Scientists discover why ripe fruit is more susceptible to necrotrophic pathogens than unripe fruit

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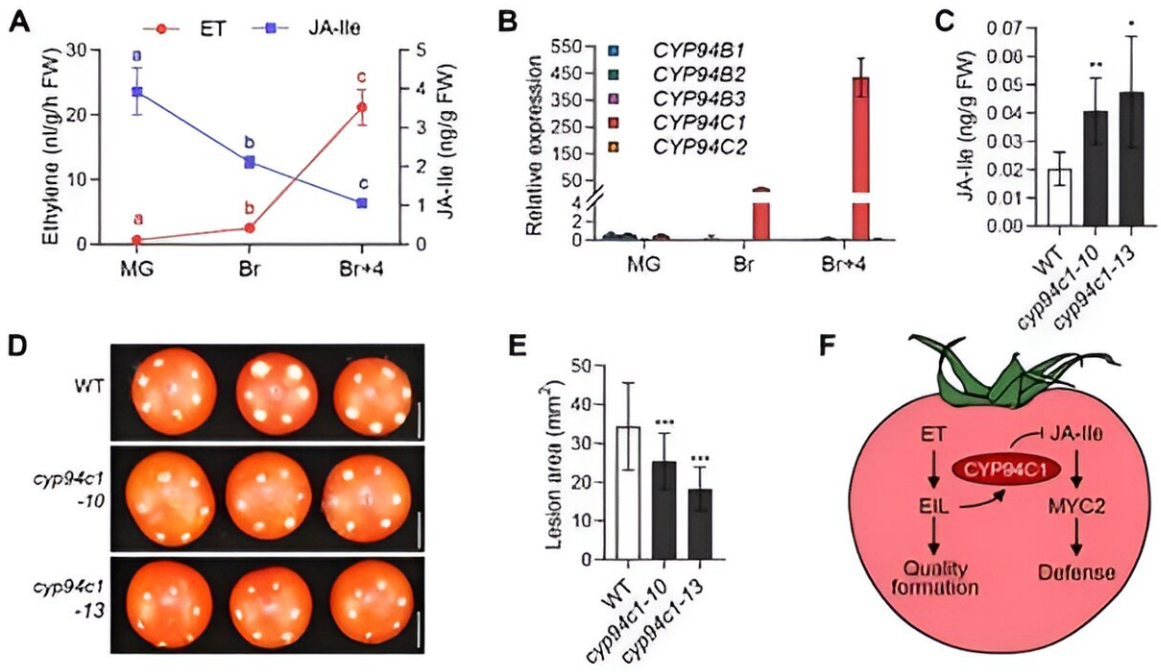

Tomato CYP94C1 inactivates JA-Ile to attenuate JA-mediated defense during fruit ripening. Credit: IGDB

In a recent study published in *Molecular Plant*, researchers have elucidated the mechanism underlying the increased susceptibility to necrotrophs during fruit ripening and have developed a rapid strategy to

improve tomato fruit resistance to necrotrophs without compromising fruit quality.

Ethylene (ET) is a key ripening signal, while jasmonate (JA) is a major defense hormone. In tomatoes, EIL transcription factors are at the core of the ET signaling pathways. The research group of Prof. Li Chuanyou from the Institute of Genetics and Developmental Biology (IGDB) of the Chinese Academy of Sciences (CAS) previously demonstrated that EIL physically interacts with the Mediator subunit MED25 to orchestrate a hierarchical transcriptional cascade to promote quality formation in tomato.

As a widespread phenomenon in fleshy fruit species, ripe fruits are more susceptible to necrotrophic pathogens than unripe fruits. This sophisticated mechanism enables fruits to protect the developing seeds and facilitates the dispersal of mature seeds in nature but causes severe postharvest losses in production.

Since most fruit quality attributes are determined during ripening, breeding fruit resistance to necrotrophs without compromising ripening-related quality is a major challenge for many crops.

The researchers found that while ET production is highly induced by ripening, the levels of JA-Ile (the most bioactive form of JA) are significantly reduced during this process. Consistent with this, JA-mediated defense responses decrease during ripening. Further studies showed that EIL directly activates the expression of CYP94C1, whose protein product, in turn, converts JA-Ile to the inactive form 12-COOH-JA-Ile, thereby attenuating JA-mediated defense during fruit ripening.

These results reveal the central role of CYP94C1 in linking ET-mediated ripening and JA-mediated defense. It is likely that plants use JA to protect themselves prior to seed maturation. Once the seeds mature,

plants use ET to promote quality formation and remove JA-mediated defense, thereby facilitating seed dispersal.

Strikingly, knockout of CYP94C1 improves tomato fruit resistance to necrotrophs. Importantly, this strategy does not affect fruit ripening and quality, including days from anthesis to ripening initiation and levels of sugars, acids, lycopene, and ascorbic acid.

In addition, the cyp94c1 mutation does not lead to unfavorable effects on growth and yield.

More information: Tianxia Yang et al, Tomato CYP94C1 inactivates bioactive JA-Ile to attenuate jasmonate-mediated defense during fruit ripening, *Molecular Plant* (2024). DOI: 10.1016/j.molp.2024.02.004

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