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Bacterial Leaf Scorch of Landscape Trees

A newly described bacterium has been added to the host of factors that plague and weaken landscape trees. The bacterium *Xylella fastidiosa*, which clogs the water-conducting xylem cells, is associated with a leaf scorch of at least five tree species. Environmental factors such as drought, excessive salt, or root damage have long been known to cause leaf scorch. Not until 1978, however, were scientists able to culture *X. fastidiosa* and prove that this unique plant pathogen also causes leaf scorch.

Although the effects of the pathogen on a wide range of plants were known for some years, the connection with landscape trees is recent. This bulletin describes the symptoms for five trees: elm, oak, sycamore, mulberry, and maple. Familiarity with the distinctive symptoms illustrated here should assist in accurately diagnosing this widespread tree disease.

Bacterial leaf scorch affecting a young American elm on the National Mall

ELM

Leaf scorch symptoms begin to develop in mid- to late June and increase in severity through summer and early fall. Scorch appears as an irregular scalloped browning along the leaf margin bordered by a yellow halo. As browning spreads toward the midvein, leaves may curl and drop early. Symptom severity progresses from older to younger leaves on a branch; newest leaves at the tip sometimes remain unaffected. Symptoms recur each year and spread over the tree's crown. Reduction in growth and dieback are common in severely affected trees.

Bacterial leaf scorch can be confused with Dutch elm disease caused by the vascular wilt fungus *Ophiostoma ulmi,* but there are distinct differences. Dutch elm disease is usually noticed in early summer, while bacterial leaf scorch symptoms appear later. Dutch elm disease causes a true wilt, with leaves becoming flaccid or drooping before losing color and dying, while bacterial leaf scorch causes leaf browning, not wilt. Also, one characteristic of Dutch elm disease, brown streaking of the sap wood, does not occur with bacterial leaf scorch. Most significantly, Dutch elm disease is an acute disorder that usually kills a tree in one or two years. By

Elm leaf margins exhibit browning and yellow halo

contrast, bacterial leaf scorch causes slow decline over may years. Elms infected with *Xylella,* however, are weakened and therefore more attractive to bark beetles that transmit *O. ulmi*. Bacterial leaf scorch may therefore increase the probability of an elm contracting Dutch elm disease.

OAK

Bacterial leaf scorch affect several species in the red and black oak group including northern red oak, *Quercus rubra;* pin oak, *Q. palustirs;* scarlet oak, *Q. coccinea;* southern red oak, *Q. falcata;* laurel oak, *Q. laurifolia;* shingle oak, *Q. imbricaria;* and the water oak, *Q. nigra*. In midsummer leaves start to die along the edges. The leaf margin is usually composed of alternating reddish and light brown tissue. The leading edge (red-brown) shows a pale halo next to green tissues.

All leaves of this oak branch show disease symptoms

Because of the determinate growth pattern of oaks, all leaves on a branch share the same age and thus are affected at the same time in contrast to the symptoms in elm and sycamore. Each year, as is typical of chronic infections, leaf scorch, dieback, and crown reduction affect more of the tree. Severely scorched leaves commonly drop off early. Leaf scorch symptoms are obvious when a single limb is affected in an otherwise healthy oak, but in trees whose crowns are extensively affected, leaf scorch may be mistaken for stress.

Bacterial leaf scorch may be mistakenly attributed to oak wilt caused by the fungus *Ceratocystis fagacearum* but, like Dutch elm disease, oak wilt results in distinctive vascular streaking and rapid death of the tree.

Dying area of sycamore leaf is tan, edged by red-brown

Sycamore branch with older leaves affected leaves

SYCAMORE

Symptoms appear in midsummer with leaves developing an olive drab discoloration that soon turns brown. Discoloration occurs along the leaf margin and between the veins. The leading edge of the dead tissue is often dark red-brown. As in elm, leaf scorch symptoms progress from older to younger leaves, with leaves at the tips of branches often remaining symptom-free. Scorched leaves curl upwards but stay attached.

Dieback marks final stage of severely affected sycamore

Symptoms appear first in a single branch or limb and spread throughout the canopy in later years. Affected trees linger for many years, developing a general decline characterized by progressive dieback, likely promoted by secondary factors.

Sometimes bacterial leaf scorch is misdiagnosed as sycamore anthracnose caused by the fungus *Apiognomonia veneta*. Anthracnose primarily affects new leaves in cool wet springs, whereas bacterial leaf scorch symptoms appear in midsummer.

MULBERRY and MAPLE

Mulberries are often affected but are not so severely debilitated by bacterial leaf scorch. In some cases, leaves dry up with only a slight change in color before curling upward. In other cases, leaf margins turn brown and have a distinctive yellow halo between dead and green tissue. As in elm and sycamore, symptoms progress from older to younger leaves. Leaves may fall early, leaving bare branches with tufts of green leaves at the tips.

Leaf scorch associated with *X. fastidiosa* has been observed in red maple. Maple leaves develop an irregular pattern of light and reddish brown tissue separated from green tissue by a yellow halo. Symptoms contrast sharply with the uniform marginal browning caused by drought and commonly seen in curbside plantings. As with other species, there is an annual progression of the symptoms of bacterial leaf scorch in the tree canopy.

Red maple leaf showing irregular pattern of light and reddish-brown tissue with yellow halo

DIAGNOSIS

Bacterial leaf scorch has been observed most often in the mid-Atlantic and southeastern states. However, oak leaf scorch has been seen as far north as New York; affected sycamores are common in Texas; and diseased mulberries have been seen as far west as Nebraska. These observations refer to managed landscapes- planted areas, park lands, or urban landscaping.

Once bacterial leaf scorch has been confirmed in a locale, the diagnosis can usually be based on symptoms alone. Note, however, that symptoms can be confused with other diseases, and infected trees may be suffering from other problems that mask the presence of *X. fastidiosa*. In some cases the bacterium's presence must be confirmed. The species name *"fastidiosa"* refers to the bacterium's exacting growth requirements. Because of its fastidious nature, confirming infections of trees by isolating the bacterium is difficult. A serological test has been developed to aid diagnosis. The test is an enzyme-linked immunosorbent assay (ELISA) called 'PATHOSCREEN Xf' (Agdia Inc., Elkhart, IN). Tissue samples of leaves, buds, and stems may be sent directly to the Agdia laboratory for analysis; or the test kit can be purchased from Agdia and used by diagnosticians.

TRANSMISSION

The bacterium has a wide host range including grasses and broad-leaved plants in some 30 families. Many infected plants show few symptoms. However, in addition to leaf scorch of landscape trees, *X. fastidiosa* causes several diseases that have economic consequences: Pierce's disease of grape, phony disease of peach, almond leaf scorch, plum leaf scald, and alfalfa dwarf. Xylem-feeding sharpshooter leafhoppers (*Cicadillinae*) and spittle bugs (*Cercopidae*) are known transmitters for these diseases. Insect transmission is just now being studied in landscape trees, but the same vectors are probably responsible. Also, since several vascular fungal pathogens are transmitted in elm and oak by root grafts, it is possible that *X. fastidiosa* can be transmitted by root grafts.

MANAGEMENT

Bacterial leaf scorch of landscape trees caused by *X. fastidiosa* is not a new disease but simply one that has been misdiagnosed or overlooked. Now that researchers recognize the disease and the pathogen that causes it, methods of prevention and treatment are being studied. Experimental antibiotic injections to the xylem have resulted in symptom remission, but no cure. Currently, there are no antibiotics or bactericides commercially available to treat bacterial leaf scorch. Management of insect vectors is not practical since leafhoppers are active throughout the growing season.

Pruning therapy is only now being tested. As with Dutch elm disease, surgical removal of an infected limb well below the last scorched leaf may cure early infections; however, surgery cannot benefit trees with widespread infection. Extra care to fertilize and irrigate may prolong the life of an infected tree, but trees with extensive leaf scorch and dieback should be removed.

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