



# Common Abiotic Plant Problems

Diagnosing a plant problem when there are no apparent biotic (disease pathogen or pest) causes can present a real challenge. An abiotic plant problem is not caused by any disease organisms or insects. An accurate diagnosis, whether biotic or abiotic, involves both science, (botany, entomology and pathology) and art (strategy, investigation and decision making). Abiotic problems can be very difficult to diagnose because they include site conditions, weather and cultural practices.

Determining the difference between the “symptom” and the “sign” of a problem is the first step in making a diagnosis. A “symptom” is the plant’s reaction to the causal agent. Typical distress symptoms of an abiotic problem may include very slow growth, poor foliage color, scorch, sparse growth, die-back, or even death of the plant. A “sign” is the actual presence of organisms such as insects, mites, or fungal mycelia (the vegetative part of a fungus). Insect or disease injury may be present but not severe enough to be the primary cause of the problem.

This fact sheet deals with typical abiotic problems of woody plants, especially trees. Woody plants, unlike herbaceous plants, are most severely affected by abiotic problems. Herbaceous plants tend to adapt better to adverse site conditions than woody plants. They also are less expensive, not as permanent, and easier to replace if they die than trees and shrubs.

Unfortunately, by the time many gardeners notice that a tree or shrub is dying, it is already too late for a cure. That is why the recognition and prevention of adverse site conditions is very important.

Regular consultations with a licensed and certified tree expert (arborist) can be very helpful. Problems with trees require a site visit for an accurate diagnosis. Always select an arborist who is a member of a professional association, such as the Maryland Arborist Association or the International Society of Arboriculture. You may also want to check references regarding their performance.

## Soil Grade Changes

Grade changes typically are necessary during new building construction. Any addition or subtraction from the natural soil grade will adversely affect tree roots. Certain species of trees respond to grade changes differently than others. Sometimes, very young plants adjust to minor soil grade changes. However, older, well established trees and shrubs are very sensitive to grade changes around their root systems. Trees particularly sensitive to grade changes are American beech, tulip poplar and oak. Soil placed over roots reduces soil aeration, and soil placed against the trunk decays lower trunk bark.

If a soil grade must be changed, plan to construct tree wells and perforated pipe systems to provide the roots with needed oxygen. Consultation with an arborist can be very helpful. Three inches of soil is the maximum depth that can safely be added without making special provisions. No additional soil should touch the trunk. Problems caused by soil grade changes take a long time to manifest themselves. Die-back or complete death of a tree may not occur for two to five years. Drought or excessive rain may hasten the decline.

**Remedy:** Unfortunately, when distress symptoms become severe, it is usually too late for any recovery, even after the excess soil has been removed. If the distress symptoms are not too severe, recovery may occur if the excess soil over the root system is carefully removed.

## Soil Compaction

Soil compaction is a major problem after construction. Its effects will last for years before it gradually improves. When the soil is compressed by heavy construction equipment, trucks, cars, and heavy pedestrian traffic, the soil structure is damaged. The air spaces (macro-pores) in the soil are reduced or eliminated. Wet soil and soil with a high clay content compacts very quickly. Roots need the oxygen present in the macro-pore spaces in the

soil. Soil compaction is a slow but sure process that causes poor growth and even death of mature, well-established woody plants.

**Remedy:** A soil analysis for nutrients, pH and bulk density can be very useful in starting a remedy plan for problem soils. Compacted soils in a planting bed can be improved by tilling-in liberal amounts of organic matter prior to planting. Do not add it directly to the planting hole, as this will cause water to collect in the hole after planting. There are three methods of adding organic matter to soils: vertical mulching, radial trenching and roto-tilling.

Vertical mulching is a method of drilling two inch wide holes, ten inches deep, in the soil throughout a tree's root system. Fill them with peat moss, compost, wood chips, mulch or similar organic matter. The small columns of organic matter will improve water and air penetration.

Radial trenching requires digging trenches ten inches deep, filled with organic matter, in a radial pattern from the tree trunk out beyond the drip line.

Tilling involves working in organic matter in the same way as preparing a vegetable or flower garden. Never till the soil under an established tree, as too many roots will be damaged. However, trees planted for less than two years can safely be tilled beyond the drip line.

The addition of gypsum or lime, either to the soil surface or tilled-in, is also beneficial in breaking up a compacted clay soil. But, it alone is not a substitute for organic matter.

There is much recent evidence to show that some tree roots respond to the addition of mycorrhizae into the root area. Mycorrhizae are naturally-occurring soil fungi. They live in a symbiotic relationship with tree roots. The roots benefit from their presence. Unfortunately, mycorrhizae are lacking in soils that have been severely disturbed during building construction. Arborists and landscape maintenance professionals can add mycorrhizae to the soil around trees.

### Changes in Water Flow

Changes in the natural flow of rain water can have an adverse effect on plants. Sometimes, correction of drainage problems elsewhere on a site diverts water to a tree or shrub, adding more water than it can handle. Another common problem is a downspout that does not drain away from the house because of excessive mulch or other obstructions. The resulting puddling in the garden damages plants. The damage may not appear until dry weather, when the plant is under drought stress.

**Remedy:** Take the time to observe the flow of water after a rain or irrigation. Look for leaking gutters and downspouts that do not empty far enough away from the building. Correcting a problem can be as simple as removing a little soil or mulch away from one spot to let the water flow away naturally. In some cases, a total regrading of the site may be necessary.

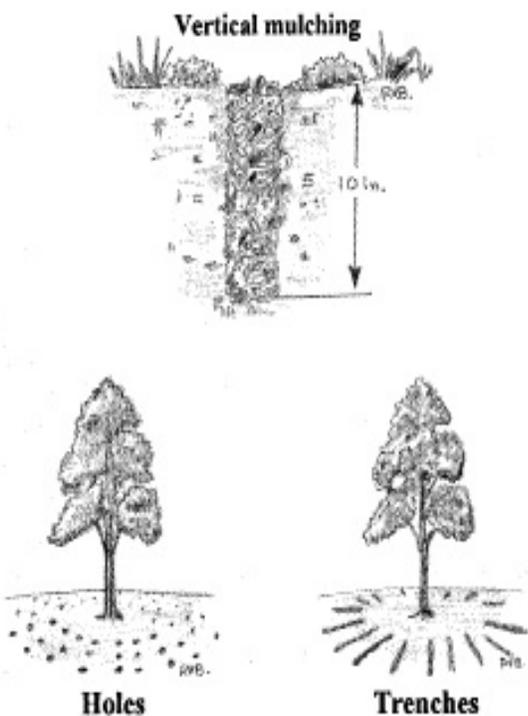
### Mechanical Root Damage

Most of the feeder roots of trees or shrubs are within the upper six inches of the soil. Any digging, trenching, or roto-tilling within the root area of established trees or shrubs will cause harm. Their recovery depends on the depth of the digging and the amount of ground covered. People easily forget the damage done when they install a driveway, patio or otherwise excavate their yard, believing that if there are no immediate symptoms their plants are unharmed. Unfortunately, this is not true. Root damage may haunt the plant months or even years later, depending on the environmental stresses that occurred.

**Remedy:** There is very little that can be done for roots damaged by digging. Fortunately, a minor amount of damage may have no visible effect but severe damage will cause branch die-back. The best help for root-damaged trees or shrubs is to prevent any additional stress. Keep them watered during droughts and provide a light fertilization in the spring or fall to stimulate new growth.

### Soluble Salt Damage to Roots

Root damage can occur from excessive fertilizer and misplaced ice-melt products. High application rates of fertilizer or ice-melt products containing rock salt can burn roots, resulting in leaf scorch or death of the plant.



**Remedy:** A soluble salts test, if done as soon as possible before too much rain, will reveal the problem of over-fertilization or ice-melt product damage. Soluble salts test results above 2.5 millimohs are excessive for most plants. With either type of damage, quickly irrigating with large amounts of water to flush the fertilizer salts is the course of action. Recovery may be successful, depending on the amount of roots killed by the salt.

## Poor Soil Drainage

The efficient movement of water through the soil is critical to root health. Soil with good porosity, such as one rich in organic matter, is capable of handling large quantities of water with no harmful effects to plant roots. Most landscape soils are not this ideal and drainage during rainy weather is a challenge.

Some popular landscape plants, such as white pines, azaleas, rhododendrons and yews, are very prone to root decay and become pre-disposed to fungal root diseases when grown in wet sites.

**Remedy:** Inspect the condition of the roots when digging out a dying plant. Dead roots are black or dark brown when scraped. Consistently wet soils will also have a foul odor caused by the anaerobic bacteria growing in it. A standard field test to check soil drainage is done by making a hole 18-inches deep and filling it with water. The water level should drop three inches every half hour. Correct the drainage problem by adding organic matter to the entire planting bed, not just the planting hole. Set the new tree or shrub a little higher than the existing soil grade. Mound the soil gradually to the top of the root ball. It is always best to match the right plant with the site. Do not choose species of trees or shrubs that can not tolerate wet conditions for poorly draining soils.

## Lower Trunk Damage

Some decline and die-back problems in woody plants are caused by stem or trunk damage. Damage may be overlooked because it is very close to the ground or even under the ground. Severe bark damage creates a strain on a plant's ability to transport water, nutrients and food.

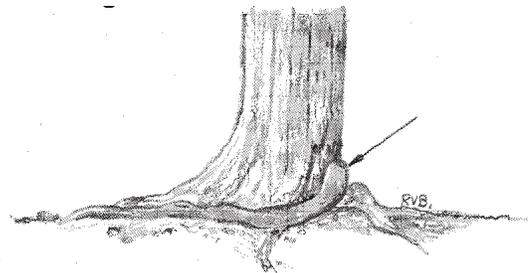
A number of things can cause trunk and stem damage. Bark can be damaged by frost cracking, excessive mulch, mowers, weed trimmers, and biotic causes such as rabbits, voles, groundhogs, and deer. Small amounts of damage can be tolerated but repeated damage that results in large masses of scar tissue is a serious problem. Below-ground tree failure often results from lower trunk damage.

**Remedy:** Damaged bark can not be repaired or reattached. The only remedy is to reduce the water stress on the tree or shrub by keeping it watered and giving it a fertilization in the spring or fall to increase growth. If the damage is not too severe, new bark tissue will form around the wound and eventually close it. Prevent damage to young trees by using trunk guards. Do not pile mulch against the trunk of a tree or shrub. A properly applied mulch ring will not harm a trunk.

## Girdling Roots

A girdling root is a root that is growing around the trunk at or below the soil line, gradually strangling the trunk. Some trees, such as maples, zelkovas, elms and birches, are particularly prone to their formation. Trees and shrubs that are container-grown and pot-bound frequently develop girdling roots. It is important to spread roots of pot-bound plants to prevent this problem.

**Remedy:** Girdling roots take years to develop. Early detection is important. Young roots that are visible on the soil surface and cutting into a tree trunk should be cut and removed. Make a clean cut with a sharp wood chisel and remove it. No wound dressing is recommended. Removal of large girdling roots (over two inches in diameter) is a more involved process. It is best to seek the advice of a consulting arborist when considering their removal.



**Above-ground girdling root**

## Planting Too Deeply

Many trees and shrubs are set too deeply from the time of planting, or they settle too deeply over time. A planting depth of only one-inch too deep can cause trouble. It is not uncommon to see trees planted as much as three or more inches too deep. Deep planting causes bark deterioration at the soil line, which will eventually kill the plant. It usually takes a few seasons for a newly planted tree or shrub to die from this.

Various symptoms point to excessively deep planting. Some new growth may develop each spring, only to die-off during the stress of summer. Advanced symptoms of depth-related stress are cankers and deep cracking of the bark. A canker is an area of dead tissue on a woody stem. Some shallow cracking of bark is normal for many trees as the trunk grows. A tree may survive until fall but may not survive the winter because of an insufficient storage of food reserves caused by the damaged bark.

**Remedy:** A properly planted and established tree flares at the base of the trunk where it joins the root system. If this is not visible, then be suspicious of deep planting or another problem such as girdling roots.

Perform a root collar excavation. Carefully remove the soil from the circumference of the trunk to the point where the trunk flares out into root growth. If the tree or shrub was recently planted it can be lifted and replanted.

To avoid excessive settling in future plantings, do not loosen the soil in the bottom of the planting hole. It is also recommended to plant trees and shrubs with the top of the root ball slightly above the existing soil line. This practice is particularly helpful when planting in heavy clay soils that tend to drain poorly.

## Excessive Mulch

Mulch is used around plants to help conserve soil moisture, moderate soil temperatures and reduce weeds. The recommended depth is approximately three inches. Each year, many gardeners add liberal amounts of mulch to trees and shrubs, believing it is the “correct” thing to do. Over time, it can accumulate to depths of five, six or more inches. Excessive mulch depth reduces soil oxygen for the roots. The roots, in their search for oxygen, grow into the mulch. During drought, the mulch dries out and the roots in the mulch die. When mulch is piled up against the trunks of trees and shrubs the bark decays and the entire plant may die.

**Remedy:** As the old mulch decomposes it can be gently worked into the planting bed to improve the soil, or removed and worked into other garden areas. Additional mulch may be added occasionally to supplement the existing covering. For complete remulching, remove the old mulch before the new is applied. Save the old mulch as a valuable soil additive for gardens.

Some desirable mulching materials are pine bark, hardwood bark, chopped leaves, pine needles, and aged wood chips.

## Mechanical Girdling of the Trunk

Often, newly planted landscape trees are secured with wire and wooden stakes to prevent them from leaning. Unfortunately, these wires remain on too long or are never removed. Over time, most trees eventually die from strangulation. In some cases, trees actually do survive. Staking newly planted landscape trees is a very old practice whose benefit is now questioned. If a tree has a proper size root ball and is correctly planted, there usually is no need for staking. Research has shown that trees tightly secured have no trunk movement. This interferes with proper root growth and trunk development. If a tree is planted in a windy site and staking is absolutely necessary, be sure to cover the wire around the trunk with a rubber hose to protect the trunk. Secure the wires so that there is some movement of the tree. Prevent future problems by removing the wires and stakes after the first year.

Another very common form of trunk girdling is caused by the nylon cords used on ball and burlap plants. The cords are tied around the trunk at the top of the root ball. They will not decay, and if not cut loose will eventually kill the plant as the trunk expands. Also, be aware of synthetic burlap. This is a plastic material that is very often used instead of natural burlap because it does not rot in the nursery.

Unfortunately, it also prevents roots from growing through it when planted. This should be removed after the tree or shrub is set into the planting site. Natural burlap should be cut loose from around the trunk and removed down to the soil line. It will decompose in a short time.

**Remedy:** Remove staking wires or nylon cords that have become imbedded in the trunk. In many cases it cannot be pulled out. The best thing to do is to simply cut them in several places to relieve the pressure. If corrected early enough the tree might recover.

## Heat and Drought Stress

Trees and shrubs, like all other plants, react to extreme dryness and heat. It takes much longer for them to show symptoms of the stress because of their size and deep roots. Although heat and dryness cause symptoms such as leaf yellowing, scorch and dropping, they usually do no permanent harm to established plants. These reactions are the plant’s way of coping. By dropping leaves, they go into a semi-dormant condition until better conditions return. Extended periods of below-average rainfall and extreme heat can weaken woody plants. Some smaller specimens may die in the first year while larger ones may become susceptible to borer infestations and exhibit dieback a few years later.

**Remedy:** Mature trees should be managed carefully to offset drought conditions. Recently planted or other smaller, trees and shrubs should be monitored for proper moisture requirements to maintain plant health. Plants that were container-grown from the nursery are especially prone to drying out because of the very porous mixture used in the pots. Soak the root ball when watering. Foliar anti-dessicants can also be very helpful.

## Herbicide damage

Many homeowners use herbicides to control broadleaf weeds in the lawn. These are called ‘selective’ herbicides because they kill only broad-leaf plants without harming the grass. Most contain 2,4-D and are safe and work well when the proper precautions are followed. If they are applied during very hot or breezy weather they may drift onto nearby landscape plants and cause harm. Selective herbicides are absorbed by the foliage. The typical damage symptom is a curling and deformation of the foliage. New growth is especially sensitive. Crabgrass pre-emergent herbicides cause no harm to landscape plants.

**Remedy:** Sometimes, the herbicide damage will be quite severe. In these cases the plant may die. Usually, however, the damage is outgrown and the plant recovers. If it is known that the plant was sprayed by an herbicide, an immediate hosing of the foliage with water can reduce the damage. After the herbicide has dried on the foliage for 3 - 4 hours, it is absorbed by the plant and cannot be rinsed off.

## GUIDE FOR DIAGNOSING ABIOTIC PROBLEMS

Symptom	Possible Causes
Older leaves turning yellow	<ul style="list-style-type: none"> <li>Early heat and drought stress</li> <li>Early stage of poor soil drainage</li> <li>Nutritional problems</li> <li>Normal deterioration of older foliage</li> </ul>
Interveinal leaf yellowing (chlorosis)	<ul style="list-style-type: none"> <li>Soil pH problem</li> <li>Very early stages of heat and drought stress</li> </ul>
Leaf scorch (brown edges) throughout the tree or shrub	<ul style="list-style-type: none"> <li>Heat and drought stress</li> <li>Soluble salt damage</li> <li>Poor soil drainage</li> <li>Soil compaction</li> </ul>
Leaves dropping while still green or beginning to turn yellow	<ul style="list-style-type: none"> <li>Heat and drought stress</li> </ul>
Leaves twisting and curling	<ul style="list-style-type: none"> <li>Herbicide damage</li> </ul>
Die-back of branches	<ul style="list-style-type: none"> <li>Severe drought stress</li> <li>Severe soluble salt damage</li> <li>Poor soil drainage</li> <li>Girdling roots</li> <li>Mechanical damage to trunk</li> <li>Changes in soil grade</li> </ul>
Stunted, poor growth, lack of establishment	<ul style="list-style-type: none"> <li>Soil compaction</li> <li>Planting too deeply</li> <li>Drought and heat stress</li> <li>Excessive mulch</li> <li>Poor soil drainage</li> </ul>
Decline and eventual death of established trees and shrubs	<ul style="list-style-type: none"> <li>Girdling roots</li> <li>Mechanical girdling of the trunk /stem</li> <li>Planting too deeply</li> <li>Soil grade changes</li> <li>Changes in water flow</li> </ul>
Bark rotting at the base of the tree or shrub	<ul style="list-style-type: none"> <li>Planting too deeply</li> <li>Excessive mulch</li> <li>Girdling roots</li> </ul>
Bark cracking along trunk	<ul style="list-style-type: none"> <li>Mechanical root damage</li> <li>Lower trunk damage</li> <li>Girdling roots</li> <li>Planting too deeply</li> <li>Severe heat and drought stress</li> <li>Frost cracking and sunscald</li> <li>Lightening injury</li> </ul>

## Summary

The most difficult plant problems to diagnose are not usually caused by an insect or disease but are cultural and site-related. In a natural, undisturbed soil, nutrition deficiencies are not much of a factor. Most soils in Maryland have fairly good levels of nutrients. However, in an urban or disturbed soil there may be a very high pH and micro-nutrient problems. You are also more likely to see damage caused by excessive fertilizer. Take the time to answer some 'historical' questions about the plant's health and care. You can prevent many problems by beginning with a soil analysis, planting recommended varieties of plants and following proper planting procedures.

Technical review by: Peter Becker, member: MD Arborist Association, International Society of Arboriculture, and National Arborist Association.

Suggested references for further study:

Tree Maintenance, P.P. Pirone, 1988. Oxford University Press.  
Arboriculture-Integrated Management of Landscape Trees, Shrubs and Vines., R. W. Harris. 1992. Prentice-Hall, Inc.  
Woody Ornamentals: Plants and Problems. 1980. Partyka, Rimelspach, Joyner and Carver.  
Chem Lawn Corporation, Columbus, Ohio.

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