

Color Changes in Autumn Leaves

Fall is indeed an exciting time when trees are ablaze with color and framed by a sky of intense blue. Many environmental factors determine the color, the intensity and the duration of these brilliant, yet transient autumn colors. Most importantly are adequate amounts of soil moisture, warm days with bright sunlight, and cool nights for the best foliar show. Some of the leaf pigments are formed under these conditions, but others are already there, only masked by the green chlorophyll in the leaves.



Joey Williamson, ©2011 HGIC, Clemson Extension

Common sweetshrub (*Calycanthus floridus*) revealing intense yellow xanthophyll pigments.

Joey Williamson, ©2011 HGIC, Clemson Extension

Fall color is observed in deciduous foliage because a series of events occur in plants with the changes in light level and temperature. Leaves have an abscission (or separation) layer on the leaf petiole that eventually allows the leaf to drop. In the fall, the cells in a leaf abscission layer begin to seal off the flow of water to the leaf, and prevent the outflow of sugars that were manufactured within the leaf. Chlorophylls, which are the primary pigments for converting sunlight into sugars within the leaf, continually break down and must be replaced.

However, in the fall, the rate of water moving into the leaf is reduced, but it is still being lost by the leaf through transpiration. This decrease in leaf moisture begins the reduction of these green chlorophyll pigments.

Assisting chlorophyll in capturing light and in the production of sugars in leaves during the growing season are the carotenoid and the xanthophyll pigments. Beta-carotene is the most common carotenoid pigment, and contributes to the orangish-yellow and orange colorations of leaves in the fall. Lutein is by far the most predominant xanthophyll pigment and when uncovered, produces the bright yellow fall colors. Although these two pigments are the most common, there are over 80 different carotenoid and xanthophyll pigments found in leaves, and this contributes to some of the wide variation seen in fall color. These pigments break down more slowly than the chlorophylls.



Joey Williamson, ©2011 HGIC, Clemson Extension

Witch hazel (*Hammelis x intermedia*) fall foliage with chromate-yellow carotenoid pigments.

Joey Williamson, ©2011 HGIC, Clemson Extension

Also present in the leaves of trees and shrubs are tannins. Tannins are believed to contribute to making foliage unpalatable to herbivores and insect

pests, as well as having antimicrobial activity against disease-causing organisms. Tannins found in leaves contribute to the golden colors found in some fall foliage and the brown color of late fall.



Sugar maple (*Acer saccharum*) displaying orange carotenoid pigments in leaves.

Joey Williamson, ©2011 HGIC, Clemson Extension

One last category of foliar pigments involved in fall color is the anthocyanins. These pigments are produced from glucose that has built up and is trapped in the leaves, and the resultant pigments give the brilliant red and purplish-red fall color. Some anthocyanins may be found in leaves during the growing season, giving a purplish color to new growth and to mature foliage, such as in red barberries or pink-flowered loropetalums. Here they act as anti-oxidants within leaves to protect cells from high light damage. These pigments, coupled with the carotenoid, xanthophyll and tannin pigments make for the tremendous variation of

colors in the numerous species of deciduous trees and shrubs in the South.



Red maple (*Acer rubrum*) with brilliant red fall color produced by anthocyanin pigments.

Joey Williamson, ©2011 HGIC, Clemson Extension

We are fortunate to live near the Appalachian Mountains, with its wide diversity of deciduous plant life. This results in many colors of fall foliage and over a long period of time. The fall colors may last for several weeks, as long as there is adequate soil moisture, sunny mild days and cool nights. But drought conditions or early freezing weather will cause a rapid breakdown of pigments and leaf drop. To find out more about the occurrence of fall color, the USDA Forest Service has a telephone hotline for fall color at 1-800-354-4595, then press #8 for the Southern Region.

Prepared by Joey Williamson, HGIC Horticulture Extension Agent, Clemson University.02/13.

This information is supplied with the understanding that no discrimination is intended and no endorsement by the Clemson University Cooperative Extension Service is implied. All recommendations are for South Carolina conditions and may not apply to other areas. Use pesticides only according to the directions on the label. All recommendations for pesticide use are for South Carolina only and were legal at the time of publication, but the status of registration and use patterns are subject to change by action of state and federal regulatory agencies. Follow all directions, precautions and restrictions that are listed.