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Spiderworts: Not Just Another Pretty Face for Science

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The Potomac Gorge

Unmatched diversity at Annual Meeting

Gary Fleming, the vegetation ecologist with Virginia's Natural Heritage Program, stood on a rocky ledge high above the Great Falls of the Potomac River explaining the globally imperiled riverside prairie, one of over 30 plant communities of the Potomac Gorge. Not far away a National Park Service interpretive sign quoted Gary about the gorge: "In more than 25 years of fieldwork I have not seen another site of this size with comparable diversity of land forms, plants, and natural communities."

The Potomac Gorge encompasses a 15-mile stretch from the piedmont province above Great Falls to the coastal plain at Georgetown, where the Potomac River drops down through the bedrock. It was created when the sea level dropped during the Pleistocene period, between 1.8 million and 11,000 years ago. As the river cut lower and lower, it left numerous bedrock terraces along the sides. The river has also migrated to the south over geological time and continually carved away at the Virginia side, creating an almost continuous line of steep bluffs and cliffs. Unlike most eastern rivers its size, the Potomac has no high dams and it is powerful enough to completely obliterate and then recreate floodplain habitats. It has fostered the dispersal and migration of plants over several physiographic provinces creating rich and diverse plant communities. Furthermore, much of the gorge has been protected on both sides of the river by federal and lo-

Great Falls is a geologic highlight of the Potomac Gorge (Photo by Nancy Sorrells)

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Spiderworts: Not just another pretty face for science

Species of *Tradescantia*, or spiderworts, are handsome plants. Several wild species, including the VNPS wildflower of the Year for 2008 (*T. virginiana*), can be found in eastern North America and additional species grace gardens, and hothouse conservatories. Spiderworts are not, however, just a bunch of pretty faces. Spiderworts have a long history of service to science, both in terms of teaching and pure research.

Several hothouse species of spiderwort have a creeping habit, for example, *T. fluminensis*, *T. sillamontana*, *T. pallida* (formerly *Setcreasia pallida*), and *T. zebrina* (formerly *Zebrina pendula*). Each of these frost-sensitive species is commonly grown in hanging pots. They also

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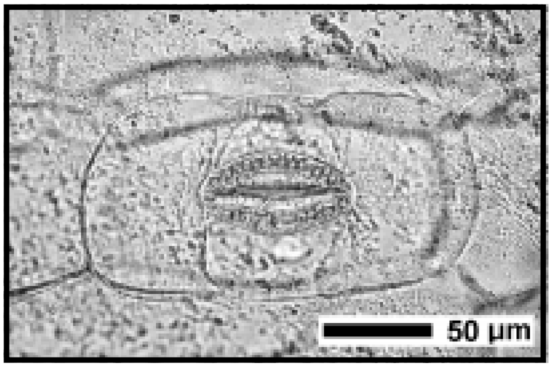
I N S I D E: VNPS Annual meeting information and registration form



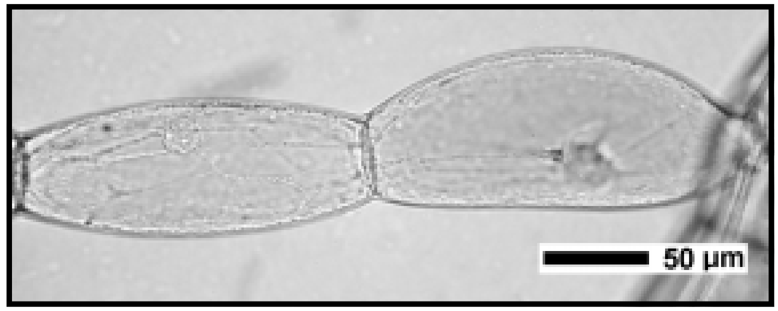


*Figure 1 (left) shows the lower epidermis of a **Tradescantia pallida** leaf with stomate. Figure 2 shows two **Tradescantia pallida** cells at the base of stamen hair. When this photographic was taken, granules in the cytoplasm strands were moving in a streaming circulation throughout the cell; most of the volume of these cells is occupied by a watery bag, the vacuole.*

• Spiderwort science

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readily form adventitious roots at each node and, as a result, they constitute excellent material with which to demonstrate vegetative propagation (asexual reproduction). Stem tip cuttings about three or four inches in length, with a few lower leaves removed, will in a matter of a week or two, strike root in moist sand, in perlite, or even in a glass of water. For students new to botany, cloning one's own plants for the first time can be a valuable and motivating lesson in the ways of plants.

For more advanced classes, spiderworts are good subjects for microscopic study. Leaves are often somewhat succulent, so they can be torn to yield thin sheets of epidermal cells that, when mounted in a drop of water on a glass slide, reveal basic aspects of plant cell structure, including cell walls, the nucleus, and large watery vacuoles. And scattered among the ordinary epidermal cells, one can easily find stomates, the adjustable pores that control both photosynthesis and water loss (figure 1). Flowering spiderworts allow for even easier microscopic preparations: a wet mount of a single stamen, plucked from any open flower with fine forceps, yields hundreds cells linked together, much like a string of pearls; these chains of cells are the stamen hairs characteristic of all *Tradescantia* species. With high power, the living cytoplasm of stamen hair cells can usually be seen in motion, streaming vigorously through the cell (figure 2). Few subjects convey dynamic aspects of cell structure better.

Of course, the same characteristics that make spiderworts useful teaching tools are also beneficial in the research lab. *Tradescantia* stamen hairs have frequently been used in experimental studies of cell division. The stamen hairs grow in buds before the flowers open by a series of successive cell divisions, which form the chains up to 30 cells long. Most dividing cells will be found at the tip of the growing hair. Unlike other plant tissues with many dividing cells (for example stem or root tips), stamen hair cells are easily exposed as nearly isolated cells, not buried among a three dimensional mass of non-dividing cells. Consequently, both observation and manipulation are facilitated. The dividing cells can easily be bathed in chemical solutions or, with the right equipment, experimental molecules can be micro-injected directly into the cell to test their impact on the division process.

Spiderworts also have an extensive history of use in monitoring the effects of mutagens, substances that cause changes in the structure of DNA. For these studies, one particular spiderwort hybrid, a cross between smooth spiderwort (*T. ohiensis*) and prairie spiderwort (*T. occidentalis*), has been used most often. One particular clone resulting from this cross contains two forms of a gene that controls flower color. One (dominant) form of the gene results in blue pigmentation whereas the other (recessive) form yields pink. The value of these plants is that mutation in the blue form of the gene generally results in loss of ability to make that color. So, when this blue-flowered plant is exposed to a mutagen, any cell that suddenly makes pink pigment rather than blue indicates that at least one mutation event happened in that cell. In essence, the scientists simply count pink spots in petals or count the presence of pink stamen hair cells among the blue ones as a means of quantifying the effects of the mutagenic substance being tested. This spiderwort mutation monitoring system has been used to study the effects of radiation, and many different chemicals, including air pollution. In fact, decades ago these spiderwort hybrids were intentionally exposed to atomic bomb blasts as part of the government's efforts to understand the power unleashed in nuclear reactions.

Our last example of spiderwort science relates to kinder and gentler themes. In the 1930s many scientists were engaged in an effort to unite the basic framework of evolutionary theory expounded by Darwin with newer developments in population genetics and ecology. The result came to be known as the "modern synthesis." One key development brought out in this era was clarification of the role of natural hybridization in evolution and speciation. Natural hybrids of spiderworts, especially hybrids involving *T. virginiana*, *T.*

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• Merrimac Farm

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outside the installation's existing border to protect against incompatible development that could impact current or future military operations occurring within the current installation boundaries, as well as to support local land conservation efforts. Merrimac Farm is the first acquisition of its kind in the Commonwealth of Virginia.

"This partnership not only allows us to continue our mission of training Marines, but also lets the local community enjoy important Virginia habitat in its natural state," said Quantico Base Commander Colonel Charles Dallachie. "We are happy to partner with the Commonwealth of Virginia and the Prince William Conservation Alliance to honor the wishes of the McDowell family and protect this land from development. I look forward to other opportunities with willing partners for compatible land use efforts on all sides of the base."

Merrimac Farm was originally owned by Col. Dean McDowell, who purchased the property after World War II and whose untimely death in 2002 put his property at risk of development. The continued support of Col. McDowell's heirs and their commitment to the preservation of Merrimac Farm for public uses has been instrumental to the success of this five-year effort. Gail McDowell said, "Our family is committed to conservation. We are delighted that the property will be protected and available to the public."

For the complete list of state-owned WMAs, visit the WMA section of the VDGIF website at http://www.dgif.virginia.gov/wmas/.

• Spiderworts

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ohiensis, and *T. subaspera*, were studied at this time by Edgar Anderson and Robert Woodson of the Missouri Botanical Garden. Anderson, in particular, working with spiderwort hybrids, developed something called the hybrid index, a method to quantify the relative contribution of different parents in the genetic makeup of hybrid offspring. Building on these early studies with spiderworts, Anderson extended his observations to other groups of naturally hybridizing plants (e.g., *Iris* species) and, eventually, he published his most famous work, *Introgressive Hybridization* in 1949; this book includes a thorough analysis of how genes can flow from populations of one species through hybrids into populations of another species. Anderson's work with spiderwort hybrids is commemorated in the name *Tradescantia x andersoniana*, the name applied to what is now a common group of garden hybrids combining the genetic characters of Virginia spiderwort (*T. virginiana*), smooth spiderwort (*T. ohiensis*), and wide-leaf spiderwort (*T. subaspera*).

Spiderworts may appear to be among the most delicate and fleeting of our native wildflowers but they and their relatives have had a profound and lasting impact on the science of botany.

---*W. John Hayden, VNPS Botany Chair*