Irrigation Management for Young Orchards

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Young Orchards: Avoiding pitfalls that cost

- Time and tree growth
- Orchard uniformity and tree health
- Water and energy
- More work and expense

My goals today

- Highlight the importance of knowing how the irrigation systems performs and evaluating the orchard soils
- Share field data and observations about water use by young walnut and almond trees
- End with suggestions for a strategy or approach to irrigating young trees

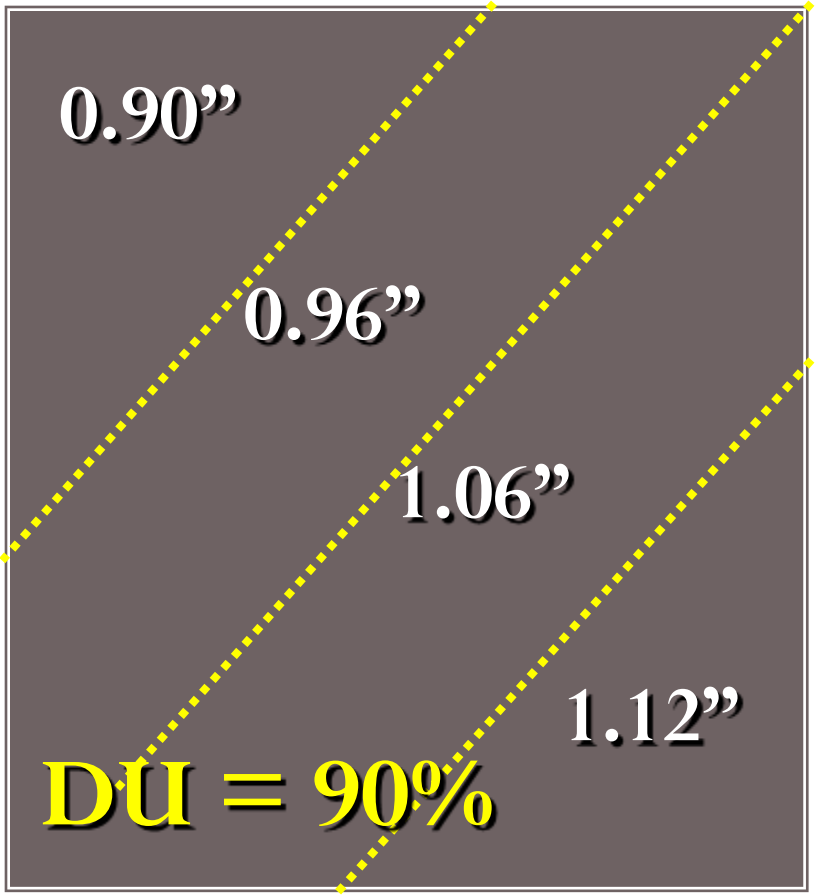
Think about the irrigation system

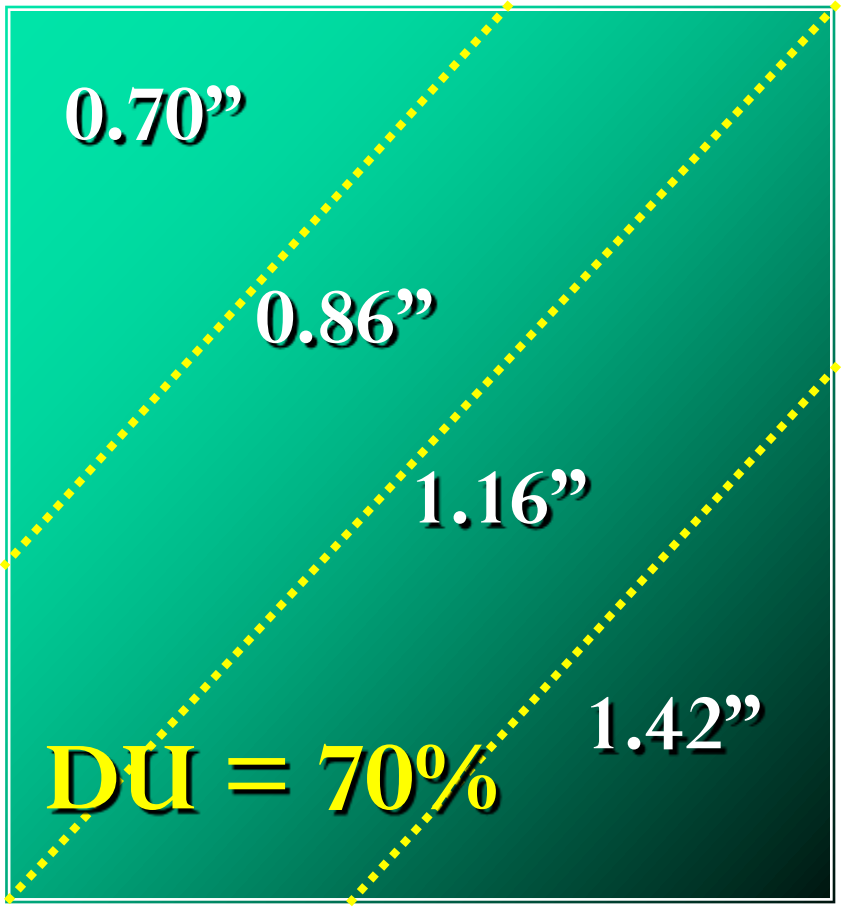
- Where will it place water relative to the root system of a newly planted tree (spatially and after re-distribution in the soil)?

Think about the irrigation system

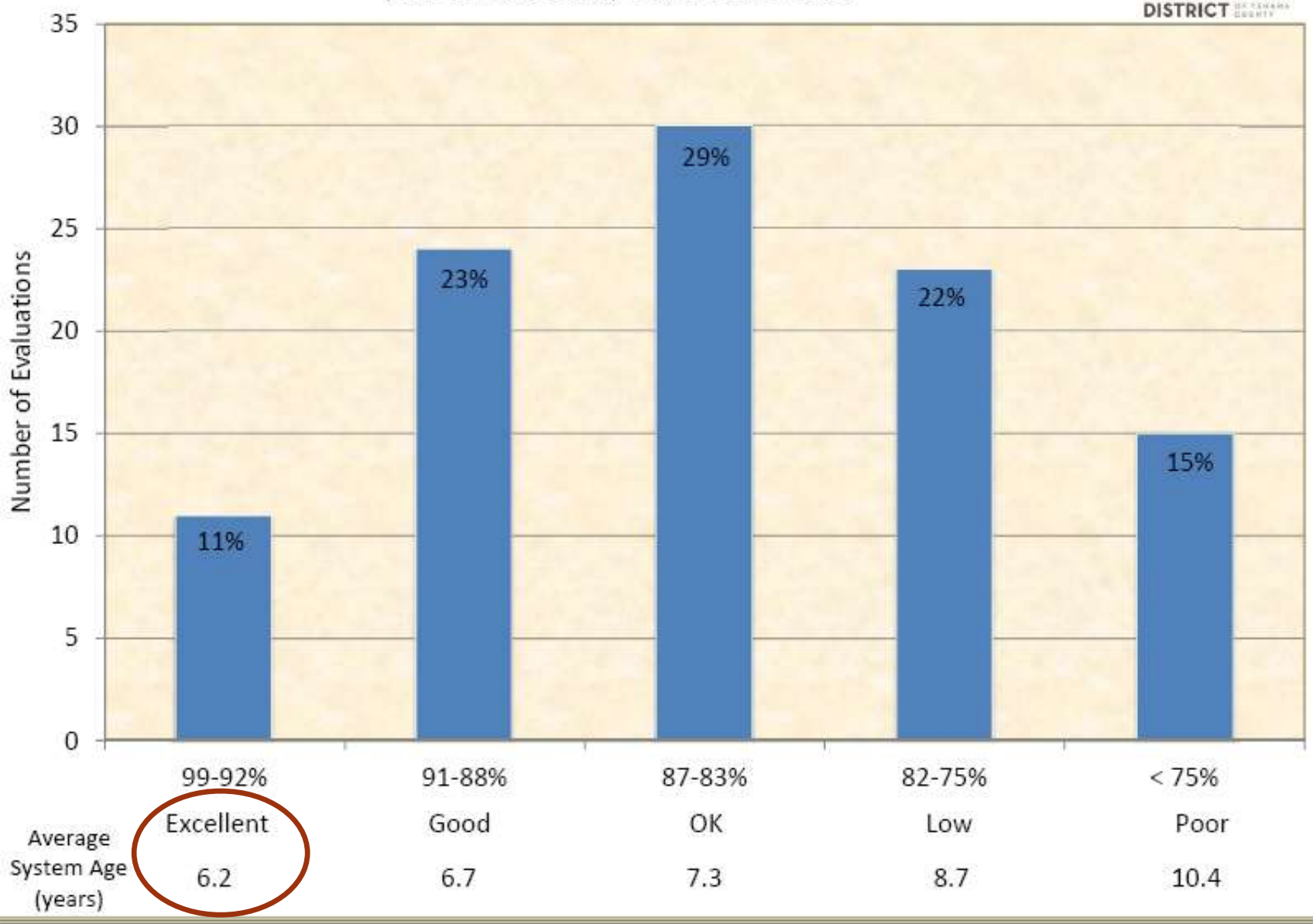
- How uniformly will it apply water?

Example: Target application 1.0 inch water



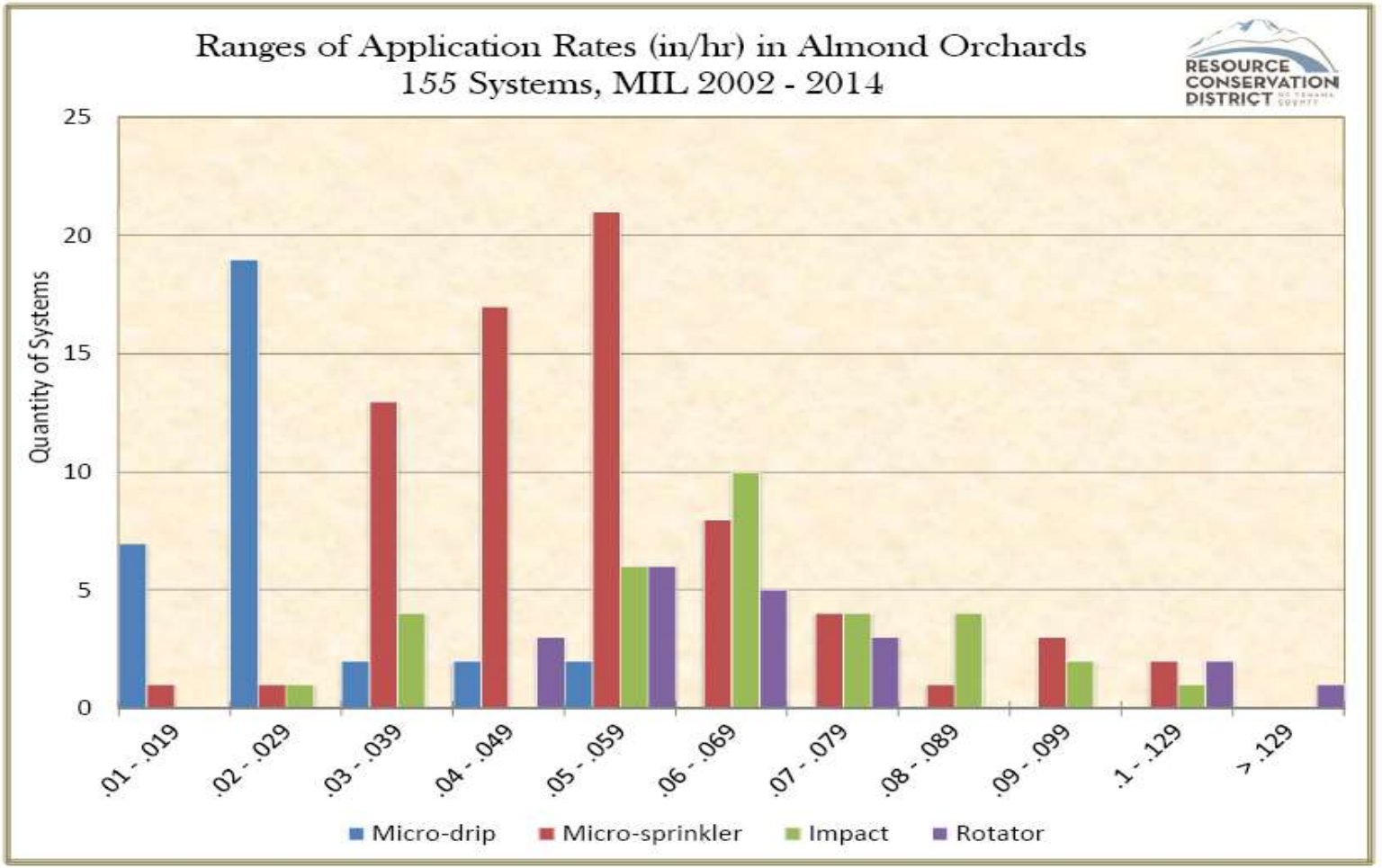


Micro Irrigation DUs of Almonds by ITRC Ranking Method (103 Evaluations) MIL 2002-2014



Think about the irrigation system?

- Do you know the hourly rate of water application?
  - How to relate it to soil water holding capacity in the root zone?



Example: calculate and consider hourly water application rate

DATA:

- 26 x 14 foot, square walnut planting, 364 sq ft per tree, 120 trees per acre
- Start new trees with two 1 gph emitters per tree (2 percent wetted area)
- Trees grew, by mid July four 1 gph emitters per tree (15 percent wetted area)

HOURLY WATER APPLICATION RATE:

- Two 1 gph emitters

  2 x 120 = 240 gallons per acre per hour

  240 ÷ 27,154 (gallons per ac-in) = 0.009 inch per hour (whole area)

  0.009 ÷ 0.02 = 0.45 inch per hour (2 percent wetted area)

HOURLY WATER APPLICATION RATE:

- Four 1 gph emitters

  4 x 120 = 480 gallons per acre per hour

  480 ÷ 27,154 (gallons per ac-in) = 0.018 inch per hour

  0.018 ÷ 0.15 = 0.12 inch per hour (15 percent wetted area)

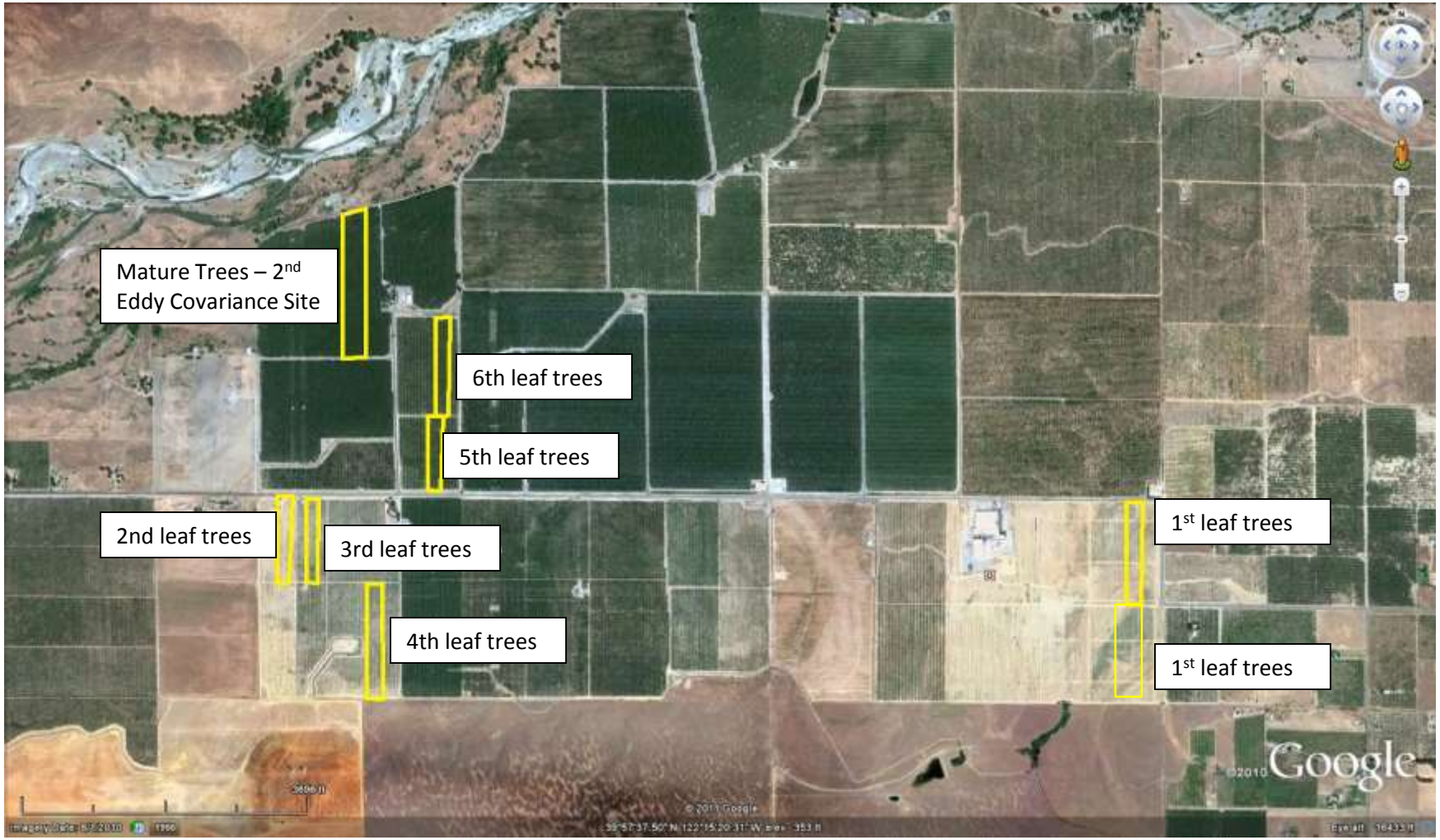
How will the irrigation water redistribute in the soil?

- depends on the soil characteristics
- how will it integrate with the young, developing root?

Example: Relating water application rates to soil water holding capacity in the root zone to estimate limits on irrigation duration and frequency.

Soil Texture	Soil Water Holding Capacity	50 Percent Depletion	Maximum Duration @ 0.45 in/hr (2 gph, 2 % Area)	Maximum Duration @ 0.12 in/hr (4 gph, 15 % area)
	(inches per foot of soil in root zone)		(hours to refill 50 % depletion per foot)	
Gravelly, loamy sand	0.8	0.4	0.9	3.3
Sandy loam	1.4	0.7	1.6	5.8
Fine sandy loam	1.8	0.9	2.0	7.5
Loam	2.0	1.0	2.2	8.3
Silt loam	2.2	1.1	2.4	9.2
Clay loam	2.0	1.0	2.2	8.3

Learning Opportunity in Tehama County (2009-2012)



Opportunity to assess water use (ET) and irrigation needs in developing walnut orchards

- 1st leaf – 2 repetitions
- 2nd leaf – 3 repetitions
- 3rd leaf – 3 repetitions
- 4th leaf – 3 repetitions
- 5th leaf – 3 repetitions
- 6th leaf or older – 4 repetitions

Types of monitoring

- Weekly monitoring from leafout up to dormancy
  - Midday stem water potential with pressure chamber (UC ANR Publication 8503)
  - Volumetric soil water content to six feet in tree row and within irrigation wetting pattern
  - Measured irrigation water with in-line flow meters
  - In-season rainfall (on-site, backed up by nearest CIMIS station)
  - Daily photos of tree growth with plant camera
- Annual canopy light interception with mobile light bar

Estimated ETc (inches)	=	Applied Water	+	In-season rainfall	+	Change in soil storage

1st Leaf, example seasonal trend of midday stem water potential and the general water management strategy in these developing Chandler walnut orchards.

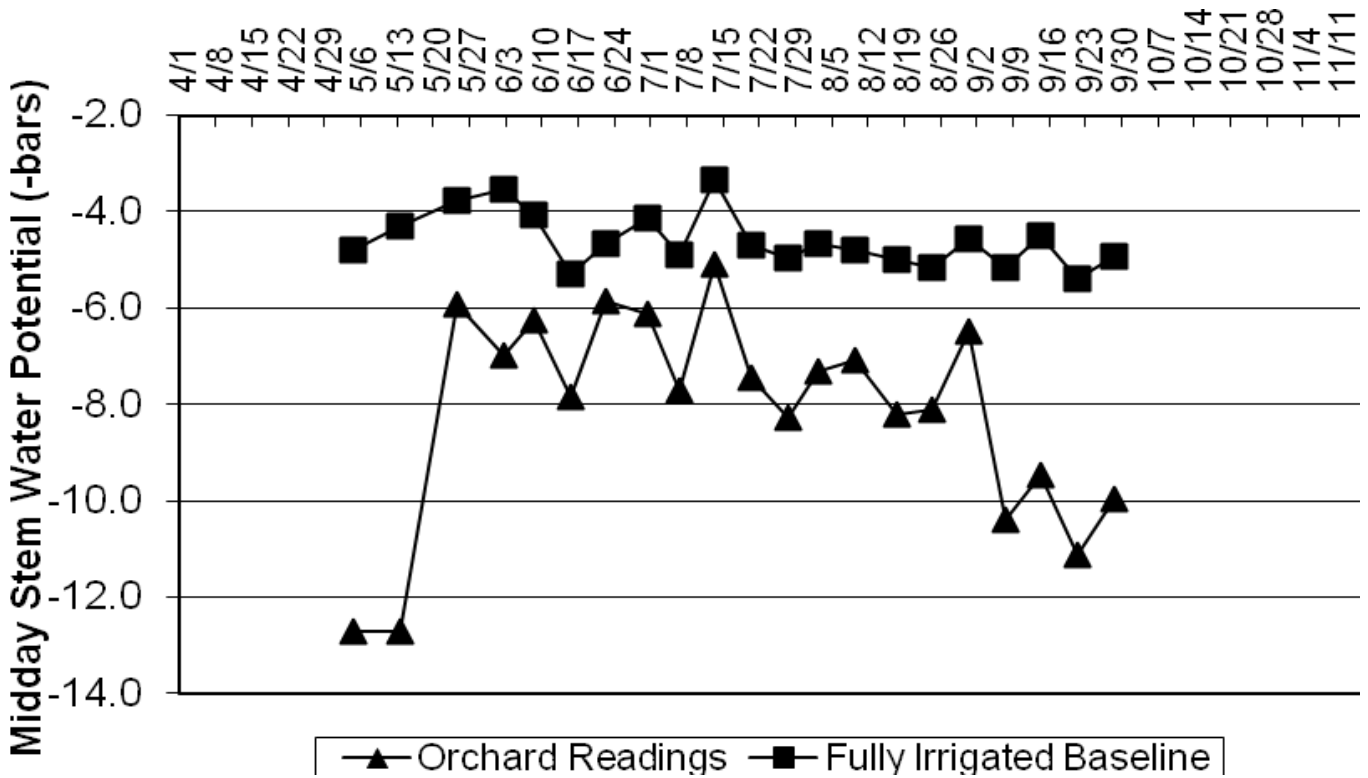
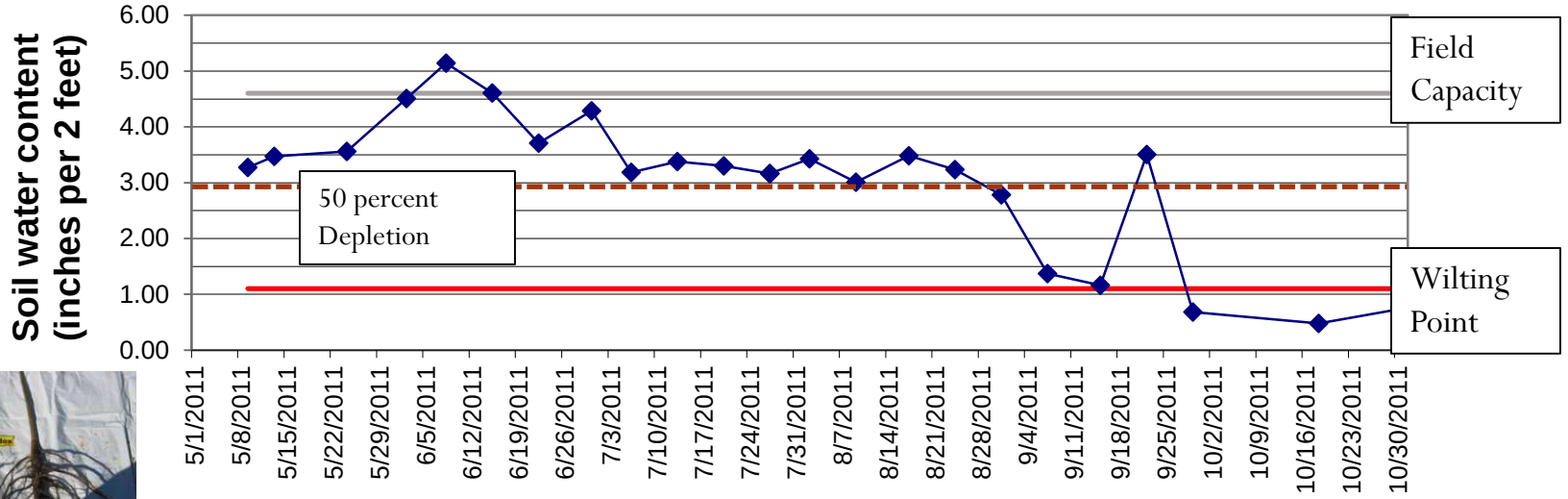
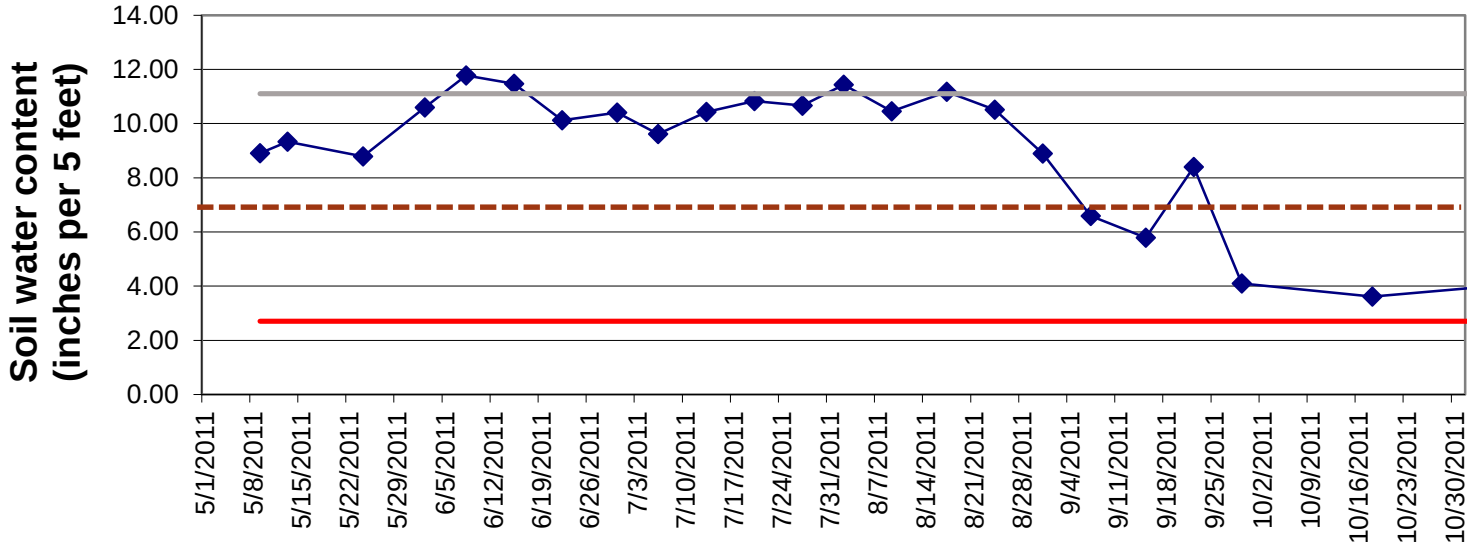


Illustration of orchard canopy development during 1st leaf.

Soil moisture levels in two foot soil profile of 1st leaf trees



Soil moisture levels in five foot soil profile of first leaf trees



Estimated water use (ETc) for1st Leaf Walnuts

Year	In-season Rainfall (in.)	Drip Irrig. (in.)	Soil Moisture Depletion (in.)	Total (in.)
2011 (Rep 1)	4.3	3.3	7.5	15.1
2011 (Rep 2)	4.3	3.1	7.0	14.4
Average	4.3	3.2	7.3	14.8

Illustration of orchard canopy development, 2nd and 3rd leaf.

Illustration of orchard canopy development at 4th leaf.

Year	Avg PAR (%)	Std PAR (%)
1st	7.2	1.8
2nd	19.5	5.0
3rd	32.0	5.0
4th	49.0	5.0

Approximate seasonal ETc of developing walnut trees.

Year	Avg PAR (%)	% of Full ETc	Seasonal ETc (inches)	Percent of ETc Supplied from Irrigation
1st	7.2	15 to 40	14.8	22
2nd	19.5	35 to 60	21.3	57
3rd	32.0	70 to 100	38.5	75
4th	49.0	100	40.1	75 to 85

Approximate water use (ETc) by young developing walnut trees.

MONTH	First Leaf (inches)	Second Leaf (inches)	Third Leaf (inches)
April	0.4	0.9	1.6
May	1.5	2.4	4.9
June	2.3	3.5	6.6
July	3.9	5.6	9.7
August	3.4	4.6	7.6
September	2.1	2.9	5.2
October	1.0	1.4	2.9
Total	14.6	21.3	38.5

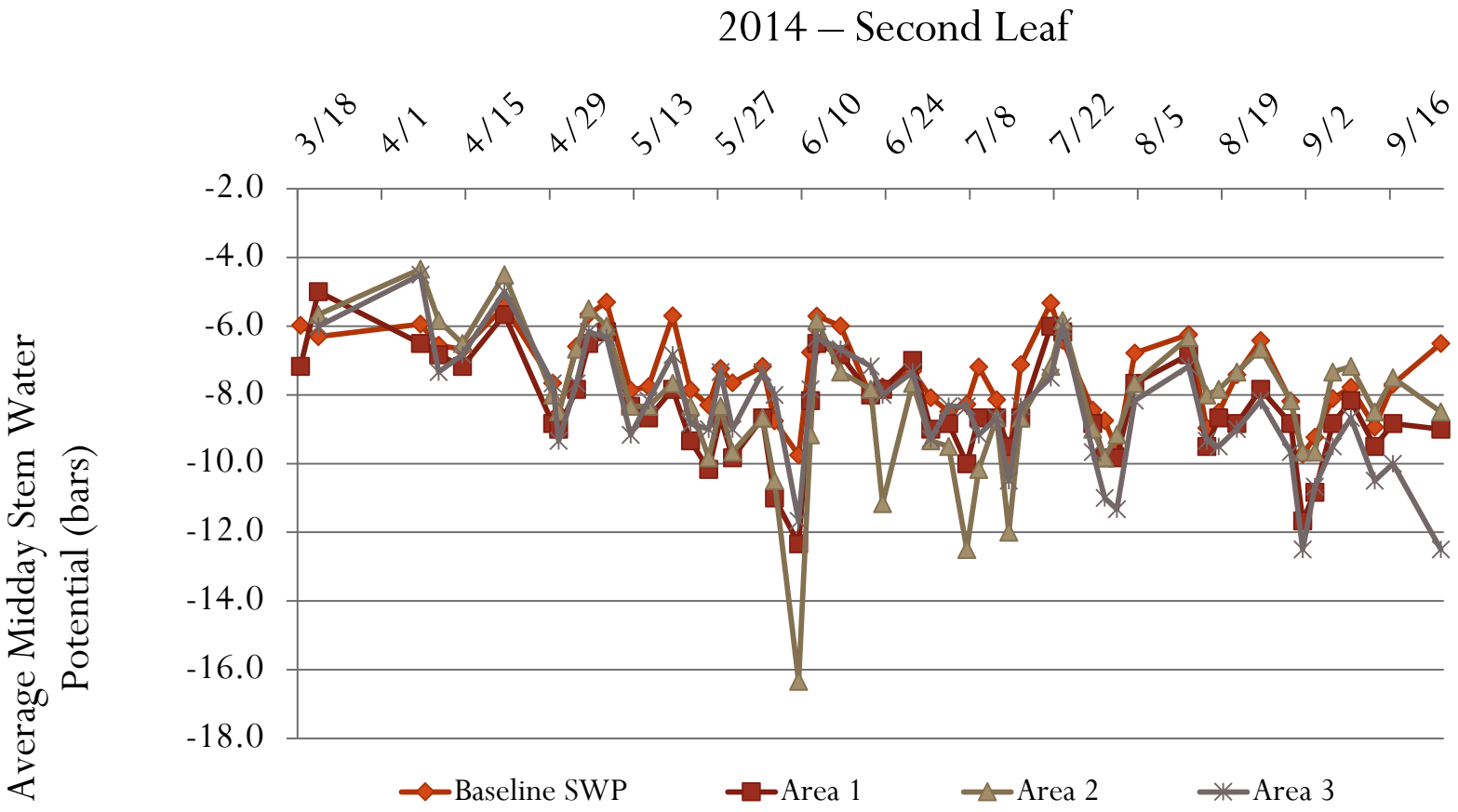
Reminder: ETc is not the same as irrigation need.
Irrigation requirement will be less.

Water Use by Young, Developing Almonds

1st Leaf

End of
2nd Leaf

2014 AVERAGE MIDDAY STEM WATER POTENTIAL LEVELS IN SECOND LEAF ALMOND ORCHARD.



1st Leaf Irrigation (inches)	2nd Leaf (inches)
2.6	15.7

Strategy for Irrigating Young Trees

- The tree canopy and root system is changing, it's growing so will the water use and irrigation needs
- Know what to expect from your irrigation system
  - Proper placement of water in relation to the root system
  - Uniform water application from one tree to the next
  - Develop a sense of a maximum irrigation duration for the orchard soils and root system development (estimate or measure)
- ET estimates help frame boundaries for irrigation but they bring risk of over-estimating irrigation needs if used exclusively
  - Irrigate at a fraction of ET to allow for rainfall and soil storage
- Use orchard feedback, either tree stress indicators or soil moisture to adjust for specific conditions
- Irrigation systems that apply water precisely at higher frequency and shorter duration often prevent some common pitfalls

THANK YOU!