

# Why Do Leaves Change Color?

We are lucky, we live in one of the parts of the world where Nature has one last fling before settling down into winter's sleep. As the days shorten and temperatures become crisp, the quiet green palette of summer foliage is transformed into the vivid autumn palette of reds, oranges, golds, and browns before the leaves fall off the trees. Some years, the colors are truly breathtaking.

## *How does autumn color happen?*

For years, scientists have worked to understand the changes that happen to trees and shrubs in the autumn. Although we don't know all the details, we do know enough to explain the basics and help you to enjoy more fully Nature's multicolored autumn farewell. Three factors influence autumn leaf color-leaf pigments, length of night, and weather, but not quite in the way we think. The timing of color change and leaf fall are primarily regulated by the calendar, that is, the increasing length of night. None of the other environmental influences-temperature, rainfall, food supply, and so on-are as unvarying as the steadily increasing length of night during autumn. As days grow shorter, and nights grow longer and cooler, biochemical processes in the leaf begin to paint the landscape with Nature's autumn palette.

## *Where do the autumn colors come from?*

A color palette needs pigments, and there are three types that are involved in autumn color. Chlorophyll, which gives leaves their basic green color. It is necessary for photosynthesis, the chemical reaction that enables plants to use sunlight to manufacture sugars for their food. Trees in the temperate zones store these sugars for their winter dormant period. Carotenoids, which produce yellow, orange, and brown colors in such things as corn, carrots, and daffodils, as well as rutabagas, buttercups, and bananas. Anthocyanins, which give color to such familiar things as cranberries, red apples, concord grapes, blueberries, cherries, strawberries, and plums. They are water soluble and appear in the watery liquid of leaf cells.

Both chlorophyll and carotenoids are present in the chloroplasts of leaf cells throughout the growing season. Most anthocyanins are produced in the autumn, in response to bright light and excess plant sugars within leaf cells.

During the growing season, chlorophyll is continually being produced and broken down and leaves appear green. As night length increases in the autumn, chlorophyll production slows down and then stops and eventually all the chlorophyll is destroyed. The carotenoids and anthocyanins that are present in the leaf are then unmasked and show their colors.

Certain colors are characteristic of particular species. Oaks turn red, brown, or russet; hickories, golden bronze; aspen and yellow-poplar, golden yellow; dogwood, purplish red; beech, light tan; and sourwood and black tupelo, crimson. Maples differ species by species-red maple turns brilliant scarlet; sugar maple, orange-red; and black maple, glowing yellow. Striped maple becomes almost colorless. Leaves of some species such as the elms simply shrivel up and fall, exhibiting little color other than drab brown. The timing of the color change also varies by species. Oaks put on their colors long after other species have already shed their leaves. These differences in timing among species seem to be genetically inherited, for a particular species at the same latitude will show the same coloration in the cool temperatures of high mountain elevations at about the same time as it does in warmer lowlands.

## *Does weather affect autumn color?*

The amount and brilliance of the colors that develop in any particular autumn season are related to weather conditions that occur before and during the time the chlorophyll in the leaves is dwindling. Temperature and moisture are the main influences.

A succession of warm, sunny days and cool, crisp but not freezing nights seems to bring about the most spectacular color displays. During these days, lots of sugars are produced in the leaf but the cool nights

and the gradual closing of veins going into the leaf prevent these sugars from moving out. These conditions-lots of sugar and lots of light-spur production of the brilliant anthocyanin pigments, which tint reds, purples, and crimson. Because carotenoids are always present in leaves, the yellow and gold colors remain fairly constant from year to year.

The amount of moisture in the soil also affects autumn colors. Like the weather, soil moisture varies greatly from year to year. The countless combinations of these two highly variable factors assure that no two autumns can be exactly alike. A late spring, or a severe summer drought, can delay the onset of fall color by a few weeks. A warm period during fall will also lower the intensity of autumn colors. A warm wet spring, favorable summer weather, and warm sunny fall days with cool nights should produce the most brilliant autumn colors.

#### *Why do leaves fall?*

In early autumn, in response to the shortening days and declining intensity of sunlight, leaves begin the processes leading up to their fall. The veins that carry fluids into and out of the leaf gradually close off as a layer of cells forms at the base of each leaf. These clogged veins trap sugars in the leaf and promote production of anthocyanins. Once this separation layer is complete and the connecting tissues are sealed off, the leaf is ready to fall.

#### *What does this do for the tree?*

Winter is a certainty that all vegetation in the temperate zones must face each year. Perennial plants, including trees, must have some sort of protection to survive freezing temperatures and other harsh wintertime influences. Stems, twigs, and buds are equipped to survive extreme cold so that they can reawaken when spring heralds the start of another growing season. Tender leaf tissues, however, would freeze in winter, so plants must either toughen up and protect their leaves or dispose of them.

The evergreens-pines, spruces, cedars, firs, and so on-are able to survive winter because they have toughened up. Their needle-like or scale-like foliage is covered with a heavy wax coating and the fluid inside their cells contains substances that resist freezing. Thus the foliage of evergreens can safely withstand all but the severest winter conditions, such as those in the Arctic. Evergreen needles survive for some years but eventually fall because of old age.

The leaves of broadleaved plants, on the other hand, are tender and vulnerable to damage. These leaves are typically broad and thin and are not protected by any thick coverings. The fluid in cells of these leaves is usually a thin, watery sap that freezes readily. This means that the cells could not survive winter where temperatures fall below freezing. Tissues unable to overwinter must be sealed off and shed to ensure the plant's continued survival. Thus leaf fall proceeds each winter in the temperate zones.

#### *What happens to the fallen leaves?*

Needles and leaves that fall are not wasted. They decompose and restock the soil with nutrients and make up part of the spongy humus layer of the forest floor that absorbs and holds rainfall. Fallen leaves also become food for numerous soil organisms vital to the forest ecosystem.

It is quite easy to see the benefit to the tree of its annual leaf fall, but the advantage to the entire forest is more subtle. It could well be that the forest could no more survive without its annual replenishment from leaves than the individual tree could survive without shedding these leaves. The many beautiful interrelationships in the forest community leave us with many fascinating puzzles still to solve.

#### *The Many Uses of Leaves*

When leaves fall onto the soil surface in autumn, they deter weeds, reduce erosion, improve infiltration of rainfall, prevent surface crusting, moderate soil temperatures, and, when they decompose, return their nutrients to the soil. As leaves decompose they invigorate the living organisms of the soil, improving

nutrient levels, soil structure, and drainage. Each year we recycle our tree leaves, into "garden gold" -- compost and mulch.

Fallen leaves are worth their weight in gold for your landscape and garden. They are full of the nutrients your trees took up all season. If you bag leaves for curbside pickup, you're throwing away free fertilizer. Instead, put those leaves to work for you. They are free, organic, slow-release fertilizers -- the way nature was designed to work. Here in West Virginia we are in the middle of yet another "leaf season." Before you head outside with rake in hand to clean up the latest leaf fall, here are a few time- and money-saving ideas.

In natural settings such as forests and meadows, we see the leaf cycle operating as it was designed. Leaves drop and collect as mulch around the base of trees, protecting soil from crusting, erosion, temperature extremes, drying out, and compaction. In time they decompose, slowly releasing nutrients for the growing plants. You can also let leaves collect as mulch around perennial beds and trees. A lot of leaves can be a problem on lawns so you need to do something there.

### *Mow Leaves*

The simplest way to recycle leaves is to mow over them. It's amazing how fast and effective a mower can be at chopping up leaves so they seem to disappear into the turf. Mown leaves will not harm turf and actually can benefit it by mulching thin grassy areas and discouraging weed seeds from sprouting. A mulching mower works great, but, so does a standard mower. Set the front wheels a notch or two higher to allow leaf litter to enter the mower housing. Mulch leaves only when the yard is dry, as wet materials will quickly clog the mower.

### *Garden Mulch*

Another method of leaf recycling is to collect them for garden mulch. With a mower, blow leaves into windrows for fast, easy collection, or attach a bagger to the mower and partially shred and collect leaves. Mulch flower and vegetable gardens with a 2-inch layer of leaves. Give shrubs and trees 3 to 4 inches. If you have any leaves left over, which is unlikely save them to replenish mulched areas when the weather gets hot in June. I use them to help build Lasagna beds for my garden plants.

### *Leaves as Compost*

A third leaf recycling technique is composting. There are numerous approaches to composting including composting in traditional heaps and bins. Walkway composting is my favorite, as it requires the least effort and allows more compost to be produced right in the garden. After building raised beds, fill the walkways with leaves. Add leaves once or twice more as they settle with time and foot traffic. In a few months you'll have a thick layer of compost beneath the leaves on the surface. Before the next planting season you can reform the raised beds using the freshly made compost from the paths.

### ***Beltsville Agriculture Research Tour - November 4th***

The Forum for Rural Innovation is sponsoring a one day bus tour of the USDA Beltsville Agriculture Research Center on November 4, 2009. The tour is being planned to highlight the innovative agriculture research of plants, animals, human nutrition, and the environment. The Beltsville ARC is the largest USDA research facility in the United States, encompassing over 7,000 acres, and located at Beltsville, Maryland. It is a dynamic, highly diversified research facility, dating back to 1910. The tour will focus on agriculture industries and practices that can be implemented to our region, and highlight some of the historic research conducted at Beltsville. The tour bus will depart from Purcellville at 7:30 am and will return by 5:30 pm. All participants must pre-register and ride the bus. A \$35.00 per person registration fee will include bus transportation, snacks, and lunch. Registration is limited to 55 persons, and will be on a first-come first-served basis. Registration information is available at [www.LoudounFarms.org](http://www.LoudounFarms.org) or by calling 703-777-0426. This tour and the Forum for Rural Innovation are sponsored by the Offices of

Agricultural Economic Development and Cooperative Extension -Loudoun, Fauquier, Clarke, Fredrick (VA), and Jefferson, Berkeley (WV), and the Shenandoah and Potomac Headwaters RC&D.

### ***Shenandoah Valley Fiber Festival October 24-25***

The Shenandoah Valley Fiber Festival will be held October 24-25 at the Clarke County Fairgrounds in Berryville, VA. Admission is \$5 per person. For more information on this event visit their website at <http://www.shenandoahvalleyfiberfest.com/index.html>

### ***Berkeley County Youth Fair Basket Bingo***

The Annual Basket Bingo will be held on Sunday, October 25, 2009 at the Berkeley County Youth Fairgrounds. Doors will open at 12:00 noon with Basket Bingo starting at 2:00 pm. Tickets/information is available by calling: Carolyn at 304-229-5968, Barbara at 304-263-8039 or Charlotte at 304-725-7451. Tickets are #20.00 in Advance or \$25.00 at the door. If you would like to be a sponsor for this event, please email Dawn Pingley at [dawnt@toast.net](mailto:dawnt@toast.net).

### ***MGT-332: Agriculture and Food Vulnerability Assessment Training***

The U.S. Department of Homeland Security (DHS), WV Department of Military Affairs and Public Safety (DMAPS), WV Department of Agriculture, and the Jefferson County Development Authority are offering free Agriculture and Food Vulnerability Assessment Training through the DHS Direct Delivery Program. This training, which has been certified and approved by DHS/FEMA, will strengthen the ability of state and local communities and industry to improve intelligence and operational capabilities for prevention and deterrence of terrorist acts that target the agriculture and food sector.

This is a one and one-half day class that is open to the agriculture and food industry, federal, state, county, and local officials, extension and crop specialists, agriculture crime units, food processors, food transportation, food wholesalers and retailers, food distributors, health department officials, emergency managements agencies, meat and poultry inspection and all others involved with food and agriculture security planning.

**When:** November 10-11, 2009-- Beginning at 8:00 a.m. on November 10 and conclude at approximately 4:30 p.m. Class will resume at 8:00 on November 11 and conclude at approximately 12:00 p.m.

**Where:** West Virginia University Tree Fruit Research and Education Center, 67 Apple Harvest Lane (Located On WV Route 9 in Jefferson County), Kearneysville, West Virginia 25403

**Cost:** No program fee. Lunch will be provided. WV Law Enforcement Training Committee has approved for 12 hours law enforcement in service hours. Travel and Lodging will be the responsibility of the attendee with NO reimbursement. Registration Deadline is Wednesday November 4, 2009.

If you have any questions or require any assistance please contact Roy McCallister or Matt Blackwood, (304)-558-2214 or [rmccallister@ag.state.wv.us](mailto:rmccallister@ag.state.wv.us)

## **Garden Tips**

- Prune roses and root cuttings
- Mulch greens (chard, collards, etc.)
- Plant garlic
- Have soil tested
- Fertilize lawn based on soil test

Until next time ...Happy Gardening and Farming!