New research on electrical signal transduction in tomato plants

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Electrical signals commonly occur in plants in response to various environmental changes and have a dominant function in plant acclimation. Recently, a research team from Zhejiang University in

China published new findings on electrical signal transduction during herbivory or wounding in tomato plants. The study can be found in the open access journal *Frontiers of Agricultural Science and Engineering* (*FASE*), which is published by Higher Education Press.

The transduction of wound-elicited electrical signals in the model plant species Arabidopsis has been characterized but the characteristics of electrical signal transduction in response to herbivory or wounding in crop species remain unknown.

Previous work of Professor Jingquan Yu and his colleagues showed that electrical signals were generated in tomato plants response to nematode attacks. These signals propagated from roots to shoots to activate Jasmonic acid (JA) accumulation and confer nematode resistance.

Based on the surface potential determination technology, in this study, Professor Yu and his colleagues found that herbivory and mechanical wounding on tomato leaves elicited electrical signals with an amplitude of about -20 to -40 mV. Electrical signals elicited by petiole wounds were stronger than those caused by leaf wounds, with larger amplitude and greater propagation. In different with electrical signals transduction in Arabidopsis, electrical signals were not transduced from leaf to leaf in tomato plants, but could propagate from leaflet to leaflet within a compound leaf. Thus, electrical signals in plants vary widely and the strength and transduction of electrical signals depend on the type of damage, wound position, plant species and plant growth stage.

Further qRT-PCR analysis of JA biosynthesis- and signaling-related genes showed that the transcript levels of the JA synthesis-related genes LOXD, OPR3 and the JA signaling-related gene JAZ10 increased significantly in both wounded leaflets and undamaged leaflets. The intensity of wound activated JA signaling was consistent with the transduction of electrical signals, suggesting the interaction of electrical

signals and JA signaling.

The roles of tomato glutamate receptor-like (GLR) genes GLR3.3 and GLR3.5 in regulating electrical signals and JA accumulation were next demonstrated by the researchers. They found that glr3.5 mutants and glr3.3/3.5 double mutants showed reduced electrical signal intensity in response to mechanical wounding, displaying lower amplitudes within the wounded leaflets compared with those displayed by untransformed plants. The propagation of electrical signals from wounded leaflet to undamaged leaflet was abolished in the glr3.3, glr3.5 and glr3.3/3.5 mutants. Moreover, the glr3.3/3.5 mutants accumulated reduced amounts of JA and JA-Ile upon simulated herbivory and the glr3.5 and glr3.3/3.5 mutants presented significantly decreased resistance to cotton bollworm (Helicoverpa armigera).

"Our study highlights the characteristics of electrical signals in tomato horticultural plant elicited by herbivory and wounding and emphasizes the role of GLR genes in JA synthesis and herbivores resistance, which will provide new insights into the mechanism of herbivory defense in crop plants and the potential role of electrical signals in balancing defense and growth tradeoffs in plants in response to herbivory," said Professor Yu.

More information: Chaoyi Hu et al, Characteristics of Herbivory/Wound-Elicited Electrical Signal Transduction In Tomato, *Frontiers of Agricultural Science and Engineering* (2021). DOI: 10.15302/J-FASE-2021395

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