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Updated Beech Leaf Disease Biology and Management

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 13 states and the province of Ontario. It's infecting beeches in all New England states. 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.

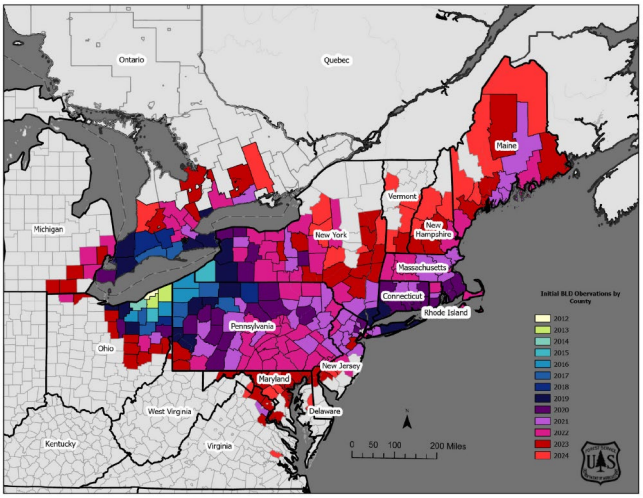

Fig. 1. Range expansion of beech leaf disease from 2012 to 2024.

Beech leaf disease is caused by a foliar nematode, *Litylenchus crenatae* (Fig. 2). Nematodes are microscopic worms that vary greatly in lifestyle and habitat, and not all are parasitic. Growing evidence supports the hypothesis that this species is not native to North America and originated from Asia. It has spread quickly, partly though rain splash and in windblown aerosolized droplets. The eastward-biased spread from its original introduction suggests that wind-assisted dispersal is important. Peak emergence of

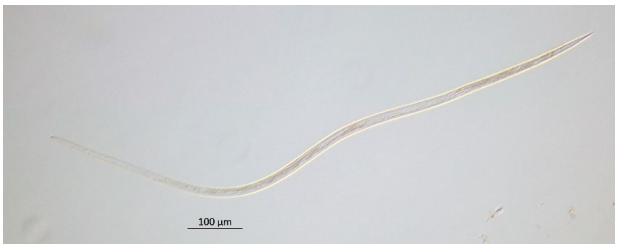

Fig. 2. Immature migrating female of *Litylenchus crenatae*. Photo by DeWei Li, C.A.E.S.

nematodes migrating from leaves to buds occurs at about the same time that beechnuts are ripening, which provides an opportunity for migrating nematodes to interact with and hitchhike on animals, including those that come to feed on the nuts. Nematodes spend the winter in beech buds, where their feeding modifies the development of young leaves to form the symptoms seen in the spring; 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. 3). 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. On heavily infected trees, many overwintering buds will be killed, resulting in tip dieback, and severely damaged leaves fall off soon after emerging in May. In response, many American beech trees produce a second flush of leaves emerging from newly produced buds that are devoid of nematodes. Because these leaves formed in the absence of BLD nematodes, they show no BLD symptoms, although they are pale and thin when compared with normal, healthy leaves, and typically lack the toothed margins characteristic of first-flush leaves (Fig. 6).

Fig. 3. Symptoms on American beech. Top, Leaf banding symptoms; middle, crinkled leaves; bottom, dead buds.

Symptoms are less obvious on European beech trees (Fig. 4). Some leaves will be banded, but many of the leaves will look tattered or distorted. In Ohio, researchers are seeing some American beech trees, particularly younger understory trees, die in a few years after infection. We are seeing much faster progression of disease and decline in the Northeast, with mortality of understory saplings in as little as three years.

Fig. 4. Symptoms on European copper beech. Top, Tattered leaves; bottom, banded leaves.

MANAGEMENT

What can be done about BLD? There are three effective treatment options: (1) systemic treatment using potassium phosphite (2) application of fluopyram-containing products to target nematodes within expanded leaves, or (3) trunk injection with thiabendazole. Of these, only the phosphite-based treatment is suitable for application by homeowners.

Fig. 5. Refoliated (second flush) leaves are paler and less robust than normal, healthy beech leaves.

Phosphite-based treatment. Potassium phosphite has unusual properties when absorbed by plants. It is bidirectionally systemic, meaning that it will move to the roots when applied to foliage, or to foliage when applied to roots. It is readily absorbed into trees when sprayed in solution onto bark. It is not metabolized within plants, and so, other than the amount that is lost when beech trees drop their leaves, the concentration in tissues can increase with each successive application. Its mode of action is to turn on biochemical defenses of plants against disease-causing organisms. In beech trees, it appears to interfere with the ability of nematodes to modify the development of leaves within buds, so that the hyperplastic (oversized) cells essential to overwintering survival of the BLD nematode cannot develop, resulting in a dramatic reduction of symptoms the following spring and in subsequent years.

In 2017, researchers in Ohio 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. The researchers made two applications 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. Notably, these were understory trees that were being repeatedly infected by migrating nematodes. So, phosphites can protect beech trees that are surrounded by untreated, infected trees.

More recently, arborists have reported that multiple years of treatment of bleeding canker of beech trees using two bark sprays of potassium phosphite per year is completely effective against beech leaf disease, even for the largest trees.
Many potassium phosphite products are sold as fungicides (Agri-FOS, Fosphite, Reliant, etc.), and are even available through online distributors. The easiest way to use a phosphite product is to make two applications as sprays to wet the bark between the months of May and August, one month apart. General directions for the bark spray are to mix the commercial product with an equal volume of water and to wet the bark from the root flare to 4.5 feet in elevation. Do not include a surfactant, such as PentraBark, as it does not enhance product absorption. To prevent overdosing small trees, wet the bark from the root flare to a height in feet equal to its dbh (diameter at breast height) in inches. For example, a tree with a trunk diameter of four inches would have bark wetted to a height of four feet. It would be impractical to attempt to follow this rule for trees with a trunk diameter greater than 12 inches. So, for larger trees wet the bark up to a convenient height, such as ten feet. Wetting the bark thoroughly to a height of 4.5 feet usually requires 1.5 fluid ounces of spray mixture per inch dbh.

Although it has been reported that this treatment can prevent disease symptoms in as little as one year, we expect that it may take two or three years to build up sufficient concentrations within buds to prevent damage. However, the potassium phosphite treatment is relatively inexpensive, has low risk to the environment, and can protect trees subject to invasion by nematodes from surrounding trees.

Fluopyram-based treatment. A fungicide/nematicide called Broadform has an ornamentals label and 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 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.

(3) 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) can be made between mid-May and late July. Earlier spray timing with this product is best because (1) populations of nematodes are lowest soon after leaf expansion, (2) leaf tissue is still functioning, which can allow

transport of the active ingredient within the leaf to the feeding nematodes, and (3) applications made during the period when nematodes are migrating from leaves to buds are ineffective. One properly timed spray with full spray coverage can be effective.

Thiabendazole-based treatment. A product typically used for systemic treatment of elms and sycamores to prevent fungal diseases has been found to provide at least two years of protection against beech leaf disease. The advantage of this approach is that, as a fully systemic treatment, protection against nematodes feeding and causing damage within buds is possible. The disadvantage of this treatment is that it requires application through trunk injections. Drilling holes into the trunk of a thin-barked tree such as beech to apply systemic products compromises the defenses of the tree against invasion by various microorganisms and fungi that could lead to slime flux or internal decay.

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.