QUANTIFYING WATER USE OF PECANS

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Why quantify pecan water use?

Irrigation scheduling

Pecan production (yield and quality) is highly dependent on water supply

Water resource planning

Pecan water use varies with:

30% canopy cover

Region / season

Canopy cover

Cultivar

Water management

98% canopy cover

70% canopy cover

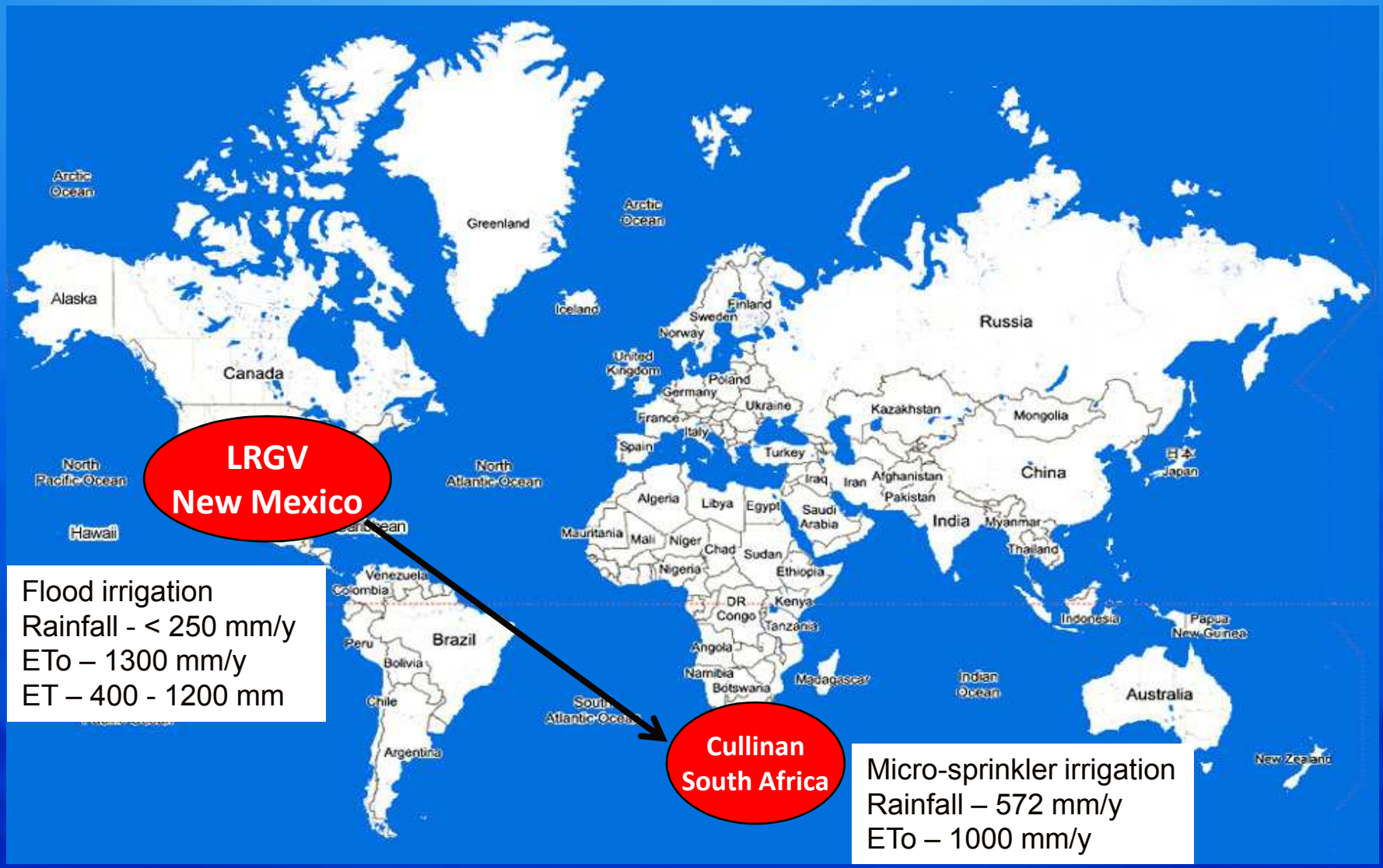
Micro-sprinkler irrigation

Flood irrigation

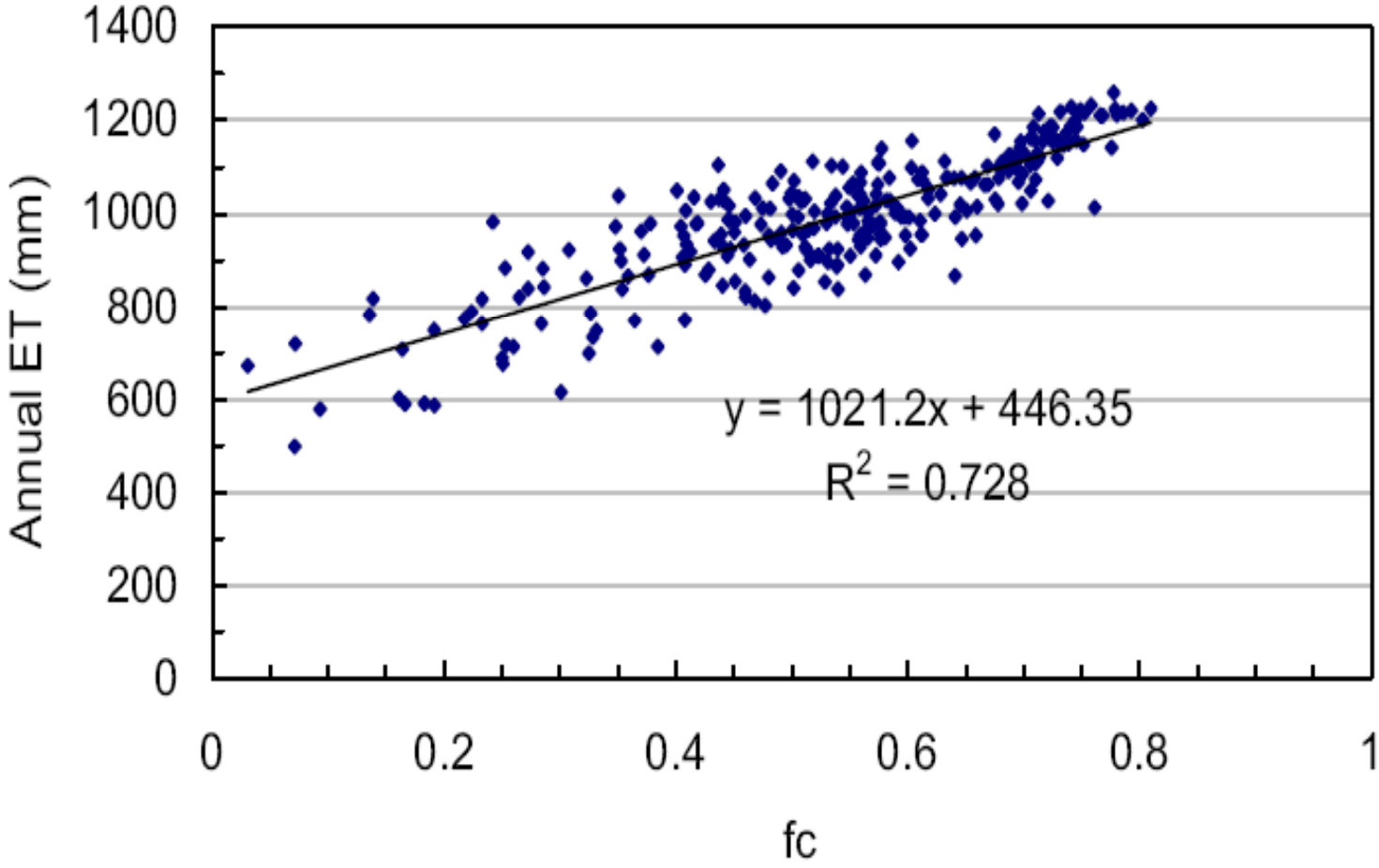
Aim of the study

To estimate water use of pecan orchards in South Africa using a simple but reliable model

Samani *et al.* (2011)

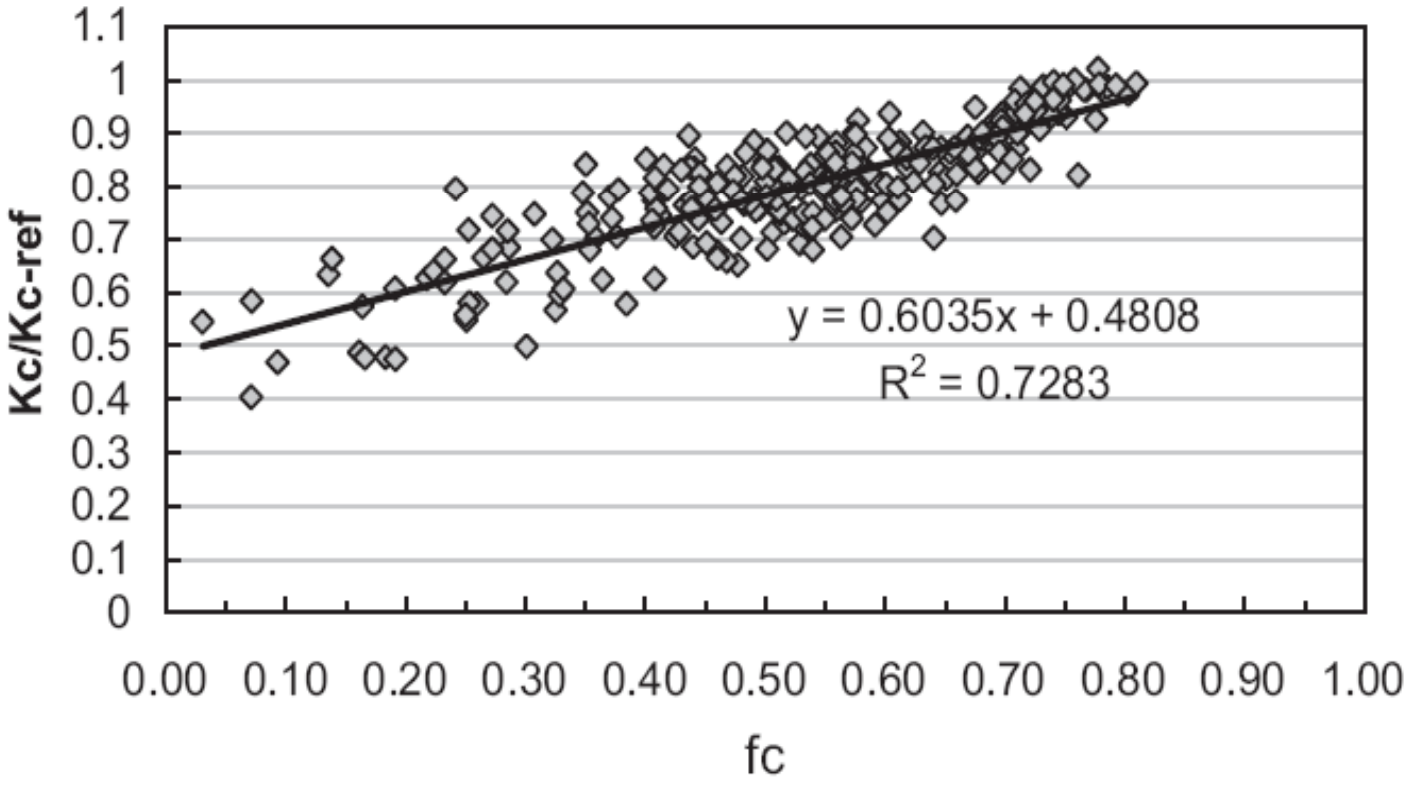


(Samani *et al.*) – Remote sensing



279 orchards

Samani *et al.*
Relative Kc – canopy cover



Samani *et al.*

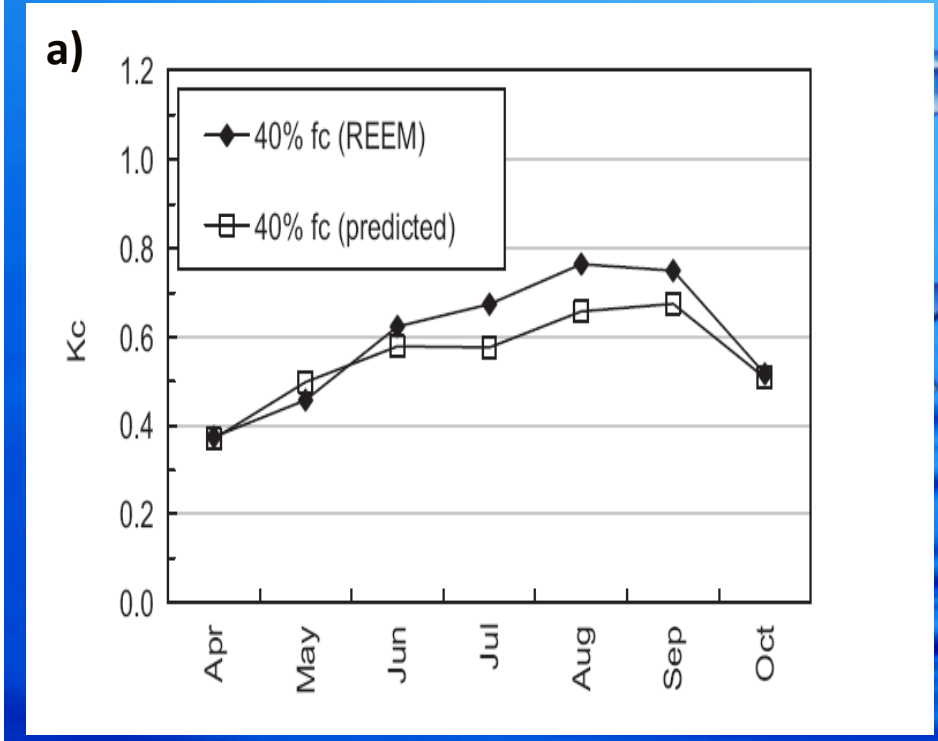
$$\frac{K}{K_c}$$

08

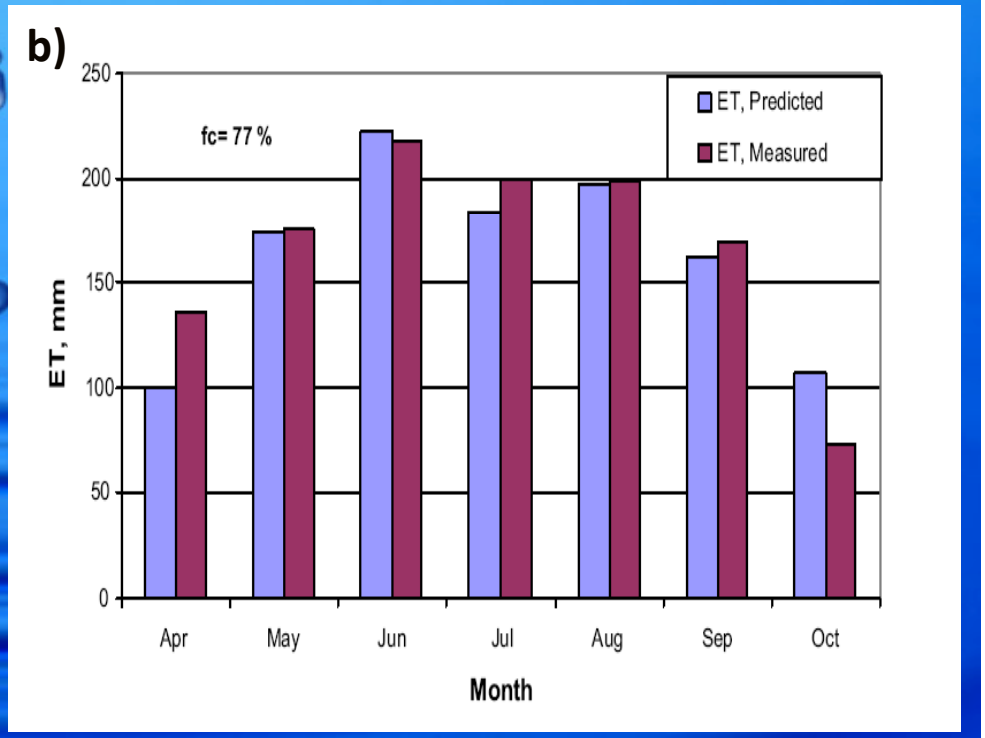
Oct	r	May
0.59	4	0.39

Samani *et al.*: validation

a)



b)



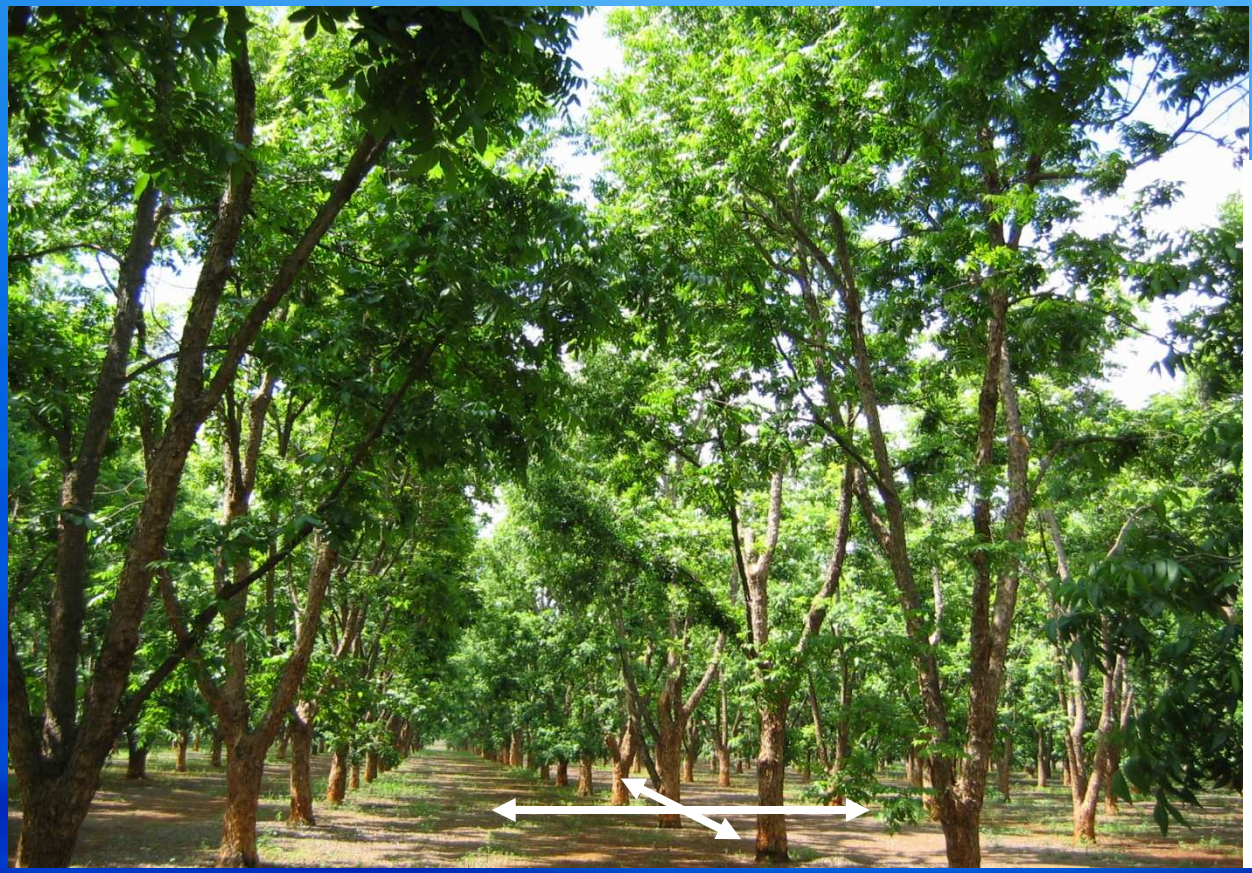
Samani *et al*. equation

- Is this simple relationship transferable to our conditions?
- Can we measure canopy cover in an orchard and then predict water use?

Field measurements Cullinan 09/10, 10/11 & 11/12

- 36 year-old ‘Choctaw’
- Spacing 9m x 9m x 9m (142 trees ha^{-1})
- Micro-sprinkler irrigation (usually once per week)

Fractional PAR measurements (Canopy cover)

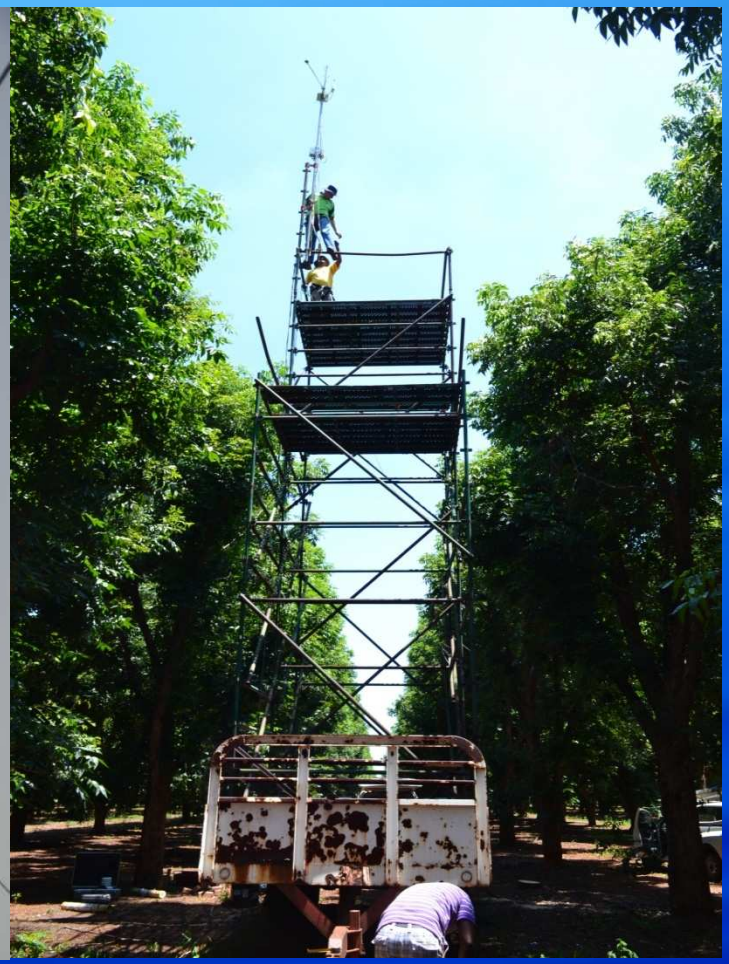


Ceptometer

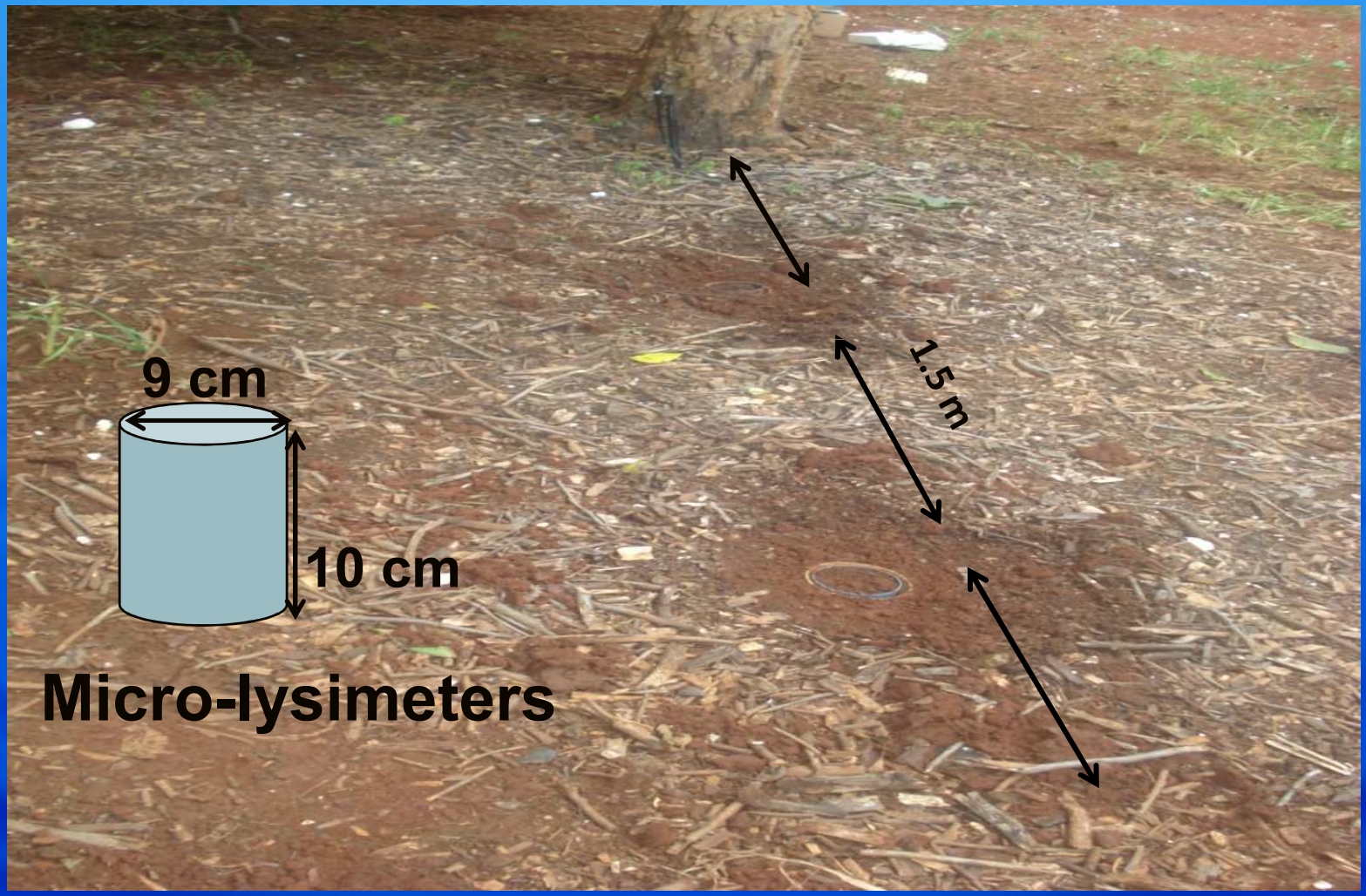
Transpiration measurements
- Heat Ratio Method -

Two trees instrumented with the HRM

Crop evapotranspiration measurements – Eddy covariance



Soil evaporation measurements



Estimation of soil evaporation - Es

FAO 56: Dual crop coefficient approach

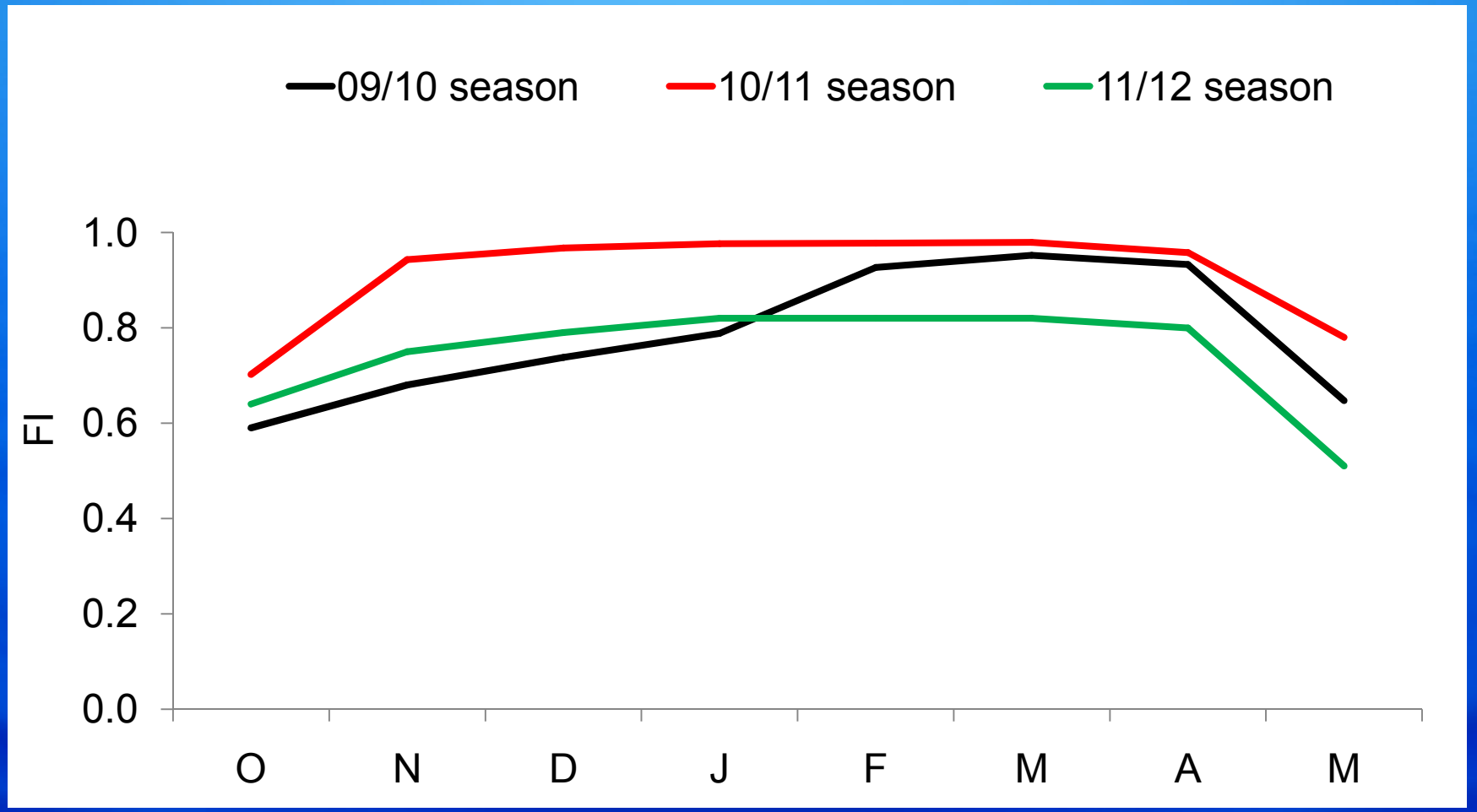
$$E_s = K_e * ET_o$$

$$K_e = K_r * (K_{c\ max} - K_{cb}) \leq f_{ew} * K_{c\ max}$$

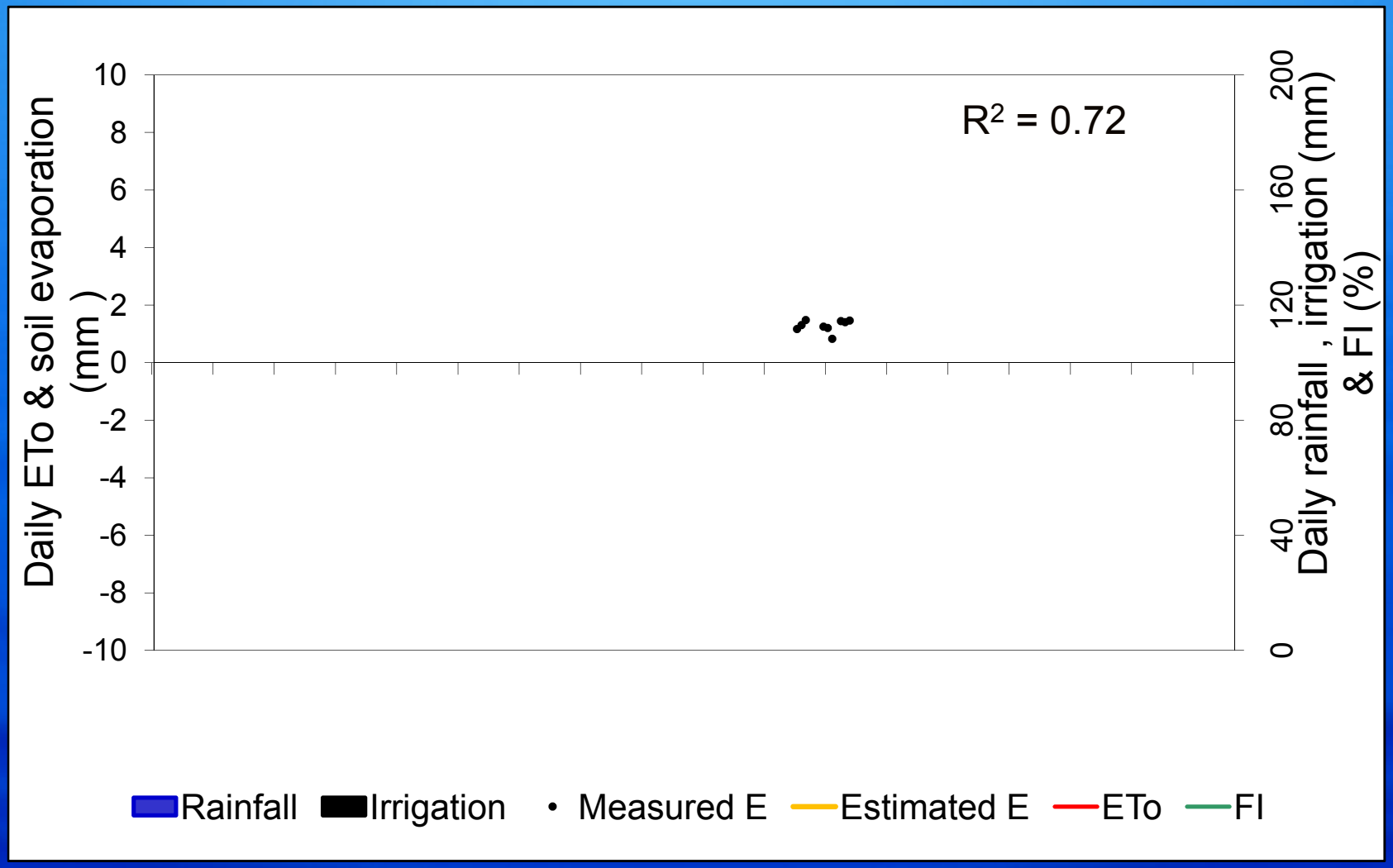
K_e – soil evaporation coefficient
K_r – evaporation reduction coefficient
f_{ew} – soil fraction, both exposed and wetted

RESULTS

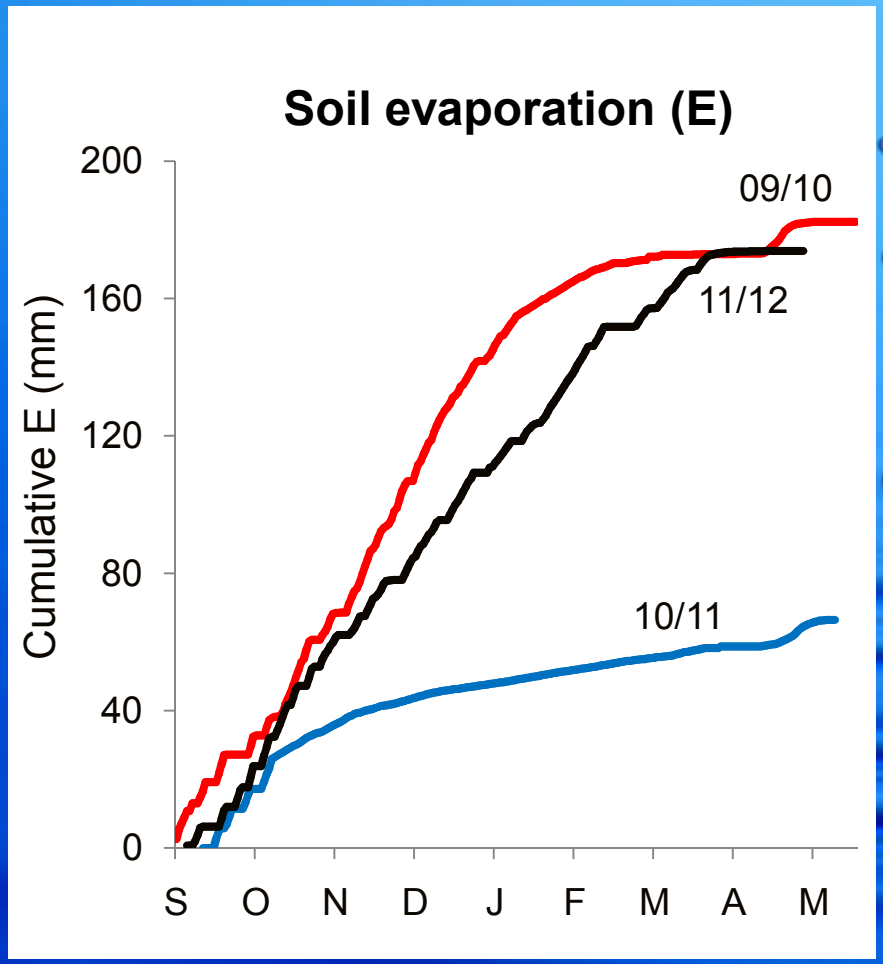
Fractional PAR (FI)

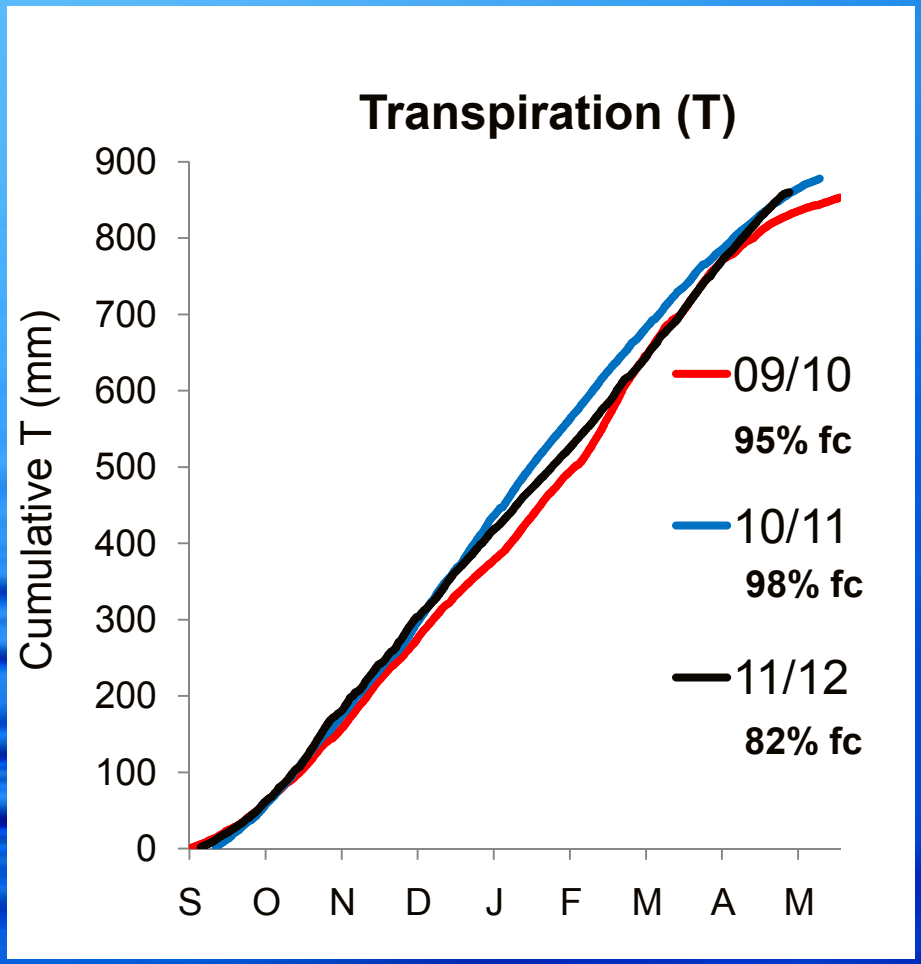


Daily soil evaporation in relation to ETo, water supply and FI -11/12

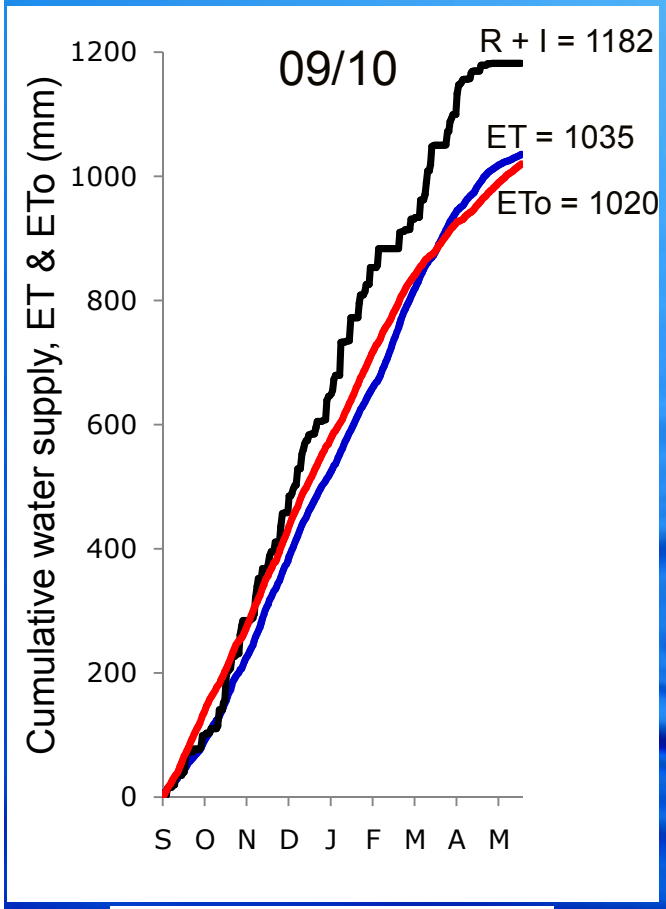


Cumulative E & T

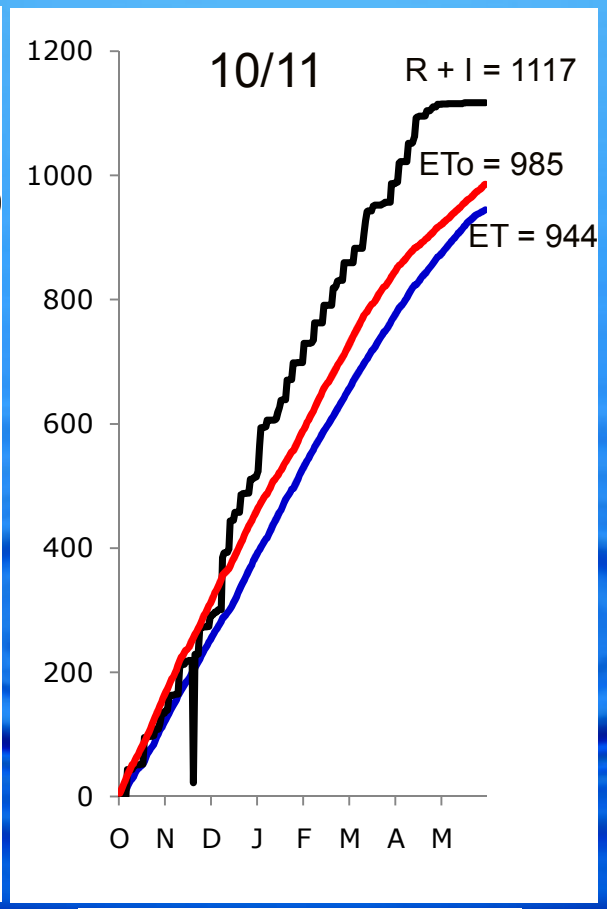




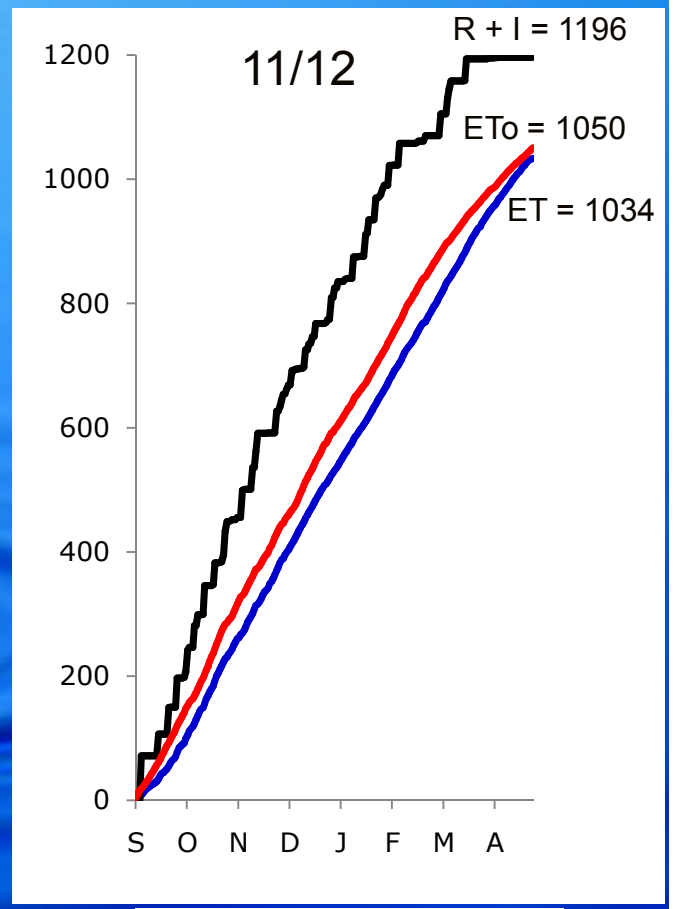
Cumulative water supply, ET and ETo



Yield = 2.4 t ha^{-1}

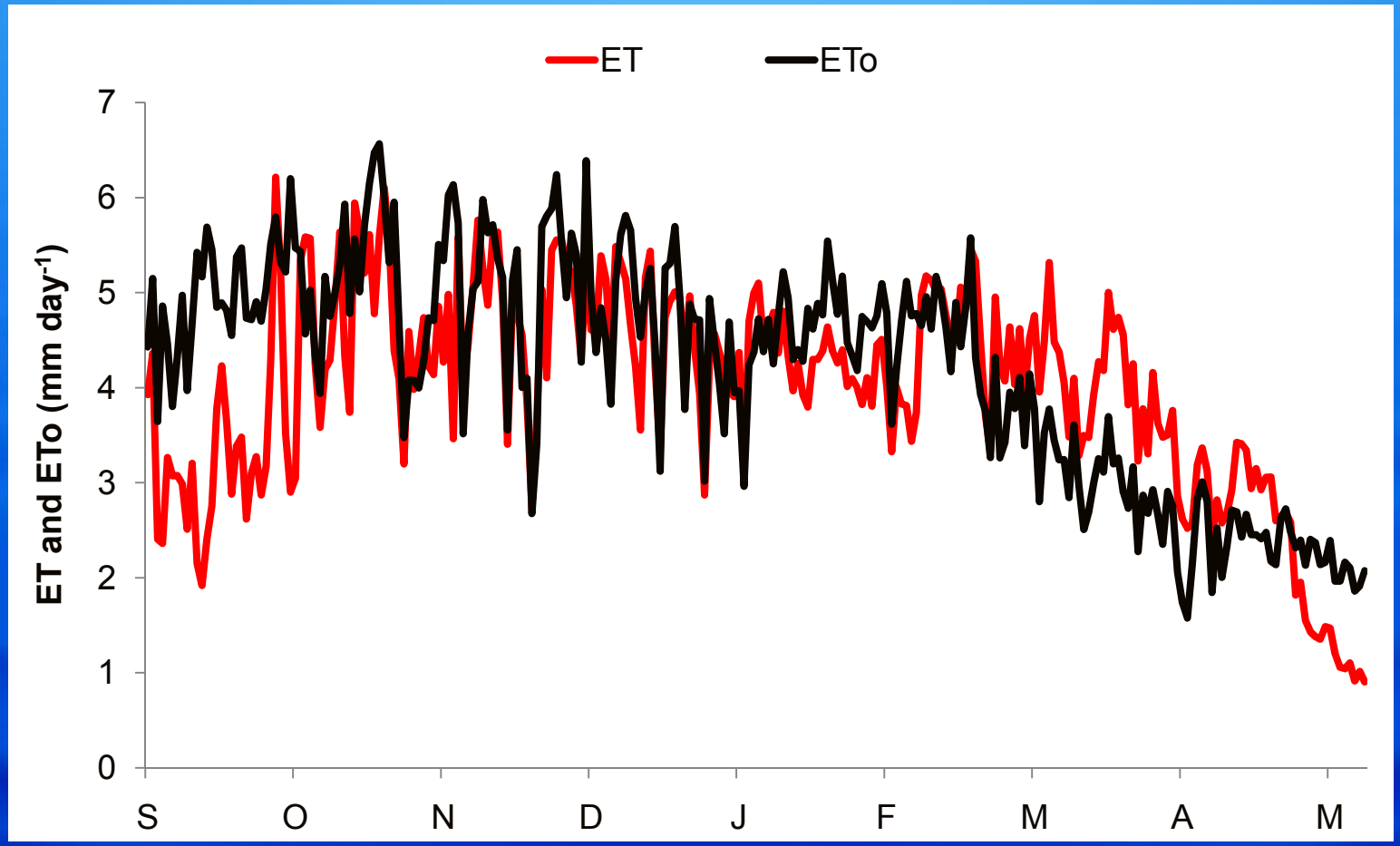


Yield = 1.3 t ha^{-1}



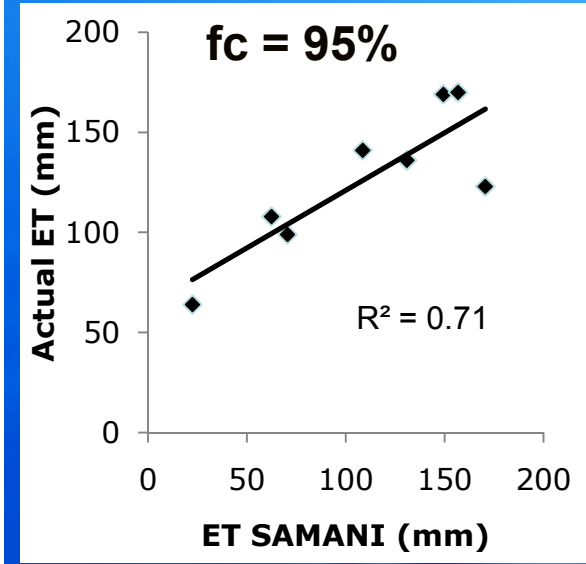
Yield = 2.0 t ha^{-1}

Daily average tree water use (ET) and ETo

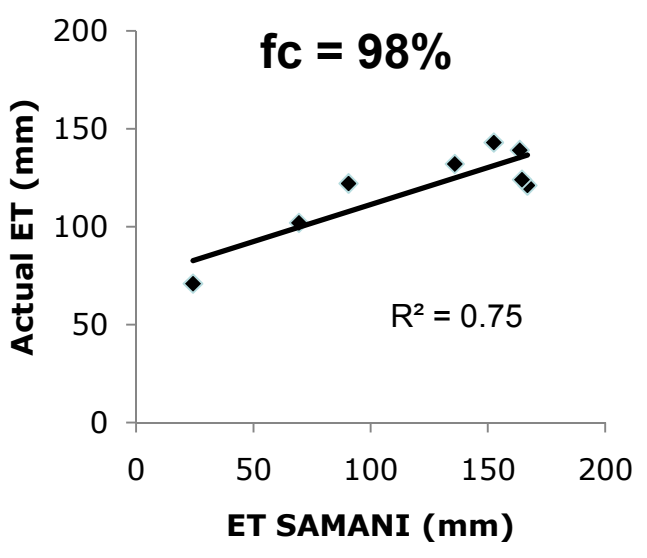


Monthly actual ET vs ET Samani equation

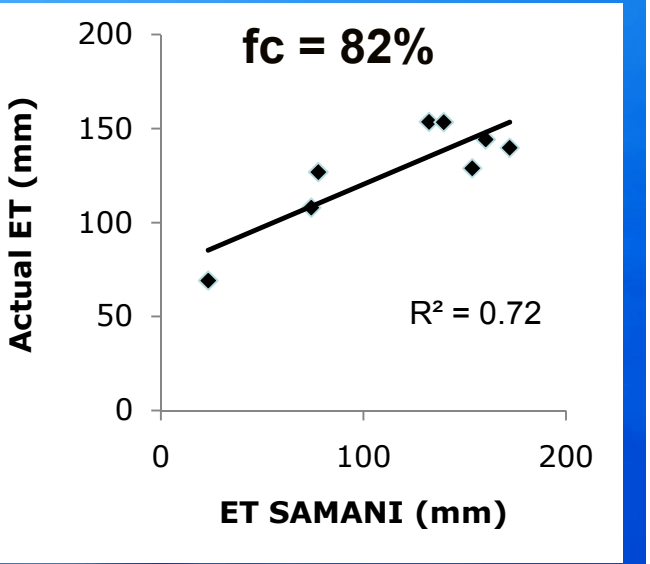
09/10



10/11



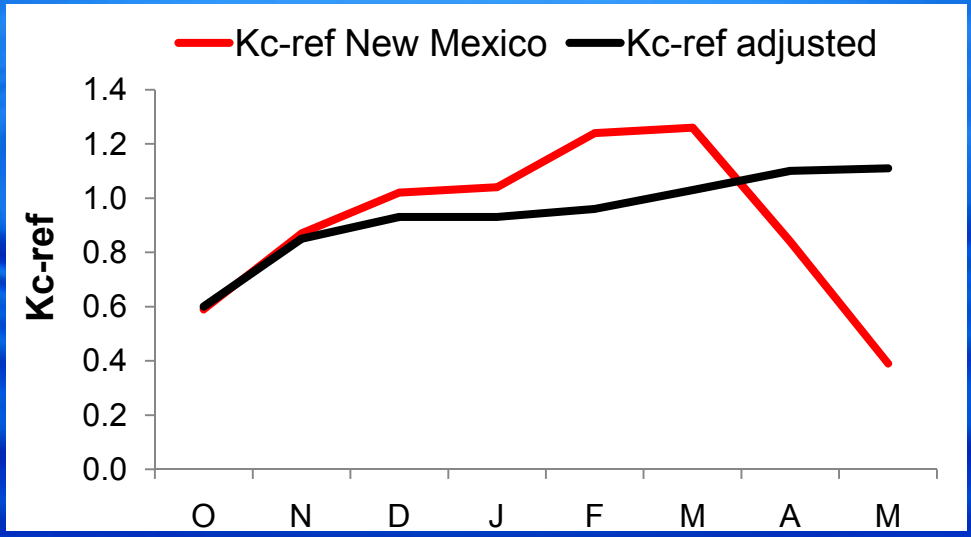
11/12



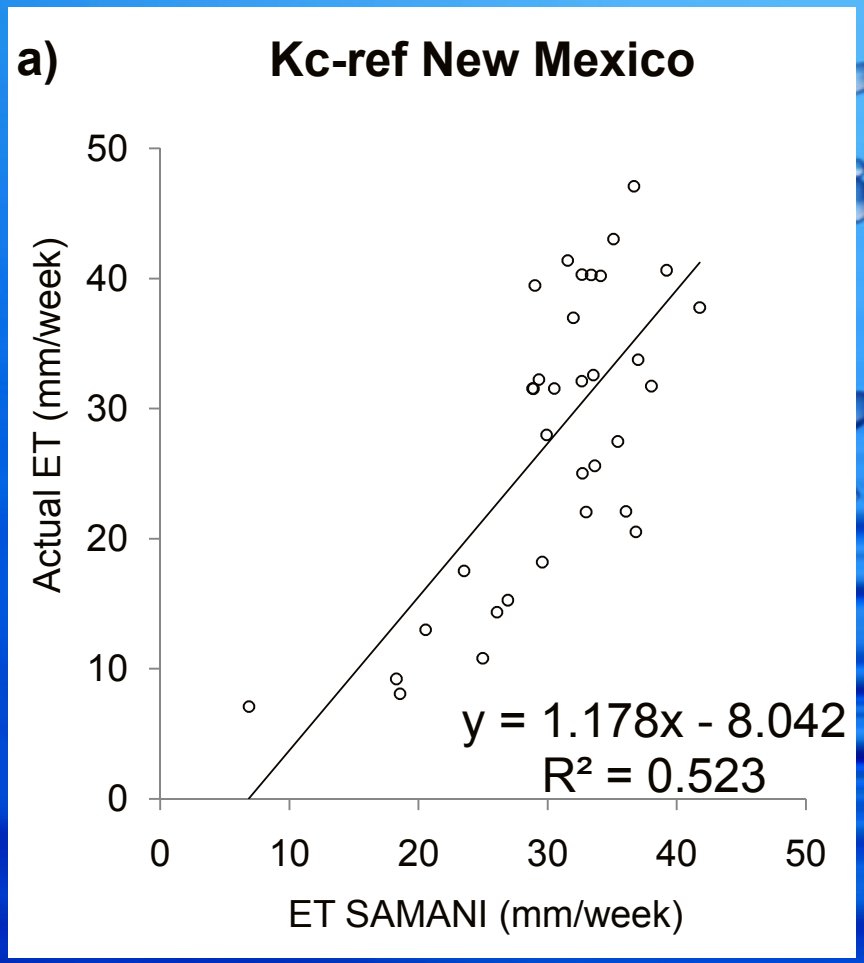
Adjustment of “Kc-ref” for climate at the study area, South Africa

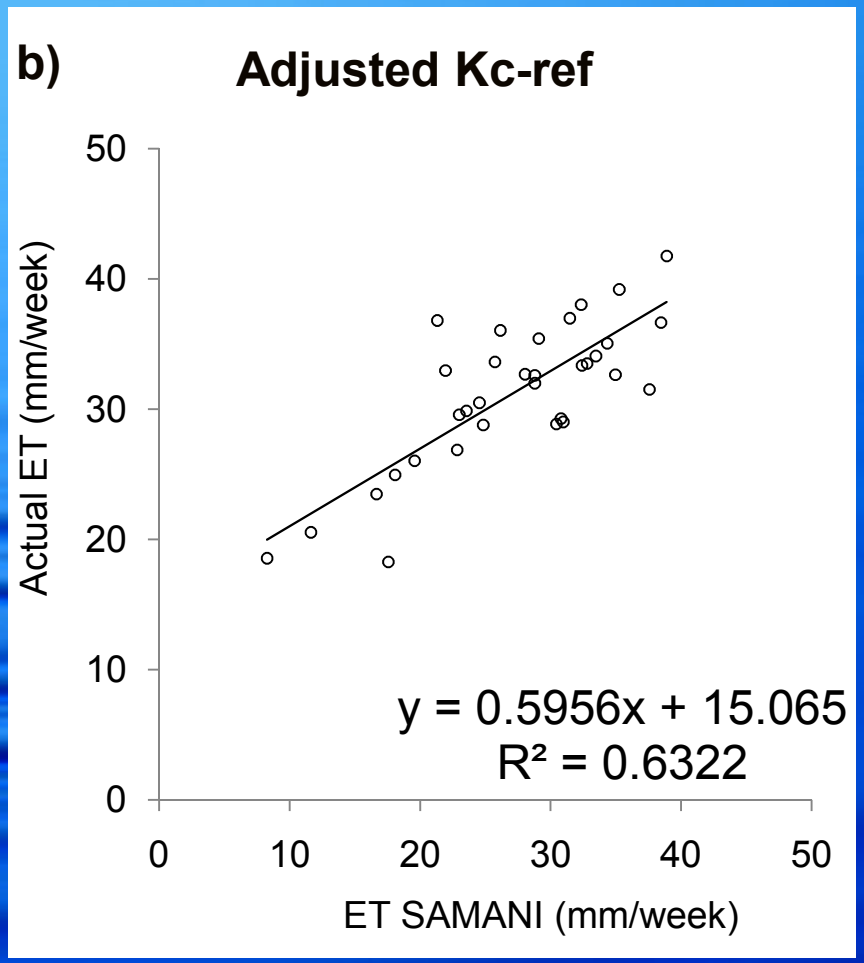
Sammis *et al.* (2004)

$$K_c = -3.9x10^{-12}\,GDD^4 + 1.1\,x\,10^{-8}\,GDD^3 - 1.1\,x\,10^{-5}\,GDD^2 + 4.3\,x\,10^{-3}\,GDD + 3.3\,x\,10^{-1}$$



Improved estimates of weekly ET with adjusted Kc-ref – 11/12





Improved estimates of weekly ET with adjusted Kc-ref

Season	Actual ET vs ET Samani with Kc-ref New Mexico	Actual ET vs ET Samani with adjusted Kc-ref
	R^2	
2009/2010	0.58	0.65
2010/2011	0.69	0.72
2011/2012	0.52	0.63

Conclusion & recommendation

- The Samani *et al.* (2011) equation shows good potential to estimate water use of pecans in South Africa, with adjusted Kc-ref for climate and measurements of canopy cover
- The Samani *et al.* (2011) equation needs to be tested in other conditions

Acknowledgements

- Water Research Commission

- Department of Agriculture, Forestry and Fisheries

- Albert Bouwmeester


Thank you