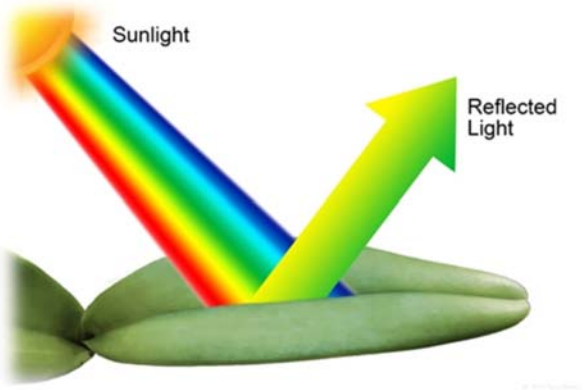
Leaf Reddening – Sign of Stress

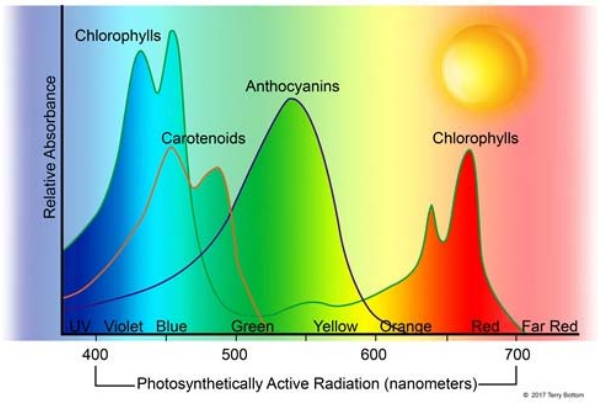
by Sue Bottom, sbottom15@gmail.com

Is there anyone that does not enjoy a ride through the mountains in the fall to see trees changing color? The spectacular color show is caused by varying concentrations of leaf pigments, including chlorophylls (green), carotenoids (yellows and oranges), and anthocyanins (reds, blues and purples). Scientists used to believe that the fall coloration occurred as result of chlorophylls breaking down, unmasking the yellow and orange colors from the carotenoids and the red to purple colors from anthocyanins. They now know that anthocyanins are strong anti-oxidants synthesized in the fall to protect the leaves from excessive radiation while the tree is reabsorbing minerals in the dying foliage.

Leaf Pigments. *Chlorophylls* are the primary pigments of photosynthesis in leaves, and found in the chloroplasts. Chlorophyll absorbs red and blue wavelengths of light. Leaves with high relative proportions of chlorophyll appear green because light reflected from the leaf is enriched in the green wavelength and deficient in red and blue. Chlorophyll molecules require a lot of magnesium and nitrogen. Chlorophyll is normally broken down towards the end of the leaf's life span, and much of the nitrogen, magnesium and other mineral nutrients within the chloroplast are transferred into other parts of the plant that are retained through winter.



1. Most leaves reflect light in the yellowish green to green wavelengths so they appear green to our eyes.



2. Photosynthetic pigments include chlorophylls and carotenoids. The anthocyanins protect leaves from excess radiation, but do not participate in photosynthesis.

Carotenoids absorb light in wavelengths that chlorophyll is inefficient at absorbing, the blue-green and blue wavelengths. This pigment assists chlorophyll in the process of photosynthesis. Once light energy is absorbed, carotenoids pass the energy on to neighboring chlorophyll molecules. Another function of carotenoids is to dissipate excess energy as heat when too much light strikes a leaf, protecting the leaf from photo-damage.

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Anthocyanins absorb blue, blue-green and green wavelengths of light, so leaves with a high relative concentration of anthocyanins appear red or red-purple to our eyes. Leaves that are purple still contain chlorophyll for photosynthesis; the chlorophyll is just masked by the high concentration of anthocyanins. Anthocyanins are not involved in photosynthesis, instead they provide protection from solar radiation.

Purple Leaves. Many orchids have reddish purplish pigmentation, a pre-adaptation to high light that is triggered by some environmental variable. This coloration is often seen in healthy plants and is no cause for concern. If the leaves start to appear to be too purple or the purple freckles start coalescing, it may be receiving too much light.

3. New growths and young leaves often exhibit purple freckling. The antioxidant anthocyanins act as a sunscreen protecting tender new leaves from excessive solar radiation.

4. *Phalaenopsis schilleriana* usually has beautiful foliage. If grown in lower light, markings on the leaves almost disappear.

5. This *Epidendrum magnoliae* is purple on the right side of the mount from receiving more sun than the green side, though both sides are loaded with bloom spikes.

6. Phalaenopsis often have purple leaf undersides and those with *Phal. pulcherimma* in their heritage often have purplish leaves because of their naturally high anthocyanin content.

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Bright Light Growers. When grown in bright light, anthocyanins are formed in the pseudobulbs and leaves to protect them from the damaging effects of the sun, a natural sunscreen. Sometimes when the undersides of leaves unaccustomed to sun are exposed, they will turn purple. Undoubtedly there is some level of stress causing the plant to form anthocyanins, but we usually accept that in exchange for the plant maximizing its photosynthetic output so it can store more energy and bloom more prolifically. At some point the anthocyanins can be a warning that light levels are excessive. If the purple freckles agglomerate into large purple areas or the plant starts looking too purple, it may be best to dial down the light a bit.

7. Jewel orchids like this *Sarcoglottis sceptrodes* and the various *Habenarias* surrounding it have very pleasing foliage, adapted to growing in low light.

Low Light Growers. Plants that grow naturally in the understory of a forest encounter very different conditions from those growing in bright sunlight. Tree canopies filter out much of the sunlight so shade growers have had to adapt different strategies to maximize energy capture. Some produce leaf colors and textures that are very different from orchids growing in the canopy and exposed to bright light. Leaves are often thinner and less waxy. Some are highly pigmented and others have purple undersides, thought to increase photosynthesis by back-scattering light.

Leaf Reddening. Red coloration can also be produced in leaves that are overheating because of damage to the vascular system that transports water and nutrients to leaves. Nutrient deficiency, mechanical damage, cold temperatures, insect attack and any disease that interrupts the ability of your orchid to maintain an appropriate internal temperature in leaves can induce leaves to develop red or orange coloration.

Red coloration on leaves is a signal to you that your orchid is stressed requiring action on your part. Do the leaves have a bleached appearance from too much light? Typically, loss of roots in an orchid receiving good light results in reddish-orange leaves. Root loss usually occurs from overwatering and/or a degraded soggy mix, but severely under watered orchids may also lose their roots. Extreme temperatures are another cause that may go unnoticed unless there is a max-min thermometer nearby.

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8. This unhealthy leaf coloration occurred on the leaf tip, what caused it?

9. Mechanical damage caused partial separation of the leaf from the pseudobulb, causing the stress.

10. Unhealthy reddish purple markings on the leaf made me take a close look at the roots on this encyclia. It was rebasketed after discovering the roots were rotting.

11. Unhealthy red pigmentation on the leaf undersides of this little cattleya seedling made me knock it out of the pot, cut away rotten roots and tissue and repot it into fresh mix.

12. This bifoliate was repotted last year before new roots were growing. It has not yet established in its

13. The discolored leaves made me take a close look at them, only to find many small dark spots on

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new pot, so some of the leaves reddened from drought stress.

14. *Phal. pulcherimma* enjoys more light than most Phalaenopsis, and is preadapted to high light .

both upper and lower leaf surfaces from Cercosporoid fungi.

15. This poor phalaenopsis is still stressed out from the outbreak of Fusarium I had. Hopefully this is the last one to be tossed.

Senescence. To everything there is a season. If your unblemished older leaves slowly start to dry and yellow, without necrotic streaks, splotches or sunken areas, that leaf may be approaching the end of its life. Consider allowing it to drop off unassisted by you, which allows the plant to reabsorb the mineral nutrients from the dying leaf. Nitrogen, phosphorus, potassium and magnesium can be translocated from older growths and used to build new tissue. Prematurely removing a leaf will cause any remaining nutrients to be lost from the plant.

Removal will also introduce a wound on your plant that is an easy entry point for pathogens. Better to allow the leaf to separate naturally along the abscission zone at the base of the leaf, where it forms a corky layer that acts as a barrier against pathogen invasion. Many growers like to dust wounds with cinnamon to protect them from fungal invaders. Scientific studies have shown that concentrated cinnamon oils have fungicidal properties. Cinnamon powder primarily acts as a desiccant, dehydrating cells to create a necrotic barrier similar to the natural plant defense mechanism, the hypersensitive response.

Think of reddening leaves as an early warning system. Your plant is signaling that it is under stress, not that it is in imminent danger of collapse. Purple or red leaves tell you that your plant is receiving a little too much sun, but it has not received so much solar radiation that the leaf is bleached or sunburned, i.e., damaged beyond repair. A reddened leaf requires your attention, but it not life threatening. It is not necrotic as it could be from a fatal rot or yellowed so that it can longer perform photosynthesis. All you know from leaf reddening is that your plant is stressed, and then it is your job to figure out why and how to ameliorate the problem.

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Citations and Additional Reading:

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