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University of Kentucky – College of Agriculture

Ice Damage to Trees in the landscape

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The recent winter ice storm has resulted in extensive damage to many trees in our landscapes. While we may be tempted to cite this as an "Act of God" it is both a cyclic part of nature and the results of some of the landscape practices of the past. As I write this I am reminded of Thomas Edison, one of the most optimistic individuals in history. His "Invention Factory" in West Orange, NJ burned to the ground on Christmas Eve (1914). The next morning as he stood among the smouldering ruins he remarked to his associates, "All of our mistakes have been destroyed. In a new factory we can start our experiments with a clean slate." Through the pain of loss and destruction we can and should learn.

Shaking Ice and Snow From Branches

As ice begins to accumulate on branches there is the natural tendency to do something to help save our landscape trees. If the branches on your tree or shrub have begun to bend over, resist the urge to go out and knock the ice or snow off. Plants have adapted over time to grow and tolerate a certain amount of bending. Mother Nature seems to do a fair job of restoring the form for most trees suffering this type of destruction. In an ice storm rain changes to ice and hangs on branches. At this point the stems have not yet frozen. Xylem, also know as "wood" is responsible for the upward conduction of water and mineral elements from the soil to the stems and leaves. It is only after branches have bent over that the ice freezes in these conductive tubes. If we remove the weight of ice quickly allowing the branch to spring back up, ice in the frozen conductive tubes shatters rupturing the cell walls. We see the same thing happening when we try to straighten a bent plastic straw with ice in it. Breakage of these conductive tubes is aggravated even more by the vigorous shaking needed to get the ice to fall off. While the plant may spring back into a more upright habit, the plant pays the price in the hot, dry summer months that follow. With many of the conductive tubes shattered, the plant is unable to move enough water from the roots to the foliage. Leaf scorch and twig death are the result.

In situations where breakage is a forgone conclusion, it is better to damage some of the conductive tubes and deal with that problem later rather than to lose the entire central leader on a tree. Small shrubs often recover rapidly if broken branches are pruned to the ground and allowed to sprout back. The decision to try to remove ice and snow can be a difficult. If removal is absolutely necessary it is always better to use cold water from a water hose to melt

the ice than to shake the branch. In situations where the air temperature is close to freezing, water from a water hose is generally warm enough to melt some of the heavy load. Never use hot water. This will damage the plant you are trying to protect.

Dealing with Broken and Split Branches

What to do when branches are broken depends on may factors. When we look at the physical failures of trees, some species fail more frequently than other species. The specific way trees fail is also very species specific. Once a tree has failed, it is more likely to fail again at some point in the future. If the tree has suffered extensive damage and there is a high value target like a play area, home or driveway, it may be better to remove it and avoid the potential for future problems. If only a side branch has broken it can generally be removed without increasing the risk of future failures. While a hole may remain, it is better to have a slightly defective tree than to be without any tree. While advice from a professional arborist is valuable, the ultimate decision must rest with the owner of the tree.

When a lateral (side) branch pulls out of the socket (tears away from the trunk or larger branch), there is little that we can do other than cut it off. The branch collar has torn off with the branch so it is impossible to practice Natural Target Pruning. A large open wound remains and it will be slow to close. Decay of the remaining trunk will result and this will always be a weak spot in the trunk or larger branch.

Sometimes bifurcations (double leaders) split. It is possible to pull small branches back and bolt them together. This operation is called "installing a brace rod" or "bracing." Bracing always includes installation of a cable higher in the branch. It is very important to recognize that:

(1) This will always be a weak point in the tree and will never be as strong as it once was. Wood from the two pieces never joins back together. These pieces remain in contact only as a result of the connecting metal hardware and the new annual rings of wood that surround (cover over) the wound in subsequent years. The larger the tree becomes, the greater the weight and the greater the potential of failure becomes.

(2) With the passage of time this metal hardware will be overgrown by the new wood. Metal hardware in trees can be a danger in the future if a chainsaw comes into contact with the metal or if the log is fed into a chipper or if it comes into contact with other equipment.

(3) The connecting hardware must be of a commercial grade and is not available from local hardware stores. Hardware store grades of steel are not strong enough to withstand the stresses over time. Installation should be by a knowledgeable, trained arborist. Annual inspection of cabling and bracing systems are recommended.

(4) Duct tape, wire, chains and other materials used to bind the broken pieces together are always unacceptable. Such remedies are unsafe and result in damage to the plant's conductive tissues.

When a tree such as the fast growing river birch splits, it is possible to cut the trunk back close to the ground leaving a 3 or 4 inch stump. As spring growth begins, numerous shoots will come from this stump. Weaker shoots should be pruned back to the stump so that only the strongest shoot(s) remain. Young sprouts grow rapidly, often reaching 6 or 8 feet in a single growing season. The trunks will be straight and relatively slender so may require loose staking until the caliper increases. This type of pruning will generally result in a tree that will regrow to the size of the original in a shorter time than replanting a new tree. As additional sprouts arise from the base of the plant it is important that they be removed as soon as possible. If the tree is a grafted cultivar, the initial cut must be above the graft union.

Restoration Pruning or Removal

Restoration pruning is the term arborists use for the multi-year process of restoring the natural for a damaged tree. The form will never be the same as what it would have been. The objective is to make the tree more attractive and reduce the risk of future failures. Risk can never be reduced to zero.

If a portion of the central leader has broken, it should be trimmed back to a lateral branch that is at least a third the diameter of the broken terminal. Preference should be given to lateral branches that are more upright but do not have included bark. Pruning back to a lateral that is too small will not have sufficient foliage to result in rapid wound closure. However, in catastrophic events such as ice storms we may have no choice but to prune to smaller laterals. If the tree is young and the side branch being trained into a new lateral is small, the lateral branch can be splinted to encourage upright growth. With time this lateral branch will form a new terminal. If splinting is done it is important that it be done in such a manner that girdling does not occur. Nylon stockings or cloth strips are sometimes used for holding the branch to the splint. Wires, even with a piece of hose pipe are never recommended.

It is not feasible or desirable to remove every damaged tree. The decision making objective is to remove the most damaged trees that present the highest risk for causing future property damage; provide mitigation for those that can be saved. Of those that receive restoration pruning, some will be destined for removal in the future as replacement trees reach sufficient size to be functional entities in the landscape.

The most frequently asked question about pruning is, “What is the best time of the year to prune?” The way a branch is removed is far more important in wound closure and future health of the tree than time of year. Maples, elms, birch, yellowwood and most conifers pruned at this time of year are going to bleed from these open wounds. Sap flow from wounds has never been shown to devitalize the plant. The sugary sap may attract bees. This is not a problem. On cold nights in spring a maple icicle may form. These are more of a curiosity than a problem with the more daring of us tasting the sweet sap of the maples.

“We Have Met the Enemy and He is Us”

This famous quote from the comic strip *Pogo* identifies the real cause of many of the failures during the recent ice storm. I was watching a live feed from a local television station in residential neighborhood. In the middle of the segment, seemingly on cure the tree behind the

reporter suffered a major branch failure. The camera zoomed in on the now horizontal branch that had damaged the house. It was a silver maple (a.k.a. water maple or *Acer saccharinum*) that had been topped years before. The branch that failed was one that had regrown from a trunk that had been topped. Silver maples produce wood that is less strong and more prone to decay than many other maple. This failure was a direct result of a home owner's mistaken impression that topping reduces potential for failure. Just the reverse is true. Toping causes failures.

Trees that have suffered extreme damage may not have lateral branches remaining. Without laterals the only choices are immediate removal, make topping cuts with plans to replace the tree within a couple of years or make topping cuts and accept liability into the future. Stubbing cuts are never recommended for the long term survival of any tree. Even though some new growth will develop at the point where the stubbing cut was made, decay will occur and spread down the trunk at a very rapid rate. Young branches that arise after a tree is topped are poorly attached and, in conjunction with the column of decay in the trunk will suffer significantly higher rates of breakage in the future. While the final decision on topping remains with the owner of the tree, so does the liability for future damage that may result.

Safety

The chainsaw is the most dangerous piece of equipment that homeowners are likely to use. It only takes a moment for a fatal or devastating accident to happen. The rate of chainsaw accidents is not tracked for nonprofessionals. The profession of arboriculture is the second most dangerous profession in the United States. Only commercial fishing is more dangerous. Every year the percent injuries and deaths per worker exceed firemen and police making tree care the most dangerous job in town. Professionals hired for cleanup work are required by OSHA to wear hardhats, ear and eye protection and, while working on the ground to wear chaps (leg protection). Homeowners are not required by law to use protective equipment but are foolish not to use this protective equipment and should never attempt work around utility lines or off the ground.

Individuals who hire someone to do cleanup or pruning work should insist on proof of insurance. Should something go contrary to plans and result in damage to your property or the property of others the property owner is responsible if the worker is not insured. Likewise, it is essential that anyone hired carry workman's comp insurance. If a worker is injured on the job it is the homeowner who is acting as the employer and thus becomes responsible for the cost of injury, rehabilitation and support until the injured worker is able to return to work. Hire competent professionals. Seeking an individual who is an ISA (International Society of Arboriculture) Certified Arborist is encouraged.

Different Strategies for Growth

River birches, silver maples, ornamental pears, willows and many other species have suffered disproportionally more damage from the weight of freezing rain. These species are often referred to as "cheap" trees. They grow rapidly, reproduce early and are relatively short lived. They have a "James Dean" philosophy on life - live fast and die young. They begin making seeds at an early age investing their energy reserves in reproduction instead of sound

growth. The Mathusula trees like the bur oak are long lived. They invest their energy reserves in slower growth that is more durable with reproduction starting at a later age. We Americans are an impatient lot. We want our trees to grow rapidly and are perplexed when they do not live long, in this case breaking apart in an ice storm. Mother Nature is just showing us the error of our ways. We have planted our home landscapes and urban areas with too few species that grow too rapidly. Yes, river birch, silver maple and willows are attractive. But, we certainly over use them and grow them in ways and places that their genetic characteristics did not engineer them for.

White pine also suffered extensive damage in landscapes. They grow rapidly and don't take many dollars out of the landscaping budget so have also been overused. While this species is listed as a Kentucky native, it is really more common as a northern species. It characteristically grows in a forest where it is adjacent to and protected by other white pines. As a result it does not produce the large number of lateral branches we see in more open landscapes. It is mainly these side branches that fail under these heavy loads of ice. White pines are more adapted to more northern parts of the country that generally does not experience freezing rains.

Some trees like pin oak and beech hold onto many of their old leaves until the following spring. Broadleaf evergreens like southern magnolia retain live leaves throughout the winter. This extra leaf surface allows for more surface area for freezing rain to collect. This added weight was more than enough to result in limb failure.

The Easter Freeze of 2007

Some branch failures can be traced back to another mean trick of Mother Nature. It will be two years ago this April when we experienced a record breaking plunge in temperature just as we thought spring had arrived. This freeze killed some or all of the flowers on many of our trees. As a result these plants did not produce any fruit in the fall of 2007. When something prevents a fruit crop from forming, it is common for that plant to over-produce flowers the following year. This happened in the spring of 2008 which also happened to be a good year for pollination. This resulted in an over abundance of fruit on trees like ash and crabapple. These fruit naturally persist well into the winter.

It is often hard for even experienced professional to determine why a specific tree suffered damage while others escaped. It is depressing to see our beautiful trees in pieces on the ground. It hits us in the family budget when the absence of a large shade tree on the south side of our house causes the air conditioner to work harder. We miss the memories of happier times but we need to remember that most of these large giants of the landscape were planted by others for our enjoyment. Though the groundhog saw his shadow, spring will come. Spring is a time of renewal and the traditional time for planting. This year make a resolution to plant a new tree and do this with a young person. As you begin to select new trees for your landscape look for durable, long-lived species. Amid the destruction, it is important to recognize the many important environmental benefits our big green companions contribute to our comfort and way of life. Trees, more than any other single factor are what make our homes and cities livable.

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Trees Damaged by Ice Storm (Feb 2009)	
Damaged Tree	Comments
Acer negundo (box elder)	While not called a maple, it is. This is one of the poorest species for the managed landscape. It is prone to decay, weak wooded and has surface roots and suffers breakage in wind, snow and ice.
Acer saccharinum (silver maple, water maple)	This maple is tolerant of urban conditions but has a reputation for failures. Most of the failures are on individuals that have ben improperly pruned. Failure to practice natural target pruning (removal of the collar or leaving stubs) and topping will result in extensive columns of internal decay and can be guaranteed to fail in ice storms and high winds.
Betula nigra (river birch)	This is the only heat tolerant and borer tolerant birch. Ice will often weight branches to the point where they touch the ground. Once branches are on the ground there is relatively little danger of breakage. Semi-mature trees often suffer breakage of the central leader. When the central leader is broken or split it is often better to cut the tree to the ground and allow it to sprout back from the stump, training it back to a single leader.
Carya spp. (hickory)	While hickory wood is hard and used as tool handles, the wood can be brittle. Where there is a target below the tree, dead wood in hickory trees should be removed as soon as possible.
Celtis occidentalis (common hackberry)	Hackberry (and the less common sugar hackberry) often has included bark in its branch unions. The wood is fibrous and tends to split from bifurcations in long slabs, often all the way to the ground. The wood is prone to decay. When large wounds are present it is better to remove this tree to prevent future failures.
Cladrastis kentukea (Yellowwood)	The genus name means “brittle branches.” While brittle wood is a characteristic for most woody legumes (bean family), it is an especially significant problem with this species. Failures are typically at branch unions especially where the branch angle is tight and water pockets and/or included bark exist.
Cornus florida (flowering dogwood)	Old trees failed at a higher rate than young and middle age specimens. This is likely to be the result of (1) borer injury at the bifurcations and (2) longer branches with stress cracks from previous loading. Dogwood wood is very hard and becomes horizontal collecting significant amounts of ice on twigs, fruit and flower buds until it becomes overloaded and breaks. Branches often pull out of the trunk leaving a hollow socket. Many branches beak are the branch union because of dogwood borer injury. Trees that have been stressed by bending will be prone to attack by the dogwood borer in spring. Preventative sprays are highly recommended.

Trees Damaged by Ice Storm (Feb 2009)	
Damaged Tree	Comments
Crataegus spp. (hawthorn)	Hawthorns used in landscapes are selected for their ability to hold fruit through the winter. Fruit and other botanical structures that persist into winter hold additional ice resulting in breakage. The wood is also relatively brittle. Trees that have been stressed by bending will be prone to attack by the flatheadded apple tree borer in spring.
Fagus grandifolia (American beech)	Heartwood of beech is a relatively poor compartmentalizer. When large branches are removed it almost always results in decay of the trunk. The persistence of fruit and leaves results in additional surface area for ice to collect.
Fagus sylvatica (European beech)	This European native is more common in landscapes that the American species but responds essentially the same as its American relative.
Fraxinus americana (white ash)	Ash are dioecious. Female trees drop fruit in the fall but the pedicel that hold the fruit to the tree remains. This structure collects ice and may result in additional failures. The ash flower gall found on male trees also collects additional ice. Ash trees that are bent but may not actually break are more prone to borer injury.
Fraxinus pennsylvanica (green ash)	In addition to the problems associated with white ash, green ash is more prone to breakage than the white ash.
Juniperus virginiana (eastern redcedar)	This and other junipers that grow in a tree form suffered extensive damage. The wood is brittle but does not have strength to withstand the heavy loads of ice. This and other pioneer species are short lived. Trees in shallow soils and soils that had a high water table pulled out of the ground. Pulling these trees back upright is only moderately successful over the long term.
Magnolia grandiflora (southern magnolia)	This and related species have relatively soft wood. The large, evergreen leaves hold large amounts of snow and ice resulting in higher rates of failure.
Magnolia virginiana (sweetbay magnolia)	The more southern forms of this species (*M.v. australis*), especially the cultivar Henry Hicks remain evergreen through the winter. These individuals are more prone to breakage than trees that defoliate.
Malus sp. (crabapple)	Crabapples are selected for an abundance of small fruit that persists through winter. The fruit and abundance of fine twigs collect ice and result in a higher rate of failure than apple trees grown for their edible fruit where the fruit is removed. Trees that have been stressed by bending will be prone to attack by the flatheadded apple tree borer in spring. Preventative sprays are highly recommended.
Morus rubra (red mulberry)	This species is fast growing, has relatively soft wood and is short lived. The wood is prone to decay.

Trees Damaged by Ice Storm (Feb 2009)	
Damaged Tree	Comments
Pinus strobus (white pine)	White pines are one of the fastest growing, least expensive and thus most popular evergreen trees for the landscape. Like many other fast growing species the wood is relatively soft. Lateral branches form in a spiral around the trunk and are relatively horizontal. This leads to high rates of branch failure. Once a tree begins to fail it will continue to drop branches. Most pines have 2 needles per bundle, white pine has 5. These additional needles hold more ice resulting in additional damage.
Populus hyb. (hybrid poplar)	The poplars (tulip poplar is not a true poplar) and willows are fast growing, soft wooded trees that fail in ice storms. They are prone to decay and are poor choices for the managed landscape.
Pyrus calleryana (callery pear)	Bradford is the best known of the callery pears and the cultivar most prone to failure. The wood is soft and brittle on this fast growing species. Because it is relatively inexpensive and fast growing it is a commonly planted tree. Bradford pears rarely last more than 8 to 12 years. Once the first branch fails the rate of failure will increase. While attractive in flower and tolerant of urban conditions, this species has essentially no place in the urban landscape because of the high rate of failure and the potential for damaging property. It is also highly invasive.
Prunus serotina (black cherry)	Wood produced by black cherry is relative soft. Branches are long and slender and often do not have the size to strength ratio to prevent branch breakage. The wood is moderately prone to decay.
Quercus alba (white oak)	The white oak has large leaves that persist on the branch until spring. This foliage collects ice that adds additional weight to branches. The wood is hard and branch failure is almost always a direct result of retention of the foliage. This tends to be a more juvenile trait so young trees that escape heavy loading from winter storms have the potential to live centuries.
Quercus palustris (pin oak)	The pin oak has large leaves that persist on the branch until spring. This foliage collects ice that adds additional weight to branches. Like the white oak this tends to be characteristic of young trees and is a common cause of branch failure.
Quercus rubra (red oak)	The red oak has leaves even larger than the pin oak that persist on the branch until spring. This foliage collects ice that adds additional weight to branches. Like the white and pin oaks this tends to be characteristic of young trees and is a common cause of branch failure.
Salix babylonica (weeping willow)	This non-native has branches that bend but lack the strength to hold the excessive weight of ice. It is prone to very internal decay and produces surface roots and is not recommended for managed landscapes. Golden Curls willow suffered relatively little damage. This may be in part because the contorted twigs might allow dripping of the liquid rain before it has the opportunity to freeze.

Trees Damaged by Ice Storm (Feb 2009)	
Damaged Tree	Comments
Sassafras albidum (sassafras)	This common native produces flower buds at the end of the current season's growth. These flower buds open in April with new growth coming from lateral vegetative buds along the stem. This pattern of growth results in a zig-zag pattern that is not as strong as stems of other species with branches that grow in a straight line. Sassafras wood is relatively soft.
Ulmus alata (winged elm)	This species of elm has wings on the stems. While the wings are attractive they collect more freezing rain than species without winged stems. This and other elms have brittle wood.
Ulmus americana (American elm)	This large elm has brittle branches but is more stable under ice loading than the Siberian elm (*Ulmus pumila*), one of the species of trees most prone to breakage.
Ulmus parvifolia (Chinese elm)	This species is the only elm that flowers and fruits in the fall. The small stems attaching the seed to the tree often remain well into winter and are a collection point for freezing rain. The branches are thin and brittle.

Definitions:

Bifurcation - the point where two branches or a branch and the trunk join. Also known as a crotch or branch angle.

Branch Bark Ridge - The raised strip of bark at the top of the branch union, where growth and expansion of the trunk and adjacent branch push the bark into a ridge. The branch bark ridge should not be damaged when making pruning cuts.

Branch Collar - The enlarged area of branch tissue where the branch joins a larger branch or the trunk. The branch collar should not be damaged in pruning. (Do not make flush cuts.)

CODIT - An acronym for Compartmentalization of Decay in Trees.

Compartmentalizer - The genetically controlled ability of a plant to wall off infections and prevent their spread into healthy tissues.

Flush Cut - Pruning cut through and/or removing the collar. Do not make flush cuts.

Lateral branch - a branch coming off of the trunk or off of another branch.

Natural Target Pruning - Making a pruning cut so that the collar is not damaged or removed and that a stub does not remain. Practicing natural target pruning aids the plant's natural abilities to control the spread of disease organisms that cause wood to decay.

Phloem - The very thin layer of cells just below the bark that is responsible for downward conduction of sugars and other organic compounds.

Stem - (1) term used by foresters for a trunk. (2) term used by horticulturists for a small branch

Wound Wood Roll - The new growth that closes wounds. Often erroneously called “callus.”

Xylem - also known as “wood.” The most recent annual rings of xylem are responsible for upward conduction of water and mineral elements. Phloem handles downward conduction.

(Consult: *Glossary of Arboricultural Terms*, a publication of ISA for other definitions)

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Species that Tolerated Ice Loading	Comments
Abies nordmanniana (Nordmann fir)	Native to parts of northern Europe prone to heavy snow and ice.
Abies concolor (white fir)	Native to the Rocky Mountains and very tolerant to heavy snow and ice.
Acer palmatum 'Bloodgood' (bloodgood Japanese maple)	This species has shorter branches and does not collect as much weight. Many of the Japanese maples are not tolerant of the summer heat and drought.
Acer saccharum (sugar maple)	This species has stronger wood and is much more tolerant of ice loading than red and silver (water) maple.
Aesculus spp. (buckeye)	The wood is relatively soft but the coarse branches structure holds less ice (weight) and has a better branch strength to size ratio than species with a finer branching pattern.
Amelanchier spp. (serviceberry)	This is a relatively small, upright tree. The size and habit coupled with the hard wood make this tree less susceptible to ice damage.
Asimina triloba (pawpaw, papaw)	This is a relatively small, upright tree. Branches can bend without breaking.
Cedrus libani (cedar of Lebanon)	This needled evergreen has been very tolerant of all types of storm damage.
Chionanthus virginicus (fringetree)	This is a relatively small, upright tree. Branches can bend without breaking.
Cornus spp. (Shrub forms)	Unlike dogwood species that form tree forms, the shrubs have relatively short branches and do not hold as much weight as species with longer branches.
Gymnocladus dioica (Kentucky coffeetree)	This species, like other legumes (bean family) has somewhat brittle wood but the coarse branches give it a good strength to size ratio. This tree is dioecious (male trees and female trees). Female trees have large bean pod-like fruit that collect ice at the ends of the branches. As a result female trees fail more frequently than male trees. Male trees are recommended because they are less messy.
Juglans nigra (black walnut)	This species has hard wood and the coarse branching structure give it a good strength to size ratio.

Species that Tolerated Ice Loading	Comments
Magnolia acuminata (cucumber magnolia)	The wood is relatively soft but the coarse branches structure holds less ice (weight) and has a better branch strength to size ratio than species with a finer branching pattern.
Magnolia macrophylla (bigleaf magnolia)	The wood is soft but the coarse branching structure does not allow large areas for ice to form. The leaves are very large and this species becomes more prone to wind damage when in full leaf.
Nyssa sylvatica (blackgum, tupelo)	One of the most attractive native trees. Ability to resist ice damage is variable depending on the individual.
Picea abies (Norway spruce)	Native to the northern Europe and very tolerant to heavy snow and ice.
Picea pungens (Colorado spruce)	Native to the Rocky Mountains and very tolerant to heavy snow and ice.
Platanus x *acerifolia* (London planetree) *Platanus occidentalis* (eastern sycamore, planetree)	Individuals that have been prone to anthracnose damage to stems have suffered more breakage than other trees. This tree recovers better than most other species when it is damaged.
Quercus bicolor (swamp white oak)	Flood tolerant species that might be a better choice in wet areas than river birch. The bark is a light color and exfoliates. It is a much larger tree than river birch and must be given sufficient room to grow.
Quercus lyrata (overcup oak)	Relatively ice tolerant.
Quercus macrocarpa (bur oak)	Coarse branching that does not collect as much ice. The wood is also very hard.
Quercus phellos (willow oak)	This species is moderately flood tolerant and might be a better choice fro wet areas than river birch. It is a much larger tree than river birch and must be given sufficient room to grow.
Rhus spp. (sumac)	Coarse branching and able to bend under ice loads.
Taxodium distichum (bald cypress)	Deciduous conifer with soft wood. Relatively ice tolerant.
Tsuga canadensis (Canadian hemlock)	Small needled conifer with soft wood. Relatively ice tolerant as long as trees have not been sheered.

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Observations on Patterns of Failures in Landscape Trees:

1) Trees that have been topped are more prone to failure than trees that have been properly pruned. If extensive reduction in height is necessary to keep the tree out of power lines, the tree should be removed.

2) Trees with root systems that have been constricted or severed by trenching, sidewalk or footer installation are more likely to fail at the soil line when loaded by ice, snow or wind.

3) Trees suffering from root decay fungi often fail at the soil line.

4) Trees growing in wet areas are more prone to failure at the soil line because of shallow rooting. This is especially true during wind and ice loading while the soil is saturated.

5) Old trees with long, horizontal lateral branches are more likely to fail than branches coming off the trunk in an upward angle.

6) Branches with included bark in bifurcations (tight crotches) are prone to failure.

7) Evergreen trees are more likely to fail than deciduous species. Some species (spruce, fir, hemlock) are especially well adapted to ice and snow loads and survive better than other evergreen species.

8) Deciduous species that hold onto fruit, leaves and other vegetative parts are more likely to fail than species that drop these plant parts.

9) Species with winged stems (sweetgum, winged euonymus, winged elm) are more likely to suffer branch breakage because of the increased ability to hold ice.

10) Most shrubs will bend over but spring back with only minimal damage once the ice melts.

11) Fast growing species generally have weaker wood than slower growing species.

12) Lone trees left standing after adjacent trees have been removed are prone to failure. Failure is often on the trunk half way between the soil line and lower branches. This is especially common where homes have been built in a forest.

13) Edge trees (trees growing along the edge of a field) are more prone to failure than trees that have grown as isolated individuals. (Edge trees have significantly more foliage on the sunny side than adjacent to other vegetation so are more heavily weighted on one side.)

14) Trees with climbing vines are more prone to collecting freezing rain. This is especially true of trees with English ivy, an evergreen vine that can be so vigorous that it hangs from the ends of tree branches.

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