ISBN 0-662-24261-0 Cat. No. Fo 29-6/19-1996E

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FOREST Pest LEAFLET

Pacific Forestry Centre

Common woolly aphids and adelgids of conifers[1]

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Introduction

The term "woolly" aphids or adelgids is frequently used to describe any of a large number of aphids or aphid-like insects characterized by having a noticeable white waxy covering. A conifer-feeding woolly aphid, *Mindarus abietinus* and adelgids of the genera *Adelges* and *Pineus* are common throughout British Columbia and may be found feeding on the needles and bark or in twig galls (*Adelges* and *Pineus* only). Most native conifers are affected except cedars, cypresses and junipers. Many species of *Adelges* and *Pineus* alternate between a primary host (spruce), where they induce the formation of twig galls which form around and enclose the feeding nymphs, and a secondary host where no galls are formed and the nymphs feed externally. *Mindarus* and some species of *Adelges* and *Pineus* are confined to a single host and do not cause gall formation. Damage caused by the different species of woolly aphids or adelgids includes chlorosis, stunting and twisting of needles as well as galling and gouting of the twigs. Severe and chronic infestation may result in loss of foliage, growth reduction, or mortality.

Fig. 1.*Mindarus abietinus* adult (left) and nymph (right) showing white waxy bloom and wool.

Balsam Twig Aphid

Hosts and distribution

The balsam twig aphid, *Mindarus abietinus* Koch (Homoptera: Aphididae), has a holarctic distribution including much of British Columbia. Host species recorded in British Columbia include alpine fir, *Abies lasiocarpa* (Hook.) Nutt., amabilis fir, *A. amabilis* (Dougl.) Forbes, and grand fir, *A. grandis* (Dougl.) Lindl. Outside British Columbia it is known to attack at least six additional species of true firs.

[1] More detailed information on the balsam woolly adelgid, *Adelges piceae* (Ratz.), and the Cooley spruce gall adelgid, *Adelges cooleyi* (Gillette), are provided in FPL's 1 and 6.

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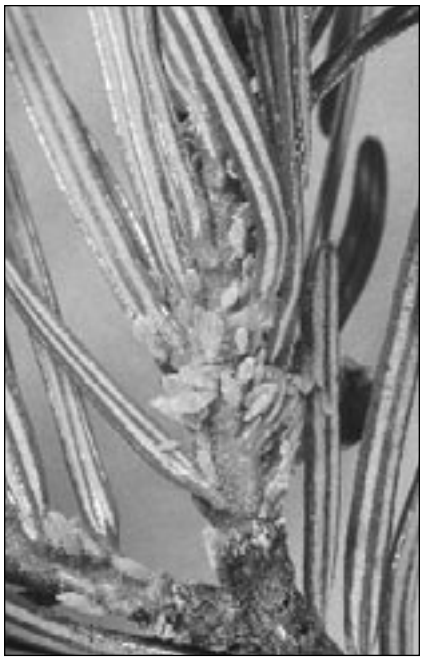

Fig. 2. Feeding colony of *Mindarus abietinus*.

Description

Egg: Ovoid, about 0.5 mm long, yellow when newly laid, becoming shiny black after about three days; covered with white waxy threads.

Nymph: There are four nymphal stages, typically ovoid in appearance, from 0.5 to 1.7 mm long. First generation appearing in spring is pale brown, later becoming green with white waxy bloom and "wool" around it. Subsequent generations are similar but yellow-green.

Adult: Similar to nymphs, 0.5 to 2.0 mm long. Females green-brown, yellow-green or yellow-brown, with or without the white waxy bloom or wool (Fig. 1); most of the second generation are winged. Males are elongate, smaller than females and brown or brown-green.

Life history and habits

The balsam twig aphid completes several generations per year. The wingless stem mother generation develops from overwintered eggs, and gives rise viviparously (young born alive) to winged and wingless

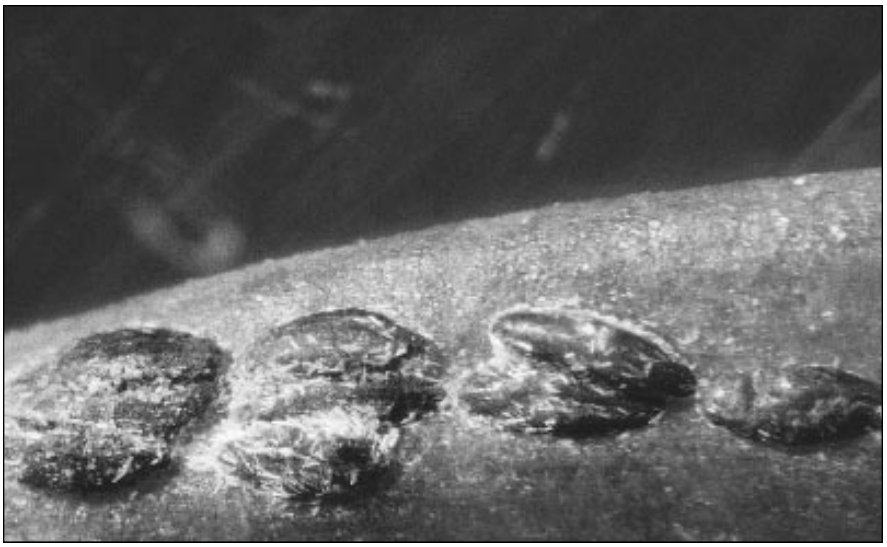

Fig. 3. Overwintering *Mindarus abietinus* eggs on needle.

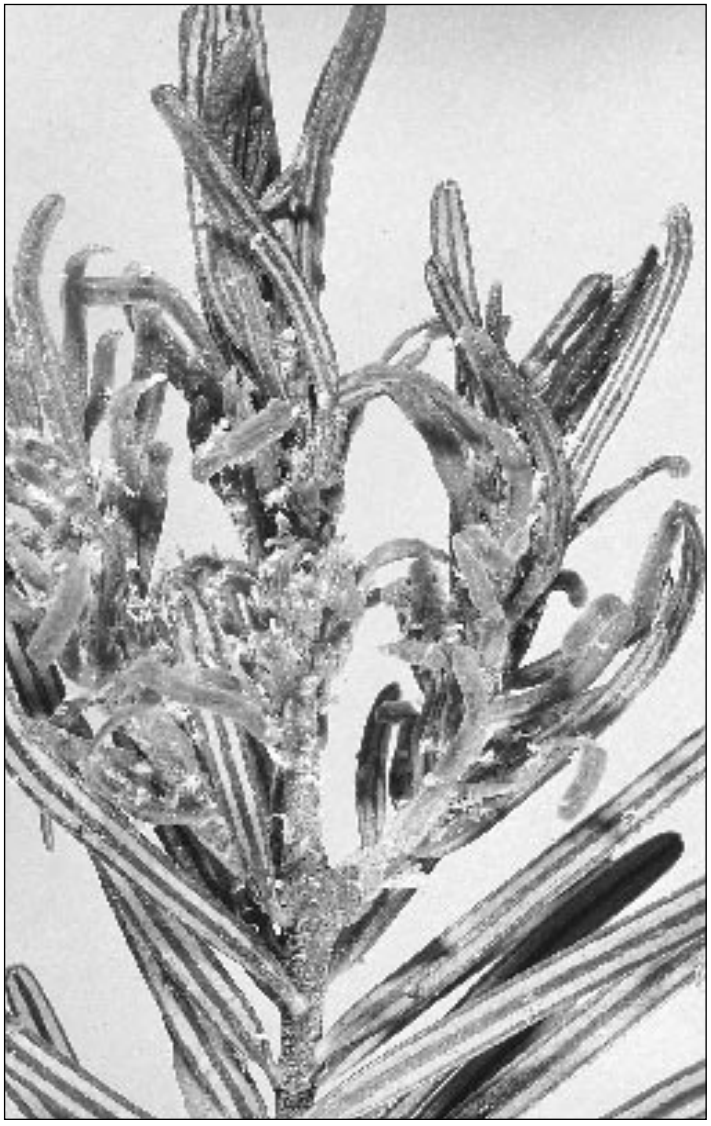

Fig. 4. Deformed foliage on amabilis fir.

Fig. 5. *Adelges tsugae* on western hemlock.

females. Successive viviparous non-sexual generations of winged and wingless females are produced until late spring. Winged females (sexuparae) disperse and produce a sexual generation consisting of males and females which mate and lay eggs.

Eggs, laid by the sexual females in July, overwinter and hatch in April or May when host buds begin to swell. Stem mother nymphs move to the elongating shoots to feed on immature needles. In May nymphs of the second generation are found feeding in colonies on newly elongated shoots (Fig. 2), producing honeydew and a white waxy wool deposit. Winged females are easily dispersed by wind currents to uninfested sites. Females of the final sexual generation lay one or more eggs cemented to the base of a needle (Fig. 3) or on the bark of new growth. Activity is usually completed by mid-July and only the eggs persist until the following spring.

Damage and detection

The balsam twig aphid feeds on new foliage in spring and early summer, causing deformation and stunting of the needles and elongating shoots (Fig. 4); in severe cases needle drop may occur. This damage can be serious in Christmas tree plantations, as damaged trees may be unmarketable. Feeding colonies are easily recognized by the white woolly wax deposits, the profusion of honeydew and a black sooty mould which is characteristically found in association with dense colonies of aphids.

Other species occurring in British Columbia include *Mindarus obliquus* (Cholodkovsky) occasionally found infesting immature spruce in nurseries and seed orchards and *Mindarus victoria* Essig on grand fir in Victoria.

Giant conifer aphids, *Cinara* spp., are sometimes found on terminal twigs of *Abies* spp. but are easily distinguished by their large size, long legs, and lack of prominent white powdery deposits.

Control

Biological: The balsam twig aphid is preyed upon by syrphids, lady beetles, and lacewings.

Chemical: Control measures are not practical or necessary under forest conditions. In nurseries and on ornamentals, control may be desirable to assure good growth and eliminate foliage damage. In Christmas tree plantations, control may be required during the last two years prior to harvest. Various insecticides recommended for aphid control may be applied just prior to bud break when aphids first become active in spring.

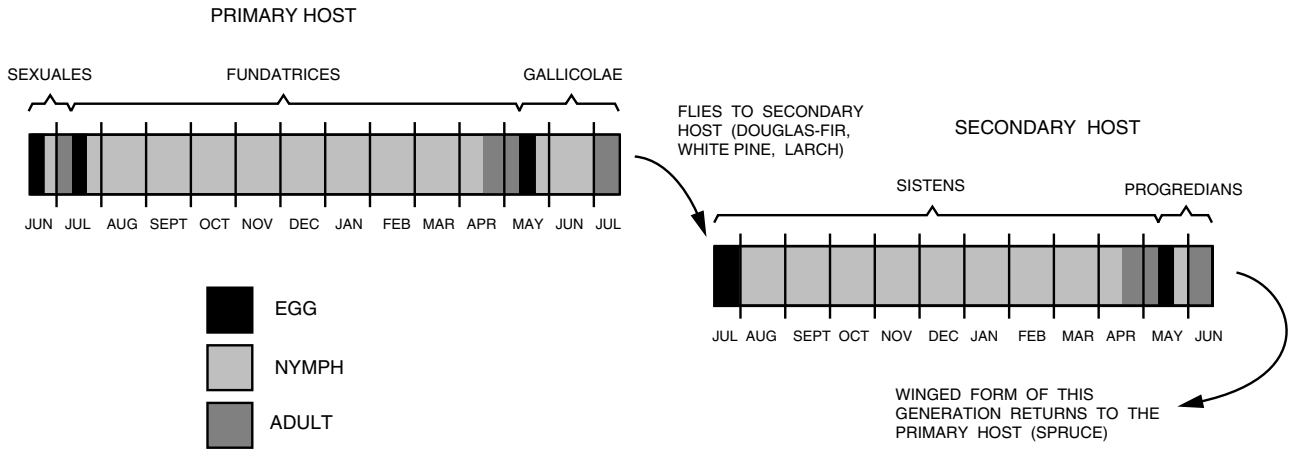

Fig. 7.Generalized life cycle of adelgids alternating between primary and secondary hosts.

Fig. 6. *Pineus coloradensis* on lodgepole pine.

Fig. 8. Overwintering *Adelges cooleyi* on spruce.

Adelgids

Hosts and distribution

Adelgids are common throughout the holarctic region. More than 20 species occur in North America, and 11 species have been recorded in British Columbia (Table 1).

Many species utilize two hosts: spruce (*Picea* spp.) is the primary host; secondary hosts include pine (*Pinus* spp.), larch (*Larix* spp.) or Douglas-fir (*Pseudotsuga menziesii* [Mirb.] Franco) (Table 1). Other species of adelgids exist only on a single host genus including true fir (*Abies* spp.), larch (*Larix* spp.), hemlock (*Tsuga* spp.), or pine (*Pinus* spp.).

Description

Egg: Ovoid, yellow-green to reddish brown, about 0.5 mm long.

Nymph: Broadly ovoid to tapered spheroid, wing pads may be present, 0.3 mm to 0.7 mm long; yellow to red-brown after hatching, later stages dark brown to black, fringed or covered with white, waxy wool.

Adult: Wingless forms sessile similar to nymph, usually more tapered posteriorly, 1 mm long; rusty brown to purplish black, covered with white, waxy wool; winged forms without wool, up to

Table 1. Common B.C. adelgids, their hosts and site of feeding.

Species	Alternate hosts		Feeding Sites
	Primary[1]	Secondary[2]	
Adelges abietis	white spruce Engelmann spruce	—	twigs
Adelges cooleyi	Engelmann spruce Sitka spruce white spruce	Douglas-fir	twigs, needles cones
Adelges nusslini	—	ornamental true firs	bole, twigs, needles
Adelges oregonensis	—	western larch	twigs, needles
Adelges piceae	—	true firs	bole, branches, twigs, buds
Adelges tsugae	—	western hemlock	bole, branches, twigs
Pineus abietinus	—	true firs	bole, branches
Pineus coloradensis	—	lodgepole pine Scots pine, ponderosa pine, western white pine	twigs, needles
Pineus pinifoliae	Sitka spruce white spruce black spruce Engelmann spruce	western white pine	twigs, needles
Pineus similis	Sitka spruce white spruce Engelmann spruce	—	twigs
Pineus sylvestris	—	Scots pine	twigs

[1] Green to purple galls on twigs.
[2] Woolly tufts on needles or bark or both, yellow spotting of needles.

2.4 mm long, with a wingspread of up to 5.6 mm. *Pineus* spp. have four abdominal spiracles, *Adelges* spp. have five.

Life history and habits

The life cycles of the different species of adelgids are variable and complex. Many species have six forms, alternate between a primary host (*Picea*) and a secondary host of a different genus, and require 2 years to complete their life cycle. Other species complete their life cycle in one year on a single host (Figs. 5,6) and lack a sexual generation.

First instar nymphs insert their stylets into the host, and remain at that location until mature. Wingless adults remain sessile and lay eggs; the winged forms may withdraw their stylet and disperse to alternate hosts.

A typical two-host life cycle (Fig. 7) includes one sexual form (sexuales). Each female of the sexuales generation lays a single egg on the primary host (spruce) in midsummer. A generation of wingless females (fundatrices) emerges in late summer and remains on the primary host, overwintering as second-instar nymphs. This generation matures (Fig. 8) and lays a large cluster of eggs in spring about the time the spruce buds are swelling. The nymphs hatching

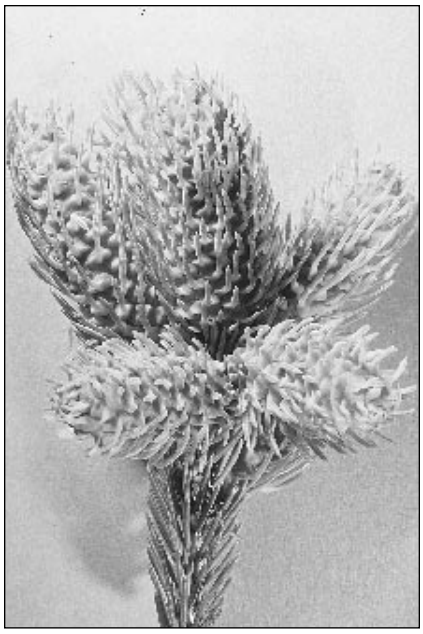

Fig. 9. *Adelges cooleyi* galls on Engelmann spruce.

Fig. 10. *Pineus similis* gall on Sitka spruce.

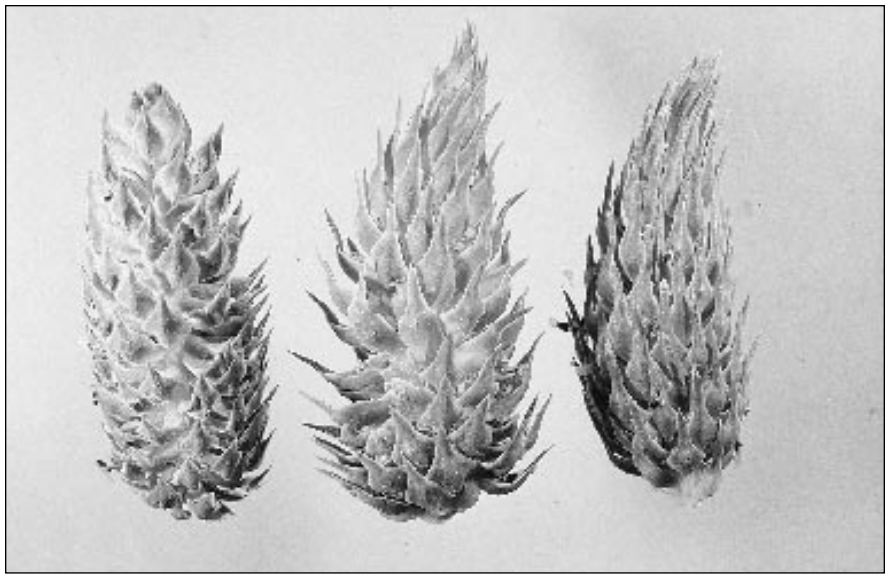

Fig. 11. *Pineus pinifoliae* galls from white spruce.

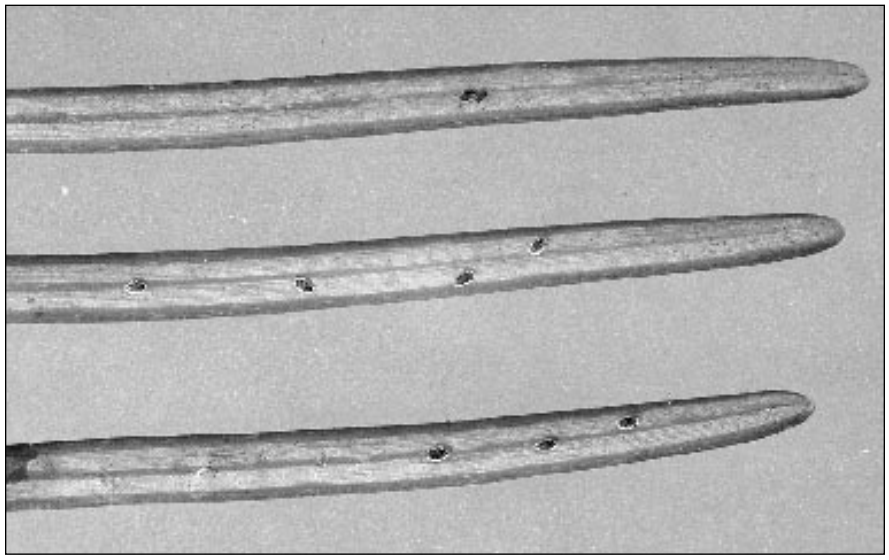

Fig. 12. Overwintering *Adelges cooleyi* nymphs on Douglas-fir.

from these eggs (gallicolae generation) crawl to the base of the needles in the expanding shoot, insert their stylets and begin to feed. This feeding activity stimulates the development of a gall within which the nymphs remain until mature. The form of the gall produced by each species has a distinctive size, color and shape (Figs. 9,10,11). Later in the summer the gall opens releasing up to 400 winged adults which disperse to the secondary host where they lay their eggs on the lower surface of the current year's needles. These eggs give rise to the sistens generation which overwinters as first-instar or second-instar nymphs (Fig. 12). The sistens mature the following spring producing wingless adults which lay large clusters of eggs. Progeny from these eggs (progredians) may develop into wingless adults which remain on the secondary host and give rise to additional progredian generations or into winged adults which return to the primary host. The eggs laid by the winged form on the primary host become the sexual generation (sexuales).

Damage and detection

The small size of adelgids precludes species identification with the naked eye; field identification is based upon host, gall-type, and damage.

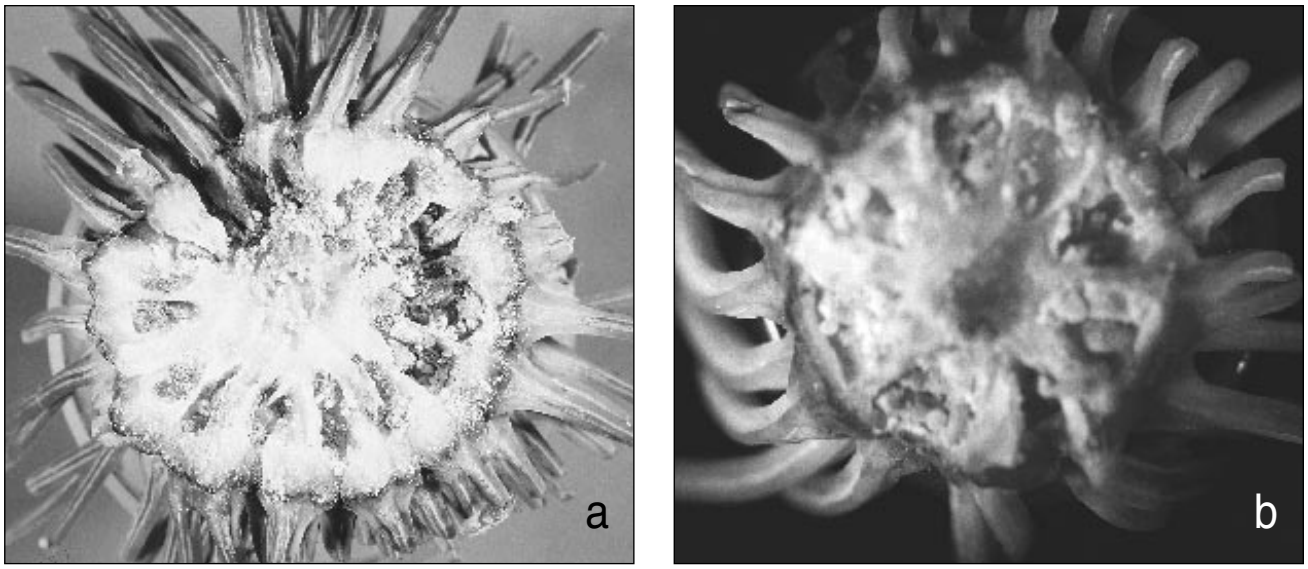

Fig. 13. Cross section of a) *Pineus similis* and b) *Adelges cooleyi* galls.

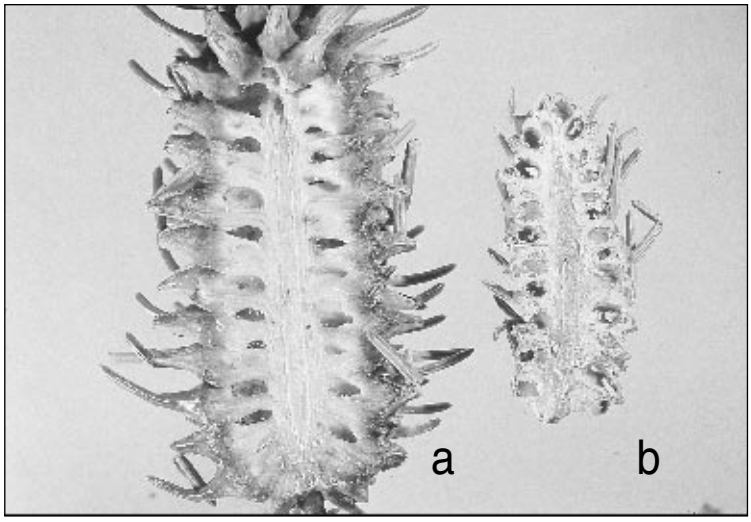

Fig. 14. Longitudinal section of a) *Pineus similis* and b) *Adelges cooleyi* galls.

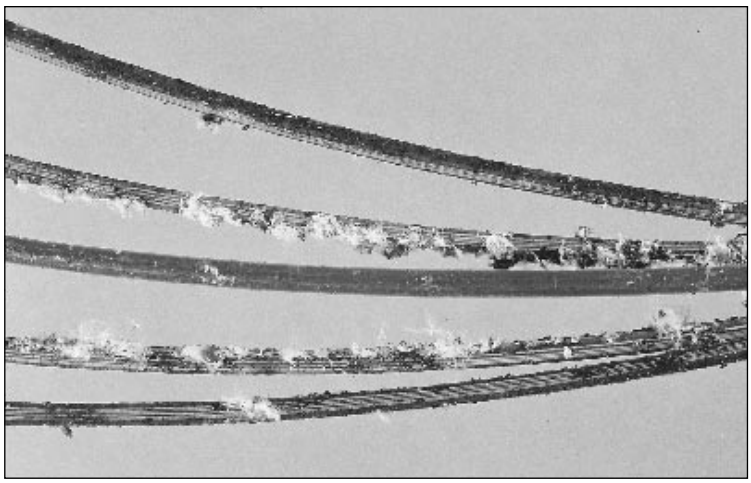

Fig. 15. *Pineus pinifoliae* on western white pine.

On spruce: The most obvious sign of adelgid infestation is the cone-like galls on the branches. These may be cone-shaped or pineapple-shaped, according to the species of adelgid, and range from pea-size to over 7 cm in length. Young galls are green shaded with pink or purple, old empty galls turn brown and may remain on the trees for several years. Galls of *Pineus* spp. have inter-connecting chambers; *Adelges* galls have separate cells at the needle bases (Figs. 13,14). Occasionally adelgids in non-gall-forming stages may be present on spruce and appear as tufts of white wool on the foliage.

On other hosts: Galls are not formed, aphids appear as tufts of white wool on the foliage and bark throughout the summer. The over-wintering form appears as tiny black nymphs (Fig. 12) located on twigs or needles of the current years growth. Foliage feeding by the adelgids causes chlorosis and distortion of needles and, when severe, needle drop. The balsam woolly adelgid feeds on the bark and causes swelling or gouting at the branch nodes and tips.

Control

Biological: Adelgids are preyed upon by over 50 insect predators including several introduced species. None is completely effective at infestation levels.

Chemical: Chemical control is generally not necessary except on high-value trees such as those in parks, nurseries, Christmas tree plantations and seed orchards. Carefully timed sprays of a systemic insecticide will control these insects. Generally insecticide applications are made in spring when buds are swelling and before damage occurs.

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March 1996
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