

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

	<u>ETo (inches)</u>	<u>Kc</u>	<u>ETc (inches)</u>
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

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 INCHES¹

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...

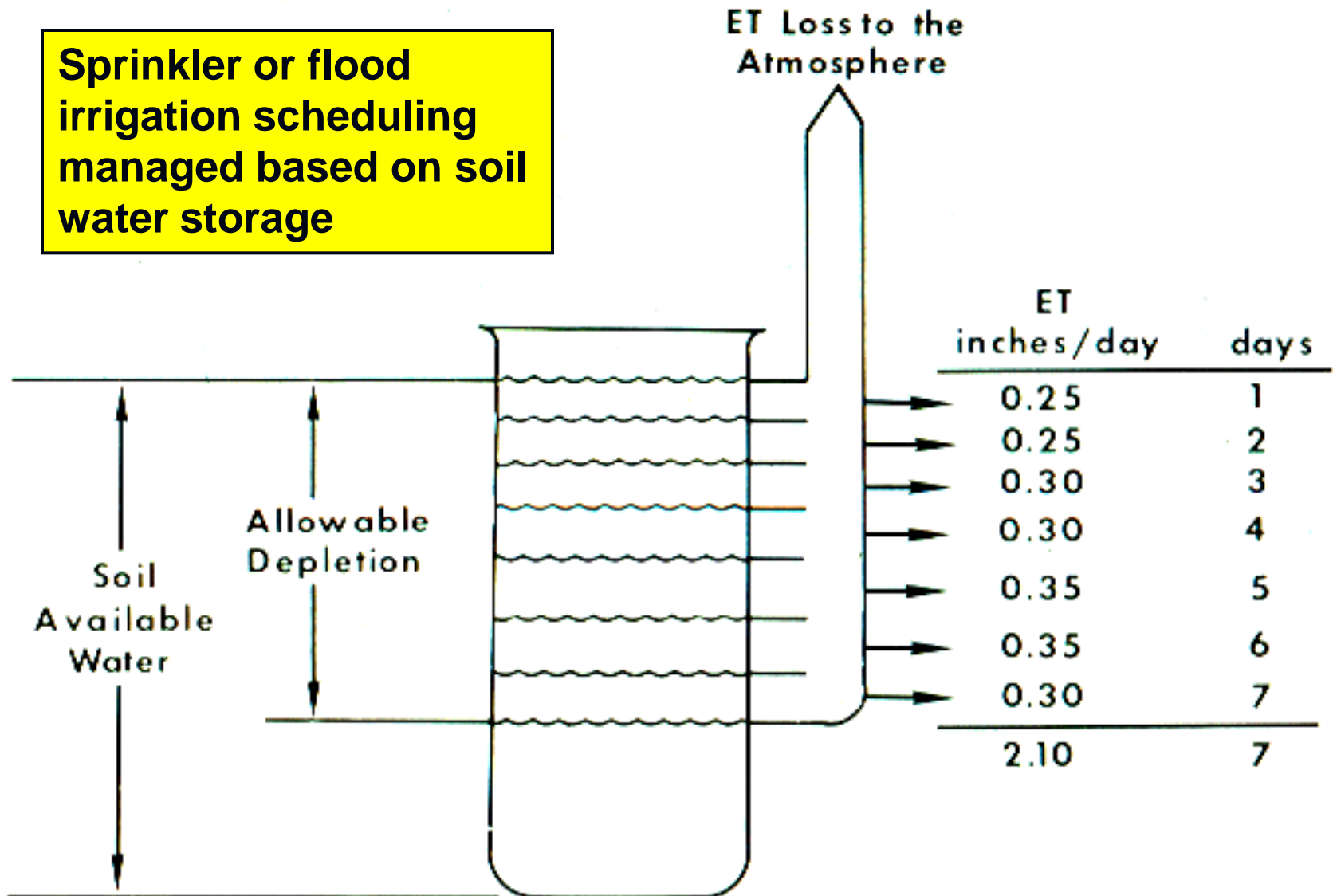
- Local papers

- 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

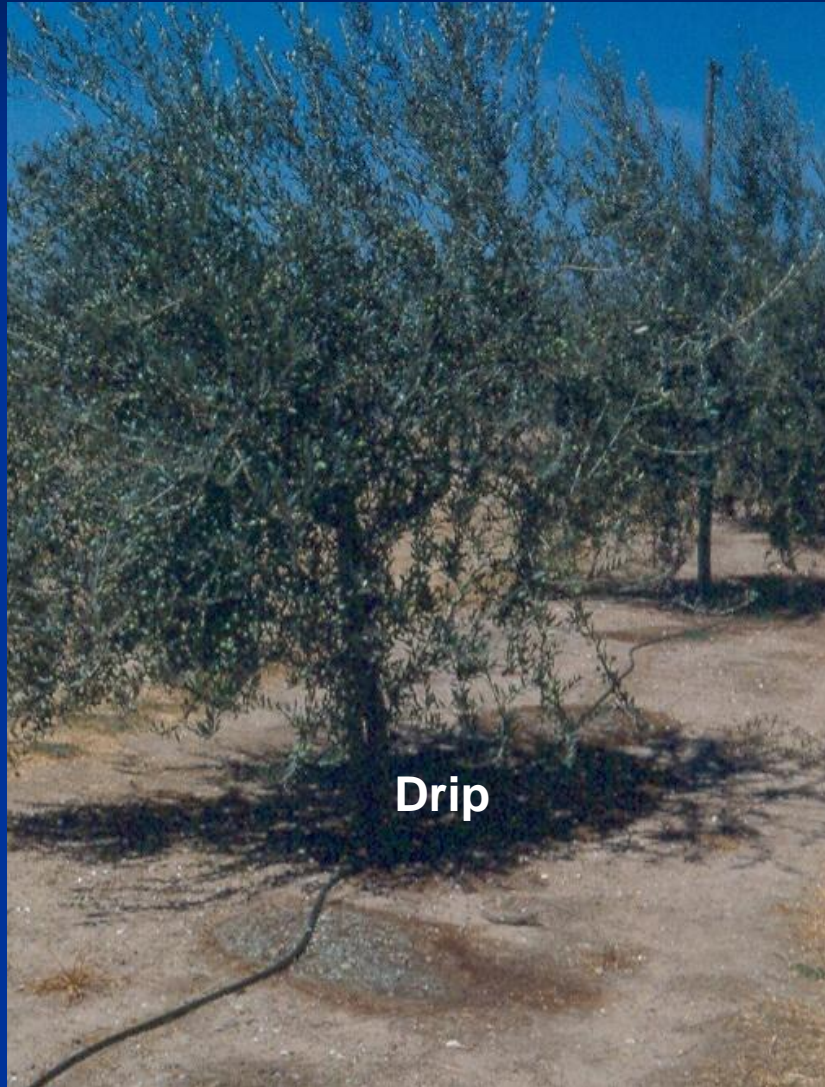


IRRIGATE

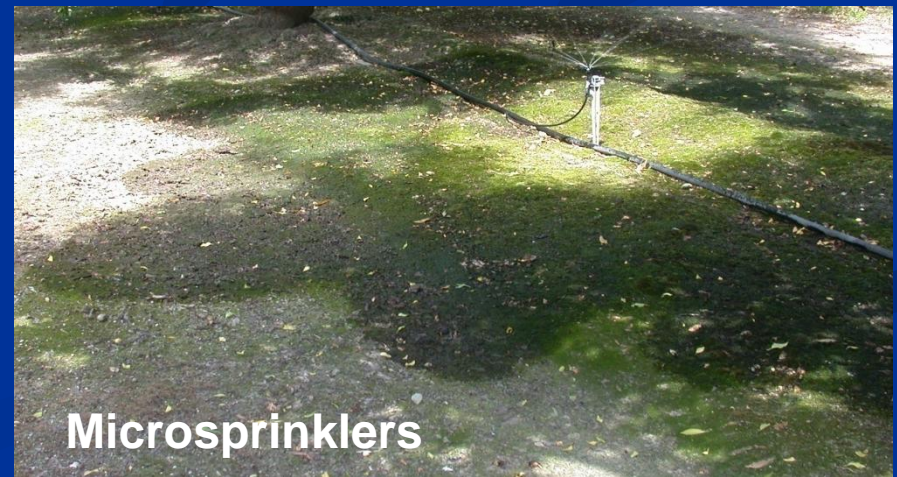
1. When?-----After 7 days

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
 - $ET_c - K_c$, canopy size, climate (temp & day length)
 - Days between irrigations
- Determine how long to irrigate
 - ET_c 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
 - 1 acre 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% ET_c
 - Young trees ~ full ET_c
- **Light cropping years:**
 - Water less to save water
 - Usually plenty of shoot growth
 - Mature trees ~ 35 - 45% ET_c
 - Young trees ~ full ET_c

*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*

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



Increasing water



15% ETc

***Olive
shoot
growth
was
affected
by July***



41% ETc

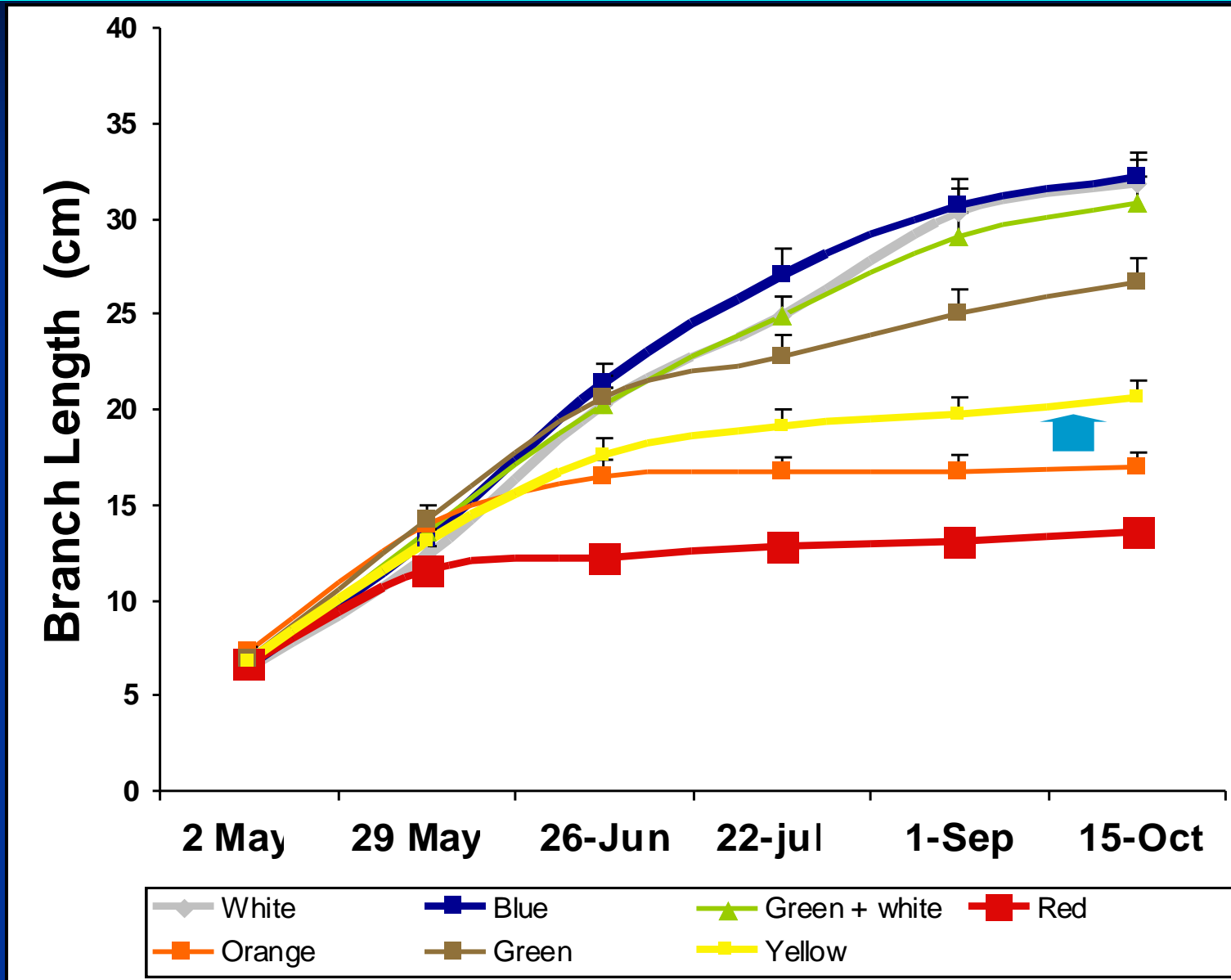


90% ETc

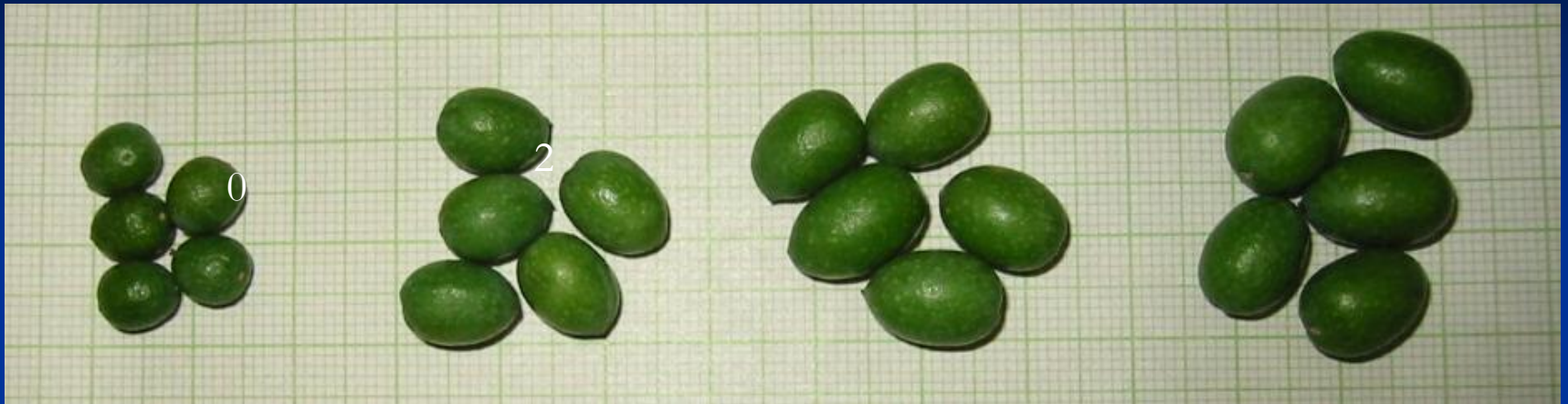


107% ETc

Vegetative growth vs. irrigation



Water affected fruit size



15% ETc

40% ETc

71% ETc

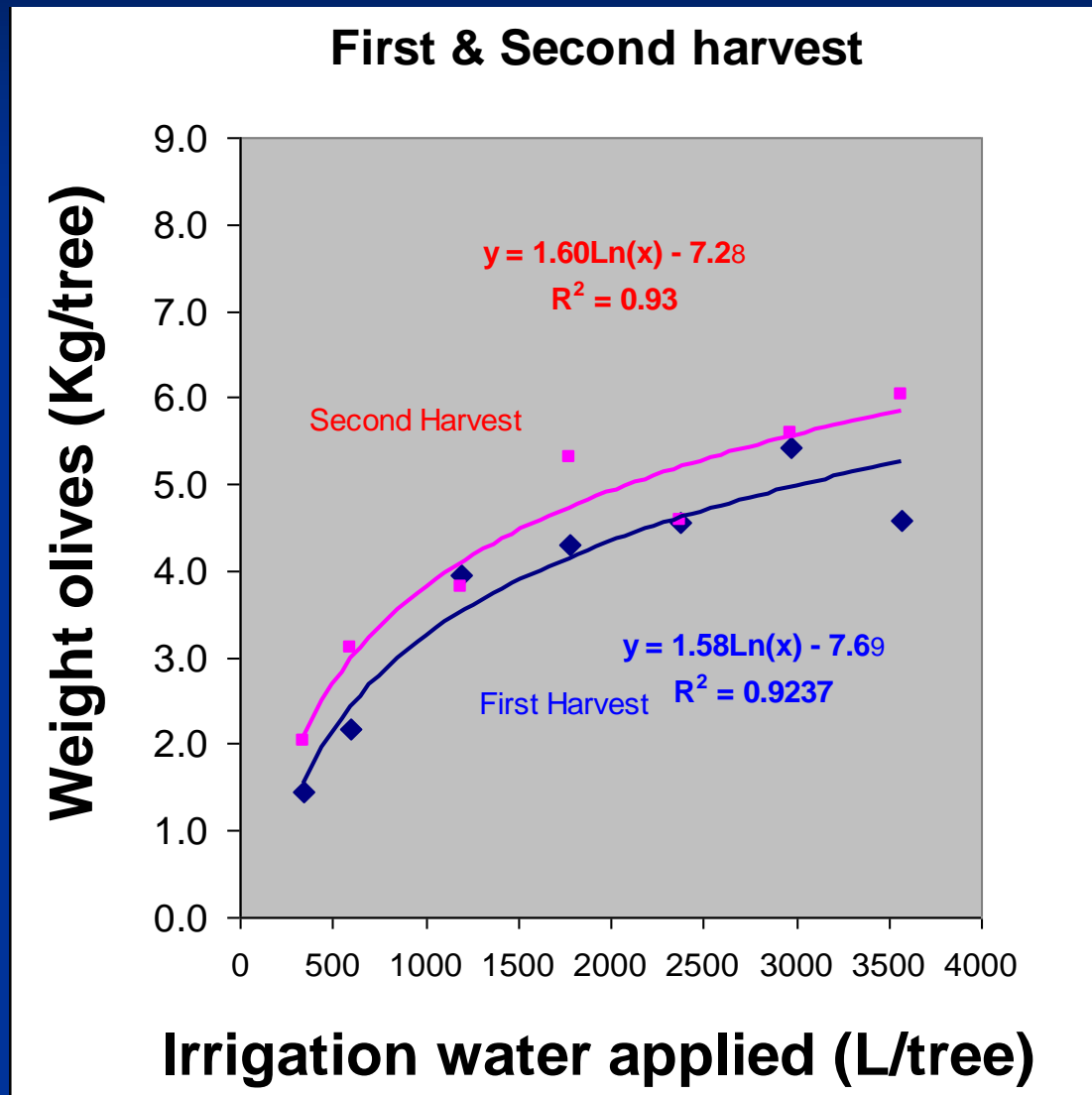
107% ETc

Driest

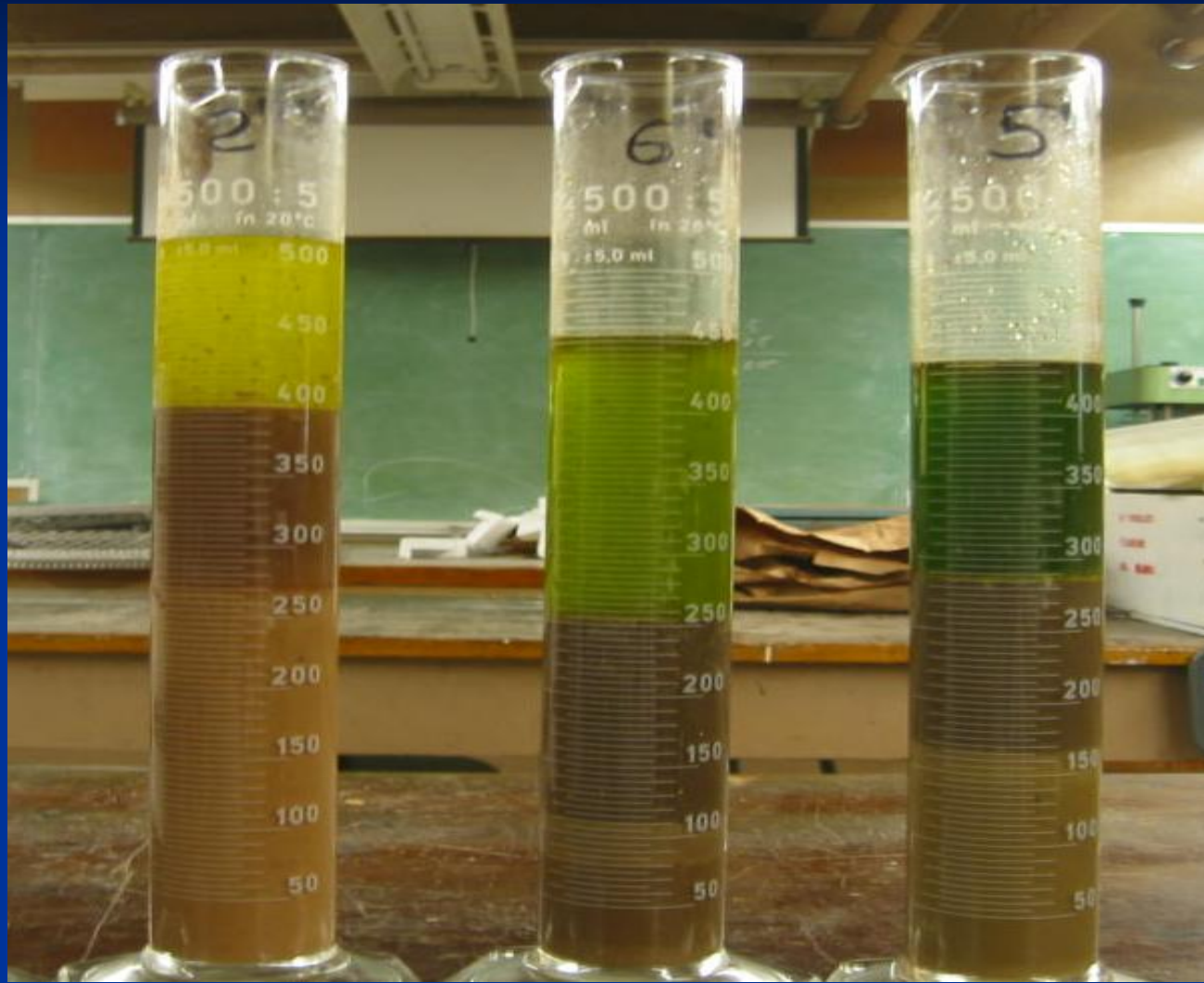
Wettest



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



Oil yield and color

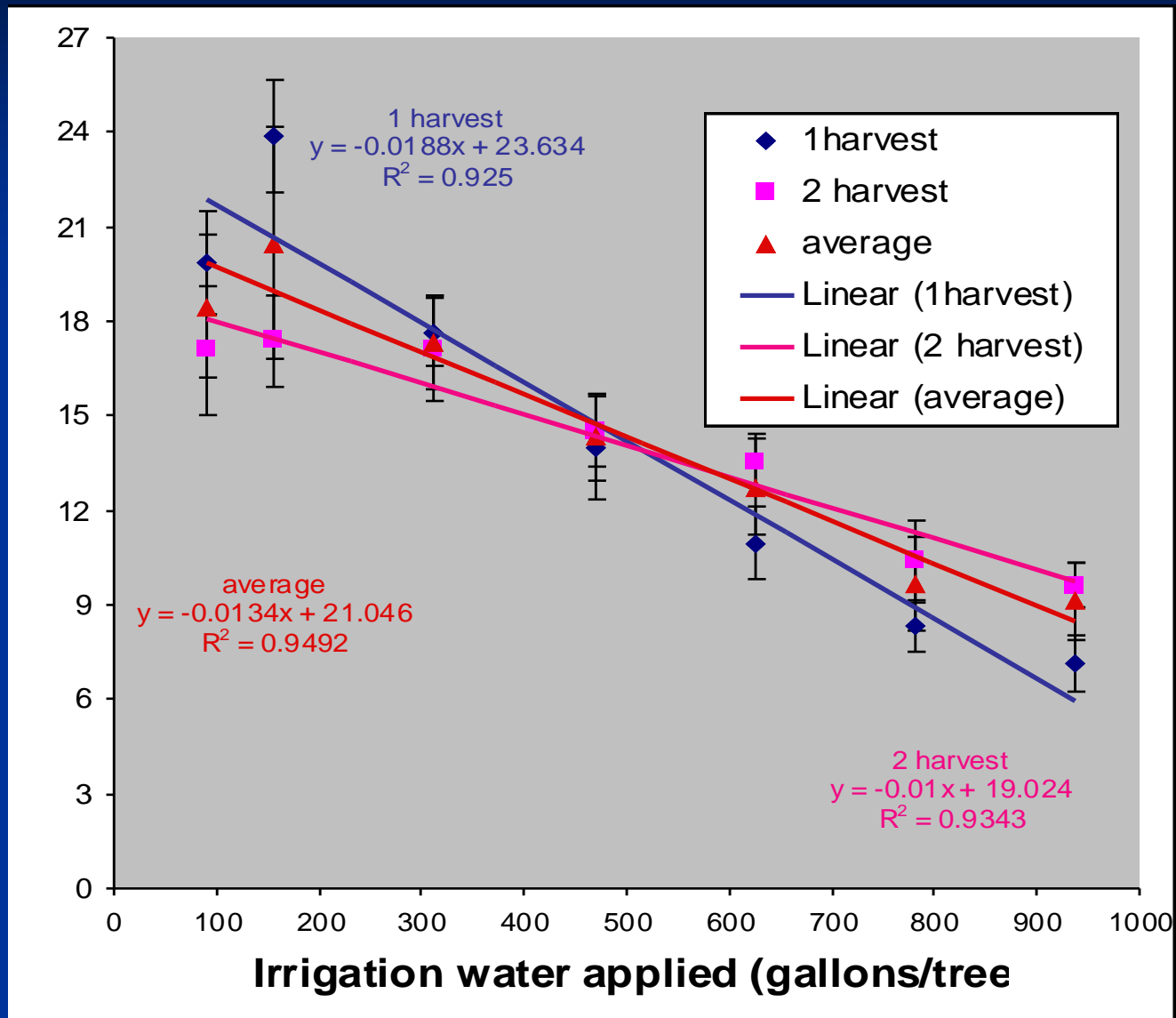


40% ETC

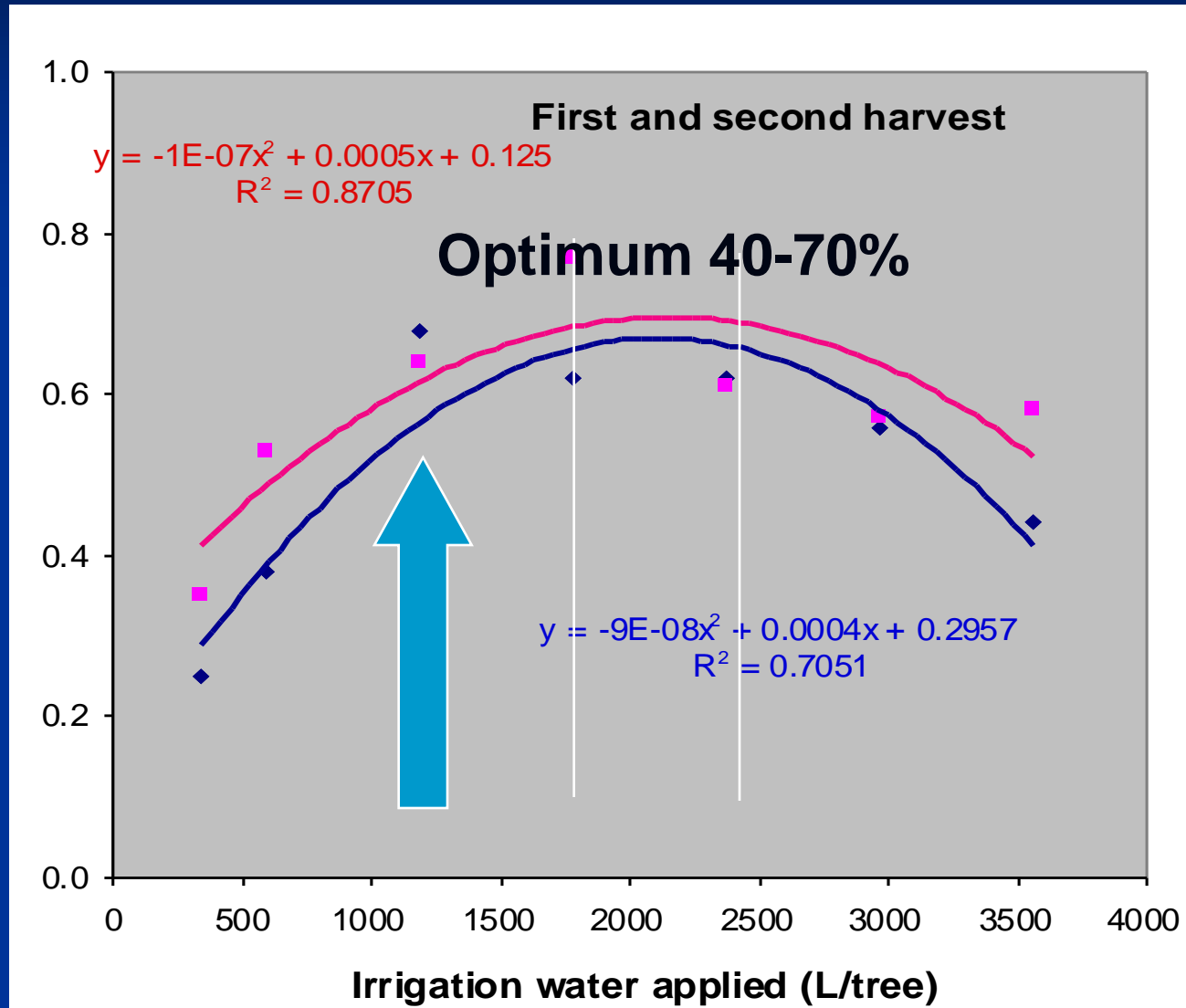
25% ETC

15% ETC

% Oil content



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...

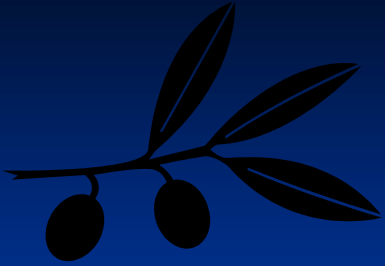
And, irrigating at 60.5% of full ETc saved 14 in. of water

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



**Replants at the low end
of the field next to a road**

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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