Progress Report

Characterizing abiotic and biotic tree stress using hyperspectral information

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Reflectance spectroscopy can capture tree stress responses

- **Rapid and accurate** observation of forest traits is necessary for effective monitoring of forest health

- **Leaf spectral reflectance** has been used to investigate functional traits and to detect **diverse forest issues at different spatial scales**

Rapid ‘Ohi’a Death, Hawaii (Greg Asner)

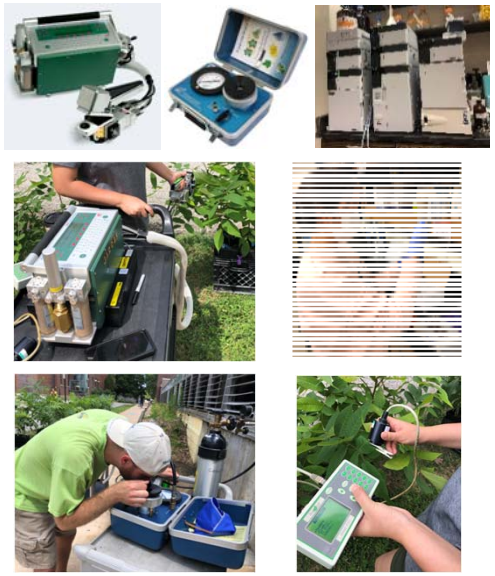
Research question

Can spectrally predicted leaf traits be used to discriminate stressed from non-stressed trees as effectively as observed leaf traits?

Abiotic and biotic stress

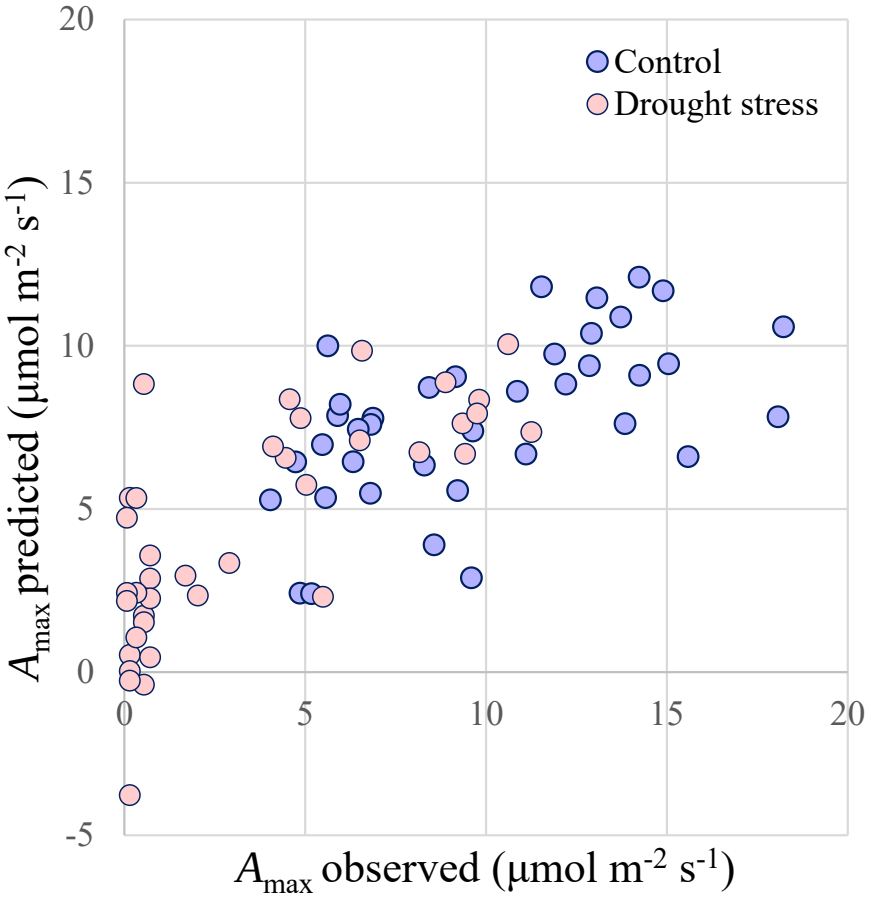
Fungal infection + Soil quality	Nitrogen deficiency + Drought
Fungal infection + Drought	Nitrogen deficiency + Salt deposition

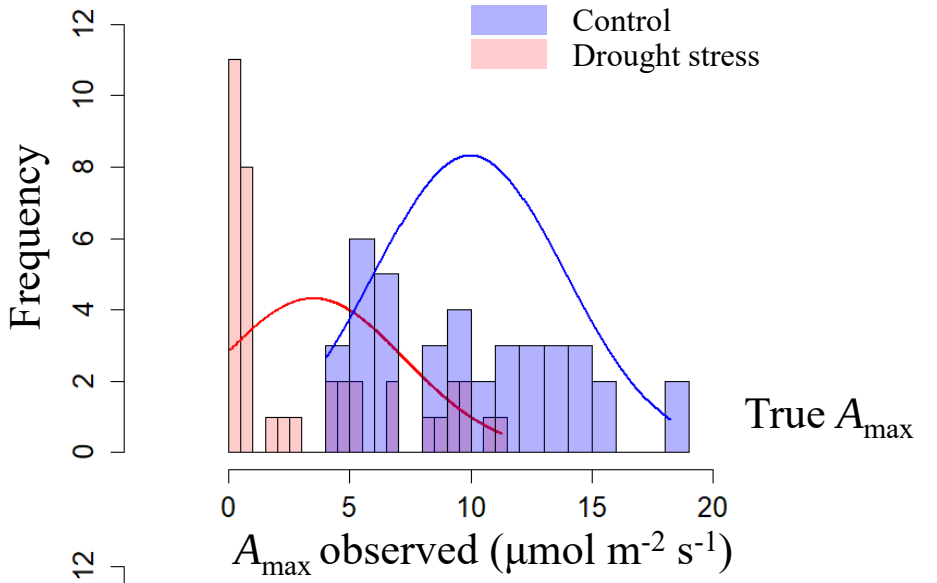
Reference data	Spectral data
Leaf functional traits Gas-exchange Water Biochemical	Leaf reflectance spectra (400−2400 nm) Spectroradiometer (SVC HR-1024i)

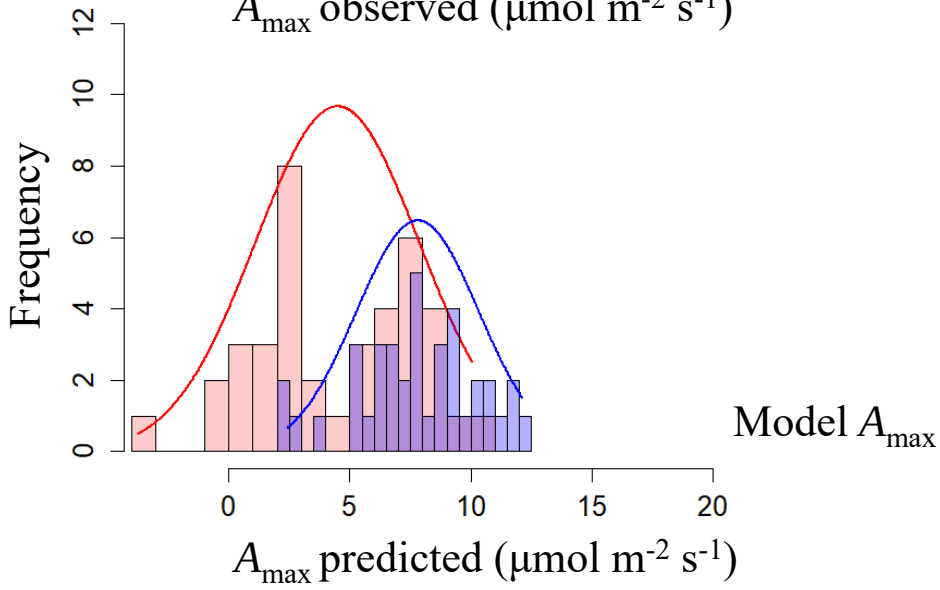


Observed vs predicted trait responses to drought

Ex 1) CO_2 assimilation rate, A_{max}

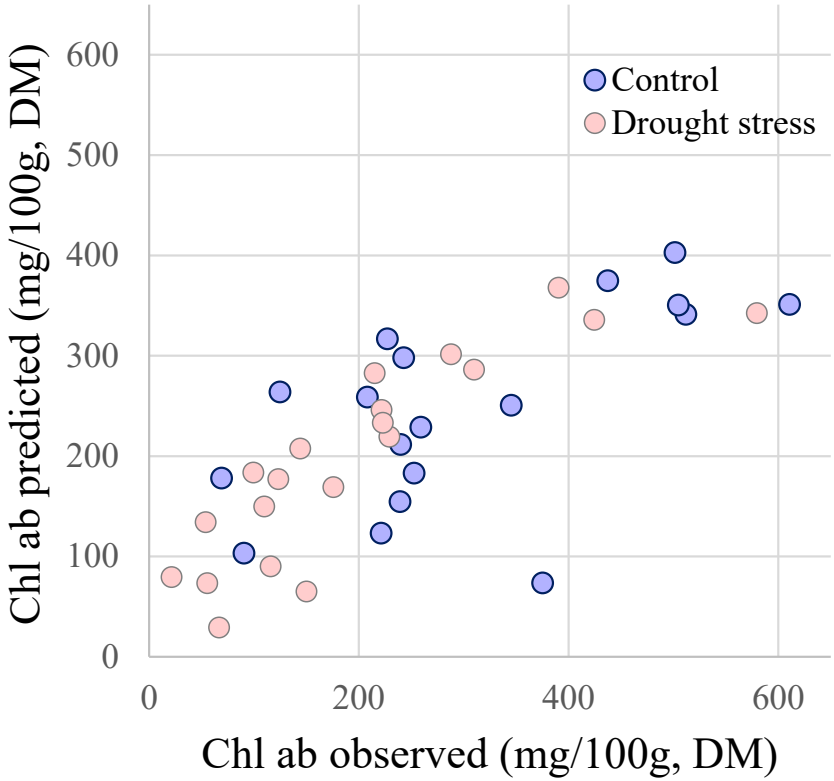


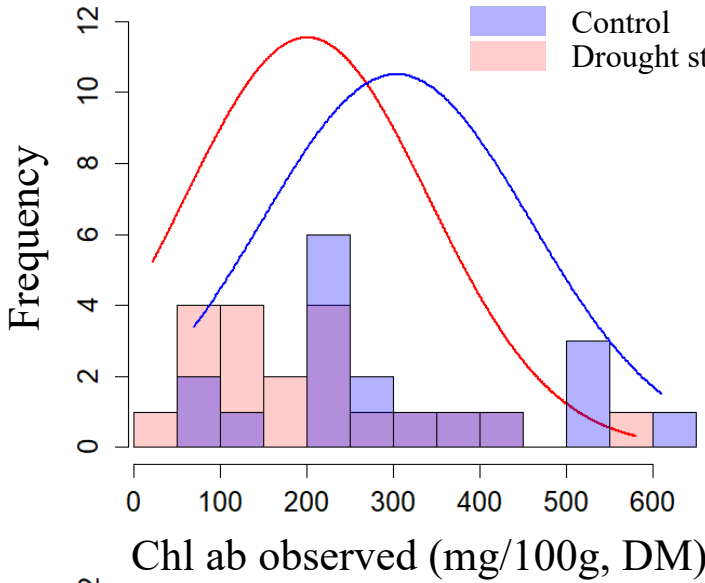


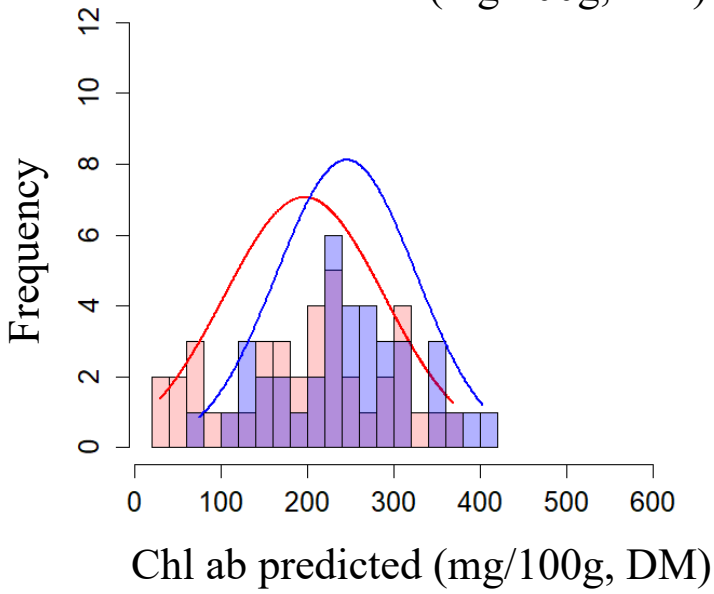


Observed vs predicted trait responses to drought

Ex 2) Chlorophyll a and b, Chl ab

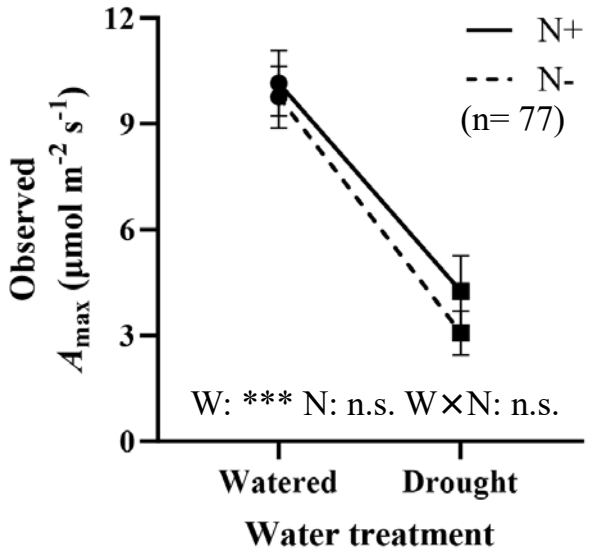


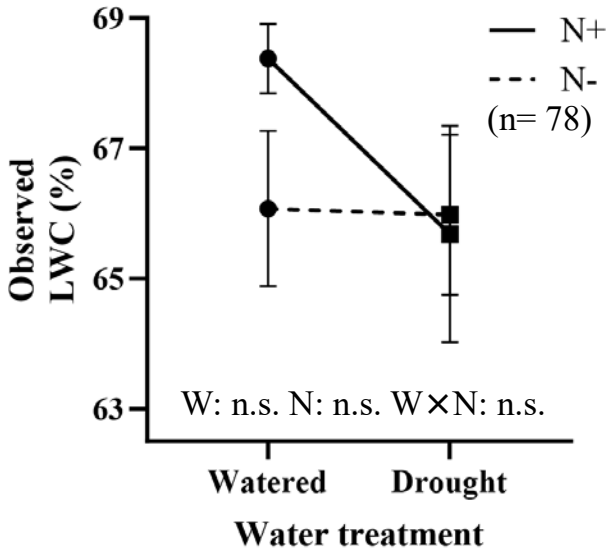


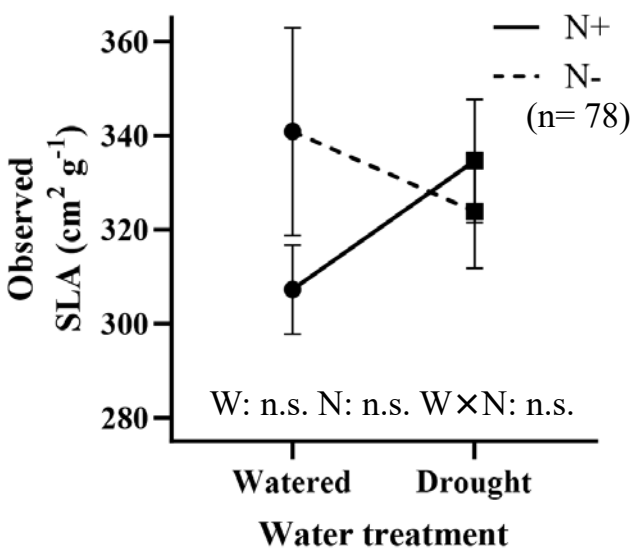


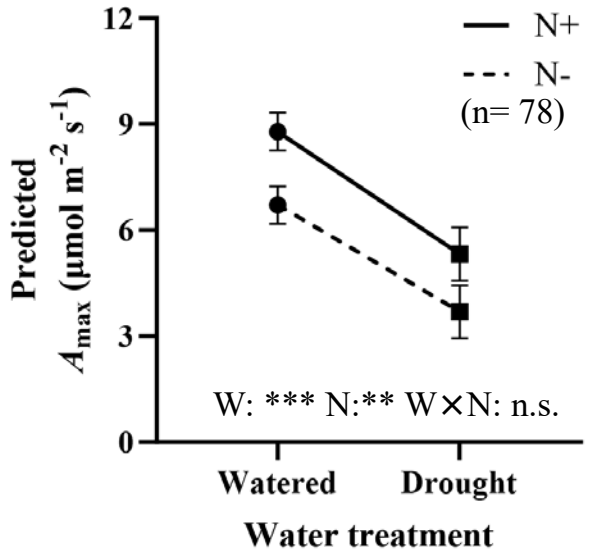
Trait responses to drought and nitrogen deficiency

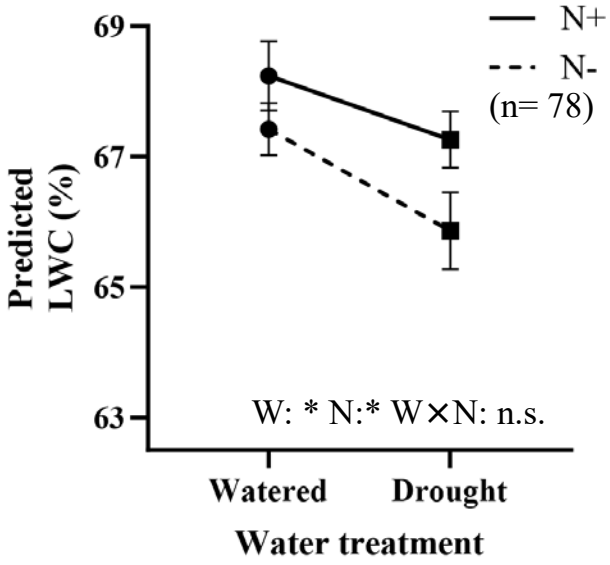
*** $p < 0.001$; ** < 0.01; * < 0.05; . < 0.1; n.s not significant

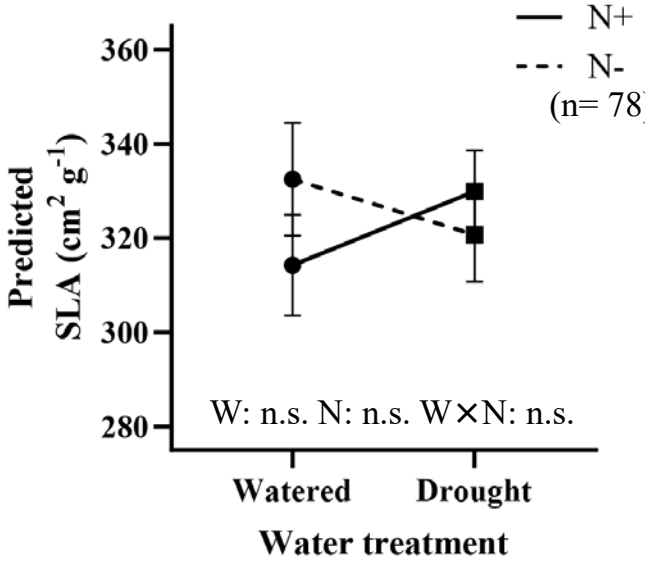












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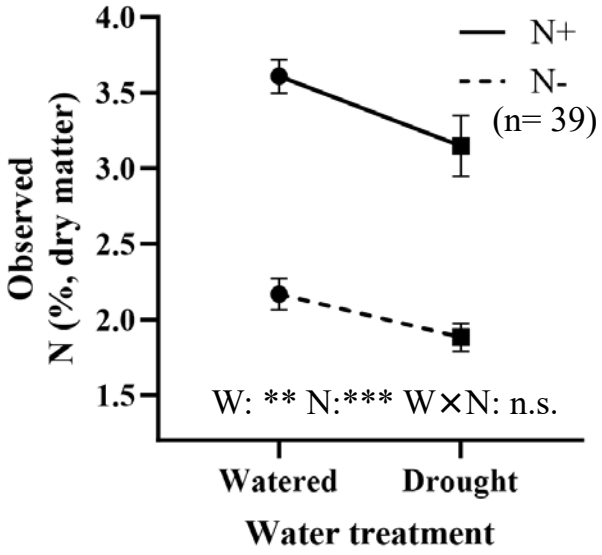

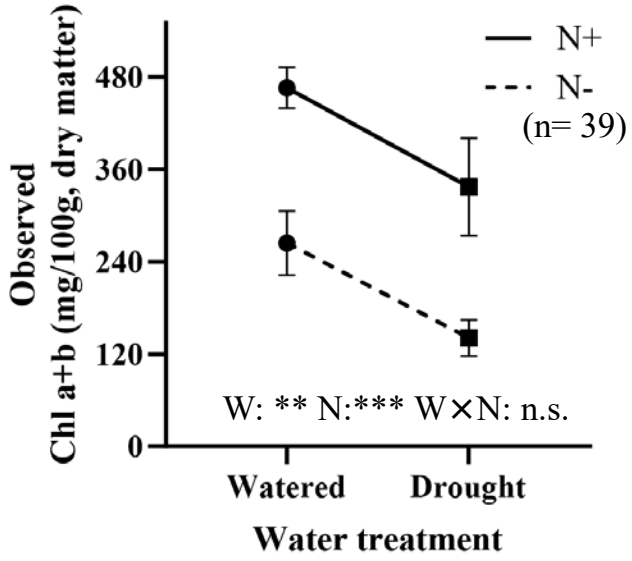

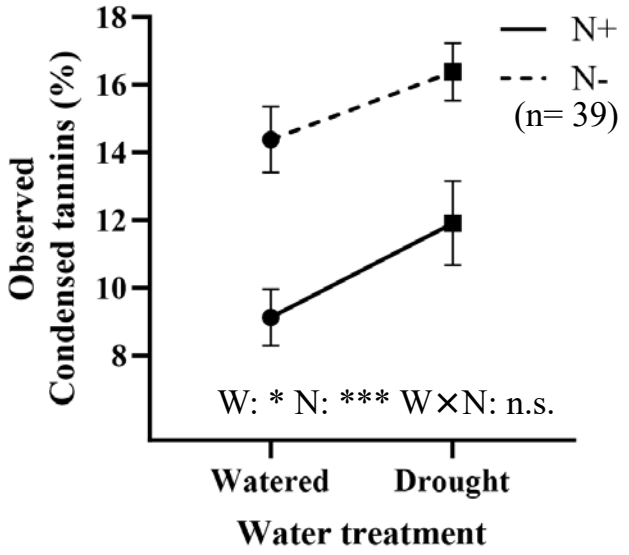

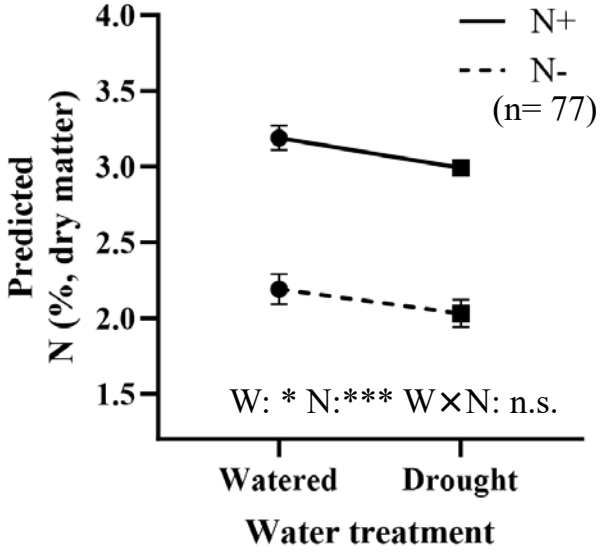

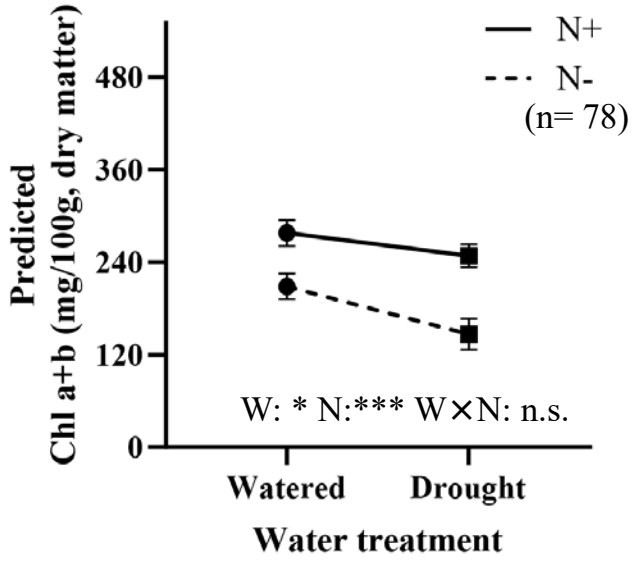

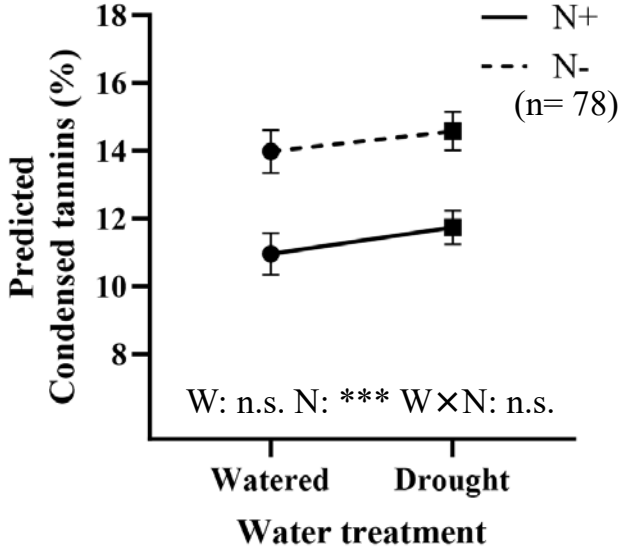

Leaf functional traits predicted from spectral data provide detailed information on shifts in tree health status

Future plans

- Integrate multiple layers of stress-specific information using leaf trait predictions and hyperspectral phenotyping for stress-specific decision tree algorithms.

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