RESEARCH LABORATORY TECHNICAL REPORT

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Conifer Care

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Conifers are commonly planted in North America to provide year-round screening, as windbreaks, or as focal trees in the landscape. However, conifers including certain species of spruce (*Picea* spp.), pine (*Pinus* spp.), hemlock (*Tsuga* spp.), cedar (*Cedrus* spp.), and fir (*Abies* spp.) planted in northern areas of North America are experiencing a myriad of issues causing a general decline in health, vigor, and resilience. There are many factors contributing to the widespread decline of conifers in these regions, and isolating a single cause has been challenging. However, both climate change and soil issues appear to be major contributors. With a changing climate, weather patterns become less consistent and extreme weather events (e.g., prolonged drought or excessive rainfall) become more common. Since 1990, the majority of North America has experienced a shift in at least one plant hardiness zone toward a warmer climate. For example, Colorado blue spruce (*Picea pungens*) is ideally planted in zone 3, however almost all of the northern United States where this species is traditionally planted is now in zone 5 or 6. These abiotic issues lead to stressed trees that become more susceptible to diseases and insect pests. Bartlett scientists, along with researchers from arboreta and academic institutions, are studying many of these issues and how to best maintain the health of these trees.

Disease Issues

Changing environmental (e.g., soil and climate) conditions appear to be substantial contributors to disease problems afflicting many species of conifers. Environmental conditions outside of the optimum range for conifers lead to decreased plant vigor and resilience, which means that these plants can no longer adequately defend against pathogen infections and/or infection take a larger toll on tree health than they otherwise would.

Diseases affecting the foliage of conifers are not normally problematic for healthy trees. However, needlecast diseases (Figure 1) caused by fungi thrive when springs are wet and summers are dry and warm, an existing trend in many northern regions. Because of this, needlecast diseases are now severely impacting many conifer species from the mid-Atlantic and New England to the Great Lakes and Midwest. The widespread nature of this phenomenon leads to increased disease pressure due to more spores in the air. Successful needlecast management on spruce and

Figure 1: Colorado blue spruce (*Picea pungens*) infected with Stigmina needlecast (*Stigmina lautii*)

pine is certainly attainable, but will likely require time and close monitoring.

Tip blight diseases such Diplodia tip blight (Figure 2) are favored by wet springs, dense plantings, and excessive nitrogen fertilization. Wet springs and stress due to mismatches in optimal plant hardiness zones have led to major Diplodia tip blight issues on exotic pines such as Austrian (*Pinus nigra*), Swiss mountain (*Pinus mugo*), and Scotch pine (*Pinus sylvestris*). Related to tip blight diseases are canker diseases that impact vascular tissue and girdle trunks and branches. These diseases are usually fought off by the tree when healthy, but may be deadly when the tree is compromised. Hotter and drier summers have contributed to major canker issues such as Cytospora and Phomopsis on many species.

Figure 2: Characteristic browning and dieback symptoms of tip blight (*Diplodia* spp.) on pine

Root rot diseases are exacerbated by excess soil moisture. The primary root disease problem is Phytophthora root rot, caused by fungus-like species in the genus *Phytophthora*. Wet conditions favor the development of this disease because *Phytophthora* species have swimming spores, but aboveground symptoms do not typically appear until drought stress in the summer sets in and root loss becomes more apparent.

Pest Problems

Conifers also suffer from attack by a variety of arthropod pests. Some of these are invasive species

Figure 3: Exit holes and "sawdust" symptoms of red turpentine beetle (*Dendroctonus valens*) attacking the vascular tissue at the base of a pine

that take advantage of the lack of natural enemies and/or hosts that have never before encountered the pest, leaving them with no appropriate means of defense. Others pests are native and have a long, intimate relationship with conifers. In this scenario, the host can typically defend itself or simply tolerate damage caused by the pest, but stressed trees will be more susceptible to damage and even death.

A single defoliation event by pests such as caterpillars or sawflies will not usually result in tree mortality, though the damage can be unsightly. This is because foliage tissue is more expendable than other tree tissues. However, a conifer under extreme stress can be severely damaged, even fatally, by a defoliating pest. Piercing-sucking pests such as aphids, scales, and mites that feed on needles and stems are also usually not a lethal issue, but can more easily cause damage and become very problematic for the tree. Keep in mind, these pests are particularly attracted to stressed trees.

The more severe and damaging pests attack vascular tissue located under the bark of stems, branches, the main trunk, roots, and root collars. Vascular tissue is critical to the host as it transports water and sugars throughout the tree, and is therefore highly defended. Pests targeting these tissues typically cannot overcome the defenses of a healthy, vigorous tree and are not a problem under normal conditions. If these defenses

are compromised, however, pests may invade and overpower a tree (Figure 3). Managing all conifer pests, but particularly those that attack vascular tissues, starts with promoting tree health and vigor.

Cultural Issues

Most, but not all, commonly planted conifers prefer acidic, well-drained soils that are high in organic matter. Some conifers such as red pine (*Pinus resinosa*) and Colorado blue spruce can remain healthy even in fairly sandy soils. Alkaline soils, soils with high clay contents, poorly drained soils, and excessively wet soils are all problematic as they can promote root disease. Stress from suboptimal soil conditions can be exacerbated by extreme weather conditions (extreme heat, increased duration of extreme heat events, wet springs, and dry autumns, for example). These combined stresses compromise a tree's defenses and lead to its inability to tolerate damage.

Substantial variation exists among conifer species when it comes to selecting a site for planting, though some generalities can be made. Most spruce and pine prefer either full sun or partial shade as excessive shading from deciduous trees can predispose trees to foliage and branch diseases. Other conifers, like eastern hemlock (*Tsuga canadensis*), prefer light shade. Additionally, proper spacing is very important because dense conifer plantings (screens and windbreaks, for example) promote moist conditions and ample host tissue for fungal pathogens to infect.

Maintenance of Tree Health

Site and soil issues stressing existing and older trees should be addressed immediately. Ensuring adequate sunlight and airflow by removing other trees or branches in dense plantings will decrease the risk of disease by allowing light and air penetration.

Applying fertilizer and soil amendments appropriately is another step in promoting conifer health. Soil analysis should be performed and specific adjustments made based on the tree species and condition. Routine applications of phosphite products will ensure proper potassium levels in the soil and will result in trees that

Figure 4: Colorado blue spruce with a proper mulch ring around the critical root zone

are better able to handle drought conditions. Additionally, this will help trees resist certain diseases, especially root disease.

Applying a light layer (2-3 inches) of mulch over the critical root zone will prevent tree roots from needing to compete with turf for water and mitigate temperature fluctuations in the soil (Figure 4). Mulch also substantially helps with Phytophthora root rot issues because the cell wall chemistry of *Phytophthora* species is similar to the cell wall chemistry of wood. Applying a layer of mulch promotes the community of microbes that break down the cell walls of both the mulch and *Phytophthora*. As always, root flares should be exposed and over-mulching, especially mulching over the root flare, should be avoided. Proper irrigation (drip irrigation is best) is also required to reduce the risk of drought stress during dry periods. Keep in mind that overwatering and watering with sprinklers that wet the foliage can promote disease.

Frequent monitoring for diseases and pests is paramount. Needlecast diseases require treatment immediately upon detection and trees with advanced disease symptoms (extensive defoliation) will require at least three to five years of treatment before tree recovery and disease control is possible. Once the

disease is detected, an annual treatment program will be necessary. Preventative product applications may also be needed when disease pressure is high and/or trees are stressed. Proper cultural practices such as pruning to promote correct tree and branch spacing will allow adequate airflow and prevent needlecast and tip blight diseases. Adequate mulching, soil maintenance, and proper irrigation are other sound cultural practices that help prevent and suppress root rot and canker diseases.

Preventative treatments for wood-boring insects may be necessary in some instances, especially during insect outbreaks and/or times of widespread environmental stress (e.g., drought). However, once a tree begins showing signs of infestation, management may be difficult or impossible. Proper fertilization and regular monitoring for piercing-sucking pests such as aphids, scales, and mites (Figure 5) are also extremely important. Preventative application of horticultural oil in the late winter/early spring typically suppresses these pests below damaging levels. In some cases, it may not be necessary to apply preventative treatments since therapeutic treatments applied once defoliators appear are adequate to manage these insects. Frequent inspections are critical to the success of this approach. Finally, there are many instances when biological control is not only desirable, but works just as well or better than product applications. Promoting beneficial arthropods such as predatory mites, spiders, and insects will go a long way toward managing pest insects.

Lastly, limited research shows that paclobutrazol, a plant growth regulator, may aid in the prevention of certain diseases of vascular tissues (stem, branches, main trunk) such as cankers. Short, warm periods in winter that are followed by drastic temperature drops can injure conifers, which are actively photosynthesizing in the winter. Some research suggests that this growth regulator can also help alleviate stress from these conditions and reduce this type of winter damage on conifers. Older trees and trees planted in stressful sites are prime candidates for growth regulation.

Figure 5: Spruce spider mite (*Oligonychus ununguis*) damage on eastern hemlock (*Tsuga canadensis*)

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