Discovery of Light-Induced Acquisition of Photosynthetic Capacity in Plant Roots and the Examination of Its Evolutionary Advantages

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In plants, roots typically do not perform photosynthesis because of the division of labor with the leaves and stems. However, it has been reported that Taeniophyllum aphyllum, a plant species with degenerated leaves, performs photosynthesis in its roots, indicating the potential for photosynthesis in plant roots. In addition, in Arabidopsis thaliana, it has been reported that roots turn green when the above-ground parts are removed, suggesting that photosynthetic potential is preserved in roots of extant species. In my research, I discovered that the roots of Trifolium repens turn green even when the aboveground parts are present, by cultivating them on agar medium. I hypothesized that this was due to exposure to light and demonstrated this quantitatively using an experimental system I developed to induce root greening by light stimulation. Furthermore, I confirmed that photosynthesis occurs in the green roots using PAM fluorometry measurements, and surprisingly confirmed that growth rate increases in the group with green roots as measured by total leaf area. These results indicate that Trifolium repens roots can turn green in response to light stimulation and have a positive effect on plant growth. These findings have the potential to significantly improve the efficiency of plant cultivation in indoor environments, which has been attracting attention in recent years. In the future, I plan to investigate how widely this phenomenon is preserved in the plant kingdom.

Awards Won: