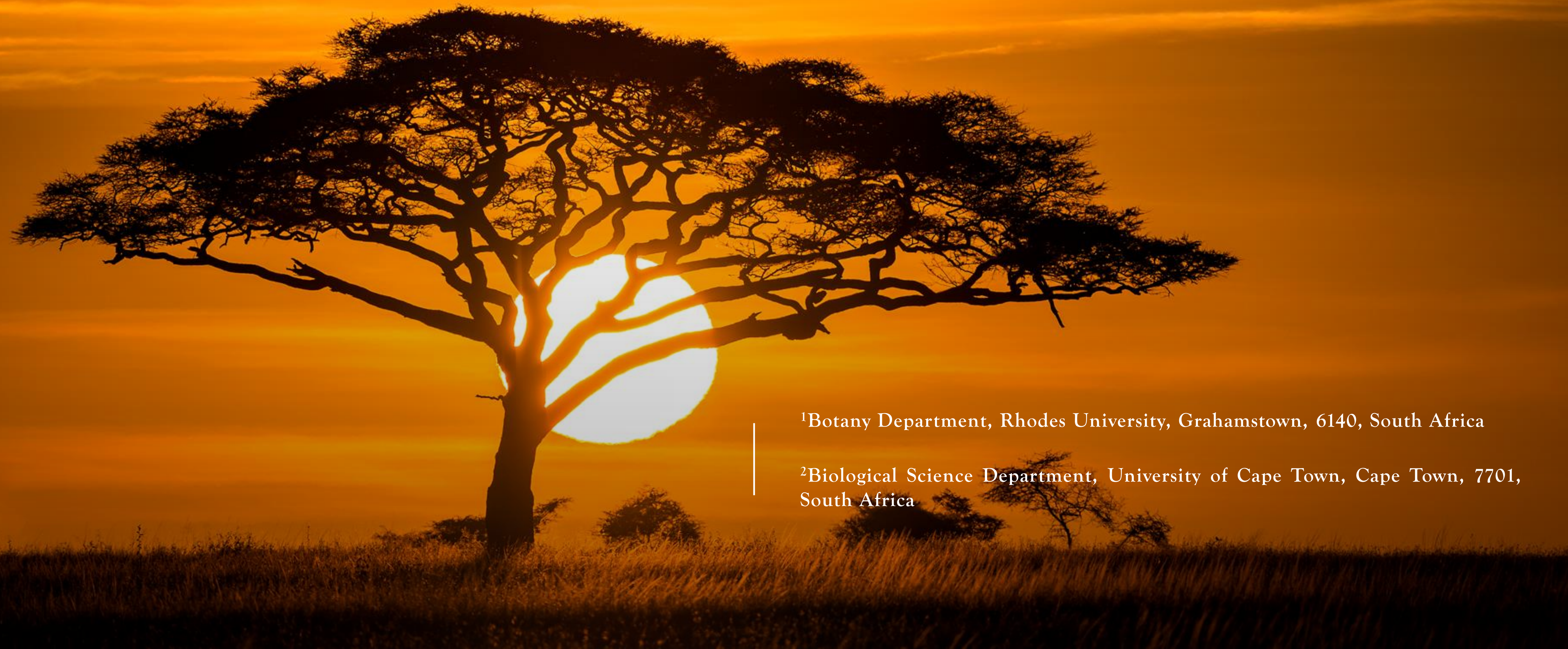
Effects of elevated CO_2 and drought on savanna tree seedling water use strategies

L.M. Reynolds[1], A.G. West[2], T. Pillay[1], and B.S. Ripley[1]



[1]Botany Department, Rhodes University, Grahamstown, 6140, South Africa

[2]Biological Science Department, University of Cape Town, Cape Town, 7701, South Africa

Species used:

- Encroachers:

1. Vachellia karroo
2. V. sieberiana
3. V. tortillis

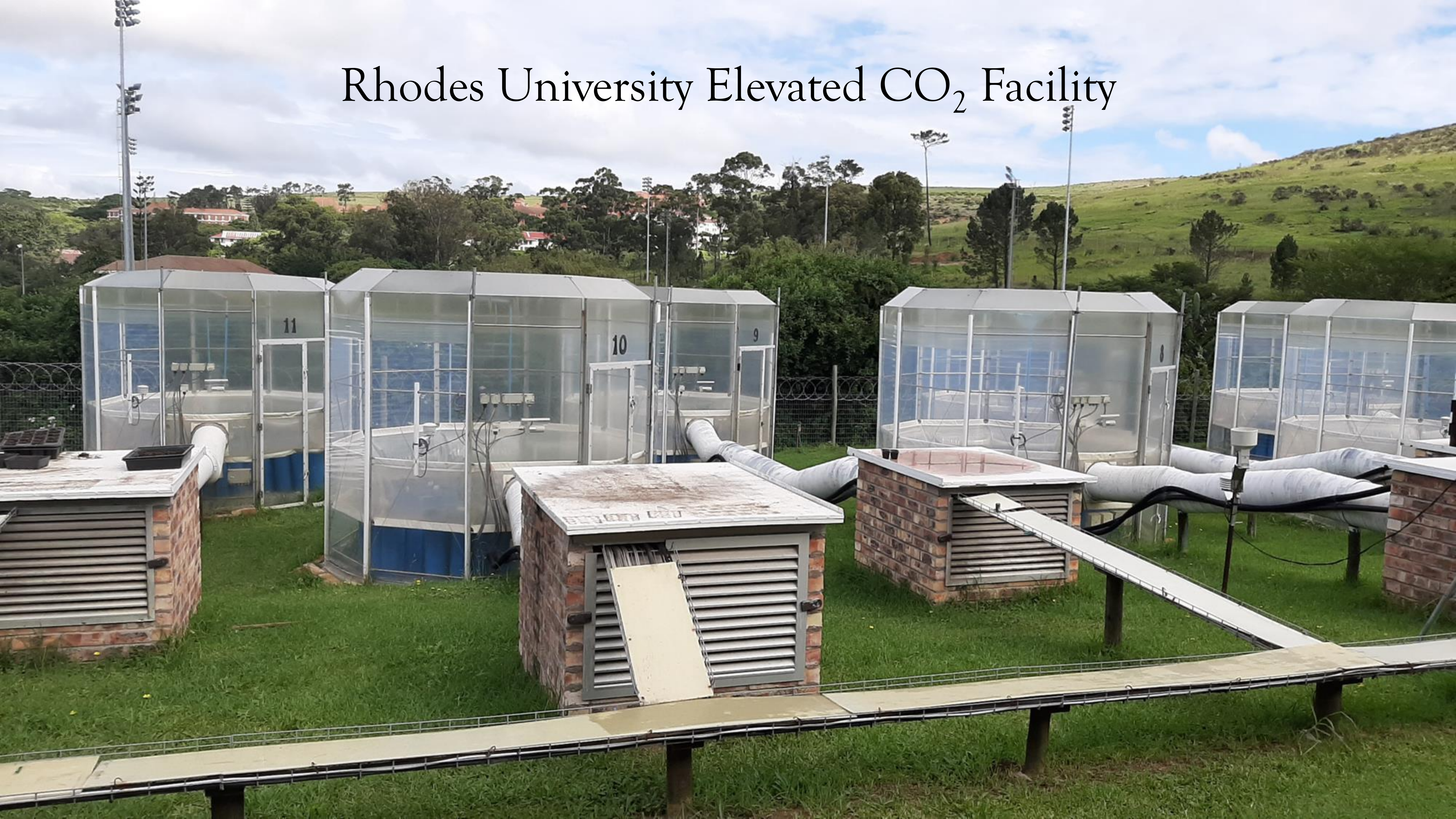
- Non-encroachers:

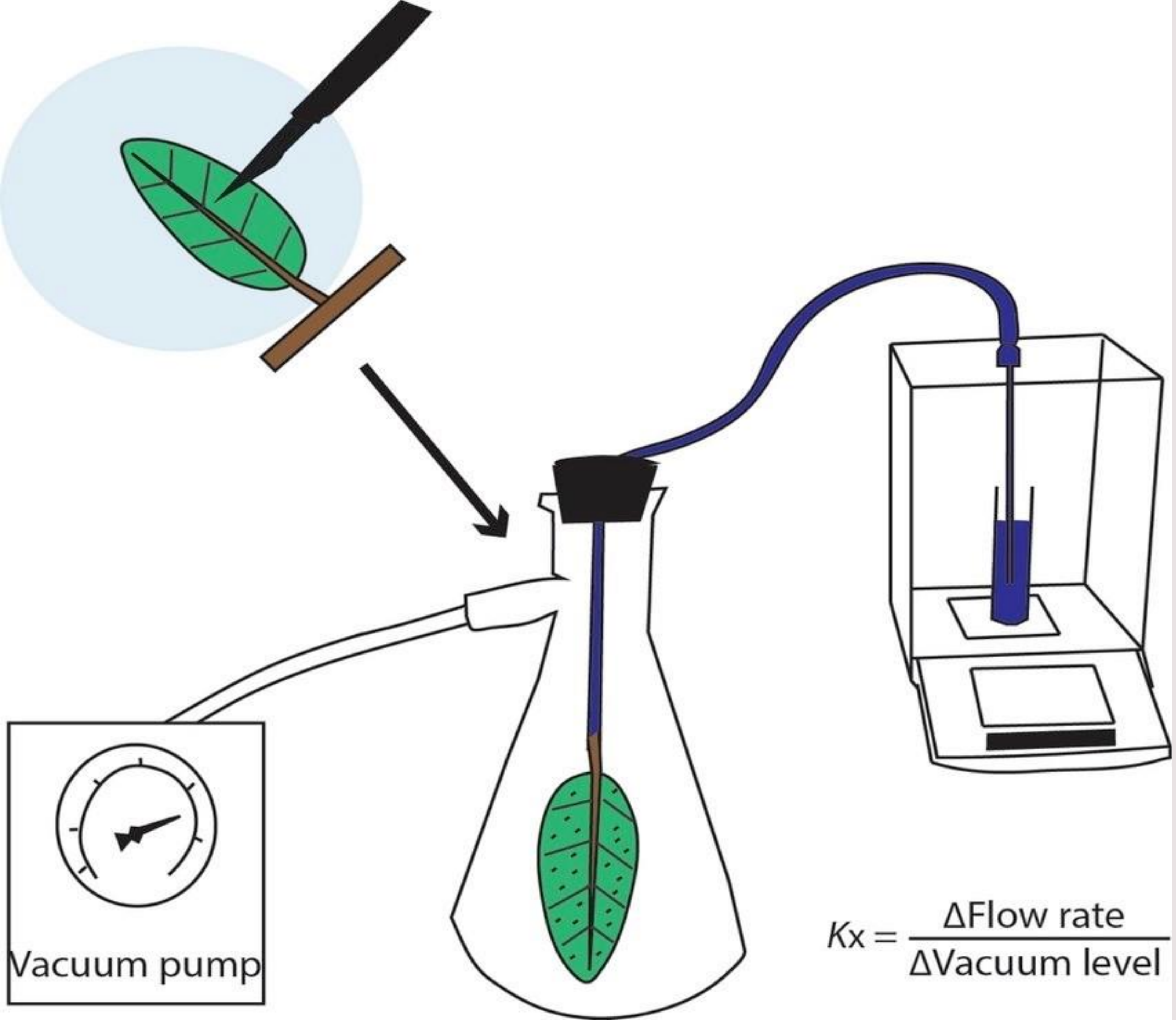
1. Senegalia burkei
2. S. caffra
3. V. robusta

Research Questions:

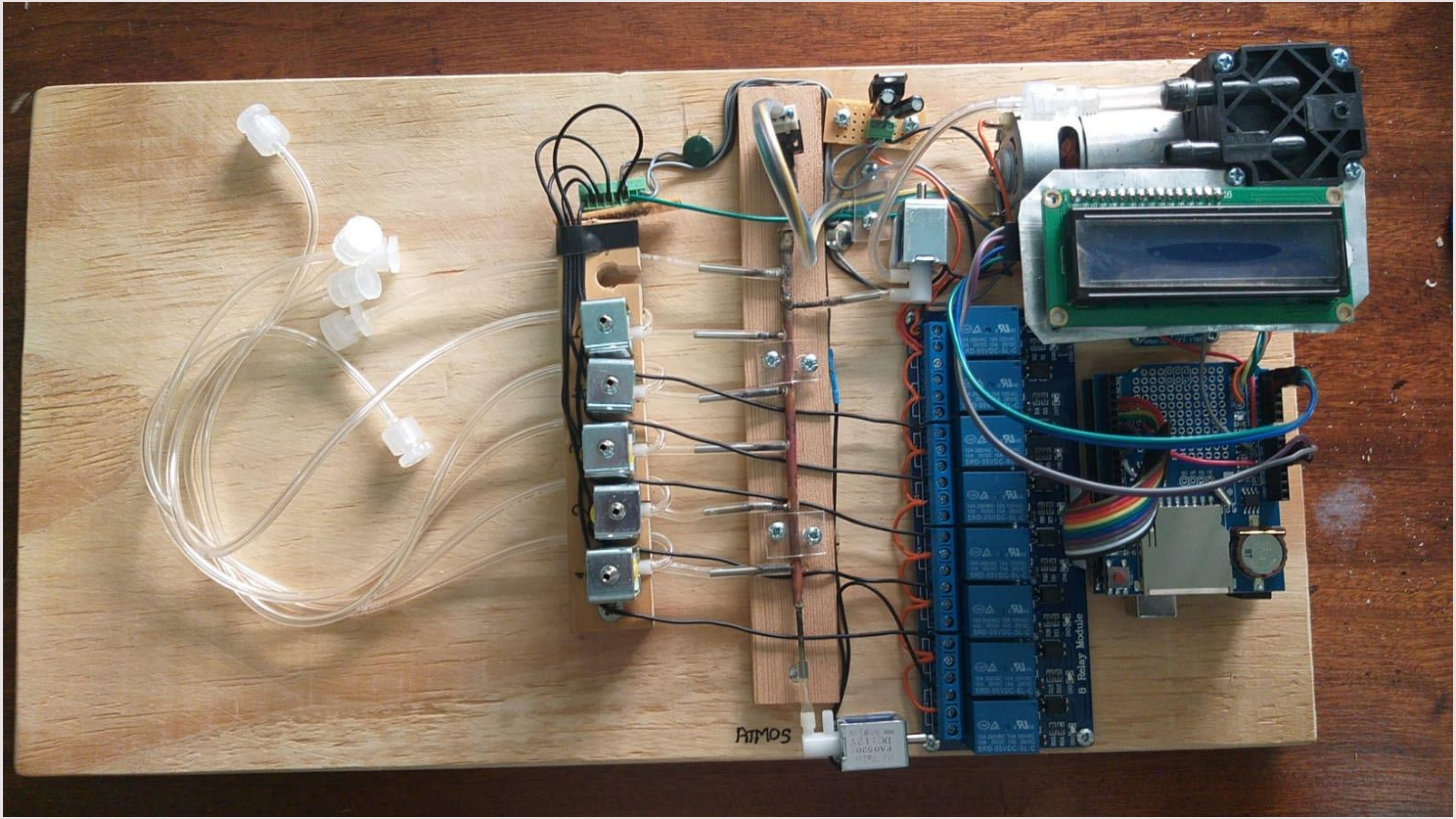
- Do encroaching species have a higher hydraulic conductance and drought resistance than non-encroaching species?
- Is this relationship the same for plants growing in drought conditions as it is for plants growing in well-watered conditions?
- What is the effect of elevated CO_2 on the hydraulic parameters of encroaching and non-encroaching species?

Methods:

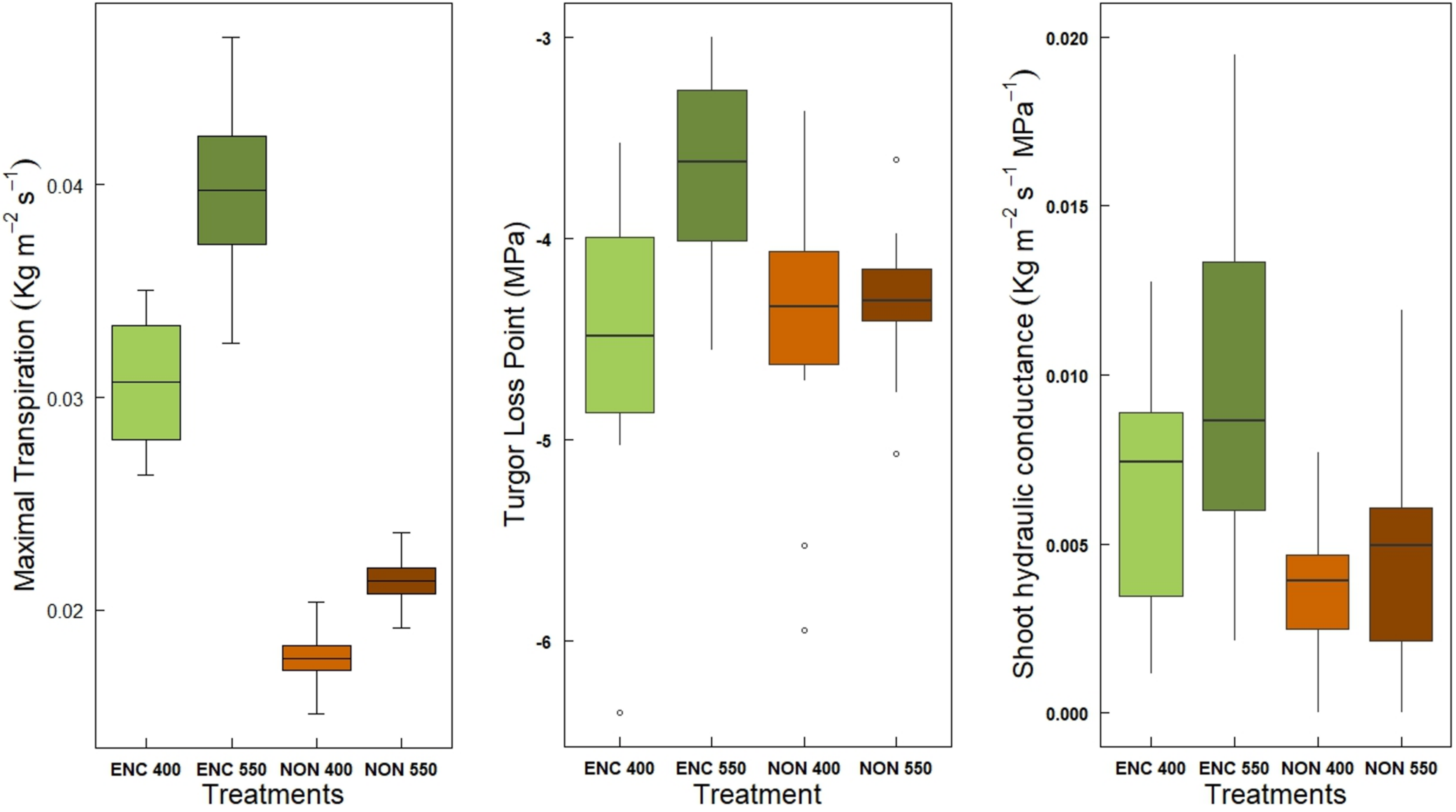

Rhodes University Elevated CO_2 Facility
11
10
9
8



- Scoffoni, C., John, G. P., Cochard, H. H., & Sack, L. (2017). Testing for ion-mediated enhancement of the hydraulic conductance of the leaf xylem in diverse angiosperms. *Journal of Plant Hydraulics*, *4*, e-004.


ATMOS
8 Relay Module
SRD-05VDC-SL-C

Results:



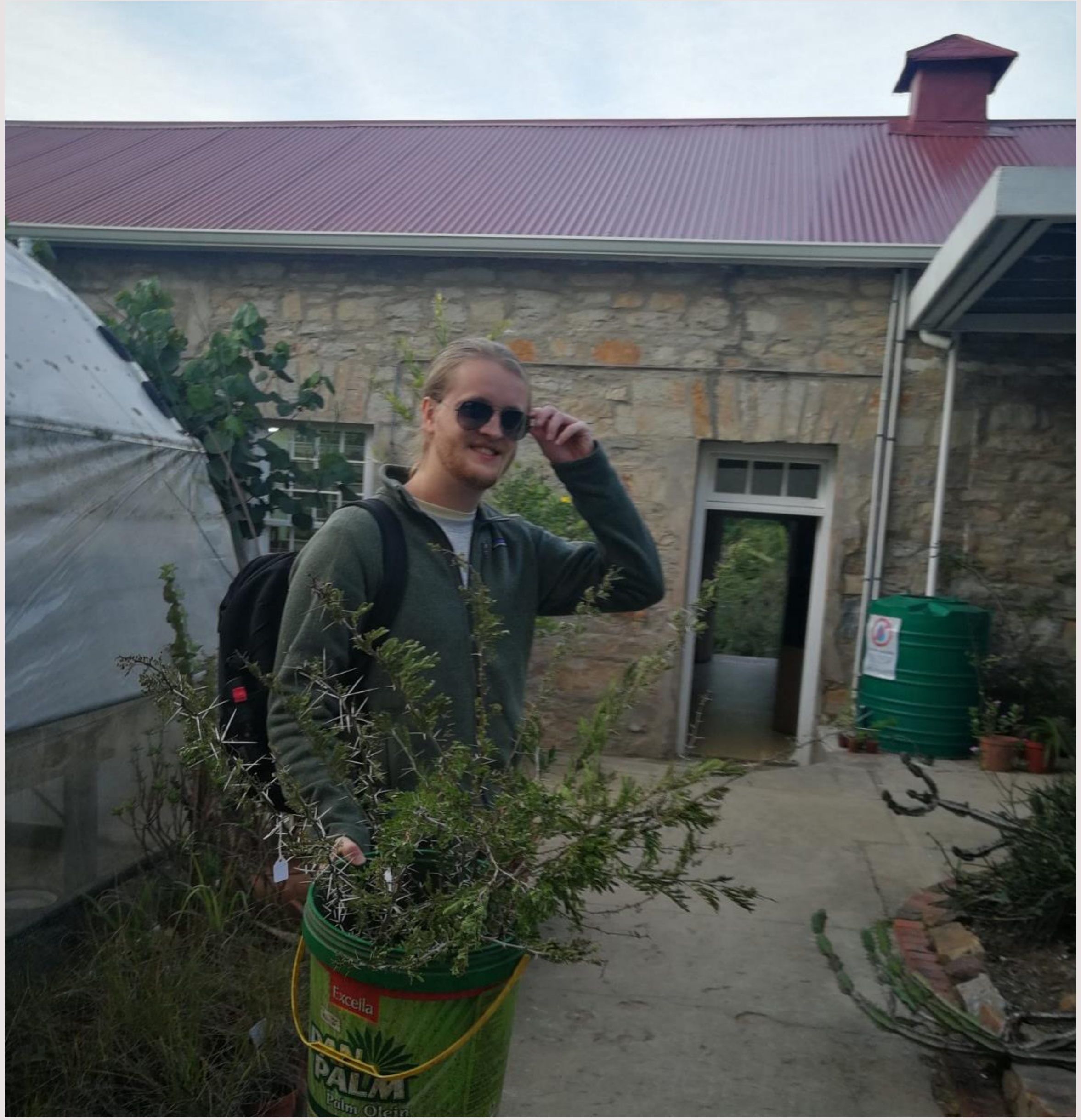
Maximal Transpiration (Kg m−2 s−1)
0.04
0.03
0.02
ENC 400
ENC 550
NON 400
NON 550
Treatments
Turgor Loss Point (MPa)
-3
-4
-5
-6
ENC 400
ENC 550
NON 400
NON 550
Treatment
Shoot hydraulic conductance (Kg m−2 s−1 MPa−1)
0.020
0.015
0.010
0.005
0.000
ENC 400
ENC 550
NON 400
NON 550
Treatments

Main findings:

- Encroaching species are stronger anisohydric “water-spenders” under elevated CO_2 that take advantage of water pulses by conducting water at a higher rate than non-encroaching species
- This comes at the cost of increased vulnerability to drought, leading to vastly reduced hydraulic conductance in response to water stress

Implications:

- Encroaching species seedlings can be expected to increase their competition with non-encroaching species seedlings and grasses under eCO_2, except under intense water stress.
- This should increase establishment rates for encroaching species following favourable water pulses, further increasing the rates of bush encroachment in these systems.



Questions: