

Assessing Sensing Technologies for Detecting Water Stress in Potatoes

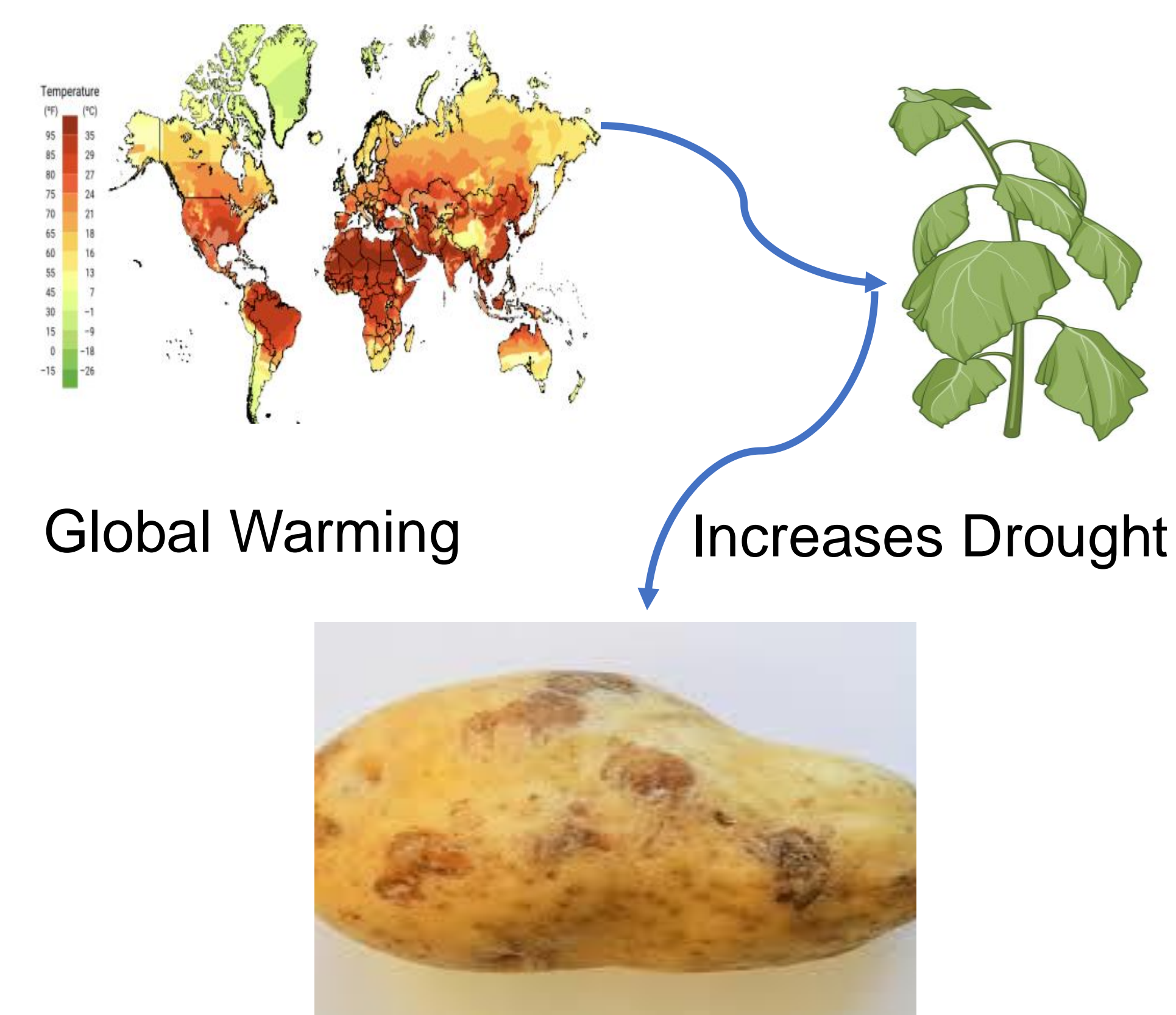
E. T. Toreveyi, P. Kettlewell, J. Monaghan, N. Randall
Agriculture and Environment Department, Harper Adams University,
Newport, Shropshire, TF10 8NB, United Kingdom
EToreveyi@live.harper.ac.uk



The Message

Thermal Imaging has the potential to predict stomatal conductance faster by measuring leaf temperature.

PROBLEM



Reduces Potato Yield & increase physiological disorders

OBJECTIVES

- Comparing the efficiency of thermal imaging (TI) and Chlorophyll fluorescence (SIF) in detecting potato crop water status.

METHODOLOGY

- Two varieties (Nectar, and Challenger, were exposed to two irrigation schemes (irrigation and no irrigation).
- Drought was induced at tuber initiation for 27 days (Days after drought, DAD).
- Leaf temperature and fluorescence variability were measured for comparison with the standard water stress detection method i.e. stomatal conductance
- Measurements were made at 14, 16, 21 (DAD).

TECHNIQUES USED

- The chlorophyll fluorescence (FluorPen): measures fluorescence ratios (Fv/Fm)



Figure 1: FluorPen equipment used to measure the ratio of variable fluorescence.

- Thermal Imaging: Measures the leaf temperature

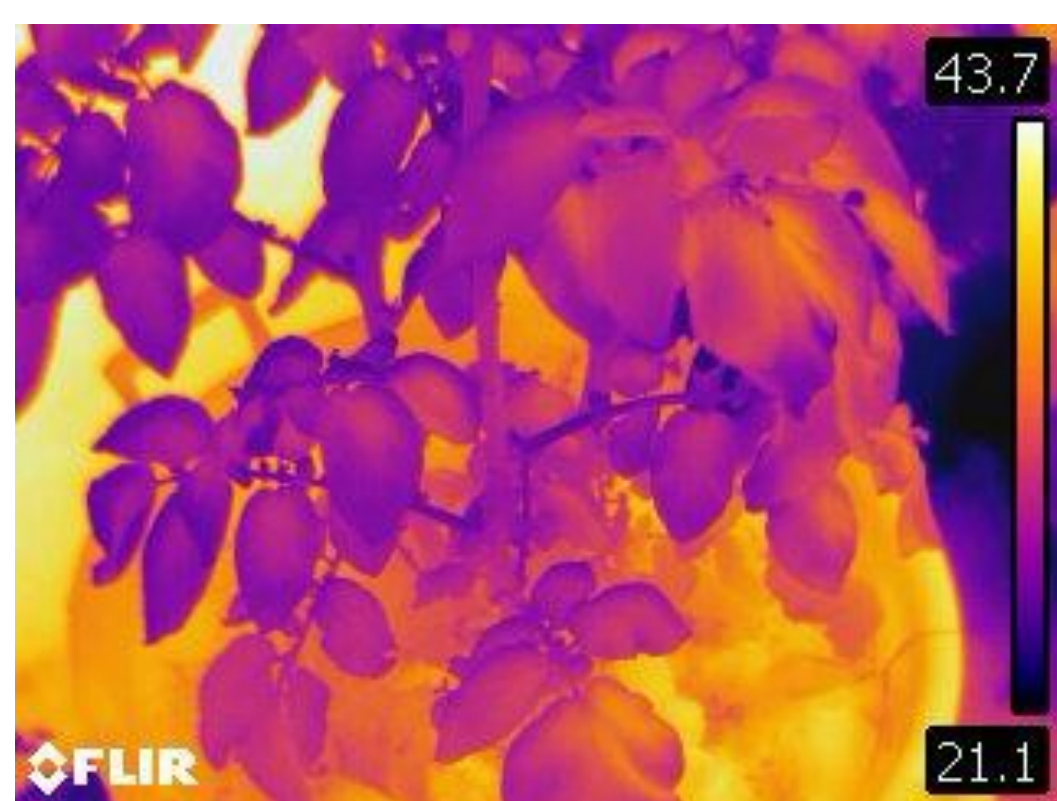


Figure 2: Thermal Image indicating variability in leaf temperatures.

TECHNIQUES USED

- Porometer: Measures the stomatal conductance. Readings were taken from one top leaf of each plant.



Figure 3: Porometer measuring stomata conductance (mmol/m²/s). The rate at which a leaf surface exchanges water vapor (H₂O) and carbon dioxide (CO₂), per unit area and time.



DROUGHT

IRRIGATED

Figure 4: Crops indicating water stress (drought) and healthy crops (irrigated).

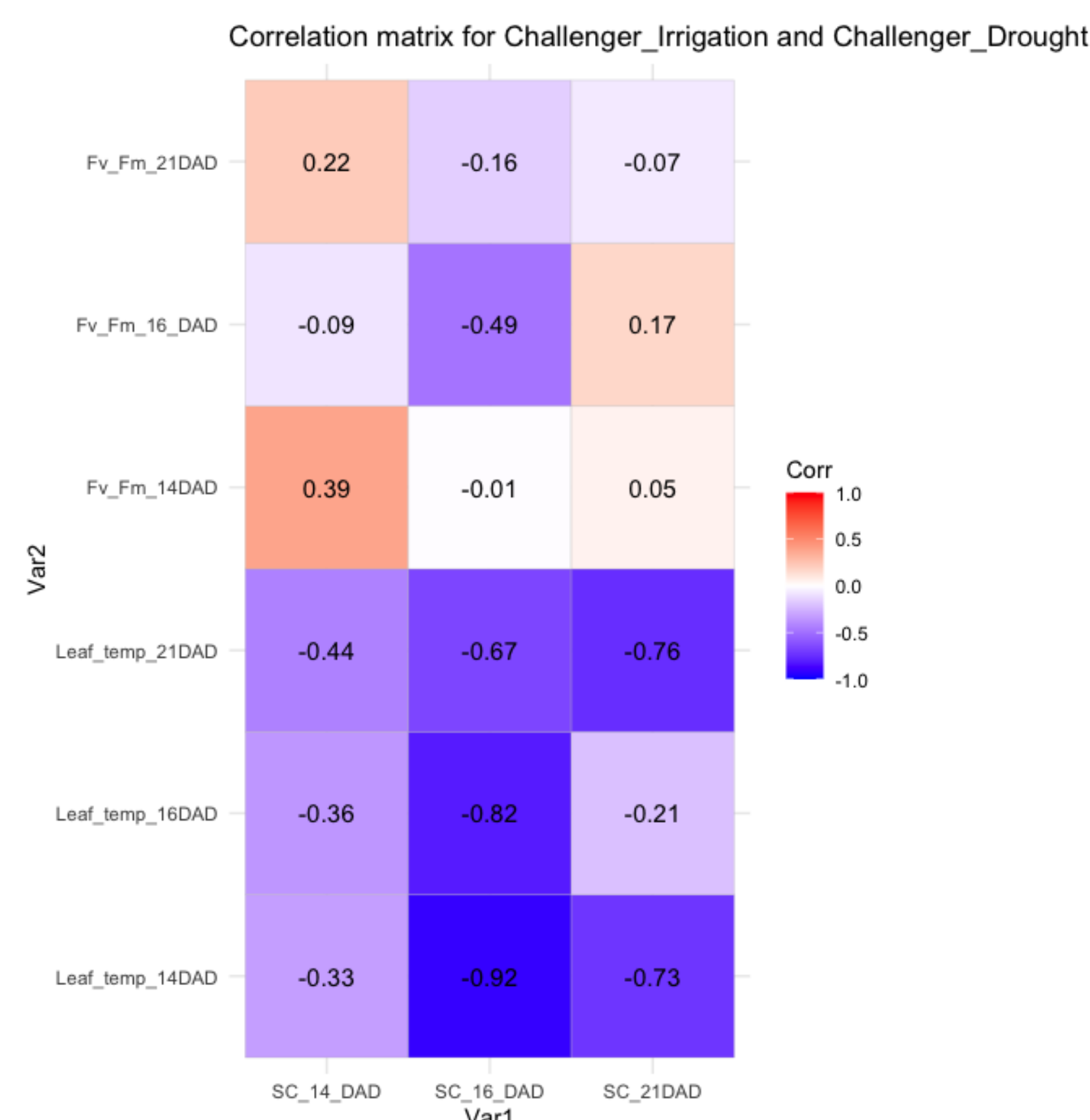


Figure 5: A correlation matrix for stomatal conductance vs leaf temperature and fluorescence ratios on the Challenger variety. A high correlation of the same - day measurement was observed on 16 DAD with leaf temperature.

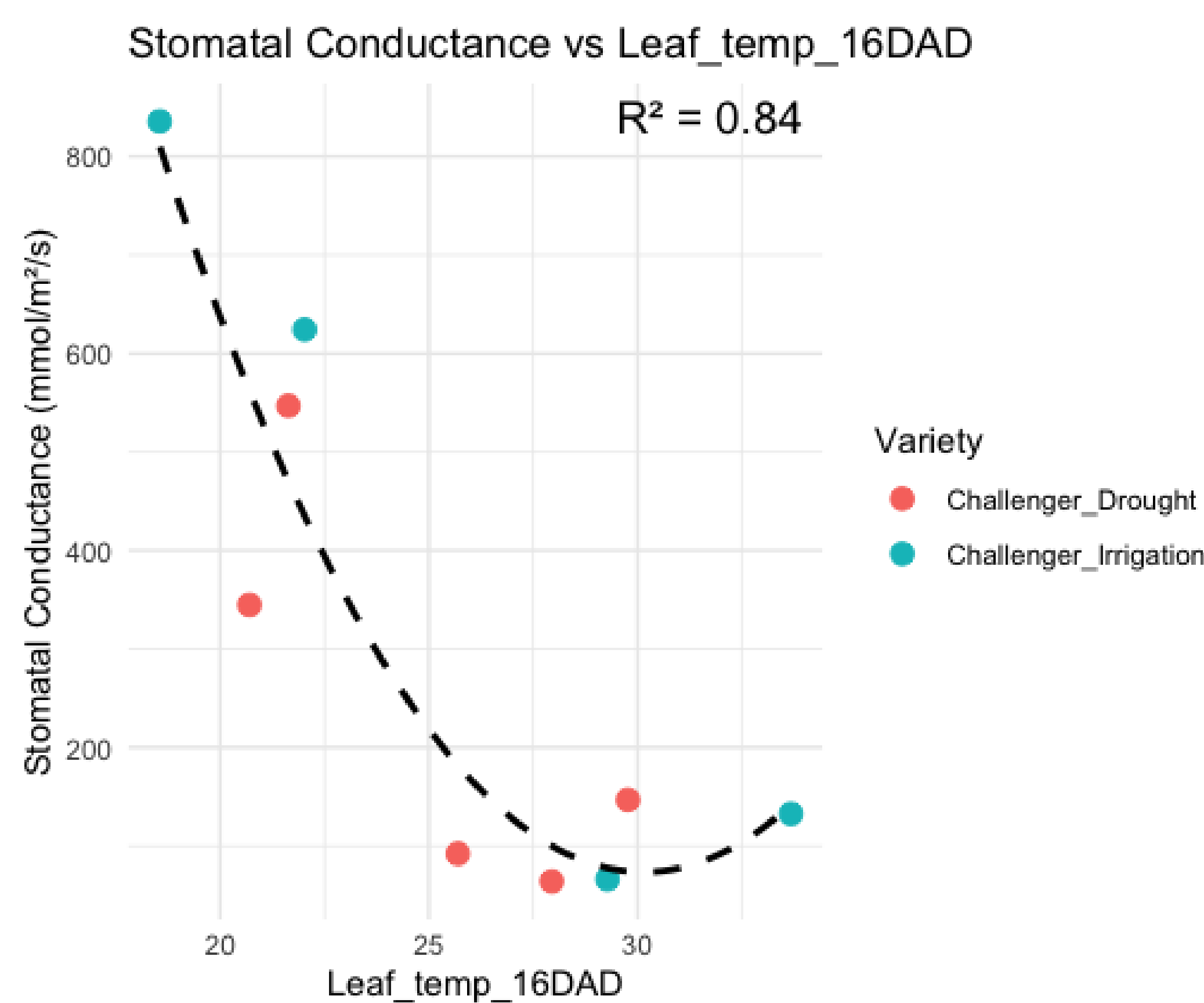


Figure 6: Scatter plot showing the relationship between Stomata Conductance and leaf temperature on Challenger variety

RESULTS

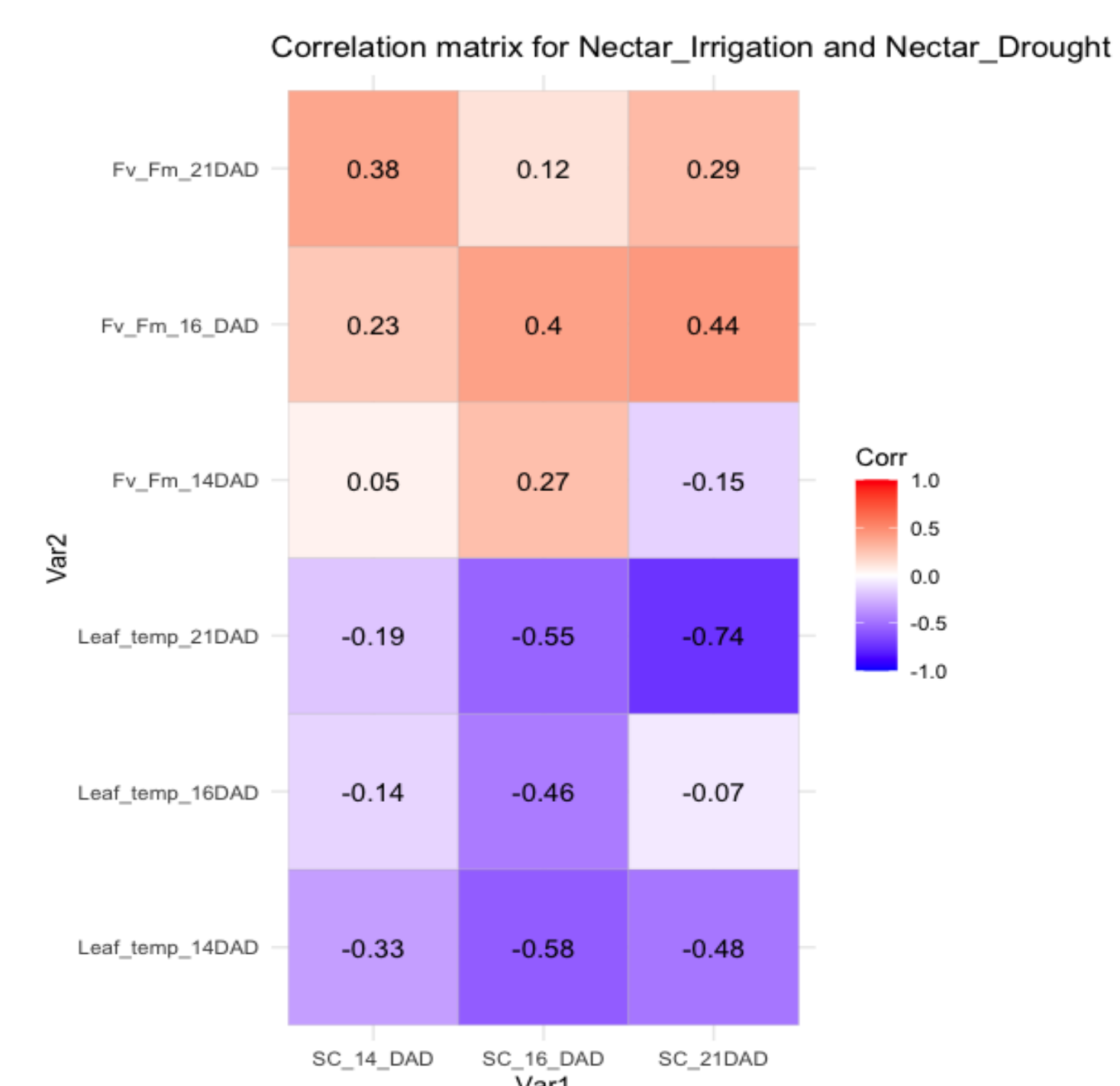


Figure 7: A correlation matrix for stomatal conductance vs leaf temperature and fluorescence ratios on the Nectar variety. A high correlation was observed on 21 DAD with leaf temperature.

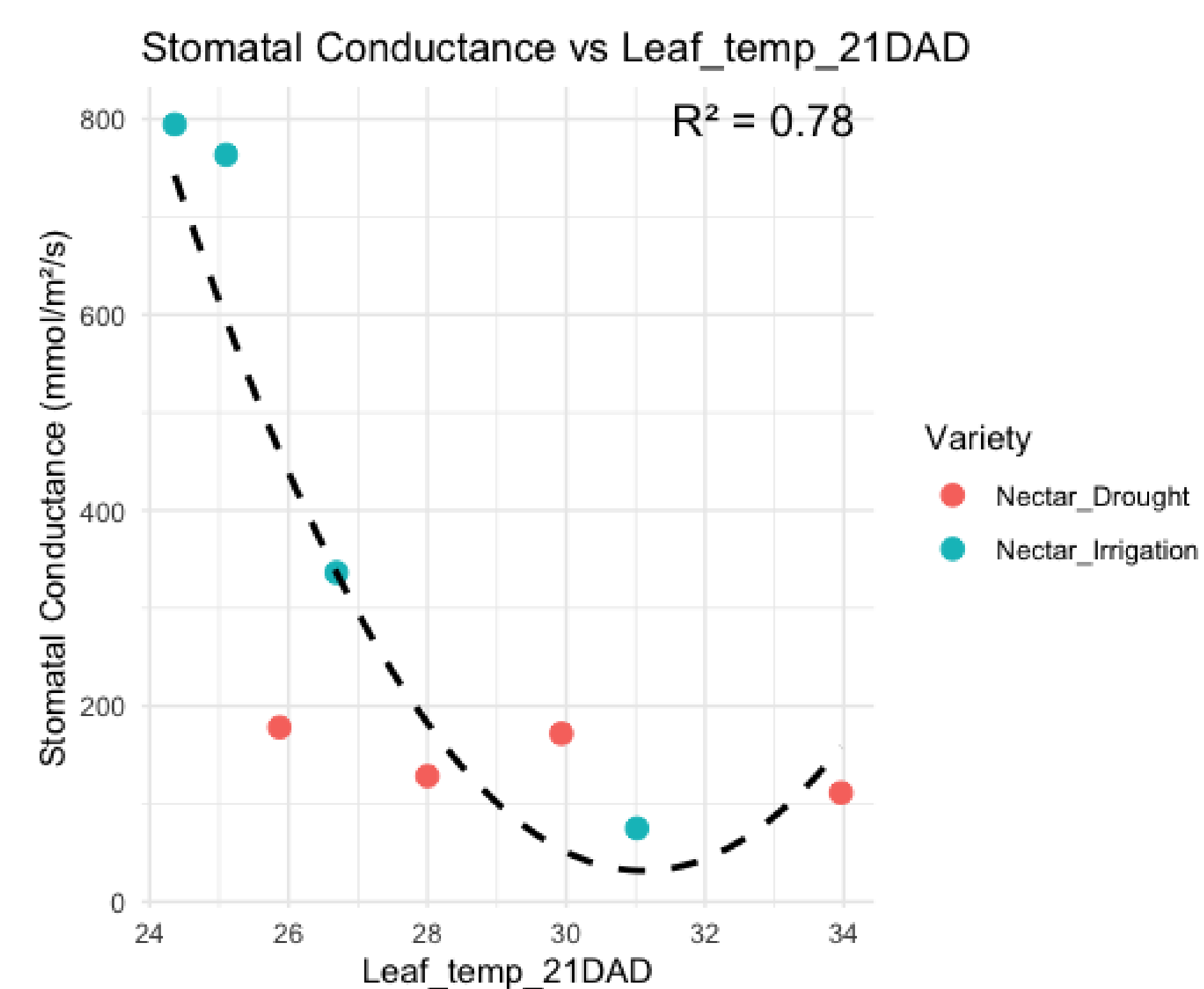


Figure 6: Scatter plot showing the relationship between Stomata Conductance and leaf temperature on Nectar variety

CONCLUSION

- Thermal Imaging shows better potential to detect stomatal conductance and evaluate crop water status than chlorophyll fluorescence
- Thermal Imaging is faster than both stomatal conductance and chlorophyll fluorescence

ACKNOWLEDGEMENTS

- I want to thank my faculty colleagues, CERC, and the Lab staff for their support.
- This work was supported by the Biotechnology and Biological Sciences Research Council (BBSRC) and the University of Harper Adams funded Midlands Integrative Biosciences Training Partnership (MIBTP) [Grant number MIBTP2023: BB/T00746X/1] and the Douglas Bomford Trust

