

# Effector knockout competition reveals individually redundant effectors are **collectively required** for successful virulence

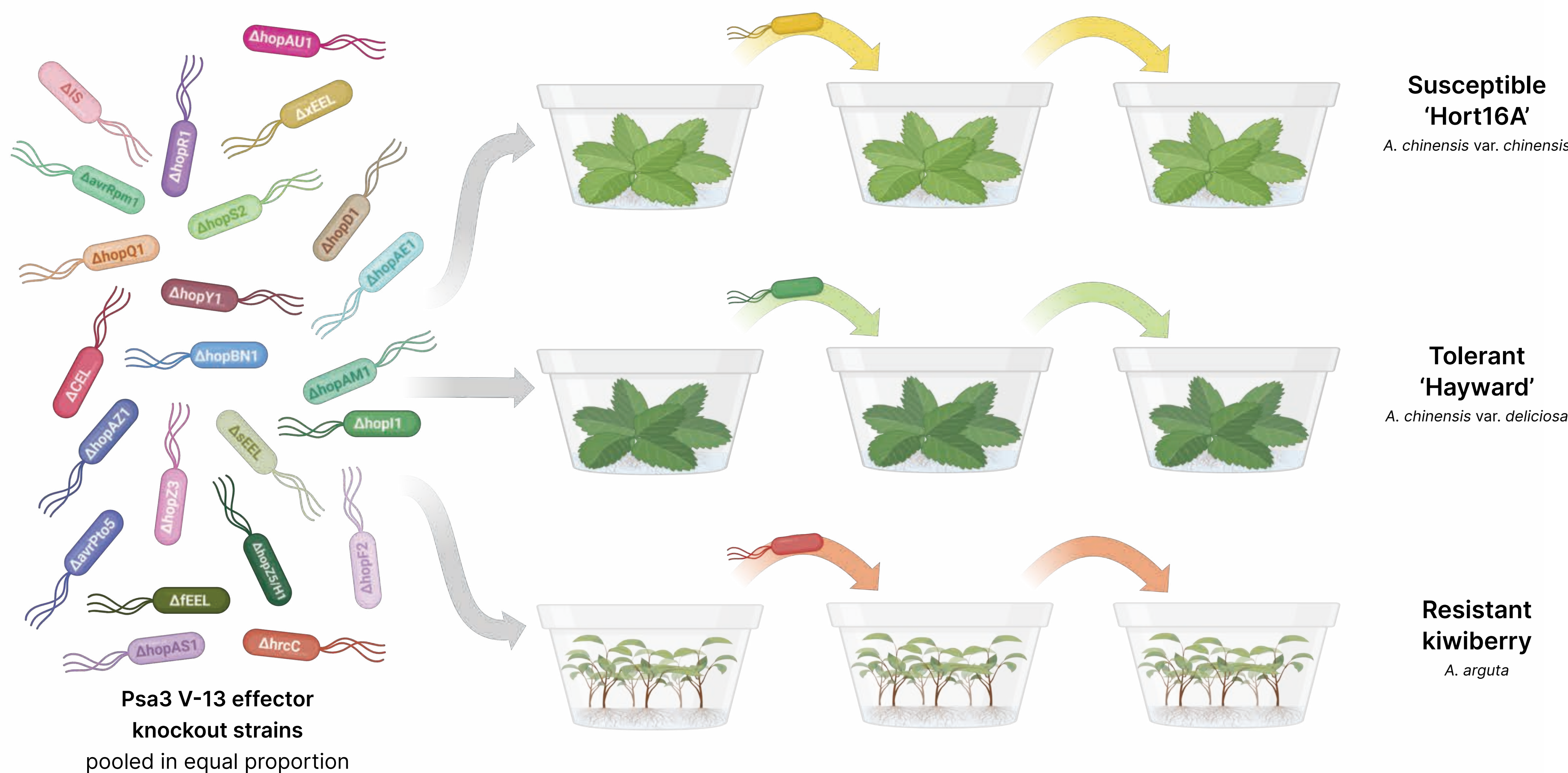
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## Do plant pathogens require all their effectors to cause disease, or just a few?

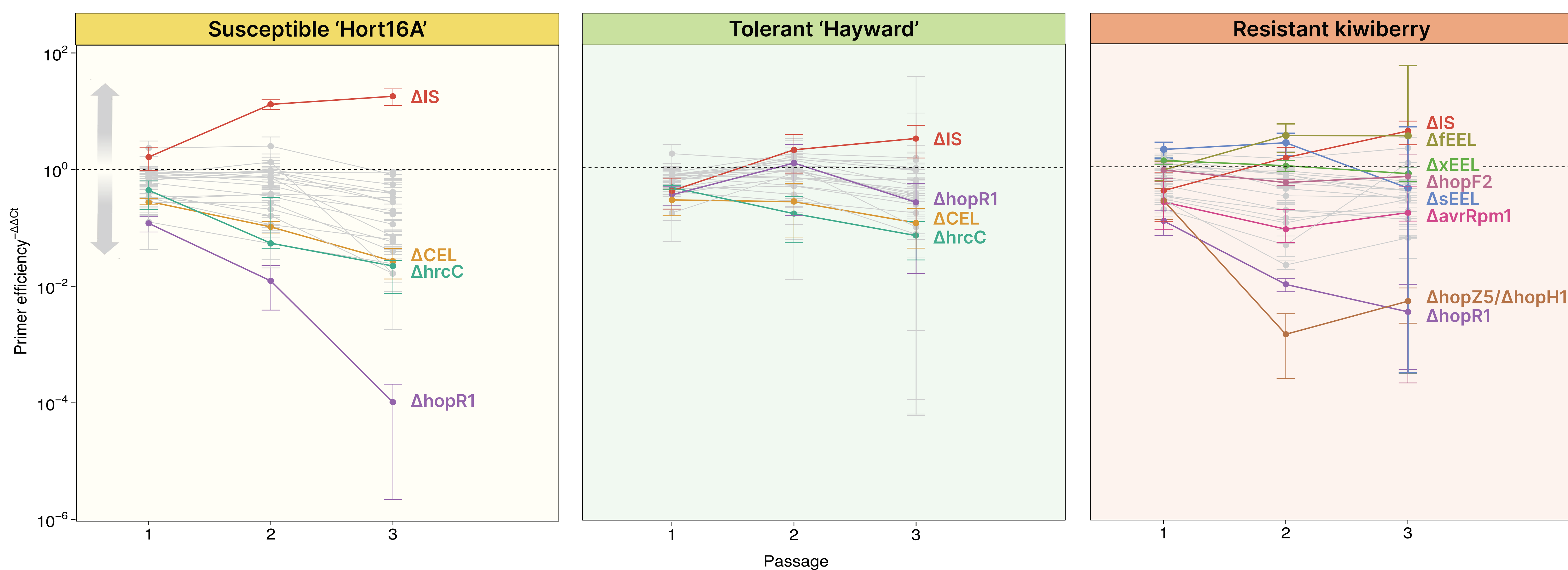
- Effectors help pathogens invade their host, extract nutrients, and suppress immunity.
- *Pseudomonas syringae* pv. *actinidiae* (Psa) is an emergent kiwifruit pathogen with over 30 effectors.
- Currently, flooding assays suggest that only a few of Psa's effectors appear to be essential for virulence.
- Kiwiberry (*Actinidia arguta*) is Psa-resistant, recognising several Psa effectors.
- Psa3 genome biosurveillance in New Zealand orchards suggests that effector loss is rare.



## Methodology

- 21 Psa3 V-13 effector knockout strains were pooled in equal proportion, with two additional control strains -  $\Delta hrcC$ , which cannot secrete effectors, and WT-like  $\Delta IS$ .
- At 12 dpi, leaf discs were harvested, ground and used to inoculate LB for passaging to new tissue culture plants.
- DNA was extracted to monitor the presence of each knockout in the population by qPCR.

By serially passaging a competitive pool of effector knockout strains, we seek to examine **effector requirements, redundancies & repertoire refinement** across kiwifruit hosts.



### The winner takes it all...

Psa3 V-13  $\Delta IS$ , a control strain which retains the full effector repertoire, took over the population in all three 'Hort16A' replicates. While Psa's effectors appear to be individually redundant, they may be collectively required for virulence.

### ... the loser has to fall

In Psa3, *hopR1* and the CEL effector *avrE1* make major, individual contributions to virulence. However, in competition on 'Hort16A',  $\Delta hopR1$  drops out further than  $\Delta CEL$ , despite the structural similarity of these effectors.

### No more ace to play

The benefit of escaping host recognition may be outweighed by the cost of losing that effector's virulence contribution. Of the effectors recognised by *A. arguta*, only EEL knockout strains appear to be selected for in competition.

## Acknowledgements

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