Dogwood powdery mildew

Thousand cankers

Sudden oak death

Diseases of Kentucky Native Plants

Bacterial leaf scorch

Dogwood anthracnose

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U.K. Plant Pathology

Boxwood blight

Laurel wilt

Wild Ones November 1, 2012

Dogwood Anthracnose

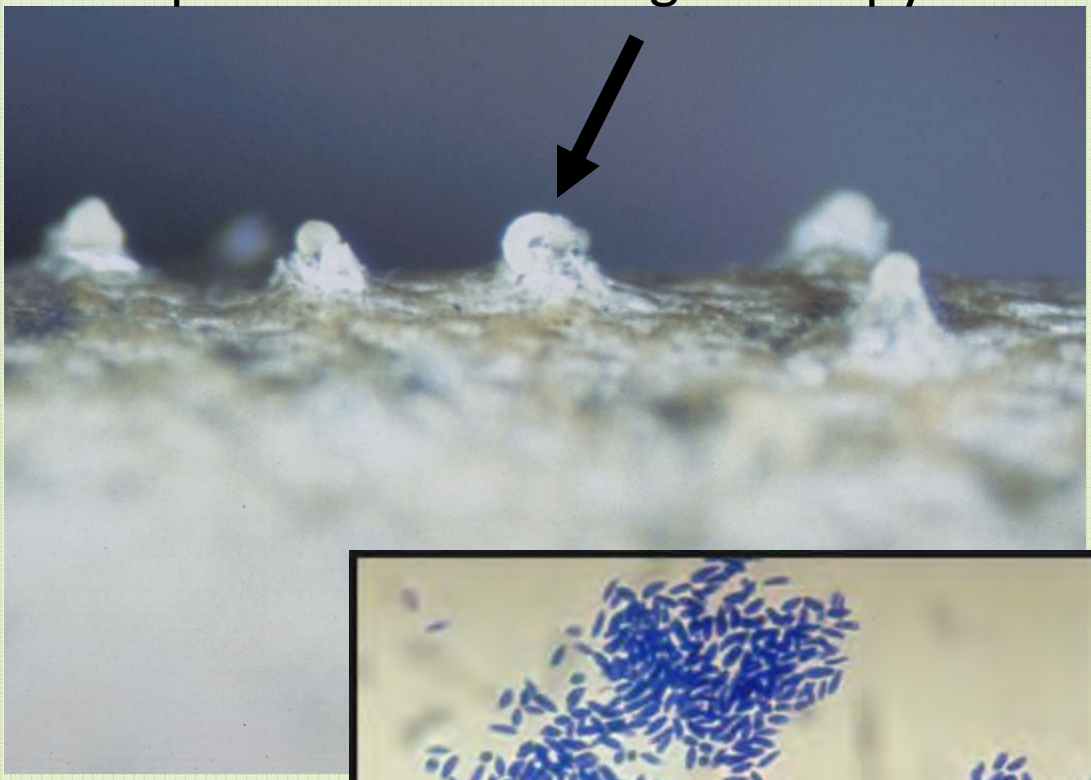
This disease, also called lower branch dieback is caused by the fungus *Discula destructiva*.

Dogwood Anthracnose

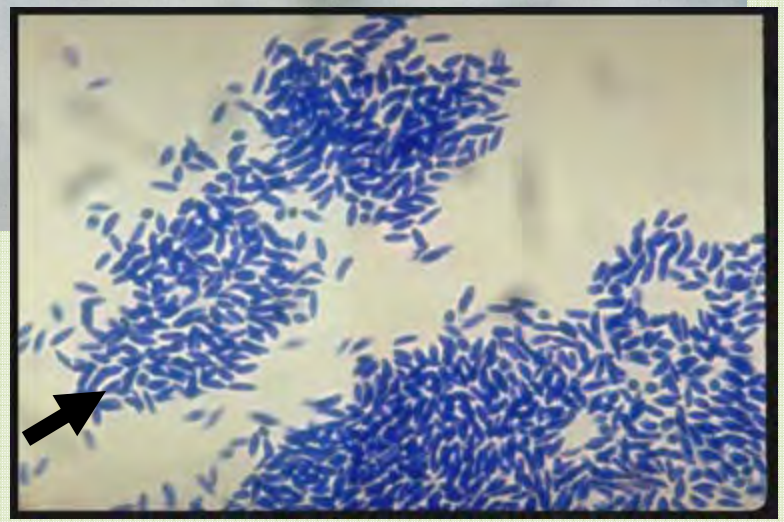
Canker

Magnified view of fruiting bodies of the dogwood anthracnose fungus

Spore masses oozing out of pycnidia



Microscopic view of fungal spores



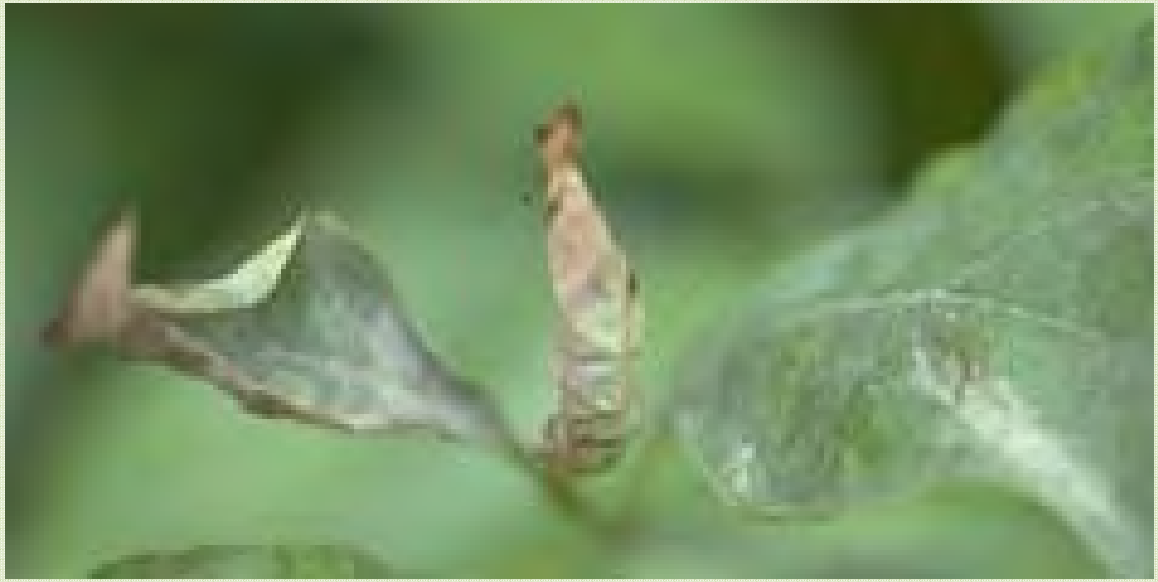
Dogwood anthracnose has devastated flowering dogwood (*Cornus florida*) in eastern forests, especially at higher elevations. Surveys of dogwoods in the Great Smoky Mountains indicate losses amounting to millions of trees.

Lower branch dieback.

Looking for a dogwood replacement, the plant industry imported many Asian trees such as Kousa dogwood (right).

Dogwood Powdery Mildew

Caused by Erisyphe pulchra (fungus)



Dogwood Powdery Mildew

In both photos, dogwood resistant (left) and not resistant (right) to powdery mildew.

Dogwood Powdery Mildew

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Thousand Cankers Disease of Walnut

Walnut Twig Beetle *Pityophthorous juglandis*

Fungus – *Geosmithia morbida*

“Death by a Thousand Cankers….” Or…. “Nightmare on Walnut Street.”

Coalescing cankers in the phloem and then in the cambium kills the walnut trees.


June 2008


September 2008


June 2009

Thousand Cankers Disease in Knoxville, TN

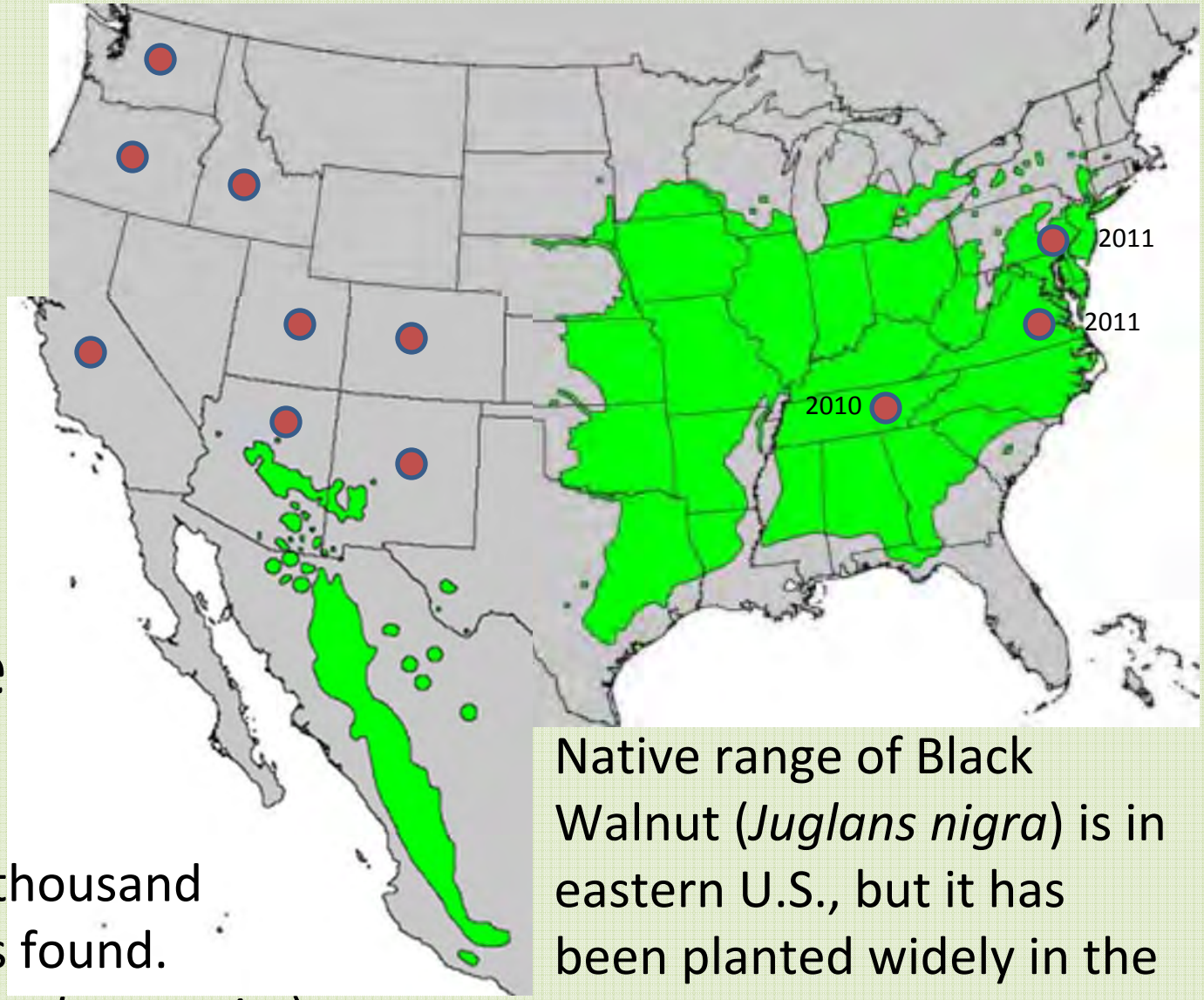
In Knoxville, the disease was discovered on urban walnut trees. Note epicormic shoots developing on trees with dieback symptoms.

Shallow cuts into the phloem reveal insect galleries (above). Fungal cankers result in staining of the cambium (left).

Healthy-appearing tree had cankers

When symptoms of twig dieback are first observed in a black walnut, it could mean that the insect and fungus have been in the area for 5-10 years.

Walnut Growing Areas and How the Beetle and Fungus Might Have Moved



- States where thousand cankers disease is found.

Arizona walnut (*Juglans major*) is resistant, but harbors the beetle and fungus.

Native range of Black Walnut (*Juglans nigra*) is in eastern U.S., but it has been planted widely in the west. Native range of Arizona walnut is in the U.S. southwest and in Mexico

Prevent the movement of infected wood to new areas.

Thousand Cankers Disease is bad news!

Thousand Cankers Photos by Whitney Cranshaw and Ned Tisserat, Colorado State University, and Dale Starkey, USDA Forest Service, Pineville, LA

Some Causes of Native Plant Diseases

- Fungi

  Root rots, stem cankers, leaf spots, blight, rust, powdery mildew, downy mildew

- Viruses

  Mosaic, rosette

- Bacteria and phytoplasma

  Galls, leaf spots, wilt, distortion

- Nematodes

  Foliar lesions, root knots and galls, wilt

Some Septoria leaf spot suscepts

Anemone quinquefolia; wood anemone
Aster macrophyllus; bigleaf aster
Cardamine douglassii; purple spring cress
Collinsia verna; blue-eyed mary
Cornus canadensis; bunchberry
Dentaria laciniata; cutleaf toothwort
Eryngium yuccafolium; rattlesnake master
Hepatica acutiloba; sharp-leaved hepatica
Lobelia cardinalis; cardinal flower
Mitella diphylla; bishops cap
Panax quinquefolia; American ginseng
Plox stolonifera; creeping phlox
Podophyllum peltatum; mayapple
Rudbeckia hirta; black-eyed susan
R. triloba; brown-eyed susan
Silene virginica; fire pink

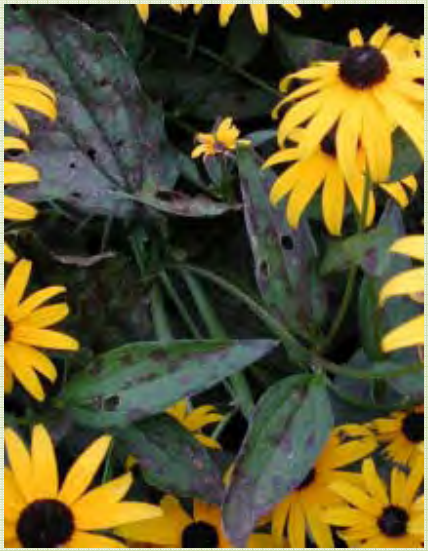
Dentaria lacinata

Images courtesy of USDA Plants Database and Thomas Barnes

Silene virginica

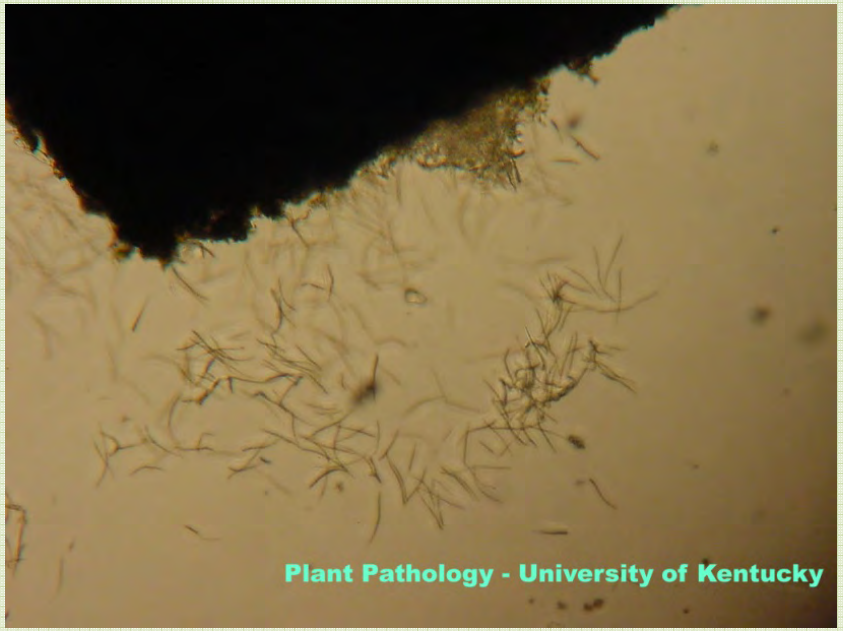
Collinsia verna

Mitella diphylla



Jana Beckerman & Karen Rane photos

Rudbeckia - Septoria leaf spot and blight



Some Powdery Mildew suscepts

Anemonella thalictroides; rue anemone
Asclepias tuberosum; butterfly weed
Aster macrophyllus; bigleaf aster
Delphinium tricorne; dwarf larkspur
Epigaea repens; trailing arbutus
Mertensia virginicus; Virginia bluebell
Parthinocissus quinquefolia; Virginia creeper
Phlox stolonifera; creeping phlox
Rudbeckia hirta; black-eyed susan
R. triloba; brown-eyed susan
Vaccinium vitis-idaea; lingenberry
Viola spp.; white, blue violiets

Epigaea repens

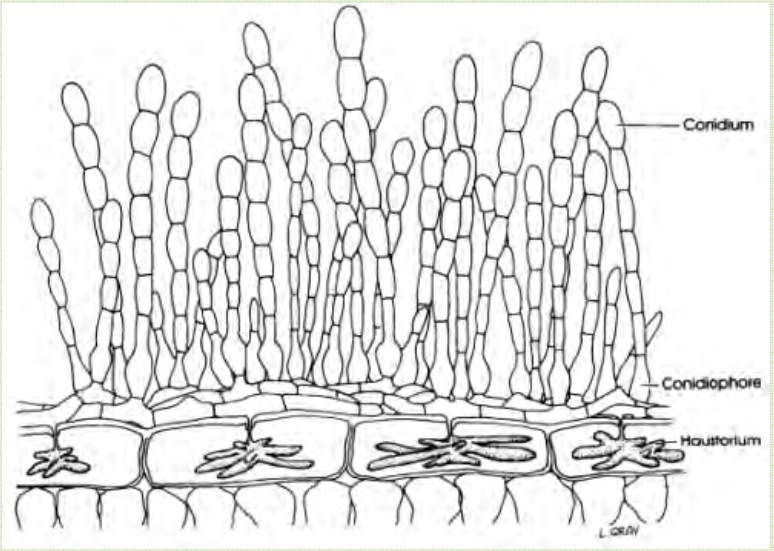
Images courtesy of USDA Plants Database and Thomas Barnes

Mertensia virginicus

Asclepias tuberosum

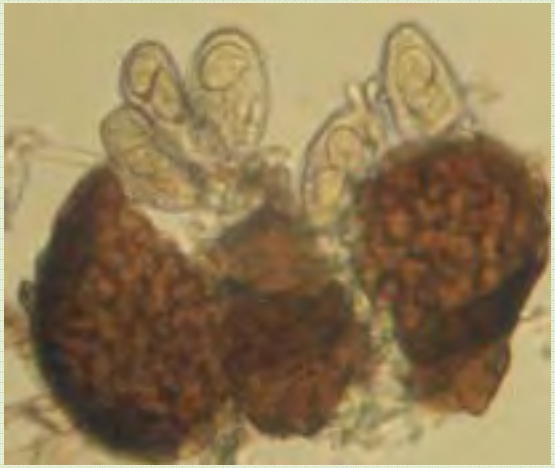
Aster macrophyllus

Rudbeckia – Powdery Mildew



University of Illinois images

Powdery mildew Oidium stage (top) and cleistothecia with ascospores (below)



Some Downy Mildew suscepts

Anemone quinquefolia; wood anemone
Cardamine douglassii; purple spring cress
Claytonia virginica; spring beauty
Dentaria lacinata; cutleaf toothwort
Hepatica acutiloba; sharp-leaved hepatica
Mertensia virginicus; Virginia bluebell
Parthenocissus quinquefolia; Virginia creeper
Rudbeckia hirta; blackeyed Susan
R. triloba; browneyed Susan

Cardamine douglassii

Claytonia virginica

Hepatica acutiloba

Parthenocissus quinquefolia

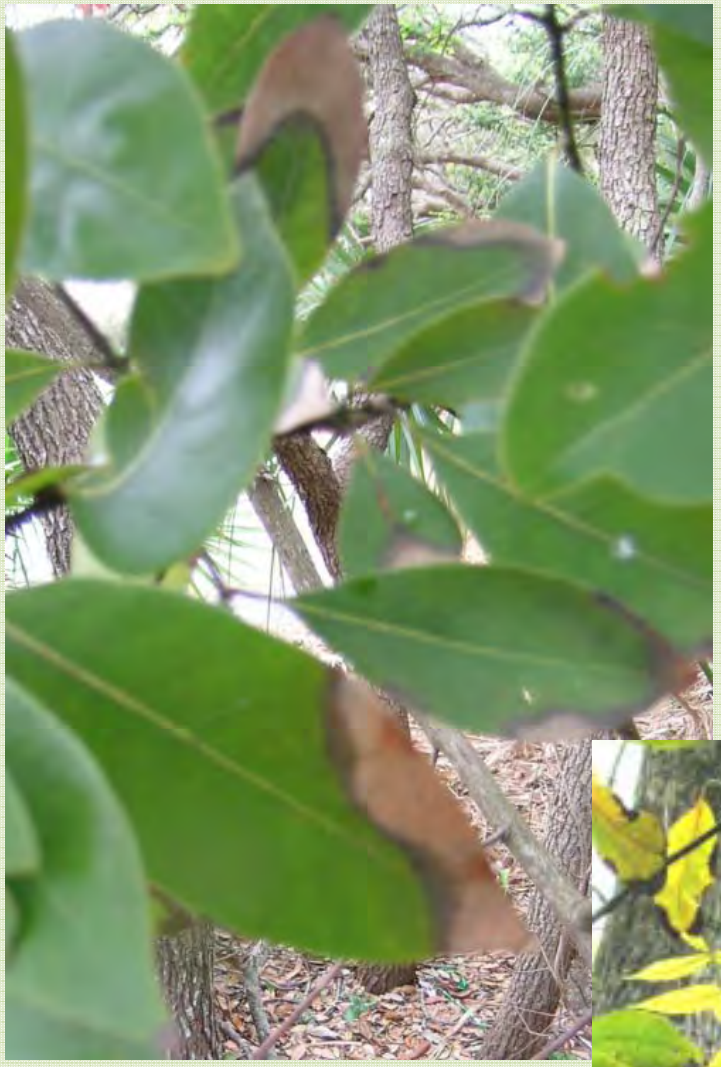
Images courtesy of USDA Plants Database and Thomas Barnes

Coreopsis - Downy Mildew

Plasmopara downy mildew sporangia, sporangiophores (left and below)

Laurel Wilt, A New Disease of Plants in the Lauraceae Family

- Lauraceae family includes Kentucky natives Sassafrass and spice bush.
- Laurel wilt is caused by the fungus *Raffaelea lauricola.*
- *The disease is v*ectored by the introduced redbay ambrosia beetle, *Xyleborus glabratus* which has been present in the U.S. for about 10 years.
- Laurel wilt is in the southeastern U.S. (FL, GA, SC, and MS) but the Kentucky hosts also occur there.
- The following photos are of diseased Redbay (*Persea borbonia*) in Florida.



Scorch symptoms can be an early indication of Redbay wilt.

Laurel wilt in Redbay may begin with shoot dieback. The causal fungus is related to the Dutch Elm Disease fungus.

Shoot dieback symptoms.

Redbay wilt in progress (left).
Redbay wilt in a park/nature preserve (right).

Dead redbay trees in a Jacksonville residential area.

Ambrosia beetles leave toothpick-like frass on the tree trunk.

Sudden Oak Death

Will SOD come to the Kentucky? Searching for *Phytophthora ramorum.*

Marin County Fire Department aerial photos

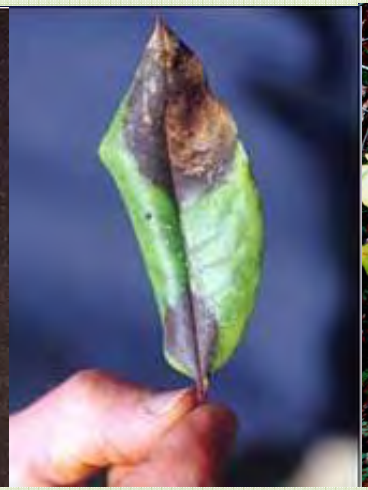
Sudden Oak Death

Three Symptoms of *P. ramorum* Infection

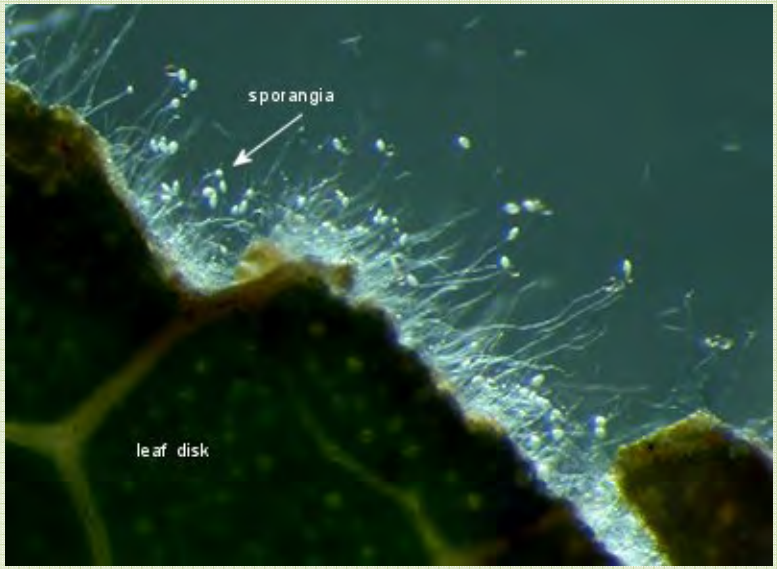
Bleeding cankers (ramorum canker)

Dieback (ramorum dieback)

Foliar blight (ramorum leaf blight)



Phytophthora ramorum



Photomicrographs: Jennifer Parke, Oregon State University

Moist weather induces sporulation which occurs after 9-12 hours leaf wetness at 18-22˚C.

Phytophthora ramorum infection on the leaves of California bay laurel (*Umbellularia californica*) drives the oak epidemic.

Photo credits on previous page: J. O'Brien, USFS; P. Shea, USFS; M. Garbolotto, Univ. of Calif.; Oregon Dept. of Agric.; BBA, Germany; S. Tjosvold, Univ. of Calif.; and www.suddenoakdeath.org.

Partial Host List – over 60 species from at least 12 plant families and still growing

Toyon

Tanoak

Douglas fir

Coast and Canyon live oak

California black oak

Shreve oak

Southern and Northern red oak

Pin oak

European Turkey Oak

Holm Oak

Coast redwood

Grand fir

California buckeye

Horse-chestnut

Sweet chestnut

European beech

Hazelnut

Coffeeberry

Bigleaf maple

Camellia

Witch hazel

Honeysuckle

Rhododendron & azalea

Blueberry

California bay laurel

Huckleberry

Viburnum

Mountain laurel

Lilac

Yew

Poison oak

Pieris

California wood fern

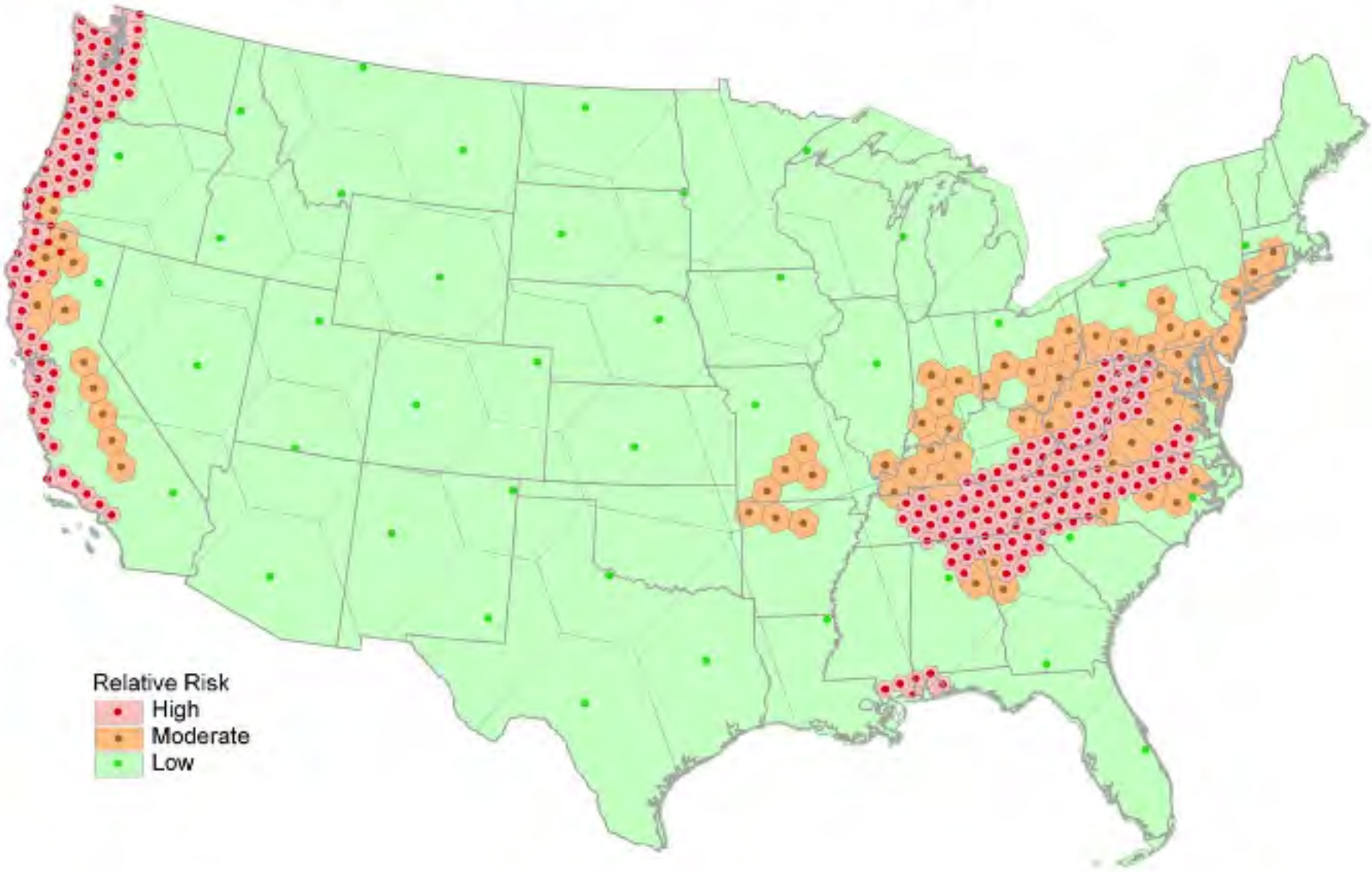
Victorian box

Scotch heather

Wood rose

Underlined hosts grow in Kentucky

Preliminary SOD Risk/Hazard Map



Prepared by John Kliejunas; USDA Forest Service

WDS/10Oct02

Return to FHM home

Microenvironment in nurseries favors disease

Mike Benson, NCSU

States with nurseries positive for *P. ramorum* in 2004

- Nationally, over 3000 nurseries / garden centers have been surveyed and over 50,000 samples have been taken.

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The Disease Triangle Disease development requires favorable environmental conditions, a susceptible host plant, and the presence of a virulent pathogen

Bacterial Leaf Scorch Disease

From a distance, pin oak trees turn yellow to brown beginning in late July or early August.

The next year, affected trees leaf out normally in spring and are green until turning brown prematurely in late summer.

Bacterial leaf scorch is caused by *Xylella fastidiosa*, a xylem-inhabiting bacterium vectored by insects.

Brown pin oak in late summer and another pin oak defoliated by late September while adjacent trees are still green. Infected trees are not dead.

Pin Oak in late spring approx. 10 and 12 years after infection.

After several years, the annual scorch and premature defoliation takes its toll and trees begin to decline, progressively showing twig, branch and limb dieback.

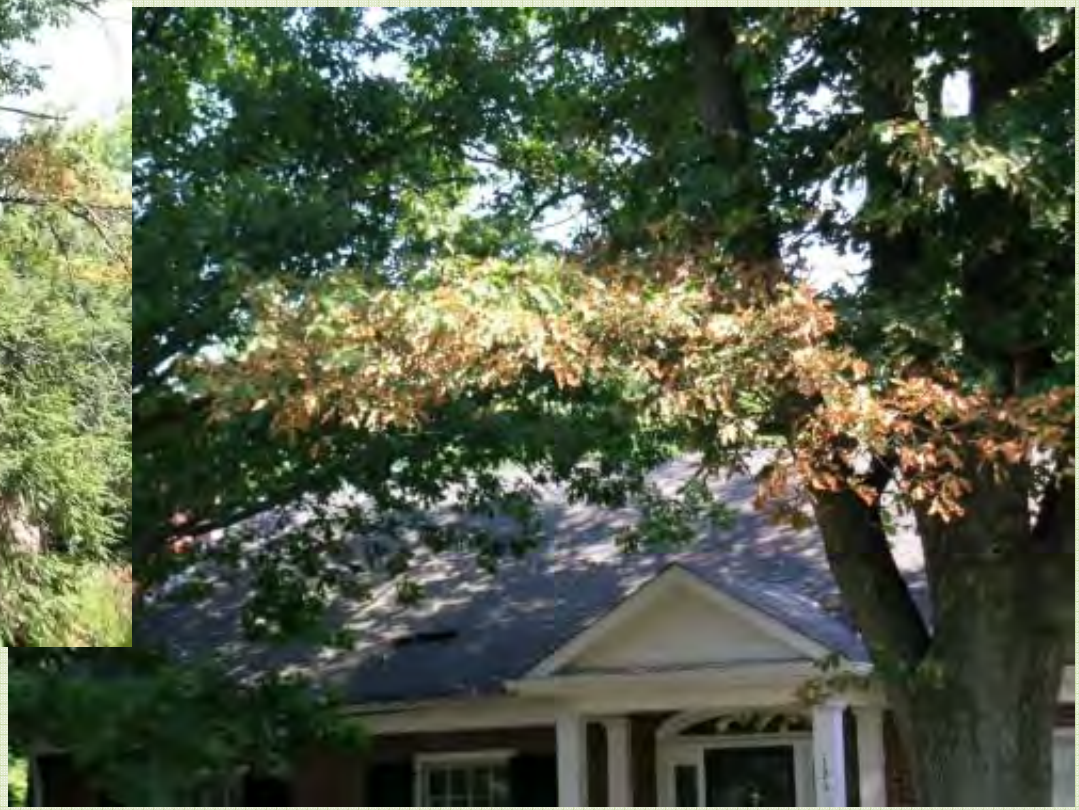
Bacterial leaf scorch can devastate trees in the community. Five trees were lost all in one year.

Note the five stumps or stump grinding piles (right).

Bacterial leaf scorch may begin with a single infected leaf.

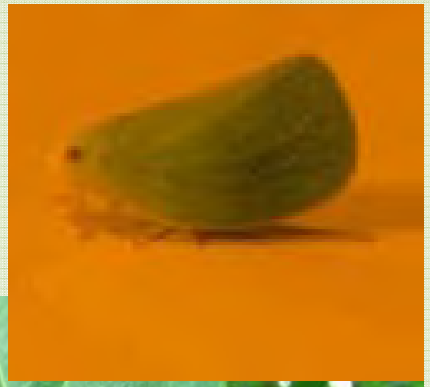
Scorched oak leaf (above). If the bacteria move from the leaf into the twig, tree will become systemically infected. Scorched leaves on an infected branch (left).

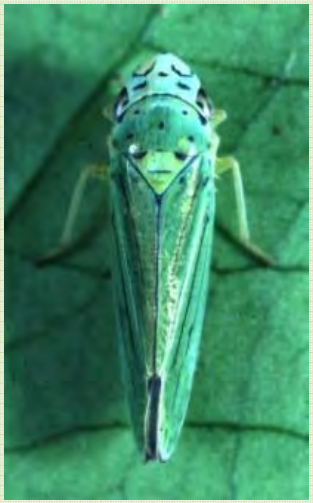
Red oak with bacterial leaf scorch-affected branches all on one side of the tree.



Bacterial leaf scorch

Bacterial leaf scorch vectors include xylem-feeding leafhoppers (sharpshooters), treehoppers, and spittlebugs.

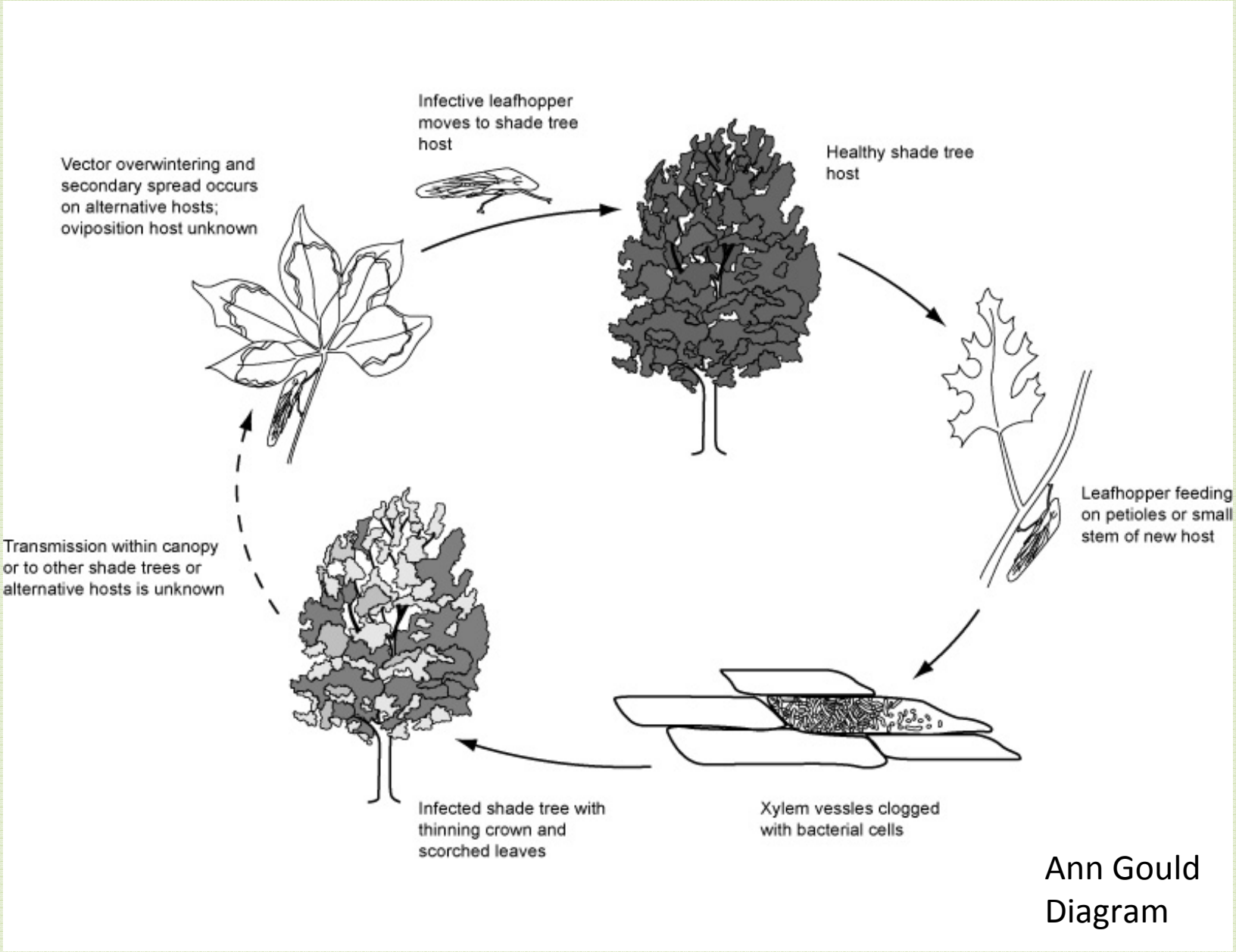




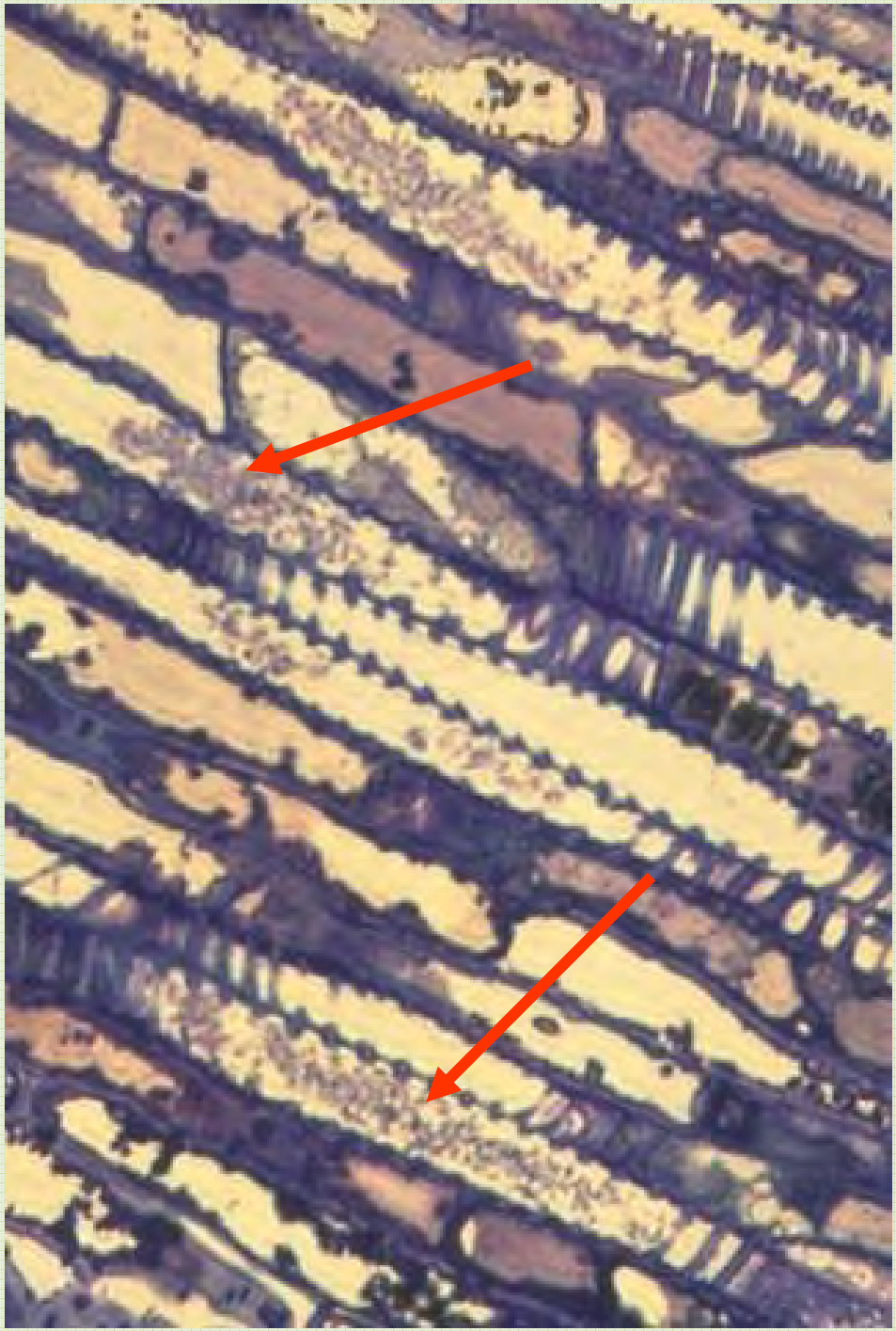
Blue-green and glassy-winged sharpshooters (above) photos courtesy of R. Bessin.

Treehopper on filbert (above) and close-up inset).

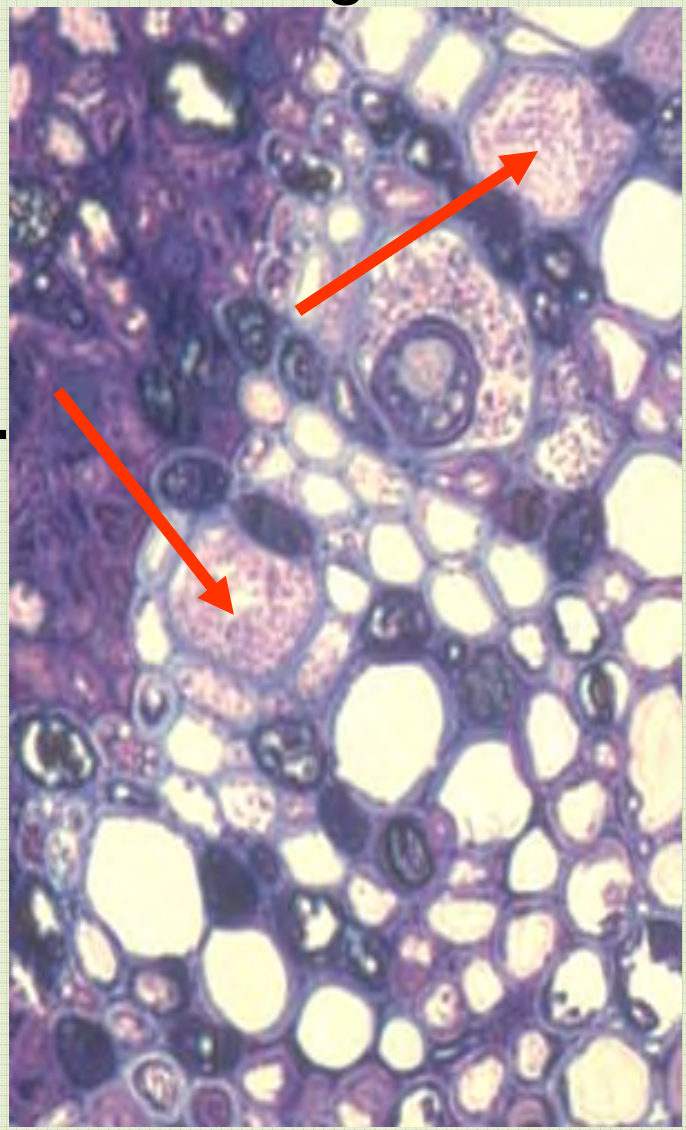
Spittlebug photos (right) courtesy of LSU Entomology.



Bacterial leaf scorch disease cycle.

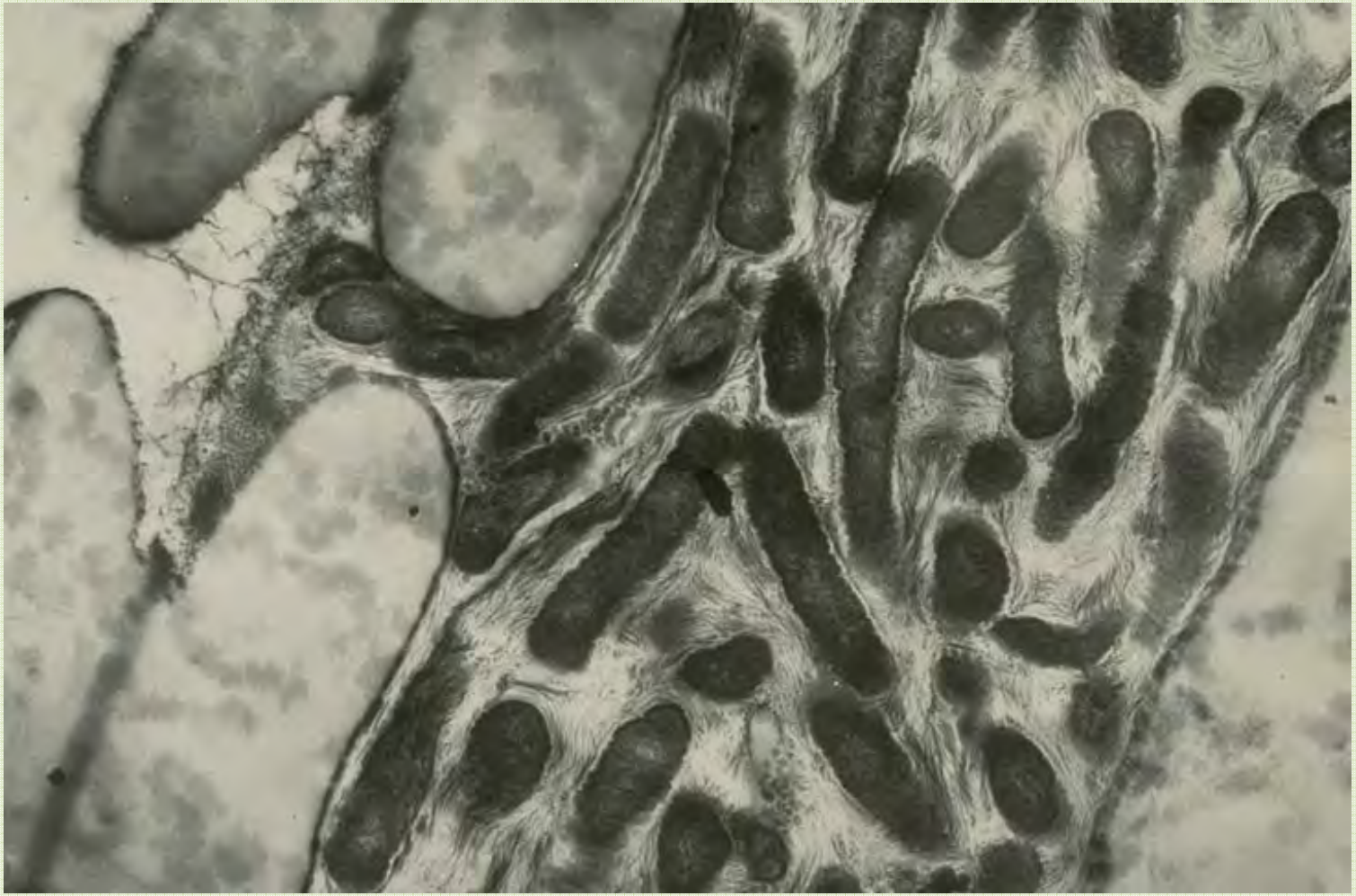


Oak leaf petiole sections: longitudinal (left) and cross (right). Bacteria grow in some, but not all xylem vessels.



Ulla Jarlfors photos

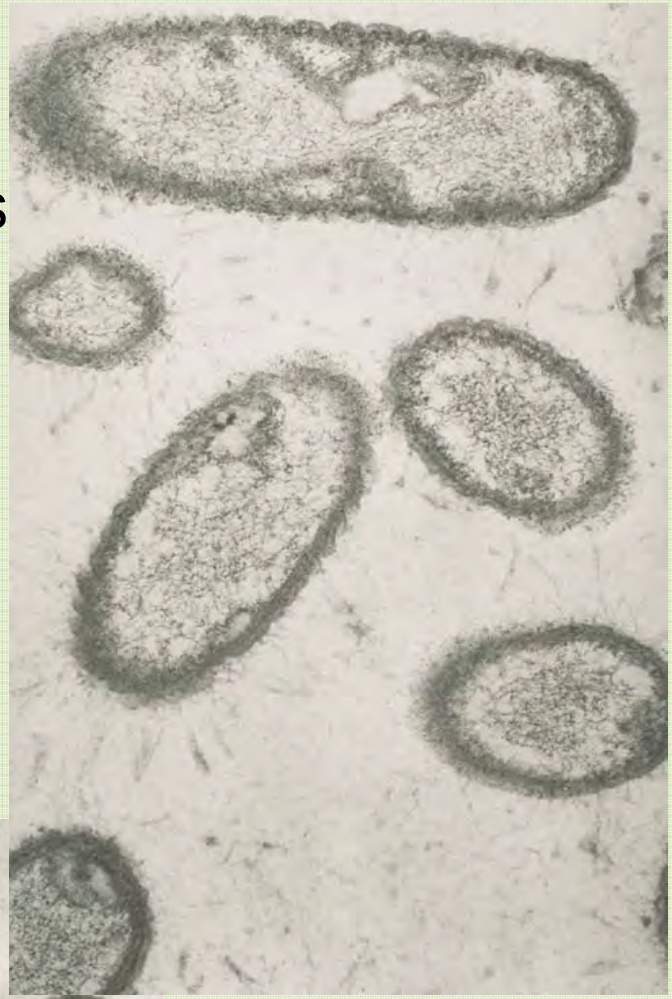
Xylella fastidiosa in oak leaf petiole xylem vessel and bordered pit. Pit membrane has blocked movement of bacteria to the adjacent vessel.



Ulla Jarlfors photo

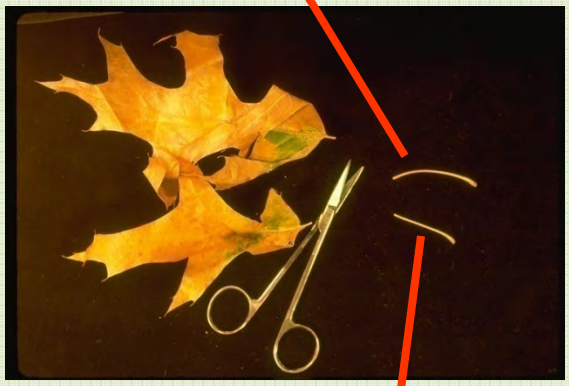
In an oak leaf petiole, electron micrographs of *Xylella fastidiosa*, showing typical rippled or undulating cell wall. This feature is unique among plant pathogenic bacteria.

Xylella fastidiosa in oak leaf petiole xylem vessel showing pili, or fimbriae thought to be involved in twitching motility (right).



Ulla Jarlfors photos

Xylella fastidiosa dividing in oak leaf petiole xylem (left).



Detecting *Xylella fastidiosa* using an ELISA test (positive reaction shows orange-yellow color, above). Leaf petioles are first macerated manually or with power tools in a buffer solution to release bacterial cell proteins that give the color reaction with test kit reagents.

To confirm ELISA results, real-time PCR is used with Schaad's ITS probe to get a match with DNA of *Xylella.* This test detects all subspecies of *Xylella*.

To determine if our bacterial leaf scorch cases are all associated with the same sub-species, additional tests done in 2007 indicated that bacterial leaf scorch in Kentucky shade trees is caused by the sub-species *multiplex*.

Xylella fastidiosa can be detected using real-time PCR.

Kentucky Oaks with bacterial leaf scorch

Bur Oak (EM), English Oak (PCR), Pin Oak (EM, PCR), and Northern Red Oak (PCR)

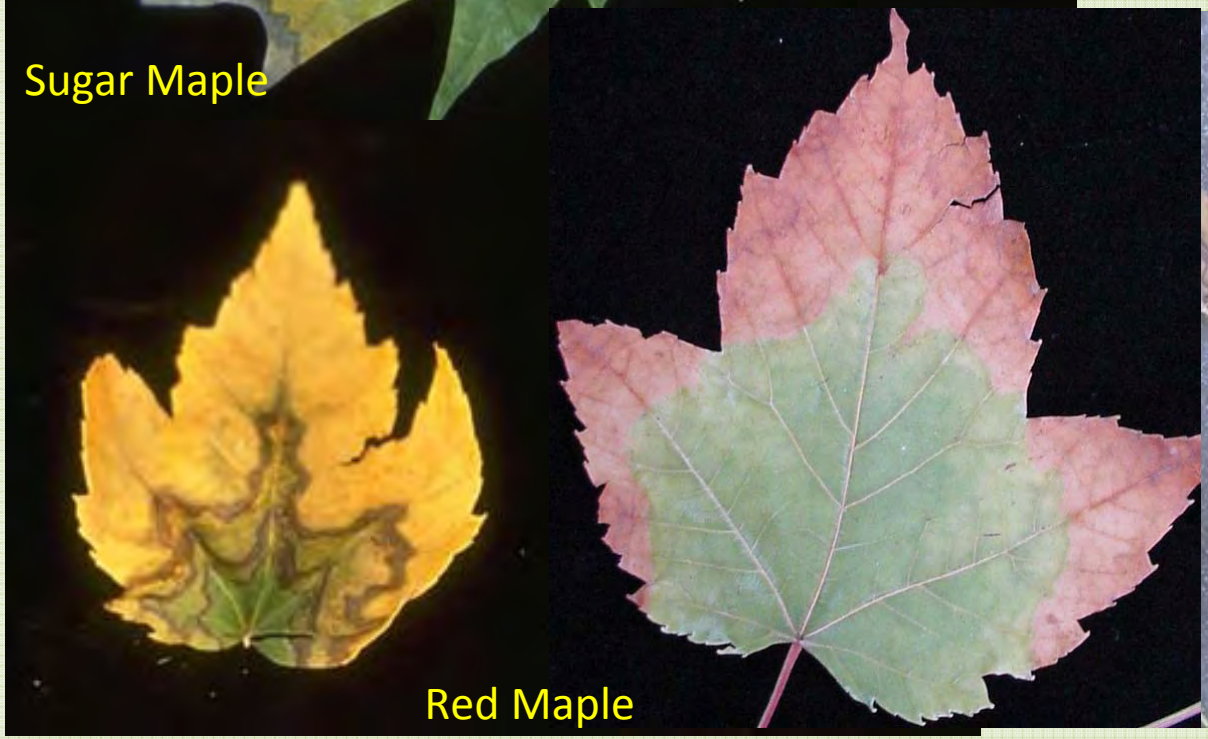
Kentucky Oaks with bacterial leaf scorch

Scarlet Oak (PCR), Shingle Oak, and White Oak; also Swamp Chestnut oak (not pictured).

In Kentucky, oaks are widely planted in the urban forest, so oaks are the most devastated.

In Kentucky, *Xylella fastidiosa* is associated with bacterial leaf scorch of Sugar (EM, PCR), Red (PCR), Norway, and Silver Maples.

Sugar Maple



Red Maple

Silver Maple

Other Kentucky trees susceptible to bacterial leaf scorch:

Sweetgum (EM), Sycamore (EM, PCR), London Plane, and Elm.

American Elm

James Sherald Photo

Bacterial Leaf Scorch in the Field

Sugar maple and sycamore

Bacterial leaf scorch is also found on Hackberry (PCR), Mulberry, and Box elder (PCR) in Kentucky.

Additional *X. fastidiosa* PCR positive hosts include Saucer Magnolia, Ash, Stephanandra, and Ginkgo. Also Paulownia (not shown).

ELISA and PCR-positive hosts

Variegated Kerria

Clematis

Sweet Woodruff

Joe-Pye Weed

Other shade trees reported as hosts

Oaks, including:

- Black
- Bluejack
- Chestnut
- Laurel
- Live
- Post
- Shumard
- Southern Red
- Swamp
- Swamp Chestnut
- Turkey
- Water
- Willow

Other trees:

- Silk tree
- Chitalpa
- Western redbud
- Flowering dogwood
- Japanese beech
- Jacaranda
- Southern Magnolia
- Walnut
- Olive
- Senegal Date Palm
- Ornamental Plum
- Siberian Elm

Large trees not yet affected by bacterial leaf scorch.

Alder. European black alder, *Alnus glutinosa*, and cultivars.

Ash. Blue Ash, *Fraxinus quadrangulata*; green ash, *F. pennsylvanica*, and cvs.

Beech. European beech, *Fagus sylvatica*, and cultivars.

Black gum. Tupelo, *Nyssa sylvatica*.

Buckeye. Yellow buckeye, *Aesculus flava*.

Catalpa. Northern catalpa, *Catalpa speciosa*.

Cork tree. Amur cork tree, *Phellodendron amurense*, and fruitless male cultivars.

Elm. Lacebark, or Chinese elm, U. parvifolia.

Hackberry. Sugar hackberry, *Celtis laevigata*

Hickory. Shagbark hickory, *Carya ovata*; shellbark hickory, *C. laciniosa*; and pignut hickory, *C. glabra*.

Katsura. Katsuratree, *Cercidophyllum japonicum*.

Kentucky Coffeetree. *Gymnocladus dioicus*, and fruitless male cultivars.

Large trees not not yet affected by bacterial leaf scorch (cont.)

Linden. American linden, *Tilia americana*; littleleaf linden, *T. cordata*.

Magnolia. Cucumbertree, *Magnolia acuminata*.

Maple. Black maple, *Acer saccharum* subsp. *nigrum*. The disease has not been detected on black maple, but because it occurs on other maples in Kentucky makes this choice risky.

Oak. Chinkapin oak, *Q. muehlenbergii*; and sawtooth oak, *Q. acutissima*; have not been seen with bacterial leaf scorch. However, the fact that it occurs on many other oaks in Kentucky would make any of these risky choices.

Osage Orange. *Maclura pomifera*, and fruitless male cultivars.

Sassafras. *Sassafras albidum*.

Tulip poplar. Tuliptree, *Liriodendron tulipifera*.

Zelkova. Japanese zelkova, *Zelkova serrata*, and cultivars.

New Boxwood Disease "Boxwood blight"

Discovered in October 2011 in North Carolina, Virginia, and Connecticut

The causal fungus is *Cylindrocladium pseudonaviculatum* (*C. buxicola*)

Images - Landis Lacey and Kelly Ivors, NCSU, Dept of Plant Pathology

Boxwood blight may begin as a leaf spot

Recently, Pachysandra has been found with boxwood blight (right)

In the cases of laurel wilt, boxwood blight, and other diseases that are still far away from our landscapes, or only affect a few unimportant plants, are concerns about these new diseases overblown?

Questions?

Educational programs of the Kentucky Cooperative Extension Service serve all people regardless of race, color, age, sex, disability, or national origin.

John Hartman

Extension Plant Pathologist Emeritus

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