

FOREST INSECT &
DISEASE SURVEY

PEST LEAFLET

NO. 41

NEEDLE RUST OF LODGEPOLE PINE

by

DAPHYNE P. LOWE

May 1972

Introduction

Western pine-aster rust, a needle rust of lodgepole pine, is "one of the most common of rusts" (1). It is caused by the fungus Coleosporium asterum (Diet.) Syd. (Basidiomycetes: Uredinales, Melampsoraceae) and is native to North America. It is the only rust known to occur naturally on previous years' needles of lodgepole pine in British Columbia. The only other needle rust of pine in British Columbia is Melampsora medusae Thuem., which occurs rarely on current years' needles of lodgepole and ponderosa pine and causes negligible damage. The pine-aster rust, described in this leaflet, causes minor needle cast and discoloration of needles of pine and, in cases of severe infection, some reduction in terminal growth, but only rarely does it kill trees.

Hosts and Distribution

As with most tree rusts, pine-aster rust requires two botanically unrelated host plants to complete its life cycle. The primary or aecial hosts are lodgepole pine (Pinus contorta Dougl.), jack pine (P. banksiana Lamb. = P. divaricata (Ait.) Dumont, and Scots pine (P. sylvestris L.). The main secondary or telial hosts are species of asters (Aster spp.) and goldenrods (Solidago spp.), but China-aster (Callistephus chinensis (L.) Nees (3)) and gumweed (Grindelia integrifolia DC.) are also susceptible. Asters and goldenrods found infected in British Columbia are: Aster ciliolatus Lindl., A. conspicuus Lindl., A. eatonii (Gray) Howell, A. engelmannii (Eat.) Gray, A. foliaceus Lindl., A. occidentalis (Nutt.) T. + G., A. subspicatus Nees, Solidago canadensis L., S. lepida DC., S. multiradiata Ait., and S. spathulata DC. (5).

Western pine-aster rust seems to be restricted to western North America, occurring in British Columbia, Alberta, Saskatchewan, Manitoba, the Northwest Territories, the Yukon Territory, Washington, Oregon, Idaho and Montana (7). In British Columbia the rust has been found throughout the range of lodgepole pine.

Life History of the Causal Organism

The life cycle of pine-aster rust follows a pattern basic for tree rust fungi. Five spore states are necessary to complete its annual life cycle. These include the development of pycnial and aecial states on the primary host (pines), and host-alternation with development of the uredinial, telial and basidial states on the secondary host (asters and goldenrods).

Pycnial droplets usually appear on 2-year-old pine needles during warm weather in April and May, followed by the appearance of conspicuous, flat-topped, columnar, white rust blisters (aecia) on the same needles about a month later (Fig. 1). Under wet conditions, these

aecia rupture, releasing their orange-yellow aeciospores which are carried to susceptible secondary host leaves by wind currents (Fig. 2). Aeciospores cannot infect other pines, only secondary hosts. The orange-yellow uredinia appear on the under side of the aster and golden-rod leaves 10 to 15 days after infection by the aeciospores (Fig. 3). From June to August, the urediniospores are wind-borne and infect other secondary host plants, thus spreading and intensifying the disease on asters and goldenrods. Urediniospores cannot infect primary hosts, only other secondary hosts. Infection of secondary hosts by both aeciospores and urediniospores requires wet conditions of 20 to 25 hours' duration (6).

The telial state follows the uredinial state on secondary hosts. Telia start forming while the uredinia are still present on the same leaves (Fig. 3). Under cool, (60 to 68 F) wet weather conditions of late summer and early autumn, the teliospores produced by the telia germinate in 10 to 12 hours to produce basidiospores which are wind-borne and carried to susceptible pine needles (6). Basidiospores are small and delicate and cannot survive even a short period of temperature extremes or drought. Unless they land on susceptible pine needles shortly after dissemination and unless climatic conditions are favorable, the basidiospores will perish. Basidiospores cannot infect other secondary hosts, only primary hosts. In the following spring, minute yellow spots followed by pycnial droplets again appear on 2-year-old pine needles and the life cycle of pine-aster rust is completed.

The rust is perennial in pine needles and, as needles usually live at least 3 years, the rust can live 3 years in the needle or until the needle dies. The rust is thus able to survive at least 2 years of unfavorable conditions for spreading (6). It is known to overwinter as uredinial mycelium in the rosettes of its secondary hosts (2) and can thus persist almost indefinitely on its secondary hosts, independent of host-alternation and in areas remote from its primary hosts. On pine, however, the rust can occur only in the vicinity of its secondary hosts.

Recognition

On its primary host, pine-aster rust is easily identified, since it is the only rust known to occur naturally on the previous years' needles of lodgepole pine in British Columbia. The first sign of infection is the appearance, in April or May, of minute yellow spots on the pine needles. The honey-colored pycnia which occur on these spots may easily be overlooked by the untrained observer. With the appearance of the pycnial droplets exuded from these spots and later, in May or June, of the conspicuous white aecial blisters, recognition is assured. However, by the end of the summer, the aecia have disappeared completely, leaving only inconspicuous brown flecks on the infected needles.

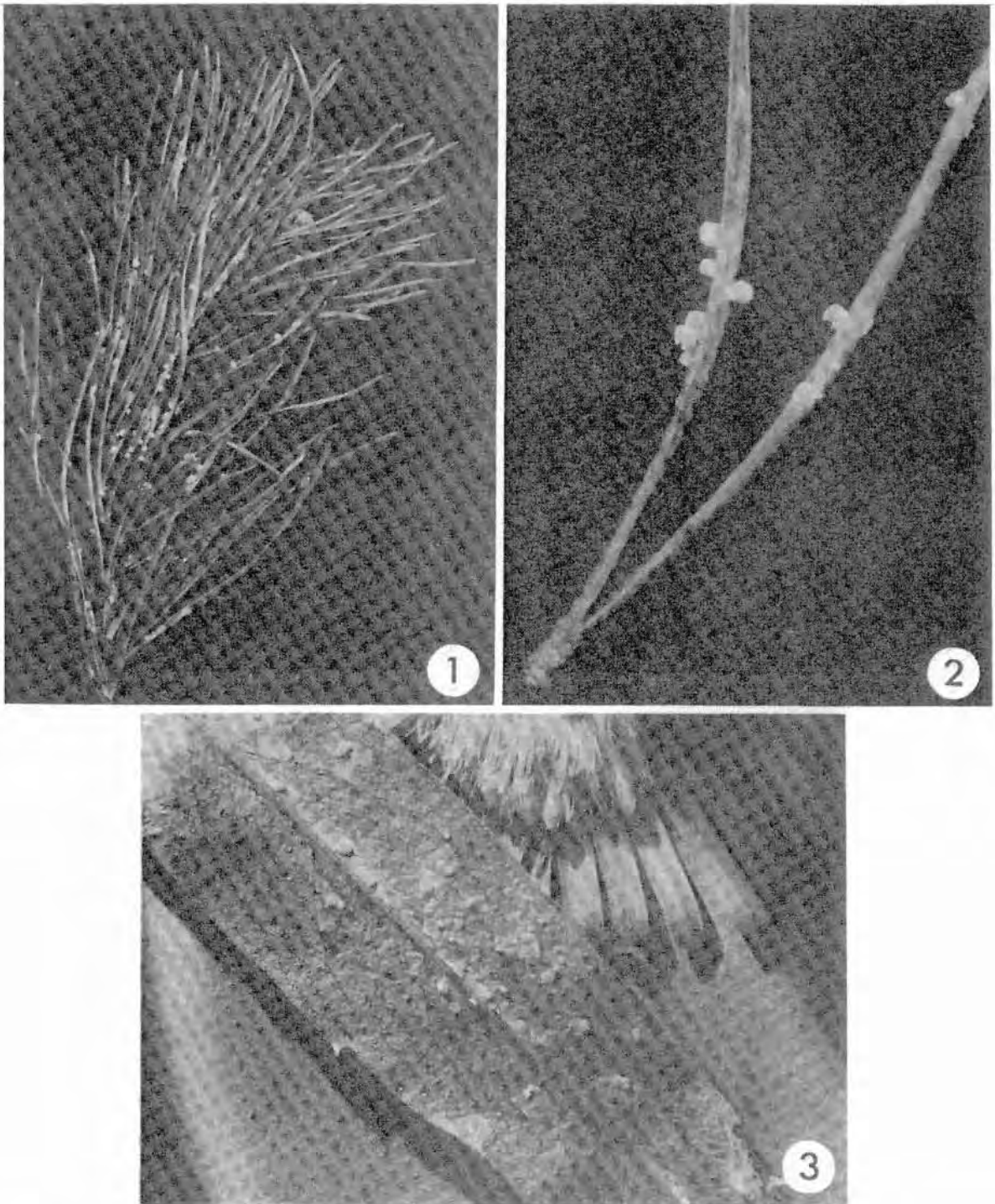


Fig. 1. Aecia of pine-aster rust on needles of lodgepole pine.

Fig. 2. Close-up of needles showing mature ruptured aecia. (Photo by W.G. Ziller).

Fig. 3. Undersurface of rust-infected aster leaf. (Photo by W.G. Ziller).

On its secondary hosts, asters and goldenrods, recognition is more difficult. The presence of orange-yellow uredinia and orange-brown telia on the under side of the leaves is not enough to distinguish pine-aster rust from other rust fungi also occurring on asters and goldenrods. Identification of pine-aster rust on its secondary hosts must therefore be confirmed by microscopic examination.

Damage

Light to severe attacks of pines by pine-aster rust have been reported annually from British Columbia and the western provinces of Canada (4). Although pine-aster rust is widespread, damage has not been great. Generally, only relatively small trees, less than 8 to 10 feet in height, are affected, and only heavily infected older needles are cast prematurely, resulting in lowered food production, consequent growth reduction, and reduced value for Christmas trees. However, death of seedlings could result from a combination of rust attack and insect attack fatal to the new shoots. In cases of severe infection, all needles except those of the current growing season may be affected.

Control

Control of pine-aster rust is probably only desirable in Christmas tree plantations and nurseries. No biological methods or practical methods of complete control have been established. However, satisfactory chemical and silvicultural methods of reducing its damage have been developed. Recommended methods in use at present include:

- 1.) Eradicating asters and goldenrods from the vicinity of Christmas tree plantations and nurseries and for approximately 1/2 mile around them by any feasible method. This should be done during the first two weeks of August, before basidiospore production, to reduce amount of infection on pine.
- 2.) Protecting pines by spraying with fungicides (6) in late summer and early autumn during wet climatic conditions favorable for infection from secondary hosts to pine.

- 3.) Avoiding the establishment of Christmas tree plantations and nurseries in small openings or on sites where wet conditions and persistence of dew in the mornings favor pine infection.
- 4.) Ensuring that pine trees are free of rust at time of planting. Before the appearance of the pycnial droplets and after the disappearance of the aecia, the presence of rust on the pines can easily be overlooked.
- 5.) Selecting, breeding and planting pine species that are resistant to infection by pine-aster rust.

Additional Information

Diseased pine needles and secondary host foliage may be submitted for identification to:

Forest Insect and Disease Survey,
Pacific Forest Research Centre
506 West Burnside Road,
Victoria, B.C.

Additional copies of this leaflet may be obtained by writing to the above address.

References

1. Arthur, J.C. 1934. Manual of the rusts in United States and Canada. Purdue Res. Found., Lafayette, Indiana.
2. Boyce, J.S. 1961. Forest Pathology, 3rd ed. McGraw-Hill Book Company, Inc., New York, Toronto, London.
3. Conners, I.L. 1967. An annotated index of plant diseases in Canada and fungi recorded on plants in Alaska, Canada, and Greenland. Canada Dep. Agr., Res. Br., Publ. No. 1251.
4. Forest Insect and Disease Survey, Forest. Br., Annual Reports, 1951-1970. Queen's Printer for Canada, Ottawa.
5. Lowe, D.P. 1969. Check list and host index of bacteria, fungi, and mistletoes of British Columbia. Canada Dep. Fish. and Forest., Forest Res. Lab., Victoria, B.C., Inform. Rep. BC-X-32.
6. Nicholls, T.H., E.P. Van Arsdell, and R.F. Patton. 1965. Red pine needle rust disease in the Lake States. U.S. Dep. Agr., Forest Serv., Lake States Forest Expt. Station, Res. Note LS-58.
7. Weir, J.R. 1925. The genus Coleosporium in the northwestern United States. Mycologia 17: 225-239.