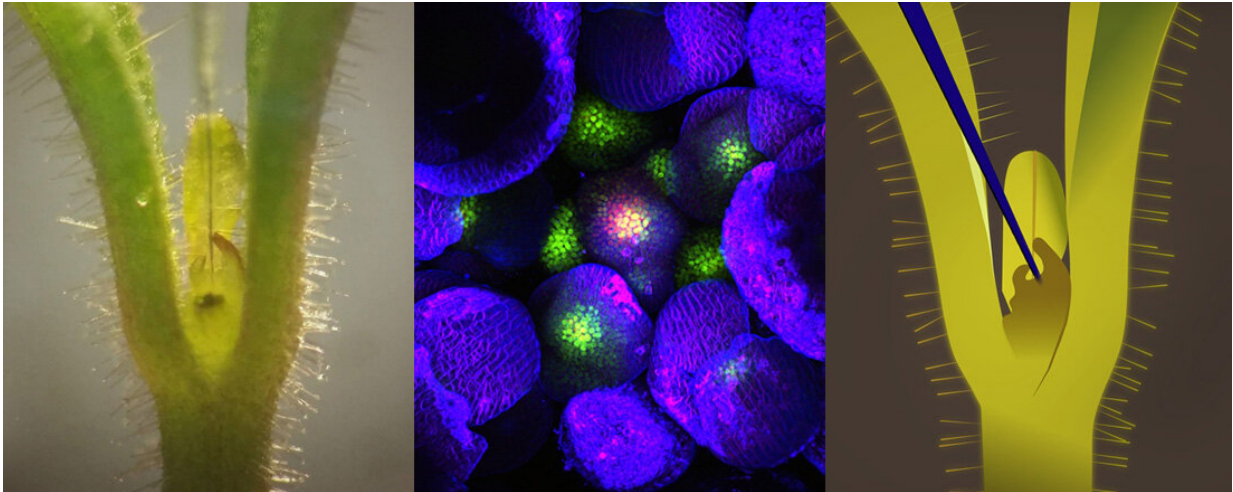


Plant stem cells require low oxygen levels

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Credit: University of Copenhagen

Plants function as the green lungs of our planet, and rightfully so, as the capacity of a large, single tree releases more than 120 kg of oxygen into the Earth's atmosphere every year through a series of sunlight-fuelled reactions in photosynthesis. However during flood events, plant tissues may experience severe oxygen shortage, a stressful situation that every year leads to substantial loss in yield for all major crops such as rice, wheat and barley.

Researchers from the Department of Biology at the University of Copenhagen, University of Pisa in Italy and RWTH Aachen University and University of Heidelberg, both in Germany, have now discovered

that low [oxygen](#) concentrations (hypoxia) provide essential conditions for plant growth.

"Equipped with a new generation of microscopic oxygen probes, we were able to measure the oxygen concentration of a tissue cubicle of approximately 30 cells, referred to as the shoot apical meristem," says professor Ole Pedersen, University of Copenhagen, who continues, "We found that in this region, a niche of [low oxygen](#) envelops the [stem cells](#) that are responsible for the production of new leaves and flowers. Here, low oxygen levels control the rate at which new leaves are produced by promoting the stability of a protein, named ZPR2, responsible for cell proliferation and differentiation."

Hence, most [plant tissues](#) suffer severely in the presence of hypoxia as caused by flood events but this new study clearly shows that hypoxia is a prerequisite for the maintenance of stem cells.

This discovery follows those made in recent years about the control of plant metabolism in anaerobiosis, also published in *Nature* and *Nature Communications* and represents a step forward towards the understanding of how the production of new organs is connected to environmental parameters that affect [plant growth](#) and productivity.

The requirement of low oxygen levels to maintain stem cells is not unique to [plants](#). Several types of animal stem cells, including human, share the same feature. This is remarkable since plants and animals are only very distinctly related in evolutionary context, but both represent the highest level of complexity in terms of multicellular organisation in tissues. Apparently, establishment and maintenance of low oxygen is a requisite for the activity of 'factories' of new cells, and therefore developed independently in both plants and animals.

Applications of this discovery are twofold. Breeders now have a new

target for the selection of novel crop varieties, better adapted to maintain productivity in suboptimal environments that affect respiration, such as high temperature or rapid flooding. Moreover, researchers will now compare plant and animal stem [cells](#) to uncover the secrets of stem cell maintenance and development of organs.

More information: Daan A. Weits et al. An apical hypoxic niche sets the pace of shoot meristem activity, *Nature* (2019). [DOI: 10.1038/s41586-019-1203-6](#)

Provided by University of Copenhagen

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