New transcription factor reveals molecular mechanism for wound-induced organ regeneration

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Fig. 1: WIND1 gene expression induced at wound site. Credit: RIKEN

Japanese researchers at the RIKEN Plant Science Center (PSC) and the National Institute of Advanced Industrial Science and Technology (AIST) have identified a novel transcription factor controlling how plants dedifferentiate cells in response to wounding.

The finding sheds first-ever light on the molecular-level mechanisms of plant cell dedifferentiation, offering fundamental insights on wound-induced organ regeneration and promising applications in agriculture and manufacturing.

One of the most remarkable properties of plants is their capacity to regenerate tissue structures and even whole organs to replace those damaged or lost through injury. Plants are able to do this thanks to high-level dedifferentiation, a process whereby mature cells withdraw from their specialized state and acquire proliferation ability and pluripotency, enabling them to develop anew into different cell types. While the knowledge and use of techniques for plant organ regeneration has a long history in horticulture, little is known about the molecular mechanisms underlying dedifferentiation.

Fig. 2: Overexpression of WIND1 gene is sufficient for cell dedifferentiation. Credit: RIKEN

To clarify these mechanisms, the researchers studied a common type of cell dedifferentiation induced by wounding, where its role in tissue and organ regeneration is critical to survival. In plants, this regeneration frequently occurs through the creation of masses of cells known as callus, which grow over the wound to protect it. Using data from earlier research, the researchers identified a gene in the model plant Arabidopsis thaliana that is upregulated in callus. Further investigation revealed that the gene is rapidly expressed at the wound site and throughout the development of the callus, pointing to a potential role in wound-induced dedifferentiation.

Through a series of experiments, the researchers went on to analyze the function of this gene and the transcription factor it encodes, referred to as WOUND INDUCED DEDIFFERENTIATION 1 (WIND1). Elevated expression of the WIND1 gene in wounds, and formation of callus in response to WIND1 activation, reveal its role as a master regulator for wound-induced dedifferentiation in plants.

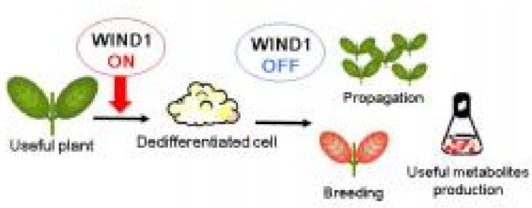

Fig. 3: WIND1 can be used as a molecular switch for plant dedifferentiation / redifferentiation. Credit: RIKEN

Together, the findings establish a mechanism for transcriptional control of cell dedifferentiation underlying wound-induced organ regeneration. While laying the groundwork for fundamental advances in plant science, the research also opens the door to applications in agricultural technology as well as in the production of useful materials.

More information: Iwase et al., The AP2/ERF Transcription Factor WIND1 Controls Cell Dedifferentiation in Arabidopsis, *Current Biology* (2011), doi:10.1016/j.cub.2011.02.020

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