Management of Insect-Vectored Diseases

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A number of insect species that attack landscape plants are capable of vectoring diseases. Insect-vectored diseases include: aster yellows, ash yellows, oak wilt, Dutch elm disease, and elm phloem necrosis. In addition, insects such as ambrosia beetle, may carry harmful fungi. The primary means of dealing with these insect-vectored diseases are prevention and sanitation.

Aster Yellows

The aster leafhopper, *Macrosteles fascifrons*, and other leafhoppers may vector aster yellows. Phytoplasmas cause virus-like symptoms in infected plants, such as leaves turning yellow (chlorosis), dwarfing of plants, proliferation of adventitious buds that results in bushy, witches' broom-like growth, and small flowers with partially green petals. Infected plants may die before reaching maturity.

The disease has a wide range of hosts including herbaceous plants such as campanula, chrysanthemum, coreopsis, delphinium, marigold, pansy, petunia, purple coneflower and salvia. The pathogen overwinters in weeds and ornamental plants.

Leafhoppers acquire the phytoplasma along with plant fluids while feeding on the phloem of infected plants. The phytoplasma incubates for a period of time inside the insect's gut. When the leafhopper feeds on healthy plants, the phytoplasma is inserted through the insect's mouthparts into the phloem, where it multiplies and establishes infection.

Management of aster yellows involves controlling insect vectors, such as leafhoppers, before they feed. Removing weeds which serve as reservoirs for the phytoplasma eliminates the source of inoculum. In addition, removing plants that are infected and display symptoms of aster yellows removes the inoculum source.

Ash Yellows

Ash yellows is caused by a phytoplasma vectored by leafhoppers. Symptoms develop 0–3 years after the phytoplasma is detected in the phloem. Laboratory tests are necessary to detect the presence of the phytoplasma. Field diagnosis is difficult, but symptoms include reduced growth, loss of dominant leader growth, progressive decline, witches' broom on trunks, loss of leaf color, and premature fall color. White ash is the most susceptible ash, green ash is intermediate, and black ash is least susceptible.

Oak Wilt

Oak wilt is a systemic disease caused by the fungus, *Ceratocystis fagacerum,* that primarily kills red oaks, more often than white oaks. The fungus clogs the vascular tissues (xylem) of trees, preventing the uptake of water. This results in branch dieback and eventually death of infected trees. Beetles in the families Scolytidae and Nitidulidae are the primary vectors of the oak wilt fungus: oak bark beetles, *Pseudopityophthorus minutissinus* and *P. pruinosus*, and sap-feeding beetles in the genera, *Carpophilus*, *Colopterus*, *Cryptarcha*, *Epuraea,* and *Glischrochilus*.

Fungal mats are formed beneath the bark of trees killed by the wilt. The fungus is spread when spores produced by the fungal mats adhere to the bodies of beetles walking and feeding on them. Beetles infested with spores fly to healthy trees and the fungus enters through feeding wounds created by the beetles.

Once trees are infected with the fungus, management is difficult and may be costly. Sanitation through the removal of dead and dying trees is imperative in preventing spread to healthy trees. Avoid using diseased oaks for firewood. If firewood is not burned by spring, the beetles emerge at that time and they may carry the fungus to healthy trees. It is also important to avoid pruning oaks when beetles are active, which is primarily from April through July; instead prune during the dormant season.

Dutch Elm Disease (DED)

The native elm bark beetle, *Hylurgopinus rufipes*, and the smaller European elm bark beetle, *Scolytus multistriatus*, vector spores of the fungus, *Ophiostoma ulmi*, the causal agent of Dutch elm disease(DED). DED is responsible for the decline of American elms, *Ulmus americana*. The fungus moves upward in the xylem plugging the water-conducting tissues. This causes wilting or flagging of branches near the tops of trees, branch dieback, and eventually death of the tree.

Managing DED relies on prevention, sanitation, and the use of resistant varieties of elms. Insecticides may be applied to the bark during peak beetle activity in March through May. However, this may not be feasible, especially for large trees. Maintaining tree health through proper watering, fertility, mulching, and pruning may alleviate problems and possibly allow trees to defend themselves from infection. Pruning wounds tend to attract beetles, so prune during the dormant season.

The primary strategy in managing DED is elimination of breeding sites, such as dead trees or wood, as beetles are attracted to infested, dying wood for reproduction. In spring, trees should be monitored for signs of wilt. Pruning infected branches may help save trees. It is essential to prune back approximately 10 feet from the initial, visible infection point (brown streaking). Infected wood and bark should be destroyed, as bark beetles can breed in piles of elm wood with the bark attached. Wood cut in late fall or winter can be used as firewood, as long as it is used before beetle emergence in the spring. If the wood cannot be used and must be stored, all bark must be removed.

Elms that are resistant to or tolerant of DED include Chinese, Japanese, and Siberian elms, and new varieties of American elms including 'Valley Forge,' 'New Harmony,' and 'Independence'.

Fungicide applications may be used once trees are infected, but this may be costly and may require repeat applications.

Elm Phloem Necrosis

The causal agent of elm phloem necrosis is a phytoplasm, primarily vectored by the white-banded elm leafhopper, *Scaphoideus luteolus*. Symptoms of infection resemble DED, including rapid decline and death of elms within a year after the onset of symptoms.

The leafhopper acquires the phytoplasma by removing plant fluids from the phloem of leaves and succulent stems of infected elms. After an approximately three-week incubation period, the leafhopper, which generally feeds along the mid-veins, transmits the organism to healthy elms. Transmission generally occurs during July through September when leafhoppers are active. Once infected with the phytoplasma, the leafhopper is a potential vector for the remainder of its life. The pathogen may also be transmitted by other insects, including the meadow spittlebug, *Philaenus spumarius,* and another leafhopper, *Allygus atomarius*.

Management of elm phloem necrosis is similar to the other insect-vectored diseases oak wilt and DED. Insecticides may be used to prevent feeding by leafhoppers, but in most cases they are not effective in reducing disease transmission. Keeping trees healthy through proper watering, fertility, mulching, and pruning can help alleviate problems with the disease. The primary management strategy is to remove all dead and diseased trees and wood.

Ambrosia Beetles

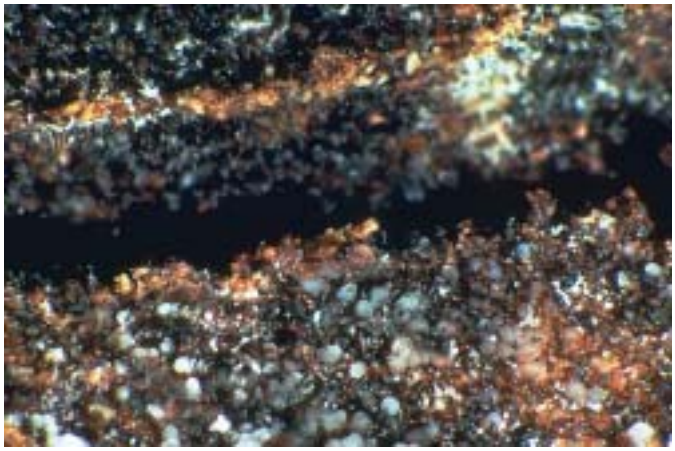
Ambrosia beetles in the families Scolytidae and Platypodidae get their name from the fact that they feed on fungi called ambrosia, produced by *Ambriosiela* spp., which is not pathogenic. However, they sometimes transport spores of fungi that cause disease.

Male beetles tunnel into wood first and create galleries consisting of small pinholes surrounded by a dark stain. Eventually, females that construct most of the tunnels join the males. The tunnels may be simple or branched. Females then lay eggs in the galleries. Larval development primarily occurs in these galleries.

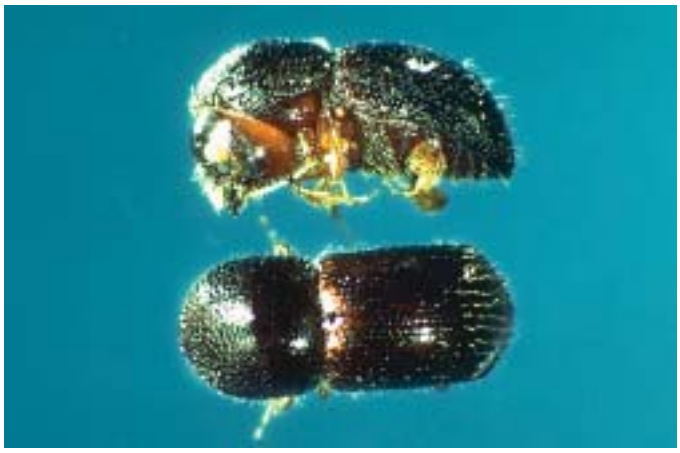
Managing ambrosia beetles relies on a variety of strategies to prevent them from feeding on trees. Insecticides may be applied to trees to prevent beetle feeding and disease transmission. However, the feasibility of this approach depends on tree size. Eliminate or remove dying trees that have been attacked.

Smaller European elm bark beetle adult. (103)
Photo: John Davidson

Fusarium and exit hole damage on *Styrax* (snowbell) caused by ambrosia bark beetle. This beetle killed an acre of *Styrax* in a nursery by carrying *Fusarium* into bark tunnels. This is becoming a widespread beetle. (1)
Photo: John Davidson



Ophiostoma ulmi fungus fruiting bodies inside galleries of smaller European elm bark beetle. (105)
Photo: John Davidson



Ambrosia bark beetle adults. (2)
Photo: John Davidson