FGC Forest Genetics Council of British Columbia

Cone and Seed Insect Pest Leaflet No. 14

British Columbia Ministry of Forests and Range,
Tree Improvement Branch, Saanichton, BC

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COOLEY SPRUCE GALL APHID (*ADELGES COOLEYI*) AND OTHER ADELGID SPECIES IN B.C.

Adelges cooleyi galls on spruce (W. Strong)

TAXONOMY:

Order: Hemiptera (true bugs)

Family: Adelgidae ("adelgids", spruce and pine aphids, gall aphids)

HOSTS: Most adelgid species have two hosts: spruces (*Picea* spp.) are primary hosts and some other Pinaceae conifer such as Douglas-fir (*Pseudotsuga menziesii*), pine (*Pinus* spp.), true fir (*Abies* spp.), or larch (*Larix* spp.) serves as the secondary host. Some adelgids are found on a primary or secondary host alone (e.g. in Canada, *Pineus similis* is known from *Picea* spp. only, *Adelges piceae* from *Abies* spp., and *Adelges tsugae* from *Tsuga* spp.).

Table 1. Some common adelgids in British Columbia seed orchards.

	Alternate hosts		
Species	Primary	Secondary	Secondary host feeding sites
Adelges cooleyi	Various spruces (*Picea* spp.)	Douglas fir (*Pseudotsuga menziesii*)	Twigs, needles and cones
Adelges tsugae (introduced species from Asia)	None	Western hemlock (*Tsuga heterophylla*)	Bole, branches, twigs
Adelges lariciatus (see CISPL #9)	Various spruces	Larch (*Larix* spp.)	Vegetative and reproductive buds
Pineus pinifoliae	Various spruces	Western white pine (*Pinus monticola*)	Twigs, needles
Pineus similis	Various spruces	None	Twigs

DISTRIBUTION: Adelgids are widely distributed (but often only locally common) around the world, wherever Pinaceae conifers occur. Eleven species have been recorded in British Columbia.

DAMAGE: On primary hosts, adelgid infestations are easily recognized by the cone-like galls formed by developing nymphs from vegetative and reproductive buds. Gall shape and size vary with adelgid species and galls may remain on the trees for several years after the nymphs have matured. Young galls are green, often with pink and purple highlights; old galls are desiccated and brown.

(R. Bennett)

(W. Strong)

Pineus pinifoliae galls on spruce. Left: late spring (note the distinct cone shape of the gall). Right: early summer.

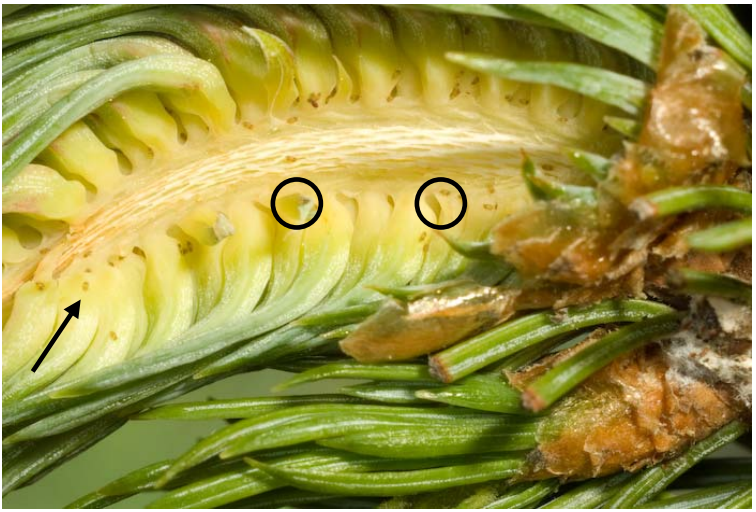
Galls impact current and future spruce cone sites and the development of twigs, especially on smaller trees. They tend to be most prevalent on lower to mid-crown branches, and therefore may not be a serious problem for seed production on mid– to large-size spruce trees. If galls are abundant however, then the amount of energy put into gall production may adversely affect cone production elsewhere on the tree.

On secondary hosts, adelgids are usually noticeable as individuals or groups of insects, each under a white, waxy covering on foliage, twigs, branches, or boles of trees. Affected needles may be discoloured. Large populations on secondary hosts may result in defoliation or occasionally death of infested branches.

	Developing adelgid gall on spruce. (D. Manastyrski)
	Desiccated old gall. Gall has opened around needle bases allowing the dispersal of mature adelgids. (D. Manastyrski)

IMPORTANCE: Adelgid populations in spruce seed orchards may impact cone production, especially on smaller trees. On secondary hosts, high adelgid populations may impact general tree health through defoliation and mortality of individual branches. Generally speaking, adelgid populations are kept under reasonable control by predatory insects. However, common seed orchard practices (*e.g.*, planting primary and secondary host orchards in

close proximity, regular insecticidal sprays, nitrogen fertilization) can cause adelgid populations to increase to problematic levels.



Longitudinal section of a *Pineus pinifoliae* gall, showing the cavities and adelgid nymphs within the developing gall. Arrow indicates nymphs; circles show the cavities. (D. Manastyrski)

LIFE HISTORY: Adelgid species usually exhibit a complex life cycle involving six generations, asexual and sexual reproduction, and host alternation between spruce and secondary host over two years. Sexual reproduction only occurs in one generation on spruce; all other generations are asexual.

On secondary hosts: Winged females arrive from spruce in mid summer, settle, and begin producing nymphs. Nymphs overwinter, usually on current year twigs. In early spring, nymphs enlarge dramatically, mature into wingless females, begin egg production and become covered in waxy "wool". Eggs hatch in spring and nymphs disperse onto foliage or branches. Nymphs mature and produce a second generation on foliage or branches. This second generation matures into winged females, which fly to spruce in mid-summer.

On primary hosts: Winged females arriving from secondary hosts give rise to a generation of males and females which mate and lay eggs. These develop into female nymphs, which overwinter on spruce twigs some distance away from dormant buds. In early spring, nymphs mature; their progeny migrate to expanding buds. Infested buds turn into distinctive galls with chambers containing maturing nymphs. When nymphs mature, gall chambers open to allow winged females to emerge and fly to secondary hosts.

Description

Adelgids are small (adults: 1-3 mm long) and difficult to identify to species even with a microscope. Field identification is usually based upon gall morphology on the primary host or on the species identity of the secondary host.

Pineus pinifoliae feeding on western white pine branches causing discoloration of foliage. (W. Strong)

Interior spruce with many *Adelges cooleyi* galls. Some galls indicated by arrows. (M. Gardiner)

EGG: Oval, yellow to reddish-brown or grey, approximately 0.5 mm; generally occurring in clumps on and around individual females under a layer of waxy, white "wool".

Adelges tsugae "wool" mass opened to reveal wingless female and eggs. (D. Manastyrski)

Adelges cooleyi wooled-up adults on Douglas-fir foliage (eggs visible in one wool mass). (D. Manastyrski)

NYMPH: Soft-bodied and oval with very short legs and antennae. Nymphs are pale yellow to dark brown, 0.5 mm to over 1 mm in length. They are "naked" when actively dispersing; covered in waxy "wool" when sessile.

Douglas-fir twigs and expanding foliar buds heavily infested by *Adelges cooleyi*. (D. Manastyrski)

Close-up of active *Adelges cooleyi* nymphs on new Douglas-fir foliage. (D. Manastyrski)

Spruce gall dissected to reveal *Adelges lariciatus* nymphs within gall chambers. (D. Manastyrski)

Sessile *Adelges cooleyi* nymphs, beginning to "wool-up", on a spruce twig. (W. Strong)

ADULT: Wingless forms: sessile, oval, approximately 1-1.5 mm long, light brown to purplish black covered with white, waxy "wool". Winged forms: active, less than 3 mm long, lacking wool, wingspan 5-6 mm, wings usually folded roof-like over back.

Winged form of a species of *Adelges*. (D. Manastyrski)

GALL: Adelgid galls show a considerable amount of within-species variation, but some general characteristics can be noted. For example, *Adelges cooleyi* galls are elongate, ranging in length from about 12 to 75 mm, with well-developed needles. *Adelges lariciatus* galls are rather squat and pineapple-shaped and are generally smaller than galls of other adelgid species. *Pineus pinifoliae* galls are similar in size to those of *A. cooleyi* but look very much like pine cones initially, and then develop short needles. *Pineus similis* produces 10-40 mm long galls similar to those of *A. cooleyi*, but much stouter.

Pineus galls usually open and release mature adult aphids several weeks before *Adelges* galls. *Pineus* galls tend to break apart easily after they have dried out; *Adelges* galls usually retain their structure after drying out.

Adelges cooleyi galls on spruce. (D. Manastyrski)

Adelges lariciatus gall on spruce. (D. Manastyrski)

Pineus similis gall on spruce. (D. Manastyrski)

Detection and Monitoring

The population size of *Adelges cooleyi* on spruce can be accurately estimated in late winter or early spring using survey methodology developed by the BC Ministry of Forests and Range. Unfortunately, overwintering population levels do not necessarily provide a clear indication of the number of galled buds developing later in the spring. Economic thresholds have not been established. A monitoring programme also exists for *Adelges lariciatus*. Formal survey methodologies are not established for other adelgids in seed orchards.

Control

Adelgids have many naturally occurring predators, which are usually effective at keeping populations in check. Adelgid populations are difficult to control with insecticidal sprays because waxy "wool" coverings usually protect the insects. Such sprays, however, easily destroy predator populations. Explosions of adelgid populations can result from poorly timed or poorly applied sprays.

Use nitrogen fertilizers carefully. Nitrogen tends to have no appreciable beneficial effect on infested trees but can increase adelgid fecundity.

To decrease the opportunities for adelgids to cycle between their primary and secondary hosts, avoid planting seed production spruces in close proximity to other conifers (especially larches, Douglas-fir or pines).

If control is warranted, measures are best taken when a majority of eggs have hatched and the nymphs are actively dispersing (*i.e.*, before they settle and become "wooled-up"). Regular monitoring is necessary as females mature and begin egg production in early

spring. When the foliage is dry (i.e. no dew or rain) and when nymphs are dispersing and exposed, spraying trees thoroughly to runoff with 2% insecticidal soap should provide effective control.

Key References

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