McHenry County Nursery, Inc.

Fall Is In The Air

Many of us look forward to the brilliant displays of color on our deciduous trees of the midwest. Each year we wonder, will we have good fall color? This is a very important question for the areas of the country that depend on the fall color as an important part of their tourism economy. Some states have gone high-tech, keeping digital maps that predict where the best color will be, and sending email updates to 'leaf peepers'. (see resources pg3)

The autumn color show is different every year, because of many factors that influence the colors and intensity of the fall display, including climate, weather, temperature, sunlight, soil moisture, and the genetic differences of plants.

Climate and Seasonal Changes

Few places in the world have the right kinds of trees and climate conditions to have noticeable fall color. Fall coloring of trees occurs in climates with warm summers and sufficient rainfall followed by winters with temperatures low enough to cause dormancy. In this type of climate, trees and shrubs evolved to identify seasonal changes in temperature and day length which trigger responses in the plant in order to survive the dramatic environmental changes. These responses are growth and storage in seasons when the conditions are right, leaf abscission and dormancy, and use of stored materials when re-growth is possible.

Fall colors are never predictable, and can vary within a group of plants in the same location, or the same plant in different locations.

Genetics

The genetic makeup of each plant determines the processes that run the plant and also the pigments that it contains or produces. Interactions between different pigments, chemicals, weather conditions, and site conditions create different effects in each individual plant. The region where a plant evolved also affects its fall coloring, for example, trees with European origin evolved in a climate with a longer and cooler growing season. The timing of the color changes depends on the rate of chlorophyll breakdown, which pigments break down first, and the amount of breakdown before the leaves drop.

Weather

The decrease in temperature and daylight in the fall triggers plants to stop the production of chlorophyll and gather the materials from the leaves that are needed to survive the coming winter. The differences in color seen from year to year are explained by factors including temperature, light, and water which influence the rate of coloring and the pigment production.

Temperature

The optimal conditions for the best fall color are warm days, with cool nights below 45 degrees F, but not freezing. This allows for photosynthesis during the day that keeps the tree running, and cool temperatures at night that favor production of anthocyanins. A severe early frost will diminish the bright colors. The New England states are popular for the fall color show because the climate is not as likely to produce a bad frost during that period when the changes are occuring.

Light

The best light conditions for color are bright, sunny days. Anthocyanins are only produced in leaves that are exposed to light, and the brighter the light, the brighter reds we see. The inner leaves of the canopy show less color because they don't receive as much light as the outer leaves. Rainy, cloudy weather during the period when colors are changing also can cause less intensity of fall colors.

Water

Any stress to the plant causes increased production of anthocyanins, so it is no surprise in times of drought, when plants are water stressed, red color will be more brilliant. This is also why plants stressed by nutrient deficiency or disease turn color earlier than healthy plants.

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Pigments

Why we see such an array of different colors and shades.

The Big 4 are the same pigments that color fruit and flowers.

1. Chlorophyll is involved in Photosynthesis, which is the process that produces the carbohydrates and energy necessary for growth of the tree.
Chlorophyll causes the green color in leaves, and is constantly produced and destroyed throughout the growing season.

2. Carotenoids are a group of pigments that reside along with chlorophyll in the leaves year round, but are for the most part of the year masked by the abundant green chlorophyll. Carotenoids help during photosynthesis by acting like an antennae. They are able to capture light energy and send it to the chlorophyll to be used in photosythesis. Carotenoids are responsible for the yellow and gold colors in leaves.

3. Anthocyanins are responsible for the shades of red and purple, and occur in the cell sap. In most cases, anthocyanins are not found in leaves during the growing season but are produced in the fall, except in some cultivars, including 'Crimson King' Maple, where anthocyanins occur during the growing season. The purposes of these pigments have been explained by several theories. Studies found that anthocyanins are produced in some plants to act as a sunscreen to the sensitive, fading fall leaves, enabling the plant to pull in the nutrients from the leaf before it drops. Some scientists also believe that the fall color is a way to appear healthy which deters pests that prefer weaker plants.

4. Tannins are the pigments that color and flavor tea and cause brown colors in leaves. They are found in the cell sap in cell walls and tend to accumulate in dead tissue.

What causes each color you see?

The following chart explains how the different pigments reveal themselves to create the overall leaf colors.

Green	Chlorophyll in a healthy leaf
Yellow Green	Chlorophyll production slows, existing chlorophyll decomposes, and yellow carotenoids begin to be revealed. Nutrients in the leaf are needed by other parts of the plant, either for storage over the winter, or because the plant is sick.
Yellow	Chlorophyll disappears from the leaf and allows the carotenoids to shine through.
Orange	A combination of the carotenoids revealed and anthocyanins produced causes orange colors to be seen in leaves.
Red	Anthocyanins are produced and revealed as the chlorophyll is reduced from the leaf. Anthocyanins appear red when the pH of the cell sap is acidic.
Purple	A higher pH in the cell causes the Anthocyanins to be more purple or blue in appearance.
Brown	Tannins are revealed as chlorophyll numbers are reduced.
Gold	Both tannins and carotenoids are revealed.
No change	Some species of woody plants are not pro grammed to change color, and the leaves simply dry up and fall off the tree.

Colors to look for:

Norway Maple, Ohio Buckeye , Sycamore, Hickory, Ash, Black Walnut, Catalpa, Elm, Basswood

Yellow Poplar, Horsechestnut, Ginkgo, Beech, Birch

Sugar Maples

Sugar Maple, Red Maple, Sassafras, Sumac, White Oak, Scarlet Oak, Shadbush, Winged Euonymus, Apple Serviceberry

Autumn Purple Ash, Viburnum, Pears

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What causes the leaves to fall off?

If trees kept their leaves during cold winters, the water in the living leaf cells would freeze and the tissue structure would be destroyed. The thawing of the frozen leaf would then create easy access for pathogens and diseases. By dropping leaves, the plant can seal off the leaf scar and protect itself.

Leaf abscission and dormancy are regulated by plant hormones produced in response to the environmental triggers. At the base of the leaf petiole where it is attached to the stem, a layer of corky cells develop - called the abscission layer. This layer gradually cuts off the phloem tissues that move the carbohydrates out of the leaf, but the xylem tissue, because it is dead tissue, remains, and continues to carry water to the leaf. Abscission is a process done by the plant, but wind or gravity makes the leaf fall.

What happens to the tree throughout the year?

Season	Environment	Plant Response
Spring	Days lenthen, temps. increase	Rapid Growth, Leaf Formation
Summer	Days long, temps. warm	Slower Growth, Wood and Inner Bark Formation, Flowering, Fruiting
Early Fall	Days shorter, warm days, cool nights	Growth Slows, Energy is stored, Growth Stops
Late Fall	Days short, Frost	Energy is Stored, Leaves Drop, Dormancy
Winter	Prolonged below freezing temps	Dormancy

For more Info visit:

Fantasy, Facts and Fall Color www.agriculture.purdue.edu/fnr/html/faculty/Chaney/FallColor.pdf

Fall Color at the Morton Arboretum Fall color report for the arboretum http://www.mortonarb.org

The Science of Color in Autumn Leaves, The US National Arboretum
http://www.usna.usda.gov/PhotoGallery/FallFoliage/ScienceFallColor.html

Those Brilliant Fall Outfits May Be Saving Trees By CARL ZIMMER Published: October 19, 2004
http://www.nytimes.com/2004/10/19/science/19leaf.html

Fall color is important part of tourism in some areas of the Northeast
http://www.visitnh.gov http://www.mainefoliage.com http://www.vermontvacation.com

Tourists Get High - Tech Foliage Reports By THE ASSOCIATED PRESS Published: September 19, 2007
http://www.nytimes.com/aponline/technology/AP-TechBit-Foliage-Reports.html

Foliage Updates (links to many states including the ones below) http://www.urbanext.uiuc.edu/fallcolor/updates.html

Wisconsin Fall Foliage Updates http://www.travelwisconsin.com/FallColor_Report.aspx

The Foliage Network Fall foliage updates from nineteen states http://www.foliagenetwork.com/

Normal Peak Times for Fall Color A map of peak times for fall color in the United States.
http://www.weather.com/maps/activity/fallfoliage/index_large.html

USDA Forest Service Fall Foliage Report http://www.fs.fed.us/news/fallcolors/

Fall Foliage Updates by Phone http://www.stormfax.com/foliage.htm