

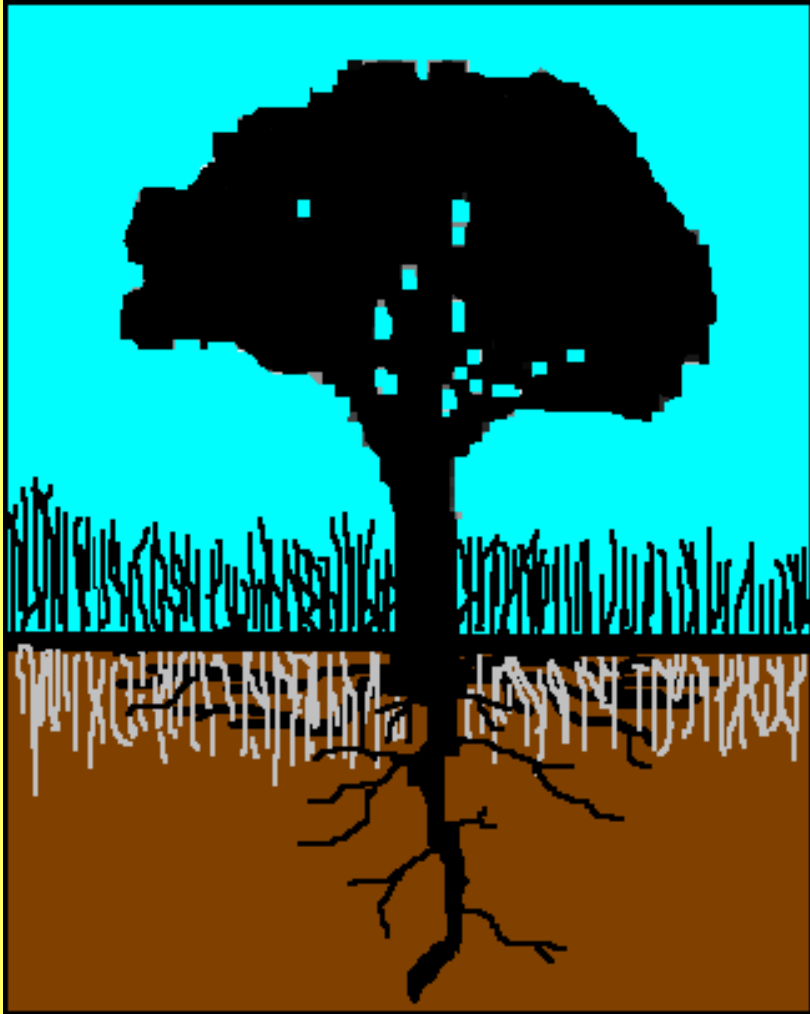
How dependent are trees on access to deep versus shallow soil water?

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Niche Separation by Rooting Depth



- Walter (1971): Trees and grasses can maintain long-term coexistence by using different soil compartments for water
- Trees may acquire part of their water from different sources than grasses, but how dependent they they on these water sources?
- Dependency on lateral roots versus deep roots is tested with a **root severing experiment**.
- The advantage of root severing over root excavation is that it tests actual root function rather than merely their presence or absence.

Experimental Design

Study Species:

- *Terminalia sericea*

- wide-spread, broad-leafed, drought-deciduous tree
- dominant in the Sourveld
- rather shallow rooting system (Smith and Grant 1986)
- reported to have taproots to 1 m depth (Hipondoka et al. 1995)

18 medium-sized individuals (3-4m tall, DBH 7-10cm)

divided over 3 groups:

A: Taproot severed

B: Lateral roots severed (1m from tree, 50cm deep)

C: Control group

Changes in plant water use were monitored over time following the root severing



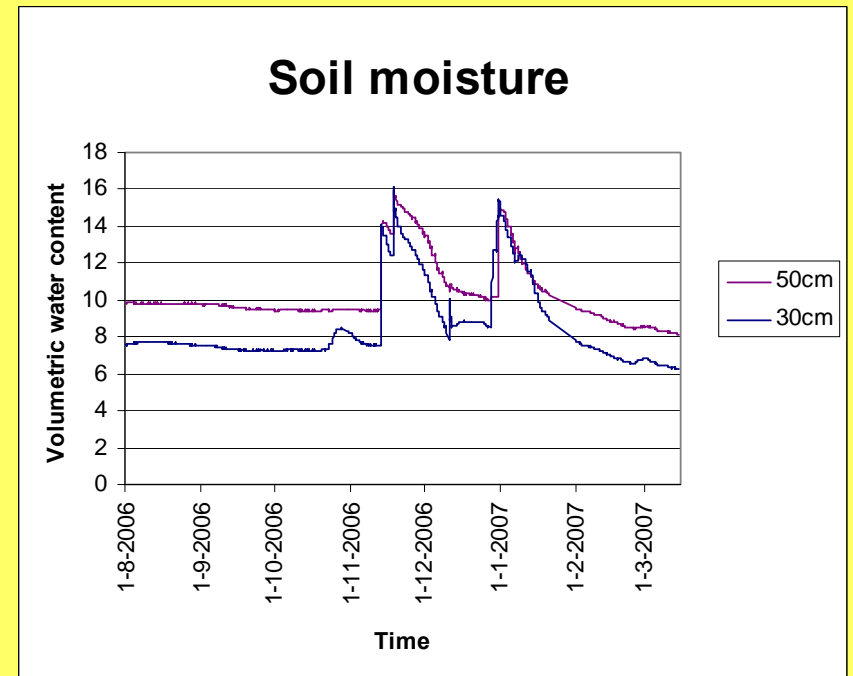
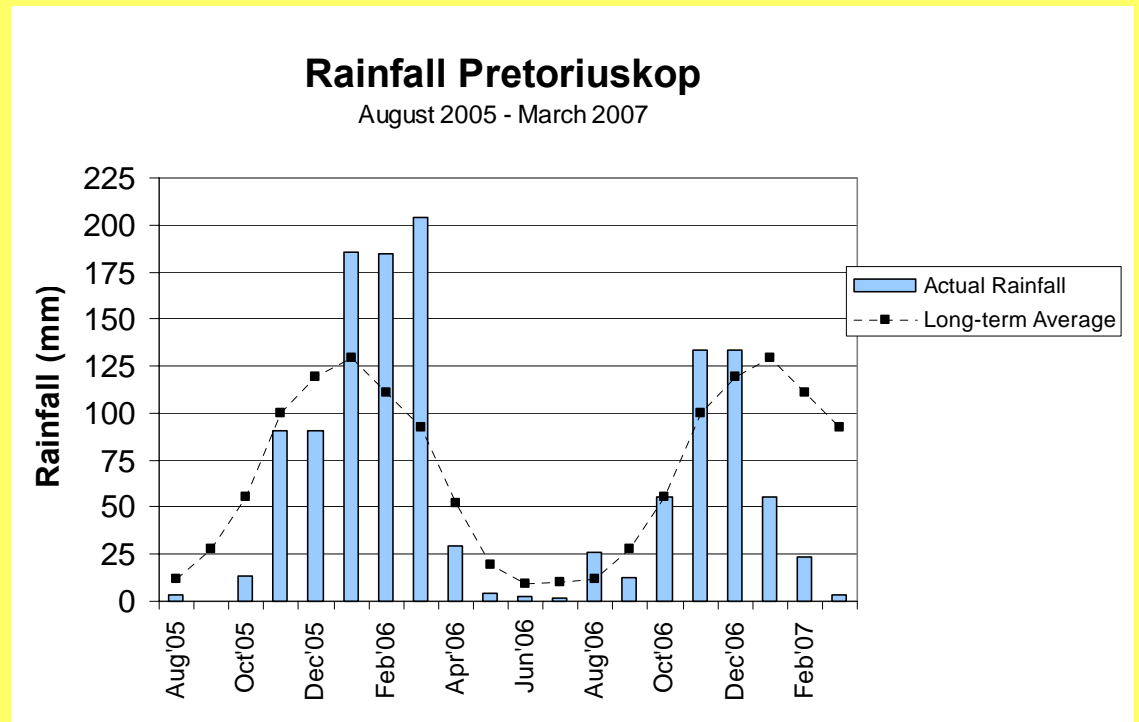
Study site:

Pretoriuskop

750 mm/year

Sandy Soils > 1m deep

Nutrient poor



Scholander Pressure Chamber



PMS Instrument Company, Albany, OR, USA

Xylem Pressure Potential (XPP) as a measure of plant water stress was measured using a Pressure Bomb.



Leaf phenology over time was recorded for all trees in the experiment

Leaf Porometer

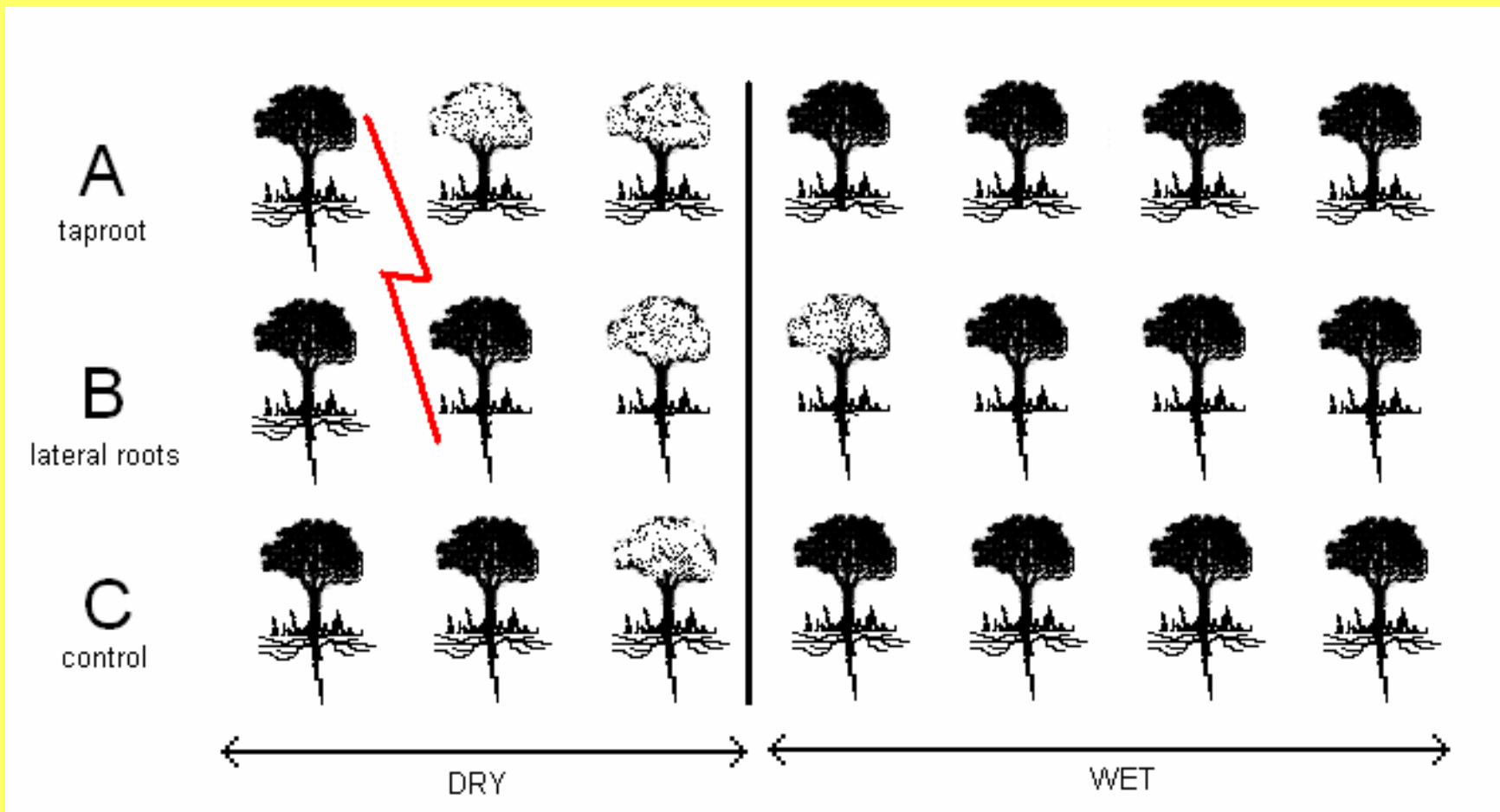


Stomatal Conductance was measured with a Leaf Porometer

Assumptions:

Taproot (deep roots): mainly water uptake

Lateral roots: mainly nutrient uptake

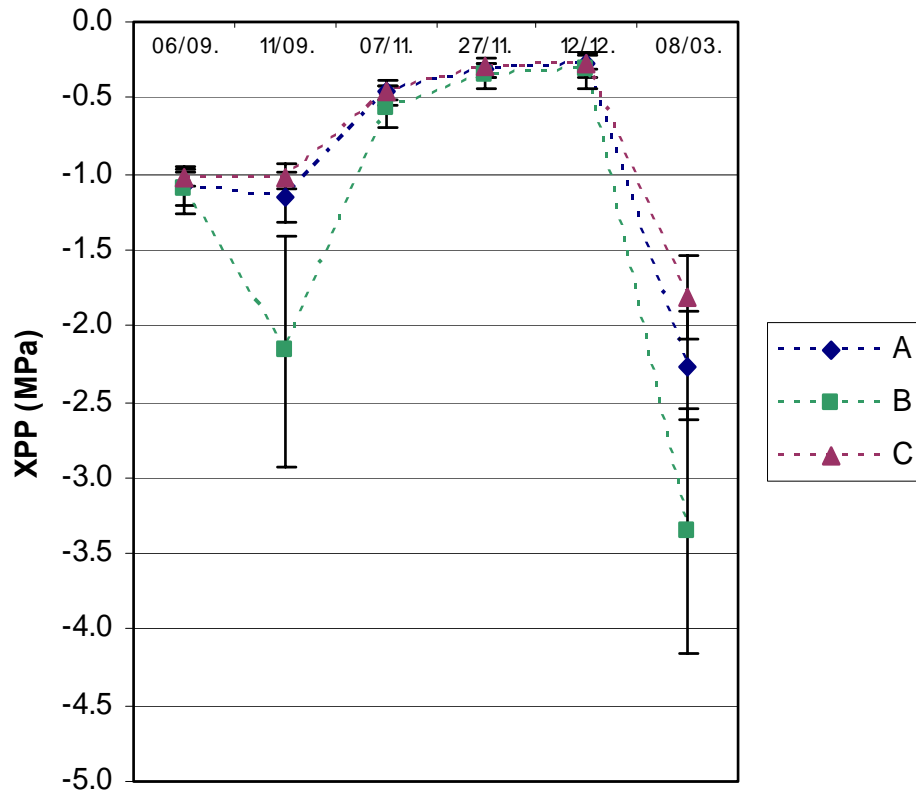


Root systems *Terminalia sericea*

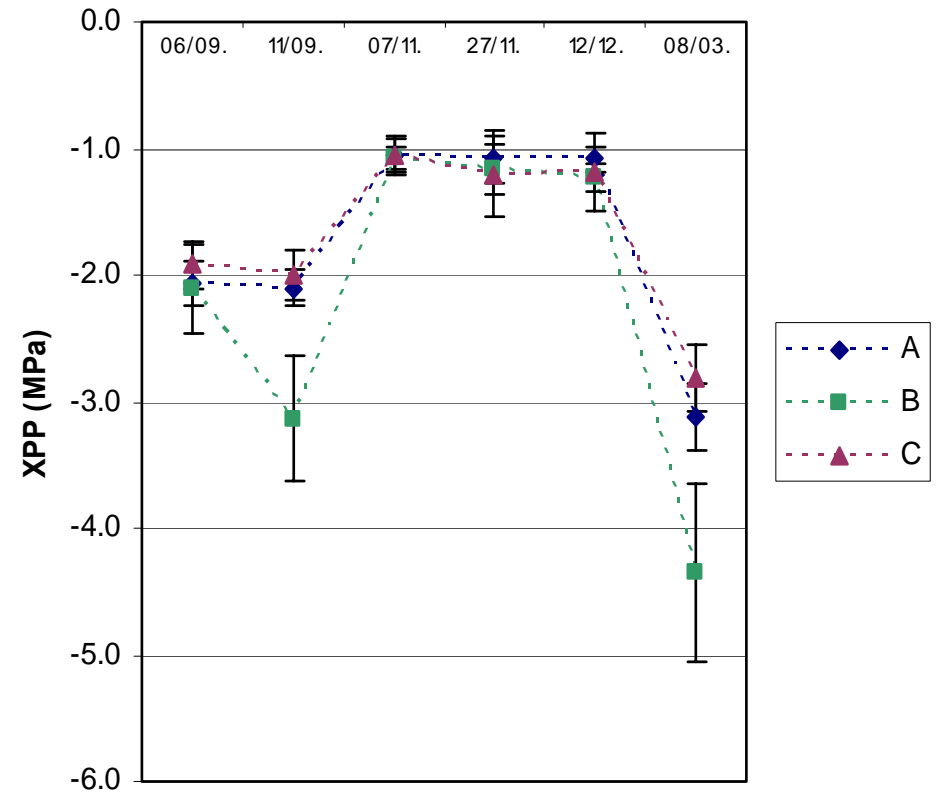


Results

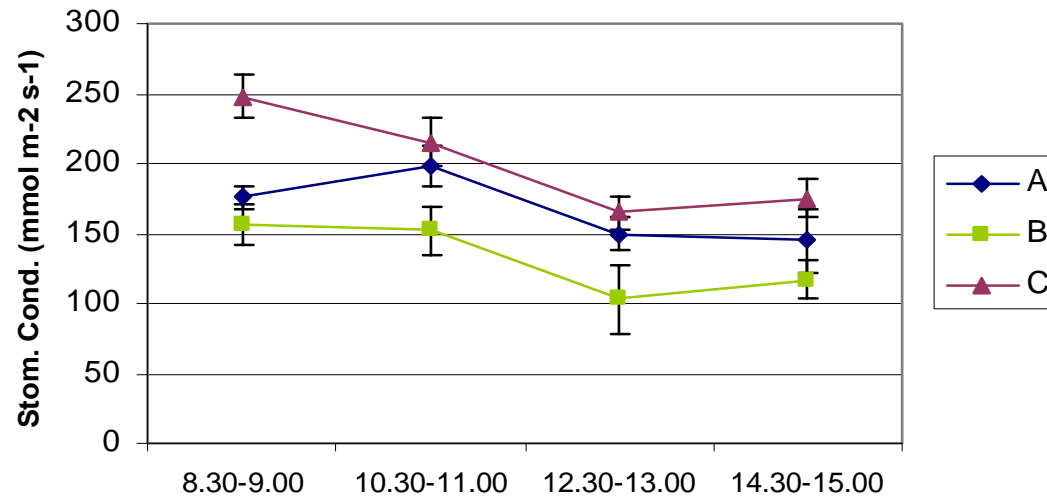
Pre-dawn Xylem Pressure Potentials



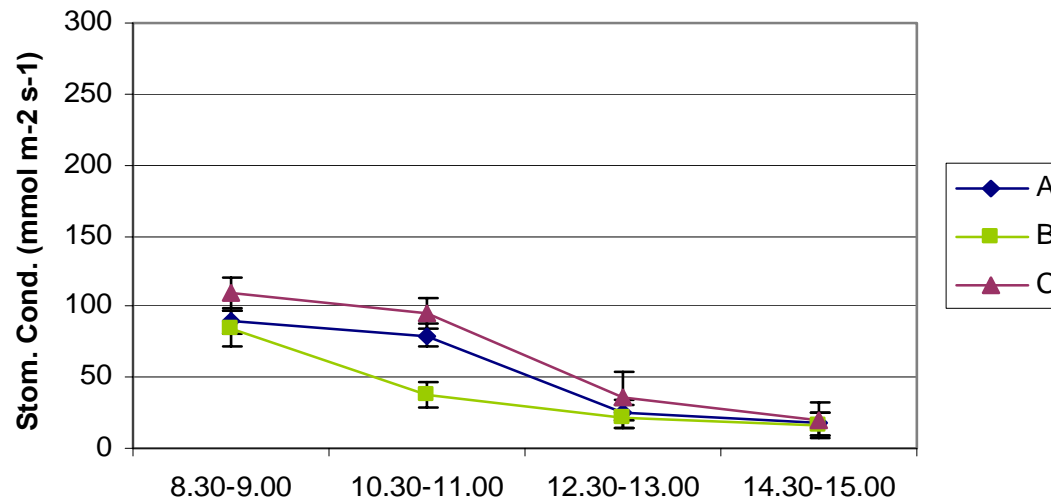
Mid-day Xylem Pressure Potentials

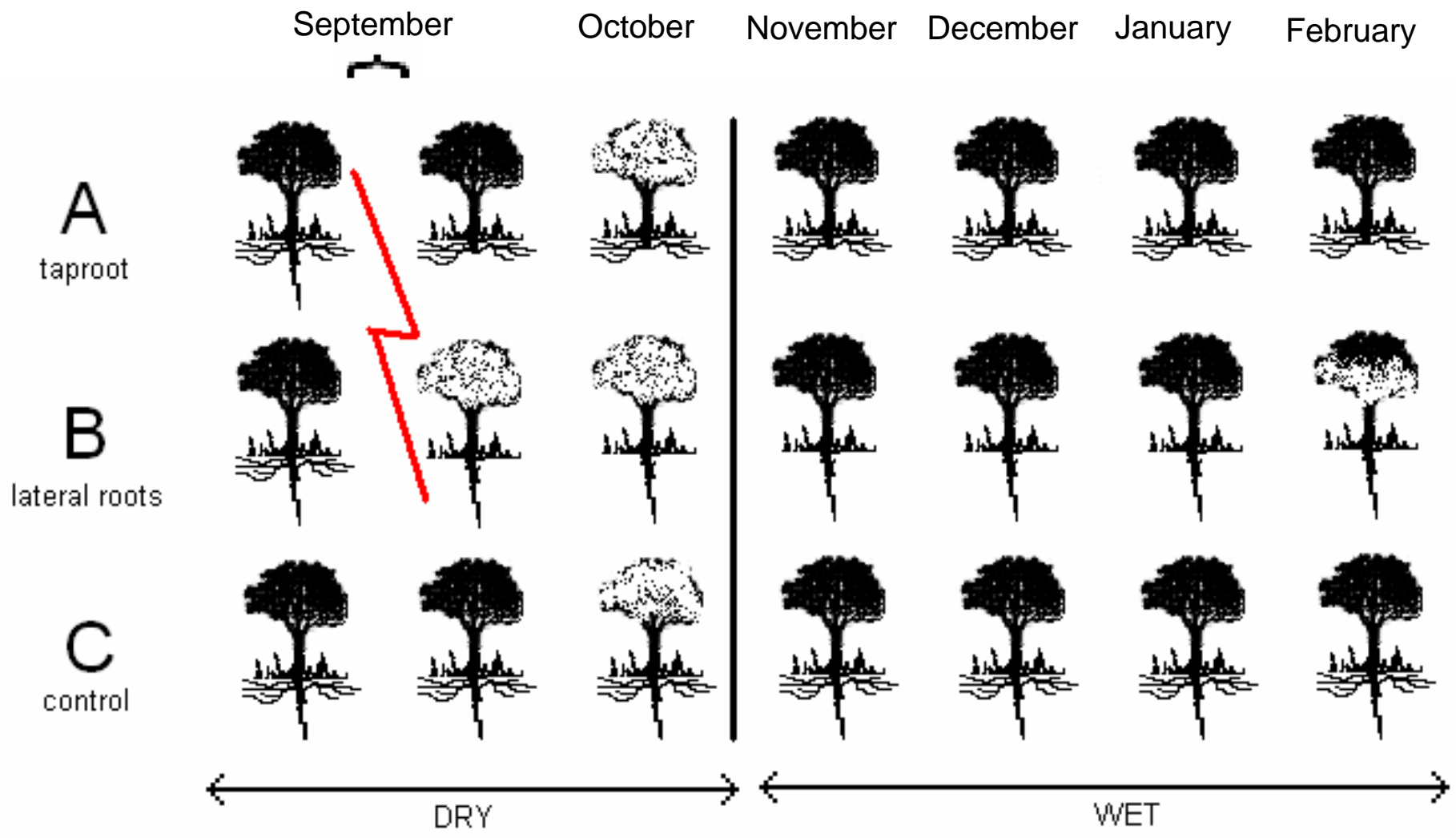


Stomatal Conductance 07/11/2006

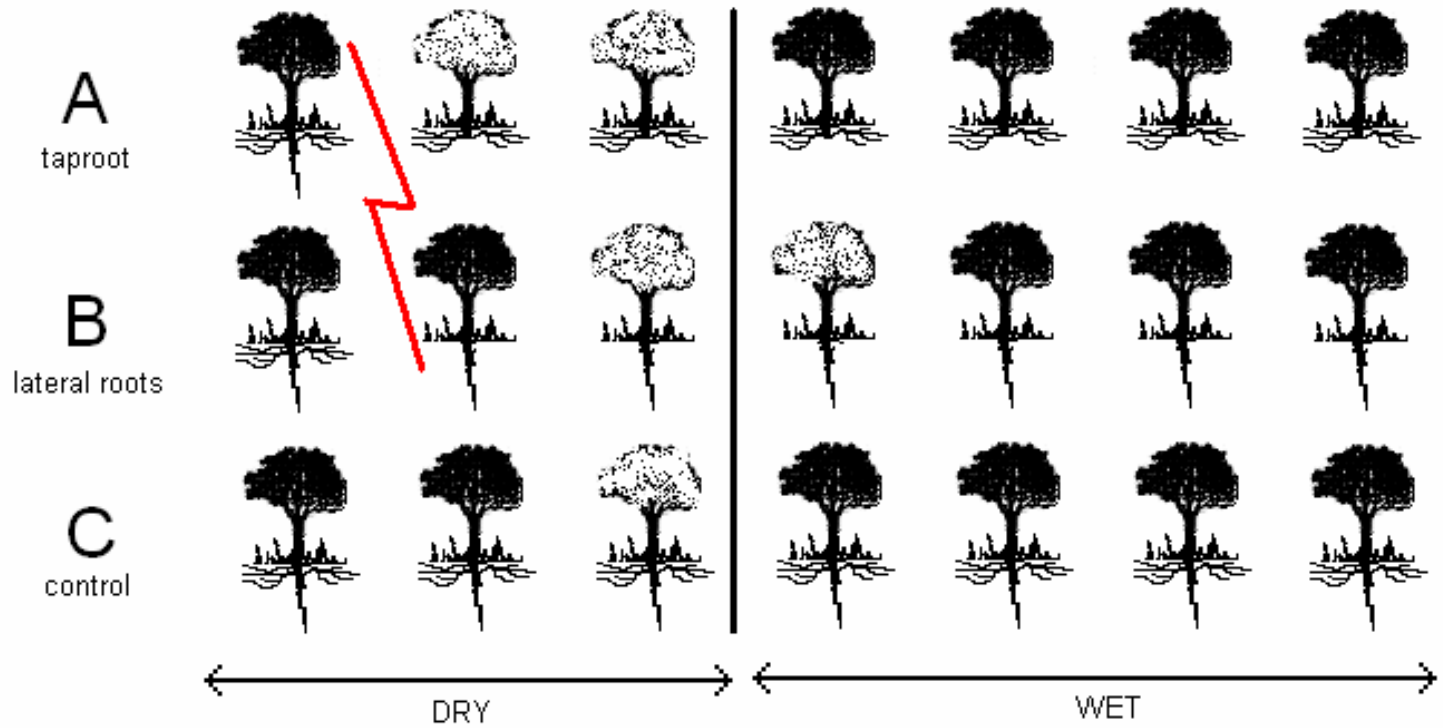


Stomatal conductance 09/03/2007

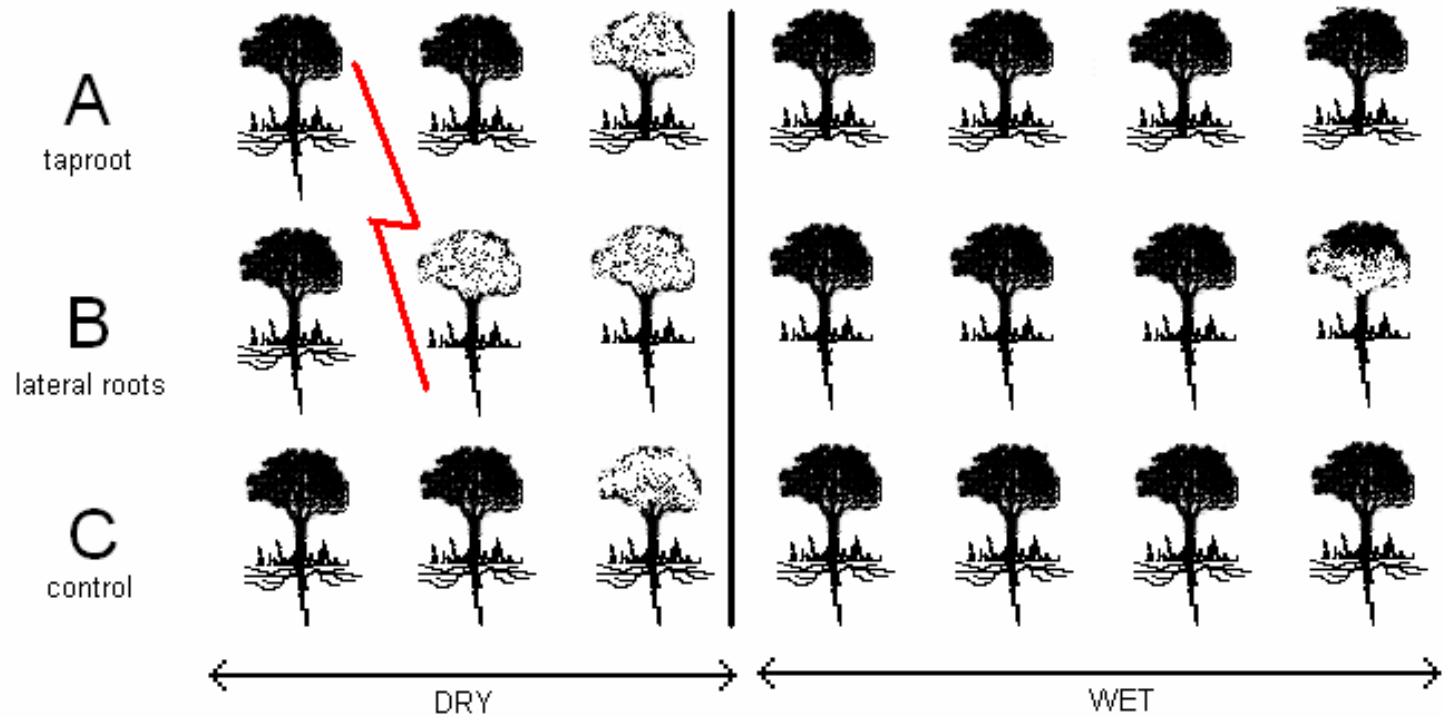




Hypothesis



Observed



Conclusions

- After severing lateral roots, trees had reduced Xylem Pressure Potentials and lower Stomatal Conductance, whereas the effect of taproot severing on plant-water relations was minimal
- Medium-sized *Terminalia sericea* seems to depend largely on its lateral roots for maintaining XPP and Stomatal Conductance
 - **This contradicts “Walter-hypothesis”**
- Variation in changes in water availability after root severing is probably due to variability in rooting structures within this species
 - Would the medium-sized individuals WITH real taproots be “*destined*” to become large trees?

Acknowledgements

The background image shows two men in khaki uniforms and hats lying on the ground in a field of dry grass. They are both smiling and appear to be resting. The man on the left is wearing a light-colored hat and has his hands near his chest. The man on the right is wearing a similar hat and has his hands behind his head. The overall scene is outdoors and appears to be a field or savanna.

We would like to thank the staff of the Tree-Grass Programme for the assistance in the field, the NRF for funding and the Kruger National Park for allowing us to do research in the Park.

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