# Chapter 7:

# Forest Health

**Melvin J. Baughman,** Extension Forester, University of Minnesota

During its long life, a tree may be subject to damage by animals, weather and other environmental conditions, insects, diseases, and fire. Inspect your woodland at the beginning and end of each growing season and whenever a fire, windstorm, ice storm, flooding, prolonged drought, or other such event may have caused damage.

It can be very costly to control damaging agents once they become established so it is wise to prevent damage before it occurs. To minimize damage:

- Match the tree species to the sites and conditions where they are likely to grow best.
- Maintain tree species diversity by either mixing tree species within a stand or growing several different species in pure stands.
- Regulate stand density to encourage fast growth while maintaining relatively full stocking.
- Use pest-resistant planting stock when available.
- Prune or thin during the winter rather than during the growing season.
- Avoid wounding trees when operating heavy equipment or logging in the woodland.
- Clear firebreaks around conifer stands.

Descriptions of common sources of tree damage follow, along with information about various types of damage, and their potential severity. Chapter 6: Managing Important Forest Types briefly describes the most common pests and diseases associated with different forest types and how to prevent or control them. Contact a forester to help you identify problems, assess damage, and design a control strategy for any serious problem. A forester also can help you plan stand management practices that will reduce future problems.

## Animal Damage

Animals that frequently damage trees include birds, deer, small mammals, and livestock.

### Birds

Woodpeckers cause the most noticeable tree damage as they probe beneath loose bark or peck holes into sapwood in search of insects. Such feeding activity is concentrated on dead, dying, or damaged trees so the bird's feeding is a sign of poor tree health, but not its cause.

One exception to this is the yellow-bellied sapsucker which feeds not only on insects, but also on sweet sap. Sapsuckers bore 1/4-inch diameter holes in closely spaced, parallel rows that may completely encircle a tree. These birds are known to feed on more than 250 species of woody plants. Birch, maple, and hemlock are their preferred food sources in the Lake States.

Sapsucker holes lead to wood stain and may become points of entry for wood decay. If you leave their favorite feeding trees untreated, sapsuckers will concentrate their feeding activities on those trees, which helps protect nearby trees from serious injury. Sapsuckers are especially attracted to aspen with heartwood decay, which they can excavate for nesting cavities. To protect a valuable aspen timber stand, eliminate trees that show signs of decay when you are thinning the stand. This may help discourage sapsuckers from using the area.

**Figure 7-1. Sapsucker damage on a tree.**

Some bird species, including pine grosbeaks and ruffed grouse, eat buds, causing minor damage.

Bird damage usually is limited, so no bird control measures are needed in woodlands. Most bird species (except English sparrows, European starlings, and pigeons) are protected by federal law. A federal permit is needed to destroy protected birds, even if they are pests. Check with the U.S. Fish and Wildlife Service before attempting any control method that may harm birds.

## Deer

Deer browse on branch tips, especially on young trees and stump sprouts. Browsing stunts tree growth and disfigures trees by causing them to develop crooked stems. Browsing may seriously damage regeneration where there is a high deer density and relatively little natural browse or few agricultural crops available. Browsing damage occurs mainly in winter. Bucks also rub small tree stems and branches with their antlers to remove velvet. Antler rubbing may kill small trees (usually those that are less than 3 inches DBH), but few trees are damaged in this manner so control is not warranted.

In most cases the deer population can be controlled by hunting following state regulations. High fences are effective deterrents, but are prohibitively expensive for forestry purposes. Electrical fences with high voltage and low impedance are more economical and in some cases may be justified to protect young, high-value plantations. Contact a forester or wildlife damage control expert for advice on fencing. Commercial chemical repellents sometimes are effective, but may need to be reapplied after a rain or wet snow. Bud caps are sometimes placed on white pine seedlings to protect them from deer browsing (see pg. 71 in Chapter 6: Managing Important Forest Types).

You also can minimize forest openings and brushy habitat, making your forest less attractive to deer, or make cutting blocks and regeneration areas as large as possible, thus providing more browse than the deer can consume.

## Small Mammals

Rabbits, snowshoe hares, mice and other small rodents can girdle or cut off young trees near the ground. Reduce damage by eliminating tall grass and brush piles that provide cover for these animals, especially in or near new tree plantations. Do not place organic mulch (such as straw or wood chips) within 4 inches of a seedling tree stem, because the mulch may provide cover for small mammals.

**Figure 7-2. Rabbits and hares eat tree bark in the winter.**

Pocket gophers feed on roots and bark around the base of young trees and other plants, especially in sandy soils. They are pests in agricultural fields that are being converted to woodland. The best control is to reduce their food sources by eliminating as much vegetation as possible in a tree plantation. In small areas gophers can be trapped. Where the population is high and the plantation is large, control them using a device that creates an artificial tunnel and drops poisoned grain into it. When using poisoned grain, take great care to prevent spills and accidental poisoning of nontarget animals.

Beavers commonly dam small streams, which can flood woodlands and kill trees in the area. They also fell trees (especially aspen and willow) near streams and lakes and either feed on the bark and small branches or use the wood for building dams and huts. The best way to solve a beaver problem

is to trap and remove the animals. Contact a wildlife conservation officer for information on trappers in your area.

Porcupines eat bark and may girdle and kill some trees, especially white and red pines. If damage is serious, they can be live-trapped or killed.

### Livestock

High concentrations of cattle, horses, sheep, goats, or other livestock pastured in a woodland compact the soil, trample young seedlings and sprouts, damage roots, rub bark from stems, and eat or defoliate small trees. Heavy grazing and forest management are not compatible on the same site. In general you should fence livestock out of woodlands if you expect to grow high-quality trees in it.

**Figure 7-3. Fence livestock out of woodlands to protect small trees.**

Grazing may be acceptable for a short period (a few months to a couple of years) when you want to suppress understory vegetation in preparation for a shelterwood harvest that will be followed by natural regeneration or planting trees. Grazing also may be appropriate in a silvo-pasture where trees and pasture are intentionally managed together. You must give appropriate attention to tree selection, spacing, pruning and other cultural practices to develop widely spaced, high quality trees. Likewise the pasture grass must be intensively managed with fertilizer, rotational grazing, and other practices as needed.

## Environmental Damage

Trees may be damaged by airborne chemicals, machinery, soil-related problems, too much or too little water, and severe weather.

### Airborne Chemicals

Airborne pollutants from industry, automobiles, fires, and other chemical sources can harm trees. Symptoms include defoliation; browning or yellowing leaf margins, tips, or tissue between leaf veins; and stunted foliage growth. Herbicides may cause distortion, curling, and browning margins, or leaf drop in deciduous trees and may cause conifer needles to turn yellow or brown, and succulent shoots to curl and deform. If trees survive such damage, their growth may be stunted or their shape deformed. Where air pollution could be a problem, plant resistant species and maintain well-thinned stands. When applying pesticides, follow label directions and standard application guidelines to minimize chemical injuries. Some pesticides may need to be applied by a licensed pesticide applicator. While most pesticide damage is caused by herbicides, insecticides and fungicides also can damage trees if the tank mix is too strong. Herbicide drift often originates on neighboring properties, so be sure to let your neighbors know the value you place on your woodland. Ask them to take special care when applying chemicals on their own properties to avoid damaging drift to your property.

### Machinery

Damage from logging equipment is a concern in any stand where some trees will be left after the harvest. Logging equipment can knock over small trees, break branches, tear bark, and destroy roots near the surface. Careful and experienced equipment operators can avoid much of this damage. Creating a physical barrier between the trees that will be left to grow and the equipment also helps.

Heavy equipment used in plantations (such as cultivators, mowers, and pesticide applicators) can sever small trees, break branches, or tear bark. Reduce damage by planting trees in rows that are 2 to 4 feet wider than the equipment, plant trees in

straight rows, and maintain even spacing between rows. Set cultivation equipment to run as shallowly as possible to avoid cutting tree roots. Consider using an herbicide rather than cultivation or mowing equipment.

**Figure 7-4. Heavy equipment can easily damage young trees in plantations.**

## Soil

Soil compaction cuts off water and carbon dioxide to tree roots. Compaction slows tree growth and interferes with root suckering in aspen stands that are clearcut. Compaction may be indicated by dying leaves on mature trees and dying branches on younger trees, but most often reduced growth is the only sign of it.

Soil compaction is a problem mainly on wet clay or silt soils. It occurs where heavy equipment has been driven across a site. Old farm fields may have a compacted plow pan a foot or two below the soil surface. Wooded sites may be compacted on the surface. Compacted soil takes decades to loosen up through freezing and thawing cycles. Reduce compaction in the first place by operating heavy equipment only when the soil is dry or frozen. On farm fields with a plow pan, deep chisel the site to break up the compacted layer, then plant trees.

Changes in the soil level around a tree also affect its growth and odds of survival. Excavating soil and severing roots may lead to windthrow or root diseases that kill trees. Adding soil decreases air movement to the roots and may kill the tree. Therefore, avoid removing or adding soil near trees.

Mineral deficiency causes a range of symptoms from foliage discoloration to reduced foliage size. A soil analysis will indicate which minerals are deficient. Soil types vary considerably in their natural nutrient content. Always try to match the tree species to sites that meet their nutrient needs. See Chapter 6: Managing Important Forest Types for more information on the soil requirements of various forest types and species. While timber harvesting removes some nutrients from a site, most nutrients are stored in the branches and bark of trees, so leaving those materials on the site after harvest will recycle the nutrients. Nutrients also enter a site from precipitation and air exchange.

Lake States woodlands rarely have significant nutrient deficiencies in stands that are managed over normal rotation lengths. Nutrient deficiencies may occur with repeated short rotations, especially when all woody material is removed from the site (called biomass harvesting). Ask your forester about best management practices for biomass harvesting.

## Water

Drought damage occurs when water loss through the leaves exceeds water uptake by the roots. It is most common on sandy and gravelly soils, which do not retain much water. It also occurs if the water table drops suddenly and remains low, depriving trees of the moisture they need. Drought symptoms include leaves wilting or turning brown—beginning with tissue between leaf veins, off-color foliage, and a general decline in vigor. Newly planted trees are especially vulnerable to drought because their root systems are not well developed. Crowns of larger, drought-stricken trees usually die from the top down. Insect attacks often are triggered by drought. For example, wood boring insects may invade drought-weakened trees. Trees already stressed by disease or physical damage may die in a drought.

**Figure 7-5. Red oak leaves damaged by drought.**

To minimize drought damage, match tree species to the sites where they grow best. Some species are more drought resistant than others, so manage drought-tolerant species on dry sites. Plant new trees in the spring or fall when soil moisture is high. When soil moisture is low, plant seedlings with soil around their roots, such as containerized stock. Do not plant shallow-rooted species in areas of low rainfall or on sandy soils. Thin stands before they become overstocked, but do not thin during a drought.

| High | Moderate | Low |
|---|---|---|
| American elm | Balsam fir | Bigtooth aspen |
| Black ash | Basswood | Bitternut hickory |
| Eastern cottonwood | Black spruce | Butternut |
| Green ash | Black walnut | Northern red oak |
| Silver maple | Bur oak | Red pine |
| Willow | Eastern white pine | Sugar maple |
| | Jack pine | White ash |
| | Northern white-cedar | White birch |
| | Quaking aspen | White oak |
| | Shagbark hickory | White spruce |
| | Swam white oak | |
| | Tamarack | |
| | Yellow birch | |

**Table 7-1. Flood tolerance during the growing season of seedlings of selected tree species.**

Extended flooding can suffocate roots and kill trees. The extent of the damage typically depends on the tree species (Table 7-1), time of year, tree size, and tree vigor. Flooding for short periods in winter or early spring is seldom a serious problem, but flooding during the growing season can kill seedlings in just a few days. Completely submerged seedlings will be killed more quickly than trees with their crowns above water. In flood-prone areas such as river flats, plant only tree species that tolerate flooding.

## Weather

High temperatures and drying winds cause rapid water loss from tree leaves. Water loss causes leaf margins to turn brown and leaves to fall prematurely. Do not plant susceptible trees (such as sugar maple) in locations that are exposed to strong sunlight or wind.

Early fall frosts or extremely cold weather shortly after leaf fall can injure succulent twigs and buds. Late spring frosts can kill buds that have begun growing. Trees usually survive these frosts, but their growth, stem quality, and vigor can be dramatically reduced. To avoid freeze damage, plant trees from seed sources that originate no more than 200 miles south of the planting site. (Near the northern edge of a tree species' range, do not plant trees from seed sources more than 50 miles south of the planting site.) If your planting site is in a low-lying, frost-prone area, select a species that breaks bud relatively late in the spring to avoid frost damage. For example, black spruce buds break dormancy about ten days after white spruce.

Winter sunscald occurs in early spring when the sun heats and activates tissue during the day and then freezing temperatures kill the active cells at night. The injury appears as peeling bark over an elongated canker on the south to southwest side of the tree stem. Thin-barked trees such as young maples are most susceptible. The tree rarely is killed, but diameter growth is reduced, decay-causing organisms often enter the tree, and logs become degraded or ruined. In hardwood stands, avoid overthinning or pruning that might expose tree stems to too much direct sun, especially if the trees

are growing near the northern limits of their range. Winterburn and winter drying are caused by warm spring winds that dry the foliage while the roots are still frozen in the ground and cannot replace the lost moisture. This damage is common on most conifer species and may be recognized by the reddening and browning of needles in the spring. Trees usually survive this, but massive defoliation may occur on trees located along exposed plantation borders or on trees that grow along highways, where road salt exacerbates the problem.

Strong winds can topple trees or break their branches. To prevent wind damage, leave a dense row of trees with intact lower branches around the perimeter of woodlands. When thinning old, dense tree stands, progress slowly over a period of years to minimize windthrow.

**Figure 7-6. Strong winds can uproot trees.**

Hail can break off buds and branches and shred tree foliage. There is no way to prevent or control this type of damage.

Lightning can split trees, cause spiral cracks in their trunks, shatter limbs, and start fires. Trees with crowns high above the general canopy level are most subject to lightning strikes. There is no control for lightning other than to remove high-risk trees before damage occurs. Once a conifer is struck by lightning, remove it quickly before bark beetles attack it and build up a population that can spread to other trees.

# Insect Damage

Each type of insect affects very specific tree parts. Insect damage is categorized here by the tree part affected by the insects. Strategies for minimizing insect damage are discussed in Chapter 6: Managing Important Forest Types for the more serious pests.

## Defoliating Insects

Defoliating insects remove all or part of a tree's foliage. They weaken the tree by lowering its capacity to respire and to produce starch and sugars. Foliage damage takes many forms. Insects that remove only soft leaf tissue and leave the network of veins are called skeletonizers. Leaf miners bore into and eat the tissue between the upper and lower surfaces of the leaf. Window feeders eat one leaf surface, leaving the other intact. Case bearers and bag makers construct and live inside individual movable cases that are made of webbing and foliage parts. Needle tiers and leaf rollers encase, fold, roll, or tie adjacent leaves and needles together with webbing. Webworms or tent caterpillars make and live in conspicuous webbed tents. Other insects are free-feeders that eat the entire leaf or needle.

Free-feeders are the most destructive defoliating insects. Populations go through boom and bust cycles. When these insects are abundant and defoliate trees in two or more consecutive years, they can kill trees.

**Figure 7-7. Red oak defoliated by Gypsy moth in June.**

## Sapsucking Insects

Sapsucking insects injure trees by removing tree fluids. They usually are not serious pests in woodlands. However, heavy attacks lower a tree's energy reserves and may lead to a secondary pest problem. The general symptoms of sapsucking injury are loss of vigor, deformed leaves or plant parts, yellowed leaves, or dead branches. Galls (abnormal tissue growths) also may form.

The destructive stage of the insect usually is required for precise identification, but sometimes the presence of feeding punctures, sooty mold, eggs, fine webbing, and other signs suffice. The Saratoga spittlebug has been a serious pest in red pine plantations. Several scale insects, such as the pine tortoise scale and the pine needle scale, are important in Midwestern forests. Aphids and mites are other sapsucking organisms that may affect your trees.

## Bud, Twig, and Seedling Damaging Insects

Most of these insects deform but do not kill trees. The white pine weevil is one of the most damaging insects in conifer plantations in the Lake States. White pine is their favorite host, they also attack other pines and spruces. The weevil larvae feed just below the terminal bud and cause forking and crooking, especially in open-grown trees from 2 to 20 feet tall. Open-grown trees are widely spaced with no crown competition between trees. The new growth elongates slightly before dying because of the larval borings. Weevils usually do not attack the current year's shoot, but it commonly wilts into a "shepherd's crook." Another damaging weevil, the pales weevil, eats the bark on young seedlings.

## Bark Beetles

The succulent and nutritious inner bark on tree stems and large branches attracts many insects, most notably the bark beetles. Adult bark beetles deposit eggs beneath the bark. The emerging larvae feed on the cambium and phloem, preventing stem growth and the normal movement of sugar and water. They hasten the death of weakened trees, attack apparently healthy trees during population explosions and drought, and lower lumber value. They also can introduce disease organisms such as Dutch elm disease fungus and blue stain fungus.

The pine engraver is the most common bark beetle in Lake States pine stands. It attacks healthy trees en masse during drought. Flat-headed inner bark borers such as the bronze birch borer, two-lined chestnut borer, some weevils, and roundheaded borers feed on the inner bark. They rarely kill or damage more than a few trees unless the trees are severely stressed by drought or defoliation.
Bark borers are difficult to control with contact insecticides because they are sheltered beneath the bark. Systemic insecticides also have little effect because these insects disrupt water movement in the tree. Cultural practices such as thinning that maintain tree vigor provide good protection.

**Figure 7-8. Bark beetles killed these drought-weakened red pines.**

## Wood-Boring Insects

Wood-boring insects attack very low vigor or recently killed trees and rarely are a problem in vigorous stands. While common, they rarely cause tree death. They feed for several weeks in the bark before boring into the wood. Flat-headed woodborers, round-headed borers, horntails, powderpost beetles, ambrosia beetles, and ants are woodboring insects of common concern. Problems with chemical controls are the same as with bark borers.

### Root-Feeding Insects

Root-feeding insects are mostly a problem in nurseries or in young plantations where sod is well established. They disrupt the absorption and movement of water and nutrients. Root maggots, cutworms, root bark beetles, white grubs, and root-collar weevils are examples of root-feeding insects. In plantations, kill or remove the sod *before* planting trees. Killing sod after planting may cause these insects to concentrate their attacks on tree roots.

### Cone and Seed Destroying Insects

Beetles, weevils, moths, and wasps may destroy cones and seeds. Usually they deposit eggs in a seed or cone. The developing larvae then eat and destroy the seed. The red pine and white pine cone beetles, red pine cone worm, spruce cone worm, acorn weevil, and walnut weevil are some of the common seed-destroying insects. Insecticides can help control these insects; however, their use is justified only in woodlands used as seed production areas. Few insecticides are registered for this use. Most are very toxic and require application by a licensed commercial applicator.

## Disease Damage

Diseases are categorized here by the tree part they most commonly affect. Strategies for minimizing damage from the more serious diseases are discussed in Chapter 6: Managing Important Forest Types.

### Foliage Diseases

Foliage diseases may cause conifer needles to turn yellow or brown or drop prematurely. Hardwood leaves may develop yellow, brown, or black spots. These diseases weaken trees by reducing the ability of their leaves to produce plant food. Brown spot disease affects only red and Scotch pines and is typically confined to the lower half of the tree. Some other typical foliage diseases are rhizosphera needle-cast in spruce, pine needle rust in conifers, and anthracnose and leaf spot in hardwoods.

When the leaves of a hardwood turn yellow or brown and droop, suspect a wilt disease. These symptoms commonly occur when a fungus blocks a tree's water-carrying vessels. Oak wilt and Dutch elm disease, verticillium, dothiorella, and phloem necrosis are typical wilt diseases. Oak wilt and Dutch elm disease are serious problems in woodlands and often spread to adjacent trees through root grafts. Adjoining trees of the same species will sometimes form grafts between their root systems, allowing not only water and nutrient flow between trees, but also disease transmission.

Sooty mold is a black powdery fungus that lives on the honeydew exuded by aphids or scale insects. Powdery mildew is a white fungus that covers leaf surfaces. Both damage trees and shrubs by blocking the sunlight needed for photosynthesis. Their damage is a minor problem in woodlands, but may be serious on some ornamental trees and shrubs.

Abnormal growth, including leaf curling; gall formation on leaves, twigs, and fruits; and witches' brooms (excessively dense branch and twig growth) are the result of high concentrations of plant growth-regulating compounds caused by insects, herbicides, or disease organisms. These conditions are rarely serious by themselves, though they may reduce wood value for some uses.

### Stem and Branch Diseases

Cankers are dead areas on stems that are symptoms of diseases such as nectria canker in maple, hypoxylon canker in aspen, and scleroderris canker in pines. Affected areas may be irregular, sunken, flattened, or swollen. They may crack open and enlarge each year until they completely girdle the stem, killing the tree above the canker.

Rust diseases in pines may cause stem cankers and turn the foliage yellow before killing the tree. White pine blister rust is the most prevalent rust in the Lake States. This stem disease requires gooseberry (currant) as an alternate host.

Dwarf-mistletoe is a parasitic plant that is causing a problem in the Lake States. It grows on limbs and small branches and may stunt, deform, or kill conifers. Its visible growth is less than one inch long

and may be either single-stemmed or branched and yellow, brown, or olive green in color. Black spruce stands are the most common host for dwarf-mistletoe in the Lake States. Control methods include destroying all trees in a cutting area and any infected trees within 60 feet, then burning the slash.

**Figure 7-10. Canker disease causes serious damage to tree stems.**

All trees are susceptible to wood rot. The most obvious signs are fruiting bodies (such as conks and mushrooms) that appear after the rot has been active for several years. Decayed wood may either be water-soaked and spongy or dry and crumbly. It usually is discolored. Many decay organisms enter through wounds in a tree's stem or roots. These rots do not kill trees, but they can destroy the commercial value of the wood. Tree stems with rot are more easily broken by the wind and so can be hazardous.

### Root Diseases

Root rot causes decline in tree vigor over weeks, months, or years. Twigs and branches die back and leaves appear small and yellowed and may drop or wilt in hot weather. Since the root system is damaged, infected trees do not respond normally to water or fertilizer and are susceptible to windthrow. Root rot also may cause stem decay.

## Fire Damage

Wildfires can cause great damage to woodlands. Even in stands where the trees are not killed outright, fires may weaken and eventually kill trees, cause wounds where insects and diseases can enter, increase soil erosion, and reduce soil fertility, wildlife habitat, and recreational quality of a stand. Fire also can be used constructively to manage forest vegetation.

Forest fires are classified as surface, crown, or ground fires based on the way they spread. Most forest fires in the Lake States are surface fires. They burn only the litter and other small fuels on the forest floor. They may scar the bases of large trees and kill small trees.

Crown fires usually start as surface fires that reach into the canopy with the help of dry winds and fuel ladders. A fuel ladder is combustible vegetation that bridges the space between the ground and a tree crown, allowing a fire to climb to a tree crown. They occur most often in conifer stands and are very damaging and difficult to control. Intense crown fires will produce showers of sparks and glowing embers that easily jump firebreaks and set additional fires well in advance of the leading edge. Although conifer crowns frequently catch fire, true crown fires that spread through the air from one crown to the next are much less common than ground fires in the Lake States.

Ground fires burn and smolder below the surface, sometimes going undetected for days or weeks. They consume soil that is high in organic matter, including dried peat and thick litter. Ground fires produce enough heat to kill most of the trees

in their path by cooking their root systems. Such a fire may cross firebreaks through roots and dry organic matter. Ground fires are very difficult to control, but are likely to occur only in dry years.

**Figure 7-11. Fires that reach tree crowns will kill trees.**

Few woodland owners can afford their own fire suppression equipment. Instead, most rely on state and local agencies to control fires. While these organizations respond quickly, there may be some delay before a fire is reported and crews arrive on the scene. For this reason you need to maintain your land so wildfires cause minimal damage before they are suppressed. The following practices will help:

- Maintain a cleared firebreak around conifer stands. A firebreak might consist of a rough bulldozed road with a bare mineral soil surface that can be driven by a four-wheel drive fire truck. Although such a firebreak may stop a surface fire, it is more likely to be a good starting place for a fire suppression crew to build a fire line.
- Consider establishing a trail or road system within a woodland that is larger than 20 acres to provide access to all areas and break it into smaller, more defensible units. The road system also may provide access for other management activities or recreation.
- Provide access for fire suppression vehicles to a stream or lake or create a pond if you have no natural water source.
- Thin and prune pine and spruce-fir stands to keep stands from building fuel ladders that permit a surface fire to climb into the tree crowns.
- Create buffer strips of hardwoods around conifers for added protection. Hardwood stands are less flammable than conifer stands and also may diversify wildlife habitat.
- After timber harvests, lop slash so that it lies close to the ground and decays quickly. You also can pile slash and burn it when there is snow cover.
- Cooperate with adjacent landowners in designing and establishing fire prevention measures.
- Place fire prevention and suppression clauses in logging contracts.

Controlled burns are fires that are set intentionally under specific fuel and weather conditions to:

- Reduce fuel loads that contribute to wildfire hazard.
- Reduce understory vegetation, thus enhancing the growth of overstory trees or benefiting wildlife.
- Kill or set back the growth of undesirable trees and shrubs and to eliminate woody debris that hinders access for planting trees or that may harbor insect and disease pests.

Soil chemistry and physical processes change temporarily after a burn, but eventually will return to normal. However, a poorly planned or improperly controlled burn may kill crop trees and cause other property damage. Consult a forester about firebreak placement, weather requirements, tools needed, legal liabilities, and other important issues. Controlled burns always pose some risk, but they can remain an option if they fit into your management plan.