Irrigating Oil Olives

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Agriculture & Natural Resources
Central Valley Region

Olive growth habit

- Olives bloom on one year old shoots
- Over-cropping:
  - decreases fruit size
  - decreases shoot growth
  - decreases flowering next season
  - aggravates alternate bearing

Relationship between olive tree growth and production

- Farm olives with two seasons in mind:
  - produce a moderate sized, high quality current crop
  - generate sufficient vegetative growth for next season's bloom and crop
  - helps minimize alternate bearing

Yield components in olive

- ✓ Shoot growth
- ✓ Fruit load
- ✓ Fruit size and distribution
- ✓ Oil Content

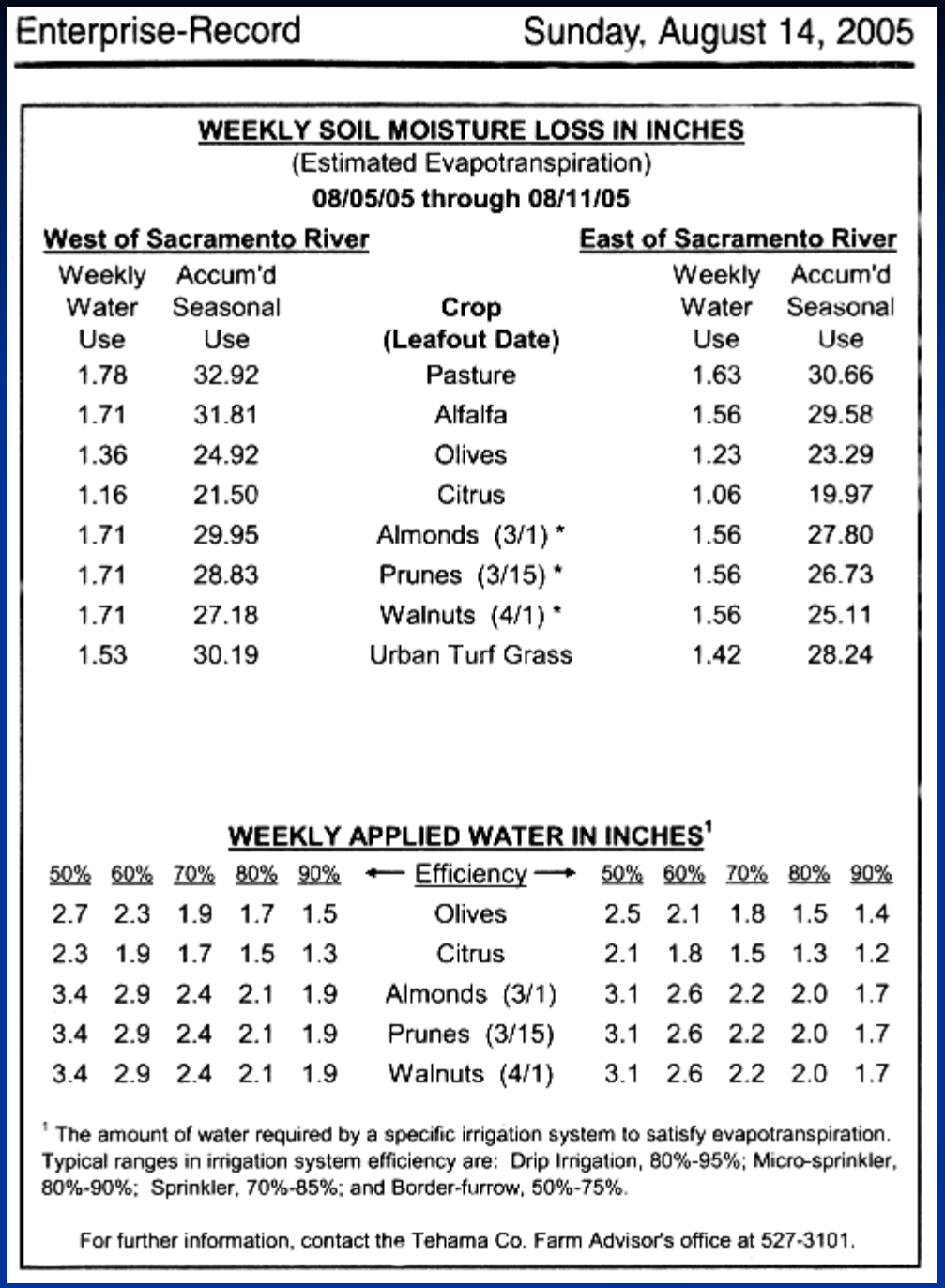
Proper irrigation is important for shoot growth & bloom, fruit sizing, total yield, and reduction of alternate bearing

Average Reference Crop Water Use, ETo, inches

	Fresno	Orland	St. Helena
March	3.3	3.1	2.8
April	4.8	4.8	3.9
May	6.7	6.7	5.1
June	7.8	7.4	6.1
July	8.4	8.8	7.0
August	7.1	7.3	6.2
September	5.2	5.6	4.8
October	3.2	3.8	3.1
November	1.4	1.7	1.4
TOTAL	**47.9**	**49.2**	**40.4**

Reference ETo, olive Kc's and orchard water use (clean cultivated) in Orland

	ETo (inches)	Kc	ETc (inches)
March	3.1	0.75	2.3
April	4.8	0.75	3.6
May	6.7	0.75	5.0
June	7.4	0.75	5.6
July	8.8	0.75	6.6
August	7.3	0.75	5.5
September	5.6	0.75	4.2
October	3.8	0.75	2.9
November	1.7	0.75	1.3
TOTAL	49.2		37.0



Enterprise-Record Sunday, August 14, 2005

WEEKLY SOIL MOISTURE LOSS IN INCHES
(Estimated Evapotranspiration)
08/05/05 through 08/11/05

West of Sacramento River			East of Sacramento River	
Weekly Water Use	Accum'd Seasonal Use	Crop (Leafout Date)	Weekly Water Use	Accum'd Seasonal Use
1.78	32.92	Pasture	1.63	30.66
1.71	31.81	Alfalfa	1.56	29.58
1.36	24.92	Olives	1.23	23.29
1.16	21.50	Citrus	1.06	19.97
1.71	29.95	Almonds (3/1) *	1.56	27.80
1.71	28.83	Prunes (3/15) *	1.56	26.73
1.71	27.18	Walnuts (4/1) *	1.56	25.11
1.53	30.19	Urban Turf Grass	1.42	28.24

WEEKLY APPLIED WATER IN INCHES[1]

50%	60%	70%	80%	90%	← Efficiency →	50%	60%	70%	80%	90%
2.7	2.3	1.9	1.7	1.5	Olives	2.5	2.1	1.8	1.5	1.4
2.3	1.9	1.7	1.5	1.3	Citrus	2.1	1.8	1.5	1.3	1.2
3.4	2.9	2.4	2.1	1.9	Almonds (3/1)	3.1	2.6	2.2	2.0	1.7
3.4	2.9	2.4	2.1	1.9	Prunes (3/15)	3.1	2.6	2.2	2.0	1.7
3.4	2.9	2.4	2.1	1.9	Walnuts (4/1)	3.1	2.6	2.2	2.0	1.7

[1] The amount of water required by a specific irrigation system to satisfy evapotranspiration. Typical ranges in irrigation system efficiency are: Drip Irrigation, 80%-95%; Micro-sprinkler, 80%-90%; Sprinkler, 70%-85%; and Border-furrow, 50%-75%.

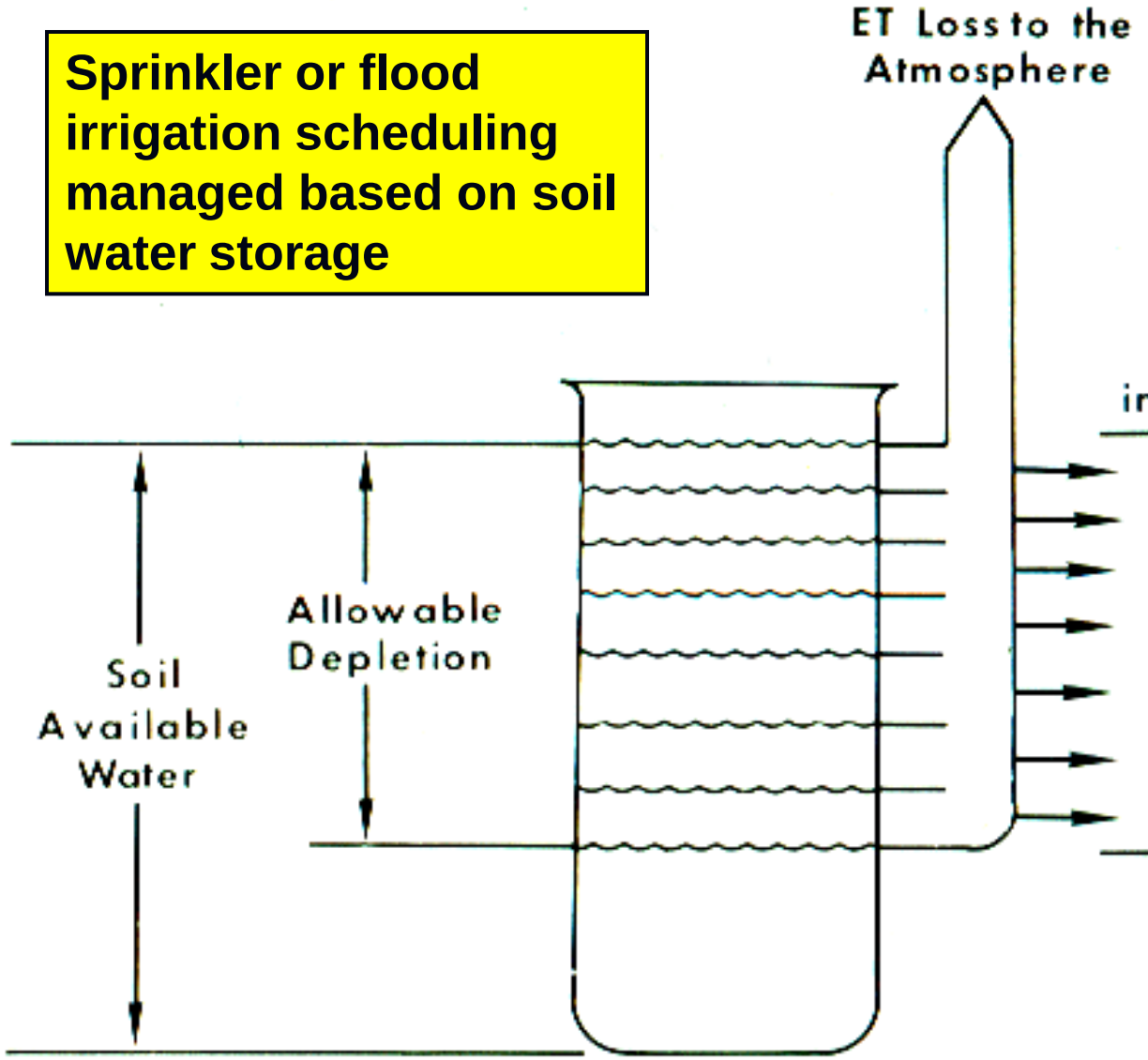
For further information, contact the Tehama Co. Farm Advisor's office at 527-3101.

ETc data…

- Local papers
- DWR CIMIS website www.cimis.water.ca.gov

The Water Budget Method of Irrigation

Sprinkler or flood irrigation scheduling managed based on soil water storage

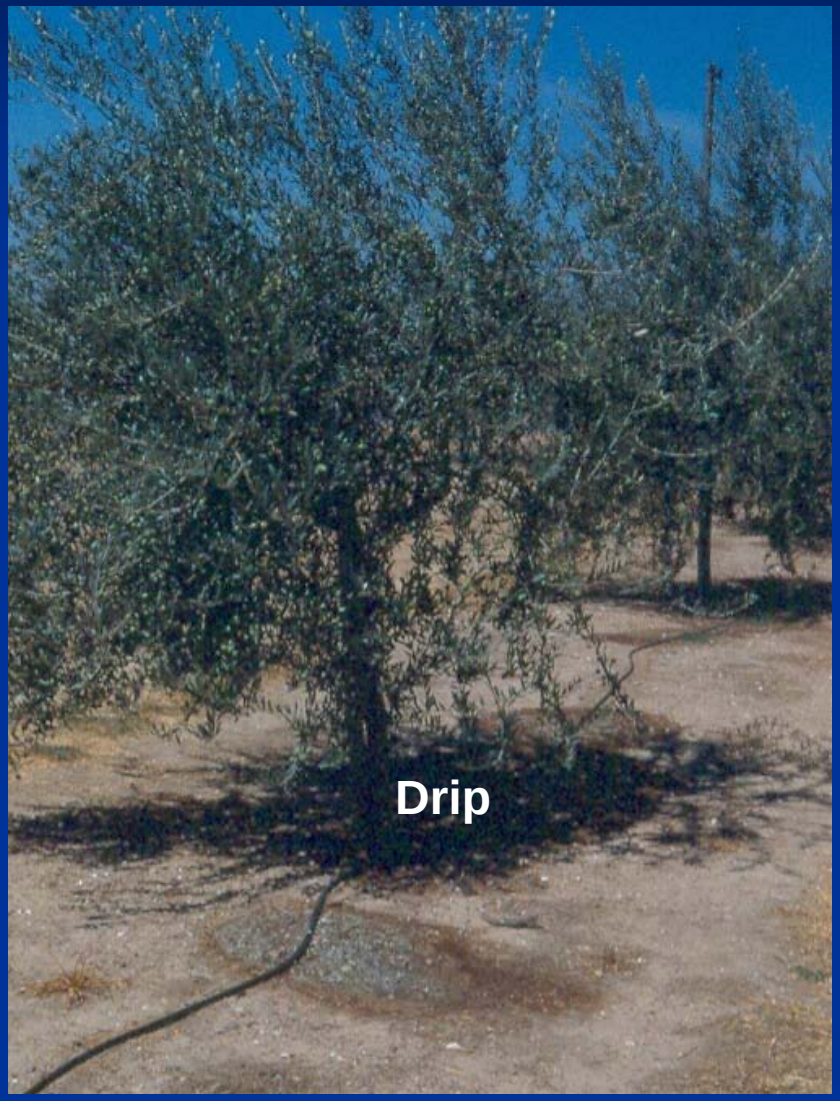


ET inches/day	days
0.25	1
0.25	2
0.30	3
0.30	4
0.35	5
0.35	6
0.30	7
2.10	7

IRRIGATE

1. When?--------After 7 days
2. How much?-- Apply 2.10 inches of water + losses (Efficiency consideration)

Low volume irrigation scheduling



- ETc determines use
- Drip or micro-sprinkler irrigation replaces what trees use every day or two
- Soil water holding capacity not important
- Keep emitters 2-3 feet away from trunk

Low volume irrigation scheduling

- Determine how much water to apply
  - ETc – Kc, canopy size, climate (temp & day length)
  - Days between irrigations
- Determine how long to irrigate
  - ETc between irrigations
  - Efficiency of irrigation system
  - Application rate of drippers or micro-sprinklers

Example: low volume irrigation scheduling

- If meeting full ETc 6.6 inches in July / 31 days = 0.21 inches/day
- Irrigated 2 days ago, assume ETc = 0.21 inch/day, must replace 0.42 inch of water use
  - 1acre inch = 27,154 gal x 0.42 = 11,405 gallons/acre in two days
  - 5’ x 13’ = 670 trees/acre
  - 11,405 / 670 = 17 gallons per tree
- Determine how long to irrigate
  - Assume single line drip w/ two, 1gal/hr emitters/tree
  - 17 gallons use / 2 gal/hr application rate = 8.5 hrs run time every other day to meet full ETc

Control water costs by installing an efficient system

- Heavy cropping years:
  - Water more to promote shoot growth
  - No water deficit early in the season
  - Mature trees ~ 45 - 65% ETc
  - Young trees ~ full ETc
- Light cropping years:
  - Water less to save water
  - Usually plenty of shoot growth
  - Mature trees ~ 35 - 45% ETc
  - Young trees ~ full ETc

Dr. Steve Grattan, Irrigation Specialist, UC Davis,
Joe Connell, Farm Advisor, Butte County, Maria Jose Berenguer-Merelo

Studied oil olive irrigation in early 2000's, applied different irrigation treatments over the season

Increasing water

Treatment	Applied Water (gallons/tree)	% ET
Red	90	15
Orange	156	25
Yellow	313	40
Green	469	57
Grn-White	625	71
White	782	89
Blue	938	107

15% ETc

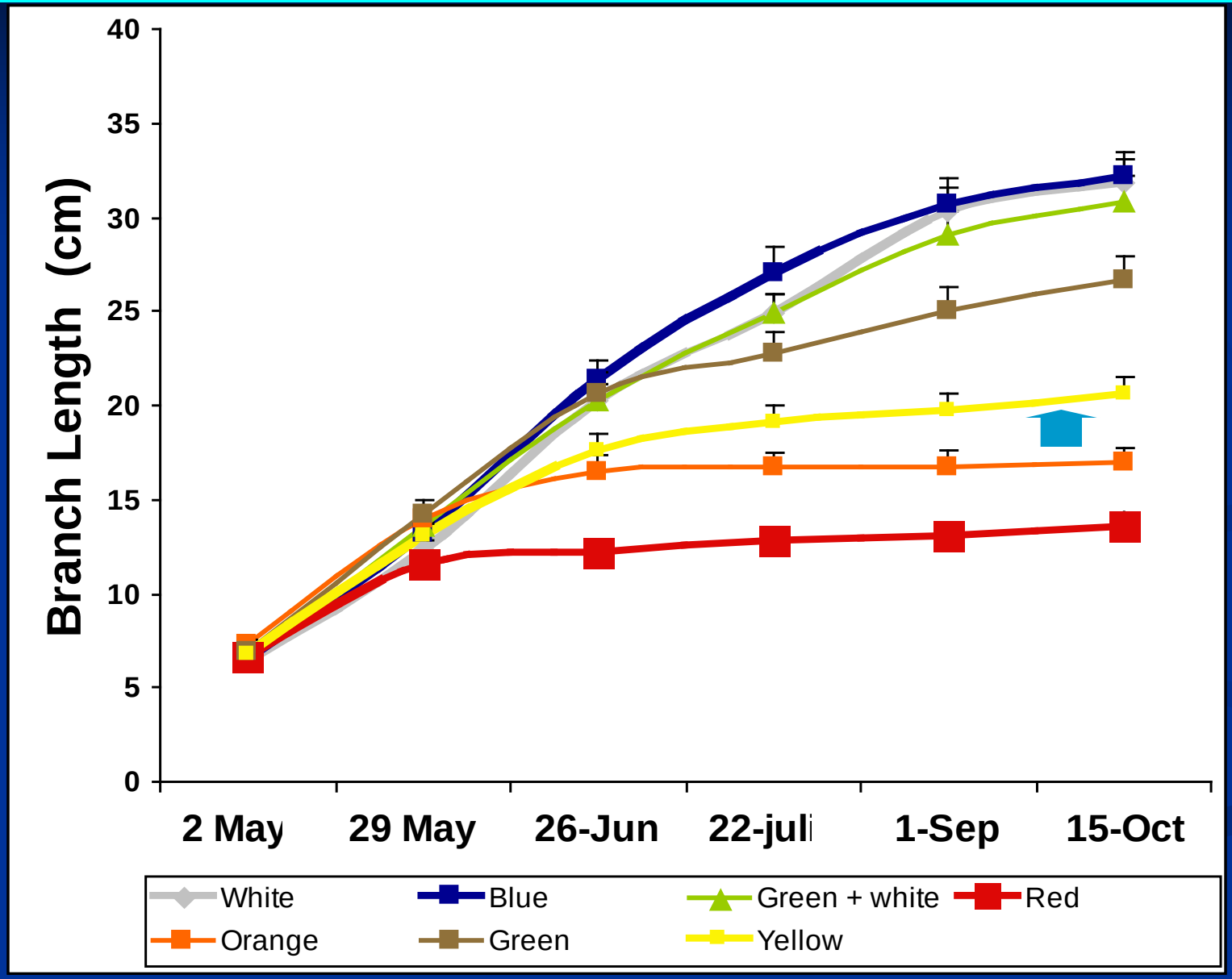
Olive shoot growth was affected by July

41% ETc

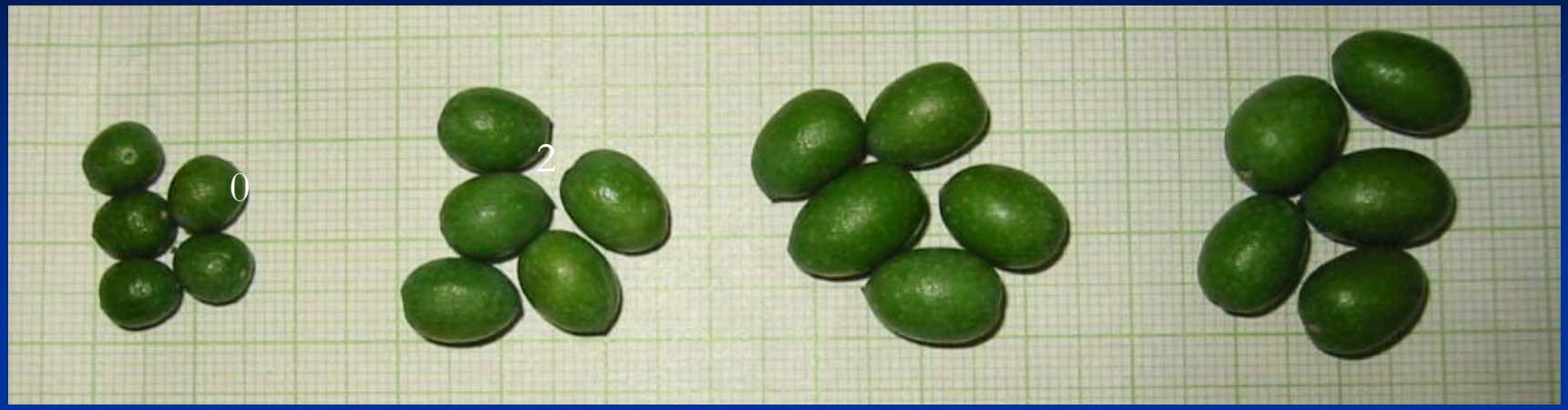
90% ETc

107% ETc

Vegetative growth vs. irrigation

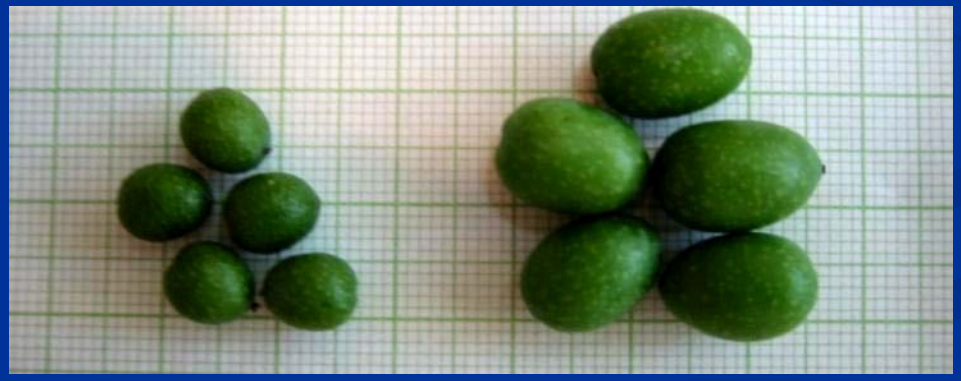


Water affected fruit size

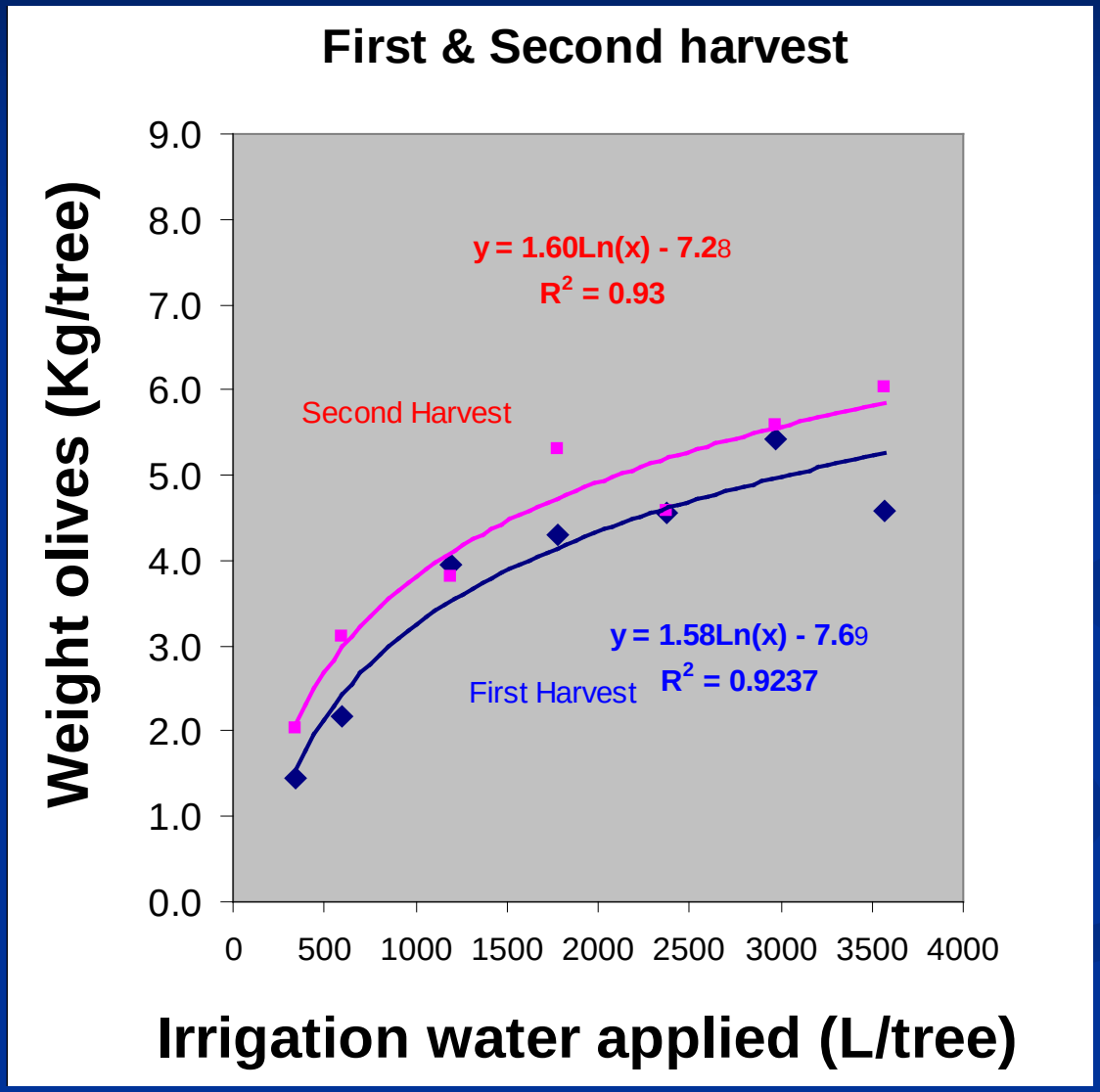


15% ETc 40% ETc 71% ETc 107% ETc

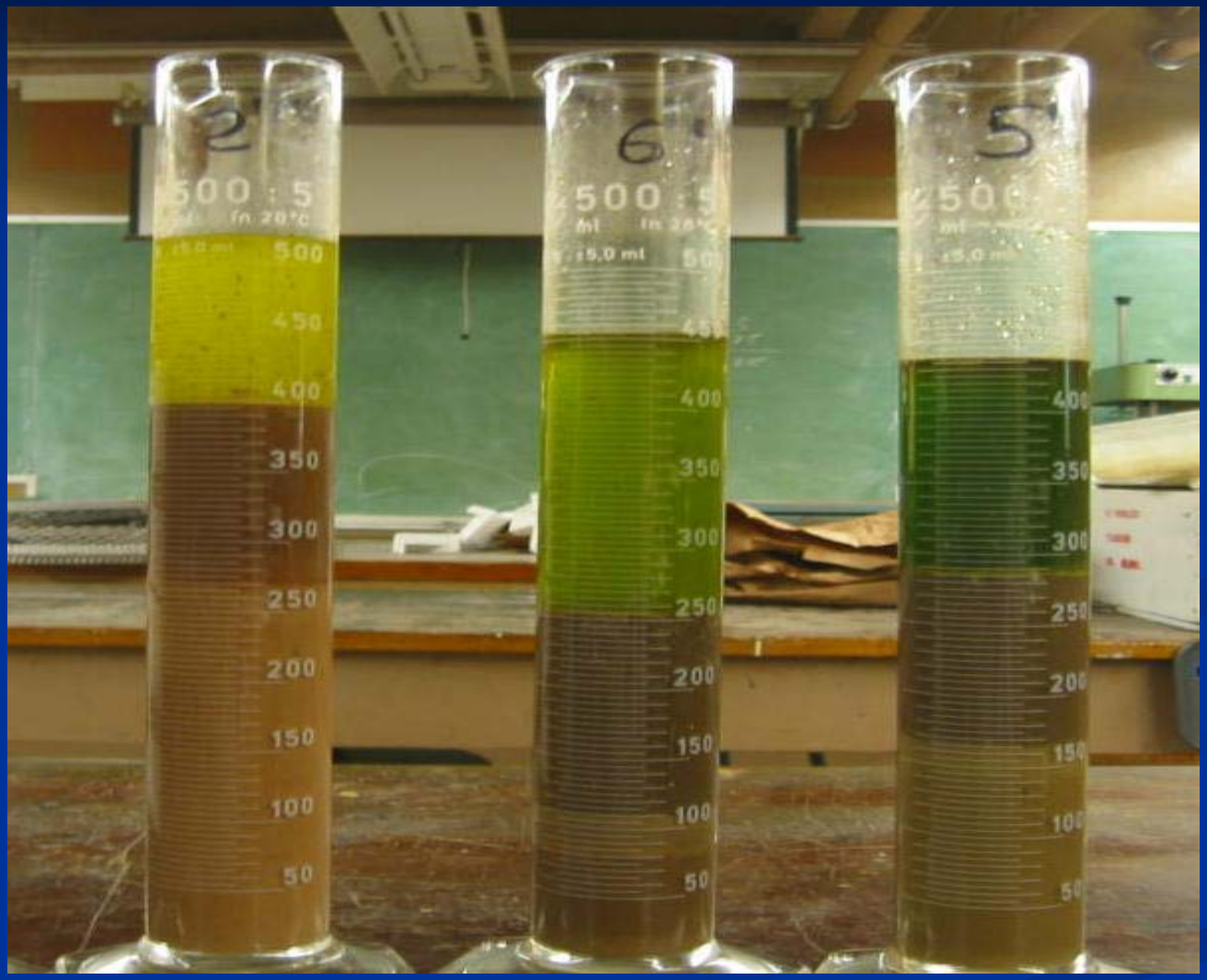
Driest Wettest



Olive fresh weight when harvested October 31st & November 18th

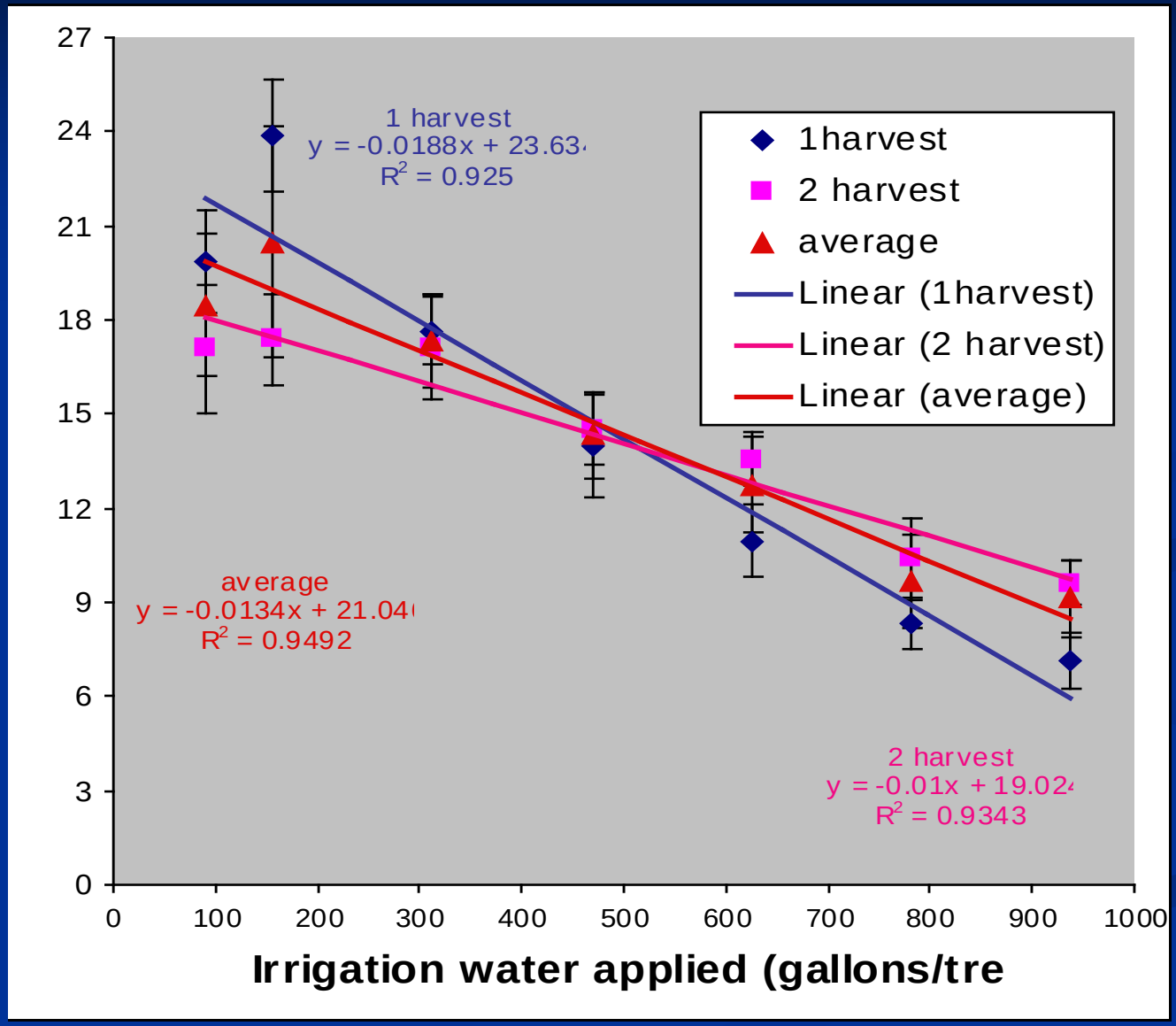


Oil yield and color

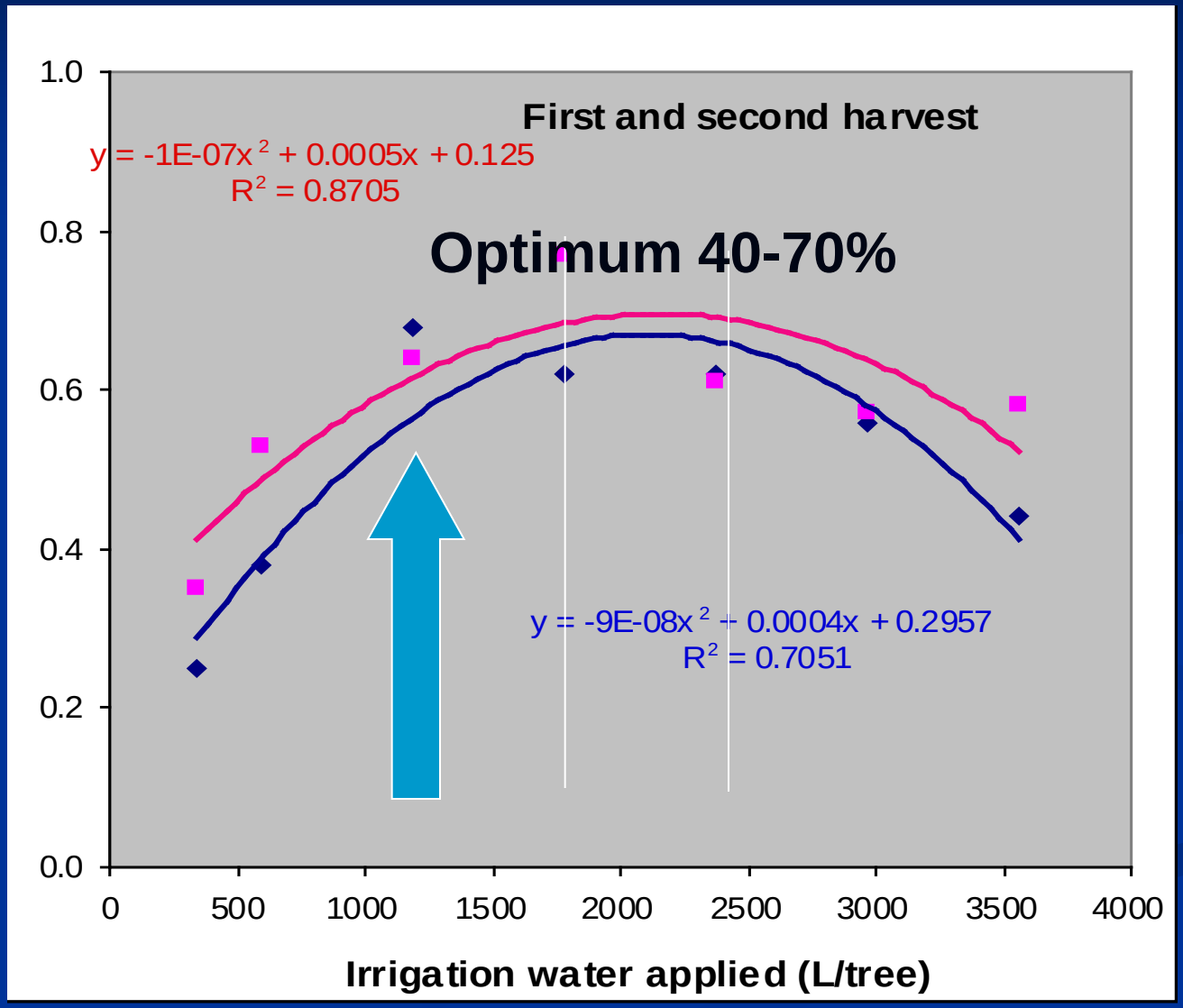


40% ETc 25% ETc 15% ETc

% Oil content


27
24
21
18
15
12
9
6
3
0
0
100
200
300
400
500
600
700
800
900
1000
1 harvest
y = -0.0188x + 23.63
R2 = 0.925
average
y = -0.0134x + 21.04
R2 = 0.9492
2 harvest
y = -0.01x + 19.02
R2 = 0.9343
1harvest
2 harvest
average
Linear (1harvest)
Linear (2 harvest)
Linear (average)
Irrigation water applied (gallons/tre

Total oil production per tree



Best irrigation level for production ranges between 50 and 70% ETc

- Higher crop yield
  - Makes up for less oil per fruit
- Good shoot growth
- Good return bloom

Fruitiness, bitterness, and pungency of oils is influenced by irrigation

Treatments	Fruitiness	Bitterness	Pungency
15% ET	**3.6 a**	**6.0 a**	**4.9 a**
25% ET	**3.2 b**	**4.2 b**	**3.9 b**
40% ET	**2.7 c**	**1.7 c**	**1.9 c**
57% ET	**2.6 c**	**0.9 d**	**1.1 d**
71% ET	**2.1 d**	**0.3 d**	**0.3 e**
89% ET	**1.8 d**	**0.2 d**	**0.2 e**
107% ET	**1.7 d**	**0.2 d**	**0.2 e**

Paul Vossen, UC Farm Advisor, Sonoma County

Best irrigation level for flavor is 35 to 55% ETc

- High level of pleasant fruitiness
- Both ripe fruit and green character
- More complexity and depth
- Higher polyphenol content
- Balanced bitterness
- Balanced pungency
- Excess water = bland oils

Summary …

- ✓ **To optimize olive oil production, don't fully irrigate trees**
- ✓ **Oil production is optimized between 40 and 70% ETc**
  - **Best production is at the high end of this range**
  - **Best oil quality is at the lower end**
- ✓ **Full irrigation increases pumping costs, promotes unnecessary vegetative growth, can reduce flowering, and increases pruning costs**

Date	Full ETc (in.)	RDI%	Irrigation (in.)
Mar 1-15	1.2	100	1.2
Mar 16-31	1.2	100	1.2
Apr 1-15	1.8	100	1.8
Apr 16-30	1.8	100	1.8
May 1-15	2.3	100	2.3
May 16-31	2.5	**50**	**1.3**
Jun 1-15	2.9	**50**	**1.5**
Jun 16-30	2.9	**25**	**0.7**
Jul 1-15	3.1	**25**	**0.8**
Jul 16-30	3.3	**25**	**0.8**
Aug 1-15	2.7	**25**	**0.7**
Aug 16-31	2.8	**50**	**1.4**
Sep 1-15	2.0	**50**	**1.0**
Sep 16-30	2.0	100	2.0
Oct 1-15	1.2	100	1.2
Oct 16-31	1.3	100	1.3
Nov 1-15	0.5	100	0.5
TOTAL (in.)	35.5		21.5
RDI Water Application ETc %			**60.5%**

How do you implement a Regulated Deficit Irrigation strategy?

With a controlled stress…

And, irrigating at 60.5% of full ETc saved 14 in. of water

Summary …

- ✓ On shallow soils, excess tree vigor can be managed by controlling water
  - Shoot growth will slow or can be stopped

- ✓ Fruit growth slows during *regulated* deficit irrigation (RDI)
  - accelerates upon return to full irrigation

Summary …

- ✓ Olive RDI is a strategy that can optimize oil yield and quality while reducing water costs

- ✓ MUST know what you're doing
  - Have good control of water applications
  - Know your full ETc water requirement
  - Know your systems water application rate
  - Understand your goal

Water problems in super high density olives

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Olives do well on shallow soils with good drainage

Aerial view of the same field

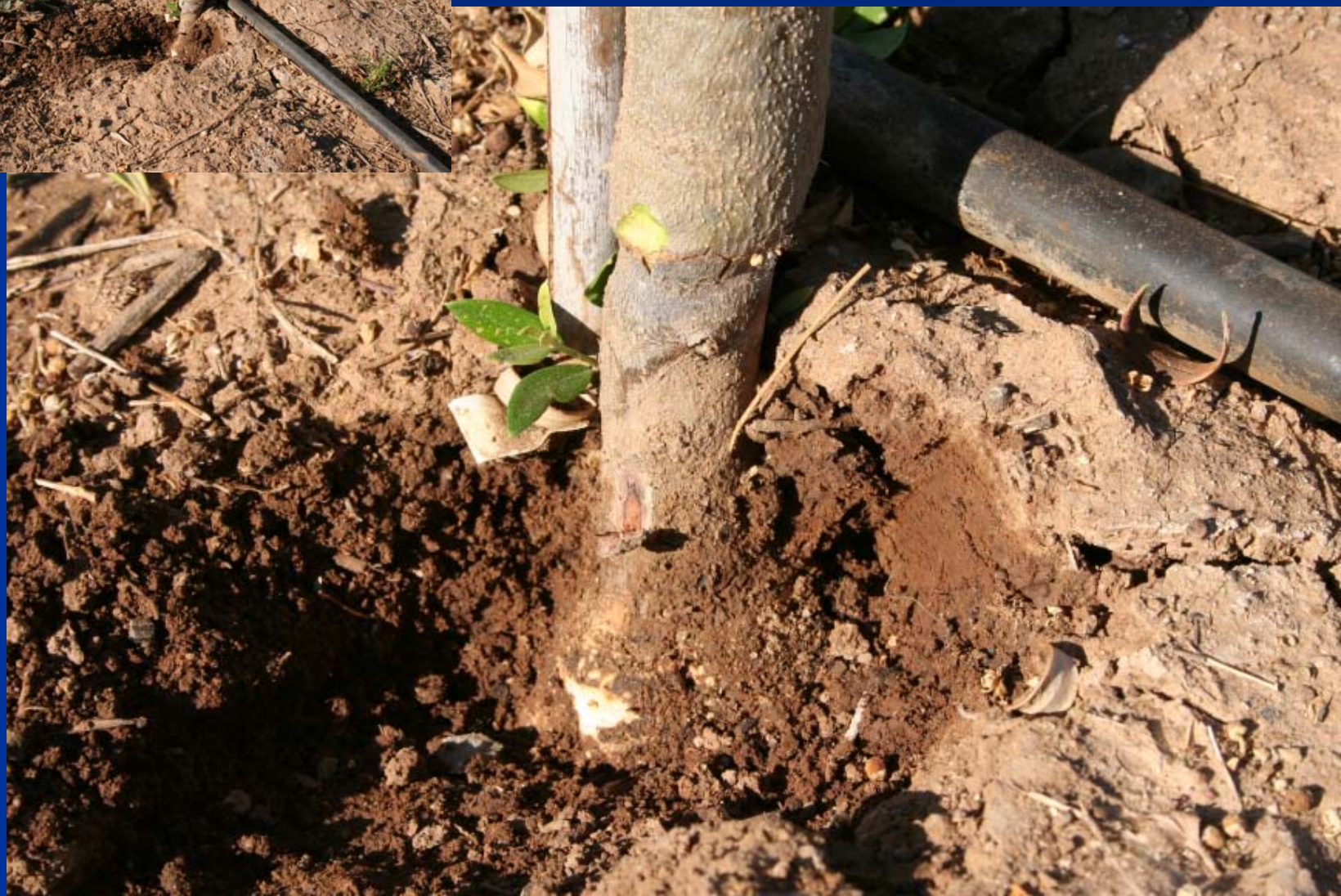
- ✓ Swales with poor drainage show up
- ✓ Wet saturated areas, trees are gone

Wet spot at ground level

Another type of drainage problem

Individual trees starting to weaken and turn yellow

Phytophthora crown rot



Water problems on young olive trees

- Saturated soil…. areas of the field die
- Puddling around the crown…. individual trees die

Questions?

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