Summary 100

VITICULTURE & ENOLOGY
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The structure of xylem vessels in grapevine (Vitaceae) and a possible passive mechanism for the systemic spread of bacterial disease

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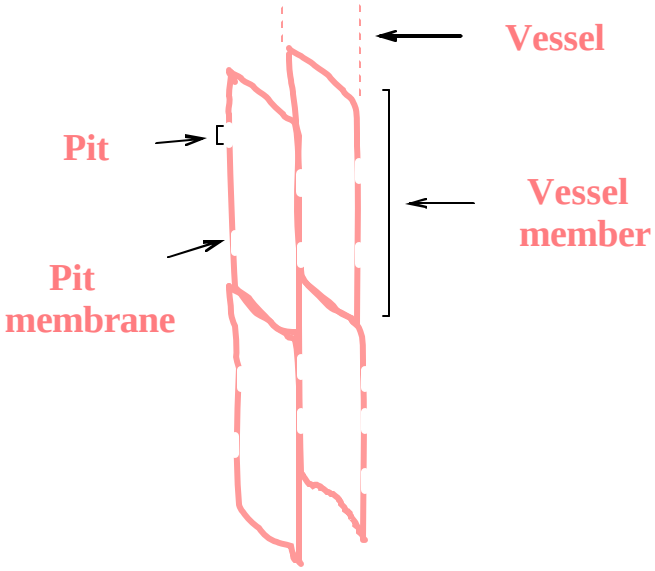
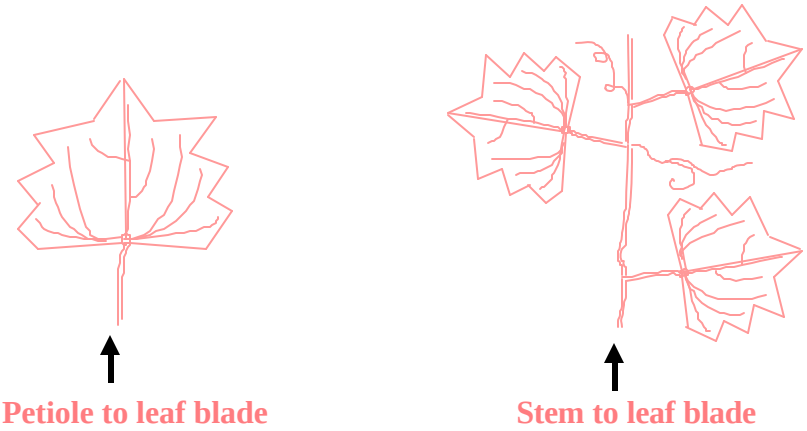
• Xylem is the principal water conducting tissue in vascular plants. *Xylem vessels* are comprised of *vessel members* -or *vessel elements*-, whose secondary walls thicken and become rigid as they mature. Xylem vessels have a finite length because, even though the individual vessel members have perforations connecting them, the vessel members at the ends of the vessel have no perforations. Thus, xylem vessels themselves are only connected through *pits* or "holes in the wall", which are lined by a membrane. The presence of these pit membranes creates a distinct difference between the flow of water versus the flow of particles inside the xylem: **water and low molecular solutes are free to pass, but microorganisms and gas bubbles cannot.**



• To better understand the xylem "highway", and how bacteria move within the xylem, the authors studied the vessel conductivity between stems and leaves using 3 methods: 1) the **light-producing bacterium** *Yersinia enterocolitica* was loaded into petioles or stems and followed using X-ray film; 2) **fluorescent polystyrene beads** were loaded into petioles and followed by microscopy, and 3) **low-pressure air** was pumped into petioles and stems, and bubbles extruding from cuts made in submerged leaves were followed. To find out whether anatomical differences within the Vitaceae existed, the authors compared the leaves of two different species, *Vitis vinifera* (Chardonnay), and *Muscadinia rotundifolia*. All tissues were observed with a light microscope after adequate slide mounting. Three replications –of 15 plants each- were used per treatment. Let's see the results.

• **Petiole to leaf blade "junction"**. When the cut end of petioles was treated with either a bacterial suspension or air, both the bacteria and air were able to travel unimpeded from the cut end of the petiole into *primary*, *secondary* and even *tertiary* veins of the leaf. Beads were found in primary and secondary veins, but not in tertiary veins. The authors believe this discrepancy might be due to the difficulty of cutting such thin pieces of tissue manually, or alternatively, to the poor light signal expected from a small number of beads going through these small veins. The authors found no difference between the leaves of *Vitis* and *Muscadinia*.

• **Shoot stem to leaf blade "stretch"**. When the basal end of a cut piece of shoot with 3 leaves attached was treated with either a bacterial suspension or air, both bacteria and air traveled from the cut stem into the primary and secondary veins of at least 3 leaves above the inoculation point. No bacteria or air were observed in any of the tertiary veins. In larger shoot segments, the authors were able to observe air flow in secondary veins of up to the fifth leaf above a cut stem. This pointed to a length of xylem vessels where air and bacteria could travel unimpeded of at least 38 cm. Once again, the authors found no difference between the two species compared.



Diagrams by the authors (modified)

In summary, all bacteria, air, and beads moved similar distances from the petiole end into the leaf blade, suggesting that only anatomical limitations prevented movement from the point of inoculation on. As the authors point out, the implications are that, if sharpshooters feed on a vine and infest any vessel with *Xyllela fastidiosa*, chances are the bacteria will be able to spread rapidly and passively into nearby leaves, contributing to a systemic infection. This is the first time such length of xylem conduits was documented in the family Vitaceae, and this work has gained Dr. Matthews and his team the cover of a leading national journal in the field of botany. You can access Dr. Matthews' webpage at: http://matthews.ucdavis.edu

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