

Almond Irrigation, Water Stress and Productivity:




Where do Drought & Deficit Irrigation Research Fit In?

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December, 2007

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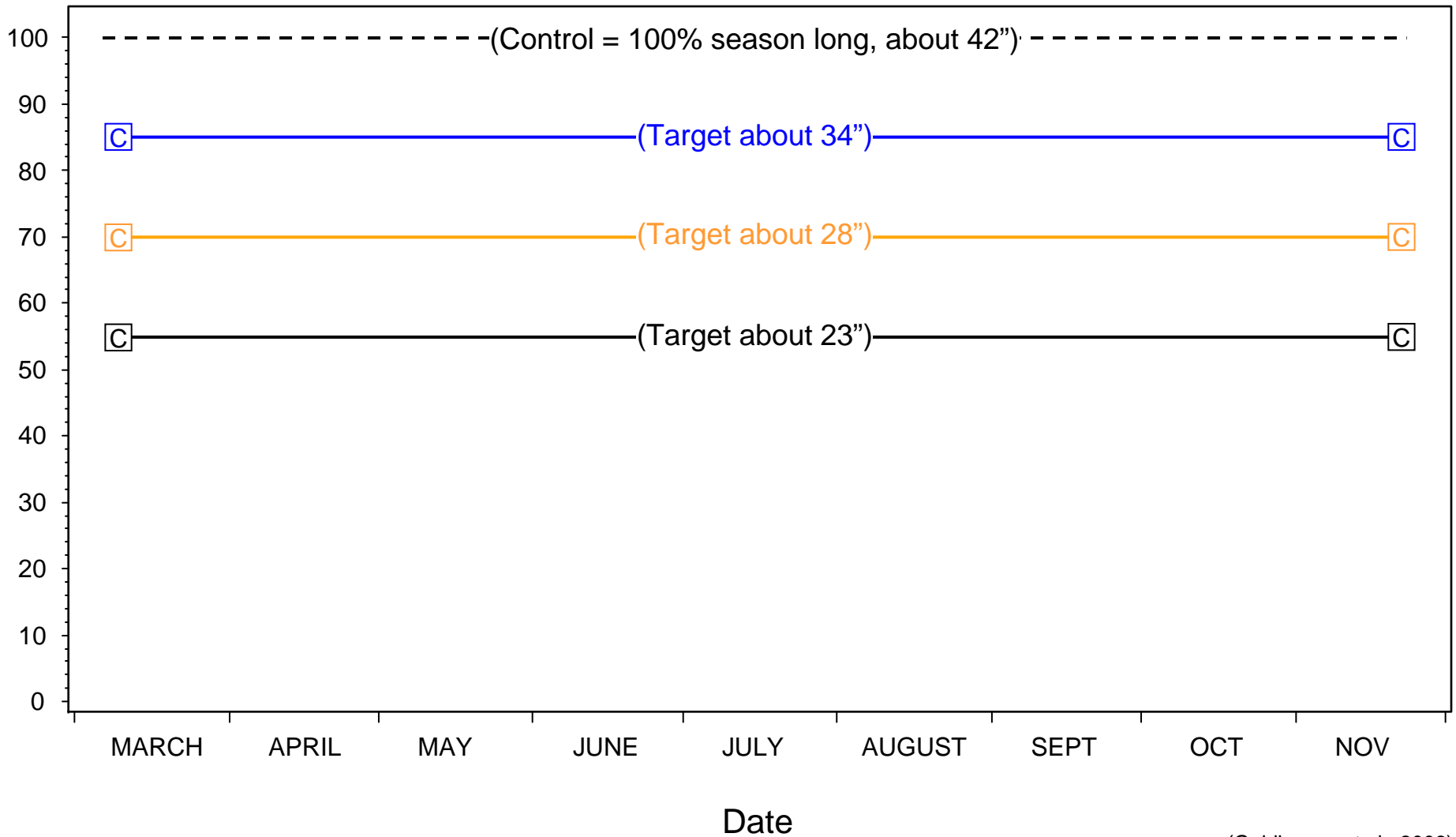
Regulated deficit irrigation in almonds: effects of variations in applied water and stress timing on yield and yield components

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- 1993 -1996 study, Southern SJV, 18 year-old orchard
- Control (100% ET_c)
- 3 levels of irrigation deficit
- 3 patterns of deficit   

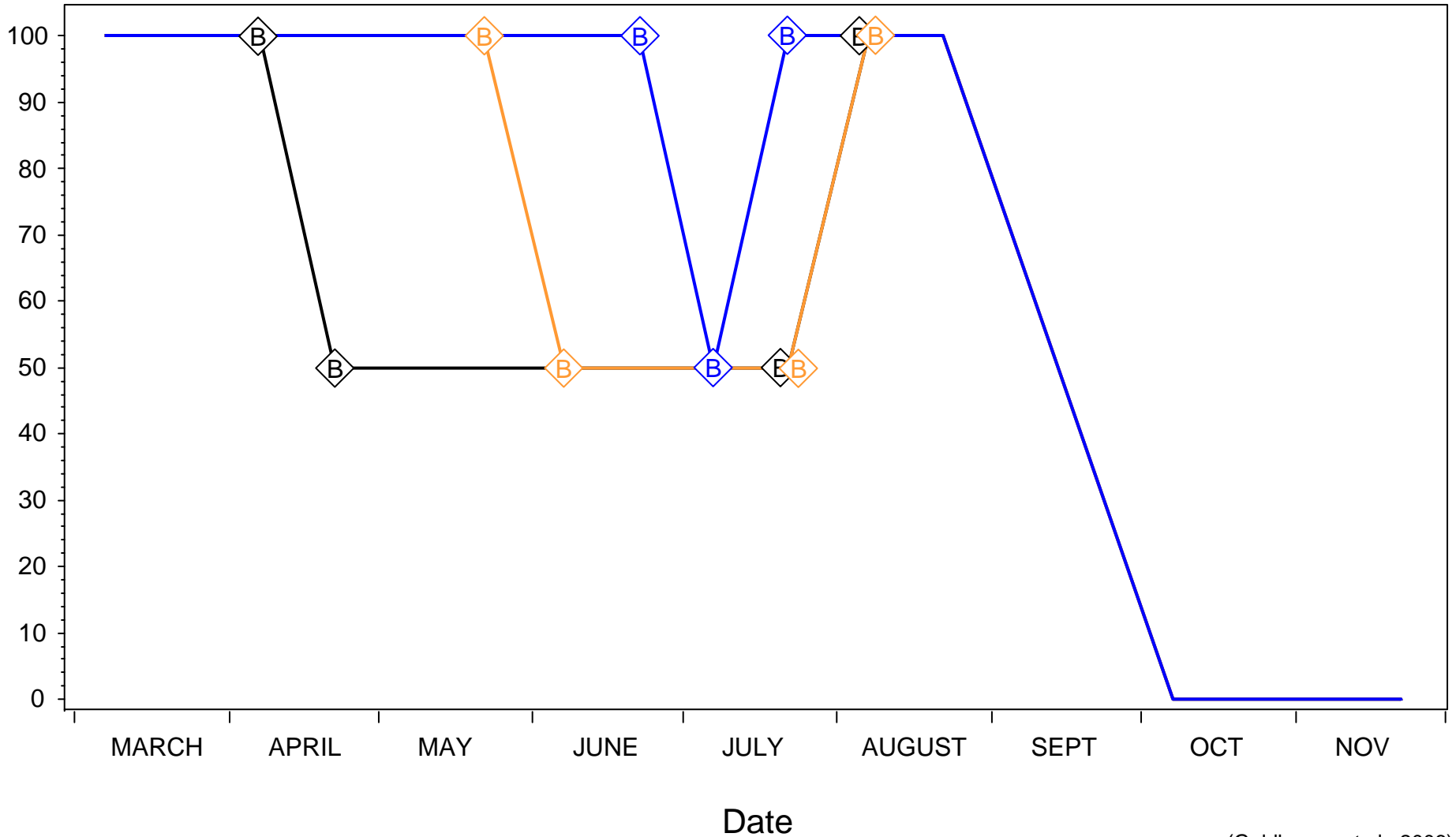
"C" Seasonal pattern in water application (% of control)

Equal irrigation deficit all season



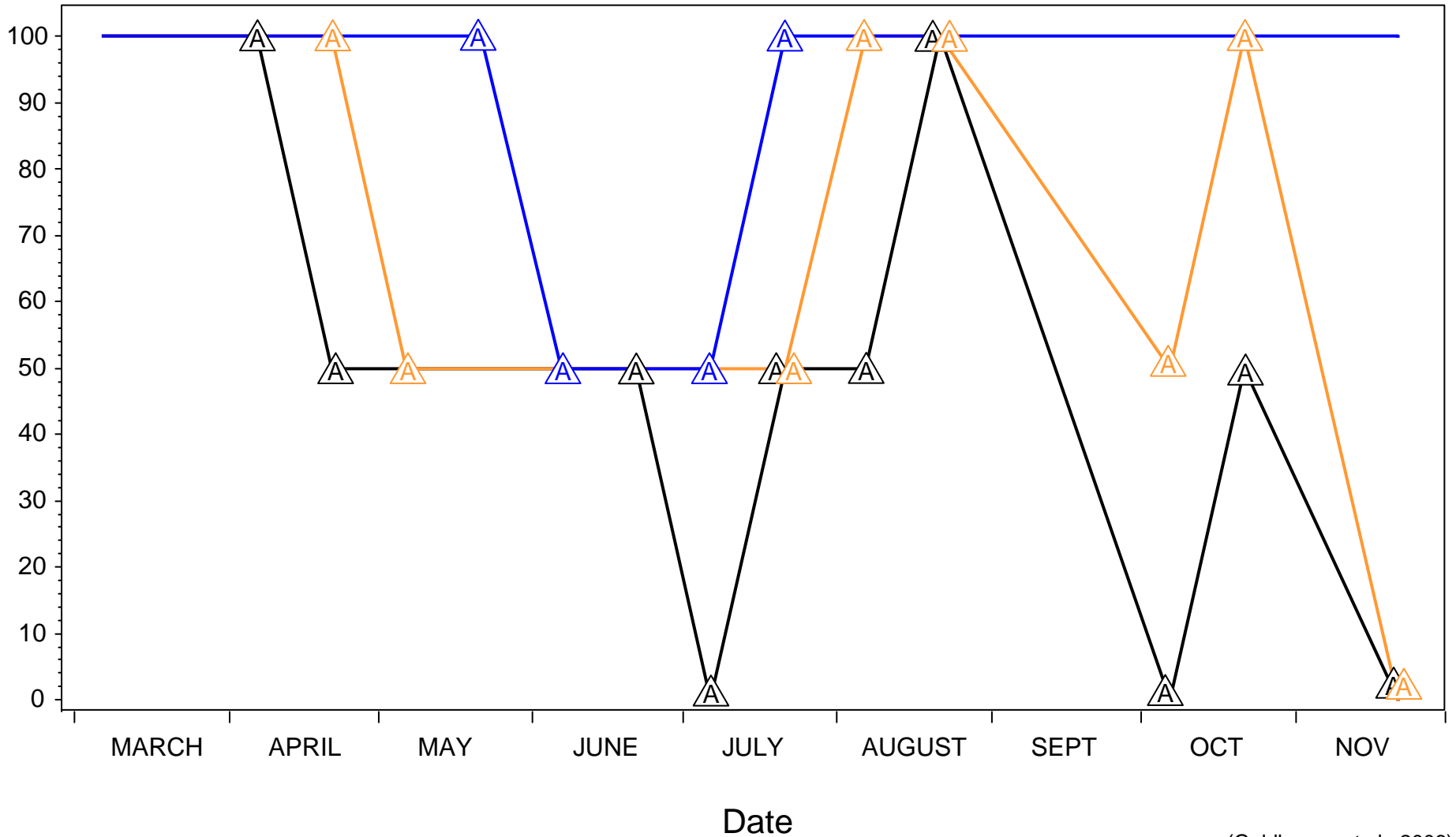
"B" Seasonal pattern in water application (% of control)

Some deficit early, most deficit post-harvest



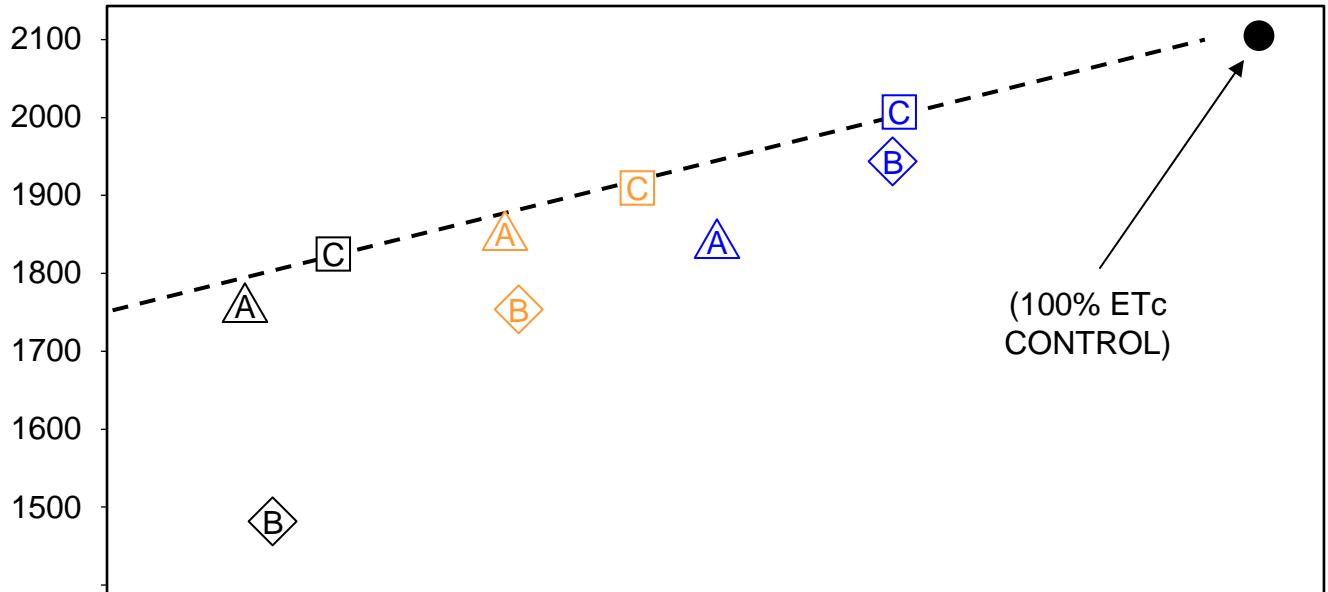
"C" Seasonal pattern in water application (% of control)

More deficit early, less deficit postharvest

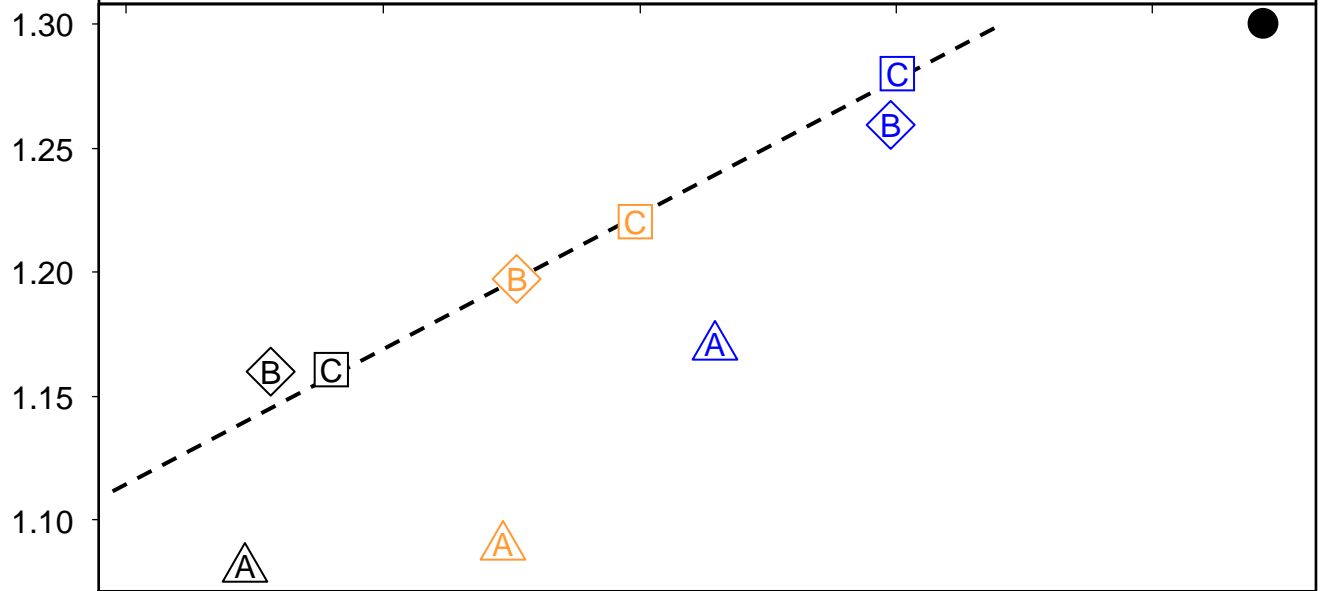


Mean Yield 1993-1996

Kernel
Yield
(lbs/ac)



Kernel Size
(g/nut)



20

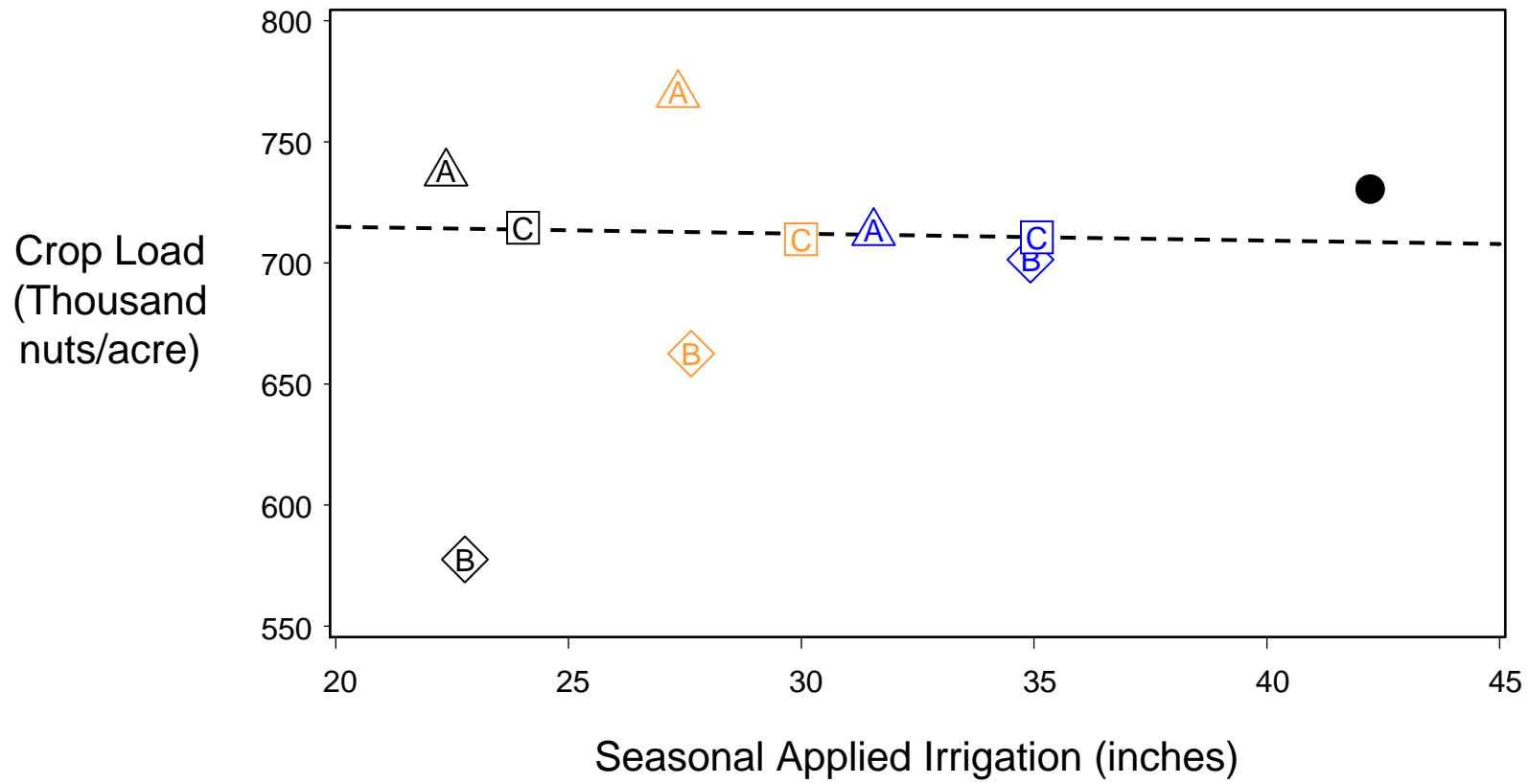
Seasonal Applied Irrigation (inches)

25

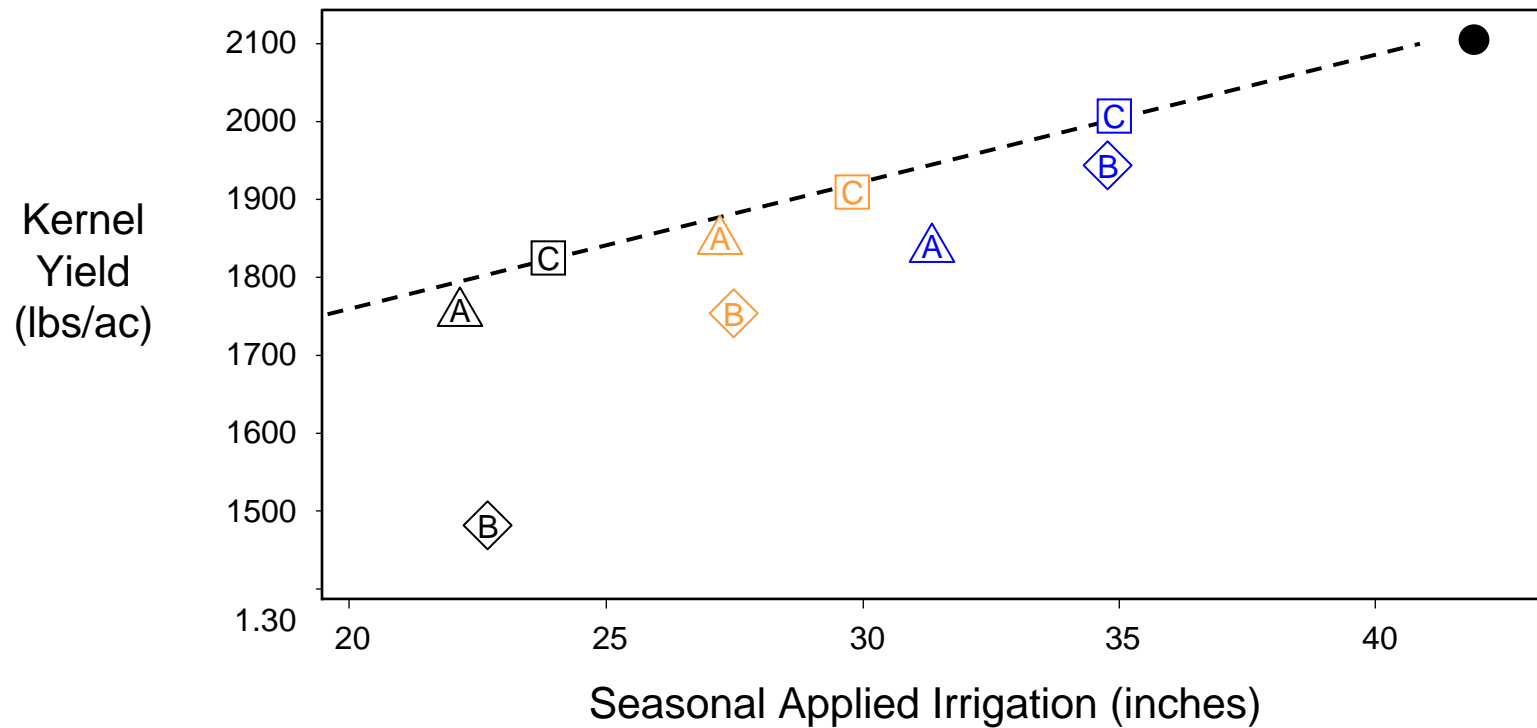
30

35

40

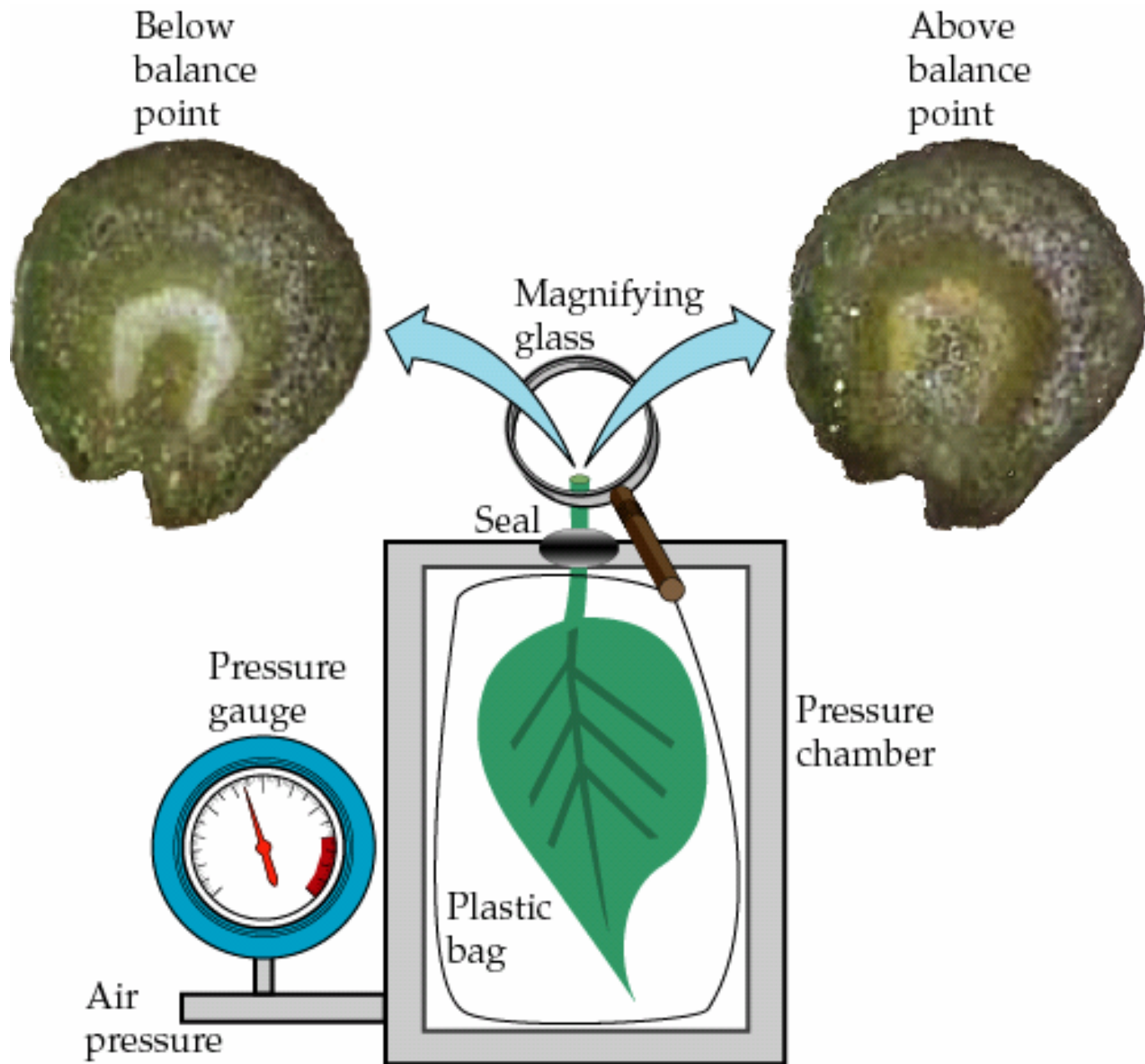


Question: is the amount and timing of irrigation all you need to know to describe the stress experienced by the tree?



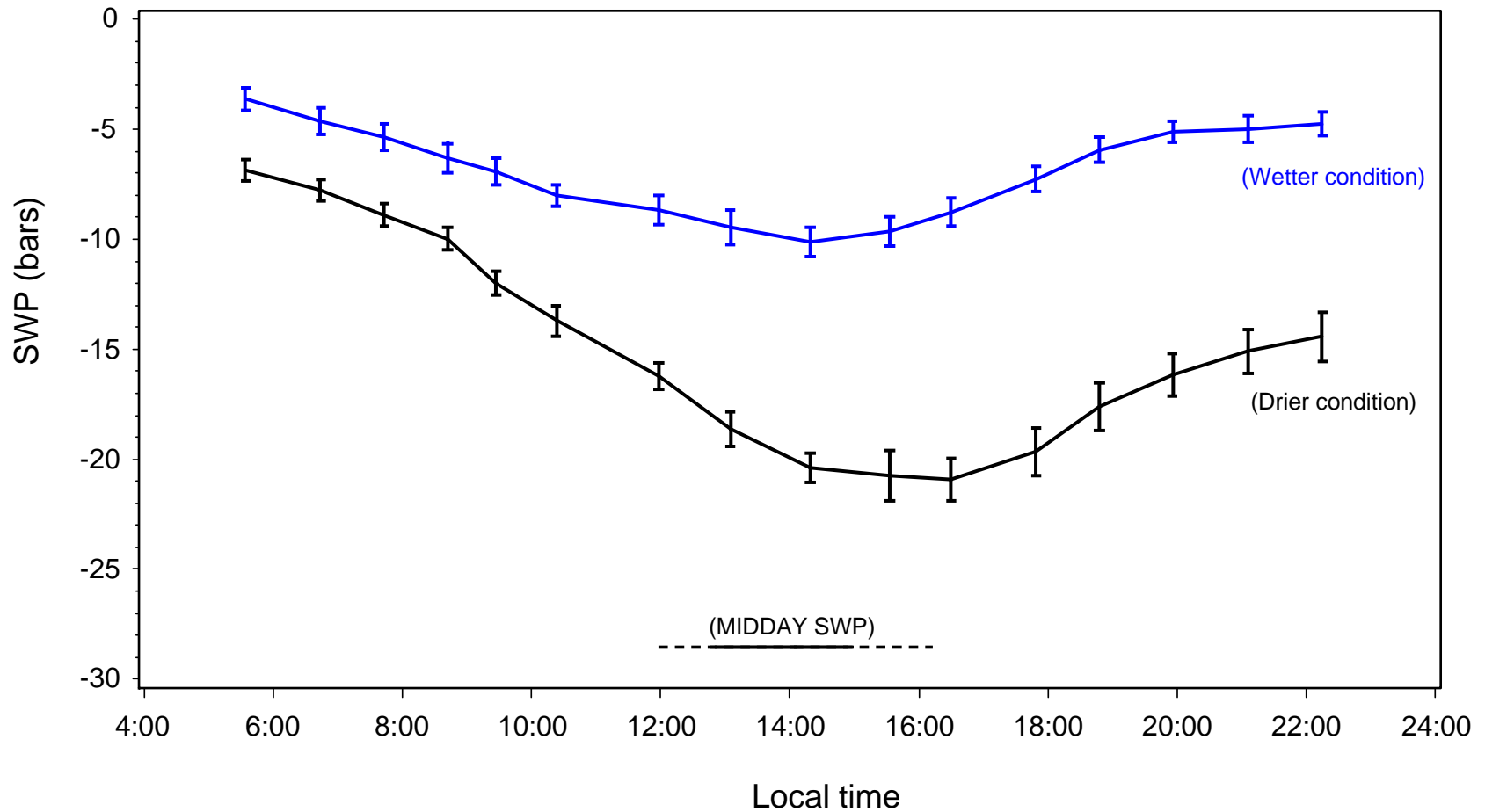
Answer:
probably not,
maybe better to
ask the tree?



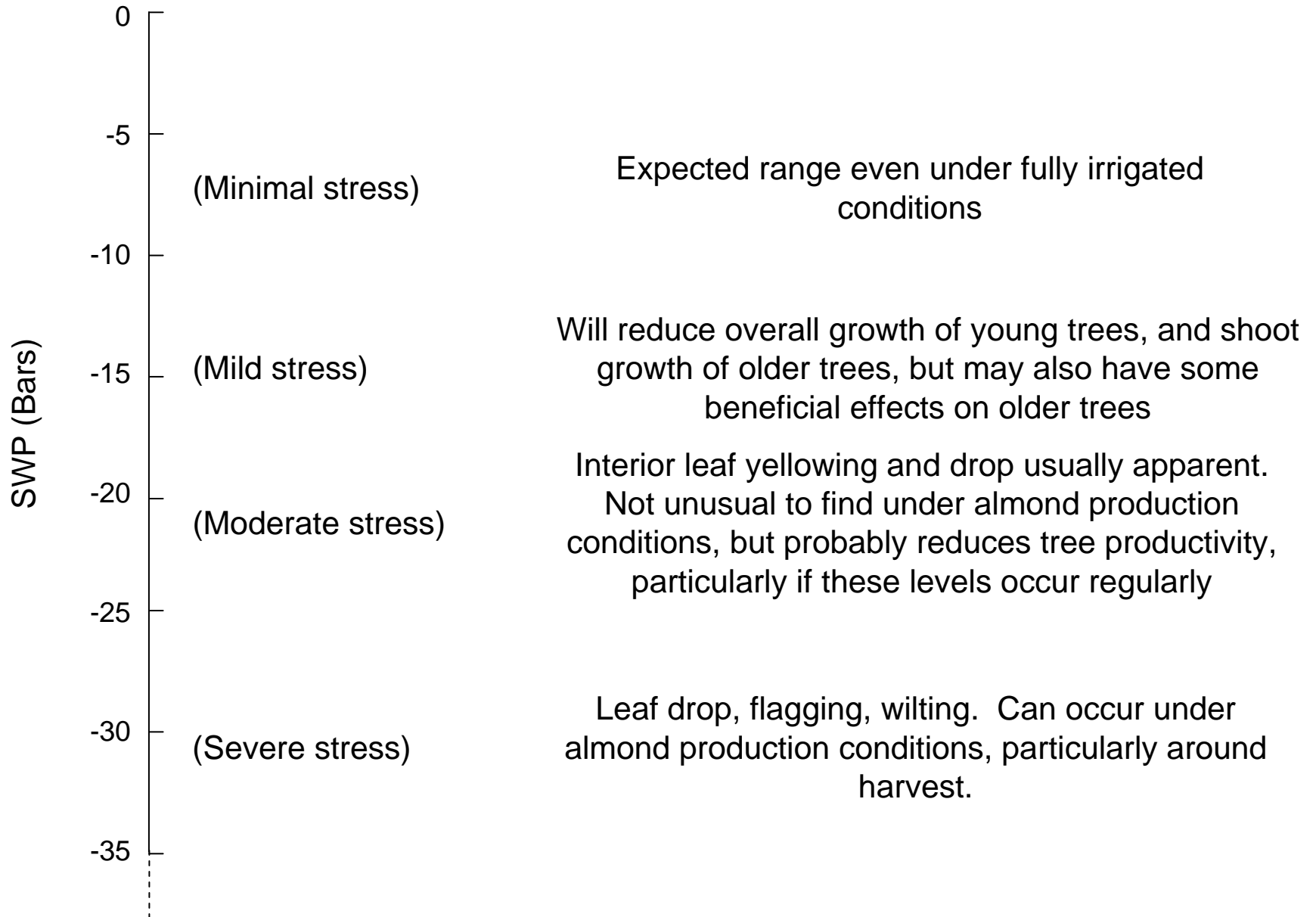


Example of the daily pattern in stem water potential (SWP) in Almonds

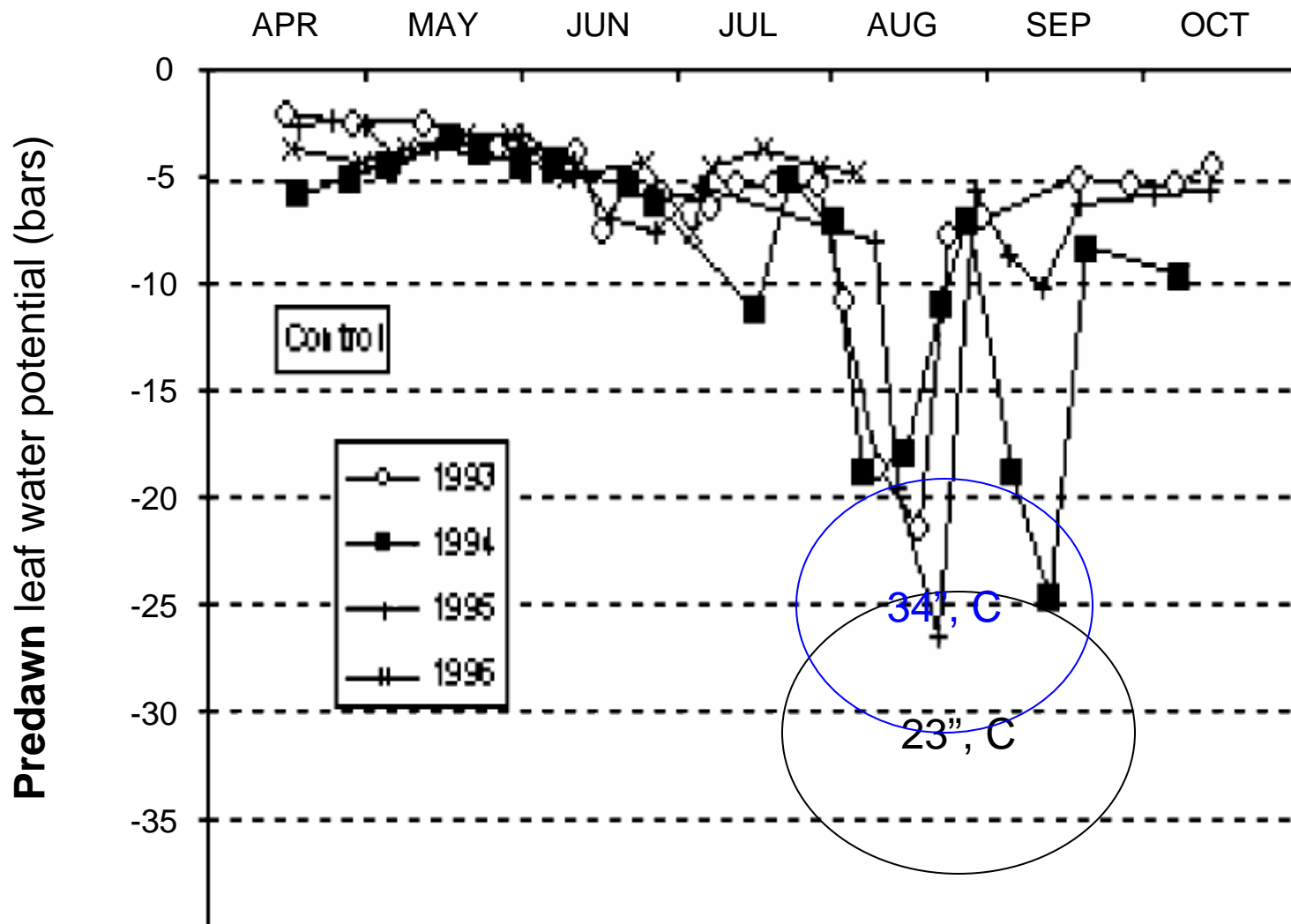
(Magnum ranch, Lassen Land Co., August 4, 2005)



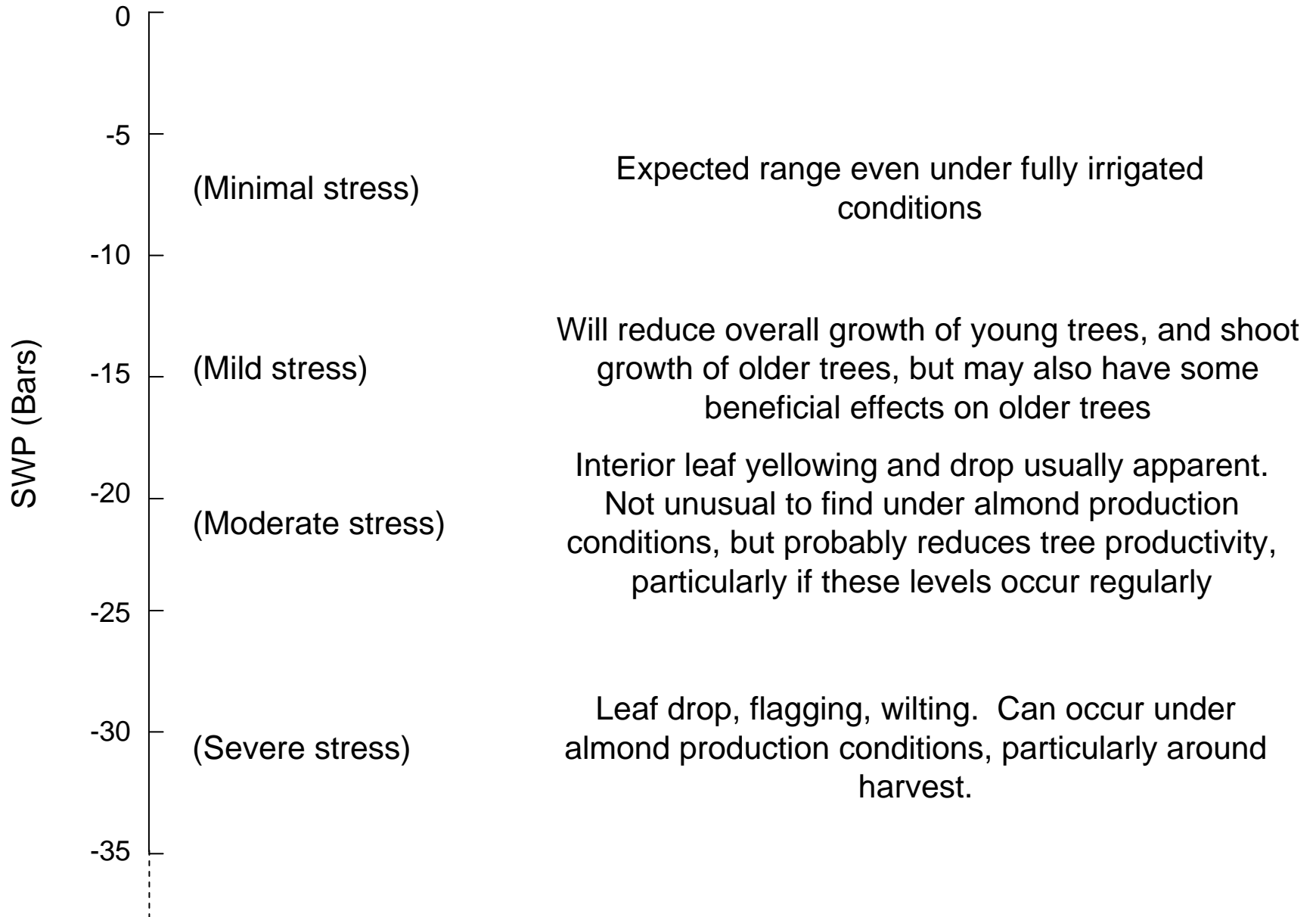
Midday SWP values in Almond



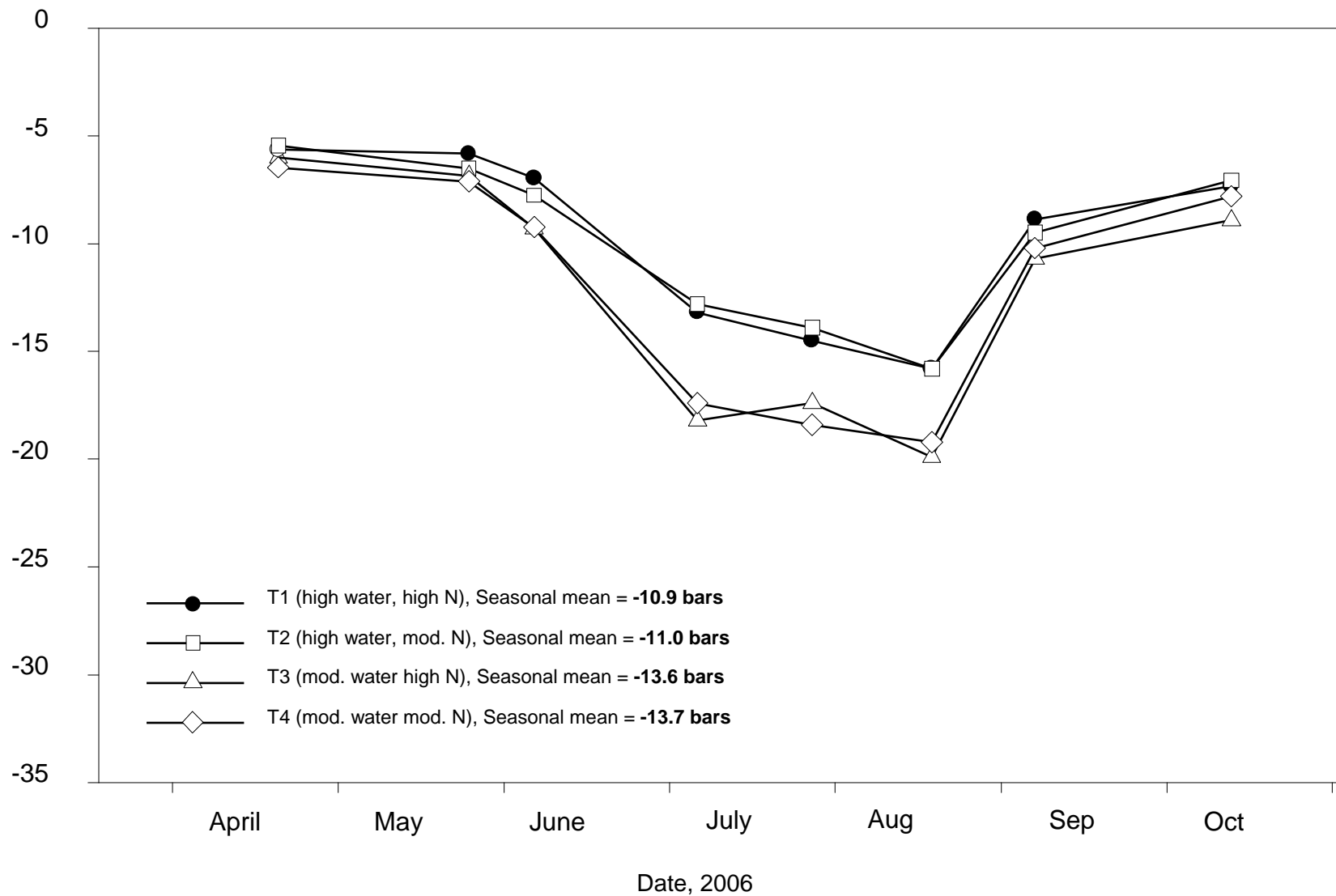
Goldhamer study, predawn water potential



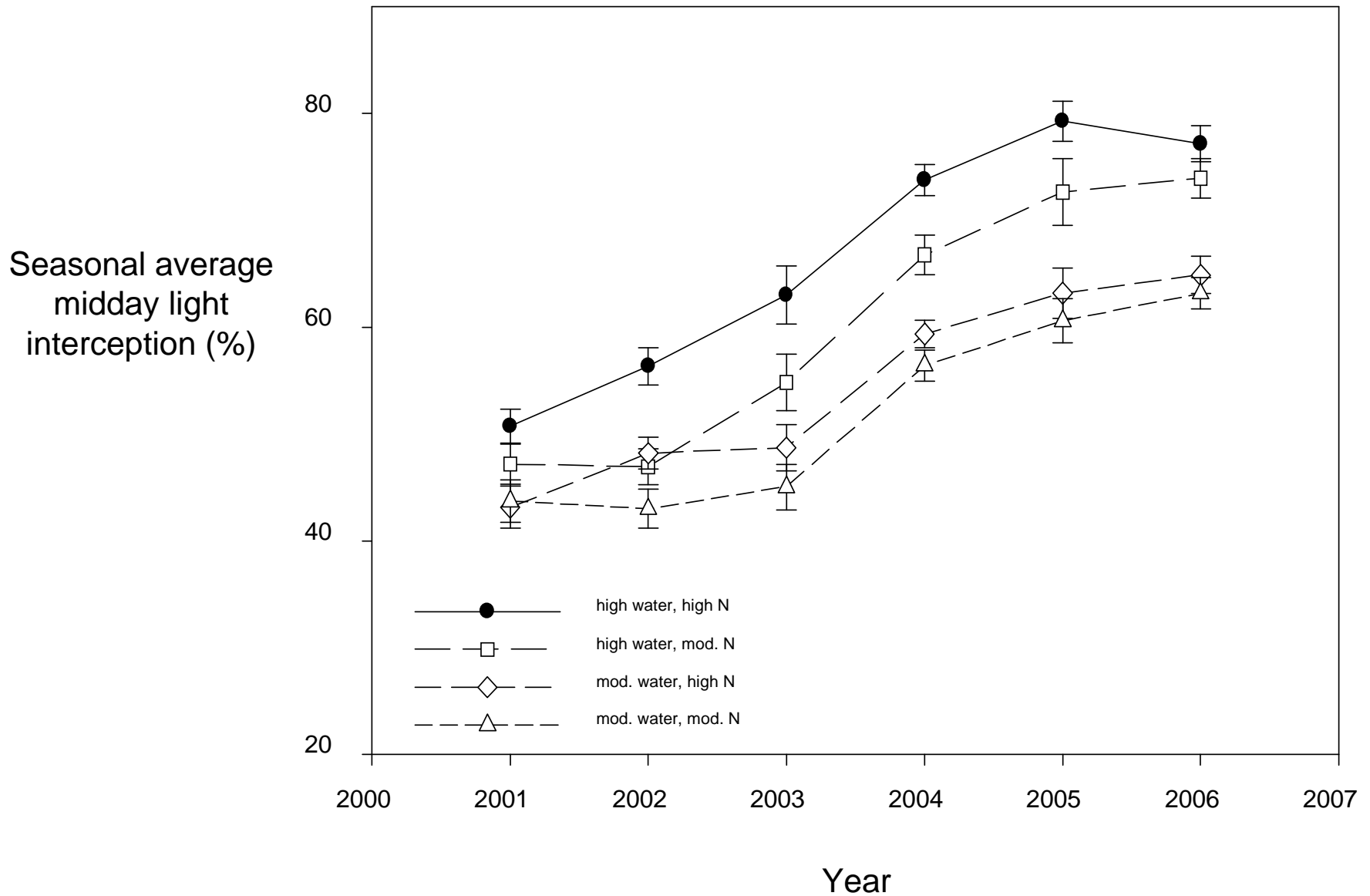
Midday SWP values in Almond



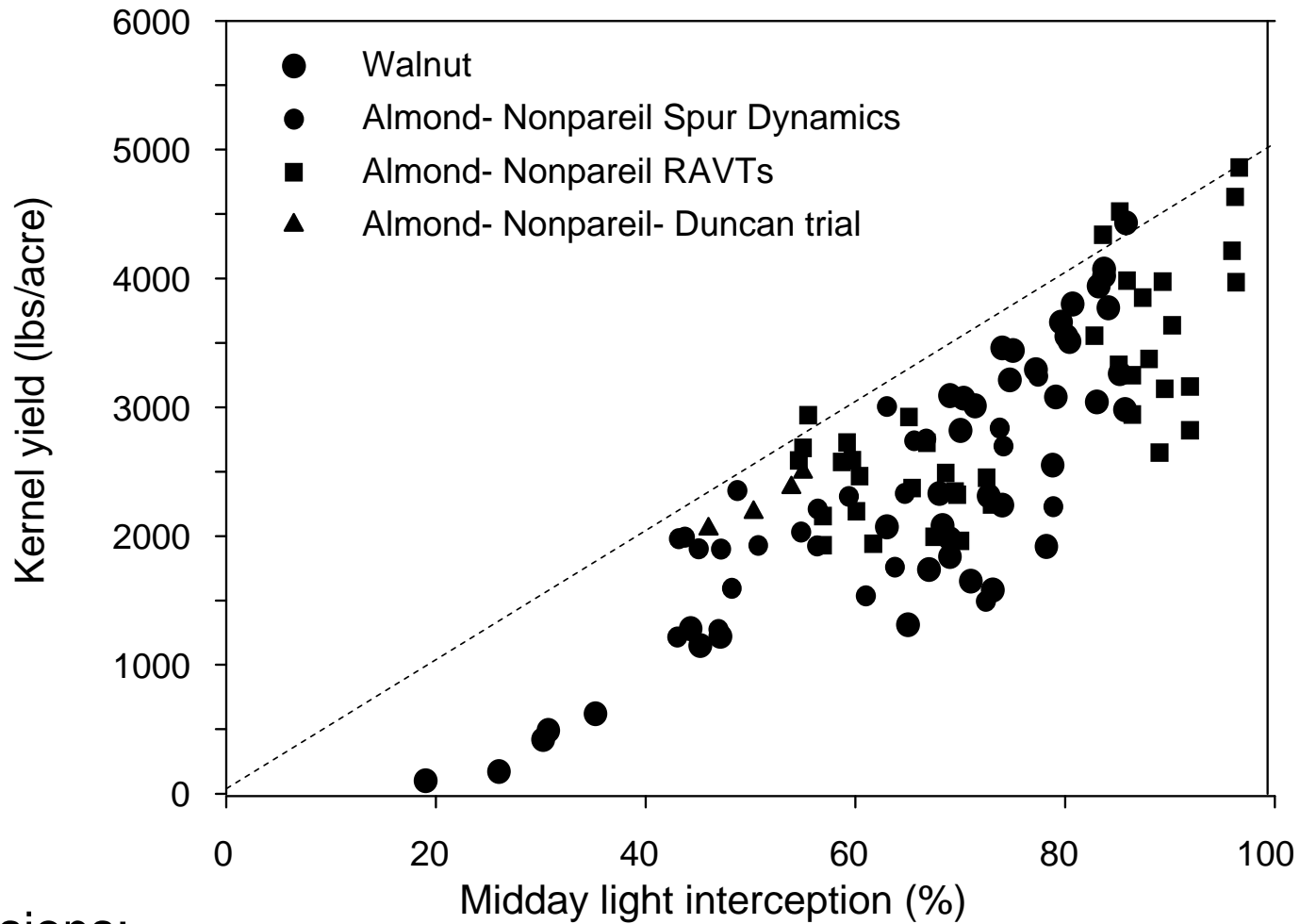
Example: **Midday** stem water potential (bars) in 2006,
Lampinen et al., Spur Dynamics



Lampinen study, canopy development (5th leaf – 11th leaf orchard)



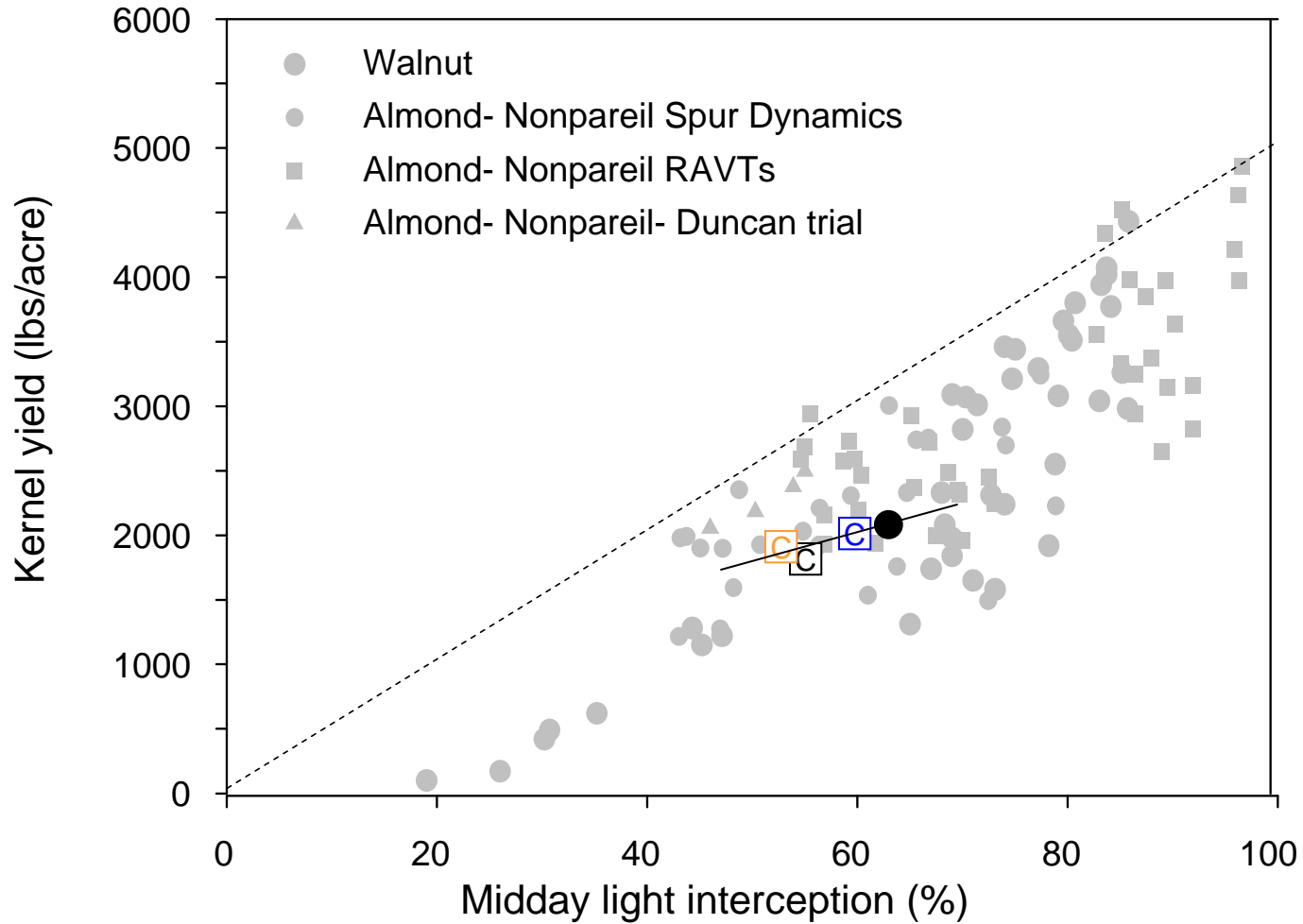
Midday light interception (%)



Conclusions:

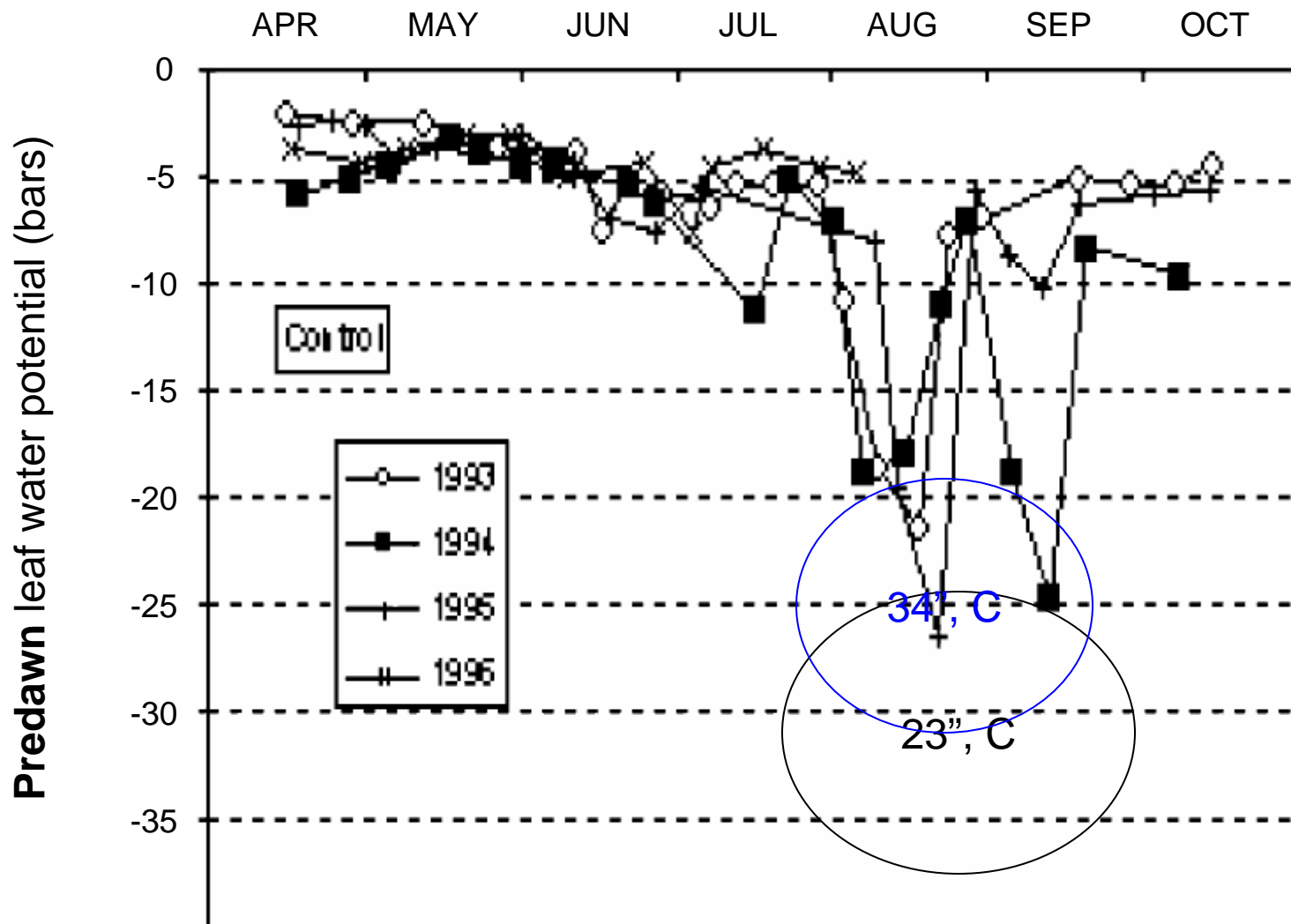
- Canopy development determines yield potential
- Approximately 10% loss in rate of canopy development per bar of seasonal average midday stem water potential deficit

Midday light interception (%)



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Goldhamer study, predawn water potential



Question: Is it possible that stress can be determined by factors other than irrigation amount and timing?

Answer: Yes – we have a good example of a non-uniform field that required substantial irrigation compensation to make it uniform.

Corning location

Farm Advisors: Allan Fulton, Rick Buchner

Grower: Brian Crane, Crane-Mills, Corning, CA

System: microsprinkler

Bomber: Cayle Little

(Almonds)

← EXPERIMENTAL PLOT

5-9-02

1:21600

TEHAMA CO.

11-Q

1 6 9 1

WILD 15/4 UAV



5-9-02

WEST
(gravel)

EAST
(silt)





% Hull Split, Carmel variety

(East/West difference similar in all varieties)

	Date, 2000					
	10 Aug	16 Aug	22 Aug	31 Aug	6 Sep	14 Sep
East (Average SWP = -8.4 bars)	0%	0%	5%	13%	32%	40%
West (Average SWP = -14.1 bars)	4%	23%	60%	83%	85%	91%

Problems with uneven hull split timing:

- Uncertain timing for hull split spray
- Irrigation management problems
- Uneven/delayed harvest

NonPareil variety (Corning) – Hull Split (RDI treatment)

2001:

East (silt)

Date	JUL 13	JUL 20	JUL 27	AUG 1	AUG 13
% HS	2	20	45	70	100

West (gravel)

Date	JUL 13	JUL 20	JUL 27	AUG 1	AUG 13
% HS	2	25	55	75	100

2003:

East (silt)

Date	JUL 29	AUG 7	AUG 15	AUG 22
% HS	29	96	100	100

West (gravel)

Date	JUL 29	AUG 7	AUG 15	AUG 22
% HS	29	88	100	100

Corning location –irrigation summary (RDI)

Soil	2002		2003		2004	
	Water applied	Cutoff date	Water applied	Cutoff date	Water applied	Cutback date
East (silt)	24"	10-Jul	14"	1-Jul	18"	7-Jun
West (gravel)	40"	25-Aug	41"	4-Sep	36"	16-Sep
ETc	43"		40"		42"	

Very long cutoff/cutback OK on East (silt) soil



2001 - 2004 Almond RDI sites:

County	Location	Soil type	Age (yr)	Irrigation
Tehama	Corning(E)	Silt-Loam	9	Microsprinkler
Tehama	Corning (W)	Gravel-Loam	9	Microsprinkler
Butte	Chico	Vina-Loam	9	Solid-set Sprinkler
Colusa	Arbuckle	Gravel-Loam (II)	13	Single line drip
Solano	Dixon	Yolo-S/CLoam	8	Solid-set Sprinkler
Madera	Madera	Dinuba FSL	10	Microsprinkler
Kern	Shafter	Sandy Loam	15	Microsprinkler

Question: Can we use RDI in the same location(s) over many years without reducing yield?

Four year yield summary

(lbs. nutmeats per acre)

	2001	2002	2003	2004
<u>Treatment</u>	<u>(2 sites)</u>	<u>(7 sites)</u>	<u>(7 sites)</u>	<u>(7 sites)</u>
Grower	2,400	3,170	2,860	2,650
RDI	2,430	3,080	2,660	2,680

**Selected sites where differences in stress
only occurred during hull split
(15 “paired” comparisons)**

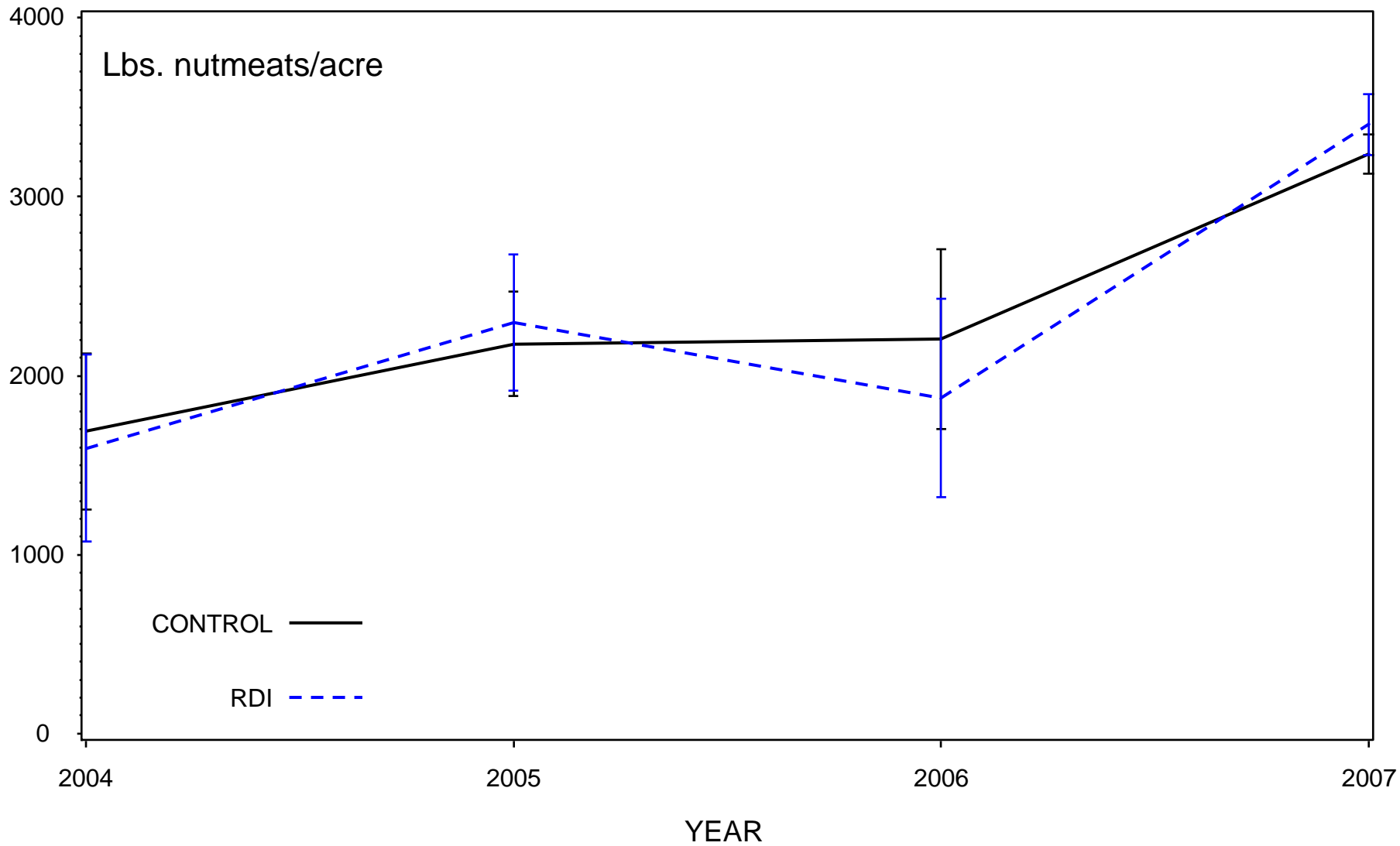
<u>(Measured Value)</u>	<u>Irrigation Treatment</u>	
	<u>Grower</u>	<u>RDI</u>
SWP (bar)	-11.1 ± 1.7	-14.7 ± 2.1
Yield (lbs/ac)	2,812 ± 787	2,858 ± 751
Nut Size (g)	1.22 ± 0.19	1.21 ± 0.20

Four year (2001 – 2004) harvest effects summary

Location	Hull rot (strikes/tree)		Days RDI advance in HS	Other effects
	Grower	RDI		
Corning (silt)	0.0	0.0	5	
Corning (gravel)	0.0	0.0	6	
Chico	1.1	2.2	0	
Arbuckle	0.0	0.0	0	
Dixon	4.4	2.4	1	60% mummy reduction, '02
Madera	20.1	5.1	4	Grower required 2 shakes, '02
Kern	24.0	17.5	0	50% sticktight reduction, '03, '04

Magnum Ranch, Lassen Land co. RDI study.

Nutmeat yields, 2004 - 2007



Benefits of RDI (mild stress)
for almonds during hull split:

- 1) Speed up Hull Split (use water as a management tool)
- 2) Reduce Hull rot
- 3) Reduce Sticktights (Improve Harvestability)
- 4) Save Water
- 5) No negative impact on yield