FULL SHADE LEAF WATER POTENTIAL AS AN ALTERNATIVE FOR STEM WATER POTENTIALS IN GRAPEVINE PLANT-BASED IRRIGATION SCHEDULING.

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INTRODUCTION

- Droughts are frequent occurrences in South Africa – crop producers need to constantly adapt due to water availability.
- The severity of droughts not deter some farmers to apply excessive amounts of water.
- Excessive irrigation is costly and may cause vigorous vegetative growth that leads to shading of clusters and reduced wine quality (Bureau et al., 2000; Chorti *et al*. 2010; Gao & Cahoon, 1994; Morrison & Noble, 1990).

INTRODUCTION

- A wide variety of techniques can be used to determine irrigation needs of crops (Jones, 2004).
- Techniques such as;
  - Plant water potentials,
  - Soil water potentials and
  - Reference Crop Evapotranspiration and Crop coefficients.
- Although the techniques mentioned can greatly improve the producer's method of irrigation scheduling, the techniques are expensive and time consuming (Tomasella *et al*. 2023).

INTRODUCTION

- Plant water potential measurements has widely been used in irrigation scheduling across several different crops (Choné *et al*. 2001).
- Stem water potential has a better relationship with soil water potentials than leaf water potential (Williams, 2012).
- Stem water potential measurements however is more time consuming due to the covering of leaves *ca*. 1 hour before measurements are taken (Myburgh, 2010).

MATERIALS AND METHODS

BROAD PROJECT INFORMATION

- In 2019 **WINETECH approached the Dept. of Soil Science** to manage an irrigation research project to demonstrate irrigation management of vineyards based on predetermined plant water potential thresholds in three different wine grape producing and climatic regions

- The main focus of the project would be to **demonstrate to producers the results** (vegetative, yield and wine quality responses) in actual vineyard conditions

- The cultivar **Shiraz** was decided on as this cultivar is not only widely planted, but also very responsive to different water availability conditions

MATERIALS AND METHODS
Experimental vineyards and design

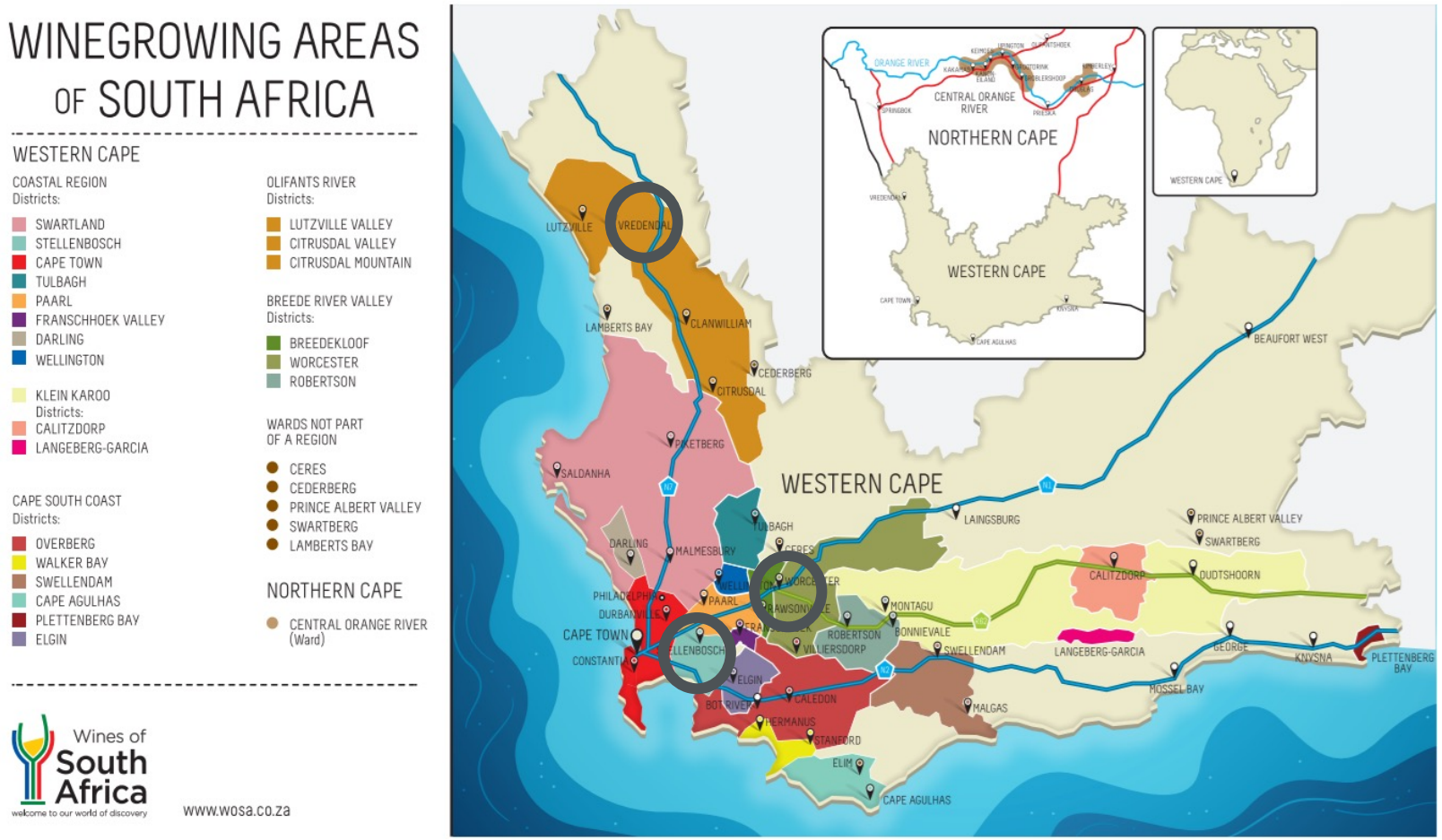

Figure 1 Map of winegrowing areas of South Africa with the three chosen regions encircled.

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MATERIALS AND METHODS
Experimental vineyards and design

Table 1: Description of trail vineyards in all three regions

Region	Coordinates		Clone	Root stock	Plant date	Plant spacing	Trellis system	Canopy management	Dripper spacing	Dripper delivery rate	Soil texture
	Latitude	Longitude				(m)			(m)	(L/h)	
Coastal	-34.0053°	18.7869°	SH1	101-14 Mgt	2002	2.5 x 1.4	Five strand Double Lengthened Perold	Vertical Shoot Positioning	0.6	2.3	Sandy Loam
Breedekloof Valley	-33.6413°	19.2167°	SH9	Paulsen	2015	2.4 x 1.5	Four Strand Lengthened Perold	Hybrid Vertical Shoot Positioning and Sprawling canopy	0.6	2.3	Sandy Loam
Olifants River Valley	-31.7711°	18.5824°	SH9	99R	2000	2.7 x 2.0	Two Strand hedge	Sprawling canopy	0.6	2.3	Sand

MATERIALS AND METHODS
Experimental vineyards and design

Table 2: Irrigation treatments that was applied to the vineyards representing the three climatic regions.

Viticulture region	Irrigation treatment		
	Treatment 1	Treatment 2	Treatment 3
Stellenbosch	Farmer's irrigation practice (± -1.1 MPa)	-1.5 MPa midday stem water potential	Dryland (if the midday stem water potential does not exceed -1.8 MPa)
Olifants River and Breedekloof Valleys	Farmer's irrigation practice (± -1.1 MPa)	-1.5 MPa midday stem water potential	-1.8 MPa midday stem water potential

All treatments commenced from pea stage up until harvest.

MATERIALS AND METHODS
Measurements

Water potentials

- Midday leaf water potential of full sunlight and shaded leaves were taken together with midday stem water potential readings.
- The pressure chamber technique Scholander *et al*. (1965) was used to measure the water potentials of mature leaves following the protocol of Myburgh (2010).
- Protocols of Choné *et al*. (2001) was used to measure midday stem water potential.
- Full shaded leaves were chosen close to the cordon with no visible sun flecks (Williams, 2012).

MATERIALS AND METHODS

- Williams (2012) reported the relationship between shaded grapevine leaves' leaf water potentials with stem water potentials.
- The study investigated the measurements only over two days in two different climatic regions.
- The current study created the opportunity to investigate the aforementioned relationship over three climatic regions from pea stage up and till harvest.

RESULTS AND DISCUSSION

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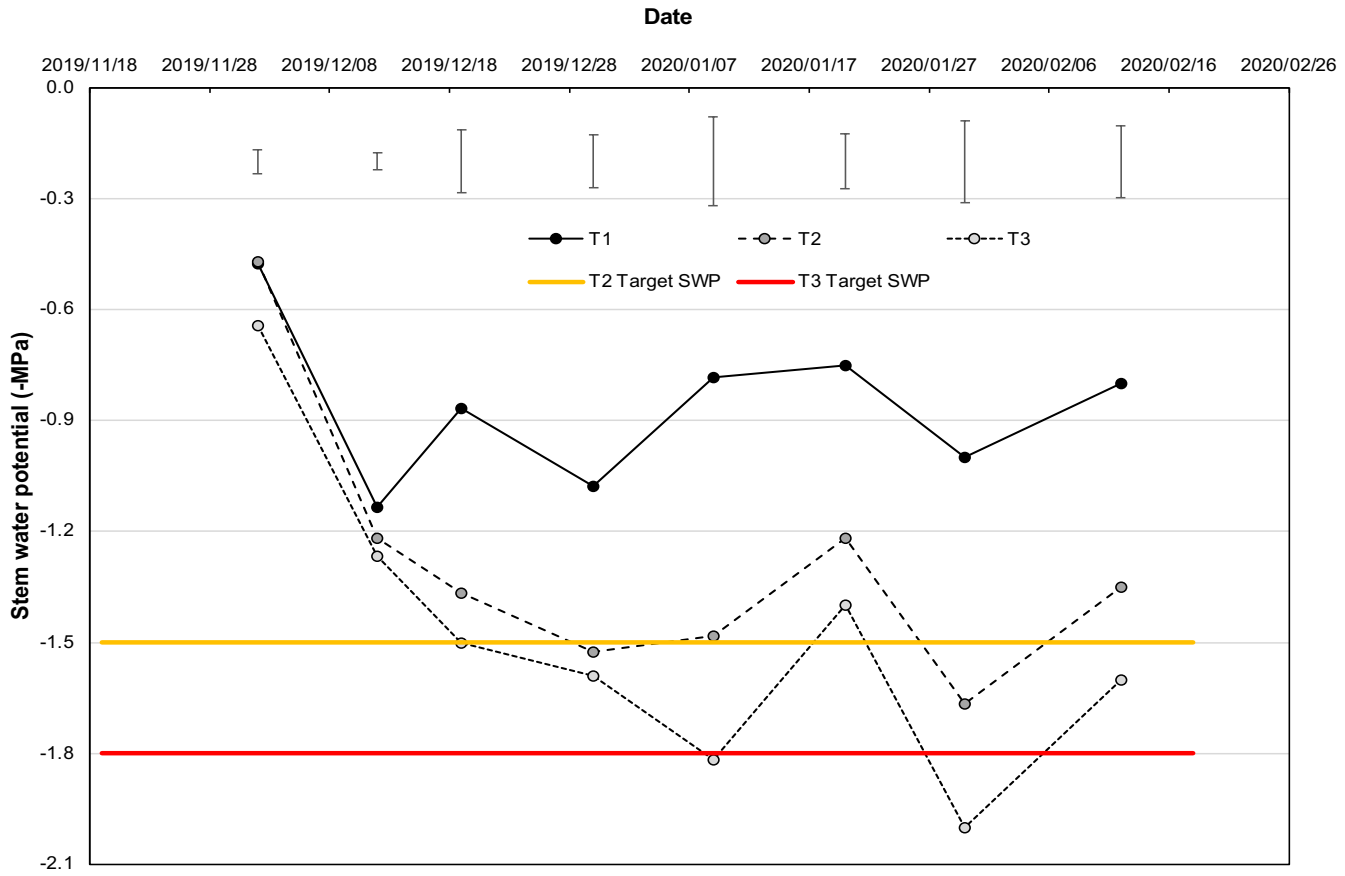
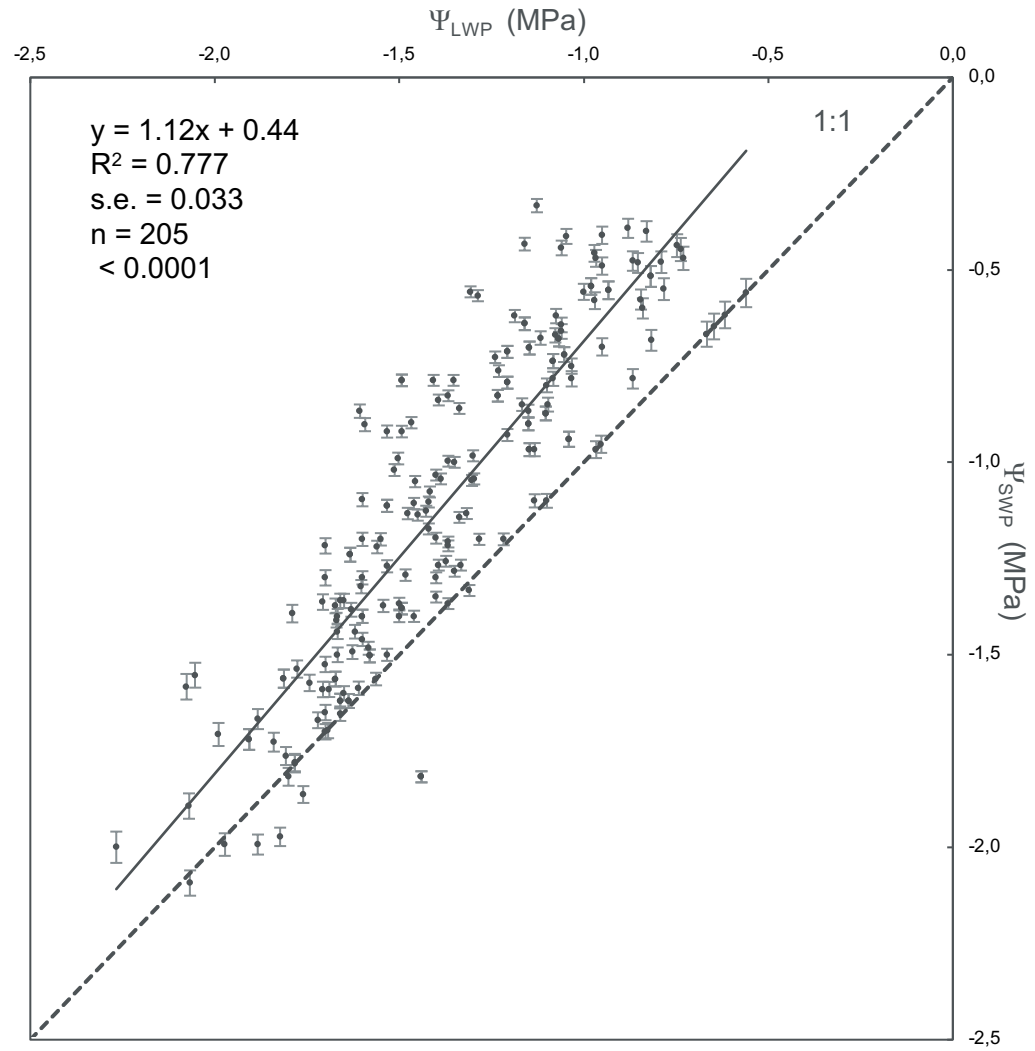


Figure 2: Variation in midday stem water potential in the 2021/22 season of three different irrigation treatments based on plant water potential measurements in the Olifants River Valley. Vertical bars indicate least significant differences ($p \leq 0.005$)

RESULTS

Figure 3: Relationship between the mean mid-day leaf (Ψ_{LWP}) and stem (Ψ_{SWP}) water potentials of Shiraz grapevines as measured in the 2019/20, 2020/21 and 2021/22 season in three different climatic regions. Vertical bars indicate standard deviation (n = 3).



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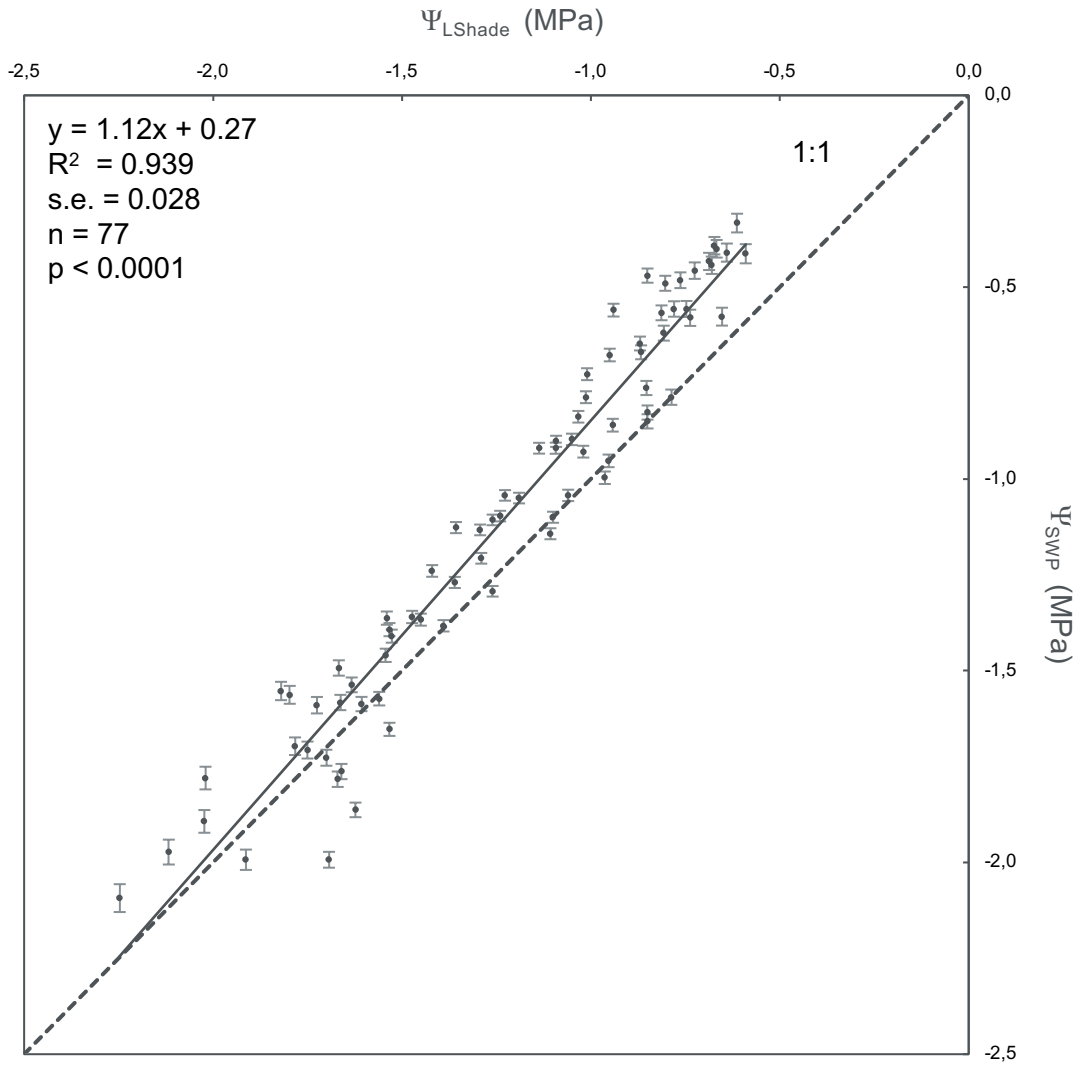
RESULTS

Figure 4: Relationship between the mean mid-day shaded leaf (Ψ_{LShade}) and stem (Ψ_{SWP}) water potentials of Shiraz grapevines as measured in the 2021/22 season in three different climatic regions. Vertical bars indicate standard deviation (n = 3).



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CONCLUSION

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- The relationship showed that shaded leaf water potentials can be used as an alternative to midday stem water potential measurements.
- This will make more reliable plant water potential measurements in commercial vineyards, to assist in irrigation scheduling, less time consuming.
- Thus, more vineyards can be monitored consecutively and be more cost efficient for producers and viticulturists.
- This trend needs to be investigated on other cultivars as well.

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