Analysis of Results of the Xylogenesis Practical

Explants on 'control' and 'zeatin' medium had not increased in fresh mass, and showed no differentiation (the suberin coat was unbroken; some students found stray vessels of the original xylem in these explants), i.e. cutting alone is insufficient to induce cell division in pith cells.

Explants on IAA (auxin) alone had increased in fresh mass approx. 4 fold over 7d due to stimulation of cell expansion. Wound vessel members (WVMs) had differentiated at $3x10^4$ to $1x10^5$ $g^{-1}FW$, in neatly spaced files, one cell wide, running parallel to the direction in which auxin diffused from the medium into the tissue. The spacing is due to positive feedback interactions within cells competing for auxin, and auxin-stimulated auxin uptake is the key interaction, generating a drainage pattern as in a sand tray.

Explants on IAA+GA_3 (gibberellin) had increased in fresh mass approx 5 fold due to additive stimulation of cell expansion by GA_3. WVMs reached $5x10^5$ $g^{-1}FW$, due entirely to stimulation of cell division prior to induction of xylem differentiation by auxin. GA_3 has no direct effect on xylogenesis.

Explants on IAA+zeatin (cytokinin) had increased in fresh mass only 2 fold due to inhibition of auxin-induced cell expansion by zeatin. WVMs reached $3x10^5$ $g^{-1}FW$, due partly to stimulation of cell division prior to induction of differentiation by auxin, but partly as an indirect consequence of the reduction in fresh mass increase relative to auxin alone. Increased cell division in combination with decreased cell expansion resulted in a larger number of smaller cells and WVMs. Cytokinins have, if anything, an inhibitory effect on xylem differentiation at the relatively high concentration we used, but this is masked by the increases due to the factors mentioned above: more cells in a smaller mass. Some groups reported broken chains of isolated WVMs for this treatment, an indication that this year the inhibition of auxin-induced differentiation is more apparent.

Explants on all three morphogens increased in fresh mass 3 to 4 fold, the net result of stimulation of cell expansion by auxin and gibberellin, and inhibition of this process by cytokinin. In previous years, this treatment generated the most WVMs per gramme fresh mass (10^6) but this year the class found values of $4x10^5$ $g^{-1}FW$, further support for the idea that inhibition of xylogenesis by cytokinin is stronger this year than previously. Tissue response varies from year to year as a result of the conditions in which the tubers develop.

The chains of WVMs in tissue on the three treatments: IAA+zeatin, IAA+GA_3, and IAA+GA_3+zeatin, were mostly composed of strands two to three cells thick, and the clear spacing of parallel strands seen on auxin alone was obscured by multiple interconnections, creating a dense network. It appears that the extra cell divisions are resulting in multiplication within the auxin 'channels', and the increase in numbers of cells differentiating seems to lead to chains merging as a network.