Protein that triggers plant cell division

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From the valves in a human heart to the quills on a porcupine to the petals on a summer lily, the living world is as varied as it is vast. For this to be possible, the cells that make up these living things must be just as varied. Parent cells must be able to divide in ways that create daughter cells that are different from each other, a process called asymmetric division. Scientists know how this happens in animals, but the process in plants has been a mystery.

Now Stanford biologists have found a plant protein that appears to play a key role in this type of cell division. The presence of the protein, called BASL, is vital to asymmetric cell division. In plant cells where it was absent, the cells did not divide.

"This is crucial information if we really want to understand plants' unique ways of making the different types of cells in their bodies," said Dominique Bergmann, an assistant professor of biology.

Bergmann, along with Juan Dong, a postdoctoral researcher, and Cora MacAlister, a doctoral candidate, both in the Biology Department, tracked BASL in epidermal cells of Arabidopsis, a small plant used for genetic studies. The epidermis of Arabidopsis contains small pores called stomata that allow the plant to breathe and these stomata are generated by asymmetric cell divisions. The three researchers have written a paper describing their work that will be published online June 11th in the journal *Cell*.

"For asymmetric cell division in animals, we know many of the proteins that control the process, but plants just don't make any of those proteins," Bergmann said.

By following where in the cell BASL resides during successful asymmetric cell divisions, they have discovered that BASL behaves like many of the proteins vital for animal asymmetric cell divisions, even though BASL's structure doesn't look like any of them.

Bergmann, Dong, and MacAlister tracked BASL by adding a fluorescent tag that could be monitored under the microscope. This way, they could watch BASL as cells divided. They found that BASL behaved in some ways like proteins involved in asymmetric animal cell division--that is, they observed BASL in both the nucleus and in a small region out near the periphery in cells that were about to divide asymmetrically. After the division, only one cell inherited BASL at the cell periphery and this helped the two daughter cells become different.

What's more, it wasn't just the stomatal cells that could do this. When the instructions to make BASL were artificially put into any other cell in the plant, those cells (which normally wouldn't be able to make BASL) not only made BASL, but the protein was found in both the nucleus and a small region at the periphery. This proved that "all plant cells have within them the ability to put proteins in specialized areas," said Bergmann. This is something scientists assumed must be true because it was a necessary step for asymmetric cell division, but until now no one had been able to see it.

So why would nature invent a different protein to solve the same problem? Bergmann explained that it was not surprising to find that plants used a unique protein for their divisions because of the way their cells are built.

"The animal cell is sort of squishy and doesn't have a wall around it--it just has a membrane," said Bergmann, who pointed out that the process of plant cell division is structurally different from animal cell division. "It's like you've taken a string around the center of an animal cell and you've pinched it down ... and that works because it's flexible." Plant cells, on the other hand, have stiff cell walls and can't divide this way. "A plant cell actually has to build a new wall from the inside out in order to divide" said Bergmann.

Bergmann said that the next steps will be to understand how BASL moves from where it is made to the nucleus or out to the periphery of the cell, and what it actually does in those regions of the cell.

"What we don't know is whether cells make a bunch of BASL protein and ship half of it out the periphery and half to the nucleus and the two pools of protein never mix, or whether any one individual BASL protein molecule could 'shuttle' between being at the nucleus and being at the periphery," said Bergmann.

BASL is a valuable signpost for deciphering the workings of plant cell asymmetry, said Bergmann, adding, "Now that we can actually see a protein moved around to a very specific place in the cell, we've opened up the possibility of finding all the internal machinery that plants cells use to get it there."

Source: Stanford University (news : web)

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