

Spruce Broom Rust

by Paul Hennon and Lori Trummer, Forest Pathologists, USDA Forest Service, Alaska Region, State and Private Forestry

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Forest Health Protection
State and Private Forestry
USDA Forest Service
3301 "C" Street, Suite 522
Anchorage, Alaska 99503-3956
Phone: (907) 743-9455

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SPRUCE BROOM RUST



Spruce broom rust, caused by the fungus *Chrysomyxa arctostaphyli* Diet., is one of the most conspicuous diseases of white, black, and Sitka spruce trees in Alaska. The disease affects trees in interior, south-central, and several parts of southeast Alaska. Infected trees have dense clusters of branches with a yellow or orange appearance (Cover photo) and can be found in urban areas as well as in forests. These branch clusters are sometimes referred to as "witches'-brooms" or "brooms."

Identification

Brooms can occur on the branches or the main bole of spruce trees. During spring and summer the brooms have a yellow or orange appearance because of the short, yellowish needles they contain (Figure 1). In midsummer, the yellow or orange spores that erupt from pustules on the needles add to the color. These microscopic spores are so numerous that clouds of spores are dispersed when brooms are shaken. A distinct sweet but earthy odor is often noted from sporulating brooms. Needles are shed in the fall, giving the broom a bare, dead appearance, but the twigs in brooms do not normally die. The following spring, brooms produce new, yellowish needles (Figure 1).

To complete its life cycle, most rust fungi must infect two different types of plants. Spruce broom rust infects kinnikinnik (Figure 2), sometimes called bearberry (*Arctostaphylos uva-ursi* (L.) Spreng). This low-growing, trailing plant has flexible stems, round and leathery perennial leaves, and red berries.



Figure 1. Live broom in spring with short, yellowish needles.

Spruce broom rust only attacks and causes symptoms on spruce growing near infected kinnikinnik. Consequently, the rust on spruce closely follows the distribution of kinnikinnik (Figure 3). Both the disease and kinnikinnik are absent from most portions of southeast Alaska, but can be found in many areas of south-central and interior Alaska. Close relatives of kinnikinnik e.g., *A. alpina* (L.) Spreng and *A. rubra* (Rehd. & Wilson) Fern. may also be susceptible to the fungus. These host plants may extend the range of the disease to spruce growing in northern and northwestern Alaska.

Life history

Spruce broom rust has a total of four spore stages. Only two spore stages can spread the disease (Figure 4). These two spore stages are discussed below.

The orange pustules that occur on spruce needles in brooms consist of numerous microscopic fungal spores. Dispersed by air currents during



the summer months, the spores are only capable of infecting the leaves of kinnikinnik; they cannot reinfect spruce trees.

Once transmitted to kinnikinnik, the leaves of this plant develop small purple-brown spots where spores have made infections. The following spring, a different type of spore is produced on kinnikinnik. This spore occurs at the same time that spruce needles are emerging and elongating. It is believed that the spores infect these developing shoots or needles of spruce.

Once spruce trees are infected, the perennial witches'-brooms develop over a period of several years. The fungus remains alive in the infected bud and twig tissues of spruce for many years. It probably alters the growth hormones at the point of infection; resulting in increased growth and production of numerous short, lateral shoots. Over several years this abnormal growth develops into a witches'-broom.



Figure 2. Kinnikinnik (*Arctostaphylos uva-ursi*), the alternative host of spruce broom rust. Notice spots on leaves caused by the rust fungus.

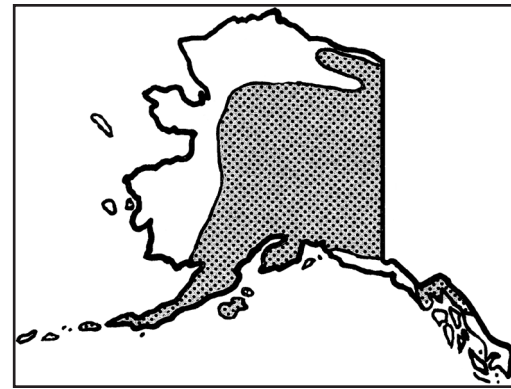


Figure 3. The distribution of kinnikinnik in Alaska (adapted from E. Hulten, 1968, *Flora of Alaska*). Because the disease is never far from kinnikinnik, this map roughly shows the range of spruce broom rust in Alaska. Notice that it is missing from most of southeast Alaska.

Impacts

Many infected spruce trees suffer no apparent consequences. Other trees, however, may suffer some damage including reduced growth, top-kill, and infection by wood decay-causing fungi, or tree death.

Reduced tree growth. Because the rust fungus causes extra nutrients to be channeled to the witches'-brooms, fewer nutrients are available to spruce trees for height and radial growth.

Top kill. When witches'-brooms occurs on the main bole of spruce trees, the top portion of the tree, above the broom, sometimes dies.

Wood decay fungi. The dead portions of trees infected by spruce broom rust (e.g., tops, large limbs, and large scars) may serve as entrance courts for wood decay fungi. These fungi remove structural compounds from wood, which reduces usable wood volume for for-

esters. Also, trees with internal decay are unstable and potentially hazardous if located near homes, or in parks and recreation areas.

Tree death. Spruce trees with several large witches'-brooms sometimes die, although this does not typically occur. It is possible that severely broomed trees are weakened, allowing other fungi, bark beetles, or abiotic factors to finally kill these trees.

Ecologically, the brooms appear to serve as important, perhaps critical, winter habitat for birds and mammals. Studies on flying squirrels in interior Alaska indicate that squirrels create a "cavity" or hollow within the brooms and utilize the site for dens.

Management

Since spruce broom rust does not normally kill spruce trees, one management option is to take no action. In addition, witches'-brooms offer

refuge for many birds and small mammals, perhaps a desirable feature for some homeowners or woodlot owners.

The only spores of this disease that infect spruce are produced on kinnikinnik; therefore, removing or killing kinnikinnik can help to reduce damage on nearby spruce. For effective protection, all kinnikinnik plants within 1,000 feet of spruce must be removed.

Chemical control (i.e., fungicides) has not been shown to be effective in combating this disease on spruce.

Pruning is sometimes the best form of control, especially for homeowners. Witches'-brooms that occurs on branches can be removed by pruning. Unfortunately, many witches'-brooms occur on the main bole, and for effective control, the top of the tree (including the broom) would have to be removed.

In forests managed for wood production, the most practical means of controlling this disease may be the removal of spruce trees with brooms during thinning operations.

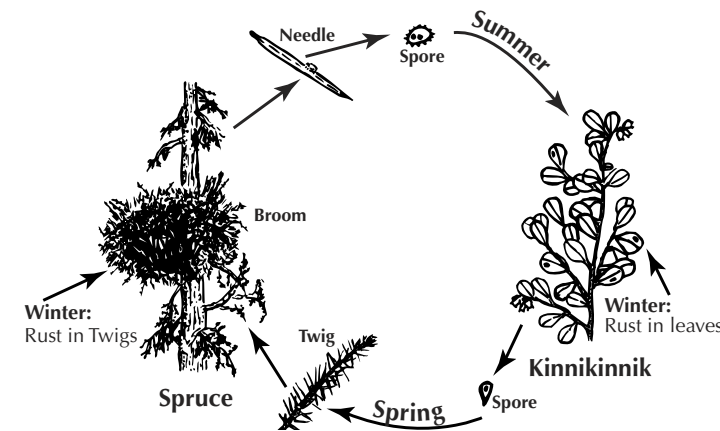


Figure 4. The life cycle of spruce broom rust requires two host plants: spruce and kinnikinnik. Fungal spores are microscopic seed-like structures. Noticeable brooms develop several years after infection.

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