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Bacterial Leaf Scorch of Landscape Trees

Elizabeth A. Bush, Extension Plant Pathologist,
Department of Plant Pathology, Physiology and Weed Science, Virginia Tech

Bacterial leaf scorch is an important and often lethal disease of many landscape trees, particularly in the southern and eastern U.S. In Virginia landscapes it is most often observed on oak, elm, and sycamore; however, many other landscape tree species are susceptible to this disease. The bacterium that causes bacterial leaf scorch colonizes the tree's water-conducting tissue (xylem) where it disrupts water movement and reduces water availability to the tree. The symptoms of bacterial leaf scorch are very similar to symptoms of other problems that limit water uptake. This is why marginal leaf scorch symptoms caused by other problems, such as drought-stress or root disease, are often mistaken for symptoms of bacterial leaf scorch. Laboratory identification of the causal bacterium (*Xylella fastidiosa*) from affected petiole and leaf tissue is necessary for positive confirmation of the disease.

Symptoms

Symptoms of bacterial leaf scorch usually appear in the latter part of summer and progress through the fall. The most characteristic symptom of this disease is marginal leaf scorch. Often a yellow band is evident between brown and green tissue (Figures 1 A and B).

Figures 1 A and B. Characteristic marginal scorch symptoms of bacterial leaf scorch with a band of yellow between brown and green tissue on elm (A) and gingko (B) leaves.

This yellow band is characteristic of bacterial leaf scorch. In contrast, when marginal leaf scorch is caused by other problems (e.g. drought, root disease, salt injury) no yellow band is typically observed between brown and green tissue. However, this symptom is not

always present on bacterial leaf scorch-diseased leaves (Figure 2).

Figure 2. This oak was confirmed positive for bacterial leaf scorch, yet the leaf symptoms are not very characteristic of the disease.

Other symptoms, depending on the host species, include leaf yellowing, browning and premature leaf drop. On many oak species, brown leaves do not drop prematurely; however, on pin oak (*Quercus palustris*) marginal scorch symptoms may not occur, but leaves may drop prematurely. On trees with an indeterminate growth habit, such as elm and sycamore, symptoms on infected branches begin on older leaves and move to younger leaves; on trees with a determinate habit, such as oak, all leaves on a diseased branch are the same age and show symptoms at the same time.

Initial symptoms of bacterial leaf scorch often appear on only one or two branches before gradually spreading to more and more branches in subsequent years (Figure 3).

*Figure 3. A cluster of bacterial leaf scorch affected branches are apparent low on this Camperdown elm (*Ulmus glabra *'Camperdownii') while the rest of the tree appears unaffected by the disease.*

Diseased trees may also leaf out later than normal in the spring and leaves may be stunted. Although this disease is a vascular disease, the vascular tissue does not discolor. The severity of bacterial leaf scorch on an individual tree can vary considerably from year to year and drought can contribute to greater disease severity. Over time, however, trees suffer a gradual decline and loss of vigor as defoliation and dieback continue to occur, and eventually the disease may be lethal.

Disease Cycle

The pathogen that causes bacterial leaf scorch is spread by insect vectors. The primary vectors are leafhoppers called sharpshooters (Figure 4), but other insects, such as spittlebugs, also vector the bacterium.

*Figure 4. This adult glassy-winged sharpshooter (*Homalodisca vitripennis*) is a type of leafhopper and a known vector of* Xylella fastidiosa*. (Image courtesy of Reyes Garcia III, USDA Agricultural Research Service, Bugwood.org.)*

These insect vectors have piercing and sucking mouthparts that allow them to penetrate the tree's water-conducting tissue (xylem) and extract nutrients. An insect acquires the bacterium by feeding on infected plant tissue; subsequently, the insect may spread the bacterium to non-infected hosts while feeding. Once a plant is infected with the bacterium, the disease becomes systemic, since the bacteria move throughout the tree in the tree's water transport system.

Susceptible Tree Species

Many oaks are susceptible to bacterial leaf scorch and oaks in the red oak group are most commonly afflicted with this disease. Elms and sycamore are also relatively common hosts of the disease in Virginia. The disease is also reported on many other tree species, such as maple, hackberry, mulberry, sweet gum, and gingko. (Refer to Table 1 for a list of selected susceptible tree species.)

Table 1. Some trees on which bacterial leaf scorch has been reported. (Note: This list is not exhaustive regarding either species or genera and new hosts of bacterial leaf scorch continue to be identified.)

Acer species	*Acer negundo*	boxelder
	A. rubrum	red maple
	A. saccharinum	silver maple
	A.saccharum	sugar maple
Cornus species*	*Cornus florida*	flowering dogwood
	C.kousa	Kousa dogwood
Platanus species	*Platanus occidentalis*	American sycamore
	P. x *acerifolia*	London planetree
Quercus species	*Quercus alba*	white oak
	Q. bicolor	swamp oak
	Q. coccinia	scarlet oak
	Q. falcata	southern red oak
	Q. imbricaria	shingle oak
	Q. incana	bluejack oak
	Q. laevis	turkey oak
	Q. laurifolia	laurel oak
	Q. macrocarpa	bur oak
	Q. nigra	water oak
	Q. palustris	pin oak
	Q. phellos	willow oak
	Q. prinus	chestnut oak
	Q. rubra	northern red oak
	Q. shumardii	shumard oak
	Q. stellata	post oak
	Q. velutina	black oak
	Q. virginiana	live oak
Ulmus species	*Ulmus americana*	American elm
	U. glabra	wych elm
	U. pumila	Siberian elm
	U. x *hollandica*	Dutch elm
other species	*Celtis occidentalis*	hackberry
	Gingko biloba	gingko
	Liquidambar styraciflua	sweetgum
	Morus rubra	red mulberry

* To date, *Cornus* species have not been diagnosed with bacterial leaf scorch in the Virginia Tech Plant Disease Clinic (http://www.ppws.vt.edu/~clinic).

Some other woody plants that are reported hosts of *X. fastidiosa* include oleander (*Nerium oleander*), peppervine (*Ampelopsis arborea*), beauty berry (*Callicarpa americana*, Virginia creeper (*Parthenocissus quinquefolia*), American elder (*Sambucus canadensis*), southern highbush blueberry (interspecific *Vaccinium corymbosum* hybrids), and grape (*Vitis* species). *X. fastidiosa* is also an economically significant pathogen of several important fruit and nut trees (e.g. almond, citrus, plum, peach, pecan) and many weeds and grasses are hosts to *X. fastidiosa*. Many plant species have also been identified as asymptomatic hosts of *X. fastidiosa.* The host list of this pathogen continues to grow.

Diagnosis

Late summer or early fall are the best times to test for bacterial scorch, since this is when *X. fastidiosa* is most active and bacterial populations in the tree's water conducting tissue are highest. Testing too early in the growing season has sometimes been demonstrated to result in a false negative result. Samples consisting of a dozen symptomatic leaves with the petioles still attached are sufficient for testing for this disease. In the Virginia Tech Plant Disease Clinic (http://www.ppws.vt.edu/~clinic/) an extremely sensitive assay, real-time polymerase chain reaction, is used to test for *X. fastidiosa.* Plant samples for diagnosis may be submitted through your local Virginia Cooperative Extension office (http://www.ext.vt.edu/offices/index.html).

Control

There are currently no curative controls for bacterial leaf scorch. Injection of antibiotics into diseased trees has been shown to slow the spread of the disease, but will not cure the tree. Antibiotic injection is an expensive option and trees must be treated on an ongoing basis. Injection holes are also prone to colonization by wood decay fungi that can negatively impact the health of the tree. Control of leafhoppers and other vectors of *X. fastidiosa* is not effective in preventing spread of bacterial leaf scorch to non-infected trees.

Avoiding stress to trees and maintaining them in optimal health can help trees better withstand the effects of bacterial leaf scorch, resulting in a longer period of time in which they are aesthetically acceptable and survive. Since bacterial leaf scorch progresses gradually over a period of years, this is a reasonable approach to controlling the disease. Providing water to trees during hot, dry periods of the summer and during drought are the most critical tactics to help trees avoid stress. This is particularly important if a tree has been already been diagnosed with bacterial leaf scorch. Mulching trees can also help avoid water stress. Ensuring adequate nutrient uptake by having soil tested by the Virginia Tech Soil Testing Lab (http://www.soiltest.vt.edu/) is also recommended. Soil samples should be submitted through your local Virginia Cooperative Extension office (http://www.ext.vt.edu/offices/index.html). Soil test results will give details on correcting the soil pH if pH is found to be a problem. Inspecting diseased trees on an annual basis to determine the extent of dieback is also recommended, so that pruning and/or removal options may be considered. Pruning out dead wood is recommended: remove branches back to healthy tissue (white or cream-colored in cross-section).

Replacing diseased trees is another option for homeowners and urban landscapers. Trees with extensive dieback are best removed. Choose replacement trees that are not reported hosts of bacterial leaf scorch or other major pests and

that are well-adapted to the location. (New hosts of bacterial leaf scorch continue to be identified, so it is prudent to avoid all species of tree genera on which the disease has been reported.) Some trees to consider as replacements include: European black alder (*Alnus glutinosa*), European beech (*Fagus sylvatica*), black gum (*Nyssa sylvatica*), yellow buckeye (*Aesculus flava*), northern catalpa (*Catalpa speciosa*), katsuratree (*Cercidophyllum japonicum*), Kentucky coffeetree (*Gymnocladus dioicus*)**, American linden (*Tilia americana),* littleleaf linden (*T. cordata*), silver linden (*T. tomentosa*), cucumbertree *(Magnolia acuminata*), Osage orange (*Maclura pomifera*)**, tulip poplar (*Liriodendron tulipifera*), and Japanese zelkova *(Zelkova serrata)*. Refer to the Virginia Cooperative Extension fact sheet: Problem-free Trees for Virginia Landscapes (publication #450-237) [http://www.pubs.ext.vt.edu/450/450-237/450-237.html] for recommendations on relatively trouble-free trees for Virginia landscapes.

**Purchasing fruitless male cultivars of these species may be desirable, since the fruits may be a nuisance.

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