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Tree and forest restoration following wildfire

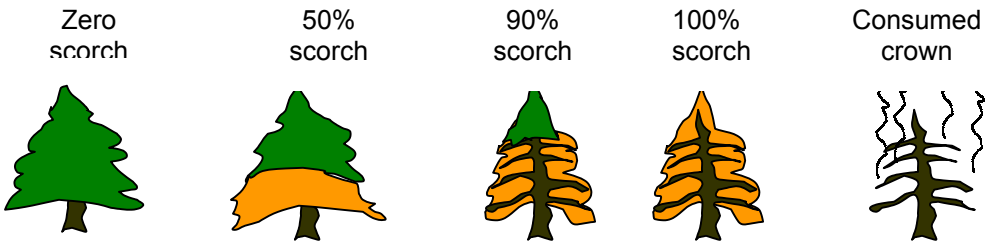
After a wildfire has run across a landscape, it often appears as if all vegetation has been destroyed by the flames. However, many of our native trees, shrubs, forbs and grasses have some mechanism of coping with fire. Some will grow new leaves or needles, others will resprout from their roots while others have fire resistant seeds that will sprout following a fire. Much of the response will depend on the intensity (how hot) and duration (how long) of the fire. Fast moving fires such as those that occur on grasslands usually scorch leaves from trees but do not kill the woody stems or root systems. On the opposite side of the spectrum, fires that occur where heavy woody fuels have built up tend to burn for a longer duration around tree bases releasing intense and direct heat that in essence cooks tree stems and root systems. Under the later conditions the damage that fire causes to trees and shrubs can be more severe even though the tree may look as if it sustained less damage.

A secondary wildfire effect results from blackened surfaces absorbing more of the sun's energy. This causes severe increases of soil surface temperatures and plant stems and may kill plants that had survived the initial fire. The following paragraphs will summarize some of the things that can be done to help trees and shrubs recover after a wildfire.

Assessing trees

Although the initial temptation following a wildfire is to remove every blackened tree, it is important to first assess actual damage. Trees that look burned and have their leaves or needles scorched are not necessarily dead. Fire usually kills trees in two ways: (1) by killing the cambium layer just under the bark of a tree, and (2) by killing all of the leaves and buds. Often some of the cambium and some of the leaves have been burned, but not enough to kill the tree. How much damage was done will depend on how the fire behaved and what tree species burned. In most cases if salvage logging is not being considered, it is best to wait until the following spring to determine if new leaves and needles will reappear before deciding whether or not to cut down a scorched tree. If new leaves appear, the tree will survive and often fill out to its former glory in 1 to 3 years. If no new needles or leaves appear by June, the tree is most likely dead.

There are several ways of assessing trees after a wildfire has damaged them. The first and is to determine the extent of damage to the live needles on the crown of the tree. Needles that are intact but have turned orange or brown are referred to as "scorched" (Figure 1). Needles that have been burned are referred to as "consumed". Of all the conifers across Montana two tree species, ponderosa pine and western larch can recover from a severely scorched crown. Ponderosa pine and Larch that have had over 90% of their needles scorched occasionally recover. Douglas-fir has an intermediate resistance to crown scorch and the other common native tree species (lodgepole pine, grand fir, subalpine fir, hemlock, cedar and spruce) are often killed if their crowns are scorched more than 40%. If the needles in the crown have been *consumed* it is highly unlikely that any tree species will survive.



Most ponderosa pine, larch & Douglas-fir will survive < 50% crown scorch. Spruce, grand & subalpine fir, lodgepole pine may have severe cambium damage.

Ponderosa pine and larch with 9" or larger diameter stems may survive

Few ponderosa pine and larch can survive

Figure 1

Of equal importance to a tree as foliage damage is heat related injury to the tree's cambium layer. This is the part of the tree that adds woody growth to the stem every year and is found just underneath the tree's bark. Some tree species have evolved a thick bark to insulate this layer. Ponderosa pine and western larch that have stem diameters greater than 9 inches are often characterized by bark that is 1 to 3 inches thick with a heat resistant plate-like structure. Older Douglas-fir can also have heat resistant bark, and is distinguishable from ponderosa pine and larch by having a much more tightly glued-together bark. All of the other native conifers will usually have much thinner bark and, therefore, are more easily killed by fire.

To assess a tree shortly after a fire, the bark on twigs and the stem may be peeled back in a few areas (dime sized or smaller cuts should be made in the bark, Figure 2) to determine if the cambium area has been killed. If the bark under the scorched area is white or green and juicy looking, the stem has survived the fire and the tree has a good chance of resprouting leaves or needles. If the inner bark that lies next to the wood is dark brown and/or dried out, the stem you are examining is more than likely dead. Another assessment that can be made is to check for intact buds at the ends of branches. Buds that are still green and moist inside are alive, and if the tree stem has survived the fire the tree has a good chance of recovering. Be sure to check several branches and the main stem of the tree. Depending on the intensity of the fire, small twigs may be killed but larger branches left alive, or if there was a lot of fuel around the base of the tree, the stem adjacent to the ground may have been killed while the branches still look alive. **It is important to check the entire tree (base of the main stem, cambium, larger branches and smaller twigs) to determine the extent of the damage**. Or, wait until next spring for new leaves to form.

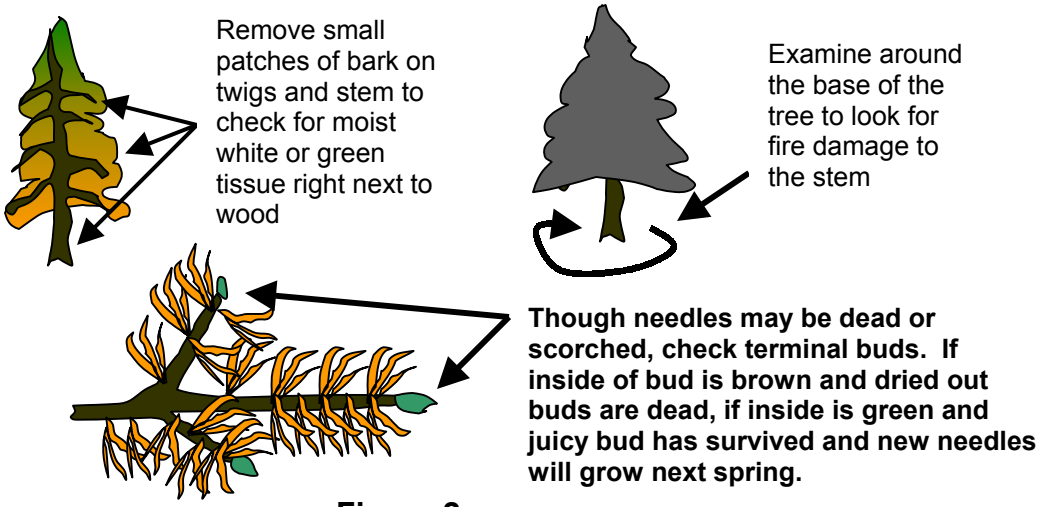


Figure 2

Assessing soils

Wildfires usually travel quite rapidly over the surface of the soil. As the fire approaches, the intense radiated heat preceding the flames usually vaporizes a lot naturally occurring terpenes, resins and waxes that plants produce to protect their stems and needles. Although many of these vapors burn off, some condense on the cooler soil surface and form a water impermeable layer. (Ironically, these same substances are captured by wood processing plants and become major ingredients in the wood preservatives people apply to their decks.) Typically, the greater the intensity of a fire, the more gases condense on the soil surface water and the more impermeable the soil surface will become to water. This results in what are called *hydrophobic soils* and can also significantly decrease the recovery of plant species on burned areas by excluding water recharge to the soil and promoting serious erosion.

Often hydrophobic soil conditions are only present in the upper ½ to 2 inches of soil and in a patches across the burned area. On lightly burned areas where soil surface organic matter did not completely burn (Figure 3), hydrophobic conditions usually do not persist very long. On sites where soil surface organic matter completely burned and mineral soil particles were baked, hydrophobic conditions can last up to 1 year. These areas are often identifiable by a layer of powdery white ash and orange colored soils. When possible, the later conditions can be amended by lightly scarifying soil surfaces. This can be accomplished by dragging a shallow chisel implement over the area that does not penetrate the soil any deeper than 1 – 2 inches. Deeper penetration can result in serious tree root injury. Mulching scarified or hydrophobic areas will further help increase water absorption and reduce surface erosion from the site.

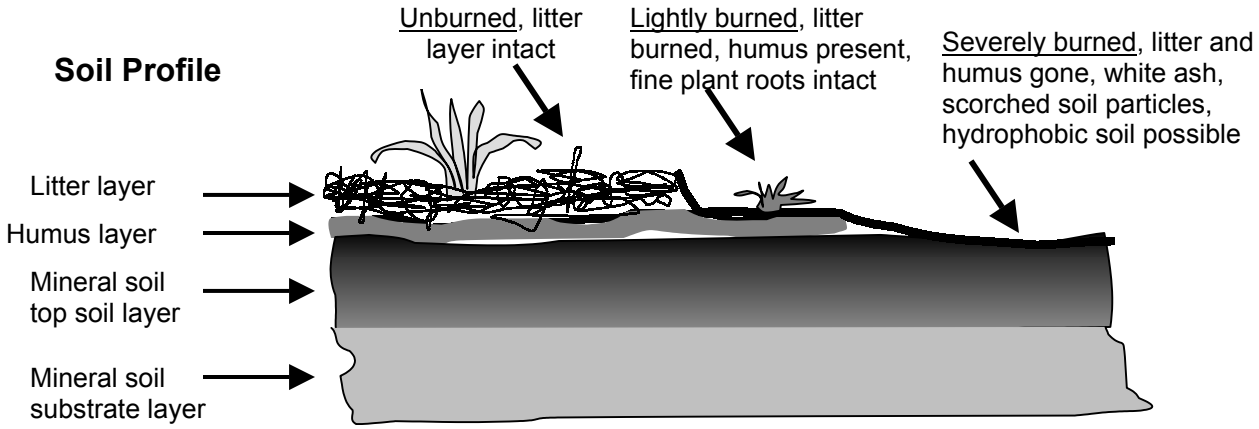


Figure 3

Soil surface amendments

The black surface left by a fire absorbs almost all of the suns energy resulting in high soil temperatures, which also can cause the soil to dry-out more rapidly than normal. Both the increased temperature and dry soil conditions can harm the root systems of surviving trees. (An exception to this may be quaking aspen and cottonwood – warmer soil temperatures can stimulate root suckering if the mature trees have been killed). Since vigorous roots are required for a tree to recover from needle or leaf scorch it is important

to protect them. Soil temperatures can be kept cool by mulching lightly with straw around the bases of trees. The mulch should extend out from the tree stem 1 ½ times as far as the longest branches. Straw mulch has a much lower absorption of the suns energy and keeps the soil cool and moist. Often breaking up the black surface left by fire will also reduce excessive soil surface temperatures.

Applying grass seed to undisturbed burned soil surfaces often results in poor grass seedling survival. Black surfaces warm to lethal temperatures for grass seed when exposed to the sun and often do not retain enough moisture for good seed germination. If a site has been severely burned and has hydrophobic soil conditions, it is recommended to break up this type of surface condition. Shallow plowing, raking, or logging equipment operation can accomplish this. Note: this is the only circumstance where "heavy handed" soil disturbance is recommended! On sites where the organic layer on the soil surface is intact, only light disturbance is recommended to enhance the surface roughness and thereby allowing for a better seed bed. Care must be taken to avoid losing the remaining organic layer to erosion.

What to do to help trees

Water and fertilizer

If the tree has survived the fire with some scorch damage it is important to help your tree recover. Loss of leaves or needles results in the tree not being able to produce the sugars and starches it needs to live. Depending on the time of year and the tree species, some trees will try to grow new leaves. Watering and fertilizing trees with ornamental value (such as those around your house) with a mild solution of balanced fertilizer (10-10-10 : ¼ lb dissolved in 3 gallons of water and applied in concentric circles around tree base, Figure 4) will help trees regrow leaves, either immediately after the fire or the following spring. If the fire occurred in August or later, it is best to fertilize in the fall after freezing temperature has set in so as not to stimulate new growth that will not have time to become frost hardy.

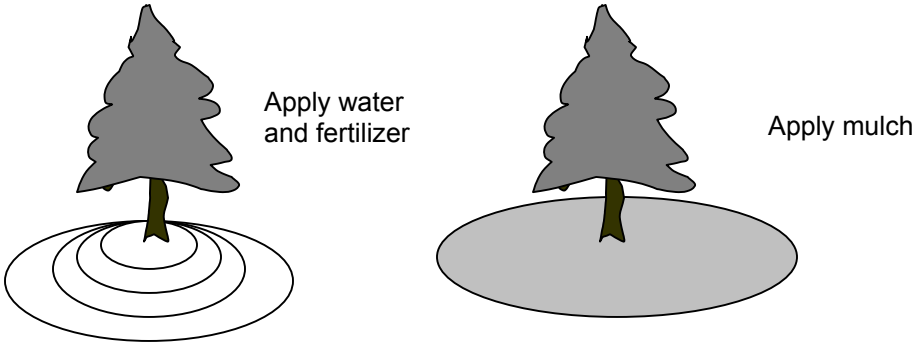


Figure 4

Stem care and pruning

Fire blackened tree stems can also absorb too much solar radiation causing the living tissue under the bark to die. For trees that have ornamental value, it may be worthwhile to try and protect stems from getting too hot from the sun. Deciduous trees (most broadleaved trees) are most susceptible to this because of their thin bark. An

application of lime or white latex paint on the south side of the tree will help keep the stem cooler. No oil based or petroleum products should be used as this can kill the tree.

If your tree has survived the fire but suffered some damage, proper pruning will help it recover more quickly. Dead branches will remain on the branch for a long time and act as entrance areas into the stem for pests and pathogens. Any time a branch is removed, it should be cut off flush with the stem so that no stobs are left protruding (Figure 5). Any easy rule of thumb to follow is: if you can hang a coat or hat from the residual branch stob it is too long!

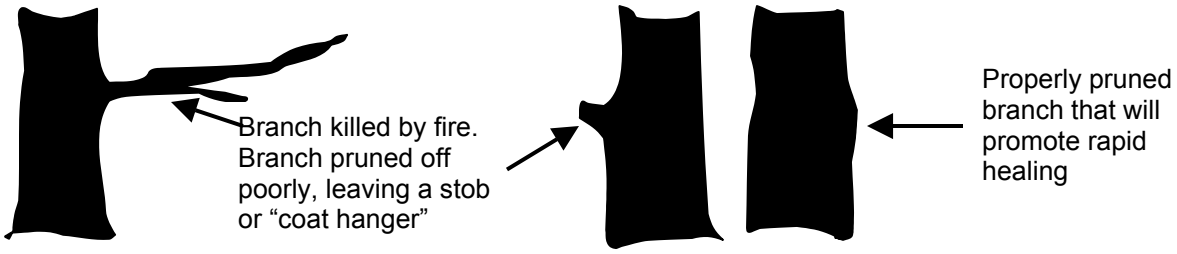


Figure 5

When pruning it is important to recognize that conifers and deciduous trees will recover differently from fire damage. If the lower branches of a pine, spruce or fir tree are killed by fire, the tree will not regrow these branches. A deciduous tree, on the other hand, will often resprout new branches either from where the dead branch attached to the stem or along the base of the tree. For both conifers and deciduous trees it is important to prune off dead branches (Figure 6). Deciduous trees will require subsequent pruning to culture strong new branches to form. If no follow-up pruning is done the tree will not know which branch to put its energy into result in clumps of weak and poorly formed branches.