A smartphone based system to assess grapevine water stress

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Introduction

Smartphones have several advantages over specialist monitoring systems including ubiquity, price, and ease of implementing updates. Thermal imaging can be used to assess plant water status and allow more informed irrigation decisions; unfortunately, this technique has not been widely adopted due to the high cost of equipment and the lack of a system to provide analysis and results real-time.

Materials and method

Several inexpensive thermal cameras that connect to smartphones have recently been released and one of these (FLIR One) was evaluated as part of a system to assess grapevine water status. Irrigation treatments were established on Cabernet Sauvignon and Chardonnay in an arid region. Thermal images were taken from the shaded side of the grapevine canopy and an application was developed to automatically determine the temperature of the canopy and artificial reference leaves. Sixteen user acceptance testers from across Australia trailed the application.

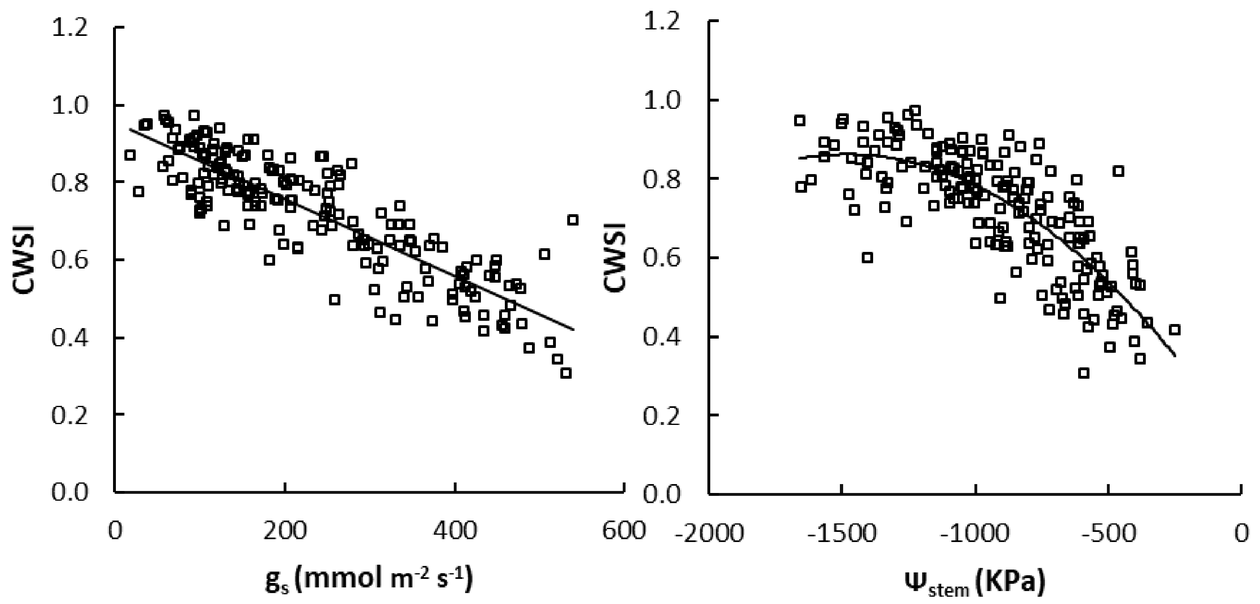

Figure 2: The relationship between the CWSI and plant water status as measured by stomatal conductance (g_s, left) and stem water potential (Ψstem, right).

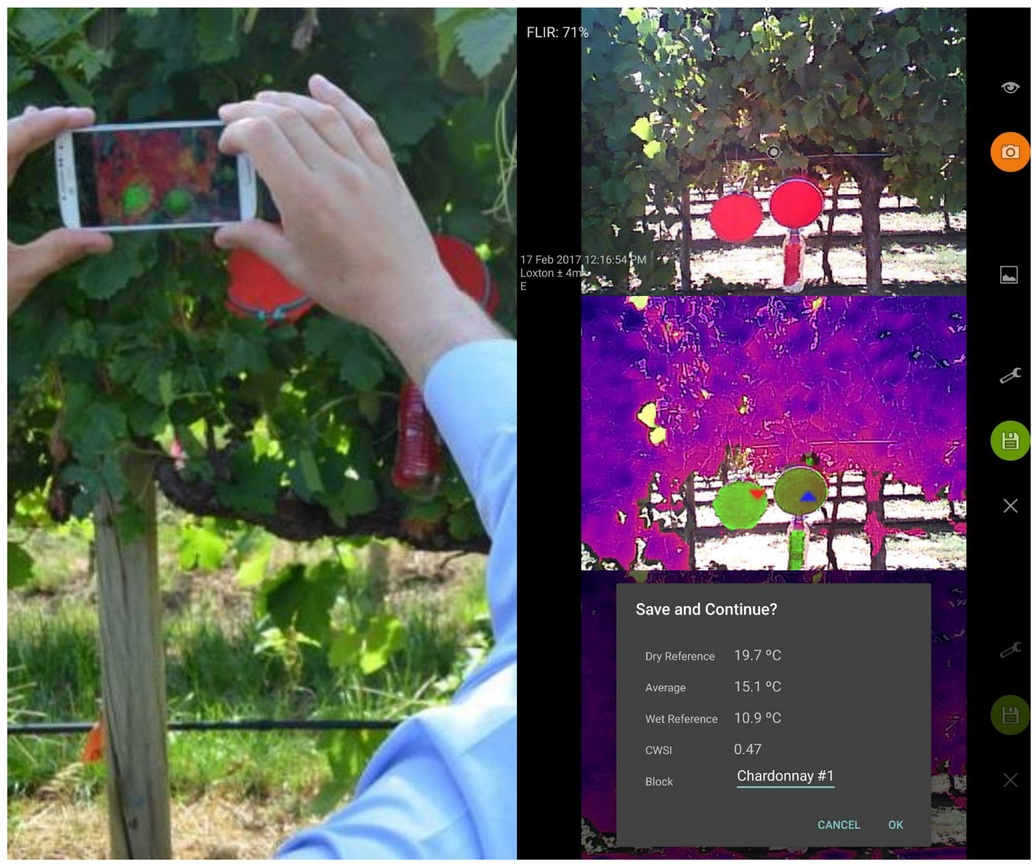

Figure 1: The smartphone water stress app being used in the vineyard (left); vine canopy with wet and dry references in position (top); thermal image of the canopy and references with the temperature of the wet (blue triangle) and dry references (red triangle) identified (center), the application reports the CWSI (bottom), above approximately 0.7 suggests the vines are stressed.

Results

The temperature readings and metrological inputs were used to calculate a range of indices of grapevine water status. The best was the Crop Water Stress Index (CWSI), which does not require input from a weather station. Over 30 days of assessment, and a range of irrigation levels, measurements collected with the thermal camera were correlated with stem water potential (R_2 = 0.61) and stomatal conductance (R_2 = 0.74). Over 80% of user acceptance testers suggested they would consider using the application in the future and recommend it to others to use.

Conclusion

Inexpensive thermal cameras have the potential to be an easy and accessible tool for the assessment of plant water status and to make better irrigation decisions.

ACKNOWLEDGEMENTS

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FOR MORE INFORMATION

Petrie, P. R., Wang, Y., Liu, S., Lam, S., Whitty, M. A., & Skewes, M. A. (2019). The accuracy and utility of a low cost thermal camera and smartphone based system to assess grapevine water status. Biosystems Engineering, 179, 126-139.

FURTHER INFORMATION

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