Methods to measure soil health in Florida citrus

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Take home messages

- Cover crops and compost can improve soil health
- Humic acids had little impact on soil health
- Specific soil health indicators are correlated with citrus production
- Be patient: improving soil health in Florida citrus takes time

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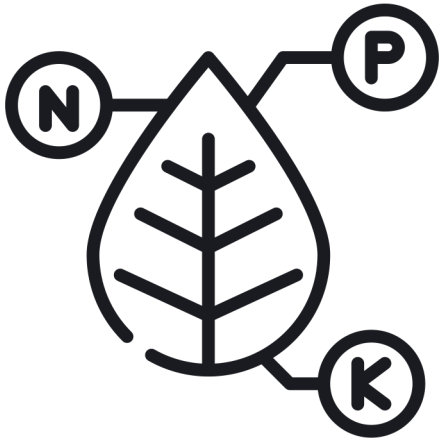
Thank you to Dr. Yaslin (Yaz) Gonzales for the data and slides

Soil health

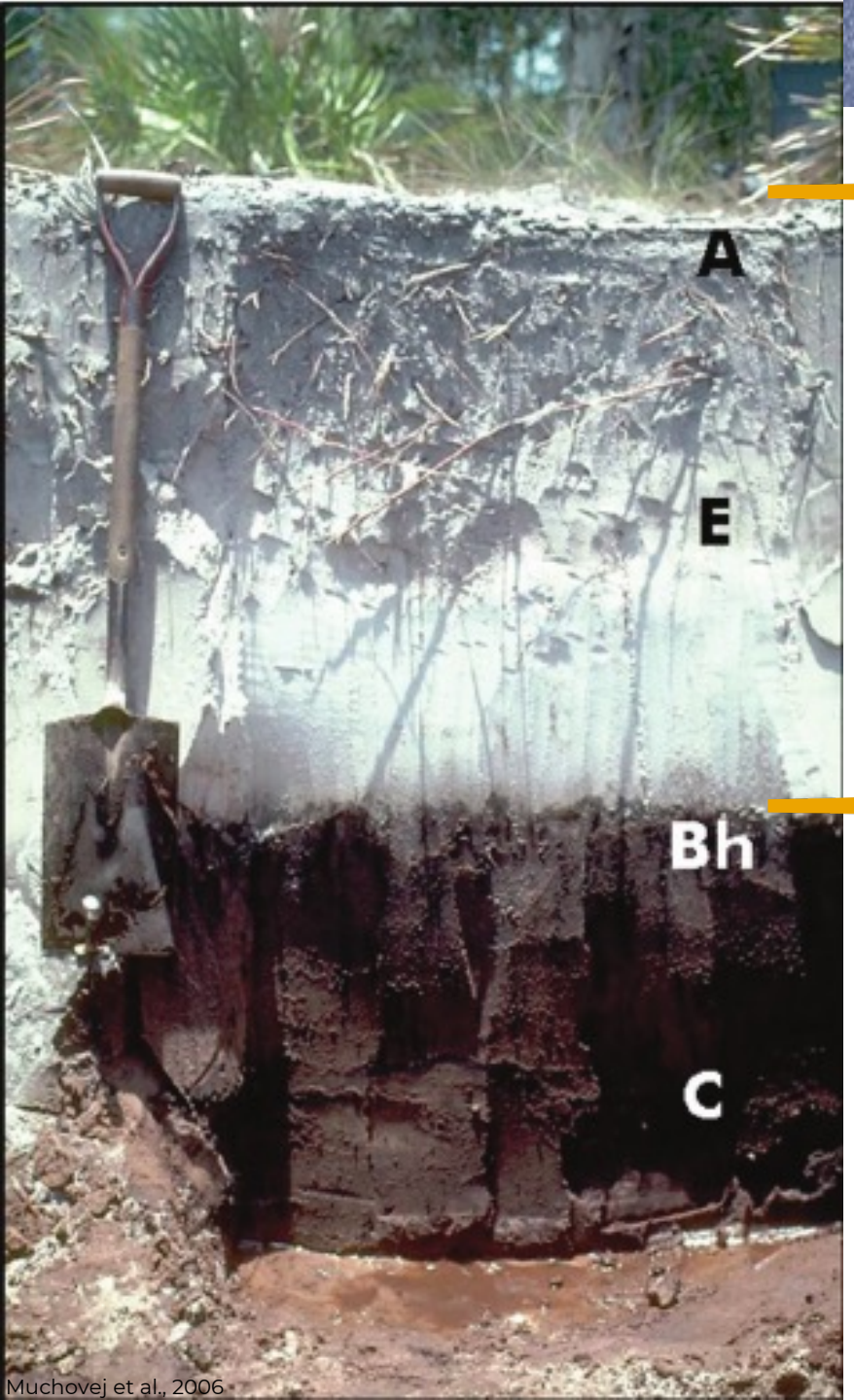
Resilience



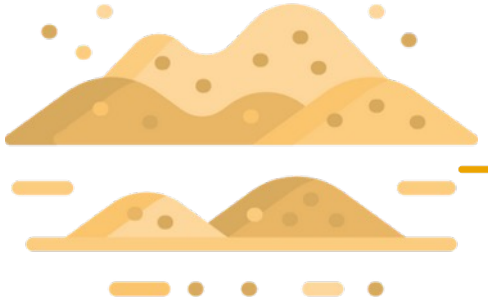
Nutrient availability

Climatic extremes

Pests and diseases



Muchovej et al., 2006



98% Sand

Nutrient deficient

Low organic matter

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Practices to improve soil health

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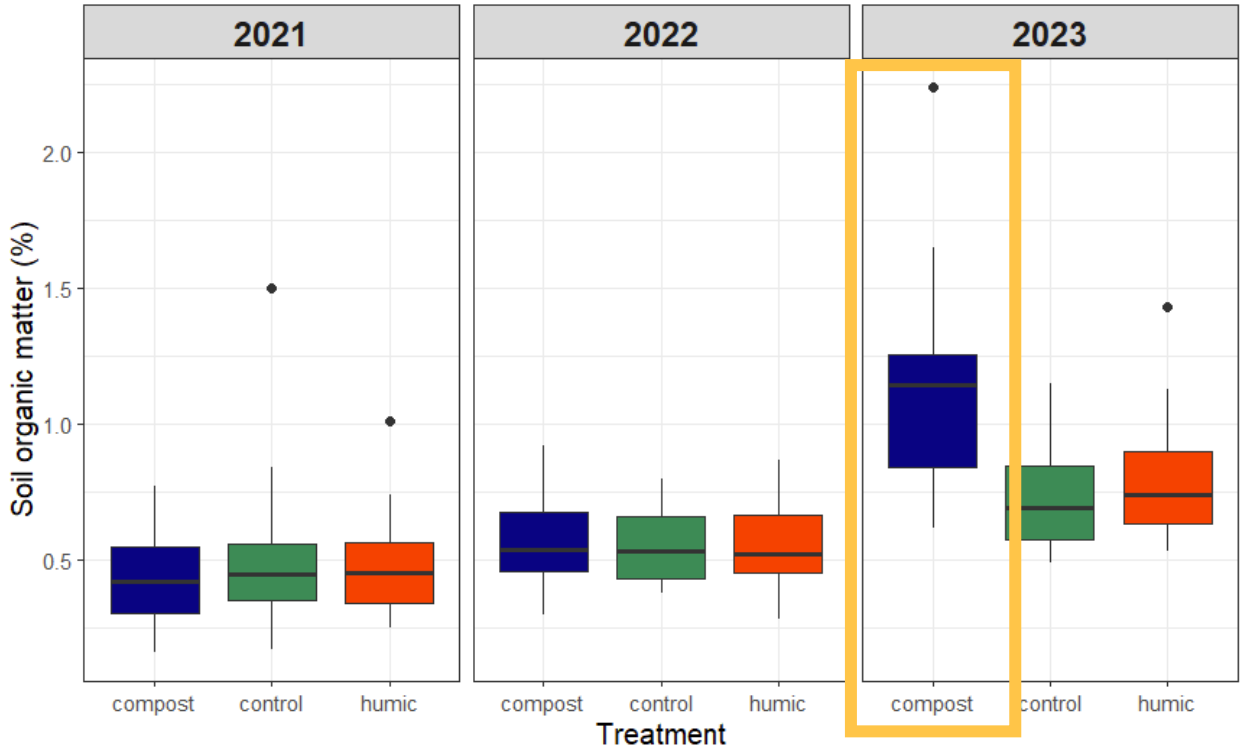
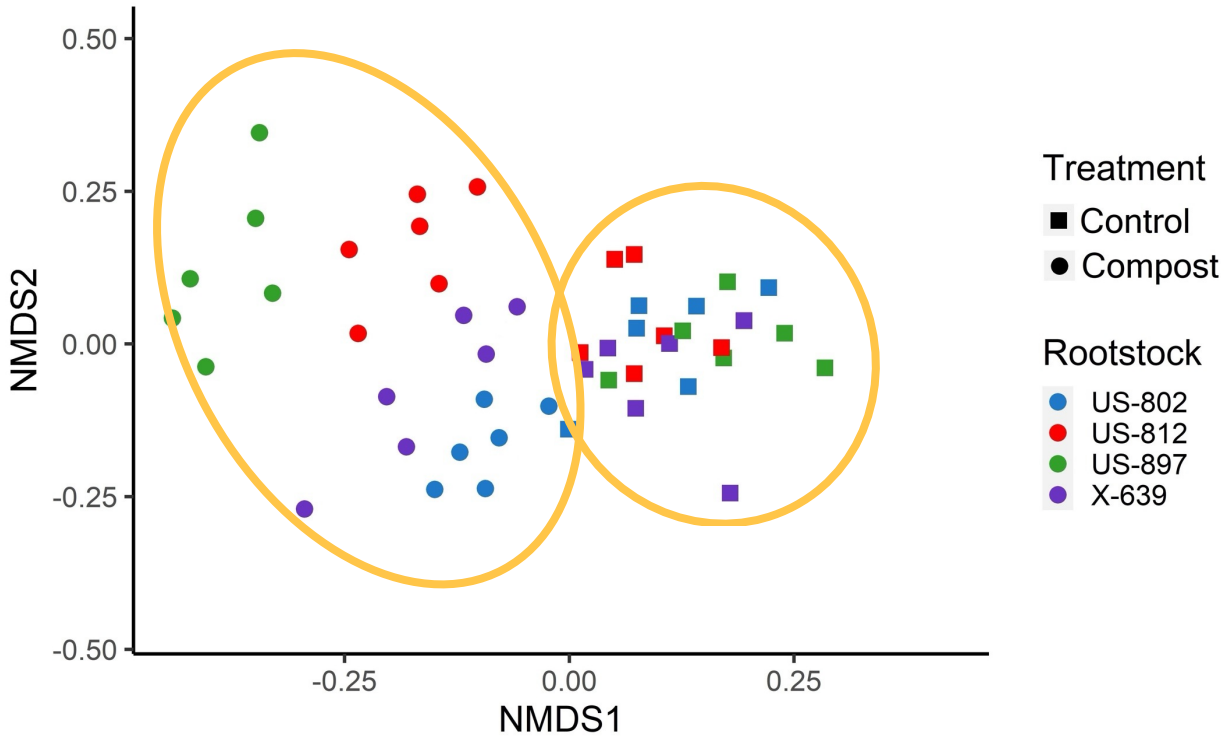
Compost increases SOM and changes soil microbes

Soil organic matter (SOM)



Active soil microbes



- Plant-based compost broadcast under the canopy at 12.3 tons/ha twice/year

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Thank you to Dr. Emma Dawson and Dr. Antonio Castellano-Hinojosa for the data

Practices to improve soil health

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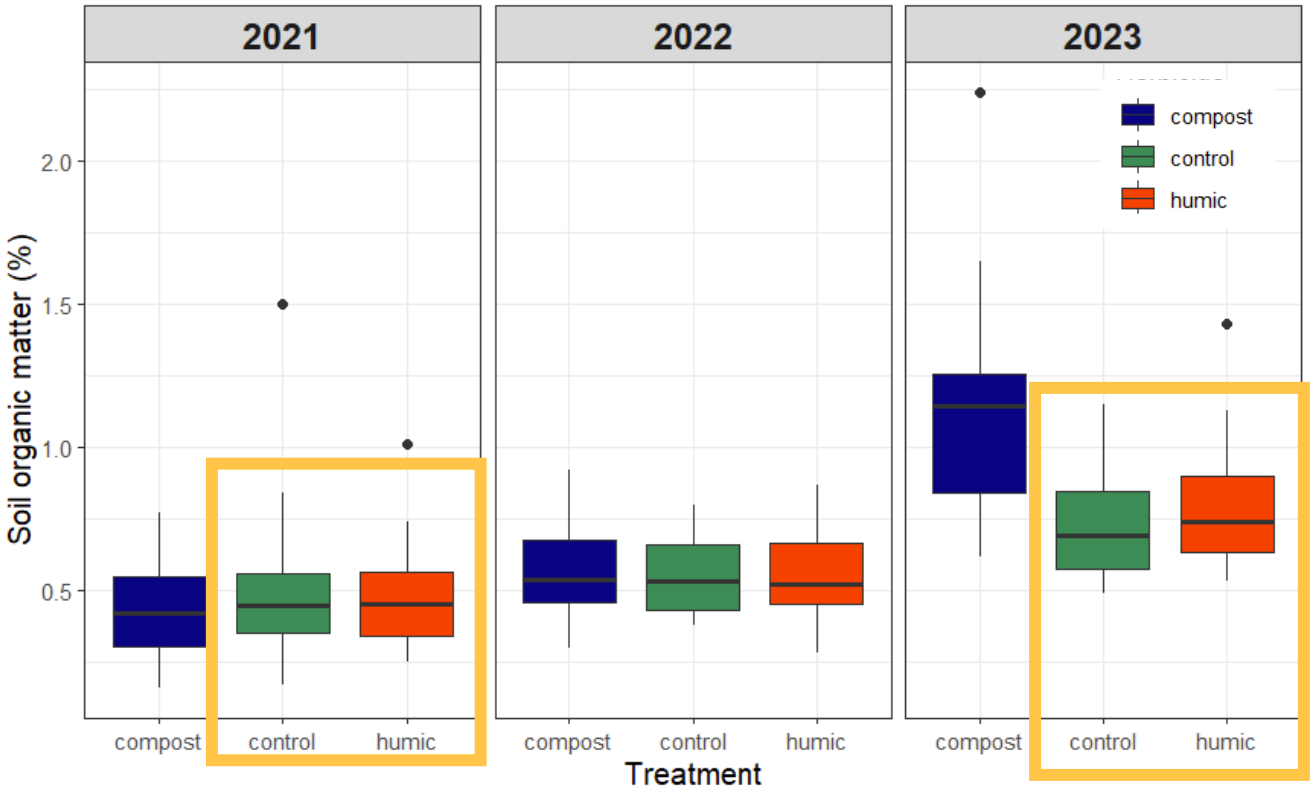
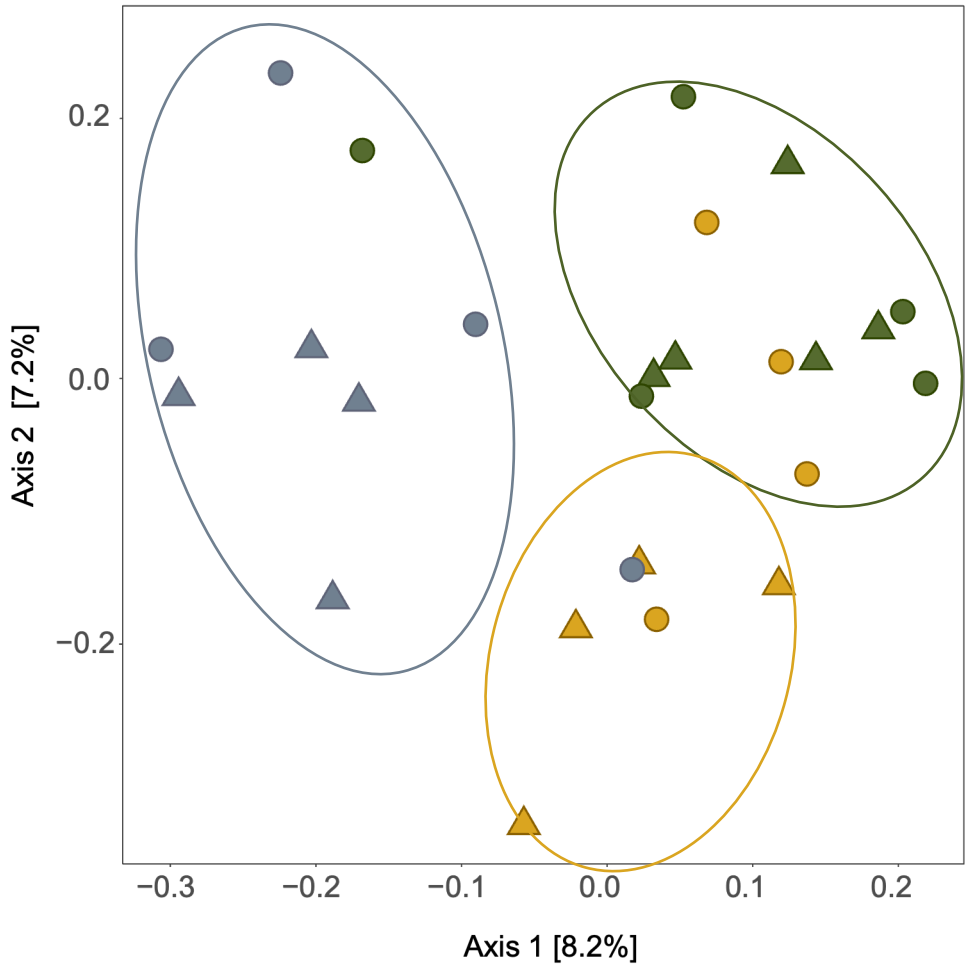
Humic acids had no impact on soil C or microbes





- Granular humic acid applied at 675 lbs/acre twice/year

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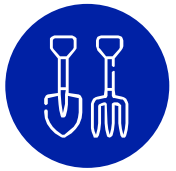
Thank you to Dr. Emma Dawson for the data

How do we measure soil health?

Chemical indicators:

- POXC
- C mineralization
- N mineralization
- ACE protein content
- Extractable P
- CEC
- pH
- Inorganic N (nitrate and ammonium)
- Total C
- Total N
- SOM

Physical indicators:

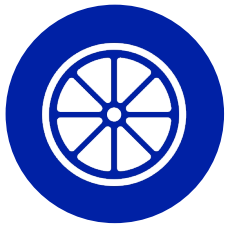


- Aggregate characterization
- Water content
- Infiltration
- Bulk density

Microbial indicators:

- Enzyme activities (C, N, and P cycling enzymes)
- Abundance of N and P cycling genes
- Plant growth promoting bacteria abundances and activity

Cover crop and production data:



- Cover crop C and N inputs
- Tree yield
- Leaf N concentration
- Tree growth

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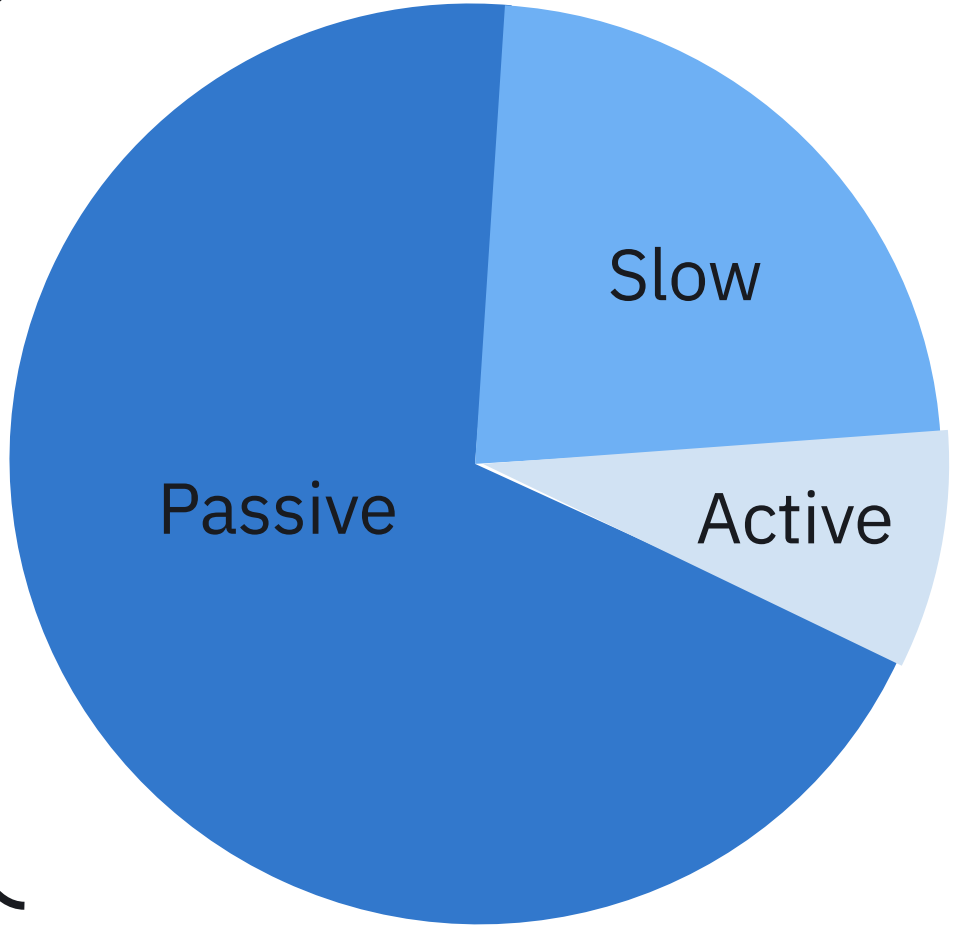
Soil functions: carbon and nitrogen cycling

TOTAL
Soil organic matter (SOM)



Permanganate oxidizable carbon (**POXC**)

Carbon mineralization (**Cmin**)

Autoclaved citrate extractable (ACE) **protein**

Potentially mineralizable nitrogen (**PMN**)

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Practices to improve soil health

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Old Grove

Young Grove

Experimental Design

3 treatments x 5 replicates x 2 sites

Treatments:

GC: Grower Standard/Control

NL: Non-legume mix

LG: NL + legumes

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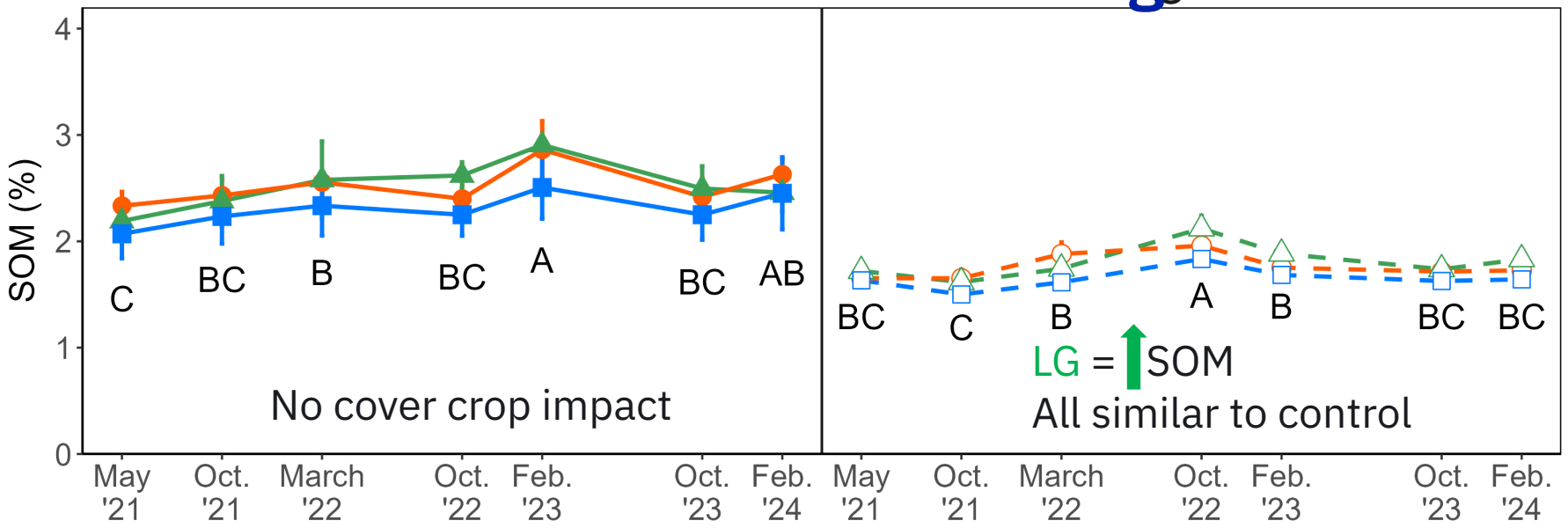
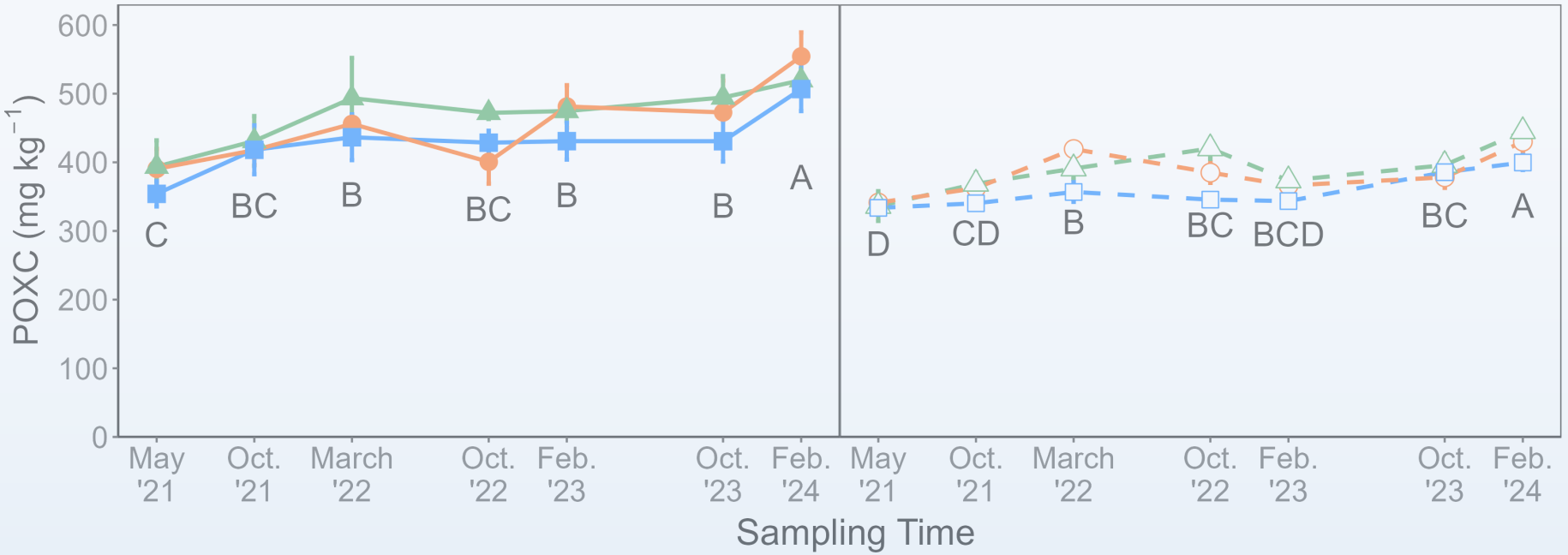
Carbon Cycling

Old Grove

Young Grove





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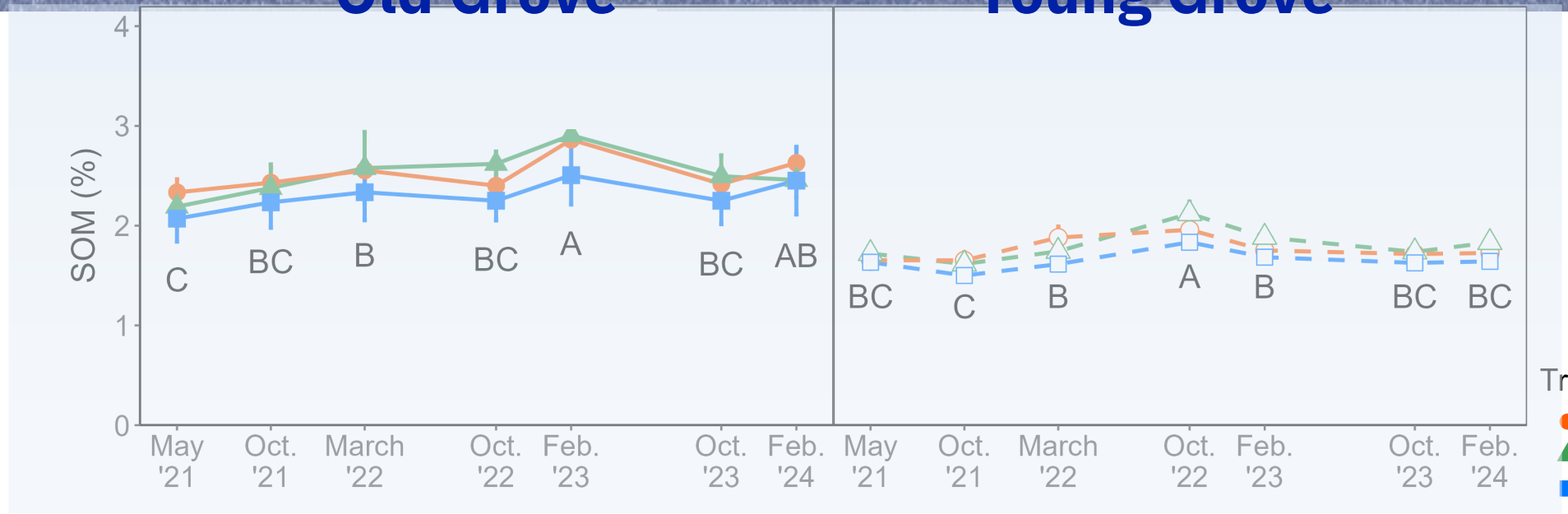
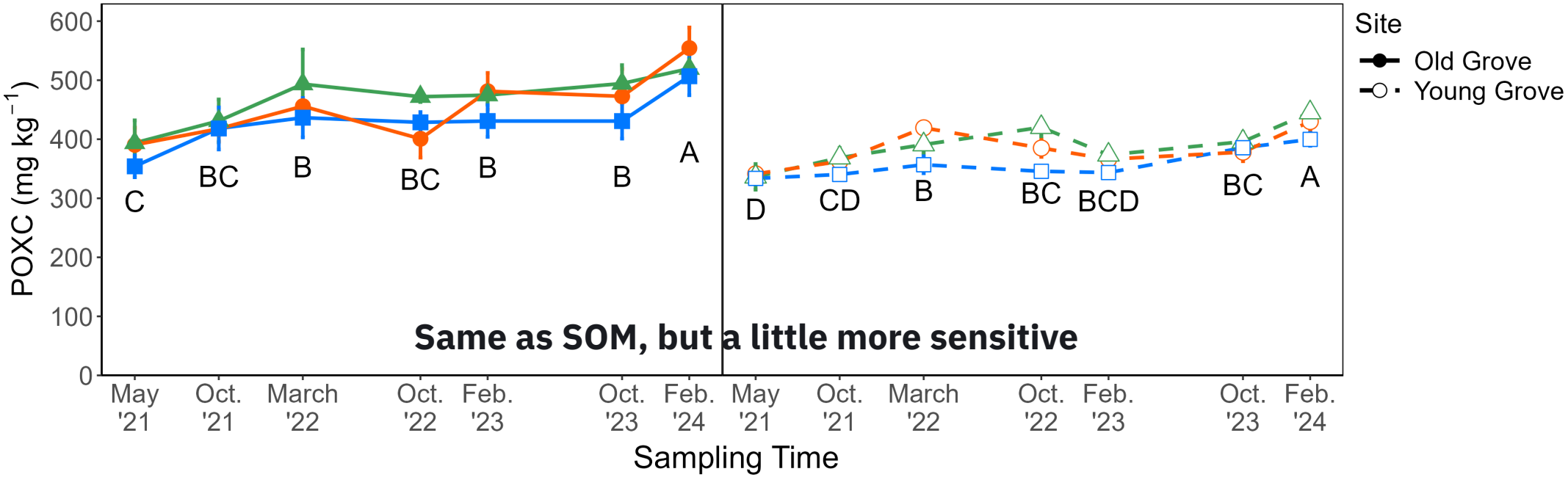
Carbon Cycling

Old Grove

Young Grove





Same as SOM, but a little more sensitive

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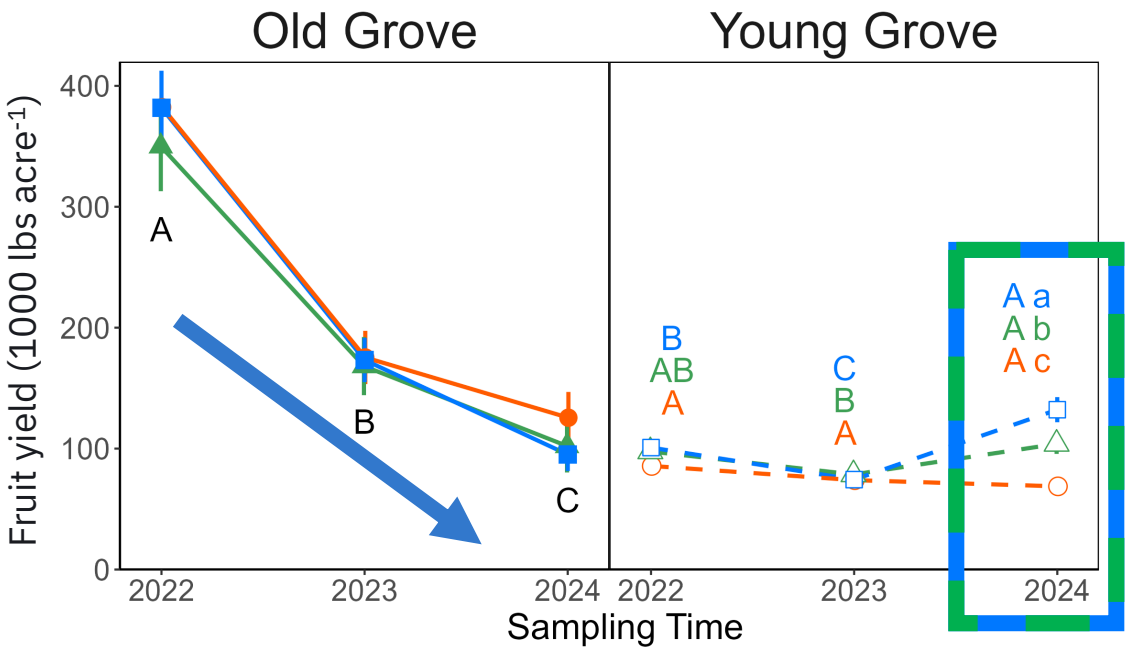
Citrus Production



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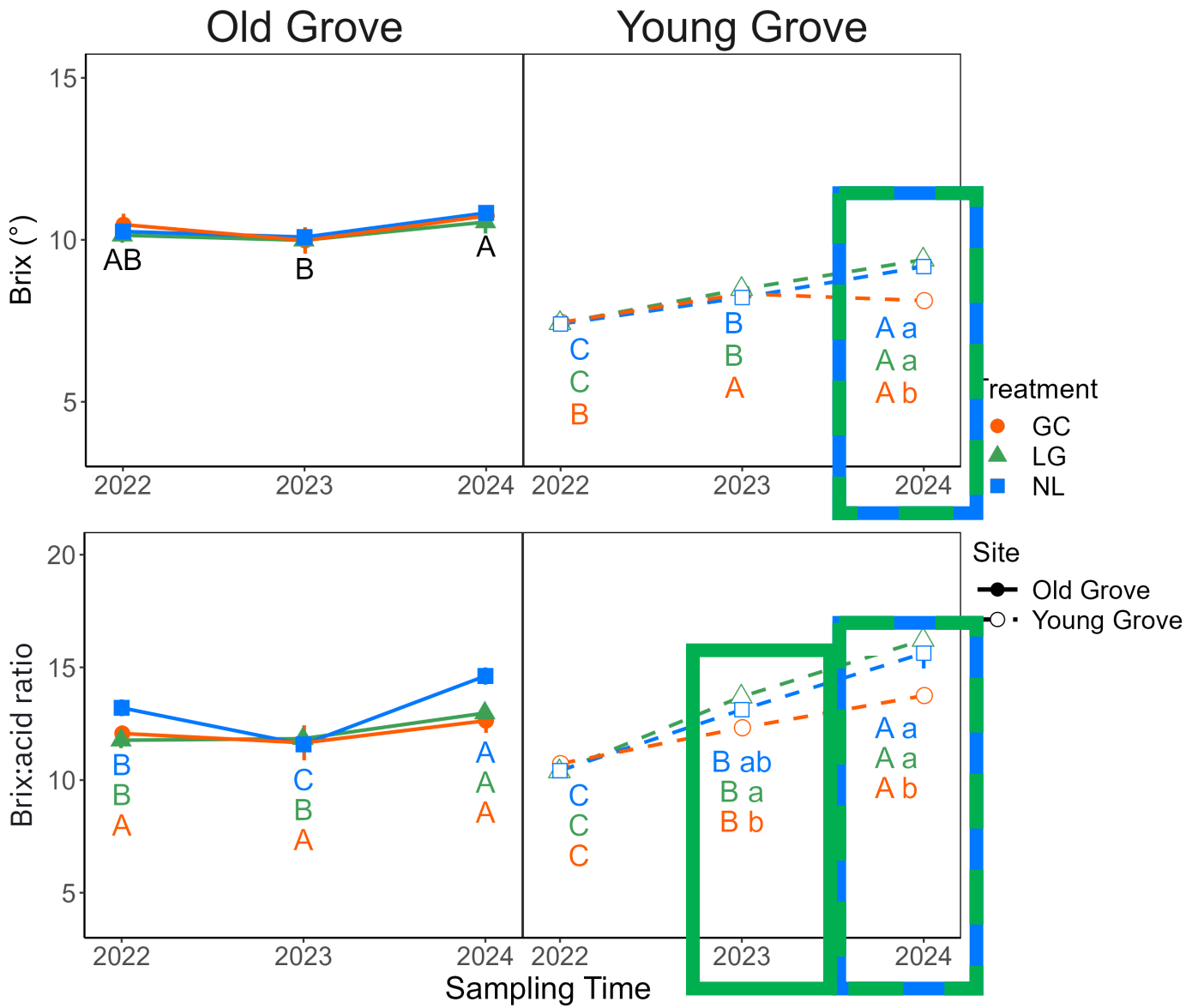
Citrus Production



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Correlations with Citrus Production

SOIL FERTILITY

SOIL HEALTH INDICATORS

LEAF NUTRIENTS

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Soil health correlations with production

RESPONSE VARIABLES

Fruit Yield, Brix,
Acid, Brix:acid, Color

EXPLANATORY VARIABLES

Soil health (n=5)
Soil fertility (n=10)
Leaf nutrients (n=10)

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Soil health correlations with production

SOIL HEALTH INDICATORS

~~Resin P~~

~~PMN~~

Protein

Cmin

POXC

SOIL FERTILITY INDICATORS

~~Ammonium, Nitrate, soil pH, and Mehlich III nutrients (K, Ca, P, Mn, Cu, Zn, Fe~~)

LEAF NUTRIENTS

~~P, S, Mn, Fe,~~

Ca, B, Mg, K, Zn, Cu

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Correlations with Citrus Production

Cmin

Protein

POXC

Leaf nutrients

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Conclusion

- Cover crops and compost can improve soil health
- Humic acids had little impact on soil health
- Soil protein, Cmin, and POXC are correlated with citrus production
- **Be patient**: improving soil health in Florida citrus takes time

THANK YOU

Collaborators

Dr. Gabriel Maltais-Landry
Dr. Danielle Treadwell
Dr. Yaslin Gonzalez
Kendall Mackin

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