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FSVeg Common Stand Exam User Guide Foliage Diseases (Category 25)

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INTRODUCTION

Generally, foliage diseases affect specific age classes of needles. Needles prematurely turn yellow, then red, then tan, and are often associated with red or black fruiting bodies. Often only 1 year's needles are visibly affected. Foliage diseases are seldom a serious problem, except Rhabdocline in Christmas tree and nursery stock, and Elytroderma in ponderosa pine.

Needle rusts are identified by the yellow-orange spore masses, a sticky sweet substance, and yellowed, swollen, twisted nature of the affected needles. Conifers, except western redcedar and yew, may be infected with needle rusts. The so-called "yellow witches brooms" on spruce and "true firs" are dense yellow-green clusters of rust-infected foliage. Other needle rusts affect current year's one, two, or 3-year old needles, and then usually only 2-5 needles per branch are affected.

Needle cast diseases of "true" firs are common, affecting 1- to 3-year old needles, often with a dark brown or black swelling along center of the needle. Needle cast of pines and larch often produces black football-shaped bodies, black dots, or black lines on prematurely dead, bleached needles. On lodgepole pine, the black bodies are not often found. Red bands appear on the previous year's needles of pines with the "red band" disease.

(25-001) BLIGHT

Description: Blight is a disease causing rapid death or dieback.

(25-002) BROOM RUST

Description: Broom rust causes "brooms" in the foliage. A broom is an abnormally profuse, dense mass of host branches and foliage.

(25-003) JUNIPER BLIGHT

Host: Juniper, cypress, redcedar, giant sequoia, redwood

Injury: Tips of branches turn brown with progressive die back until a whole branch or even a young tree is killed. Trees over 5 years old are less seriously injured. Small, sunken lesions give a flattened appearance to some seedlings.

Description: Spores on diseased twigs ooze out in little tendrils in moist weather, to be spread by splashing water or insects. Entrance is through unbroken tissue as well as wounds. The stem is killed above and below the point of entrance.

(25-004) LEAF SPOTS

Description: Leaf spots on trees may be caused by insects, toxic gasses, bacteria, and fungi. The characteristic symptom is the formation of dead areas in the leaf. The areas vary in size and shape.

(25-005) NEEDLECAST

Description: Depending on the identity of the infecting fungus, needles begin to turn yellow-brown by winter or early spring. Later, the browning progresses, and fungal fruiting bodies are produced. These small, black, fruiting bodies may be bordered by brown or yellow margins, or both. In the more advanced stages, the tree has a scorched appearance. The fungus can be identified only after examining the spores microscopically.

(25-006) POWDERY MILDEW

Description: Powdery mildew is caused by several genera of fungi. Many occur on hardwoods, attacking leaves or occasionally fruits and young twigs. They are unknown on conifers. Usually the damage is slight except when young trees, particularly sprouts, are attacked. They are mostly confined to the upper or lower surface of leaves, forming a white, superficial, cobweb like growth of hyphae.

(25-007) TOBACCO MOSAIC VIRUS

Description: Mostly present in nurseries. There may be some curling and malformation of the leaves, often with a fern-leaf effect. A yellow strain of the virus causes a striking yellow mottling of leaves.

(25-008) TOBACCO RINGSPOT VIRUS OF ASH

Host: Ash

Injury: Ringspot, either partial or full on leaves, non-descript yellow spots

(25-009) TRUE FIR NEEDLECAST

Description:

(25-010) SYCAMORE ANTHRACNOSE

Species: *Apiognomonia veneta*

Host: Sycamore

Injury: The most common symptom is dead areas or blotches on the leaves. Because of the brown and black scorched appearance of the leaves, the disease is sometimes called leaf blight. Under certain conditions, the whole leaf dies and falls prematurely. Repeated defoliation reduces growth, weakens the tree, and increases its susceptibility to attack by other pests and winter injury. Symptoms on infected leaves range from tiny dead spots to large circular or irregular dead blotches. Dead areas are brown, black, or purple. Infected areas are often found along the veins and midrib of the leaf. The dead areas may merge until the whole leaf dies.

Infection in early spring may turn the leaves black so they resemble leaves damaged by frost. If they are not killed by fungi, young leaves may become distorted by the unequal growth in healthy and infected parts. When severely infected, trees may lose their leaves. If defoliation occurs in spring or early summer, a tree will usually produce a second crop of leaves. The fungi may also infect twigs, buds, and shoots.

On sycamores, there are four distinct stages; twig blight, bud blight, shoot blight, and leaf blight. These stages often overlap; any one or more stages can be seen during the spring or summer when weather conditions are just right for the development of the disease.

Twig blight: Occurs in the spring before the leaves emerge. After the tips of 1-year old twigs are killed, small, black fruiting bodies of the fungus often break through the bark of the dead twigs. Later, cankers may appear on older branches below the dead twigs. These cankers girdle and kill the branches.

<u>Bud blight:</u>	Occurs at the same time as twig blight. When cankers girdle the individual buds, the buds die before the caps begin to break.
<u>Shoot blight:</u>	Emerging shoots and new immature leaves suddenly die.
<u>Leaf blight:</u>	Both young and mature leaves are infected with spores produced on twigs and branch cankers. Necrotic spots or blotches are found on the leaves, and dark-brown fruiting bodies of the fungus are found on diseased leaf tissue.

(25-011) CERCOSPORA BLIGHT OF JUNIPER

<u>Species:</u>	<i>Cercospora sequoia</i>
<u>Host:</u>	Eastern redcedar, Rocky Mountain juniper
<u>Range:</u>	Great Plains
<u>Injury:</u>	Severely damage older windbreak and landscape plantings. Successive seasons of infection can eventually kill trees. Initial infection can occur on any juvenile needles and on previous years' spur needles in the inner crown of the tree during late June and July. Generally all of the needles on a spur shoot become infected, turn bronze-colored, become necrotic, and die by late September. These dead shoots drop from the tree in the fall, resulting in the characteristic appearance of infected trees—the interior of the tree is bare of foliage while the branch ends have healthy, green foliage. Whip foliage appears to be resistant to infection. It tends to start in the lower, inner branches and spread upward and outward.
<u>Description:</u>	The black fruiting bodies are found on the needles and have a fuzzy appearance.

(25-013) LARGE SPORED SPRUCE-LABRADOR TEA RUST

<u>Species:</u>	<i>Chrysomyxa ledicola</i>
<u>Host:</u>	White spruce, black spruce, red spruce, blue spruce, Englemann spruce, Sitka spruce
<u>Range:</u>	Where the range of spruce and Labrador tea coincides
<u>Injury:</u>	This rust frequently discolors infected needles so badly that the trees appear yellowish in color.

Description:

Heterocyclic rust with one stage of its life cycle on Labrador tea. Spores produced on Labrador tea infect the current year's needles. Pustules produced by the rust fungus are orange or yellow with dry spore deposits.

Figure 1: Needle rust



Figure 2: Current year's needles infected



Figure 3: Labrador tea is the alternate host



(25-014) INK SPOT OF ASPEN

<u>Species:</u>	<i>Ciborinia whetzellii</i>
<u>Host:</u>	Aspen, cottonwood, poplar
<u>Injury:</u>	The symptoms include black, inky looking spots on the leaves that drop out in late summer, leaving “shotholes.”

(25-015) PINE NEEDLE RUST

<u>Host:</u>	Pine
<u>Range:</u>	Eastern states
<u>Injury:</u>	This is primarily a Christmas tree plantation and nursery disease. Infected pines often have white-orange blisters on the needles. Although these are actually fruiting structures of the fungus, they are an obvious feature of infection.
<u>Description:</u>	The fungus has four stages. The first stage on the pine needles looks like small, white-orange “sacks.” Aecispores infect the alternate host, which results in orange, powdery spores on the leaves. Later, orange, cushion-like objects are produced on the underside of the leaf. The last stage looks like frosty, orange droplets on the pine needles.

Figure 4: Fruiting bodies of pine needle rust (photo by Robert L. Anderson)



(25-016) ANTHRACNOSE ON RUSSIAN OLIVE

<u>Species:</u>	<i>Colletotrichum spp.</i>
<u>Host:</u>	Russian olive
<u>Injury:</u>	Appears as a black, sunken leaf or stem. It is caused by a fungus.

(25-017) TRUE FIR PEST COMPLEX

Species: *Cronartium arizonicum*

Host: Ponderosa pine

Range: Arizona

(25-018) LEAF SHOT HOLE

Species: *Cylindrosporium spp.*

(25-019) CEDAR LEAF BLIGHT

Species: *Didymascella thujina*

Host: Western redcedar

Injury: It is severest on seedlings and the lower branches of older trees. The foliage is attacked, and in severe cases appears as if scorched by fire. In late autumn, many young infected twigs drop off. On the remaining leaves, the presence of the disease is easily recognized by the deep pits, which remain in the leaves after the fruiting bodies drop out.

Description: In spring, circular to elliptical olive-brown to black fruiting bodies are formed in the upper surfaces of infected leaves. These are exposed by the rupture of the covering host epidermis.

Figure 5: Cedar leaf blight



(25-020) DOGWOOD ANTHRACNOSE

Species: *Discula spp.*

Host: Dogwood

Injury: Causes a blue stain of the sapwood. The grayish, dark blue or blackish discoloration may appear as spots, streaks, or irregular areas on the surface of a board or end of log.

(25-021) MANGO SCAB

Species: *Elsinoe magiferae*

Host: Mango

Injury: Spots usually originate on the underside of young mango leaves but become visible above. They are circular to angular, dark brown to black with olive buff centers. Spots on mature leaves are larger, slightly raised with narrow brown margins and dirty white centers. Stems have irregular grayish blotches. The fruit has spots with dark margins.

(25-022) ELYTRODERMA NEEDLECAST

Species: *Elytroderma deformans*

Host: Ponderosa pine, Jeffery pine, jack pine, lodgepole pine

Secondary host: Pinyon pine

Injury: It causes stunting and reddening of needles (best observed in spring and early summer), upward curving of branches, defoliation, and witches' brooms. Witches' brooms tend to be compact balls that curve upward. (Distinguish from dwarf mistletoe brooms by lack of dwarf mistletoe plants, presence of fruiting bodies on needles, and compact "balled" nature.) Severe infection can lead to tree death. Thin black lines of fruiting bodies are produced on dead and dying needles of the previous year's growth. Infection is usually heaviest in understory poles and large saplings, and in dense stands. Most infection occurs at edges of meadows, in wide draws, and on gentle slopes where cool moist air drainage is common. One-year needles of 2-3 needle pines visibly infected, die after 1 year.

Defect: No defect is applied unless tree death is imminent or unless the broom bases have entered the stem. In this case, the wood directly beneath each broom is cull.

Figure 6: Elytroderma needlecast



Figure 7: Elytroderma needlecast



(25-023) FIRE BLIGHT

Species: *Erwinia amylovora*

Host: Hawthorn

Injury: Blossoms and leaves of infected twigs suddenly wilt, turn dark brown to black, shrivel and die, but remain attached to twigs. The bark is shrunk, dark brown to purplish, sometimes blistered with gum oozing out. Brown or black blighted branches with dead persistent leaves look as if scorched by fire. There are cankers, which are dead, slightly shrunk areas with a definite margin or slight crack where dead tissue has shrunk away from living.

(25-024) WALNUT ANTHRACNOSE

Species: *Gnomonia leptostyla*

Host: Black walnut, butternut, California walnut

Injury:

Leaves, nuts, and, occasionally, shoots of the current season's growth are likely to be attacked. Tiny dark-brown or black spots, circular to irregularly circular, appear on infected leaves. Gradually, these spots become more numerous, enlarge, and often merge to form still larger dead areas. Yellowish to golden leaf tissue usually borders these spots. Infected leaves and leaflets generally fall prematurely, but some infected leaflets usually remain attached to the tree for most of the season. Nuts from diseased trees commonly have dark, unattractive, and shriveled meat. Sunken, necrotic spots, smaller than those on the leaves, appear on husks of infected nuts. Nuts that become diseased when immature do not develop normally and many drop prematurely. Lesions also appear on current shoots, which are attacked on rare occasions, and form dead, sunken areas that are oval to irregularly circular, and light, grayish-brown with dark, reddish-brown margins.

Figure 8: Spots on leaves

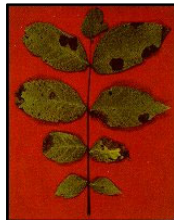


Figure 9: Spots on fruit



Figure 10: Walnut anthracnose



(25-025) ANTHRACNOSE

<u>Species:</u>	<i>Gnomonia spp.</i>
<u>Host:</u>	Walnut, oak, sycamore, ash, hickory
<u>Injury:</u>	Causes symptoms on leaves and young shoots or twigs on linden, oak, sycamore, and walnut. These diseases are favored by wet, humid weather. Injury usually includes irregular patches of dead leaf tissue (blotches), blackened bases of the leaf stem, cankering of the branch at the base of the leaf stem, and shoot dieback. Cankering is not commonly seen on walnut.
<u>Description:</u>	The fungi are different for each host. The fruiting bodies, which occur on twigs and leaves, are distinctive in color and shape. Samples of affected twig and leaf material should be sent to a specialist if this disease is suspected.

(25-027) BROWN FELT BLIGHT (SNOW MOLD)

<u>Species:</u>	<i>Herptichia juniper</i>
<u>Host:</u>	Grand fir, subalpine fir, juniper, Englemann spruce, western hemlock, Douglas-fir, western white pine, lodgepole pine, limber pine, whitebark pine
<u>Range:</u>	High elevation sites
<u>Injury:</u>	Snow covered foliage is infected and killed resulting in branch death and occasional death of seedlings. Needles are matted together by thick growth of gray, black, or brown mycelium on portions of the tree which were covered by snow. The appearance is unique and easily recognized.

(25-028) LARCH NEEDLE BLIGHT

Species: *Hypodermella laricis*

Host: Western larch

Injury: This often occurs together with *Meria*. Yellowing and browning of scattered needles on the branches and needle casting is apparent. Needles with brown spots or bands as well as dead tips are present. Both kill infected needles. Growth loss can result from severe infections particularly if successive years of severe infections occur. Seedlings can be killed by severe infections. Spur shoots and, occasionally, succulent new shoots can be killed. Infection is usually heaviest low in the crown. Needle cast causes infected needles to be shed within a few weeks of infection. Needle blight kills infected needles quickly and causes the dead needles to remain attached to the spur shoots for 1 to 3 years. It begins infecting needles in early spring and continues to re-infect throughout the summer if rainy weather continues. Infected needles have discolored spots or bands which are yellow at first, becoming red-brown. Within a month of infection, the needles drop to the ground.

(25-029) HARDWOOD ANTHRACNOSE

Species: *Kabatella apocrypta*

Host: Maple

Injury: The most common symptom is dead areas or blotches on the leaves. Because of the brown and black scorched appearance of the leaves, the disease is sometimes called leaf blight. Under certain conditions, the whole leaf dies and falls prematurely. Repeated defoliation reduces growth, weakens the tree, and increases its susceptibility to attack by other pests and winter injury. Symptoms on infected leaves range from tiny dead spots to large circular or irregular dead blotches. Dead areas are brown, black, or purple. Infected areas are often found along the veins and midrib of the leaf. The dead areas may merge until the whole leaf dies. Infection in early spring may turn the leaves black so they resemble leaves damaged by frost. If they are not killed by fungi, young leaves may become distorted by the unequal growth in healthy and infected parts. When severely infected, trees may lose their leaves. If defoliation occurs in spring or early summer, a tree will usually produce a second crop of leaves. The fungi may also infect twigs.

(25-030) CONE DAMAGE

Species: *Lasiodiplodia* spp.

(25-031) SPRUCE NEEDLE CAST

Species: *Lirula macrospora*

Host: Sitka spruce, white spruce, black spruce

Injury: It is not damaging to spruce trees unless there are several successive years of attack. Outbreaks are triggered by weather patterns that usually do not repeat several years in a row; therefore, epidemic levels of these fungi do not typically occur. Infection often takes place in the lower portion of the crown. Infected needles turn a reddish-brown color in the spring one year after infection and become tan color two years after infection.

Description: It occurs on the needles of spruce. Fruiting bodies are small, black, and elongated. They occur on the undersides of the needles. It makes its infection in spring on new needles as they emerge during bud break, but the infected needles do not show any symptoms for one year.

Figure 11: Close-up of fruiting bodies



Figure 12: Fruiting bodies on 2-year-old needles



Figure 13: Blight on Sitka spruce



(25-032) FIR NEEDLE CAST

<u>Species:</u>	<i>Lirula spp.</i>
<u>Host:</u>	White fir, grand fir, Noble fir, Pacific silver fir, subalpine fir, California red fir
<u>Injury:</u>	They occur sporadically and only attack one years compliment of needles. If several successive years of infection were to occur, they would defoliate trees and affect growth and vigor. This is significant on Christmas tree plantations.
<u>Description:</u>	The fungi may be identified by their elongate, dark brown to black fruiting bodies on two year old or older straw colored needles. The fruiting bodies extend down the center of the lower needle surface for almost its full length.

(25-033) WHITE PINE NEEDLE CAST

<u>Species:</u>	<i>Lophodermella arcuate</i>
<u>Host:</u>	Sugar pine, western white pine
<u>Injury:</u>	It attacks only the current year's needles, and a single attack results in only partial defoliation. Repeated infections have led to reduced vigor and growth, and occasionally mortality. The fungus infects newly developed foliage. Infected foliage remains green an entire year until the following spring when the needles turn brown. This browning appears before bud break, giving heavily infected trees a scorched appearance. Fruiting bodies appear in July and August. The needles are cast in mid to late summer.

(25-034) LOPHDERMELLA NEEDLE CAST

<u>Species:</u>	<i>Lophodermella spp.</i>
<u>Host:</u>	Lodgepole pine, whitebark pine, limber pine, Eastern white pine, loblolly pine, slash pine, shortleaf pine, Virginia pine, Scotch pine, spruce, firs
<u>Injury:</u>	Reddish diseased needles are easily confused with winter damage except for several distinguishing symptoms caused only by a needle cast. These are; tree-to-tree variation in color, individual needle discoloration that begins at random spots, only one age class is involved, and sunken, colorless spots of fruiting bodies may be visible on needles. Depending on the identity of the infecting fungus, needles begin to turn yellow-brown by winter or early spring.

(25-035) LOPHODERMIIUM NEEDLE CAST

<u>Species:</u>	<i>Lophodermium pinastri</i>
<u>Host:</u>	Red pine, whitebark pine, knobcone pine, eastern white pine, digger pine, jack pine, lodgepole pine, limber pine, sugar pine, Austrian pine, pitch pine, Scots pine
<u>Range:</u>	Eastern states
<u>Injury:</u>	It is most damaging on red pine seedlings, but will infect Scots pine of all ages. The damage is usually more severe on the lower part of the tree, but the whole tree may become infected. Nursery seedlings may be killed, and entire beds often turn brown. Small gray-black spots form on the needles in the spring. The spots later turn brown with yellow margins. The entire needle eventually turns yellow then brown. Tree often have green foliage on tips of branches, but dead or missing 2- and 3-year old needles. Small black fruiting bodies form on dead needles.

(25-036) MARSSONINA BLIGHT

<u>Species:</u>	<i>Marssonina populi</i>
<u>Host:</u>	Balsam poplar, aspen
<u>Injury:</u>	It causes a leaf spot and shoot blight. In cases of heavy infections, it results in premature defoliation.

(25-037) MELAMPOSRA RUSTS

<u>Species:</u>	<i>Melampsora medusa</i>
<u>Host:</u>	Aspen, cottonwood
<u>Injury:</u>	Very severe in plantations and nurseries. Heavy infection and subsequent defoliation may kill the trees.
<u>Description:</u>	Yellow or orange pustules, containing spores, form on the under-surface of the leaves in mid-summer. These are replaced by dark brown fungal growths in the fall.

Figure 14: Rust pustules of *Melampsora* on the underside of a leaf



(25-039) LARCH NEEDLE CAST

<u>Species:</u>	<i>Meria laricis</i>
<u>Host:</u>	Western larch
<u>Injury:</u>	Meria and Hypodermella often occur together. Yellowing and browning of scattered needles on the branches and needle casting is apparent. Needles with brown spots or bands as well as dead tips are present. Both kill infected needles. Growth loss can result from severe infections particularly if successive years of severe infections occur. Seedlings can be killed by severe infections. Infection is usually heaviest low in the crown. Needle cast causes infected needles to be shed within a few weeks of infection. Needle blight kills infected needles quickly and causes the dead needles to remain attached to the spur shoots for 1 to 3 years.

(25-040) DOTHISTROMA NEEDLE BLIGHT

<u>Species:</u>	<i>Mycosphaerella pini</i>
<u>Host:</u>	Monterey pine, Bishop pine, ponderosa pine, sugar pine, lodgepole pine, Austrian pine
<u>Range:</u>	Eastern Rockies, north Pacific Coast, northeastern states
<u>Injury:</u>	The disease is distinguished by a small reddish band encircling the infected needle. Fruiting bodies of the causal fungus develop during July below the needle epidermis, and raise and split the epidermis. Needles may die soon after first appearance of symptoms, and these needles are cast prematurely. The fungus often causes severe damage in pine plantations, and infection in certain new plantings has indicated that seedlings infected in the nursery have been responsible for disease outbreaks in those plantings. The fungus has been commonly found on 4- to 5-year-old pine transplants in some nurseries.

(25-041) BROWN FELT BLIGHT OF PINES

<u>Species:</u>	<i>Neopeckia coulteri</i>
<u>Host:</u>	Whitebark pine, jack pine, lodgepole pine, limber pine, Jeffery pine, western white pine, sugar pine, ponderosa pine, sugar pine, Pacific yew
<u>Injury:</u>	Attacks the foliage. This fungus is usually found at high elevations of mountainous regions, where enough snow falls to meet the unique requirements of the fungi. The disease develops under the cover of snow; therefore, its attack is limited to smaller trees and the lower branches of larger trees that are buried under snow in the winter. The fungus envelops twigs and needles in a dark brown, felt like growth. Needles within the felt are infected and killed. This disease may occasionally kill seedlings and saplings that are covered by snow, but it has little effect on trees once they reach the pole size.

(25-042) SNOW BLIGHT

<u>Species:</u>	<i>Phacidem abietis</i>
<u>Host:</u>	White fir, grand fir, subalpine fir, balsam fir, Douglas-fir
<u>Injury:</u>	The fungus attacks all ages of needles during winter while under cover of snow. After the snow has melted, the infected needles remain on the tree and turn brown. Only the needles covered by snow are attacked.
<u>Description:</u>	In summer and fall, dark brown round to oval disc like fruiting bodies break through the lower epidermis of the needle. The fruiting bodies are arranged in two rows, one on either side of the midrib. The following year the needles remain attached to the host and turn gray. The fruiting bodies fall away, leaving a cavity in the lower needle surface.

(25-043) SWISS NEEDLE CAST

<u>Species:</u>	<i>Phaeocryptopus gaeumannii</i>
<u>Host:</u>	Douglas-fir
<u>Injury:</u>	The fungus attacks the needles, causing them to turn yellow, brown, and finally drop. Only needles 3 years old and older show signs of infection. The small fruiting bodies push their way through the stomata in fall and winter and mature in spring. The numerous small black spherical fruiting bodies appear as soot like streaks on the undersurface of the needle along each side of the midrib.

(25-044) PHOMA BLIGHT

<u>Species:</u>	<i>Phoma spp.</i>
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(25-045) PHYLLOSTICTA LEAF SPOT

<u>Species:</u>	<i>Phyllosticta</i> spp.
<u>Host:</u>	Maple
<u>Injury:</u>	Infects foliage causing small tannish-gray leaf spots with dark, brown to purple borders. Leaf spots are usually small and separate, but sometimes can cover large areas of the leaf.

(25-046) BUD ROT

<u>Species:</u>	<i>Phytophthora palmivora</i>
<u>Host:</u>	Coconut palm, queen palm
<u>Range:</u>	Pacific Islands including Guam and Hawaii
<u>Injury:</u>	It causes bud rot, stem rot, leaf drop and wilt

(25-047) PLOIODERMA NEEDLE CAST

<u>Species:</u>	<i>Ploioderma lethale</i>
<u>Host:</u>	Austrian pine, especially in nurseries
<u>Injury:</u>	May cause severe stunting, needle discoloration, and premature defoliation where needles are heavily infected. Some trees may be killed by repeated severe infestations. Symptoms include yellow to brown spots, which begin to show up in late winter or early spring on the previous year's needles. As the weather warms up in the spring, a portion of each infected needle quickly turns a straw brown color even though the base of the needle may remain green.
<u>Description:</u>	Diagnostic feature is the appearance of tiny, elongate, black lines which are formed by fungal tissue and run lengthwise along the infected part of the needle. Beneath this fungal tissue lie the individual fruiting bodies. Several fruiting bodies may be found on a single infected needle. Symptoms will not appear on the newly infected needles until late that winter.

(25-048) ASH RUST

<u>Species:</u>	<i>Puccinia sparganioides</i>
<u>Host:</u>	Ash
<u>Injury:</u>	It is characterized by swellings on the twigs and petioles and distortion of the leaves. After the swellings form, they are covered with cluster cups filled with a yellow powder. The alternate hosts are marsh and cord grasses.

(25-049) FIR NEEDLE RUST

<u>Species:</u>	<i>Pucciniastrum spp.</i>
<u>Host:</u>	Grand fir, subalpine fir
<u>Injury:</u>	Needles are killed within 1 or 2 years of infection. Severe infections may reduce growth. The greatest infection generally occurs low in the crown. A single year's complement of needles is usually most severely infected at a time. Chronic infections leave trees with thin crowns and dead lower branches. It infects the current years needles. Fruiting bodies develop in early or late summer. Infected needles turn yellow and have protruding pustules of white or yellow spores on lower surfaces.

(25-050) DOUGLAS-FIR NEEDLE CAST

<u>Species:</u>	<i>Rhabdocline spp.</i>
<u>Host:</u>	Douglas-fir
<u>Injury:</u>	Swiss needle cast has small round black fruiting bodies erupting from stomata are most visible winter through early summer on one to two-year-old needles. Rhabdocline has fruiting bodies that are tan with flaps of epidermis. Red-brown needle spots evolving into long, cushion-like fruiting bodies (best seen in spring) form on both sides of the midrib on the underside of needles. Most often 1-year old needles are visibly affected, but in late fall the current year's needles may also turn yellow. Red-orange pustules appear in the needles. Mortality seldom occurs except in seedling-sapling size.

(25-051) RHIZOCTONIA NEEDLE BLIGHT

<u>Species:</u>	<i>Rhizoctonia spp.</i>
<u>Host:</u>	Red spruce
<u>Injury:</u>	Seedlings are occasionally killed or injured by this damping-off fungus that attacks the tops after the plants have developed stems stiff enough to continue standing after death. The disease is most severe in moist seasons in dense stands where the tops of seedlings are in contact with each other. This fungus causes an angular bending of the stem tips.

(25-052) RHIZOPHAERIA NEEDLE CAST

<u>Species:</u>	<i>Rhizophaeria spp.</i>
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(25-053) RHIZOPUS ROT

<u>Species:</u>	<i>Rhizopus artocarp</i>
<u>Host:</u>	Jackfruit, breadfruit
<u>Range:</u>	Pacific Islands including Hawaii
<u>Injury:</u>	Fruit rot disease occurs during flowering stage, mature stage, and post-harvest stage. Fruit drops off early stage of infestation. At maturity the fruits rot completely.

(25-054) BROWN SPOT NEEDLE BLIGHT

<u>Species:</u>	<i>Shirrhia acicula</i>
<u>Host:</u>	Scots pine, loblolly pine, longleaf pine, digger pine, eastern white pine, knobcone pine, shortleaf pine, slash pine, pitch pine, pond pine, Virginia pine
<u>Range:</u>	Southern and eastern states, and in Christmas tree plantations in Oregon

Injury:

It causes losses to Christmas tree plantations, especially Scots pine. Short-needled Scots pine varieties are more susceptible to fungal attack than the long-needled varieties. The fungus causes two kinds of needle spots. These appear on needles at any time of the year, but most commonly from May through October on longleaf, and during August on Scots pine. The most common spot is straw yellow at first, later changing to a light brown, often with chestnut-brown borders. Dark-purplish borders are common after the advent of cool weather in the autumn. Individual spots are usually one-eighth inch in diameter. When the needle dies, the green tissue between the spots shrinks more than the diseased areas and the resulting embossed appearance is the most distinctive symptom. Needles with multiple infections take on a mottled appearance.

The second spot, called bar spot, is less common. It is a combination of a brownish spot on an amber-yellow band about one-eighth inch wide. The tissue between the bands often remains green. Bar spots are infiltrated with resin that prevents normal growth and fruiting of the fungus. Both spot types have distinctly defined margins, a feature which readily distinguishes them from those caused by other needle diseases. The infected needle of long-leaf pine usually has three distinct zones: the basal portion, which is green, the middle portion which is mottled, and the apical portion which consists of dead needle tissue. With the gradual death of needles, the affected parts curve outward, down, and finally assume an orange-red color similar to those killed by fire. The characteristic spots remain visible even after the needle dies.

With repeated infections, long-leaf seedlings are characterized by a long needle less stem with a tuft of severely infected needles at the base of the terminal end. The unusual growth habit of longleaf pine makes it especially susceptible to brown spot. The normal 3- to 5-year grass stage presents an excellent target for fungal infection. Active height growth is inhibited for many years and the young trees may die. The majority of infected Scots pine needles are found on the lower branches of the tree, especially on the north side. Infected needles, of all ages, start dying from the tips backward until the entire needle turns brown and drops. This occurs during October and November. The result is mostly bare branches. In severe cases, branches are killed, but usually buds of infected branches remain healthy and produce new foliage the following spring. The new foliage becomes infected, continuing the disease cycle.

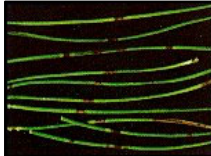
Figure 15: Infected tree



Figure 16: Infected needles



Figure 17: Infected needles



(25-055) SEPTORIA LEAF SPOT

Species: *Septoria alnifolia*

Host: Aspen

(25-056) SEPTORIA LEAF SPOT AND CANKER

<u>Species:</u>	<i>Septoria musiva</i>
<u>Host:</u>	Balsam poplar, cottonwood
<u>Injury:</u>	The fungus causes brown leaf spots with yellowish or white centers. These spots may affect as much as half the leaf tissue. Cankers are formed in twigs of the current season's growth. The fungus does not girdle the stems, but the cankers may allow entry of other fungi that do.
<u>Description:</u>	Small, black, asexual fruiting structures develop on both cankers and leaves. It over-winters in tiny, black, flask-shaped sexual fruiting bodies on branches and fallen leaves.

(25-057) SIROCOCCUS TIP BLIGHT

<u>Species:</u>	<i>Sirococcus conigenus</i>
<u>Host:</u>	Red pine, Colorado blue spruce
<u>Injury:</u>	Infects new shoots causing tip blight, and may also kill seedlings. Infections occur on or next to the base of new needles. First symptoms include a small purplish lesion and small resin droplet at infection points. Infections on expanding shoots often cause the shoot to curl downward. Infected red pine needles often droop conspicuously. Lesions eventually expand, killing the shoots. Dead shoots become apparent from June to August.
<u>Description:</u>	Small brown to black reproductive structures are produced on newly infected shoots, cones, and needles in the fall or early spring after infection. On spruce, these structures are most common on the shoots whereas on red pine they are most abundant under needle sheaths. Spores are disseminated by rain splash and most new infections occur within a few yards of previous infections.

(25-058) DIPLODIA BLIGHT

<u>Species:</u>	<i>Sphaeropsis sapinea</i>
<u>Host:</u>	Ponderosa pine
<u>Injury:</u>	New shoots are killed by the canker-causing fungus. Severe infections may lead to death of trees of all sizes. Stunted new shoots or flagged branches with drooping red or gray needles occur anywhere in crown. Needles are infected as they emerge from the sheath. Infected needles are stunted and may have a resinous droplet associated with the infection point. The fungus commonly girdles the entire new shoot by the end of summer. Minute, round, black fruiting bodies are produced on twigs, bases of needles, or on cone scales.

(25-059) LEAF BLISTER OF OAK

<u>Species:</u>	<i>Taphrina caerulescens</i>
<u>Host:</u>	Oak, California live oak
<u>Injury:</u>	Yellowish-green to purple blisters appears on leaves. Blistered leaves remain on the tree.
<u>Description:</u>	This fungus over winters on bud scales. When buds expand, infection of new leaves occurs. Spores produced on leaves are disseminated by wind.

(25-060) VENTURIA LEAF BLIGHT OF MAPLE

<u>Species:</u>	<i>Venturia acerina</i>
<u>Host:</u>	Red maple, silver maple, sugar maple
<u>Injury:</u>	A leaf spot with an angular to orbicular dark reddish brown spot.

(25-061) SHEPARD'S CROOK

Species: *Venturia tremulae*

Host: Quaking aspen

Injury: Angular leaf spots form in early summer and enlarge until the entire leaf is blackened and wilted. The fungus spreads down the stem of the leaf and blackens the shoot. The shoot then withers and forms a characteristic "Shepard's crook." Under moist conditions, dark-greenish spores form on the infected leaves and shoots. Severe outbreaks rarely occur in successive years, and the fungus invades and kills only the current year's tissue. The repeated loss of current growth can cause stag-headed trees. Trees older than 5 years are seldom affected.

Figure 18: Shepard's crook



(25-062) DOTHISTROMA NEEDLE BLIGHT

Species: *Dothistroma septospora*

Host: Austrian pine, ponderosa pine, mugho pine

Injury: Symptoms initially appear as yellow to tan colored spots on the needles. These spots enlarge into brown or reddish brown bands that encircle and girdle the needle. Girdling causes death of the needle from the point of infection outward, while the base of the needle often remains green. The transition from green to dead areas is abrupt. New growth is not affected until midsummer. In the fall, tiny black fungal fruiting bodies appear in the bands or in dead areas of the needles. These fruiting bodies will release spores the following spring to begin a new disease cycle.

(25-063) YELLOW CEDAR SHOOT BLIGHT

<u>Species:</u>	<i>Apostrasseria spp.</i>
<u>Host:</u>	Alaska yellow cedar
<u>Range:</u>	Southeast Alaska
<u>Injury:</u>	Infection causes dieback of branches or the terminal leader.
<u>Description:</u>	The small black fruiting bodies of the casual fungus can be found in the spring when infection has just killed shoot tissues. The disease is restricted to seedlings and saplings and has not been found in mature trees.

Figure 19: Yellow cedar shoot blight



(25-064) BROOM RUST

<u>Species:</u>	<i>Chrysomyxa arctostaphyli</i>
<u>Host:</u>	White spruce, Sitka spruce, black spruce
<u>Range:</u>	It is found across Alaska where the range of spruce and bearberry coincide. Sitka spruce is not affected throughout most of southeast Alaska, but populations have been found on Kuiu Island and Glacier Bay.
<u>Injury:</u>	Loss of height and diameter growth, bole deformation, and mortality. Dead rust brooms serve as entrance courts for decay fungi.
<u>Description:</u>	Trees develop dense perennial witches brooms. In summer, spores are produced on current year's needles giving the brooms an orange or yellowish coloration. The needles are shed in the fall and the brooms appear dead until spring.

Figure 20: Perennial broom



Figure 21: Sporulating on the needles of a live crown



(25-065) SPRUCE NEEDLE RUST

<u>Species:</u>	<i>Chrysomyxa weirii</i>
<u>Host:</u>	Englemann spruce, black spruce, white spruce, Sitka spruce, red spruce
<u>Injury:</u>	The waxy orange to orange-brown elongate-elliptical telia occur on 1-year old needles causing yellowish spots. This rust occasionally becomes epidemic causing considerable defoliation.

(25-066) CEDAR LEAF BLIGHT

<u>Species:</u>	<i>Gymnosporangium nootkatense</i>
<u>Host:</u>	Alaska cedar
<u>Injury:</u>	The fungus is bright orange, but soon fades to pale yellow. It mainly attacks tender green stems, but injury is usually slight.

(25-067) SPRUCE NEEDLE CAST

<u>Species:</u>	<i>Lophodermium picea</i>
<u>Host:</u>	Englemann spruce, white spruce, black spruce, Sitka spruce
<u>Injury:</u>	The small, black elliptical fruiting bodies occur in longitudinal rows on either side of the middle ridge of the outer faces of the needles. The areas occupied by one, or a group of, fruiting bodies are separated from one another by heavy black lines extending through the needle and along which the needle readily breaks. It may infect new needles, but typically appears in older groups of adjacent needles.

(25-068) HARDWOOD LEAF RUSTS

<u>Species:</u>	<i>Melampsora spp.</i>
<u>Host:</u>	Poplar, aspen, cottonwood, birch, willow
<u>Injury:</u>	Young trees can be severely damaged. In the summer, golden-yellow or orange powdery pustules appear on the undersides of the leaves, either scattered or so closely crowded that the entire surface seems powdery. In late summer and autumn, small slightly raised areas or crusts appear. At first orange yellow in color, they change to dark brown or black.

Figure 22: Rust pustules on the underside of a hardwood leaf



(25-070) HEMLOCK NEEDLE RUST

<u>Species:</u>	<i>Pucciniastrum vaccinia</i>
<u>Host:</u>	Eastern hemlock
<u>Injury:</u>	This is the most common rust on eastern hemlocks. Often, only a single leaf on a small twig will be infected. This rust only occurs on needles of the current year.

(25-071) SPRUCE NEEDLE CAST

<u>Species:</u>	<i>Rhizosphaera pini</i>
<u>Host:</u>	Black spruce, Sitka spruce, white spruce
<u>Injury:</u>	Shade trees, ornamentals, Christmas trees, and seedlings in nurseries are affected. Damage in forest stands is rarely significant. The fungus attacks needles on the lower tree branches first, and then moves upward. The 1-year old needles become infected in May and June and drop prematurely in late fall or the following spring. The infected needles turn yellow and then purplish brown before they drop.
<u>Description:</u>	Small fruiting bodies develop in the openings of the needles in late fall or early spring. The fruiting bodies appear as tiny black dots in rows along the needle surface.

Figure 23: Fungus on older needles of Sitka spruce



(25-072) SIROCOCCUS SHOOT BLIGHT

<u>Species:</u>	<i>Sirococcus strobilinus</i>
<u>Host:</u>	Red pine, western hemlock, mountain hemlock, Sitka spruce
<u>Range:</u>	Nurseries and natural reproduction in the Pacific Northwest and Alaska
<u>Injury:</u>	It causes tip blight and produces sunken, purplish cankers on the stems of current year's growth. Young needles are infected first, and small black fruiting bodies develop on stem cankers and infected needles as the cankers mature. These fruiting bodies produce spores that are dispersed to other seedlings by splashing water droplets. The spores then germinate and infect young needles of susceptible seedlings. Restricted stem growth in a cankered area causes the terminal to curl. Trees with multiple infections are killed; additional nursery losses result from culling of deformed stock.

Figure 24: Numerous dead shoots caused by Sirococcus shoot blight



(25-073) SHEPARD'S CROOK

Species: *Venturia populina*

Host: Balsam poplar

Injury: Angular leaf spots form in early summer and enlarge until the entire leaf is blackened and wilted. The fungus spreads down the stem of the leaf and blackens the shoot. The shoot then withers and forms a characteristic "Shepard's crook." Under moist conditions, dark-greenish spores form on the infected leaves and shoots. Severe outbreaks rarely occur in successive years, and the fungus invades and kills only the current year's tissue. The repeated loss of current growth can cause stag-headed trees. Trees older than 5 years are seldom affected.

Figure 25: Shepard's crook



(25-074) DELPHINELLA SHOOT BLIGHT

Species: *Delphinella abietis*

Host: Subalpine fir, grand fir

Injury: New shoots and leaves are killed in spring or early summer. Shoots and needles wilt and shrivel. Severe infection halts branch and terminal growth for season; chronic infections result in bushy trees because terminal buds are killed.

Description: Earliest signs of infection are slightly chlorotic needles on new shoots in spring. Needles may be girdled by cankers at their bases. As the fungus moves into shoots, shoots begin to wilt and shrivel. Infections occurring early in the season tend to kill all needles on a shoot and all or most of the shoot. Later season infections may kill selected needles, only the tips of some needles, and only the tips of new shoots. Tiny, round, black fruiting bodies develop on the upper surfaces of needles and on dead shoots in midsummer. Dead needles and shoots are red or brown the first year after infection and gray or black the second year. Blighted shoots and needles remain attached for one to several years.