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Salt Damage in Landscape Plants

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In the upper Midwest, each state applies approximately 100,000 to 300,000 tons of de-icing salt to roads each winter. And nationwide each year, we apply more than 15 million tons to de-ice sidewalks, walkways, and driveways.

As salt dissolves and spreads to adjacent soil it is taken up by plant roots. Plants vary in their sensitivity to salt, with some plants seemingly unaffected by salt while others are killed outright (Figure 1). This publication examines the causes of salt damage in plants and offers some tips for reducing its risks.

What Is Salt?

The most commonly used salt, whether found in the pantry or in a de-icing truck, is sodium chloride. Salt occurs in a variety of forms, including the mineral halite, which is mined and used in rock salt.

Sodium chloride is sold in several different particle sizes depending on its intended use. Rock salt is very coarse and consists of discrete crystals that have the consistency of loose gravel. On the opposite end of the scale, common table salt and popcorn salt have very fine granules. In between are kosher salt, which is made up of coarse flakes, and compressed pellets that are used in water softeners. Road de-icers often consist of both salt and sand, with the salt component consisting mostly (98.5 percent) of common sodium chloride with traces of other mineral salts.

How Salt Damages Plants

Salt's toxic effects on plants have been known since ancient times when it was used for biological warfare to destroy an enemy's fields and crops. Common salt is

Photo by Janna Beckerman

Figure 1. *Different plants have different sensitivity to salt. The leaves from this oak tree show telltale signs of extreme salt damage.*

Photo by Janna Beckerman

Figure 2. *The symptoms of salt damage are often more severe where plants face roads or sidewalks — as with these yews.*

toxic because it is made up of sodium and chloride and both are toxic to plants when present in high concentration.

When salt dissolves in water, the sodium and chloride ions separate. When this happens, the sodium ions in the salt replace the other nutrients in the soil that plants need (potassium, calcium, and magnesium), so these nutrients are unavailable to the plant. Rock salt also absorbs the water that would normally be available to roots, which dehydrates the roots, changes their physiology, and causes additional plant stress. Meanwhile, roots absorb the chloride ions and transport them to the leaves, where they accumulate and interfere with chlorophyll production and photosynthesis.

One study found that the soil from a highway median had a chloride concentration of 1,050 parts per million (ppm) (Hofstra and Smith, 1984). The soil less than 30 feet from the highway had a chloride concentration of 890 ppm, which is still ten times greater than levels that are known to inhibit seed germination and root growth in grasses and wildflowers. Such salty soil is one reason the salt-loving and invasive giant reed *Phragmites* can colonize sites near many Midwest roads.

Salt damage doesn't stop with the roots. When passing vehicles spray salt on plants, it can damage a plant's leaves, buds, and small twigs, which in turn can reduce the plant's cold hardiness, making tissue more susceptible to freeze damage.

How to Diagnose Salt Damage

The amount and duration of salt exposure directly affects the potential damage to plants. As you may expect, higher concentrations of salt in the soil cause more damage.

To determine if salt is playing role in damaging your plants, be sure to note which side of the plant has more severe symptoms. In salt-damaged plants, the symptoms will be more severe on sides facing the road or sidewalk (Figure 2). In evergreens, damage usually appears in late winter as needle browning that starts at the tips. Keep in mind that snow covered branches will be less affected than those exposed to salt spray, and that as you move away from the spray zone, the symptoms should abate.

It is more difficult to diagnose spray damage on deciduous plants. Usually, leaf buds facing the road are killed or are very slow to break dormancy and bud and leaf out in spring. Flower buds facing the road often fail, but the unaffected side of the tree or shrub flowers normally. Repeated salt damage over several winters may produce a witch's broom effect, which is a tufted and stunted appearance of the plants on the side facing the road.

Salt Alternatives and How to Prevent Salt Damage

The easiest way to prevent salt damage is to avoid it. Whenever possible, use coarse sand instead of salt to provide traction and make sidewalks and driveways less slick. If you must use salt, use it judiciously, and erect barriers with plastic fencing, burlap, or snow fencing to protect sensitive plants and minimize their contact with salt (Figure 3).

When possible, consider non-sodium de-icing agents such as calcium chloride or calcium magnesium acetate (CMA), a salt-free melting agent made from limestone and acetic acid. The relative costs of these products are provided in Table 1.There

Photo by Janna Beckerman

Figure 3. *Covering plants especially sensitive to salt with burlap or other materials can reduce damage caused by salt spray from roads.*

are simple practices that homeowners can implement when plants are grown in areas that receive heavy salt applications. Keep in mind that plants are highly adaptive and vary in their ability to grow in salty soils.

Plants that tolerate high-salt soils are referred to as "halophytic" or salt loving. These plants naturally occur by ocean coastlines, estuaries, and salt-water marshes. By utilizing more salt-tolerant plants, salt damage may be minimized or avoided. Table 2 lists salt-tolerant plants hardy for Indiana. But remember: severe salt can still damage or kill even salt-tolerant plants — the dose makes the poison!

In those years when large amounts of salt are used, minimize plant damage by irrigating soils to leach out the sodium and chloride prior to spring growth. Since most salts are water-soluble, thorough and repeated applications of water can effectively leach salts out of the root zones

Salt damage can be deadly when excessive or repeated exposure occurs with a salt-sensitive plant. Simple preventative measures can help prevent salt damage or plant death. These measures include avoiding salt-sensitive plants in high-traffic areas, protecting plants (salt sensitive and salt tolerant) with barriers, using sand to de-ice rather than salt, using formulations of salt that don't contain sodium chloride, and irrigating soils deeply if sensitive plants were repeatedly exposed to salt.

Table 1. *De-icing Alternatives*

De-icing Product	Characteristics
Calcium Chloride ($CaCl_2$)	• Melts ice at temperatures to -25°F • Effective to -59°F • If used as recommended, will not harm vegetation • More expensive than than sodium chloride
Calcium Magnesium Acetate (CMA)	• Will work below 0°F • Provides needed nutrients (Ca, Mg) for plants • Low toxicity and biodegradable • Most expensive
Magnesium Chloride ($MgCl_2$)	• Lowest practical temperature: 5°F • Will not harm vegetation, if used as recommended; however, MgCl2, on a percentage basis, contains 17-56% more chloride ion than other "salt"-type deicers • More expensive than sodium chloride
Potassium Chloride (KCl)	• Lowest practical temperature: 12°F • Will not harm vegetation • More expensive than sodium chloride
Sodium Chloride (NaCl)	• Effective to 16°F • Can soften ice at lower temperatures • Inexpensive and effective, but damaging to roadside plants due to sodium and chloride ion toxicity • Least expensive de-icing product
Urea	• Lowest practical temperature: 15°F • Potential harm to vegetation • Could cause nitrogen pollution to ponds and waterways • More expensive than sodium chloride

Source: *Stormwater: The Journal for Surface Water Quality Professionals.*

Table 2. Landscape Plants with Reported Salt Tolerance

When selecting plants for residential, city, or highway plantings, keep salt tolerance in mind. This table provides the reported salt tolerances of selected trees, shrubs, and vines. The tolerances are for resistance to salt spray, soilborne salt, and salt from other sources (including uncommon or rare sources such as naturally saline water and salts from home plumbing).

Choose your plants carefully, and remember that the degree of injury your plants could suffer depends on many variables. Salt tolerance can vary within the same species, so the information provided here is a relative judgment — there are even conflicting reports about many species. Also, data recorded from different climates or soil types may have questionable application in other areas.

Key

T = tolerant
M = intermediate
S = sensitive
— = No information available
* = invasive, not recommended in Indiana

Plant Name	Salt Spray	Soil-Borne Salt	Other Salt Source
Abies balsamea Balsam Fir	M	S	M, S
Abies concolor White Fir	T	—	—
Acer campestre Hedge Maple	T, M	—	—
Acer ginnala Amur Maple	M, S	—	M
Acer negundo Box-elder	M, S	M	M, S
Acer palmatum Japanese Maple	S	—	—
Acer pseudoplatanus Sycamore Maple	T	S	S
Acer rubrum Red Maple	M, S	S	S
**Acer saccharinum* Silver Maple (native invasive, not recommended)	T, M	S	M, S
Acer tataricum Tatarian Maple	S	—	S
Aesculus hippocastanum Horse-Chestnut	T	T	—
Alnus incana Speckled Alder, White Alder	M	S	S
Alnus rugosa Speckled Alder, Hazel Alder	M	—	S
Amelanchier x grandiflora Apple Serviceberry	S	—	—
Amelanchier laevis Allegany Serviceberry	S	—	—
**Berberis* species Barberry	M, S	S	S
Betula alleghaniensis Yellow Birch	—	—	T
Betula davurica Dahurian Birch	—	—	S
Betula lenta Cherry Birch, Sweet Birch	—	—	T

Table 2. Continued

Plant Name	Salt Spray	Soil-Borne Salt	Other Salt Source
Betula nigra River Birch	—	S	—
Betula papyrifera Canoe Birch, Paper Birch	M	—	T, M, S
Betula pendula European White Birch	M	—	—
Betula populifolia Gray Birch	M	—	T
Buxus sempervirens Common Boxwood	—	S	S
Caragana arborescens Siberian Pea-shrub	T	—	T
Carpinus betulus European Hornbeam	S	S	S
Carpinus caroliniana American Hornbeam, Blue Beech	—	—	S
Carya glabra Pignut Hickory	S	T, S	—
Carya ovata Shagbark Hickory	T, M	—	S
Carya species Hickory	—	—	S
Catalpa speciosa Northern or Western Catalpa	M	—	—
Celtis occidentalis Hackberry	S	—	M, S
Cercis canadensis Eastern Redbud	S	—	—
Chaenomeles speciosa Flowering-Quince	M, S	—	—
Chamaecyparis pisifera Sawara False-cypress	S	—	—
Cladrastis lutea American Yellowwood	M	—	—
Cornus alba Tartarian Dogwood	S	—	—
Cornus mas Cornelian-Cherry	S	—	—
Cornus racemosa Gray Dogwood	S	—	—
Cornus sericea (*Cornus stolonifera*) Red Osier Dogwood	S	—	S
Corylus avellana European Filbert	S	S	S
Crataegus crus-galli Cockspur Hawthorn	S	—	S
Crataegus laevigata (*Crataegus oxyacantha*) English Hawthorn	S	—	—

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Table 2. Continued

Plant Name	Salt Spray	Soil-Borne Salt	Other Salt Source
Crataegus species Hawthorn	M, S	M	T
Euonymus europaea European Spindletree	S	—	—
Fagus grandifolia American Beech	M, S	—	S
Fagus sylvatica European Beech	S	S	S
Forsythia x intermedia Showy Border Forsythia	M	—	—
Fraxinus americana White Ash (not recommended due to emerald ash borer)	M	S	T, M
Fraxinus excelsior European Ash (not recommended due to emerald ash borer)	T	—	—
Fraxinus pennsylvanica Green Ash (not recommended due to ash emerald borer)	M	T, M	T, M
Ginkgo biloba Maidenhair Tree	M	—	—
Gleditsia triacanthos Honey-Locust	T, S	T	T
Gymnocladus dioicus Kentucky Coffee Tree	T	—	—
Halimodendron halodendron Salt Tree	T	—	—
Hippophae rhamnoides Sea-buckthorn	T, M	T	T
Juglans nigra Black Walnut	M	S	S
Juglans regia Carpathian Walnut, English Walnut	M	—	—
Juniperus chinensis '*Pfitzerana*' Pfitzer Juniper	—	T	—
Juniperus horizontalis '*Plumosa*' Andorra Juniper	—	T	—
Juniperus species Juniper	T, M	—	—
Juniperus virginiana Eastern Red-cedar	T, M	M	T, M
Kolkwitzia amabilis Beauty Bush	S	—	—
Larix decidua European Larch	T	—	—
Larix species Larch	T	—	S

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Table 2. Continued

Plant Name	Salt Spray	Soil-Borne Salt	Other Salt Source
**Ligustrum* species Privet	M, S	—	—
**Ligustrum vulgare* Common Privet	M, S	S	S
Liriodendron tulipifera Tulip Tree, Yellow-poplar	S	—	—
**Lonicera* species Honeysuckle (some species are invasive and not recommended)	S	—	—
Lycium species Matrimony Vine	T	T	T
Malus baccata Siberian Crabapple	—	—	M
Malus species and cultivars Apple, Crabapple	S	—	M, S
Metasequioa glyptostroboides Dawn Redwood	S	—	—
Parthenocissus quinquefolia Virginia Creeper, Woodbine	T	—	T
Physocarpus opulifolius var. *intermedius* Dwarf Eastern Ninebark	—	—	M, S
Picea abies Norway Spruce	M, S	S	—
Picea glauca White Spruce	T, S	M	M, S
Picea glauca '*Densata*' Black Hills Spruce	—	—	T
Picea pungens Colorado Spruce	—	M, S	—
Picea pungens '*Glauca*' Blue Colorado Spruce	T	—	T, M
Pinus banksiana Jack Pine	T	—	—
Pinus cembra Swiss Stone Pine	S	—	—
Pinus mugo Mugho Pine	T	T	—
Pinus nigra Austrian Pine, Black Pine	T	—	T, M
Pinus ponderosa Ponderosa Pine	—	M	T, M
Pinus resinosa Norway Pine, Red Pine	S	S	S
Pinus strobus Eastern White Pine	S	S	S
Pinus sylvestris Scotch Pine	M, S	—	T, M, S
Pinus thunbergiana (*Pinus thunbergii*) Japanese Black Pine	T	—	—

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Table 2. Continued

Plant Name	Salt Spray	Soil-Borne Salt	Other Salt Source
Platanus x acerifolia London Plane Tree	S	—	—
Platanus occidentalis American Sycamore	S	—	—
Populus canescens Gray Poplar	T	T	T
**Populus deltoides* Eastern Cottonwood (native invasive, not recommended)	T	T, S	T, M, S
Populus grandidentata Bigtooth Aspen	T, M	—	T
Populus laurifolia Laurel Poplar	—	S	S
Populus nigra '*Italica*' Lombary Poplar	T, M	S	T, S
Populus tremuloides Quaking Aspen	T, M	T	T, M, S
Potentilla fruticosa '*Jackmanii*' Jackman Shrubby Cinquefoil	—	—	T
Prunus armeniaca Apricot	—	—	T
Prunus avium Mazzard Cherry	M	—	—
Prunus padus European Bird Cherry	T, M	T	—
Prunus persica Peach	S	—	—
Prunus serotina Black Cherry	S	—	T, S
Prunus serrulata '*Kwanzan*' Kwanzan Flowering Cherry	S	—	—
Prunus virginiana Chokecherry	T, M	—	—
Pseudotsuga menziesii Douglas-fir	M, S	M, S	M, S
Pyracantha coccinea Scarlet Firethorn	S	—	M
Pyrus species Pear	T, M	—	—
Quercus alba White Oak	M, S	T	T
Quercus bicolor Swamp White Oak	S	—	—
Quercus coccinea Scarlet Oak	S	—	—
Quercus macrocarpa Bur Oak	M	T	T, M
Quercus muehlenbergii Chinkapin Oak, Yellow Chestnut Oak	S	—	—
Quercus palustris Pin Oak	S	—	S

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Table 2. Continued

Plant Name	Salt Spray	Soil-Borne Salt	Other Salt Source
Quercus robur English Oak	S	T	T
Quercus rubra Northern Red Oak	M, S	T	T
Quercus velutina Black Oak	—	T	—
Rhus glabra Smooth Sumac	—	—	M
Rhus trilobata Skunkbush, Squawbush	—	T	T
Rhus typhina Staghorn Sumac	T	—	—
Ribes alpinum Alpine Currant	T	—	T
Ribes nigrum Black Currant	T	—	T, M
**Robinia pseudoacacia* Black Locust (native invasive, not recommended)	T	T	T
Rosa canina Dog Brier Rose	S	—	S
Rosa rugosa Rugosa Rose	T, S	—	T
Rosa virginiana Virginian Rose	S	—	—
Salix alba White Willow	T, M, S	—	M
Salix alba '*Tristis*' Golden Weeping Willow	S	T	T
Salix alba '*Vitellina*' Golden Willow	M, S	T, M	T, M
Salix caprea Goat Willow	M	—	M
Salix fragilis Crack Willow	T	T	T
Salix nigra Black Willow	M	—	—
Salix pentandra Laurel Willow	M	—	M
Salix purpurea Purple Osier Willow	—	T, M	T
Salix purpurea '*Nana*' Dwarf Arctic Willow	—	S	S
Sambucus species Elderberry	S	—	—
Shepherdia argentea Buffalo Berry	T, M	—	T
Sophora japonica Japanese Pagoda-tree	S	—	—

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Table 2. Continued

Plant Name	Salt Spray	Soil-Borne Salt	Other Salt Source
Sorbus aucuparia European Mountain-ash	M, S	—	S
Spiraea x bumalda Bumalda Spirea	S	—	M
Spiraea x vanhouttei Vanhoutte Spirea	—	S	T
Symphoricarpos albus Snowberry	T, M	—	T
Symphoricarpos orbiculatus Coralberry	S	—	S
Syringa reticulata (*Syringa amurensis var. japonica*) Japanese Tree Lilac	M	—	—
Syringa vulgaris Common Lilac	M, S	—	M
Tamarix species Tamarisk	T	T	T
Taxus baccata English Yew	S	—	—
Taxus cuspidata Japanese Yew	M, S	—	T
Thuja occidentalis American Aborvitae	M, S	M	T, M
Tilia americana American Linden, Basswood	M	S	S
Tilia cordata Littleleaf Linden	T, S	T, M, S	M, S
Tilia x euchlora Crimean Linden	S	—	—
Tilia platyphyllos Largeleaved Linden	T	—	—
Tsuga canadensis Canada or Eastern Hemlock	S	S	S
Ulmus americana American Elm	M	T, M, S	T, M, S
Ulmus carpinifolia Smoothleaf Elm	M, S	T	—
Ulmus glabra Scotch Elm	T	M	T
Viburnum species Viburnum	S	—	S

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