The roots of Blue Carbon: Effects of soil properties on stilt root development in *Rhizophora stylosa*

Anne Ola & Catherine E. Lovelock

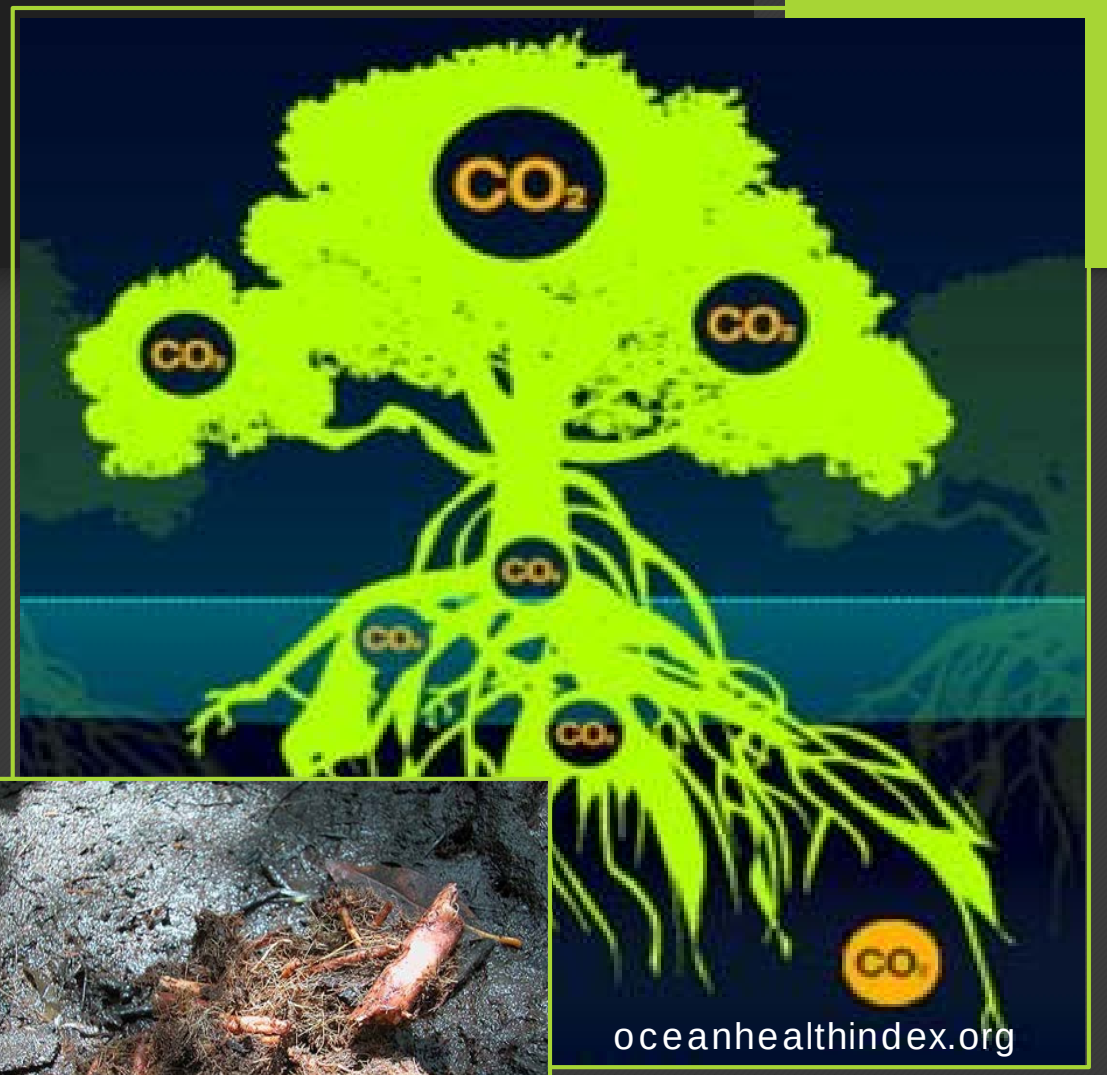
The University Of Queensland
AUSTRALIA

Blue Carbon

- Mangroves have large carbon (C) stocks in sediments, 5 - 10.4 Pg (Atwood *et al*. 2017)

➡ Climate change mitigation

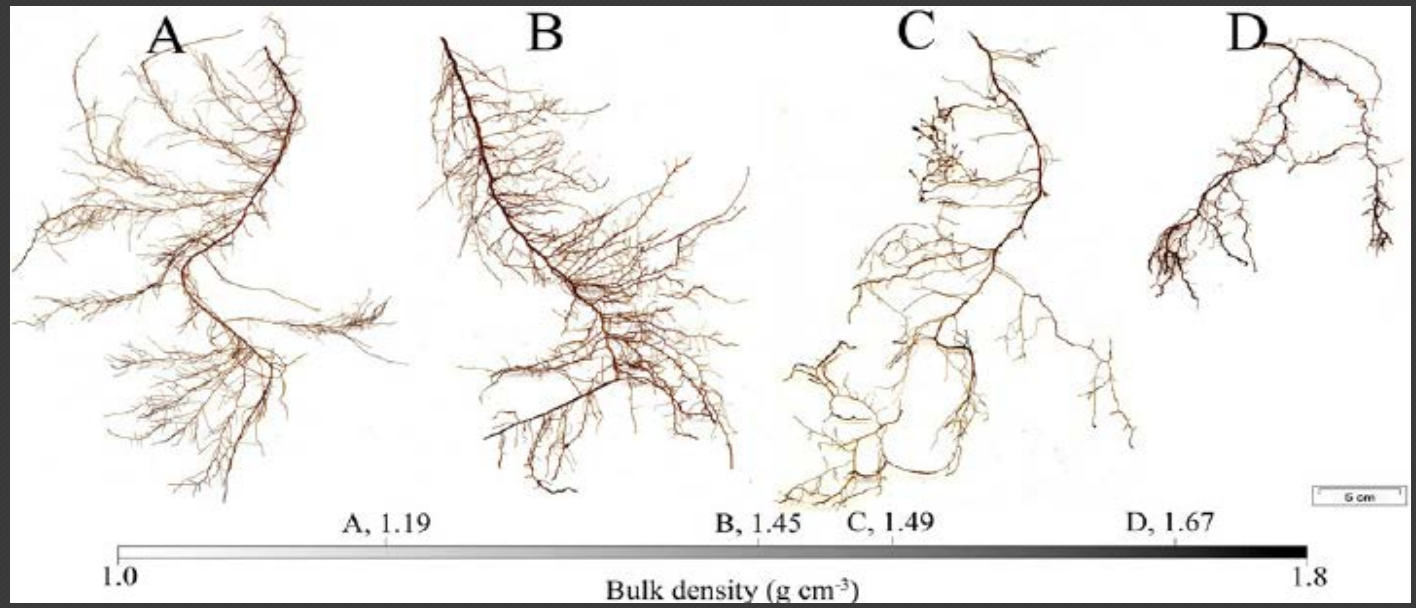
- Root biomass is a major contributor to these C sinks (McKee *et al.* 2007)



Plasticity and soil bulk density

- Plasticity of root development in response to environmental conditions (Zolla *et al.* 2010)

- Soil Bulk Density (BD):
  g soil per cm^3 volume



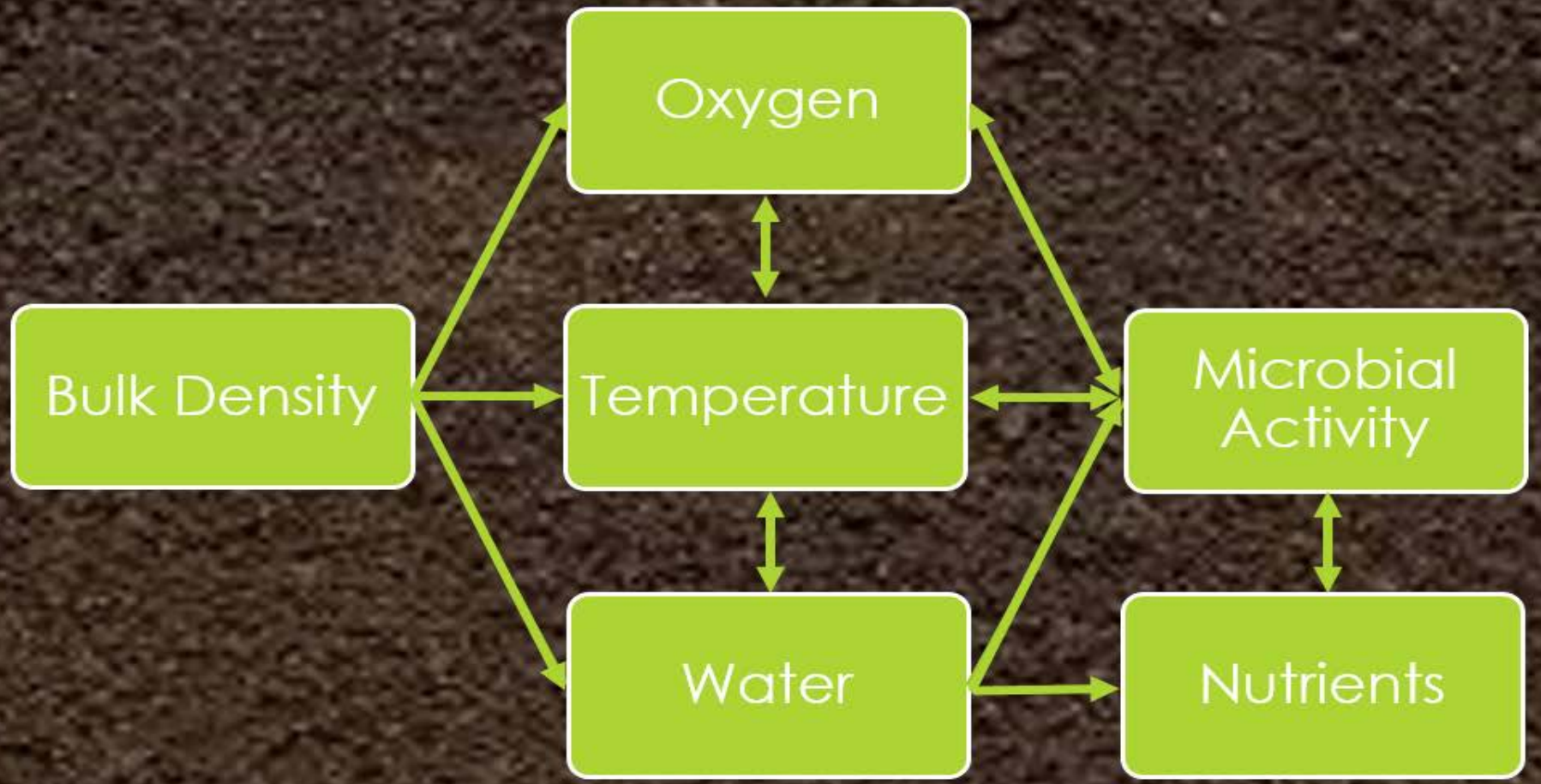
Alameda and Villar, 2012

Mangrove soil bulk density

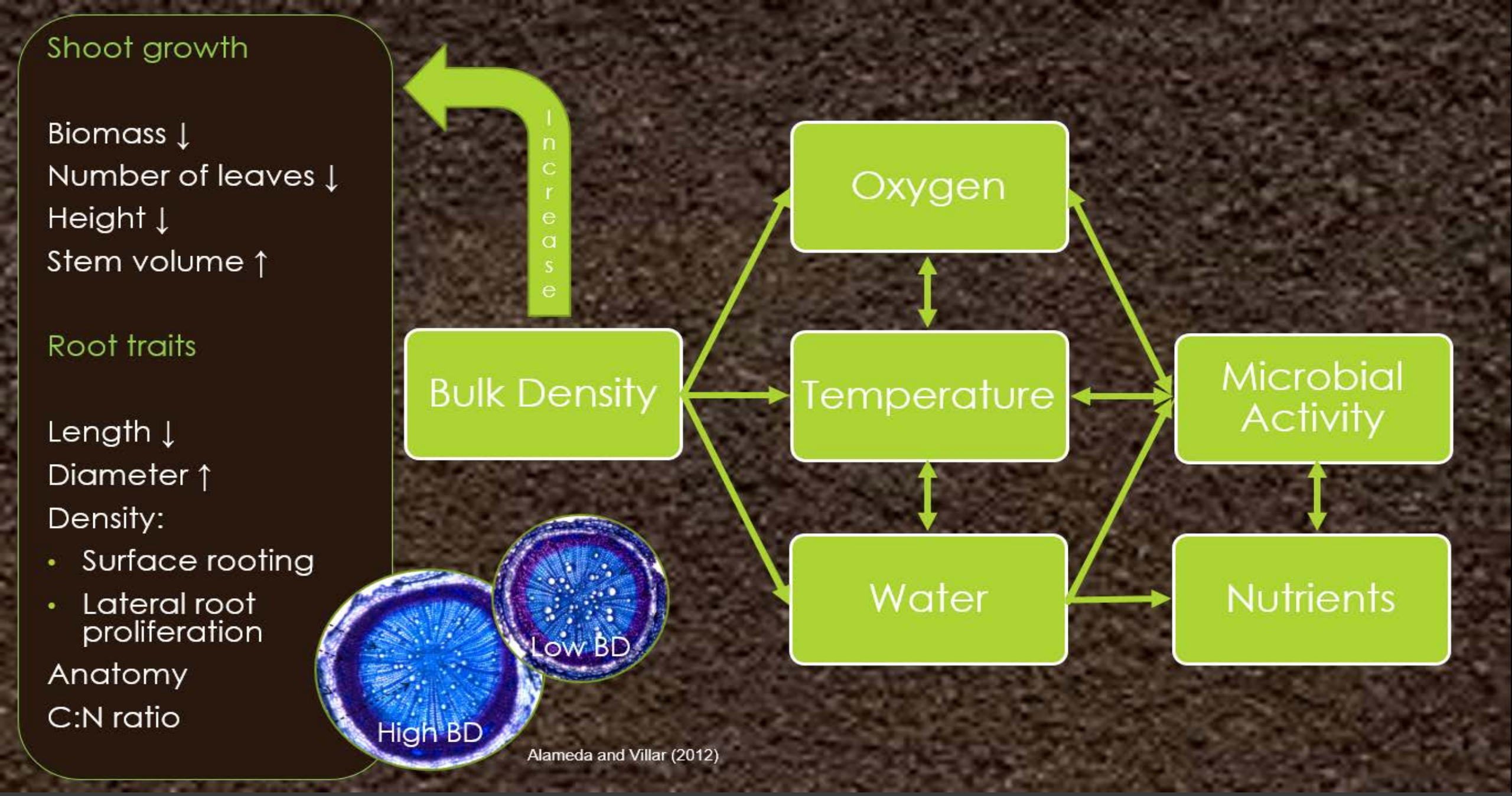
- Large range of soil BD in mangroves
- For example, 0.12 g cm^{-3} in the US (Genthner *et al.* 2013) to 1.37 g cm^{-3} in Australia (Lovelock *et al.* 2014)

High BD mineral soil

Low BD organic soil

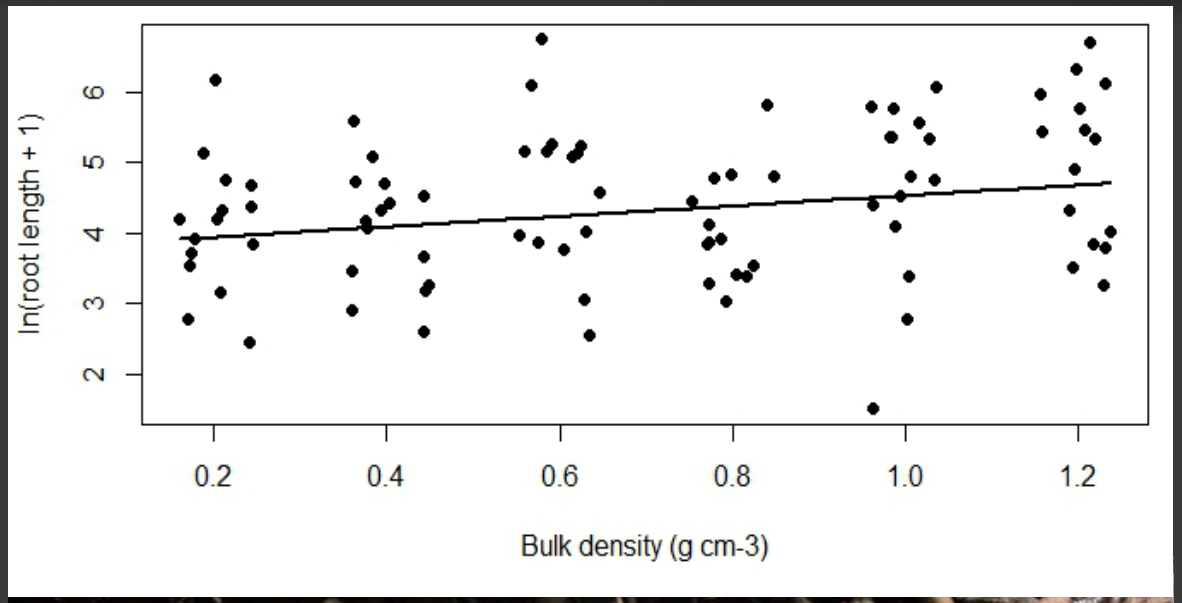


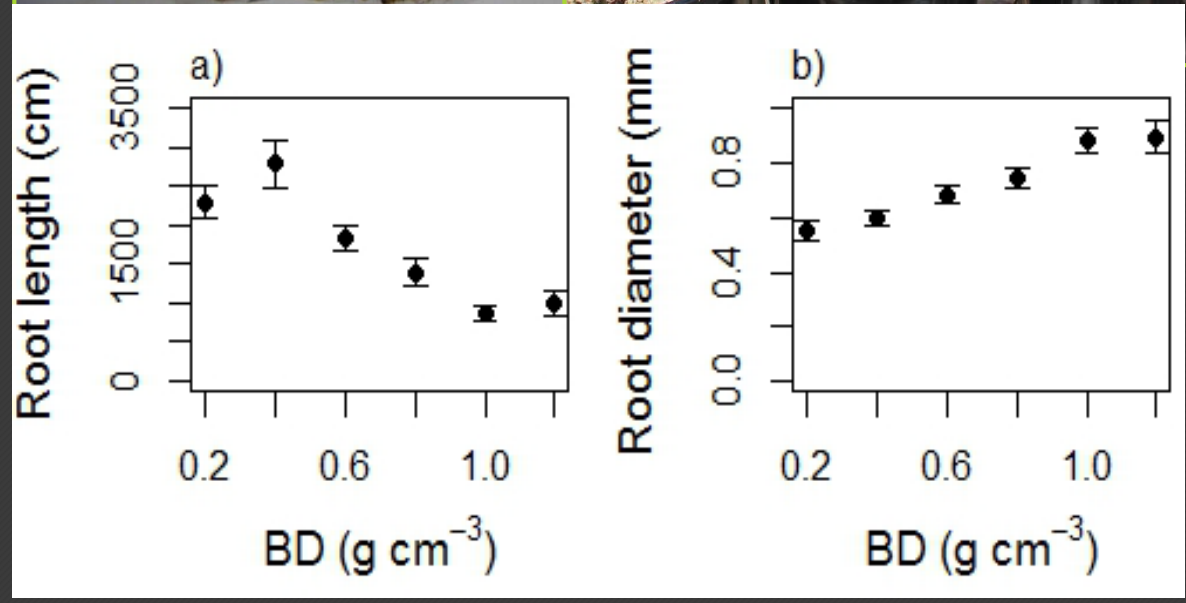
Schematic drawing of the effect of soil bulk density (BD) on soil properties.



Schematic drawing of the effect of BD on root growth.

Contrasting responses –field and lab





Aim and Hypothesis

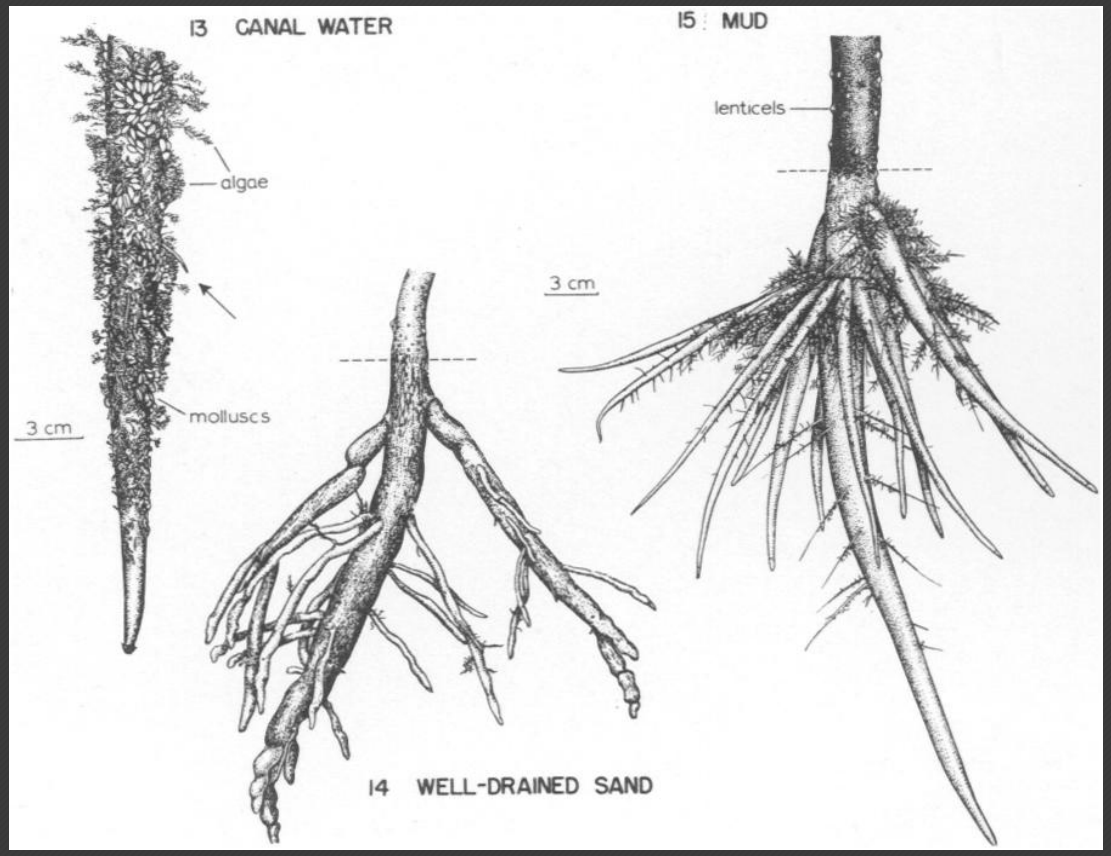
Aim:

To assess the morphological and anatomical response of *R. stylosa* stilt roots upon exposure to soils of different BDs.

Hypothesis:

1) BD has an effect on root traits.

2) The effect of soil BD on root growth is also reflected on anatomical features.



Gill and Thomlinson, 1977

Burial: 6 month

WinRHIZO

BD (g cm^{-3})	Peat (g)	Perlite (g)	Sand (g)
0.4	10.6	14.3	156.6
0.8	10.6	7.3	345.6
1.2	10.6	0.4	529.2

Root traits: C & N

Diameter Volume

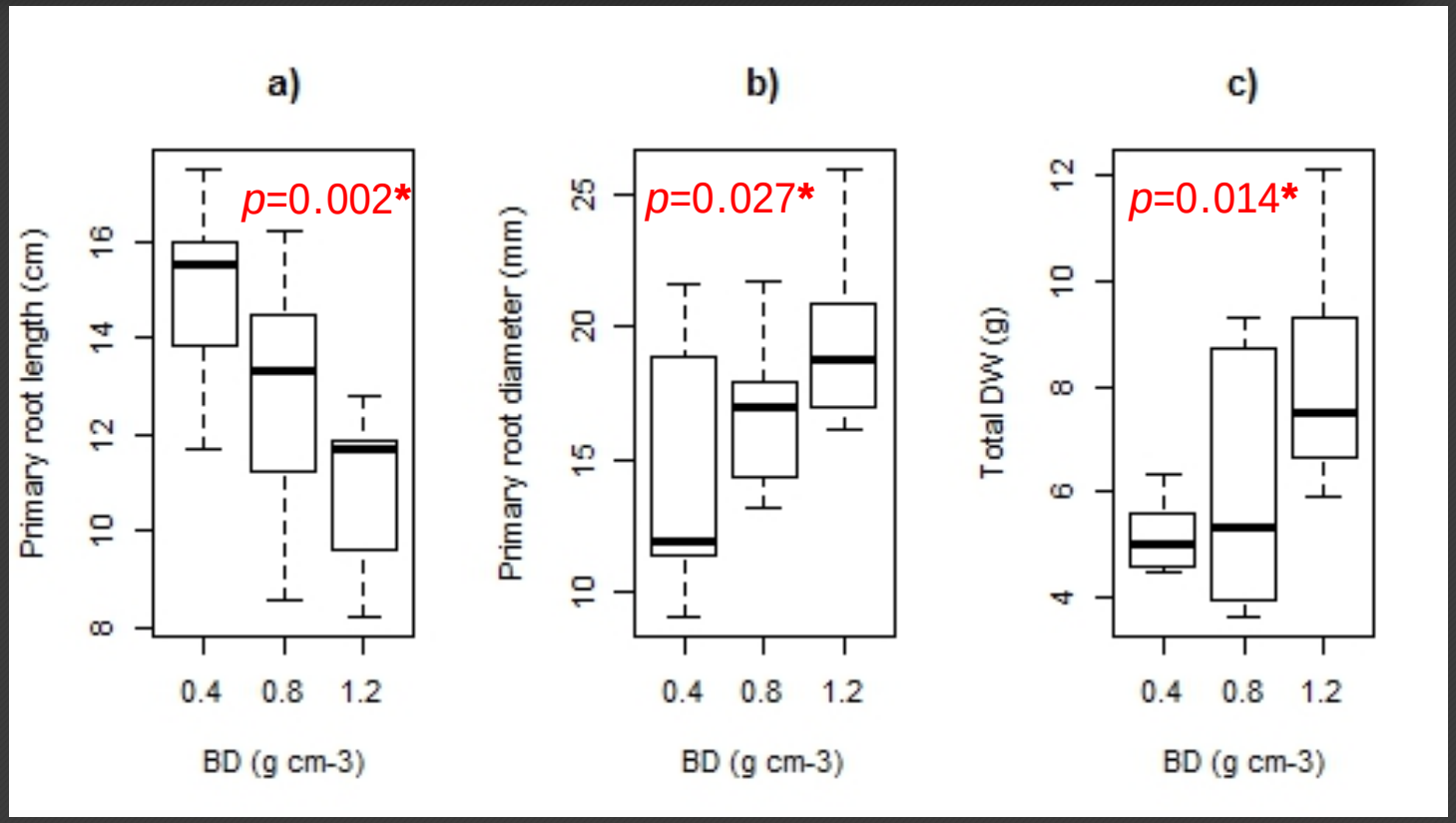
Biomass Tissue density

Length (total, primary, lower order)

Results

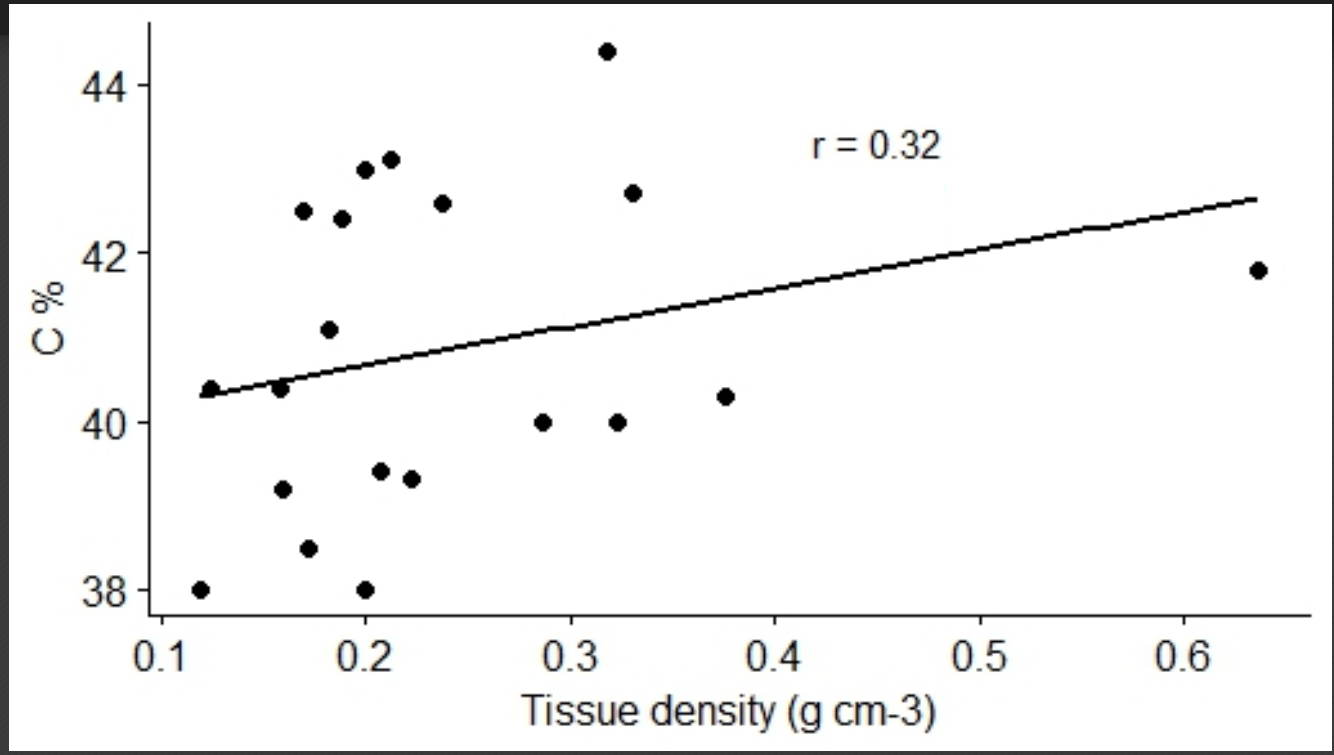
Loose soil (0.4 g cm^{-3})

Dense soil (1.2 g cm^{-3})

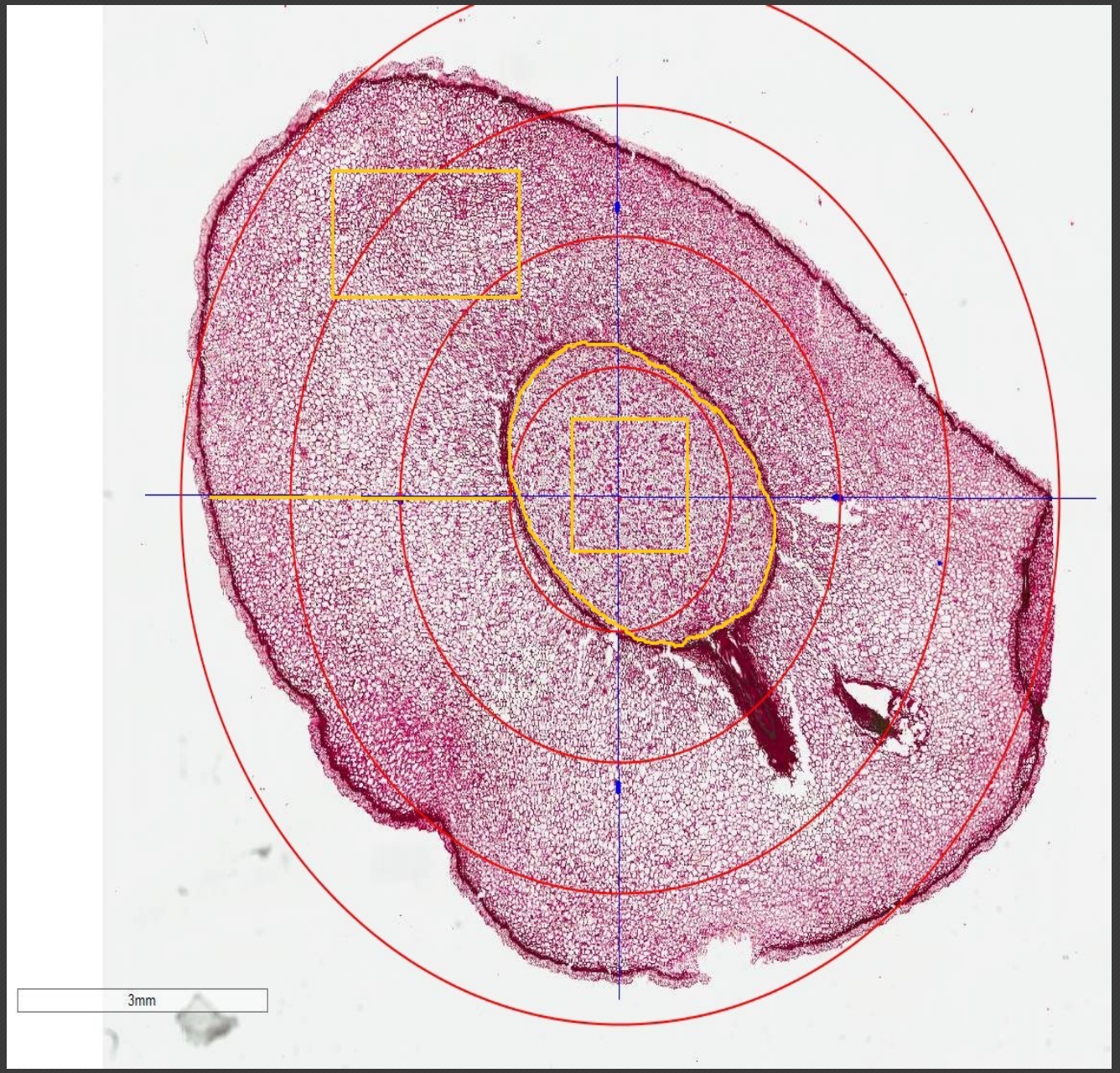


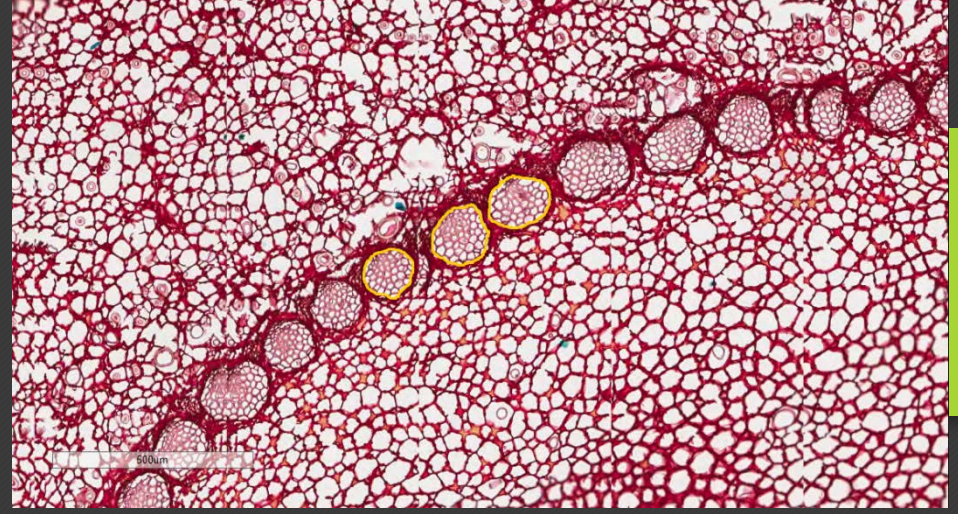
Soil BD affects primary root length and diameter, as well as root biomass of *R. stylosa* stilt roots.

Results



Stepwise linear regression analysis suggests root C % is influenced by log(tissue density) (*p*=0.03). C:N is not only influenced by log(tissue density) (p=0.007) and primary root diameter (p=0.025).





↑ Fibrous strand size/phloem area (μm^2)

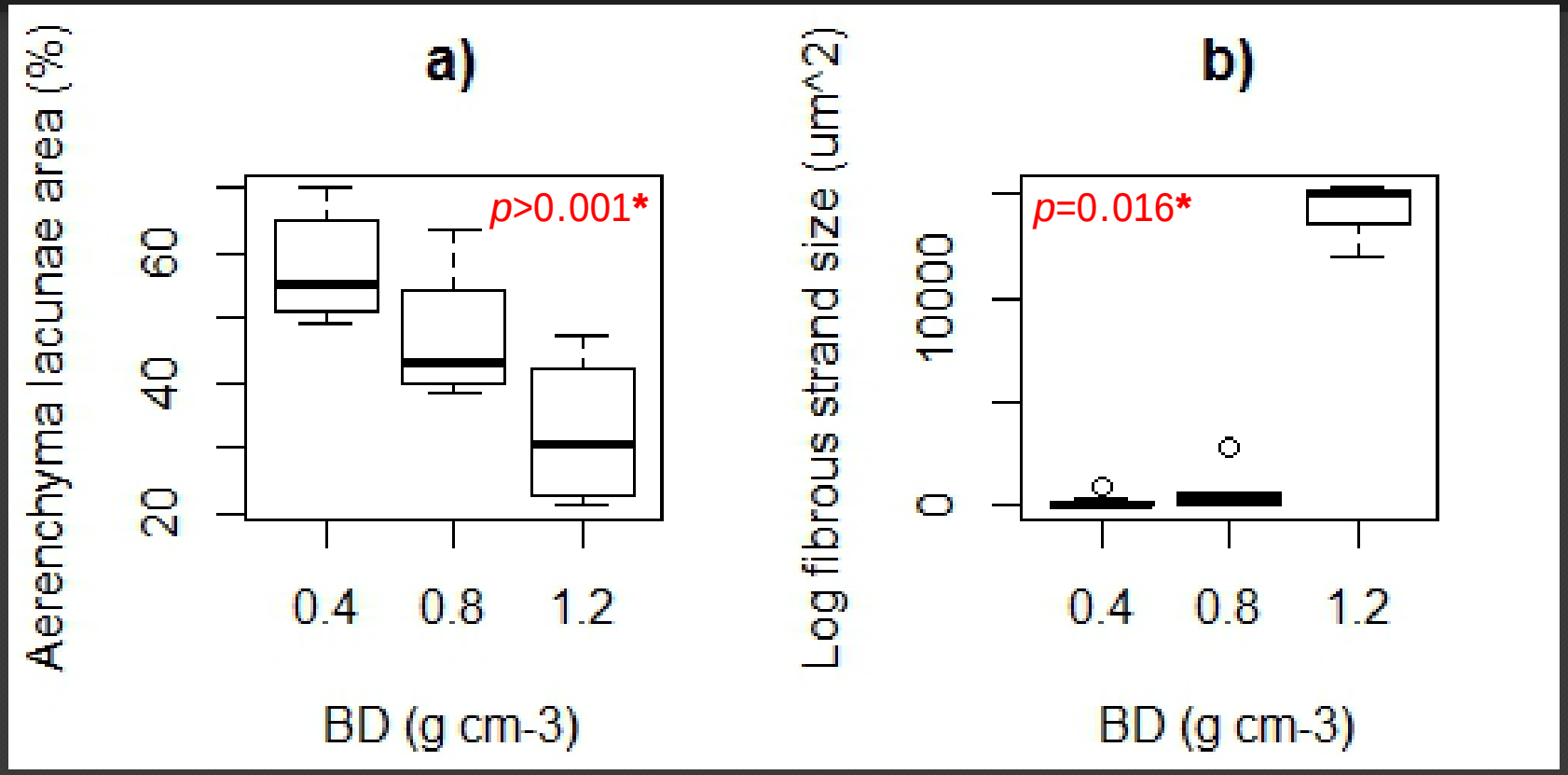
← Cortex thickness (mm)

← Aerenchyma lacunae (% area)

← Vascular tissue cell wall (% area)

← Vascular cylinder (mm^2)

Results



Soil BD affects anatomical features (aerenchyma, fibrous strands) of stilt roots, features important in root aeration and structural support, respectively; and influence tissue density and composition.

Conclusion

- Stilt roots of *R. stylosa* are strongly influenced by variation in soil BD.
- Soil BD also affects root anatomical features such as aerenchyma and fibrous strands found within the vascular circle.
- Tissue density influences root C %, and together with primary root diameter the C:N ratio.

Variations in soil type and stilt root traits are likely to influence C cycling in *Rhizophora* forests.