Plant research seals importance of microbes for survival and growth

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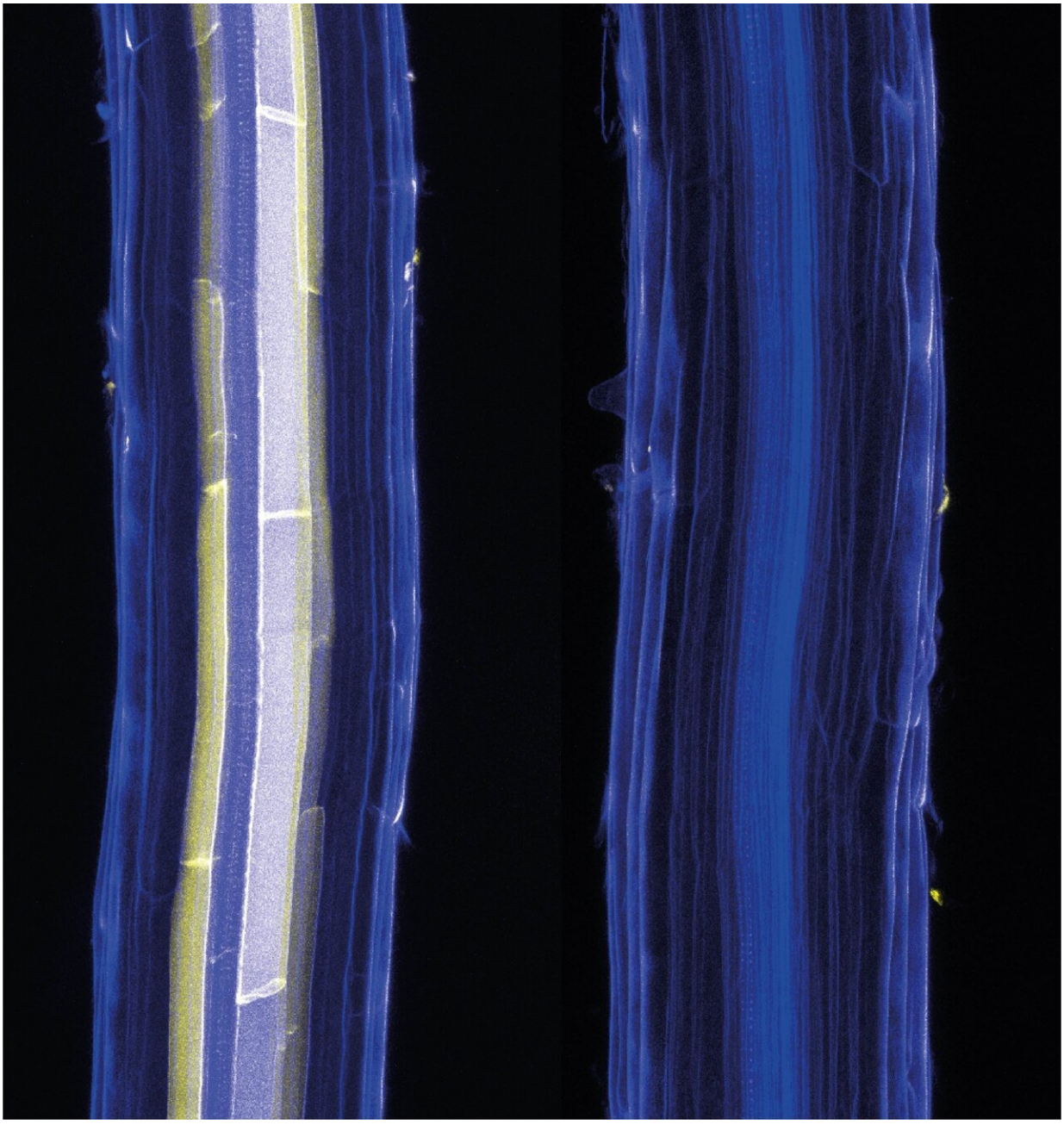

Plant root showing differences between a root from a plant grown in axenic conditions (left) with high amount of suberin in the endodermis (in yellow) and a root from a plant inoculated with the bacterial synthetic community used in this work (right). The synthetic community reduces endodermal suberization. Credit: Gabriel Castillo

Scientists have revealed that plants have a 'sealing' mechanism supported by microbes in the root that are vital for the intake of nutrients for survival and growth.

Plant Scientists from the Future Food Beacon at the University of Nottingham have demonstrated that the mechanism controlling the root sealing in the model plant Arabidopsis thaliana influences the composition of the microbial communities inhabiting the root and reciprocally the microbes maintain the function of this mechanism. This coordination of plant-microbes plays an important part in controlling mineral nutrient content in the plant. The study has been published online by the journal *Science*.

Gabriel Castrillo of the Future Food Beacon and lead author on the research said: "In mammals the specialized diffusion barriers in the gut are known to coordinate with the resident microbiota to control nutrient flow. Although similar regulatory mechanisms of nutrient diffusion exist in plant roots, the contribution of the microbes to their function was unknown until now.

This study has, for the first time, shown the coordination between the root diffusion barriers and the microbes colonising the root. They combine to control mineral nutrient uptake in the plant, which is crucial

for proper growth and reproduction. Understanding this could lead to the development of plants more adapted to extreme abiotic conditions, with an enhanced capacity for carbon sequestration from the atmosphere. Alternatively, plants with a high content of essential mineral nutrients and the capability to exclude toxic elements could be developed."

All living organisms have evolved structures to maintain a stable mineral nutrient state. In plant roots and animal guts these structures comprise specialized cell layers that function as gate-keepers to control the transfer of water and vital nutrients.

To perform this function, it is crucial that cells forming these layers are sealed together. These seals need to maintain integrity in the presence of local microbial communities. In animals, microbes inhabiting the gut are known to influence the intestinal sealing and, in some cases, this can cause diseases.

In roots, two main sealing mechanisms have been found: Casparian Strips, which seal cells together, and suberin deposits that influence transport across the cell plasma membrane. This research shows how these sealing mechanisms in multicellular organisms incorporate microbial function to regulate mineral nutrient balance.

Food security represents a pressing global issue. Crop production must double by 2050 to keep pace with global population growth. This target is even more challenging given the impact of climate change on water availability and the drive to reduce fertilizer inputs to make agriculture become more environmentally sustainable. In both cases, developing crops with improved water and nutrient uptake efficiency would provide a solution and this.This discovery could lead to the development of new microbial approaches to control nutrient and water diffusion, presenting new opportunities to design more resilient crops, new feeding strategies and possible ways to harness carbon dioxide through carbon

sequestration.

More information: Isai Salas-González et al, Coordination between microbiota and root endodermis supports plant mineral nutrient homeostasis, *Science* (2020). DOI: 10.1126/science.abd0695

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