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TEXAS A&M AGRILIFE EXTENSION

An Index of Salinity and Boron Tolerance of Common Native and Introduced Plant Species in Texas

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Soil and water salinity and boron thresholds for selected trees, shrubs, turfgrasses, ornamental ground covers, fruit and nut crops, vegetables, flowers, herbaceous crops, field grasses, forages, and field crops.

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Background

Considerable research has been conducted to evaluate the effects of excessive amounts of soluble salts in the rooting zone on plant growth. Salinity may affect plant growth in two ways: 1) osmotic stress, and 2) specific ion toxicity. As the salt concentration in the soil water increases, the ability of plants to absorb water is reduced and can result in an osmotic or "drought" stress, even when sufficient soil water is present. High soluble salt concentrations also may cause the accumulation of toxic amounts of some ions within the plant. Specific ion toxicities have been reported for boron, chloride, sodium, and sulfate.

Plant species vary widely in their tolerance to salts in soil and irrigation water. The salt tolerance of most plant species is lowest at germination and during early seedling establishment, and tolerance levels can vary substantially with soil and environmental conditions. Efforts should be made to minimize the salt stress on plants, particularly during early development, to promote successful establishment and growth.

Salt tolerance is a good indicator of drought tolerance. Plant species that are more salt tolerant are typically better suited to situations where irrigation is limited and are often, but not always, more resistant to drought conditions. Some species do not require any supplemental irrigation. Other species can tolerate higher salt levels in irrigation water applied to the soil, but not when applied to the leaves (sprinkler irrigation). In such cases, drip, soaker hose, or furrow irrigation may be necessary. Selection of more salt and drought tolerant plant species can substantially enhance water conservation for landscapes.

About The Index

While the salt tolerance level of some plant species has been reported, there is very limited or no information on many species. Data for this publication were obtained from a wide range of sources, including early research reports, not all which could be accurately referenced. However, every effort was made to recognize original research and information sources.

Salt tolerance limits listed in this publication are intended as a general reference for use in selecting plant species for horticultural and agricultural applications. This report contains thresholds for both soil salinity and irrigation water salinity. In addition, thresholds for boron in irrigation water, one of the more common toxic ions, are provided when available. Plant species are grouped by crop type (trees, ornamentals, field crops, etc.) and tolerance level (very sensitive, moderately sensitive, tolerant, etc.).

Only those species having reported values for soil salinity thresholds are listed in this document. Due to limited data, most of the irrigation water salinity thresholds had to be estimated based on the assumption that soil salinity can effectively increase by 2-fold or more due to evaporation and transpiration following application of irrigation water. However, changes in soil salinity as a result of irrigation vary substantially depending on soil properties and environmental conditions.

For example, accumulation of salts will occur more rapidly in finer textured, and consequently less well drained, clay and loam soils compared to sandy soils. As a result, estimated irrigation thresholds should only be used as a general guide. If proposed irrigation water approaches the salinity threshold value, soils must be managed and sufficient water must be added to leach salts and limit accumulations in the root zone. This may include the need for additions of soil amendments such as gypsum. In addition, routine (annual or more frequent) testing of the soil may be needed to monitor salt accumulation and guide irrigation and soil amendment decisions.

To search the on-line version of this document for a particular species, hit control+f and type a common or scientific name. Alternatively, the tables are followed by a full listing of all the plant species in alphabetical order by common name.

Salinity is a measure of the total dissolved salts and can be determined both in the root zone of the crop (soil salinity) and in irrigation water. The units used by different laboratories to report salinity vary and may require conversion so values can be compared. For example, in this publication soil and irrigation water salinity are reported in units of decisiemens per meter (dS/m). The following table presents simple conversion factors that can be used when needed to compare laboratory water salinity and soil salinity results to the suggested thresholds presented in this publication.

Conversion factors for different units of electrical conductivity (EC).

Measurement	Units	Abbreviation	Example	Conversion to dS/m
Conductivity	Micromhos	µmhos/cm	1000 µmhos/cm	divide by 1000
Conductivity	Microsiemens	µS/cm	1000 µS/	divide by 1000
Conductivity	Millisiemens	mS/cm	1.0 mS/cm	multiply times 1
Conductivity	Millimhos	mmhos/cm	1.0 mmhos/cm	multiply times 1
Total Dissolved Salts	Parts per million	ppm	1280 ppm	divide by 640
Total Dissolved Salts	Milligrams per liter	mg/L	1280 mg/L	divide by 640

Water and Soil Testing

This publication uses electrical conductivity of irrigation water and/or soil as a primary indicator for assessing the impacts of salinity on plants. However, electrical conductivity only evaluates potential osmotic effects caused by salts. As noted above, individual ions in water can be toxic to plants. In addition, the balance of positively charge ions (cations) which is usually dominated by calcium, magnesium, potassium, and sodium, and negatively charged ions (anions) which is usually dominated by bicarbonate, chloride, and sulfate is very important. As a result, a complete irrigation water analysis is needed to fully assess the suitability of a water source. When either the total salts or an individual ion are elevated, a water professional should be consulted to interpret test results and determine the suitability of a water source for irrigation.

Water wells should be tested annually at a minimum, especially during extended dry periods, since the quality of water in a well can change as a result of pumping demand and/or limited

recharge. Aquifers, ponds, lakes, and rivers subject to rapid changes in depth or flow can experience significant changes in water quality over short periods of time. More frequent testing may be necessary in some cases to monitor water quality and enable appropriate management decisions. The Texas A&M AgriLife Extension Soil, Water, and Forage Testing Laboratory (SWFTL) can analyze irrigation water for agricultural and urban use. Forms and information for water sampling and testing are available on the laboratory website: http://soiltesting.tamu.edu.

Salts added to soil in irrigation water, fertilizer and manure, and mineralization of organic matter can all result in increased soil salinity if leaching is limited and/or the net removal of nutrients is less than the inputs. Homeowners and land managers should obtain annual soil tests for landscapes and fields that are receiving irrigation water with elevated salinity. A complete routine soil test will include a measurement for soluble salts. The SWFTL provides a basic salinity analysis as part of the routine test, and offers a detailed salinity analysis when needed. Additional information about managing salts in irrigation water can be found in the following publications:

1) Fipps, G. 2003. Irrigation Water Quality Standards and Salinity Management Strategies. B-1667. Texas A&M AgriLife Extension Service, College Station, Texas. http://soiltesting.tamu.edu/publications/B-1667.pdf

2) Provin, T.L. and J.L. Pitt. 2012. Managing Soil Salinity. E-60. Texas A&M AgriLife Extension Service, College Station, Texas. http://soiltesting.tamu.edu/publications/E-60.pdf

Trees and Shrubs					
Very Sensitive		**Salinity Threshold**			
Common Name	**Botanical Name**	**Electrical Conductivity**			**Boron in Irrigation Water**
		Irrigation Water	**Soil**		
		(dS/m)[1]	(dS/m)	R/P[2]	(mg/L)[3]
Cotoneaster	Cotoneaster sp.	1*	1-2	-**	-
Douglas fir	Pseudotsuga menziesii	1*	1-2	-	-
Oregon grape	Mahonia aquifolium	1*	1-2	-	<0.5
Pin oak[4]	Quercus palustris	1*	1-2	-	-
Post Oak[4]	Quercus stellate	1*	0-2	-	-
Bradford pear	Pyrus calleryana	1*	1-2	-	-
Red tip photinia	Photinia fraseri	1*	1-2	-	<0.5
Scots pine	Pinus sylvestris	1*	1-2	-	-
Norway spruce	Picea albies	1*	1-2	-	-
Walnut[4]	Juglans sp.	1*	1-2	-	≤1
Japanese yew	Taxus cuspidate	1*	1-2	-	-

[1] Salt concentration in decisiemens per meter (dS/m); see page 2 for conversion factors for other units of measurement.
[2] Relative percentage reduction in yield for each one unit increase in soil salinity.
[3] Units of milligrams per liter, which are equivalent to parts per million (ppm).
[4] Native species (not all natives listed may be identified).
[5] Invasive species.
* Estimated threshold based on evapotranspiration of irrigation water during and after application.
** No data available.

Trees and Shrubs					
Moderately Sensitive		**Salinity Threshold**			
Common Name	**Botanical Name**	**Electrical Conductivity**			**Boron in Irrigation Water**
		Irrigation Water	**Soil**		
		(dS/m)[1]	(dS/m)	R/P[2]	(mg/L)[3]
Glossy abelia	Abelia grandiflora	1-1.5*	2-3	-**	-
European ash	Fraxinus exceisior	1.5-2*	3-4	-	-
European mountain ash	Sorbus aucuparia	1-1.5*	2-3	-	-
Green ash[4]	Fraxinus pennsylvanica	1.5-2*	3-4	-	-
Single leaf ash	Fraxinus anomola	1.5-2*	3-4	-	-
Bird of paradise	Caesalpinia Mexicana	1-1.5*	2-3	-	-
Chitalpa	Chitalpa tashkentensis	1-1.5*	2-3	-	-
Leyland cypress	Cupressocyparis leylandii	1-1.5*	2-3	-	-
White (flowering) dogwood[4]	Cornus florida	1-1.5*	2-3	-	-
American elm[4]	Ulmus americana	1.5-2*	3-4	-	≤1
Balsam fir	Abies balsamea	1-1.5*	2-3	-	-
Goldenrain tree	Koelreuteria paniculata	1.5-2*	3-4	-	-
Pineapple guava	Feijoas sellowiana	1-1.5*	2-3	10	-
Hackberry[4]	Celtis occidentalis	1.5-2*	3-4	-	-
Netleaf hackberry[4]	Celtis reticulate	1.5-2*	3-4	-	-
Canadian hemlock	Tsuga canadensis	1-1.5*	2-3	-	-
Chinese hibiscus	Hibiscusr rosa-sinensis	1.5-2*	3-4	-	-
Burford holly	Ilex cornuta	1-1.5*	2-3	-	-
Chinese holly	Ilex cornuta	1-1.5*	2-3	-	-
Laurustinus, cv. Robustum	Viburnum tinusm	1.5-2*	3-4	-	-

American linden[4] (American Basswood)	Tilia americana	1-1.5*	2-3	-	-
Littleleaf linden	Tilia cordata	1-1.5*	2-3	-	-
Maidenhair tree	Gingko biloba	1.5-2*	3-4	-	-
Red maple[4]	Acer rubrum	1-1.5*	2-3	-	-
Silver maple	Acer saccharinum	1-1.5*[4]	2-3	-	-
Sugar maple	Acer saccharum	1-1.5*	2-3	-	-
Crape myrtle	Lagerstroemia indica	1.5-2*	3-4	-	-
Nandina[5] (Heavenly bamboo)	Nandina domestic	1.5*	<3	-	-
Bur oak[4]	Quercus macrocarpa	1.5*	<3	-	-
Holly oak[4]	Quercus ilex	1-1.5*	2-3	-	-
Shumard red oak[4]	Quercus shumardii	1.5*	<3	-	-
Mexican redbud[4]	Cercis Canadensis var. mexicana	1.6	2-3	-	-
Japanese pagoda	Sophora japonica	1-1.5*	2-3	-	-
Cabbage palm	Sabal palmetto	1.5*	<3	-	-
Chinese windmill palm	Trachycarpus fortune	1.5*	<3	-	-
Pindo palm	Butia capitata	1.5*	<3	-	-
Red or Norway pine	Pinus resinosa	1-1.5*	2-3	-	-
Japanese pittosporum	Pittosporum tobira	1.5-2*	3-4	-	-
London plane	Plantanus acerifolia	1-1.5*	2-3	-	-
Pomegranate	Punica granatum	1-2	2-3	-	-
Eastern redbud[4]	Cercis canadensis	1.5-2*	2-3	-	-
Western redbud[4]	Cercis occidentalis	1.5-2*	3-4	-	-
Rose	Rosa sp.	1.5-2*	2-3	-	-
Strawberry tree	Arbutus unedo	1.5-2*	3-4	-	-
American sycamore[4]	Platanus occidentalis	1.5-2*	2-3	-	-
Arizona sycamore[4]	Platanus wrightii	1.5-2*	2-3	-	-
Tulip tree[4]	Liriodendron tulipifera	1.5-2*	2-3	-	-

Vitex, Chaste tree[5]	Vitex agnus-castus	1-1.*5	2-3	-	-
Black walnut[4]	Juglans nigra	1-1.5*	2-3	-	≤1
Desert willow[4]	Chilopsis linearis	1-1.5*	2-3	-	-
Southern yew	Podocarpus macrophyllus	1-1.5*	2-3	-	-
Yucca[4]	Yucca brevifolia	1-1.5*	2-3	-	-

Trees and Shrubs					
Moderately Tolerant		**Salinity Threshold**			
Common Name	**Botanical Name**	**Electrical Conductivity**			**Boron in Irrigation Water**
		Irrigation Water	**Soil**		
		(dS/m)[1]	(dS/m)	R/P[2]	(mg/L)[3]
American arborvitae	Thuja occidentalis	2-3*	4-6	-**	-
Oriental arborvitae	Platycladus orientalis	2-3*	4-6	-	-
White ash[4]	Fraxinus americana	2-3*	4-6	-	-
Large-toothed aspen	Populus grandidentata	2-3*	4-6	-	-
Trembling (Quaking) aspen[4]	Populus tremuloides	2-3*	4-6	-	-
Grey birch	Betula populifolia	2-3*	4-6	-	-
Paper birch	Betula papyrifera	2-3*	4-6	-	-
Sweet birch	Betula leta	2-3*	4-6	-	-
Yellow birch	Betula alleghaniensis	2-3*	4-6	-	-
Japanese boxwood	Buxus microphylla var.japonica	2-3*	4-6	-	≤1
Northern catalpa	Catalpa speciosa	2-3*	4-6	-	-
Eastern red cedar[4]	Juniperus virginiana	1.5-3*	3-6	-	-
Black cherry[4]	Prunus serotina	2-3*	4-6	-	≤1
Choke cherry[4]	Prunus virginiana	2-3*	4-6	-	≤1
European bird cherry	Prunus padus	2-3*	4-6	-	-
Eastern cottonwood[4]	Populus deltoids	2-3*	4-6	-	-
Fremont cottonwood[4]	Populus fremontii	2-3*	3-6	-	-
Thorny elaeagnus[5] (Silverthorn)	Elaeagnus pungens	2-3*	4-6	-	-
Box elder[4]	Acer negundo	2-3*	4-6	-	-
Siberian elm	Ulmus pumila	2-3*	4-6	-	-
Indian hawthorn	Raphiolepis indica	2-3*	4-6	-	-

Brush holly[4]	Xylosma flexuosa	2-3*	4-6	-	-
Yaupon holly[4]	Ilex vomitoria	1.5-2*	3-6	-	-
Bluepoint juniper	Juniperus chinensis 'Bluepoint'	1.5-2*	3-6	-	-
Hollywood juniper	Juniperus chinenses 'Torulosa'	1.5-2*	3-6	-	-
Rocky Mountain Juniper[4]	Juniperus scopulorum	1.5-2*	3-6	-	-
Spreading juniper	Juniperus horizontalis	2-3*	4-6	-	-
Texas mountain laurel[4]	Sophora secundiflora	2-3*	4-6	-	-
Southern magnolia[4]	Magnolia grandiflora	2-3*	4-6	-	-
Amur maple	Acer ginnala	2-3*	4-6	-	-
Mimosa (silk tree)	Albizia julibrissin	1.5-2*	3-6	-	-
Southern live oak[4]	Quercus virginiana	1.5-2*	3-6	-	-
Desert olive	Forestiera neomexicana	1.5-2*	3-6	-	-
Orchid tree	Bauhinia purpurea	2-3*	4-6	-	-
Brazilian fan palm	Brithrinax brasiliensis	1.5-2*	3-6	-	-
Mexican blue fan palm	Brahea armata	1.5-2*	3-6	-	-
Dwarf blue palmetto	Sabal minor 'Riverside'	1.5-2*	3-6	-	-
Japanese black pine	Pinus thunbergiana	2-3*	4-6	-	-
Ponderosa pine[4]	Pinus ponderosa	2-3*	4-6	-	-
Mount atlas pistache	Pistacia atlantica	1.5-2*	3-6	-	-
Dwarf pittosporum	Pittosporum tobira	1.5-2*	3-6	-	-
Purple cherry plum	Prunus cerasifera	1.5-2*	3-6	-	$\leq$1
Bolleana poplar	Populus alba 'Bolleana'	1.5-2*	3-6	-	-
Lombardy poplar	Populus nigra	2-3*	4-6	-	-
White poplar	Populus alba	2-3*	4-6	-	-
Glossy privet	Ligustrum lucidum	2-3*	4-6	-	-
Pyracantha	Pyracantha fortuneana	2-3*	4-6	-	-
Silverberry[4]	Elaeagnus commutata	1.5-2*	3-6	-	-
Soapberry[4]	Dodonaea viscose	2-3*	4-6	-	-

Black willow[4]	Salix nigra	2-3*	4-6	-	-
Golden willow	Salix alba ‘vitellina’	2-3*	4-6	-	-
Golden Weeping willow	Salix alba ‘tristis’	2-3*	4-6	-	-
Seep willow[4]	Baccharis salicifolia	2-3*	4-6	-	-

Trees and Shrubs					
Tolerant		**Salinity Threshold**			
Common Name	**Botanical Name**	**Electrical Conductivity**			**Boron in Irrigation Water**
		Irrigation Water	**Soil**		
		(dS/m)[1]	(dS/m)	R/P[2]	(mg/L)[3]
Spreading acacia	Acacia redolens	3-4*	6-8	-**	-
Wafer ash	Ptelea trifoliate	3-4*	6-8	-	-
Weeping bottlebrush	Callistemon viminalis	3-4*	6-8	-	-
Bougainvillea	Bougainvillea spectabilis	3-4*	6-8	-	-
Coyote brush	Baccharis pilularis	3-4*	6-8	-	-
Arizona cypress[4]	Cupressus arizonica	3-4*	6-8	-	-
Italian cypress	Cupressus sempervirens	3-4*	6-8	-	-
Chinese elm	Ulmus parvifolia	3-4*	6-8	-	-
Japanese euonymus	Euonymus japonica	3-4*	6-8	-	-
Guayule[4]	Parthenium argentatum	3.5-4*	7-8	11	-
Black gum[4]	Nyssa sylvatica	3-4*	6-8	-	-
Sweet gum[4]	Liquidambar styraciflua	3-4*	6-8	-	-
Cockspur hawthorn[4]	Crataegus crus-galli	3-4*	6-8	-	-
Norway maple	Acer plantanoides	3-4*	6-8	-	-
Red oak[4]	Quercus rubra	3-4*	6-8	-	-
White oak[4]	Quercus alba	3-4*	6-8	-	-
Oleander	Nerium oleander	3-4*	6-8	-	-
European olive	Olea europaea	3-4*	6-8	-	1-2
Russian olive[5]	Elaeagnus angustifolia	3-4*	6-8	-	-
California fan palm	Washingtonia filifera	3-4*	6-8	-	-
European fan palm	Chamaerops humilis	3-4*	6-8	-	-

Mexican fan palm	Washingtonia robusta	3-4*	6-8	-	-
Afgan pine	Pinus eldarica	3-4*	6-8	-	-
Aleppo pine	Pinus halepensis	3-4*	6-8	-	-
Austrian pine	Pinus nigra	3-4*	6-8	-	-
Pinon pine[4]	Cupressus semperirens	3-4*	6-8	-	-
White pine[4]	Pinus strobus	3-4*	6-8	-	-
Chinese pistache	Pistacia chinensis	3-4*	6-8	-	-
Texas pistache[4]	Pistacia texana	3-4*	6-8	-	-
Rosemary	Rosmarinus officinalis	3-4*	6-8	-	-
Texas sage[4]	Leucophyllum frutescens	3-4*	6-8	-	-

Trees and Shrubs					
Very Tolerant		**Salinity Threshold**			
Common Name	**Botanical Name**	**Electrical Conductivity**			**Boron in Irrigation Water**
		Irrigation Water	**Soil**		
		(dS/m)[1]	(dS/m)	R/P[2]	(mg/L)[3]
Salt cedar[5]	Tamarix sp.	4-5*	8-10	-**	-
Ceniza[4] (Texas silverleaf)	Leucophyllum frutescens	4*	>8	-	-
Century plant[4]	Agave americana	4-5*	8-10	-	-
Brush cherry[4]	Syzygium paniculatum	4*	>8	-	≤1
Black locust[4]	Robinia pseudoacacia	4-5*	8-10	-	-
Honey locust[4]	Gleditsia triacanthos	4-5*	8-10	-	-
Chilean mesquite	Prosopis chilensis	4-5*	8-10	-	-
Honey mesquite[4]	Prosopis glandulosa	4-5*	8-10	-	-
Screwbean mesquite[4]	Prosopis pubescens	5*	>10	-	-
Canary Island date palm	Phoenix canariensis	4-5*	8-10	-	2-4
Evergreen pear	Pyrus kawakamii	4*	>8	-	≤1
Italian stone pine	Pinus pinea	4*	>8	-	-
Natal plum	Carissa grandiflora	4*	>8	-	≤1
Fourwing saltbush[4]	Atriplex canescens	4-5*	8-10	-	-

Turfgrasses, Flowers, and Ornamental Ground Covers					
Sensitive		**Salinity Threshold**			
Common Name	**Botanical Name**	**Electrical Conductivity**			**Boron in Irrigation Water**
		Irrigation Water	**Soil**		
		(dS/m)[1]	(dS/m)	R/P[2]	(mg/L)[3]
Begonia	Begonia sp.	1.5*	<3	-**	-
Colonial bentgrass[4]	Agrostis capillaris	1-1.5*	2-3	-	-
Kentucky bluegrass[4]	Poa pratensis	1-1.5*	2-3	-	-
Rough bluegrass[4]	Poa trivialis	1-1.5*	2-3	-	-
Centipedegrass	Eremochloa ophiuroides	1-1.5*	2-3	-	-
Spring cinquefoil	Potentilla tabernaemontanii	1.5*	<3	-	-
Virginia creeper[4]	Parthenocissus quinquefolia	1.5*	<3	-	-
Gerbera	Gerbera jamesonti	1.5*	<3	-	-
Japanese honeysuckle	Lonicera japonica	1.5*	<3	-	-
English ivy	Hedera helix	1.5*	<3	-	-
Asian jasmine	Trachelospermum asiaticum	1.5*	<3	-	-
Carolina jasmine	Gelsemium sempervirens	1.5*	<3	-	-
Star jasmine	Trachelospermum jasminoides	1*	1-2	-	-
Lily of the Nile	Agapanthus africanus	1.5*	<3	-	-
Mexican primrose	Oenothera berlandieri	1.5*	<3	-	-

Turfgrasses, Flowers, and Ornamental Ground Covers					
Moderately Tolerant		**Salinity Threshold**			
Common Name	**Botanical Name**	**Electrical Conductivity**			**Boron in Irrigation Water**
		Irrigation Water	**Soil**		
		(dS/m)[1]	(dS/m)	R/P[2]	(mg/L)[3]
Aster	Aster sp.	1.5-2*	3-6	-**	-
Buffalograss[4]	Buchloe dactyloides	1.5-2*	3-6	-	-
Carnation	Dianthus sp.	1.5-2*	3-6	-	-
Coleus	Coleus hybridus	1.5-2*	3-6	-	-
Algerian ivy	Hedera canariensis	1.5-2*	3-4	-	-
Lantana[4] (Yellow sage)	Lantana camara	1.5-2*	3-6	-	-
Trailing lantana	Lantana montevidensis	1.5-2*	3-6	-	-

Turfgrasses, Flowers, and Ornamental Ground Covers					
Tolerant		**Salinity Threshold**			
Common Name	**Botanical Name**	**Electrical Conductivity**			**Boron in Irrigation Water**
		Irrigation Water	**Soil**		
		(dS/m)[1]	(dS/m)	R/P[2]	(mg/L)[3]
Spreading acacia	Acacia redolens	3-4*	6-8	-**	-
Bermudagrass	Cynodon dactylon	4.6	6-8	6	-
Bougainvillea	Bougainvillea spectabilis	3-4*	6-8	-	-
Fountaingrass	Pennisetum setaceum	3-4*	6-8	-	-
Germanium	Pelargonium sp.	3-4*	6-8	-	-
Pfizer juniper	Juniperus chinensis Pfitzeraiana	3-4*	6-8	-	-
Spider plant	Chlorophytum comosum	3-4*	6-8	-	-
Zoysiagrass ‘Zenith’	Zoysia sp.	3-4*	6-8	-	-

Turfgrasses, Flowers, and Ornamental Ground Covers					
Very Tolerant		**Salinity Threshold**			
Common Name	**Botanical Name**	**Electrical Conductivity**			**Boron in Irrigation Water**
		Irrigation Water	**Soil**		
		(dS/m)[1]	(dS/m)	R/P[2]	(mg/L)[3]
Creeping boobialla	Myoporum parvifolium	4-5*	8-10	-**	-
Croceum iceplant	Hymenocyclus croceus	5*	>10	-	-
Purple iceplant	Lampranthus productus	5*	>10	-	-
Rosea iceplant	Drosanthemum hispidum	5*	>10	-	-
St. Augustinegrass	Stenotaphrum secundatum	4-5*	8-10	-	-
White iceplant	Delosperma alba	5*	>10	-	-
Seashore paspalum[4]	Paspalum vaginatum	4-5*	8-10	-	-

Vegetables and Herbaceous Crops					
Very Sensitive		**Salinity Threshold**			
Common Name	**Botanical Name**	**Electrical Conductivity**			**Boron in Irrigation Water**
		Irrigation Water	**Soil**		
		(dS/m)[1]	(dS/m)	R/P[2]	(mg/L)[3]
Jerusalem artichoke (sunroot)	Helianthus tuberosus	1*	0-1	10	≤1
Bean	Phaseolus vulgaris	1	1	19	1-2
Kidney bean	Phaseolus vulgaris	1*	0-1	-**	1-2
Lima bean	Phaseolus lunatus	1*	0-1	-	1-2
Mung bean	Vigna radiata	1*	1-2	21	1-2
Broad bean	Vicia faba	1*	1-2	10	2-4
Brussel sprouts	Brassica oleracea gemmifera	1*	0-1	-	-
Cabbage	Brassica oleracea capitata	1	1-2	10	2-4
Carrot	Daucus carota	0-1	1-2	14	2-4
Celery	Apium graveolens	1*	1-2	6	-
Sweet corn	Zea mays	1-2	1-2	12	1-2
Eggplant	Solanum melongena esculentum	1*	1-2	7	-
Kale	Brassica oleracea acephala	1*	1-2	-	-
Kohlrabi	Brassica oleracea gongylode	1*	1-2	-	-
Lettuce	Lactuca sativa	1-2	1-2	13	2-4
Okra	Abelmoschus esculentus	1*	<2	-	-
Onion	Allium cepa	0-1	1-2	16	2-4
Hot (chile) pepper	Capsicum annuum	1*	1-2	14	1-2
Potato	Solanum tuberosum	1-2	1-2	12	1-2
Sweet potato	Ipomoea batatas	1	1-2	11	1-2

Pumpkin	Cucurbita pepo pepo	1*	1-2	-	1-2
Radish	Raphanus sativus	0-1	1-2	13	1-2
Sunflower	Helianthus annuus	1*	0-1	-	1-2
Cherry tomato	Solanum lycopersicum var. cerasiforme	1*	1-2	9	-
Turnip	Brassica rapa	1*	0-1	10	2-4

Vegetables and Herbaceous Crops					
Sensitive		**Salinity Threshold**			
Common Name	**Botanical Name**	**Electrical Conductivity**			**Boron in Irrigation Water**
		Irrigation Water	**Soil**		
		(dS/m)[1]	(dS/m)	R/P[2]	(mg/L)[3]
Broccoli	Brassica oleracea botrytis	1-2	2-3	9	-**
Canola (rapeseed)	Brassica campestris	1-1.5*	2-3	-	-
Cantaloupe	Cucumis sp.	1-2	2-3	9	-
Cauliflower	Brassica oleracea botrytis	1-2*	2-4	-	-
Cucumber	Cucumis sativus	1-2	2-3	13	-
Garlic	Allium sativum	1.5-2*	3-4	14	-
Muskmelon	Cucumis melo	1-2*	2-4	-	-
Pea	Pisum sativum	1.5-2*	3-4	11	1-2
Sweet (bell) pepper	Casicum annuum	1-1.5*	2-3	6	1-2
Spinach	Spinacia oleracea	1-2	2-3	-	-
Squash	Cucurbita pepo	1-2*	2-4	-	-
Scallop squash	Cucurbita pepo var. clypeata	1.5-2*	3-4	-	-
Tomato	Solanum lycopersicum var. lycopersicum	1-2	2-3	10	1-2
Watermelon	Citrullus lanatus	1*	2.0	20	-

Vegetables and Herbaceous Crops					
Moderately Tolerant		**Salinity Threshold**			
Common Name	**Botanical Name**	**Electrical Conductivity**			**Boron in Irrigation Water**
		Irrigation Water	**Soil**		
		(dS/m)[1]	(dS/m)	R/P[2]	(mg/L)[3]
Artichoke	Cynara cardunculus var. scolymus	2.5-3*	5-6	12	≤1
Asparagus	Asparagus officinalis	2-3	4-5	2	2-4
Red beet	Beta vulgaris	2-3	4-6	9	2-4
Sugar beet	Beta vulgaris	2-3*	4-6	-**	2-4
Big Bend bluebonnet[4]	Lupinus havardii	3-4	6-7	-	-
Texas bluebonnet[4]	Lupinus texensis	5-6	-	-	-
Chocolate daisy[4]	Berlandiera lyrata	3-4	6-7	-	-
Mexican hat[4]	Ratibida columnaris	5-7	-	-	-
Hooker's evening primrose	Cynara cardunculus var. scolymus	4-5	5-7	-	-
Purslane	Portulaca oleracea	3-3.5*	6-7	10	-
Mealy cup sage[4]	Salvia farinacea	4-5	5-5	-	-
Zucchini squash	Cucurbita pepo var. cylindrica	2-3*	4-6	-	-

Fruit and Nut Crops					
Very Sensitive		**Salinity Threshold**			
Common Name	**Botanical Name**	**Electrical Conductivity**			**Boron in Irrigation Water**
		Irrigation Water	**Soil**		
		(dS/m)[1]	(dS/m)	R/P[2]	(mg/L)[3]
Almond	Prunus dulcis	1-2	1-2	19	≤1
Apple and crabapple	Malus species and cultivars	1-2	1-2	-**	≤1
Apricot	Prunus armeniaca	1-2	1-2	24	≤1
Avocado	Persea americana	1	1-2	-	≤1
Blackberry	Rubus sp.	1-2	1-2	22	≤1
Blueberry	Vaccinium sp.	1*	1-2	-	-
Boysenberry	Rubus ursinus	1-2	1-2	22	-
Grape	Vitis sp.	1-2	1-2	10	≤1
Grapefruit	Citrus paradisi	1-2	1-2	14	≤1
Lemon	Citrus limon	1-2	1-2	13	≤1
Orange	Citrus sinensis	1*	1-2	13	≤1
Peach	Prunus persica	1-2	1-2	21	≤1
Pear	Pyrus communis	1-2	1-2	-	≤1
Pecan	Carya illinoinsis	<1	1-2	-	≤1
Plum[4]	Prunus domestica	1*	1-2	21	≤1
Raspberry	Rubus idaeus	1*	1-2	-	-
Strawberry	Fragaria sp.	1*	1-2	33	-
Walnut[4]	Juglans sp.	1*	1-2	-	≤1

Fruit and Nut Crops					
Sensitive		**Salinity Threshold**			
Common Name	**Botanical Name**	**Electrical Conductivity**			**Boron in Irrigation Water**
		Irrigation Water	**Soil**		
		(dS/m)[1]	(dS/m)	R/P[2]	(mg/L)[3]
Cherry	Prunus avium	1.5*	<3	-**	≤1
Fig	Ficus carica	1-2	2-3	-	≤1
Persimmon[4]	Diospyros virginiana	1.5*	<3	-	≤1
Pomegranate	Prunicia sp.	1-2	2-3	-	-

Fruit and Nut Crops					
Moderately Tolerant		**Salinity Threshold**			
Common Name	**Botanical Name**	**Electrical Conductivity**			**Boron in Irrigation Water**
		Irrigation Water	**Soil**		
		(dS/m)[1]	(dS/m)	R/P[2]	(mg/L)[3]
Guava	Psidium guajava	2-2.5*	4-5	10	-**
Jujube	Ziziphus jujuba	2-3*	4-6	-	-
Date palm	Phoenix dactylifera	1-2	4-6	4	2-4

Fruit and Nut Crops					
Tolerant		**Salinity Threshold**			
Common Name	**Botanical Name**	**Electrical Conductivity**			**Boron in Irrigation Water**
		Irrigation Water	**Soil**		
		(dS/m)[1]	(dS/m)	R/P[2]	(mg/L)[3]
Jojoba	Simmondsia chinensis	5-6	6-8	-**	-
European olive	Olea europaea	3-4*	6-8	-	1-2

Field Grasses, Forages, and Field Crops

Very Sensitive		Salinity Threshold			
		Electrical Conductivity			Boron in Irrigation Water
Common Name	Botanical Name	Irrigation Water	Soil		
		(dS/m)[1]	(dS/m)	R/P[2]	(mg/L)[3]
Bean	Phaseolus vulgaris	0-1	0-1	19	1-2
Broad bean	Vicia faba	1*	1-2	10	2-4
Old World bluestem	Bothrichloa sp.	1*	1-2	-**	-
Alsike clover	Trifolium hybridum	1*	1-2	12	-
Berseem clover	Trifolium alexandrinum	1*	1-2	-	-
Red clover	Trifolium pretense	1*	1-2	12	-
Strawberry clover	Trifolium fragiferum	1*	1-2	-	-
White (Ladino) clover	Trifolium repens	1*	1-2	12	-
Corn	Zea mays	1*	1-2	7	1-2
Cowpea	Vigna unguiculata	1*	0-1	11	-
Flax	Linum usitatissimum	1	1-2	10	-
Meadow foxtail	Alopecurus pratensis	1*	1-2	-	-
Lovegrass	Eragrostis sp.	1*	2	8	-
Lupine	Lupinus hartwegii	1*	0-1	-	-
Orchardgrass	Dactylis glomerata	1-2	1-2	6	-
Sesame	Sesamum indicum	1*	0-1	-	-
Sugarcane	Saccharum sp.	1*	1-2	-	-
Sunflower	Helianthus annuus	1*	0-1	-	1-2

Field Grasses, Forages, and Field Crops					
Sensitive		**Salinity Threshold**			
Common Name	**Botanical Name**	**Electrical Conductivity**			**Boron in Irrigation Water**
		Irrigation Water	**Soil**		
		(dS/m)[1]	(dS/m)	R/P[2]	(mg/L)[3]
Alfalfa	Medicago sativa	1-2	2-3	7	2-4
Sweet clover	Melilotus indica	1-2*	2-4	-**	-
Tall fescue	Festuca elatior	1.5-2	3-4	5	-
Sideoats grama[4]	Bouteloua curtipendula	1-2*	2-4	-	-
Johnsongrass[5]	Sorghum halepense	1-1.5*	2-3	-	-
Muskmelon	Cucumis melo	1-2*	2-4	-	-
Mustard	Brassica juncea	1-2*	2-4	-	-
Oat	Avena sativa	1-2*	2-4	-	1-2
Peanut	Arachis hypogaea	1-2	3-4	29	-
Rice (paddy)	Oryza sativa	1-1.5*	2-3	-	-
Annual ryegrass	Lolium multiforum	1-1.5*	2-3	-	-
Sesbania	Sesbania exaltata	1-1.5*	2-3	7	-
Sphaerophysa	Sohaerophysa salsula	1-1.5*	2-3	7	-
Sudangrass	Sorghum sudanense	1-1.5*	2-3	4	-
Tobacco	Nicotiana tabacum	1-2*	2-4	-	-
Big trefoil	Lotus uliginosus	1-1.5*	2-3	-	-
Narrowleaf birdsfoot trefoil	Lotus corniculatus tenuifolium	1-1.5*	2-3	-	-
Common vetch	Vicia angustifolia	1-1.5*	2-3	11	-
Durum wheat (forage)	Triticum durum	1-1.5*	2-3	3	
Standard crested (Desert) wheatgrass	Agropyron desertorum	1.5-2*	3-4	-	-
Beardless wildrye[4]	Leymus (Elymus) triticoides	1-1.5*	2-3	-	-

Field Grasses, Forages, and Field Crops					
Moderately Tolerant		**Salinity Threshold**			
Common Name	**Botanical Name**	**Electrical Conductivity**			**Boron In Irrigation Water**
		Irrigation Water	**Soil**		
		(dS/m)[1]	(dS/m)	R/P[2]	(mg/L)[3]
Bahiagrass	Paspalum notatum	1.5-2*	3-6	-**	-
Creeping bentgrass	Agrostis palustris	1.5-2*	3-6	-	-
Big bluegrass	Poa secunda	1.5-2*	3-6	-	-
Plains bluegrass[4]	Poa arida	1.5-2*	3-6	-	-
Big bluestem[4]	Andropogon gerardii	1.5-2*	3-6	-	-
Plains bristlegrass[4]	Setaria leucopila	1.5-2*	3-6		-
Buffalograss[4]	Buchloe dactyloides	1.5-2*	3-6	-	-
Sand dropseed[4]	Sporobolus cryptandra	1.5-2*	3-6	-	-
Blue grama[4]	Bouteloua gracilis	1.5-2*	3-6	-	-
Dallisgrass[5]	Paspalum dilatatum	1.5-2*	3-6	-	-
Hardinggrass	Phalaris tuberosa	2-3*	4-6	-	-
Yellow indiangrass[4]	Sorghastrum nutans	2-4*	4-8	-	-
Kleingrass	Panicum coloratum L.	2-2*	4-6	-	-
Parsley	Petroselinum crispum	2-2*	4-6	-	-
Perennial ryegrass	Lolium perenne	2-2*	4-6	8	-
Safflower	Carthamus tinctorius	2-2*	4-6	-	-
Soybean	Glycine max	2-2*	4-6	-	-
Switchgrass[4]	Panicum virgatum	2-4*	4-8	-	-
Purple vetch	Vicia benghalensis	2-2*	4-6	-	-
Wheat	Triticum aestivum	4	4-5	3	1-2
Intermediate wheatgrass	Agropyron intermedia	1.5-2*	3-6	-	-

Field Grasses, Forages, and Field Crops					
Tolerant		**Salinity Threshold**			
Common Name	**Botanical Name**	**Electrical Conductivity**			**Boron in Irrigation Water**
		Irrigation Water	**Soil**		
		(dS/m)[1]	(dS/m)	R/P[2]	(mg/L)[3]
Barley	Hordeum vulgare	5	8	7	1-2
Bermudagrass	Cynodon dactylon	4.6	6-8	6	-**
Castor bean	Ricinus communis	3-3.5*	6-7	-	-
Little bluestem[4]	Schizachyrium scoparium	3-3.5*	6-7	-	-
Cotton	Gossypium hirsutum	3-5*	6-10	-	1-2
Red fescue[4]	Festuca rubra	3-4*	6-8	-	-
Rye	Secale cereale	3-4*	6-8	5	-
Sorghum	Sorghum bicolor	3-5*	6-10	-	1-2
Triticale	x Triticosecale	3-3.5*	6-7	5	1-2
Fairway crested wheatgrass	Agropyron cristatum	3-4*	6-8	7	-
Siberian wheatgrass	Agropyron fragile	3-4*	6-8	-	-
Streambank wheatgrass	Elymus lanceolatus	3-4*	6-8	-	-

Field Grasses, Forages and Field Crops					
Very Tolerant		**Salinity Threshold**			
Common Name	**Botanical Name**	**Electrical Conductivity**			**Boron in Irrigation Water**
		Irrigation Water	**Soil**		
		(dS/m)[1]	(dS/m)	R/P[2]	(mg/L)[3]
Fults alkaligrass	Puccinellia distans	5*	>10	-**	-
Gulf cordgrass[4]	Spartina spartinae	5*	>10	-	-
Alkali muhly[4]	Muhlenbergia asperifolia	5*	>10	-	-
Alkali sacaton[4]	Sporobolus airoides*	5*	>10	-	-
Desert/Inland saltgrass[4]	Distichlis spicata	5*	>10	-	-
Tall Wheatgrass	Thinopyrum ponticum	5*	>10	-	-
Western wheatgrass	Agropyron smithii	5*	>10	-	-

Alphabetical Listing of All Plant Species

Common Name	Botanical Name	Salinity Threshold			
		Electrical Conductivity			Boron in Irrigation Water
		Irrigation Water	Soil		
		(dS/m)[1]	(dS/m)	R/P[2]	(mg/L)[3]
Glossy abelia	Abelia grandiflora	1-1.5*	2-3	-**	-
Spreading acacia	Acacia redolens	3-4*	6-8	-	-
Alfalfa	Medicago sativa	1-2	2-3	7	2-4
Fults alkaligrass	Puccinellia distans	5*	>10	-	-
Almond	Prunus dulcis	1-2	1-2	19	≤1
Apple and crabapple	Malus species and cultivars	1	1-2	-	≤1
Apricot	Prunus armeniaca	1-2	1-2	24	-
American arborvitae	Thuja occidentalis	2-3*	4-6	-	-
Oriental arborvitae	Platycladus orientalis	2-3*	4-6	-	-
Artichoke	Cynara cardunculus var. scolymus	2.5-3*	5-6	12	≤1
Jerrusalem artichoke (sunroot)	Helianthus tuberosus	<1*	0-1	10	≤1
European ash	Fraxinus exceisior	1.5-2*	3-4	-	-
European mountain ash	Sorbus aucuparia	1-1.5*	2-3	-	-
Green ash[4]	Fraxinus pennsylvanica	1.5-2*	3-4	-	-
Single leaf ash	Fraxinus anomola	1.5-2*	3-4	-	-
Wafer ash	Ptelea trifoliate	3-4*	6-8	-	-
White ash[4]	Fraxinus americana	2-3*	4-6	-	-
Asparagus	Asparagus officinalis	2-3	4-5	2	2-4
Large–toothed aspen	Populus grandidentata	2-3*	4-6	-	-
Trembling (Quaking) aspen[4]	Populus tremuloides	2-3*	4-6	-	-
Aster	Aster sp.	1.5-2*	3-6	-	-

Avocado	Persea americana	1	1-2	-	≤1
Bahiagrass	Paspalum notatum	1.5-2*	3-6	-	-
Barley	Hordeum vulgare	5	8	7	1-2
Bean	Phaseolus vulgaris	1	1	19	1-2
Broad bean	Vicia faba	1*	1-2	10	2-4
Castor bean	Ricinus communis	3-3.5*	6-7	-	-
Kidney bean	Phaseolus vulgaris	1*	0-1	-	1-2
Lima bean	Phaseolus lunatus	1*	0-1	-	1-2
Mung bean	Vigna radiata	1*	1-2	21	1-2
Red beet	Beta vulgaris	2-3	4-6	9	2-4
Sugar beet	Beta vulgaris	2-3*	4-6	-	2-4
Begonia	Begonia sp.	1.5*	<3	-	-
Colonial bentgrass[4]	Agrostis capillaris	1-1.5*	2-3	-	-
Creeping bentgrass[4]	Agrostis palustris	1.5-2*	3-6	-	-
Bermudagrass	Cynodon dactylon	3-4*	6-8	6	-
Grey birch	Betula populifolia	2-3*	4-6	-	-
Paper birch	Betula papyrifera	2-3*	4-6	-	-
Sweet birch	Betula leta	2-3*	4-6	-	-
Yellow birch	Bertula alleghaniensis	2-3*	4-6	-	-
Bird of paradise	Caesalpinia Mexicana	1-1.5*	2-3	-	-
Blackberry	Rubus sp.	1-2	1-2	22	≤1
Blueberry	Vaccinium sp.	1*	1-2	-	-
Big Bend bluebonnet[4]	Lupinus havardii	3-4	6-7	-	-
Texas bluebonnet[4]	Lupinus texensis	5-6	-	-	-
Big bluegrass	Poa secunda	1.5-2*	3-6	-	-
Kentucky bluegrass[4]	Poa pratensis	1-1.5*	2-3	-	-
Plains bluegrass[4]	Poa arida	1.5-2*	3-6	-	-
Rough bluegrass[4]	Poa trivialis	1.5-2*	2-3		-
Big bluestem[4]	Andropogon gerardii	1.5-2*	3-6	-	-

Old World bluestem	Bothrichloa sp.	1*	1-2	-	-
Little bluestem[4]	Schizachyrium scoparium	3-3.5*	6-7	-	-
Weeping bottlebrush	Callistemon viminalis	3-4*	6-8	-	-
Bougainvillea	Bougainvillea spectabilis	3-4*	6-8	-	-
Japanese boxwood	Buxus microphylla var.japonica	2-3*	4-6	-	≤1
Creeping boobialla	Myoporum parvifolium	4-5*	8-10	-	-
Boysenberry	Rubus ursinus	1-2	1-2	22	-
Plains bristlegrass[4]	Setaria leucopila	1.5-2*	3-6		-
Broccoli	Brassica oleracea botrytis	1-2	2-3	9	-
Brussel sprouts	Brassica oleracea gemmifera	1*	0-1	-	-
Buffalograss[4]	Buchloe dactyloides	1.5-2*	3-6	-	-
Cabbage	Brassica oleracea capitata	1	1-2	10	2-4
Canola (rapeseed)	Brassica campestris	1-1.5*	2-3	-	-
Cantaloupe	Cucumis sp.	1-2	2-3	9	-
Carnation	Dianthus sp.	1.5-2*	3-6	-	-
Carrot	Daucus carota	0-1	1-2	14	2-4
Northern catalpa	Catalpa speciosa	2-3*	4-6	-	-
Cauliflower	Brassica oleracea botrytis	1-2*	2-4	-	-
Eastern red cedar[4]	Juniperus virginiana	1.5-2*	3-6		-
Salt cedar[5]	Tamarix sp.	4-5*	8-10	-	-
Celery	Apium graveolens	1*	1-2	6	-
Ceniza[4] (Texas silverleaf)	Luecophyllum frutescens	4*	>8	-	-
Centipedegrass	Eremochloa ophiuroides	1-1.5*	2-3	-	-
Century plant[4]	Agave americana	4-5*	8-10	-	-
Cherry	Prunus avium	1.5*	<3	-	≤1
Black cherry[4]	Prunus serotina	2-3*	4-6	-	≤1
Brush cherry[4]	Syzygium paniculatum	4*	>8	-	≤1
Choke cherry[4]	Prunus virginiana	2-3*	4-6	-	≤1

European bird cherry	Prunus padus	2-3*	4-6	-	-
Common horse chestnut	Aesculus hippocastanum	3-4*	6-8	-	-
Chitalpa	Chitalpa tashkentensis	1-1.5*	2-3	-	-
Spring cinquefoil	Potentilla tabernaemontanii	1.5*	<3	-	-
Alsike clover	Trifolium hybridum	1*	1-2	12	-
Berseem clover	Trifolium alexandrinum	1*	1-2	-	-
White (Ladino) clover	Trifolium repens	1*	1-2	12	-
Red clover	Trifolium pretense	1*	1-2	12	-
Strawberry clover	Trifolium fragiferum	1*	1-2	-	-
Sweet clover	Melilotus indica	1-2*	2-4	-	-
Coleus	Coleus hybridus	1.5-2*	3-6	-	-
Gulf cordgrass[4]	Spartina spartinae	5*	>10	-	-
Corn	Zea mays	1*	1-2	7	1-2
Sweet corn	Zea mays	1-2	1-2	12	1-2
Cotoneaster	Cotoneaster sp.	1*	1-2	-	-
Cotton	Gossypium hirsutum	3-4*	6-10	-	1-2
Eastern cottonwood[4]	Populus deltoids	2-3*	4-6	-	-
Fremont cottonwood[4]	Populus fremontii	1.5-2*	3-6	-	-
Cowpea	Vigna unguiculata	1*	0-1	11	-
Coyote brush	Baccharis pilularis	3-4*	6-8	-	-
Virginia creeper[4]	Parthenocissus quinquefolia	1.5*	<3	-	-
Cucumber	Cucumis sativus	1-2	2-3	13	-
Arizona cypress[4]	Cupressus arizonica	3-4*	6-8	-	-
Leyland cypress	Cupressocyparis leylandii	1-1.5*	2-3	-	-
Italian cypress	Cupressus sempervirens	3-4*	6-8	-	-
Chocolate daisy[4]	Berlandiera lyrata	3-4	6-7	-	-
Dallisgrass[5]	Paspalum dilatatum	1.5-2*	3-6	-	-
White (flowering) dogwood[4]	Cornus florida	1-1.5*	2-3	-	-

Blue dracaena	Cordyline indivisa	3-4*	6-8	-	-
Sand dropseed[4]	Sporobolus cryptandra	1.5-2*	3-6	-	-
Thorny elaeagnus[5] (Silverthorn)	Elaeagnus pungens	2-3*	4-6	-	-
Box elder[4]	Acer negundo	2-3*	4-6	-	-
American elm[4]	Ulmus americana	1.5-2*	3-4	-	≤1
Chinese elm	Ulmus parvifolia	3-4*	6-8	-	-
Siberian elm	Ulmus pumila	2-3*	4-6	-	-
Eggplant	Solanum melongena esculentum	1*	1-2	7	-
Japanese euonymus	Euonymus japonica	3-4*	6-8	-	-
Red fescue[4]	Festuca rubra	3-4*	6-8	-	-
Tall fescue	Festuca elatior	1.5-2*	3-4	5	-
Fig	Ficus carica	1-2	2-3	-	≤1
Balsam fir	Abies balsamea	1-1.5*	2-3	-	-
Douglas fir	Pseudotsuga menziesii	1*	1-2	-	-
Flax	Linum usitatissimum	1.1	1-2	10	-
Fountaingrass	Pennisetum setaceum	3-4*	6-8	-	-
Meadow Foxtail	Alopecurus pratensis	1*	1-2	-	-
Garlic	Allium sativum	1.5-2*	3-4	14	-
Gerbera	Gerbera jamesonti	1.5*	<3	-	-
Germanium	Pelargonium sp.	3-4*	6-8	-	-
Goldenrain tree	Koelreuteria paniculata	1.5-2*	3-4	-	-
Blue grama[4]	Bouteloua gracilis	1.5-2*	3-6	-	-
Sideoats grama[4]	Bouteloua curtipendula	1-2*	2-4	-	-
Grape	Vitis sp.	1-2	1-2	10	≤1
Oregon grape	Mahonia aquifolium	1*	1-2	-	<0.5
Grapefruit	Citrus paradisi	1-2	1-2	14	≤1
Guava	Psidium guajava	2-2.5*	4-5	10	-
Pineapple guava	Feijoas sellowiana	1-1.5*	2-3	10	-

Guayule[4]	Parthenium argentatum	3.5-4*	7-8	11	-
Black gum[4]	Nyssa sylvatica	3-4*	6-8	-	-
Sweet gum[4]	Liquidambar styraciflua	3-4*	6-8	-	-
Hackberry[4]	Celtis occidentalis	1.5-2*	3-4	-	-
Netleaf hackberry[4]	Celtis reticulate	1.5-2*	3-4	-	-
Hardinggrass	Phalaris tuberosa	2-3*	4-6	-	-
Mexican hat[4]	Ratibida columnaris	5-7	-	-	-
Cockspur hawthorn[4]	Crataegus crus-galli	3-4*	6-8	-	-
Indian hawthorn	Rhaphiolepis indica	2-3*	4-6	-	-
Canadian hemlock	Tsuga canadensis	1-1.5*	2-3	-	-
Chinese hibiscus	Hibiscusr rosa-sinensis	1.5-2*	3-4	-	-
Burford holly	Ilex cornuta	1-1.5*	2-3	-	-
Brush holly[4]	Xylosma flexuosa	2-3*	4-6	-	-
Chinese holly	Ilex cornuta	1-1.5*	2-3	-	-
Yaupon holly[4]	Ilex vomitoria	1.5-2*	3-6	-	-
Japanese honeysuckle	Lonicera japonica	1.5*	<3	-	-
Croceum iceplant	Hymenocyclus croceus	5*	>10	-	-
Purple iceplant	Lampranthus productus	5*	>10	-	-
Rosea iceplant	Drosanthemum hispidum	5*	>10	-	-
White iceplant	Delosperma alba	5*	>10	-	-
Yellow indiangrass[4]	Sorghastrum nutans	2-3*	4-8	-	-
Algerian ivy	Hedera canariensis	1.5-2*	3-4	-	-
English ivy	Hedera helix	1.5*	<3	-	-
Asian jasmine	Trachelospermum asiaticum	1.5*	<3	-	-
Carolina jasmine	Gelsemium sempervirens	1.5*	<3	-	-
Star jasmine	Trachelospermum jasminoides	1*	1-2	-	-
Johnsongrass[5]	Sorghum halepense	1-1.5*	2-3	-	-
Jojoba	Simmondsia chinensis	5-6	6-8	-	-
Jujube	Ziziphus jujuba	2-3*	4-6	-	-

Bluepoint juniper	Juniperus chinensis 'Bluepoint'	1.5-2*	3-6	-	-
Hollywood juniper	Juniperus chinenses 'Torulosa'	1.5-2*	3-6	-	-
Pfizer juniper	Juniperus chinensis 'Pfitzeraiana'	3-4*	6-8	-	-
Rocky Mountain Juniper[4]	Juniperus scopulorum	1.5-2*	3-6	-	-
Spreading juniper	Juniperus horizontalis	2-3*	4-6	-	-
Kale	Brassica oleracea acephala	1*	1-2	-	-
Kleingrass	Panicum coloratum L.	2-3*	4-6	-	-
Kohlrabi	Brassica oleracea gongylode	1*	1-2	-	-
Lantana[4] (Yellow sage)	Lantana camara	1.5-2*	3-6	-	-
Trailing lantana	Lantana montevidensis	1.5-2*	3-6	-	-
Texas mountain laurel[4]	Sophora secundiflora	2-3*	4-6	-	-
Laurustinus, cv. Robustum	Viburnum tinusm	1.5-2*	3-4	-	-
Lemon	Citrus limon	1-2	1-2	13	≤1
Lettuce	Lactuca sativa	1-2	1-2	13	2-4
Lily of the Nile	Agapanthus africanus	1.5*	<3	-	-
American linden[4] (American Basswood)	Tilia americana	1-1.5*	2-3	-	-
Littleleaf linden	Tilia cordata	1-1.5*	2-3	-	-
Black locust[4]	Robinia pseudoacacia	4-5*	8-10	-	-
Honey locust[4]	Gleditsia triacanthos	4-5*	8-10		-
Lovegrass	Eragrostis sp.	1*	2	8	-
Lupine	Lupinus hartwegii	1*	0-1	-	-
Southern magnolia[4]	Magnolia grandiflora	2-3*	4-6	-	-
Maidenhair tree	Gingko biloba	1.5-2*	3-4	-	-
Amur maple	Acer ginnala	2-3*	4-6	-	-
Norway maple	Acer plantanoides	3-4*	6-8	-	-
Red maple[4]	Acer rubrum	1-1.5*	2-3	-	-

Silver maple	Acer saccharinum	1-1.5*	2-3	-	-
Sugar maple	Acer saccharum	1-1.5*	2-3	-	-
Chilean mesquite	Prosopis chilensis	4-5*	8-10	-	-
Honey mesquite[4]	Prosopis glandulosa	4-5*	8-10	-	-
Screwbean mesquite[4]	Prosopis pubescens	5*	>10	-	-
Mimosa (silk tree)	Albizia julibrissin	1.5-2*	3-6	-	-
Alkali muhly[4]	Muhlenbergia asperifolia	5*	>10	-	-
Muskmelon	Cucumis melo	1-2*	2-4	-	-
Mustard	Brassica juncea	1-2*	2-4	-	-
Crape myrtle	Lagerstroemia indica	1.5-2*	3-4	-	-
Nandina[5] (Heavenly bamboo)	Nandina domestic	1.5*	<3	-	-
Bur oak[4]	Quercus macrocarpa	1.5*	<3	-	-
English oak	Quercus robur	3-4*	6-8	-	-
Holly oak[4]	Quercus ilex	1-1.5*	2-3	-	-
Pin oak[4]	Quercus palustris	1*	1-2	-	-
Post Oak[4]	Quercus stellate	1*	0-2	-	-
Red oak[4]	Quercus rubra	3-4*	6-8	-	-
Shumard red oak[4]	Quercus shumardii	1.5*	<3	-	-
Southern live oak[4]	Quercus virginiana	1.5-2*	3-6	-	-
White oak[4]	Quercus alba	3-4*	6-8	-	-
Oat	Avena sativa	1-2*	2-4	-	1-2
Okra	Abelmoschus esculentus	1*	<2	-	-
Oleander	Nerium oleander	3-4*	6-8	-	-
Desert olive	Forestiera neomexicana	1.5-2*	3-6	-	-
European olive	Olea europaea	3-4*	6-8	-	1-2
Russian olive[5]	Elaeagnus angustifolia	3-4*	6-8	-	-
Onion	Allium cepa	1	1-2	16	2-4
Orange	Citrus sinensis	1*	1-2	13	≤1
Orchardgrass	Dactylis glomerata	1-2	1-2	6	-

Orchid tree	Bauhinia purpurea	2-3*	4-6	-	-
Japanese pagoda	Sophora japonica	1-1.5*	2-3	-	-
Brazilian fan palm	Brithrinax brasiliensis	1.5-2*	3-6	-	-
Cabbage palm	Sabal palmetto	1.5*	<3	-	-
California fan palm	Washingtonia filifera	3-4*	6-8	-	-
Canary Island date palm	Phoenix canariensis	4-5*	8-10	-	2-4
Chinese windmill palm	Trachycarpus fortune	1.5*	<3	-	-
Date palm	Phoenix dactylifera	1-2	4-6	4	2-4
European fan palm	Chamaerops humilis	3-4*	6-8	-	-
Mexican blue fan palm	Brahea armata	1.5-2*	3-6	-	-
Mexican fan palm	Washingtonia robusta	3-4*	6-8	-	-
Pindo palm	Butia capitata	1.5*	<3	-	-
Dwarf blue palmetto	Sabal minor 'Riverside'	1.5-2*	3-6	-	-
Parsley	Petroselinum crispum	2-3*	4-6	-	-
Seashore paspalum[4]	Paspalum vaginatum	4-5*	8-10	-	-
Pea	Pisum sativum	1.5-2*	3-4	11	1-2
Peach	Prunus persica	1-2	1-2	21	≤1
Peanut	Arachis hypogaea	1-2	3-4	29	-
Pear	Pyrus communis	1-2	1-2	-	≤1
Bradford pear	Pyrus calleryana	1*	1-2	-	-
Evergreen pear	Pyrus kawakamii	4*	>8	-	≤1
Pecan	Carya illinoinsis	<1	1-2	-	≤1
Sweet (bell) pepper	Casicum annuum	1-1.5*	2-3	6	1-2
Hot (chile) pepper	Capsicum annuum	1*	1-2	14	1-2
Persimmon[4]	Diospyros virginiana	1.5*	<3	-	≤1
Red tip photinia	Photinia fraseri	1*	1-2	-	<0.5
Afgan pine	Pinus eldarica	3-4*	6-8	-	-
Aleppo pine	Pinus halepensis	3-4*	6-8	-	-

Austrian pine	Pinus nigra	3-4*	6-8	-	-
Italian stone pine	Pinus pinea	4*	>8	-	-
Japanese black pine	Pinus thunbergiana	2-3*	4-6	-	-
Mugho pine	Pinus mugo	3-4*	6-8	-	-
Pinon pine[4]	Cupressus semperirens	3-4*	6-8	-	-
Ponderosa pine[4]	Pinus ponderosa	2-3*	4-6	-	-
Red or Norway pine	Pinus resinosa	1-1.5*	2-3	-	-
Scots pine	Pinus sylvestris	1*	1-2	-	-
White pine[4]	Pinus strobus	1-4*	6-8	-	-
Chinese pistache	Pistacia chinensis	3-4*	6-8	-	-
Mount atlas pistache	Pistacia atlantica	1.5-2*	3-6	-	-
Texas pistache[4]	Pistacia texana	3-4*	6-8	-	-
Dwarf pittosporum	Pittosporum tobira	1.5-2*	3-6	-	-
Japanese pittosporum	Pittosporum tobira	1.5-2*	3-4	-	-
London plane	Plantanus acerifolia	1-1.5*	2-3	-	-
Plum[4]	Prunus domestica	1*	1-2	21	≤1
Purple cherry plum	Prunus cerasifera	1.5-2*	3-6	-	≤1
Natal plum	Carissa grandiflora	4*	>8	-	≤1
Pomegranate	Prunicia sp.	1-2	2-3	-	-
Bolleana poplar	Populus alba ‘Bolleana’	1.5-2*	3-6	-	-
Lombardy poplar	Populus nigra	2-3*	4-6	-	-
White poplar	Populus alba	2-3*	4-6	-	-
Potato	Solanum tuberosum	1-2	1-2	12	1-2
Sweet potato	Ipomoea batatas	1	1-2	11	1-2
Mexican primrose	Oenothera berlandieri	1.5*	<3	-	-
Hooker’s evening primrose	Cynara cardunculus var. scolymus	4-5	5-7	-	-
Glossy privet	Ligustrum lucidum	2-3*	4-6	-	-
Pumpkin	Cucurbita pepo pepo	1*	1-2	-	1-2
Purslane	Portulaca oleracea	3-3.5*	6-7	10	-

Pyracantha	Pyracantha fortuneana	2-3*	4-6	-	-
Radish	Raphanus sativus	1	1-2	13	1-2
Raspberry	Rubus idaeus	1*	1-2	-	-
Eastern redbud[4]	Cercis canadensis	1-1.5*	2-3	-	-
Mexican redbud[4]	Cercis Canadensis var. mexicana	1.6	2-3	-	-
Western redbud[4]	Cercis occidentalis	1.5-2*	3-4	-	-
Rice (paddy)	Oryza sativa	1-1.5*	2-3	-	-
Rose	Rosa sp.	1-1.5*	2-3	-	-
Rosemary	Rosmarinus officinalis	3-4*	6-8	-	-
Rye	Secale cereale	3-4*	6-8	5	-
Annual ryegrass	Lolium multiforum	1-1.5*	2-3	-	-
Perennial ryegrass	Lolium perenne	1-3*	4-6	8	-
Alkali sacaton[4]	Sporobolus airoides	5*	>10	-	-
Safflower	Carthamus tinctorius	2-3*	4-6	-	-
Mealy cup sage[4]	Salvia farinacea	4-5	5-5	-	-
Texas sage[4]	Leucophyllum frutescens	3-4*	6-8	-	-
Fourwing saltbush[4]	Atriplex canescens	4-5*	8-10	-	-
Desert/Inland saltgrass[4]	Distichlis spicata	5*	>10	-	-
Sesame	Sesamum indicum	1*	0-1	-	-
Sesbania	Sesbania exaltata	1-1.5*	2-3	7	-
Shadblow	Amelanchier canadensis	3-4*	6-8	-	-
Silverberry[4]	Elaeagnus commutata	1.5-2*	3-6	-	-
Soapberry[4]	Dodonaea viscose	2-3*	4-6	-	-
Sorghum	Sorghum bicolor	3-4*	6-10	-	1-2
Soybean	Glycine max	2-3*	4-6	-	-
Sphaerophysa	Sohaerophysa salsula	2-3*	2-3	7	-
Spider plant	Chlorophytum comosum	3-4*	6-8	-	-
Spinach	Spinacia oleracea	1-2	2-3	-	-
Black Hills spruce	Picea glauca ‘densata’	3-4*	6-8	-	-
Norway spruce	Picea albies	1*	1-2	-	-

Squash	Cucurbita pepo	1-2*	2-4	-	-
Scallop squash	Cucurbita pepo var. clypeata	1.5-2*	3-4	-	-
Zucchini squash	Cucurbita pepo var. cylindrica	2-3*	4-6	-	-
St. Augustinegrass	Stenotaphrum secundatum	4-5*	8-10	-	-
Strawberry	Fragaria sp.	1*	1-2	33	-
Strawberry tree	Arbutus unedo	1.5-2*	3-4	-	-
Sudangrass	Sorghum sudanense	1-1.5*	2-3	4	-
Sugarcane	Saccharum sp.	1*	1-2	-	-
Sunflower	Helianthus annuus	1*	0-1	-	1-2
Switchgrass[4]	Panicum virgatum	2-4*	4-8	-	-
American sycamore[4]	Platanus occidentalis	1-1.5*	2-3	-	-
Arizona sycamore[4]	Platanus wrightii	1-1.5*	2-3	-	-
Tobacco	Nicotiana tabacum	1-2*	2-4	-	-
Tomato	Solanum lycopersicum var. lycopersicum	1-2	2-3	10	1-2
Cherry tomato	Solanum lycopersicum var. cerasiforme	1*	1-2	9	-
Tree of Heaven	Ailanthus altissima	1-4*	6-8	-	-
Big trefoil	Lotus uliginosus	1-1.5*	2-3	-	-
Narrowleaf birdsfoot trefoil	Lotus corniculatus tenuifolium	1-1.5*	2-3	-	-
Tulip Tree[4]	Liriodendron tulipifera	1-1.5*	2-3	-	-
Triticale	x Triticosecale	3-3.5*	6-7	5	-
Turnip	Brassica rapa	1*	0-1	10	2-4
Common vetch	Vicia angustifolia	1-1.5*	2-3	11	-
Purple vetch	Vicia benghalensis	2-3*	4-6	-	-
Vitex, Chaste tree[5]	Vitex agnus-castus	1-1.5*	2-3	-	-
Black walnut[4]	Juglans nigra	1-1.5*	2-3	-	≤1
Walnut[4]	Juglans sp.	1*	1-2	-	≤1
Watermelon	Citrullus lanatus	1*	2.0	20	-

Wheat	Triticum aestivum	4	4-5	3	1-2
Durum wheat (forage)	Triticum durum	1-1.5*	2-3	3	-
Wheatgrass	Agropyron sibiricum	3-4*	6-8	-	-
Fairway crested wheatgrass	Agropyron cristatum	3-4*	6-8	7	-
Intermediate wheatgrass	Agropyron intermedia	1.5-2*	3-6	-	-
Siberian wheatgrass	Agropyron fragile	3-4*	6-8	-	-
Standard crested (Desert) wheatgrass	Agropyron desertorum	1.5-2*	3-4	-	-
Streambank wheatgrass	Elymus lanceolatus	3-4*	6-8	-	-
Tall wheatgrass	Thinopyrum ponticum	5*	>10	-	-
Western wheatgrass	Agropyron smithii	5*	>10	-	-
Beardless wildrye[4]	Leymus (Elymus) triticoides	1-1.5*	2-3	-	-
Black willow[4]	Salix nigra	2-3*	4-6	-	-
Desert willow[4]	Chilopsis linearis	1-1.5*	2-3	-	-
Golden willow	Salix alba ‘vitellina’	1-3*	4-6	-	-
Golden weeping willow	Salix alba ‘tristis’	2-3*	4-6	-	-
Seep willow[4]	Baccharis salicifolia	2-3*	4-6	-	-
Japanese yew	Taxus cuspidate	1*	1-2	-	-
Southern yew	Podocarpus macrophyllus	1-1.5*	2-3	-	-
Yucca[4]	Yucca brevifolia	1-1.5*	2-3	-	-
Zoysiagrass	Zoysia sp.	3-4*	6-8	-	-

References

Fipps, G. 1996. Irrigation Water Quality Standards and Salinity Management Strategies. Texas Agricultural Extension Service. College Station, Texas. Pub. B-1667.

Harivandi, M.A., J.D. Butler, and L. Wu. 1992. Salinity and turfgrass culture. P. 207-229. *In* Waddington, D.V., R.N. Carrow, and R.C.Shearman (ed.) Turfgrass Agron. Monograph No. 32. ASA-CSSA-SSSA. Madison, WI.

Maas, E.V. 1990. Crop Salt Tolerance. In: K.K. Tanji (ed.) Agricultural Salinity Assessment and Management. American Society of Civil Engineers, New York, pp. 262-304.

Miyamoto, S., I. Martinez, M. Padilla, A. Portillo, and D. Ornelas. 2004. Landscape Plant Lists for Salt Tolerance Assessment. Texas Agricultural Experiment Station. http://www.plantanswers.com/Landscape_Plant_Lists_for_Salt_Tolerance_Assessment.pdf

Miyamoto, S., K. Piela, J. Davis, and L.G. Fenn. 1984. Salt effects on emergence and seedling mortality of guayule. Agron. J. 76:295-300.

Niu, G. and D.S. Rodriguez. 2010. Salinity tolerance of Sophora secundiflora and Cercis canadensis var. Mexicana. HortScience. 45:424-427.

Niu, G., D.S. Rodriguez, L. Aguiniga, and W. Mackay. 2007. Salinity tolerance of *Lupinus havardii* and *Lupinus texensis*. HortScience. 42: 526-528.

Niu, G., D,S, Rodriguez, and C. McKinney. 2012. Response of selected wildflower species to saline water irrigation. HortScience 47:1351-1355.

Provin, T. and J.L. Pitt. 2012. Managing Soil Salinity. Texas A&M AgriLife Extension Service. E-60.

Richards, L.A. (ed.). Diagnosis and Improvement of Saline and Alakli Soils. United States Salinity Laboratory. Agricultural Handbook No. 60.

Swift, C.E. 2012. Salt Tolerance of Various Temperate Zone Ornamental Plants. Colorado State University Extension. http://www.coopext.colostate.edu/TRA/PLANTS/stable.shtml

Tanji, K.K. and N.C. Kielen. 2002. Agricultural Drainage Water Management in Arid and Semi-Arid Areas. FAO Irrigation and Drainage Paper 61. ISBN 92-5-104839-8.

Unlukara, A., A. Kurunc, G.D. Kesmez, E. Yurtseven, and D.L. Suarez. 2010. Effects of Salinity on EggPlant Growth and Evaportanspiration. Irrig. and Drain. 59:203-214.

Zhou, G. B.L. Ma, J. Li, C. Feng, J Lu, P. Qin. Determining the Salinity Threshold Level for Castor Bean Emergence and Stand Establishment. Crop Sci. 50:2030-2036.

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