The balancing act between plant growth and defense

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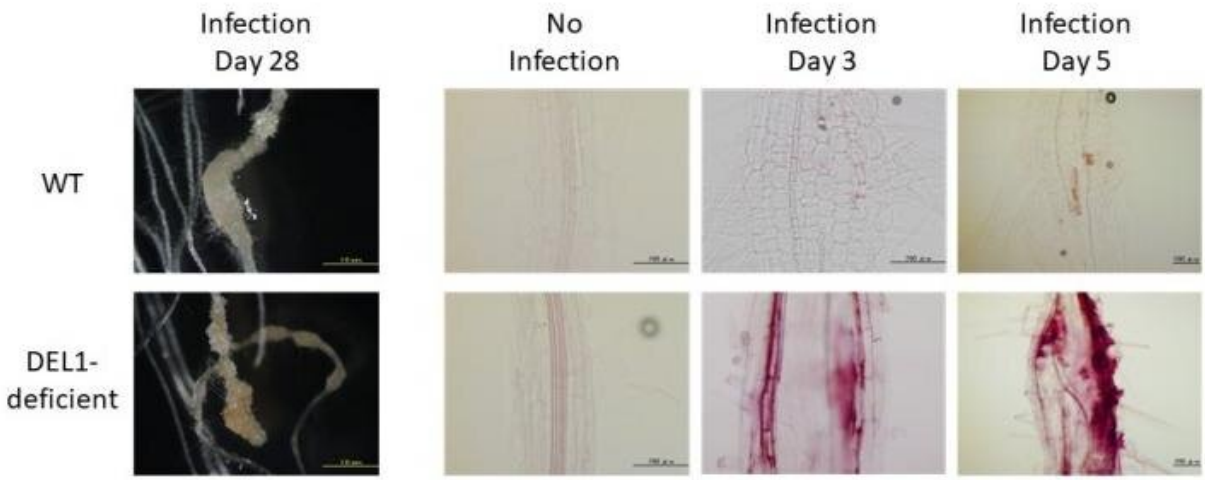

The nematode-infected site of the DEL1 deficient plants became brown. When stained with lignin, the infection site produced a strong reaction color (red). Credit: Professor Shinichiro Sawa

Researchers from Kumamoto University in Japan have pinpointed the mechanism that regulates the balance between plant growth and defense. Plants synthesize and accumulate protective hormones to protect them from pathogen infections, but excessive accumulation significantly hinders plant growth. Researchers found that the DEL1 gene plays a role in balancing growth and defense of plants infected with nematodes. This finding is expected to contribute to the improvement of agricultural crop

varieties and the identification of infection mechanisms of various pathogens.

Plants grow continuously throughout their life but growth becomes suppressed and energy is put into defense responses, like the synthesis of the defense hormones salicylic acid and lignin, when attacked by pathogens. When the accumulation of salicylic acid and lignin becomes excessive, plants show significant growth inhibition. It is therefore believed that plants keep an appropriate balance between growth and defense. However, this type of balance regulating mechanism has only been reported in leaves; the existence of a similar mechanism in roots was unknown.

To test for a mechanism in roots, researchers infected wild-type and DEL1-deficient *Arabidopsis*, a plant related to cabbage or mustard frequently used in plant-based genetic research experiments, with *Meloidogyne Incognita*, a parasitic roundworm that infects roots. After nematode infection, DEL1 deficient plants exhibited excessive salicylic acid accumulation and infected sites turned brown, a strong reaction color, when stained with lignin. Additionally, the DEL1 deficient plant had a higher nematode resistance than the wild type, indicating that the DEL1 gene acts to suppress the defense response against nematodes. Furthermore, when the DEL1 deficient plant was infected with nematodes, significant root growth inhibition was observed.

Nematode infection of DEL1 deficient plants resulted in significant root growth inhibition. Credit: Professor Shinichiro Sawa

This is the first study to demonstrate that the DEL1 gene plays an important role in the growth vs defense balancing mechanism in plant roots.

"This study should allow us to develop more diverse strategies for controlling pathogens," said study leader Professor Shinichiro Sawa. "For example, plant varieties that have excellent appearance, taste, and resistance traits often have slow growth and low yield. By focusing on genes involved in growth vs defense balance regulation like the DEL1 gene, increased yields and better plant varieties may be produced. We believe that direct control over DEL1 activity will improve our ability to breed pest resistant, high yield plants."

More information: Satoru Nakagami et al, The atypical E2F

transcription factor DEL1 modulates growth–defense tradeoffs of host plants during root-knot nematode infection, *Scientific Reports* (2020). DOI: 10.1038/s41598-020-65733-3

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