Managing Bark Beetles in Pines

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A glance at almost any forest in Montana will reveal groups of orange and red trees across the landscape. Extended drought has allowed trees to deplete soil water reserves to the point where they are severely stressed. A lack of water makes trees weak and unable to produce defense compounds that protect them from a wide variety of pests and pathogens, resulting in trees predisposed to insect and disease attackers. Perhaps the number one pest affecting pine forests is the Mountain pine beetle (Dendroctonus ponderosae). This barley kernel sized beetle bores under the bark in pine stems larger than 4" diameter to make its home and lays its eggs. Lodgepole, ponderosa, limber, whitebark , and especially Scots pines are all susceptible. When the eggs hatch the resulting larvae feed on the growing layer of tree tissue (called the cambium) just inside the bark. Normally a healthy tree can push the intruder out by producing copious amounts of pitch that is laced with numerous secondary chemicals toxic to beetles. Drought stressed trees lack the water pressure to produce pitch and the food reserves needed to produce defense chemicals.

Beetles have also developed two strategies to overcome a tree's defenses. First, beetles carry with them a fungus that infects the water conducting wood of the tree, blocking water transport. Infection by the fungus, which is noted by blue and black streaking in the sapwood of the tree, can by itself kill a tree. Second, these tiny beetles coordinate their attacks through the use of chemical signals (pheromones) that result in thousands of beetles attacking a single tree and overwhelming the defenses. Each pair of beetles that attacks the tree has the potential of laying over 50 eggs, that develop into mature beetles in a couple of months. If the right conditions prevail for several years beetle populations can build to epidemic proportions, which is the current state of affairs in many of our forests. For example, if two mountain pine beetles produce 50 offspring in early summer, those offspring will mate and produce 625 larvae by the end of summer. The next spring those larvae mature into 625 beetles, which will produce 97,500 new larvae that when they mature and reproduce by the end of the third summer will have produced 2,376,562,500 larvae!

What can we do to help our trees?

Tree needles often start turning red or orange a couple of weeks before the young beetles emerge from the bark, ready to attack new trees. About the time most of us start to notice a problem with a tree, it's far too late to help. Even if the beetles under the bark could be destroyed, the fungus they introduced has already been at work for many weeks and the tree can no longer transport water from roots to needles (which is why they are turning orange).

The key to protecting trees from bark beetles is to keep them healthy. Each bark beetle species prefer specific tree species and often tree age groupings. Having a landscape covered with dens trees of the same species and age provides beetles with a large food source that can breed epidemic populations. A forest with patches of different species, or age groups of trees of the same species offers a more limited food source and will stress beetle populations. For individual groups of trees, healthy means providing

them with the resources they need to survive: adequate sunlight and water. Irrigating a forest during drought is obviously not possible, but reducing the number trees competing for limited resources is. Numerous scientific studies have shown that thinning dense groups of trees to an approximate 15 x 15 foot spacing dramatically increases their ability to survive beetle attacks. The best spacing between trees depends on how old, how crowded, and what species they are. A helpful spacing rule is "Diameter plus 8 feet". To determine the optimum spacing measure the average tree diameter 4.5 feet above ground level and add 8, this then gives the best spacing between tree stems in feet. (for example, a 6-inch diameter tree plus 8 equals 14-ft of spacing, whereas a 20-inch tree plus 8 requires a 28-ft spacing). Consulting with a forester is advised, especially since this often involves trees that have some commercial value that might provide you with an income. If action is taken quickly enough, infested trees can be removed before the new beetle population matures. Milling or burning the tree stems kills the beetles.

Beetles can fly well over a mile, and much further if a wind is pushing them along. Mature beetles can be seeking out stressed trees during most of the mid to late summer. Usually in July the first major population flight occurs, with a possible second flight in the middle of summer. If you have crowded or stressed trees, and evidence of bark beetle activity within a mile, there is a high likelihood that they will eventually find your trees. Early attack symptoms to look for are fine sawdust appearing in the cracks of the bark. Next, as the tree tries to defend itself, popcorn sized white and reddish pitch blobs appear on the bark of the tree. An attacked tree will have hundreds of such pitch blobs. Finally, all of the needles of the tree will suddenly turn orange. Peeling back small patches of bark down to the wood will reveal small tunnels and the wood, which is normally off white in a healthy tree, will be blue or black stained.

If there are specific trees that a person wishes to protect, defensive insecticides can be used. This requires that the entire tree stem up to a height where the stem diameter is less than 5 inches is coated with a long acting insecticide that will kill beetles that try to bore through the bark. Several studies have shown that the active ingredients Carbaryl or Cyfluthrin have been effective for one year and sometimes up to two years. The trade names Sevimol, Sevin SL or XLR and Tempo WP, and Tempo 2 have been available in many stores that carry yard and garden products. Spraying already infected trees may work if the adult beetles are still excavating brood tunnels as indicated by fresh fine sawdust coming out of the BB sized holes in the tree bark. If the eggs have been laid and the larvae feeding spraying is futile as they are under the bark and protected from surface applications. Certain case examples have also shown that infections detected early enough in ornamental situations have also been stopped by watering trees for 4-8 hours every week during the dry summer months.

Systemic insecticides such as the soil applied "Merit" (produced by Bayer) may hold some promise though results will vary based upon soil type and application time. From a theoretical perspective, soil applied insecticides should work best if applied during early spring as rain should help transport the insecticide to the roots, there is not as much time for the soil to tie up the active ingredients and the tree is in the physiological process of translocating nutrients from the roots to the stems and needles.

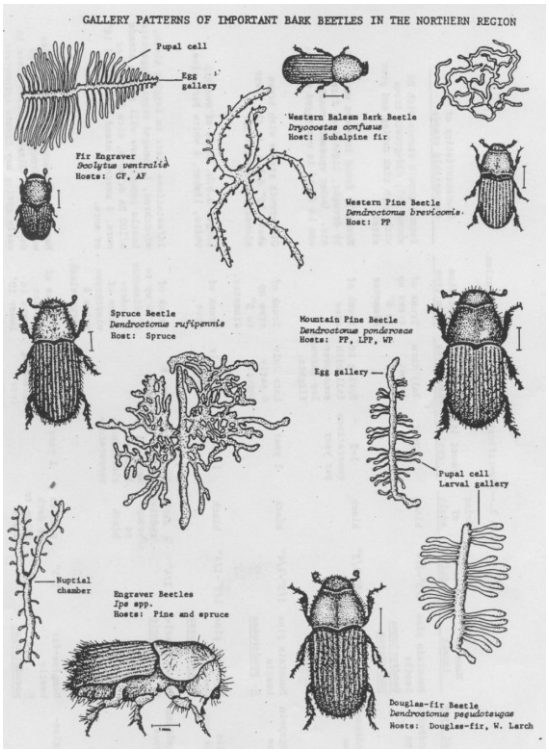
Insecticides applied as "injections" into the stem through drilled holes or pressurized capsules are not usually effective on pine trees. The same defense mechanism that trees use against beetles, "pitch" is very effective at blocking the transport of injected chemicals. One would have to bore hundreds of holes into the tree much as the beetles do to overcome tree defenses. A treatment as bad as the pest!

There have also been efforts to interfere with the chemical signals that bark beetles use to coordinate attacks. Such chemicals, called "Pheromones" have been successfully produced to interfere with Douglas-fir beetle attacks on Douglas-fir trees. New formulations of the mountain pine beetle pheromone "verbenone" has shown some effectiveness, especially when a larger area has many of such anti-aggregation pheromone pouches attached. Imagine every pouch giving off pheromones much like a cigarette gives off smoke. To protect a tree the area needs to be saturated in a cloud of pheromone "smoke". One packet on a single tree has less chance in protecting that tree than a series of packets surrounding the tree.

How natural is this event?

Bark beetles such as mountain pine beetle are normal and natural inhabitants of our forests. Healthy trees can be killed by beetle mass attacks but this usually occurs in a very small percentage of the trees in a forest. Lodgepole pine forest are the exception as they are normally killed by Mountain pine beetles when they become overmature or crowded. Often bark beetles act as thinning agents where they "naturally" thin overcrowded groups of trees. Under conditions where large acreages support crowded trees, during drought, or when a tree is stressed by changes in the immediate environment such home building, high nitrogen lawn fertilizers, soil compaction, etc., beetles can build to epidemic populations that affect healthy trees. There are many areas currently where tree mortality is approaching 50% across forested landscapes. The same factors that have been contributing to large uncontrollable wildfires also have been allowing beetle populations to build: drought and overcrowded forests. For lodgepole pine, this is part of the survival strategy. Beetles kill the mature trees and create fuel for wildfires, the heat from which opens the fire resistant cones and prepares a perfect seedbed for the lodgepole pine seedlings. For other pine species the news is not so good. Large and severe wildfires do not benefit ponderosa pine, and promote a conversion from forest to grassland unless replanting is done after the fire.

There are more than 102 species of bark beetles specific to trees of the NW United States. Unless portions of the forest are proactively treated for tree species and age diversity that promotes individual tree vigor, such epidemics will continue to be a part of our landscape. As a landowner, I would rather select and leave the trees that have the best chance for getting big and old and make money in the process, than have beetles decide for me which trees get left and pay money for fighting the ensuing wildfires that start and get out of control in the resulting dead trees.



Bark beetles can be identified by the larval galleries that are etched into the wood under the bark of infested trees. Shown are some of the major "tree killing" beetles.

Typical "pitch tube" tree response to bark beetle attack. A successfully attacked tree will have hundreds of such pitch masses on the stem from the base up to a 4" diameter top.

Normal fall needle drop of older needles from a healthy tree

Ponderosa pines killed by bark beetles with all needles turning orange at once.