# Plant Talk

DECEMBER 2012

## Understanding Cold Hardiness

*by Michael Yanny*

People from Wisconsin are considered a hardy bunch. We can take whatever nature throws at us and revel in it. We bask in our cold, snowy winters. Heck, some of us even take off our shirts in freezing temperatures at Packer games in Lambeau Field in January. We are hardy, even though some of us are not always smart about it.


*"The cold does not affect me, though the beer does!"*

When it comes to plant hardiness, it is actually a bit more complicated than with humans. Plants can't go in the house and turn up the heat when it's cold or put on more clothes. Since they are immobile individuals, they can't take a winter vacation in Florida. Plants are stuck with the weather that Mother Nature dishes out to them. They have developed a number of ways to survive the harsh conditions of winter. It's part of their genetic makeup.

Plants have the ability to sense the day length and temperature changes in their particular area. They acclimatize themselves for the coming of winter based on their location on the planet. To a great extent, plants know where they are and what's coming with each season. You can see this each fall when Sugar Maples (*Acer saccharum*), color magnificently in the 2nd to 3rd week in October in Southern Wisconsin. They are beginning the process of preparing for winter. This is the time of year when they start developing metabolites in their systems to protect themselves from the upcoming severe temperatures. I like to think of it as plant winterizing. The metabolites are a type of anti-freeze that allows them to survive cold temperatures. Just like the radiator of your car can't have pure water in it throughout the winter, the cells of plants must not either. They produce sugars, some of which are different from those produced in the growing season, that act as the anti-freeze in the cells. In addition, plants move water from inside their cells to the spaces between their cells where water can freeze and not cause harm to the plants. In other words, some parts of the plants can freeze while other areas must have a super cooling capability to protect them from freezing. This acclimatization process is definitely more complex than I'm making it out to be. It is not entirely understood by scientists nor this Cheesehead.

Where many plants run into trouble is when temperature swings are so rapid they don't have time to adjust. This causes their cells to explode. It is similar to an

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undrained water pipe freezing and blowing apart in winter. When the water freezes, the pipe expands and breaks. If plant cells are not prepared properly, they will do the same thing.

It is quite common to see cold temperature damage on plants caused by cells exploding. It usually happens in late fall or late winter when plants are not fully acclimatized or are de-acclimatized due to late winter warm-ups. In the winter of 2008-2009 we saw significant damage on Boxwood from cells blowing apart. It showed up on the plants in the form of bark splitting.

In the Northern Plains of the U.S. and Canada, one of the primary killers of trees is not the extreme cold they have in their area, but the temperature fluctuations. A nurseryman from Manitoba once told me that they lose more trees in November than any other month. The reason for this is they often have rapid temperature swings of forty degrees or more at this time year. He said it is not uncommon in November to have temperatures in the 60's in the day and then have a cold front come through that will drop the temperatures into the low 20's in the matter of a few hours. Many plants cannot adjust quickly enough to deal with these rapid changes. He told me that during some of these times you can go outside and hear tree trunks exploding with violent cracks caused by the rapid freezing. They blow apart. Similar damage can occur in late winter as trees de-acclimatize. The sun's rays intensify at this time of year and rapid temperature swings on the trunks of trees will cause frost cracking or sun scalding, especially on young trees.

Besides death by cell explosion, desiccation is another major cause of winter plant damage. Plants simply can't retain water in their systems throughout the entire winter. Plant tissues can dry out to the point where they die. Water loss from the tops of plants can't be replenished by the root systems when the soil is frozen. Desiccation damage is most noticeable in evergreens, showing up in the spring as browning foliage. It is usually the worst on the south and southwest sides

*Left: Bark splitting on Boxwood. Left Middle: Brown shoots can usually be traced back to the stem damage. Left Bottom: Desication damage on the Southwest sides of Japanese Yews. Bottom: Bark splitting on Techny Arborvitae due to cell explosion in late winter of 2012.*

of plants where the drying from the sun and wind is most severe. Desiccation damage can be most easily prevented by thoroughly watering your plants before freeze up in the fall. Also, protection from the drying winter sun and winds will prevent this damage. Proper siting can usually solve this problem. In cases such as newly transplanted materials or plants that have had their root systems compromised, anti-desiccant sprays, such as Wilt Pruf, can be helpful in preventing winter damage.

Another interesting facet of plant hardiness is that different parts of a plant may be hardier than others. For instance, many of you who have tried growing different cultivars of Forsythia have noticed that some are flower bud hardy in our area while others aren't. Many of the older, less flower bud hardy varieties, will only bloom on the lower parts of the shrubs following a severely cold winter. The tender flower buds under the snow are protected from the cold while those above the snow line are killed. The rest of the plants parts are usually unfazed by the cold. Two excellent flower bud hardy varieties

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are *Forsythia* x 'Happy Centennial' and *Forsythia* 'Sunrise'. *Forsythia viridissima* 'Bronxensis' is a poor selection for Wisconsin because its flower buds will rarely survive.

Plant roots are typically the least hardy part of a plant. This is a major concern for growers who produce plants in containers in cold regions of the country. They require various levels of protection based on the type of plant produced. Star Magnolia (*Magnolia stellata*), Corneliancherry Dogwood (*Cornus mas*), and *Ginkgo biloba* will typically suffer root loss at temperatures between 15 and 18 degrees Fahrenheit. *Potentilla fruticosa* roots can handle temperatures as low as minus 9 degrees. Sugar Maple (*Acer saccharum*) and Staghorn Sumac (*Rhus typhina*) can experience damage at 0 degrees. Growers most often use poly houses to protect their plants from the stresses of winter. They often group their plants based on their requirements for root protection from severe cold. Some growers minimally heat poly houses for certain tender plants. The use of two layers of white poly with air inflated in between for added insulation but no heat is another method. Some plants may only require a single layer of white plastic to overwinter well. At Johnson's Nursery, an unheated insulated building is used to store the tenderest of varieties. The beauty of this is that the plants will freeze very slowly and only once and will thaw in the reverse manner, giving the plants plenty of time to adjust to the cold.

Non-native plants from more southerly latitudes and native plants from more southerly seed provenances (meaning where plants originate from in the wild) are often times not in sync with their environment when grown here in Wisconsin. For instance, Musclewood (*Carpinus caroliniana*), plants that originate from seed collected from Tennessee wild sources do not acclimatize themselves early enough to survive most Wisconsin winters. The trees from these southern origins don't begin developing their fall colors in early September like plants that evolved in Wisconsin. They

*Top: Musclewood from a Tennessee seed provenance. Notice the dead twigs on the plant that didn't harden properly for the winter the previous season. Bottom: Vigorous Osage Orange shoot on bottom. Much less vigorous shoot from the same tree on top. The vigorous shoot is still green and hasn't developed the woody tissues necessary to over winter. The less vigorous shoot is fine.*

start acclimatizing later, like they would in Tennessee where they don't have to get ready for winter as early as our plants do here. So the fall coloring on these southerners will generally be two to three weeks later, if they color at all. The most important point though is not the lateness or the lack of ornamental show they exhibit but the fact that they are not getting ready for winter soon enough. Often times, these trees from the south will have die back on them in the spring as a result of their lack of genetic adaptation to our climate. The plants simply cannot properly acclimatize themselves to Wisconsin winters.

This is why many of the non-native plants that do well in Wisconsin originate from similar latitudes of the globe rather than from more southerly ones. The importance of day length stimuli to trigger acclimatization is likely a main factor in allowing their success. Amur Maackia (*Maackia amurensis*), Japanese Tree Lilac (*Syringa reticulata*), Koreanspice Viburnum (*Viburnum carlesii*), Korean Spirea (*Spiraea fritschiana*), and Norway Spruce (*Picea abies*) are some of the landscape plants that come from similar latitudes as ours.

Some plants from more southerly latitudes do succeed in Wisconsin. It could be that these plants had an

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evolutionary phase of their development that had a much more severe climate than we have now. So when we bring these plants north they are able to survive. I've noticed numerous plants that are native to the south and east of us that can be grown in Wisconsin quite successfully, at least as adult plants.

Tuliptree (*Liriodendron tulipifera*) though not native, can grow to be large trees in Southeastern Wisconsin. In Southeastern Michigan and Northern Indiana, the species is native. So why isn't it native here? I have tried growing seedlings from Southeast Michigan trees. I was successful at germinating them but failed to get them to grow to maturity. The seedlings would die the first winter if we left them in our outdoor seedbeds. If we protected them by controlling their overwintering environment we could get them to survive. We did this by putting them in our unheated insulated building to reduce the speed at which they froze. This worked. However, once we put the seedlings out into the field to produce a whip (a small 5' tree with little or no branching) , we'd encounter more problems with the plants not overwintering. Most years the trees would grow quickly and late into the season. Then, in the spring, they would be dead to the ground or nearly so. They obviously were not acclimating properly for winter. This seems to only be a problem with small, juvenile trees of this species. When trees are older, say 1" in trunk diameter or larger, they don't keep growing late into the season like the youngsters do. They acclimatize sufficiently enough and can make it through our winters. I think this explains why Tuliptree wasn't able to extend its native range into Wisconsin. It's all because of the juvenile delinquency of the kid trees. The youngsters just don't prepare for winter.

Another tragedy of nature as relates to hardiness is the story of the Bottlebrush Buckeye (*Aesculus parviflora*). This is another case of where mature adult plants are hardy in Wisconsin. However, in this case the small plants are also sufficiently hardy. It's the seed itself that prevents this species from moving north from its range

*Left: Sunscald on Tuliptree. Bottom: Desication damage on a young Green Giant Arborvitae. This cultivar does not prepare well for winter as a youngster.*

in the Deep South. This shrub is not seed hardy. In some years, the first hard frost will kill the seeds of this plant even before they fall from the shrubs. In their southern, native environment, they quickly germinate in the fall after being dispersed. They rarely see hard frost so they succeed. In the north the seed doesn't have a chance. Why the plants are hardy all the way into Wisconsin and the seed is not is a mystery to me.

Plant hardiness is an important consideration for all gardeners when deciding what to plant, especially in Wisconsin. We need to constantly be considering it in our long range planting decisions. Though some of us are Cheeseheads in an endearing sort of way, we will hopefully support our plants in a way that is slightly more sensible than our approach to our football team.

Go Pack!!!
Let's win one for the *Quercus*!!!
Roots, roots, roots, for the home trees
Go Natives!!!
Bush league is alright by Us!!!
Grow Plants Grow!!!

Plant hardy plants!!!!

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