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The paper by researchers from IISER, Pune and Thiruvananthapuram, Netherlands' Wageningen University, and UK-based John Innes Centre was published in the journal Current Biology on July 25.

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Roots are important facilitators that support nutrient intake. Their naturally tapered shape and conical tip aid better soil penetration. (File)

Gardeners are often seen pruning shrubs or tree branches to maintain plant health and promote fresh growth. Soon, however, the pruned branches regrow with stunning resemblance to their original form. An international group of scientists, led by biologists at the Indian Institute of Science Education and Research, Pune (IISER), has now zeroed in on the key mechanisms in plants that help restore damaged parts to their original shape.

Unlike animal cells, plant cells are far more rigid and depend more on growth rates and anisotropy (how a material's physical characteristics change depending on its direction) during cell regeneration. Roots are important facilitators that support nutrient intake. Their naturally tapered shape and conical tip aid better soil penetration. When they get damaged due to natural or

external causes, it is observed that the lost cell types and layers get restored and the root regrows to the original tapered shape.

In the latest paper published on July 25 in the journal *Current Biology*, mathematicians and physicists from IISER, Pune and Thiruvananthapuram, Netherlands' Wageningen University, and UK-based John Innes Centre, have attempted to track the mechanisms that may be responsible for restoring the root's tapered shape.

In the study, the researchers describe a distinct geometric pattern as per which plant roots regrow after being damaged. This understanding, they said, could help establish fundamental cellular processes, like cell shape and cell regeneration in plants and, in particular, plants vital for food cultivation and securing food security.

The group studied the regeneration of the *Arabidopsis thaliana* root after it was surgically chipped off. They observed notable behaviour in the root regrowth from the 12th hour since being chipped.

Instinctively, the injured root's first response was to generate new cells at the wound site. And their goal was to remain oriented in the right direction and help restore the shape and function of the root and maintain its original function.

"The usual cuboidal root cells got morphed into rhomboid shapes. These altered cells then divided diagonally, producing triangular prism-like cells. The diagonal divisions redirected the growth of neighbouring cells along a slanted path — collectively recreating the lost tapered tip," Kalika Prasad, biologist at IISER-Pune and co-author of the paper, told *The Indian Express*.

After about 18-19 hours post-cutting, the previously flat root end had grown and bulged. By 24 hours, it had become more prominent, indicating the onset of some trigger mechanisms.

Corresponding to about 12 hours post the injury, the researchers said, a mechanical tension was noted developing during the growth stage of the injured root. And this tension, they said, guided and controlled the new cells to align and develop in a certain geometric manner.

The root tip has multiple cell layers. While cells in the outermost layer grow slower, the cells present in the innermost layer grow rapidly. "This differential growth then leads to build up in mechanical tension within the cells and, as a response, their shape or geometry starts aligning. In the end, we found the regrown root to have restored perfectly with respect to cell types and the shape. It functioned optimally like an uninjured root," Prasad said.

Similar post-injury cell regeneration behaviour was demonstrated by a mustard plant called *Brassica*, which the team tested.

Source:

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