Trees in winter: Frost, snow, and the lame duck syndrome

Derrick Rooney[1]

Gardeners have it made in frosty weather. They can get indoors, with a fire or the central heating, and think in comfort about how to remodel the garden when spring comes.

Their plants, other than the favoured few growing in containers that can be taken inside, do not have this soft option. Plants have to sit and take whatever the weather throws at them. When we have a winter as cold as the 2015 edition in New Zealand (my garden is in inland Canterbury), damage is inevitable.

On the plus side, many garden plants are capable of resisting the coldest weather. Dormant grape vines, for example, can tolerate as much as 40°C of frost without damage, whereas a summer frost of only two or three degrees can put the vine out of production for a year. To achieve this level of winter-cold hardiness, plants use a variety of strategies.

One of the most interesting winter strategies in my garden is that of a hybrid viburnum, *V.* × *rhytidophylloides* (Fig. 1).

Fig. 1 *Viburnum* × *rhytidophylloides*.

If you can get your mouth around the Latin (alas, there is no simple English name) you might find this to be an interesting shrub in the summer also, in any garden that can give it a bit of space.

Fig. 2 *Viburnum lantana* 'Versicolor' (wayfaring tree).

Fig. 3 *Viburnum rhytidophyllum* (the leatherleaf viburnum).

It is an unusual cross in that one of the parents (*V. lantana*; Fig. 2) comes from Europe, and is more or less deciduous, depending on the severity of the winter, while the other (*V. rhytidophyllum*; Fig. 3) is evergreen and Chinese. The two could never hybridise in the wild, but the cross sometimes occurs spontaneously in gardens where people have brought the two together. Gardeners often play matchmaker in this way for species that could never meet in nature.

The main claim to fame of the evergreen parent, *V. rhytidophyllum*, is that it is a big tough shrub capable of surviving and sometimes thriving in dry shade. The flowers, in late spring, are small and dirty white and the fruits are black, so there is no great ornamental value in either. I like this shrub, though. The leaves are dark green, long, and wrinkly and make a good backdrop for brighter plants.

The hybrid, which varies in the size and shape of its leaves, has the same wrinkly leaf texture and dirty white flowers, and is usually evergreen. However, unlike the evergreen parent, which merely looks darker and duller green in winter, the hybrid reacts to cold weather by turning various shades of bronze, purple, and beetroot red, depending on the quality of the soil and the severity of the cold. The colder the weather and the poorer the soil, the better the colour. When warmer weather arrives in spring, the leaves revert to their normal dull green. Offhand, I can think of no other evergreen shrub that reacts to winter cold in quite so dramatic a way.

One of the challenges that evergreen shrubs and trees face in winter is the phenomenon known as frost-drought. Leafy plants need to transpire continuously, but even if there is plenty of water about they are unable to take it up through the roots while the ground is frozen. Thus, in

[1] PO Box 43, Hororata 7544, Canterbury, New Zealand; woodlot@clear.net.nz

a prolonged frosty spell, plants can suffer the sort of desiccation and damage that occurs after a hot, dry spell in summer.

Deciduous shrubs and trees partially counter this winter risk by shedding their foliage, so that there is less need for transpiration. Some plants undergo complex chemical changes that fill their cells in winter with sugars that act as natural anti-freeze. Conifers such as firs and spruces have small, needle-like foliage with a thick, waxy covering resistant to both cold and heat.

Deciduous broadleaf trees (angiosperms or "hardwoods") and conifers (gymnosperms or "softwoods") have different plumbing. Deciduous trees lose most of their ability to circulate water after the first freeze and need to regrow the necessary tissues in the spring. Conifers better accommodate the transfer of water in winter. They have special "check valves" that can allow resumption of water movement should conditions be just right, if unseasonable. The conifer cell walls are stronger than those of hardwoods and better able to cope with ice expansion.

Conifers have higher leaf densities than hardwoods, which means that the extra weight of accumulated snow would damage stems and break branches if they had not evolved alternative growth and branching patterns to counter the problem. Where hardwood trees usually have multiple leaders or main stems (indeterminant growth), often with narrow branch angles, conifers tend to have single leaders (determinant growth) and wider branch angles that enable them to shed snow without bending as much. Conifers also usually have longer wood fibres that make their stems more flexible.

Broadleaf hardwoods, on the other hand, whether they are deciduous or evergreen, are often more vulnerable to snow damage because lowland snow in New Zealand is usually classified as heavy and wet and is apt to accumulate and stick even on bare branches. This is particularly noticeable in species such as silver birch which are adapted to deep snow in their natural habitats but vulnerable to breakage in New Zealand, possibly because the snow in their natural habitats is more powdery and less likely to accumulate in the crown.

Some evergreen species, including rhododendrons and buddlejas, are also vulnerable to snow damage but have evolved strategies to deal with frosty mornings. One is the "lame duck syndrome". Typically, the leaves of plants that adopt this technique curl up or wilt when the temperature drops below zero, but return to normal as soon as the day warms up (Fig. 4A–B).

Fig. 4 *Buddleja salviifolia* (the sage-leaved butterfly bush).
A, photographed at 8 am and wilted following an overnight frost.
B, same plant photographed at 10 am with revived leaves.

If a plant could experience emotion, a rhododendron on a frosty winter morning would be the epitome of depression. Usually, it will bounce back with no apparent harm as soon as the frosty spell ends, but if the frost is unusually severe and prolonged the large-leaf types may have their foliage browned. Some of the more tender species and hybrids may have their stems split, with fatal consequences, if the moisture inside them freezes sufficiently to rupture the cell walls.

Other factors, including the amount of summer or autumn ripening the growth receives, and the frequency of damaging early-autumn frosts, or spring frosts after growth resumes, can also affect hardiness. This applies mainly to plants from stable continental climates grown in changeable maritime climates such as that of New Zealand. An example is the silk tree, *Albizia julibrissin*, which was promoted for horticultural shelter in the North Island in the 1960s and 1970s and is a common ornamental tree in Christchurch gardens. Known as silk tree in New Zealand and mimosa in the United States, *Albizia* is native to the east Asian continent and is an attractive small to medium-sized garden tree with very fragrant flowers. In the United States it is rated as hardy in Zone 5b, and is widely grown. It seeds freely in Massachusetts (Zone 6, -23°C) and has been declared an invasive pest plant in some states, including Florida and Tennessee. This hardiness rating implies it should be tolerant of winter frosts down to about -25°C. However, on parts of the Canterbury Plains very much lesser frosts are usually fatal to it.

Numerous other plants of continental origin suffer a similar fate here. The wonder tree (*Idesia polycarpa*) is another example. In Rotorua this is a familiar sight and is even used as a street tree. Its big bunches of sealing wax-red berries hanging from bare branches are a charming sight in winter. Sadly, in most of the South Island away from a narrow coastal strip sheltered from salt-laden winds, wonder tree is a non-starter. A native of northern Japan, the Korean Peninsula, and nearby parts of China, wonder tree is rated as hardy to US Zone 6 and should be hardy everywhere in the South Island except the coldest parts of Central Otago and the Mackenzie Country. Again, the problem is not extreme winter cold but our unstable oceanic climate with its frequent unseasonable cold or warm snaps and lack of reliable summer and autumn heat to ripen the wood.