



United States Department of Agriculture
US Forest Service
Natural Resource Manager (NRM)



FSVeg Common Stand Exam User Guide Decline Complexes/Diebacks/Wilts (Category 24)

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(24-001) ALASKA YELLOW CEDAR DECLINE

<u>Host:</u>	Alaska yellow cedar
<u>Range:</u>	About 500,000 acres throughout Southeast Alaska from Portland Canal to northwestern Chichagof Island
<u>Injury:</u>	The cause is not completely understood and the primary stress agent appears to be abiotic and probably underground. The organisms (i.e., fungi, insects, and nematodes) that are associated with dying cedars lack the capability of killing a healthy, unstressed tree. <i>Phloeosinus</i> bark beetles, <i>Armillaria</i> sp., and other fungi that are frequently found on the dying or recently dead trees have been shown not to be the primary cause of death.
<u>Description:</u>	Trees are dead or dying in small patches of less than one acre to expansive areas stretching for several miles. Mortality is usually associated with boggy (muskeg) conditions. Affected stands have a mixture of trees that dies long ago, died more recently, are currently dying, and appear relatively healthy. On average two-thirds of the volume of yellow-cedar is dead and standing in declining forests. Affected cedars die quickly, with their entire complement of foliage turning red and then brown over 2 or 3 years, or die slowly (e.g., 15 or more years) with the crown slowly thinning and terminal foliage the last to die. Cedars with thin or off-green crowns frequently have vertical lesions of dead cambium on the lower bole.

(24-002) NORFOLK ISLAND PINE DECLINE

<u>Range:</u>	Pacific Islands including Hawaii
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(24-003) NORFOLK ISLAND PINE DECLINE

<u>Description:</u>	
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(24-004) ASH DECLINE/YELLOW

<u>Host:</u>	White ash, green ash
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Injury: The cause is unknown. Drought plays an important role. The disease, which appears to begin in the tips of small twigs, gradually works into larger branches. The leaves are pale yellow-green and may be slightly dwarfed. Small twigs and branches begin to die throughout the crown. On any one branch, the line between dead and living wood is evident. Callus ridges form, particularly where small limbs join larger ones. The trees may produce water sprouts along the trunk or on the branches. Yellowish to reddish-brown sunken cankers form on dying twigs and branches. Eventually the crown becomes thin and tufted, and the leaves and leaflets dwarfed. The foliage in the stag-headed crown may be reduced to a small area near the top of the tree. Infected trees do not recover.

(24-005) BIRCH DIEBACK

Host: Yellow birch, paper birch

Range: Northeastern United States

Injury: The first symptom is a thinning of the foliage accompanied by small, sometimes chlorotic or curled leaves at the tip of shoots in the periphery of the crown. Later, twigs become bare because buds die or fail to open and the foliage grows thinner in the interior of the crown. Still later, branches and whole portions of the crown die, the foliage remaining is bunched because of shortening of internodes, and it is usually confined to lower branches and adventitious shoots. Death of trees, when it occurs, takes place within three to five years after the initial appearance of symptoms.

(24-006) CADANG-CADANG YELLOW MOTTLE VIRUS

Host: Coconut

Range: Pacific Islands including Hawaii and Guam

Injury: This is a terminal viral disease with no known control. It causes the decline of copra production. Fronds of affected trees turn yellow and gradually die.

(24-007) COMPLEX

Description:

(24-008) DECLINE

Injury: Affected trees show a dieback of the crown, beginning with the uppermost and outermost branches first. In the final stages, the trees may have only a few green sprouts and leaves attached to the main stem. Crowns most frequently begin to die back when the roots have been damaged or are diseased. When a portion of the roots ceases to function, a portion of the crown dies as well. Often, disease fungi enter the weakened portion of the tree and further damage it.

Description: Among the problems leading to decline are: air pollution, soil compaction, mower- and machine-caused injuries, poor pruning, heat reflected from streets and buildings, direct root damage from excavations and turf cultivation, paving, improperly applied herbicides, potting above and below ground level, over planting, and lack of understanding about tree growth and development. For these and other reasons, urban trees generally suffer a diseased existence and must be frequently replaced. Those that survive are often aesthetically unpleasing. In addition, a variety of fungi can attack trees that have been weakened. Most are heart, butt, and root rotting fungi that can affect trees structurally, making them unsafe. Others attack the roots, causing the tops to die back. Only rarely will all the causal agents in urban decline be identified.

(24-009) FALL HARDWOOD DEFOLIATOR COMPLEX

Host: Hardwoods

(24-010) JOGA DECLINE

Range: Pacific Islands including Hawaii

(24-011) LARCH DECLINE

Description:

(24-012) LOOPER; ABIOTIC COMPLEX

Description:

(24-013) MAPLE DECLINE

<u>Host:</u>	Sugar maple, Norway maple, red maple
<u>Range:</u>	Northeastern states
<u>Injury:</u>	Reduced twig growth, reduced foliage growth, early fall coloration, dead branches in upper canopy, and poor root condition
<u>Description:</u>	Maples usually begin decline after several successive years of defoliation by insects. Affected trees not only lose their first set of leaves to these insects, but also use up valuable food reserves to produce a second set. During and after “refoliation,” chemical changes occur in the tree that increases its susceptibility to secondary pathogens. <i>Armillaria mellea</i> (root rot), <i>Nectria cinnabarina</i> (branch canker) and <i>Steganosporium ovatum</i> (twig blight) are three fungi that frequently attack and may kill trees weakened by defoliation and refoliation.

(24-014) WESTERN SPRUCE DWARF MISTLETOE

<u>Host:</u>	Englemann spruce, blue spruce, bristlecone pine
<u>Secondary host:</u>	Ash, birch, beech, maple
<u>Range:</u>	Eastern states

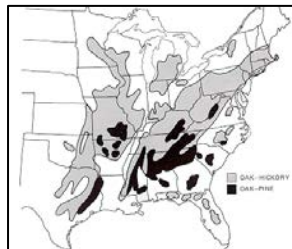
Injury:

Trees are weakened by environmental stresses such as drought, water logging, and frost or by pests such as defoliating or sucking insects. Weakened trees are then invaded and killed by insects and diseases that cannot successfully attack healthy trees. Usually the progression of decline is slow, occurring over several years. Affected trees show a general and progressive dying back from the tips of the branches. Other symptoms include production of chlorotic, dwarfed, and sparse foliage; development of sprouts on main branches and stem; and premature autumn leaf color and leaf drop. Often, growth is reduced before the appearance of symptoms. The amount of food stored as starch is reduced, especially in the roots.

The initiating stress factors associated most frequently with oak decline are drought, frost injury, or insect defoliation. Trees on ridge tops and in wet areas suffer most severely from drought. Frost often affects trees growing in valleys and frost pockets. Defoliated trees that refoliate the same season may exhibit dieback symptoms the next year. Other factors such as leaf diseases and soils that are waterlogged, compacted, or shallow have occasionally been implicated in oak decline. Water logging is especially important in the heavier clay soils of the Midwest. Stress factors may be more frequent and severe in urban forests, where trees are often subjected to disturbances associated with human activities.

These stress factors often weaken trees so much that they succumb, sometimes suddenly, to the root killing and girdling actions of insects and diseases. The two major pests associated with oak decline are armillaria root rot, and the two lined chestnut borer.

Figure 1: Distribution



(24-015) PINGELAP DISEASE

Range:

Pacific Islands including Hawaii

(24-016) SPROUT DIEBACK

Description:

(24-017) TRUE FIR PEST COMPLEX

Description:

(24-018) WESTERN X DISEASE

Host: Stone fruits such as chokecherry and sour cherry

Injury: Newly infected chokecherries begin growth later in the spring than healthy trees. Six to eight weeks after growth begins, the leaves turn bright orange to red and many affected leaves drop off. A second flush of growth may occur in mid-summer; at first the leaves may be a yellowish-green but later they turn red. The fruits are pointed and remain pale red. In succeeding years, the growth forms rosettes or tufts of leaves, which are a dull yellow. The leaves are fewer and smaller than normal and there are few fruits. Twig and branch dieback occurs, and the trees die within three or four years of infection.

On infected sour cherries, the fruits are smaller than normal, pale red to greenish white, and often pointed. Normal and abnormal fruits may be mixed on the same branch, with the abnormal ones failing to ripen. By late summer a few leaves on infected branches may be rusty colored with traces of red or orange along the midrib. Severely diseased trees have rosetted terminals, pale green foliage, and twig and branch dieback.

Description: Caused by a specialized kind of bacterium called a mycoplasma. It is transmitted from tree to tree by grafting and by various species of leafhoppers. Wild chokecherries are the natural reservoir host and X-disease spreads from them into new orchards or other plantings.

(24-019) PINWOOD NEMATODE

Species: *Bursaphelenchus xylophilus*

Host: Virginia pine

Injury: Affected trees show symptoms of wilting, coupled with a significant reduction in resin flow. Wilted trees will turn yellow to brown within 3 months after becoming infested.

Description: The pinewood nematode can be identified only through microscopic examination of a specimen.

(24-020) SAPSTREAK DISEASE OF SUGAR MAPLE

<u>Species:</u>	<i>Ceratocystis coerulescens</i>
<u>Host:</u>	Sugar maple
<u>Range:</u>	A few locations in Michigan, North Carolina, Vermont, Wisconsin
<u>Injury:</u>	This is an uncommon, but lethal disease. It first causes a dwarfing of the leaves in all or a portion of the crown. Over the next several years, the tree gradually declines: the leaves become more dwarfed, the condition spreads to all portions of the crown, and twigs and branches often die back. After 3 or 4 years the tree dies. As crown symptoms develop, the wood, usually only in the lower stem and roots, becomes stained. A cross section of the stem usually shows a radiating pattern of dull gray or brown stain with green outer tips. This fungus often grows as a saprophyte on recently killed or cut wood. Wounds caused by logging are the most common entry points for the fungus.
<u>Description:</u>	The spores are sticky and are spread by insects or other animals.

(24-021) OAK WILT

<u>Species:</u>	<i>Ceratocystis fagacearum</i>
<u>Host:</u>	Red oak, white oak, tanoak

Injury – red
oak:

The main period of infection is in the spring, when new vessel wood is being formed. Symptoms occur as early as May. The leaves turn dull green or bronze, appear water-soaked, wilt, and then turn yellow or brown. Damage occurs from the tip and outer edges toward the midrib and base. Wilting leaves typically curl around the midrib and the line between the bronze and green tissues in individual leaves are very distinct. These symptoms quickly appear throughout the crown, often within a few weeks, and leaves at the ends of branches are shed. Heavy defoliation accompanies leaf wilting and discoloration. Leaves fall in all stages of discoloration. Even entirely green leaves may fall from affected branches. Some affected branches hold green leaves longer than others do, sometimes until autumn. Therefore, the crowns are seldom as brown as trees without disease that have been poisoned, girdled, or killed by lightning. In dry years, the appearance of trees with oak wilt may be confused with that of trees with drought symptoms. The disease progresses rapidly, and some trees die within 1 or 2 months after the onset of symptoms. Most trees die within a year. Sprouts frequently grow from the bole and larger branches during the year of defoliation or the following year. Fungus mats are commonly associated with red oaks in some sections of the country, especially Wisconsin, Minnesota, Iowa, and Illinois. These mats, composed primarily of mycelium, form beneath the bark. Sometimes the mats raise and crack the bark giving off a fermenting odor that attracts insects. Discoloration of infected annual rings is seldom a symptom of oak wilt in the red oak group.

Injury – white
oak:

The disease symptoms are much more variable in white oaks, although the foliage symptoms are often the same. In a few, particularly bur oaks, symptoms are essentially the same as in the red oaks, and the tree may die within one growing season. Usually, however, white oaks die slowly. Only one or two branches may show symptoms and die in a year. If the fungus persists, a few branches are killed in a season. Over several years, the tree declines and may die. Some white oaks seem to recover from the disease, but may harbor the pathogen and serve as reservoirs without symptoms. White oaks, unlike the red, frequently have discolored infected annual rings when diseased. Fungus mats seldom appear on white oaks. Natural root grafts and insect vectors spread the oak wilt fungus from diseased to healthy trees. Healthy oaks growing next to infected ones become infected through their roots. Root grafts offer a path to transmit the fungus and are a major factor in the spread, especially in areas with deep, sandy soils and dense, pure stands of red oaks.

The fungus over-winters as mycelium in living, infested trees. It over-winters as fungus pads on dead trees. The fungus can be spread more than a mile by at least two groups of insects: sap and bark-feeding beetles. When the fungus mats enlarge and crack the bark, the emitted odor attracts insects such as sap-feeding beetles. When the beetles feed on the mats of the infected tree, fungus spores adhere to their bodies. As the beetles move from diseased trees to wounds on healthy oaks, the disease-causing spores are transmitted to a new host.

Figure 2: Symptoms on red oak leaves



Figure 3: Oak wilt symptoms



Figure 4: Fungus mat



(24-022) DUTCH ELM DISEASE

<u>Species:</u>	<i>Ceratocystis ulmi</i>
<u>Host:</u>	American elm
<u>Injury:</u>	ymptoms of the disease include wilting, yellowing, and browning of the leaves, brownish or purplish brown streaking of the wood under the bark, and crown dieback. Symptoms normally progress rapidly through the crown. Complete wilting often occurs within six weeks of infection.
<u>Description:</u>	No fruiting bodies of this fungus are seen in the field.

(24-023) BACTERIAL WETWOOD

<u>Species:</u>	<i>Erwinia nimipressuralis</i>
<u>Host:</u>	American elm, maple, oak, poplar, willow

Injury: This causes a slime flux due to bacteria pathogenic in trunk wood. A water soaked dark discoloration of the heartwood is correlated with chronic bleeding at crotches and wounds and abnormally high sap pressure in trunk, with wilting a secondary symptom. The flux or pressure forces the sap out of the trunk through cracks, branch crotches, and wounds. The flux flows down the trunk, wetting large areas of bark and drying to a grayish white incrustation. Bacteria and yeast working in the flux cause an offensive odor that attracts insects.

(24-024) MIOSA WILT

Species: *Fusarium oxysporum f. sp. Perniciosum*

Host: Mimosa

Range: Maryland to Florida and west to Texas

Injury: Symptoms include chlorotic and wilting foliage. Discoloration of the outer ring of sapwood usually occurs, and trees may die within six weeks after becoming infected.

Description: Fruiting of the fungus is inconspicuous. Small pads of fungal tissue, which bear spores, are sometimes formed on dead twigs. Laboratory culturing and diagnosis are needed to identify the casual fungus.

(24-025) VERTICILLIUM WILT

Species: *Verticilium albo-atrum*

Host: Silver maple, sugar maple, red maple

Secondary host: American elm

Injury: Symptom expression can be quite variable. The foliage may yellow before wilting, and this may involve only a few twigs or branches. Occasionally, the entire crown may suddenly wilt. Dieback of twigs and branches may occur. Elongated stem and branch cankers may develop. Sometimes, green or green-brown discoloration occurs in the outer sapwood of the affected branches or stems. This discolored tissue readily yields the fungus on culturing.

Description: Laboratory culturing and microscopic observations are necessary for accurate identification.

(24-026) XYLELLA FASTIDIOSA

<u>Species:</u>	<i>Xylella fastidiosa</i>
<u>Host:</u>	Oak, maple, elm, sycamore
<u>Range:</u>	Southeastern states and California
<u>Injury:</u>	Leaf scorch, die-back of twigs and branches

(24-027) WETWOOD

<u>Host:</u>	Quaking aspen
<u>Injury:</u>	This is a common defect in many hardwood trees. It is the general name for discolored zones not associated with decay columns. These zones can encompass most of the cross section of the bole but generally are more restricted. Such zones are characterized by a high mineral and moisture content, by variable bacterial population, and by being impermeable to liquid. The discoloration in aspen largely disappears when dried. However, the wood is brash, subject to splitting and cracking, and is reduced in strength.

(24-028) HEMLOCK DECLINE

<u>Host:</u>	Eastern hemlock
<u>Range:</u>	Eastern United States
<u>Injury:</u>	In some areas, defoliation and tree mortality have advanced at such a rapid pace that near complete mortality of some hemlock stands occurred within 3-4 years, while other stands have been less severely impacted. In other areas, the adelgid is present in large numbers but no significant mortality of hemlocks has been observed. The patchy nature of hemlock decline suggests that landscape-level processes may affect hemlock mortality either by regulating the dispersal potential of hemlock wooly adelgid, or by affecting the sensitivity of the trees themselves.
<u>Description:</u>	Widespread hemlock defoliation and mortality has largely been attributed to the hemlock wooly adelgid, an exotic insect that is native to Japan.

(24-029) PACIFIC MADRONE DECLINE

<u>Host:</u>	Pacific madrone
<u>Range:</u>	Pacific Northwest
<u>Injury:</u>	Trees are dying or are in poor health. Tree vigor declines over an extended period before they die. The combined effects of a complex set of environmental stresses such as drought, flooding, soil fertility, sun, and wind cause the trees to have low resistance to primary infection by canker fungi and root diseases. The most destructive disease on Pacific madrone is caused by the canker fungus, which further reduces the vigor of these trees and secondarily allows root rots, heart rots, and branch dieback fungi to become established.

(24-030) ELM PHLOEM NECROSIS

<u>Host:</u>	American elm
<u>Range:</u>	Eastern states
<u>Injury:</u>	Symptoms appear initially on one branch or a small portion of the crown. Leaves wilt, become chlorotic, and their margins curl upward. Defoliation follows, and the crown appears bushy. Defoliation and death can occur in a few weeks. Some of the brown, wilted leaves persist, separating this disease from Dutch elm disease.
<u>Description:</u>	There often is a butterscotch discoloration of the inner bark of host trees. A wintergreen odor can sometimes be smelled after placing the affected bark in a vial or plastic bag.