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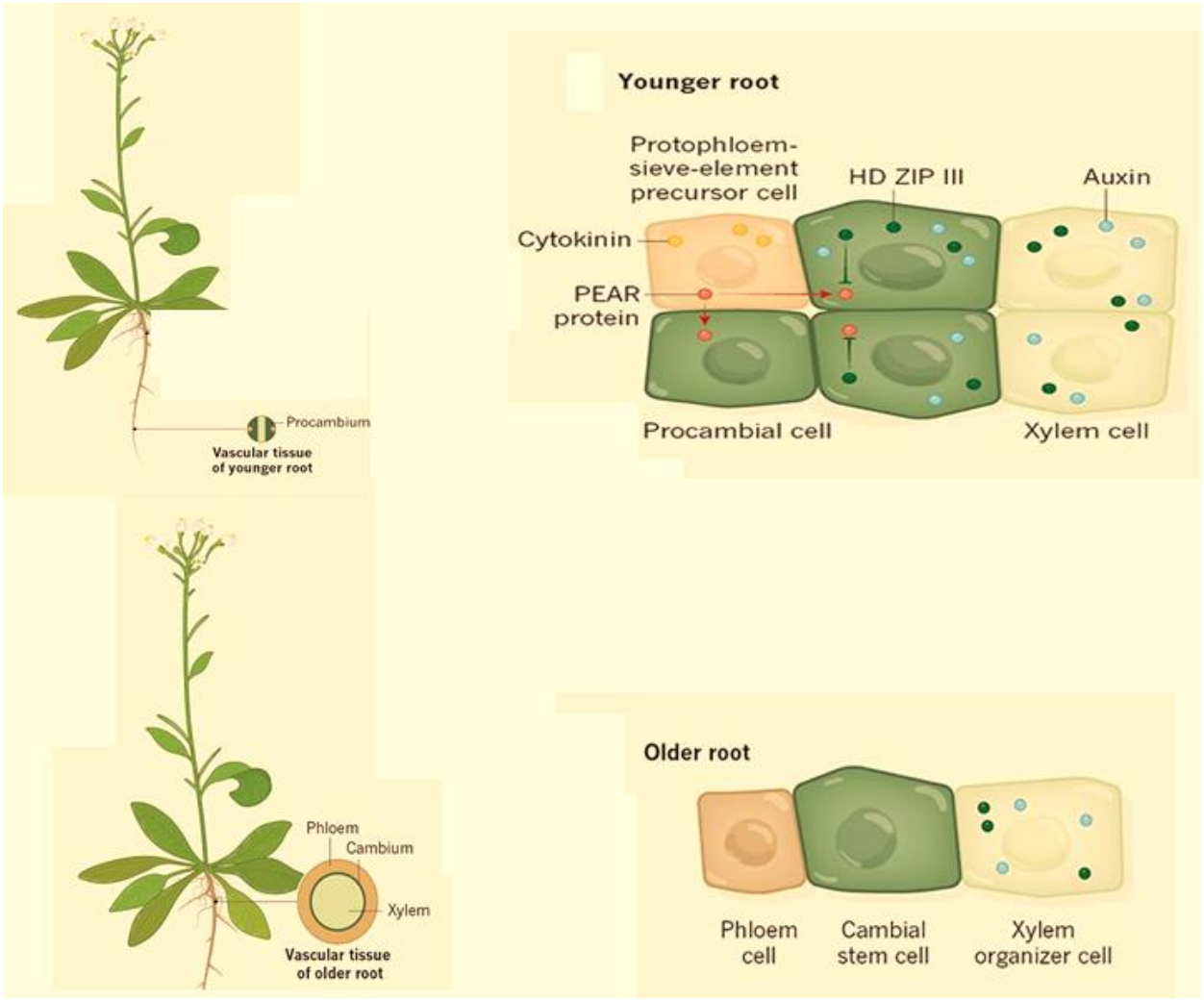
Plasticity of cambial stem cells – A Broken Dogma - *Dr A. Manivannan and Dr K.PM. Dhamayanthi, ICAR CICR, RS, Coimbatore*

In plants cambium is a layer of actively dividing cells located between Xylem and Phloem. This cambium undergoes continues division which resulted in secondary growth of Xylem and Phloem. Xylem transfers water and phloem conducts food materials inside the vascular bundles. When these cambium grows towards inner resulted in secondary growth of Xylem called as "Wood" and upon growing in their outer regions resulted in growth of Phloem known as "Bast". Kind of cell types generated by root-tip stem cells make up the cell layers from which the cambium develops. They show that cambial precursor cells, also known as procambium cells. These procambium cells show the plasticity for the further transfer elements formation called as cambium stem cells.



(Source: Wolf and Lohmann, 2019)

Cambium stem cells by producing daughter cells of distinct fates towards the interior and exterior, respectively, cambial stem cells differ substantially from those in root and shoot tips. In the root tip, stem cells generally produce daughter cells in one direction only. In the shoot tip, cells acquire their fate depending on their relative final position after they have left the shoot-tip region. Cambial stem cells need to receive signals from neighboring xylem cells that are acting as organizers. The division of cambial stem cells leads to the generation of xylem and phloem daughter cells towards the root interior and periphery, respectively.

Phloem cells at the periphery of the vascular tissue act as 'organizers' cells that promote the division of nearby cells (procambial cells). Certain type of developing phloem cell called "protophloem-sieve element precursor" responds to the hormone cytokinin by expressing proteins of a family of transcription factors called as "PEAR(PHLOEM EARLY DOF) proteins", which gives cells the ability to divide(Miyashima et al.,2019). Towards the root interior, the hormone auxin, aided by PEAR proteins, causes HD ZIP III transcription factors to accumulate, inhibiting PEAR function. Certain cues determine organizer function is provided by the local accumulation of auxin which promotes the expression of HD-ZIP III (CLASS III HOMEODOMAIN-LEUCINE ZIPPER) transcription factors (Smetana et al.,2019). These, in turn, maintain the organizer cells in a non-dividing state called quiescence, which is a hallmark of this type of cell.

Cambial stem cells seem to have a rapid cell-division cycle. This is against the dogma that plant and animal stem cells usually have a lower cell division rate than do their most recently formed daughter cells. single stem cell can give rise to xylem and phloem cells is tricky, by considering that the relative rates of xylem and phloem production are not same, and the generation of these elements is subject to developmental and environmental regulation.

Suggested Readings

- Miyashima, S. et al. 2019. Mobile PEAR transcription factors integrate positional cues to prime cambial growth. Nature https://doi.org/10.1038/s41586-018-0839-y
- Smetana, O. et al. 2019. Nature High levels of auxin signalling define the stem-cell organizer of the vascular cambium. Nature, 565:485-489.

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