New rhomboid-like protein helps plants produce lipids

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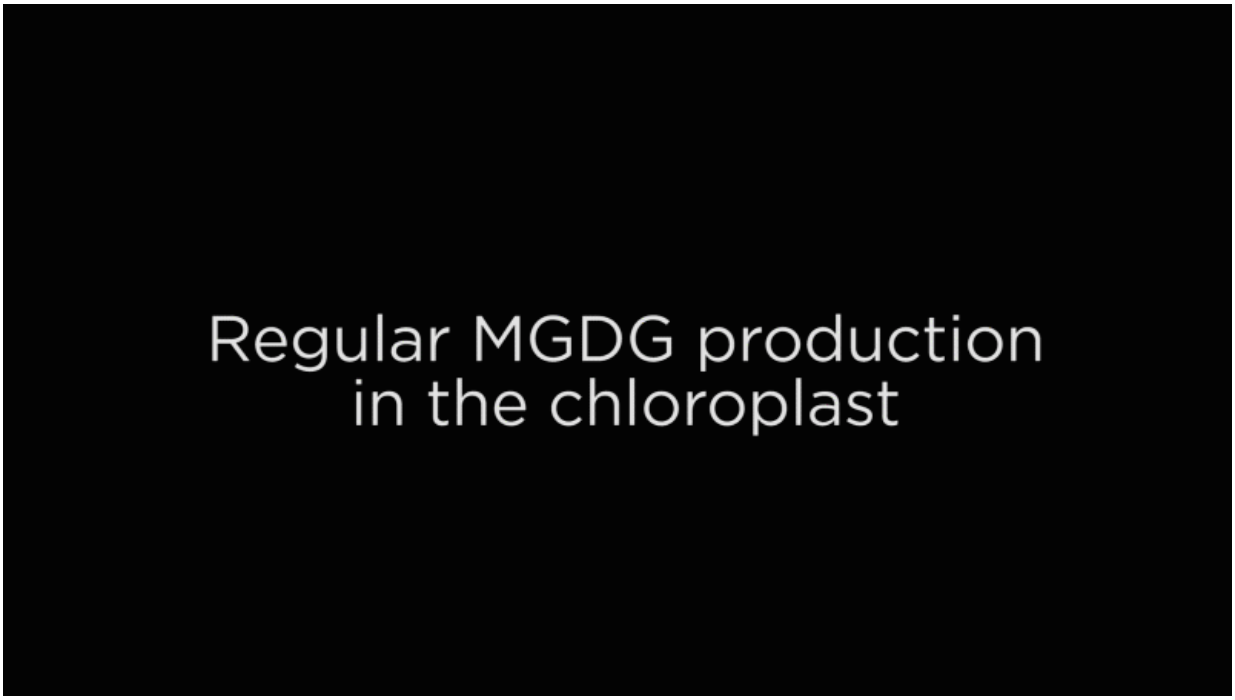

Credit: Michigan State University

The Benning lab has identified a rhomboid-like protein that may help plant chloroplasts tune their lipid production. The study is published in *The Plant Journal*.

Lipids are molecules that make up fats and oils in living beings, and they perform a variety of functions. They make up our cell boundaries, from

which we get tissues and organs. Lipids store more energy than other molecules, which is desirable for developing biofuels. They also provide plants with the membrane building blocks needed to harvest light for photosynthesis.

In plant cells, an assembly line of enzymes makes, modifies and deploys lipids to the proper locations in a cell.

One of the big mysteries in plant lipid studies is how plants control this production system. Figuring this out could give us clues on how plants optimize photosynthesis, even when surrounding conditions are difficult, like drought or heat. We might also learn how to boost plant productivity, through genetic or breeding tools.

"When I joined the Benning lab, I wanted to start a new project addressing these outstanding questions," said Anastasiya Lavell, a graduate student in the lab of Christoph Benning. "I searched a database for mutants that had changes in their lipid make-up and found one with a disrupted gene that encoded a rhomboid-like protein 10, which we call RBL10."

Credit: Michigan State University

The team of scientists thinks the protein is found in the inner envelope membrane of chloroplasts, a busy conveyor belt of processes.

"When we remove RBL10 from plants, we see a blockage in chloroplast lipid production," Lavell said. "Specifically, phosphatidic acid, or PA, an intermediary form of lipid, does not turn into monogalactolipid, or MGDG, the most abundant lipid in plants that's very important for photosynthesis."

Lavell suspects RBL10 helps move the intermediary lipid towards the next processing station in the assembly line. Or, perhaps, RBL10 affects another protein that moves this lipid.

This is the first time a rhomboid-like protein—and how it influences the

synthesis and transport of lipids—has been studied in detail in plants.

"Rhomboid-like proteins are found across a large number of organisms, like bacteria, flies, even us humans," Lavell said. "These proteins are better studied in those other organisms, but not in plants. For context, the plant we study, Arabidopsis, has thirteen of them. Two are in the chloroplast. So, it's probably important."

"One reason we lag behind in plant science is that plant lipids are hard to study," Lavell said. "For example, the chloroplast has a complex membrane structure, tough to observe. It also is deeply interwoven into many plant functions, like growth, photosynthesis, and defense. So, it is hard to tease out where its influence begins or ends. But the challenge makes it all the more exciting to see where this goes."

More information: A Lavell et al. A Predicted Plastid Rhomboid Protease Affects Phosphatidic Acid Metabolism in Arabidopsis thaliana, *The Plant Journal* (2019). DOI: 10.1111/tpj.14377

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