



Almond Drought Management

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Irrigation Considerations

Climate Contribution

Rainfall
Snowpack
Season's temperatures

Irrigation
Management
Considerations

Water quality
Salinity management
Fertilizer timing
Fertilizer types

Chemical and
Water Inputs

Distribution uniformity (DU)
Frost protection/pre-irrigating
Ground cover/residual
vegetation
Soil moisture/plant monitoring
Vigor, canopy coverage (PAR)

Orchard Production
and Monitoring
Practices

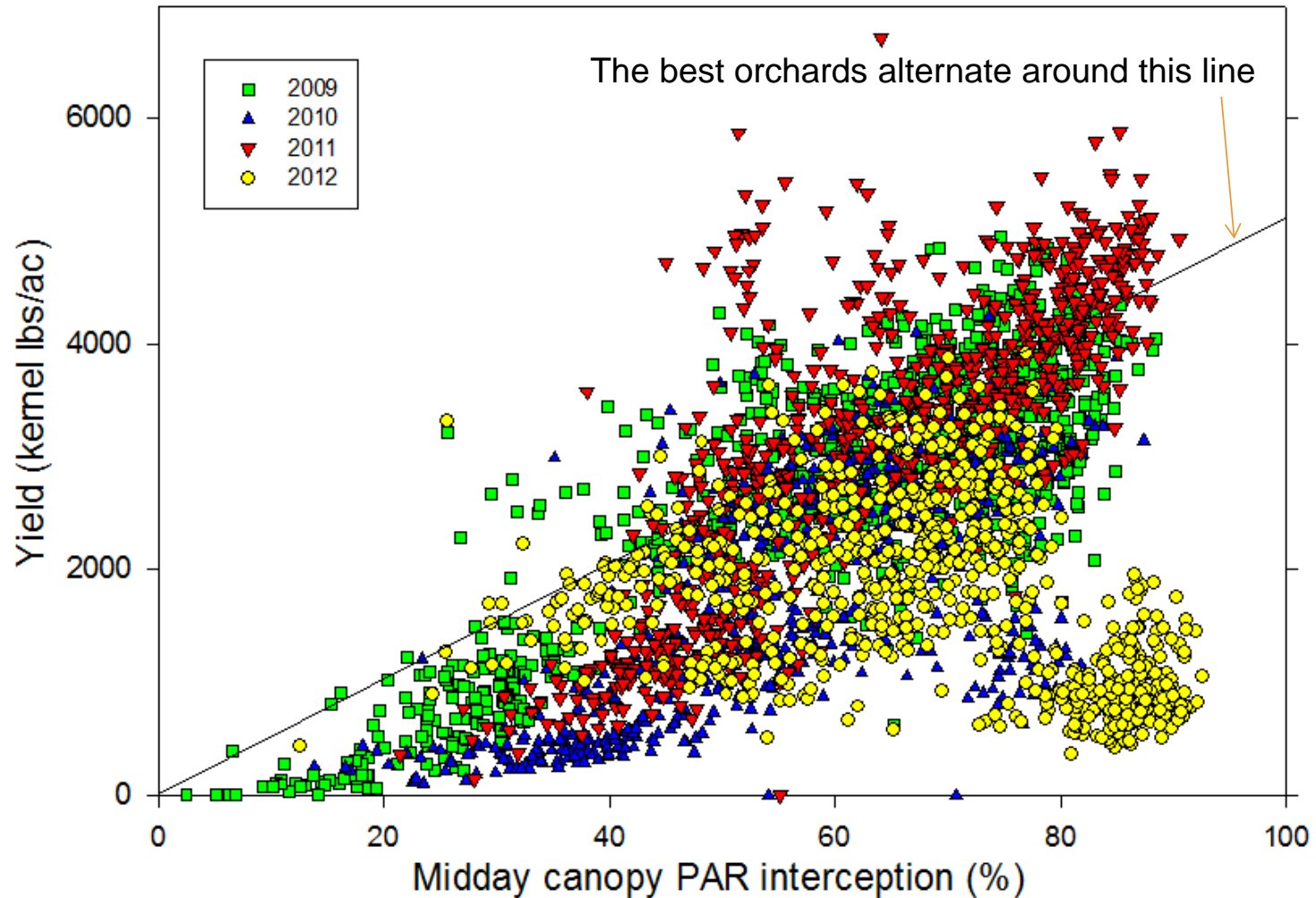
Determining Water Needs



Canopy coverage dictates water needs.

Determining Water Needs

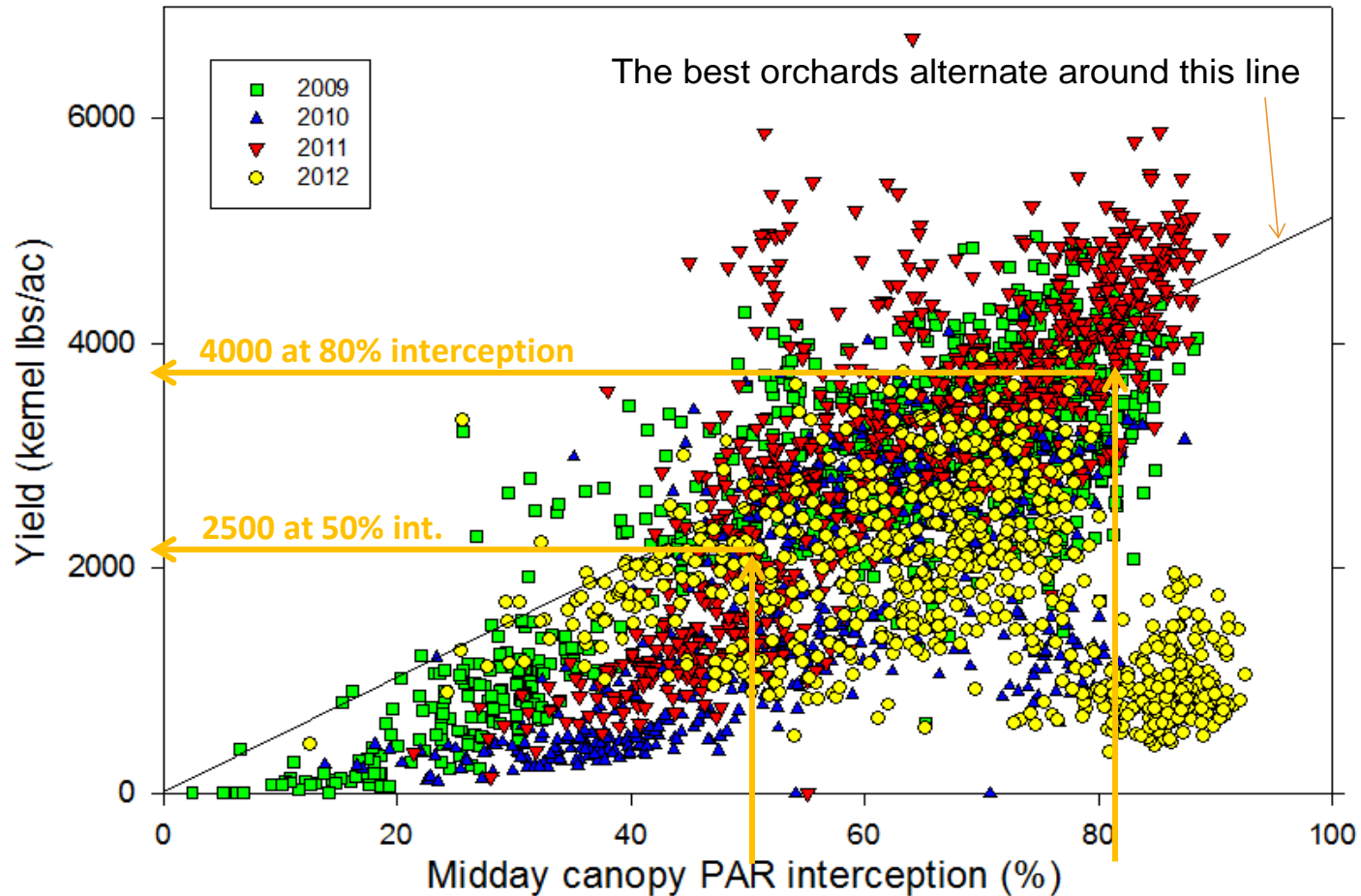
All almond light bar sites 2009-2012 data



Reminder- PAR = photosynthetically active radiation

Determining Water Needs

All almond light bar sites 2009-2012 data

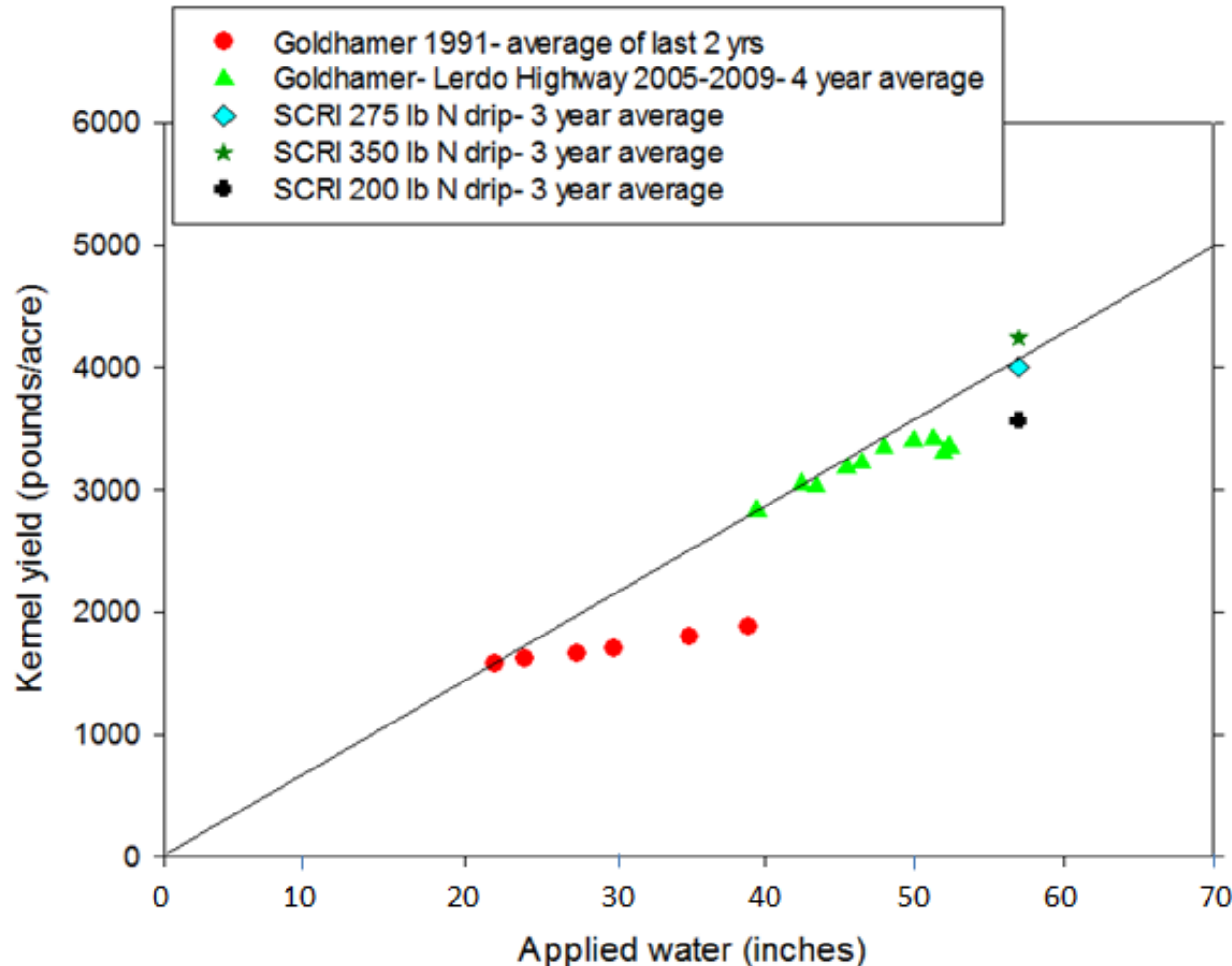


Yield potential is 50 kernel pounds per 1% of total incoming PAR intercepted by the canopy^{B. Lampinen}

Determining Water Needs

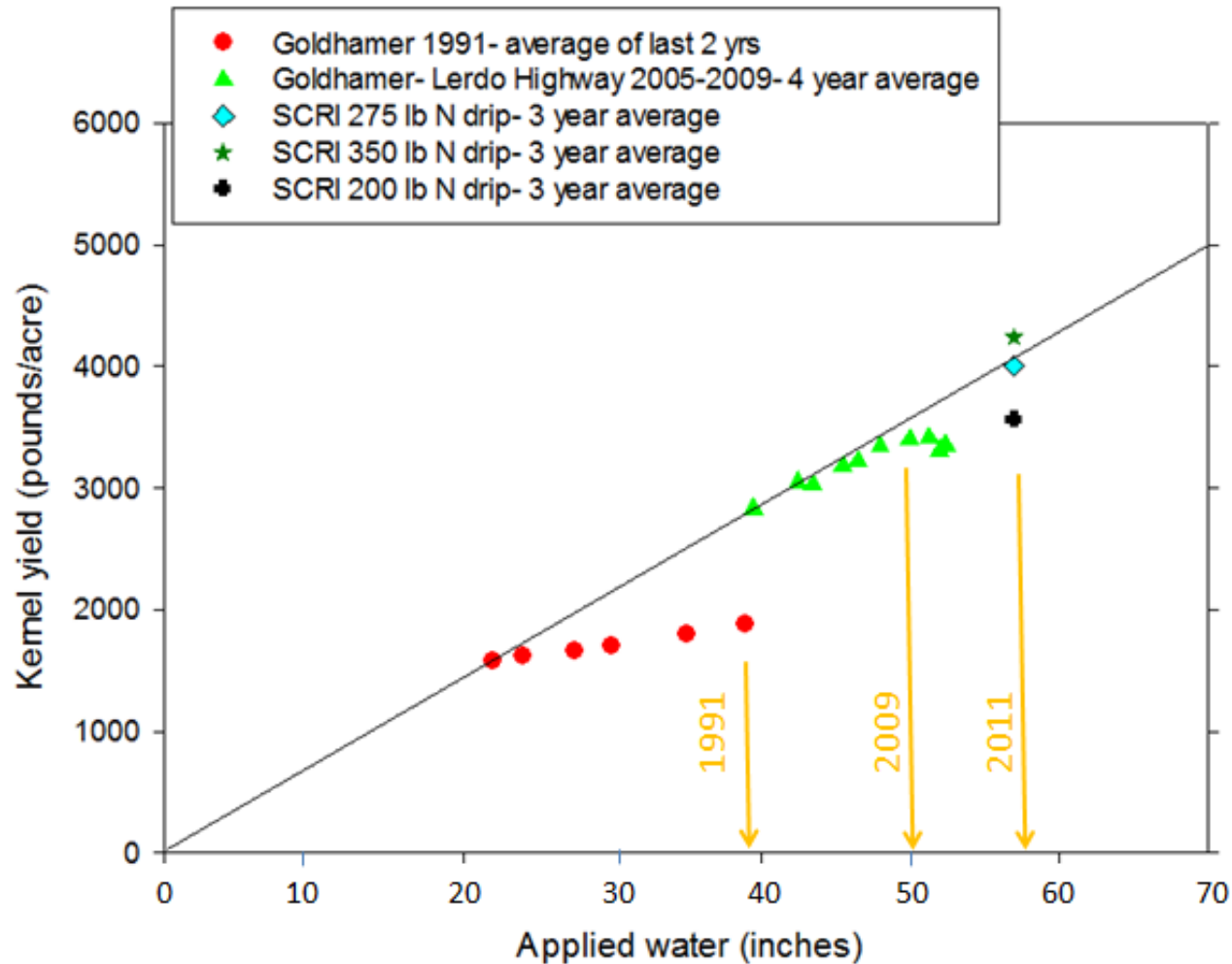
Multiple year yield results for different levels of water application

If we consider the three trials that have 2-4 year average yield versus applied water data



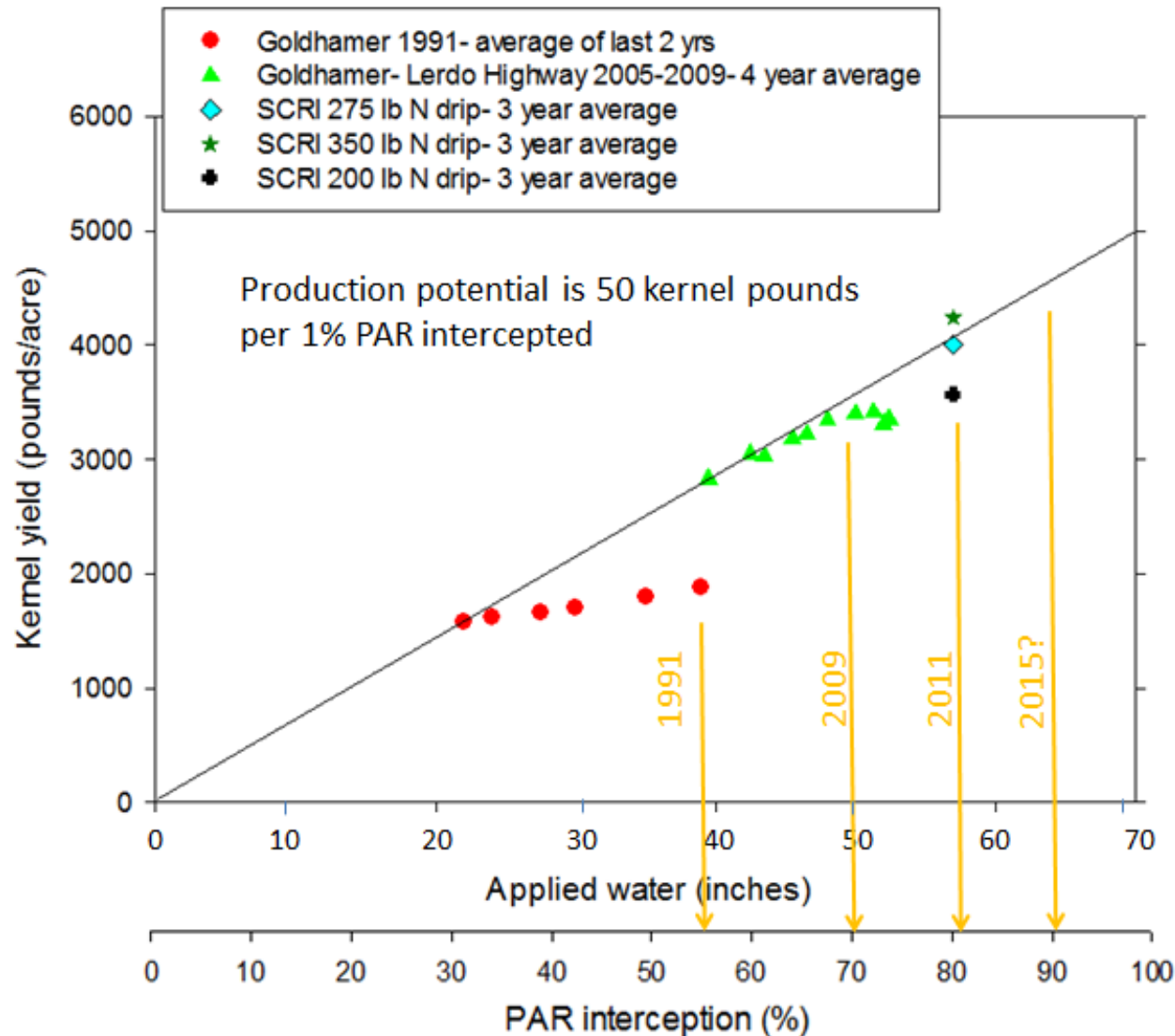
Determining Water Needs

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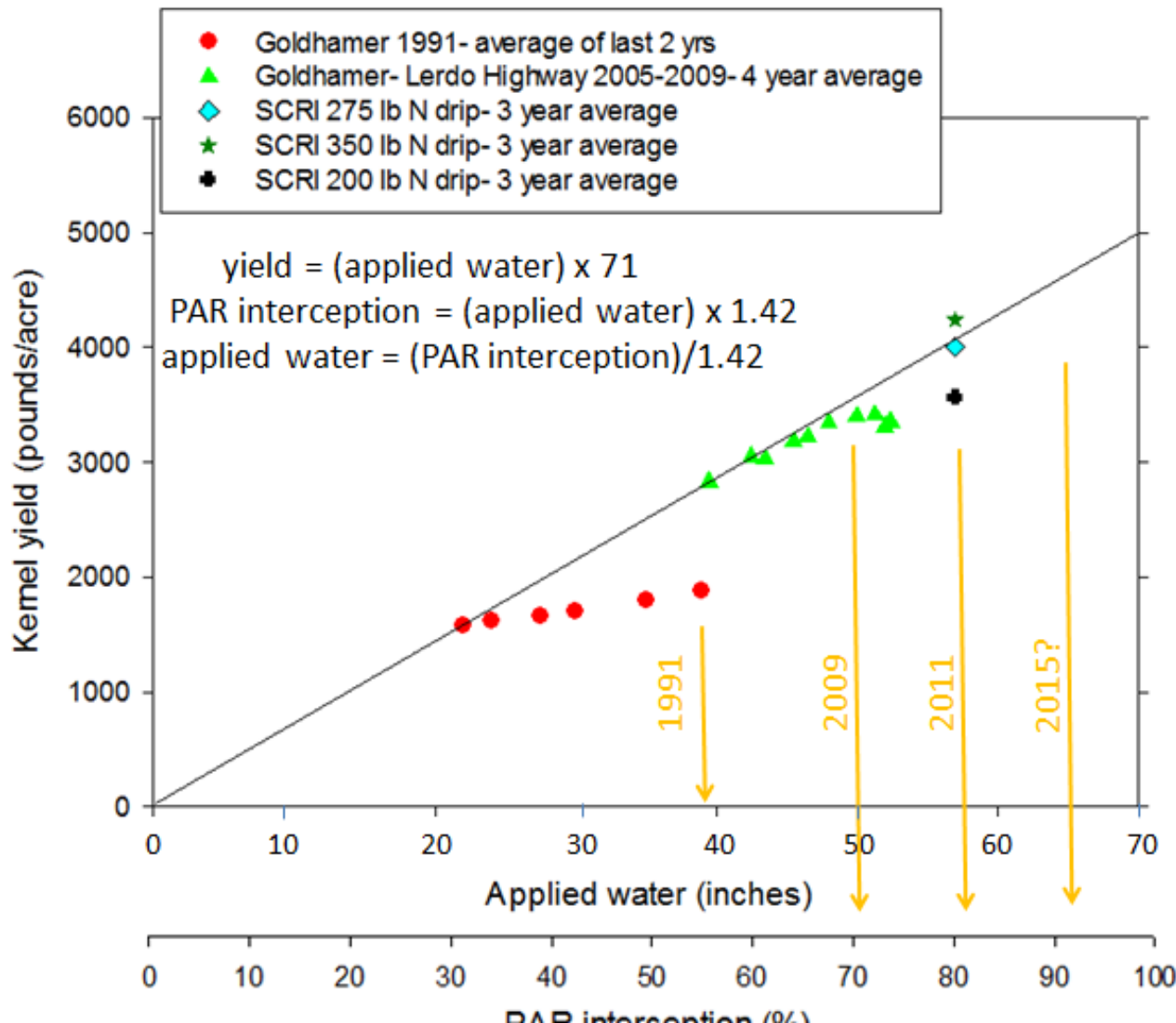
Determining Water Needs

If we consider the three trials that have 2-4 year average yield versus applied water data



Determining Water Needs

If we consider the three trials that have 2-4 year average yield versus applied water data



Determining Water Needs

midday PAR/1.42 = applied water

applied water x 71 = yield potential

PAR interception/142 = applied water

Midday PAR interception	Applied water (inches)	Yield potential (kernel lbs/ac)
10	7	500
20	14	1000
30	21	1500
40	28	2000
50	35	2500
60	42	3000
70	49	3500
80	56	4000
90	63	4500

Determining Water Needs



35%+ PAR interception
Needs ~25" of water

Determining Water Needs



80%+ PAR interception
Minimal to no pruning
Needs ~57" of water

Applying the Water

2 Strategies:

0-15% reduction:

Strategic Deficit Irrigation:

applied during June/Hullsplit period

16% or greater reduction:

Proportional Deficit Irrigation:

Apply available water at the percentage of available ETC evenly through the season

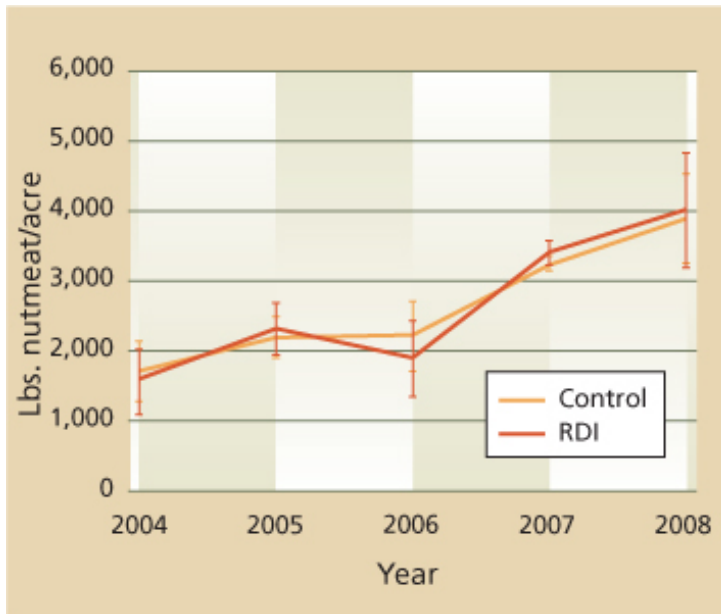
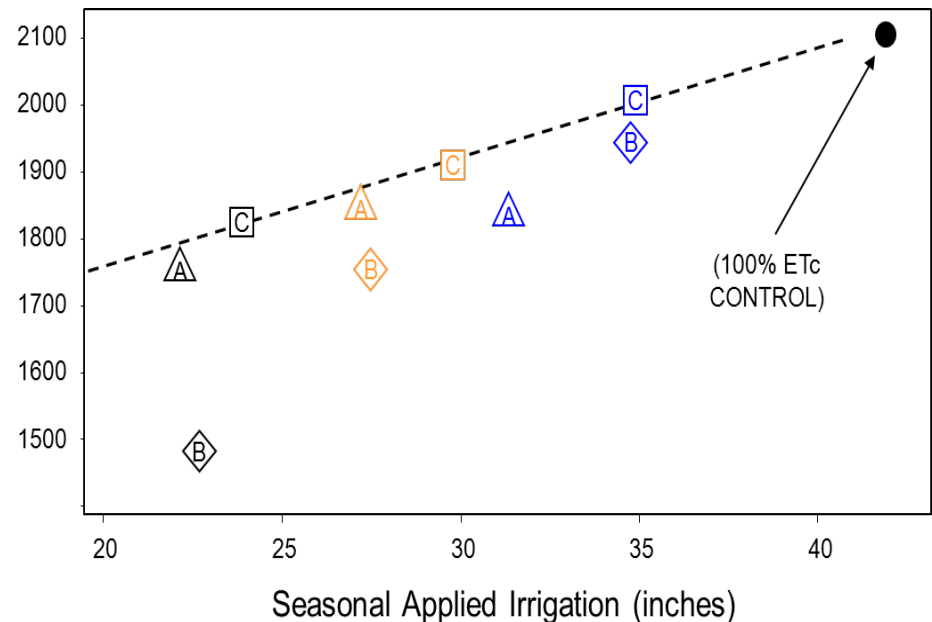


Fig. 1. Annual pattern of nutmeat yield, 2004–2008. Error bars are ± 2 SE.



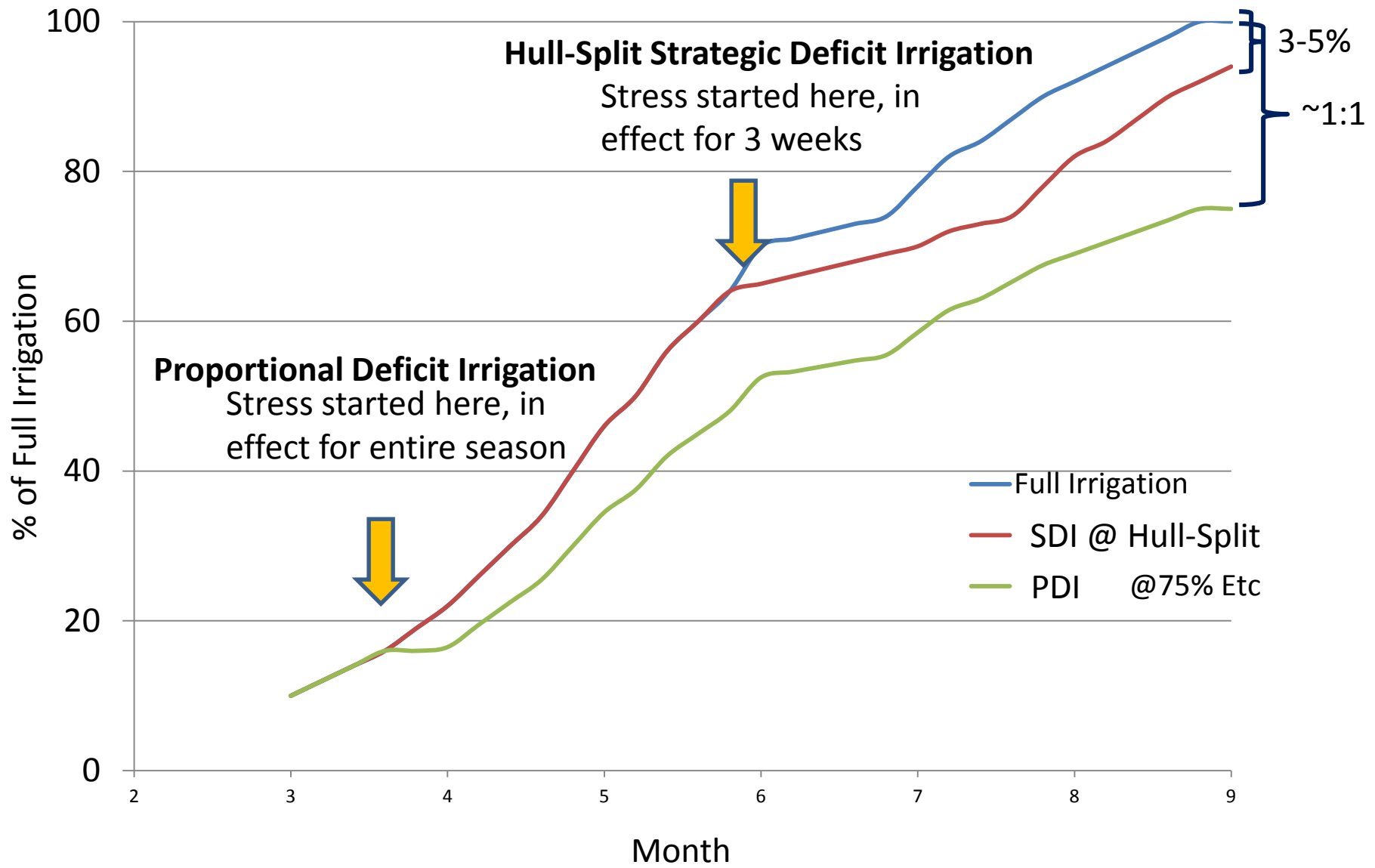
(Goldhamer et al., 2006)

Applying the Water

		Full Irrigation Zone 12 ⁴			SDI Zone 12		PDI@75% Zone 12		PDI@55% Zone 12	
Month	Kc ³	ET _o	Etc	Amount Applied	% of Full Etc	Amount Applied (in)	% of Full Etc	Amount Applied (in)	% of Full Etc	Amount Applied (in)
Jan	0.4	1.24	0.5							
Feb	0.41	1.96	0.81							
Mar	0.62	3.41	2.11	1.6	100	1.6	75	1.2	55	0.9
Apr	0.8	5.1	4.09	4.09	100	4.1	75	3.1	55	2.2
May	0.94	6.82	6.44	6.44	100	6.4	75	4.8	55	3.5
Jun	1.05	7.8	8.2	8.2	60 *	4.9	75	6.2	55	4.5
Jul	1.11	8.06	8.93	8.93	80*	7.2	75	6.7	55	4.9
Aug	1.11	7.13	7.9	7.9	100	7.9	75	5.9	55	4.3
Sep	1.06	5.4	5.73	5.73	100	5.7	75	4.3	55	3.2
Oct	0.92	3.72	3.41	3.41	100	3.4	75	2.6	55	1.9
Nov	0.69	1.8	1.23							
Dec	0.43	0.93	0.4							
Total (in)			49.73	46.3	89%	41.2	75%	34.8	55%	25.4

*Irrigations are cut varied on tree stress. Most start off as a 50% reduction 2 weeks prior to Hull-Split in mid-June. Stress is applied for 3-4 weeks.

Applying the Water: Strategies Explained

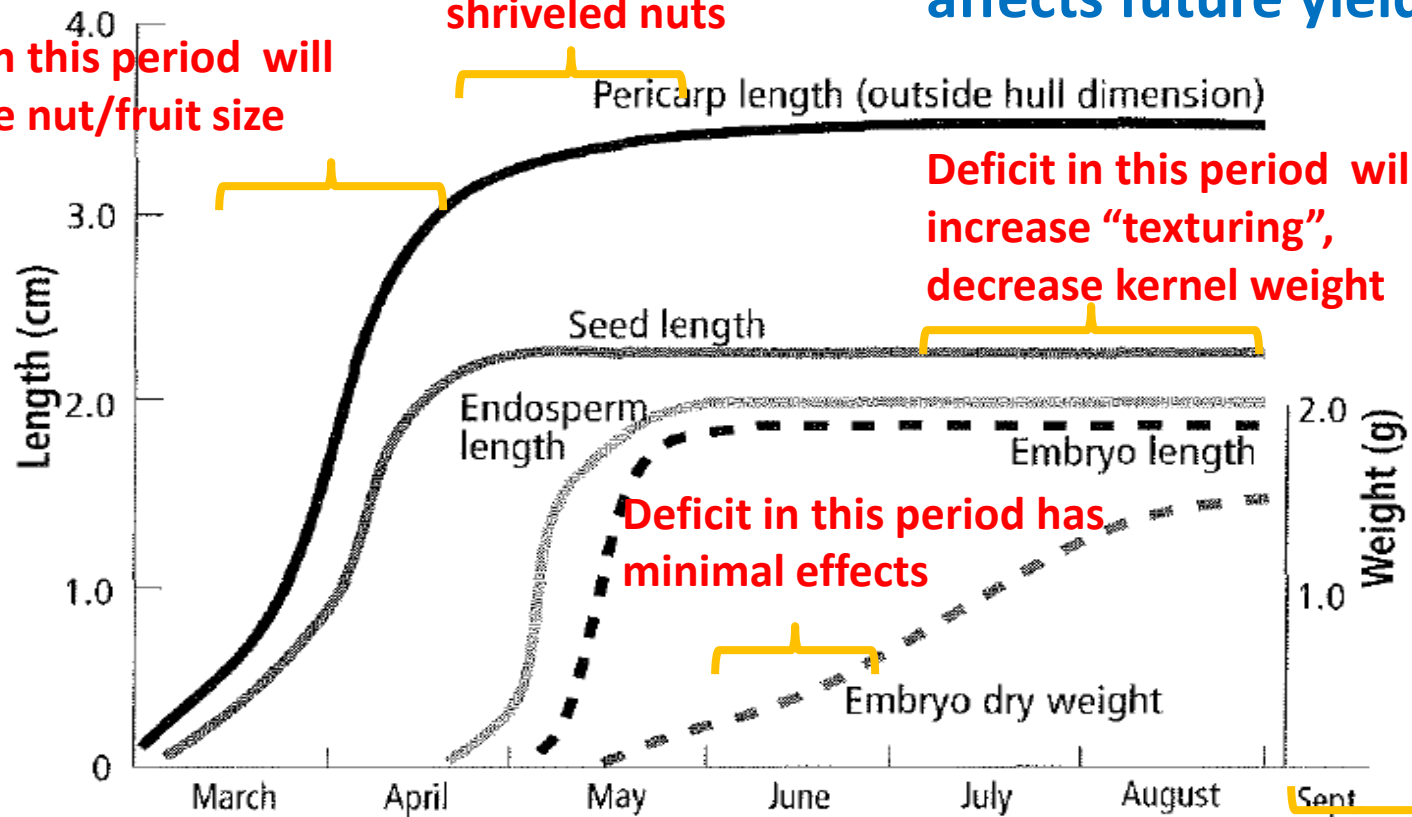


Applying the Water: Strategies Explained

Stress at any period reduces vegetative growth, affects future yield!

Severe Deficit in this period will increase shriveled nuts

Deficit in this period will decrease nut/fruit size



Deficit in this period will increase "texturing", decrease kernel weight

Deficit in this period has minimal effects

Deficit in this period effects fruit bud set

Applying the Water: Incorrectly Applied

Full Irrigation Respective to
Orchard Canopy
(~44" applied)



Normal:
15 nuts/18 grams
Marketable

Full Irrigation until June,
ran out of water – (~22"
applied, 50% Deficit)



Normal Size/Shriveled:
15 nuts/13.5 grams
Reduced Marketability

50% Proportional Deficit–
(~22" applied, 50% Deficit)



Small Size/ Not Shriveled:
15 nuts/12.5 grams
Marketable

Other Strategies to Conserve Water



Resident or planted groundcover uses 20-30% more water!



Chemically Mow: Ground cover will use any stored soil moisture

Trade off with soil compaction

Other Strategies to Conserve Water



Most systems start declining in performance after the first few years

Lack of annual maintenance

A 70% DU takes 22% more water to adequately irrigate than 90% DU

Reduced Field variability, “hotspots”

Guidelines for DU Testing:

<http://micromaintain.ucanr.edu/>

Other Strategies to Conserve Water



Exposed soil surfaces, wind, and high temperatures increase evaporative losses.

Other Considerations for Drought

- Irrigation sets should be a minimum of 6 hours
- Insect Pressures: Stressed trees will flare mites, have earlier hull-spit
- Nitrogen rates should be reduced to match crop requirements
- A dormant leaching program should be considered – start in early December



Other Considerations for Drought

Salinity

- Wells have varying salinity levels
 - Established thresholds:

Salinity of:	Degree of Growth/Yield Reduction			
	Unit	None	Increasing	Severe
Avg. root zone ¹	dS/m	< 1.5	1.5 – 4.8	> 4.8
Irrigation water ¹	dS/m	< 1.1	1.1 – 3.2	> 3.2

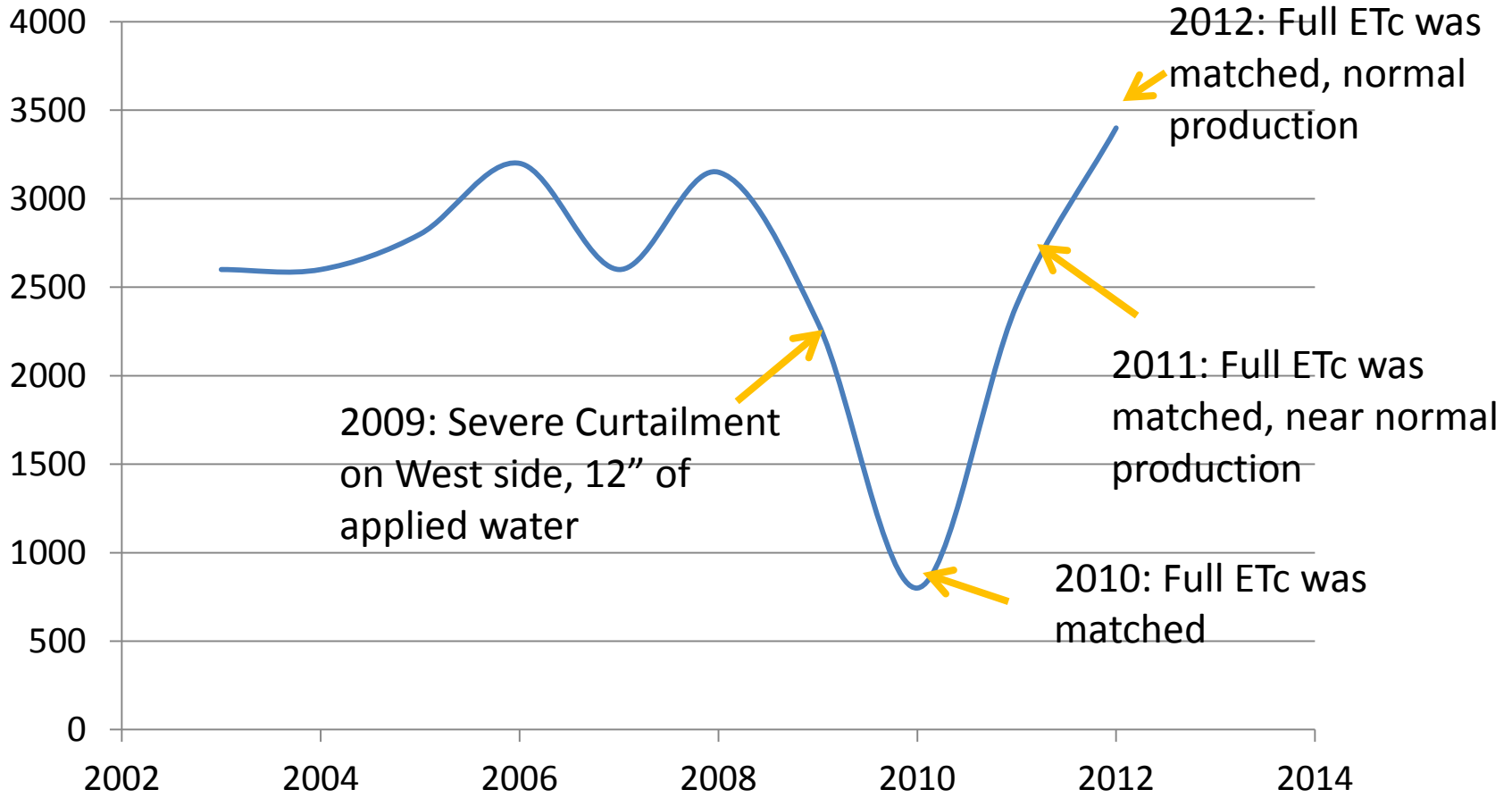
* Source: Adapted from E.V. Maas (1990), p. 280. Guidelines assume a 15 percent leaf

- “Buffering Capacity” of soils are different – expect salt injury more rapidly in LOW CEC soils
- Some water may be able to be modified to reduce SAR, pH
- Some water is just too hot to use
 - will kill trees and require reclamation



“Drought” Scenario - 2009

Mature Orchard near Firebaugh, 2003-2012



Severe Drought: Expectations

Growth and Yield will be Impacted:

- Reduction of kernel weights from current seasons deficit
- Reduction of growth and bud development reduces next year's crop
- Results will be compounded if deficit is continued

Recovery will be slow:

- Yields will take two years at full irrigation to recover.

Don't "Shoot Yourself in the Foot:"

- Plan the season's water allocation using SDI or PDI
- Be careful with too salty of water
- Try to apply a dormant leaching program