Bacteria genes gave ancient plants traits to colonize land

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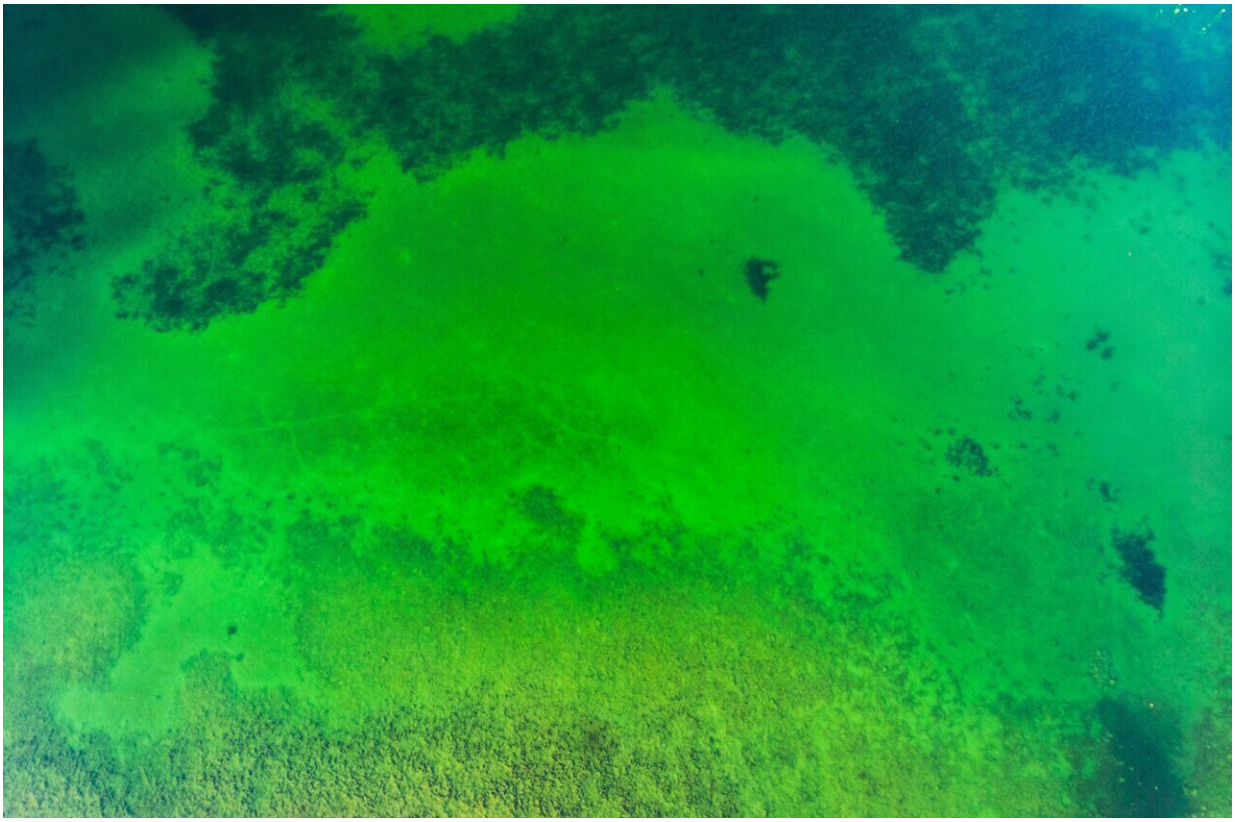

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Genes jumping from microbes to green algae hundreds of millions of years ago might have driven the evolution of land plants, researchers report March 1 in the journal *Molecular Plant*. Their analysis reveals that

hundreds of genes from bacteria, fungi, and viruses have been integrated into plants, giving them desirable traits for a terrestrial life.

"Our study changes the conventional view on land-plant evolution," says senior author Jinling Huang, a biologist at East Carolina University. "I have suspected that horizontal gene transfer helped plants to move from water to land, but we didn't know how big of a role it played until now."

Horizontal gene transfer (HGT) describes the movement of genetic materials between organisms of difference species. The genome-swapping events are common in bacteria, and they're responsible for the rapid spread of antibiotic resistance in these prokaryotes. But the role of HGT in complex multicellular eukaryotes—organisms such as plants and animals—remains controversial.

Conventionally, scientists thought eukaryotic genes move only via vertical gene transfer, during which genes pass down from parents to offspring and mutations can occur to give rise to new genes and traits. But Huang and his colleagues, including plant biologist Chun-Peng Song at Henan University, have found evidence from prior studies that HGT in plants might be common.

To investigate the role of HGT in plant evolution, the researchers scanned the genomes of 31 plants. They included species from all four plant groups, including mosses, ferns, and trees, as well as charophytes, a group of green algae related to modern land plants. They found that nearly 600 gene families in modern plants—far more than were previously thought—were transferred from other organisms, especially from microbes such as bacteria and fungi.

In addition, the team identified two major episodes of HGT during the early evolution of charophyte algae and the origin of land plants, when over a hundred gene families hopped from microbes to plants.

"Our finding suggests that HGT plays a significant role in land-plant evolution. Compared with mutations from vertical gene transfer, HGT enables plants to gain new traits rapidly, and some of these new traits could help plants adapt to a drastically different environment, like when they moved from water to land," Huang says.

Many of the genes acquired are known to perform important biological functions in plants. For example, the late embryogenesis abundant genes, which came from bacteria, helps plants adapt to a drier environment. The ammonium transporter gene, acquired from fungi, helps plants absorb nitrogen from soil for growth.

"Almost everyone has experienced teary eyes when chopping an onion. We found that the gene in onions responsible for producing the tear-jerking agent actually came from bacteria. That's very interesting because we are all aware of this reaction but didn't realize it's a result from HGT until now," Huang says. "There're many more examples like this."

Next, the team plans to further explore the transferred genes in bryophytes, which is the plant group that includes mosses. Many foreign genes in these plants have unknown functions, and future research might help identify desirable genes that can one day be transferred to crops to enhance their fitness.

More information: *Molecular Plant*, Ma and Wang et al.: "Major episodes of horizontal gene transfer drove the evolution of land plants" www.cell.com/molecular-plant/f … 1674-2052(22)00049-1 , DOI: 10.1016/j.molp.2022.02.001

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