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Soil Salinity and Salt Tolerance of Horticultural Landscape Plants

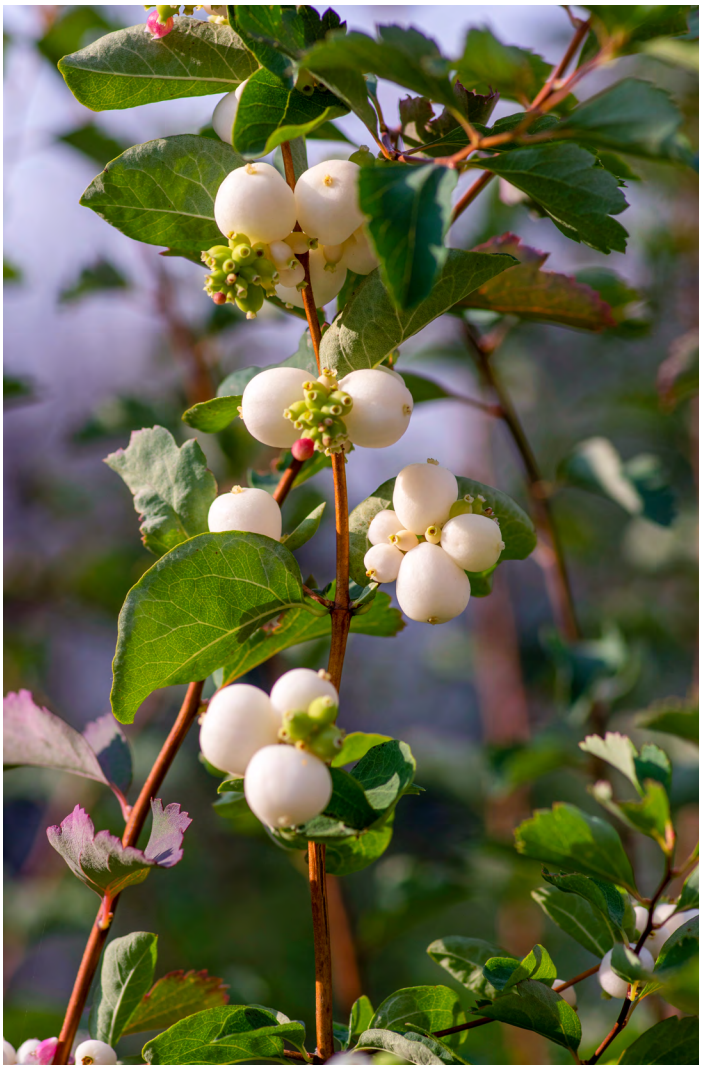
SOIL SALINITY

Plants absorb essential nutrients in the form of soluble salts. But accumulation of soluble salts can reduce plant growth and development. Soil salinity is common in arid and semi-arid regions. Salts can be released from weathered minerals in the soil. They can also be applied to the soil in irrigation water and fertilizers, or can migrate upward in the soil from shallow groundwater. When precipitation or irrigation is not enough to leach salts down through the soil profile, salts accumulate in the soil and salinity results.

The most common cause of soil salinity is poor soil drainage. Poor quality irrigation water can also cause salinity problems. Inadequate irrigation management can increase the risk of soil salinity developing. To prevent salt buildup, enough water must pass through the root zone to leach out salts. Keep in mind that some of these salts, such as nitrates, are also essential plant nutrients. Excess nitrates, for example, become water pollutants if leached into groundwater.

When soil salinity is high, plants use extra energy to get the water that would otherwise by used for growth, flowering, or fruiting. As salt concentrations increase in the soil, water becomes more difficult for plants to absorb. Plants can even die from water stress or drought in moist soil if the soil salt concentration is high enough.

Nutritional imbalances can also occur in saline soils. Some elements, such as sodium, chlorine, and boron, can be toxic to plants in and of themselves. High salt levels in the soil can



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Snowberry (*Symphoricarpos albus*) is more tolerant of salt than other shrubs (Table 1).

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upset the nutrient balance in plants or interfere with nutrient uptake because many salts are also plant nutrients.

Soil testing labs estimate salt content by extracting solution from a soil sample and measuring the ability of that solution to conduct electricity. The more electricity is conducted through the solution, the higher the salt content is in the soil. The electrical conductivity of an extracted solution is referred to as EC. It is expressed in deciSiemens/meter (dS/m) or millimhos/centimeter (mmhos/cm). Both units are equivalent ways of reporting electrical conductivity: 1 dS/m = 1 mmho/cm.

PLANT RESPONSES

Symptoms of salt injury in plants mimic those of drought damage. Both conditions can result in wilting and reduced growth. Exposure to long stretches of high soil salinity causes stunted plants and tissue death. Growth is reduced more and more as salinity increases.

Some plants are salt tolerant and can adjust to the effect of high soil salinity better than salt sensitive plants. Salt tolerant plants are able to absorb more water from saline soils than sensitive plants. A listing of some examples of salt sensitive and tolerant plants is available in Table 1. Use the table as a guide for comparing tolerances among plants.

Other factors play roles in salt tolerance, including climate, soil conditions, cultural practices, and variety selection. During cool weather when water demands from plants are low, salt injury will be less than during hot, dry weather.

Also, salt tolerance of young plants during germination and emergence, is often less than mature plants. One example is beets. The seedlings are more sensitive to soil salinity than another common plant, corn. Reducing soil salinity at the time of seed sowing will help. Salinity can be reduced by leaching with excess water before sowing seeds and planting on the sides of sloping beds.

Table 2 lists salinity ranges expected to give a specific growth or yield for relative tolerances of plants. Use Table 2 along with the results of a soil testing lab EC report. Many laboratories in the western United States routinely perform soil salinity tests.

Soil salinity can be difficult to manage. Salts can be removed from the soil by leaching if drainage is not restricted. Watering plants more frequently can reduce salt injury. Using good management practices, including adequate fertilization, can reduce the effects of high salts in the soil. If you think soil salinity may be a problem, contact your local county University of Wyoming extension educator. Your extension professional can help you get more information on soil salinity, where to get your soil tested for EC, and ways to correct high EC levels.

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Asparagus is a vegetable more tolerant of salt (Table 1).

TABLE 1. SALT SENSITIVITY

Salt sensitive	Moderately sensitive	Moderately tolerant	Tolerant
Trees and shrubs			
Alnus - alder	*Abies* - fir	*Euonymus* - euonymus	*Caragana* – peashrub
Amelanchier – serviceberry	*Acer* – maple	*Juniperus* - juniper	*Gleditsia* – honeylocust
Celtis – hackberry	*Cotoneaster* – cotoneaster	*Potentilla* - cinquefoil	*Juniperus* – juniper
Cornus - dogwood	*Crataegus* – hawthorn	*Rhus* – sumac	*Lonicera* - honeysuckle
Mahonia - mahonia	*Forsythia* - forsythia	*Shepherdia* – buffaloberry	*Robinia* – black locust
Rosa - rose	*Fraxinus* – ash	*Syringa* - lilac	*Quercus* – bur oak
Spiraea - spirea	*Gymnocladus* – Kentucky coffee tree	*Ulmus* - elm	*Symphoricarpos* - snowberry
Symphoricarpos - snowberry	*Lonicera* – honeysuckle		
Tilia - linden	*Philadelphus* – mock orange		
	Picea - spruce		
	Pinus - pine		
	Populus – cottonwood, poplar, aspen		
	Quercus – oak		
	Sorbus – mountain ash		
Annual and perennial flowering plants			
Saintpaulia – African violet	*Aster* – aster	*Chrysanthemum* - chrysanthemum	
Salvia – mealy cup sage	*Catharanthus* - periwinkle	*Dianthus* – Sweet William	
Verbena - verbena	*Clematis* – clematis		
	Gladiolus – gladiola		
	Hemerocallis – daylily		
	Iris - iris		
	Portulaca – moss rose		
	Viburnum - viburnum		
Vegetables			
Allium – onion	*Capsicum* - pepper	*Brassica* – cauliflower	*Asparagus officinalis* – asparagus
Apium graveolens – celery	*Citrullus lanatus* - watermelon	*Cucurbita* – squash	*Beta vulgaris* – beet
Cucumis sativus- cucumber	*Cucumis* – muskmelon, cantaloupe	*Daucus* – carrot	*Brassica* – broccoli, cabbage, cauliflower, kale, turnip
Daucus - carrot	*Cucurbita* – pumpkin, squash	*Lactuca* – lettuce	*Capsicum* – bell pepper
Pastinaca – parsnip	*Lactuca sativa* - lettuce	*Pisum* – peas	*Spinacea* – spinach
Phaseolus – bean	*Pisum sativum* - pea	*Solanum tuberosum*– potatoes	*Solanum lycopersicum* - tomato
Raphanus sativus - radish	*Raphanus sativus* - radish		
	Solanum lycopersicum - tomato		
	Solanum tuberosum - potato		
	Spinacea oleracea - spinach		
	Zea mays - corn		

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Table 1, continued

Salt sensitive	Moderately sensitive	Moderately tolerant	Tolerant
Fruits			
Malus – apple, crabapple	*Ribes* - currant		
Prunus – apricot, cherry, plum	*Vitis* – grape		
Rubus – raspberry			
Grasses			
	Poa pratensis – Kentucky bluegrass	*Agrostis* – creeping bentgrass	*Puccinellia* - alkali grass
	Festuca – fine fescue, tall fescue	*Bouteloua gracilis* – blue grama	
		Buchloe dactyloides - buffalo grass	
		Agropyron cristatum - crested wheatgrass	
		Lolium perenne - perennial ryegrass	

TABLE 2. SOIL SALINITY LEVELS AND POTENTIAL YIELD LOSSES OF SALT TOLERANCE CATEGORIES OF HORTICULTURAL PLANTS.

Relative salt tolerance	**Expected loss of yield or growth** (%)			
	0%	25%	50%	100%
	Soil salinity (dS/m, mmho/cm)			
Sensitive	<1.3	1.4-2.7	2.6-4.2	>8.0
Moderately sensitive	<3.0	2.7-6.3	4.2-9.5	>16.0
Moderately tolerant	<6.0	6.3-10.5	9.5-15.0	>24.0
Tolerant	<10.0	10.5-15.5	15.0-21.0	>32.0

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