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Beech Leaf Disease: Management Options

Beech leaf disease (BLD) is a serious threat to our native American beech trees and ornamental European and oriental beeches. The disease has spread quickly from Ohio since first being detected in 2012. It is now found in 12 states and the province of Ontario. It's infecting beech in all New England states except Vermont. It was first found in CT in 2019, and in RI and MA in 2020 (Fig. 1). The American beech, *Fagus grandifolia*, is a foundational tree species in several important eastern forest types, and critical for the hard mast (beechnuts) eaten by wildlife and shade they provide.

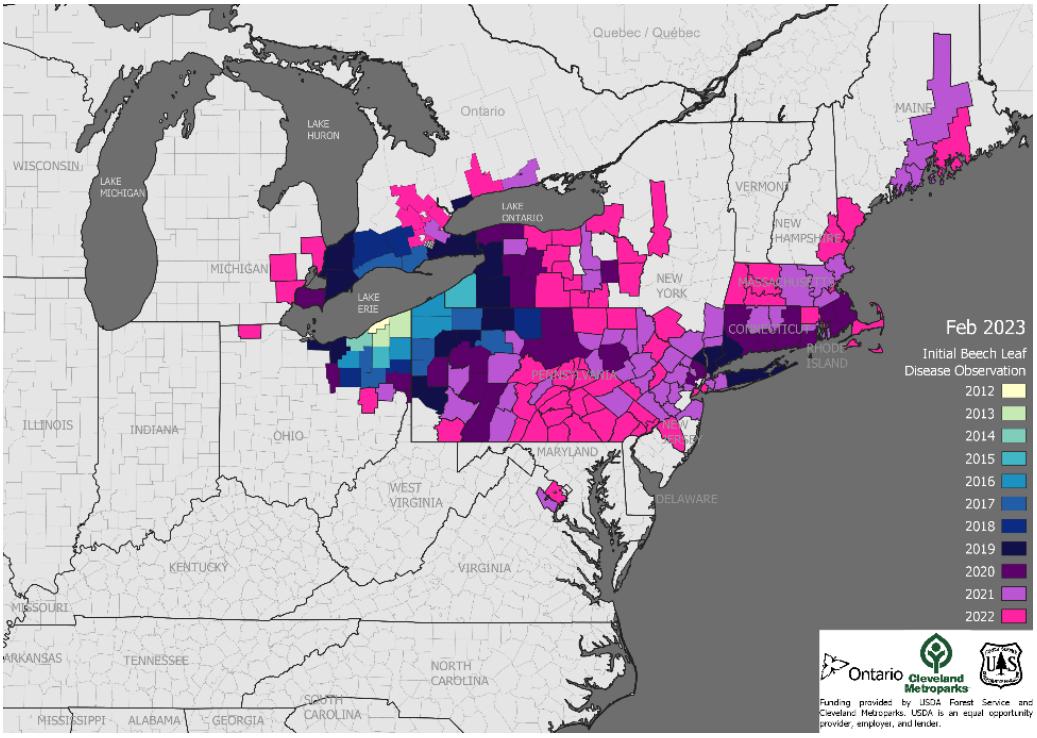

Fig. 1. Range expansion of beech leaf disease from 2012 to 2023.

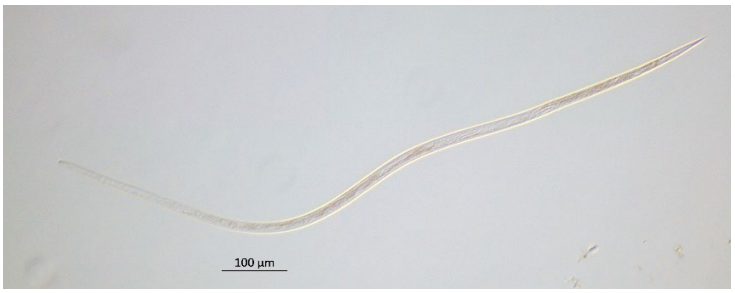

Fig. 2. Immature migrating female of *Litylenchus crenatae* ssp. *mccanni*. Photo by DeWei Li, CAES

Beech leaf disease is caused by a foliar nematode, *Litylenchus crenatae* ssp. *mccannii* (Fig 2.). Nematodes are microscopic worms that vary greatly in lifestyle and habitat, and not all are parasitic. We don't know where the nematodes came from, but growing evidence supports the hypothesis that this species is not native to North America. It has spread quickly, partly though rain splash, and likely also by hitchhiking on birds, squirrels, and insects. Peak emergence of nematodes migrating from leaves to buds occurs about the same time that beechnuts are ripening, which provides an opportunity for migrating nematodes interact with animals that come to feed on these nuts. We do know that the nematodes spend the winter in beech buds, that beech leaves emerge fully symptomatic in the spring, and that no further symptoms appear during the growing season. Therefore, management of this disease needs to either prevent nematodes from entering the buds or prevent nematodes that enter buds from inducing changes in leaf development.

SYMPTOMS

It's easy to determine if American beech trees are infected with BLD (Fig. 4). In the spring when new leaves are emerging from buds, infected leaves will have some dark bands between leaf veins, or the leaves will be very crinkled, smaller, and leathery. In severely infected trees, some buds won't open because the buds were killed. Banded leaf symptoms can best be seen by backlighting infected leaves against the sky.

Fig. 4. Symptoms on American beech. Left, Leaf banding symptoms; middle, crinkled leaves; right, dead buds.

Symptoms are less obvious on European beech trees (Fig. 5). Some leaves will be banded, but many of the leaves will look tattered or distorted.

Fig. 5. Symptoms on European copper beech. Left, Tattered leaves; right, banded leaves.

On heavily infected trees many overwintering buds will be killed, and severely damaged leaves fall off soon after emerging in May. In late May or early June, many American beech trees produce new, second flush leaves in response to defoliation. These leaves are formed in newly produced buds. Second flush leaves don't have nematodes and do not show symptoms of BLD because they form in the absence of BLD nematodes. The new leaves are pale and thin when compared with normal, healthy leaves, and usually lack the toothed margins characteristic of first-flush leaves (Fig. 6).

Fig. 6. Refoliated (second flush) leaves are paler and less robust than normal, healthy beech leaves.

In Ohio, researchers are seeing some American beech trees, particularly younger understory trees, die in 6 – 10 years after infection. While we are seeing much faster progression of disease and decline in the Northeast, actual mortality has not yet been documented in Connecticut. However, we expect that some trees will succumb in as little as four years after the first appearance of symptoms.

MANAGEMENT

What can be done about BLD? In 2017, Ohio researchers associated with Davey Tree Expert Co., Cleveland Metroparks, and ACRT Services started treating the soil around small beech trees (2 - 4 inches in diameter) with a phosphite product sold as a potassium fertilizer. Such potassium phosphite and potassium polyphosphite fertilizers are made by several companies. The researchers

applied product twice each year and got encouraging results after the first year. Treated trees were significantly healthier than untreated control trees with respect to reduced symptoms of leaf banding, defoliation, and dieback of twigs and branches. With annual treatments, trees have remained healthy for five years. Fewer nematodes were found in the leaves of treated trees than in the control trees. Our hope is that we will see similar results in New England.

Phosphite products are known to stimulate plant defenses. Earlier research demonstrated that phosphites can interrupt gall formation by root nematodes, in which the plant cells modified to form the gall benefit nematode feeding. The positive results from the OH studies are consistent with the recent discovery by Dr. Paulo Viera at USDA that nematodes feeding within the bud cause tissue changes to initiate formation of a leaf gall. By interrupting this process, phosphite products can maintain plant health, even though nematodes may still survive within leaf tissues.

Many phosphite products are sold as fungicides such as Agri-FOS, Fosphite, Reliant, Fungi-Phite, and Prophyt. Beech trees treated with either a fertilizer formulation or a product labeled as a fungicide should respond similarly. When using a fungicide formulation, you may not apply at a higher dose than allowed on the label. However, multiple applications of products labeled for plant protection use should reach effective concentrations of phosphite in tree tissues. To use a phosphite product, plan to make at least two applications between the months of May and August. Mix 2 fl. oz. of phosphite product plus 14 oz. of water per inch DBH (diameter at breast height). So, a 4-inch diameter tree will require 8 oz. of phosphite fertilizer in 48 oz. of water. Pour this around the base of the tree (Fig. 7). If the soil is dry, moisten the soil first with water so that the solution can penetrate the soil.

Fig. 7. Drenching a phosphite product into soil at the base of a beech tree.

Research in Ohio was performed on small (2-4” diameter trees) trees. The rate of 2 oz. of phosphite fertilizer per inch DBH may not be enough to improve the health of larger beech trees. Bigger trees have more foliage than smaller trees, and to account for this difference you may need to increase the number of applications. Please recognize that potassium phosphate is a salt, which may damage roots if present in excessive quantities or under drought conditions. Concern over overloading the soil with salts implies that greater quantities of product should not be concentrated near the root

flare but should be applied over a larger area. Otherwise, we may damage the tree with too much fertilizer.

A fungicide/nematicide called Broadform, which has an ornamentals label, kills nematodes when sprayed on beech leaves – a job best left to professional arborists. Here are several considerations for deciding whether Broadform is an appropriate option:

(1) Are there untreated beech trees nearby? Fluopyram sprayed on the foliage does not enter the buds. If nematodes migrate from neighboring untreated trees to the buds, where the damage occurs, then a fluopyram spray will be ineffective. Therefore, fluopyram should only be considered for treating trees isolated from other, untreated beech trees.
(2) If the tree is less than 4 inches in trunk diameter, then the phosphite treatment can be effective as a stand-alone treatment, whether or not there are other untreated trees nearby.
(3) If there are any bodies of water nearby, or hardscape leading to storm drains, then fluopyram products are inappropriate. Fluopyram is very toxic to aquatic organisms.
(4) Can the foliage be sprayed? If the tree is very tall or if it overhangs a neighbor's property, it may not be possible to spray the foliage.

If appropriate, fluopyram application(s) should be made between late May and late August. It's currently unknown if more than one application of fluopyram is needed. Monitoring for the continued presence of nematodes by extracting them in water from leaves is a convenient method to determine whether foliar sprays with fluopyram have been effective. If live nematodes are not detected following overnight leaf extraction, then further sprays may not be warranted.

Another important concern is pesticide resistance. It seems likely that BLD nematodes will develop resistance to fluopyram if this product is overused.

How to test for nematode presence using bud or leaf extraction

Step 1. Preparing the sample for extraction

1a. During the dormant season, overwintering buds can be collected and tested for the presence of nematodes. To test buds, remove six buds from around the perimeter of a tree. With a needle, forceps (tweezers), probe, or fine scissors (nail scissors work well), cut the bud lengthwise and tease the scales and developing, tiny leaves open. Place the buds in a small shallow clear plastic or glass dish and cover with water. Proceed to Step 3.

1b. During the growing season, nematodes that cause BLD can be detected from leaves between late July through leaf fall. Attempts to extract nematodes before mid-July are unsuccessful, even though nematodes are present in the leaves! Pick several symptomatic leaves. Vigorously rinse the leaves off with a stream of water to remove any surface-dwelling nematodes. Pat the leaves dry. Manually tear out the symptomatic areas of leaves from between the veins. Shred these symptomatic portions into small pieces (1 cm square).

Step 2. Conducting the extraction

Submerge the sample from Step 1b into a shallow layer of water in a dish or pan in a cool location. Aluminum pie pans work well. The objective is to have a high surface area to volume relationship, so that the nematodes have enough oxygen to remain active. Hold the samples overnight.

Step 3. Observe the results

Remove the plant material from the water with forceps. Extracted nematodes can be seen easily with good magnification, either by using a dissecting microscope or a USB microscope (the cost is about $60 from online retailers). They appear as highly mobile, thread-like animals (Fig. 2) with sinuous movements in the water. It is easiest to see them when the liquid containing them is held over a dark surface and the liquid is illuminated from the side.

Note: If a fluopyram treatment is effective and samples are evaluated within weeks of spraying, dead nematodes may be extracted with the procedure given above. They can be so numerous that dead nematodes can spill out of torn leaf tissue.

Note: Product trade names are used for convenience, and not to promote a product. Always read and follow pesticide label directions. The label is the law.