

THE IMPACT OF DE-ICING SALT ON ROADSIDE VEGETATION

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INTRODUCTION

Vegetation is exposed to salt from a variety of sources. These sources include sea water, salt-laden rain and snow, fertilizers, pesticides, sewage effluent, and de-icing products. In New Jersey, the demand for ice-free roadways and sidewalks has led to an increase in the use of de-icing salts. Runoff from treated pavement contains dissolved salts that can injure adjacent vegetation. In plants sensitive to excessive salt, affected foliage may appear "scorched" and drop prematurely. In severe cases, the death of twigs, branches, and sometimes the entire plant, may occur.

DEICING SALTS AND THEIR USES

Deicing salts make roadways, driveways, and sidewalks safer by melting snow and ice. In the Northeast, up to 1/2 inch of salt is applied to road surfaces each year. During the 1980s, de-icing salt was applied annually on the New Jersey Turnpike and the Garden State Parkway at the rate of 400 lbs per mile. De-icing salts are usually applied during snow storms before the snow can accumulate. These salts dissolve in water to form a brine that possesses a freezing point much lower than water. The brine melts ice and helps to prevent the formation of more ice as temperatures drop.

The two most commonly applied deicing salts are sodium chloride and calcium chloride. Although calcium chloride is a better material for melting ice, sodium chloride (rock salt) is used most widely because it is relatively inexpensive and is easier to handle. To improve traction, de-icing salts are usually mixed with abrasives. These abrasives, which include sand, cinders, gravel, and sawdust, can accumulate along roadways and cause drainage problems.

HOW SALT AFFECTS VEGETATION

Plants become injured by salt when roots and foliage come into contact with salt-laden water. Salted water percolates down through the soil and comes into contact with soil particles, soil microbes, and plant roots. Salt injures vegetation in four ways:

- Salt increases water stress. Salt accumulates on the surface of affected plant tissue. In the root zone, water molecules are held very tightly by salt ions. Roots must expend considerable energy to absorb water from a salt solution. Although sufficient water may be present in the soil, the plant may have difficulty absorbing it and a condition known as "physiological drought" occurs. In sensitive species, this may result in depressed growth and yield.
- Salt affects soil quality. The sodium ion component in salt becomes attached to soil particles and displaces soil elements such as potassium and phosphorus. As a result, soil density and compaction increases and drainage and aeration are reduced. Plant growth and vigor are poor under these conditions.
- Salt affects mineral nutrition. When the concentration of both the sodium and chloride components of salt in the root zone is excessive, plants preferentially absorb these ions instead of nutrients such as potassium and phosphorus. When this occurs, plants may suffer from potassium and phosphorus deficiency.

- Salt accumulates within plants. The chloride component of salt is absorbed by roots and foliage. Although this ion can accumulate in any plant part,

it is usually concentrated in actively growing tissue. Plants repeatedly exposed to salt over long periods of time may accumulate chloride ions to toxic levels, resulting in leaf burn and twig die-back. The injury a plant sustains increases with an increase in foliar chloride levels. Foliage in direct contact with road salt sprayed by tires and wind becomes desiccated and may appear “burned.”

Unlike animals, plants do not have mechanisms to excrete excess salt from tissues and can only “shed” salt in dead leaves and needles. Because conifers do not shed leaves on a yearly basis, they tend to suffer damage from accumulated salt more easily than do deciduous trees.

HOW PLANTS RESPOND TO EXCESSIVE SALT

Plant species vary in their tolerance to salt exposure (Table 1). Plants that are tolerant of salt grow as well in saline soils (soils high in salt) as they do under normal conditions. Salt tolerance is directly related to the concentration of chloride ions in the foliage. Many herbaceous plants such as grasses adapt fairly readily to high salt levels. Among woody plants, tolerance varies with the species. Plant species with waxy foliage are generally more tolerant of salt spray.

In salt-sensitive plants, exposure to salt often results in an unthrifty appearance and poor growth. Other symptoms of salt injury include stunted leaves, heavy seed loads, twig and branch die-back, leaf scorch, and premature leaf drop. In addition, plants stressed by excessive salt concentrations are more susceptible to biotic diseases and insect pests. The extent of injury a plant sustains in response to salt depends on:

- **The kind and amount of salt applied.** Although sodium chloride (rock salt) is less expensive and easier to handle than calcium chloride, it is also more damaging to vegetation.
- **The volume of fresh water applied.** In well-drained soils, salt is easily leached by water low in salt. Salts tend to accumulate, however, in poorly-drained soils, so the potential for damage to vegetation in these soils is high. High volumes of water, whether from rainfall or melting snow, will decrease the possibility of injury. Rainfall also washes salt from foliage surfaces.
- **The distance plants are situated from treated pavements.** Plants within the “spray zone” of moving vehicles are more likely to sustain salt injury. Injury is usually most evident on the side of the plant that faces the highway.
- **The direction of surface-water flow.** The channeling of drainage water away from susceptible plants will prevent salt from coming into contact with plant roots. If plants are situated up-slope or away from drainage areas, they are less likely to be affected.
- **The time of year salt is applied.** Salt applied in late winter and early spring is more likely to damage vegetation than is salt applied in early- to mid-winter. This is because there is less time for winter snow and precipitation to leach salt from the root zone before growth resumes in the spring. The depth and duration of soil freezing is also

important. Dormant trees continue to absorb water and nutrients in unfrozen soils. Salted water can percolate through frozen soils, reaching active plant roots in unfrozen soil horizons.

MINIMIZING SALT INJURY

The best solution to the de-icing salt problem is to prevent contamination. Homeowners can use abrasives instead of salt when treating driveways and walkways. If vegetation is located in areas where salt spray occurs, barriers or screens can be erected to protect plants during the winter months. Antidesiccants may also help prevent injury when applied to evergreen foliage along the coast or where de-icing salt will be used. County, state, and municipal officials can help prevent salt injury by carefully training equipment operators and frequently calibrating equipment.

Once soil becomes contaminated with salt, damage can be reduced by leaching the salt with fresh water as soon as possible after exposure. Under certain circumstances, incorporation of gypsum at the rate of 50 lb./1 000 sq. ft. into the top six inches of soil at the drip-line of trees may also be helpful. Furthermore, foliage exposed to salt spray may be washed with salt-free water to remove deposited salt.

When landscaping, place trees and shrubs that are sensitive to salt as far as possible from problem areas. Select planting sites that are not subject to salt-contaminated waters, and place shallow diversion ditches between roadways and plantings. When vegetation must be placed near roadways, utilize salt-tolerant plants.

Table 1. Salt tolerance of common woody landscape plants.

SHRUBS

Tolerant	Sensitive
Autumn elaeagnus (<i>Elaeagnus umbellata</i>)	Japanese barberry (<i>Berberis thunbergii</i>)
bayberry (<i>Myrica</i> spp.)	boxwood (<i>Buxus</i> spp.)
honeysuckle (<i>Lonicera</i> spp.)	winged euonymus (<i>Euonymus alata</i>)
Pfitzer juniper (<i>Juniperus chinensis</i>	multiflora rose (<i>Rosa multiflora</i>)
‘Pfitzerana’)	Van houtte spirea (<i>Spiraea x vanhouttei</i>)
California privet (<i>Ligustrum ovalifolium</i>)	viburnum (<i>Viburnum</i> spp.)
rugosa rose (<i>Rosa rugosa</i>)	
yucca (<i>Yucca filamentosa</i>)	

DECIDUOUS TREES

Tolerant	Sensitive
green ash (<i>Fraxinus pennsylvanicum</i>)	beech (<i>Fagus</i> spp.)
boxelder (<i>Acer negundo</i>)	flowering dogwood (<i>Cornus</i> spp.)
black cherry (<i>Prunus serotina</i>)	shagbark hickory (<i>Carya ovata</i>)
Siberian elm (<i>Ulmus pumilla</i>)	ironwood (<i>Carpinus</i> spp.)
honeylocust (<i>Gleditsia triacanthos</i>)	American linden (<i>Tilia americana</i>)
black locust (<i>Robinia pseudoacacia</i>)	little-leaf linden (<i>Tilia cordata</i>)
bur oak (<i>Quercus macrocarpa</i>)	red maple (<i>Acer rubrum</i>)
English oak (<i>Quercus robur</i>)	silver maple (<i>Acer saccharinum</i>)
red oak (<i>Quercus rubra</i>)	sugar maple (<i>Acer saccharum</i>)
white oak (<i>Quercus alba</i>)	sycamore (<i>Platanus</i> spp.)
Russian olive (<i>Elaeagnus angustifolia</i>)	black walnut (<i>Juglans nigra</i>)
white poplar (<i>Populus alba</i>)	

weeping willow (*Salix babylonica*)

EVERGREENS

Tolerant

red cedar (*Juniperus virginiana*)
Austrian pine (*Pinus nigra*)
Japanese black pine (*Pinus thunbergiana*)
pitch pine (*Pinus rigida*)
white spruce (*Picea glauca*)
yew (*Taxus* spp.)

Sensitive

balsam fir (*Abies balsamea*)
Douglas-fir (*Pseudotsuga menziesii*)
Canadian hemlock (*Tsuga canadensis*)
eastern white pine (*Pinus strobus*)
red pine (*Pinus resinosa*)

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