



Dogwood leaves are quick to show symptoms of drought stress with curling of the tips, flagging of the entire leaf, and dead leaf edges.

Because Kentucky had subnormal amounts and uneven distribution of rainfall during the last five to 10 years, you may be worried about your landscape plants. Having invested time and money in these plants, now you need to take protective measures to keep them alive.

Landscape plants probably suffer more from moisture-related problems than from any other cause. Because of water, plants experience feast or famine, flood or drought, air or suffocation. Plants are 70 to 90% water, which is essential for plant growth, manufacture of food, and nutrient transport.

However, too much water can be a problem. Excess water often causes a plant's decline and death, because when water fills the soil's pore spaces, roots can no longer get air, and they die.

During 1988 Kentucky experienced its sixth dry year. Starting in 1983, each year has had untimely, prolonged dry spells, so if you put plants in your landscape during the last 10 years, they have struggled to survive, and many have died. Also during these years, many old, well-established trees growing in shallow soils have died because they could not adapt to long periods without rain. Sensitive plants begin to have problems after three weeks without rain, and the past few years have included many such dry periods.

Plants' Ability to Survive Prolonged Dry Weather

Plants generally fall into three categories relating to their capacity to get and conserve moisture (Harris 1983):

How Dry Seasons Affect Landscape Plants

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- **Water spenders** water freely but in deep soils have extensive root systems that absorb water from a large volume of soil. As long as some of their roots are in moist soil, they can survive. Many common landscape plants are of this type, e.g. black walnut, London plane tree, and mulberry.

- **Drought evaders** avoid water stress in several ways: they dry up or drop their leaves, sometimes they shed twigs and branches, or they become virtually dormant in dry weather. An example is the yellow-poplar, or tulip tree. While they have leaves, however, these plants usually transpire as rapidly as water spenders.

Another excellent example of a drought evader is Kentucky bluegrass. During a hot, dry summer, it turns brown while going dormant. After cooler, moist weather returns, bluegrass will green up and begin active growth again.

- **Water conservers** have ways of reducing water loss. Their leaves may be small, gray-colored, leathery, or arranged to reduce the amount of sunlight that strikes them. Their stomata may be structured to conserve moisture. Many plants from desert and Mediterranean climates are of this type, with the Russian olive as a typical example.

Managing Soil Water for Your Plants

Many people plant trees in soil with undesirable characteristics, which affects how plants respond to drought or to too much watering during drought. To understand this plant response and how you can deal with it, you need to know a little about how plants get their water.

Plants get most of their water directly from soil surrounding their roots. The soil's physical characteristics largely govern the amount of water that it can hold and the amount available for plant use. By the same token, these same physical soil properties govern how much air is in the soil surrounding plant roots. Both water and air exist in the pore space surrounding individual soil particles and aggregates. In an ideal situation, about half the volume of soil surrounding roots should be solid mineral or organic material and about half pore space. Ideally, about half the

pore space should hold air and about half, water. Under such conditions, plant roots can get both the air and water they need. In contrast, when soil is waterlogged (most of its pores filled with water) roots cannot get enough air; when soil is dry (most of its pores filled with air) roots cannot get enough water.

The soil's natural characteristics at any specific site govern how much pore space it has and how much water can be stored in pores. Some soils have a high available water-holding capacity (medium-textured soils like fine sandy loams, loams, silt loams, and silty clay loams), whereas others have lower capacity to provide plant-available water. Coarse-textured soils (sands, loamy sands) cannot store enough water to last longer than a few days after rain or irrigation, while fine-textured soils (silty clays, clays) hold much of their stored water so tightly that plants cannot extract it fast enough for optimum benefit.

When new houses or buildings are built and when the area around them is prepared for landscaping, many changes affect the soil. The naturally occurring physical relationship between the amount of solid material and pore space in soil is often modified. Most often, soil is compacted. That is, the amount of pore space is lowered because more solid material is compacted into the same volume of soil. Machinery traffic or even too much human traffic can cause compacting, and it takes place more easily when soil is moist or wet rather than dry. Because areas around foundations are often backfilled with compacted, clay-textured soils, or because topsoil is often scalped down into clayey subsoil, you often have no choice but to use such soils for your plantings.

To minimize soil structure breakdown and compaction, try these suggestions (Harris, 1983):

- Cultivate soil when it is dry or moderately moist; avoid working with wet soils.
- Avoid recompacting freshly plowed or loosened soil; the less tillage after loosening, the better.
- Schedule landscape maintenance work when soil is as dry as possible.
- Keep travel over the site to a minimum; confine it to a few paths, and keep it away from trees.
- Use lightweight vehicles with large, smooth, low-pressure tires.
- Spread thick, coarse mulch on the soil surface to disperse the weight of heavy equipment.

How Landscape Plants Respond to Drought

When plants do not get enough water, leaf scorch can occur. In this situation, leaves and tips of young shoots begin to wilt. If they are not turgid again by the next

morning, lack of moisture may seriously affect the plant. First, leaf tips and margins can begin to brown; then this condition spreads into areas between veins. After that, oldest leaves on weak branches turn brown and begin to fall. Species most susceptible to leaf scorch are flowering dogwood, maple, horse chestnut, ash, elm, and beech.

Lack of moisture usually affects all the leaves on one or more branches. Leaves affected first and most severely are those exposed to afternoon sun and prevailing winds. Older leaves; leaves that are small, thick, and rigid; and most conifer leaves may not wilt visibly but may turn brown entirely or just at the tips or margins. When leaves drop as the plant tries to conserve water, reduced foliar cover per unit of ground surface area helps the plant conserve water further.

During 1975-1977, California suffered a severe drought, with annual rainfall below 10 inches. Most trees that were lost had shallow root systems or were growing on shallow or poor soils. Trees and shrubs planted in deep, well-drained, undisturbed soils that had well-developed, extensive root systems survived.

Long-Term Effects of Drought

When an area has repeated dry periods, even if lack of rain occurs during different seasons, the long-term effects are substantial:

- Plants show increased susceptibility to diseases and insects. Typical examples of pest problems on vulnerable plants include *Botryosphaeria* cankers and *Phomopsis* cankers on redbud and *Rhododendron*; white pine decline; Armillaria root rot on many plants; *Verticillium* wilt on maples; *Endothia* canker on pin oaks; pine wilt nematode; and borers on birches, oaks, dogwoods, chestnuts, and hornbeams.
- Plants show increased susceptibility to winter injury. Cold injury takes several forms:
 - Black heart in stems of trees and shrubs
 - Sun scald and frost splitting of tree trunks
 - Winter burn of conifer foliage
 - Dieback of overwintering broad-leaved plants.

Plants can be injured or totally killed by low temperatures at any time of year, but especially in spring and autumn, in the coldest part of winter, and when low temperatures follow warm winter periods.

How to Keep Woody Plants Alive During Extended Droughts

Q. When should I start worrying about lack of rain? Should I worry about all my plants?

A. If rain is lacking for three weeks or more, and if you put in plants during the last 10 years, they need supplemental water. If the plant has been transplanted in the past 13-26 weeks, it will need water every five to 10 days.

Q. How often do I water?

A. If plants are well-established and in a well-drained soil, a thorough watering once every two weeks will usually keep them alive. If the soil is shallow or structurally poor, however, you need to water once every one to two weeks. Conditions conducive to water loss (day temperatures in the 90s, night temperatures above 70, reduced humidity, etc.) will require more frequent watering.

Q. How much do I water?

A. Try to put a minimum of 3/4 to 1 inch of water on at a time. Be sure not to overwater dense, clayey soil. Remember, after a clayey soil is wet, it doesn't dry out nearly as fast as a medium or coarse-textured soil, so it doesn't need watering as often.

Q. How do you know whether once a week or once a month is often enough for supplemental water on older, more established plants?

A. Let the plant tell you. Flagging or drooping leaves is one of the first symptoms of water stress. If this occurs late in the afternoon, don't get alarmed—this is a normal happening. But if leaves are still flagged early the next morning, start watering the plant. The number of irrigations and the amount of water required during a dry summer depend on the soil's water-holding capacity, the plant's rooting depth, and environmental conditions.

Other Important Recommendations

► One good irrigation is better than the same amount of water applied more frequently in smaller doses. What you want is to get plants to root more deeply in stress situations rather than encouraging surface rooting with frequent, shallow irrigations. Remember that rooting depth generally changes with minimum irrigation schedules, because roots are opportunistic. They can grow toward areas that provide the two most important survival needs: water and air.

Observations by experts show that in areas where dry summers are normal, most woody plants with extensive root systems can survive on only half the water they would otherwise transpire.

► Get rid of cover crops around trees and shrubs. Kill or remove grass around them (creating a no-till situation) and put organic mulch around the base 3 inches deep, all the way to the dripline if possible.

Dormant bluegrass during dry periods no longer competes for water with woody plants and probably has a mulch effect, though dormant bluegrass or fescue is not as effective as other organic mulch. However, it is certainly better than bare soil for reducing evaporative loss.

► Choose most susceptible areas first when you develop your watering schedule. Plants near driveways, sidewalks, buildings, and other reflective surfaces will dry out much faster than plants in the middle of a grassy field or yard. Berms, raised beds, and hilly areas will also dry out much faster.

► Do not prune plants in extremely hot, dry weather. If you do, then when rains begin, plants may put on additional new growth that will not have a chance to harden off before late fall.

► On new construction sites, give special consideration to places where

- topsoil has been removed
- soil has been added (often subsoil from someone else's basement)
- soil has been compacted
- construction materials have been buried
- pavement has been put in, etc.

► Avoid overwatering. Overwatering plants in poor soils is easy, and proper aeration is almost impossible. Poor soils often have wet spots, and the plant ends up dying from excess water even during dry periods.

► Loosen your soil before watering. For example, you can till, bore holes, hoe, etc. The less tillage after loosening, the better. Avoid working with or walking on soils when they are wet. Spread thick coarse mulch on the soil surface 3 inches deep after watering. Avoid further watering until plants begin to show signs of having reached the permanent wilting point.

► If you watered your trees and shrubs shallowly during the first part of the dry season, you need to wean them gradually from this schedule. For example, if plants were watered twice a week during June for one hour, cut back to once a week, then once every two weeks and finally, to once a month. Irrigate only until no more water soaks into the soil. After that, water merely runs off, so it's time to move to a new spot.

► For the home buyer, choose homesites with undisturbed topsoil that has not been compacted or damaged in any other way.

➤ Avoid using antitranspirants (like Wiltpruf and others) during very hot weather. Even though these materials are recommended to retard the rate of transpiration, you could do additional damage to your plants by creating a mini-greenhouse effect and heating them up even more drastically. Many of these products are waxy and coat leaves and stomata with an impermeable layer that reduces air and water exchange, thus reducing photosynthesis. This waxy layer could raise leaf temperature even higher than it already is on a 90 to 100° F day.

➤ Do not plant new trees and shrubs during summer.

Plants with Poor Survival Records During Droughts

These 10 plants showed widespread decline and death during the last 10 years in Kentucky:

Dogwood	White pine
Burning bush	Japanese maple
Sugar maple	Birch
Hemlock	Taxus (Yew)
Dwarf Alberta spruce	Norway Spruce

Plants with Good Survival Records During Droughts

Some native plants in Kentucky have a good record of survival during the last 10 years. These plants have potential for poor landscape sites (shallow soils, compacted soils and other disturbed soils):

Pitch pine	Virginia pine
Pignut hickory	American hazelnut
White oak	Scarlet oak
Southern red oak	Shingle oak
Bur oak	Black jack oak
Chestnut oak	Post oak
Dwarf hackberry	Black gum, Black tupelo
Fringe tree	

References

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