



The impact of elevated CO₂ on mature oak and seedling defence against powdery mildew

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Background

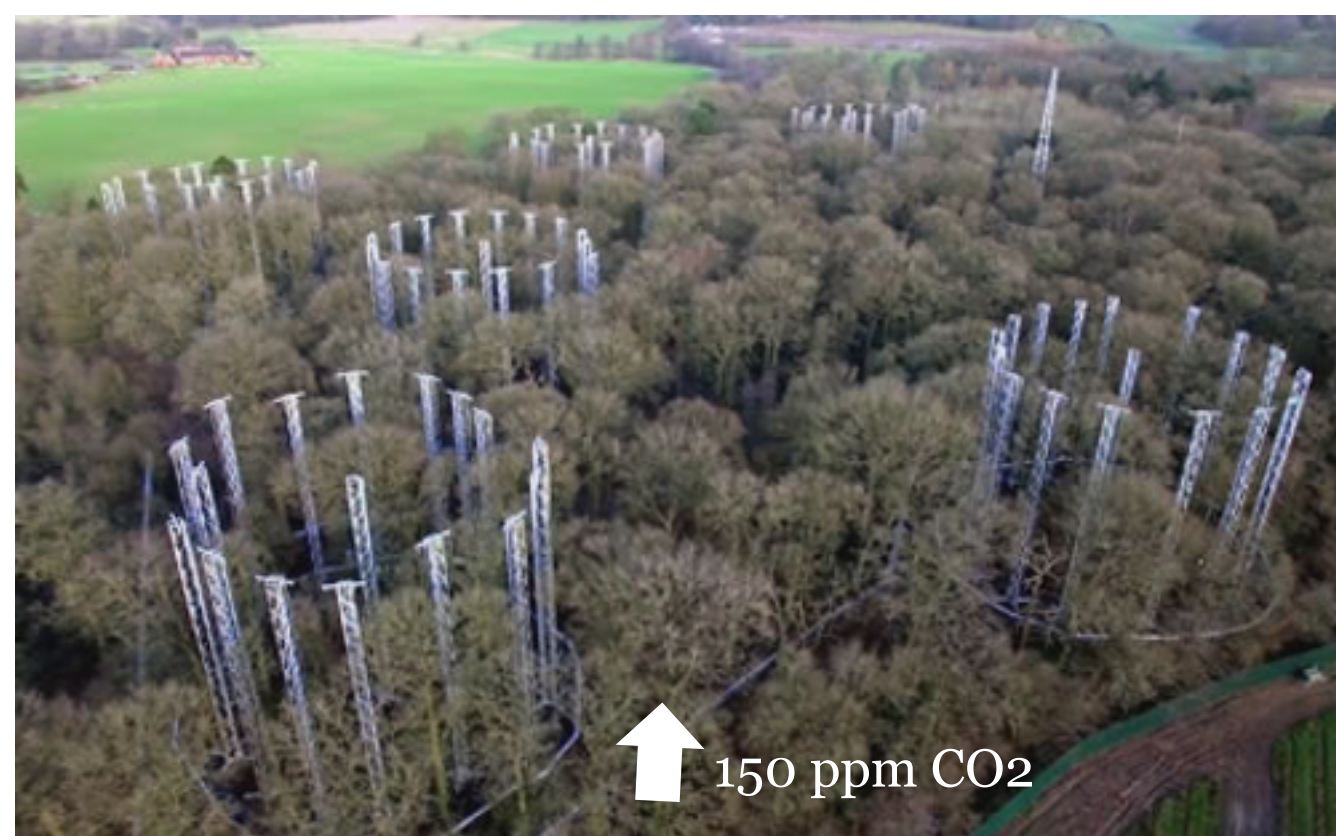
Human activity is causing CO₂ levels to rise which has been shown to impact plant growth and metabolism. Oaks are a vital aspect of British woodland and their regeneration is limited by powdery mildew (PM) infections of oak seedlings.

Objectives:

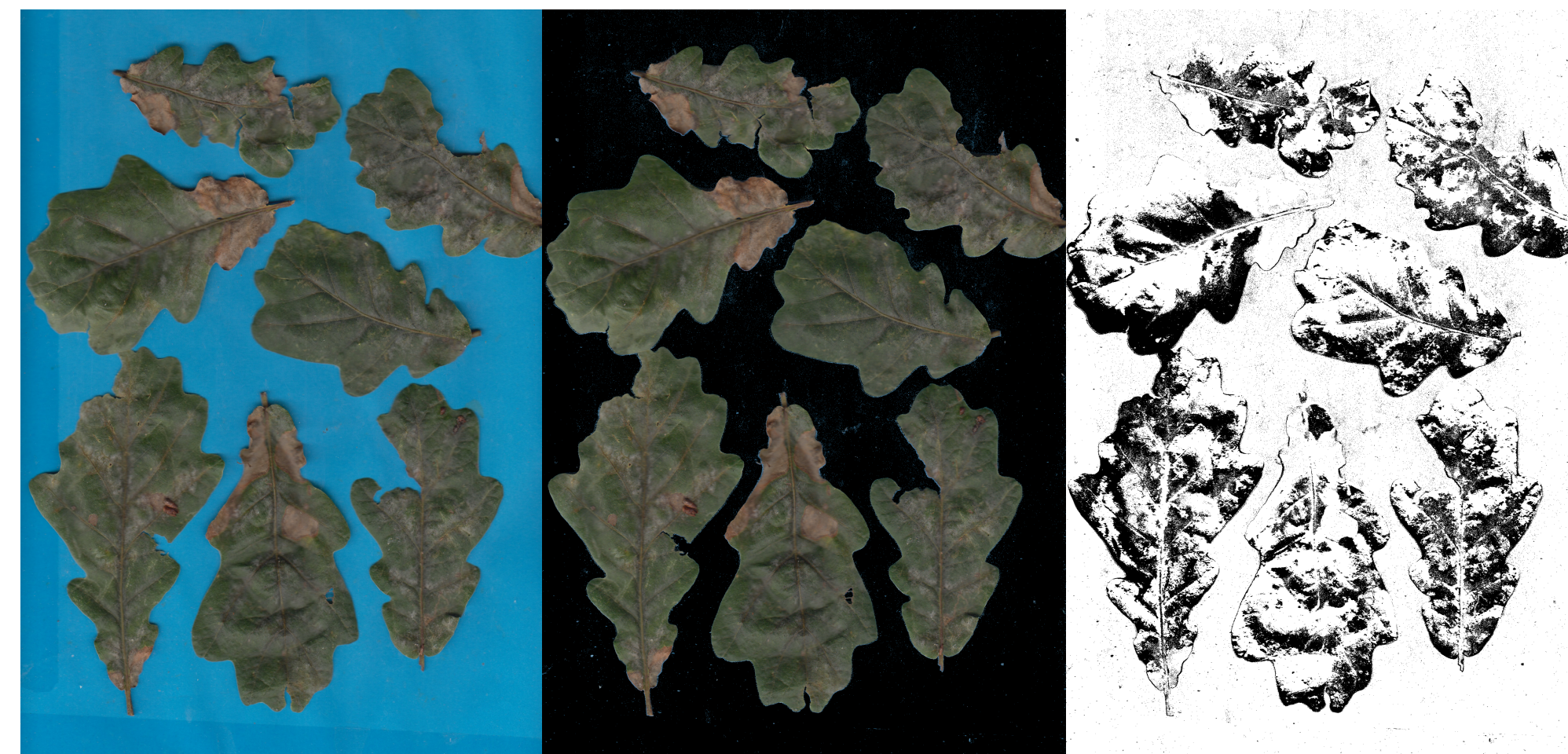
- Identify phenotypic differences in mature and seedling PM infections
- Explore the potential molecular causes using an untargeted metabolomics approach.

Approach

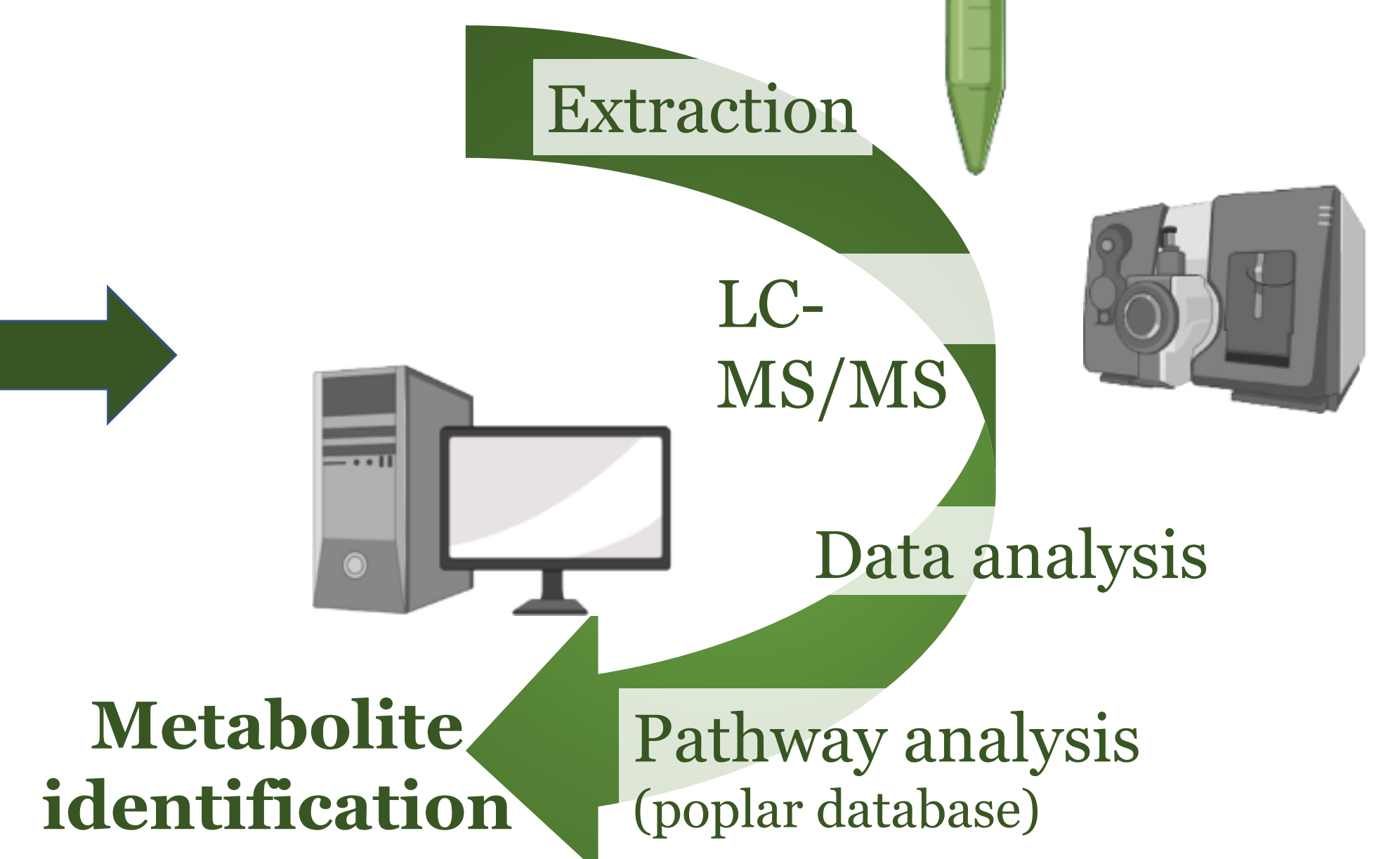
Free Air CO₂ Enrichment (FACE) Experiment



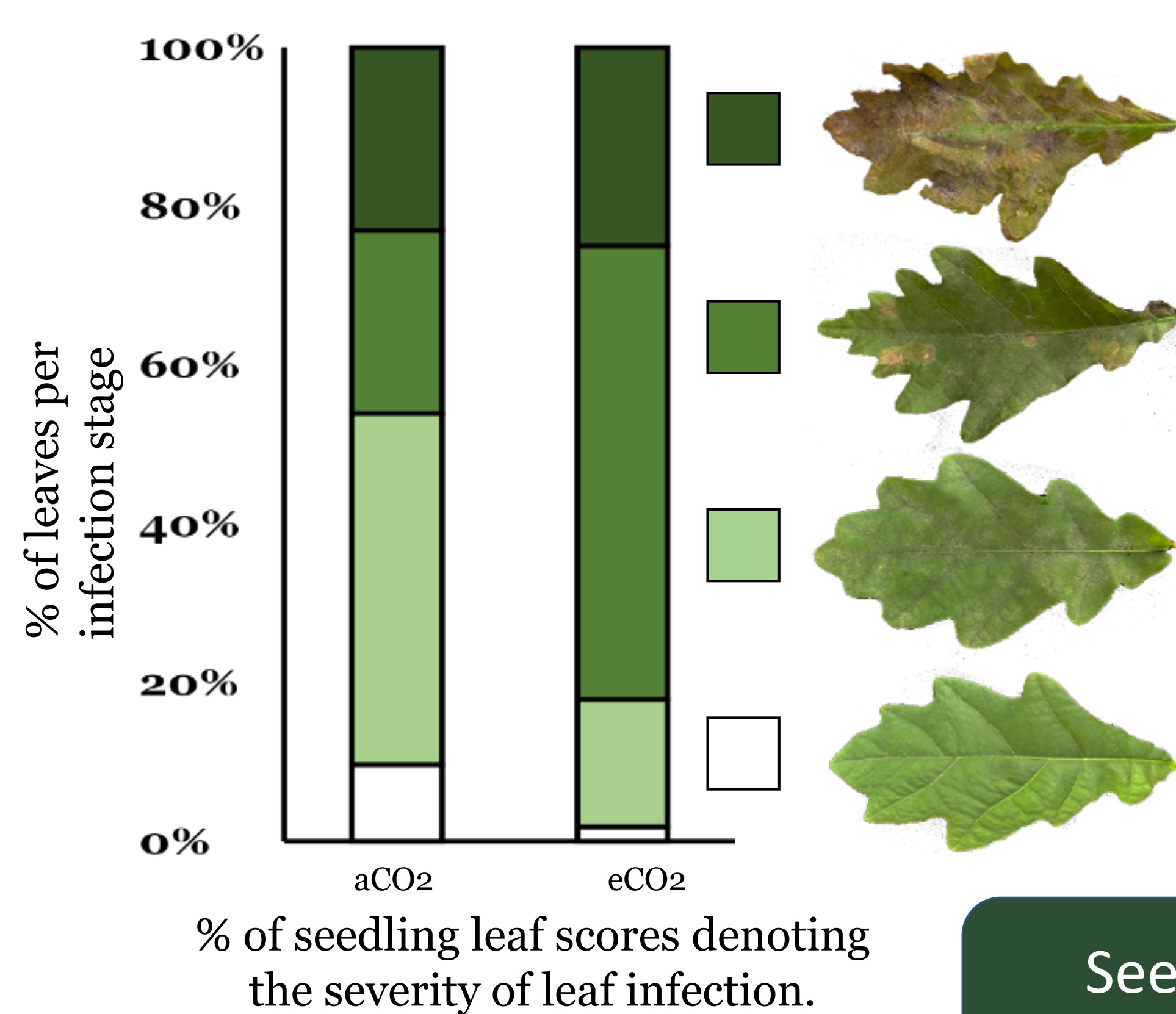
PM quantification in leaves of seedlings and mature trees using image J analysis



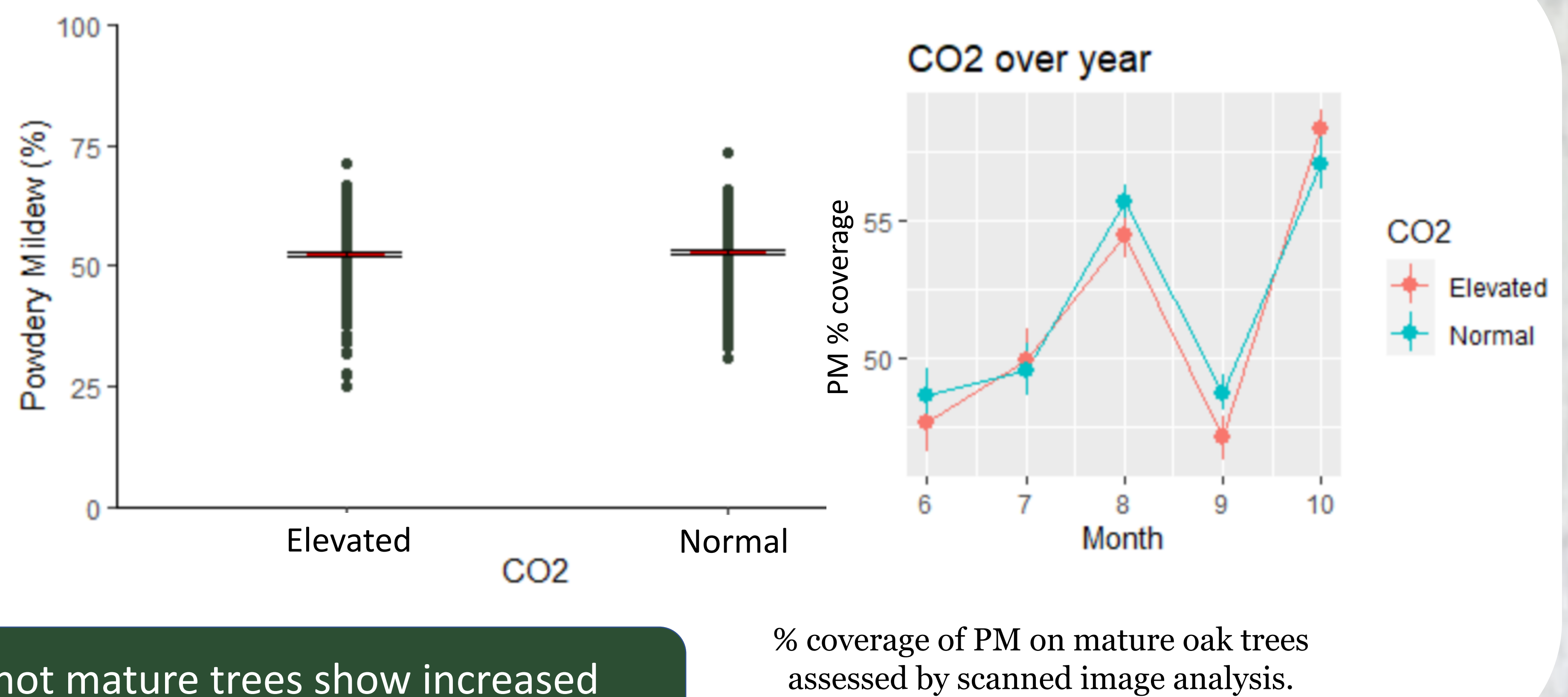
Untargeted MS/MS metabolomics analysis



Seedling disease scores



Mature leaf disease %

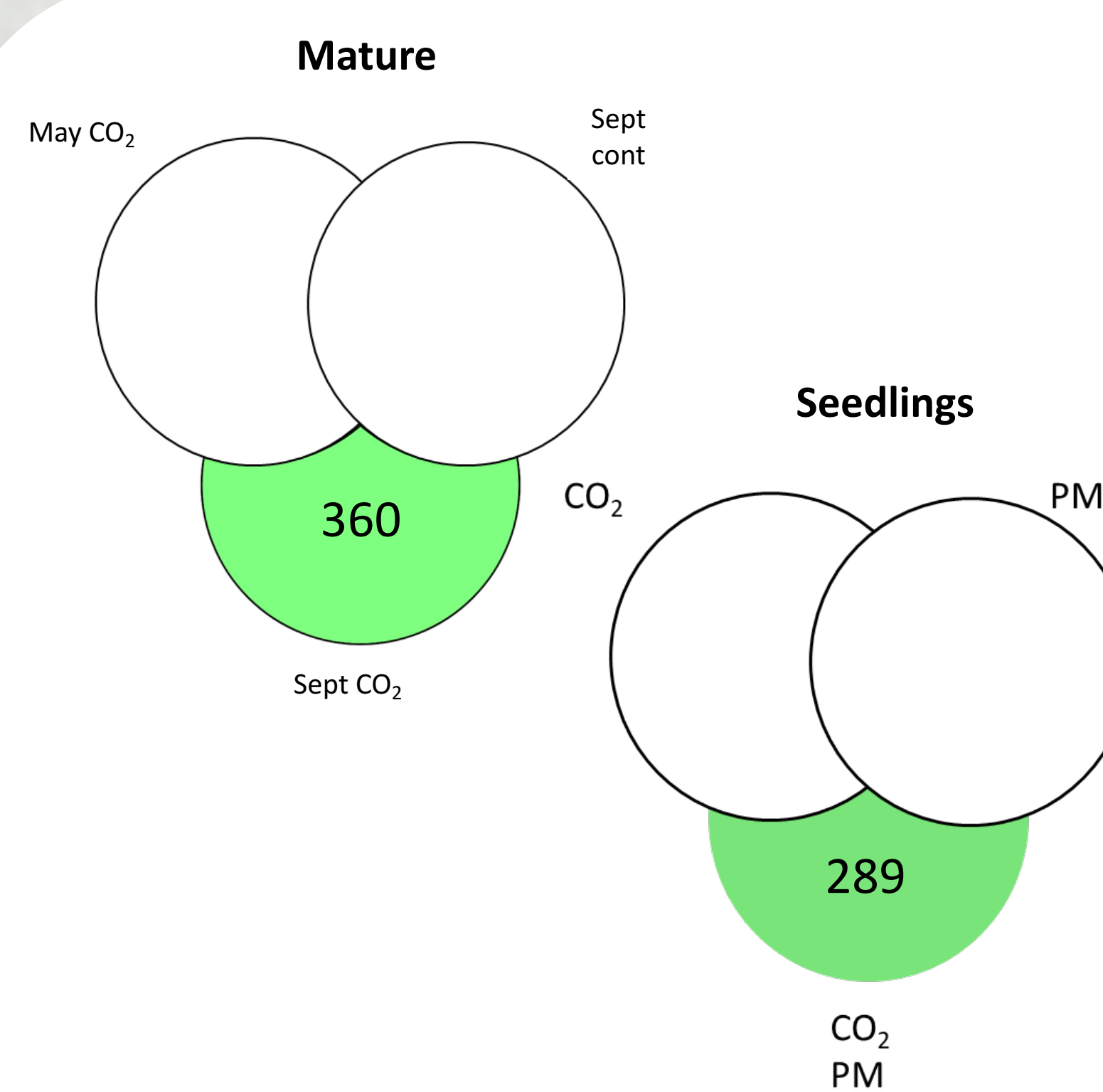


Seedlings but not mature trees show increased susceptibility to PM under eCO₂.

Seedling and mature PCA comparison



Seedlings and mature trees display high levels of separation in their metabolomes. Seedlings show greater variance in their metabolome.



Shared pathways

- ABC transporters
- Anthocyanin biosynthesis
- Arachidonic acid metabolism
- Cysteine and methionine metabolism
- Degradation of aromatic compounds
- Glutathione metabolism
- One carbon pool by folate
- Phenylpropanoid biosynthesis
- Secondary metabolism

Stress and defence pathways were shown to be shared between mature trees and seedlings under eCO₂ when infected with PM

Conclusions

- Seedlings show increased susceptibility to PM under eCO₂.
- Mature trees show no difference in susceptibility.
- Seedlings and mature trees show highly different metabolite profiles.
- Some differentially accumulated pathways are shared and are known to play a role in defence.

Future work

- Confirmation of shared metabolites presence in samples
- Study their role in oak immunity through external application of metabolites
- Assess the survivability of oak seedlings infected with powdery mildew under raised CO₂