Letter from the Desk of David Challinor
November 2006

As a child I was enchanted with "Jack and the Beanstalk," a fairy tale that lives firmly in my memory. Pole beans grew in our garden on eight-foot poles, which seemed for my size then to reach the sky, where lived the giant in his castle. I thought little more about vines until I was 10 or 11 and watched Johnny Weissmuller and Maureen O'Sullivan in "Tarzan of the Apes." I clearly remember Tarzan (doubtless doubled by a trapeze artist) swinging through the African jungle on conveniently spaced "lianas," all the while bellowing his high-pitched call.

I loved adventure movies, especially ones about animals and jungles, but Tarzan's use of lianas bothered me. I wondered whether these vines were rooted on tree branches so that the stem conveniently hung down and if so, would their roots be anchored strongly enough to carry the weight of a grown man? I soon discovered that all the vines I found locally were rooted in the soil, therefore, concluding that Hollywood did not care about natural history at all, an attitude reinforced in the Tarzan movie by a herd of Asian elephants ambling through the African jungle.

I lost interest in vines until I came to the Smithsonian and gained responsibility for the Chesapeake Bay Center for Environmental Science (CBCES), now known as the Smithsonian Environmental Research Center (SERC). When the Institution first acquired the former dairy farm, it had been abandoned for almost 20 years and vines covered the derelict buildings.

Among the common woody vines at SERC is Japanese honeysuckle (*Lonicera japonica*) —an oriental exotic now well-established in eastern North America. It is an evergreen twiner and after climbing saplings, it often constricts their growth as the tree increases in diameter, while the vine grows stouter. In extreme cases the vine can girdle and kill the tree. Honeysuckle roots compete for soil moisture and nutrients with their host trees. A hardy vine, it sprouts readily when cut. Deer browse it in winter, but with relatively little effect on the vines' growth, particularly on well-established ones that have reached the canopy. Old vines can reach 2" (5cm) in diameter at their base.

Honeysuckle and other twiners such as morning glory generally ascend clockwise. This has always puzzled me because occasionally I have found one spiraling in the opposite direction. Why do most twine clockwise? There is still no answer and the odd exception is about as rare as a four-leaf clover. Few people bother to look for four-leaf clovers or counterclockwise spiraling vines; I am one, and I also scan spiral staircases. Of three separate houses in which I have lived, the spiral staircase in one rose counterclockwise, and in the other two clockwise. To make matters even more baffling, the tendrils of vines, such as grape, twine counterclockwise—opposite to the stem-twining vines.

Tendrils are specially adapted organs that help vines climb. When walking in a vineyard, one finds them conspicuous, especially the long thin ones sprouting from the stem and seeking a support to entwine. Tendrils are thigmatropic, that is when one touches an object such as a stem or a stretched wire, a hormone is released in the tendril that alters its straight growth to a rapidly coiling spiral. Foxgrape (*Vitis labrusca*), a local wild species, often has stems more than an inch in diameter. Tendrils have one disadvantage in that they can only wrap around relatively small stems. The large grape vines in mature forest all must have had their start when the surrounding trees were small.

Some vines such as English ivy (*Hedera helix*), a European native, and poison ivy (*Toxicodendrou radicans*), a scourge for those susceptible to it, ascend via stem rootlets that allow them to climb almost any tree, even one with smooth bark. At SERC, a cornfield abandoned in 1946 was promptly invaded by poison ivy and sweet gum seedlings from a coincidental good seed year for that tree. The sweet gum (*Liquidambar styraciflua)* and the ivy thus matured together, but what interested me was the vines' selectivity. The forest floor was covered with sprawling vines in the 1980's and although shaded by a closed canopy, there was still sufficient sunlight for the ivy to survive. I noticed that the ivy climbed some sweet gum or an occasional cherry that had also seeded in, but not other trees of the same species. Was the bark of some individuals less attractive to the vines or more hostile in some fashion than its conspecific neighbors, or was it all a matter of chance? I would like to revisit this tract (now > 20 years later) to see if the canopy is thick enough to shade out the poison ivy or if there are still enough canopy vines to sustain (photosynthetically) the ground-spread non-climbers.

The woody vines of eastern North America are tough and hard to control. English ivy, for example, readily climbs trees, although I have observed they seem to prefer deciduous hardwoods over conifers. The reason may be that this ivy tends to grow close to the tree trunk and not along the branches. This makes good strategic sense because, being evergreen, the ivy enjoys full sunlight all winter when the host tree has dropped its leaves. The vine can thus accumulate enough reserves to maintain itself when the host is in full foliage and blocks the ivy from direct sunlight.

Like poison ivy, English ivy grows well on the ground. Years ago my front lawn had scattered patches of ivy that were invisible in summer, being covered by lawn grass. In winter, when the grass was dormant, green ivy leaves stood out to take advantage of the winter sun. It took two or three years of yanking out the winter-visible stems and leaves to clear the ivy from the lawn. Whenever the stems broke off and stuck in the soil I would merely pull off whatever leaves I could find so there would be no photosynthesis to sustain the remnant vine. Today, the ivy is gone.

Control of English ivy by defoliation in winter is effective. Deciduous poison ivy is harder to kill. Arborial vines can be cut near their base and salt applied to the cut stem to prevent sprouting. Open field-grown poison ivy has to be leaf-sprayed, a tedious and long-drawn effort.

Compared to controlling the two ivy species, Asiatic kudzu (*Pueraria lobata*) is a killer. The leguminous kudzu was originally planted as a fast-growing ground cover to control erosion in the southeastern U.S. It soon escaped cultivation and rapidly took over open, disturbed sites. Like Japanese honeysuckle, kudzu is a stem-twiner, which makes it particularly adaptable to disturbed sites where invading vegetation is small-stemmed. Saplings are soon completely draped with a thick blanket of relatively large leaves. In full sun and with adequate moisture, kudzu stems grow from 6 to 12 cms (2 ½ to 5") a day. Blanketed small trees and shrubs die from failure of their covered leaves to carry on photosynthesis. Kudzu dies back to the ground with the first frost and its luxuriant foliage quickly decomposes. The energy from the massive photosynthetic activity each summer, however, is stored in its tuberous roots, which are occasionally harvested for commercial starch production. Each spring the vine draws on this stored energy to sprout and reoccupy its site. Control of kudzu is difficult because it is impractical to excavate all the tuberous roots. One expensive approach is to cover the infested area with black plastic sheeting in winter while the vines are dormant. They will still sprout in the spring under plastic, but lacking sunlight, they cannot store energy. However, it is labor-intensive to keep the plastic sheeting in place for at least two years and to ensure that no sprouts grow through holes created by deer hooves or fallen branches.

The final vine to consider is dodder vine (*Cuscuta pentagona*), a parasite whose survival strategy depends on plant communication by airborne volatile compounds, a topic I discussed in last month's letter. Dodder seedlings have no roots and barely photosynthesize. Rather, they depend on the energy stored in the small seed from which they germinate to start growing. The seedlings (pale green, rootless and leafless) have only a few days to find a host plant to which they must attach; otherwise, they will succumb to lack of nutrients. To find a host, the seedling evidently has chemical receptors that allow it to grow towards the favored host. For example, the seedling will seek out tomatoes before wheat, the latter apparently have in their volatile chemicals one that is partially repellant to dodder. Should this repellant ever be isolated, it would give promise in the development of a control agent for this agricultural pest. The mature vine is yellowy-orange and about the diameter of a thick string; it can rapidly smother, but generally not kill its host plants.[*]

Other native woody vines in our eastern forests seldom rank as pests. The evergreen, thorny smilax, is a favored winter deer browse and the scarlet-flowered trumpet creeper is an important nectar source for Ruby-throated humming birds. In tropical forests, vines vigorously compete for access to the canopy and host trees have evolved elaborate defenses. For example, one canopy-tree species in Panama generally is host to arboreal ant colonies. When vine tendrils start to invade its canopy, the ants cut back the tendrils to keep it clear.

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[*] See Runyon, J.B., M.C. Mescher and C.M. DeMoraes, Volatile Chemical Clues Guide Host Location and Host Selection by Parasitic Plants. Sci. 313 (5795):1964-67 (2006).

Competition for sunlight and nutrients is rampant in the plant world. Recent research is beginning to expose not only the existence of, but the nature of, airborne volatile chemicals. Plants, indeed, can communicate with each other in ways we are just now beginning to understand. What an exciting time this is for plant physiologists!

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