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Pruning-induced tylose development in stems of current-year shoots of *Vitis vinifera* (Vitaceae)

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• *Tyloses* are outgrowths of parenchyma cells into the lumen of vessels through holes in the vessel cells called pits. In many species, the formation of tyloses is a common response to traumas such as infection by fungi or bacteria, flooding, freezing, or mechanical injury. Previous observations associated the sealing of pruning wounds with tylose formation. The goal of this paper was to study the process of *tylose development*, and evaluate possible differences in wounding repair depending on the location of the wound on the shoot.

• The authors cut through a Chardonnay current-year shoot at one of 3 heights: basal cut (10-20 cm from the base); middle cut (60-80 cm from the base), or apical cut (20-40 cm from the shoot end). To have a chance of observing the development of tyloses with time, they collected a 4-cm piece of shoot from the apical side of the cut immediately after pruning, and fixed it for later analysis. They then repeated this on the basal side of pruning cuts every day for the next 6 days, using a different pre-cut shoot each time. Once at the lab, each sample was transversely hand-sectioned at 2, 4, 6, 8, and 10 mm below the pruning cut (I assume, by someone with a very steady hand). Samples were then prepared and observed for the presence of tyloses using a scanning electron microscope, or SEM.

• **Results**. 1) Tyloses were not present in those vessels in the stems that did not receive a cut, but only in those vessels that had been injured by pruning. Tyloses started forming on Day 1, and continued growing until they contacted each other, blocking the vessel (which normally took anywhere from 3 to 10 tyloses in larger vessels). 2) The percentage of vessels with tyloses was greatest (up to 85%) in the basal region, and decreased towards the tip of the shoot (which has less secondary, late-forming xylem). This pattern was also true for the percentage of vessels completely occluded by tyloses, which was highest at the base (up to 40%). 3) The depth at which most tyloses developed was 4 mm from the cut at the base of the shoot, and 2 mm from the cut in the middle and apical cuts. 4) Tylose development continued for 1 week at every cut point, but was fastest in the basal and middle cuts. That is, basal cuts (10-20 cm from the base) healed sooner.

Some food for thought from the authors' discussion:

_ the tylose-forming capacity found in this study –greatest at the base- contrasts with that observed in other species –greatest at the tip-, meriting further studies;
_ summer pruning in *V. vinifera* did not lead to the formation of callus and/or secretion of resins or gels, unlike in other species;
_ the distribution of tyloses found along the stem would indicate that pruning near the shoot apex (summer hedging) may expose vines to airborne pathogens for longer than more basipetal cuts (like spur pruning). [*A mature, fully-peridermed cane, however, might differ in tylose formation from a less weathered, younger shoot, which is what the authors studied*]

_ it is still not clear whether tylose formation protects from, or on the contrary, exacerbates disease (many species show more tyloses in susceptible than in resistant genotypes). For more on this controversial topic, we recommend reading the authors' interesting discussion).
_ there are still 2 questions important for our understanding of the role of tyloses in disease that still need resolution: 1) do tyloses form in fully functioning vessels and 2) are enough vessels occluded by tyloses to limit water and solute transport?

In summary, tyloses formed *more frequently*, *deeper*, and *faster* on wounds at the base than at the tip of current-year-shoots. This information brings us closer to an understanding of the possible role of tyloses in defending vines against bacterial diseases such as Pierce's disease. This work also gained Dr. Matthews and his team a special recognition on the cover of the prestigious *American Journal of Botany* (for a second time the same year!) So be sure to check out the full-colored "new world" that Dr. Matthews is exposing to our eyes –and if you don't have a color printer, you may want to email the link to a friend who does. Finally, to learn more about how a scanning microscope works, you can go to: http://www.mos.org/sln/SEM/sem.mov.

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