The curious link between brain diseases and blue-green algae

January 24 2019, by Will Wright

A scientific breakthrough intended to help boost the yields of food crops—such as wheat, cowpeas and cassava—might also improve understanding of neurodegenerative diseases such as Alzheimer's that could one day lead to a cure.

Scientists from ANU and the Max Planck Institute of Biochemistry in Germany revealed that blue-green algae produces tiny carbon-capturing engines akin to the way blobs form in a lava lamp and liquid protein droplets form in Alzheimer's disease.

ANU researcher Dr. Ben Long said the study solved a long-standing question of how cyanobacteria, known as blue-green algae, builds the carbon-capturing engines called carboxysomes in a protein liquid droplet formation.

Carboxysomes are responsible for making blue-green algae extremely efficient at transforming carbon dioxide into energy-rich sugars—three times faster than crop plants. Computer models have shown that upgrading plant photosynthesis to use the same mechanism in blue-green algae will lead to dramatic increases in plant growth and yield.

"Crop breeding in agriculture has hit a road-block in terms of achieving gains in food production," said Dr. Long from the ANU Research School of Biology whose work has been funded by the international Realizing Increased Photosynthetic Efficiency (RIPE) consortium.

"We need to double food production to meet demand in 2050."

Dr. Long said the team's work was focused on eventually being able to transplant these blue-green algae carboxysomes into important crop plants to help them capture carbon more efficiently and to increase yields.

He said the study's findings could also lead to other exciting outcomes.

"Protein liquid droplet formation appears to play a very important role in a number of neurodegenerative diseases such as Alzheimer's," he said.

"Understanding how this phenomenon works in these cyanobacterial systems not only enables us to push toward a future with strengthened food security, it may also assist scientists working on neurodegenerative diseases to develop innovative new treatments.

"Scientists are now realising the formation of protein liquid droplets is a driving force in many biological systems, as we find more and more instances where this occurs.

"Realising these curious links shows that there's huge potential to learn from other disciplines to make breakthroughs like cures for Alzheimer's and engineering super crops that will feed the growing populations around the world."

This research is published in *Nature*.

More information: Benedict M. Long et al. Carboxysome encapsulation of the CO2-fixing enzyme Rubisco in tobacco chloroplasts, *Nature Communications* (2018). DOI: 10.1038/s41467-018-06044-0

Provided by Australian National University