Assessing the components of vineyard evapotranspiration in the Barossa Valley

V. Phogat[1,2] M. Bonada[1], G.C. Sepulveda[1], C. Collins[2,3] and P.R. Petrie[1,4,5]

[1]South Australian Research and Development Institute, Adelaide, SA
[2]School of Agriculture, Food and Wine, The University of Adelaide, Waite Campus, Glen Osmond SA 5064
[3]ARC Training Centre for Innovative Wine Production, The University of Adelaide, Glen Osmond SA 5064
[4]Flinders University, Adelaide, SA
[5]University of New South Wales, Sydney, NSW

Introduction

Water availability for irrigation is a key management issue for Australian vineyards. Water scarcity is intensified due to climate variability and increased occurrence of droughts. Optimum irrigation application can help improve water use efficiency and regulate water stress to improve the sustainability of the production system. This study estimated the water balance components, site-specific values of crop coefficients and a water stress component at different sites in the Barossa.

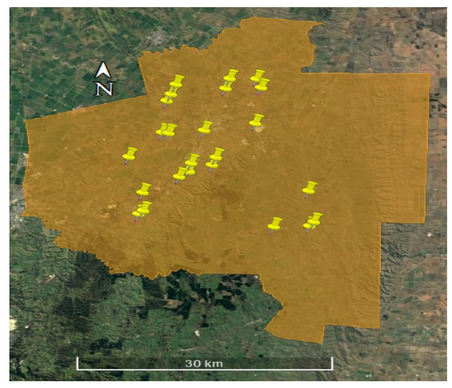

Figure 1: Location of study sites (24) in the Barossa.

Materials and methods

- Soil water, canopy growth and climate monitoring sites were established at 24 locations in the Barossa (Fig. 1).
- Soil samples were collected from two zones (with small and large canopies) at each site and soil moisture probes were installed in each zone.
- Grapevine canopy cover and soil moisture dynamics were measured over the three seasons (2018-2021).
- Canopy measures were used to estimate the site-specific vegetative fraction and canopy density required to adjust the crop coefficients for local growing conditions.
- Plant available water capacity (PAWC) and daily real time plant available water (PAW) were estimated from the soil analysis and moisture measurements.
- The FAO-56 dual crop coefficient (Allen et al. 1998) was used to estimate the daily evapotranspiration (ET) components and crop coefficients (K_c).

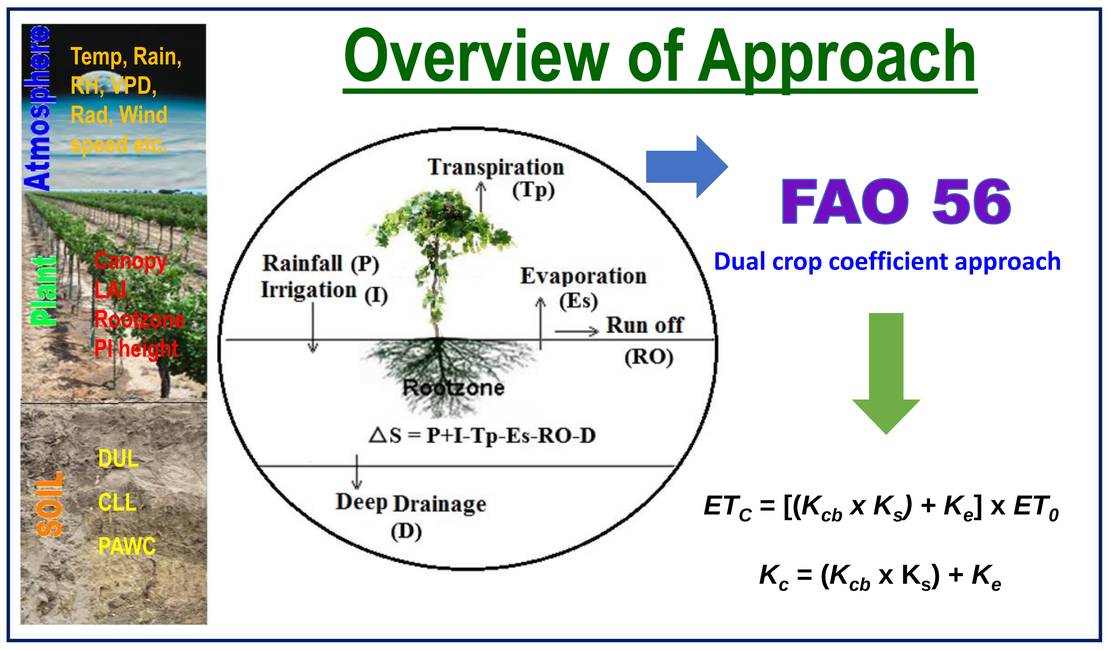

Figure 2: Schematic representation of the FAO-56 approach for the estimation of crop evapotranspiration (ET_C), water stress (K_s), single crop coefficient (K_c), basal crop coefficient (K_{cb}) and evaporation coefficient (K_e). ET_0 represents the reference crop evapotranspiration.

Results

- Estimated average seasonal evapotranspiration for the Barossa was 325 mm with 31% of water use occurring from bud burst to flowering, 47% from flowering to veraison and 22% from veraison to harvest (Fig. 3).

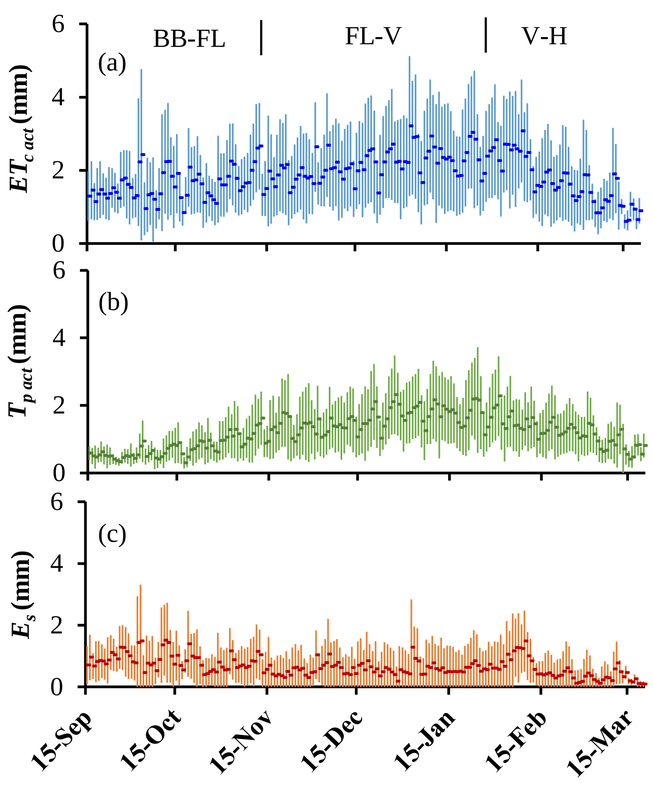

Figure 3: Predicted values of (a) average actual evapotranspiration ($ET_{C\ act}$), (b) transpiration ($T_{p\ act}$) and (c) evaporation (E_s) components of vineyards across Barossa study sites and three seasons (2018 to 2021).

- Across the season 65% of the water was transpired by the canopy and 35% evaporated from the soil surface (Fig. 3).
- Crop coefficients which are used for irrigation scheduling were estimated and standard values ($K_{c\ std}$) adjusted for local climate ($K_{c\ adj}$) and grapevine growing conditions ($K_{c\ act}$) (Fig. 4a).
- The estimated average of actual ($K_{c\ act}$) crop coefficient from flowering to harvest was 44% of the expected value for a fully irrigated vineyard (Fig. 4a).
- The average water stress imposed on grapevines was highest from late November (0.47), between flowering and veraison (Fig. 4b).
- The water stress decreased by 15% for the veraison to harvest period when irrigation was used (Fig. 4b).

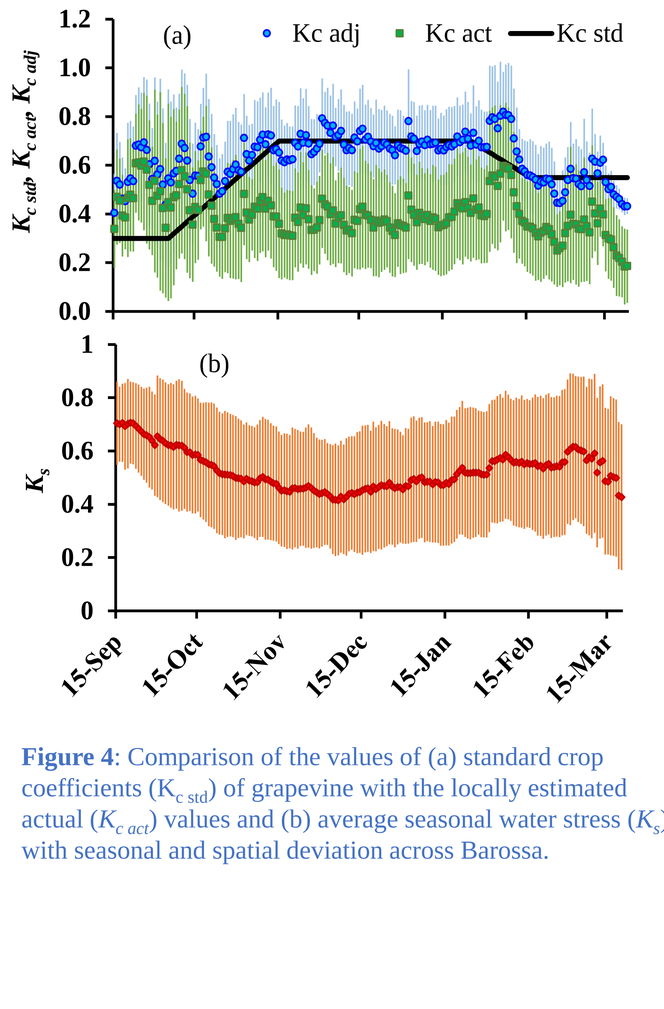

Figure 4: Comparison of the values of (a) standard crop coefficients ($K_{c\ std}$) of grapevine with the locally estimated actual ($K_{c\ act}$) values and (b) average seasonal water stress (K_s) with seasonal and spatial deviation across Barossa.

Conclusions

- ✓ Evaporation (which accounted for 35% of the water use) is a potential target for water savings.
- ✓ Vineyards experience considerable water stress, which peaks in late November before the start of widespread irrigation.
- ✓ Local crop coefficients relative to the theoretical values illustrates the irrigation savings and can be used to schedule irrigation for producing high quality Barossa shiraz.
- ✓ Future parts of this project will attempt to relate water stress to canopy development, yield and fruit style.

FURTHER INFORMATION

VINOD PHOGAT
P: (08) 84290678
E: vinod.phogat@sa.gov.au
www.pir.sa.gov.au

REFERENCES

Allen, R.G., Pereira, L.S., Raes, D., Smith, M., 1998. Crop evapotranspiration: Guidelines for computing crop water requirements. FAO Irrigation and Drainage Paper No. 56, FAO, Rome, Italy.

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