Technical Note #56 from Watershed Protection Techniques. 1(4): 221-223

Choosing Appropriate Vegetation for Salt-Impacted Roadways

Many communities rely on the use of grassed swales or biofilters to filter out pollutants in road runoff. The performance of these vegetative practices along roadsides depends to a great degree on the vigor and density of the floral cover. Two recent studies in Minnesota and Ontario have found that winter use of road salt can exert a significant impact on roadside vegetative communities. Since most locations still rely on road salt as a primary deicing agent, designers need to consider the selection of salt-tolerant roadside vegetation.

In the Minnesota study, Biesboer and Jacobson (1994) studied the role of road salt in limiting germination in six warm season grasses and surveyed roadside soil salt concentrations during a one-year period. Salt levels were measured at prescribed intervals from roadsides. Soil chloride concentrations were highest in the winter (October-May), reaching 22,000 ppm and fell below 2,500 ppm in the summer and early fall after spring rains flushed away accumulated salts. Areas within six feet of busy roads were either largely devoid of vegetation or the originally planted grasses were replaced by undesirable, weedy non-grass species. This pattern was attributed to several factors, including salt accumulation in roadside soils due to winter salting operations.

Biesboer and Jacobson found that salt concentrations were highest within the first three feet from the road and then rapidly declined within 30 feet. They concluded that most warm and cool season grasses could germinate and grow beyond 10 feet from a road without experiencing salt stress. Planting grasses within 10 feet of a road requires careful selection for salt tolerance. In particular, warm season grasses such as blue grama *(Bouteloua gracilis)* and buffalo grass *(Buchloe dactyloides)* are attractive choices due to their ability to withstand high salinities.

Table 1: Characteristics of Native Minnesota Grass Species That Make Them Desirable for Roadside Use (Biesboer and Jacobson, 1994)

- Germination of seedlings or an initial flush of growth from overwintering plants typically occurs in late May-June, after roadside salt accumulations and debris have been flushed from soils by spring rains
- Deep root systems enable them to reduce soil erosion and possibly draw water from the road bed
- Generally short structures may reduce or eliminate the need for mowing.

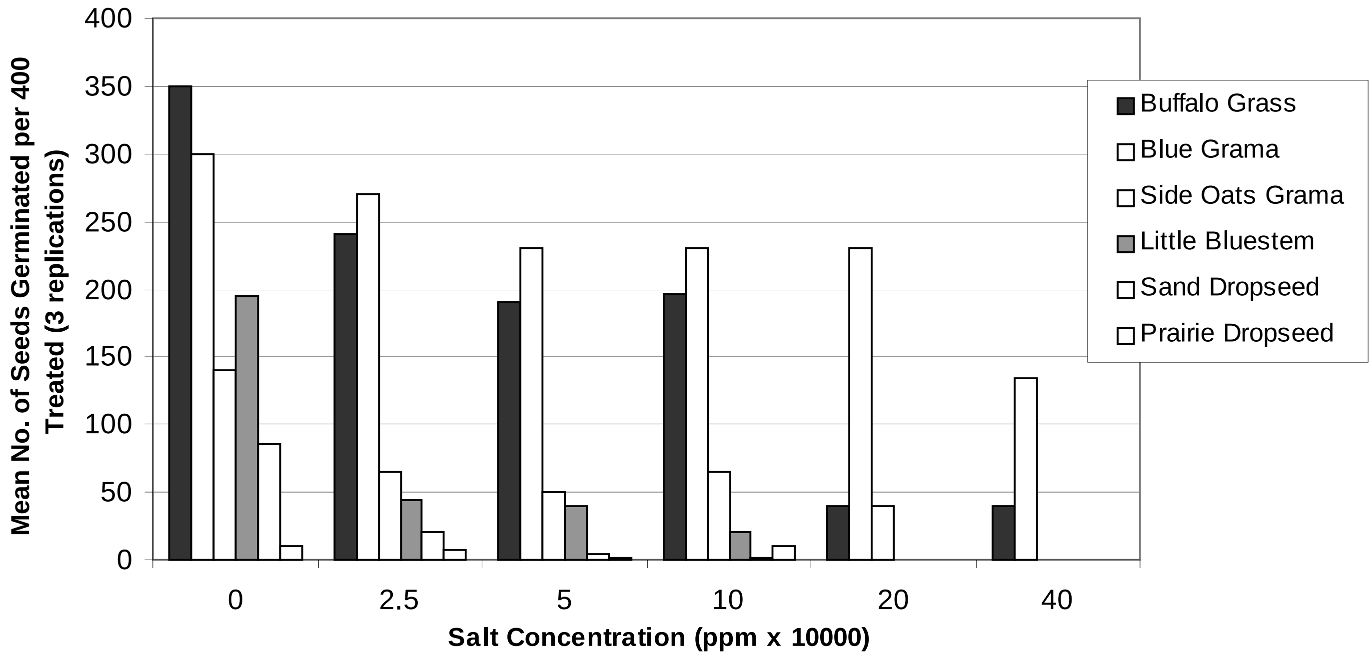
Traditionally, most road designers used cool season grass species along Minnesota roadways. Native warm season grasses, however, have several characteristics making them more attractive options for on-site planting (Table 1). Most importantly, warm season grasses typically germinate in early summer, well after spring rains reduce soil chloride concentrations. Biesboer and Jacobson investigated the salt tolerance of six native warm season grass species, based on their ability to germinate after being surface sterilized and exposed to various salinities (Figure 1). It was discovered that all germination was reduced when seeds were exposed to salt concentrations greater than 2,500 mg/l. Salt concentrations rarely approach this level in early summer, when warm season grasses typically germinate. Consequently, the authors concluded that most of the warm season species could germinate in roadside soils along Minnesota roads. Indeed, some species (blue grama and buffalo grass) exhibited particularly high salinity tolerances.

Two roadside sites were selected in 1993 to field test the survival of warm season grass species. Interestingly, while blue grama was planted, buffalo grass was not among those species included in the field study. Preliminary field data are still being collected and will be useful in evaluating several species' tolerances of road salt.

Germination of wetland plants can also be affected by roadside salt concentrations. Isabelle and his colleagues (1987) demonstrated that roadside snowmelt can alter both the species composition and biomass of wetland vegetation. Snow treated with salt was collected from Ontario roadsites. Scientists then sowed seeds of five wetland plant species in greenhouse plots and exposed them daily to snowmelt/tapwater mixtures containing 0, 20, and 100% snowmelt. Seedlings were harvested one month later.

The study found that the number of germinating seeds was inversely proportional to snowmelt salt

Figure 1: Salt Concentration vs. Germination



concentration and only two undesirable species, purple loosestrife *(Lythrum salicaria)* and common cattail *(Typha latifolia)*, germinated when exposed to undiluted snowmelt (Table 2). This finding may explain why these two species often become dominant in urban wetlands in northern states. Overall, it was found that species diversity, evenness, and richness in the greenhouse plots decreased significantly with increased snowmelt concentration. Total biomass also declined. This information underscores the importance of excluding road salt from sensitive environments.

In addition to those evaluated by Biesboer and Jacobson, grass species that may be studied for roadside application in Midwestern areas include: inland saltgrass *(Distichlis stricta)* for alkaline soils that are poorly drained; plains lovegrass *(Eragrostis intermedia)*; James' galetta *(Hilaria jamesii)*; and alkali sacaton *(Sporobolis airoides)*. Other non-grass species should also be evaluated. In a study of plant succession and viability, Wilcox and Andrus (1987) showed that secondary *Sphagnum* succession in a road salt-impacted Indiana bog was dominated by a single species *(S. fimbriatum)* as chloride concentrations surpassed 300 mg/l. The study also illustrated the great sensitivity of *S. fimbriatum* to chloride compared with other salts (Table 3). Although grasses are generally more salt-tolerant than trees, there are several tree species that can withstand relatively high salinities (Table 4). This information may be helpful to practitioners in the selection of deicing agents. For regions outside the Midwest ecoregion, the tolerance of other desirable native species should be investigated.

The studies have important implications for the design of swales, filters and wetlands along roadways. The extensive use of road salt can reduce the biomass, diversity, or density of roadside vegetation communities. Consequently, steps should be taken to protect these resources from the impacts of salt. Plant species able to withstand the physiological stress imposed by road salts should be selected for areas where such stress is expected. Similarly, existing plant communities need to be assessed before adjacent roads are treated by deicing agents. This approach and the plants' natural filtering abilities will help to ensure that impervious area-associated pollutants are kept away from sensitive environments.

—RLO

Table 2: Number of Seeds (Mean and Standard Deviation) of Each Species Germinating When Exposed to Different Snowmelt Concentrations (Isabelle *et al.*, 1987)

	Snowmelt concentration (%)		
Species	0	20	100
Aster umbellatus	5.8 (4.1)	2.0 (5.0)	0
Dulichium arundinaceum	11.6 (2.7)	3.4 (2.3)	0
Scirpus cyperinus	14.2 (4.1)	10.2 (4.5)	0
Typha latifolia	13.2 (4.8)	7.2 (3.9)	1.0 (0.7)
Lythrum salicaria	30.0 (4.6)	19.2 (2.3)	9.0 (5.1)

Table 3: Changes in Length and Biomass of *Sphagnum fimbriatum* by Type of Salt (Wilcox and Andrus, 1987)

Salt*	$CaSO_4$	Control	Na_2O_4	$CaCl_2$	NaCl
Mean increase in length (cm)	2.61	2.60	1.90	0.52	0.40
Mean increase in biomass (%)	499.1	337.1	207.3	88.7	42.4

* Concentrations are equimolar to 1,500 mg/L Cl^- treatment (42.3 mM Na^+, 42.3 mM Cl^-, 21.1 mM Ca^{2+}, 21.1 mM SO_4^{2-}).

Table 4: Tree and Shrub Species Which Show High Tolerance to Road Salt (MDOT, 1993)

Deciduous Plants		Evergreen Plants
Ash, European	Mountain ash, Showy	Adam's Needle
Ash, White	Mulberry, Red	Juniper, Creeping
Aspen, Quaking	Oak, English	Juniper, Eastern Redcedar
Bald cypress	Oak, White	Juniper, Pfitzer
Birch, Gray	Poplar, Bigtooth Aspen	Juniper, Rocky Mountain
Birch, Paper	Poplar, Cottonwood	Pine, Austrian
Buckthorn, Common	Poplar, Lombardy	Pine, Jack
Butternut	Poplar, Quaking Aspen	Spruce, Colorado
Elm, Siberian	Poplar, White or Silver	Spruce, Blue Colorado
Honeylocust, Thornless	Privet	
Honeysuckle	Russian-olive	
Horsechestnut, Common	Staghorn Sumac	
Larch, European	Tree of Heaven	
Lilac, Peking	Walnut, Black	
Locust, Black	Willow, Black	
Maple, Hedge	Willow, Corkscrew	
Maple, Norway	Willow, Pussy	
Maple, Silver		

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