

The Effects of Flooding on Plants and Woody Plants Tolerant to Wet Soil

Laura G. Jull, Dept. of Horticulture, UW–Madison

Growing plants in wet, poorly drained soil can be quite difficult. To the extreme, very heavy rainfall followed by flooding can not only cause tremendous damage to buildings and homes, but also can kill woody and herbaceous plants, while other plants remain unaffected. The question is often raised, “How long can my plants tolerate their roots being submerged?”

It would depend on the time of year the flood event occurs, duration of the flood event, species sensitivity to flooding, and type of soil the plants are growing in. Dormant plants are more tolerant than actively growing plants to flooding. Most plants can tolerate a couple of days of flooding during the growing season, but for some plants, a week or more of flooding can cause severe injury and death, particularly for sensitive tree and shrub species like: lindens, Norway and sugar maples, beech, northern red, white, and chinkapin oaks, hickories, black walnut, black locust, buckeyes, tuliptree, white-barked birches, American hophornbeam, Siberian elm, mulberry, yellowwood, cherries and plums, eastern redbud, magnolias, crabapples, mountainash, Washington hawthorn, lilacs, rhododendrons, privets, cotoneaster, spirea, euonymus, daphne, weigela, and evergreens like pines, Norway and Colorado blue spruces, Canadian hemlock, eastern red-cedar, Siberian cypress, yucca, and yews. Soil type is also an important factor to keep in mind with regard to drainage patterns. Sandy soil drains much faster than predominantly clay-based soils, which remain wet for longer durations.

Are there differences in a plant’s ability to tolerate flooding? Established, healthy trees and shrubs will be more tolerant to flooding than very old trees, stressed trees, or young trees and seedlings of the same species. Symptoms of plants under excessive water stress include yellowing or browning of leaves, leaf curling and pointing downward, leaf wilting, reduced new leaf size, early fall color, defoliation, branch dieback and in extreme cases, gradual plant decline and death over the next couple of years. There are plants that can recover from flooding injury in as little as one growing season while others do not recover at all. However, these stressed trees are more susceptible to secondary organisms such as canker fungi and wood boring insects. Trees that had a substantial amount of root injury and death are more subject to wind throw and should be monitored closely or removed entirely.

What causes plants to die in water-soaked soils? Besides the obvious killing of submerged branches and foliage, many

plants are intolerant to having their roots submerged for long periods of time. Excessive moisture in the soil causes oxygen levels in the soil to decrease, impeding proper root respiration. As a result, carbon dioxide, methane, hydrogen and nitrogen gas levels around the roots increase sharply, thus, roots can suffocate and die. Toxic compounds, such as ethanol and hydrogen sulfide, as well as numerous other harmful compounds, can build up in saturated soils. Photosynthesis is inhibited and growth slows or even stops. Excessively wet soils also favor soil-borne, root and crown rot organisms including *Fusarium* spp., *Phytophthora* spp., *Pythium* spp., and *Rhizoctonia solani*. These organisms have wide host ranges and prefer wet soil conditions. Even when standing water is not present, poorly drained soil can reduce plant growth and long-term survival in the landscape.

Another thing to be concerned about is the deposition of excess soil and rocks over tree roots following floodwater recession. Excess soil greater than three inches may impede oxygen transport from the atmosphere to tree and shrub roots, especially on smaller growing plants. This excess sediment should be removed after the water recedes. In contrast, tree roots may also become exposed due to soil erosion following flooding. These roots should be covered with soil to prevent drying out and damage of exposed roots. Improving drainage and aeration is critical to prevent future root injury. Finally, tree fertilization is not a cure for root injury and can make the problem worse.

How can I alleviate poorly drained soils in the future? If possible, avoid planting in areas that drain slowly after rain or are flooded consistently after a very heavy rainfall. The next step is to improve the site’s drainage. Addition of loose organic material, such as composted leaves, pine bark, and peat moss can improve porosity in the soil. Plant on raised beds or berms, install swales, waterways, and drain tiles to divert excess water away from trees and shrubs. Finally, plant health care is an important step to reduce further plant decline. Remove dead or diseased branches, water plants during extended droughts, aerate the soil around the tree’s roots, and properly mulch trees with no more than three to four inches of shredded bark, avoiding mulch from touching the bark on the trunk and branches, all key to improving plant vigor.

If your soil is subject to standing water after a heavy rainfall, it is best to plant species that are tolerant to wet soils. Bottomland plants—plants that naturally grow in lowland areas along riverbanks

subject to fluctuating water tables—are able to tolerate wet soils better than upland species that grow at higher elevations. Also, different plants tolerate different degrees of wetness. Is your area permanently wet, somewhat wet, or wet for only a few days at a time? Roots need oxygen for growth and respiration and the longer the roots stay submerged, the more difficult it is for the plant to survive. The following is a list of wet soil tolerant woody species. Some species are known to tolerate extended periods of flooded conditions and are indicated with an asterisk (*).

Trees

- Acer negundo*: boxelder, zone 2b, native, reseeds and sprouts readily
- **Acer rubrum*: red maple, zone 3b or 4b, (depends on cultivar), native, acid soils only
- **Acer saccharinum*: silver maple, zone 3a, native, reseeds and sprouts readily
- **Acer x freemanii*: Freeman maple, zone 3b, native hybrid
- **Alnus glutinosa*: European black alder, zone 4a, invasive
- **Betula nigra*: river birch, zone 4a, native, acid soils only
- Carpinus caroliniana*: musclewood, American hornbeam, zone 3b, native, periodic flooding only
- Catalpa speciosa*: northern catalpa, zone 4a
- **Celtis occidentalis*: common hackberry, zone 3b, native
- **Fraxinus nigra*: black ash, zone 3a, native, susceptible to EAB
- **Fraxinus pennsylvanica*: green ash, zone 2a, native, susceptible to EAB
- Fraxinus mandshurica*: Manchurian ash, zone 3, susceptible to EAB
- **Gleditsia triacanthos* var. *inermis*: thornless honeylocust, zone 4a, native
- Gymnocladus dioica*: Kentucky coffeetree, zone 4a, native, periodic flooding only
- **Larix laricina*: tamarack, American larch, zone 2, native, acid soils
- **Liquidambar styraciflua*: sweet gum, zone 5b
- Maclura pomifera*: osage-orange, Bois-D’arc, zone 4b, female trees have very large fruit
- Metasequoia glyptostroboides*: dawn redwood, zone 5b
- Nyssa sylvatica*: black gum, sour gum, tupelo, zone 4b, native
- **Platanus occidentalis*: American sycamore, American planetree, zone 4b, native
- Platanus x acerifolia*: London planetree, zone 5b
- **Populus deltoides*: eastern cottonwood, zone 3a, native, reseeds readily, messy tree
- Quercus bicolor*: swamp white oak, zone 4a, native
- **Quercus palustris*: pin oak, zone 4b, acid soils only
- **Salix* ‘Golden Curls’: Golden Curls willow, zone 4b
- **Salix lucida*: shining willow, zone 2, native

- **Salix matsudana* 'Tortuosa': corkscrew willow, curly willow, zone 4b
- **Salix nigra*: black willow, zone 4a, native, messy tree
- **Salix x pendulina* 'Blanda': Wisconsin weeping willow, zone 4, messy tree
- **Salix pentandra*: laurel willow, zone 2b
- **Salix* 'Prairie Cascade': Prairie Cascade willow, zone 3b
- **Salix x sepulcralis* var. *chrysocoma*: golden weeping willow, zone 4a, messy tree
- **Taxodium distichum*: baldcypress, zone 4b
- **Ulmus americana*: American elm, zone 3a, native, pest prone, use only DED resistant cultivars

Narrow-leaved Evergreens

- Abies balsamea*: balsam fir, zone 3a, native, evergreen, acid soils only
- **Chamaecyparis thyoides*: Atlantic white-cedar, zone 4b, evergreen, shrub forms available
- **Picea mariana*: black spruce, zone 3a, native in bogs, hard to grow, shrub forms available, evergreen
- Thuja occidentalis*: eastern or northern white-cedar, zone 3a, native, evergreen, periodic flooding only

Shrubs

- **Alnus incana* subsp. *rugosa*: speckled alder, swamp alder, zone 3b, native
- Andromeda polifolia*: bog rosemary, zone 3, native in bogs, hard to grow, broad-leaved evergreen
- Aronia arbutifolia*: red chokeberry, zone 4b
- Aronia melanocarpa*: black chokeberry, zone 4b, native
- Aronia x prunifolia*: purple chokeberry, zone 4a
- **Cephalanthus occidentalis*: buttonbush, zone 4b, native
- Chamaedaphne calyculata*: leatherleaf, zone 3, native in bogs, hard to grow, broad-leaved evergreen
- Clethra alnifolia*: summersweet clethra, zone 4b, acid soil
- **Cornus alba*: Tatarian dogwood, zone 3a
- **Cornus amomum*: silky dogwood, zone 4, native
- Cornus racemosa*: gray dogwood, zone 3b, native
- **Cornus sanguinea*: bloodtwig dogwood, zone 4a
- **Cornus stolonifera*: red twig dogwood, red osier dogwood, zone 3a, native
- Dirca palustris*: leatherwood, zone 4a, native
- Hamamelis vernalis*: vernal witchhazel, zone 4b, acid soils only
- **Ilex verticillata*: winterberry, Michigan holly, zone 3b, native, acid soil
- Itea virginica*: Virginia sweetspire, zone 5b, acid soils only
- Kalmia polifolia*: bog kalmia, zone 2b, native in bogs, hard to grow, broad-leaved evergreen

- Ledum groenlandicum*: Labrador tea, zone 2b, native in bogs, hard to grow, broad-leaved evergreen
- Lindera benzoin*: spicebush, zone 5b
- Morella pensylvanica* (formerly *Myrica*): northern bayberry, zone 4a, periodic flooding only
- Rhododendron arborescens*: sweet azalea, smooth azalea, zone 5b, acid soils only, periodic flooding only
- Rhododendron vaseyi*: pinkshell azalea, zone 5b, acid soils only, periodic flooding only
- Rhododendron viscosum*: swamp azalea, zone 5a, acid soils only
- Rosa blanda*: meadow rose, zone 3b, native, periodic flooding only
- Rosa carolina*: Carolina rose, pasture rose, zone 3b, native, periodic flooding only
- **Rosa palustris*: swamp rose, zone 4a, native
- **Salix alba* 'Britzensis': coral bark willow, zone 2b, prune to keep it a shrub
- **Salix chaenomeloides*: Japanese pussy willow, zone 5b
- **Salix caprea*: goat willow, zone 4a
- **Salix discolor*: common pussy willow, zone 3a, native
- **Salix elaeagnos*: rosemary or hoary willow, zone 4
- **Salix gracilistyla* var. *melanostachys*: black pussy willow, zone 4b
- **Salix integra* 'Hakuro Nishiki': Japanese dappled willow, zone 4b
- **Salix purpurea* 'Gracilis': blue arctic willow, zone 3b
- **Salix udensis* 'Sekka': Japanese fantail willow, zone 4
- Sambucus canadensis*: American elderberry, zone 3b, native
- Sambucus nigra*: European elderberry, zone 4b
- Spiraea alba*: meadowsweet, zone 4, native
- Spiraea tomentosa*: hardhack, steeplebush, zone 4, native
- Staphylea trifolia*: American bladdernut, zone 4a, native
- Vaccinium corymbosum*: highbush blueberry, zone 3b, native, acid soils only, periodic flooding only
- **Vaccinium macrocarpon*: American cranberry, zone 2b, native in bogs, hard to grow, broad-leaved evergreen
- Viburnum cassinoides*: witherod viburnum, zone 4a, native
- Viburnum lentago*: nannyberry viburnum, zone 3a, native, pest prone, periodic flooding only
- Viburnum opulus*: European cranberrybush viburnum, zone 3a, invasive
- Viburnum trilobum*: American cranberrybush viburnum, zone 3a, native
- Vitis riparia*: riverbank grape, frost grape, zone 4, native
- Xanthorhiza simplicissima*: yellowroot, zone 3b, groundcover

Resources

- Ball, J. and D.F. Graper. 1996. *What to do about flood damaged trees?* South Dakota State University Extension Extra publication, Brookings, SD.
- Coder, K.D. 1994. *Flood damage to trees.* University of Georgia Extension Publication FOR 94-61, Athens, GA.
- Dirr, M.A. 1997. *Dirr's Hardy Trees and Shrubs: An Illustrated Encyclopedia.* Timber Press, Portland, OR.
- Iles, J. and M. Gleason. 1994. *Sustainable Urban landscapes: Understanding the effects of flooding on trees.* Iowa State University Extension Publication SUL-1, Ames, IA.
- Hudelson, B. and L.G. Jull. 2004. *Root and crown rots.* University of Wisconsin Extension Garden Fact Sheet XHT 1070, Madison, WI.
- Kozlowski, T.T. 1997. *Responses of woody plants to flooding and salinity. Tree Physiology Monograph No. 1.* Heron Publishing, Victoria, Canada.
- Ranney, T.G., R.E. Bir, M.A. Powell, and T. Bilderback. 1994. *Qualifiers for quagmires: Landscape plants for wet sites.* N.C. State University Extension Publication HIL-8646, Raleigh, NC.