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Tree Susceptibility to Salt Damage

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Although de-icing salts assist in keeping pavement dry and safe during ice and snow, their extensive use can cause damage to woody species along streets and highways. Trees and shrubs can be injured by salt spray and drift, by salt that leaches into the soil or by a combination of both.

Symptoms of Salt Injury

On evergreens, injury from salt spray first appears as browning of the needles facing the road. The browning occurs at the tip of the needle and progresses to the base. Browning is evident in February and March and becomes more prominent through the spring and summer. As injury continues, needles drop prematurely and the branches become bare. As needles die, the photosynthetic capacity of the tree is curtailed. Over several years, the amount of new growth is reduced, causing the tree to weaken, dieback and perhaps die.

On deciduous trees, salt spray affects opening of buds and twigs in the spring, with the flower buds being the most sensitive. Injured buds are slow to open or fail to open. Factors that influence sensitivity include bud size, nature of the bud scales, twig thickness and bark covering. Trees with thin bark, such as beech, are highly susceptible. Trees with resinous buds, such as cottonwood, are fairly resistant to injury, as are trees whose buds are submerged in the twig, such as black and honey locust. Generally, plants with naked buds are injured more than trees with scaly buds. Salt symptoms on deciduous trees include reduced green leaf coloration, smaller leaves with scorched margins, thin crowns with dying twigs and branches, early fall coloration and leaf fall, tufting and clumping of foliage and sparseness of leaves, and small growth rings. The irregularity in foliage thickness from year to year reflects both the growth conditions and differences in the amount of injury each year.

Salt spray injury is most severe on the side of the tree facing the road. Trees become more one-sided as needles and branches are continually killed on the road side of the tree. Trees on the downwind side of the road are damaged to a greater extent than similar plants on the opposite side of the road. Tree damage decreases with increasing distance from the road.

The degree of damage to plants from salt varies considerably from year to year. Fluctuations in the quantity and frequency of frozen precipitation determine the amount of salt applied each year. Weather conditions such as wind and temperature will influence the amount of salt taken up by plants. Damage to trees is also affected by climatic factors such as frequency of freezing and thawing.

Influence of Salt on Plant Growth

The accumulation of salt within plants and soils affects plant nutrition and water absorption. Sodium reduces nutrient uptake of potassium, calcium and magnesium by displacing those nutrients. Excessive sodium in soils causes soil aggregates to break down, resulting in poor aeration and slow water permeability. The resulting soil lacks good drainage and proper oxygen concentrations and leads to reduced moisture uptake by roots.

The availability of water to plants is decreased because of increased osmotic tension, by which water is held in the soil. Water does not move into the plant and could even move osmotically from the cells to the soil with elevated salt content. Increased salt contents tend to draw water toward the salt solution. Salts absorbed by the plant can desiccate leaf cells, causing browning and leaf abscission.

Minimizing Salt Injury

Although alternatives other than salt are available to de-ice roads, salt remains the preferred method because of its lower cost, availability and efficiency in melting snow and ice. Assuming that the use of salt to de-ice roadways will not change greatly, there are some management techniques that can be used to minimize damage to trees from salt.

1. All trees are affected by salt to some degree, but some species are more tolerant than others. Table 1 is a compilation from the literature listing trees that are the most vulnerable and the most tolerant of salt. Trees that are

relatively tolerant to salt should be planted in locations where salt accumulates in the soil or is sprayed through vehicular traffic near roads.

2. Irrigate soils to leach sodium and chloride before spring growth. A saline soil condition is relatively easy to correct. Since most salts are water-soluble, applications of water will effectively leach salts out of the root zones. A general formula suggests that 6 inches of water should be applied to leach out about half the soluble salts. Leached potassium and magnesium can be replaced through application of fertilizer.

3. Apply gypsum (calcium sulfate) to soils that are high in sodium. The addition of calcium displaces the sodium and lessens the dispersion of soil particles and the loss of soil aggregates, improving soil aeration and drainage.

4. Avoid sites at high risk from salt injury by planting trees away from salt spray drift zones and areas where salt-laden brine and slush are likely to accumulate. Plant trees at least 60 feet away from the roadside. Trees that are closer stand a higher chance of being affected.

5. Plants that are injured and exhibit dieback should be watered, pruned and fertilized. Mulch should be applied to reduce water loss. Weakened or stressed plants are often attacked by insects and diseases.

6. Design or engineer sites to keep salt spray, runoff and plowed snow away from trees. Examples include raised planters to eliminate effects from runoff, lowered speed limits to reduce splash and spray, and high-density fabric fencing around trees to protect trees from splash and spray. Grade salt-treated areas and install barriers so that surface drainage water does not accumulate near plants.

Summary

De-icing salt is detrimental to vegetation, especially trees and shrubs. Most of the injury results from the salt spray that is deposited on trees during the winter as well as increased salt in the soil solution. Evergreens are particularly vulnerable, but developing buds of deciduous trees are also affected. Species do vary in their sensitivity to salt damage. Management prescriptions for roadside plantings should use techniques that minimize salt injury and select trees for planting that are more tolerant to salt.

Literature Cited

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Marginal leaf burn is a common indication of salt injury.

Table 1. Salt Susceptibility of Trees[1]

Vulnerable to Salt		*More Tolerant to Salt*	
Botanical Name	**Common Name**	**Botanical Name**	**Common Name**
Acer rubrum	Red Maple	*Acer platanoides*	Norway Maple
Acer saccharum	Sugar Maple	*Aesculus* spp.	Buckeyes
Albizia julibrissin	Mimosa	*Betula* spp.	Birch
Amelanchier spp.	Serviceberry	*Carya* spp.	Hickories
Carpinus caroliniana	American Hornbeam	*Fraxinus* spp.	Ash
Cornus florida	Dogwood	*Ginkgo biloba*	Ginkgo
Crataegus spp.	Hawthorn	*Gleditsia triancanthos*	Honeylocust
Fagus grandifolia	American Beech	*Juglans nigra*	Black Walnut
Liriodendron tulipifera	Yellow-Poplar	*Juniperus virginiana*	Eastern Redcedar
Lagerstroemia spp.	Crapemyrtle	*Populus* spp.	Cottonwood/Aspens
Magnolia grandiflora	Magnolia	*Prunus* spp.	Cherries
Picea spp.	Spruces (most)	*Quercus* spp.	Oaks (most)
Pinus strobus	Eastern White Pine	*Robinia pseudoacacia*	Black Locust
Pinus sylvestris	Scotch pine	*Taxus* spp.	Yews
Tilia spp.	Lindens	*Ulmus* spp.	Elms
Tsuga canadensis	Eastern Hemlock		

[1] Adapted from Dirr 1976; Johnson & Sucoff 1999; Lumis et al. 1975

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Salt damage to eastern white pine along a major highway.

Michael Patrick/Knoxville News Sentinel

Truck spreading salt on residential streets.

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