

## The Colors of Autumn



Fall has arrived. It seems as if a magician colored our trees in red, orange, yellow, or purple colors almost overnight.

The whole process of fall color change is a wonderfully complex chemical process.

Starting in spring, most trees sprout green leaves containing chlorophyll molecules. Chlorophyll captures the waves of sunlight, adds carbon dioxide and water, and in a chemical reaction known as photosynthesis, produces sugar. Sugar is the energy source, the food storage material, and the building block for manufacturing other chemical compounds. Chlorophyll is a light sensitive compound that is continually produced and broken down during the growing season.

In autumn as nights get longer, chemicals called phytochromes sense the change in daylight, and the plant responds by slowing down the production of chlorophyll. Now compounds called carotenes and xanthophylls start to appear. Both pigments were present all season, but had been hidden by the green color of the chlorophyll. Carotenes are also found in the orange pigment of carrots, pumpkins, and sweet potatoes. Xanthophylls give us the yellow color of papaya, peaches and squash. Ash and willows display both pigments in their fall colors.

The tree also responds to the lengthening nights by blocking off the connection between the leaf and the rest of the tree. Cells will grow rapidly and divide at the point where the leaf meets the branch. A corky layer called the abscission layer forms. This abscission layer blocks the vascular system, trapping the exit of sugars from the leaf. This causes all chlorophyll production to shut down and the remaining chlorophyll disappears. As the nutrient supply dwindles, leaves will start to color at their margins where the food supply is lowest. Later the color change will progress inward. As the leaf begins to die, ethylene is produced. This plant growth regulator triggers enzyme production which breaks down cells in the area where the leaf stem is attached to the branch. The attachment weakens and causes the leaf to fall. A leaf scar forms where the leaf was attached to the tree. Such scars enable us to identify the tree in winter.

Most leaves will drop off, but some oaks and beeches will hang on to their leaves until spring. Brown pigments, called tannins, remain in these trees. Tannins are always present in such leaves, but are masked by chlorophyll during the growing season.

Most conifers, except larches, are evergreen and hold onto their leaves. Needles may remain on the tree for two years or longer. Unlike deciduous trees with their tender leaves, the tough needles and scales have a protective waxy coating to protect them from cold and an antifreeze-like fluid within their cells. Needles that fall because of old age, usually in the interior of the plant, are replaced by new growth. If new growth turns brown, dies, and falls, search for a problem.

Many trees produce other pigments called anthocyanins, but only in the fall. Anthocyanins usually are not present in the growing season. One exception is the 'Crimson King' Norway maple, which produces the red color of anthocyanin throughout the growing season. Anthocyanins cause red and purple colors of grapes and apples, and color the leaves of plants such as red maples, sumac, burning bush, and red oaks. Anthocyanins are assembled from the sugars that are trapped in the leaf by the abscission layer.

Leaves turn color at around the same time each year. Color change is prompted by the shortened daylight. Weather can affect color. The red color of anthocyanins requires sunlight for its manufacture. Cold, but not freezing, sunny days increase the intensity of red color in autumn, and hasten the destruction of chlorophyll. Wind and rain can cause leaves to drop, shortening the color show. Warm and moist weather will delay the elimination of chlorophyll and the production of anthocyanins. Frost does not start the fall color change, but an early frost will shut down the anthocyanin production and decrease the amount of red colors. An early, hard frost can kill the leaves and produce dull or brown colors. As climate changes, over the years scientists have noted that peak color change is gradually occurring later and later in the season.

Trees sometimes change color in the summer. Drought can stress the tree and causes premature leaf drop. Slow, deep watering of your landscape trees during dry spells is a good investment. Insect damage, disease, soil compaction, girdling roots, nutrient problems, chemical damage, or mechanical can also lead to early leaf color and leaf drop. Heavy Spider mite infestation may cause early coloring of Burning bush. Try to diagnose and correct such problems, or consult an arborist for an opinion.

Fall is a great time to scout for that invasive pest, common buckthorn. Its leaves stay green late into the fall, and it stands out from all of the other fall time colors. It is a good time to cut the trunks, making sure to paint the cut with brush-killing herbicide. At this time of the year, trees are drawing nutrients into their roots for storage, and herbicide will be drawn down into the buckthorn roots, effectively killing it. The cool weather is perfect for this project.

Don't forget to grab your camera and go for a hike in the woods. Record the best colors for your later enjoyment.

The Minnesota Department of Natural Resources provides a web site, Fall Color Finder ([http://www.dnr.minnesota.gov/fall\\_colors/index.html](http://www.dnr.minnesota.gov/fall_colors/index.html)) that maps the percentage of fall color in the state and provides ideas for best viewing sites in our state parks.

We Minnesotans are so lucky to be in one of the few places in the world with such vivid fall colors.

Happy Gardening,

Joe Baltrukonis