multiple comparison of means using Tukey's protected honestly significant difference at $P = 0.05$ (SAS Institute Inc., Cary, NC). Leaf chlorophyll content was determined on attached leaves by using a portable SPAD-502Plus meter (Konica Minolta, Tokyo, Japan) on three leaflets for each of three compound leaves with and without pecan leafroll mite injury. Additional compound leaves with and without pecan leafroll mite injury were collected and taken to the lab for leaf area analysis. On three trees, three compound leaves with pecan leafroll mite injury were collected from three terminals having compound leaves with pecan leafroll mite injury ($n = 27$ leaves). On the same three trees, compound leaves without pecan leafroll mite injury were similarly collected from terminals without pecan leafroll mite injury ($n = 27$ leaves). The total number of leaflets per compound leaf was recorded because the number of leaflets per compound leaf varies. Because all leaflets on a compound leaf may not exhibit mite injury, the number of leaflets with pecan leafroll mite damage on those compound leaves with pecan leafroll mite injury was documented. The area of each leaflet on all compound leaves was measured using image analysis software (Image-Pro Premier v.9.3.1, Media Cybernetics, Rockville, MD). Leaflet area for compound leaves with and without pecan leafroll mite injury was analyzed using a one-way ANOVA (JMP 1989–2021). On compound leaves with pecan leafroll mite injury, leaflets with and without injury were analyzed using one-way ANOVA (JMP 1989–2021).

SPAD readings are a nondestructive measure of leaf chlorophyll concentrations in which the value is proportional to amount of chlorophyll in the leaf. In this study, leaves with pecan leafroll mite damage had higher SPAD values, but no significant differences in chlorophyll content were observed between healthy leaflets and leaflets with mite damage ($P = 0.2146$). Differences in net carbon A were not observed between treatments among the three sampling periods. However, significance was observed among dates and treatments for E and g_{sw} (Table 1). Because g_{sw} is a measure of the degree of stomatal opening, it can be used as an indicator of plant water status. A reduced g_{sw} on leaves with pecan leafroll mite damage may indicate water stress and hence lower E, or water movement through the plant as the stomates close to preserve water.

Table 1. Gas exchange parameters for leaves affected and nonaffected by leaf roll mites in cv. Desirable pecan trees in middle Georgia.*

	Net A (μmol m^{-2} s^{-1})	E (mol m^{-2} s^{-1})	g_{sw} (mol m^{-2} s^{-1})
Mite injury	5.65	0.002063 b	0.1219 b
No injury	6.30	0.002564 a	0.1580 a
Significance	0.1084	0.0106	0.0079

* Least-squares means followed by different letters within treatment are significantly different based on Tukey's honestly significant difference ($\alpha = 0.05$).

Upon visual inspection, pecan leaf roll mite damage on individual leaflets appears to decrease leaflet area, which could affect net photosynthesis and in turn nut development, quality, and yield (Lombardini 2006, HortScience 41: 1469–1473). A comparison of mean leaflet area from compound leaves with pecan leafroll mite injury compared with compound leaves without this injury did not reveal a significant difference in leaflet area for 28 July ($F = 12.31$; df = 1, 5; $P = 0.0725$), 29 August ($F = 11.69$; df = 1, 5; $P = 0.0759$), or 27 September ($F = 1.47$; df = 1, 5; $P = 0.3487$). However, on compound leaves with mite injury, those leaflets with mite injury had lower leaflet area than those leaflets without mite injury and the difference was significant on 28 July ($F = 123.68$; df = 1, 5; $P = 0.0080$) and 27 September ($F = 51.58$; df = 1, 5; $P = 0.0188$) (Fig. 1).

Pecan leafroll mite-damaged compound leaves remain on trees through the season. These damaged leaves are photosynthetically active, and the overall reduction in leaflet area is not different between compound leaves with or without pecan leafroll

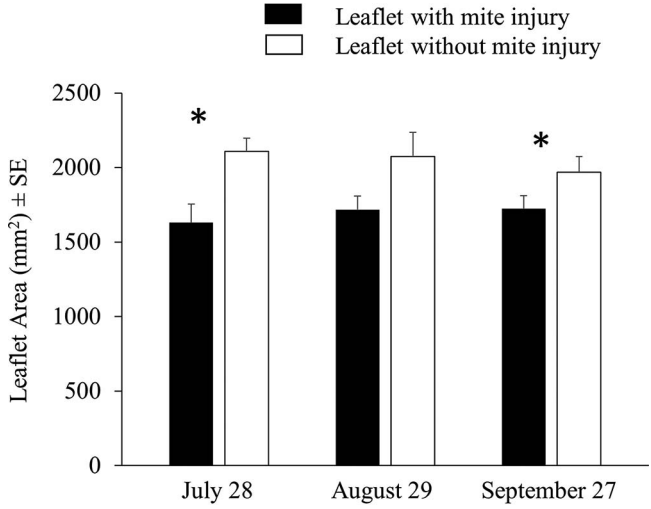

Fig. 1. On compound leaves with pecan leafroll mite damage, the leaflet exhibiting mite injury had less leaf area than leaflets without injury, and significantly so ($P < 0.05$), on July 28 and September 27.

mite injury. Thus, the leaf parameters measured during this study indicated that the level of damage was cosmetic and would not require treatment. These results suggest, however, that pecan leafroll mite damage may increase leaflet water stress. Severe outbreaks of pecan leafroll mite may cause injury at an economic level and so future studies should investigate the relationship of irrigation on tree health and incidence of pecan leafroll mites on pecan canopies.

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