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Opinion Article

Concept of stem cells in plants

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DESCRIPTION

Plant stem cells are innately undifferentiated cells located in the meristems of plants. Plant stem cells serve as the origin of plant vitality, as they maintain themselves while providing a steady supply of precursor cells to form differentiated tissues and organs in plants.

Undifferentiated cells called stem cells have the ability to divide for self-renewal as well as differentiate into specialised cells. Plants use stem cells as a reserve to continuously create new tissues/organs during development and to start de novo organogenesis during regeneration.

Plants' shoot apical meristems (SAMs) contain populations of pluripotent stem cells that generate new aboveground organs on a regular basis. Single-cell RNA sequencing was used to characterise the transcriptional landscape of the maize shoot stem-cell niche and its differentiated cellular offspring (scRNA-seq). The stem cells in the SAM tip play a role in maintaining genomic integrity and have a modest cell division rate, which is consistent with their contributions to germline and somatic cell fates.Surprisingly, there has been no evidence of a classical stem-cell organising core subtending these cells.

Plant stem cells are distinct in that they are produced from the ground up throughout development and regeneration, retain their pluripotency, and build a new stem cell niche in a systematic manner. Plants may live for longer periods of time and continue to grow new organs as a result of this, demonstrating that their developmental path differs from that of mammals.

Two essential qualities of stem cells are their ability to form a range of differentiated cell types and their ability to self-renew in such a way that one daughter cell remains a stem cell. To understand how multicellular plants are created, we must first understand how stem cell populations regenerate themselves while sustaining tissue synthesis. Long ago, it was postulated that the cells that surround stem cells create a distinct microenvironment that serves as a "niche" for the stem cells to maintain and nourish them. However, the findings have only recently been confirmed by research on tractable stem cell populations in vivo, such as the Drosophila germline.

Plant stem cell research has had a tumultuous history. Plants have had "initial" cells in cell division zones within their growing tips for a long time. Despite this, these early cells were usually disregarded due to the inflated assumption that all plant cells are totipotent, which is found in many textbooks. Plant developmental biologists have known for a long time that plants have stem cells with growing daughter cells that can revert to stem cell destiny under specific conditions.

Stem cells are a type of cell that can be used to replace or develop specialised tissues. To perform this function, these cells must divide to renew themselves, and some of their progeny will eventually differentiate to form new tissues. The ability of stem cells to continuously create new tissues must be weighed against the needs of the overall body. Tissues cannot grow or be replaced if stem cells do not divide frequently enough (as occurs with normal ageing); stem cells that multiply uncontrollably disrupt normal development. As a result, it's not surprising that stem cells rely entirely on signals from other cells to function.

Stem cells are normally only retained in locations where these extracellular signals are present. Only children that remain within reach of the maintenance signals continue to act as stem cells as the cells expand, while those that are driven away from the signals start to differentiate. Extracellular signals enable stem cells to survive in stem cell habitats. The maintenance of stem cells only inside the niche can explain why a genetically defined stem cell finally stopped acting like a stem cell. If adjacent stem cell divisions drive the targeted cell away from the niche, this can happen by coincidence.

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