Stem diseases:

Cankers of conifers

Canker: A disease that causes the death of definite and relatively localized areas of bark on branches or trunks of trees. Repeated callusing is necessary before a lesion can be classed as a canker.

Plant callus: is a mass of unorganized parenchyma cells derived from plant tissue. Callus cells are those cells that cover a plant wound.

Causes of cankers

Most cankers are of fungus origin, but they can also be caused by non-infectious agents such as frost, sunscald, or illuminating gas. Death of the bark and cambium is followed by death of the underlying wood, although the casual organism may or may not penetrate the wood.

Damages caused by cankers

- Kill of the bark to the cambium
- Superficial lesions with little damage
- Roughening the bark
- Slough off the bark exposing the wood

Types of cankers

Cankers are categorised on different bases:

1. **According to their age:**
    - **Annual cankers:** the agency that causing the disease is operative for one season only. The injured tissues then being sloughed off or grown over by a single callus in the same way that a mechanical injury is healed.

- **Perennial cankers:** Most destructive and conspicuous. The casual agency functions year after year. With fungal infections, little or no callus is formed, and therefore the stem girdled.

Girdling: is the process by which stem or branches disintegrate the plant tissue around a stem or a branch in a canker area of the perennial canker making this area weaker and narrower than normal stem.

2. **According to their appearance:**
   - **Sunken:** the canker is going inward of the stem
   - **Swollen:** the stem is going outward and swollen
3. **According to their shape:**
   - **Regular (concentric or target):** A perennial canker of long standing is produced that persists without girdling the stem. The host develops new calluses around the advancing border of the lesion is killed until the canker consists of more or less regular concentric ridges around the point of first infection (figure A).
   - **Irregular:** They are broken in outline resulting in misshapen canker swollen in some places and sunken in others. These cankers often result in an unusual or even crooked trunk owing to the killing of the diseased region and the continued growth of the healthy portion of the trunk (figure B).

A

B

Examples of cankers on conifers

Cytospora Canker

- Cytospora canker is caused by several species of fungi in the Genus *Cytospora.*
- The disease occurs on woody shrubs and trees or parts of plants that are slightly stressed.
- Many trees are affected by this disease (apple, ash, aspen, birch, cottonwood, elm, maple, peach, spruce, willow).
- The canker-causing fungi cause girdling of the plant, killing the plant above the canker.
- To manage the disease, reduce stress on trees, use resistant plants, remove infected limbs, clean wounds and prune properly.

Figire 1. Orange discoloration found in spring and early summer associated with cytospora canker.

Cytospora canker is caused by various species of the fungus *Cytospora*. These pathogens affect many species of shrubs and trees in Colorado, including aspen, cottonwood, lombardy and other poplars, apple, cherry, peach, plum, birch, willow, honeylocust, mountain ash, silver maple, spruce and Siberian elm. Some *Cytospora* species are host specific while other species can infect several different tree species. For example, cottonwoods and aspen are susceptible to one specie. Willow, green ash, alder and elm, however, are attacked by Cytospora species that are host specific. Further work is needed to clarify the various host and fungal relationships.

Figure 2. Cytospora canker on three branches, each with scattered pycnidia.

Figure 3. Orange spores oozing from pycnidia.

The fungus attacks trees or parts of trees that are injured or in a weak or stressed condition. The fungus grows in the living bark (phloem) and wood (xylem) and kills by girdling the branch or tree. The fungus can attack tree bark during the fall-winter spring seasons when temperatures are warm but the tree is dormant and cannot defend itself. Trees affected by drought, late spring frosts, insect and fungi defoliation, sunscald, herbicides, or mechanical injury are susceptible to Cytospora infection. The disease especially affects trees with root damage, which are often found in areas under construction, or trees that recently have been transplanted. Stands of aspen that have been thinned and young aspen sprout stands may suffer from Cytospora canker.

Symptoms

The symptoms of this disease are yellow or orange-brown to black discolored areas on the bark of the trunk and branches (Figure 1). Liquid ooze on aspen and gummy ooze on peach and cherry are common. Cankers, sunken dead areas of bark with black pinhead-sized speckling or pimples, may be evident (Figure 2). The pimples are the reproductive structures of the fungus. Under moist conditions, masses of spores (seeds) may ooze out of the pimples in long, orange, coiled, thread-like spore tendrils (Figure 3). Reddish brown discoloration of the wood and inner bark also may be evident. Dead bark may remain attached to the tree for several years, then fall off in large pieces.

On spruce trees, the disease appears as sunken, resinous areas surrounded by swollen callus giving a gall-like appearance. Small black fruiting bodies may occur on the canker. Once the branch is girdled, needles may yellow or redden. The branch eventually dies. Large amounts of resin flow from infected areas, coating branches and stems. Unless you see sunken areas surrounded by swollen callus, resin flow on spruce may indicate that other stresses, diseases or Insects are affecting the tree.

Control

1- Maintain high tree vigor. Trees should be watered deeply during dry summer months to prevent drought stress. Fertilize in the spring to keep trees vigorous. Avoid late summer applications of nitrogen because it stimulates growth in autumn which does not harden off before winter. Trees stressed with iron chlorosis are particularly susceptible to Cytospora infections. The roots of birch trees are quite shallow and are damaged or killed by high soil temperatures and drought on south or west facing slopes. Keep soil cool and moist by frequent irrigation.

2- Prevent stress on the tree. Drought and oxygen starvation of roots by flooding soil with water are the two most common stresses that predispose trees to Cytospora infection. To help a tree resist infection, prepare soil before planting, fertilize, water properly for winter and summer, prune, and avoid injury to the trunk and limbs. Proper care of recently transplanted trees also is essential to avoid stress and infection.

3- Avoid wounds caused by lawnmowers and weed trimmers are prime targets for infection on trees in landscaped areas. Insects, such as oystershell scale, stress the tree and predispose it to cytospora infection. Insects should be controlled to prevent mortality by the combined stress of the insects and Cytospora canker.

4- The use resistant species or varieties in new plantings. It is still important to keep all trees healthy since resistant trees may still become infected if severely stressed. Purchasing healthy nursery stock will decrease the possibility of infection. Once infection occurs, the best treatment is to increase plant vigor and sanitation. Remove all infected limbs and other areas. When removing branches, make a smooth cut at the base of the limb, as near the trunk as possible, without damaging the branch collar (swollen area at base of branch). Jagged and rough cut surfaces promote infection.

5- Clean wounds to avoid further spread of infection. Remove dead bark to dry out the diseased area and help the tree defend itself against insect and fungal attacks on the cankered area. Directions for proper wound and canker treatment are as follows:

6- Prune out and destroy dead or diseased twigs and branches. Do not leave stubs or narrow crotches. Prune on a regular basis so that large cuts will not be necessary. Pruning wounds are susceptible to infections, so prune in the early spring and not when rain is imminent. Treat pruning cuts larger than one inch in diameter with a paint of 1% thiram or 3-10% Copper Naphthenate. Asphalt pruning paints are not effective. An application of benomyl as a spray immediately following the pruning of a fruit orchard may reduce new infections. Benomyl is no longer registered for use on ornamental trees.

7- Prevent sunscald by painting the trunk of thin-barked trees with white latex paint. The trunks of newly planted trees should be wrapped with burlap or white-colored tree wraps to prevent sunburn. These techniques will also reduce winter damage which occurs on the southwest side of trunks.

8- Control borers and other wood-attacking insects.

Stem diseases: Cankers of hardwoods

Black Knot of Ornamental Cherry and Plum

Black knot is a serious disease of plum and cherry trees (*Prunus* species) throughout the United States. Black knot is a disease that gets progressively worse each year unless controlled, and it will eventually stunt or kill the tree. It is frequently seen in the woods on wild black cherry (Prunus serotina) and in orchards that are not sprayed regularly. Hosts include American, European, and Japanese cultivars of plums. Although wild black cherry is a very common host, damage is less severe on sweet and sour cherries. Apricots, peaches, and flowering almonds are occasionally damaged.

Symptoms

The most obvious signs of the disease are the hard, black, swollen galls, commonly called knots, on branches and twigs. Black knot also infects fruit spurs, and sometimes trunks. Infected trees may produce few flowers or fruit. Usually infection originates in the newest growth, causing small twigs to die. The conspicuous black gall does not appear until the second year of infection. As the knots grow they eventually cut off the flow of water and nutrients to the branches, causing stunting, wilting, and dieback. Gradually the entire tree may weaken and die if the severity of the disease increases.

Disease cycle

Black knot is caused by the fungus *Dibotryon morbosum* (formerly called *Apiosporina morbosa*). Spores are released from mature knots from early spring to early summer, and carried by wind and rain. The fungus enters the plant, usually on the youngest growth, either through wounds or by penetrating the bark. Most infections occur under wet conditions when the temperature is between 55 and 77 degrees F. Plants are most susceptible when they are blooming. By autumn, light-brown swellings appear on twigs, which eventually rupture as they enlarge. The following spring, the rapidly growing knots are covered with a velvety, olive-green fungal growth. They become larger and darker over the summer. By fall, they are hard, rough, and black. Slowly the knots enlarge and girdle the twig or branch, killing it. It may take the twigs or branches several years to girdle and die.

Control

- Plant resistant species. Japanese plum varieties are less susceptible than most American species. Purchase disease-resistant trees that are free of abnormal swellings or visible knots.
- Pruning is the most important control measure. Research has shown pruning can reduce infection by 80%. Prune off all knots in late winter or early spring before growth starts. Bury, burn, or compost all discarded plant material. Pruning cuts should be made at least four to eight inches below any swellings or knots because the fungus grows beyond the edge of the knot. Pruning tools should be sterilized between cuts using 1 part bleach to 4 parts water.
- Apply a delayed dormant oil spray just before bud break to destroy spore-bearing structures. This must be applied for two consecutive years since black knots produce spores for at least that long.
- Fungicides containing copper can show some effectiveness when sprayed 4 times according to label directions. Begin at bud break, again at pink bud, after petal fall, and then two or three weeks after the third spray, or until mid-June.

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Septoria canker of poplar

Economic impact

This fungus causes severe cankering and dieback exotics and hybrids, and has resulted in extensive losses in hybrid *Populus* plantings. Although trees of all ages are susceptible, the canker stage is restricted to the bark on younger stems and branches.

Symptoms

Because of the wide variation in host reaction to stem infection among the different hybrid poplar clones, no distinctive canker can be described. In addition, rapid invasion by secondary fungi tends to mask the presence of this organism. Leaves on the young basal shoots and lowest branches are most commonly infected. Necrotic leaf spots of various sizes appear soon after the leaves develop, about 3-4 weeks after the buds open. These lesions are brown with yellowish-white centres. Small black pycnidia develop through the lesion on both leaf surfaces. The spots rapidly increase in size and number and, under moist conditions; curled pink tendrils of conidia are seen.

On young, vigorously growing shoots, a series of cankers appears; these are dark-brown with black margins and have light-tan centres which may bear inconspicuous brown pycnidia about 4 weeks after infection. These infections are usually less than 1 m from the ground.

On very susceptible hosts, a recent infection appears slightly sunken with several slightly raised irregularly concentric rings of unbroken bark. The cankers may be distinguished from those caused by *Cytospora* and *Nectria* on the basis of sporulating bodies of these fungi, although it is possible that advanced cankers may result from a combined attack of *Septoria* and these fungi.

Stems less than 2 cm in diameter are usually girdled within the season. On larger stems, the wood is killed inward to the pith, producing a flattened canker,

swollen at the sides and distorting the stem. On more resistant clones, lesion development is slow and callus formation occurs.

The pathogen

The disease is caused by the fungus *Septoria musiva* (perfect stage is *Mycosphaerella populorum*). The fungus produce pycnidia. Pycnidia dark-brown, globose or depressed, 45-105 µm wide, with thin walls. Conidia hyaline, cylindric, straight or slightly curved variously septate (1-6) 17-56 x 3-4 µm. Spermogonia dark and globose. Asci cylindrical, short stipitate, 51-73 x 12-17 µm. Ascospores hyaline, 1-septate, 17-24 x 3-6 µm.

Under natural conditions, *M. populorum* spreads by ascospore dispersal and wind-borne conidia. In international trade, *M. populorum* is liable to be carried on infected seedlings, cuttings or cankered bark of older trees, or infected bark on logs or sawn wood.

Control

1- In nurseries, several applications of a protective fungicide (such as benomyl) can help to reduce the impact of the disease
2- Planting of resistant clones remains the most effective control measure.
3- Ploughing reduces the inoculum levels by turning infected leaves under the soil surface but is not sufficient as such.