2014-15 Winter Injury to Trees and Shrubs

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The welcomed warming temperatures of spring and early summer are a relief from the cold winter temperatures of 2014-15. The USDA Plant Hardiness Zone Map for Kentucky (http://planthardiness.ars.usda.gov/phzmweb/Images/72dpi/KY.jpg) places most of the state in zone 6 (–10° to 0°F). The far western counties are in Zone 7a (0° to +5°F). This winter we experienced temperatures below this. The visible indications are the marginally hardy plants that are now damaged or dead.

Temperatures associated with the hardiness map are based on the 30-year average of the single **lowest** winter temperatures recorded each year. This is not the absolute lowest temperature experienced over a 30 year period, just the average. Plant hardiness is based on the lowest temperature that, under optimum growing conditions, the plant can tolerate. The map also does not take into effect the duration of the cold, soil moisture, humidity, solar radiation, topography or wind.

The hardiness map (http://planthardiness.ars.usda.gov/PHZMWeb/Maps.aspx) shows that Kentucky shares Zone 6 with places that have dramatically different environments (e.g. Texas panhandle, coastal New England and the Alaskan panhandle). While there are shortcomings to this map, it is still a valuable aid in making the decision of what to plant and where it should be located. The problem arises when we use marginally hardy plant material and experience colder than average winters.

The winter of 2014-15 approached all time historical lows in many parts of the Commonwealth. Numerous daily records for low temperatures were broken by significant margins. The extensive damage to plants being observed is the result of factors not recorded in the hardiness map.

Pattern of Cold

Late fall arrived with snow and lower than normal temperatures. This was followed by warmer than average temperatures in early winter. Late winter brought the coldest temperatures in recent years. These fluctuating temperatures made it difficult for plants to acclimate. This pattern is often found in a continental climate like ours.

Wind, Low Humidity and Sun

The majority of the water lost by plants is from their foliage. Deciduous plants drop foliage in the fall to reduce their need for water when it is likely to be frozen. Water loss from deciduous plants continues through winter but at significantly lower rates than during the growing season. The small amounts of water lost from dormant stems must still be replaced to prevent damage. Sometimes this is not possible if the soil and/or stems are frozen.

The winter of 2014-15 had numerous sunny days when the wind, coupled with low humidity (often below 20 percent) resulted in more water loss from evergreen foliage and twigs

than the plant could absorb and transport. The bright winter sun, wind and low humidity increased the rate of water loss. With water in the soil and stems frozen, the pull of transpiration resulted in embolisms (air pockets) developing in xylem cells (conducting tubes that move water from the soil to the top of the plant). Like the air pocket in a syphon, plants are unable to move water through these xylem tubes. This was compounded when frozen stems were physically shaken to remove ice and snow or bent by ice, snow and wind. Bending frozen xylem cells can fracture the cell walls reducing the plants ability to conduct water and mineral elements.

What Has Happened?

Many broadleaf and needled evergreen plants turned brown in late winter and early spring. Many of these broadleaf evergreens are marginally hardy in our climate. They are from milder climates where they retain evergreen foliage all year long. Some of these species survived previous winters because of the milder than normal temperatures experienced. Examples include:

Japanese aucuba (*Aucuba japonica*)
Boxwood (*Buxus* spp.)
Chinese holly (including Burford) (*Ilex cornuta*)
Monkey grass (*Mondo japonica*)
Southern magnolia (*Magnolia grandifolia*)
Laurel cherries (*Prunus laurocerasus*)
Leyland cypress (x *Cupressocyparis leylandii*)

The southern magnolia is a good example of a broadleaf evergreen with a wide provenance (where it evolved). Though they may look identical, southern magnolias originally from the upper parts of the south are more winter hardy than those that were originally from the deep south. Because they are the same species does not mean that all individuals in this group have the same genetic level of winter hardiness.

We typically think of needled conifers as being very winter hardy. Leyland cypress (x*Cupressocyparis leylandii*) is an exception to this rule. This marginally hardy plant suffered extensive damage this winter and in the winter of 2013-14. The cold damage predisposes this species to cankers (seiridium and botryosphaeria) and is not recommended in our climate.

The Japanese maple (*Acer palmatum*) is a deciduous species that frequently suffers the ill effects of our continental climate. As the common name indicates this plant is native to Japan, a series of islands bathed in the warming currents flowing north from the equatorial Pacific. The moderate climate of these east Asian islands do not experience the wide swings in temperature common to Kentucky. This is especially true for the late spring frosts and freezes. After a brief warm spell our Japanese maples leaf out prematurely only to be damaged by a late spring frost.

Many broadleaf evergreens may look green and healthy as the coldest of winter temperatures transition into the warmth of spring. Unseen is significant damage to the xylem cells (long tubes that conduct water upward). Up to this point the individual plant has been able to supply its foliage with sufficient water. But, the limited amount of healthy conductive tissue has been working at maximum efficiency to supply the plant's water needs. With a few days of

80°F in early spring the ability of the plant to absorb and translocate water as rapidly as it is lost becomes a water deficit. The result is leaf and stem death as if it were much hotter and dryer.

Snow and ice are a common form of winter precipitation. Many gardeners are afraid that the slight bending will result in stem breakage. If the xylem in a branch freezes and then bends downward as a result of the ice or snow load, the ice crystals can result in the rupturing of the xylem cells. This type of damage is made worse by strong wind or when the owner of the plant shakes the snow or ice off of the plant thinking that they are helping the plant.

Sometimes provenance (where it originated) is the major issue for winter injury. Other times it is the location, specifically failure to match the plant to its site. In winter the sun is very low on the horizon. Locating broadleaf evergreens on the north side of a structure will help to protect them from the warming rays of the winter sun. These same plants also need to be protected from the drying effect of the wind. Though we may have fond attachment to them, marginally hardy southern plants do not belong in most Kentucky landscapes.

Sunscald


Sunscald on red maple

In late May or June, well after the cold winter months have passed from our minds we begin to see the development of another type of winter injury. This problem is called sunscald. It is not only disfiguring but often leads to a long, slow mortality spiral. It usually appears only on the southwest side of trunks and only on recently planted trees. The first indication is a small vertical crack in the bark. These cracks often run from close to the soil line up to the lower branches. As the crack opens, the bark begins to peel back exposing the wood. The damage that caused this injury occurred during winter when the cambium died. As the bark peels back exposing the wood fungi attack the xylem and insects are attracted to the open wound. It is common for 40% of the trunk's circumference to be damaged by sunscald. This is more than a disfiguring problem. It results in the loss of conductive tissues essential for growth and development. Trees can no longer move water and mineral elements from the roots to the

foliage nor supply the roots with sugars and other organic chemicals necessary for growth. At best, trees stressed by sunscald will reestablish more slowly and are more susceptible to diseases and insects. While these trees may ultimately survive, replacement trees outgrow severely damaged trees.

Sunscald is almost always limited to young, recently installed landscape trees. It is not seen on mature trees or those in forests. It is most common on species with thin bark than trees with thick or exfoliating bark. Problematic species include:

Maple (*Acer* spp.)
Linden (*Tilia* spp.)
Pear (*Pyrus calleryana*)
Crabapple (*Malus* spp.)
Cherry, plum (*Prunus* spp.)
Willow (*Salix* spp.)

The most common species associated with this problem is red maple (*Acer rubrum*). This is in part because it is the most widely planted (over-used) species and because it is a floodplane species. While this problem can develop on any tree, it is more problematic on species with high water demands. Understanding the multiple causes of this problem is the solution to preventing it. Installing trees with larger soil balls (containing more roots) and watering during the winter months helps prevent water deficiencies leading to sunscald.

Though not seen until later in the growing season, this damage occurred during the colder parts of winter. Though the air is well below freezing, the intense winter sun warms the thin bark and the cambium below it. This is most likely to occur in late afternoon when the low angle of the sun results in sunlight hitting the trunk directly. The intense sunlight causes the cambium cells to begin dividing. As a cloud moves across the sun or the sun sets below the horizon, the trunk quickly returns to sub-freezing temperatures and the cambium freezes and dies.

Sunscald can be prevented by shading the trunks of young, newly planted, thin-barked trees. A double layer of plastic or fiberglass or plastic windowscreen is an easy and economical way to accomplish this. Wrap the double layer of screen around the trunk. Hold the two ends of screen and staple them together (not to the tree). Leaving excess screen will prevent girdling damage to the tree. Screen is better than plastic pipe or paper wraps sometimes sold for this purpose. Windowscreen allows moisture to evaporate from the trunk. This protective covering should be removed after the tree begins to become established, usually one or two years. White latex paint diluted 50:50 with water is also effective but is messy, unsightly and remains for many years after it is needed.

Cold Damage to Roots

The least hardy part of any plant is its root system. Roots grow in the ground where the insulating effect of soil buffers the roots against extremes of heat and cold. Plants growing in above ground containers and plants being transplanted (balled and burlapped, bare root or container grown plants) lack the temperature moderating protection of surrounding soil. When roots are subjected to low temperatures they can be killed even though the above ground portions of the plant are hardy and remain alive. As a rule of thumb, roots are two USDA Plant Hardiness

Zones less hardy than the rating assigned to the above ground portions. As spring growth begins the buds begin to pop open but fail to put out new foliage. The green stems quickly turn brown, and die. This occurs because the roots were killed by cold and were unable to absorb water essential for growth.

Winter injury to landscape plants appears with multiple visual symptoms. While these injuries are associated with low temperatures, injury is usually the result of a combination of different environmental and cultural conditions (low temperatures, duration of cold, lack of soil moisture, low humidity, wind and sun). Healthy landscapes are not an accident. It is important to always match the plant to the site conditions. This helps ensure that your investment will have every opportunity to thrive and return aesthetic dividends for years.

Managing Winter Injury on Landscape Plants

Rule number one in diagnosing winter injury and making recommendations is don't be impatient. If the foliage or the tips have been damaged but the stems and buds are still green, give the plant the opportunity to put out new growth. Sheering dead foliage will immediately improve the appearance of the plant. Pruning should not be done until after the chance of the last frost has passed.

Spring fertilization is not recommended, especially for plants suffering winter injury. The addition of nitrogen can encourage more growth than the damaged stems can supply with water during the hot, dry summer months. The addition of water during dry periods is more beneficial than the addition of fertilizer. When necessary, fertilization of woody landscape plants should occur in late fall after leafdrop (e.g. Thanksgiving to Christmas).

Broadleaf evergreens that are established and exposed to winter sun can be protected from the intensity of winter sun and wind. Cover these plants with light-colored cloth or burlap prior to the onset of winter. Spray moisture on the cloth prior to the onset of extremely windy sub-freezing temperatures. Water frozen on the cloth will further reduce the effect of the wind. The best long-term approach is to match the plant to the site. This can involve using hardy needled evergreens where evergreens are desired and deciduous species that originated in our climatic zone.

Damage to plants will vary widely depending on exposure and location in the state. The following tables will offer suggestions on degree of damage and cultural advice. The degree of damage varies widely across the state and even locally depending on exposure, vigor of the plant and genetic adaptions.

Table 1.

Broadleaf evergreens	**Comments:**
Abelia (*Abelia* x *grandifolia)*	Foliage burn and stem dieback, can be cut back almost to the ground (3 inch stubs).

Broadleaf evergreens	**Comments:**
Japanese aucuba (*Aucuba japonica*)	Severe foliage dieback and stem dieback. This marginally hardy evergreen should only be grown in full winter shade.
Barberry (*Berberis juliana*)	Moderate foliage and twig death
Boxwood (*Buxus* spp.)	Foliage damage, can be sheered back
Camellia (*Camellia japonica*)	Foliage and twig death. Even the cold hardy cultivars are not reliably hardy.
Threadcypress, Chamaecyparis (*Chamaecyparis* spp.)	Moderate foliage damage variable by species and cultivar. These plants do not generally tolerate heavy sheering.
Bigleaf wintercreeper (*Euonymus fortunei*)	Foliage damage and twig dieback. This plant will rebound (unfortunately).
Japanese euonymus (*Euonymus japonicus*)	not reliably hardy, cut back to the ground
Spreading euonymus (*Euonymus kiautschovicus*)	not reliably hardy, cut back to the ground
Foster holly (*Ilex* x *attenuata*)	moderate foliage damage with some twig death
Japanese holly (*Ilex crenata*)	variable by cultivar but moderate foliage damage
American holly (*Ilex opaca*)	slight to moderate foliage damage in sunny locations. Hard sheering often does not regrow.
Blue holly (*Ilex* x *meserveae*)	numerous cultivars with slight to moderate damage. Do not prune unless severely damaged
Privet, ligustrum (*Ligustrum* spp.)	Damage to foliage and stems. Plants resprout from the base. (Note: this species is considered invasive and not recommended.)
Liriope, bigblue lilyturf (*Liriope muscari*)	Trim back dead foliage being careful not to damage the crowns.
Southern magnolia (*Magnolia grandiflora*)	Severe foliage to twig death. Most cultivars are of southern provenance. Damaged plants will often produce sprouts on the trunk.
Oregon grapeholly, Mahonia holly (*Mahonia bealei, M. aquifolium*)	severe damage to death of the entire plant. These species are marginally hardy and should only be grown in areas protected from wind and winter sun.

Broadleaf evergreens	**Comments:**
Nandina (*Nandina domestica*)	Severe damage with many plants killed to the ground or killed completely. Cut dead canes back to 3-inch stubs.
Laurel cherry (*Prunus laurocerasus*)	Severe damage to foliage and stems. Plants that have not been killed will sprout back from the base. Plants should be protected from wind and sun during severe winters.
Azalea, rhododendrons (*Rhododendron* spp.)	Damage is variable by species and location. Damage is from slight foliar damage to complete death of the plant. Protect evergreen forms from winter wind and sun.
Yew (*Taxus* x spp.)	Damage is variable depending on location and species. Sheering will remove dead foliage though most Taxus do not tolerate hard pruning.
Willowwood viburnum (*Viburnum* x *rhytidophylloides* 'Willowwood')	Foliage and twig death. Plants generally come back from the base.
Leatherleaf viburnum (*Viburnum rhytidophyllum*)	slightly less winter hardy than Willowwood

Table 2.

Marginally hardy deciduous species	**Comments:**
Mimosa (*Albizia julibrissin*)	Killed to the ground. Trees will sprout back as shrubby or multi-trunk forms. (Note: this species is considered invasive)
Orange-eye butterfly bush (*Buddleia davidii*)	Severe dieback to the ground. (Note: this species is often listed as invasive.)
European hornbeam (*Carpinus betulus*)	Dieback of stems; expect flatheaded borers
Border forsythia (*Forsythia* x *intermedia*)	Flower buds of less hardy cultivars are often killed by sub-zero temperatures
Crape myrtle (*Lagerstroemia indica*)	Many cultivars have been killed to the ground. Cutting dead plants to the ground will generally result in regrowth from the base. These plants will be shrubs or multi-trunk trees unless trained back to a single leader.
Knockout rose (*Rosa* x spp.)	Stem damage or killed to the ground.