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Needle Discolorations of Western Larch

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Fall yellowing of larch trees interlaced in an evergreen background presents a beauty all its own. Though not as spectacular as the fall color changes of the eastern hardwoods, this normal yellowing of larch foliage gives the Northwest one of its great esthetic treasures. But larch needles also discolor prematurely, in spring and summer. Then too a striking scene may be presented, but as a warning of abnormality and possible trouble ahead. Foliage discoloration in larch has many causes and it is important to know what the various changes in foliage coloration may mean.

Causes

Five causes of larch needle discoloration are discussed in this leaflet: normal physiological processes, fungus diseases, climatic abnormalities, noxious fumes, and insects. Discoloration is a prelude to death and eventual shedding of foliage. The time between foliage death and replacement varies according to the cause.

Symptoms

Normal Physiological Processes.—It is normal for larch foliage to turn yellow in the fall. Death and shedding of the needles soon follows, and the trees stand bare through the winter. Excepting subalpine larch, western larch is the only native conifer in the West that has this characteristic. Thus, it is understandable why persons not acquainted with the tree often become alarmed about this natural process.

Needles start to change color in early October, often coincident with the first general snowfall. They first turn bright yellow, then light tan, and by mid-November most have been shed. New needles are produced the following spring, usually between mid-April and mid-May. The time between shedding of the old needles and production of the new varies somewhat from year to year and also with elevation.

Fungus Diseases.—Two needle fungi, *Hypodermella laricis* and *Meria laricis*, are probably the most common and widespread causes of

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abnormal discolorations of larch foliage. Shortly after needle growth is completed in spring, entire hillsides of larch may appear as though scorched by fire or extreme climatic fluctuations. On small trees the entire crown may become discolored, on large trees only the lowermost portions.

Several other fungi, including two needle rusts, *Melampsora epitea* and *M. medusae;* a needle cast, *Lophodermium laricis;* and a needle blight primarily of seedlings, *Botrytis douglasii*, have also been reported on larch needles but much less frequently.

Hypodermella laricis is the most common of the fungi affecting larch needles and its symptoms are the most striking. Needles apparently get infected soon after foliage growth starts in spring. Early in June, all infected needles suddenly turn reddish brown. In severe outbreaks the color change is often so sudden and so spectacular that it is no wonder inexperienced observers think the entire forest is dying.

Soon after the needles die, fruiting bodies of *Hypodermella laricis* appear as little black dots, usually on the upper surfaces of the needles (fig. 1). These dull black oval bodies sometimes merge into short narrow rows. Many needles infected by *H. laricis* cling to the spur shoots for more than a year (fig. 2). Tufts of dead needles persist through the winter, serving as sources of the spores that infect the newly formed needles next spring. These tufts of dead needles are almost as reliable an identifying symptom as the black fruiting bodies found on the dead needles.

Meria laricis is the second most important of the fungi causing discoloration and death of larch foliage. It can be found on trees of all ages. Infected needles begin to discolor near the middle or at the distal end. They first turn yellow and then brown or dark brown around the point of initial infection. The entire needle gradually turns brown as the infection spreads. Needles are attacked soon after they emerge in the spring and infection may continue throughout the growing season, in contrast to *Hypodermella* infection which occurs only early in the growing season. *Meria*-infected needles are shed after they die and these dead needles lying on the ground are the source of spores for early season infection of the new needles next spring.

Fruiting bodies of *Meria laricis* cannot be seen with the naked eye. Even under the microscope they appear only as white dots, usually along the lower needle surface. Positive identification can be made by staining infected needles with cotton blue or picroaniline blue. The fruiting bodies then show up clearly as blue dots at the stomata.

All these needle fungi are favored by moist spring seasons. Even so, outbreaks cannot be predicted and are not discovered until foliage discoloration becomes apparent.

Climatic Abnormalities.—Frost and drought both may cause discoloration and premature death of western larch foliage. *Early fall frosts* cause a reddening or brown-

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FIGURE 1.—Larch needles showing black fruiting bodies of *Hypodermella laricis* (4⅓ ×). Note the preponderance of fruiting bodies on the upper surfaces.

ing of the foliage and, of course, hasten normal fall shedding. *Damage from late spring frosts*, because of symptoms produced and time of occurrence, can easily be confused with fungus infections. Spring frost injury may kill the needles at once, but the dead needles remain attached to the tree for the remainder of the growing season. Frost-injured foliage is most commonly found on the outermost parts of branches and on foliage near the ground.

Drought-induced symptoms are similar to those of normal fall discoloration, except the needles turn yellow prematurely and are shed earlier and over a shorter period of time. Prolonged drought causes injury to larch growing on shallow, sandy, or hardpan soils. On the most severe sites, discoloration may occur as early as the first week of August, a full 2 months ahead of normal schedule. Unlike trees affected by needle fungi or late spring frosts, trees losing their foliage from drought do not put forth a new complement of needles until the following spring.

Noxious Fumes.—Western larch, because of its deciduous foliage, is not as seriously affected by industrial fumes as other conifers, which suffer a cumulative effect. Young larch foliage is, however, extremely sensitive to noxious fumes. Needles become less susceptible to damage as they mature. Discolorations may progress through different shades of yellow to brown or

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FIGURE 2.—Branch section of western larch showing foliage infected with *Hypodermella laricis* (1¼ ×): *A*, 2-year-old spur shoot with its first set of needles infected; *B*, 3-year-old living spur shoot with the previous season's infected needles still clinging and current season's foliage emerged but infected; *C*, 3-year-old spur shoot killed by fungus and with foliage clinging to it.

from a water-soaked appearance to bright reddish brown, depending upon the specific poison in the fumes. After they are killed and completely discolored needles are shed.

Within the western larch type there are industrial plants that may produce two gases injurious to needles: fluorine and sulfur dioxide. Fluorine is apparently more injurious than sulfur dioxide. Either one, however, can kill the entire needle or only parts of it, depending upon the concentration and duration of exposure. Fluorine damage can be distinguished from sulfur dioxide damage; fluorine damage is characterized by the formation of a narrow dark-brown band between the green and discolored portions of the needle. The

proximity of smelters is an obvious help in diagnosing needle discolorations of western larch where noxious fumes may be among the suspects.

Insects.—Western larch is attacked by several insect pests. Varying degrees of needle discoloration are caused, depending upon the type of insect and severity of attack. Defoliators are the only insects commonly associated with crown discoloration. Their depredations may be confined to small areas of larch forests, or visible defoliation may extend over thousands of acres under outbreak conditions.

Needle discolorations caused by insect feeding and fungus infection are frequently difficult to distinguish at a distance. Unlike fungus diseases that are often more conspicuous in the lower parts of tree crowns, insect feeding usually appears over the entire crown, or is more conspicuous in the uppermost parts. Close examination shows three main types of insect feeding on western larch: (1) Needles are chewed off close to the base of the fascicle, leaving short needle stubs protruding from the spur shoot; (2) only fleshy parts of needles are eaten, leaving the midrib which shrivels and turns brown; and (3) needles are hollowed out by insects that tunnel into them.

The time of year that foliage is attacked, and subsequently discolors, helps identify the responsible insect. One cause of needle discoloration in early spring is the larch casebearer (*Coleophora laricella*) (fig. 3). The casebearers overwinter as partly grown larvae attached to twigs of larch. The larvae resume feeding concurrently with appearance of new needles, about mid-April at lower elevations. By early May the tree crowns assume a reddish-brown, scorched appearance.

Other forest insects may overwinter as eggs or pupae and complete their development several weeks later than the larch casebearer. Needle discoloration caused by such defoliators as larch budmoth (*Zeiraphera griseana*), larch sawfly (*Pristiphora erichsonii*), spruce budworm (*Choristoneaura fumiferana*), and false hemlock looper (*Nepytia canosaria*) becomes apparent in late June and July.

Still another group of insects develops at a slower rate during the summer months. Consequently, the effects of their larval feeding do not become visible until August and September. Among these insects are the two-lined larch sawfly (*Anoplonyx occidens*), the western larch sawfly (*Anoplonyx laricivorus*), and a looper (*Semiothisa sexmaculata*).

Damage

Little is known about the damaging effects of abnormal discolorations or premature loss of foliage in western larch. Unless subjected to repeated abnormal defoliation, larch usually regains its health and vigor rapidly. The habit of producing a new complement of foliage appears to save larch from significant injury except for an undetermined amount of growth loss.

Most foliage of western larch is borne on spur shoots. *Hypodermella laricis* has been reported to kill spur shoots in addition to the foliage. However, new foliage grows from some spur shoots whose foliage was previously killed (fig. 2). The effects of spur shoot mortality have not been evaluated, but death of foliage and shoots must reduce tree growth, especially in severe epidemics. Tree mortality is rare, but occasionally small seedlings may be killed.

Meria laricis has been reported as killing larch reproduction. One-year-old seedlings probably can be killed. Older trees, unless attacked repeatedly in successive years, are not likely to be killed. Like *Hypodermella*, *Meria* may cause growth loss in trees, but the amount is not yet determined.

Growth loss caused by nonliving factors has never been fully evaluated. Losses from fume damage are both localized and minor. Larch persists on drought-affected sites and sustains little damage except some reduction in growth. The ability of larch to shed all its foliage under drought conditions is a protective measure. Other conifers, which lack this habit, often suffer permanent damage to foliage, twigs, and stems.

The majority of outbreaks of defoliating insects in western larch stands have been short lived and have caused little damage. However, since discovery of the larch

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FIGURE 3.—Needle discoloration and defoliation caused by the larch casebearer. Branches from western larch, comparing the normal appearance of undamaged foliage of the branch on the left with that of a heavily defoliated branch. Needles of the branch on the right have been destroyed by larch casebearer larvae.

casebearer in 1957, populations have increased tremendously, and the insect is spreading rapidly through the range of western larch. In areas where trees have suffered severe defoliation for 3 or 4 years, needle growth is considerably stunted. No tree mortality has been recorded as yet, but trees in the younger age classes probably cannot withstand many more years of complete defoliation.

Control

Smelter fumes can be controlled. Fume injury has become much less extensive in recent years since devices have been developed and installed to purify stack gases at their source.

Feasible methods of preventing climatic abnormalities in forest stands have not yet been derived.

Control of fungus diseases in natural stands is not now economically practicable. Western larch has never been grown commercially in nurseries. Should the species be cultivated, experience in Great Britain has shown that *Meria laricis* can be controlled by spraying with lime-sulfur every 2 or 3 weeks from the time of bud bursting until early August. Control of diseases caused by other fungi has not been tried because of the low economic significance of the diseases.

No method of chemical control has been developed against defoliating insects of western larch. An attempt at biological control of the larch casebearer was started in 1960 by releasing in north Idaho several thousand *Agathis pumilus* adults that were shipped from Connecticut. It is hoped that this insect, a parasite of the larch casebearer, will be as effective in the West as it appears to have been in reducing epidemics in the East.

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