Spruce Broom Rusts

The information accessed from this screen is based on the publication: Baranyay J.A. and Ziller W.G. 1972. Broom Rusts of Conifers in British Columbia. Forestry Canada, Forest Insect and Disease Survey, Forest Pest Leaflet No. 48 6p.

Introduction

There are two species of rust fungi (Uredinales) which cause witches' brooms, i.e. excessive proliferation of branches, on coniferous hosts in British Columbia: spruce broom rust (*Chrysomyxa arctostaphyli* Diet.) and the fir broom rust (*Melampsorella caryophyllacearum* Schroet.)

The spruce broom rust occurs throughout North America where spruce is found, but it occurs more commonly in the west (1). The fir broom rust is "native in almost the entire range of firs in Eurasia and North America" (3) and extends far beyond this range on its alternate hosts, the chickweeds.

Hosts and Distribution

Spruce Broom Rust (also known as yellow witches' broom of spruce)

Primary hosts: The native spruces: black spruce (Picea mariana (Mill.) B.S.P.), Engelmann spruce (P. engelmannii Parry) (Fig), Sitka spruce (P. sitchensis (Bong.) Carr.), white spruce (P. glauca (Moench) Voss) and the introduced Norway spruce (P. abies (L.) Karst.)

Secondary hosts: Kinnikinnick or bearberry (Arctostaphylos uva-ursi (L.) Spreng.)

Distribution: Throughout western Canada. Also in eastern Canada and in the United States, including Alaska (1). The distribution of spruce broom rust is restricted to North America, but since Norway Spruce is susceptible to the disease, and kinnikinnick is a common associate of spruce in Eurasia (2), the spread of the rust in Eurasia is possible and should be guarded against.

Fir broom rust (also known as yellow witches' broom of fir)

Primary hosts: The native true firs: alpine fir (Abies lasiocarpa (Hook.) Nutt.) (Fig), amabilis fir (A. amabilis (Dougl.) Forbes), grand fir (A. grandis (Dougl.) Lindl.) and balsam fir (A. balsamea (L.) Mill.)

Secondary hosts: chickweeds (species of Cerastium and Stellaria)

Distribution: Throughout western Canada. Within the range of true firs in North America, Europe and Asia. On chickweeds within the range of true fir in North America and Eurasia and far beyond it.

Life History of the Causal Organisms

The essential basic information to understand the complicated life cycles of rust fungi were given in previous pest leaflets (No. 54, 37, etc.). The broom rusts are heteroecious rusts, requiring two unrelated host plants to complete their life cycles.

Spruce Broom Rust

In spring, airborne basidiospores originating from leaves of kinnikinnick land on young needles of spruce, where they germinate and cause infection (Fig). The infection spreads to the young shoots, and early in summer of the following year the infected spruce buds give rise to a proliferation of short shoots bearing short, yellowish-green needles (witches' brooms). Pycnia and aecia soon develop on these stunted needles, which are shed in fall.

The airborne aeciospores are carried to the leaves of kinnikinnick, they germinate, and cause infection. In spring of the following year, conspicuous purple-brown spots appear on the infected overwintered foliage of kinnikinnick. On these spots telia develop. The uredinial state is missing in this rust. The telia produce basidiospores, which become airborne, land on young needles of spruce, germinate, and cause new infections of spruce. The two-year life cycle of spruce broom rust is thus completed.

Witches' brooms of spruce caused by rust are very conspicuous during summer because of their large size and their orange-yellow color (Fig). They are perennial, becoming larger every year, producing an abundant crop of aeciospores each summer, and shedding all their needles each fall. On kinnikinnick, the rust is annual, dying out in spring soon after the basidiospores are produced on the overwintered leaves. Host-alternation between spruce and kinnikinnick is obligatory for spruce broom rust; the rust can spread only in areas where both hosts occur.

Fir Broom Rust

The life history of fir broom rust is basically the same as that of spruce broom rust; the hosts of course, are different. However, urediniospores are produced on the leaves of chickweed, as well as telia, and these serve to spread the rust on the chickweed. In perennial species of chickweed, the rust overwinters as systemic perennial mycelium. In spring, the rust extends to the new leaves. Telia, followed by uredinia, appear on these leaves.

Host-alternation in fir broom rust is optional, since the rust can propagate itself for indefinite periods on chickweeds alone. Occurrence and spread of the disease on true fir, however, depends on the presence of chickweeds in the vicinity.

Recognition

Brooms caused by these two rusts are peculiar in certain features and therefore easy to separate from brooms caused by dwarf mistletoes or other physiological agents. The affected needles on the rust brooms are yellow in summer, die and are shed in fall, leaving the broom to appear dead during winter and early spring. The needles of the fir broom are shorter, arranged spirally, and thicker than healthy needles. The greenish-yellow color of needles shows up clearly in the background of healthy green needles of the same tree (Fig). These brooms are less conspicuous than the orange-yellow brooms of spruce broom rust (Fig). In contrast, needles of mistletoe brooms are not usually discolored or shortened. The infected fir branch or trunk becomes swollen at the base of a broom into a spindle-shaped or sometimes a nearly spherical gall or bud (3). The bark usually dies, and cracks and cankers may develop. This kind of malformation is unknown on spruce. The infected leaf of kinnikinnick produces a purple-brown spot. Rust-infected chickweed leaves are sometimes smaller, and are yellowish in color (4). Leaf and shoot blight is a consequence of infection.

Damage

Rust brooms affect the shape of the crown (Fig); they are associated with dead tops, stunted growth and even mortality. Volume loss caused by fir broom rust in Europe is regarded as most important in the management of silver fir stands.

Due to the changed physical characteristics of fir-broomrust-infected wood, the cull is large in severely infected alpine fir stands in the western United States (3).

The damage caused by the broom rusts in western Canada has not been appraised.

Control

In the intensively managed silver fir stands of Europe, "a schedule of three thinnings is enough for gradual elimination of the disease without creating excessive openings" (3).

Control of broom rusts in the United States and Canada has not been attempted.

References

1. Peterson, R.S. 1961. Notes on western rust fungi. I. Chrysomyxa. Mycol. 53: 427-431.

2. Peterson, R.S. 1963. Spruce broom rust. In: Internationally dangerous forest tree disease. U.S. Dep. Agr., Forest Serv., Misc. Publ. No. 939: 91-92.

3. Peterson, R.S. 1964. Fir broom rust. U.S. Dep. Agr., Forest Serv., Forest Pest Leafl. 87.

4. Willson, M. and D.M. Henderson. 1966. British rust fungi. Cambridge Univ. Pres.

Figures

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Figure 237-0072. Yellow witches' broom.

Figure 237-0053. Rust broom on alpine fir caused by Melampsorella caryophyllacearum.

Figure 237-0071. Spruce needle rust, Chrysomyxa weirii.

Figure 240-0093. Witch's broom of Picea caused by Chrysomyxa sp. Discolouration is due to chlorosis and aecia.

Figure 237-0073. Yellow witches' broom.

Figure 237-0054. Witches' broom on alpine fir caused by rust.