Scientists shed new light on pollen tube growth in plants

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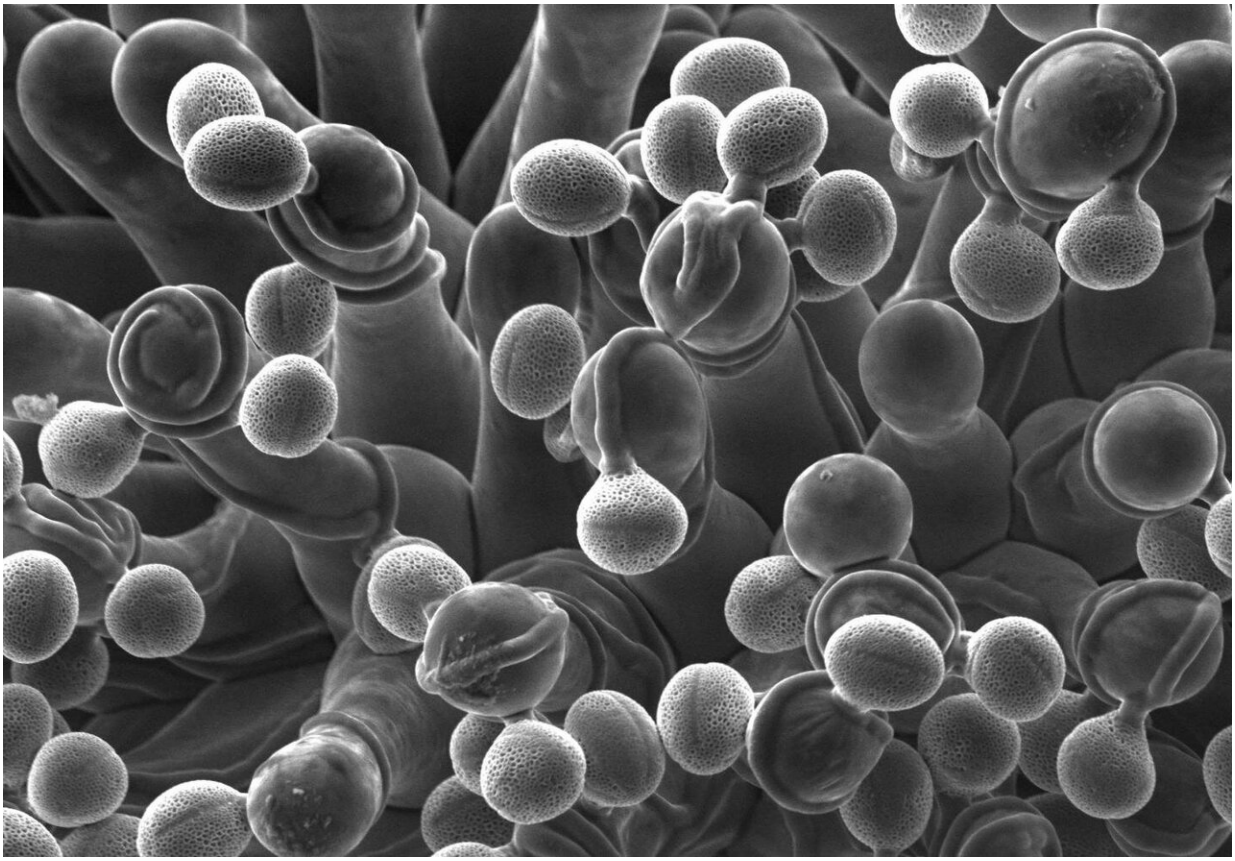

Pollen grains deposited on receptive papilla cells lacking KATANIN. Credit: Lucie Riglet (CC BY 4.0)

New insight on how an enzyme ensures the correct growth of pollen tubes in flowering plants has been published today in the open-access

journal *eLife*.

The study reveals an unexpected role of KATANIN in moderating the mechanical properties of the papilla cell wall in Arabidopsis thaliana (A. thaliana), thereby preventing disordered pollen tube growth and allowing the tube to find its correct path to the underlying female plant tissues. These findings suggest that KATANIN has likely played a major role in the success of flowering plants on earth more widely.

Seeds are produced in flowering plants when male and female germ cells called gametes fuse together. Male gametes are contained in the pollen grain while female gametes are found in the ovules, which are embedded in a female reproductive organ called the pistil. For successful seed production to happen, pollen grains need to meet with the surface of the pistil, which is composed of a layer of elongated cells called papillae. When a pollen grain lands on a papilla, it rehydrates and then produces a tube that will carry the male gametes toward the ovules.

Pollen tubes grow first within the papilla cell wall, exerting a physical pressure on the cell. After crossing the papilla layer, they then grow in the intercellular space of underlying tissues. The pistil then produces compounds that guide the pollen tube to the ovules where it reaches the female gametes. But how the tube orients itself when it emerges from the pollen at the papilla surface remains unknown.

"It is striking that, whatever the position of the flower and hence the pistil on the stem, the pollen tube grows to the base of the papilla in the direction of the ovules. We wanted to explore the mechanisms that allow for this proper orientation of pollen tubes on the papilla cells," says lead author Lucie Riglet, who was a Ph.D. student in senior author Thierry Gaude's lab at the Laboratory of Plant Reproduction and Development, ENS Lyon, France, at the time the study was carried out, and is now a postdoctoral researcher at the Sainsbury Laboratory, University of

Cambridge, UK.

Mechanical forces are known to play a major role in plant cell shape by controlling the orientation of cortical microtubules, which in turn mediate the deposition of cellulose microfibrils. For their study, Riglet and her team combined imaging, genetic and chemical approaches to show that the enzyme KATANIN, which cuts microtubules, also acts on cellulose microfibril orientation and confers mechanical properties to the papilla cell wall that allow for correct pollen tube orientation.

"By forcing the pollen tubes to take the right direction from their early places in the papilla, KATANIN has likely played a major role in the success of flowering plants on earth by promoting fertilization," explains senior author Thierry Gaude, Group Leader at the Laboratory of Plant Reproduction and Development, ENS Lyon. "As KATANIN is found in most organisms, including humans, it is possible that the enzyme plays a role in regulating mechanical properties in other processes—but this is a fascinating question that remains to be explored."

More information: Lucie Riglet et al, KATANIN-dependent mechanical properties of the stigmatic cell wall mediate the pollen tube path in Arabidopsis, *eLife* (2020). DOI: 10.7554/eLife.57282

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