

ACP research and management

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Psyllid infestation reduces tree health with and without HLB—the combo is lethal

HLB +; No ACP



HLB +; Pulsed (monthly) ACP



HLB +; Continuous ACP



HLB -; No ACP



HLB -; Pulsed (monthly) ACP

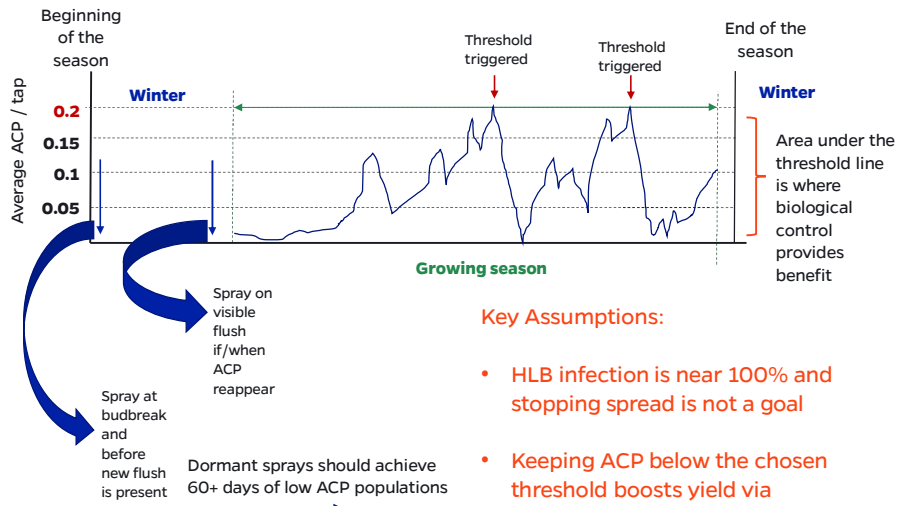


HLB -; Continuous ACP



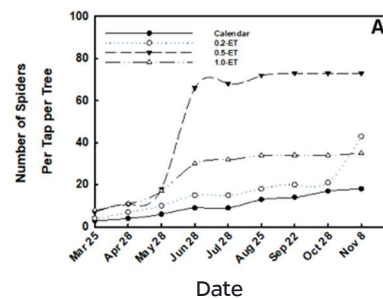
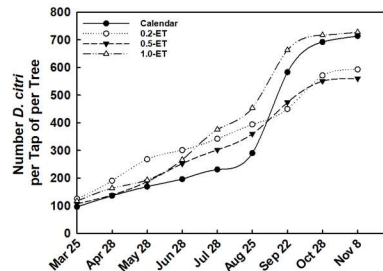
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Economic Injury Level of 0.2 ACP/ tap = average of 10 trees sampled



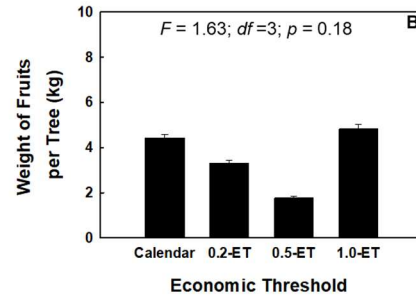
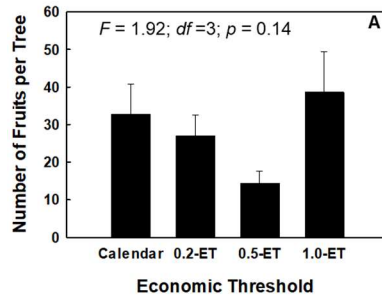
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Example: Threshold reduced spray frequency with no negative impact on psyllid counts



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Example: Threshold reduced spray frequency with no negative impact on yield



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OTC registered for trunk injection

Treatments

1. Remedium (11,000 ppm)
2. Rectify (11,000 ppm)
3. Fireline (70,000 ppm; Experimental)
4. Non-injected control

- 15 trees per TRT
- 60 trees total

FIFRA Section 24(c)
Special Local Need Label

ReMedium T⁺

For distribution and use only within Florida.

ReMedium T⁺ is a systemic injectable antimicrobial for the control or suppression of Huanglongbing (HLB, Citrus Greening) for Citrus Group 10-10.

OXYTETRACYCLINE GROUP	41	FUNGICIDE/BACTERICIDE
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Active Ingredient
Oxytetracycline Hydrochloride* 95.0%
Other Ingredients 5.0%
Total 100.00%
*Equivalent to 87.9% Oxytetracycline

KEEP OUT OF REACH OF CHILDREN
CAUTION
See inside booklet for Additional Precautionary Statements, Directions for Use and Restrictions.
Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle.
(If you do not understand the label, find someone to explain it to you in detail.)

FIFRA Section 24 (c)
Special Local Need Label

RECTIFY™

Fungicide/Bactericide Agricultural Oxytetracycline

OXYTETRACYCLINE GROUP	41	FUNGICIDE
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For distribution and use only within Florida.
This labeling must be in the possession of the user at the time of the pesticide application.

Rectify™ is a systemic injectable bactericide for the control of Citrus Greening (HLB) or suppression of Huanglongbing (HLB, Citrus Greening) for Citrus Group 10-10.

Active Ingredient:		
Oxytetracycline Hydrochloride	95.0%
Other Ingredients	5.0%
TOTAL	100.00%
*Equivalent to 88% oxytetracycline		

KEEP OUT OF REACH OF CHILDREN
CAUTION
See inside booklet for Additional Precautionary Statements, Directions for Use and Restrictions.
Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle.
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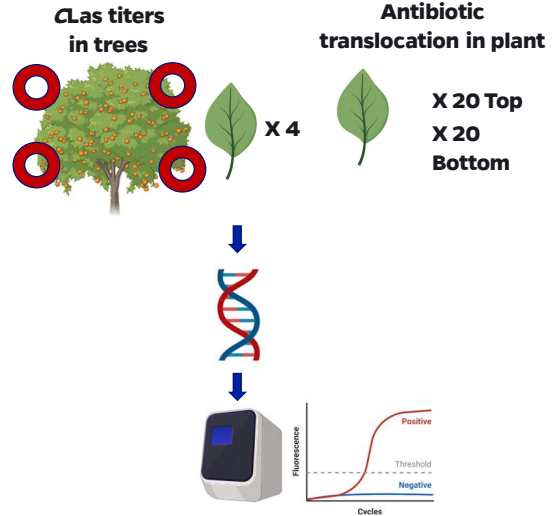


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Assessment of CLas infection in citrus trees

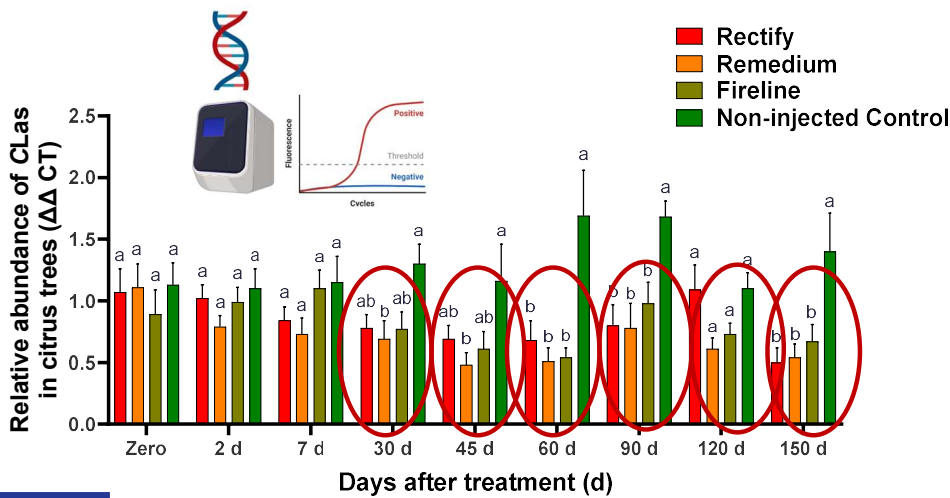
Leaf samples at collected over time:

- Pre-treatment
- 2 days after the injection
- 7 DAI
- 30 DAI
- 45 DAI
- 60 DAI
- 90 DAI
- 120 DAI
- 150 DAI



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Available OTC formulations reduced CLas abundance in trees

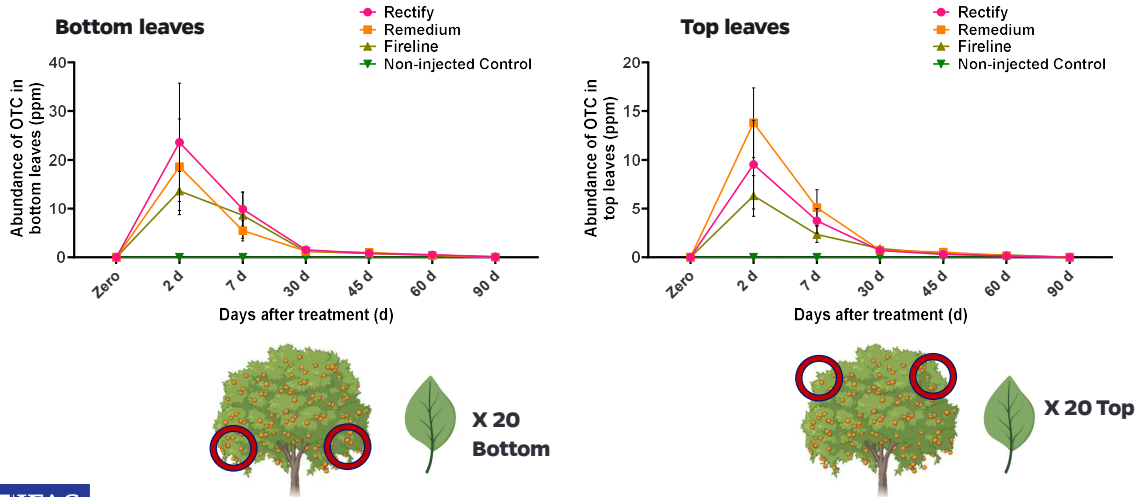


One year after OTC injection



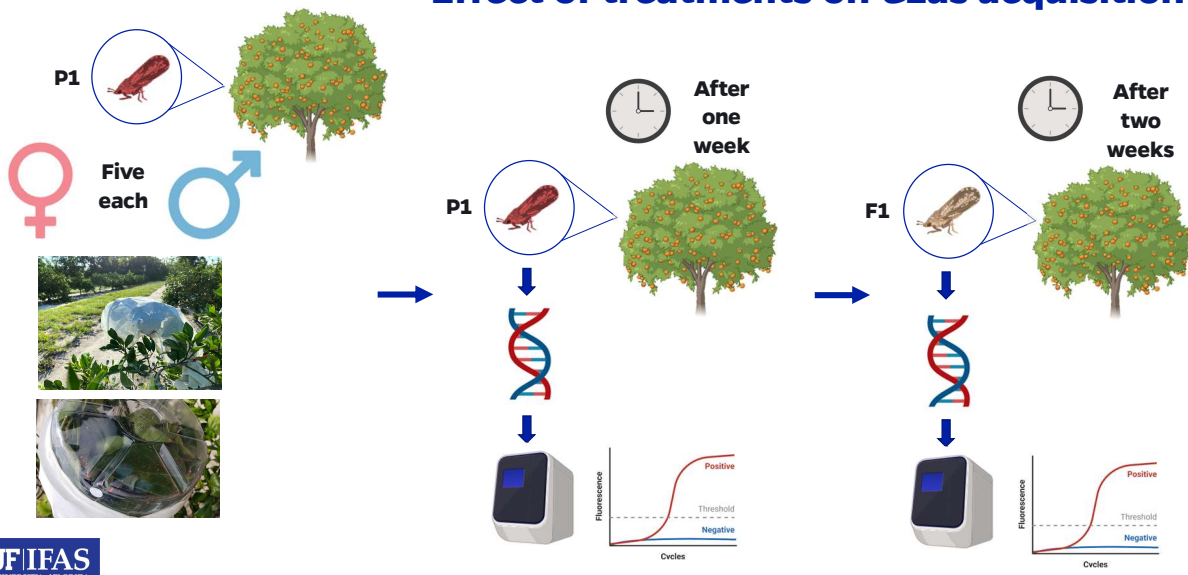
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OTC translocation in the tree



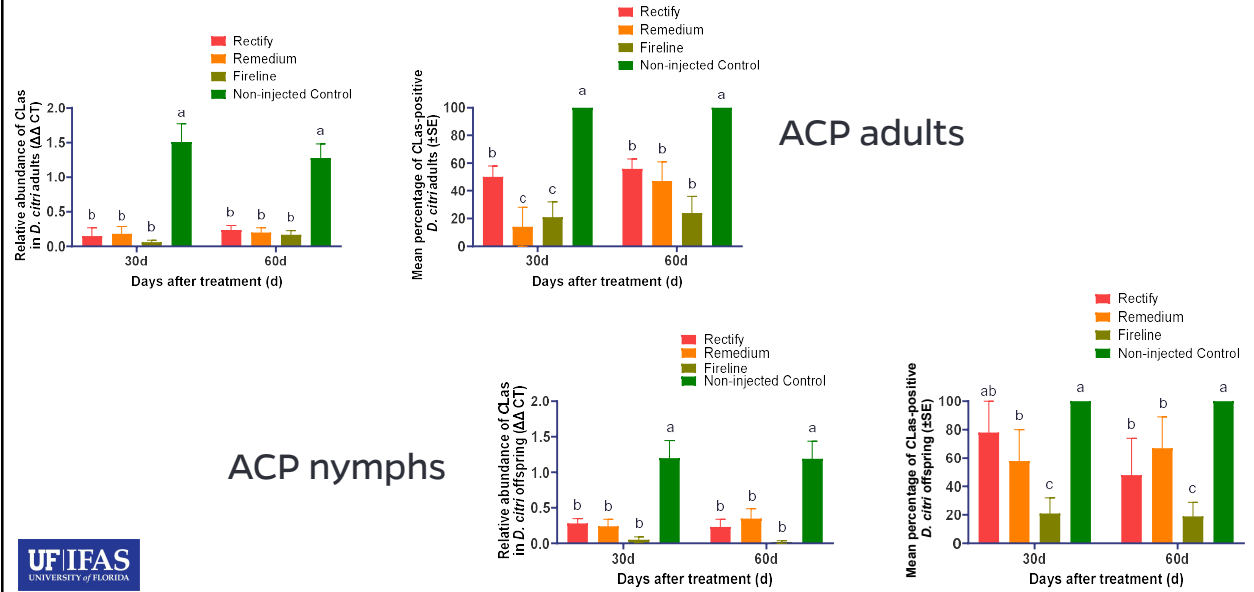
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Effect of treatments on CLas acquisition



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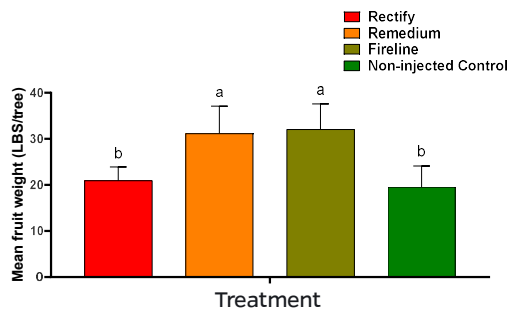
CLAs acquisition by psyllids is reduced



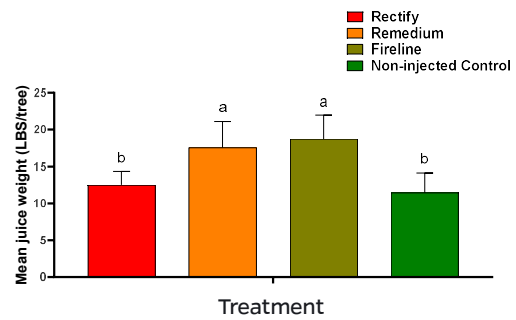
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Yield data after year 1 suggest possible improvement

Mean fruit weight per tree



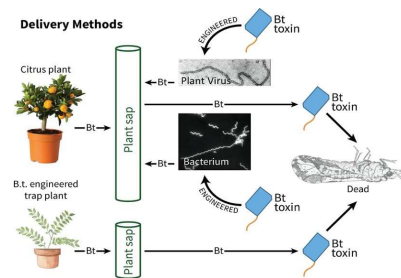
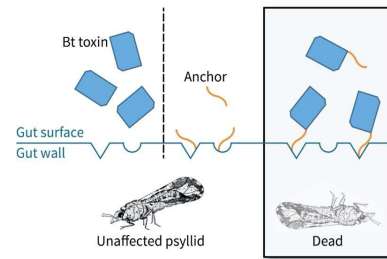
Mean juice weight per tree



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Novel mechanisms for reducing pathogen transmission are needed

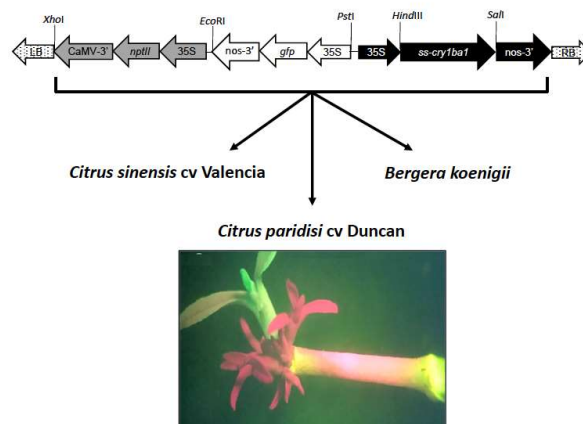
- Bt identified in 1901 from dead silkworm larvae
- Bt is a naturally occurring insecticidal toxin produced by a soil borne bacterium
- Bt was first manufactured commercially in 1958 and EPA-approved as a bio-insecticide in 1961.
- Commonly used in sprays for organic agriculture and for mosquitoes



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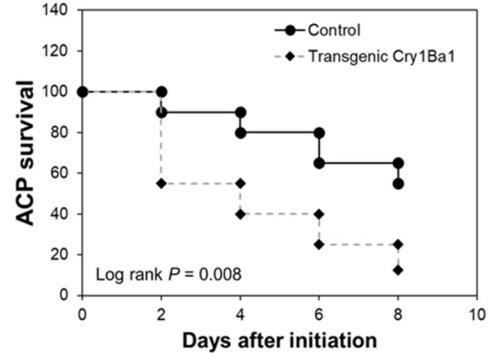
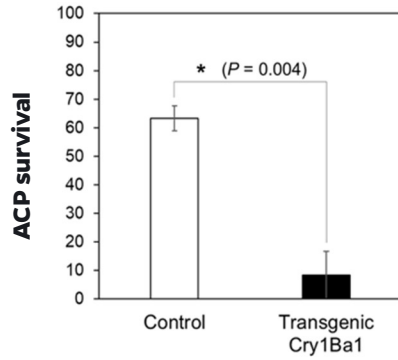
Schematic of T-DNA used for transformation:

- An explant with a transgenic shoot of *C. paridisi* cv Duncan with green fluorescence is shown alongside red, non-transgenic shoots.
- CaMV 35S promoter was used for constitutive transcription of *cry1ba1*.



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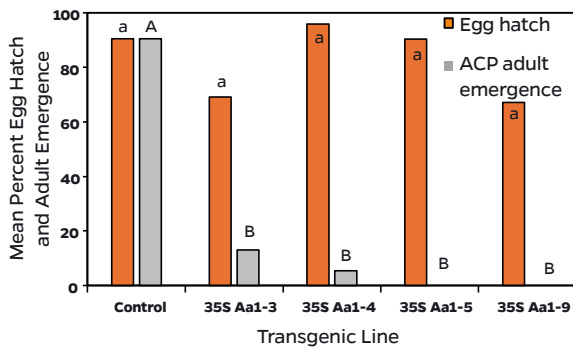
ACP survival reduced on transgenic plants expressing Cry1Ba1



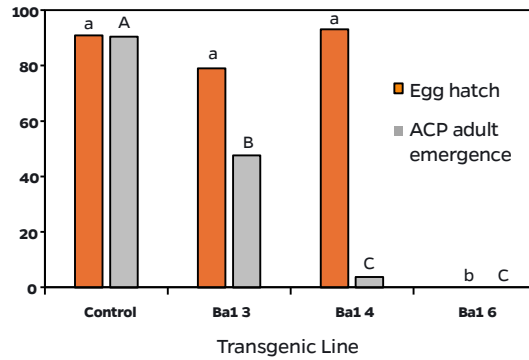
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Mean % egg hatch and emergence of F1 adults on transformed Valencia

A. Mpp51Aa1 expression driven by 35s



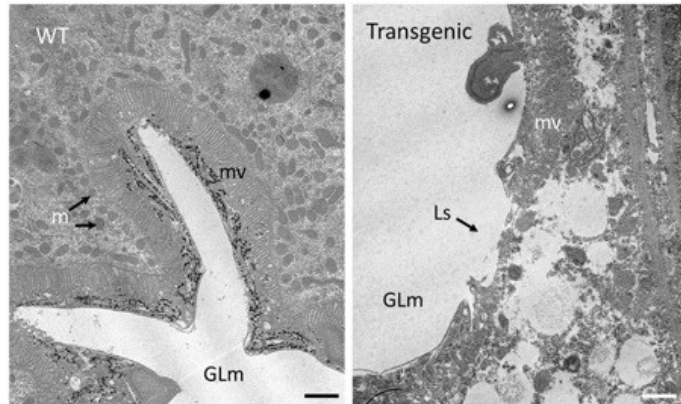
B. Cry1Ba1 expression driven by 35s



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Bt causes holes in ACP gut

TEM of Cry1Ba1-mediated damage to gut epithelial tissues of Asian citrus psyllid.



Ravanfar et al. 2022. Genetic modification of *Bergera koenigii* for expression of the bacterial pesticidal protein Cry1Ba1. *Frontiers in Plant Science*. 13: 899624.



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Managing psyllids while reducing cost

- Psyllid density is related to tree stress—more psyllids--> higher damage, which compromises tree health (yield)
- Spray for adults at bud break at the beginning of first flush before there is feather flush on which adults can lay eggs.
- If the pest population (and the resulting damage) is sufficiently low, it might not pay to take control measures
- As the pest population continues to rise, it reaches a point where the resulting damage (=reduced immune response) would justify taking control measures
- 0.2 – 1.0 psyllids per tap seems like an effective ballpark.



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Antibiotics reduce CLas titer in trees and acquisition by vectors

- ReMedium TI and RECTIFY caused comparable reductions in pathogen titer and transmission.
- We did not see statistical differences between response of Valencia and Hamlin to OTC injection.
- Acquisition of CLas by ACP was lower on OTC treated trees.
- In year 1, we only saw statistical increase in fruit yield in response to single annual application of OTC in one controlled experiment, but no increase in two others.
- Year 2 data will be critical to evaluate possible yield benefits.

