



Flood-damaged Trees

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FLOODING'S EFFECTS ON TREES

Tree health is adversely affected when the surrounding soil is temporarily flooded by the overflow of streams and rivers or when the soil is saturated by persistent rains. The primary effect of flooding is the reduction in soil oxygen. The upper 6 inches of a typical soil has an abundance of oxygen and is where the roots responsible for the absorption of water and nutrients reside.

Most people are aware of photosynthesis, the process where trees "take in the bad air" (CO_2) and "give back the good air (O_2)," but many are unaware that living tree tissue is also respiring, taking in the good O_2 and giving off the bad CO_2 ; this applies to all the living tissue in a tree, including the roots. When flooding occurs, the soil has less oxygen for root respiration and the roots begin to die. As the roots die, the tree's ability to absorb water decreases and the foliage begins to wilt. Paradoxically, the tree dies from the lack of water because it is standing in water—a phenomenon referred to as "physiological drought."

SYMPTOMS OF FLOOD INJURY

The most common symptoms associated with flooding:

- leaf discoloration, usually yellowing
- leaf scorching and wilting
- premature fall color
- premature defoliation
- sprouting along the trunk
- twig and branch dieback
- with severe or persistent flooding, death

The above symptoms may occur during or after flooding. It may take several years for a tree to decline after a flood, and many more years before the tree begins to recover.

TREE SPECIES AND FLOODING

Tree species do not respond the same to flooding. Some tree species, typically those found growing natu-

rally along rivers and streams, can tolerant and adapt to flooded conditions. Species that are tolerant to flooding may be able to withstand more than a month of flooding, depending on other conditions. Species that are intolerant of flooding may begin to die with as little as a week's exposure to flooding. An individual tree's tolerance to flooding is also dependent upon its age and health. Overmature trees generally cannot withstand as long a period of flooding as younger trees, though seedlings and saplings are also killed. The trees most likely to survive are usually 4- to 16-inches in diameter (measured at 4.5 feet above the ground). Trees that are in good health are more likely to survive the stress of flooding, regardless of age.

The commonly planted species with the highest tolerance to flooding (these trees may be able to withstand more than a month of flooding):

- Acer negundo* – boxelder
- Acer rubrum* – red maple
- Fraxinus pennsylvanica* – green ash
- Fraxinus nigra* – black ash
- Salix nigra* – black willow

The commonly planted species with an intermediate tolerance to flooding (these trees may be able to withstand several weeks to a month of flooding during the growing season):

- Acer x freeman* – Freeman maples (common cultivars, including 'Autumn Blaze')
- Acer saccharinum* – silver maple
- Betula nigra* – river birch (though foliage may yellow)
- Celtis occidentalis* – hackberry
- Fraxinus americana* – white ash
- Gleditsia triacanthos* – honeylocust
- Platanus occidentalis* – sycamore
- Populus* – cottonwood and poplars
- Quercus* – bur oak, swamp white oak
- Ulmus americana* – American elm

The commonly planted species with the lowest tolerance to flooding (these trees may decline after only

weeks of flooding during the growing season):

Acer platanoides – Norway maple
Acer saccharum – sugar maple
Aesculus glabra – Ohio buckeye
Betula – birch (except river birch)
Crataegus – most hawthorns
Elaeagnus angustifolia – Russian-olive
Gymnocladus dioica – Kentucky coffeetree
Juglans nigra – black walnut
Malus – crabapples and apples
Prunus – all cherries (including black cherry) and stone fruits such as peaches and plums
Pinus – pines
Picea – spruce
Quercus rubra – northern red oak
Sorbus – mountainash
Tilia – lindens
Ulmus – many of the hybrid elms, including ‘Discovery’ and ‘Accolade’
Ulmus pumila – Siberian elm

CONDITIONS OF FLOODING

Season of flooding

Late spring and early summer flooding is the most harmful to trees, as they are the times when roots are actively growing. Standing in water, or even saturated soils, is harmful to all trees at this time of year. Flooding in late winter while the tree is dormant is the least harmful.

Duration, depth, water temperature, and movement

Duration, depth, and water temperature and movement are all key factors in determining the impact of flooding on trees. The longer the water remains during the growing season, the greater the impact. If the floodwater recedes within a week, most trees will recover. If the waters remain for a month or two, many trees will begin to decline and may die. The depth is also an important factor. Water on the trunks is considerably more harmful than water just covering the roots, so a good rule of thumb is the higher the water the greater the injury. Lastly, the water temperature and movement

have an influence on the amount of oxygen carried in the water. The warmer the water and the less movement, the lower the oxygen level and the more potential for injury.

Simply put, if the floodwaters become stagnant and remain for several weeks or more, covering the lower 2 or 3 feet of the tree’s trunks, most likely the tree will decline and die, though this may take a year or more to occur.

HELPING TREES AFTER FLOODING

After the floodwaters have receded, inspect the tree to determine whether the root collar, the base of the tree where the roots flare out and enter the soil, has been covered by sediment. If the flood has deposited sediment around the tree, carefully remove this material and restore the original grade as far out from the trunk as possible.

Ideally, all the deposited soils can be removed, but at the least, an area within 4 to 5 feet of the trunk should be restored to the pre-flooding grade—even an additional 3 inches of soil deposited around the base of a tree can have detrimental effects.

Also inspect the lower trunks for any torn bark. Use a sharp knife to cut away any torn bark, but do not attempt to carve the wound into an elliptical pattern or apply any wound dressing or paint. Any broken branches should be pruned off the tree.

It may take several years for a mature tree to recover from a single summer of flooding. During this recovery time, the tree is very vulnerable to attack by a number of insects and pathogens. Inspect your trees several times during the growing season and identify and manage any pest outbreak.

Do not fertilize your trees. Generally they will not benefit from any additional nutrients applied as a fertilizer; however, once the soils have dried, you may need to water the tree, as the root system may have declined enough that it cannot absorb sufficient water to maintain the canopy. Also expect some dieback in the canopy; remove these branches as they die. Do not prune any living branches unless they are broken.



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