ALGAE CHANGES PLANT EVOLUTION TIMELINE

Except for a few fungi, Earth's land was barren until plants emerged from the oceans about 450 million years ago. Key to that transition was the organic compound lignin, a component of the woody tissue that helps plants to stand up straight. Now a new study suggests lignin evolution began far earlier than scientists realized: possibly more than a billion years before plants took to land.

Evolutionary biologist Patrick Martone of the University of British Columbia in Vancouver was studying seaweed in California's intertidal zone when he and colleagues wondered what made red algae, seaweed composed of jointed calcified segments, so durable against the battering of ocean waves. Martone got a surprising answer when he shared samples of the plant with a group of chemists: The red algae contained lignin.

This red seaweed produces lignin, a primary component of wood previously thought to be unique to land plants.

The discovery "throws a monkey wrench" into biologists' current understanding of lignin and plant evolution, Martone says — especially because red algae are so distantly related to land plants.

Biologists think the lineages of green seaweeds — which led to land plants — and red seaweeds, which include red algae, split about 1.5 billion years ago. "The fact that we have found these lignin in a red algae … suggests that at least some of those biosynthetic pathways [for lignin] may go all the way back to the split of green seaweeds and red seaweeds," Martone says. He points out, however, that even if land plants and red algae's common ancestor did produce lignin or a lignin-like substance, it would have likely served a different purpose.

The study, published in Current Biology, should not dramatically change previous research on plant evolution beyond correcting timelines in textbooks, says Karl Niklas, an evolutionary biologist at Cornell University in Ithaca, N.Y. He also seconds a notion by Martone that the red alga may also be "a beautiful example of convergent evolution," in which different species independently adapt to environmental challenges in similar ways.

Why red algae and their ancestors developed lignin, however, is not yet clear, Martone and Niklas say. As of now, ideas range from the need to fortify cell walls against microbial attack to UV light protection.

For now, Martone and his colleagues plan to test other seaweeds for lignin, in addition to analyzing genes of lignin-containing seaweeds and land plants to compare each group's cellular machinery for producing the woody tissue. How different or similar those pathways are, Martone says, could provide clues as to how much land plants and seaweeds, like red algae, developed lignin independently versus inheriting it from a common ancestor. "Either way," he says, "is completely possible and equally intriguing."

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