New Evapotranspiration Estimates and Crop Coefficients for Optimizing Sub-Surface Drip Irrigation Scheduling

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INTRODUCTION

- Agriculture is a major user of ground and surface water in the United States.
- However, with the increasing demand for water due to population growth and environmental issues as well as uncertainty linked with climate change, water allocation to the agriculture sector may be declining in the future.
- One approach to conserve water is to optimize irrigation scheduling through the development of new evapotranspiration (ET) estimates and crop coefficients (K_c) that better reflect the current agricultural and irrigation management practices.
- Irrigation scheduling are usually estimated by multiplying reference evapotranspiration (ET_o) with coefficients specific to a particular crop (K_c).
- Coefficients have been compiled for many crops but were developed under very specific management practices that do not always reflect current cultural and irrigation practices in California.

OBJECTIVE

- Determine crop coefficients for processing tomato grown under sub-surface drip irrigation using weighing lysimeter.
- Develop relationship between crop coefficients (K_c) and fractional ground cover (F_c).
- Determine water use efficiency (WUE).

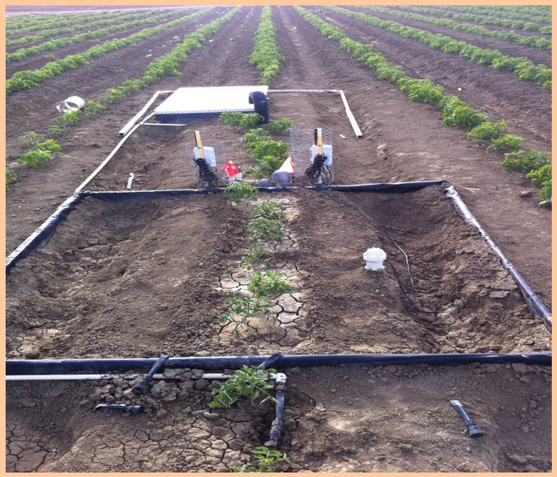

Fig. 1. Crop Lysimeter used to generate ET_c data

METHODOLOGY

Study Description:

•Location: UC Westside Research & Extension Center- Five Points, CA.

•Crop: Processing tomatoes.

Irrigation:

•Sub-surface drip irrigation (12").

•When equivalent of 2 mm (0.08") crop ET measured by scale, irrigation system is turned on (100% ET).

•Surrounded field irrigated based on lysimeter ET.

Measurements:

•ET_c, ET_o, K_c, Water application.

•Fractional ground cover.

•Yield, Water use efficiency.

Fig. 2. CIMIS Station #2 (above) and reference Lysimeter used to generate ET_o.

RESULTS

- Data indicated that coefficients obtained at peak season were relatively higher than those generally reported for tomatoes.
- Results show a good correlation between K_c and fractional cover ($r^2 = 0.92$).
- Results also show a good correlation between F_c and Date After Transplant (DAT) ($r^2 = 0.99$).
- The K_c increased curve linearly until canopy reached about 75% of fractional cover.

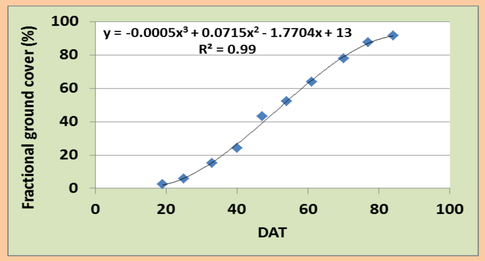

Fig. 3. Increase in Fractional ground cover (F_c) during the growing season

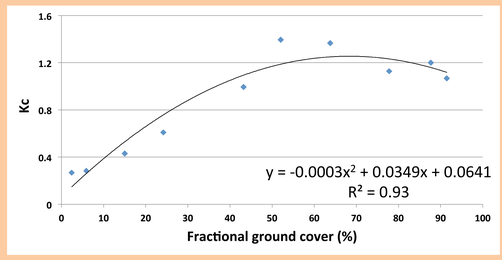

Fig. 4. Relationship between crop coefficients (K_c) and Fractional ground cover (F_c)

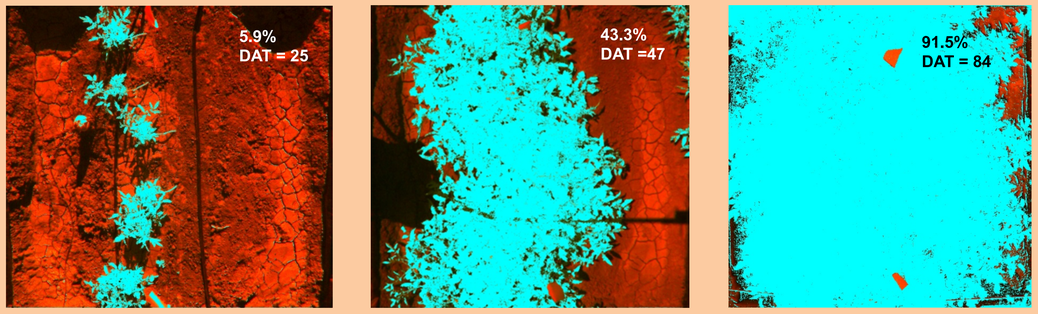

Fig. 5. Percent Fractional ground cover (F_c) at different dates during the growing season

RESULTS CONT' D

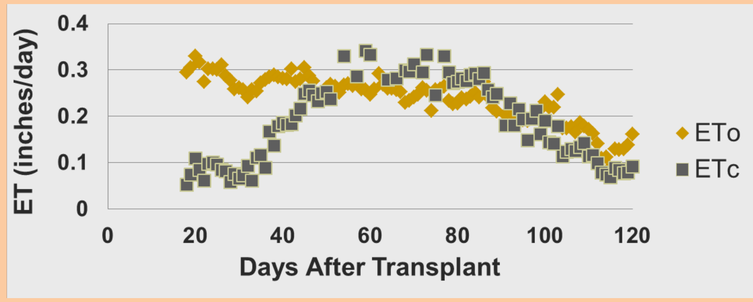

Fig. 6. Daily rates of crop evapotranspiration (ET_c) and reference evapotranspiration (ET_o)

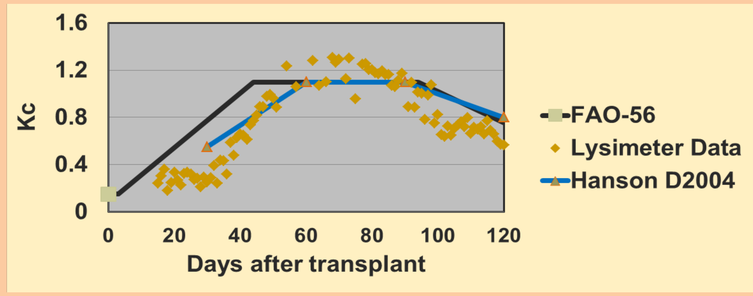

Fig. 7. Daily crop coefficients (K_c) during the growing season. Comparison with published data.

Table 1. Water use efficiency based on seasonal ET_c and crop yield

(WUE = yield / ET_c)	Tomato
Seasonal ET_c (in)	21.4
Yield (tons/ac)	38.8
Water Use Efficiency (tons/ac/in)	1.81

FUTURE DIRECTION

- Validate ET_c and K_c data for tomato under sub-surface drip with additional study.
- Validate relationship between K_c and ground cover.
- Develop standard method for estimating irrigation scheduling through development of a decision support system that will also integrate CIMIS and WATERIGHT data.

REFERENCE:

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Hanson, B. R., & May, D. M. (2006). Crop coefficients for drip-irrigated processing tomato. Agricultural Water Management, 81(3), 381-399.

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