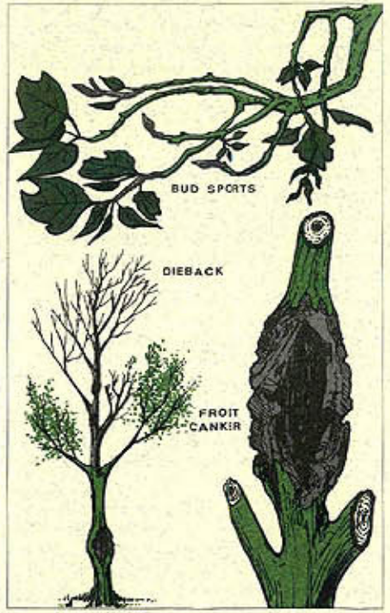
Frost damage of poplar



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Distribution and Hosts

In the prairie provinces of Canada, frost damage commonly occurs on native poplars (trembling aspen, balsam poplar, and plains cottonwood) and cultivated poplar hybrids, such as Northwest, Brooks, Griffin, and Russian. Frost can affect poplar trees of all ages in shelterbelts or natural stands, whether grown for timber or as ornamentals.

Symptoms and Damage

There are a number of symptoms of poplar damage that, when present, provide evidence for identification of frost as the cause of the damage: dieback, bud sports, frost heaving, frost cankers, frost burls, and frost ribs.

Dieback is a condition that is easily recognized from a distance because of the contrast between living and dead branches on the same tree. In the spring, dieback occurs when frost kills the smaller branches in the upper crown. During the growing season, leaves shrivel and die a few days after the frost. When the frost injury occurs during the fall or winter, damage is not apparent until spring, when the tree either fails to leaf or produces foliage with smaller than normal leaves; in midsummer this foliage turns yellow, shrivels, and dies. Dead leaves and branches resulting from dieback tend to remain on the tree. In a case of severe dieback, whole sections of the crown may be killed.

Bud sports are buds that develop into abnormal shoots and leaves. When the original main stem (leader) has been killed by frost, the more vigorous bud sports develop into new leaders and replace the dead branches. Such a tree becomes candelabrum like, multistemmed, or very bushy. Weaker bud sports develop into short spindly branches that bear leaves of different sizes, shapes, and numbers. These branches often grow in a downward or horizontal direction.

Frost heaving is the uprooting of the tree by frost action, which breaks off the small feeder roots and exposes the shallow root system to more frost damage, either killing the root or forming cankers. Damage to the root system weakens the tree, delaying repair and inhibiting the growth of new shoots in the crown. The survival of the whole tree may be threatened; a tree may fail to leaf, or it may produce only small sparse leaves. A seriously damaged tree often forms sprouts around its base.

Frost cankers are dead, blisterlike areas of bark found on the main stem and larger branches. After being killed by frost the bark tissues are discolored to light or dark brown. Some cankers heal; others persist and increase in size each year as the new tissues that form around them are repeatedly killed by frost. The dead bark eventually cracks and sloughs off, exposing the central core of wood. The bark around an old canker is much thicker than normal, and the canker itself can form a scar up to 5 m long on a tree trunk.

Frost burls are woody swellings that may develop around cankers. They increase in size year by year and are characterized by thick furrowed bark. They are often accompanied by clusters of bud sports, which produce short-lived spindly branches. Frost burls strengthen the frost cankered area of the stem and prevent wind breakage.

Frost ribs are ridges of new wood and bark that form over elongated frost cankers on the main stem. The outer rough bark eventually sloughs off, leaving a smooth bark surface on the ridges of new wood that eventually join together to form a single unit. Frost ribs grow in size each year and serve to strengthen the stem.

It is sometimes difficult to recognize climate-related poplar damage. There may be few obvious signs of the cause, and damage may be followed by many other events such as the natural pruning of shoots and twigs, with results camouflaged by current growth, weathering (sloughing) of dead tissues, and growth of secondary microorganisms. The microorganisms that quickly colonize frost-killed tissues can be easily mistaken for primary causal agents: previously reported poplar-damaging cankers (*Cytospora* spp. *Nectria* spp., and some of the *Septoria* spp.) were probably either frost-damaged tissues subsequently colonized by these fungi or samples identified only visually.

Causal Agent

Rapid alternation of freezing and thawing temperatures kills some poplar tissues and causes the tissues around these areas to grow abnormally. Mortality occurs when moisture within the tree freezes, and the resulting crystals of ice expand to crush and heave various tissues, especially those as sensitive as buds and the layer of growth cells (cambium) under the bark. Freeze–thaw cycles occur mainly during the spring and fall: March–April and September–October are the critical months. On the eastern slopes of the Rockies and in southwestern Alberta, freeze–thaw cycles also occur during the winter and are caused by the frequent warm winds (chinooks).

Prevention and Control

There is no fully effective method to protect poplars from frost damage, and no frost-resistant hybrids have been developed to date. Changes in crown form and tree height resulting from frost damage are unavoidable; in some settings a short or bushy tree may be preferred.

The best way to prevent frost damage is to plant the tree carefully, encouraging vigorous growth so that it becomes well established. On the prairies a young poplar is usually slow to develop strong roots and shoots. Therefore, a newly planted tree should be pruned to a single leader and its crown density allowed to increase gradually over the next 3–4 years. The application of fertilizer causes vigorous growth, which reduces the occurrence of dieback and frost canker formation; it also accelerates the repair of frost-damaged tissues, and it encourages the formation of new roots, as well as vigorous upright branches that can take over as new leaders. The poplar responds best to the application of either 16-20-0 or 20-0-0 fertilizer (at the rate recommended for lawns) and watering during the first week of leaf production. Fertilizer should never be applied in late summer because vigorous new growth will not harden off and will therefore be susceptible to frost injury.

Some protective measures can be taken. Aerial parts of the poplar are the most difficult to safeguard; however, when an overnight killing frost has been predicted during the growing season, the continual watering of a small poplar should help to reduce the damage. Roots are much easier to protect. In the fall they can be covered by a mulch of straw or leaves, especially if there is no heavy sod over the root area. In the early spring a liberal supply of good topsoil, peat moss, or rotted manure applied to the root area will encourage root growth in a young tree.

If frost does strike the poplar, many resulting growth defects can be corrected. A tree that becomes unevenly foliated—sparse in some parts, full in others, but with no dead branches—should be well watered and fertilized during the first week after leafing out. When a tree is stunted by dieback, a new leader should be chosen (and the competing shoots pruned out) as soon as dominance is shown. Bud sports should be pruned out when they produce either branches growing horizontally or downward or branches that are overcrowded. On trembling aspen the pruning of live branches should be completed by late May so that the wounds have ample time to heal; on all other poplars it should be finished by late June. After pruning, it is essential to fertilize and water the tree well so that it will resume normal growth as soon as possible after leafing out.

Dead branches on a small poplar may be pruned at any time, but for safety reasons dead branches should be removed from a large tree as soon as possible. No treatment is necessary for frost cankers. A canker exudes its own protective resinlike substance, and the burls and ribs that may form later over the canker will strengthen the tree trunk.

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