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DE-ICING SALTS: DAMAGE TO WOODY ORNAMENTALS

De-icing salts used to maintain ice-free roadways, driveways, and sidewalks can damage woody ornamental trees and shrubs in several ways. Although there has been increasing concern about the environmental impact and adverse effects of de-icing salts in recent years, these issues have been overshadowed by concerns for public safety. As much as 40-80 tons of salt per lane mile are applied to many highways for ice and snow control each year. The two most commonly applied de-icing salts are sodium chloride (rock salt) and calcium chloride. Although calcium chloride is a better material for melting ice, sodium chloride is used most extensively since it is less expensive and easier to handle. Unfortunately, sodium chloride is also more damaging to vegetation than calcium chloride. Most roads in Connecticut are now being treated with both types of salts: sodium chloride in solid and liquid form, and liquid calcium chloride.

Salt can injure plants at any time but applications in late winter (March) are thought to be more damaging than early-to mid-winter applications, since there is less time for winter snow and precipitation to leach the salts from the root zones.

SALT DAMAGE AND SYMPTOMS:

De-icing salts cause damage through direct contact of salt solutions with plant foliage (referred to as "spray zone" injury) (Figures 1 and 2) and through chemical and physical modification of the soil as a result of accumulating salt and uptake of salt ions by plant roots.

Spray zone injury results from the deposition of salt water on plant foliage and subsequent uptake of the salt by that foliage. Salt enters plant cells or the spaces between plant cells directly and can affect the hardiness of buds and small twigs.

Figure 1. Spray zone injury on conifers along a Connecticut highway. (Photo J. S. Ward, CAES)

Figure 2. Spray zone injury on white pine. (Photo J. S. Ward, CAES)

In the soil, dissolved salts separate into sodium and chloride ions which chemically, and to a certain extent physically, modify the soil. For example, the structure of the soil is altered when levels of sodium accumulate and cause clay particles to pack more densely. The chloride ions are readily taken up by the plant roots and transported to growing tips and foliage where they accumulate to toxic levels. In needles and leaves, these toxic accumulations result in marginal scorch or "burn" symptoms (Figure 3). The sodium ions also cause damage by competing with other ions in the soil. When high levels of sodium ions compete with lower levels of magnesium and potassium ions, it often results in selective uptake of sodium at the expense of the other two important nutrients. When this occurs, plants may develop deficiency symptoms, particularly those associated with potassium deficiency.

Symptoms of de-icing salt injury resemble those associated with root damage or drought stress. They vary with salt concentration, length of exposure, and plant species. Common symptoms include foliar browning, tip necrosis, marginal scorch, leaf/needle drop, tip and branch dieback, stunting, premature fall coloration (on deciduous species), death of vegetative and flower buds, and in extreme situations, outright tree death. One diagnostic feature of salt injury is that "spray zone" symptoms are often confined to the side of the tree or shrub facing the road and usually occur within 30-50 ft. of the road. Additionally, a gradient of damage can often be seen with trees or shrubs closer to the road showing more damage than those farther back.

Figure 3. Sugar maple with marginal scorch or "burn" associated with salt uptake.

Woody ornamentals show considerable variation in their relative tolerance to de-icing salts. However, research has demonstrated that trees and shrubs that have been weakened by drought-stress are more sensitive to de-icing salts than their healthy counterparts. Among those with high tolerance are Norway maple, autumn olive, white ash, white oak, honeylocust, Japanese black pine, white spruce, and yew. Moderately tolerant species include black cherry, green ash, American elm, Scots pine, and red cedar. Salt-sensitive species include winged euonymus, viburnum, sugar maple, dogwood, little-leaf linden, sycamore, eastern white pine, balsam fir and Canadian hemlock. More extensive lists are available upon request.

STRATEGIES TO MINIMIZE PROBLEMS WITH DE-ICING SALTS:

Although ***preventing*** problems with de-icing salts is certainly the best solution, it is not always practical or possible. However, the damage associated with de-icing salts can be managed or minimized using a number of different strategies. These include:

- **Washing salts off foliage**- Excess salts can be washed off foliage with fresh water and should be done as soon after exposure as possible.
- **Minimizing snow piles**- Avoid piling snow containing salt around plants or in places where the runoff will affect desirable plants. It is also helpful to alter road or walkway drainage patterns away from desirable plant species.
- **Removing sand**- With the recent movement towards using salt brines and salts in liquid and solid forms, this is not as common a problem. However, in areas where sand and salt combinations are still being used, buildup of sand can sometimes present additional problems. Sweeping, "brooming," or any other method that physically removes sand that has accumulated on the soil surface can be helpful. Since the type of sand applied to roads is extremely sharp, it is not a desirable addition to native soil. Thick layers of sand can also inhibit gas exchange and water penetration into the root zones of desirable plants.
- **Leaching salts-** To whatever extent possible, salts should be leached from the root zones of affected plants as soon as the ground is no longer frozen. *This is probably the most effective way to minimize soil salinity problems.* Repeated applications of fresh water will help to flush the salts down into the soil profile, below the root zones. The volume of water required to leach the salts will depend on the amount of salt in the soil. Leaching of excess salts can however, be difficult in heavy clay soils, which naturally don't have good internal drainage.
- **Amending soil**- Additives to the soil such as organic matter, activated charcoal, and gypsum can help with rectifying soil salinity problems. However, these are not quick fixes and if the salinity levels are extremely high, no amendments will reverse the situation. All additives, regardless of the material used, need to be incorporated into the soil, usually to a depth of at least 6 inches. This need to incorporate the amendment is one of the limiting factors in using soil additives to mediate road salt problems. Although a few reports suggest surface applications can be helpful (particularly for gypsum), the general consensus maintains that the additives need to be fully incorporated into the soil in order to be effective. Since plants growing in soils rich in organic matter show increased tolerance to salt, a program to increase organic matter in areas prone to road salt is a good preventative plan. Gypsum ($CaSO_4 \cdot 2H_2O$) is the most common additive used to counter salinity problems associated with sodium chloride, the most common de-icing salt. Gypsum separates into calcium and sulfate in the soil. The sulfate forms sulfuric acid in the soil and helps to neutralize any effect that calcium may have in raising the soil pH. The calcium replaces the sodium on the cation exchange sites. The sodium and sulfate form sodium sulfate ($NaSO_4$) which is a product that can be leached from the soil with water. Rates for gypsum applications depend on the salinity of the soil. However, rates in the range from

10-50 lbs. per 100 sq. ft. are commonly suggested.

- **Determining salt levels**- If concerned about the level of salt with which you're dealing, a soil test can help. Soil salinity is determined by measuring the electrical conductivity of the soil solution. This can be done with soil samples taken from the root zones of the areas in question. Testing for soluble salts is not part of the normal soil test performed by The Connecticut Agricultural Experiment Station. However, soluble salt levels can be tested *when requested at the time the soil sample is submitted for analysis.*
- **Selecting plants**- In areas where de-icing salt is likely to be a recurring, chronic problem, it is important to select and plant salt-tolerant species.
- **Maintaining plant vigor**- Maintain overall plant vigor by following sound cultural practices, which include watering during periods of drought, and pruning of dead or weakened branches or twigs in order to minimize problems with secondary or opportunistic pests.

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