Occurrence of Thielaviopsis basicola and Phytopathogenic Nematodes on Healthy and Declining Landscape-Grown Ilex crenata 'Helleri'[1]

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Abstract

Examination of the soil and root systems of 34 landscape-grown Japanese holly, (17 rated as healthy/17 as declining) was undertaken to determine the role of *Thielaviopsis basicola* and phytopathogenic nematodes in plant decline. One hundred roots per plant were cultured on carrot discs and the recovery of *T. basicola* was recorded. Soil was assayed for phytopathogenic nematodes and tested for P, K, Ca, Mg, soluble salts and pH. *Thielaviopsis basicola* was found to have colonized 33 of the 34 plants and the extent of occurrence was positively correlated with the presence of decline symptoms. Declining plants had a total of 34% of intact roots colonized while healthy plants had 17%. Only one plant had a significantly high number of nematodes. Nematodes, soil pH, soluble salts, P, K, Ca, and Mg were not correlated with decline.

Index words: Holly, *Thielaviopsis basicola*, decline

Introduction

Japanese holly (*Ilex crenata* Thunb. 'Helleri') is an important landscape shrub. During 1979 in Virginia alone, more than 500,000 plants were propagated (5). Japanese holly is also one of the plants most frequently submitted to the Plant Disease Clinic at Virginia Tech., Blacksburg for diagnosis of dieback and decline (13). Dieback and decline or decreased growth rate of Japanese holly has been associated with *Thielaviopsis basicola* (Berk. & Br.) Fr. (8, 10), and nematodes (1, 2, 3, 6, 12). Colonization of holly roots by *T. basicola* resulted in stunted growth, chlorosis and ''reduction'' of foliage (10). Colonized roots developed distinct dark brown to black lesions (9, 14). Root-knot nematodes [*Meloidogyne javanica* (Treub.) Chitwood, *M. arenaria* (Neal) Chitwood] cause stunting, defoliation, root knot and root necrosis on holly (2, 12). *Tylenchorhynchus claytoni* Steiner, *Criconemoides xenoplax* Raski (1) and *Pratylenchus penetrans* (Cobb) Filip. & Shuum-Stekh are also reported as pathogens of Japanese holly (6). This study was conducted to document the incidence of *T. basicola* and phytopathogenic nematodes associated with healthy and declining landscape-grown Japanese holly.

Materials and Methods

Five, three and seven different sites in the counties of Montgomery and Roanoke (southwest Virginia) and Fairfax (northern Virginia) respectively, were selected. In most cases, the sites were selected because healthy appearing and declining plants were growing adjacent to each other thus minimizing environmental variables. From these sites, 34 'Helleri' Japanese holly were chosen and rated as either healthy or declining. Healthy plants had dark green leaves of normal size, and no defoliation. Declining plants had either chlorosis, dieback or both. Plants with evidence of insect infestations or other obvious problems were not included in this study.

Ten to twelve 2.5 cm (1 in) dia. soil cores were taken randomly throughout the root zone of each plant. Roots were removed from the soil cores by wet sieving and placed in 250 ml beakers which were then covered with cheesecloth and washed with running tap water for 30 minutes. After the washing, approximately 300 intact feeder roots, 3–5 mm (0.1–0.2 in) in length, were excised from each root system, placed in 9 cm (3.5 in) sterile plastic petri dishes and rinsed with three changes of sterile distilled water. Although feeder roots were selected without regard to black root disease symptoms, obviously dead (shriveled or decayed) roots were intentionally not selected. One hundred roots were selected from the 300 (again, without regard to symptoms) and depending on the diameter of the carrot, 1–3 roots were placed on each slice. To prepare the slices, whole carrots were surface disinfected for 10 min. in 0.5% sodium hypochlorite, rinsed in sterile distilled water, sliced into 8 to 10 mm (0.3–0.4 in) thick discs and placed in sterile incubation chambers consisting of moistened filter paper in glass petri dishes. After 6 days incubation at 27°C (73°F), the total number of roots colonized by *T. basicola* was recorded for each plant.

The soil was assayed for nematodes with a semi-automatic elutriator (4) followed by sugar flotation (6). Soil was tested for P, K, Ca, Mg; pH and soluble salts by the Virginia Tech Soil Testing Laboratory, Blacksburg, Va.

Results and Discussion

Thielaviopsis basicola was recovered from 33 of the 34 plants examined. Twenty six percent of the 3,400 roots cultured were positive for *T. basicola*. Analysis of varience showed that hollies rated as healthy had significantly less ($p = 0.05$) incidence of *T. basicola* than those rated as declining. Seventeen percent of the feeder roots of healthy plants were colonized by *T. basicola*; declining plants had 34% incidence of colonization (Table 1). These data are

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Table 1. **Percent recovery of *Thielaviopsis basicola* from roots, number of phytopathogenic nematodes in soil, and soil characteristics for healthy and declining 'Helleri' Japanese holly in the landscape.**

	Healthy		Declining	
	Mean[z]	S.D.	Mean	S.D.
Roots with *T. basicola*[y]	17.41	17.12	33.82	20.17
Nematodes:[x]				
Pratylenchus	1.18	3.32	5.88	24.25
Meloidogyne	1.18	4.85	0.00	0.00
Xiphinema	32.94	53.24	30.59	49.04
Helicotylenchus	102.94	287.66	49.41	140.91
Hoplolaimus	1.18	4.85	1.18	4.85
Crinonemoides	37.65	111.38	0.00	0.00
Hemicycliophora	3.53	10.57	0.00	0.00
Trichodorus	2.35	9.70	4.71	13.28
Paratylenchus	0.00	0.00	4.71	15.05
Soil characteristics[w]				
pH	6.92	0.60	7.10	0.61
Soluble salts	253.12	109.56	279.41	172.20
Phosphorus	14.94	7.94	21.82	12.89
Potassium	103.18	37.15	90.05	38.67
Calcium	1161.18	94.82	1167.53	130.82
Magnesium	112.76	14.17	114.00	14.38

[z]Data for calcium and magnesium do not represent the true mean because in most cases, soil samples were in excess of the upper limit of detection.

[y]Number of intact roots per 100 from which *T. basicola* was recovered.

[x]Number of nematodes extracted by wet sieving/sugar flotation per 500 cc of soil.

[w]Soluble salts and soil nutrients are expressed in ug/g.

representative of intact roots, irrespective of symptoms. No attempt was made to quantify the amount of detached or dead roots in the soil samples.

Japanese holly has been reported to be a host of a number of phytopathogenic nematodes. With the exception of one plant, which had 100 *Pratylenchus* sp./500 cc (1 pint) of soil, none of the soil samples in this study had a significant number of nematodes. Recovery of *T. basicola* was also high for this plant (64%). Root-knot nematode was only recovered from one sample (20 juveniles/500 cc soil) and the plant was rated as healthy. The nematode extraction procedure used would not have detected root-knot nematodes most efficiently; however, galls were not observed on any of the roots examined.

Analysis of soil nutrients and soluble salt levels did not reveal significant differences between healthy and declining plants (Table 1). This was expected since most of the plants rated as healthy and declining were adjacent to each other. Phosphorous was low (less than 6 ug/g) for three healthy plants but not for any of the declining plants. Calcium was low (less than 1,100 ug/g) for two healthy plants and for one declining plant.

A cause and effect relationship between the incidence of *T. basicola* and decline symptoms was not established here but there was a positive correlation. Also, it is apparent that undetermined factors are involved in Japanese holly decline. One plant that was rated as declining had only 1% of the intact roots positive for *T. basicola*. In this case, neither nutritional problems or nematodes were correlated with decline. Conversly, approximately 50% of the hollies listed as healthy occurred within the same frequency distribution with respect to incidence of *T. basicola* colonization, as declining plants (Fig. 1). Above-ground symptoms alone can be deceiving. For example, two specimens that were rated as healthy had 44% and 57% of the intact roots positive for *T. basicola*. Since the majority of plants rated as healthy and declining shared the same site, the influence of environmental factors such as exposure, air pollution, temperature and availability of water take on less importance as primary or predisposing factors. Furthermore, the random distribution of declining plants among healthy plants is symptomatic of an infectious, soil-borne disease.

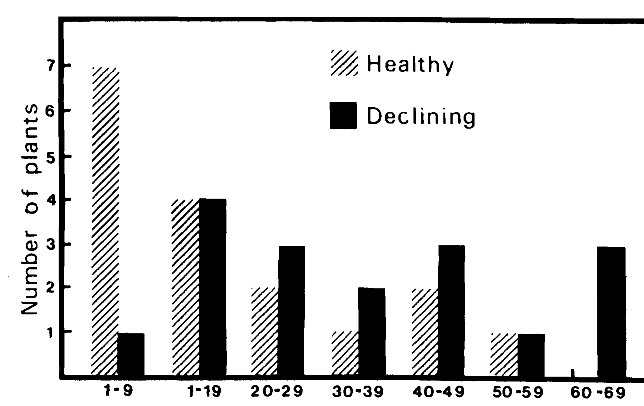

Fig. 1. **Frequency of distribution of the number of intact Japanese holly feeder roots colonized by *Thielaviopsis basicola* from a random sample of 100 roots per plant in plants rated as healthy and as declining.**

Significance to the Nursery Industry

Black root disease caused by *Thielaviopsis basicola* has been reported to be destructive to Japanese holly in nursery production. The study reported here demonstrates that there is also a correlation between decline of landscape-grown Japanese holly and the presence of *T. basicola* in the roots. In some cases, the disease may only result in decreased rate of growth without symptoms of dieback or chlorosis, thus poor health may not be recognized. Holly transplanted into the landscape with this disease may in time, decline. Furthermore, the site will become infested with a fungal pathogen that has the ability to survive in soil for many years. It is in the best interest of propagators, nurserymen and landscape contractors to learn to recognize the root symptoms of this disease and to avoid out-planting diseased plant material.

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Reducing Moisture Stress in *Cornus florida*[1]

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Abstract

Two experiments were conducted to evaluate potential means for reducing moisture stress in *Cornus florida*. In experiment 1, the antitranspirant (Folicote), and defoliation treatments were applied before inducing stress and after withholding water for 1 week. Folicote was not effective at either application time in reducing moisture stress; plants treated with Folicote had similar shoot water potentials as untreated. Defoliation at both times reduced moisture stress compared to control plants. In experiment 2, two defoliants, (2 chloroethyl) phosphonic acid (ethephon) and 2,3 dihydro-5,6-dimethyl-1,4-dithiin 1,1,4,4, tetroxide (Harvade), were compared at 3 rates each. Percent defoliation of dogwood was similar among treatments after 26 days, with defoliation ranging from 78 to 94 percent.

Index words: Defoliation, antitranspirants, moisture stress

Introduction

Flowering dogwood is a moisture sensitive plant grown widely in the southeastern United States. Periods of drought stress occur almost annually in this area. Prolonged drought stress is detrimental to growth and survival of dogwood.

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Reduction of the transpiring surface is one of the drought resistant mechanisms in many plants. Antitranspirants have been used for reducing transpiration rate and thus moisture loss from plants. According to Gale and Hagan (4), there are 3 basic types of antitranspirants—film forming, stomata closing and reflecting. Folicote, a film forming antitranspirant, when applied at a 5% (volume) rate, reduced total transpiration in *Hydrangea macrophylla* by 10–15%, (8). In a study by Davies and Kozlowski (3), Folicote reduced transpiration in *Fraxinus americana* for 8 days, but exhib-