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Photo: istockphoto.com

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Apple scab
Venturia inaequalis

Figure 1

Figure 2

Figure 3
Apple scab
Venturia inaequalis

AUTHORS: Joseph Zeleznik and Kasia Kinzer

HOSTS: Apple, crabapple, mountain-ash, pear, hawthorn, cotoneaster

SYMPTOMS
- Early season – Round, velvety, olive-green spots (less than ½ inch) form on leaves and fruit.
- Midsummer – If infection is severe, leaves will turn yellow and fall prematurely.
- Fruit – Spots turn brown and corky through time; fruit may crack and deform.

FIGURE 1 - Infected crabapple leaf, midsummer
FIGURE 2 - Crabapple with thinning crown due to premature defoliation
FIGURE 3 - Early infection of crabapple fruits

MANAGEMENT/OTHER IMPORTANT FACTS
- When possible, plant resistant cultivars. See “Managing Apple Scab in North Dakota Crabapples” (PP1735).
- Raking and removing fallen leaves helps reduce the source of infection for the following season.
- Prune to allow plenty of air movement, and avoid hitting tree leaves with irrigation water.
- Many fungicides are available to prevent this disease, but the spray schedule is intensive.
Ash anthracnose

_Gnomoniella fraxini_

Figure 1

Figure 2

Figure 3

Photo: J. Zeleznik, NDSU
Ash anthracnose

*Gnomoniella fraxini*

**AUTHORS:** Joseph Zeleznik and Kasia Kinzer

**HOSTS:** Ash (*Fraxinus* spp.); especially common in green ash

**SYMPTOMS**

- Leaves may fall from severely infected trees in the spring; tree leaves usually regrow but tree may be stressed.
- Mid- and late-season – Leaves appear deformed, with black, dead margins; living tissue curves around dead areas.
- Leaf surfaces may have small purplish-brown spots.

**FIGURE 1** - Leaves covering the ground are an early season symptom of anthracnose

**FIGURE 2** - Dead leaf margins and curved growth of remaining leaf tissue are typical symptoms

**FIGURE 3** - Small spots of purplish-brown, dead tissue indicate ash anthracnose entered leaves through ash plant bug feeding wounds

**MANAGEMENT/OTHER IMPORTANT FACTS**

- Severe defoliation (greater than 25 percent) several years in a row can stress trees severely. Lightly fertilizing around the tree may help recovery.
- Rake and remove fallen leaves to reduce infection the following season.
- Protectant fungicides are available but the spray schedule is intense and providing good coverage on large trees is difficult.
Black knot of cherry
Apiosporina morbosa

Photo: A. Bergdahl, N.D. Forest Service

Figure 1

Figure 2

Figure 3
Black knot of cherry

*Apiosporina morbosa*

**AUTHORS:** Esther McGinnis and Kasia Kinzer

**HOSTS:** Chokecherry, Mayday tree, plum, other *Prunus* spp.

**SYMPTOMS**
- Small twigs and branches begin to swell, and turn olive green and soft the first year of infection.
- The second year, the swelling enlarges along the twig, resembles coal on a stick (black knot) and is hard.
- Knot-girdled branches may wilt and die.

**FIGURE 1** - Olive-green swelling the first year of infection
**FIGURE 2** - Characteristic sign of black knot
**FIGURE 3** - Black knot girdling the stem

**MANAGEMENT/OTHER IMPORTANT FACTS**
- In late winter, prune out black knots. Remove 6 to 8 inches of healthy wood below the knot; carefully inspect each year for new knots.
- Promptly bury, burn or dispose of pruned wood to prevent the release of fungal spores.
- Protect high-value trees with a fungicide containing active ingredients such as captan or chlorothalonil.
- Remove wild chokecherry and plum trees from nearby hedgerows when possible to protect high-value trees.
Black rot

*Botryosphaeria obtusa*

**Figure 1**

*Photo: A. Bergdahl, N.D. Forest Service*

**Figure 2**

*Photo: University of Georgia Plant Pathology, Bugwood.org*

**Figure 3**

*Photo: J. Zeleznik, NDSU*
Black rot  
*Botryosphaeria obtusa*

**AUTHORS:** Kasia Kinzer and Joseph Zeleznik

**HOSTS:** Apple, crabapple

**SYMPTOMS**
- Small brown to tan, nearly circular spots with darker brown margins (frogeye leaf spot) appear on leaves.
- Dark brown, sunken cankers can form on branches and main stems. Leaves on cankered branches turn bright yellow and eventually die. Cankers can girdle and kill branches and stems.
- On fruit, lesions appear as reddish flecks and expand to blotches with a red halo, then, alternating brown and black rings (black rot). Affected fruit can shrivel and remain attached to the tree.

**FIGURE 1** - Frogeye leaf spot  
**FIGURE 2** - Black rot symptoms on fruit  
**FIGURE 3** - Yellowing leaves indicate a black rot canker

**MANAGEMENT/OTHER IMPORTANT FACTS**
- Remove and destroy mummified fruit and leaf debris to minimize infection the following year.
- Properly prune out infected branches and dead wood when trees are dormant. See “Basic Guidelines for Pruning Trees and Shrubs” (H1036).
- Fungicides are not recommended.
Cedar-apple rust

_Gymnosporangium juniperi-virginianae_

Figure 1

Figure 2

Figure 3

Figure 4

Photo: A. Bergdahl, N.D. Forest Service

Photo: M. Kangas, N.D. Forest Service

Photo: A. Bergdahl, N.D. Forest Service

Photo: A. Bergdahl, N.D. Forest Service
Cedar-apple rust  
Gymnosporangium juniperi-virginianae

AUTHORS: Aaron Bergdahl and Joseph Zeleznik

HOSTS: Apple, crabapple, hawthorn, Juneberry, juniper

SYMPTOMS

• Yellowish-orange lesions develop on leaves and fruit of infected Rosaceous plants. Juniper-infecting spores develop in these lesions.
• New infections on junipers result in small galls (or witches’-brooms) that, in moist conditions, produce orange gelatinous structures, which produce spores that infect Rosaceous hosts.

FIGURE 1 – Gall growth on juniper host
FIGURE 2 – Spore-producing structures on hawthorn
FIGURE 3 – Orange spore-producing structures resulting from cedar-apple rust infection on Juneberry
FIGURE 4 – A witches’-broom caused by Gymnosporangium nividus, a different species of cedar-apple rust found in North Dakota

MANAGEMENT/
OTHER IMPORTANT FACTS

• Do not plant the juniper/cedar and Rosaceous/apple hosts closely together because both are required for infection.
• Picking the galls or pruning the witches’-brooms off junipers may mitigate the disease.
• Several species of this pathogen are found in North Dakota.
• Several crabapple cultivars are resistant to cedar-apple rust.
Cytospora canker of spruce

Valsa kunzei (Leucostoma kunzei)

Figure 1

Figure 2

Figure 3

Figure 4

Photo: A. Bergdahl, N.D. Forest Service

Photo: J. Walla, Northern Tree Specialties
Cytospora canker of spruce

Valsa kunzei (Leucostoma kunzei)

AUTHORS: Aaron Bergdahl and Kasia Kinzer

HOSTS: All spruce trees

SYMPTOMS

• The fungus occurs in wounds or cracks in the bark and kills the cambium tissues.
• Often, a bluish-white sap oozes from the cankered area and dries on infected and nearby branches.
• Newly infected branches often have pale green to yellowish foliage that turns purplish later in the year.

FIGURE 1 - A flagging branch showing discolored foliage consistent with Cytospora infection
FIGURE 2 - Close-up of a branch showing white, hardened spruce pitch that oozed through the wound
FIGURE 3 - Cytospora infection spreading through the crown from the bottom up
FIGURE 4 - Orange spore tendrils emerging from spore-producing structures

MANAGEMENT/
OTHER IMPORTANT FACTS

• Properly space trees when planting; avoid wounding and drought stress.
• Prune out and destroy infected branches during dry weather or in the winter; sanitize pruning tools between cuts.
• Do not locate new spruce plantings near infected trees.
Diplodia tip blight
*Diplodia pinea*

Figure 1

Figure 2

Figure 3

Figure 4

Photo: A. Bergdahl, N.D. Forest Service

Photo: A. Bergdahl, N.D. Forest Service

Photo: A. Bergdahl, N.D. Forest Service
Diplodia tip blight

*Diplodia pinea*

**AUTHORS:** Joseph Zeleznik and Jared LeBoldus

**HOSTS:** Austrian, ponderosa and Scots pines

**SYMPTOMS**
- Recently infected shoots have short, brown, dead needles.
- Resin soaking of shoots is common.
- Fungal fruiting bodies are evident on the scales of mature cones, which otherwise appear normal.

**FIGURE 1** - Healthy shoot (L – normal needles) and infected shoot (R – short, dead needles) of ponderosa pine

**FIGURE 2** - Healthy cone scales

**FIGURE 3** - Cone scales showing black fungal fruiting bodies

**FIGURE 4** - Infected tree with flagging branches

**MANAGEMENT/OTHER IMPORTANT FACTS**
- New infections of current-year needles and shoots usually occur in late spring or early summer.
- This fungus can live asymptometrically in pine trees and does not kill trees until they become stressed or damaged.
- Fungicides will prevent new infections but will not cure old infections. Apply copper hydroxide + mancozeb, propiconazole, copper salts or thiophanate methyl as new growth is emerging.
Dutch elm disease

*Ophiostoma ulmi* and *O. novo-ulmi*

Figure 1

Figure 2

Figure 3

Photo: J. LeBoldus, Oregon State Univ.

Photo: A. Bergdahl, N.D. Forest Service

Photo: A. Bergdahl, N.D. Forest Service
Dutch elm disease

*Ophiostoma ulmi* and *O. novo-ulmi*

**AUTHORS:** Esther McGinnis and Kasia Kinzer

**HOSTS:** Elm species native to North America

**SYMPTOMS**

- Leaves on upper branches turn yellow and wilt when infection is transmitted by elm bark beetles.
- Infections in lower, larger branches are usually caused by root grafting from neighboring trees.
- Brown streaking may be visible in the sapwood when bark is removed from small twigs and branches.

**FIGURE 1** - Branches turning yellow and flagging

**FIGURE 2** - A healthy (A) and infected (B) American elm branch

**FIGURE 3** - Dead elm trees next to an infected tree; infection likely spread by root grafting

**MANAGEMENT/OTHER IMPORTANT FACTS**

- Dutch elm disease kills trees by clogging the water-carrying vascular tissues.
- Promptly remove and destroy infected trees.
- Immediately dispose of infected elm wood by burning, burying, chipping or debarking the logs.
- Fungicides may be injected into healthy elms every three years to protect high-value trees; fungicides with the active ingredients thiabendazole and propaconazole are most effective.
- See “Dutch Elm Disease in North Dakota” (PP1635).
- Plant only Dutch elm disease-resistant elm trees; resistant selections are available but none are completely immune.
Eutypella canker of maple

Eutypella parasitica

Figure 1: Photo: A. Bergdahl, N.D. Forest Service

Figure 2: Photo: J. Zeleznik, NDSU
Eutypella canker of maple

_Eutypella parasitica_

**AUTHORS:** Joseph Zeleznik and Jared LeBoldus

**HOSTS:** All maple species

**SYMPTOMS**

- Cankers are usually in the lower portion of the tree and grow slowly for several years; cankers may develop around branch stubs, wounds or sunscald areas.
- Newer cankers under the bark may not be visible until the area becomes sunken.
- In older cankers, the bark falls off, revealing concentric rings like a bull’s-eye.
- Black spore-producing structures often are visible on old cankers.

**FIGURE 1** – A Eutypella canker on a sun-scalded maple; note the characteristic concentric rings

**FIGURE 2** – A sunken canker on Norway maple

**MANAGEMENT/OTHER IMPORTANT FACTS**

- Avoid wounding the trunks of maple trees, and do not leave branch stubs when pruning. See “Pruning Trees and Shrubs” (H1036).
- Prune out and dispose of all infected branches.
- Small-diameter trees typically are killed by Eutypella.
- No chemical control of this disease is recommended.
- Large, old cankers may destroy the structural integrity of the tree; consult an arborist for a risk assessment.
Fireblight
*Erwinia amylovora*

Figure 1

Figure 2

Figure 3
Fireblight

*Erwinia amylovora*

**AUTHORS:** Esther McGinnis and Kasia Kinzer

**HOSTS:** Apple, cotoneaster, crabapple, mountain ash, hawthorn and other rose family plants

**SYMPTOMS**

- Young shoots wilt and droop, forming a distinctive “shepherd’s crook.”
- Leaves turn brown as if scorched.
- Fruit may turn dark and shriveled and persist on the branch.
- Slightly sunken bark cankers may appear on branches and stems.

**FIGURE 1** – Distinctive “shepherd’s crook” on cotoneaster

**FIGURE 2** – Scorched appearance of crabapple leaves

**FIGURE 3** – Shriveled cotoneaster fruit

**MANAGEMENT/OTHER IMPORTANT FACTS**

- Plant less susceptible apple and crabapple cultivars.
- Mark infected twigs with ribbon or paint during the growing season.
- Prune all marked twigs and cankered branches in late winter at least 8 to 12 inches below the infection.
- Prune a severely diseased cotoneaster hedge to 6 inches above the ground in late winter.
- Avoid excessive application of fertilizer that may promote overly lush growth.
- Apply a copper spray just as the leaf buds are starting to swell in the spring on high-value trees.
Herbicide damage

Figure 1

Figure 2

Figure 3

Figure 4
Herbicide damage

AUTHORS: Aaron Bergdahl and Joseph Zeleznik

HOSTS: Deciduous trees and conifers

SYMPTOMS
• Abnormal growth, necrosis, blistering and discoloration occurs in plant tissues.

FIGURE 1 - Leaf cupping of elm due to exposure to growth regulator-type herbicides

FIGURE 2 - Strapping of leaves (oak), and discoloration and growth defects (spruce) due to glyphosate exposure

FIGURE 3 - Yellowing leaf tissue and between-vein necrosis due to photosynthesis inhibitor-type herbicides (resembles iron chlorosis)

FIGURE 4 - Spiral pattern of abnormality on spruce due to direct exposure of broadleaf weed control herbicide (dicamba) to a mower-wounded root; pattern of damage indicated by the orange lines below the discolored needles

MANAGEMENT/
OTHER IMPORTANT FACTS
• Always read and follow the product label when applying herbicides.
• Avoid applying herbicides during windy conditions to prevent herbicide drift.
• Avoid applying broadleaf herbicides on warm days.
• The use of farm-grade chemicals for broadleaf weed control on lawns has killed even mature trees.
Iron chlorosis

Figure 1
Photo: E. McGinnis, NDSU

Figure 2
Photo: E. McGinnis, NDSU

Figure 3
Photo: J. Zeleznik, NDSU
Iron chlorosis

AUTHORS: Esther McGinnis and Kasia Kinzer

HOSTS: Freeman maples, silver maple, river birch, Swedish columnar aspen

SYMPTOMS
- Leaves turn yellow-green or bright yellow but veins remain green.
- Leaf margins may turn brown and appear scorched.
- Twigs and branches may die back from the crown.

FIGURE 1 – River birch leaf with interveinal chlorosis
FIGURE 2 – Swedish columnar aspen leaf with bleached interveinal areas
FIGURE 3 – Branch dieback on silver maple

MANAGEMENT/OTHER IMPORTANT FACTS
- Iron chlorosis is caused by an iron deficiency associated with alkaline and wet soils, and cool temperatures.
- Foliar sprays of chelated iron may provide quick green-up of the foliage, but this treatment is temporary and trees do not always respond.
- Apply iron chelate products to the soil or inject them into trees for longer-lasting relief.
- Broadcasting soil acidifiers (elemental sulfur, iron sulfate) onto the soil may lower its pH.
- Replace iron-deficient trees with those better adapted to alkaline soils.
Melampsora leaf rust of cottonwood, aspen and willow

*Melampsora* spp.

**Figure 1**

Photo: J. Zeleznik, NDSU

**Figure 2**

Photo: W. Jacobi, Colorado State University, Bugwood.org
Melampsora leaf rust of cottonwood, aspen and willow

*Melampsora* spp.

**AUTHORS:** Joseph Zeleznik and Jared LeBoldus

**HOSTS:** Aspen, cottonwood, hybrid poplar and larch

**SYMPTOMS**

- Bright orange spores appear on both sides of the leaf.
- Premature leaf drop (as early as July) may occur on severely infected clones.
- The orange spores turn brown to black by the end of the summer and are prevalent on fallen leaves.

**FIGURE 1** - Infected leaf showing spore structures

**FIGURE 2** - Cottonwood leaf infected by Melampsora rust

**MANAGEMENT/OTHER IMPORTANT FACTS**

- Melampsora rust diseases require larch trees to complete their life cycle. However, one spore type (urediniospores) can cause a continuous cycle of reinfection on poplar trees alone.
- Premature defoliation in successive years can reduce a tree’s vigor and contribute to the decline of susceptible trees.
- Protectant fungicides such as triadimefon can help prevent infection.
- Plant resistant cultivars of hybrid poplar (e.g., Norway, Robusta and Imperial).
Oak anthracnose
*Apiognomonia quercina*

Figure 1

Photo: M. Kangas, N.D. Forest Service

Figure 2

Photo: M. Kangas, N.D. Forest Service

Figure 3

Photo: M. Kangas, N.D. Forest Service
Oak anthracnose
 Apiognomonia quercina

AUTHORS: Aaron Bergdahl and Jared LeBoldus

HOSTS: Bur and other oak species

SYMPTOMS

- Leaf blight produces necrotic lesions on susceptible leaf tissue, and distortions may occur around the necrotic lesions.
- Shoot blight occurs as new, expanding shoots are infected and killed quickly, yielding a scorched appearance.
- Numerous shoots interior to dead twigs and buds are a common symptom of previous infection.

FIGURE 1 – Lower portion of an oak tree affected by oak anthracnose
FIGURE 2 – Distorted and necrotic leaves resulting from oak anthracnose infection
FIGURE 3 – Evidence of repeated twig dieback from oak anthracnose

MANAGEMENT/
OTHER IMPORTANT FACTS

- Rake and dispose of leaves in the fall.
- Wet spring weather drives disease development.
- Plant and prune for more air movement.
- Chemical control may be warranted for aesthetically important trees or those with severe infections for consecutive years.
- Use fungicides at properly timed intervals.
- Avoid planting oak seedlings in the understory of older infected oaks.
Oak leaf blister
*Taphrina caerulescens*

**Figure 1**
Photo: M. Kangas, N.D. Forest Service

**Figure 2**
Photo: A. Bergdahl, N.D. Forest Service

**Figure 3**
Photo: D. Stevens, Bugwood.org
Oak leaf blister
*Taphrina caerulescens*

**AUTHORS:** Aaron Bergdahl and Jared LeBoldus

**HOSTS:** Bur and other oak species

**SYMPTOMS**
- Leaf blisters appear as wrinkled, distinctly raised, unusually lighter-colored bulges on the upper leaf surface. The tissue turns brown later in the year, making leaves appear tattered.
- Unlike with oak anthracnose, multiple cycles of the disease will not occur.
- Severely blistered leaves may curl and fall from the tree prematurely.

**FIGURES 1 and 2** - Oak leaf blister symptoms on bur oak

**FIGURE 3** - Close-up of a blister on an oak leaf

**MANAGEMENT/OTHER IMPORTANT FACTS**
- Disease symptoms are more prominent in the lower, shaded portions of the crown.
- Cool, moist weather in spring enhances disease development.
- Avoid planting oak seedlings in the understory of older infected oaks.
- Chemical control may be warranted for trees that have experienced severe infection for consecutive years or are high-value/aesthetically important.
- Fungicides labeled for control in North Dakota must be applied just before budbreak to be effective.
Plum pockets and leaf curl
*Taphrina communis*

**Figure 1**

Photo: A. Bergdahl, N.D. Forest Service

**Figure 2a**

Photo: A. Bergdahl, N.D. Forest Service

**Figure 2b**

Photo: A. Bergdahl, N.D. Forest Service
Plum pockets and leaf curl  
*Taphrina communis*

**AUTHORS:** Aaron Bergdahl and Esther McGinnis

**HOSTS:** Plum, other *Prunus* spp.

**SYMPTOMS**
- Early infection of fruit first appears as small white spots that enlarge, eventually infecting the whole fruit.
- Fruit is unusually enlarged, discolored and “puffy;” leaves can be curled/distorted.

**FIGURE 1** - (A) A diseased fruit infected with the plum pockets fungus and (B) a healthy fruit

**FIGURE 2** - (a) A spongy early season infected fruit beginning to disseminate spores that turns hard and mummified (b) and will persist on the tree through the winter

**MANAGEMENT/OTHER IMPORTANT FACTS**
- Taphrina diseases have only one infection cycle per year.
- Infection sources include spores that lay dormant on/near buds and mummified fruits that disseminate spores via rain splash and wind.
- Remove and destroy mummified fruits.
- Apply a Bordeaux mixture or chlorothalonil to all parts of the tree when temperatures are above freezing but before buds begin to swell.
Powdery mildew of lilac

*Erysiphe syringae*

**Figure 1**

Photo: W. Upham, Kansas State Univ., Bugwood.org

**Figure 2**

Photo: M. Shomaker, Colorado State Forest Service, Bugwood.org
Powdery mildew of lilac

*Erysiphe syringae*

**AUTHORS:** Esther McGinnis and Aaron Bergdahl

**HOSTS:** Lilac spp.

**SYMPTOMS**

- Leaves develop grayish-white powdery-looking spots or blotches. Dark spore-producing structures are visible in the powdery areas.
- Symptoms are most common on the upper surfaces of leaves but also may appear on the lower surface.
- The condition worsens in late summer and fall.

**FIGURE 1** - Powdery mildew on the upper surface of a lilac leaf

**FIGURE 2** - Powdery mildew on both leaf surfaces

**MANAGEMENT/OTHER IMPORTANT FACTS**

- Powdery mildew is extremely common on lilacs and usually does not affect plant health.
- The disease is more likely to occur in high humidity, but rainfall isn’t required for the disease to develop.
- Plant lilacs in full sun with good air circulation.
- Prune crowded plantings to improve airflow.
- Avoid fertilizing lilacs after July 4.
- Fungicides are usually not necessary, but in severe cases, wettable sulfur, thiophanate-methyl or chlorothalonil may be applied.
Rhizosphaera needle cast of spruce

*Rhizosphaera kalkhoffii*

Figure 1

Figure 2

Figure 3

Photo: A. Bergdahl, N.D. Forest Service

Photo: N.D. Forest Service

Photos: J. Walla, Northern Tree Specialties
Rhizosphaera needle cast of spruce

*Rhizosphaera kalkhoffii*

**AUTHORS:** Aaron Bergdahl and Jared LeBoldus

**HOSTS:** Blue and white spruce

**SYMPTOMS**
- In the spring, round, smooth, spore-producing structures appear on infected needles
- Infected needles may turn yellow, then brown.

---

**FIGURE 1** - Very low needle retention in the lower portions of trees can indicate needle cast

**FIGURE 2** - I: Current-year needles infected but do not show symptoms. II: Second-year needles, infected last year, begin to show discoloration; spore-producing structures appear on some needles. III: Most needles have been cast; the rest contain many spore-producing structures. IV+: Most 4-year-old and older needles have dropped

**FIGURE 3** - Close-up of a healthy needle (L) and an infected needle with round spore-producing structures (R)

**MANAGEMENT/OTHER IMPORTANT FACTS**
- Needle cast diseases require moisture for infection and spread, so improve spacing and airflow.
- Avoid wetting of foliage during irrigation.
- Protect needles for two months after budbreak with chlorothalonil or Bordeaux mixture. Apply when new needles are 50 percent elongated in the spring; repeat one month later. Repeat treatment two consecutive years.
- See “Two Needle Diseases of Spruce” (F1680).
Salt injury

Figure 1
Photo: J. Zeleznik, NDSU

Figure 2
Photo: K. Froelich, NDSU

Figure 3
Photo: J. LaForest, Univ. of Georgia, Bugwood.org
Salt injury

AUTHORS: Joseph Zeleznik and Aaron Bergdahl

HOSTS: All trees and shrubs, deciduous and conifer

SYMPTOMS
• On leaves and needles, tip dieback is common.
• On deciduous trees and shrubs, leaves also can become two-toned, from deep green to yellow.
• On conifers, salt damage is seen as browning of needle tips. Symptoms are often increasingly severe with increasing needle age class.
• De-icing salt damage to conifers occurs at the point of contact and may not appear as brown needle tips.

FIGURE 1 - A common lilac bush showing symptoms of salt injury
FIGURE 2 - Increasing tip burn on older age classes
FIGURE 3 - Injury from de-icing salts on yew

MANAGEMENT/OTHER IMPORTANT FACTS
• Improve drainage to help decrease salinity problems.
• Utilize more salt-tolerant trees and shrubs in salt-prone areas.
• When watering, use nonsaline water; apply enough for deep, internal drainage of excess salt. Do not allow water to pond at the base of trees.
• Use products such as calcium chloride or calcium magnesium acetate instead of de-icing salts.
• Protect susceptible plants with a physical barrier.
Septoria leaf spot and stem canker

*Septoria musiva*

Figure 1: Photo: J. LeBoldus, Oregon State Univ.

Figure 2: Photo: J. LeBoldus, Oregon State Univ.

Figure 3: Photo: M. Kangas, N.D. Forest Service
Septoria leaf spot and stem canker

*Septoria musiva*

**AUTHORS:** Jared LeBoldus and Aaron Bergdahl

**HOSTS:** Cottonwood, poplar

**SYMPTOMS**

- Leaf spots are small and angular, sometimes coalescing to form large spots, and may vary from small, silvery white spots to larger, circular spots with tan centers and yellow to black margins.
- Small black dots (pycnidia) may appear in the center of the leaf spots and produce spores that cause new infections.
- Severely infected leaves may fall prematurely (as early as July).
- Cankers are often flat-faced with swollen margins, and the bark over young cankers is dark brown or black.

**FIGURE 1** - Leaf spot symptoms

**FIGURE 2** - Stem canker on young branch of hybrid poplar

**FIGURE 3** - Premature defoliation due to infection by Septoria leaf spot

**MANAGEMENT/OTHER IMPORTANT FACTS**

- Poplar clones vary in susceptibility.
- Plant resistant poplar clones.
- In landscape plantings, leaf litter cleanup in the fall may help reduce inoculum the following spring.
Stem girdling roots

Figure 1

Figure 2

Figure 3
Stem girdling roots

AUTHORS: Joseph Zeleznik and Esther McGinnis

HOSTS: All tree species

SYMPTOMS

• Leaves are smaller than normal, appear scorched and drop early.
• The crown thins and turns fall colors early, and branch ends and main branches/leaders die.
• The trunk leans and is flattened on one side near the base or doesn’t taper where it enters the soil.

FIGURE 1 - Large green ash tree with stem-girdling roots well-formed, but damage to the stem just beginning
FIGURE 1 - Stem-girdling roots helped kill this maple tree
FIGURE 2 - The large stem-girdling root (red arrow) structurally weakened this linden tree’s stem (white arrow)

MANAGEMENT/OTHER IMPORTANT FACTS

• Prevention is the key to management. Remove all potentially girdling roots before planting.
• Remove roots that are not yet girdling the tree. Cut the root cleanly with a sharp tool and avoid injuring the underlying stem tissue.
• Removing the whole tree may be necessary.
Stigmina needle cast of spruce

*Stigmina lautii*

Figure 1

Photo: A. Bergdahl, N.D. Forest Service

Figure 2

Photos: A. Bergdahl, N.D. Forest Service

Figure 3

Photos: A. Bergdahl, N.D. Forest Service
Stigmina needle cast of spruce

Stigmina lautii

AUTHORS: Aaron Bergdahl and Kasia Kinzer

HOSTS: Colorado blue spruce and white spruce

SYMPTOMS

• Needle loss and branch dieback occur from the bottom up.
• Discolored needles typically remain attached to the tree for another year.
• Microscopic spore-producing structures appear as black, fuzzy, round masses in needle pores.

FIGURE 1 - Needle loss and branch dieback

FIGURE 2 - I: Current-year needles infected but do not show symptoms. II: Second-year needles, infected last year, begin to show discoloration; spore-producing structures appear on some needles. III: Most needles have been cast; the rest contain many spore-producing structures. IV: Most needles have dropped

FIGURE 3 - Close-up of a healthy needle (L) and an infected needle (R)

MANAGEMENT/
OTHER IMPORTANT FACTS

• Needle cast diseases require moisture for infection and spread, so improve spacing and airflow.
• Avoid wetting of foliage during irrigation.
• Protect needles with chlorothalonil for two months after budbreak; repeat every year for 4 to 5 years for high value trees.
• See “Two Needle Diseases of Spruce” (F1680).
Winter injury of evergreen

Figure 1
Photo: J. Zeleznik, NDSU

Figure 2
Photo: J. Zeleznik, NDSU

Figure 3
Photo: S. Markell, NDSU

Figure 4

Winter injury of evergreen

AUTHORS: Esther McGinnis and Joseph Zeleznik
HOSTS: Arborvitae, juniper, pine, spruce

SYMPTOMS
• Evergreen foliage turns rusty-brown in the spring following winter injury.
• Foliar damage often appears on the tree portion above the snow line, the side facing prevailing winds or the side facing the sun.
• In some cases, the dead needles are found throughout the crown and do not follow a pattern.

FIGURE 1 – Winter injury above the snow line
FIGURE 2 – Winter injury showing a directional pattern
FIGURE 3 – Close-up of needles
FIGURE 4 – Recovery is possible from new growth

MANAGEMENT/
OTHER IMPORTANT FACTS
• Plant evergreens that are hardy in North Dakota.
• Winter injury usually only kills the foliage and recovery is possible from the buds; wait to see if new growth emerges before pruning branches.
• Decrease watering from early August to mid-September to allow buds and shoots to harden up for winter; resume watering in mid-September and into late fall until the ground freezes.
• Construct a burlap windbreak on the windward side to protect yews and arborvitae.