

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



Grasses

- Present on Earth for over 70 million years (MYs)
- Grassland ecosystems prominent for over 20 MYs
- ~12,000 species (~3% of total vascular plants)
- Account for ~1/4 of terrestrial carbon cycle
- Critical dietary component of humans and grazing animals



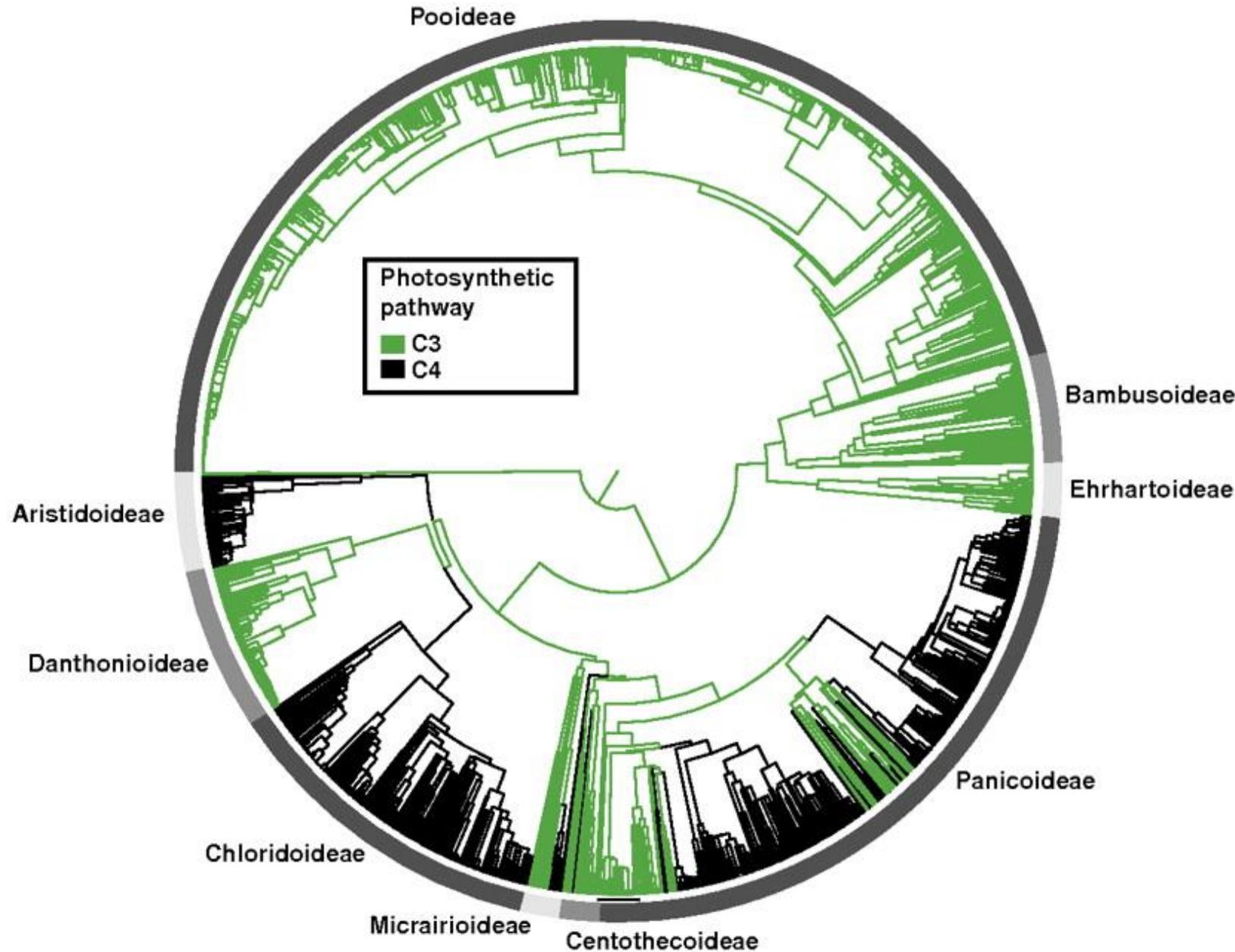
<https://wallpapersafari.com/grassland-wallpaper/>



<http://www.regeneratinggrassland.com/>

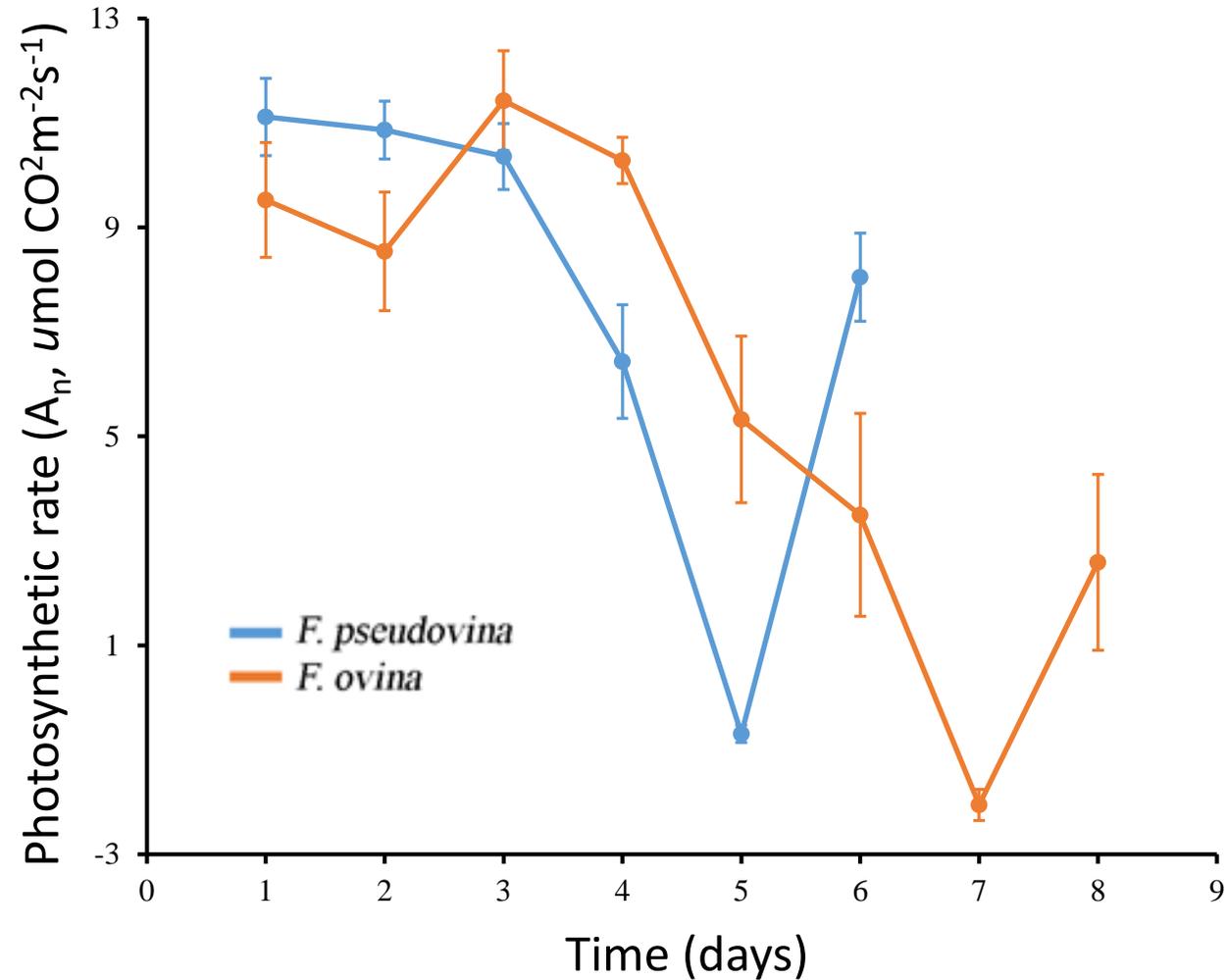
C₃ vs C₄ grasses

- 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

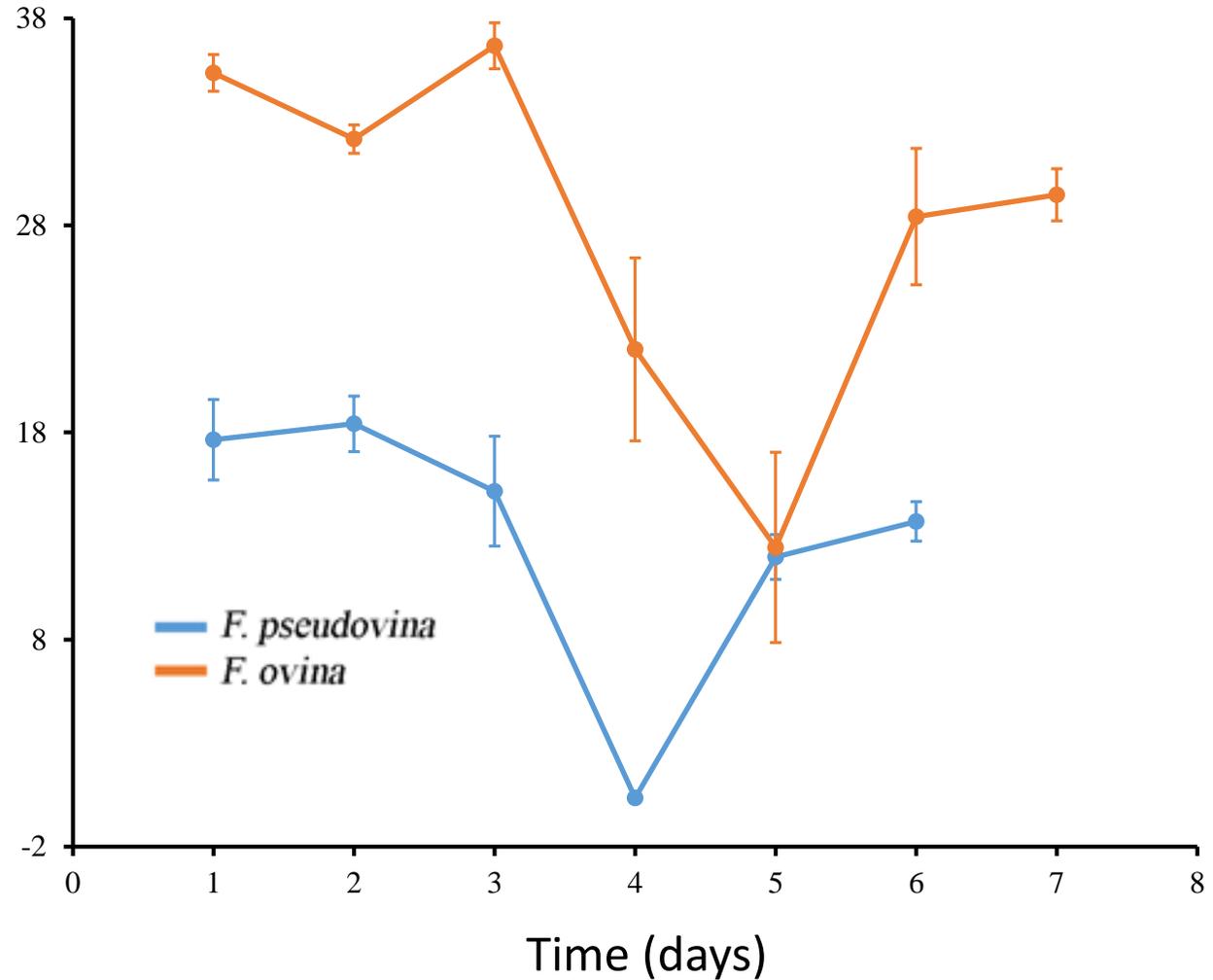


Dry-down experiments

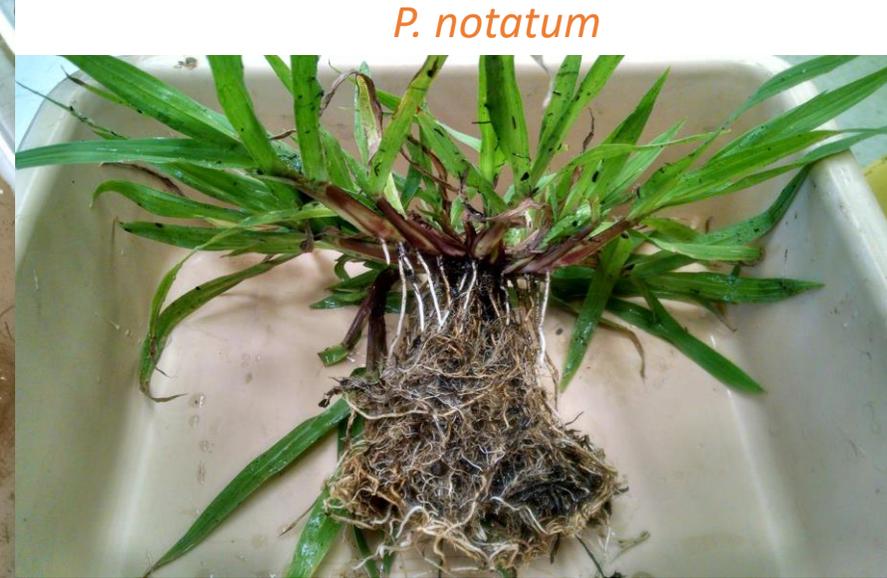
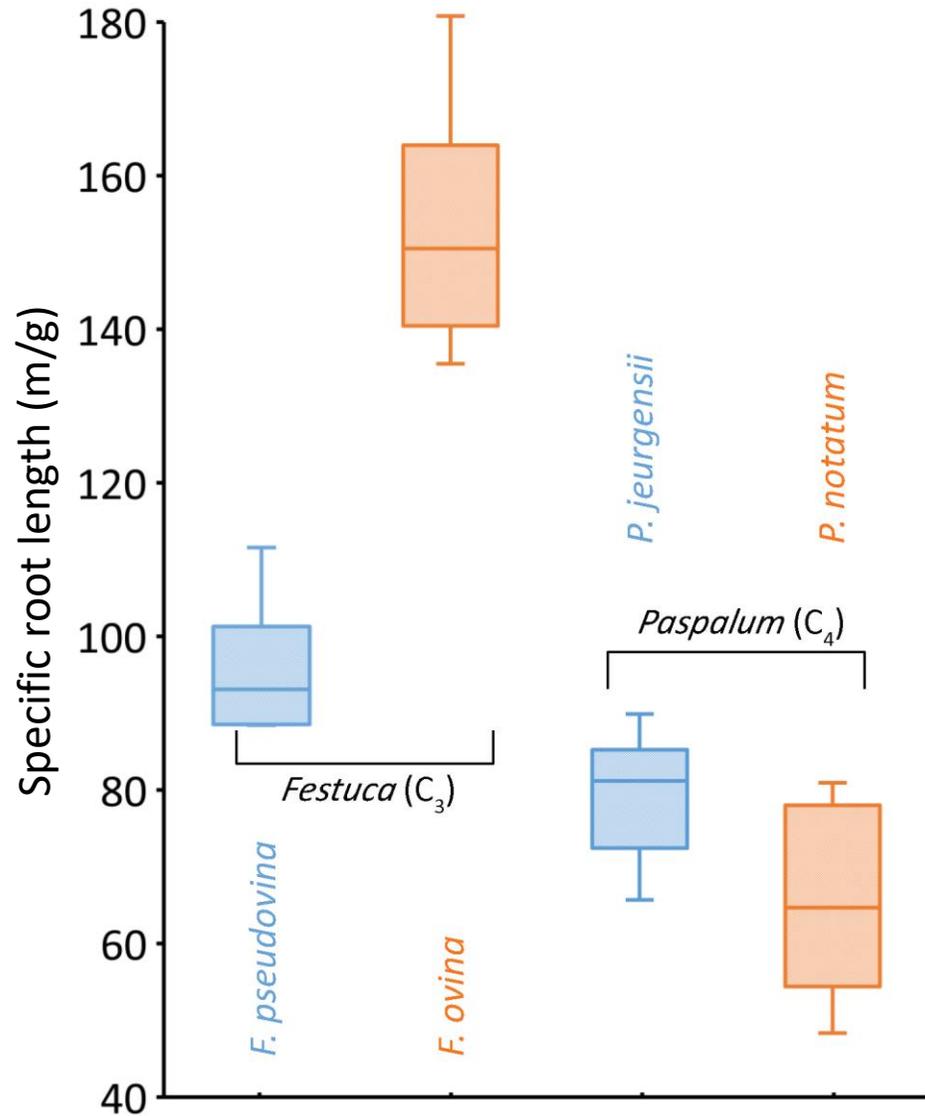
Festuca (C₃)



Paspalum (C₄)



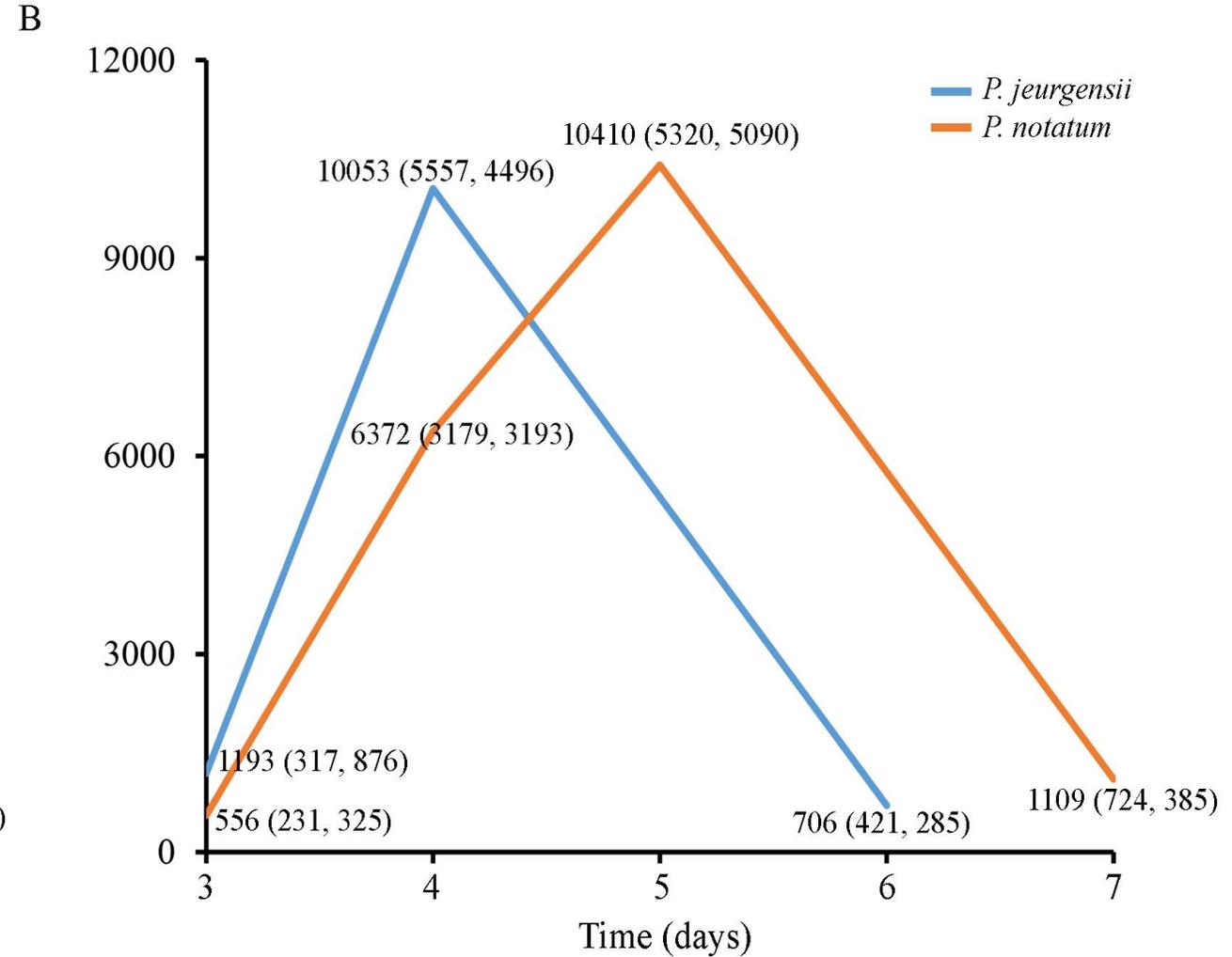
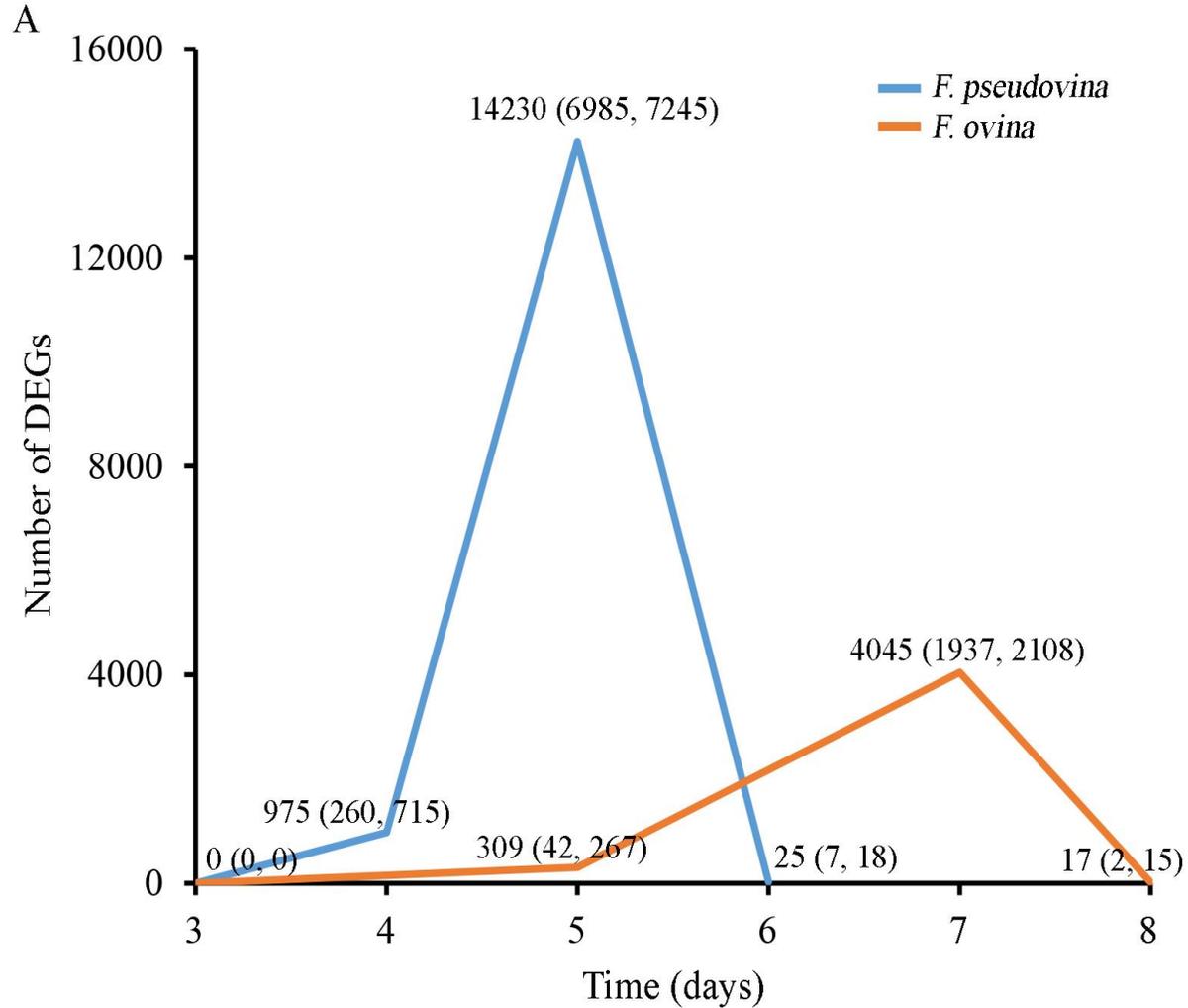
How does root architecture influence physiology during water stress?



Differential gene expression (RNA-seq)

Festuca (C₃)

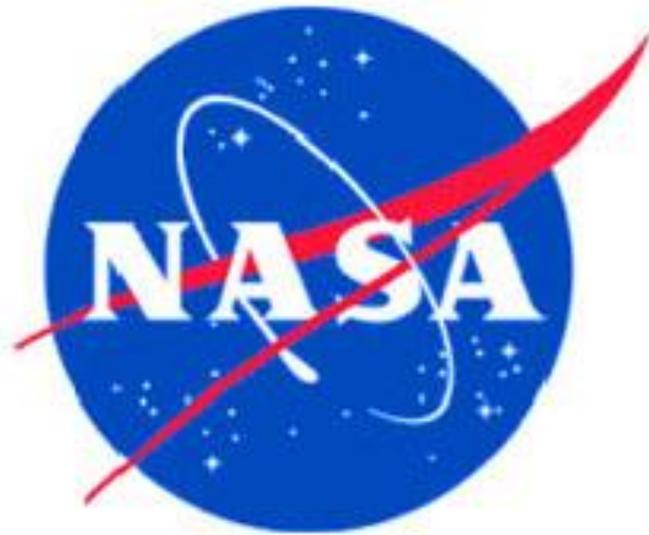
Paspalum (C₄)



Conclusions

- Leaf shape evolution across the grass family exhibits phylogenetic trends and environmental correlates
- Dry-down experiments of C₃ and C₄ congener species offer insights into physiological, anatomical, and gene expression determinants of tolerance/susceptibility to water stress
 - SRL explains differences in sensitivity to water stress in C₃ congeners only
 - Greater gene expression responses in less tolerant species (C₃ only)
 - Differential recovery of genes involved in photosynthesis between C₃ and C₄
 - Stress-responsive pathways differentially activated between congener species

Acknowledgements



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