

Pathogenicity of *Xiphinema chambersi* on Sweetgum

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ABSTRACT

Seedlings of *Liquidambar styraciflua* were stunted severely when grown in the greenhouse in soil infested with *Xiphinema chambersi*. These nematodes parasitized the seedlings and multiplied, and their feeding resulted in malformed and necrotic feeder roots. Root and shoot

weights and height of seedlings grown in infested soil were significantly less than those of seedlings in noninfested soil.

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Additional key words: phytonematode, forest nematology, host-parasite relations.

In an effort to determine the plant-parasitic nematode populations commonly associated with southern hardwoods of economic importance, soil samples were taken under trees of various species at different locations in Georgia and surrounding states. *Xiphinema chambersi* Thorne was recovered from soil around the roots of several 25-year-old sweetgum (*Liquidambar styraciflua* L.) trees growing on a streambank in a natural forest near Athens, Georgia. Finding this nematode was of interest because *Xiphinema* spp. are important not only as plant pathogens but also as vectors of soil-borne viruses (1).

In woodland areas in New Jersey, Springer (8) found *X. chambersi* associated with American beech (*Fagus grandifolia*), white ash (*Fraxinus americana*), chokecherry (*Prunus virginiana*), and pin oak (*Quercus palustris*). This nematode has also been found in a pine nursery in Florida (2), associated with the roots of pine in Louisiana (7), and recovered from soil under eastern hemlock (*Tsuga canadensis*) in the mountains of Georgia (5).

Little is known about the nature of parasitism of *X. chambersi* on forest trees. This experiment was conducted to establish the parasitism and determine the pathogenic nature of *X. chambersi* to sweetgum.

MATERIALS AND METHODS.—Nematodes extracted from forest soil were successfully cultured on sweetgum seedlings, but only after many had died during and after inoculation. Apparently, *X. chambersi* is adversely affected by routine extraction procedures, and it was a year before numbers exceeding the inoculum level were found in the culture containers (7.6-liter glazed crocks). Inoculum for both tests in the experiment was obtained from these initial cultures. To avoid injury to nematodes during extraction, the infested soil from the cultures was mixed, sampled to determine nematodes per gram of soil, and added to a mixture of steam-treated sandy loam soil and sand (2 to 1, v/v) in sufficient quantity to provide the desired numbers of nematodes per crock. A more precise estimate of numbers per crock was then made by randomly collecting two 100-cc soil samples from each crock and assaying them separately by a centrifugal-flotation procedure (3).

The first test was conducted to determine the parasitism of *X. chambersi*. The bottom drains in

each of 12 crocks were covered with screen, a layer of fine gravel 2 cm deep was added, and the remaining space was filled with infested soil. A 4-month-old sweetgum seedling grown in steamed sand was planted in each crock. After 3 months, the seedlings were removed, the roots rinsed with water, and nematodes assayed from the rinse water. The number of nematodes in the soil of each crock was estimated as previously described. The counts from the soil samples and root rinses were combined to give an estimate of the total number of nematodes per crock. New seedlings were planted in the remaining infested soil in each crock and allowed to grow for 6 months to increase inoculum for the next test.

Twenty-four crocks were used in the next test, which was conducted to determine the pathogenic nature of *X. chambersi* to sweetgum. Each crock was filled with the mixture of steam-treated sandy loam soil and sand (2 to 1, v/v) and placed on the greenhouse bench for 2 months. This 2-month period allowed natural recolonization of airborne fungi before the start of the test. One hundred g of soil infested with ca. 6,000 nematodes were added to the steam-treated mixture in each of six crocks; 225 g of soil infested with ca. 9,000 nematodes were added to each of six crocks; and 360 g of soil infested with ca. 15,000 nematodes were added to each of six crocks. One hundred g of soil from previously prepared crocks containing only roots and no nematodes were added to each of the six remaining crocks which served as controls. A 3-month-old seedling grown in a 10-cm pot was planted in each crock. No fertilizer was added during the course of the experiment. Greenhouse temperatures during the period of the test ranged from 22 to 31 C. The plants were watered with tap water often enough so that the moisture content of the soil remained at ca. 15% of the dry weight.

After 3 months, the second test was terminated. Plants were removed by gently shaking the soil from the roots. Two 100-cc aliquants were removed from the remaining soil in each crock after the soil had been thoroughly mixed. The roots were rinsed, and the rinse and two soil samples were assayed separately for nematodes by a centrifugal-flotation technique (3). The height of each seedling was measured, and the tops and roots were weighed. The roots were

TABLE 1. Population increase of *Xiphinema chambersi* on potted sweetgum seedlings after 3 months

Crock	Approximate no. nematodes ^a per crock	
	Initial	Final
1	75	150
2	125	650
3	75	150
4	100	100
5	100	300
6	50	100
7	50	450
8	125	750
9	125	400
10	350	650
11	175	550
12	175	450

^a Two 100-cc samples assayed for each crock (7.6 liters capacity); root rinse included in final counts.

examined under a binocular microscope for abnormal growth and nematode damage.

RESULTS.—In the first test, *X. chambersi* reproduced well on sweetgum and averaged more than a twofold increase in 3 months (Table 1). In only one crock out of 12 did the number of nematodes fail to exceed the inoculum level.

The injury produced by *X. chambersi* was moderate to severe, and generally proportionate to the number of nematodes used as inoculum (Fig. 1). All three nematode inoculations caused significant reduction in top and root weights and height as compared with the check plants. Damage to roots ranged from surface necrosis and slight reduction in lateral root development in the inoculations with 6,000 nematodes/crock to severely stunted root systems in those with 15,000 nematodes/crock (Fig. 2). Many tips of the arrested lateral roots were dark brown. In the inoculations with 15,000 nematodes/crock, roots were severely damaged in the center of each crock, whereas roots growing just below the soil surface and down the sides of the cylinder appeared to have escaped damage (Fig. 2-B). Root clusters from the tap root were darkened, swollen, irregular, and twisted at several angles. On some lateral roots, the tips behind the root cap were swollen in a fashion similar to damage caused by *X. diversicaudatum* on roses (6), *X. index* on Thompson seedless grapevines (4), and *X. bakeri* on Douglas fir (*Pseudotsuga menziesii*) (9). The "coarse root" and "curly-tip" root damage observed on roses was also seen on the galled roots of sweetgum, but the root galls on sweetgum were apparently not so large as those reported on roses (6).

On the basis of these data, I conclude that *X.*

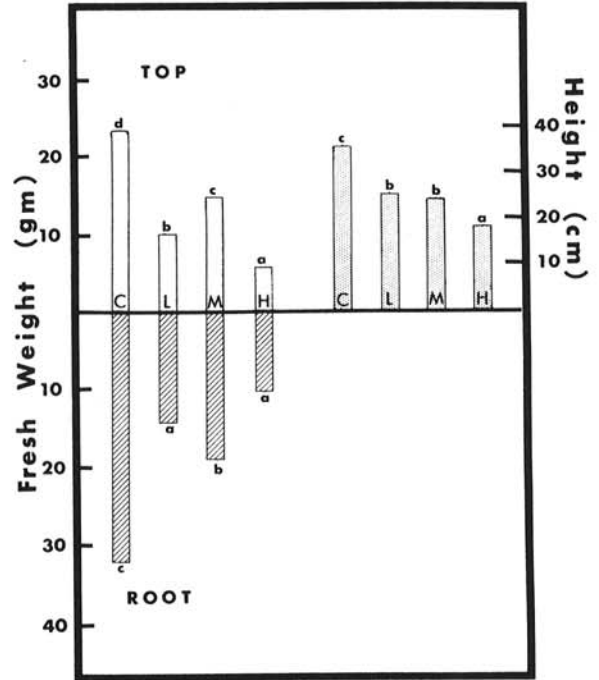


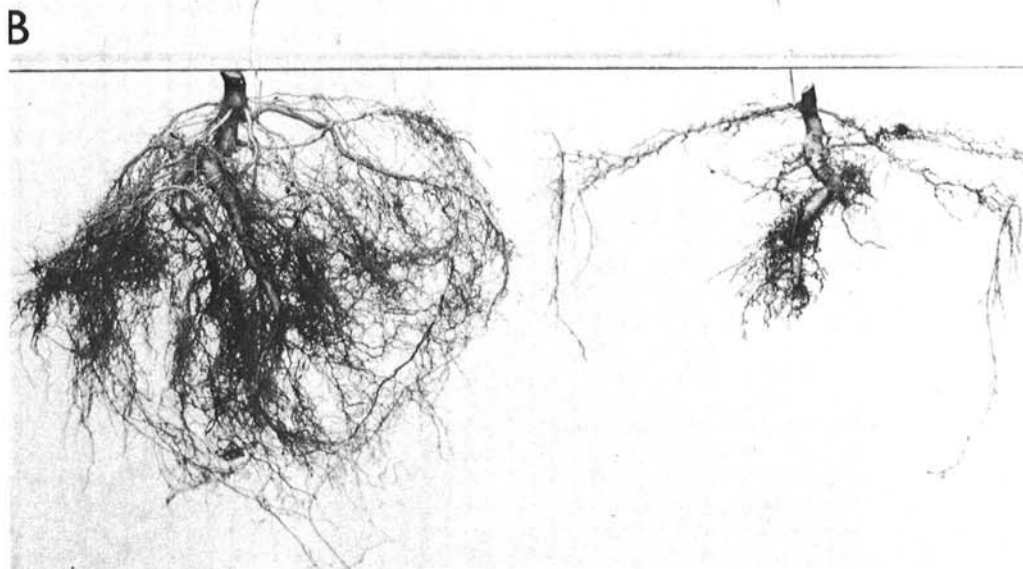
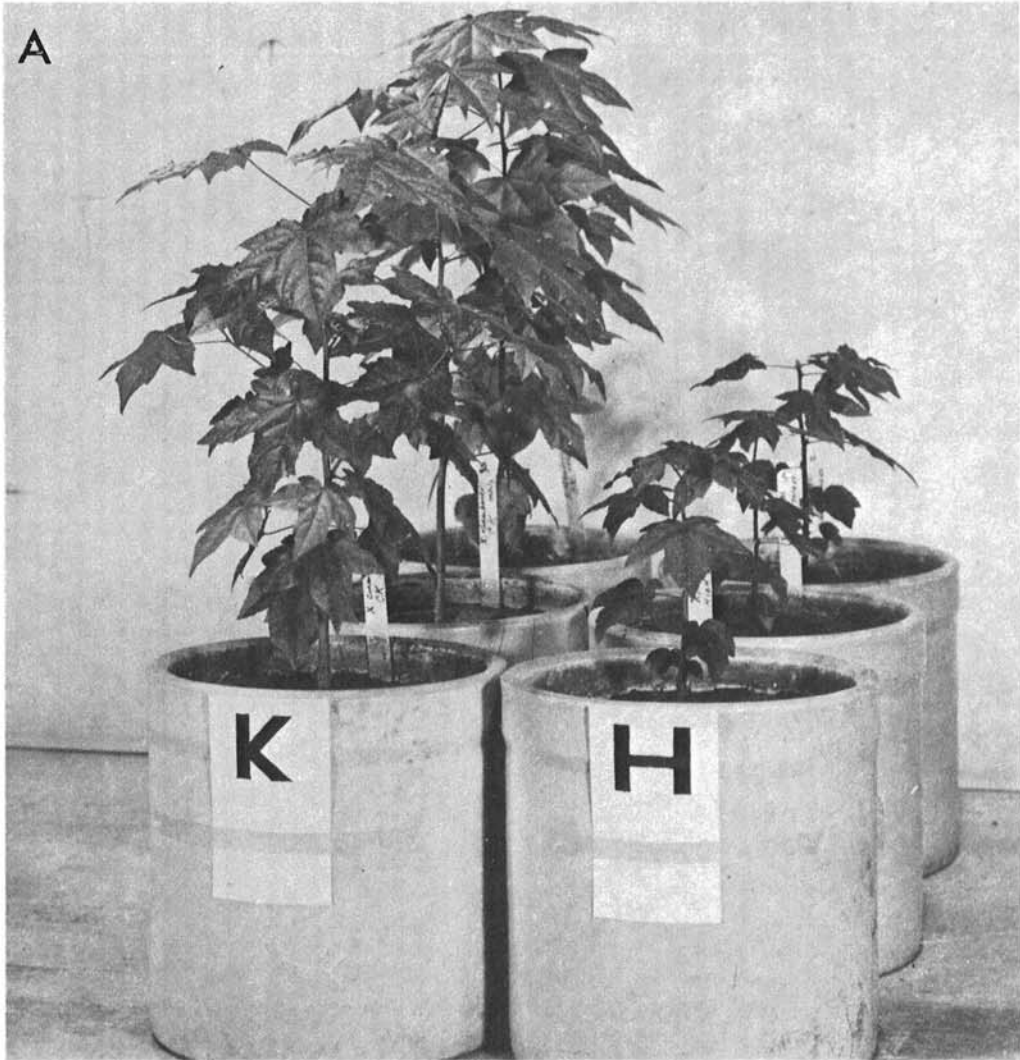
Fig. 1. Effect of *Xiphinema chambersi* on top and root weights and height of sweetgum seedlings. C = control; L = ca. 6,000 nematodes/crock; M = ca. 9,000 nematodes/crock; H = ca. 15,000 nematodes/crock. Bars having different lower-case letters are significantly different (5% level).

chambersi is both parasitic and pathogenic on sweetgum, and that attempts to plant sweetgum on infested sites may fail.

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Fig. 2. Effect of *Xiphinema chambersi* on growth of sweetgum seedlings. A) Top growth of seedlings (H) inoculated with 15,000 nematodes/crock, and that of control seedlings (K) not inoculated. B) Healthy, fibrous root system of control plant on the left; damaged root system on the right taken from crock initially containing 15,000 nematodes.



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