Damage and Mortality to Pecan *(Carya illinoensis* (Wangenh.) K. Koch) Seedlings by Subterranean Termites *(Reticulitermes flavipes* (Kollar)) in an Oklahoma Forest Nursery

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*Termite injury to pecan (*Carya illinoensis *(Wangenh.) K. Koch) was characterized by yellow, necrotic foliage. Tap roots of infested seedlings exhibited one or more small round or oval holes 4 to 8 centimeters (1.6 to 3 inches) below the soil surface -- some were tunneled so badly that only a thin shell remained. Sampling revealed that 47.5 percent of the seedlings showed foliar symptoms and 2.5 percent of the seedlings were dead.* Tree Planters' Notes 38(2):28-30; 1987.

Subterranean termites (*Reticulitermes* spp.) destroy more wood in use in the United States than does any other insect pest (2). *Reticulitermes flavipes* (Kollar) is the most common species in the eastern and southern United States, while *R. tibialis* Banks is important in the West (4).

Although subterranean termite damage to wooden structures is well documented, damage to living trees occurs infrequently in the United States and is less well known. St. George (6) reported damage by *R. flavipes* to living shrubs in Washington, DC. Edelson and Hyche (3) mentioned termite damage to sycamore and oak seedlings in Alabama. Payne (4, 5) stated that pecan nursery stock and small trees are sometimes killed by termites feeding, but he cited no specific cases. Herein, we describe a case of termite damage to nursery-grown pecan seedlings in Oklahoma.

Nursery Setting

The observation was made in a nursery near Washington (Cleveland County) in central Oklahoma. A single bed 213 meters (700 feet) long was planted to pecan, *Carya illinoensis* (Wangenh.) K. Koch. The seed were planted in fall 1983, three rows per bed, and 12 seeds per linear foot (0.3 meter). No sawdust or other mulch was added. Nitrogen was applied at the rate of 90 kilograms per hectare (80 pounds per acre) split among six applications distributed over the growing season.

Shortleaf pine (*Pinus echinata* Mill). was grown during the previous season (1983-84). A bed of bur oak seedlings was planted on one side of the pecan bed. A cover crop of Sudan grass and wheat was planted in a strip 4.6 meters (15 feet) wide between the pecan planting and an arborvitae windbreak.

Description and Extent of Injury

Damage was first observed in mid-July 1984. Earliest symptoms on affected seedlings were yellowing of foliage and leaf necrosis, followed by browning and drying of leaves, and subsequent mortality. A sample of affected seedlings was lifted and examined, revealing tunnels in the roots. Termites (*R. flavipes*) were found in the tunnels of some roots, while other tunnels (fig. 1) contained only fecal material.

On July 27, the nursery bed was sampled for extent of injury. The sample included thirteen 1.2-meter (4-foot) linear plots selected at random. Sample plots contained 122 seedlings that were examined for foliar symptoms and mortality. The sampling revealed that 47.5 percent of the seedlings showed foliar symptoms of leaf necrosis, and 2.5

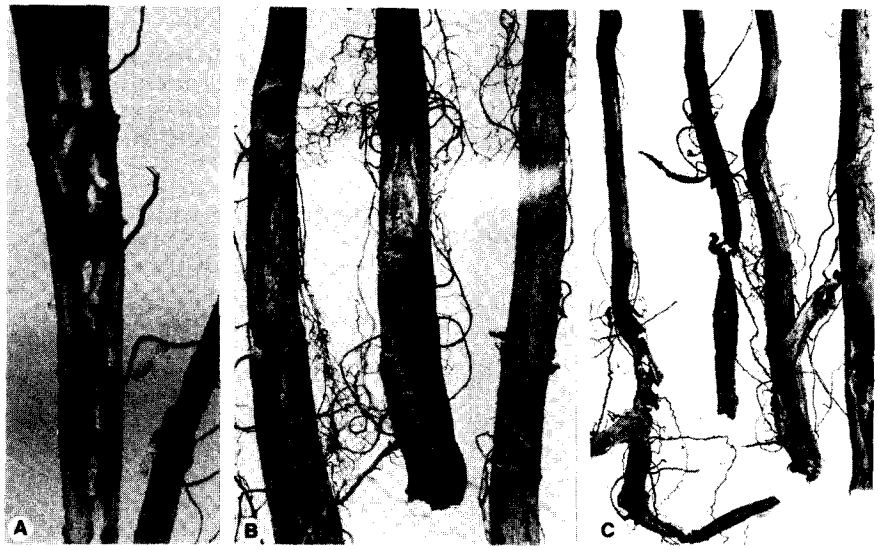

Figure 1—*Pecan seedlings injured by termites.* **(A)** *Tap root of seedling dissected to expose the tunneling termites.* **(B)** *Entrance holes made in sides of tap roots.* **(C)** *Tap roots tunneled so badly that only thin shells remain.*

percent of the seedlings were dead. Mortality was spotty throughout the nursery bed, with mortality in some pockets greatly exceeding the average of 2.5 percent. Damage was heaviest at the east end of the nursery bed.

A smaller sample of affected seedlings was randomly selected for excavation and examined for root tunneling. Six (46.2 percent) of 13 living seedlings excavated with necrotic foliage exhibited galleries in the roots. Eleven (78.5 percent) of 14 dead seedlings had root galleries.

Infested seedlings typically exhibited one or more small, nearly round or oval entrance holes in the tap roots (fig. 1B). Entrance holes 1 to 3 millimeters (0.04 to 1.14 inch) in diameter were present from just below the root collar down to a depth of 10 centimeters (3.9 inches), but most holes occurred from 4 to 8 centimeters (1 .6 to 3.2 inches) below the soil surface.

Dissection of infested roots revealed galleries extending in both directions from the entrance holes, from about the root collar down to depths of 14 centim eters (5.5 inches). A few galleries extended slightly above the root collar, but were not visible externally. The tap roots of some seedlings were tunneled so badly that only a thin shell or bark remained (fig. 1C). Seedlings pulled from the ground commonly broke at these weakened sites, leaving part of the tap root in the soil.

After the damage was discovered and identified in late July, the nursery bed was treated for control of the termites. The bed was treated with Lorsban 4E (41 percent) (1) at the rate of 43 grams active ingredient per 93 square meters (1 .5 ounces a.i. per 1,000 square feet) and irrigated. No further damage was observed. No further samples were taken.

Discussion and Conclusion

Termites are known to establish in soil where there is decay-

ing wood, sawdust, and other organic matter suitable for food. When this happens, termites can successfully invade living plants, especially when the plants have injuries or are weakened from other causes. Some of the pecan seedlings may have been weakened by causes other than termites because only about half of the lifted seedlings with foliar symptoms exhibited termite entrance holes and tunnels. However, we found no pathogen or other obvious adverse factors. No mulch or other organic matter was added to the nursery soil, nor were there any wood stakes, form boards, etc., placed in the nursery.

Because the bed of pecan seedlings was only 4.6 meters (15 feet) from the arborvitae windbreak, it seems most likely that this was the source of infestation. In all likelihood, the termites tunneled through the soil in search of food, reaching the nursery bed with the pecan seedlings.

Because many of the damaged seedlings are vacated after some degree of tunneling, the entrance holes and gallery within the tap roots can easily lead to the mistaken diagnosis of insect borers. Therefore, the description of injury presented here can help nursery workers and others to correctly identify the cause of injury and apply appropriate treatment. Moreover, good sanitation and preventive treatment of small amounts of soil insecticide incorporated into beds could help prevent or minimize termite infestations in nurseries.

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