From Scars to Shoots

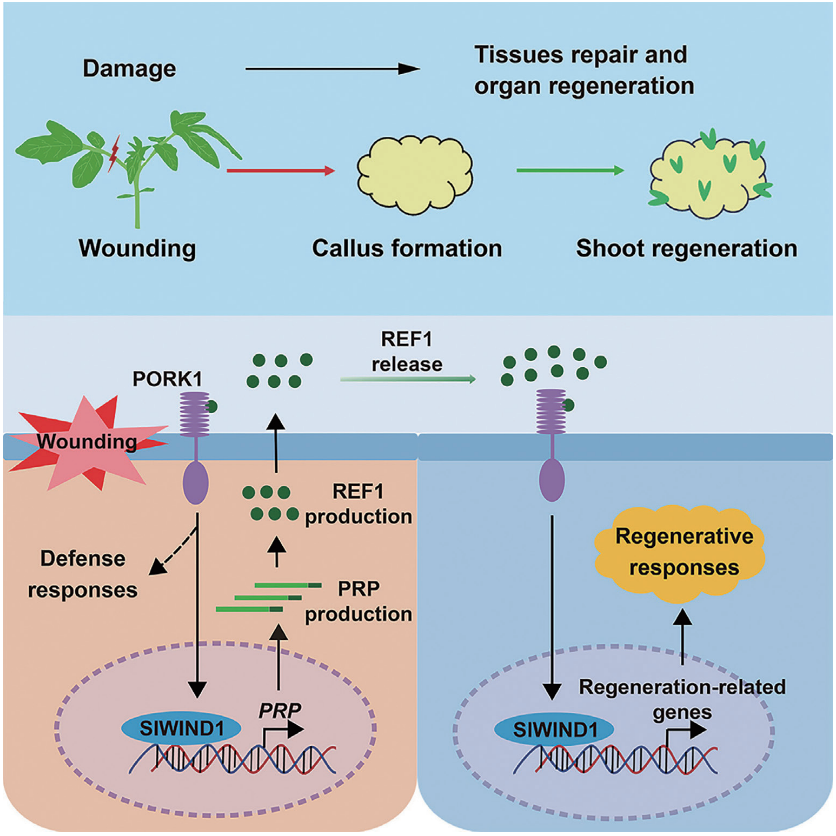
By YAN Fusheng

Many staple crops like wheat, soybeans, and maize stubbornly resist regrowing from lab-grown tissues—a major bottleneck for genetic modification and improvement of these crops. A *Cell* study in June 2024 may become a game-changer. Led by Dr. DENG Lei (Shandong Agricultural University) and Dr. LI Chuanyou (the CAS Institute of Genetics and Developmental Biology), the collaborative effort identified a peptide called REGENERATION FACTOR1 (REF1) as a local wound signal that regulates damage-triggered tissue repair and organ regeneration. This very finding may greatly expand opportunities for improving crop resilience through targeted bioengineering.

The Secret Life of Plant Scars

Plants lack the luxury of fleeing danger. When insects munch on leaves or hailstorms shred stems, they rely on an ancient survival toolkit: regeneration. For decades, scientists knew plants could regrow organs from wounds, but the molecular "alarm bell" triggering this process remained elusive. Now, researchers have pinpointed REF1—a peptide that acts like a "botanical 911 call"—rallying cells to heal injuries and even sprout new shoots.

Peptide REF1 is a local wound signal promoting plant regeneration. (Graphic: Yang *et al.*, 2024)



Using tomato plants as their lab rat, the team discovered that REF1 operates through a dedicated receptor named PORK1. When injury strikes, REF1 molecules swarm around the wound site, locking into PORK1 like a key turning an ignition. This activates a genetic cascade culminating in WIND1, a "master switch" protein that reprograms cells into regenerative stem cells. Intriguingly, REF1 also fuels its own production through a feedback loop, ensuring repairs continue until completion.

From Lab Bench to Crop Innovation

The implications are profound. While tomatoes naturally regenerate well, many staple crops like wheat, soybeans, and maize stubbornly resist regrowing from lab-grown tissues—a major bottleneck for genetic modification. When researchers spiked growth media with synthetic REF1, recalcitrant crops underwent stunning transformations. Soybean regeneration rates skyrocketed by 900%, wheat shoots emerged 800% faster, and even maize—notoriously finicky in laboratory conditions—quadrupled its regeneration capacity.

"Although we have exemplified the application potential of REF1 in promoting genetic transformation of several recalcitrant crops, REF1-dependent enhancing effect on transformation efficiency varies among different crops. Understanding the underlying mechanisms should be helpful to fully realizing the application potential of REF1 in crop breeding," the authors noted in the study.

So, it seems that REF1 isn't just a scientific curiosity—it's a practical tool. Farmers could one day spray peptides to accelerate field recovery after storms, while biotech firms might dramatically cut the time needed to develop climate-resistant crops.

The Bigger Picture

Beyond agriculture, the new discovery on REF1's function bridges a century-old gap in botany. Since Charles Darwin's experiments with plant signaling in the 1880s, scientists have been hunting for the molecules coordinating regeneration. The discovery that REF1 shares functional parallels with animal wound hormones suggests a deep evolutionary logic to healing across kingdoms.

"Discovery of REF1 likely provides a molecular basis to understand why plants exhibit higher regeneration capacity compared with their animal counterparts," the study states.

As climate change intensifies environmental stresses, such discoveries may prove vital for food security. The team is now exploring REF1 variants tailored to specific crops—potentially unlocking a new era of rapid, sustainable crop engineering.

Reference

Yang, W., Zhai, H., Wu, F., *et al.* (2024) Peptide REF1 is a local wound signal promoting plant regeneration. *Cell*, 187(12), 3024–3038.e3014. doi:10.1016/j.cell.2024.04.040