

The biogeography and evolution of drought tolerance in grasses

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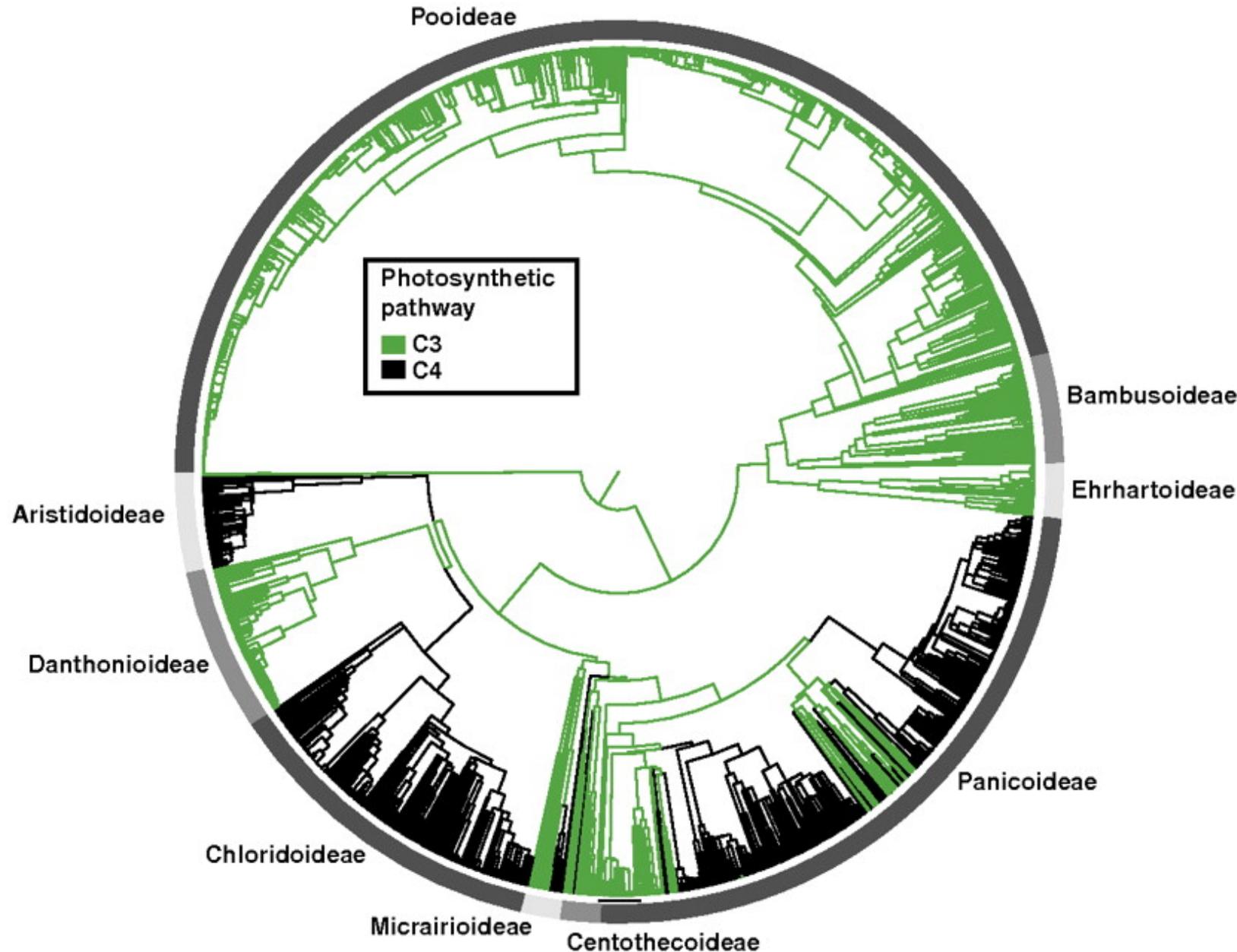
Drought stress

- Limit ecosystem and agricultural productivity
- Influence plant community structure
- Likely to be more frequent and severe in the future

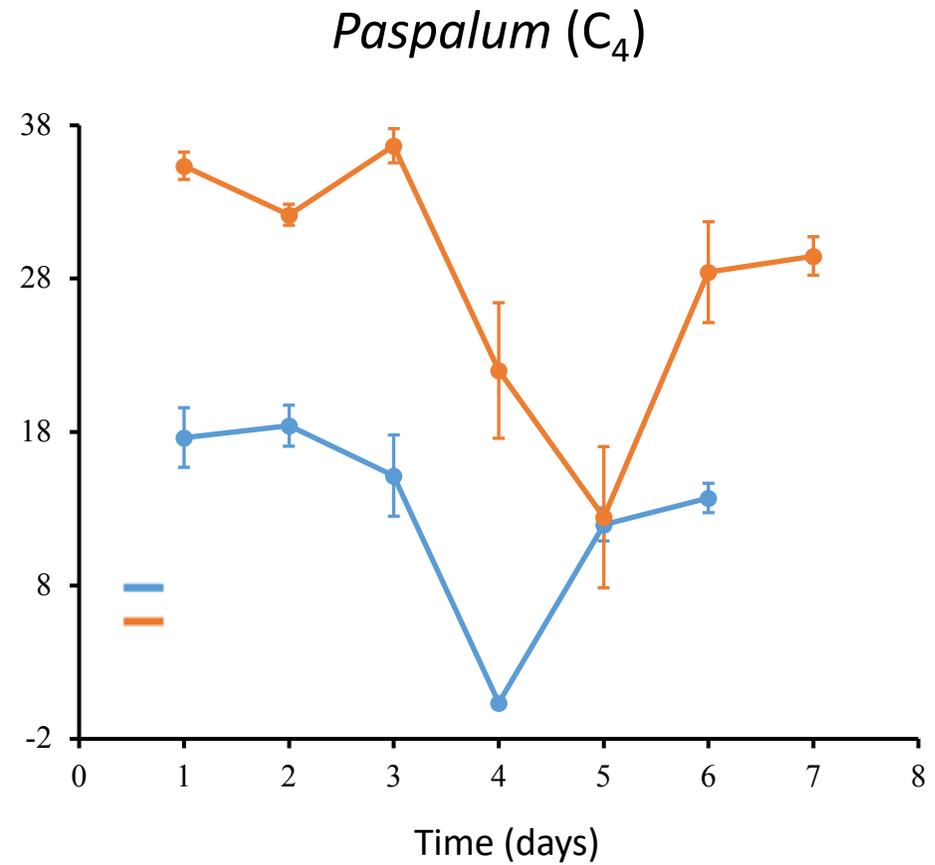
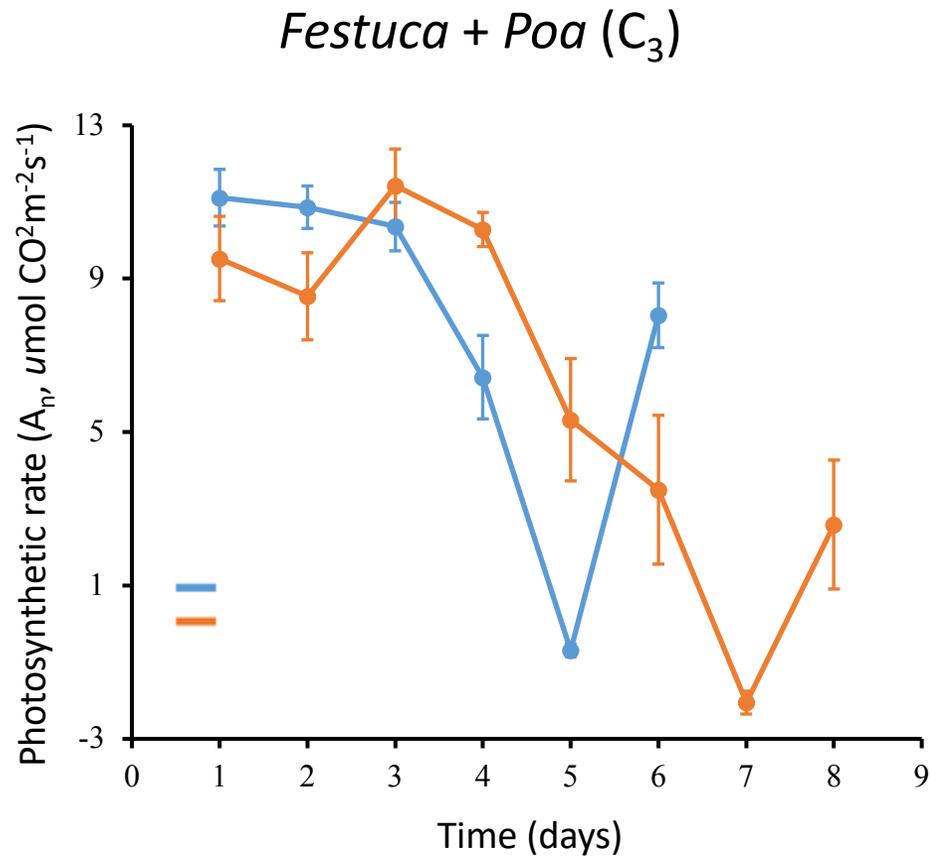


C₃ vs C₄ grasses

- Two photosynthetic pathways
 - C₃: typical of most plants, dominating in cooler temperate regions
 - C₄: increased photosynthetic rates, enhanced water use efficiency (WUE), dominating in tropical and subtropical grasslands
- Multiple origins of C₄ pathway



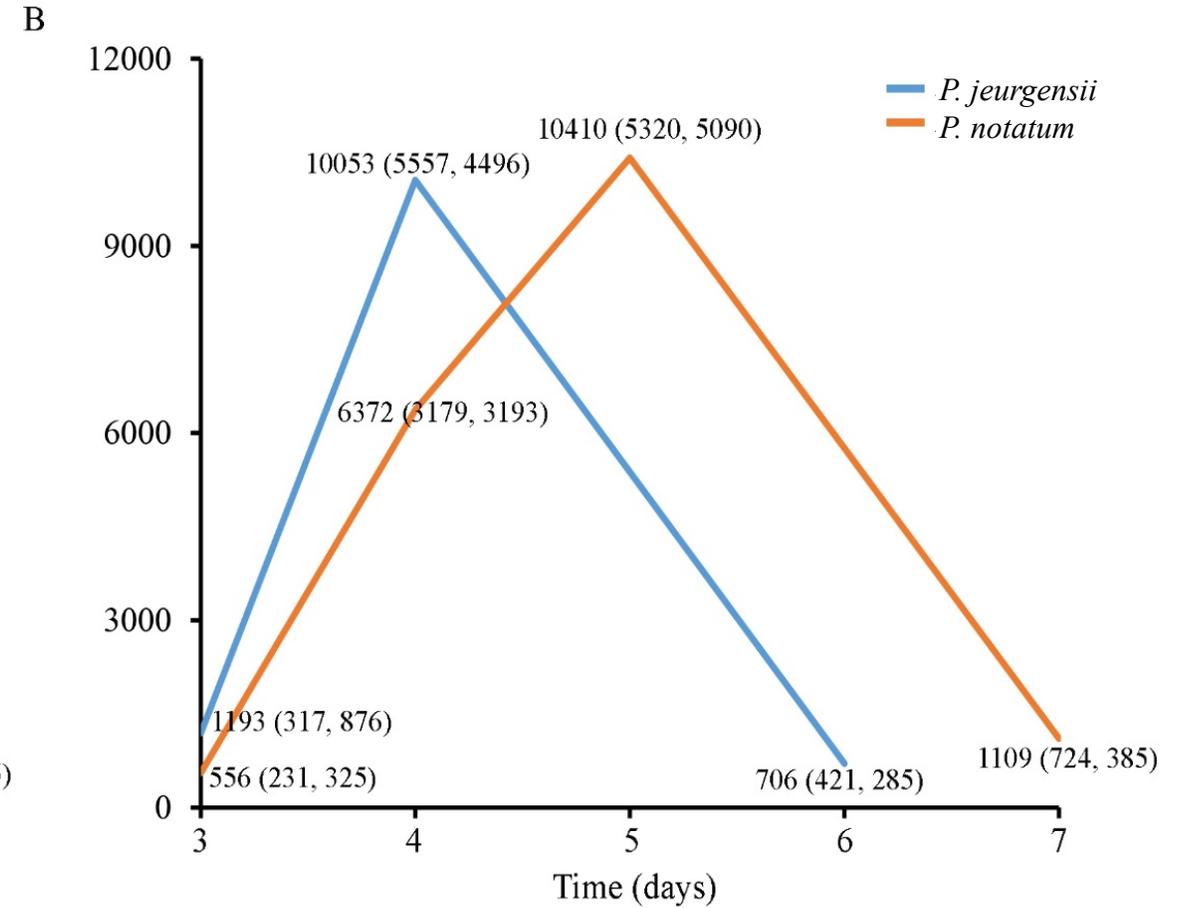
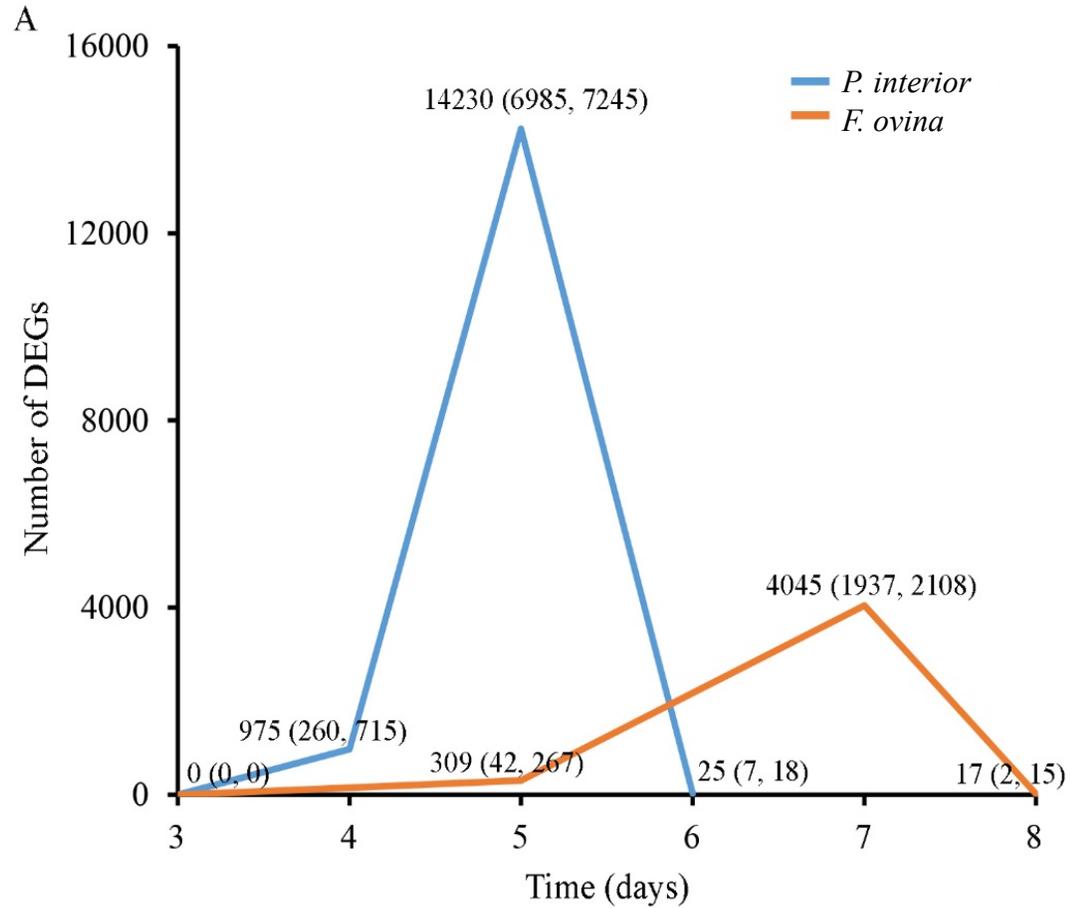
Dry-down experiments



Differential gene expression (RNA-seq)

Festuca + Poa (C_3)

Paspalum (C_4)



Enrichment test

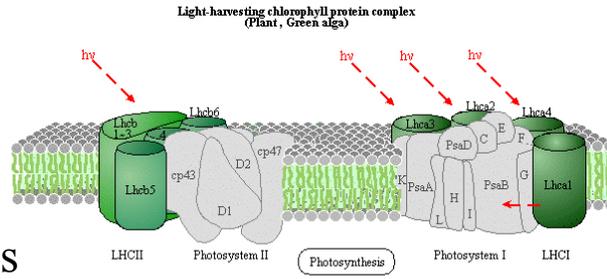
- Genes related to
 - Photosynthesis
 - Gene regulation (transcription factors, TFs)
 - Regulation of stomatal movement
 - Response to water deprivation
 - Response to temperature stimulus/heat
 - Response to abscisic acid (ABA)
 - Response to abiotic stress

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PHOTOSYNTHESIS - ANTENNA PROTEINS

■ Down-regulated
■ Up-regulated



C₃ species

C₄ species

P. interior

F. ovina

P. jeurgensii

P. notatum

Severe drought

Light-harvesting chlorophyll protein complex(LHC)

I Lhca1 Lhca2 Lhca3 Lhca4 Lhca5

II Lhcb1 Lhcb2 Lhcb3 Lhcb4 Lhcb5 Lhcb6 Lhcb7

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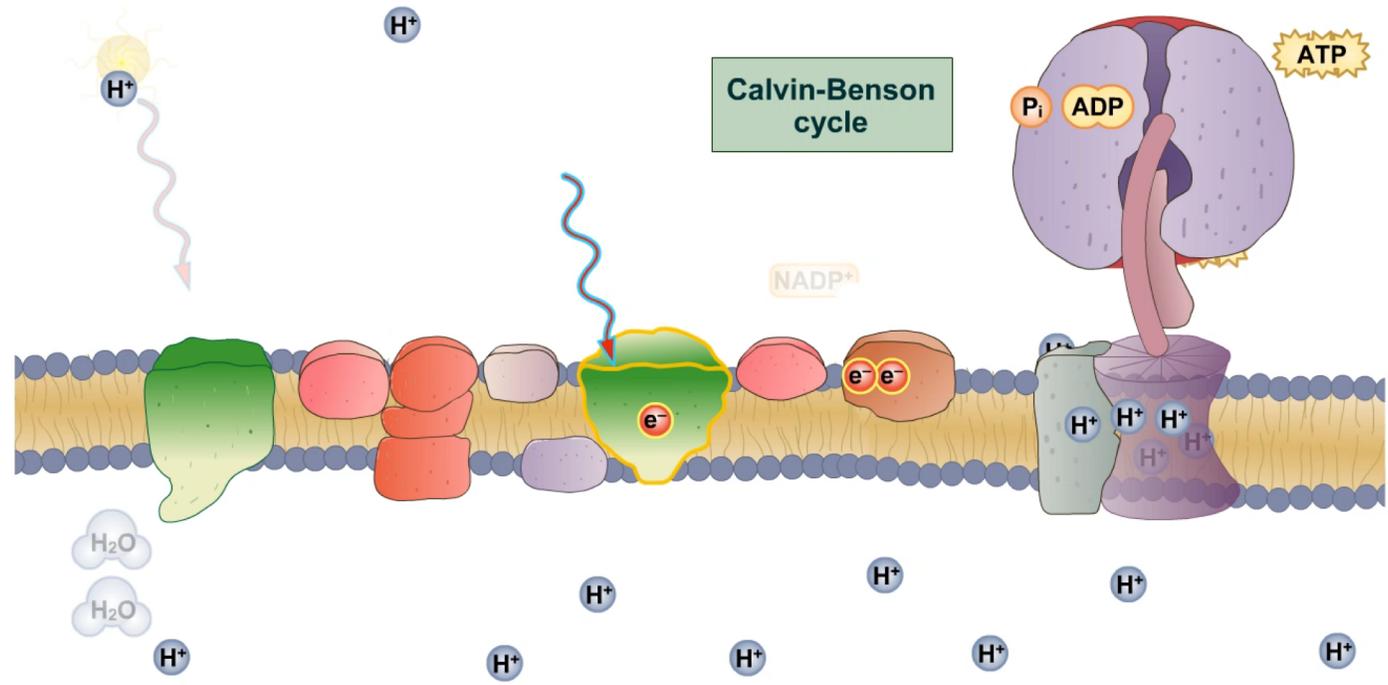
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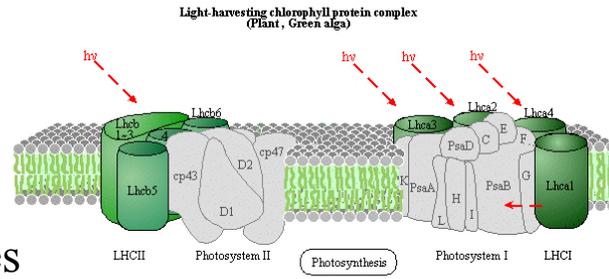
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Photosynthesis



PHOTOSYNTHESIS - ANTENNA PROTEINS

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C₃ species

C₄ species

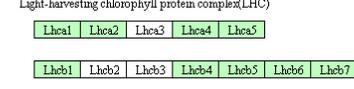
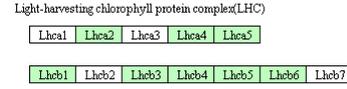
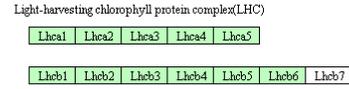
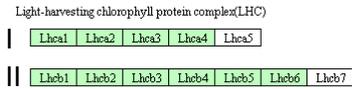
Severe drought

P. interior

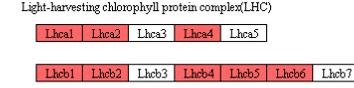
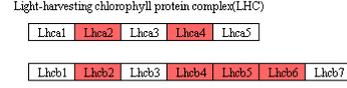
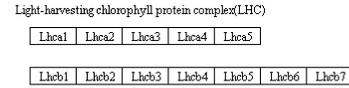
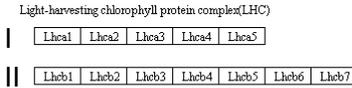
F. ovina

P. jeurgensii

P. notatum

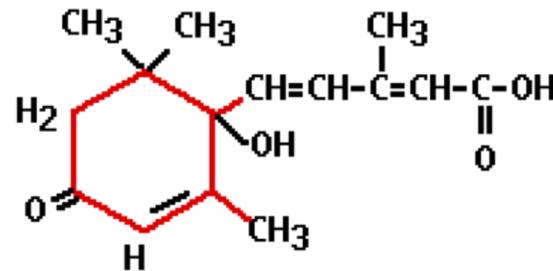


Recovery



Abscisic Acid (ABA)

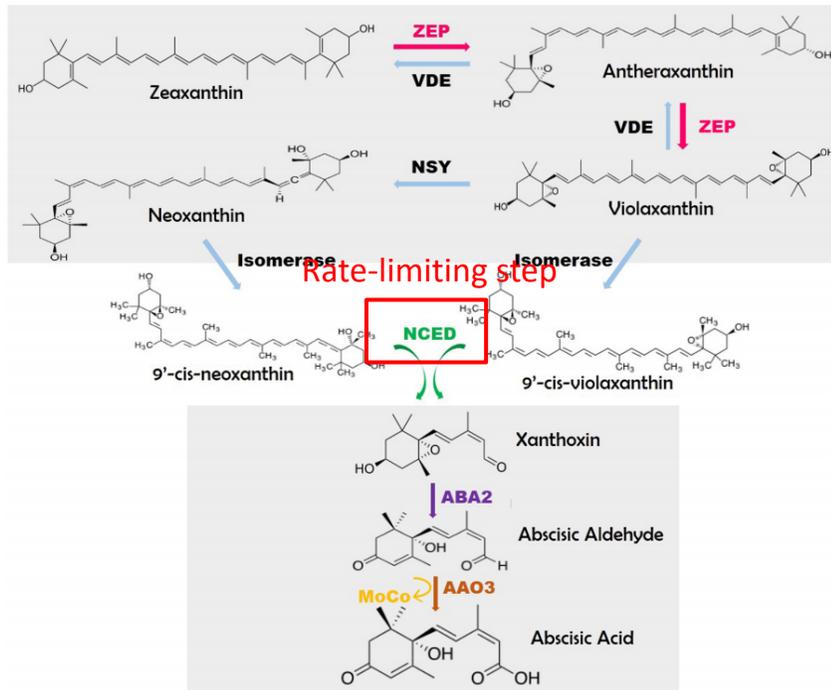
- Plant hormone, the major player in mediating the adaptation of the plant to stress
 - Triggers closing of the stomata when water is insufficient
 - Stimulates root growth in plants that need to increase their ability to extract water from the soil



Abscisic acid (ABA)

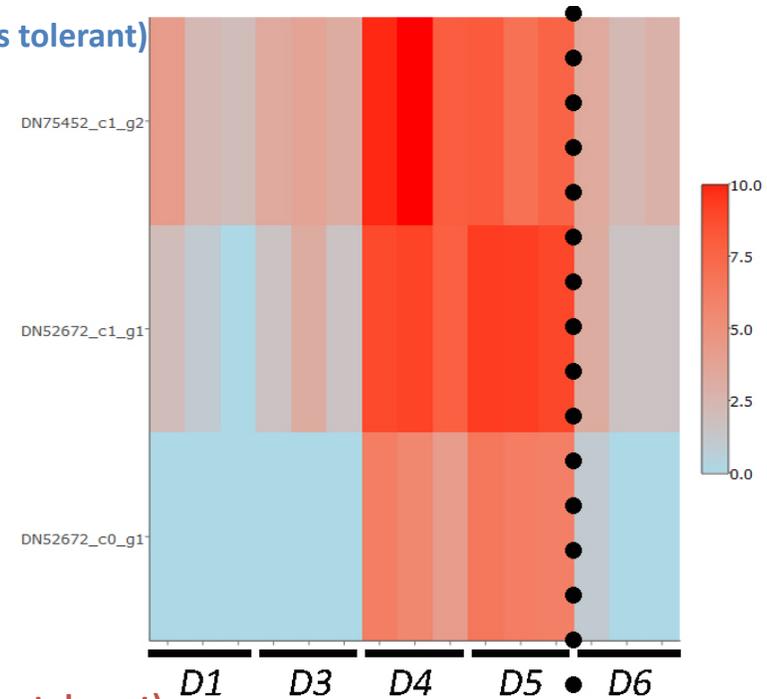
ABA biosynthesis pathways

NCED: 9-cis-epoxycarotenoid dioxygenase

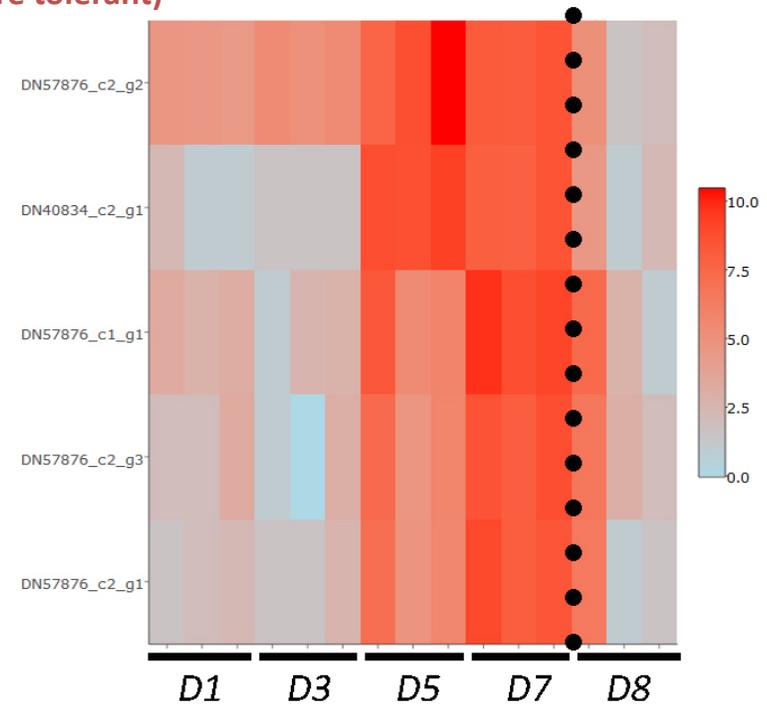


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P. interior (less tolerant)

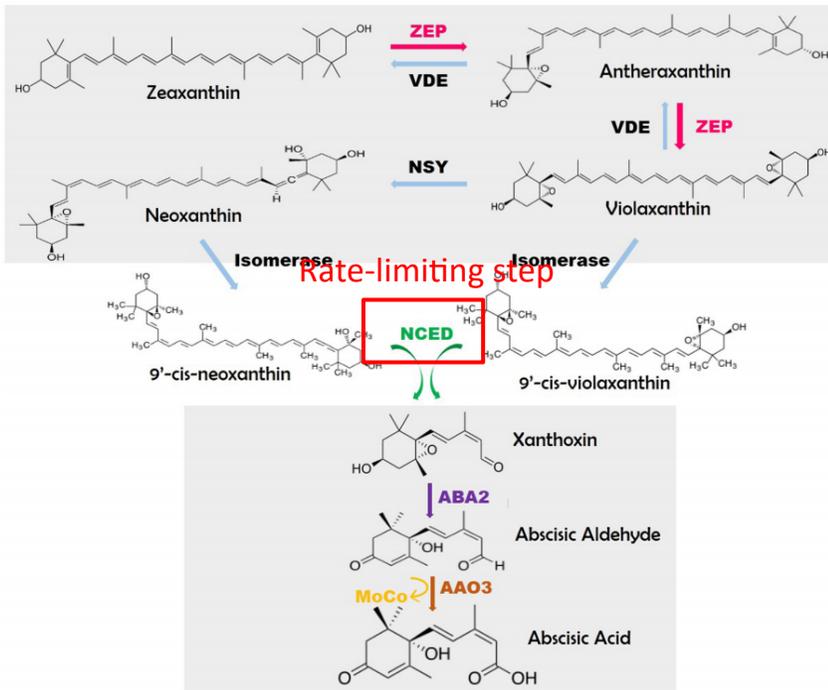


F. ovina (more tolerant)



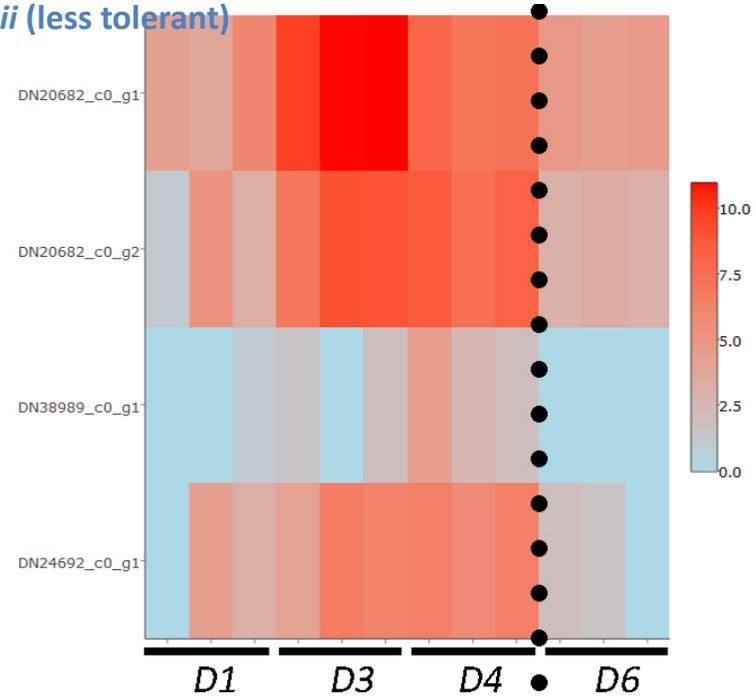
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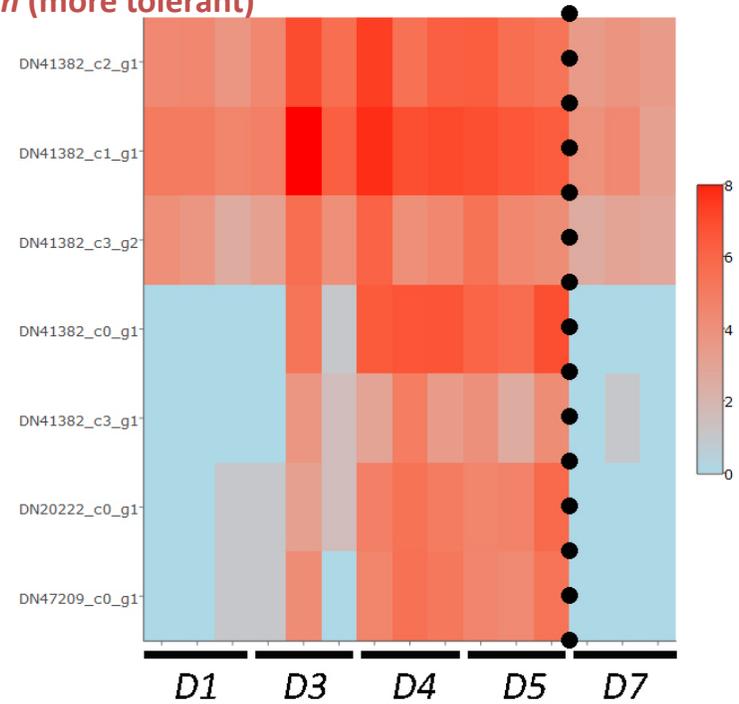


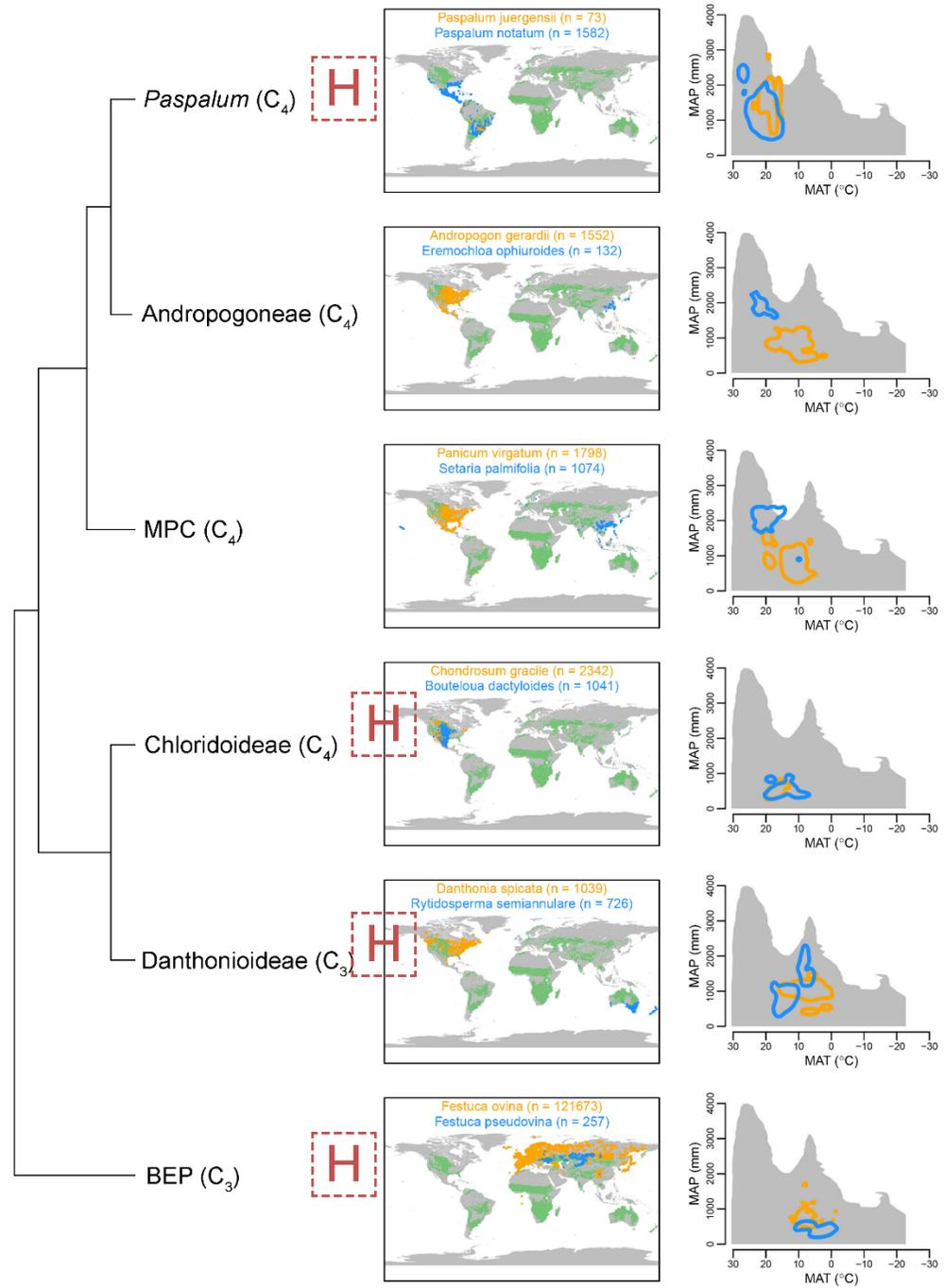
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P. jeurgensii (less tolerant)



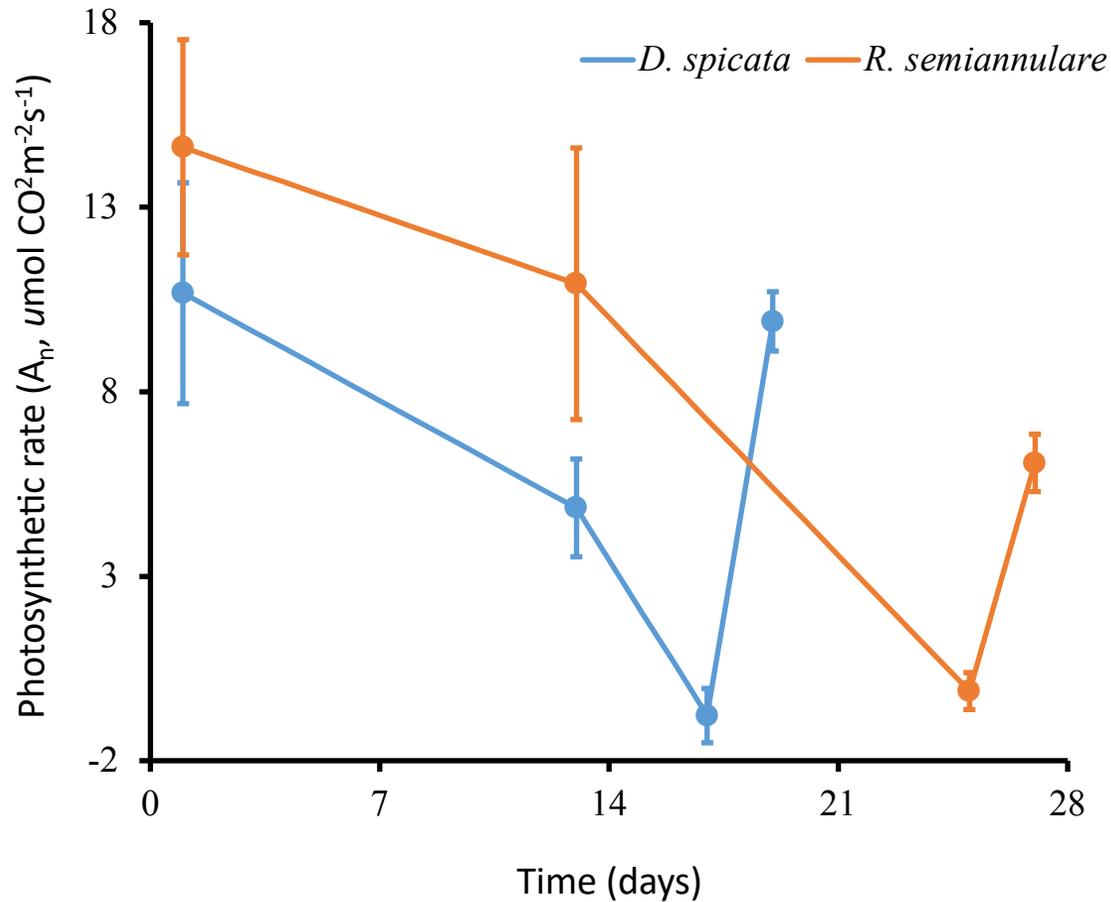
P. notatum (more tolerant)



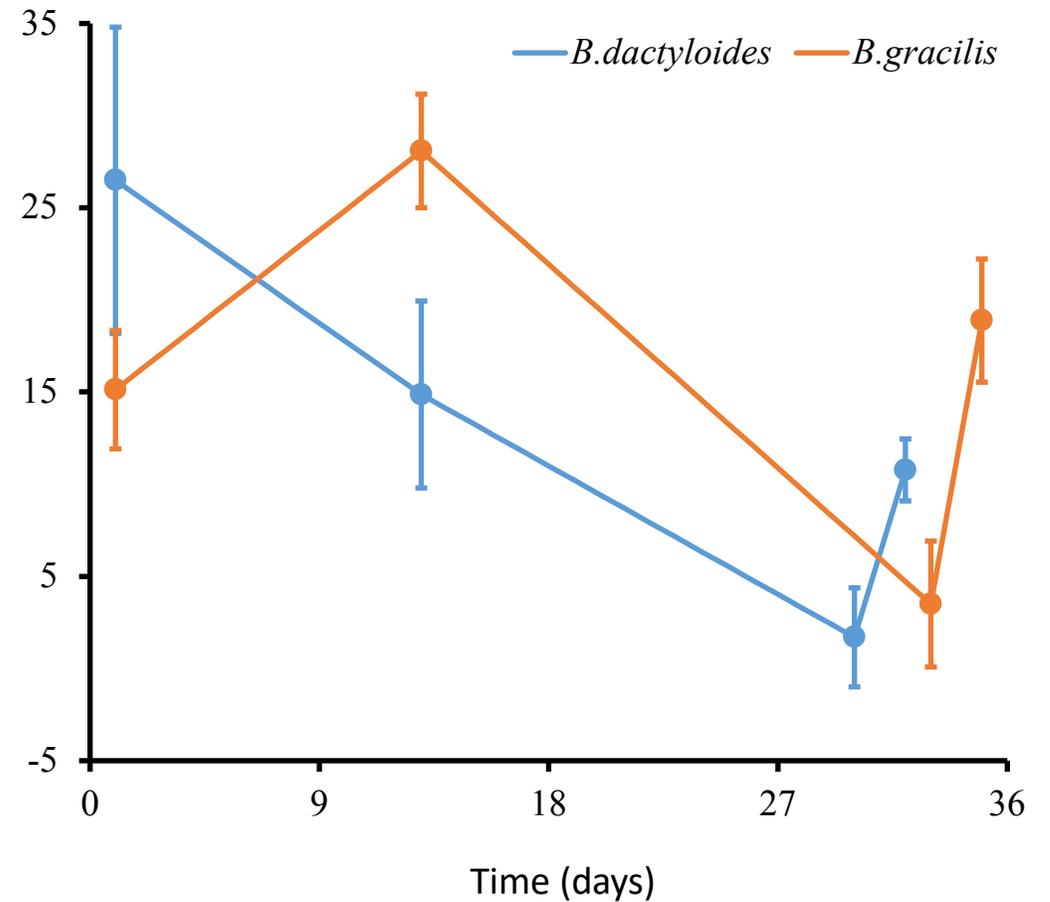


Dry-down experiments

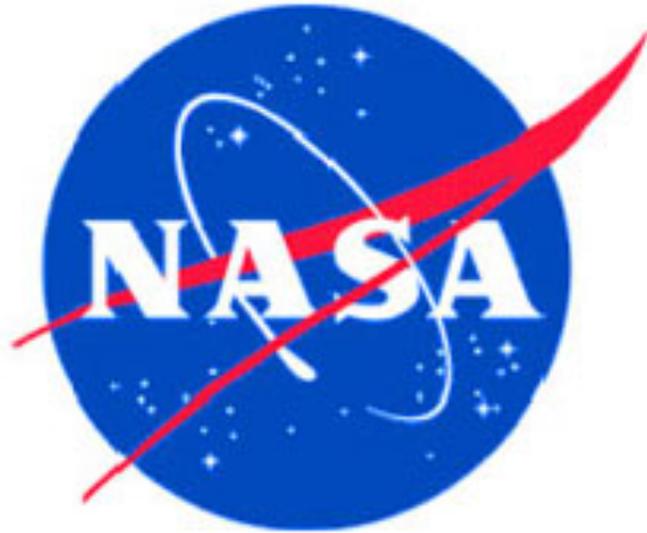
Danthonia + Rytidosperma (C₃)



Bouteloua (C₄)



Acknowledgements



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UNIVERSITY

