

# Do adjuvants improve delivery of foliar-applied oxytetracycline?



Christopher Vincent and Nabil Killiny





DEADLY GERMS, LOST CURES

## *Citrus Farmers Facing Deadly Bacteria Turn to Antibiotics, Alarming Health Officials*

In its decision to approve two drugs for orange and grapefruit trees, the E.P.A. largely ignored objections from the C.D.C. and the F.D.A., which fear that expanding their use in cash crops could fuel antibiotic resistance in humans.

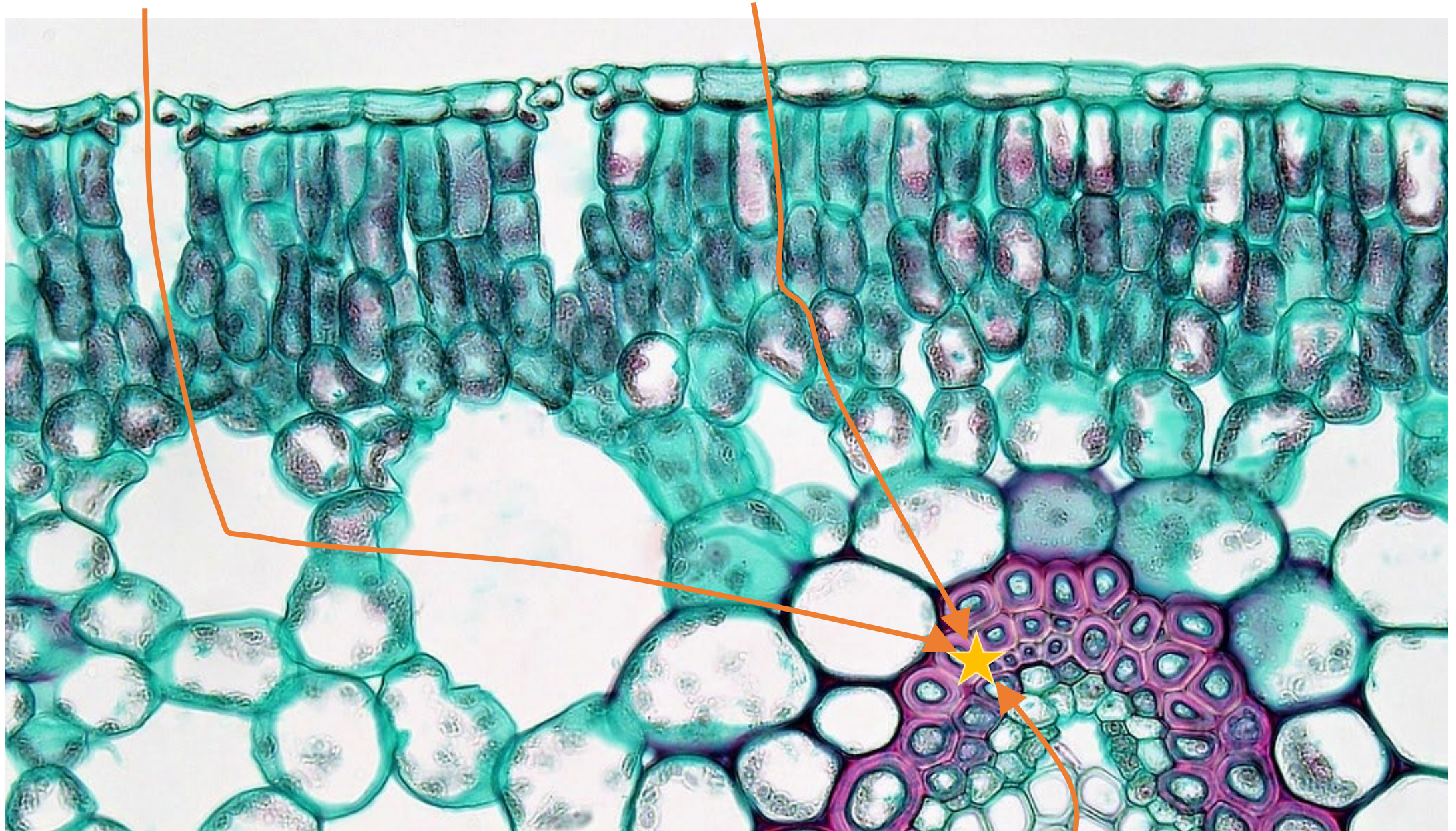


# What is “delivery”?

- The journey of a molecule to its destination
- HLB
  - Delivery of anti-microbials to the phloem, where they can affect the *Candidatus Liberibacter asiaticus* that reside there.
- What is its path?







Fayette A. Reynolds, Bekshire Community College, 2014

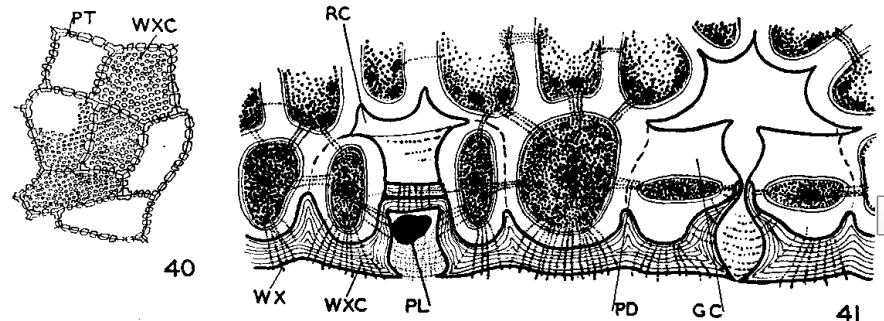
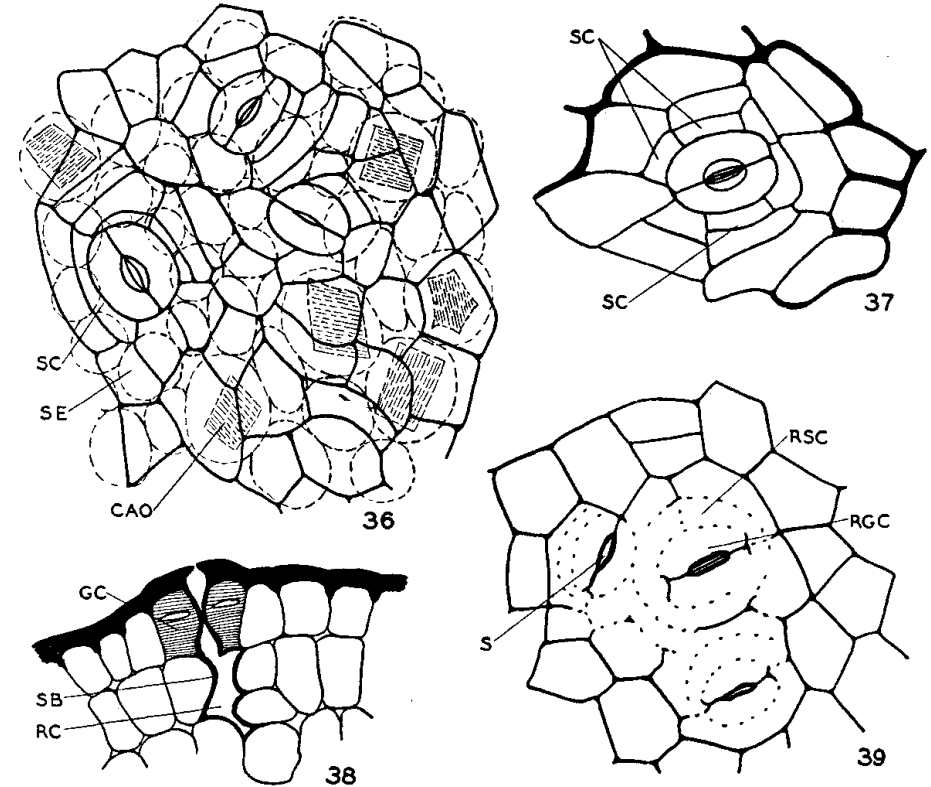
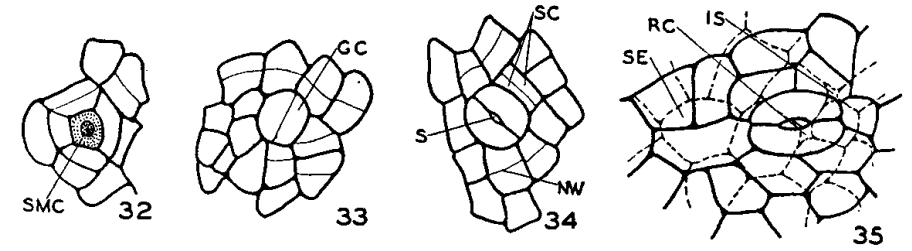
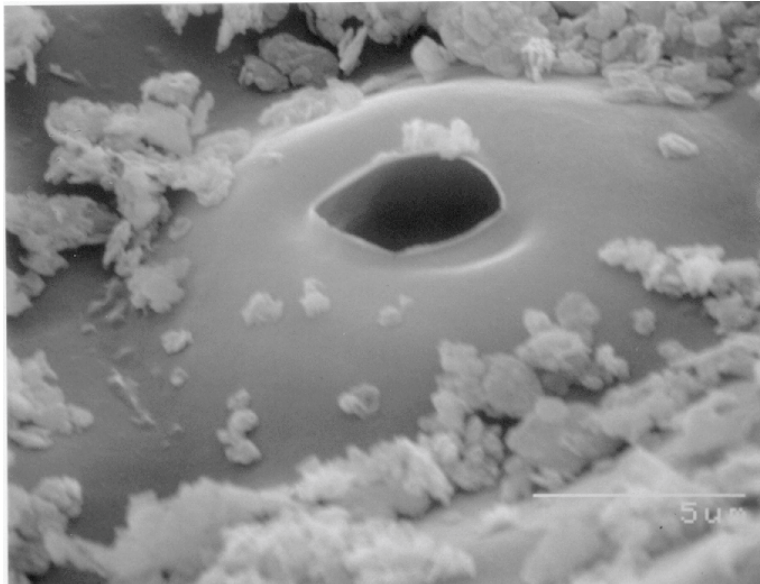
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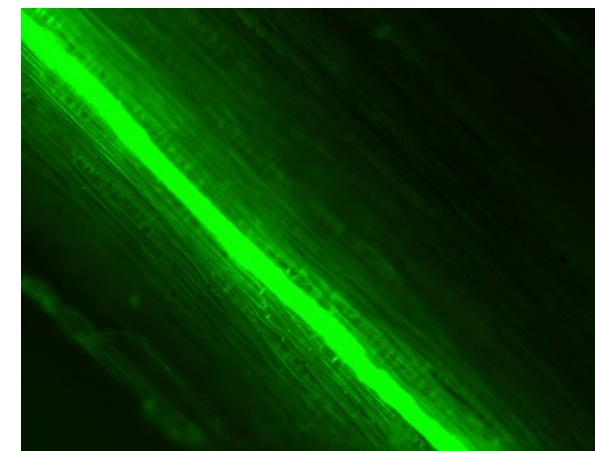
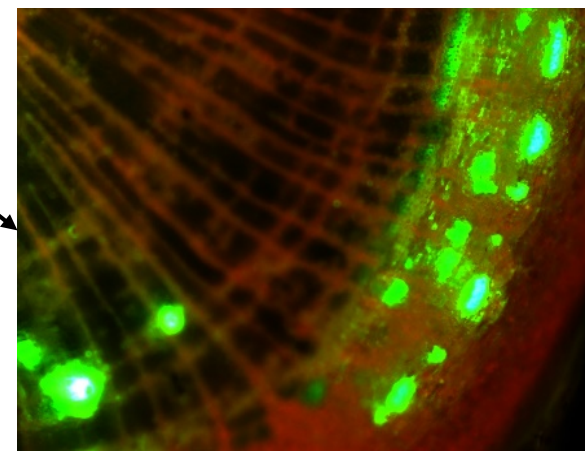
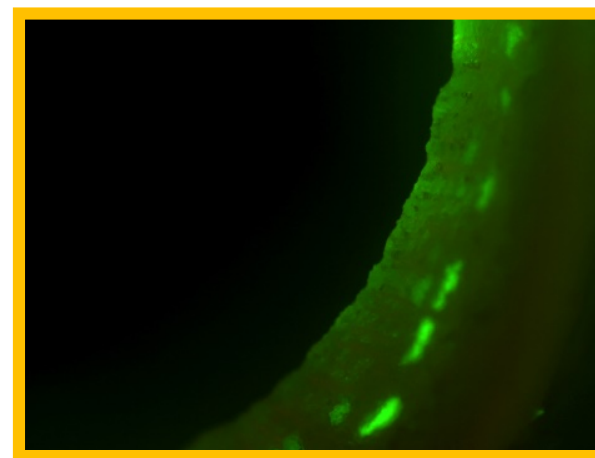
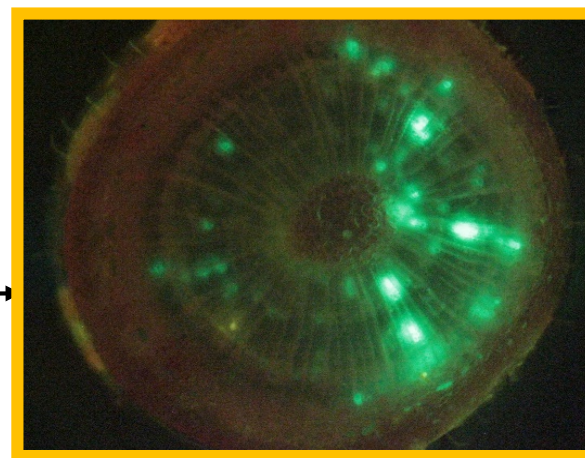
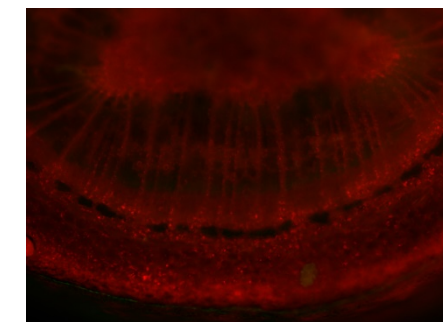
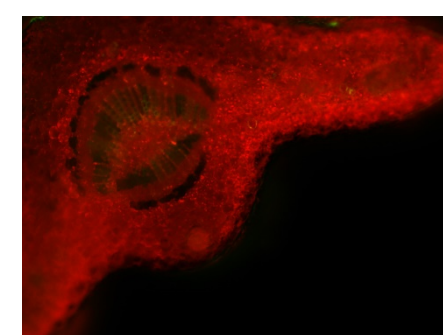
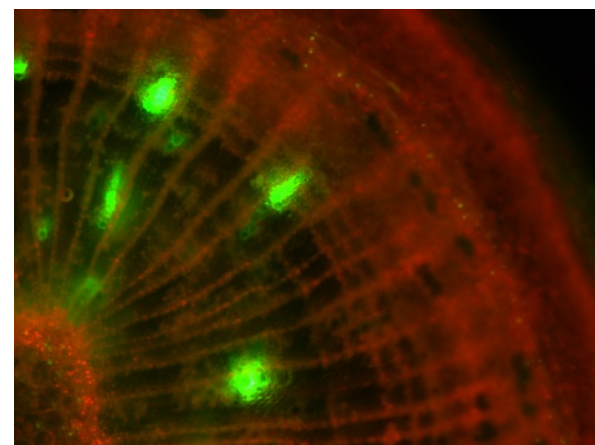
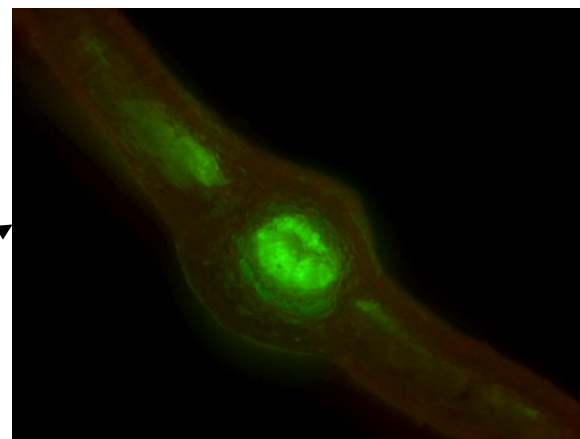




# Citrus?

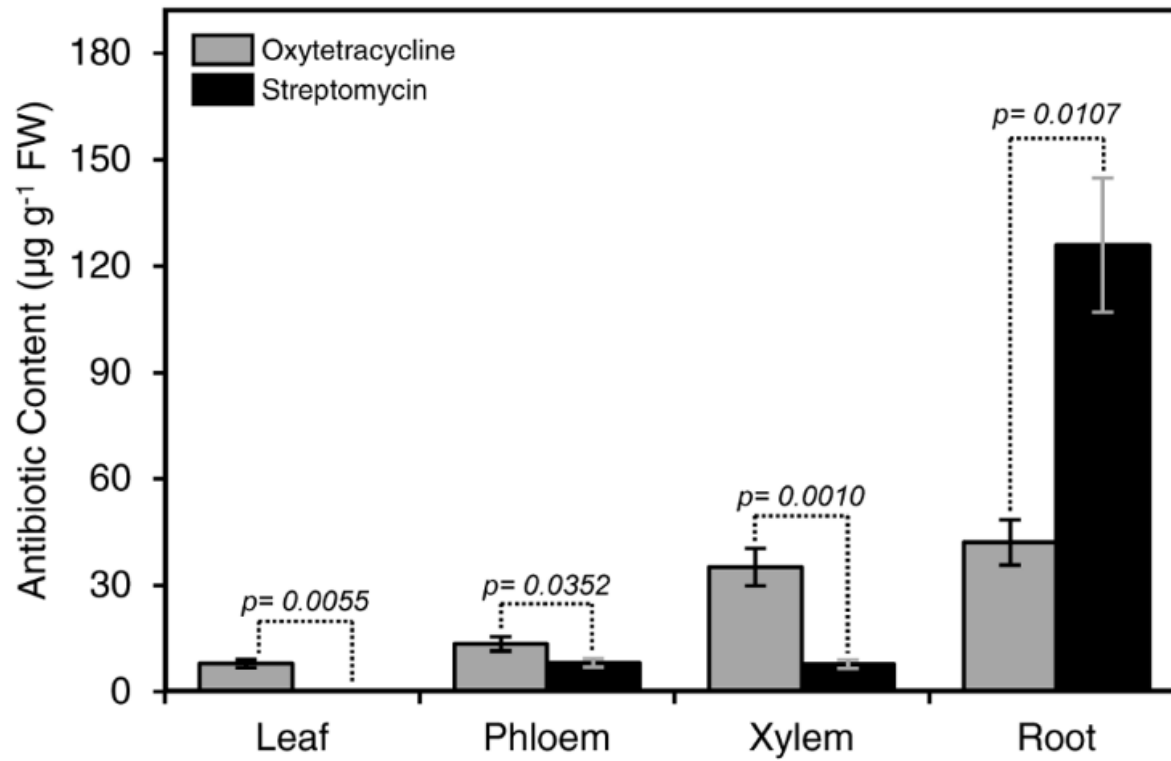
- Leaf morphology
  - Thick cuticle
    - Overhangs stomata
    - Wedged between epidermal cells
    - Limited mesophyll conductance





Control





Comparison between streptomycin and oxytetracycline translocation in citrus plants.





# Does foliar application deliver OTC?

## The in Planta Effective Concentration of Oxytetracycline Against '*Candidatus Liberibacter asiaticus*' for Suppression of Citrus Huanglongbing

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TABLE 1. Oxytetracycline (OTC) residual content in leaf tissues (midribs) of Valencia sweet orange (*Citrus sinensis* [L.] Osbeck) trees sprayed with 200 ml of OTC at 0.50 g/liter or water in a greenhouse at the Citrus Research and Education Center, Lake Alfred, Florida, U.S.A.<sup>w</sup>

Treatment	OTC content (µg/g of fresh tissue)					
	0 DPA <sup>x</sup>	2 DPA	4 DPA	7 DPA	14 DPA	21 DPA
OTC spray	– <sup>y</sup>	0.073 ± 0.013 a <sup>z</sup>	0.068 ± 0.008 a	0.048 ± 0.006 b	–	–
Water spray	–	–	–	–	–	–





# Objective

- Assess the role of adjuvants in delivery of oxy-tetracycline through foliar application.
- Determine the most effective adjuvants in delivery.



# Approach



- 6 yo Hamlin/Swingle
- 1.56 g OTC content in Fireline WP/plant
- Equivalent to 9 oz per acre of FireLine
- Treatments:
  - Control: Water without OTC
  - Water + OTC
  - Phase
  - N-Sure
  - Tactic
  - Exit
  - Grounded
  - Joint Venture
  - Nutrisync Micro Pak
  - Keyplex 445 DP
  - Experimental 1 and 2
  - Injection, no foliar application





# Approach

Bagged shoots to assess systemic delivery





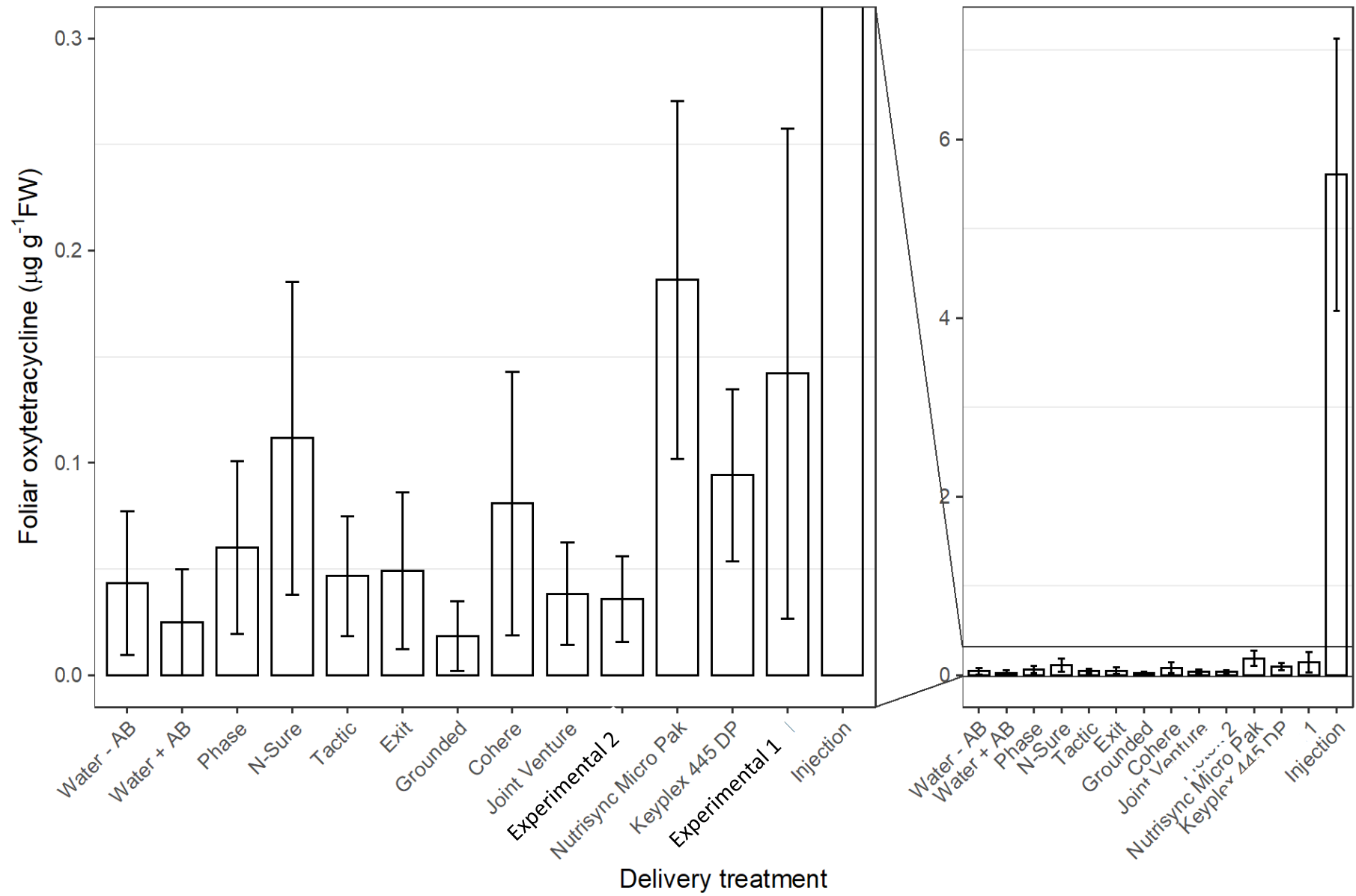
# Sampling

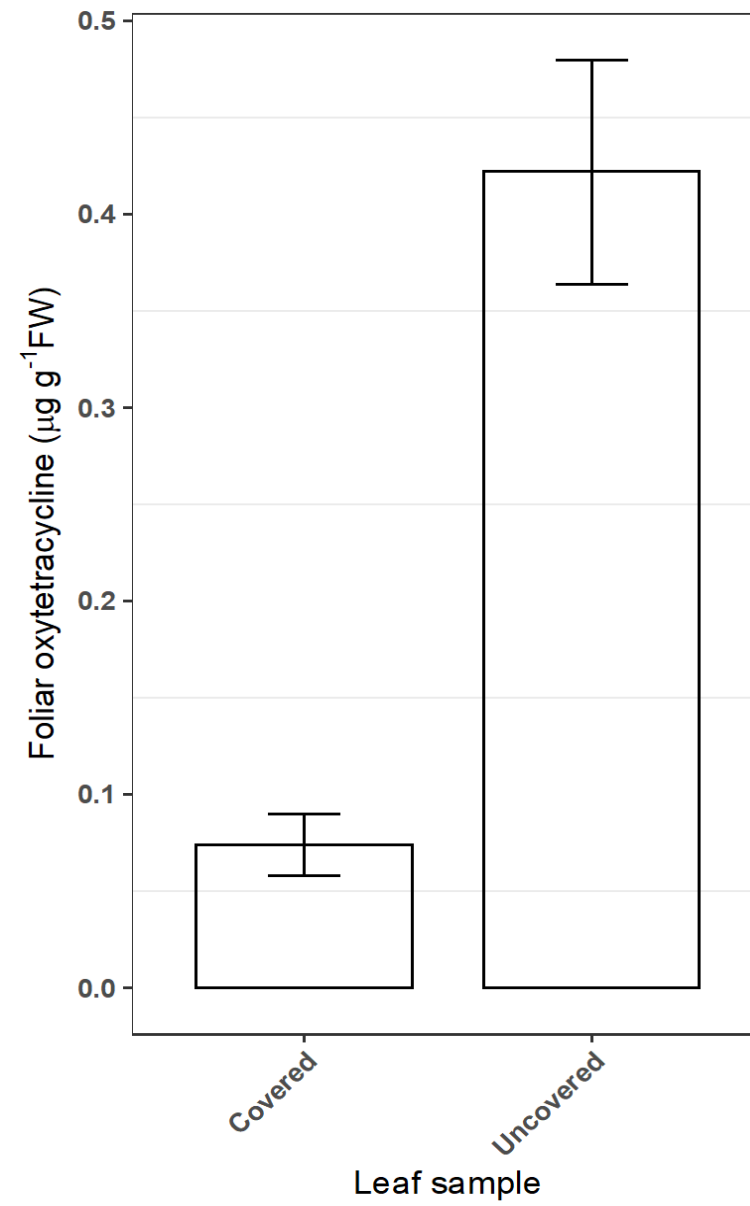
- OTC: Sampling after 4 days
  - Covered and uncovered
  - Quantification: blind, ELISA
- CLas titer
  - Sampling before, 4-days after, and 4-weeks after
  - qPCR for cycle threshold of CLas DNA
  - Also blind sampling





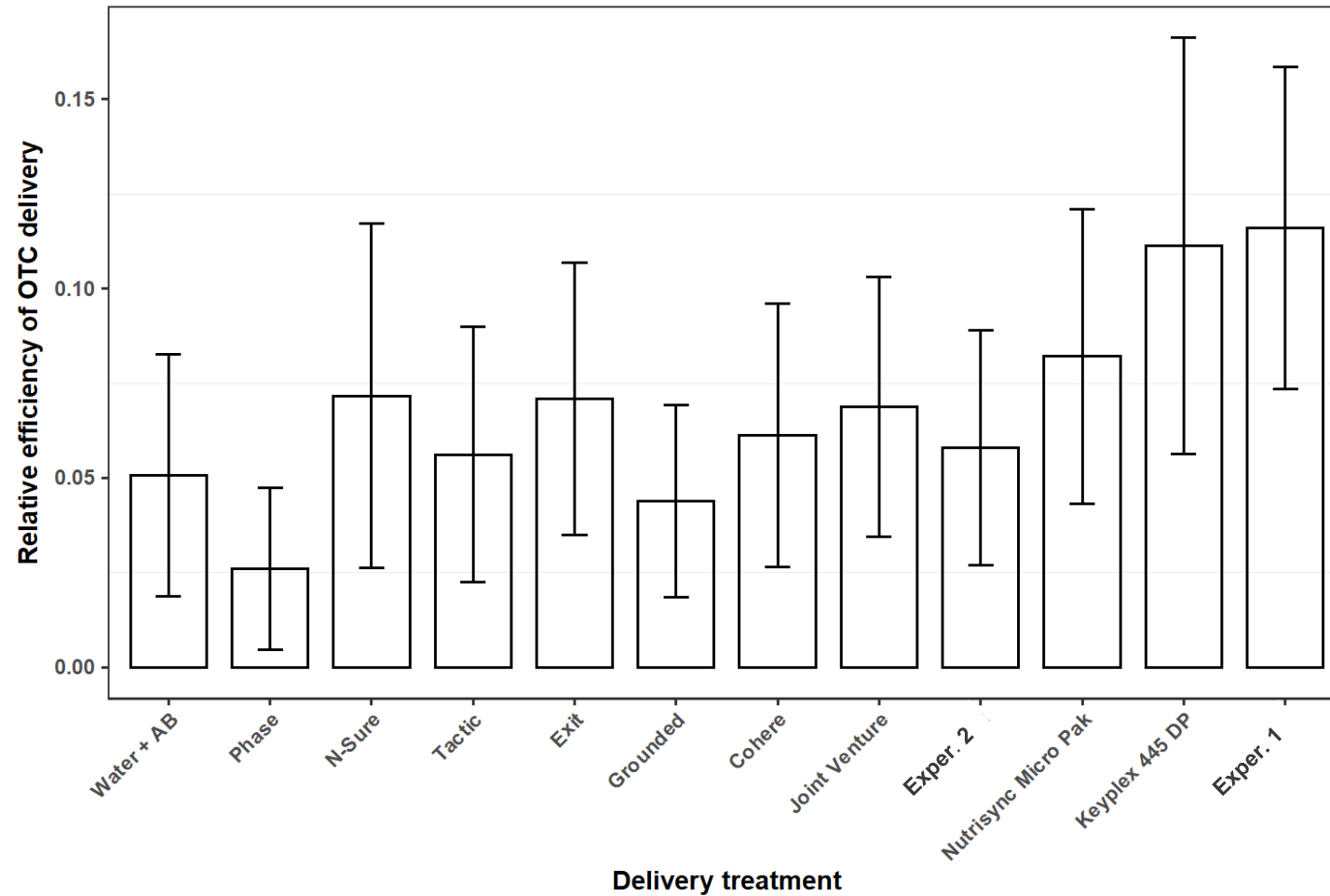
# Results



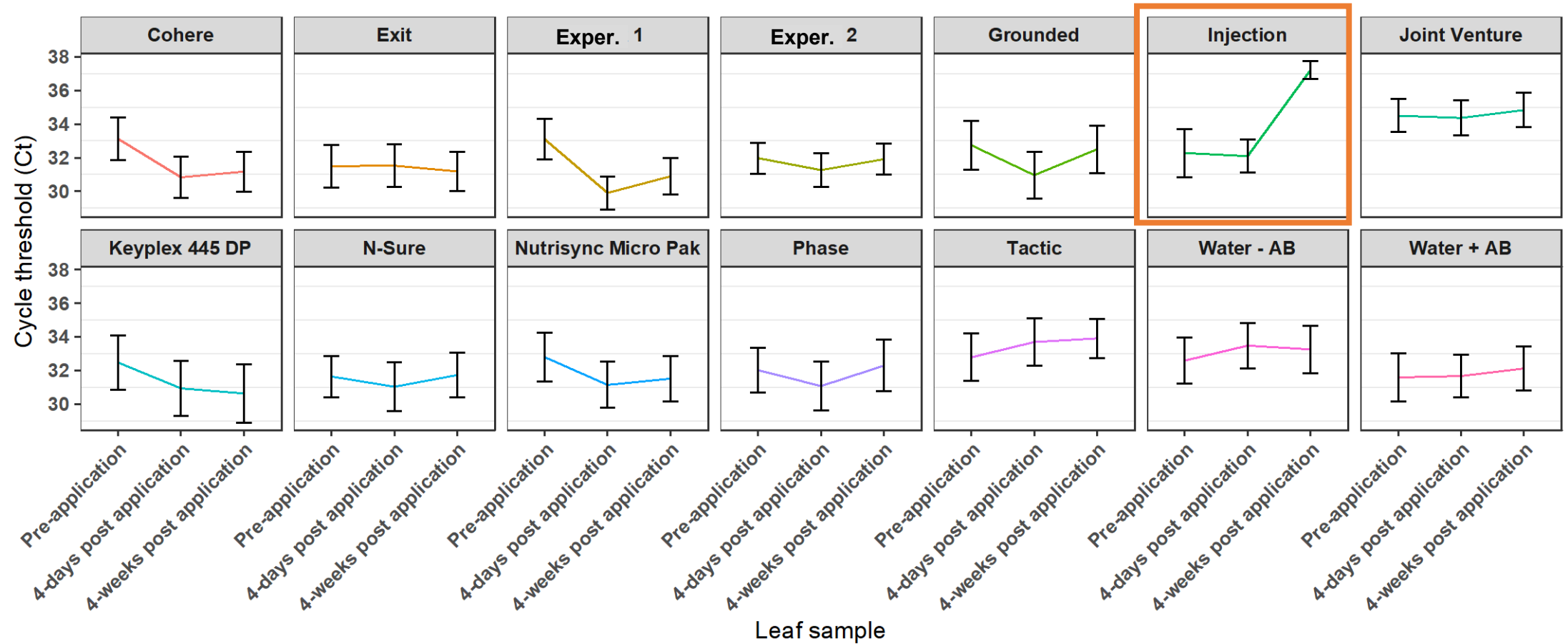




# Relative efficiency



# Impact on Clas

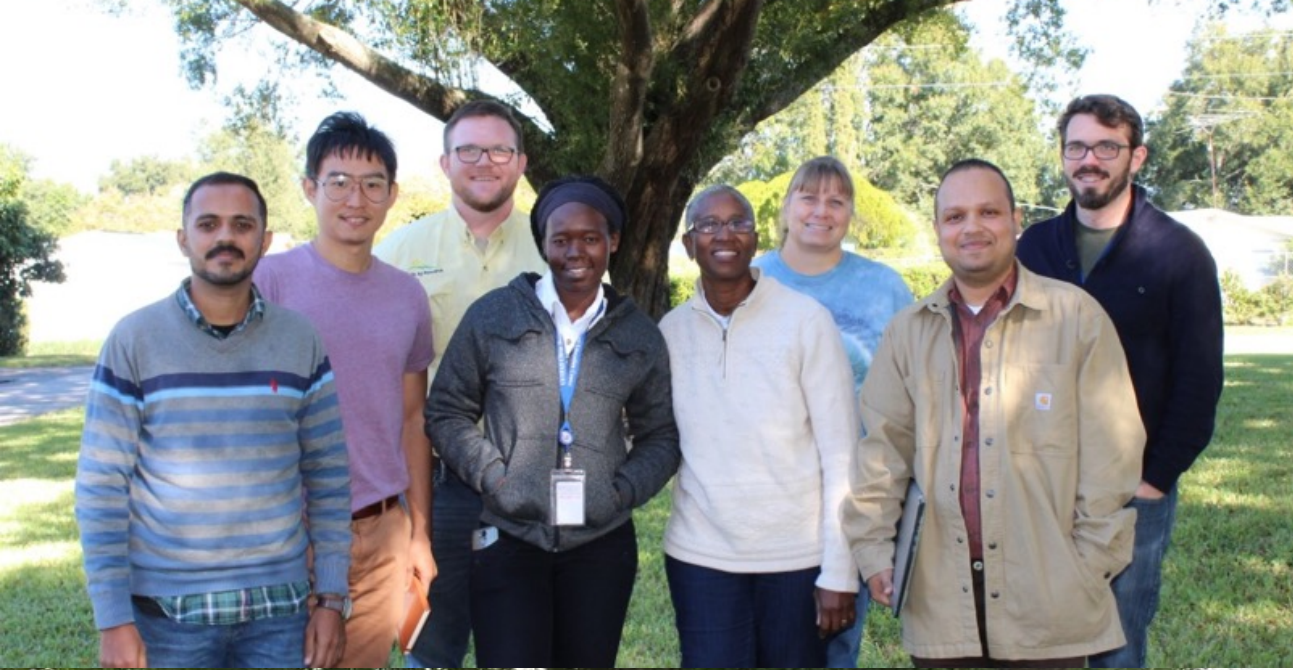




# Conclusions

- No foliar adjuvant increased delivery of oxytetracycline.
- The systemically moved proportion was 20% of the concentration of the concentration in leaves receiving direct application.
- The concentrations delivered were 5-12% of those delivered by injection.
- Only injection reduced CLas titer (increased Ct).





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## Questions?



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