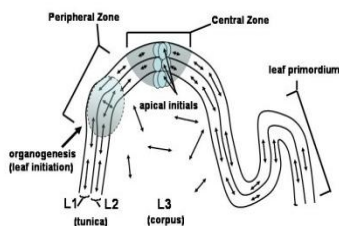


Optimising Plant Growth

The growth and development of plants is critically dependent on mechanisms that control increases in biomass, cell division and differentiation. Unlike animals, whose basic body plan is formed during a relatively brief embryogenesis, plants elaborate their architecture through the activity of so-called meristems, that lie at the tips of roots and shoots and which enable growth over long periods. Using a combination of molecular and genetic approaches, we seek to understand basic mechanisms that regulate the activities of apical meristems and use this knowledge towards creating better plants.

Meristems make the plant

The diverse and often complex architectures of plants can be attributed almost completely to the activity of small groups of cells termed “apical meristems”. Located at the tips of shoots and roots, these structures include clusters of slowly dividing embryonic-like cells whose fate remains undetermined throughout the life of the plant. At the same time, derivatives of these cells are somehow organised into the various tissues and organ systems throughout the plant. Common to both processes are mechanisms that somehow respond to positional cues to control the division and differentiation of cells.



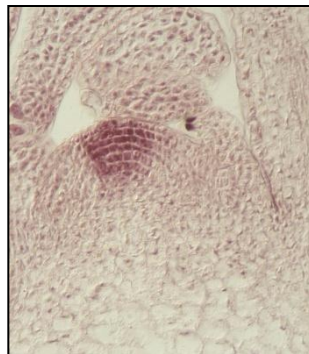
Schematic cross section of a shoot tip showing location of embryonic-like cells in the “central zone”

Genetic control of growth by apical meristems

Using a combination of molecular and genetic approaches, a detailed understanding of how meristems function is beginning to emerge. In the model plant Arabidopsis, key regulatory genes have been defined which can be thought to act as switches in two types of complex processes. One type of process ensures that a reservoir of cells whose fate remains undecided is maintained in the tip of the root or shoot. A second type of process controls the recruitment of newly formed cells into the various organs and tissues that make up the shoot and root.

A common mechanism for maintaining the potential for growth in the root and shoot?

Recent research suggests that shoots and roots, despite having contrasting appearances and activities, both use similar molecular mechanisms to promote growth. Work at AgResearch has identified a new class of genes that appears to contribute to this growth through a previously undescribed mechanism.



Cross section of a shoot tip showing localised activity of a gene that promotes growth

Altering genes that control growth can be used to augment plant growth and modify architecture

The growth of plants and their architecture reflects the complex outcome of intrinsic, gene driven programmes interacting with extrinsic factors, such as nutrient levels and stress. By understanding the role of specific genes in promoting growth, we can uncouple their activity from intrinsic or external factors that would otherwise limit growth. This strategy offers a promising new approach to develop robust plants that are able to perform well in limiting growth environments.



Comparison of flowers in which growth has been artificially limited in the outer organs (right) versus normal flowers (left)

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