

Portulacaria afra (L.) Jacq. growth and survivorship in response to watering supply and soil type

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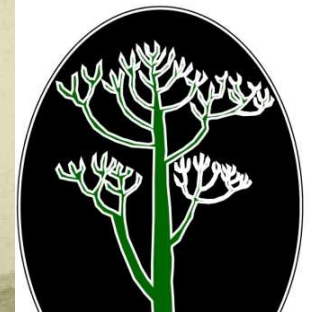
Gamtoos Irrigation Board
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environment & tourism

Department:
Environmental Affairs and Tourism
REPUBLIC OF SOUTH AFRICA

<http://www.miller-mccune.com/uncategorized/commander-carbon-alter-ego-spekboom-3745/>



Rhodes Restoration Research Group

***Portulacaria afra* - Spekboom**

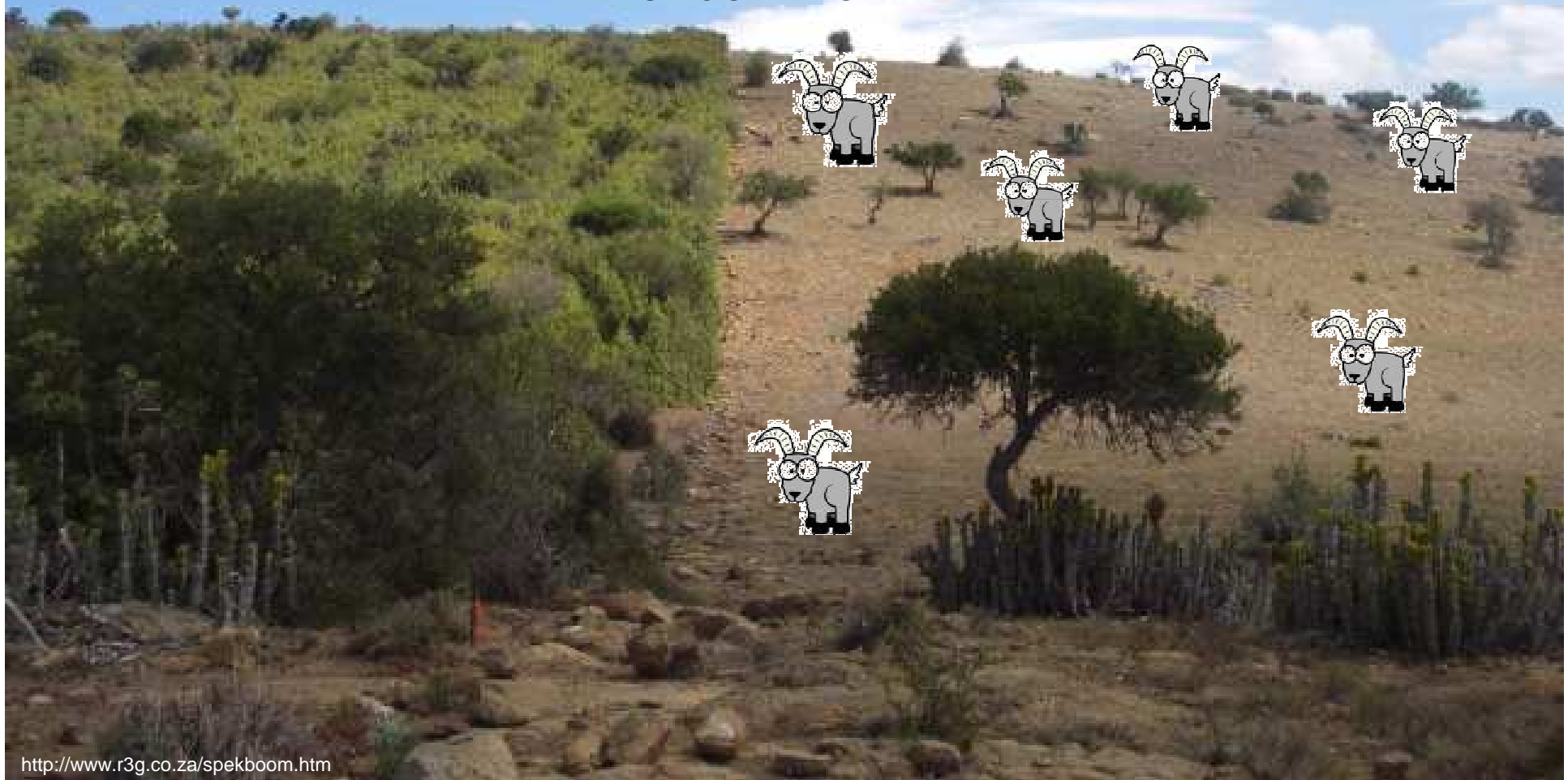
- Small leaf, succulent plant species
- Facultative CAM photosynthesis
- Acquired the name “Super plant”
- Ecosystem engineer
- Widely distributed in Thicket Biome of Western and South Eastern Cape
- Characteristic species of Spekboom Succulent Thicket.



15% Intact: dense closed succulents canopies

85 % degraded: pseudo-savannas & soil erosion

Fence- line



Restoration via spekboom

Spekboom's ability to:

- Sprout from replanted cuttings
- Possession of good ground cover
- Soil binding properties

= Good Candidate


Eastern Cape= semi- arid+ has different soil types

- Influences establishment, survival & growth
- Less than 1/2 cuttings survive during initial 2 years of establishment

15 3 2009

Solution to this problem?

- Determine and implement a successful watering regime during initial establishment to:

-  establishment, survivorship & growth

- Most spekboom farmers practice these methods

BUT Key questions remain unanswered:

- Does soil water supply & soil type affect survivorship and growth of spekboom?
- What is the optimal watering regime required to achieve successful results?

Aims of the study

AIM 1:

- To determine whether growth & survival is affected by moisture availability

AIM 2:

- To determine whether moisture availability is affected by:
 - frequency and magnitude of watering
 - & by soil type

AIM 3:

- To determine a successful watering regime to improve growth & survivorship of spekboom

Methods

- X 50 non-rooted cuttings planted
- X 2 soil types used
- X 5 treatments conducted/soil:
 - < 8% SWC (no watering)
 - 8-10% SWC
 - 10-15% SWC
 - 15-20% SWC
 - > 20% SWC (regular watering)
- SWC measured every 4 to 7 days and plants watered, if necessary.



Prior to harvest

Establishment measured:

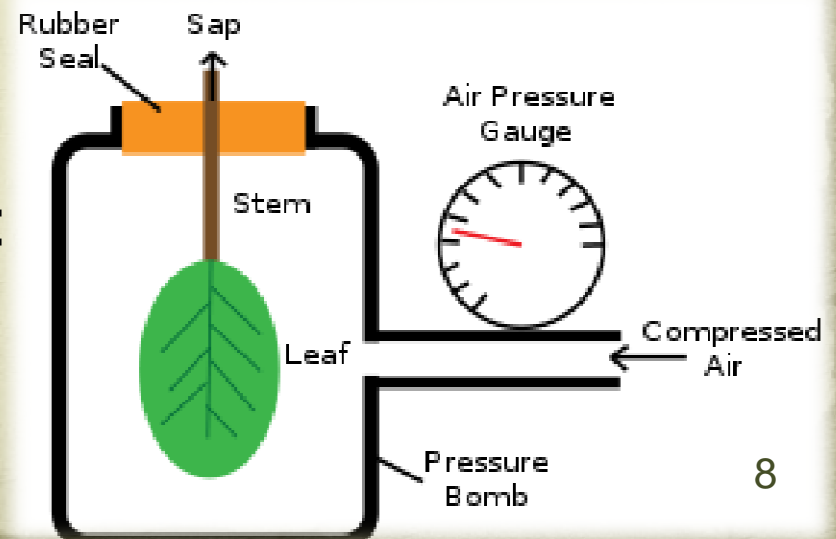
- Absence/presence of roots recorded after two weeks of planting

Survival measured:

- No. dead leaves, leaf area & leaf weight

Shoot water potential measured:

- with a Shönland pressure chamber



Post Harvest

- Growth measured:
- Dry biomass for:
 - Roots
 - Stem/truncheon
 - Leaves
 - Branches
 - Whole plant

- Data Analysis:

- Factorial ANOVA used to determine:

- What & how variables affected survival & growth

Soil type*SWC



SWC

Soil type









- Post-hoc analysis (Fisher LSD) used to identify:
 - Where significance differences occurs within data

Results

 Survival
 Growth

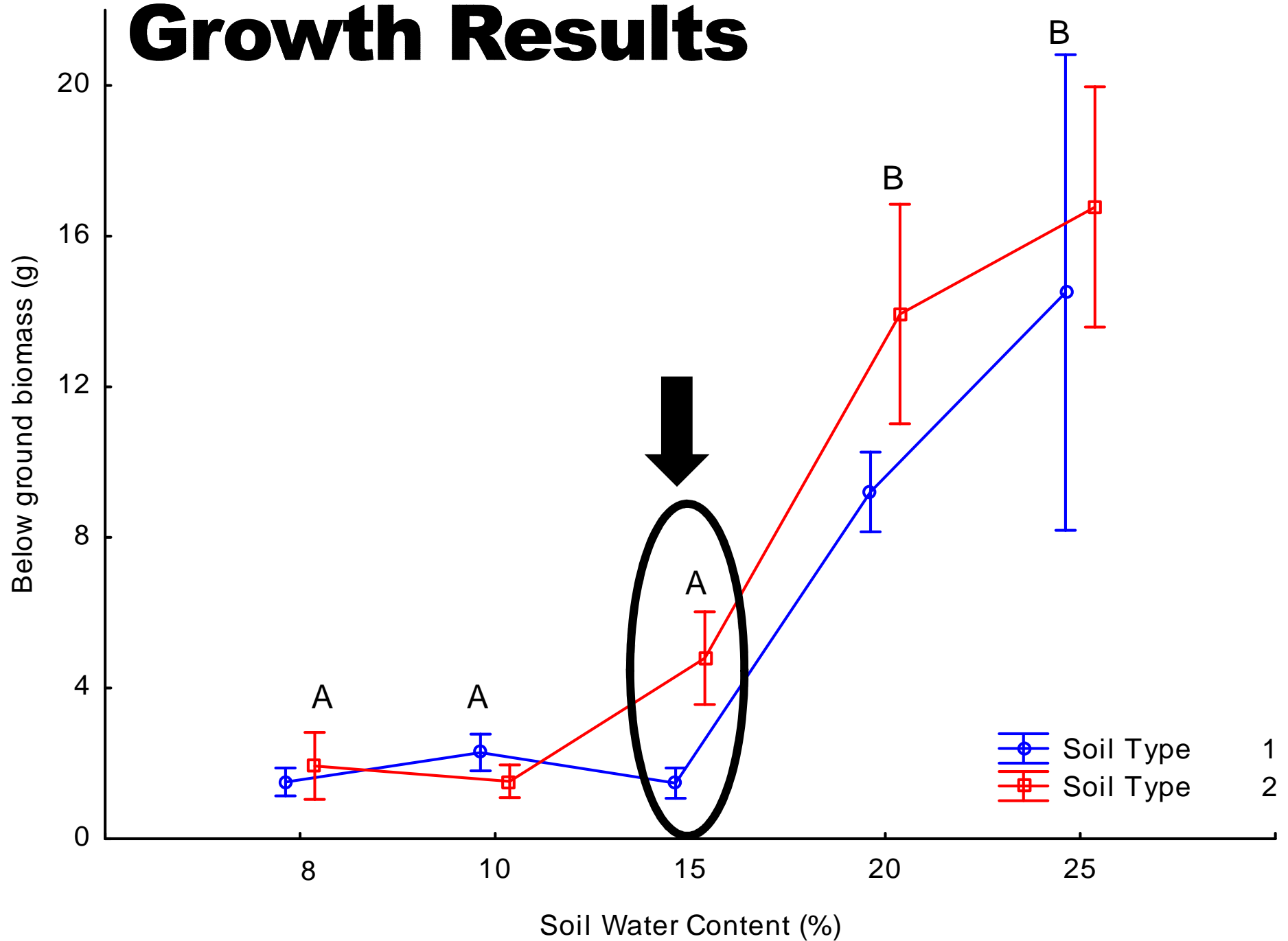
Survival & Growth Parameters	Soil Water Content (SWC)	Soil Type	Survival & Growth Parameters	Soil Water Content (SWC)	Soil Type
Leaf area (cm ²)	$F_{4,40} = 16.63$, $p < 0.000^*$	$F_{1,40} = 22.16$, $p < 0.000^*$	Total biomass (g)	$F_{4,40} = 5.97$, $p < 0.001^*$	n.s.
Average weight of 10 leaves (g)	$F_{4,40} = 68.37$, $p < 0.000^*$	$F_{1,40} = 4.70$, $p < 0.036^*$	Leaf biomass (g)	$F_{4,40} = 5.81$, $p < 0.001^*$	n.s.
Number of dead leaves	$F_{4,40} = 3.08$, $p < 0.017^*$	n.s.	Average growth of plants (g)	$F_{4,40} = 28.32$, $p < 0.00^*$	n.s.
Below ground biomass (g)	$F_{4,40} = 13.08$, $p < 0.000^*$	n.s.	Above ground biomass (g)	n.s.	n.s.

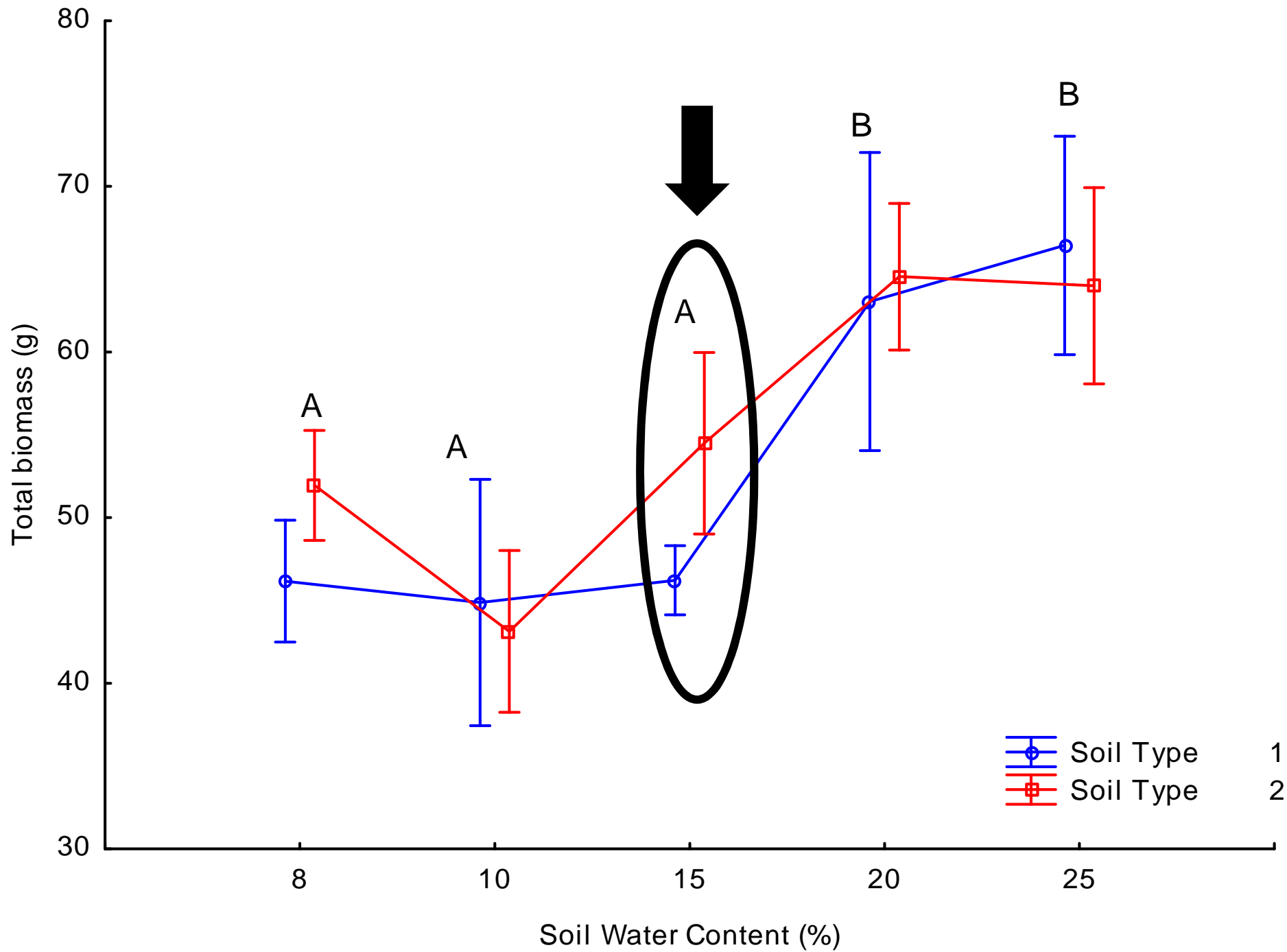
Est. & Survival Results

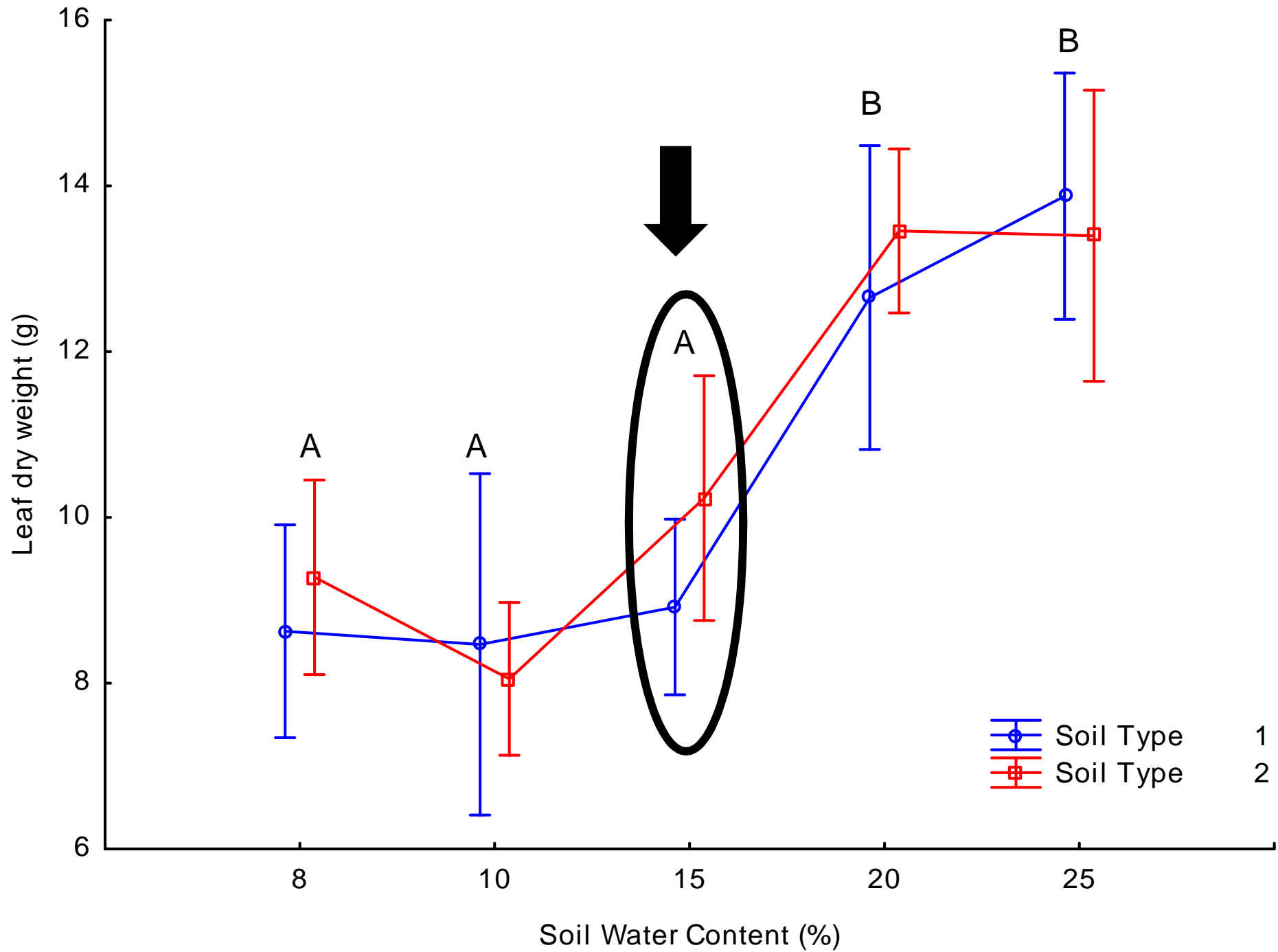
- 90% of cuttings established after 2 weeks
- Leaf area (cm²)  as SWC .
- Leaf area of Soil 2 > Soil 1
- Average weight of leaves  as SWC .
- Average weight of leaves of Soil 2 > Soil 1.
- No. of dead leaves  as SWC .
- No. of dead leaves of Soil 2 similar to Soil 1.

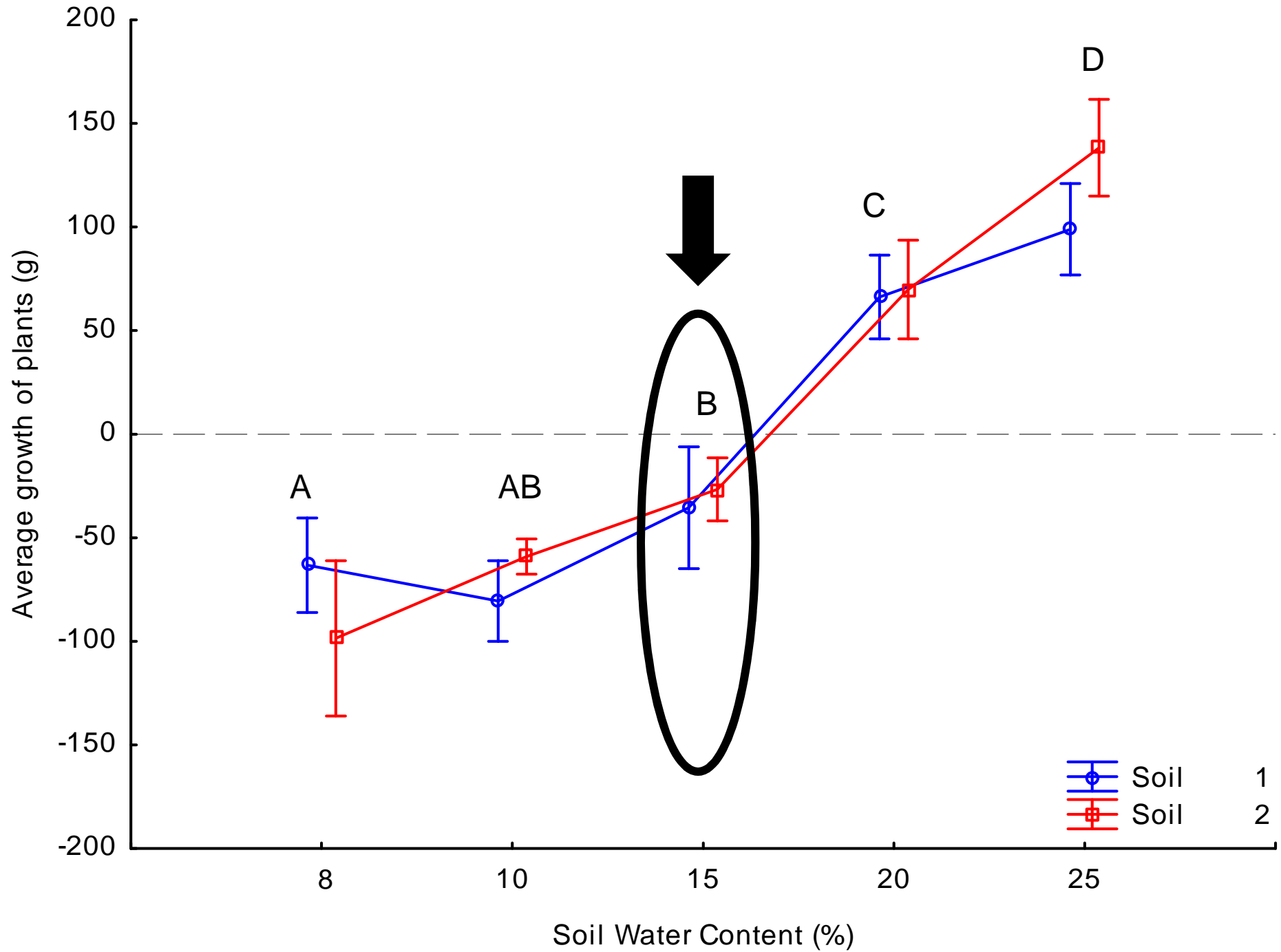


Growth Results

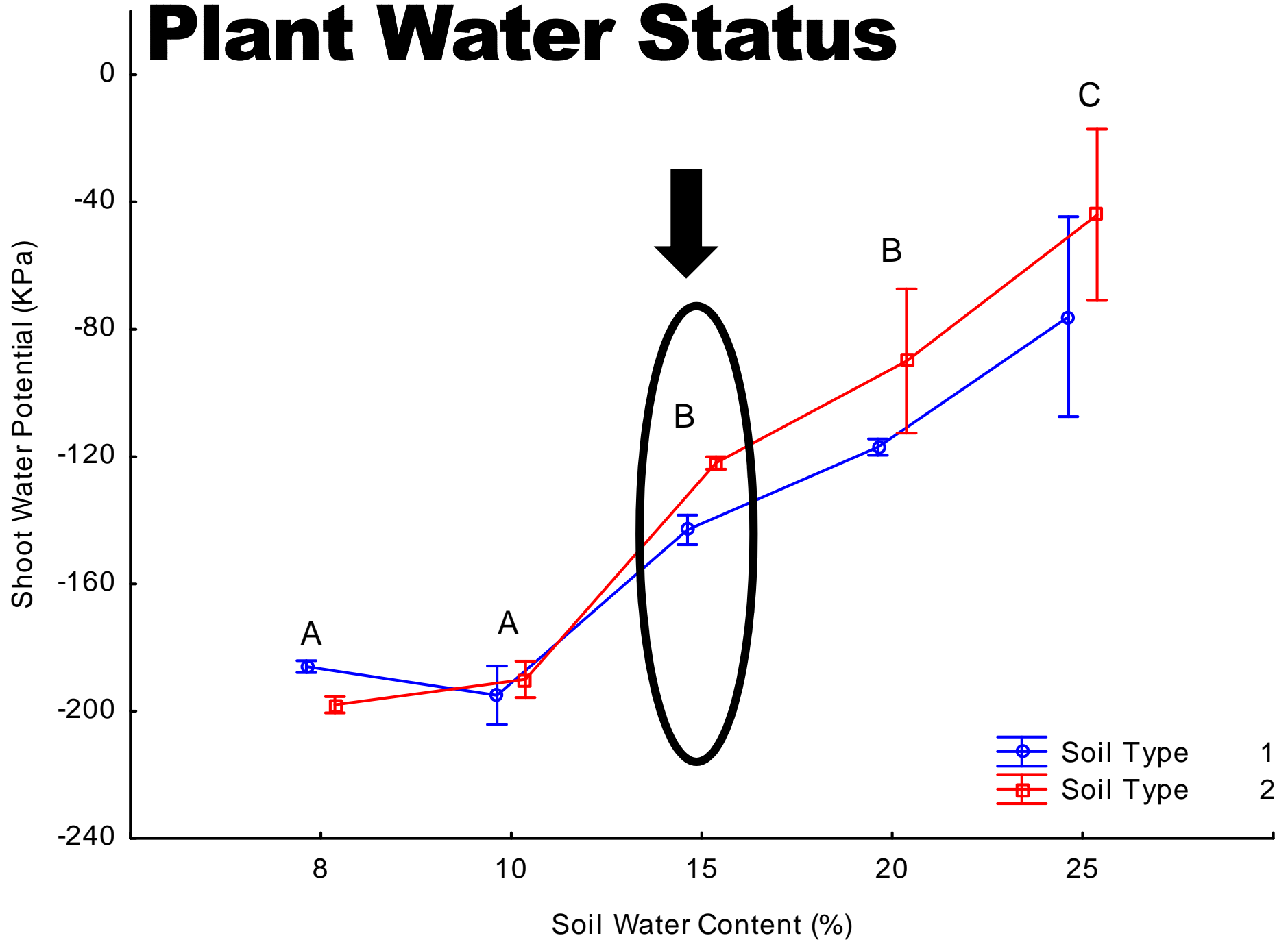








Plant Water Status



Watering regime results

SWC (%)	Volume of water (litres)/ 7- litre pot		Volume of water (litres)/ m ² soil surface area	
	Soil Type 1	Soil Type 2	Soil Type 1	Soil Type 2
0	0.00	0.00	0.00	0.00
5	0.30	0.25	1.20	1.00
10	0.60	0.50	2.50	2.00
15	0.90	0.75	3.70	3.00
20	1.20	1.00	5.00	4.00

Conclusion

- Moisture availability DOES have an effect on growth of cuttings. Unable to fully assess effect on survival.
- Moisture availability IS affected by frequency & magnitude of watering regimes, not so much soil type.
- 15% SWC is the minimal watering point that could allow est. and growth of spekboom.
- Below 15%= reduced growth = plants “stressed”.

Watering regime: frequently irrigating spekboom every 4-7 days with >15% SWC (3- 4litres) promotes establishment, survival & growth.

MY STORY



“Love at first sight.”

Acknowledgements

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- Rhodes Restoration Research Group
- Gamtoos Irrigation Board
- Department of Environmental Affairs, Natural Resource Management Programme

Discussion

- Growth highly affected by SWC, not so much soil type.

Possibly due to moisture availability effect:

- Less negative SWP, more moisture available
 - More negative SWP, less moisture available
-
- Or fact that when water limiting: CAM photosynthesis kicks in = growth rate reduced:
 - Drought-induce hydraulic failure (cavitation/embolism)
 - Carbon- starvation (Stomatal closure & depletion of carbohydrates)
 - Physiological changes under diff watering regimes still needs to be assessed.

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Soil moisture levels for irrigation and crop management

