

Ancient plant genes could increase food production without added fertilizer use, mitigating deadly algal blooms

Some 500 million years ago — when our continents were connected in a single land mass and most life existed underwater — hornworts (Anthoceros) were one of the first groups of plants to colonize land. An international team led by University of Zurich (UZH) and the Boyce Thompson Institute has now [sequenced three hornwort genomes](#), providing insights into the genetics underlying the unique biology of the group, an extant representative of the earliest land plants.

The research team began the project in 2011. “It took us three years to figure out how hornworts can be grown and pushed through its sexual life cycle under laboratory conditions, and another three years to properly assemble and annotate its genome,” says Péter Szövényi, researcher at UZH and last author of the paper.

Higher crop yields with less fertilizer

One of the researchers’ goals was to find genes that play a role in hornworts’ method of concentrating carbon dioxide inside chloroplasts, which boosts the plants’ ability to make sugar resulting in increased yield. Hornworts are unique among land plants in this capability, but some species of algae share the trait. The researchers thus compared the hornwort genomes with those of algae and found one gene, LCIB, that is shared by the two groups of plants but not with other land plants. “If this carbon-concentrating mechanism could be installed in crop plants, then they could grow larger with the same amount of fertilizer,” explains first author Fay-Wei Li, plant biologist at the Boyce Thompson Institute and Cornell University.

Symbiosis with bacteria to acquire nitrogen

Furthermore, hornworts live in symbiosis with fungi and cyanobacteria providing phosphorus and nitrogen to the plant. The researchers also identified 40 genes that may promote the hornworts’ source of nitrogen, which comes from an interdependent relationship with cyanobacteria — a unique feature in land plants. “If this capability of hornworts can be transferred to crop plants, many tons of nitrogen fertilizer could be saved,” says Szövényi. Such a reduction in fertilizer could benefit the environment, since excess agricultural nitrogen frequently enters waterways, where it can cause deadly algal blooms. Szövényi and Li are already working on a project to understand the genetic mechanism underlying the symbiotic plant-cyanobacteria interaction.

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