

Orchard irrigation based on the 'ET' approach

$$(ET_c = K_c * ET_o)$$

Gallons per tree per day

$$= ET_o * K_c * Row\ spacing * tree\ spacing * 0.623$$

$$Hours\ run\ time\ per\ day = \frac{Gallons\ per\ tree\ per\ day}{emitter\ output\ in\ gal\ per\ tree\ per\ hr}$$

Example: Almond orchard in Davis, CA. 12'X24' spacing, 1 microsprinkler per tree at 10 gal per hour (gph).

Question: how many hours run time per day in mid-June (week of 6/14)?

CIMIS #6 (Davis) Historical averages

| Week Ending | ET _o ("/Day) | Almond K _c |
|-------------|-------------------------|-----------------------|
| 5/3/2014 | 0.2 | 0.8 |
| 5/10/2014 | 0.21 | 0.83 |
| 5/17/2014 | 0.22 | 0.86 |
| 5/24/2014 | 0.23 | 0.89 |
| 5/31/2014 | 0.25 | 0.92 |
| 6/7/2014 | 0.26 | 0.95 |
| 6/14/2014 | 0.28 | 0.98 |
| 6/21/2014 | 0.28 | 1.01 |
| 6/28/2014 | 0.29 | 1.03 |
| 7/5/2014 | 0.29 | 1.03 |

This is a portion of a table obtained from the "Waterright" website: <http://www.waterright.org/> for a "mature" almond orchard.

Direct access to CIMIS ET_o data is: <http://www.cimis.water.ca.gov/cimis/>

Answer:

$$Gallons\ per\ tree\ per\ day = 0.28 * 0.98 * 12 * 24 * 0.623$$

= 49.2 Gallons per tree per day

$$Hours\ run\ time\ per\ day = \frac{49.2}{10\ gph}$$

= 4.92 hours per day (about 35 hours per week)

| Typical systems & specs | Example tree type (& typical spacing) | |
|-------------------------|--|----------------------------------|
| | Almond (12 X 24) Prune (14 X 17) | Walnut (14 X 26) |
| Drip | Double line drip, 1 gph emitter every 3.3' | |
| Micro or mini sprinkler | 1 micro per tree, 8-12 gph | 1 mini per tree, 10-30 gph |
| Sprinkler | | 1 every other tree, 45 – 120 gph |

Example crop coefficients (K_c values)

| Week Ending | Crop coefficients | | | |
|-------------|-------------------|--------|-------------|-------|
| | Almond | walnut | Stone Fruit | Olive |
| 1/8 – 2/26 | | | | 0.79 |
| 3/8 | 0.57 | | 0.57 | 0.79 |
| 3/15 | 0.6 | | 0.6 | 0.79 |
| 3/22 | 0.63 | | 0.63 | 0.79 |
| 3/29 | 0.66 | | 0.66 | 0.79 |
| 4/5 | 0.69 | 0.57 | 0.69 | 0.79 |
| 4/12 | 0.72 | 0.6 | 0.72 | 0.79 |
| 4/19 | 0.74 | 0.63 | 0.74 | 0.79 |
| 4/26 | 0.77 | 0.66 | 0.77 | 0.79 |
| 5/3 | 0.8 | 0.69 | 0.8 | 0.79 |
| 5/10 | 0.83 | 0.72 | 0.83 | 0.79 |
| 5/17 | 0.86 | 0.74 | 0.86 | 0.79 |
| 5/24 | 0.89 | 0.77 | 0.89 | 0.79 |
| 5/31 | 0.92 | 0.8 | 0.92 | 0.79 |
| 6/7 | 0.95 | 0.83 | 0.95 | 0.79 |
| 6/14 | 0.98 | 0.86 | 0.98 | 0.79 |
| 6/21 | 1.01 | 0.89 | 1.01 | 0.79 |
| 6/28 | 1.03 | 0.92 | 1.03 | 0.79 |
| 7/5 | 1.03 | 0.95 | 1.03 | 0.79 |
| 7/12 | 1.03 | 0.98 | 1.03 | 0.79 |
| 7/19 | 1.03 | 1.01 | 1.03 | 0.79 |
| 7/26 | 1.03 | 1.03 | 1.03 | 0.79 |
| 8/2 | 1.03 | 1.03 | 1.03 | 0.79 |
| 8/9 | 1.03 | 1.03 | 1.03 | 0.79 |
| 8/16 | 1.03 | 1.03 | 1.03 | 0.79 |
| 8/23 | 1.03 | 1.03 | 1.03 | 0.79 |
| 8/30 | 1.03 | 1.03 | 1.03 | 0.79 |
| 9/6 | 1.03 | 1.03 | 1.03 | 0.79 |
| 9/13 | 1.03 | 1.03 | 1.03 | 0.79 |
| 9/20 | 1.03 | 1.03 | 1.03 | 0.79 |
| 9/27 | 1 | 1 | 1 | 0.79 |
| 10/4 | 0.88 | 0.97 | 0.88 | 0.79 |
| 10/11 | 0.77 | 0.94 | 0.77 | 0.79 |
| 10/18 | | 0.91 | | 0.79 |
| 10/25 | | 0.89 | | 0.79 |
| 11/1 | | 0.86 | | 0.79 |
| 11/8 | | 0.83 | | 0.79 |
| 11/15-12/27 | | | | 0.79 |

These values were taken from the “Waterright” website (<http://www.waterright.org/>) to illustrate the basic pattern of “mature” K_c that is assumed for different crops. Note the different start and end dates for different crops and the similarity of K_c for some crops at some times in the season.

Class exercise: use the average ET_0 values on page 1, and the K_c 's on page 2

| Group # | Crop & Spacing | Irrigation system | Date | Hours/day |
|--------------|------------------|--|------|-----------|
| 1 | Almonds, 10 X 20 | Micro, 1/tree at 12 gph | 5/3 | |
| 2 | Almonds, 10 X 20 | Micro, 1/tree at 12 gph | 7/5 | |
| 3 | Almonds, 12 X 24 | Micro, 1/tree at 12 gph | 7/5 | |
| 4 | Walnuts, 14 X 26 | Mini, one every 2 trees at 100 gph | 5/3 | |
| 5 | Walnuts, 14 X 26 | Mini, one every 2 trees at 100 gph | 7/5 | |
| 6 | Walnuts, 20 X 20 | Mini, one every 2 trees at 100 gph | 7/5 | |
| 7 | Olives, 20 X 20 | Single line drip, 2/tree at 1 gph each | 5/3 | |
| 8 | Olives, 20 X 20 | Single line drip, 2/tree at 1 gph each | 7/5 | |
| Extra Credit | Olives, 20 X 20 | Double line drip, 1 gph every 3' | 7/5 | |