Understanding HLB Tolerance

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Take Home Message

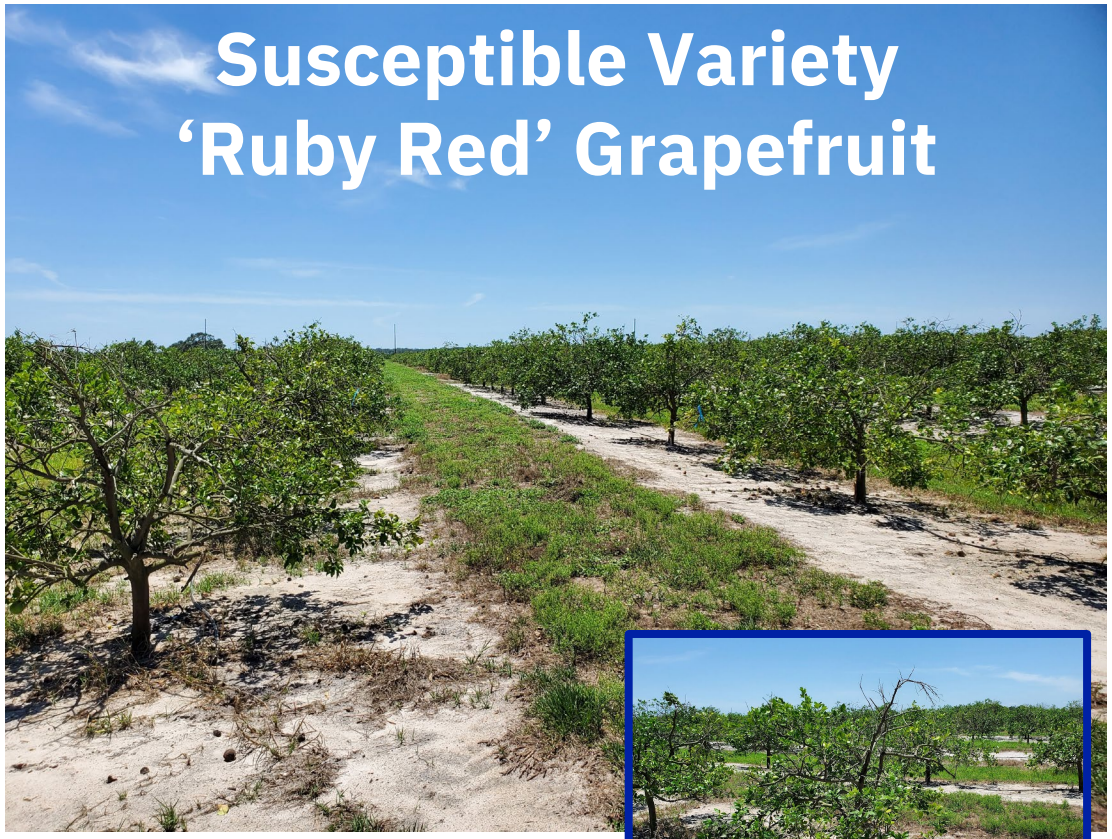
- Understanding what makes a tree tolerant to HLB can help us target the correct treatments and gene editing candidates
- We compared different HLB susceptible and tolerant varieties
- We found differences in sugar transport, water usage, and immunity
- Susceptible varieties respond stronger than tolerant varieties
- NPR1 seems to give true tolerance
- Early stages of field testing in progress
- Waiting for regulatory approval

Tolerance is when the plant has the pathogen but doesn’t develop a disease.

Resistance is when the pathogen can't infect at all.

HLB Susceptible and Tolerant Variety Comparison

Susceptible Variety
‘Ruby Red’ Grapefruit



Tolerant Variety
‘Orri’ Mandarin

Both infected with *C*Las

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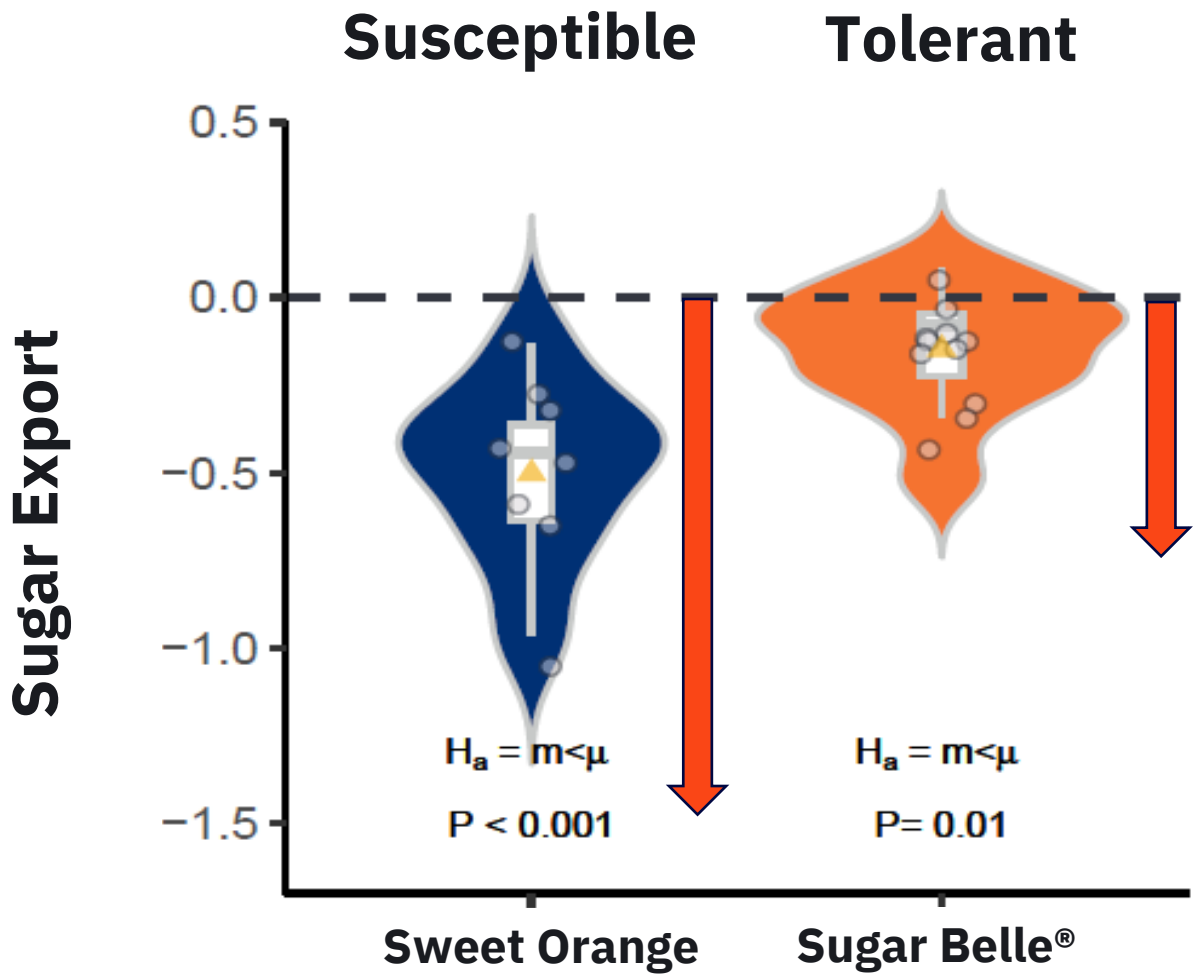
What Are The Main Differences?

Tolerant Varieties: Sugar Movement

In tolerant variety sugar movement does not stop after infection



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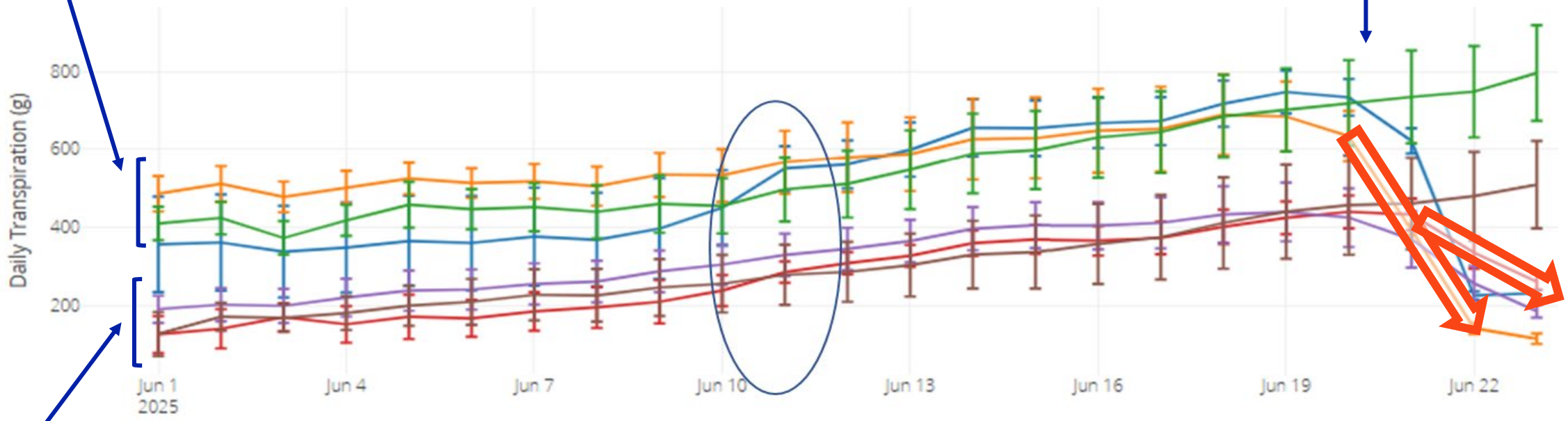
Tolerant Varieties: Water Stress

Susceptible: Murcott

Drought began



Tolerant: Orri

Susceptible: Transpires more, but has transpiration shuts down after drought stress

Tolerant: Transpires less, but keeps transpiring after drought stress

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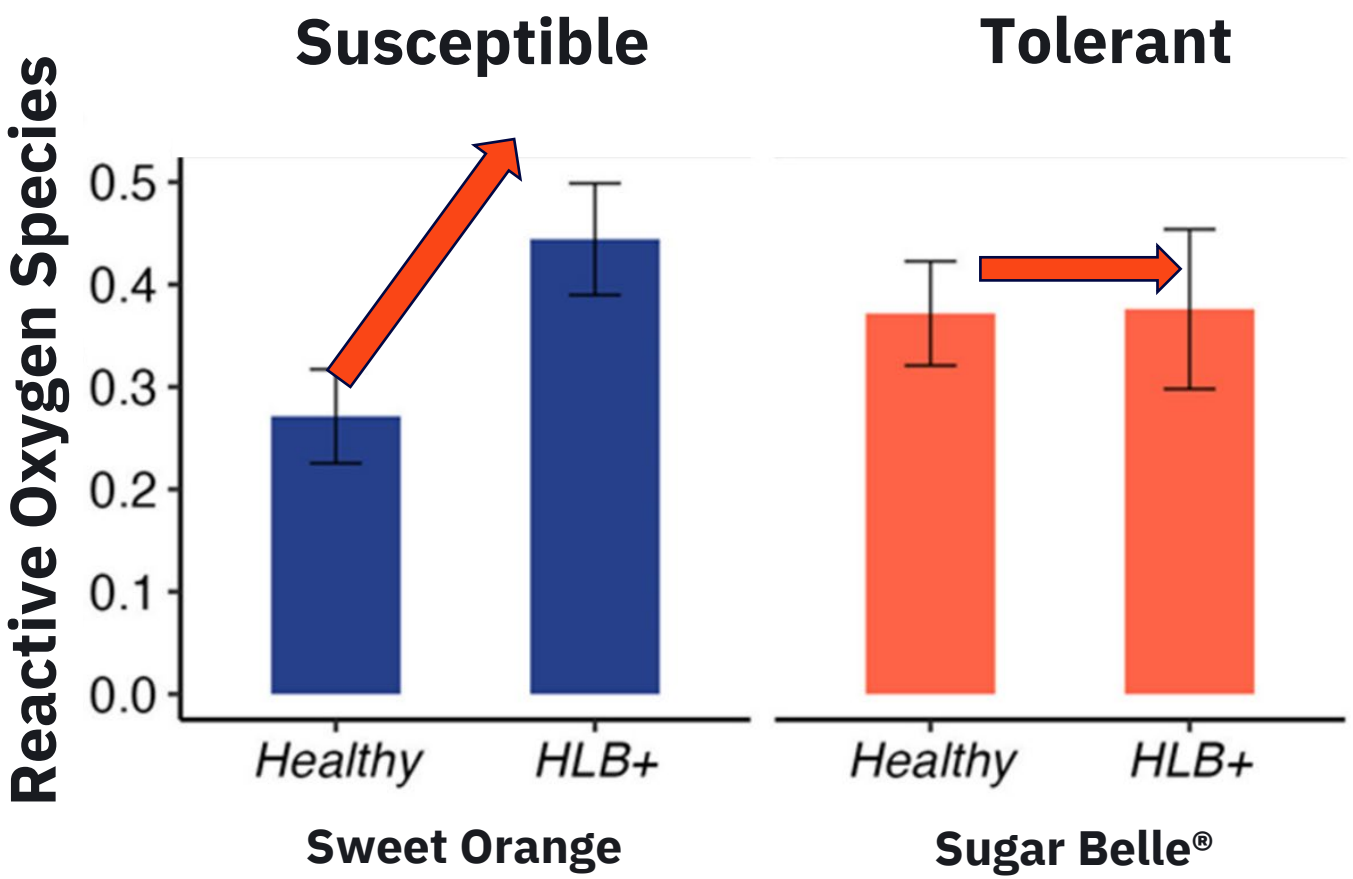
Tolerant Varieties: Stress Response



Reactive Oxygen Species
Measures the tree stress response

Tolerant varieties' stress response does not increase after infection

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Tolerant Varieties Respond Slow and Steady to HLB

Susceptible Varieties

Weak Starting point

↓

Strong Defense Response

↓

Phloem Block

↓

HLB Symptoms

Tolerant Varieties

Strong Starting Point

↓

Weak Defense Response

↓

No Phloem Block

↓

No HLB Symptoms

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Do we have a way to make trees tolerant?

NPR1 Transgenic Plants

- NPR1 is immune regulator, type of plant protein
- Regulates one of the defense systems in a tree
- Research has shown that an increase in the NPR1 creates a tolerance to pathogens (ex. HLB)

HLB-infected citrus tree with NPR1

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NPR1 Field Trials, Ft. Pierce (Hamlin)

May 2019

August 2025

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What makes NPR1 trees tolerant?

We Tested This Question with HLB Infection

- No treatment
- Infection with healthy psyllids
- Infection with infected psyllids

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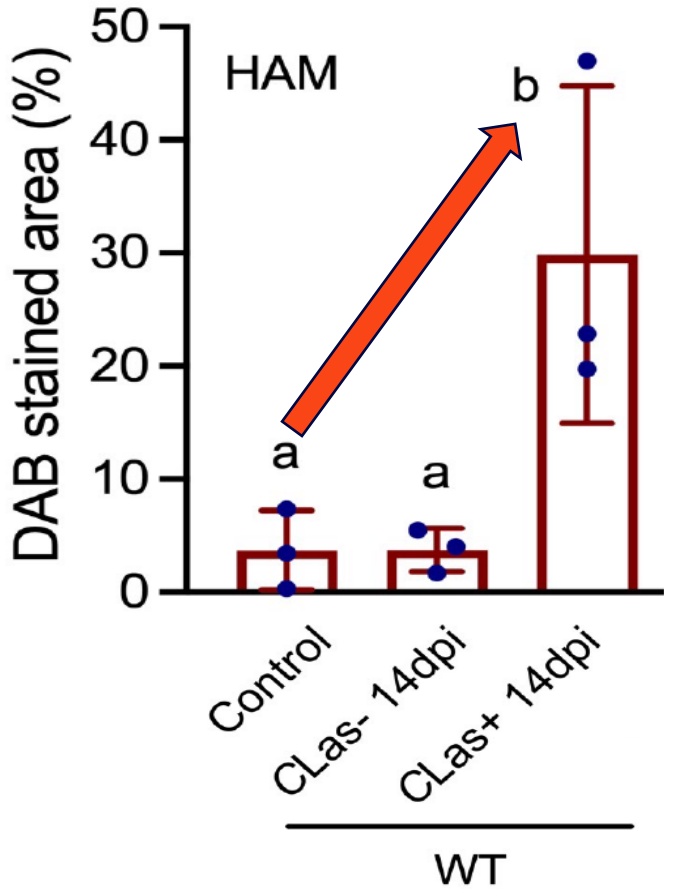
ROS Response



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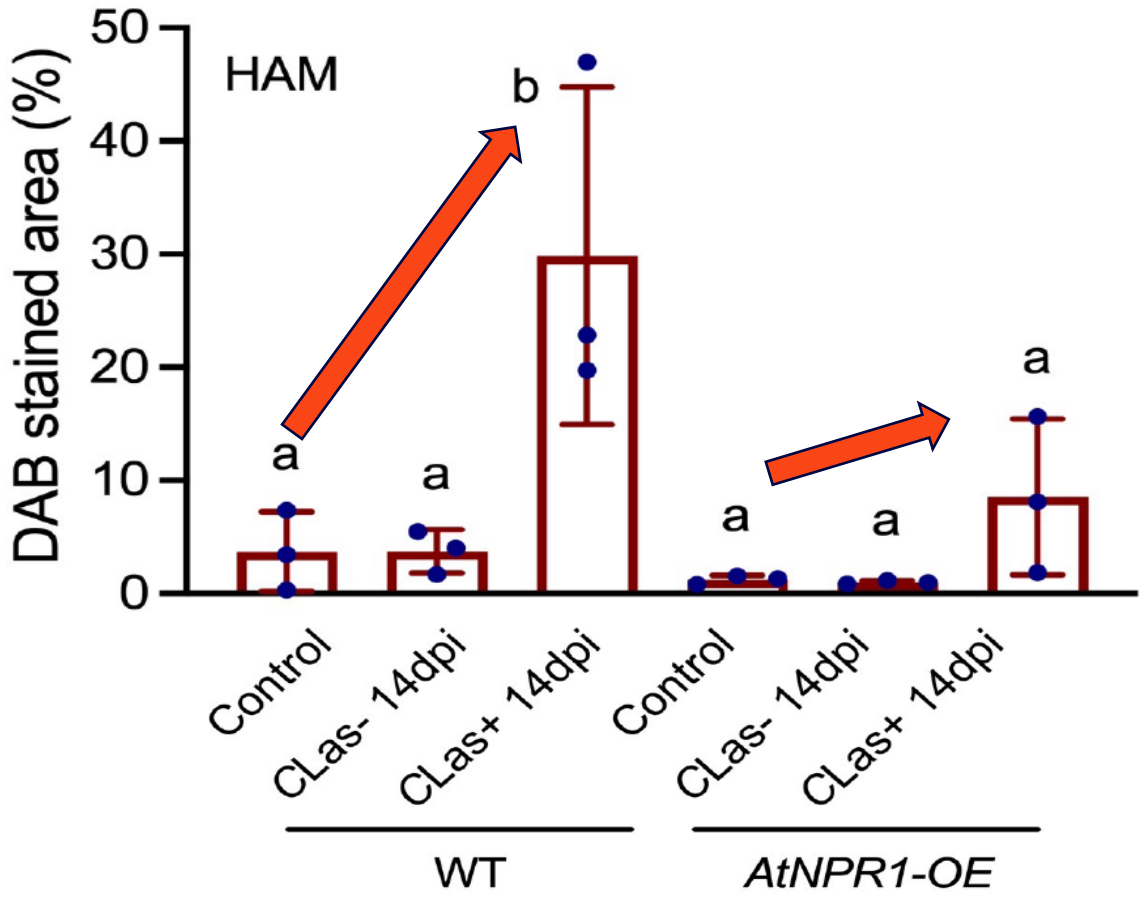
NPR1 plants do not increase ROS



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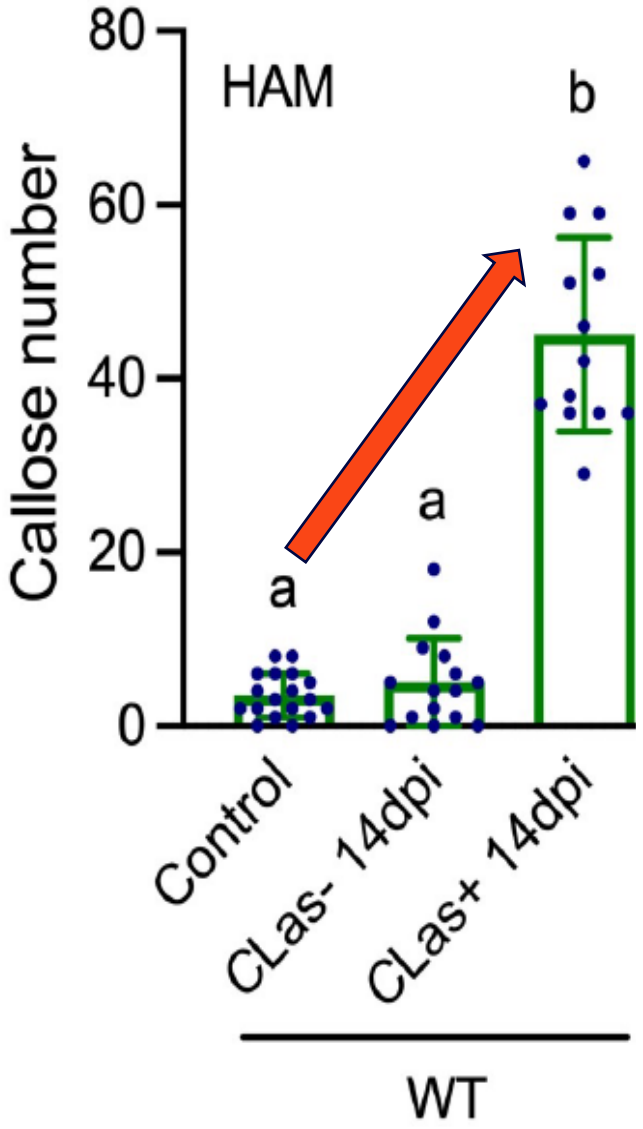
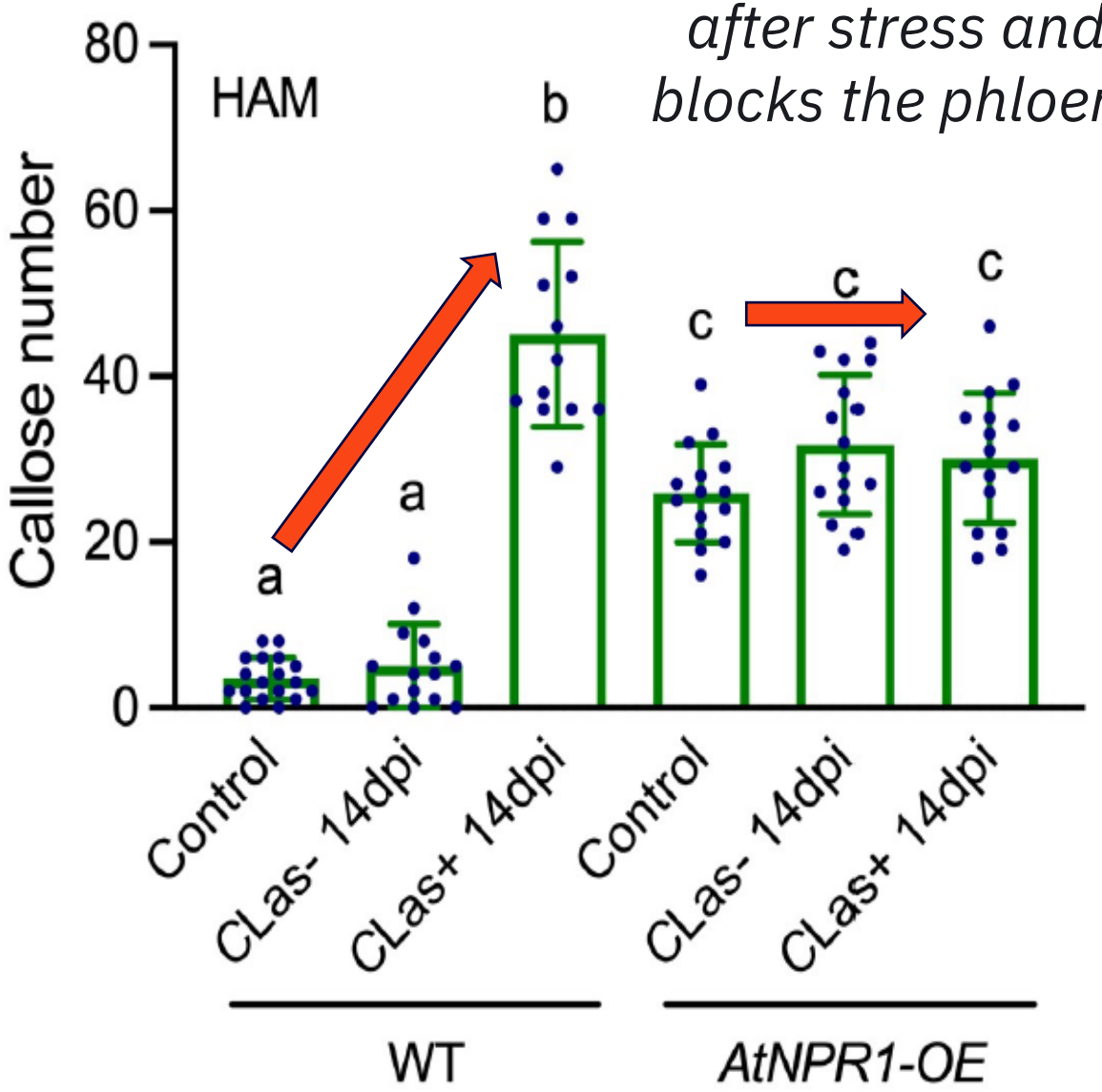
Callose Response



Callose is deposited after stress and blocks the phloem

NPR1 plants do not increase callose

Callose is deposited after stress and blocks the phloem



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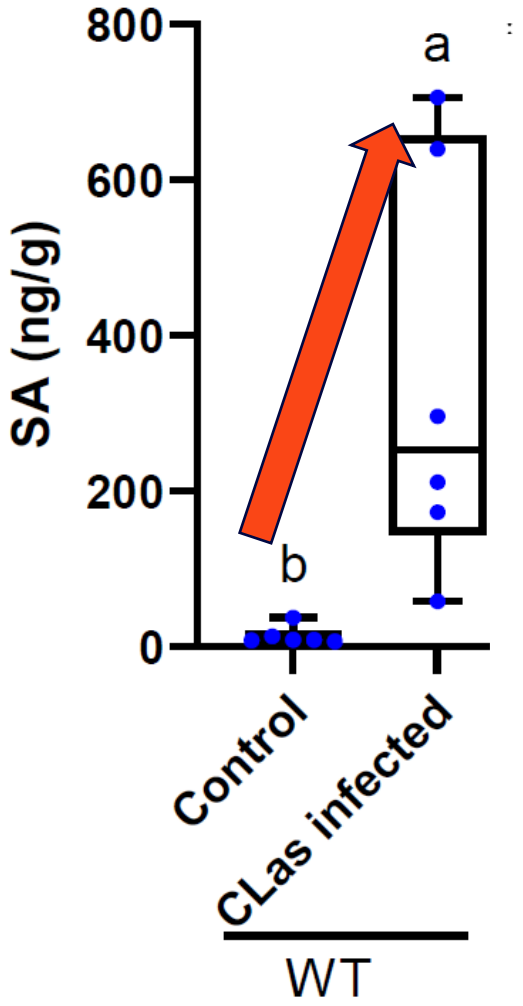
Salicylic Acid Response

Salicylic Acid is a plant defense hormone



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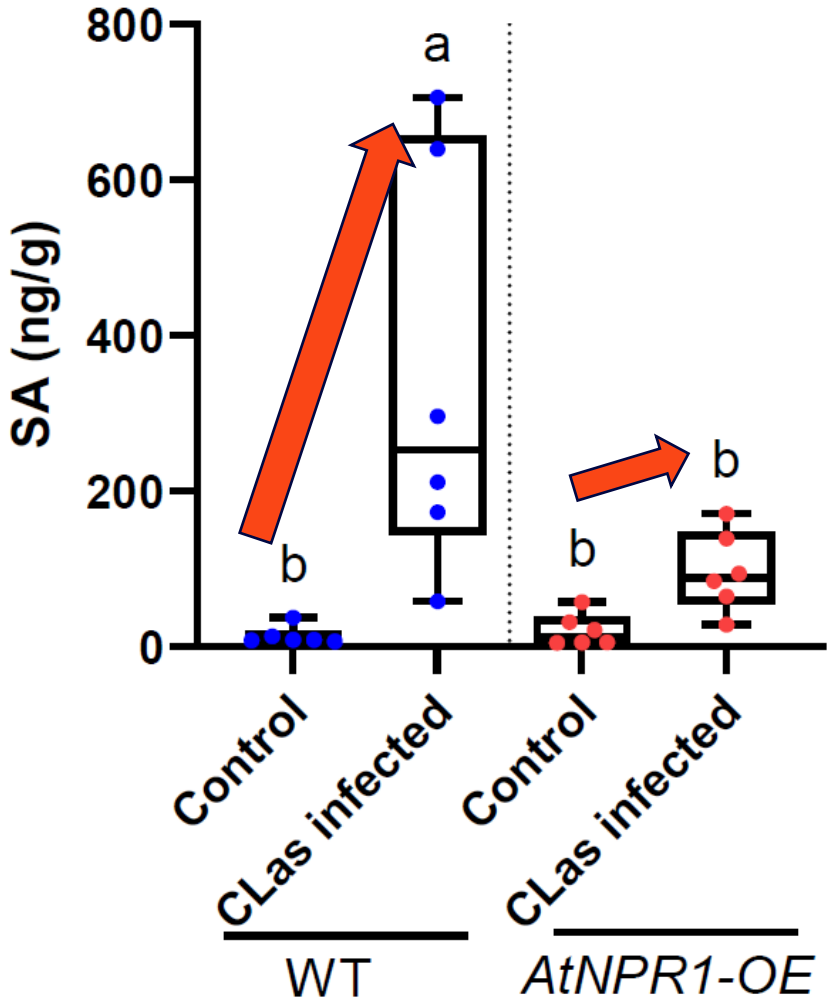
Salicylic Acid Response

Salicylic Acid is a plant defense hormone

NPR1 plants do not increase Salicylic Acid



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Conclusion

- The key for HLB tolerance is **UNRESPONSIVENESS**-not responding too strong to HLB, keeping balanced and stable response
- Strong immunity is important
- NPR1 seems to create real tolerance because it is reducing the response
- NPR1 trees are now going through the approval process

THANK YOU

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