Irrigating Olives

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Alameda & Contra Costa Counties

Olive Production Basics:
Introduction to Irrigation Management
Sunday, July 21, 1 – 3:30 pm, Livermore

UC CE University of California
Agriculture and Natural Resources

Why do olives need irrigation?

Sufficient moisture during critical development stages assures consistent cropping

Feb-June	**bud development** **bloom*** **fruit set** **shoot growth**
July-harvest	fruit growth (stage 1-3) fruit quality shoot growth (next year's crop)

The Water Budget Method

Tells you when to begin & how much to apply

You'll need information on:

1. Crop water use (evapotranspiration)
2. Rainfall
3. Soil type & depth (available soil water)
4. Your irrigation system output
5. Soil moisture monitoring

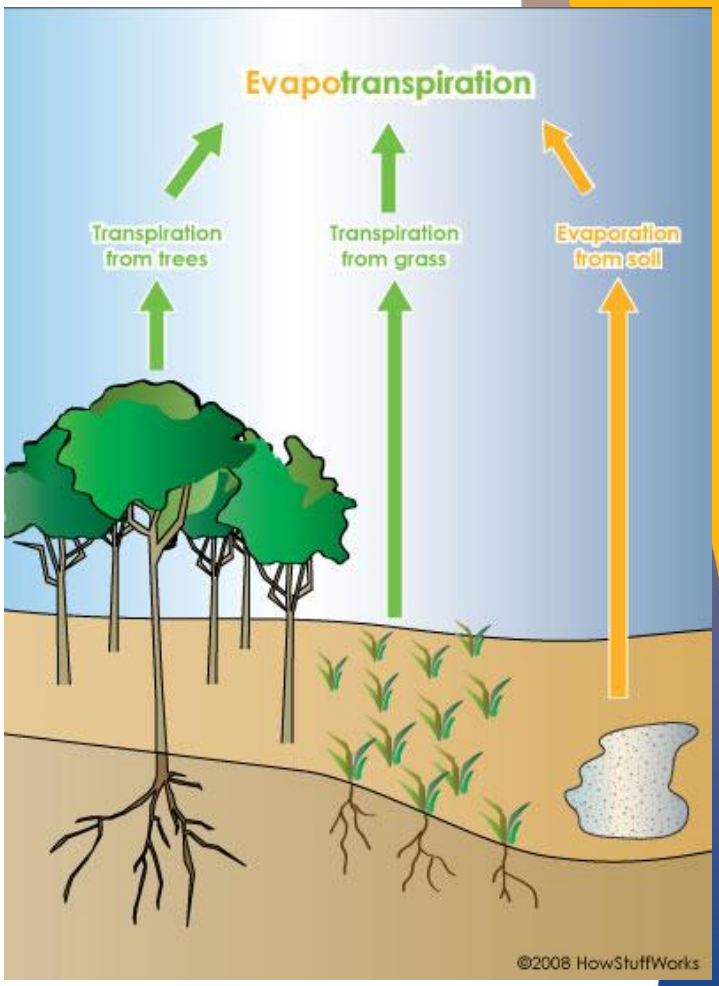
1. Evapotranspiration (ET)

= Evaporation from soil

+ Transpiration from leaves

Depends on weather:

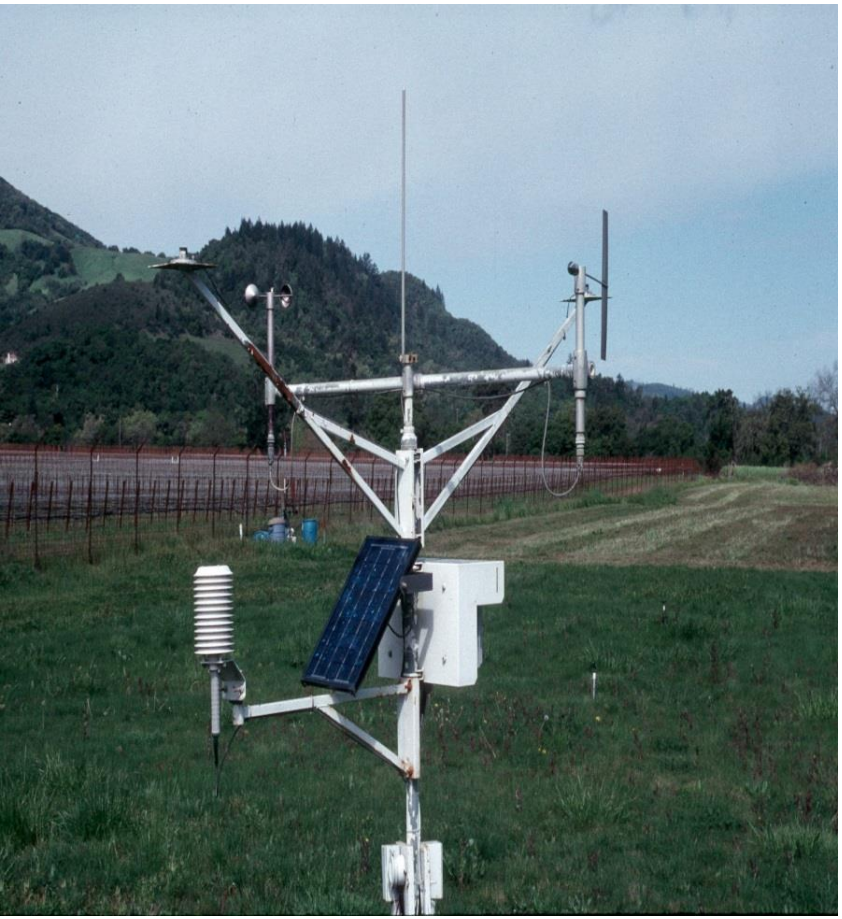
- Temperature
- Wind
- Humidity
- Solar radiation



1. Evapotranspiration

CIMIS

CALIFORNIA IRRIGATION MANAGEMENT INFORMATION SYSTEM
DEPARTMENT OF WATER RESOURCES
OFFICE OF WATER USE EFFICIENCY



ETo is available from local CIMIS weather stations:

- Pleasanton (CIMIS # 191)
- Tracy (CIMIS # 167)
- Brentwood (CIMIS # 47)

www.cimis.water.ca.gov

OR

www.ipm.ucdavis.edu/

1. Evapotranspiration (ET)

ETo = Reference ET = ET of grass

How to convert ETo to Crop ET (ETc)?

- Kc = crop coefficient
- Kc = proportion of ETo that the crop uses
  - For deciduous trees – KC varies with growth stage, climate
  - For evergreen crops – Kc is the same all year
    - Oil Olive Kc = .65
    - Table Olive Kc = .75
- ETo x Kc = Crop ET (ETc)

Evapotranspiration (ET)

Pleasanton CIMIS Station #191*

1	2						
MONTH	ETo						
	grass						
Jan	0.8						
Feb	1.5						
Mar	2.9						
Apr	4.4						
May	5.5						
Jun	6.6						
Jul	7.4						
Aug	6.4						
Sep	4.7						
Oct	3.3						
Nov	1.5						
Dec	1.0						
TOTAL	**46.1**						

*(inches/month)

Evapotranspiration (ET)

Pleasanton CIMIS Station #191*

ETo x Kc = ETc

1	2	3					
	ETo	Kc (oil olives)					
MONTH	grass	bare soil	cover crop				
Jan	0.8	0.65	1.05				
Feb	1.5	0.65	1.05				
Mar	2.9	0.65	1.05				
Apr	4.4	0.65	1.05				
May	5.5	0.65	1.05				
Jun	6.6	0.65	1.00				
Jul	7.4	0.65	1.00				
Aug	6.4	0.65	1.00				
Sep	4.7	0.65	1.00				
Oct	3.3	0.65	1.00				
Nov	1.5	0.65	0.95				
Dec	1.0	0.65	0.95				
TOTAL	46.1						

*(inches/month)


Cover increases water use by 25-30%

Evapotranspiration (ET)

Pleasanton CIMIS Station #191*

MONTH	ETo	Kc		ETc			
	grass	bare soil	cover crop	bare soil	cover crop		
Jan	0.8	0.65	1.05	0.5	0.9		
Feb	1.5	0.65	1.05	1.0	1.5		
Mar	2.9	0.65	1.05	1.9	3.1		
Apr	4.4	0.65	1.05	2.9	4.6		
May	5.5	0.65	1.05	3.6	5.8		
Jun	6.6	0.65	1.00	4.3	6.6		
Jul	7.4	0.65	1.00	4.8	7.4		
Aug	6.4	0.65	1.00	4.1	6.4		
Sep	4.7	0.65	1.00	3.1	4.7		
Oct	3.3	0.65	1.00	2.2	3.3		
Nov	1.5	0.65	0.95	1.0	1.5		
Dec	1.0	0.65	0.95	0.7	1.0		
TOTAL	**46.1**			**30.0**	**46.7**		

*(inches/month)

Evapotranspiration (ET)

Pleasanton CIMIS Station #191*

Notice the seasonal variation in cover and water use

1	2	3		4			
	ETo	Kc		ETc			
MONTH	grass	bare soil	cover crop	bare soil	cover crop		
Jan	0.8	0.65	1.05	0.5	**0.9**		
Feb	1.5	0.65	1.05	1.0	**1.5**		
Mar	2.9	0.65	1.05	1.9	**3.1**		
Apr	4.4	0.65	1.05	**2.9**	4.6		
May	5.5	0.65	1.05	**3.6**	5.8		
Jun	6.6	0.65	1.00	**4.3**	6.6		
Jul	7.4	0.65	1.00	**4.8**	7.4		
Aug	6.4	0.65	1.00	**4.1**	6.4		
Sep	4.7	0.65	1.00	**3.1**	4.7		
Oct	3.3	0.65	1.00	**2.2**	3.3		
Nov	1.5	0.65	0.95	1.0	**1.5**		
Dec	1.0	0.65	0.95	0.7	**1.0**		
TOTAL	**46.1**			**30.0**	**46.7**		

Evapotranspiration (ET)

Pleasanton CIMIS Station #191*

Regulated deficit irrigation (RDI) uses only ½ of ETc Jun-mid Aug

1	2	3		4		5		
	ETo	Kc		ETc		ETc + RDI		
MONTH	grass	bare soil	cover crop	bare soil	cover crop	bare soil	cover crop	
Jan	0.8	0.65	1.05	0.5	**0.9**	0.5	**0.9**	
Feb	1.5	0.65	1.05	1.0	**1.5**	1.0	**1.5**	
Mar	2.9	0.65	1.05	1.9	**3.1**	1.9	**3.1**	
Apr	4.4	0.65	1.05	**2.9**	4.6	**2.9**	4.6	
May	5.5	0.65	1.05	**3.6**	5.8	**3.6**	5.8	
Jun	6.6	0.65	1.00	**4.3**	6.6	**2.1**	3.3	
Jul	7.4	0.65	1.00	**4.8**	7.4	**2.4**	3.7	
Aug	6.4	0.65	1.00	**4.1**	6.4	**3.1**	4.7	
Sep	4.7	0.65	1.00	**3.1**	4.7	**3.1**	4.7	
Oct	3.3	0.65	1.00	**2.2**	3.3	**2.2**	3.3	
Nov	1.5	0.65	0.95	1.0	**1.5**	1.0	**1.5**	
Dec	1.0	0.65	0.95	0.7	**1.0**	0.7	**1.0**	
TOTAL	**46.1**			**30.0**	**46.7**	**24.4**	**38.1**	**21.9**

The Water Budget Method

Tells you when to begin & how much to apply

You'll need information on:

✓ 1. Crop water use (evapotranspiration)
2. Rainfall
3. Soil type & depth
4. Your irrigation system output
5. Soil moisture monitoring

The Water Budget Method

Tells you when to begin & how much to apply

You'll need information on:

1. Crop water use (evapotranspiration)
2. Rainfall (13-17" of annual rainfall)
3. Soil type & depth
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The Water Budget Method

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You'll need information on:

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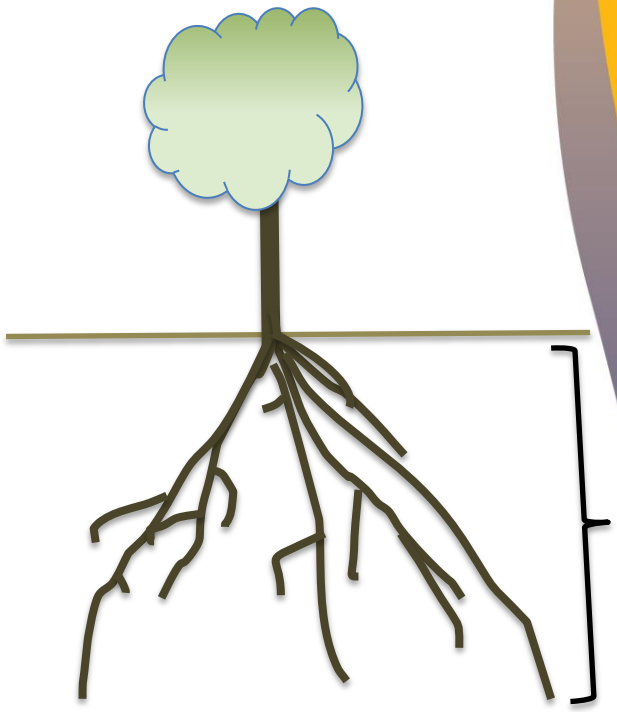
Soil Contribution

Available Water Capacity x rooting depth

Soil Texture	Available Water Capacity (inches/foot of soil)
Sandy loam	1.5
Gravelly Loam	1.0 – 2.0
Loam	2.0
Silt Loam	2.1
Clay loam	2.0 – 2.4
Clay	1.7 – 2.0

Find the AWC of your soil in the County Soil Survey



For example:

Danville silty clay loam holds 2.0”/foot x 4’ root zone = 8” AWC

Deplete ½ of the AWC – then start irrigating to supply the ETc+RDI

Make a Water Budget chart

[ETc+RDI] – [Rain] – [½ AWC] = Irrigation Requirement

Month	5 ETc + RDI		Average Rainfall	Extra Rainfall for Soil storage	Cumulative Soil Storage	Supplied by Irrigation
	inches/mo		inches/mo	inches/mo	inches/mo	inches/mo
October	2.2	bs	1.3	-0.9	0.0	0.9
November	1.5	cc	1.7	0.2	0.2	
December	1	cc	3.7	2.7	2.9	
January	0.9	cc	2.7	1.8	4.7	
February	1.5	cc	2.3	0.8	5.5	
March	3.1	cc	3	-0.1	5.4	
April	2.9	bs	1.4	-1.5	**4.0**	
May	3.6	bs	0.4	-3.2	**4.0**	3.2
June	2.1	bs	0.2	-1.9	**4.0**	1.9
July	2.4	bs	0	-2.4	**4.0**	2.4
August	3.1	bs	0	-3.1	**4.0**	3.1
September	3.1	bs	0	-3.1	**4.0**	3.1
TOTAL	**27.33**		**16.7**	**-10.6**		**14.6**

Once you use up ½ of the AWC, start irrigating to provide ETc+RDI

Make a Water Budget chart

[ETc+RDI] – [Rain] – [½ AWC] = Irrigation Requirement

Month	5 ETc + RDI		Average Rainfall	Extra Rainfall for Soil storage	Cumulative Soil Storage	Supplied by Irrigation
	inches/mo		inches/mo	inches/mo	inches/mo	inches/mo
October	2.2	bs	1.3	-0.9	0.0 4.0	0.9
November	1.5	cc	1.7	0.2	0.2 4.2	
December	1	cc	3.7	2.7	2.9 6.9	
January	0.9	cc	2.7	1.8	4.7 **8.0**	
February	1.5	cc	2.3	0.8	5.5 8.0	
March	3.1	cc	3	-0.1	5.4 7.9	
April	2.9	bs	1.4	-1.5	**4.0** 6.5	
May	3.6	bs	0.4	-3.2	**4.0** **4.0**	3.2-1.5=1.7
June	2.1	bs	0.2	-1.9	**4.0**	1.9
July	2.4	bs	0	-2.4	**4.0**	2.4
August	3.1	bs	0	-3.1	**4.0**	3.1
September	3.1	bs	0	-3.1	**4.0**	3.1
TOTAL	**27.33**		**16.7**	**-10.6**		14.6 **13.1**

The Water Budget Method

Tells you when to begin & how much to apply

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Scheduling Irrigations

Rate: How much water does your system put on?

- For full coverage sprinkler systems –
  - Inches/hour (corresponds to column 5: ETc+RDI)
- For drip and micro sprinklers:
  - How many GPH per emitter or sprinkler
  - How many emitters or sprinklers per tree

} Gal/hour/tree

Convert ETc+RDI inches to Gallons/tree/week (or day) [column 8]

$$\text{Gallons/tree/day} = \frac{[\text{inches/period}] \times .622 \times \textbf{[tree spacing (ft}^2\textbf{)]}}{\text{no. days/period}}$$

Measuring drip emitter output

Measuring sprinkler output

Scheduling Irrigations

Timing: How often does the system go on? (Column 9)

- By interval (ie. daily, once a week)

OR

- By set (ie. 12 or 24 hour set)

For example: Pleasanton orchard column 8: July 16-31

123 gallons = 62 hours per week

- 9 hours every day
- 18 hours every other day

Never leave the system on for more than 24 hours!

Drip vs Sprinkler Irrigation

Sprinklers:

- Wet the entire rootzone – refills the reservoir
- Let the rootzone dry down until it needs a "set"
- Puts on lots of water in a 24 hour set (3-6")
- Irrigate less frequently than with drip (7-21 days)

Drip & Microsprinklers:

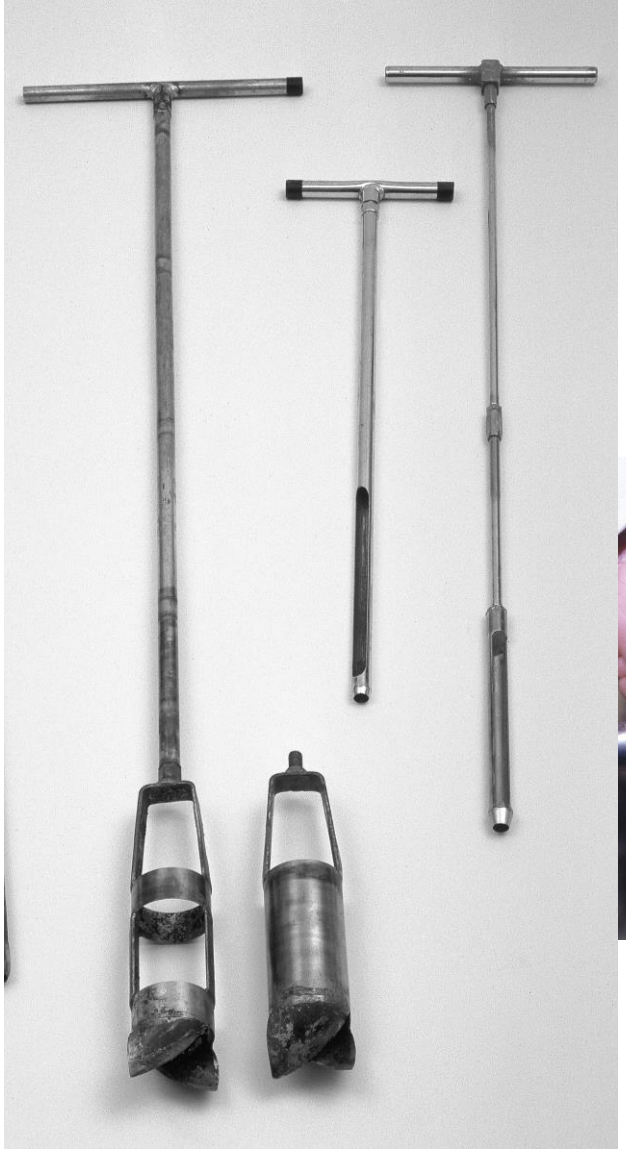
- Wets only part of the rootzone
- The trees need the same amount of water delivered in a smaller area – so the wetted zone doesn't dry down
- Irrigate more frequently (daily to weekly)

Estimates for young trees

- Mature trees:
  - shade >62% of the ground @ noon -> full water use
- Immature trees: < 62% shading
  - Use a 2:1 ratio
    - 25 % shade = 50%water use of mature orchard

Checking your Water Budget

- Your budget can be off due to:
  - Estimate errors (root zone, AWC,cover use, tree size …)
  - Irrigation system variations (clogging, efficiencies, pressure, distribution uniformity…)
  - Real time vs. historical time weather data
  - Plant health
- Monitor your soil moisture to double check
  - Feel method
  - Electrical resistance blocks



Soil Monitoring

Direct soil moisture by feel

Dry medium-textured soil

Wet medium-textured soil

Soil Monitoring

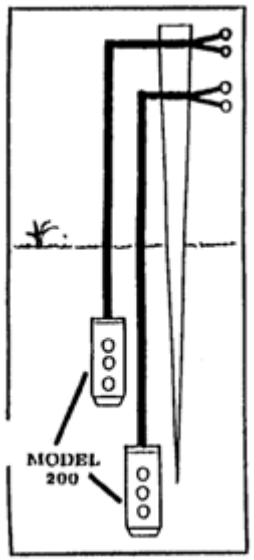
Direct soil moisture by feel

- Needs a well practiced hand
- Good way to learn your soil types and their water holding ability
- Testing your other methods
- Simplest tools required
  - Shovel
  - Soil augur
- **Con:** takes a long time and often do not go to deepest rooting depths

Soil Monitoring

Modified electrical resistance blocks

- Measure the surface tension that holds water to the soil
- The tension increases as soils dry



Soil Monitoring

➢ Reading Soil Tension

Use the following readings as a general guideline:

0-10 Centibars = Saturated soil

10-30 Centibars = Soil is adequately wet (except coarse sands, which are beginning to lose water)

30-60 Centibars = Usual range for irrigation (most soils)

60-100 Centibars = Usual range for irrigation in heavy clay

100-200 Centibars = Soil is becoming dangerously dry for maximum production. Proceed with caution!

http://www.irrometer.com

Soil Monitoring

- Modified electrical resistance blocks
  - Pros-
    - No maintenance
    - Least cost
    - Can have many sensors going different depths and areas
    - Possible to use data loggers or send info remotely
    - Easy hand held meter option
    - Easy to install
  - Cons-
    - Can have problems contacting soil in course textures
    - Can be affected by salinity
    - Need to periodically replace them (3-4 years)

Water Quality

- Quality of the irrigation water can affect:
  - Plant growth
    - EC, pH, Boron, N
  - Water infiltration
    - EC, SAR
  - Irrigation system performance (clogging)
    - pH, TDS, HCO3, Ca, Fe, Mn…
- Well water vs. surface water
- Send a sample to an agricultural lab
  - Ask for a comprehensive irrigation analysis
  - with interpretation

Putting the tools to work

1. Track ET
2. Track rainfall
3. Track soil moisture
4. Start irrigating when ½ the AWC is used
5. Continue irrigating according to your water budget – by set or interval timing
6. Check soil moisture to fine tune

More Information

From our catalog: www.anrcatalog.ucdavis.edu
1-800-994-8849

- Olive Production Manual #3353, $35
- Organic Olive Production Manual # 3505, $13.50
- Micro-irrigation of Trees and Vines #3378, $25
- Maintaining Micro-irrigation Systems #21637, $20
- Olives: Safe Methods for Home Pickling #8267 FREE
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Questions?

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