Researchers study plants' natural sunscreen

The next time you walk in the woods or around the neighborhood, look for plants with red stems. If you see them, you are witnessing a phenomenon in which the stem of certain plants changes color to protect the plant from too much solar radiation.

This natural sunscreen is a chemical called anthocyanin, the same compound found in red plants, such as roses, blueberries, cherries and strawberries, and is thought to provide health benefits for humans.

Biology professor Howie Neufeld studies a natural sunscreen in plant stems called anthocyanin that turns green stems red in plants like Echinacea. His research about the protective chemical has been published in the Journal of Experimental Botany. (Appalachian photo by University Photographer Marie Freeman)

A chemical called anthocyanin causes some plant stems to turn red when exposed to sunlight. Researchers think the substance acts like a sunscreen, protecting plants from sun exposure that impedes photosynthesis. Other red-stemmed plants include milkweed, evening primrose and certain goldenrods. Appalachian photo by University Photographer Marie Freeman)

Red-stemmed plants are extremely common, yet the functions of stem anthocyanins are largely unknown, according to Dr. Howie Neufeld, a professor of biology at Appalachian State University and coauthor of a study of red-stemmed plants published in the Journal of Experimental Botany. The other authors are Kevin Gould from Victoria University of Wellington in New Zealand and Dana Dudle from DePauw University.

While plants with leaves that turn red, such as galax, have received scientific scrutiny in recent years, there had been very little research published on plants whose stems turn red when exposed to the sun, he said. “There was one study that showed anthocyanins protected the stem of a plant from having the sun destroy a compound that deters herbivores. But that was the only study we could find on this subject,” Neufeld said.

“Anthocyanins are the pigments responsible for red coloration in the stems of most herbaceous species,” Neufeld explained. “Despite the abundance of red-stemmed plant species, there is a surprising dearth of information on their possible functions. We know anthocyanins act as a sunscreen to protect leaves, particularly in cold weather. We didn’t know what it was doing in stems.”

Gould and Dudle examined cross sections from fresh cuttings of the stems of several plants common in New Zealand and Neufeld assisted with data analysis. “The research was primarily
derived from work conducted by Dudle while she was on a sabbatical leave in Kevin Gould’s lab. I was honored to be asked to join in as an author because they were doing work that we had been discussing prior to the initiation of Dudle’s work in New Zealand,” Neufeld said.

“While it may not be apparent to most people, plants can conduct photosynthesis with their stems, similar to what they do in leaves. This research shows that the changing stem color aids in the plants’ stem photosynthesis by protecting it from harmful exposure to the sun,” Neufeld said.

By studying unrelated plants, the researchers believe that the stem-changing attribute is a universal principle, and not specific to just one particular species. For example, if you plot the degree of “redness” against the relative photoprotective effect of the anthocyanins, the data for each species all fall on the same line, indicating this effect is a general phenomenon.

The plants studied produced anthocyanins in the stem’s outer layer. “Exposure to high light stimulates the stems to make the anthocyanins, and this confers protection from further high radiation,” Neufeld said. “We think this is a way for the plant to protect itself from photoinhibitory stress.” The anthocyanins block the sun’s greenish yellow light, but allow the blue-red spectrum, which is important for photosynthesis, to remain.

While this is the first published paper to look at the role anthocyanins play in a plant’s changing stem color, the concept was first proposed at the turn of the century by Muriel Wheldale, a biochemist at Cambridge University. She published a book on anthocyanins in plants in 1916. “She was one of the first to notice and speculate that they acted as sunscreens. They just didn’t have the technology then to prove her hypothesis,” Neufeld said.