# RED-OSIER DOGWOOD REVEALS ITS INNER STRUCTURE

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Ripping a red-osier dogwood (*Cornus sericea*) leaf in half, very, very, slowly often produces a fine white thread-like material stemming from the end of a severed vein (Figures 1 and 2).

A photograph of the thread taken through a light microscope reveals helical structures (Figure 3). Each of these helices are wall thickenings that act as reinforcing secondary cell wall of a tracheary elements. Tracheary elements are specialized cells that form part of the vascular conducting tissue found in the veins of leaves, among other tissues.

To explain the presence of these secondary cell wall thickenings, I refer to a scientific study on plant vascular development by De Rybel, Mähönen and Harietta.[1] Although the plant used in that study was thale cress (*Arabidopsis thaliana*), I am assuming that the process of tracheary element development is largely similar across taxa.

As a tracheary element nears the end of its developmental stages, two processes are initiated by the cell. One involves the appearance of digestive vacuoles that will consume the remaining soluble cellular metabolites, leaving a full mature element hollow and dead at maturity. Only then can it perform its intended duties of transporting water and nutrients from the environment. The second process occurring during this latter developmental stage is the deposition of lignin, a phenolic polymer, in the apoplastic (wall) spaces of the spiral thickenings. The spiral thickenings provide the rigidity needed to withstand the tensional forces created by water transportation in the plant vascular and prevent the water conducting cells from collapsing. These hollow cells, connected end to end, form long tubes through which water and nutrients are directed to foliar tissue from the roots.

The helical thickenings, because of their inherent strength often remain intact while the rest of the cell wall is destroyed by the gentle force used to pull the leaf apart. There are no other cell parts, such as chloroplasts, a nucleus, etc. in the microscope photograph because mature tracheary elements are devoid of all organelles.

The midvein, being the largest vein in leaves, would have considerably more tracheal elements than any of the smaller branching veins. This would explain why there is a large white mass emanating from the ends of the midvein, while fewer tracheary elements appear protruding from the ends of the small veins.

The existence of these unique thread-like structures had been known by the author for at least 30 years, but their structure and origin had remained a mystery to me until now. If it was not for Sandy Jasieniuk's curiosity and her insightfulness to use a microscope, the mystery may never have been solved.

1. De Rybel B, Mähönen A, Helariutta Y et al (2016) Plant vascular development: from early specification to differentiation. *Nature Reviews Molecular Cell Biology* 17:30-40. https://doi.org/10.1038/nrm.2015.6

**FIGURE 1.** White threads protruding from both ends of the midvein of a red-osier dogwood leaf. Photo credit: Doug Adams.

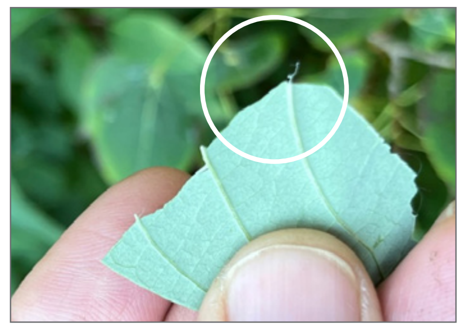

**FIGURE 2.** A fine, white thread protruding from the end of a small leaf vein. Photo credit: Doug Adams.

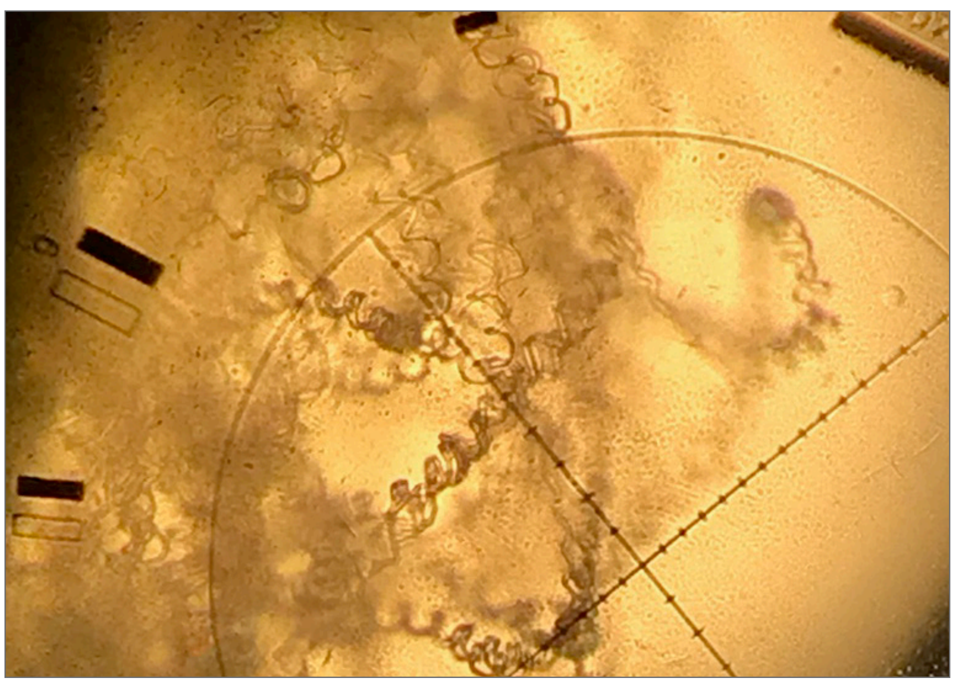

**FIGURE 3.** Sandy Jasieniuk was looking at the white threads through a microscope on loan from Dale Parker. She then held her cellphone up to the ocular lens and took this picture. Each helical structure is the wall thickening coming from separate tracheal elements.