Minimizing De-Icing Salt Injury to Trees

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More than 200,000 tons of de-icing salt are applied to state and municipal roads in Minnesota each winter. Some years, as much as 300,000 tons have been applied. De-icing salts (primarily sodium chloride) are helpful in providing dry, safe pavement for high-speed traffic. They are also used in large quantities within our urban areas to improve safety on streets, driveways, parking lots, and sidewalks. Despite the benefits, the extensive use of salt causes widespread damage. De-icing salt has caused the disfiguration of trees and shrubs along highways, and may have contributed to the decline and death of many city shade trees.

Injury occurs when salt is deposited by spray or drift on dormant stems and buds of deciduous woody plants, and on the stems, buds, and needles of evergreens. Injury may also occur when excessive amounts of salt accumulate in the root zone of these plants.

Both spray salt and soil salt can cause stem and foliage disfigurement, reduce growth, and even cause death.

Spray-salt damage is most evident along heavily traveled highways where high speed and high volume truck traffic have deposited salt spray on adjacent plants **(cover photo)**. Damage is most severe within 60 feet of the road, although it can sometimes extend much farther (e.g., spray deposited on elevated highways).

Another source of plant injury occurs gradually, due to the buildup of high salt levels in the soil. This buildup occurs along city streets, driveways, and sidewalks when salt runoff washes into the soil and when salt is plowed and shoveled onto boulevards and lawns.

Toxic quantities of sodium and chloride can damage plants:

(1) by direct absorption into the roots, and

(2) by contributing to the deterioration of soil structure, thereby impeding soil drainage and root growth.

Overmaturity and drought can intensify the problem of high salt levels. For example, prolonged drought interacts with soil salt to increase damage to trees. Also, as trees age they lose their ability to tolerate soil- and salt-related stresses.

Control of infectious diseases is complicated by high salt levels in the soil. For example, the Dutch elm disease epidemic forced the removal of many elms along streets and boulevards. The young replacement trees were subjected to accumulated salt in their planting holes as well as the dangers of additional salt spray.

Salt-related damage to city and highway trees is costly; injury means increased maintenance expenses for pruning, fertilizing, and other extra care, as well as the expense of replacing removed trees.

Symptoms of Salt Injury*

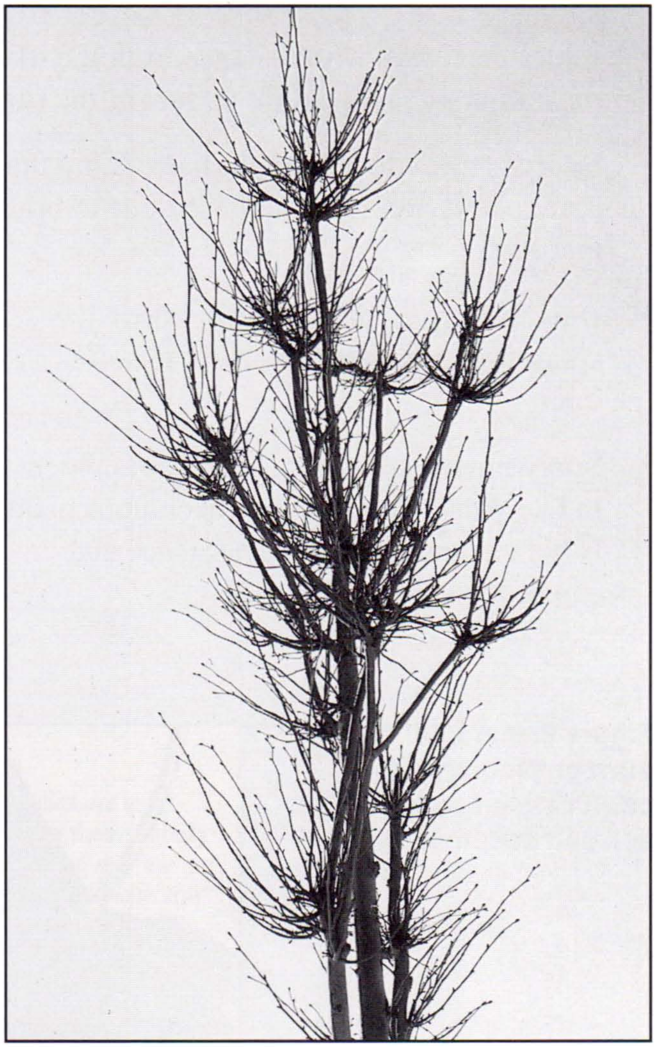
Salt spray commonly causes bud death and twig dieback in deciduous plants. Subsequent shoot growth results in the development of "witches'-brooms" (tuft-like growths) from the basal section of branches facing the road **(figure 1)**. The symptoms become evident when growth resumes in the spring. In addition, salt-damaged deciduous trees and shrubs leaf out later in the spring.

On conifers such as pines, spruces, and firs, salt spray causes moderate to extreme needle browning, beginning at the tips of needles and twigs facing the road. Browning usually is first evident in late February or early March and becomes more extensive through spring and summer.

Soil salt damage to deciduous species often becomes evident late in the summer following the growing season in which the salt damage occurred, or during periods of hot, dry weather. However, many years of high soil salt accumulation may pass before injury becomes apparent. The symptoms initially include an abnormal foliage color, needle tipburn, and marginal leaf burn progressing toward the mid-vein of affected leaves **(figure 2)**. Progressive symptoms may include a reduction in leaf, flower, and fruit size; premature fall coloration and defoliation; stunting; and a general decline in health.

**The symptoms of salt injury are similar to injury caused by other stresses. When in doubt, suspected salt injury can be verified with soil and tissue analysis, as well as observation of the planting site location where the damage occurred.*

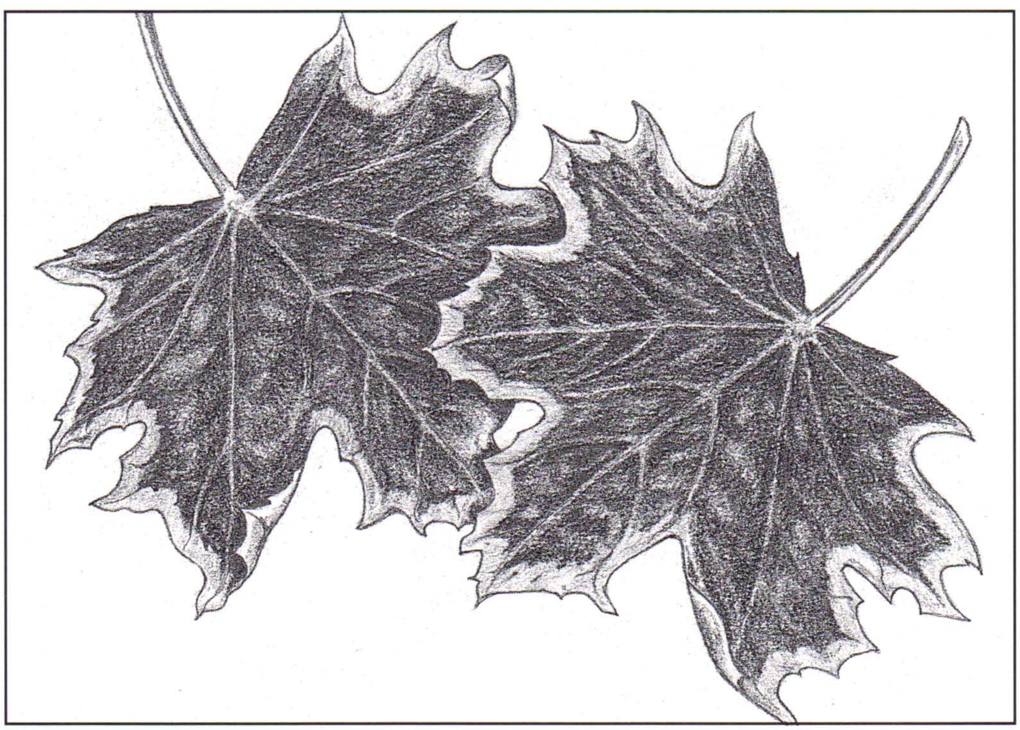
Figure 1. "Witches'-brooms" is a common condition along roads because of spray salt injury.



Salt Injury Patterns for Metro Areas

- Damage increases as traffic increases from 10,000 to above 80,000 vehicles per day (ADT: average daily traffic).
- Injury decreases with distance from the road; most injury occurs within 60 feet of the road.
- Injury is more severe on the side facing the road; plants are often one-sided due to branch dieback.
- Branches covered by snow or above the spray-drift zone are less likely to suffer injury.
- Spray injury to conifers becomes apparent in late winter, but injury to deciduous plants is not evident until leaf emergence and expansion.
- Salt spray penetrates only a short distance into dense plants. Plants in sheltered locations generally lack injury symptoms.
- Plants that are less winter-hardy may be injured more severely.
- Plants at street intersections, at the foot of a hill, near major drainages from the street, or on poorly drained soils are injured more severely.
- Plants damaged over several years can lose vitality and decline; these plants are subsequently more vulnerable to secondary diseases and insect damage.

Figure 2. Marginal leaf burn or "scorching" is often caused by high soil salt accumulation.



Common Street and Landscape Trees

Column headings designate tolerance to *spray salt* damage.
The symbol after the name of the plant indicates its tolerance to *soil salt.*

S=sensitive, I=intermediate, T=tolerant

Tolerance to Spray Salt

Sensitive	Intermediate	Tolerant
Abies balsamea (I) **Balsam Fir**	Acer ginnala (I) **Amur Maple**	*Acer platanoides (T) **Norway Maple**
Acer negundo (I) **Boxelder**	Acer saccharinum (S) **Silver Maple**	*Aesculus glabra (T) **Ohio Buckeye**
Acer rubrum (I) **Red Maple**	*Betula spp. (I) **Birch**	Aesculus hippocastanum (T) **Horse Chestnut**
Acer saccharum (S) **Sugar Maple**	Catalpa speciosa (I) **Northern Catalpa**	Amelanchier spp. (S) **Serviceberry**
Betula nigra (I) **River Birch**	Fraxinus pennsylvanica (I) **Green Ash**	Elaeagnus angustifolia (T) **Russian Olive**
Carpinus caroliniana (S) **Blue Beech**	Juniperus spp. (I) **Juniper**	Fraxinus americana (T) **White Ash**
Celtis occidentalis (I) **Hackberry**	Pinus nigra (T) **Austrian Pine**	*Ginkgo biloba (T) **Ginkgo**
Crataegus spp. (S) **Hawthorne**	Pinus ponderosa (I) **Ponderosa Pine**	Gleditsia triacanthos (T) **Honey Locust**
Juglans nigra (T) **Black Walnut**	Populus deltoides (I) **Cottonwood**	Larix decidua (S) **European Larch**
Juniperus virginiana (I) **Eastern Redcedar**	Pseudotsuga menziesii (S) **Douglas Fir**	Picea glauca densata (T) **Black Hills Spruce**
Malus spp. (I) **Crabapple**	Pyrus spp. (I) **Pear**	Picea pungens (S)) **Colorado Spruce**
*Ostrya virginiana (S) **Ironwood**	Ulmus americana (I) **American Elm**	Pinus banksiana (T) **Jack Pine**
Picea abies (S) **Norway Spruce**		Populus alba (T) **White Poplar**
Picea glauca (I) **White Spruce**		Robinia pseudoacacia (T) **Black Locust**
Pinus resinosa (S) **Norway Pine**		Salix alba tristis (I) **Golden Weeping Willow**
Pinus strobus (S) **White Pine**		Sorbus spp. (S) **Mountain Ash**
Pinus sylvestris (I) **Scots Pine**		*Syringa reticulata (T) **Japanese Tree Lilac**
Prunus serotina (T) **Black Cherry**		
Quercus alba (T) **White Oak**		
Quercus macrocarpa (I) **Bur Oak**		
Quercus palustris (S) **Eastern Pin Oak**		
Quercus rubra (T) **Northern Red Oak**		
Taxus spp. (S) **Yew**		
Thuja occidentalis (I) **American Arborvitae**		
Tilia americana (S) **American Linden**		
Tilia cordata (S) **Littleleaf Linden**		
Tsuga canadensis (S) **Canada Hemlock**		
Populus tremuloides (I) **Quaking Aspen**		

Salt-Tolerant Species

Although salt-tolerant species are available, there are relatively few of them. If only tolerant species are planted, there are few opportunities to match tree species with soil characteristics, and the risks of a single disease or insect pest destroying a high proportion of the trees are increased. No species is completely tolerant of salt injury; even salt-tolerant trees have limits on the amount of salt they can accept before they weaken and become vulnerable to other problems.

This table lists trees commonly used on streets and landscapes in Minnesota. Plants listed as intermediate or tolerant are recommended for areas where spray salt is common. Note that a species that tolerates spray salt will not necessarily tolerate soil salt.

** Species marked with an asterisk show serious inconsistencies because the evaluations are based on a single parameter and insufficient data.*

Minimizing Salt Injury

Use the following guidelines to minimize or possibly eliminate salt damage to trees and shrubs in urban areas.

- Avoid de-icing salt completely, or reduce quantities applied by prewetting the salt with a liquid such as salt brine or by mixing the salt with abrasives such as sand, cinders, and ash. Limit applications to high-risk locations such as high-speed roads, intersections, hills, steps, and walkways. Use alternative de-icing salts such as calcium chloride and calcium magnesium acetate (CMA).
- Improve the structure and drainage of poorly drained soils.
- Reduce sodium. Add organic matter, activated charcoal, or gypsum, and thoroughly leach the soil.
- Protect susceptible plants; construct a physical barrier made of plastic, burlap, or snow fencing **(figure 3)**. Place the barrier between the pavement and the plants.
- Avoid high risk sites; plant trees and shrubs away from the spray drift zone and areas where salt-laden snow will be deposited.
- Maintain plants in a healthy condition. Provide adequate irrigation and mulching to reduce water loss. Prune, add fertilizers to correct nutrient deficiencies, and control damaging diseases and pest infestations.
- Use plants sufficiently tolerant of the expected exposure to salt. This is the only successful technique in high-salt locations.

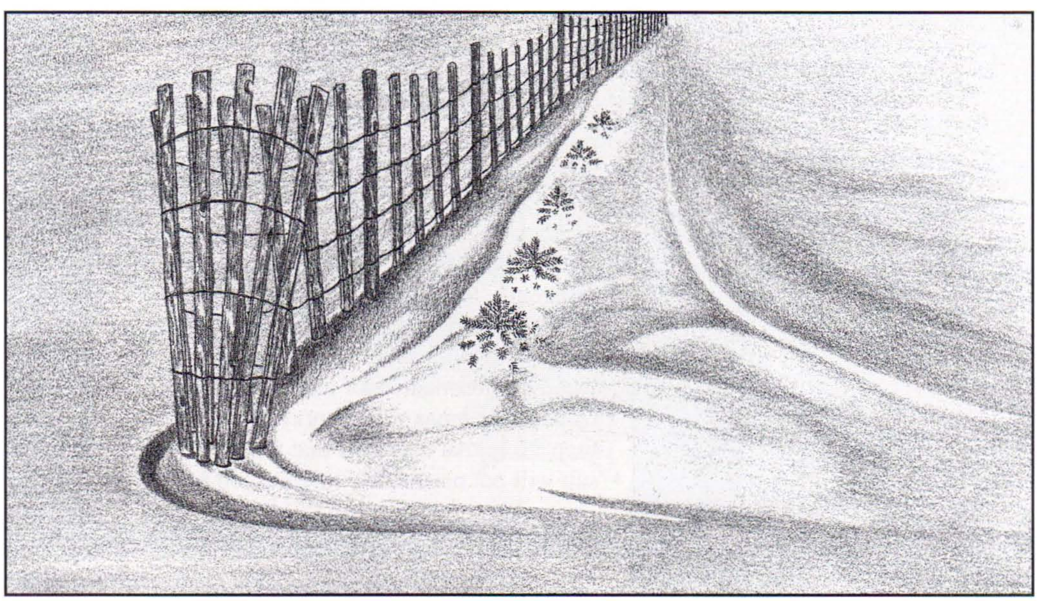


Figure 3. A simple snow fence can provide effective protection for susceptible plants.

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