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Of all the colors a rose might be, red was a fortunate genetic occurrence.

Garden Science: Red Roses

The ancient roses roaming wild across Europe and North America in the last thousand years were dominated by shades of pink and crimson. Only one specie can be said to have a truly red color, and that is Rosa gallica. But of all the colors a rose might be, red was a fortunate genetic occurrence and became fixed in the sensibilities of an emerging rose consciousness. Color was then, and now, an effective motivator and is sometimes more expressive than words. Red roses have always been associated with special occasions, passionate sensibilities, and emotions speaking directly to the heart.

If red roses are desired above all the other beautiful colors of rose blossoms, then perhaps one should ask -- What is it that makes the rose red?

Colors in the realm of plants are contained in natural chemical pigments endowed by family genetics. Just as human eye and hair color are determined by the haphazard toss of parental genes, flower reproduction results in progeny with specific color traits. There are many different types of plant pigments and they can be mixed in endless combinations, although nature is less inclined to experiment and hybridzers more likely to do so. The color green (stems, leaves) indicates the presence of chlorophyll. Yellow and orange tones (sunflowers, rudbeckia, marigolds) are caused by carotenoids. The colors red, purple and purple-blue (roses, asters, campanula) indicate the presence of anthocyanins, the crucial pigments necessary to color a rose petal red.

There are more than 300 kinds of anthocyanins, and their possible combinations in a rose petal dictate the differences between pink, crimson, cerise, magenta and purple, as well as all the hues and tints that can be made from those primary red colors. Peonin is an anthocyanin pigment commonly found in peonies, and also in some roses, particularly R. rugosa and its many pinkish and purple-red hybrids. Peonin is also found in the cardinal red petals of the roses ‘Europeana’ and ‘Adelaide Hoodless’. Pelargonidin is an anthocyanin named after the familiar summer geranium (actually a Pelargonium) and contributes scarlet and shrimp-pink shades in modern roses like ‘Independence’ and ‘Tropicana’ (but is not to be found in specie roses).

Roses are not the only plants that anthocyanins make red. They play a key role in the coloration of red and purple fruits and vegetables like raspberries, blackberries and boysenberries, and are pigment contributors to strawberries, plums, peaches and apples. (Surprisingly, tomatoes are made red by an entirely different element, the anti-oxidant lycopene which is protective against prostate cancer.) Anthocyanins are known to be powerful phytonutrients with anti-oxidant capabilities to delay cellular aging and help the heart by blocking the formation of blood clots. As a dietary constituent of grape pigment in red wine, anthocyanins are believed to be a likely key to the “French paradox.” Health professionals have studied the diets of French and Italian red-wine drinkers with generous amounts of saturated fats in their diets, but much lower rates of coronary heart disease than their North American and Northern European counterparts. It is believed that anthocyanins in the wine (derived from grape skins during the fermentation process), along with alcohal and resveratrol (a

phytoalexin associated with red fruits), have a protective effect against coronary disease. White wine, which is fermented without grape skins in the mix, doesn't have the same anti-oxidant pigments, but the alcohol is still a factor in promoting heart health.

The presence of anthocyanin combinations in red roses creates many deeply saturated shades of red -- blue-red, purplish red, rose red, currant red, cardinal red, Turkey red, blood red, Oriental red, as well as dark purple, Tyrian purple, Soferino purple, lavender-violet, mauve-red, magenta-red. Anthocyanin reds are fairly stable in rose petals, with a few exceptions. Certain roses such as the Damask rose 'Leda', the hybrid tea rose 'Double Delight', and the miniature rose 'Magic Carousel' change their color through the growing season by producing more anthocyanins in response to environmental changes. In spring these roses have bi-color petals that are predominantly creamy-white with just a fine edge of red. As the arc of the summer sun rises in the sky, increasing heat and solar radiation trigger anthocyanin production and the petals are erratically flushed with red coloration. This is a genetically dictated behavior and may be an indication that petal tissues are vulnerable to burning by ultraviolet sunlight and need a protective covering. While only a few rose cultivars express fluctuating petal colors in summer heat, many more deepen their color in cool autumn temperatures. It's not unusual to see a medium pink rose like the grandiflora 'Queen Elizabeth' turn several shades darker in the cool air of October. Even a pale yellow rose such as the hybrid tea 'Garden Party' will develop spots and flushes of pink anthocyanin in autumn.

But the same anthocyanin pigments behave quite differently in stems and leaves, particularly in early spring when new growth emerges with dark red to bronze coloring and then fades to green in summer. This temporary red coloration is genetically determined in the same way petal pigment is, and there are certain rose shrubs that initiate new growth with only green color and no sign of red. The most likely explanation is that the temporary presence of anthocyanins in stems and new leaves protects immature tissue from ultraviolet light, particularly UV-B radiation that can damage plant cells (and cause skin cancer in humans). New plant tissue needs time to harden and thicken through a weathering process over the first six to eight weeks of spring, and during that time anthocyanin is produced as a sunscreen to shade and protect leaves and stems. When too much UV-B radiation enters plant tissues, it releases energy that damages outer cell membranes and organelles within cells, interfering with photosynthesis and damaging DNA within the nucleus. Leaves with too much exposure appear bronzed and burned, eventually turning brittle. The cells of plant stems and leaves thicken with exposure to light and wind across their surfaces, and are able to cope with the full spectrum of sunlight later in early summer when the protective anthocyanin pigment fades.

Red pigment in rose petals is also affected by soil pH, in much the same way as the colors of hydrangea blossoms are manipulated in acid and alkaline soils. (Hydrangeas are famously blue in acid soil with low 5.0 pH, but turn pink in alkaline soil with high 7.5 pH.) Anthocyanin production increases in acid soil environments, causing red roses grown in soil with a pH of 6.0 to 6.5 to produce deeper and clearer red pigment than the same plants grown in alkaline soil at pH 7.0 and higher. Their ornamental hips are also brighter in slightly acid soil. Environmental stress can affect anthocyanins and cause red colors to fade. Red and pink rose blossoms receiving too much ultraviolet sunlight will bleach out as the intense exposure diminishes anthocyanin production. As the red pigment fades, purple pigment is left behind and causes the petals to take on an ashen blue tone. (The antique rose 'Tour de Malakoff' blooms cerise pink, then fades to beautiful grey-mauve as anthocyanin is removed from the petal tissues.) Roses certainly benefit from six hour of strong sunlight (preferrably south-east exposure), but ten hours in an open field is more than the plant needs or can handle. Drought stress will also cause red colors to fade and appear blue. Conversely, under stress conditions, cole vegetables like cauliflower and brocolli will produce purple-red distress flushes of anthocyanin under the florets when grown in depleted soils and deprived of essential nutrients such as phosforus.

Judith Adam's books are available through many mainstream and speciality bookstores, and can be purchased online through amazon.com, amazon.ca, and chapters.indigo.ca.

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