Irrigation Scheduling Program for Alfalfa

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UCD Alfalfa Workgroup

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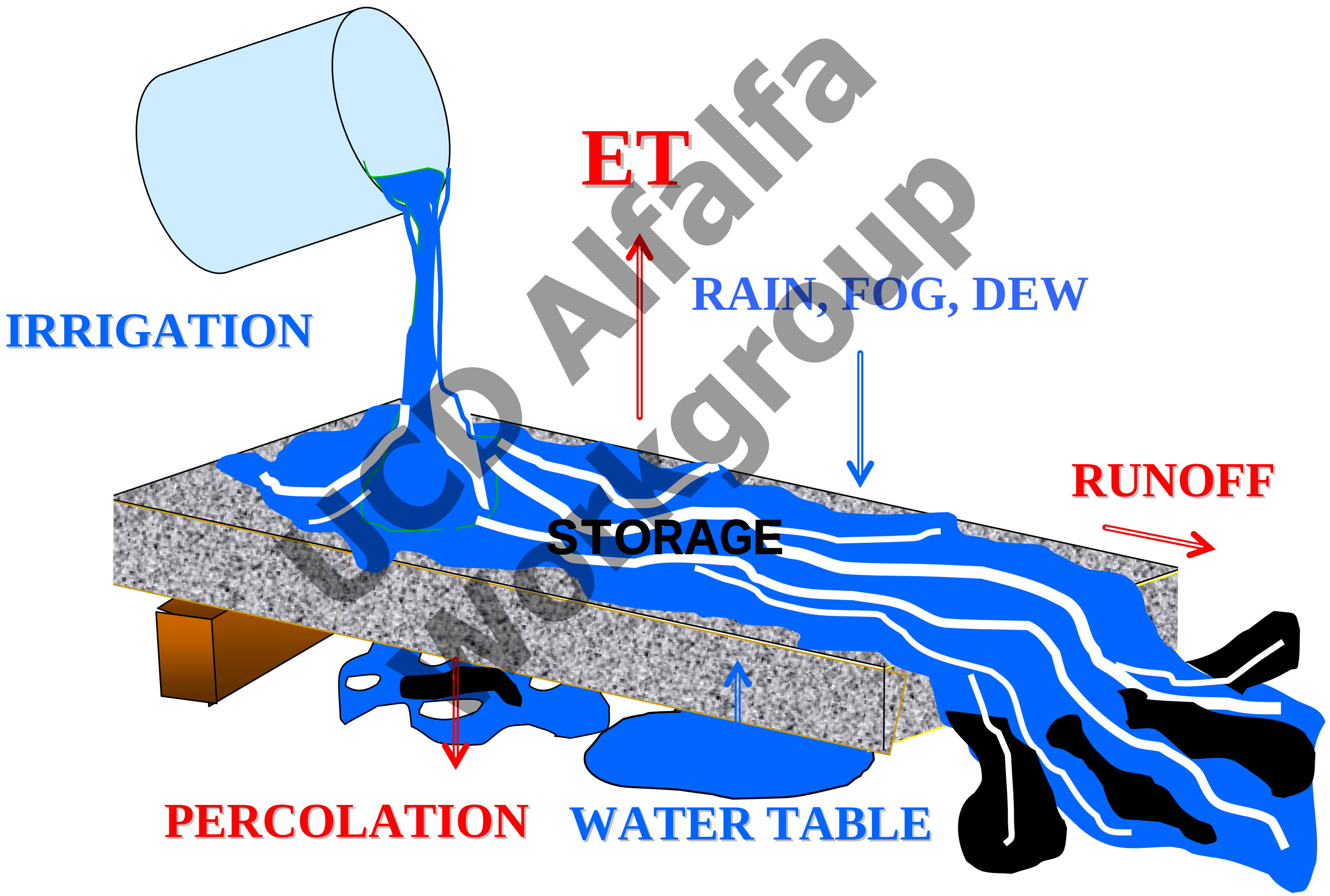
Water Balance



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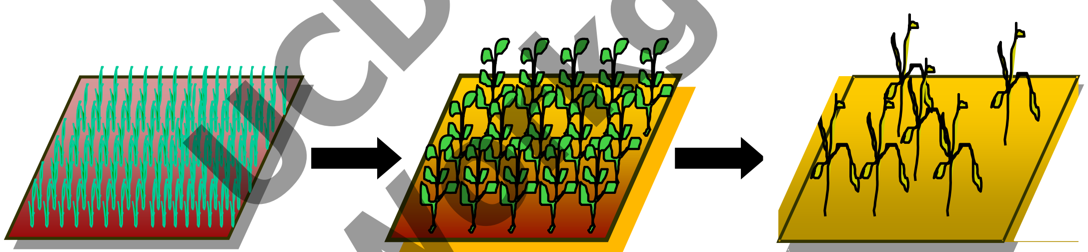
Actual Evapotranspiration

$$ET_o \times K_c = ET_c \times K_s = ET_a$$



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Estimating ET_o

$$ET_o = \frac{0.408\,\Delta\,(R_n - G) + \gamma\,\frac{900}{T + 273}\,u_2\,(e_s - e_a)}{\Delta + \gamma\,(1 + 0.34\,u_2)}$$

ET_o **accounts for weather**

Approximates pasture ET_c

CIMIS ≈ Penman Monteith

Penman Monteith Eq.

ASCE-EWRI Committee on Evapotranspiration in Irrigation and Hydrology

Allen et al. (2005)

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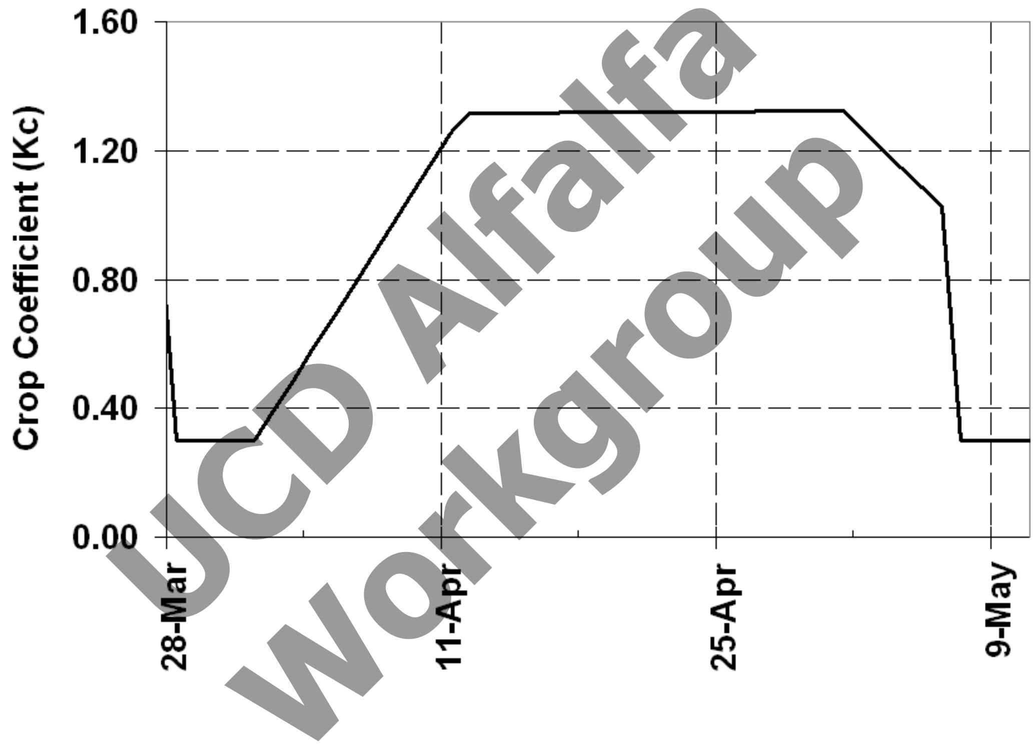
Crop Coefficients



Mid-cycle Kc Critical

$K_{c,max}$ Climate Correction

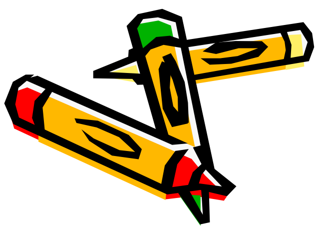
$$K_{c,\max} = K_{ct} + \left[0.04(u_2 - 2) - 0.004(RH_{\min} - 45)\right]\left(\frac{h}{3}\right)^{0.3}$$

K_{ct} = 1.20 for alfalfa

U_2 – wind speed (m s^{-1}) at 2 m over grass

RH_{min} – minimum daily relative humidity

h – canopy height (m)



Allen et al. (1998) – FAO 56

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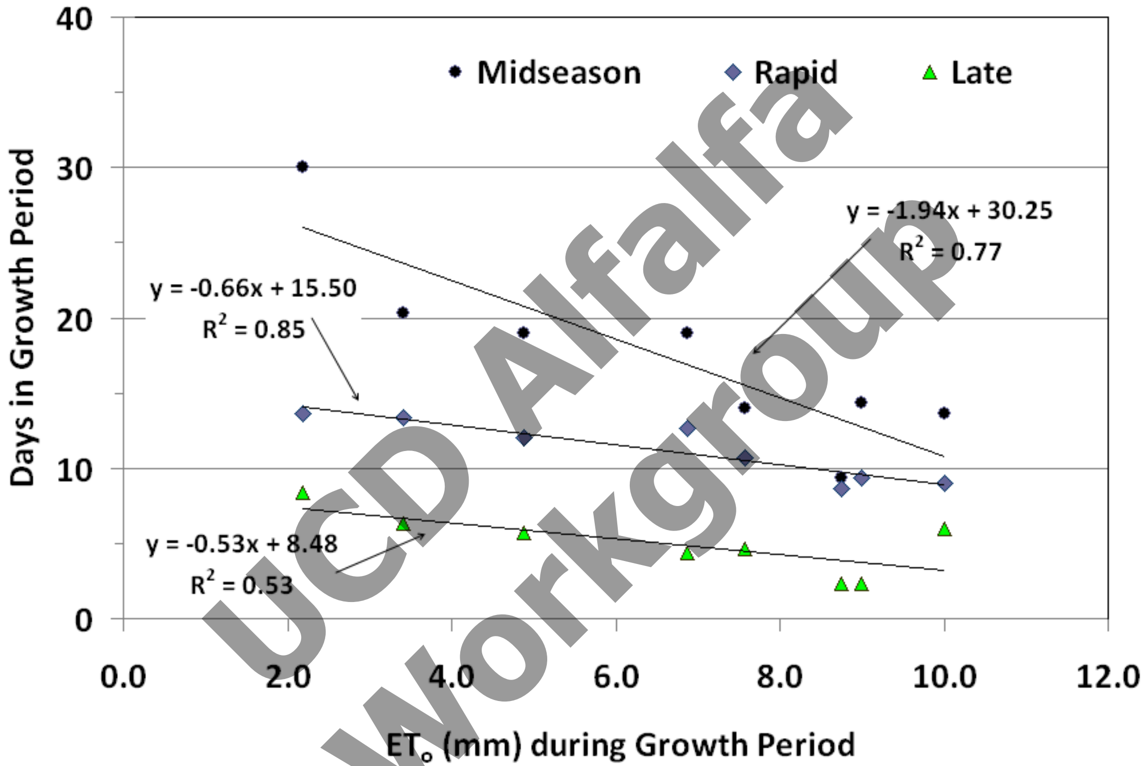
Length of Stages



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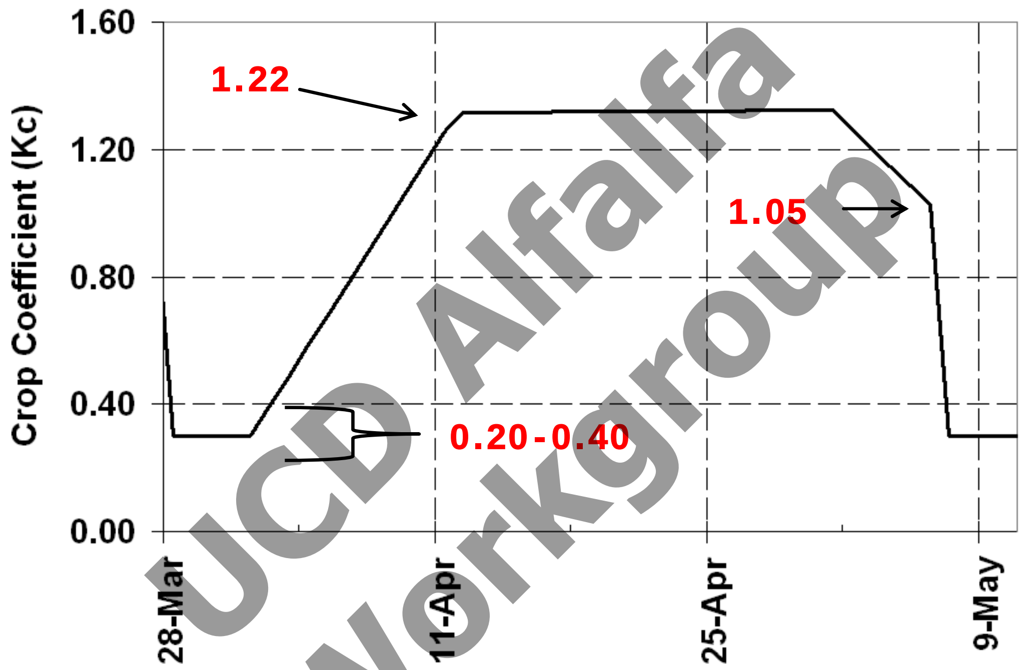
Hunsaker, D.J., Pinter,P.J., Jr., Cai, H. (2002)

K_c Comparison



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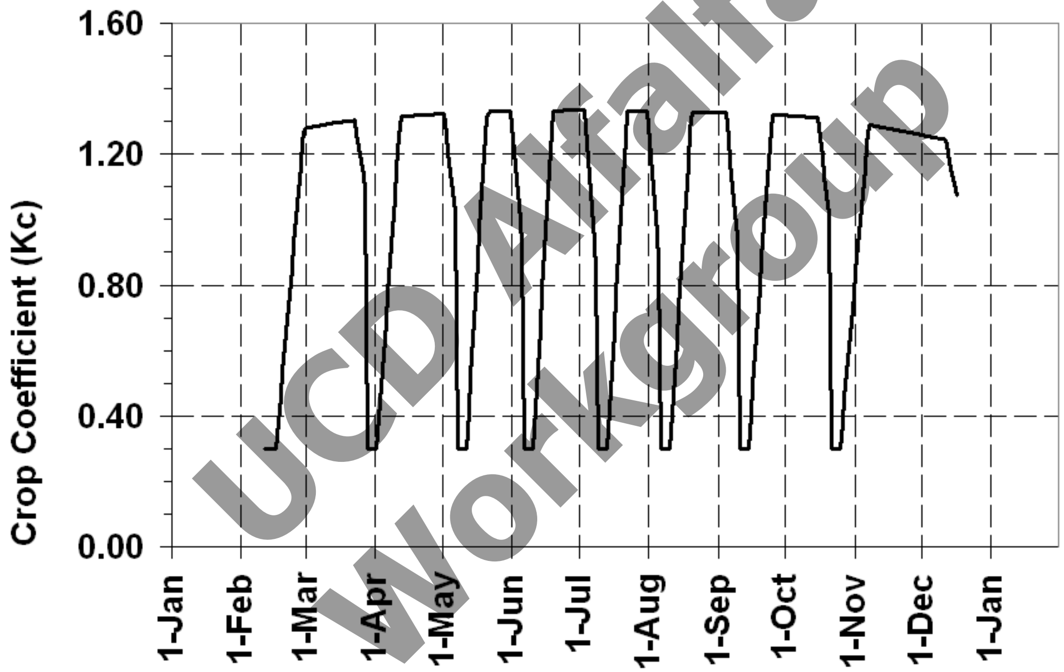
Mean basal Kc values from

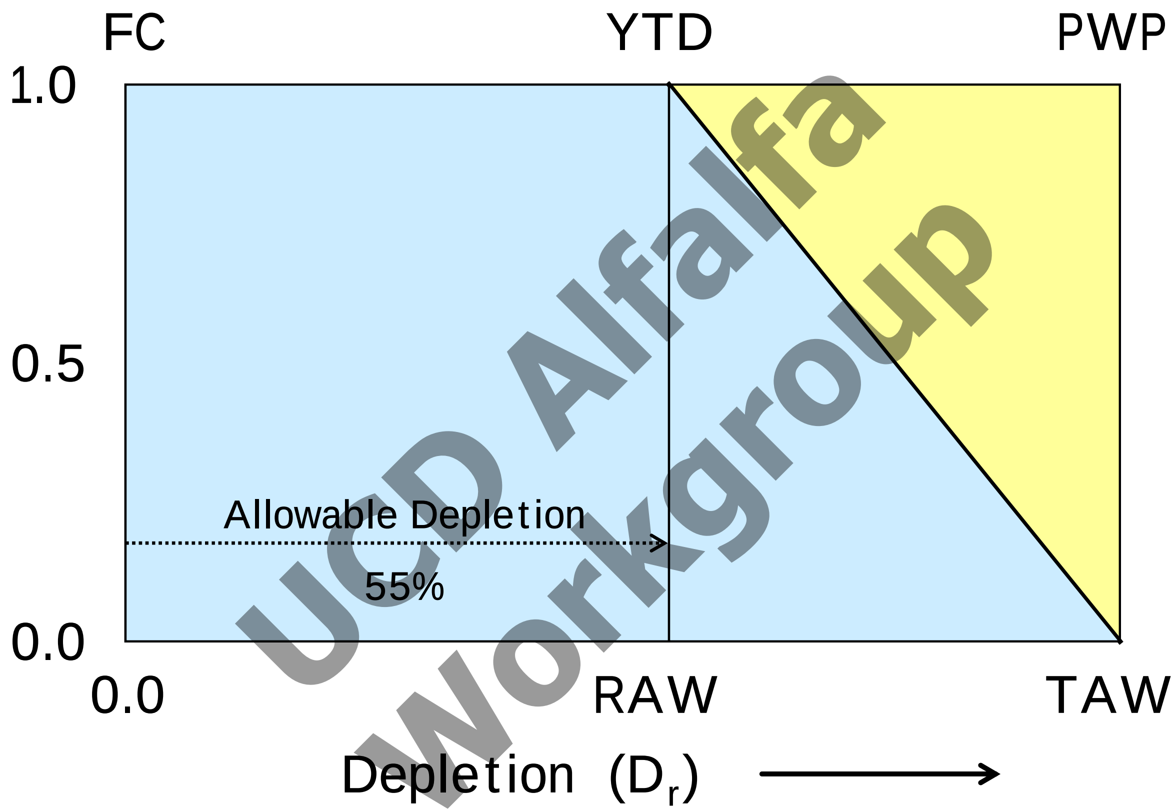
3 lysimeters and 8 cutting cycles

Hunsaker, D.J., Pinter,P.J., Jr., Cai, H. (2002)

Annual Climate Corrected K_c Curve for 8 cuttings of Alfalfa near Indio



Stress Coefficient



$$K_s = 1$$

$$K_s = 1 - \left(\frac{D_r - RAW}{TAW - RAW} \right)$$

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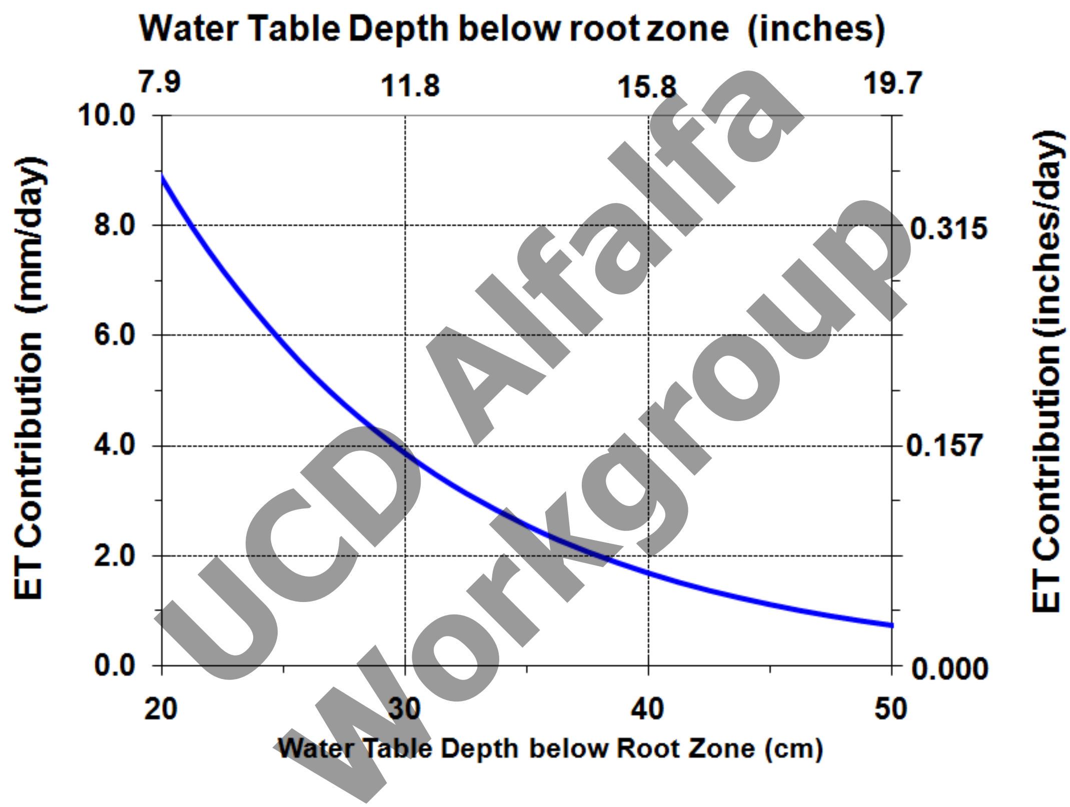
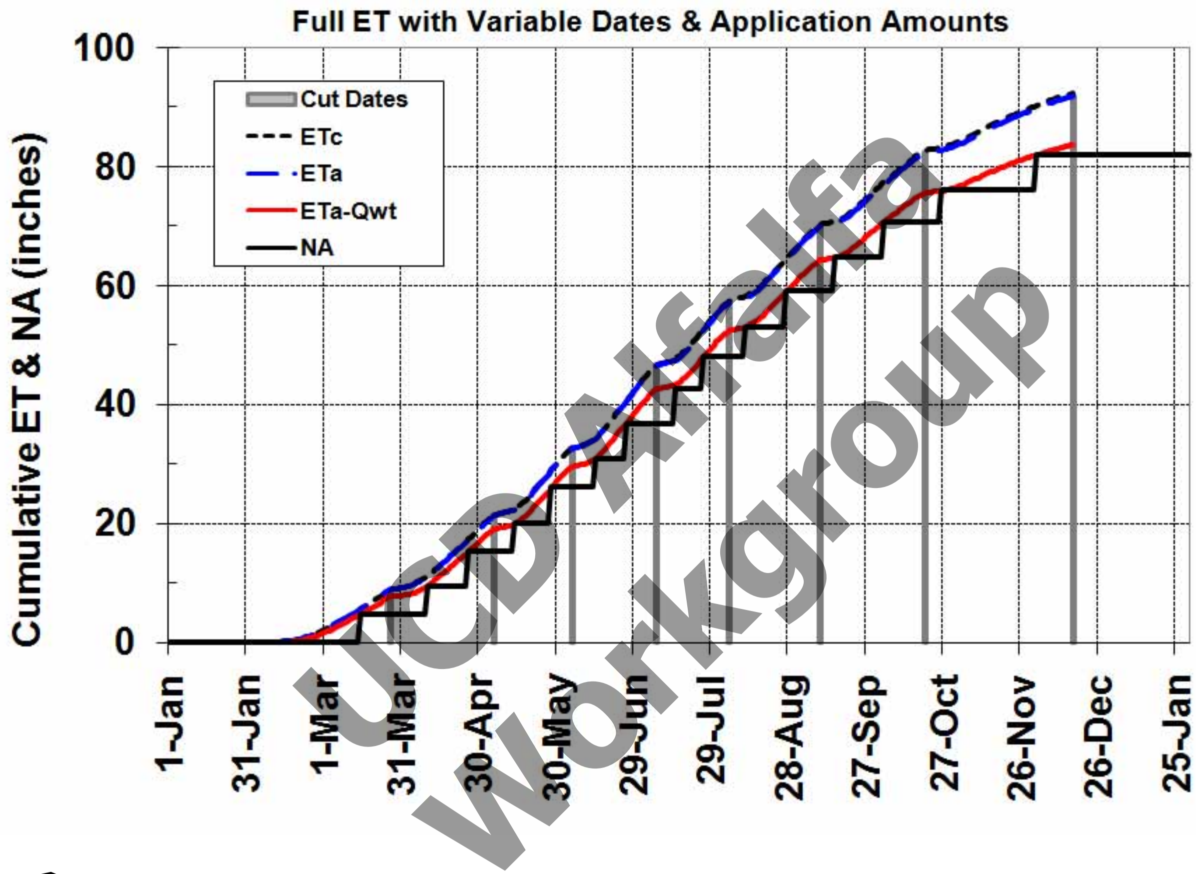
Water Table Contribution



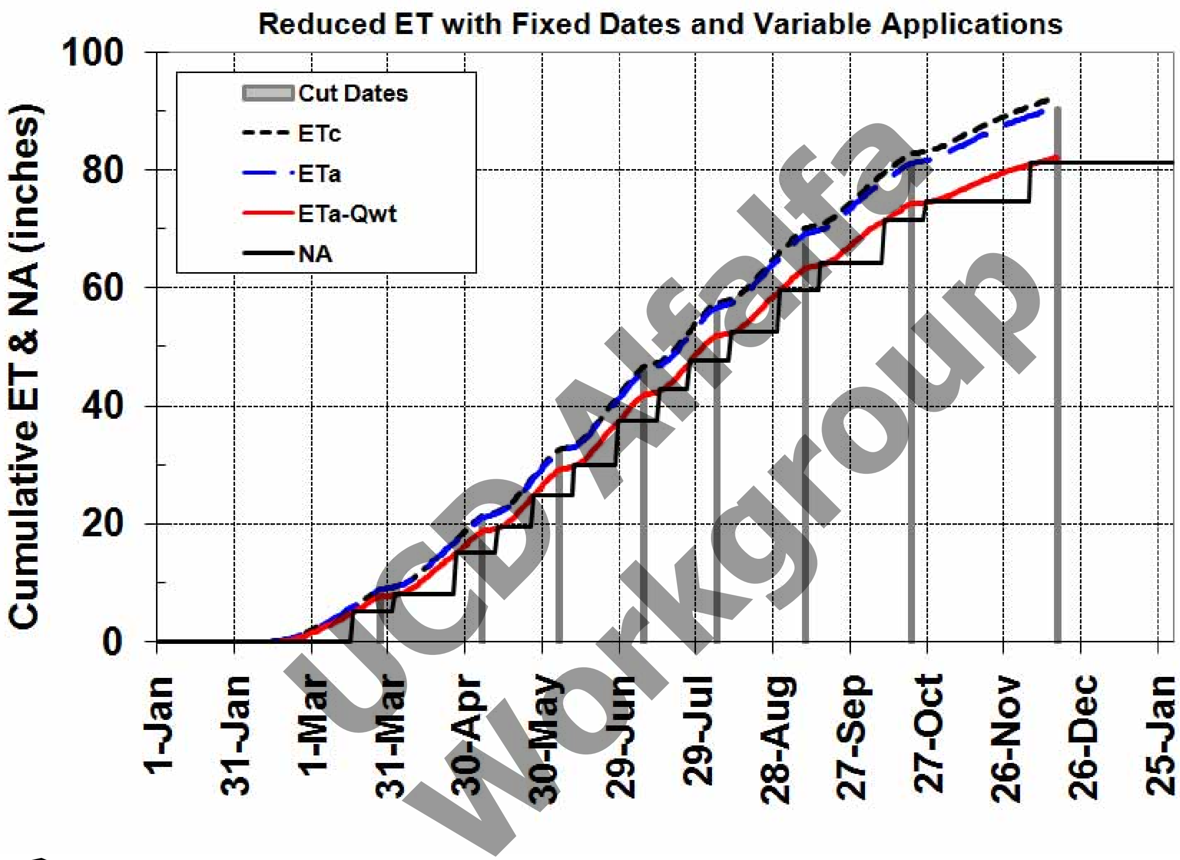
$$Q_m = 4.65 e^{-0.083 z_m}$$

RAGAB and AMER (1986)

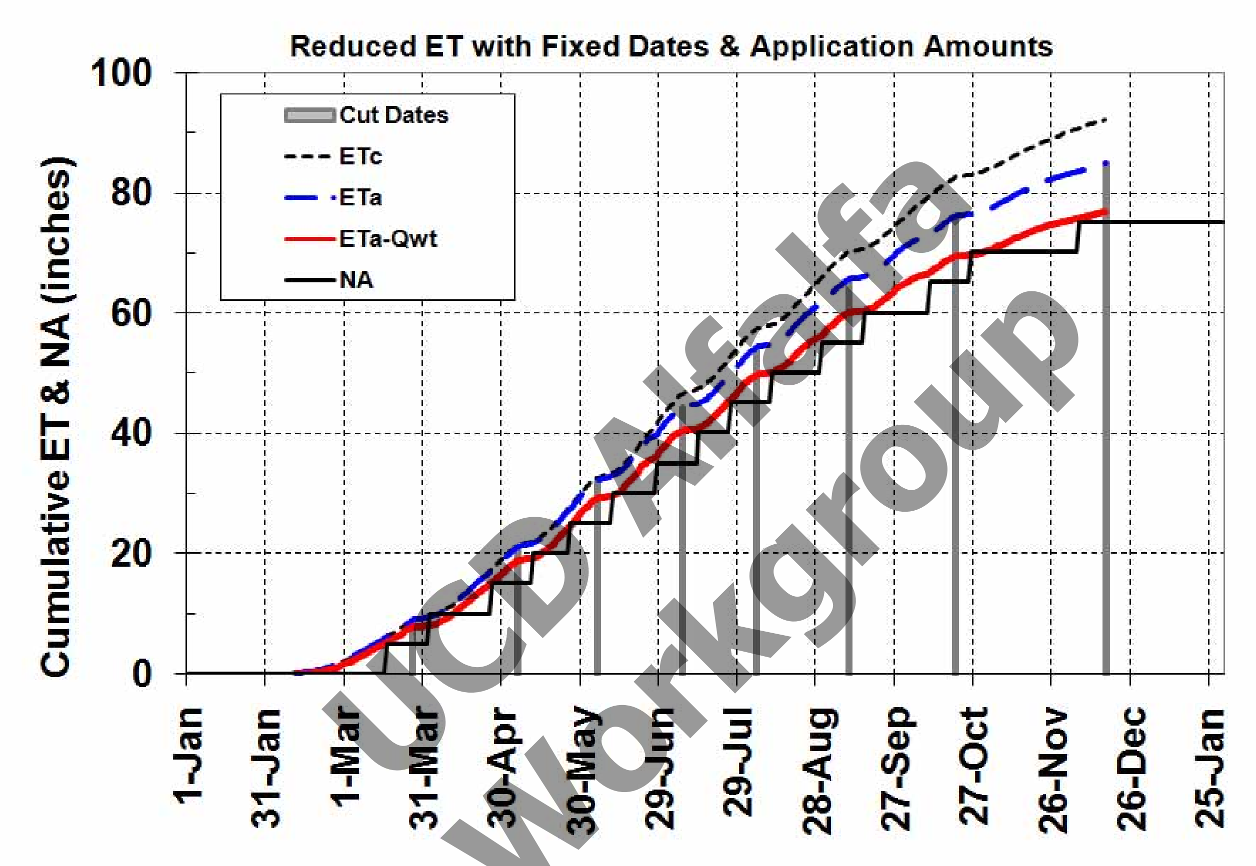
for z_m (cm) and Q_m (cm/day)



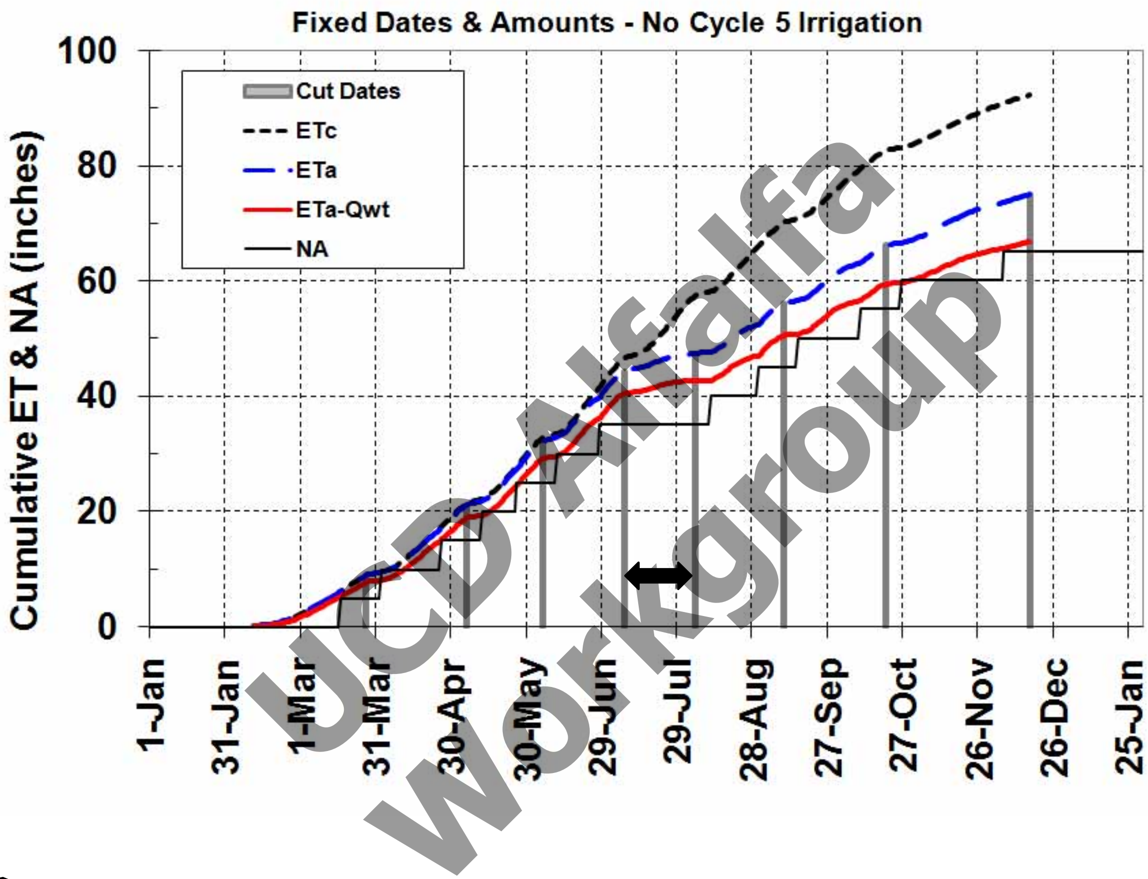
Alfalfa schedule near Indio, California with 8 cuttings, a water table at 20 inches below the root zone, and flexible dates and application amounts.



Alfalfa schedule near Indio, California with 8 cuttings, a water table at 20 inches below the root zone, irrigations 5 days following cutting and 10 days prior to cutting, and variable application amounts.



Alfalfa schedule near Indio, California with 8 cuttings, a water table at 20 inches below the root zone, irrigations 5 days following cutting and 10 days prior to cutting, and fixed application amounts.



Alfalfa schedule near Indio, California with 8 cuttings, a water table at 20 inches below the root zone, irrigations 6 days following cutting and 10 days prior to cutting, fixed application amounts, and no cycle 5 irrigation.

Yield Estimation

$$1 - \frac{Y_a}{Y_c} = K_y \left(1 - \frac{CET_a}{CET_c} \right)$$

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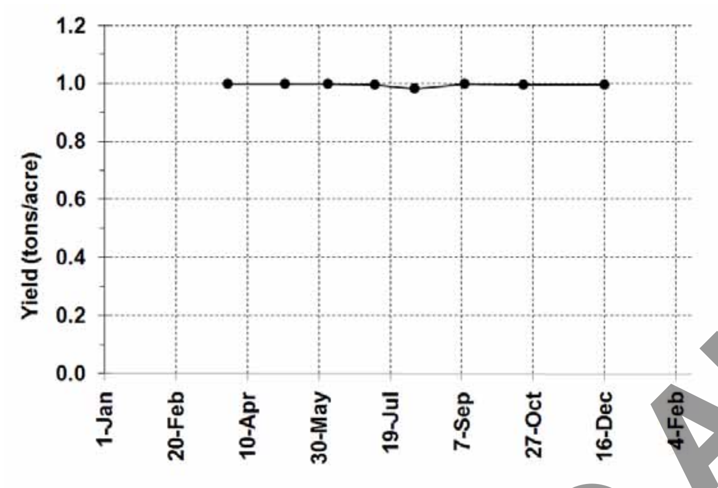
K_y = 1.1 yield function for alfalfa

$Y_c \approx$ 1.0 tons/acre = yield max

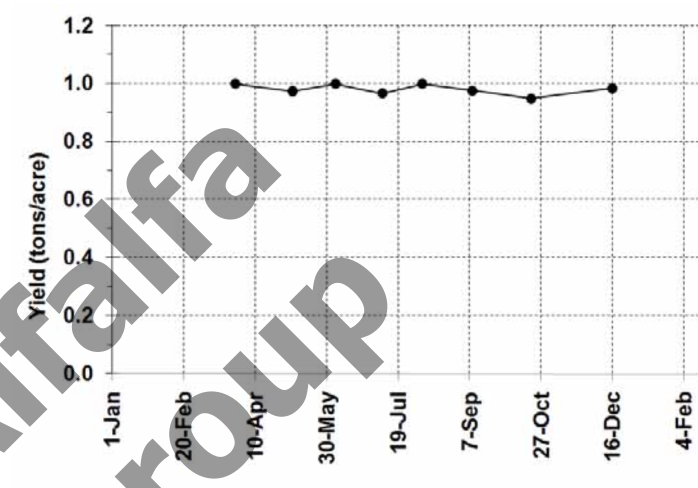
CET_a = cumulative ET_a

CET_c = cumulative ET_c

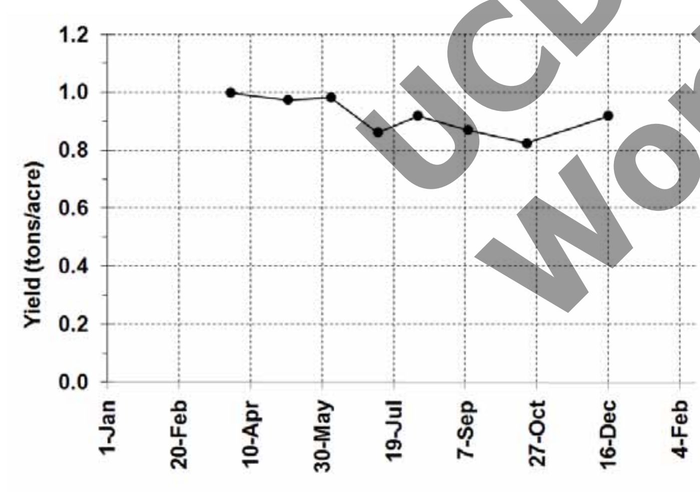
Flexible Dates & Amounts



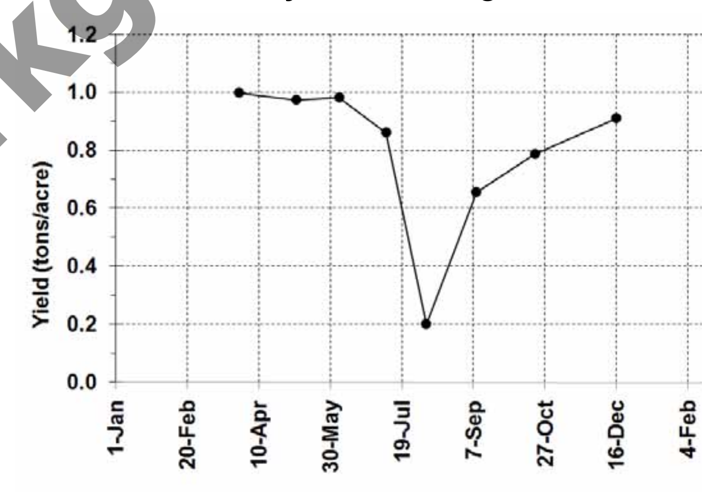
Fixed Dates & Variable Amounts



Fixed Dates & Amounts



No Cycle 5 Irrigation



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Conclusions

- ISA is based on use of ETo and climate corrected Kc values
- ISA accounts for water table contributions
- ISA adjusts ETa for water stress
- ISA estimates effects on yield
- ISA helps determine optimal schedules

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