Light on the horizon: A molecular discovery opens the door for developing cabbage varieties resistant to black rot

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Outline

- An overview of Black Rot in New York State
- Cabbage resistance and susceptibility to the Black Rot pathogen
- Using the Black Rot pathogen to find cabbage weak spots

Black rot of crucifers is caused by *Xanthomonas campestris* pv. *campestris* (*Xcc*)


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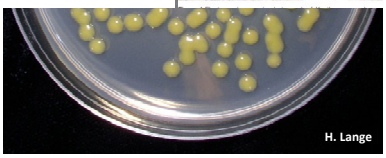
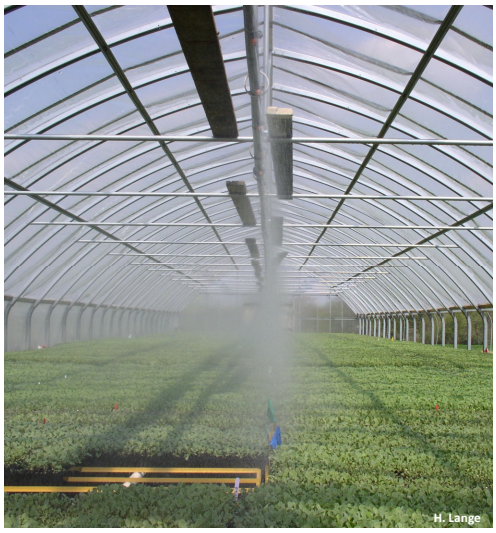


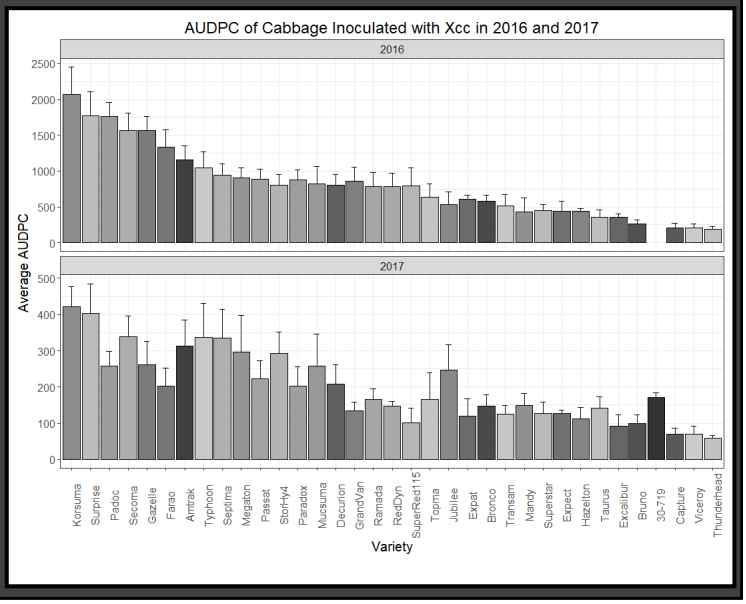
Black Rot in New York State

- Smart Lab collected isolates of Xcc for 15 years
  - Genetically different isolates each year
  - Not overwintering in fields
- Xcc primarily spread via seed
- Hot water treatments can limit disease, but…
- 1 in 10,000 infected seed can cause an epidemic



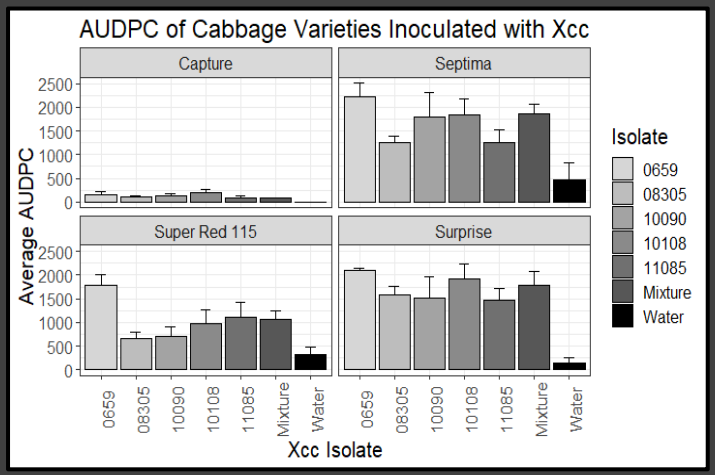
Black Rot in New York State

- Susceptibility of 35 varieties to a **single** NY Xcc isolate
- Tolerant varieties available, but no true resistance!



Black Rot in New York State

- Susceptibility of 4 varieties to diverse NY Xcc isolates
- Conclusion: Broad tolerance or susceptibility to the range of Xcc isolates in New York



Resistance and Susceptibility of Cabbage Varieties to Black Rot

- Tolerant varieties available, but what makes them tolerant is unknown
- Understanding which genes make cabbage tolerant or susceptible to Black Rot -> commercial variety improvement
- **Question: What makes cabbage tolerant or susceptible to Black Rot?**

What makes cabbage tolerant or susceptible to Black Rot?

- No major resistance (R) genes for black rot
- Bogdanove lab at Cornell studies Susceptibility (S) genes in rice
- Breeding plants that lack susceptibility genes leads to less disease



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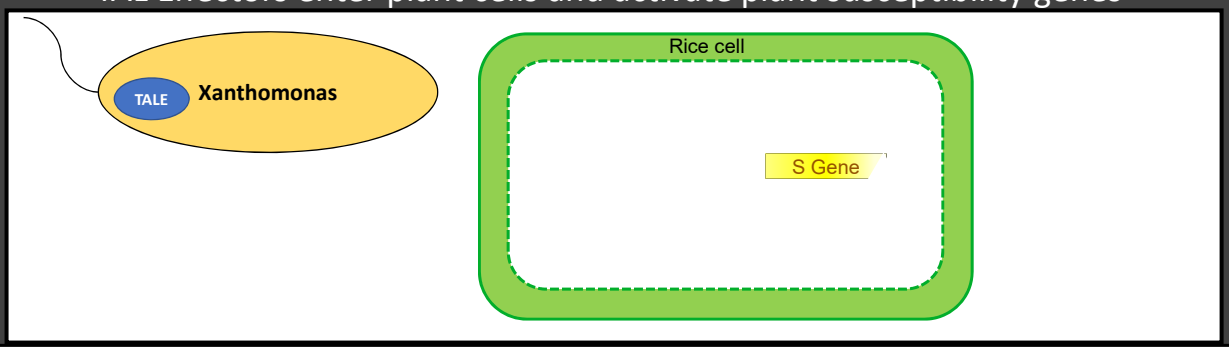

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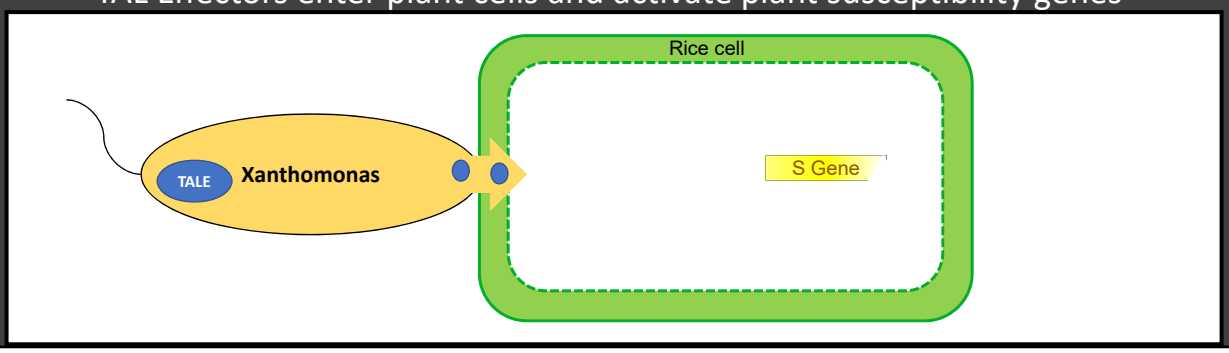

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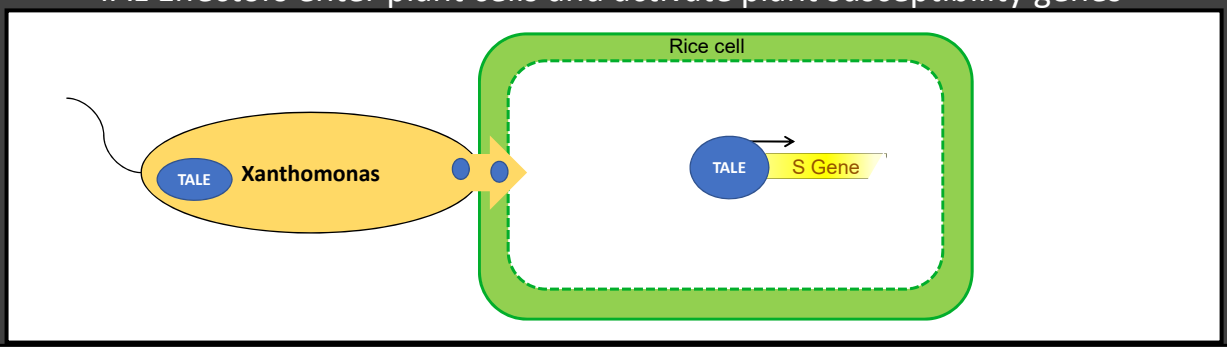

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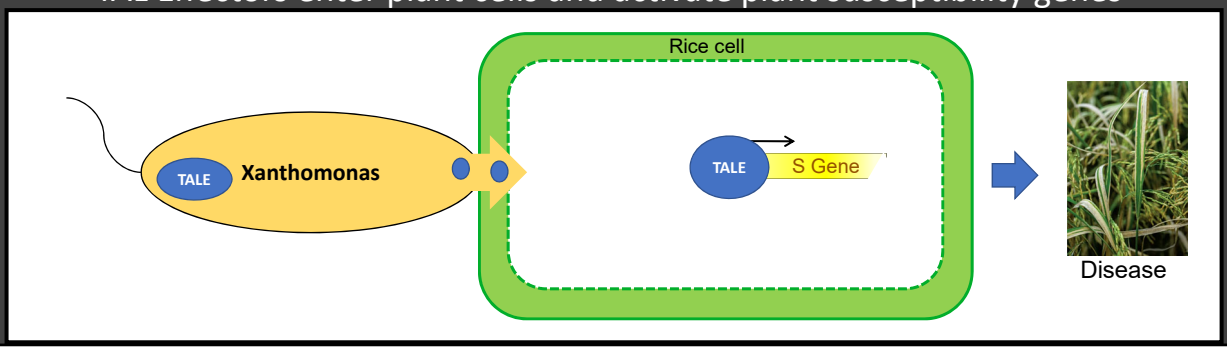

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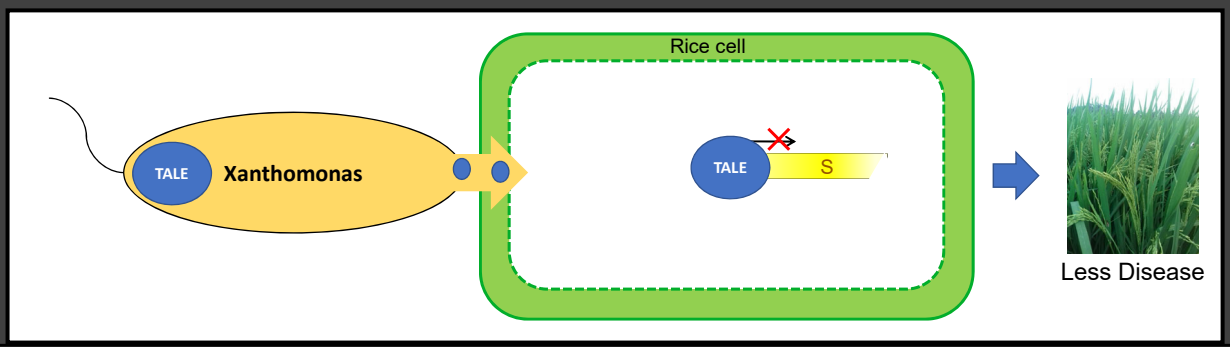
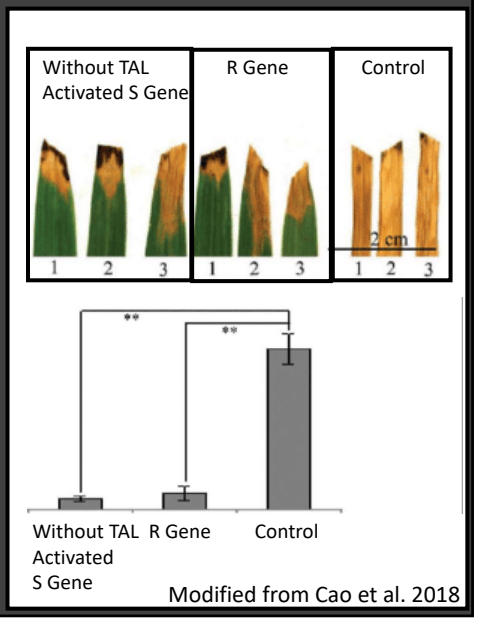


Loss of TAL Effector activated susceptibility genes results in resistance in rice

- TAL effector activated Susceptibility genes have been bred out of rice to control Bacterial Blight
  - Susceptibility genes are often Sugar Transporters
- Successfully used in the field
- Can we do this in cruciferous crops?



Modified from Cao et al. 2018

Will this strategy work to reduce susceptibility of cabbage to Black Rot?

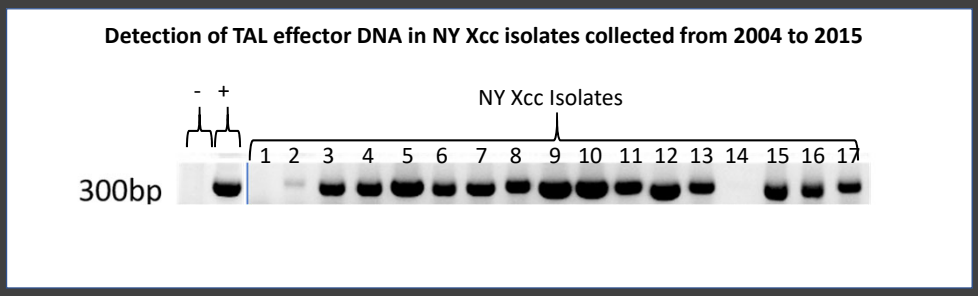
1. Does the pathogen have TAL effectors?
2. Are TAL effectors using genes important to susceptibility?
3. What genes are the TAL effectors using?
4. Modify or remove susceptibility genes and determine if plants are less susceptible to disease

Will this strategy work to reduce susceptibility of cabbage to Black Rot?

- Does Xcc have TAL effectors?
  - Lab test to see if TAL effector DNA is present

Will this strategy work to reduce susceptibility of cabbage to Black Rot?

- Does Xcc have TAL effectors?



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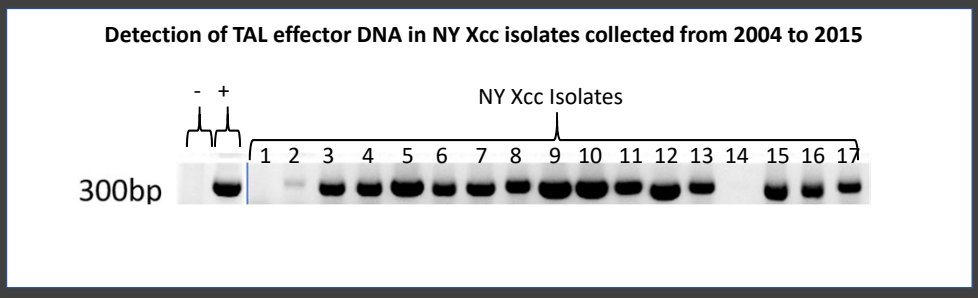

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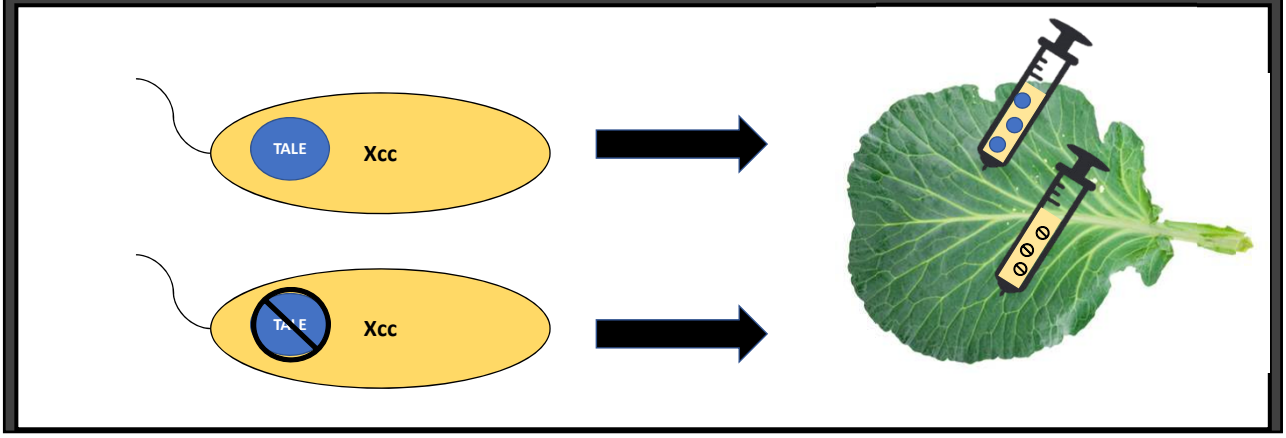
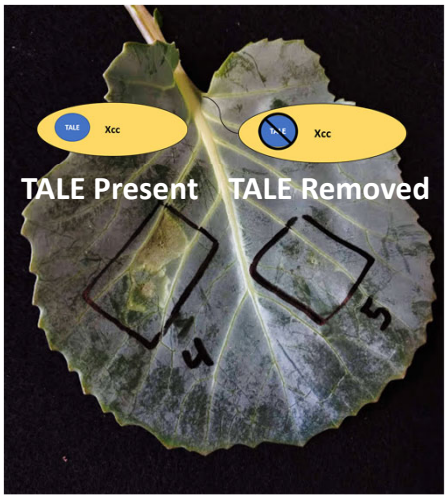
- Remove TALEs from Xcc
- Xcc without TAL effectors less virulent than Xcc with TAL effectors?



Are TAL Effectors important in black rot? Yes!



Xcc isolate from 2010

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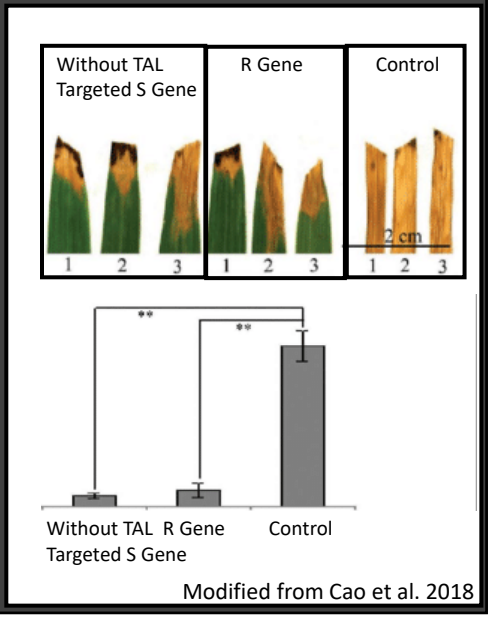
- Does Xcc have TAL effectors? ✓
- Are Xcc TAL effectors using genes important to susceptibility? ✓
  - Removal of several TAL effectors from NY Xcc strains, results in reduced disease
- What genes are the TAL effectors using?
  - Experiments in progress
  - Initial data: Sugar transporter genes (the same susceptibility genes from rice, cotton, and cassava)



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Conclusions

- Finding susceptibility genes that can be bred out of cabbage = strategy to reduce disease
- TAL effectors can be used to find susceptibility genes in cabbage
- Successful in other crops like rice
- Still a lot to do!

Acknowledgments

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    - Holly Lange
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    - Laurent Noel
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