Pecan Aphid Complex and Their Management

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Pecan production in the U.S. is primarily divided into two production regions: the southwestern region and the southeastern region. One insect pest complex is common to both production regions—pecan aphids. Growers regularly make insecticide applications to manage these aphids every year. The pecan aphid complex is represented by three aphid species: yellow pecan aphid, the blackmargined aphid, and the black pecan aphid. This article will discuss some of the important aspects of pecan aphids in relation to their management in commercial pecan orchards. Earn 0.5 CEUs in Integrated Pest Management by reading this article and taking the quiz at https://web.sciencesocieties.org/Learning-Center/Courses.

The pecan, *Carya illinoinensis* (Wangenh) K. Koch, is one of the major native nut crops in North America. It belongs to the genus *Carya* and the family Juglandaceae. There are more than a dozen species under the genus *Carya* that are commonly known as hickory. Pecan is a hickory that is commercially cultivated and widely available across the United States. The native range of the pecan tree extends primarily across the southeastern United States, particularly in river valleys and bottomlands. Historically, pecan trees were found growing naturally along riverbanks, floodplains, and other moist habitats from Texas and Oklahoma in the west to the Mississippi River Valley and beyond in the east.

Pecan production is concentrated in 14 states in the southern United States (Oliveira-Hofman et al., 2021). Georgia is one of the largest producers of pecans, along with New Mexico, Texas, and Oklahoma, which contribute to the nation’s total pecan production. According to a recent USDA census, in 2023, the total pecan-bearing area in Georgia was 146,000 acres, which produced 88,300,000 lb of pecans worth $150,110,000 (USDA, 2024). Considering the newly planted young trees in a number of counties in Georgia, this number will certainly be higher in the coming years.

Pecan production in the U.S. is primarily divided into two production regions: the southwestern region, which is characterized by limited water availability, a higher incidence of insect pests, but a low level of disease pressure; and the southeastern region, which receives higher rainfall that leads to increased levels of disease incidence. The insect pest pressure in the southeastern production region is relatively low compared with the states in the southwest, such as Texas, Oklahoma, and New Mexico. Nonetheless, one insect pest complex is common to both production regions—pecan aphids. Growers regularly make insecticide applications to manage these aphids every year.

The pecan aphid complex is represented by three aphid species: the yellow pecan aphid, *Monelliopsis pecanis* Bissell; the blackmargined aphid, *Monellia caryella* (Fitch); and the black pecan aphid, *Melanocallis caryaefoliae* (Davis) (Figure 1). Both the blackmargined aphid and the yellow pecan aphid are collectively known as the yellow aphids and are difficult to identify at their immature or nymphal stages. However, the black pecan aphids are clearly distinguishable at both immature and adult stages from the yellow aphids. Among these three species, the black pecan aphid is the most serious aphid species, with the action threshold of one aphid per compound leaf compared with 20 aphids per compound leaf for the yellow pecan aphid complex (Dutcher et al., 2012). Aphid damage remains a concern from early to late in the season; however, management actions are recommended in the late season when the aphid population is higher (Hudson & Acebes, 2019).

Biology

All three pecan aphids have similar life cycle: both sexual and asexual forms of reproduction are present (Tedders, 1978). In the first generation, nymphs hatch from the overwintered eggs around late March to April, complete four nymphal stages (first to fourth), and become apterous (wingless) adults. During the late season (mid-October to early December), males and apterous females develop and mate. Following the mating, females lay eggs on the tree canopy, likely near the terminals and under the tree bark. These eggs overwinter, stay dormant during the winter months, and with the onset of spring rain and rising temperature produce the fundatrices (founder female capable of producing offspring without sexual reproduction) of the successive generations (Tedders, 1978; Cottrell et al.,2009).

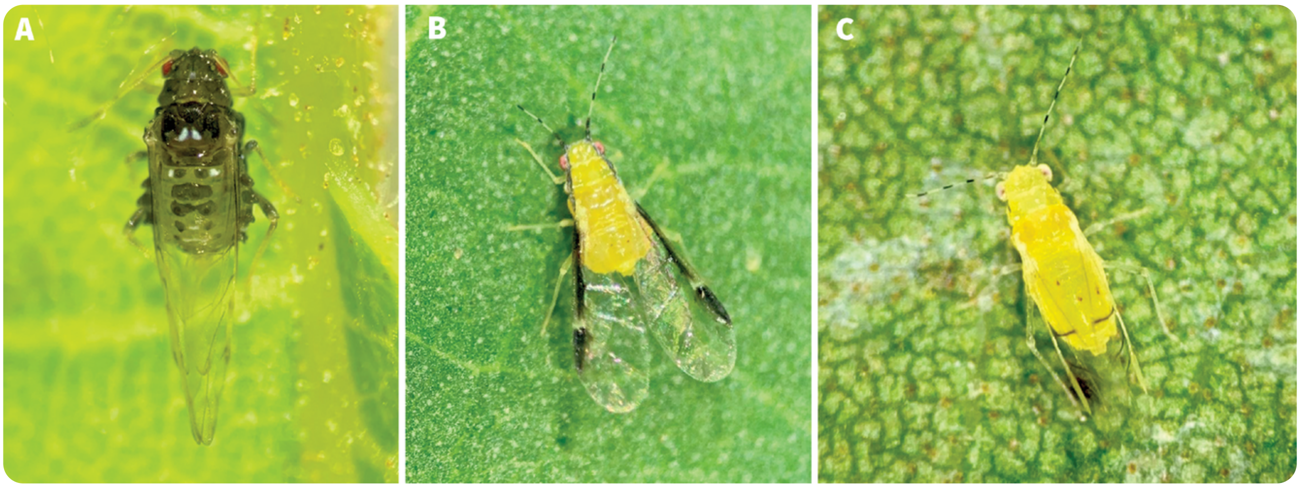

Figure 1. Adult of black pecan (A), blackmargined (B), and yellow pecan (C) aphids.

The nymphs of yellow pecan aphids and blackmargined aphids are wingless and have a streamlined, bullet-like shape. Nymphal body color ranges from pale to bright yellow with distinctive red eyes. Black markings on the antennae and nymphal body are often present, which can change with seasons. The alate yellow pecan aphids have wings that they hold gable-like over the body, and blackmargined aphid adults have wings with a heavily pigmented black costal vein (Tedders, 1978). Initially, the first instar nymphs of black pecan aphids are pale yellowish green and turn olive green to greenish-black after feeding on pecan leaves. Adults of black pecan aphids are solid black in color with red eyes and a body that is typically oval shaped, whereas apterous (wingless) females resemble their nymphs. Adults of all three species have the capacity to develop either winged (alate) or wingless (apterous) forms, depending on seasonal variations or environmental factors (Tedders, 1978; Hudson, 2007).

Seasonal Dynamics

The seasonal dynamics or abundance of each aphid species vary depending on the temperature and rainfall conditions in a given year. Initial infestation of yellow aphids can be seen as early as May and continue throughout the season till leaf drop in late October. Black pecan aphid populations build up somewhat later then the yellow aphids, and their peak infestation is observed during late July to early fall (Slusher et al., 2021; Dutcher et al., 2012). Besides their difference in seasonal abundance, there are some differences in spatial distributions among the three aphids species. Black pecan aphids initially damage the foliage of lower branches and then spread to the foliage of periphery and upper branches, whereas yellow pecan aphids and blackmargined aphids are more evenly distributed throughout the tree (Dutcher et al., 2012). Yellow pecan and blackmargined aphids are mostly found on the lower surface of leaves, whereas black pecan aphids are found on both lower and upper surfaces of leaves (Paulsen et al. 2012). Blackmargined aphids demonstrate superior adult longevity, survival, and fecundity rates in warmer temperatures than black pecan aphids (Flores-Flores, 1981).

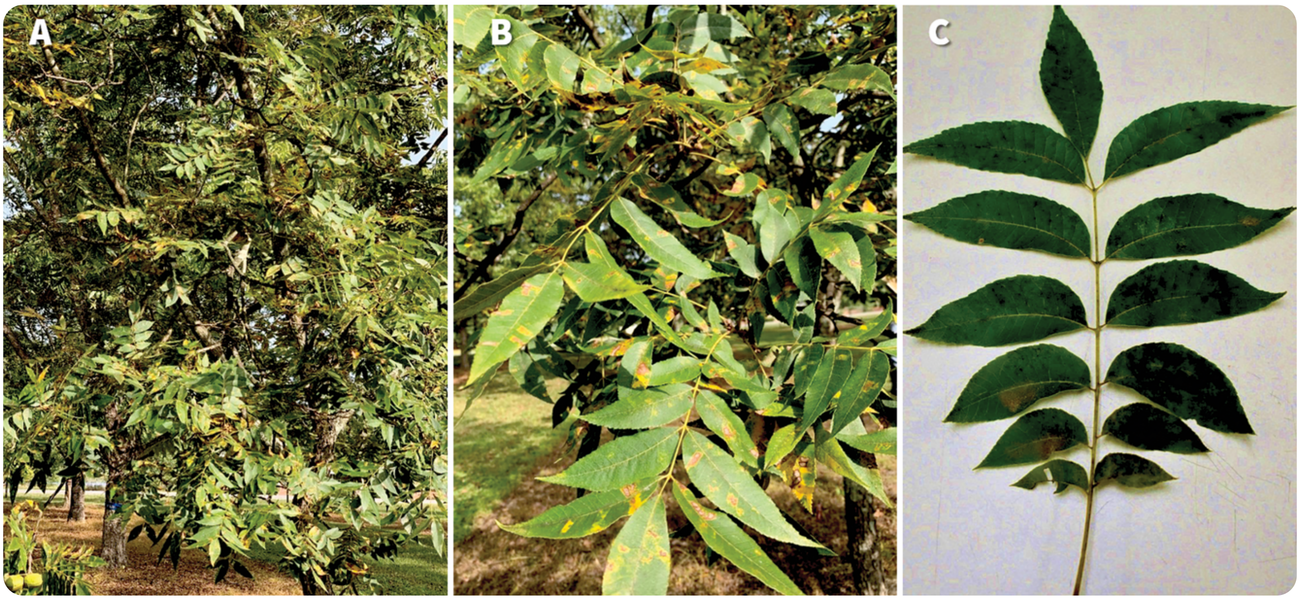

Figure 2. Damage symptoms of black pecan (A and B) and yellow pecan aphid complex (C).

Damage

All pecan aphids feed on the leaf veins, but their preferred areas are different. Black pecan, blackmargined, and yellow pecan aphids mostly feed on quaternary, primary and secondary, and tertiary veins, respectively. Both yellow pecan aphid and blackmargined aphids feed on leaf sap and produce honeydew, and its deposition on pecan foliage provides a substrate for the establishment of black sooty mold (Figure 2C), which decreases photosynthesis (Tedders & Wood, 1985). Feeding by black pecan aphids causes leaf chlorosis around the feeding area (Figure 2A, B), which can reduce leaf chlorophyll and leaf area, causing a decrease in leaf net photosynthesis and defoliation. This can also reduce current and subsequent season nut yield and quality by reducing the carbohydrate reserve for winter, which regulates the flowering of pecan trees (Tedders & Wood, 1985). Estimations indicate that the reduction in nut yield attributed to the yellow pecan aphid and blackmargined aphid is approximately 2.41 kg and 18.13 kg per individual aphid, respectively (Wood et al., 1987).

Management

In commercial pecan orchards, aphid management primarily relies on the routine application of chemical insecticides. However, other pest management approaches are taken into consideration when selecting insecticides and the timing and frequency of applications. In the following sections, we discuss different control options for managing pecan aphids.

Figure 3. Insecticide application in a pecan orchard using an airblast sprayer.

Host Plant Resistance

Not all pecan varieties are susceptible to pecan aphid infestation, especially black pecan aphids. Therefore, growers can take advantage of pecan varieties that have natural resistance to aphid feeding. Different pecan cultivars exhibit varying degrees of susceptibility to aphid infestation. Notably, varieties like Apalachee, Avalon, Caddo, Desirable, Gloria, Grande, Kiowa, Oconee, Schley, Stuart, Sumner, and Zinner are particularly prone to attack by one or more species of pecan aphids. Other cultivars, including Amling, Creek, Ellis, Elliott, Excel, Gafford, Kalos, Lakota, and McMillan, are more tolerant of aphids (Wells & Conner, 2015). Growers should expect to see lower level of infestations in some these more tolerant varieties and thus be able to minimize insecticide applications.

Biological Control

Aphelinus perpallidus Gahan (Hymenoptera: Aphelinidae) is a known parasitoid of yellow pecan aphids and blackmargined aphids, both in adult and nymphal stages (Slusher et al., 2021). Until now, no parasitoid has been reported for black pecan aphids. Predators, including spiders, different lady beetles, and green and brown lacewings, have been identified as key natural enemies of the pecan aphid complex (Dutcher et al., 2012).

Chemical Control

Pecan growers are using several insecticides, including acetamiprid, clothianidin, flonicamid, flupyradifurone, imidacloprid, pymetrozine, pyridaben, pyrifluquinazon, sulfoxaflor, thiamethoxam, and tolfenpyrad to control pecan aphids in their fields. However, their control efficacy is different in different aphid species, and aphid populations. In a field trial, we evaluated most common insecticides, including Carbine 50WG, Transform WG, Sefina, PQZ, Macho 2.0FL, and Movento, against the pecan aphids in pecan orchard in Ty Ty, GA. A Durand-Wayland 3PT hitch airblast sprayer

(Figure 3) was used to apply insecticides. Insecticides and their application rates are provided in Table 1. A randomized block complete design was used, and the experiment was repeated four times. A single tree was used as an experimental unit and was surrounded by four buffer trees. Numbers of black pecan aphid nymphs and adults and yellow pecan aphid complex (both adults and nymphs of yellow pecan aphid and blackmargined aphid) per compound leaf were recorded for five compound leaves at 7 and 14 days after treatment. A one-way ANOVA was used to determine significant differences among the treatment means, and Tukey's HSD ($P < 0.05$) was used for mean separation. JMP v. 16 (SAS Institute) software was used for statistical analysis.

Table 1. Insecticide treatment details for a field trial in a pecan orchard in Ty Ty, GA.

Treatment	Rate/acre
Untreated check/control	-
Carbine 50WG	2.4 oz[a]
Macho 2.0FL	2.8 fl oz
Movento 2SC	9.0 fl oz
PQZ 1.8SC	3.2 fl oz
Sefina 0.42DC	6.0 fl oz
Transform 50WG	1.25 oz[a]

[a]oz form. (wt)/acre.

In the pretreatment observation, no significant difference was observed in the aphid numbers for insecticide-treated and untreated control trees. In the first observation (seven days after treatment; 7 DAT), numbers of black pecan aphid adults, black pecan aphid nymphs, and yellow pecan aphid complex were significantly lower in insecticide-treated trees compared with the untreated control trees. However, no significant difference was found between the insecticide treatments. In the second observation (14 days after treatment; 14 DAT), black pecan aphid nymphs were significantly lower in the Transform-treated trees than in the untreated trees. However, the yellow pecan aphid complex numbers were significantly higher in untreated control trees than all the insecticide-treated trees. The numbers of black pecan aphid adults were not significantly different between the untreated control trees and insecticide-treated trees for both observation weeks (Figure 4).

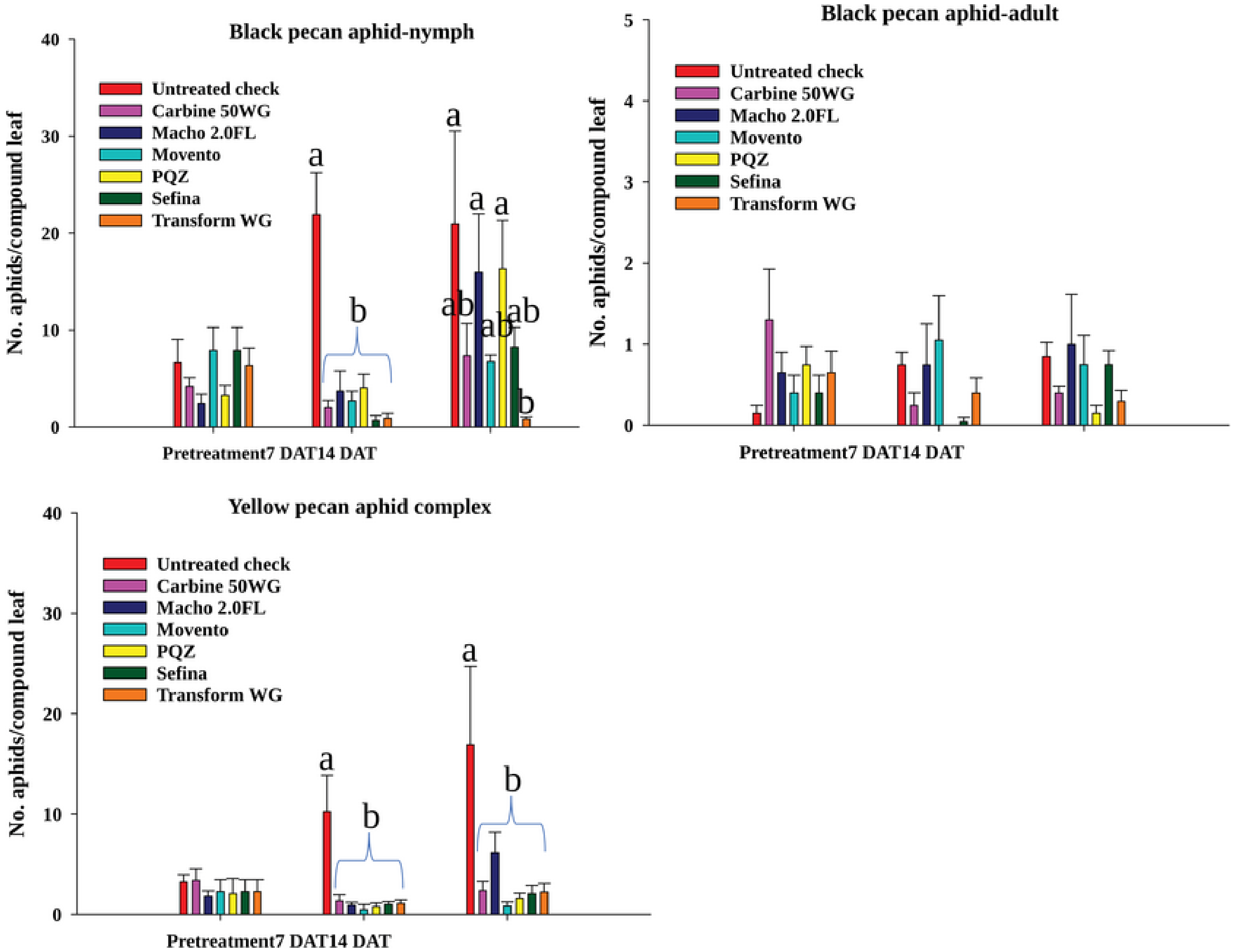

Figure 4. Control efficacy of various insecticides against pecan aphids.

Other Control Options

Application of a plant hormone, gibberellic acid (GA3), could also minimize the feeding damage by black pecan aphids to pecan leaves and therefore be considered as another option to manage aphid infestation. Research has clearly shown that rate of leaf chlorosis due to the feeding damage of black pecan aphid was significantly reduced by GA3 application at the rate of 16 to 80 g a.i./ac. Also, no negative side effect of the GA3 treatment was reported in natural enemies or on the return bloom of pecan (Cottrel & Wood, 2021).

The use of a fermenting molasses solution on pecan foliage during an aphid outbreak increased ladybeetles and lacewings while reducing the population of black pecan, black margined, and yellow pecan aphids (Dutcher et al., 2012).

The biorational insecticide Grandevo (Chromobacterium subtsugae) can also effectively control pecan aphids while preserving the natural enemy population in the field (Oliveira- Hofman et al., 2021).

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1. **The first-generation bioenergy crops are _____________.**
    a. Corn.
    b. Soybean.
    c. Both a and b.
    d. None of the above.

2. **The source of biofuel from corn is**
    a. cellulose.
    b. lignin.
    c. starch.
    d. hemicellulose.

3. **The source of biofuel from second-generation bioenergy crops is**
    a. cellulose.
    b. lignin.
    c. hemicellulose.
    d. All of the above.

4. **Which of the following was NOT listed as a reason for lower Miscanthus biomass production in Wisconsin?**
    a. High soil moisture in both Northern and Central sites.
    b. Low wintertime temperature in the Northern site.
    c. Low snow cover in the Central site.
    d. Low soil moisture in both Northern and Central sites.

5. **Switchgrass performed well in all the experimental sites.**
    a. True.
    b. False.
