Discovery in plant growth mechanisms opens new research path

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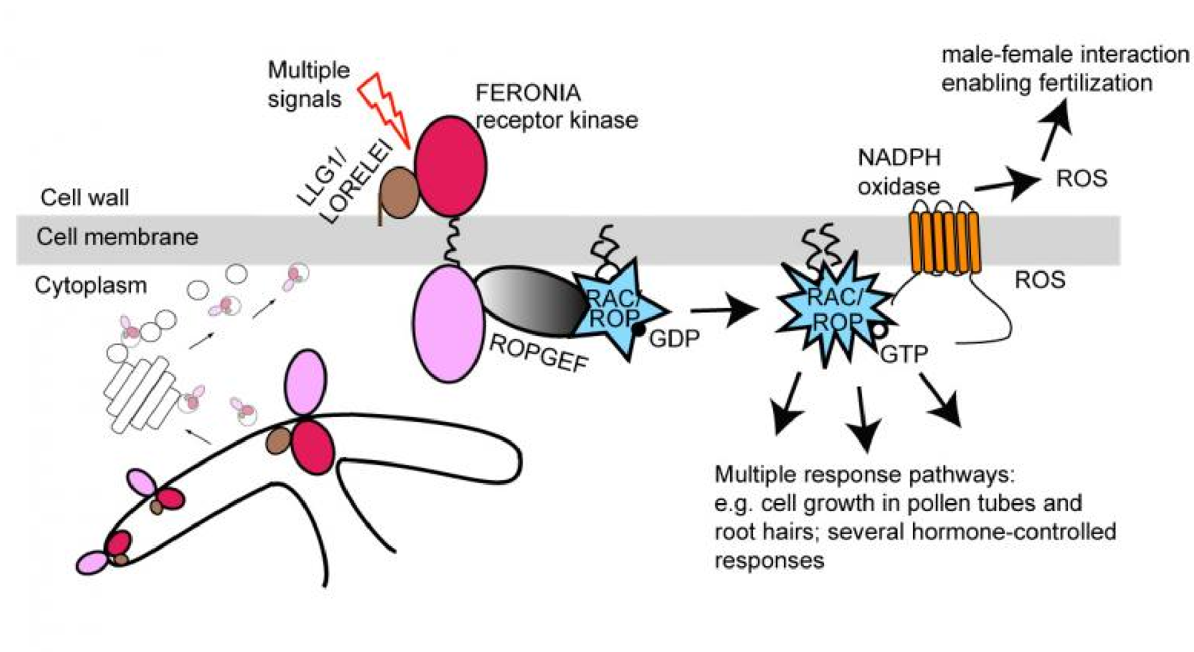

UMass Amherst molecular biologists outline how GPI-anchored proteins chaperone a receptor to the cell surface and act as its co-receptor for multiple signaling pathways. Credit: UMass Amherst

New findings reported this week by plant molecular biologists at the University of Massachusetts Amherst are deepening scientists' views of a cell surface regulator, FERONIA receptor kinase from the model plant *Arabidopsis*, once thought to be involved only in reproduction but in fact required throughout plant growth, development and in surviving environmental challenges.

Because FERONIA is a member of a considerably larger receptor family whose functions were mostly unknown, the researchers say new understanding of how FERONIA functions may open many research avenues, not only in basic plant biology, but in new methods of improving plant growth, especially in plants under stress, and improving seed yields and crop production.

Alice Cheung, Hen-Ming Wu and colleagues at UMass Amherst, who have a long-standing interest in how male and female plant cells interact to achieve fertilization, report in the current issue of *eLife* that for FERONIA to function, it requires collaboration with another protein, a glycosylphosphatidylinositol (GPI)-anchored protein called LORELEI, or its relative LLG1. Like receptor kinases, GPI-anchored proteins are known to be critical for cell signaling, but how they function is still mysterious.

The Cheung and Wu group show that LORELEI and LLG1 act as chaperones to bring FERONIA to the cell membrane where they also act as its co-receptors, assisting its many biological roles from early plant development to fertilization. This newly discovered receptor kinase and GPI-anchored protein partnership is an exciting break, Cheung says, because "we knew that GPI-anchored proteins are important, but it has been puzzling how FERONIA manages such multi-tasking ability, from promoting plant growth, ensuring fertilization and coping with pathogen attacks."

For this work the UMass Amherst group used plant growth analysis and a series of biochemical and cell biology experiments to demonstrate that LLG1/LORELEI binds to FERONIA when the two proteins are being synthesized and encounter each other in a compartment called the endoplasmic reticulum. From there, their data suggest that

LLG1/LORELEI chaperones FERONIA to the right place on the cell surface where they work together as co-receptors to receive and transduce signals to the cell.

"When you think about it, this is probably a more certain way for the cell to make sure that FERONIA is at the right place at the right time, and that the whole signal transduction process goes correctly," the molecular biologist says. The discovery of how this works "adds a novel and important piece of mechanistic information to signal transduction mechanisms not only in plants but also to key regulatory systems in animals and humans, some important to disease pathogenesis."

This work not only solves a mystery in FERONIA function but also provides a blueprint for similar efforts on related receptor kinases whose functions are known, plus a broader family of related proteins. Cheung's lab is pursuing further studies with UMass Amherst colleagues to explore receptor kinase roles in plant-pathogen interaction and symbiosis.

She believes the finding will move this field forward in previously unanticipated directions. The article in *eLife* this week is the third from the Cheung and Wu lab based on FERONIA and now more than 50 labs worldwide have requested research reagents from the UMass Amherst researchers to study it and related proteins. "I am looking forward to a blooming area of studies from a global community in the upcoming years," Cheung says.

More information: *eLife*, elifesciences.org/content/4/e06587

Provided by University of Massachusetts Amherst