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Cankers on Western Quaking Aspen

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Quaking aspen (*Populus tremuloides* Michx.) is one of the most well-known tree species in the western United States (figure 1). It is found from the northern limit of trees in northwestern Alaska through the western United States and into northern Mexico. Quaking aspen is an aggressive pioneer species that frequently colonizes burned sites, making it an important component of many western ecosystems.

Aspen reproduces primarily by means of root suckers produced from buds on shallow roots. Over much of its western range, quaking aspen is a small to medium-sized, fast-growing, and generally short-lived tree. The species reaches its most splendid development in the Rocky Mountains of southern Colorado and northern New Mexico, where some individual trees can attain diameters of up to .9 m (3 ft) and a height of 30.5 m (100 ft), and often live for more than 150 years. However, average trees are considerably smaller and many stands begin to deteriorate after 80 years.

Figure 1 – *Aspen stand with trees damaged by black canker.*

Long appreciated for its esthetic and shade tree value and its importance for wildlife, aspen is also capable of excellent growth and high yields and thus is an important commercial tim-

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ber species. However, aspen has one major drawback—its soft bark is easily wounded by abiotic factors, animals, and insects. Subsequently, these wounds can be invaded by disease organisms. In some areas of the Rocky Mountains, for example, elk gnaw extensively on the bark, leading to rapid deterioration of the stand. However, canker diseases are by far the most serious causes of tree mortality.

Canker diseases are among the primary agents in creating snags and creating infection sites for decay fungi. In turn, standing "dead and down" woody material provides biological diversity in stands and serves as habitat for cavity-nesting animals and birds. Endemic levels of infection by these organisms are essential to maintaining a balanced ecosystem and serve an important role in the dynamics and ecology of aspen stands.

Canker Fungi

Several wound-invading fungi cause the majority of damage to aspen. The taxonomy of some of these organisms has changed in recent years and several scientific and common names are in use (table 1).

Life History

Records indicate that aspen cankers, with the exception of hypoxylon canker, are found throughout the western United States (table 1). Surveys of sites in Colorado showed the following cankers present: sooty-bark canker encountered on 93% of sites sampled, cryptosphaeria canker on 83%, and black canker on 80%. The following incidences of canker were found on almost 3,000 live trees: sooty-bark, 1.1%; cryptosphaeria, 1.1%; and black, 4.4%. More than half of the tree mortality was attributed to sooty-bark canker and one-fourth to

Table 1—*Common names of cankers and scientific names of fungi inciting the disease in western aspen**

Preferred common name	Other common names	Scientific name
Sooty-bark canker	Cenangium canker	*Encoelia pruinosa* (Ellis & Everh.) Torkelson & Eckblad (= *Cenangium singulare*)
Cryptosphaeria canker	Snake canker	*Cryptosphaeria populina* (Pers.) Sacc.
Black canker	Ceratocystis or target canker	*Ceratocystis fimbriata* Ellis & Halst.
Cytospora canker		*Cytospora chrysosperma* (Pers.:Fr.)
Hypoxylon canker		*Hypoxylon mammatum* (Wahlenberg) J.H. Miller

* Hawksworth FG, Gilbertson RL, Wallis GW. 1985. Common names for tree diseases in the western United States and western Canada. In: Proceedings, 23rd Annual Western International Forest Disease Work Conference, 1984 September 25–28; Taos, NM. 37 p. (suppl.)

cryptosphaeria canker. Black canker was found on only 9% of the dead trees but was not considered responsible for tree mortality in every case. Hypoxylon canker was not found on sites examined in this survey but was observed in earlier surveys. Cytospora canker was not included in these surveys because the fungus is not a primary parasite on healthy trees, although it is commonly found on injured and stressed trees.

Life Cycle

Sooty-bark canker: Sooty-bark canker, the most lethal canker on aspen in the West, is considered the most serious, for it tends to occur on the larger trees on all sites. It is found mainly on overmature trees (over 120 years old) but can kill all sizes, usually within 3 to 10 years. Cankers are most common in stands where the incidence of wounding is high.

The fungus infects trees through wounds and invades the inner bark and cambium. Cankers develop rapidly, extending as much as 1 m (3 ft) in length and .3 m (1 ft) in width in a year. However, the mean annual extension vertically is .4 m (18 in) and .2 m (6 in) horizontally. Young cankers first appear on the bark as sunken oval areas. Formation of callus around canker margins is unusual, as host tissues are rapidly colonized by the fungus. The bark killed each year by the fungus is readily apparent and begins to slough after 2 or 3 years, exposing the blackened inner bark. This dead inner bark, which crumbles to a soot-like residue in one's hand, is the origin of the common name of this canker (figure 2). The outer bark sloughs faster in the central portions, giving the canker a "barber pole" appearance (figure 3). Eventually the bark falls off in long stringy strips,

Figure 2 – *Sooty residue from infected bark tissue.*

Figure 3 – *Sooty-bark canker exhibiting characteristic barber pole pattern of infection.*

revealing small, black, spotted areas on the bleached, dead wood where the fungal mycelia held the dead bark to the wood. Woody tissues under the canker tend to dry out and, as a consequence, are not decayed; however, wind breakage at the canker is not unusual.

Cup-shaped fruiting bodies of the fungus, called **apothecia**, develop on the surface of old dead inner bark (figure 4). These light gray structures (about 3 mm or 1/8 inch in diameter) open when wet. Spores are forcibly ejected and wind-disseminated when moisture and temperature conditions are favorable. These spores can cause new infections.

Cryptosphaeria canker: This canker causes branch, sprout, and sapling mortality; trunk cankers; and discoloration and decay of aspen stems. The cankers are commonly long and narrow, spiralling around the tree like a snake, hence the common name "snake canker" (figure 5). Small trees may be killed within a year after infection. Large trees may have cankers that girdle branches and enlarge onto the trunk.

Bark near canker edges usually becomes discolored light brown to orange. The dead, black, stringy, soot-like bark adheres tightly to the sapwood and contains small, scattered, lens-shaped, light-colored areas (figure 6).

Flask-shaped fruiting bodies, called **perithecia**, develop beneath bark dead for more than 1 year. The perithecia release spores during wet periods. These spores colonize wounds, establishing the fungus at a new site. Light-orange-colored fruiting structures, called **acervuli,** of the asexual state of the fungus (*Libertella* sp.) are occasionally found along the edges of the canker.

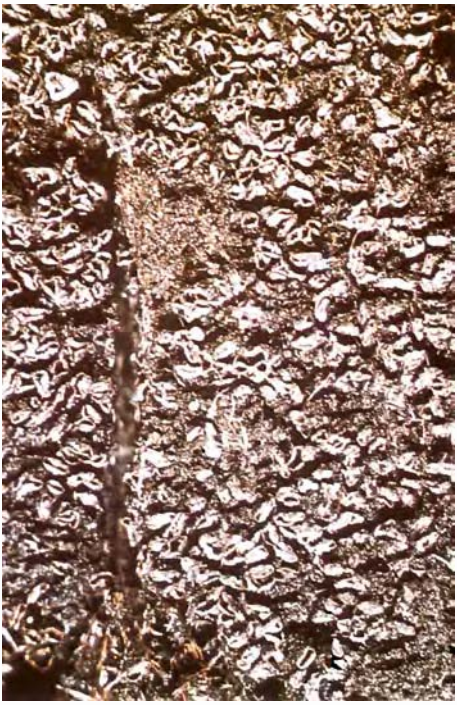

Figure 4 – *Cup-shaped fruiting bodies of* Encoelia pruinosa, *called apothecia, develop on the old inner bark.*

Figure 5 – *Cryptosphaeria canker exhibiting the typical snakelike pattern of infection.*

The fungus eventually colonizes sapwood and then heartwood, resulting in discoloration and decay. The discoloration may vary from gray and brown to yellow, orange, and even pink. Under ultraviolet light, the decay exhibits yellow fluorescence. This fluorescent material may contain toxic substances that aid the fungus in colonizing host tissues.

The decay associated with the canker predisposes infected trees to wind breakage.

Black canker: Black canker is a common and easily recognizable canker of aspen throughout its range in the West. This canker rarely kills trees because it develops so slowly; the major impacts are trunk deformity, cull, and predisposition to wind breakage. Conks of species of wood decay fungi may develop in dead portions of old cankers and wood may be decayed. However, the agent of black canker (*Ceratocystis fimbriata*) does not cause wood decay.

Following infection, a circular dead area develops on the trunk. In the spring, callus tissue develops during cambial activity and walls off the infection. During the dormant season, the tissue formed earlier in response to infection is invaded and killed by the fungus. Repetition of this annual cycle over the years results in a target-shaped canker formed of successive rings of dead bark and wood. After several years, the dead bark sloughs off, exposing concentric rings of dead woody tissue. Old cankers can be irregular in shape, with massive folds of black, flaring dead bark, hence the name "black canker" (figure 7).

Perithecia are formed in the spring along the border of the canker on tissues dead at least a year, although

Figure 6 – *Lens-shaped, light-colored areas within infected bark tissue on a cryptosphaeria canker.*

Figure 7 – *Black canker showing large callus folds.*

they form rarely and are difficult to see. Spores ooze from the perithecia in sticky masses and are often vectored to other wounded trees by insects. Boring insects often are found in the cankered area.

Cytospora canker: The fungus that causes this canker (*Cytospora chrysosperma*) is weakly parasitic and normally attacks stressed trees. Although *C. chrysosperma* is the most common canker fungus on aspen throughout the tree's range, the fungus often is associated with other, more aggressive canker fungi. Small twigs and branches can be killed without the formation of a distinct canker. Trunk cankers usually have an irregular outline, with sunken, orange-discolored perimeters (figure 8).

The first indication of infection is the orange discoloration of the bark surrounding the wound. After infection, the inner bark turns dark brown and the sapwood underneath light brown. The dead bark falls from the tree in large pieces after 2 to 3 years.

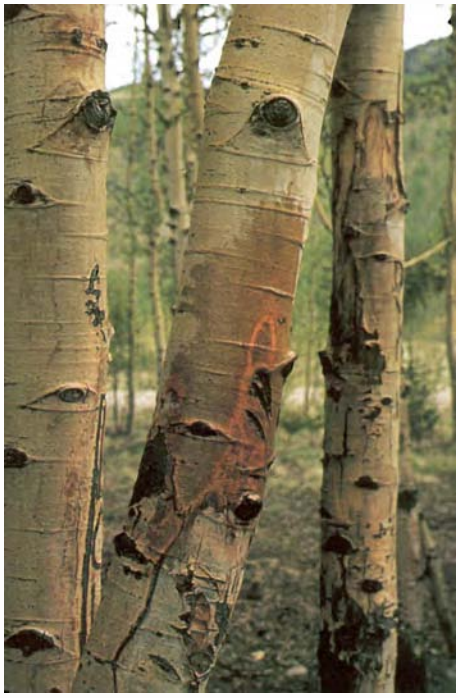

Figure 8 – *Cytospora canker showing irregular pattern of infection and orange discoloration of bark tissue.*

Pimple-like fruiting bodies, called **pycnidia,** which exude orange to red-colored spore masses in hairlike coils, are produced during wet weather several weeks after infection. During rains, these spores are partially washed away and can spread into new wounds. Insects visiting infected trees may also vector the fungus.

Perithecia are produced later in the same areas as where pycnidia developed. These structures are the sexual state of the fungus (*Valsa sordida*).

Hypoxylon canker: Trees of all ages and sizes on all sites are attacked, but usually in widely spaced stands. Although the disease causes serious mortality in localized areas, its overall importance in the West remains to be determined. Hypoxylon canker is probably more widely distributed in the West than has been reported.

Young cankers first appear as slightly sunken areas with irregular margins on the bark. The underside of diseased bark appears laminated or mottled black and yellowish white. The papery outer bark sloughs from older infections, exposing a blackened, crumbly inner bark. The cortex in the central portion of older cankers cracks in a checkerboard fashion and sloughs in small patches (figure 9).

Canker growth, usually greater in length than width, takes several years to girdle a tree.

Asexual spores are produced on small, bristlelike structures under the blistered outer bark. Cankers are easier to identify after several years, when

perithecia are formed in small, crust-like stroma up to 1.3 cm (1/2 in) across. Young stroma are covered with a grayish bloom that persists for several years. Spores discharged from perithecia during wet weather can initiate new infections.

Regulating Factors

The only practical control for canker diseases is to avoid wounding residual stems during stand entries. Infection of wounded live trees, and subsequent tree mortality can increase dramatically in managed stands. In one study in Colorado and New Mexico, 20% of residual trees in partially cut stands died 5 years after the stand was harvested. Trunk cankers developing from infected logging injuries were the major cause of tree death. Two years later, 40% of the remaining residual trees were infected with various cankers, indicating that the mortality would increase.

Figure 9 – *Hypoxylon canker showing checkered bark.*

Stands with a high proportion of cankered stems should be clearcut to stimulate sucker production and regeneration of the stand.

Because aspen is very susceptible to injury and infection by canker fungi, the installation of developed recreation sites in aspen stands should be discouraged.

High-Value Trees

Pruning diseased, dying, and dead branches on high-value trees should aid in reducing fungus spread from infected branches into the stem. Pruning tools should be disinfected with alcohol or laundry bleach after each cut to prevent infection of subsequent pruning wounds.

Small cankers on stems can be removed by excising all infected bark so there are clean edges around the infection to stimulate callus growth. Wounds should be shaped into an ellipse to promote rapid healing.

Assistance

Landowners can get more information about identification and control by contacting a County Cooperative Extension agent, their local state forestry office, or the USDA Forest Service, Forest Pest Management (FPM).

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