

Soil Salinity and Ornamental Plant Selection

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Parameters Affecting Plant Selection

Selection of plants for landscapes requires consideration of a number of factors, including cold-hardiness, aesthetic characteristics, maintenance requirements (pest control, fertilization, etc.), soil pH tolerance, drought-tolerance, and availability. Many sites in Utah also require tolerance to salt spray, soil salinity, saline irrigation water, and sodic soils. While it is possible to modify both soils and irrigation water to improve their quality and ability to grow plants, landscapes should function with minimum initial and subsequent maintenance expense. Selecting plants that will survive under the existing conditions and managing them effectively are the most appropriate solutions to soil and water concerns. This fact sheet will focus on plant tolerance to root-absorbed salts from the soil.

Causes of Saline Soils

There are five separate but related problems concerning root-absorbed salts that can occur in the landscape:

1. Soil salinity from road-salt. Salts that are applied to roads can eventually end up in the soil either with runoff from the road surface, or as a result of splashing or sprays from the street. The damage caused by soil salinity is not the same as that caused by foliar contact, and susceptibility of plants to one form of salt damage is not an indication of susceptibility to the other.
2. Soil salinity from irrigation water. Irrigation with saline water can cause increased soil salinity if

management is such that salts are left in the soil after water is lost to evaporation and transpiration. Appropriate irrigation practices provide a "leaching fraction" that removes excess salts from the soil. Leaching with irrigation water that is more saline than is tolerable for sensitive plants, however, will not lower salinity below tolerance levels. Poorly drained soils cannot be "leached" unless efforts are made to improve soil drainage problems.

3. Soil salinity from excessive use of fertilizers and soil amendments. Over-application of inorganic fertilizers, such as ammonium nitrate, or use of organic amendments, such as animal manure, can lead to build up of salts in soils. The solution is to apply fertilizers only when needed, and to water plants thoroughly after application. Animal manure is sometimes sold as a soil amendment to add nutrients. Animal manures can be high in salt and care should be taken if they are used in areas where soils are already saline or where drainage is poor. Otherwise, they should be watered in thoroughly after application to leach excess salts below plant roots.
4. Inherently saline soils. Such soils occur as a result of salt formation during weathering of parent rock materials, or in arid environments where evaporation exceeds precipitation leading to a build-up of salts in the soil. An extreme example occurs around the Great Salt Lake. Water from the lake leaches into surrounding soils and then evaporates, concentrating salts in

the soil. Urbanization is beginning to encroach on these areas, and new residents are left to cope with soils too salty for many common landscape plants.

5. Sodic soils. Sodic soils are high in exchangeable sodium relative to calcium and magnesium. The presence of high levels of sodium causes a breakdown in the soil structure leading to aeration and water infiltration problems. Sodic soils also have pH values greater than 8.5, which

can interfere with plant absorption of some nutrients. These soils are found in low-lying areas of the state where water tables were formerly high and drainage is poor. Sodic soils may have a black or white crust at their surface (Figure 1). Information on such soils and how to manage them can be found in the Utah Fertilizer Guide at the following:
URL:http://extension.usu.edu/files/publications/publication/AG_431.pdf.



Figure 1. White-crust sodic soils in east-central Utah are only sparsely populated by plants.
(Photo credit: Heidi Kratsch)

Plant Symptoms Related to Saline Soils

Salinity damage in plants looks a lot like symptoms of water deficit. This is because salts in the soil tie up soil water and make it difficult for the plant to take up water and nutrients. In essence, sensitive plants in salty soils experience a “chemical drought,” and they may show symptoms of water stress even when the soil is moist. There are also direct toxic effects of ions, such as sodium and chloride, on plant growth, metabolism, and survival. Early signs of salt stress are stunted growth and leaf yellowing. In conifers, needles yellow and then turn brown from the tips downward. Broadleaf plants show the greatest symptoms at leaf tips and margins, which eventually turn from yellow to brown. Symptoms show up first in older needles and leaves, where salts accumulate. If the roots are exposed long enough to salts, plants will lose their foliage and ultimately may die. The degree of damage by salts in soil depends upon the salt sensitivity of the plant, the concentration of salts

in the soil, and the length of time plants roots are exposed to salts. You can minimize damage to sensitive plants by diluting and leaching salts through the soil profile by applying extra water during irrigation.

Selecting Plants for Saline Soils

The most effective way to avoid salinity damage to landscape plants is to have your soil tested for salinity at the Utah State University Analytical Labs (URL: <http://www.usual.usu.edu>) and planting species and varieties tolerant to the level of salinity in your soil. Table 1 categorizes plants into high, moderate, and low salinity tolerance according to the stated ranges. Tolerance ratings for the starred species were subjective but they may still be useful as a guide for plant selection. Not all species on this list may be cold-hardy to your region of the state, so check with your local nursery or garden center for recommendations.

Table 1. Soil Salinity Tolerance Plant List
TREES

Species	Common name	Salinity tolerance		
		High EC _e > 8	Moderate EC _e 4-8	Low EC _e < 4
<i>Acacia baileyana</i>	Mimosa			X
<i>Acer buergerianum</i> *	Trident maple		X	
<i>Acer campestre</i> *	Hedge maple		X	
<i>Acer platanoides</i>	Norway maple		X	
<i>Acer pseudoplatanus</i> *	Sycamore maple		X	
<i>Acer rubrum</i> *	Red maple			X
<i>Acer saccharinum</i>	Silver maple			X
<i>Aesculus spp</i> *	Horsechestnut			X
<i>Ailanthus altissima</i> *	Tree-of-heaven		X	
<i>Betula nigra</i>	River birch			X
<i>Betula pendula</i>	European white birch			X
<i>Calocedrus decurrens</i>	Incense-cedar			X
<i>Carpinus spp</i> *	Hornbeam			X
<i>Cedrus atlantica</i>	Atlas cedar			X
<i>Cedrus deodara</i>	Deodar cedar			X
<i>Celtis reticulata</i> *	Netleaf hackberry			X
<i>Cercis occidentalis</i>	Western redbud		X	
<i>Chilopsis linearis</i>	Desert willow			X
<i>Chitalpa tashkentensis</i>	Chitalpa			X
<i>Cornus mas</i>	Cornelian cherry			X
<i>Crataegus x lavalleyi</i>	Lavalle hawthorn			X
<i>Crataegus phaenopyrum</i>	Washington hawthorn			X
<i>x Cupressocyparis leylandii</i>	Leyland cypress	X		
<i>Cupressus arizonica</i>	Arizona cypress			X
<i>Cupressus sempervirens</i>	Italian cypress		X	
<i>Cupressus sempervirens</i> 'Glauca'	Blue Italian cypress		X	
<i>Elaeagnus angustifolia</i>	Russian olive	X		
<i>Eucalyptus gunnii</i>	Cider gum	X		
<i>Fagus sylvatica</i> *	European beech			X
<i>Forestiera neomexicana</i>	Desert olive		X	
<i>Fraxinus americana</i>	White ash			X
<i>Fraxinus pennsylvanica</i> var. <i>lanceolata</i>	Green ash		X	
<i>Fraxinus velutina</i>	Arizona ash		X	
<i>Ginkgo biloba</i>	Ginkgo			X
<i>Gleditsia triacanthos</i> var. <i>inermis</i> *	Thornless honeylocust		X	
<i>Juglans nigra</i>	Black walnut			X
<i>Koelreuteria paniculata</i>	Goldenraintree			X
<i>Lagerstroemia indica</i>	Crapemyrtle			X
<i>Liquidambar styraciflua</i>	Sweetgum		X	
<i>Liriodendron tulipifera</i>	Tulip tree			X
<i>Magnolia grandiflora</i>	Southern magnolia		X	
<i>Melia azadarach</i>	Chinaberry		X	
<i>Morus alba</i> 'fruitless'	Fruitless white mulberry		X	
<i>Ostrya virginiana</i> *	Eastern hophornbean			X
<i>Parkinsonia aculeata</i>	Mexican palo verde	X		
<i>Picea abies</i> *	Norway spruce			X
<i>Picea glauca</i> *	White spruce			X
<i>Picea pungens</i> *	Blue spruce		X	

<i>Pinus eldarica</i> *	Mondel or Afghan pine		x	
<i>Pinus cembroides</i>	Mexican pinyon pine	x		
<i>Pinus edulis</i>	Pinyon pine		x	
<i>Pinus nigra</i>	Austrian black pine		x	
<i>Pinus pinea</i>	Italian stone pine	x		
<i>Pinus thunbergiana</i>	Japanese black pine		x	
<i>Pistacia chinensis</i> *	Chinese pistache		x	
<i>Platanus x acerifolia</i> *	London planetree		x	
<i>Populus alba</i> *	White poplar	x		
<i>Populus deltoides</i> *	Eastern cottonwood		x	
<i>Populus freemontii</i>	Western cottonwood		x	
<i>Populus nigra 'Italica'</i> *	Lombardy poplar			x
<i>Prosopis grandulosa</i> var. <i>torreyana</i>	Honey mesquite	x		
<i>Prunus armeniaca</i>	Apricot			x
<i>Prunus avium</i>	Sweet cherry			x
<i>Prunus cerasifera</i>	Cherry plum		x	
<i>Prunus dulcis</i>	Sweet almond			x
<i>Prunus persica</i>	Flowering peach			x
<i>Prunus sargentii</i> *	Sargent cherry		x	
<i>Pyrus calleryana</i> *	Callery pear		x	
<i>Quercus macrocarpa</i>	Bur oak			x
<i>Quercus robur</i> *	English oak		x	
<i>Quercus rubra</i> *	Red oak		x	
<i>Quercus virginiana</i> *	Southern live oak			x
<i>Robinia pseudoacacia</i> *	Black locust		x	
<i>Salix babylonica</i> *	Weeping willow		x	
<i>Sophora japonica</i> *	Japanese pagoda tree		x	
<i>Sorbus aucuparia</i> *	European mountain ash			x
<i>Taxodium distichum</i>	Baldcypress		x (> 6)	
<i>Thuja orientalis</i>	Oriental arborvitae		x	
<i>Tilia americana</i> 'Redmond'	American basswood			x
<i>Tilia cordata</i> *	Littleleaf linden			x
<i>Ulmus pumila</i>	Siberian elm	x		
<i>Vitex agnus-castus</i> *	Chastetree			x

*Salinity tolerance criteria unknown or ratings subjective.

SHRUBS

Species	Common name	Salinity tolerance		
		High EC _e > 8	Moderate EC _e 4-8	Low EC _e < 4
<i>Artemisia nova</i>	Black sagebrush		x	
<i>Artemisia tridentata</i>	Big Sagebrush			x
<i>Atriplex</i> spp.*	Saltbush	x		
<i>Baccharis hybrid</i> *	'Starn Thompson'	x		
<i>Baccharis pilularis</i>	Dwarf coyote brush		x (> 6)	
<i>Baccharis sarothroides</i>	Desert broom		x	
<i>Berberis</i> spp.*	Barberry			x
<i>Buddleia davidii</i>	Butterfly bush			x
<i>Buxus microphylla</i> var. <i>japonica</i>	Japanese boxwood		x	
<i>Buxus sempervirens</i>	English boxwood			x
<i>Caragana arborescens</i> *	Siberian peashrub	x		
<i>Ceratoides lanata</i>	Winterfat			x
<i>Cotinus coggygia</i> *	Smoketree		x	
<i>Cotoneaster apiculatus</i>	Cranberry cotoneaster			x
<i>Cotoneaster horizontalis</i>	Rockspray cotoneaster			x

<i>Cytisus scoparius</i> 'Moonlight'	Scotch broom			x
<i>Dasyliirion wheeleri</i>	Desert spoon			x
<i>Ephedra viridis</i>	Green Mormon tea			x
<i>Ericameria nauseosa</i> *	Rabbitbrush		x	
<i>Fallugia paradoxa</i>	Apache plume			x
<i>Genista</i> spp.	Broom		x	
<i>Ilex vomitoria</i> 'Nana'	Dwarf yaupon holly		x	
<i>Juniperus chinensis</i>	Chinese juniper		x	
<i>Larrea tridentata</i> *	Creosote bush	x		
<i>Lavandula angustifolia</i>	English lavender		x	
<i>Leucophyllum frutescens</i>	Texas sage	x		
<i>Ligustrum japonicum</i>	Wax-leaf privet		x	
<i>Mahonia aquifolium</i>	Oregon grape			x
<i>Philadelphus</i> spp.*	Mockorange			x
<i>Prunus besseyi</i> *	Western sand cherry			x
<i>Prunus tomentosa</i> *	Nanking cherry			x
<i>Rhus ovata</i>	Sugar bush		x	
<i>Rhus trilobata</i> *	Squawbush		x	
<i>Ribes</i> spp.	Currant			x
<i>Rosa hybrida</i>	Hybrid rose		x	
<i>Rosa rugosa</i> *	Rugosa rose		x	
<i>Rosmarinus officinalis</i>	Rosemary		x (6-8)	
<i>Salvia greggii</i>	Autumn red sage			x
<i>Shepherdia argentea</i> *	Silver buffaloberry		x	
<i>Simmondsia chinensis</i>	Jojoba	x		
<i>Spiraea vanhouttei</i> *	Spirea			x
<i>Teucrium chamaedrys</i>	Wall germander		x	
<i>Thuja occidentalis</i> *	American arborvitae		x	
<i>Thuja orientalis</i>	Oriental arborvitae		x	
<i>Thuja orientalis</i> 'Aurea'	Dwarf golden arborvitae		x (> 6)	
<i>Yucca filamentosa</i>	Adam's needle		x	

* Salinity tolerance criteria unknown or ratings subjective.

HERBACEOUS ANNUALS and PERENNIALS

Species	Common name	Salinity tolerance		
		High EC _e > 8	Moderate EC _e 4-8	Low EC _e < 4
<i>Acanthus mollis</i> 'Oak Leaf' (A)	Bear's breech			x
<i>Achillea</i> spp.*	Yarrow		x	
<i>Achillea millefolium</i>	Common yarrow		x	
<i>Agave</i> spp.*	Agave	x		
<i>Ageratum</i> spp. (A)	Floss flower		x	
<i>Antirrhinum majus</i> * (A)	Snapdragon			x
<i>Arctotheca calendula</i> (A)	Cape weed		x (> 6)	
<i>Artemisia frigida</i>	Fringe sagebrush		x	
<i>Artemisia ludoviciana</i>	Prairie sage	x		
<i>Artemisia stellerana</i> *	Dusty miller		x	
<i>Asclepias tuberosa</i> *	Butterfly weed		x	
<i>Asparagus densiflorus</i> 'Sprengeri' (A)	Sprenger asparagus	x		
<i>Aster glaucoides</i>	Blueleaf aster			x
<i>Aurinia saxatilis</i>	Basket-of-gold			x
<i>Berlandiera lyrata</i>	Chocolate flower		x	
<i>Calendula officinalis</i>	Pot marigold		x	
<i>Callistephus chinensis</i> (A)	China aster			x
<i>Celosia argentea</i> var. <i>cristata</i> (A)	Crested cockscomb			x

<i>Ceratostigma plumbaginoides</i>	Dwarf plumbago			x
<i>Chaenactis douglasii</i> *	Dusty miller			x
<i>Chrysanthemum morifolium</i> 'Bronze Kramer'	Mum		x (> 6)	
<i>Coreopsis grandiflora</i> *	Coreopsis		x	
<i>Cosmos bipinnatus</i> (A)	Cosmos			x
<i>Delosperma alba</i>	White iceplant	x		
<i>Delosperma cooperi</i>	Hardy iceplant	x		
<i>Delphinium</i> spp.	Larkspur			x
<i>Dianthus barbatus</i> * (A)	Sweet William			x
<i>Dietes iridioides</i>	Fortnight lily	x		
<i>Echinacea purpurea</i>	Purple coneflower			x
<i>Eriogonum</i> spp.*	Wild buckwheat		x	
<i>Eriogonum jamesii</i> *	James buckwheat			x
<i>Felicia amelloides</i> (A)	Felicia			x
<i>Gaillardia aristata</i>	Blanketflower		x	
<i>Gazania rigens</i> (A)	Pied gazania		x	
<i>Gelsemium sempervirens</i> * (V)	Carolina Jessamine			x
<i>Geranium viscosissimum</i> *	Sticky geranium			x
<i>Gladiolus</i> spp.	Gladiolus			x
<i>Haplopappus armerioides</i> *	Thrifty goldenweed			x
<i>Hedera canariensis</i> (V)	Algerian ivy			x
<i>Hedera helix</i> (V)	English ivy		x	
<i>Hemerocallis</i> spp.	Daylily			x
<i>Jasminum polyanthum</i> (V)	Jasmine			x
<i>Lantana x hybrida</i> 'New Gold' (A)	'New Gold' lantana		x	
<i>Lathyrus odoratus</i> * (A)	Sweetpea	x		
<i>Leucanthemum x superbum</i> 'Alaska'	Shasta daisy		x	
<i>Linum lewisii</i> *	Blue flax			x
<i>Lobularia maritima</i>	Sweet alyssum		x	
<i>Lotus corniculatus</i> (V)	Bird's foot trefoil		x	
<i>Matthiola incana</i> (A)	Stock		x	
<i>Mirabilis multiflora</i> *	Desert Four o'clock		x	
<i>Oenothera pallida</i> *	Pale evening-primrose			x
<i>Oenothera speciosa</i> *	Mexican evening primrose		x	
<i>Opuntia polyacantha</i> *	Plains pricklypear			x
<i>Parthenocissus quinquefolia</i> (V)	Virginia creeper		x	
<i>Pelargonium x hortorum</i> (A)	Geranium			x
<i>Penstemon eatonii</i> *	Firecracker penstemon			x
<i>Penstemon x mexicali</i> 'Red Rocks'	'Red Rocks' penstemon			x
<i>Penstemon palmeri</i> *	Palmer's penstemon			x
<i>Penstemon pseudospectabilis</i>	Desert beardtongue			x
<i>Penstemon strictus</i> *	Rocky mountain penstemon			x
<i>Petunia x hybrida</i> * (A)	Petunia	x		
<i>Phlox longifolia</i> *	Longleaf phlox			x
<i>Phyla nodiflora</i>	Lippia		x (> 6)	
<i>Portulaca grandiflora</i> (A)	Rose moss	x		
<i>Rosmarinus officinalis</i> 'Huntington Carpet'	Rosemary		x	
<i>Rudbeckia hirta</i>	Black-eyed susan			x

<i>Salvia</i> spp.	Sage		x	
<i>Sphaeralcea coccinea</i>	Scarlet globemallow			x
<i>Sphaeralcea grossulariifolia</i>	Gooseberryleaf globemallow			x
<i>Sphaeralcea munroana</i>	Munro globemallow			x
<i>Sedum</i> spp.*	Stonecrop		x	
<i>Stachys betonicifolia</i> *	Lamb's ear		x	
<i>Trapaeolum majus</i> *	Nasturtium		x	
<i>Verbena x hybrida</i> (A)	Garden verbena			x
<i>Verbena</i> 'Homestead Purple' (A)	Verbena			x
<i>Vinca minor</i>	Dwarf periwinkle			x
<i>Viola tricolor</i> *	Pansy			x
<i>Zinnia elegans</i> *	Zinnia			x

(A) = Annual (V) = Vine

* Salinity tolerance criteria unknown or ratings subjective

GRASSES

Species	Common name	Salinity tolerance		
		High EC _e > 8	Moderate EC _e 4-8	Low EC _e < 4
<i>Achnatherum hymenoides</i>	Indian Ricegrass			x
<i>Achnatherum speciosum</i>	Desert needlegrass			x
<i>Agropyron cristatum</i>	Crested Wheatgrass	x		
<i>Agrostis palustris</i> 'Old Orchard' 'Congressional' 'Seaside'	Creeping bentgrass		x	
<i>Agrostis tenuis</i>	Colonial bentgrass			x
<i>Arundo donax</i>	Giant reed		x	
<i>Bouteloua gracilis</i>	Blue grama		x	
<i>Bouteloua curtipendula</i>	Sideoats grama			x
<i>Bromus marginatus</i>	Mountain brome		x	
<i>Buchloe dactyloides</i>	Buffalograss		x	
<i>Cortaderia selloana</i> *	Pampas grass		x	
<i>Cynodon dactylon</i>	Bermudagrass		x (EC _e > 6)	
<i>Dactylis glomerata</i>	Orchard grass		x	
<i>Danthonia intermedia</i>	Timber oatgrass		x	
<i>Distichlis stricta</i>	Desert saltgrass	x		
<i>Elymus elymoides</i>	Bottlebrush squirreltail			x
<i>Festuca arundinacea</i>	Tall fescue		x	
<i>Festuca idahoensis</i>	Idaho fescue			x
<i>Festuca rubra</i>	Creeping red fescue		x	
<i>Festuca rubra</i> var. <i>commutata</i>	Chewing's fescue		x	
<i>Hilaria jamesii</i>	Galleta		x	
<i>Koeleria macrantha</i>	Great Basin Wildrye			x
<i>Lolium perenne</i>	Perennial ryegrass		x	
<i>Muhlenbergia montana</i>	Mountain muhly			x
<i>Paspalum vaginatum</i>	Seashore paspalum	x		
<i>Pascopyrum smithii</i>	Western wheatgrass	x		
<i>Poa fendleriana</i>	Mutton bluegrass			x
<i>Poa pratensis</i>	Kentucky bluegrass			x
<i>Poa secunda</i>	Sandberg bluegrass			x
<i>Poa trivialis</i>	Rough bluegrass			x
<i>Puccinellia</i> spp.	Alkaligrass	x		
<i>Schizachyrium scoparium</i>	Little bluestem			x
<i>Sporobolus airoides</i>	Alkali sacaton	x		
<i>Uniola paniculata</i>	Sea oats		x	
<i>Zoysia</i> spp.	Zoysiagrass			x

* Salinity tolerance criteria unknown or ratings subjective.

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This publication is issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Noelle E. Cockett, Vice President for Extension and Agriculture, Utah State University.