Developing guidelines for the judicious irrigation of table grapes according to grapevine water potential measurements

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Carolyn Howell & Philip Myburgh

Soil & Water Science Division

ARC Infruitec-Nietvoorbij, Stellenbosch

💻: howellc@arc.agric.za

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INTRODUCTION

- **Why is efficient irrigation water use critical for the table grape industry?**

- **Water resources are generally limited in most grape growing regions, and inconsistent rainfall causes periodic droughts.**

- **This scenario may worsen if climate change reduces rainfall and increases air temperature.**

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INTRODUCTION

- **Higher irrigation water tariffs will increase grape production costs.**
- **Water Act enables CMA's to terminate water use licences if growers misuse their allocated water resources.**
- **Table grape industry needs to reduce its "water footprint" to convince the consumers that scarce water resources are being used responsibly.**
- **Expansion of urban areas, *e.g.* the Cape Town metropole.**

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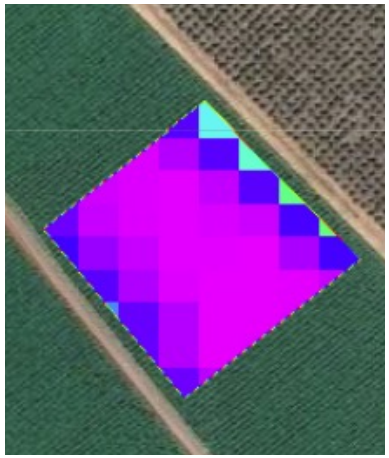
BACKGROUND

- **Limited water resources, periodic droughts, water tariffs and public image put pressure on growers to use water more efficiently. Therefore, irrigation scheduling is important.**

- **Methods of irrigation scheduling:**

Soil water status (probes)



Remote sensing (FruitLook)

Crop coefficients and reference ET (automatic weather stations)

Grapevine water status (pressure chamber)

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BACKGROUND

- Calibration of instruments used for scheduling is not necessarily correct or accurate enough, because calibrations can differ between soils and/or different soil layers.

- Refill points, *i.e.* when irrigation is required, are often selected haphazardly. Consequently, table grape vineyards are over-irrigated in many cases. Instruments can be calibrated against soil water content or plant water status.

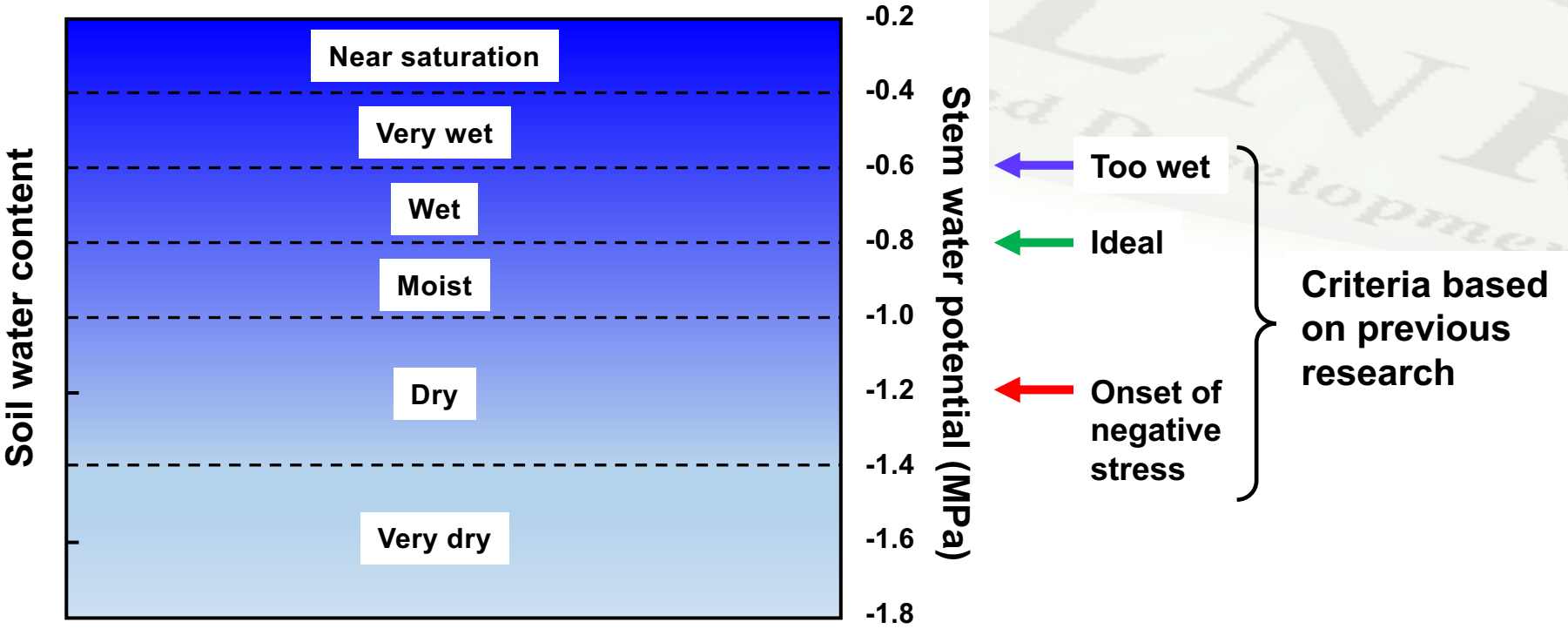
- However, soil calibrations are tedious and require specialised skills and equipment.

- On the other hand, it is fairly simple to measure grapevine water status by means of the pressure chamber technique.




BACKGROUND

- **Grapevine water status (stem water potential) in relation to soil water content.**



- **If you set irrigation refill lines according to midday stem water potential, how will different table grape cultivars respond?**

Project objective

- To set irrigation refill lines for irrigation of table grapes according to midday stem water potential (Ψ_S) thresholds.

- To determine how different table grape cultivars respond to midday Ψ_S thresholds.

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MATERIALS AND METHODS

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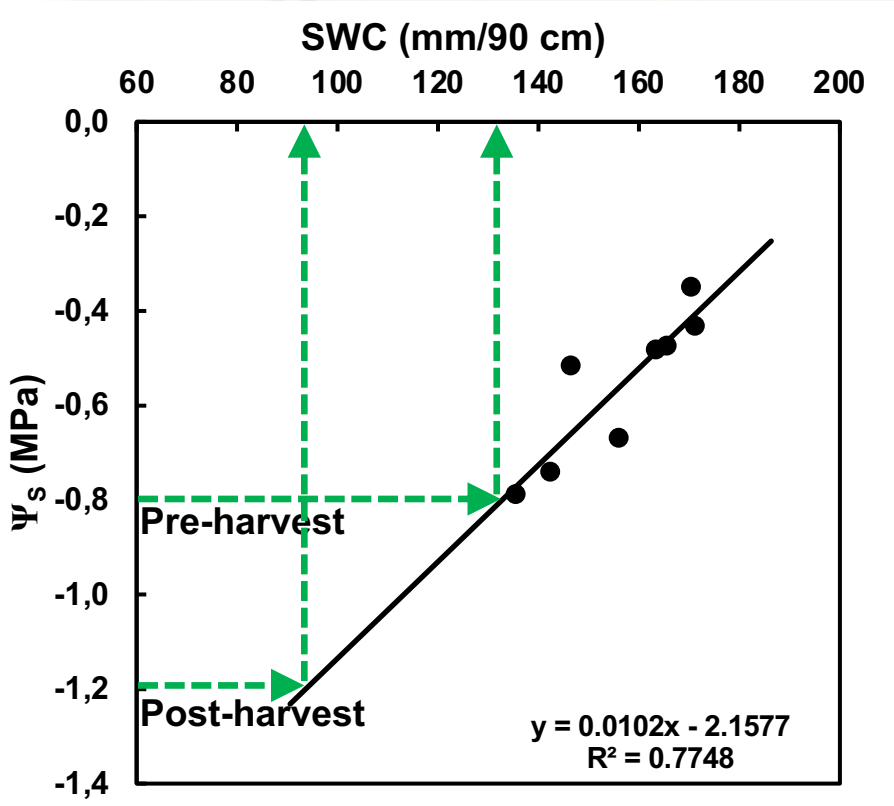
- **Project was carried out in commercial vineyards in the Noorder Paarl region for three seasons (2018/19-2020/21 seasons).**
- **Ten cultivars were included in the project - recommended by industry representatives.**

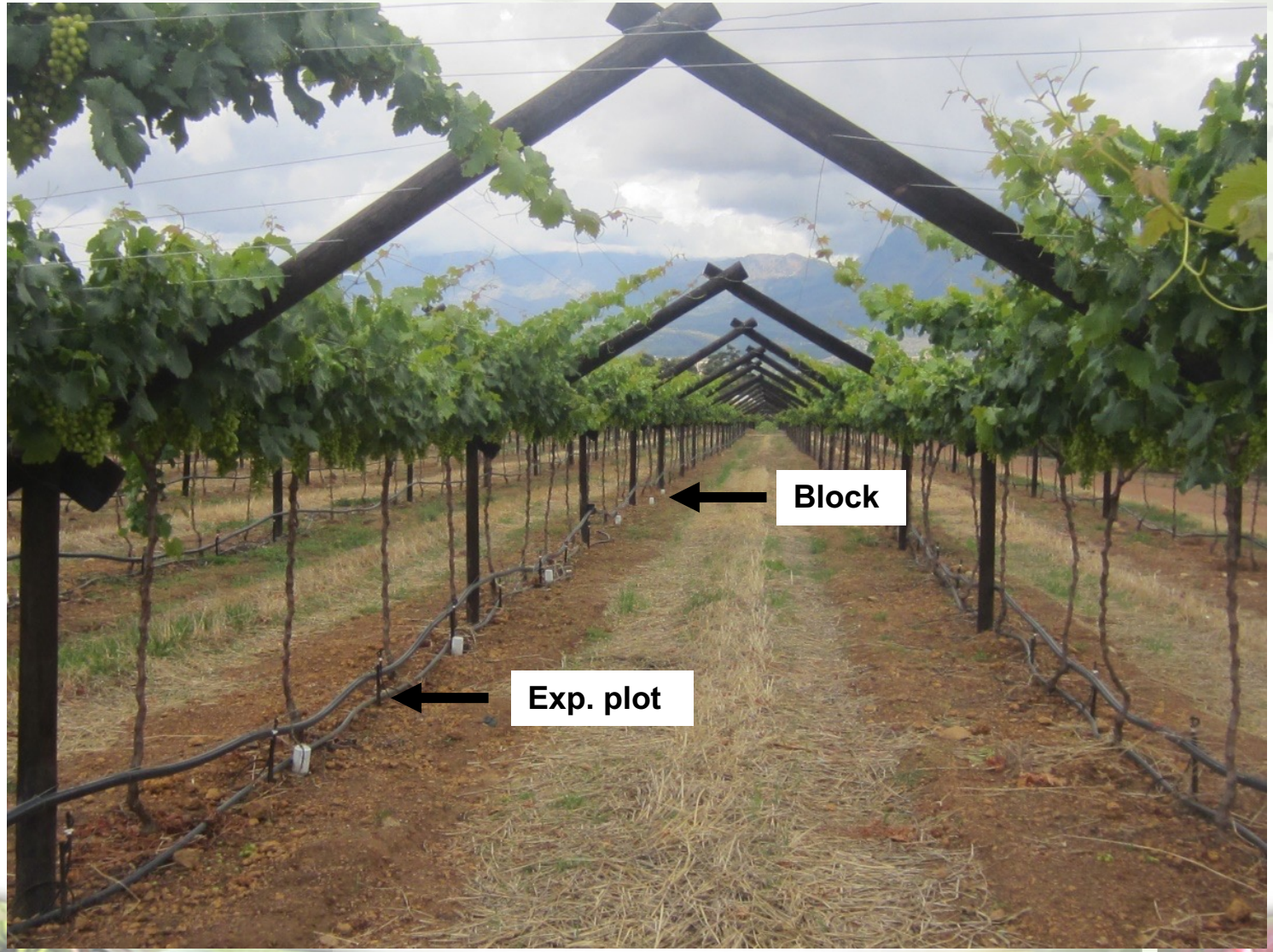
Farm no.	Cultivar	Status	Irrigation system
1	Crimson seedless	Full bearing	Micro-sprinklers
	Prime seedless	Full bearing	Micro-sprinklers
	Regal seedless	Full bearing	Micro-sprinklers
	Scarlotta	Full bearing	Micro-sprinklers
2	Autumn crisp	2nd Leaf	Micro-sprinklers
	Joybells	2nd Leaf	Micro-sprinklers
	Tawny	Full bearing	Micro-sprinklers
3	Midnight beauty	Full bearing	Micro-sprinklers
	Sweet globe	Full bearing	Micro-sprinklers
4	Starlight	Full bearing	Drip




- **Measured soil water content and midday Ψ_S as the soils began to dry out after bud break.**



- **Established an experiment plot that could be irrigated on its own in each block.**



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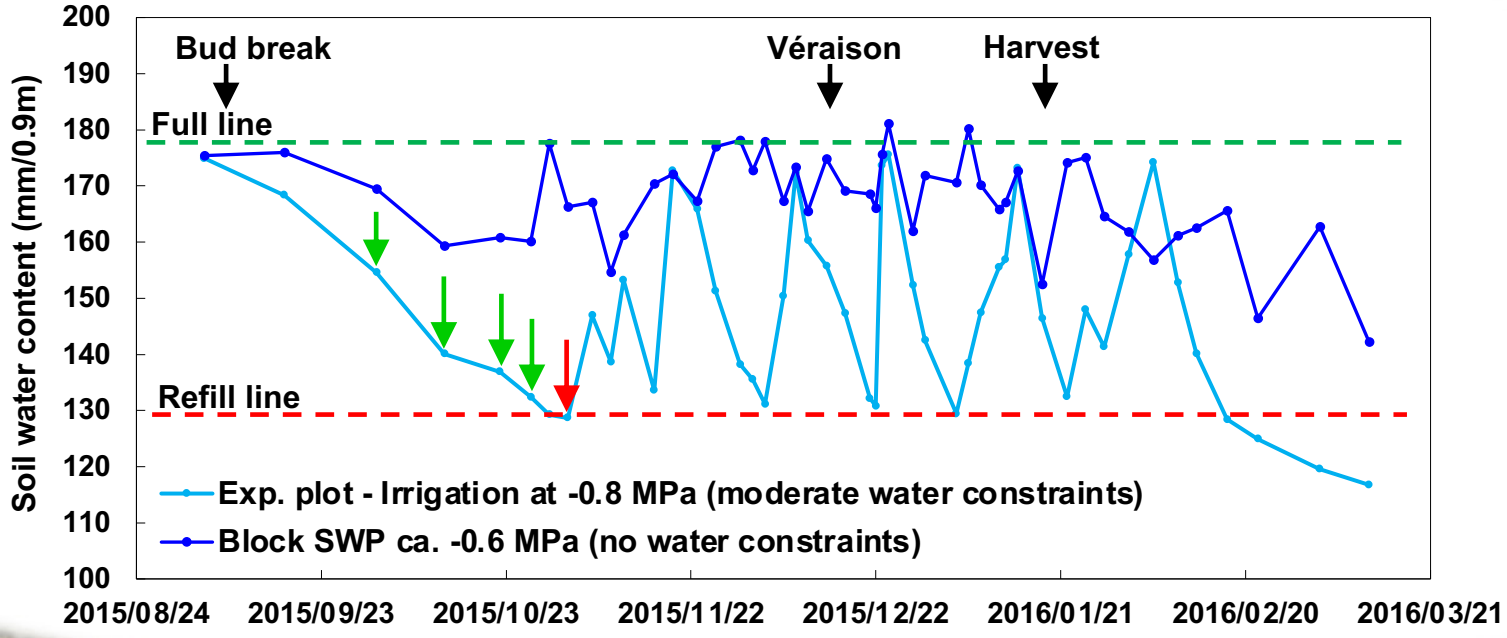
- **Measured soil water content and midday Ψ_S as the soils began to dry out after bud break.**
- **Grapevines in experiment plots received first irrigation when -0.8 MPa threshold was reached.**
- **Grapevines in blocks were irrigated according to the grower's schedule.**



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Measurements

Midday stem water potential

Irrigation volumes

Soil water content - neutron probe

Grapevine growth & yield responses

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RESULTS & DISCUSSION

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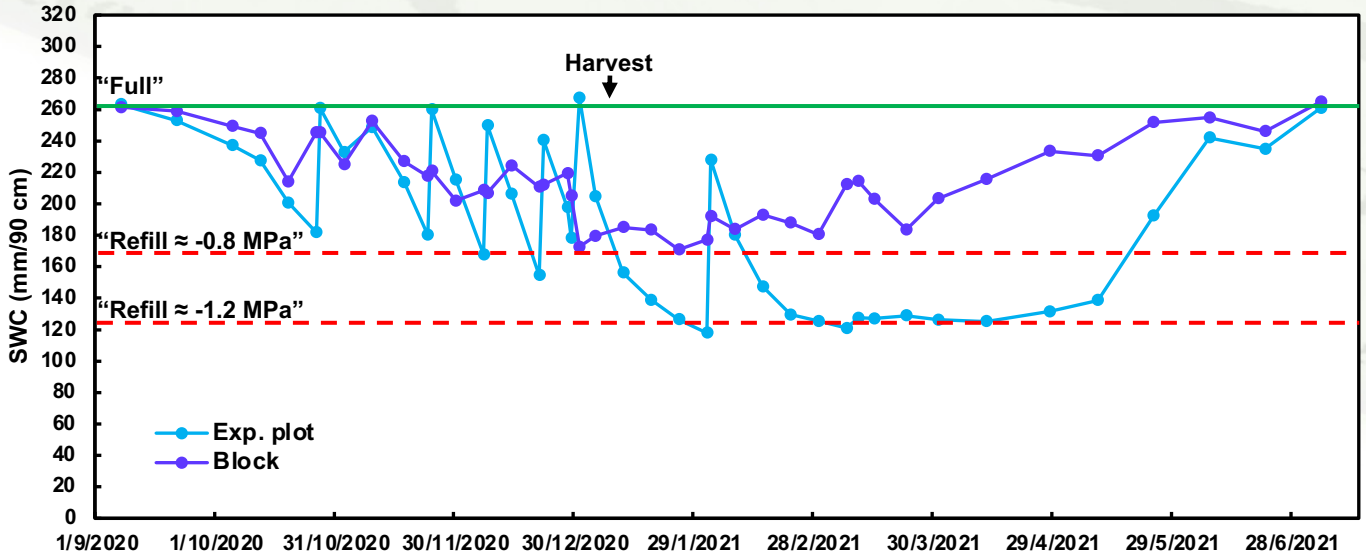
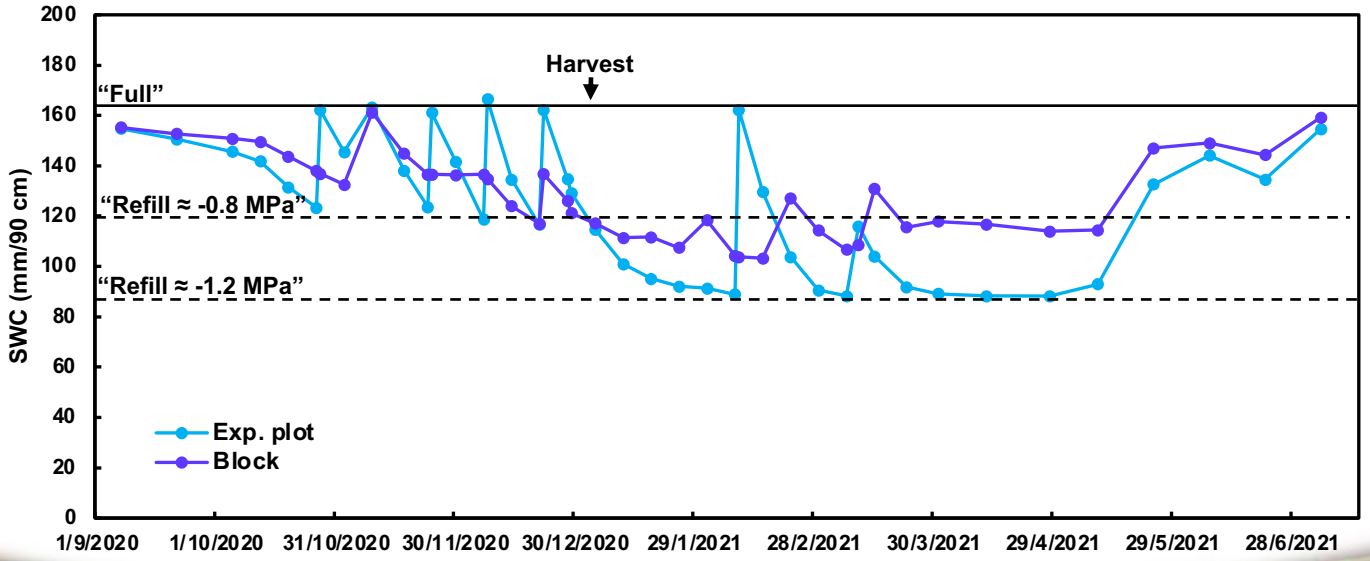
SOIL WATER CONTENT





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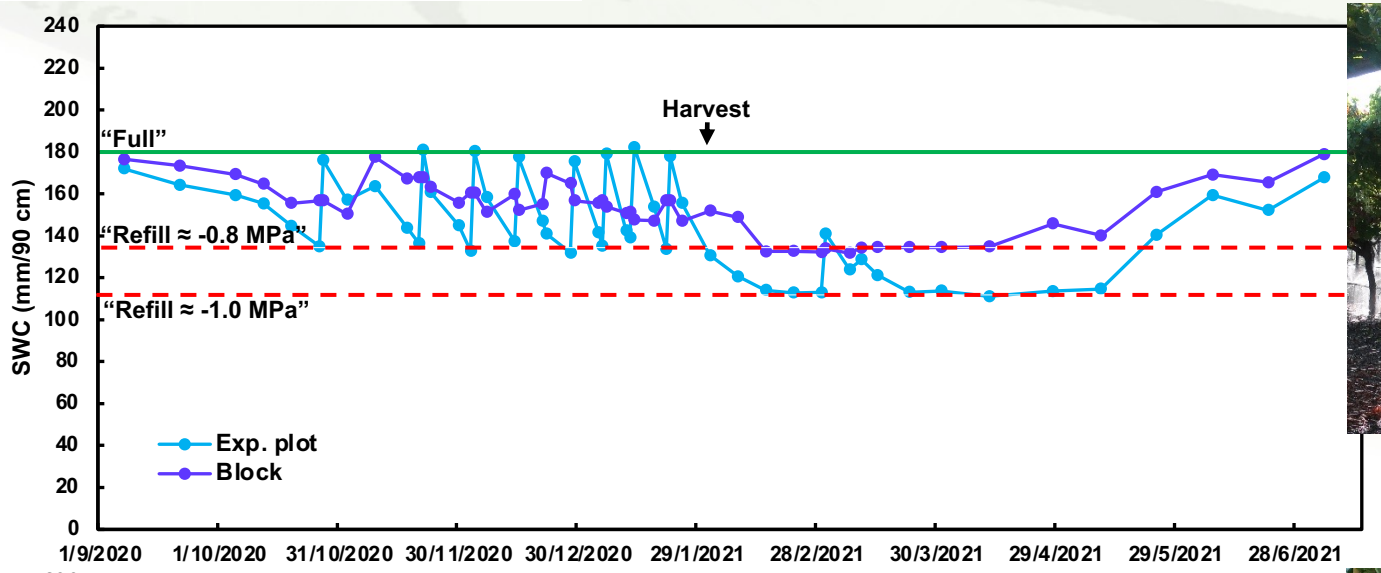
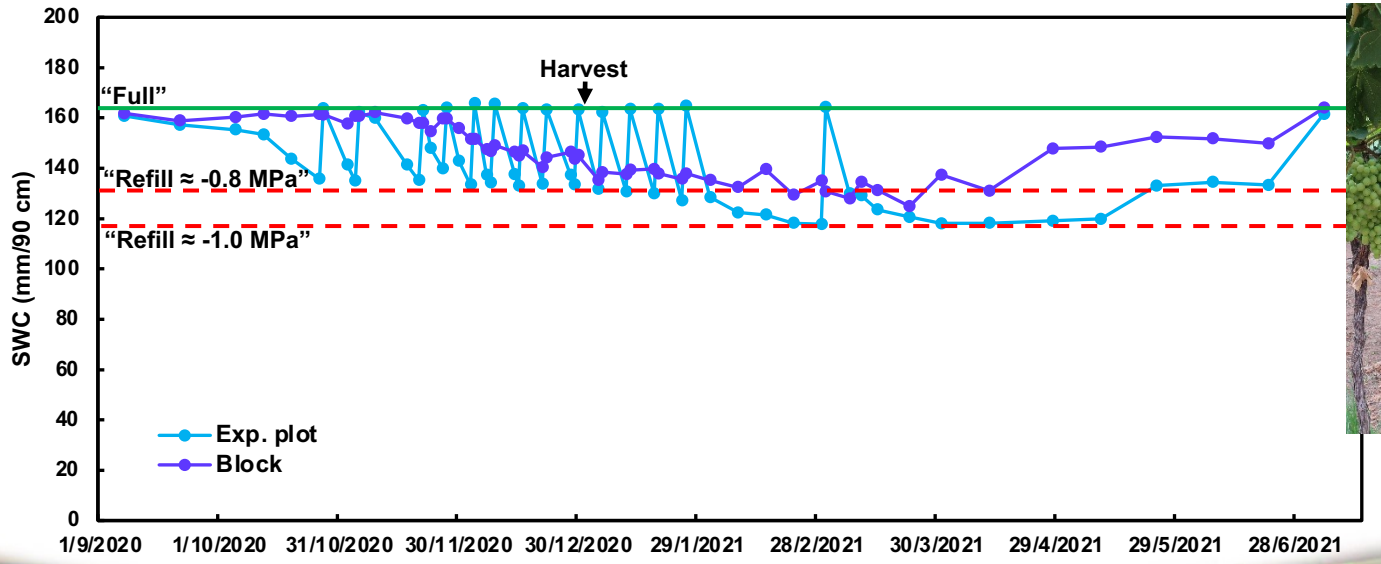
SOIL WATER CONTENT





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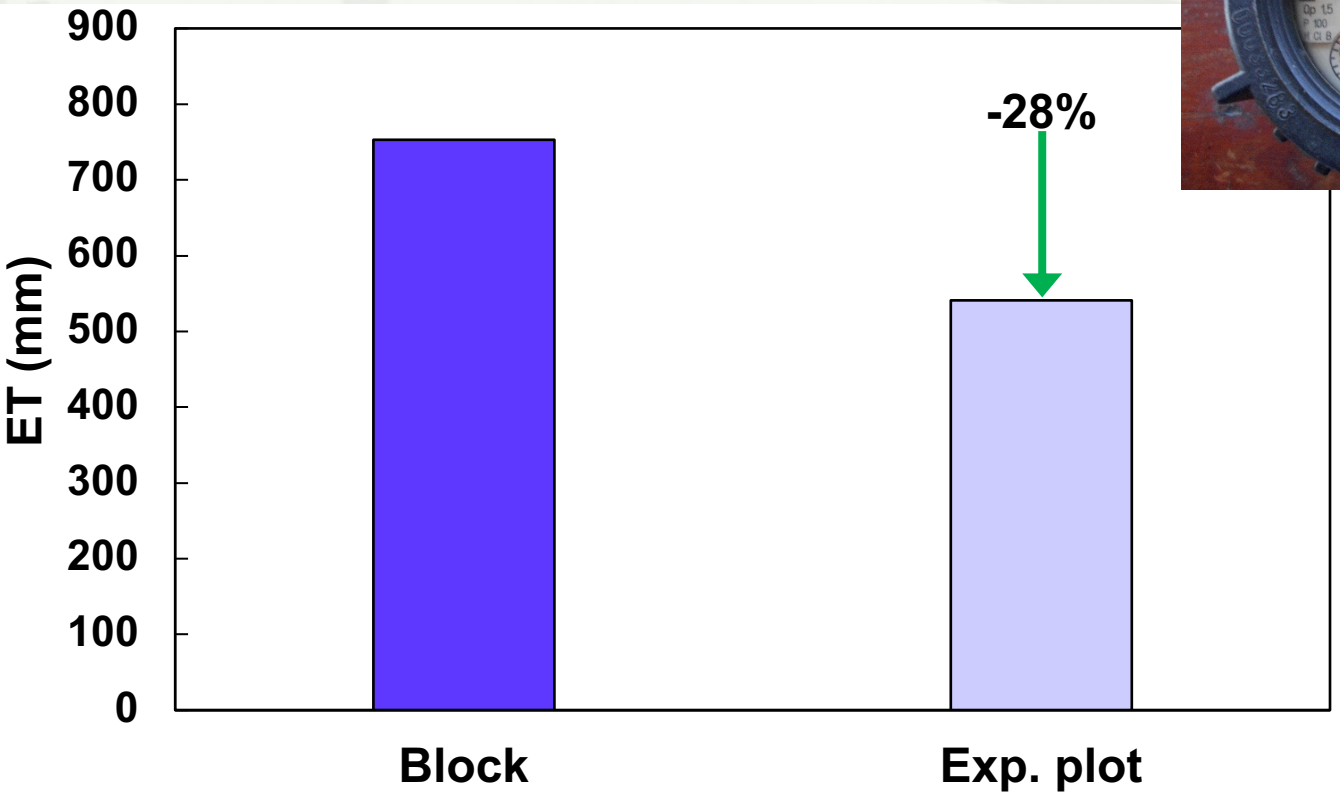
VINEYARD WATER USE (ET)



Comparison between seasonal evapotranspiration (ET) where (A) irrigation was applied according to the growers schedule (Block) and (B) midday stem water potential thresholds (Exp. plot). Data are means for ten cultivars from 2018/19 until 2020/21.

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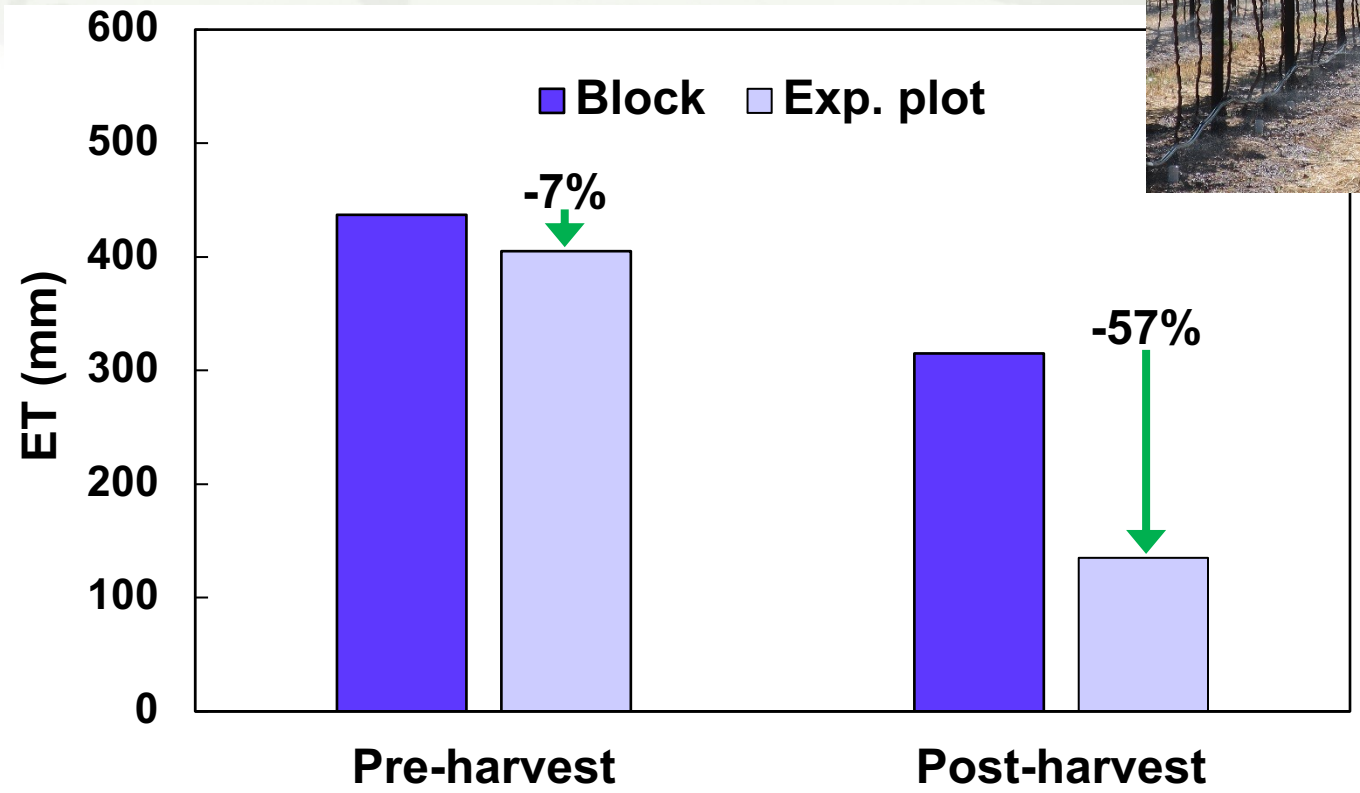
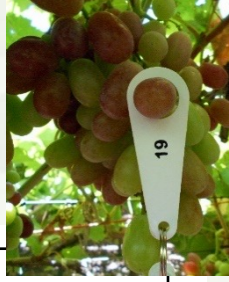
VINEYARD WATER USE (ET)

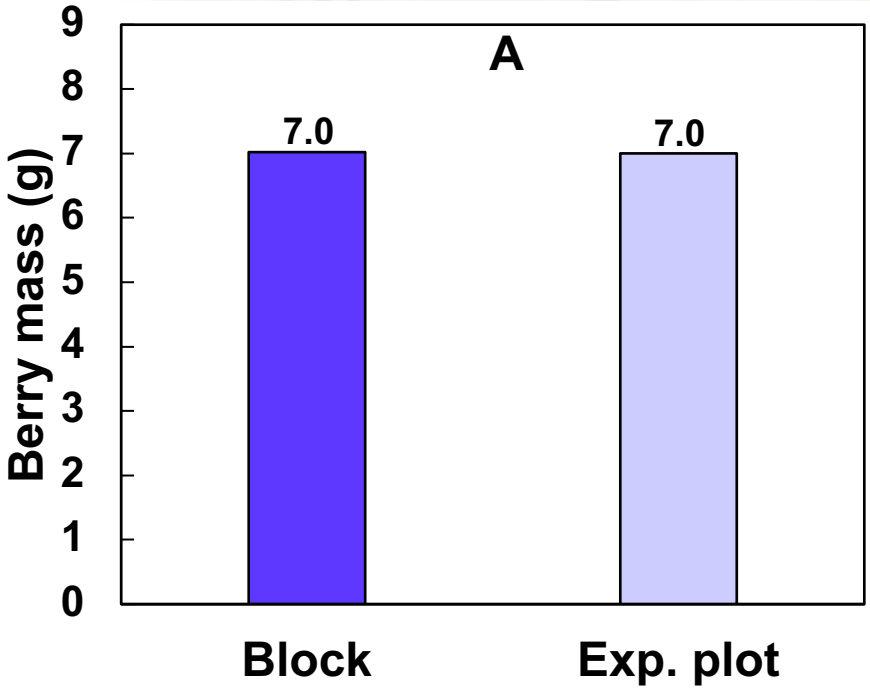


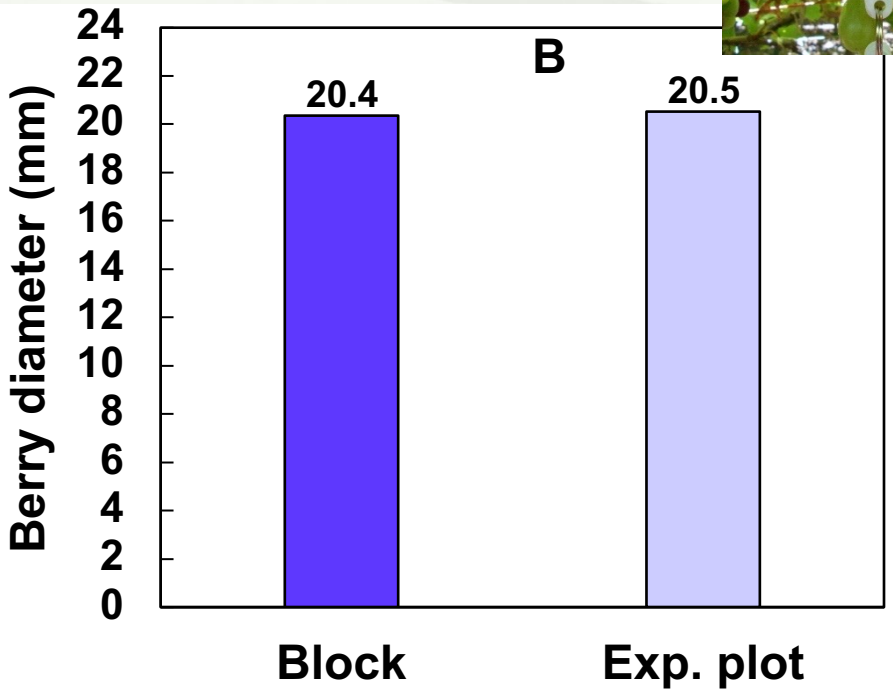
Comparison between (A) pre- and (B) post-harvest evapotranspiration (ET) where irrigation was applied according to the growers schedule (Block) and midday Ψ_S thresholds (Exp. plot). Data are means for ten cultivars from 2018/19 until 2020/21.

Yield and quality responses

YIELD COMPONENTS







Comparison between (A) berry mass and (B) berry diameter where irrigation was applied according to the growers schedule (Block) and midday Ψ_S thresholds (Exp. plot). Data are means for ten cultivars from 2018/19 until 2020/21.

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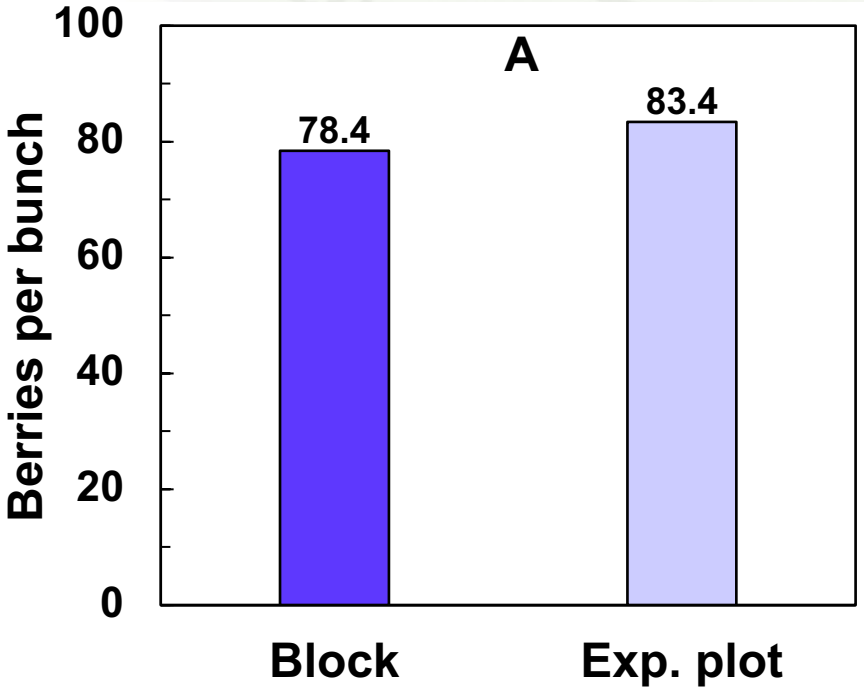
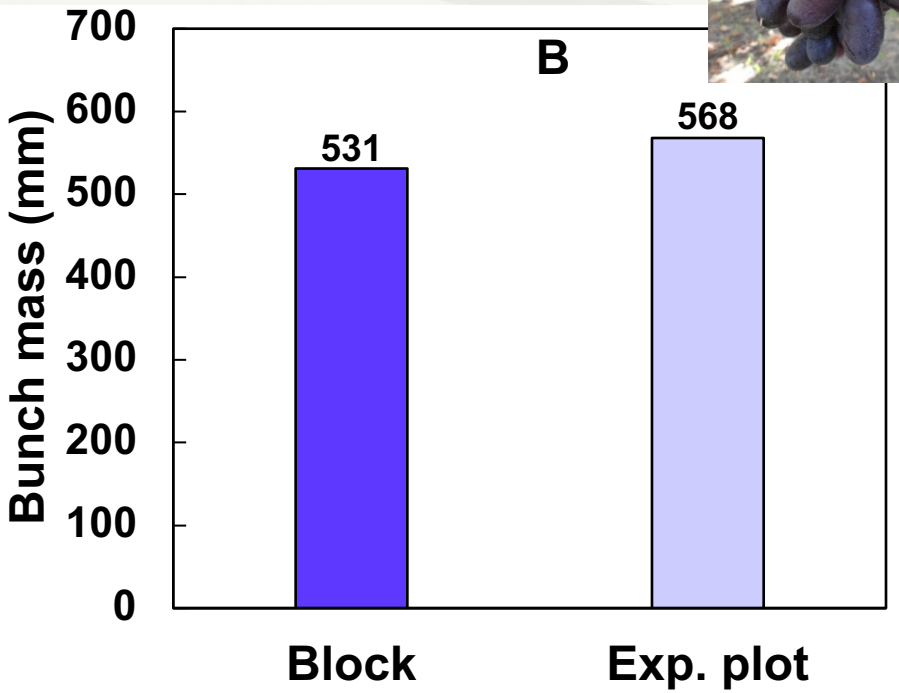
YIELD COMPONENTS





Comparison between (A) berries per bunch and (B) bunch mass where irrigation was applied according to the growers schedule (Block) and midday Ψ_S thresholds (Exp. plot). Data are means for ten cultivars from 2018/19 until 2020/21.

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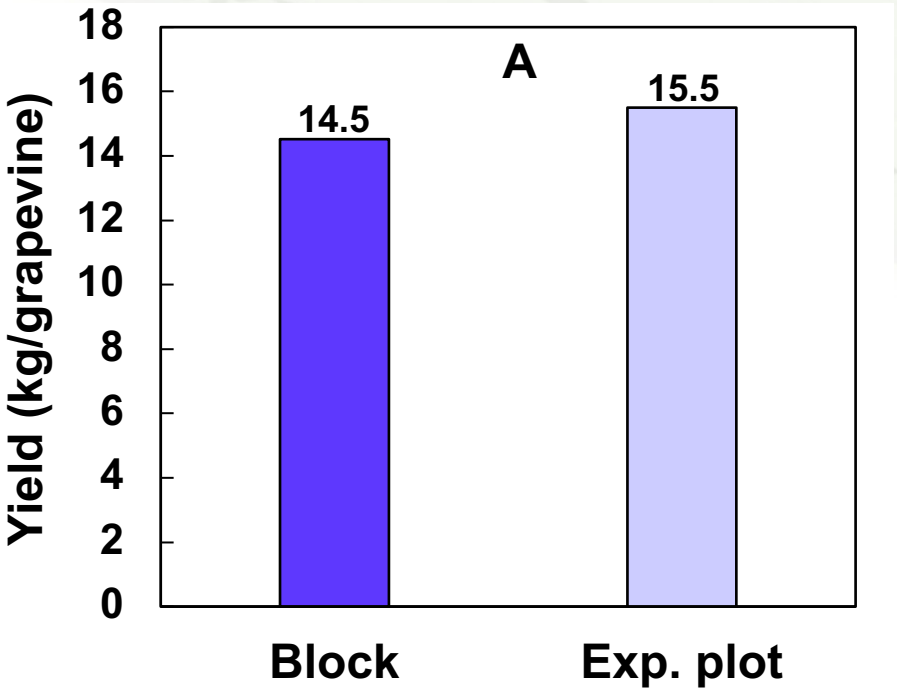
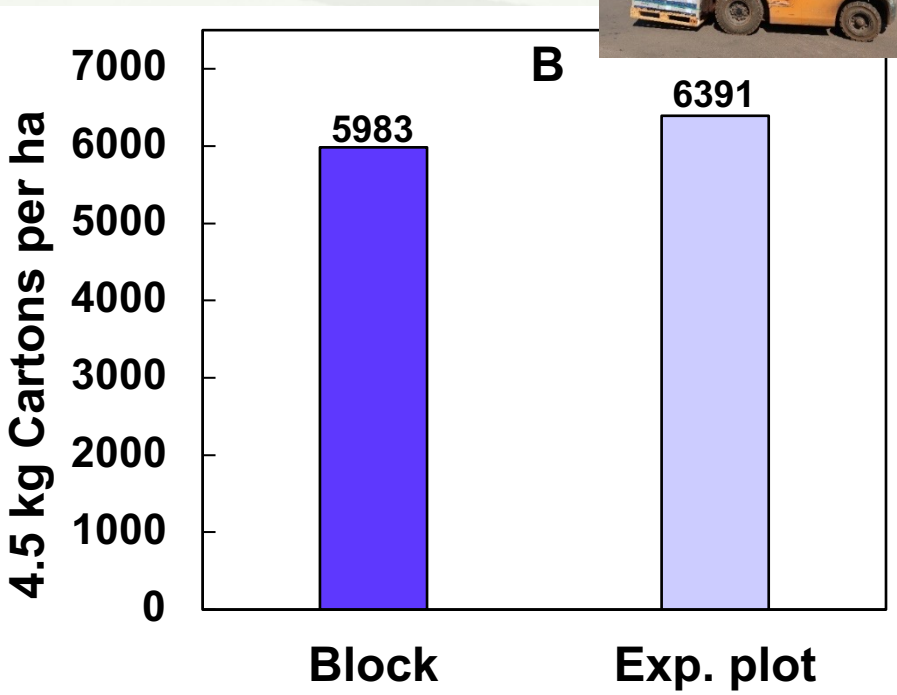
YIELD COMPONENTS





Comparison between (A) yield and (B) 4.5 kg cartons per hectare where irrigation was applied according to the growers schedule (Block) and midday Ψ_S thresholds (Exp. plot). Data are means for ten cultivars from 2018/19 until 2020/21.

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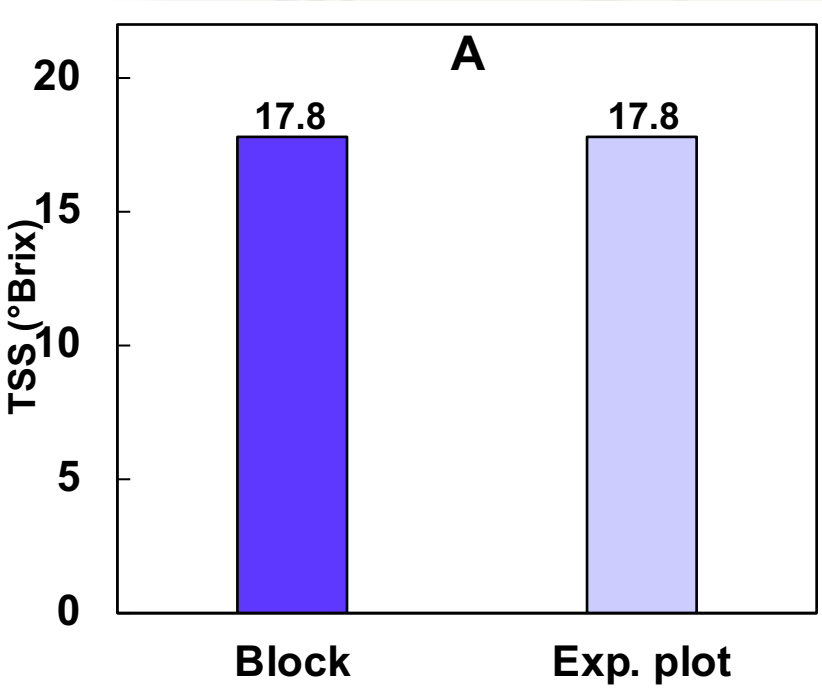
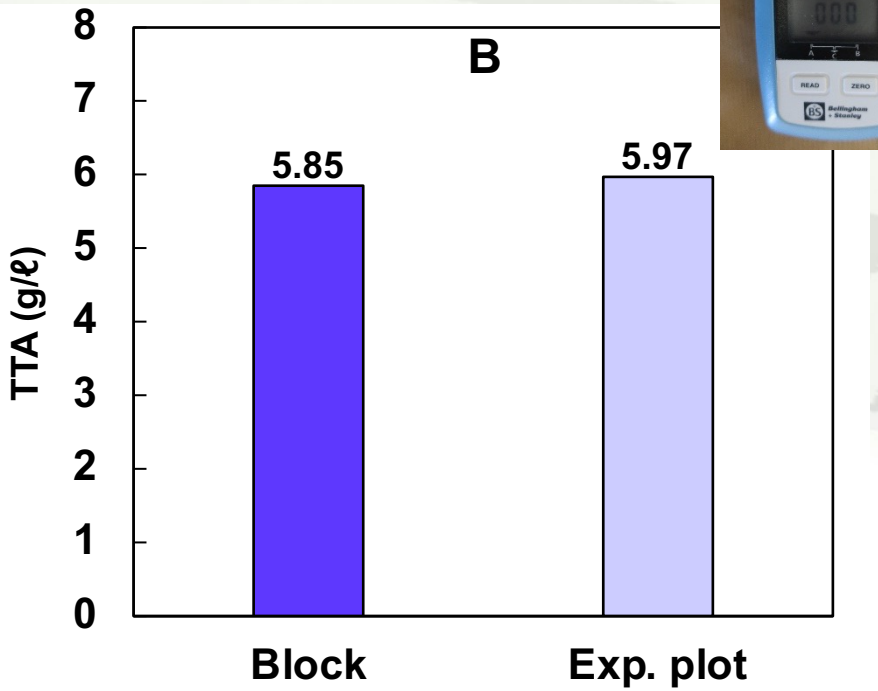
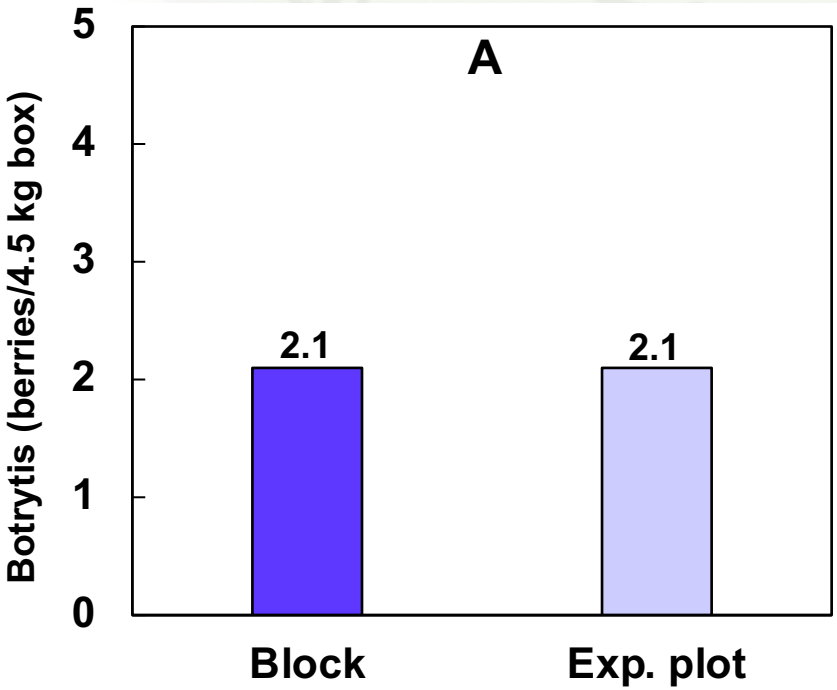
QUALITY PARAMETERS - Sugar and acidity

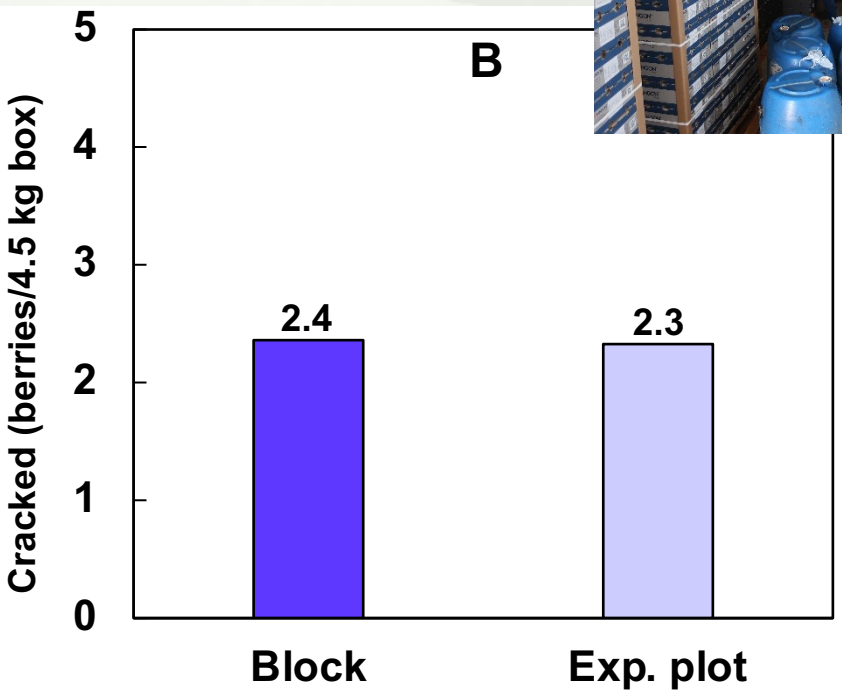




Comparison between (A) total soluble solids (TSS) and (B) total titratable acidity (TTA) where irrigation was applied according to the growers schedule (Block) and midday Ψ_S thresholds (Exp. plot). Data are means for ten cultivars from 2018/19 until 2020/21.

QUALITY PARAMETERS - Defects after cold storage





Comparison between (A) Botrytis berries and (B) cracked berries after cold storage where irrigation was applied according to the growers schedule (Block) and midday Ψ_S thresholds (Exp. plot). Data are means for ten cultivars from 2018/19 until 2020/21.

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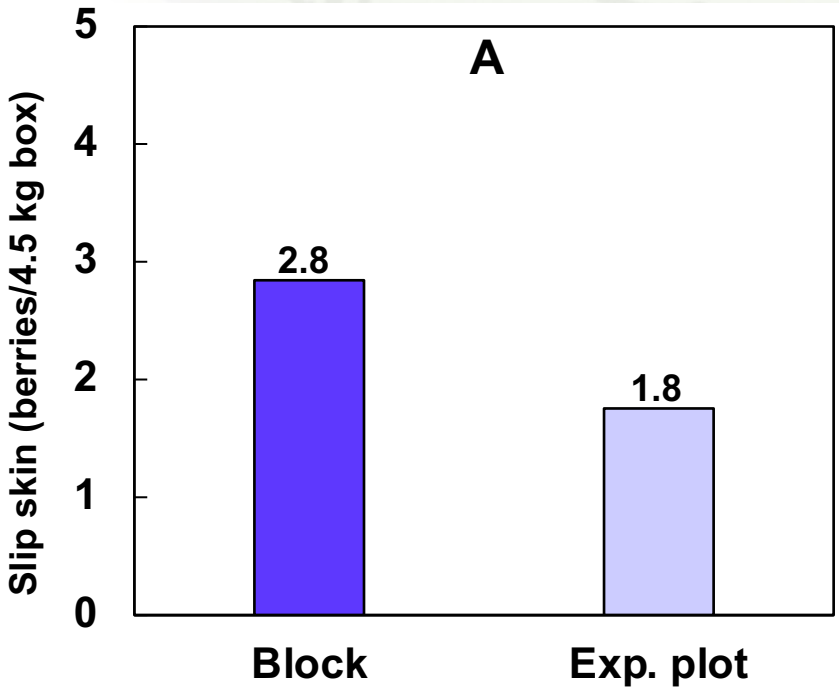
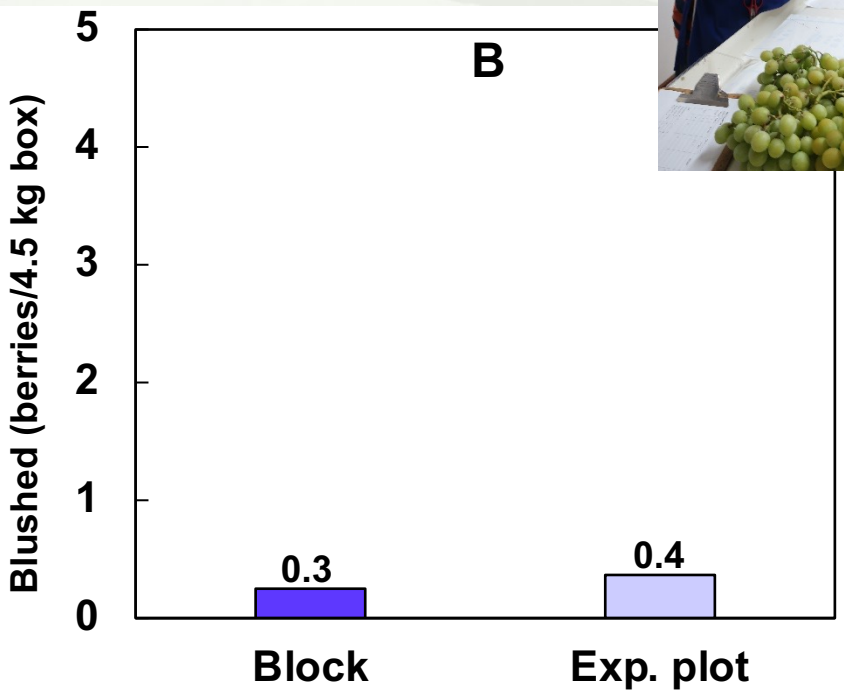
QUALITY PARAMETERS - Defects after cold storage





Comparison between (A) slip skin berries and (B) blushed berries after cold storage where irrigation was applied according to the growers schedule (Block) and midday Ψ_S thresholds (Exp. plot). Data are means for ten cultivars from 2018/19 until 2020/21.

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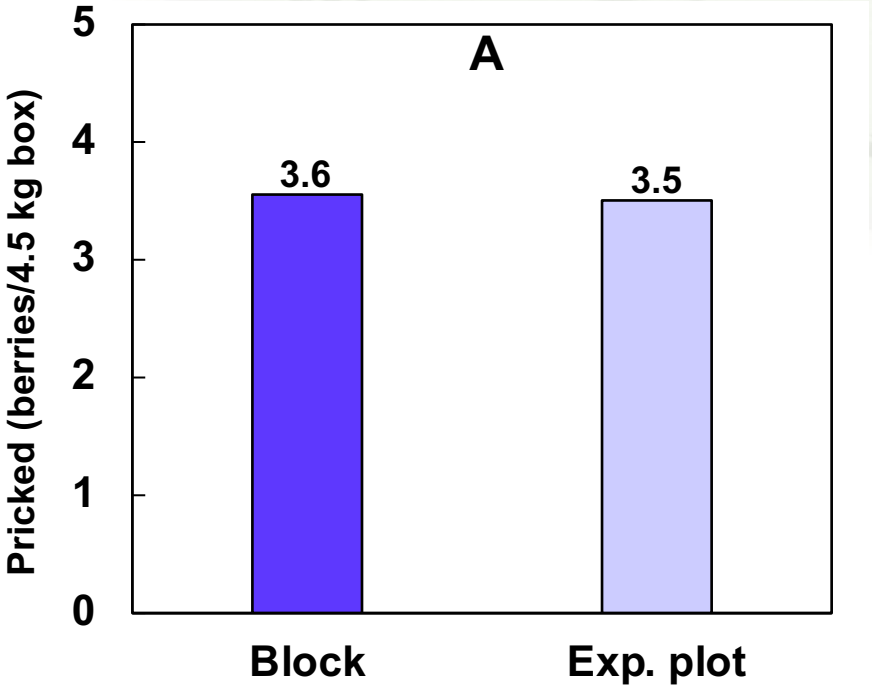
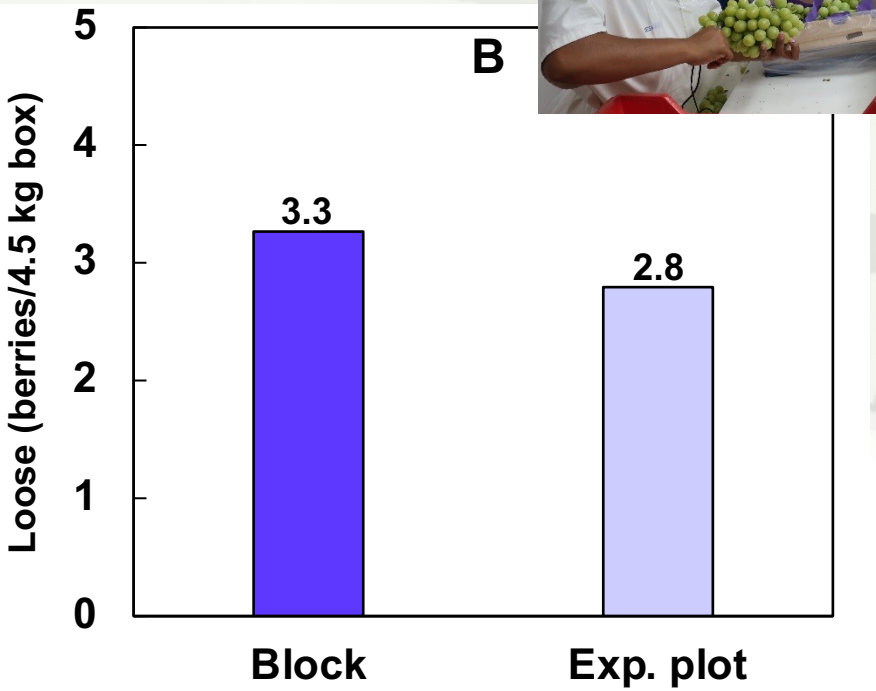
QUALITY PARAMETERS - Defects after cold storage





Comparison between (A) pricked berries and (B) loose berries after cold storage where irrigation was applied according to the growers schedule (Block) and midday Ψ_S thresholds (Exp. plot). Data are means for ten cultivars from 2018/19 until 2020/21.

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CONCLUSIONS & RECOMMENDATIONS

- **Midday Ψ_S correlated well with the soil water content.**
- **Can calibrate any SWC probe against Ψ_S, as long as the probe "sees" SWC correctly.**
- **Irrigation according to a pre-harvest Ψ_S threshold of -0.8 MPa had no negative effects compared to the controls, irrespective of cultivar.**
- **Different midday Ψ_S thresholds were established for the post-harvest period.**
- **Post-harvest Ψ_S thresholds varied between -1 MPa & -1.2 MPa.**




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CONCLUSIONS & RECOMMENDATIONS…

- **Substantial water savings are possible, particularly in the post-harvest period. The water savings have numerous advantages for growers, as well as the table grape industry.**

- **Water savings might not be possible when rainfall is low in the post-harvest period or in the summer rainfall regions.**

- **Water savings will reduce the water footprint, particularly the blue water footprint.**




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ACKNOWLEDGEMENTS

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