

Water Use Requirements of Pistachio

Irrigation Scheduling

Regulated Deficit Irrigation

Drought Strategies

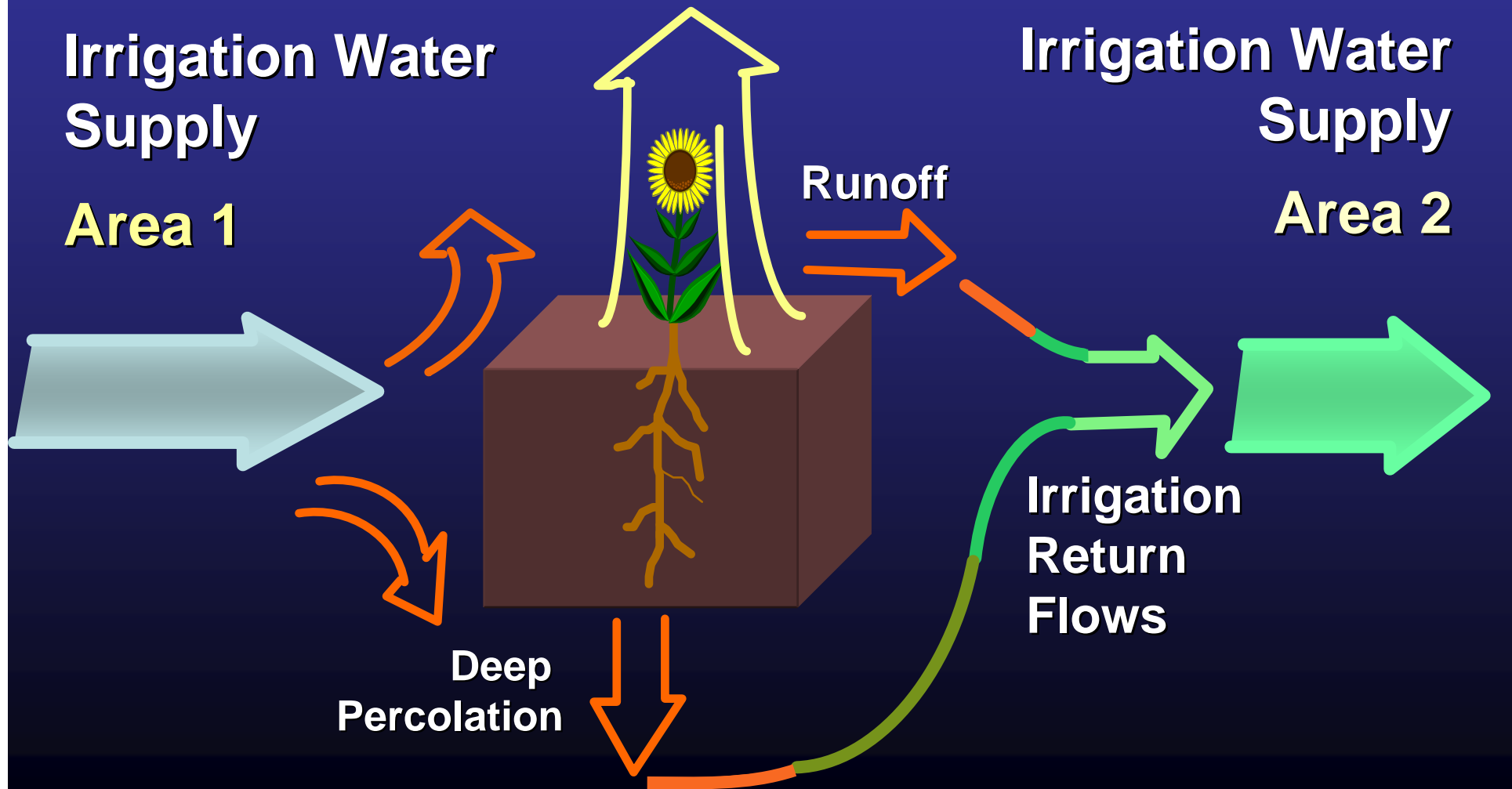
<http://cekings.ucdavis.edu/Agriculture/Pistachios.htm>

Traditional Approaches For Reducing Agricultural Water Use

1. Changing irrigation systems.
2. Improving management.

Reducing Losses \neq "Saving" Water

Evapotranspiration (ET)



Non-Traditional Approach For Reducing Agricultural Water Use

Reducing consumptive use;
evapotranspiration (ET_c)

Reducing consumptive use scenarios

Adequate Water Supply (Choice)

Reduce water cost

Be good stewards of the water

Droughts (No Choice)

Minimize negative impacts on
current and subsequent years
production

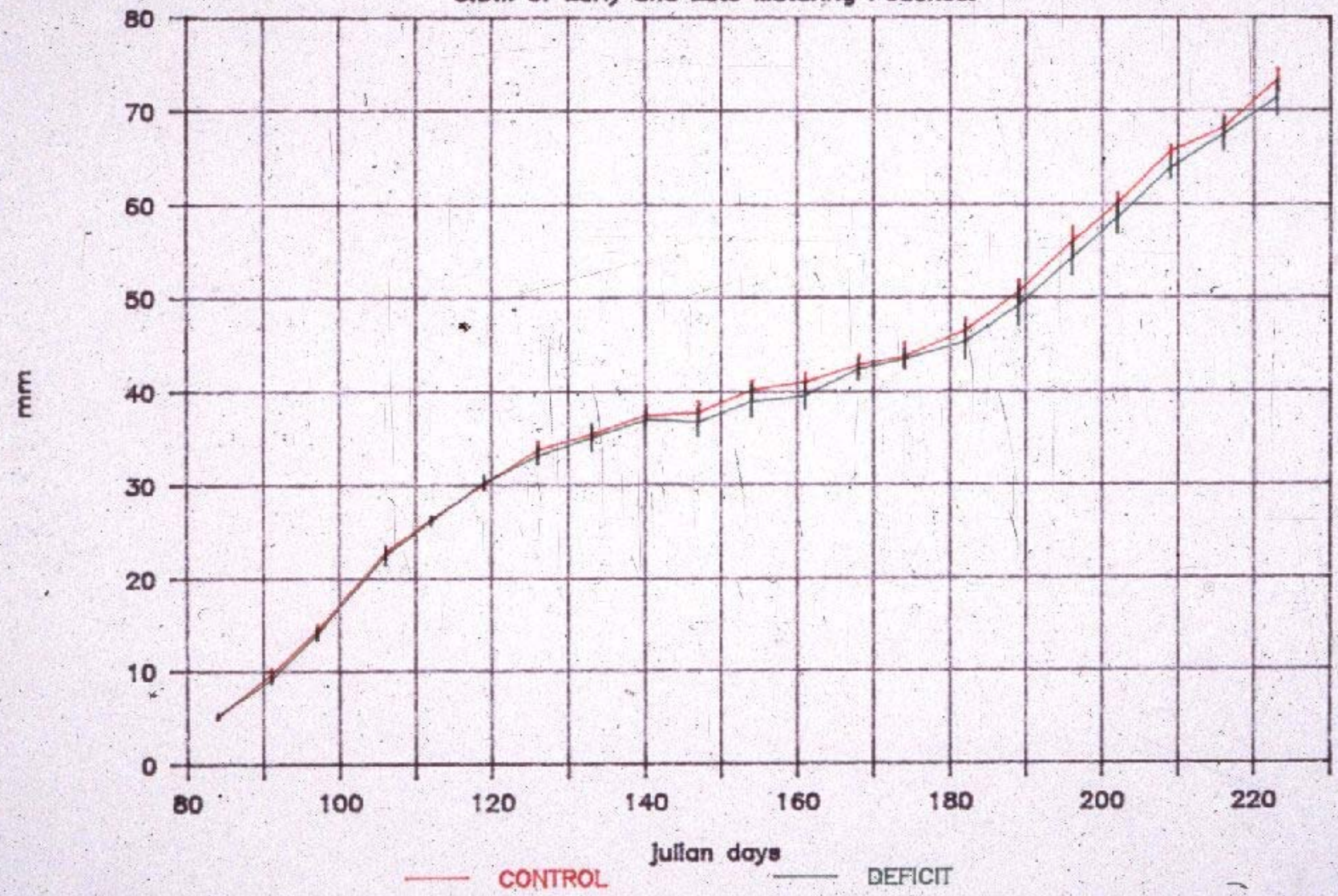
Regulated Deficit Irrigation (RDI)

Planned water deficits at specific crop developmental stages that control vegetative growth without negatively affecting production.

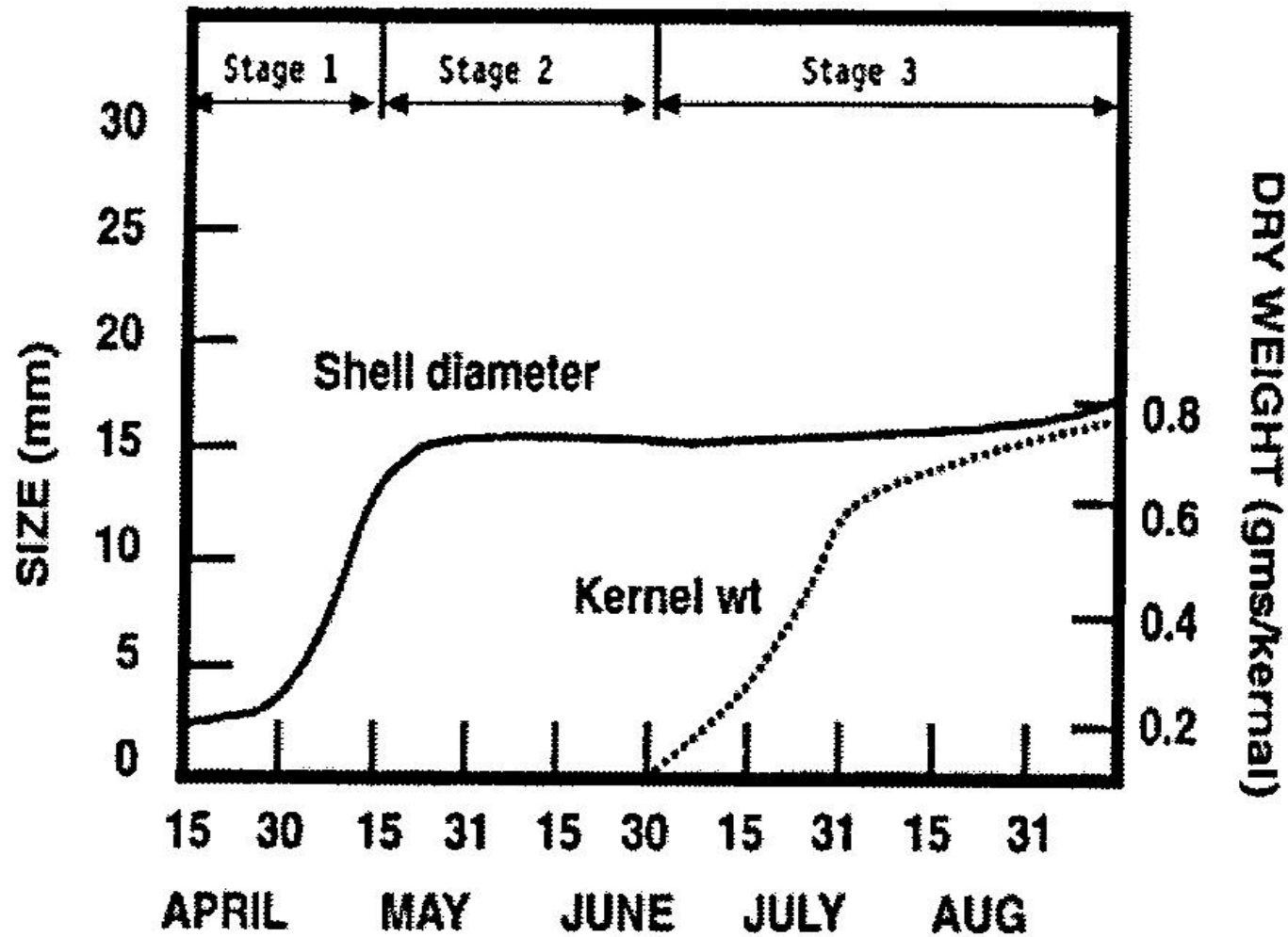
**Goals: Solve horticultural problems;
Reduce water use;
Achieve higher farm profits.**

FRUIT DIAMETER CALRED

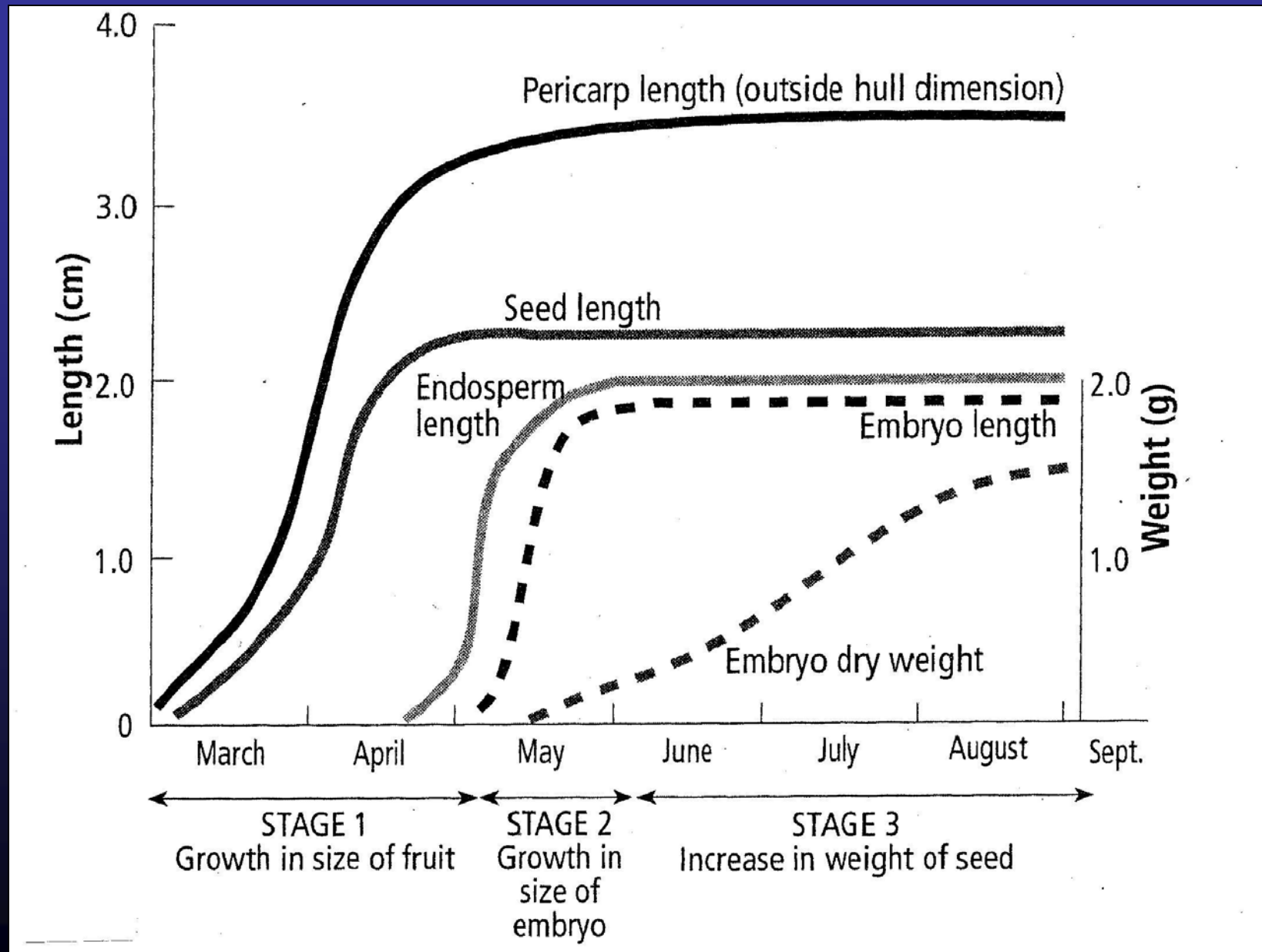
C.D.I. of Early and Late Maturing Peaches.



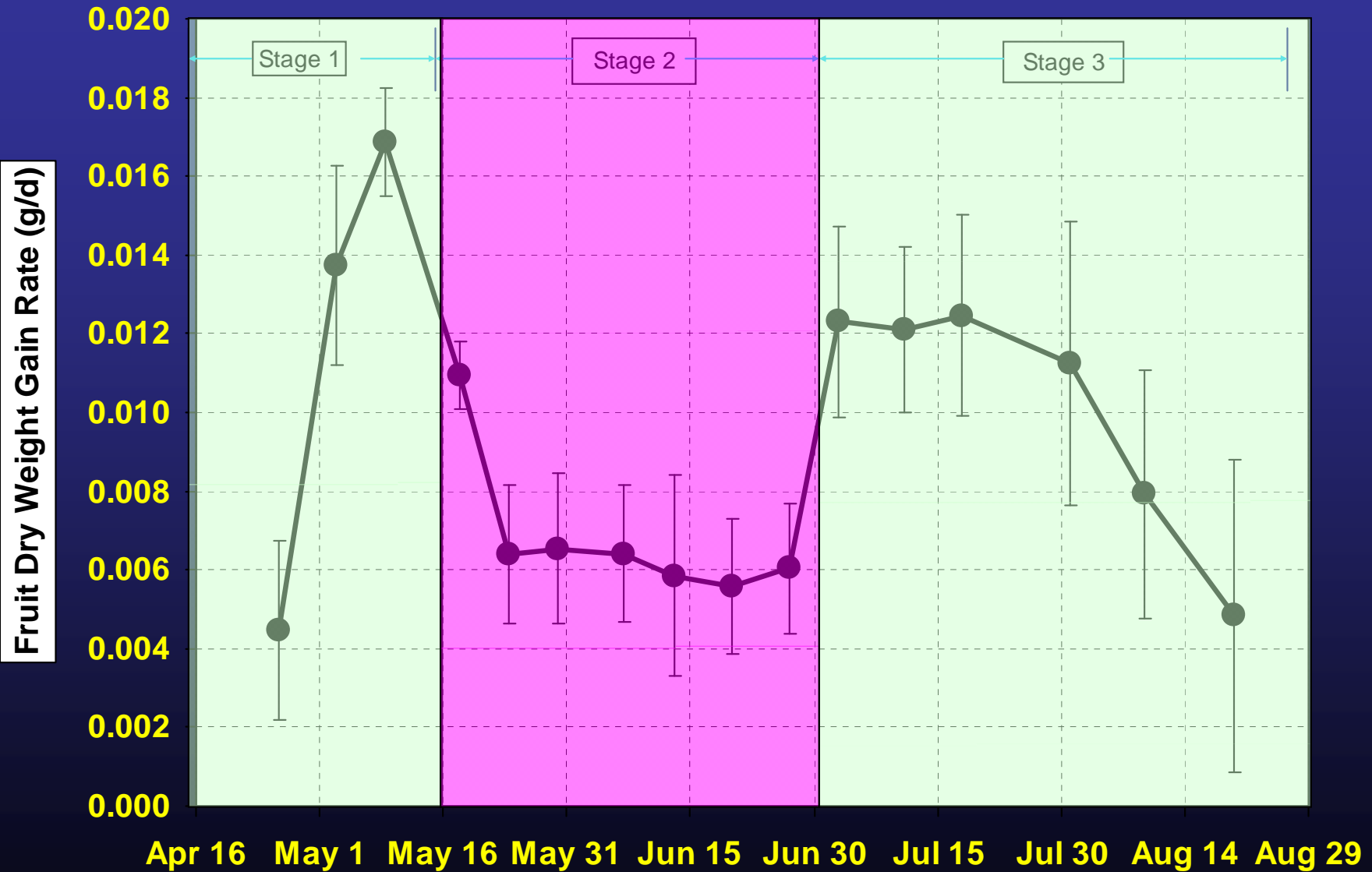
Pistachio Nut Growth Processes



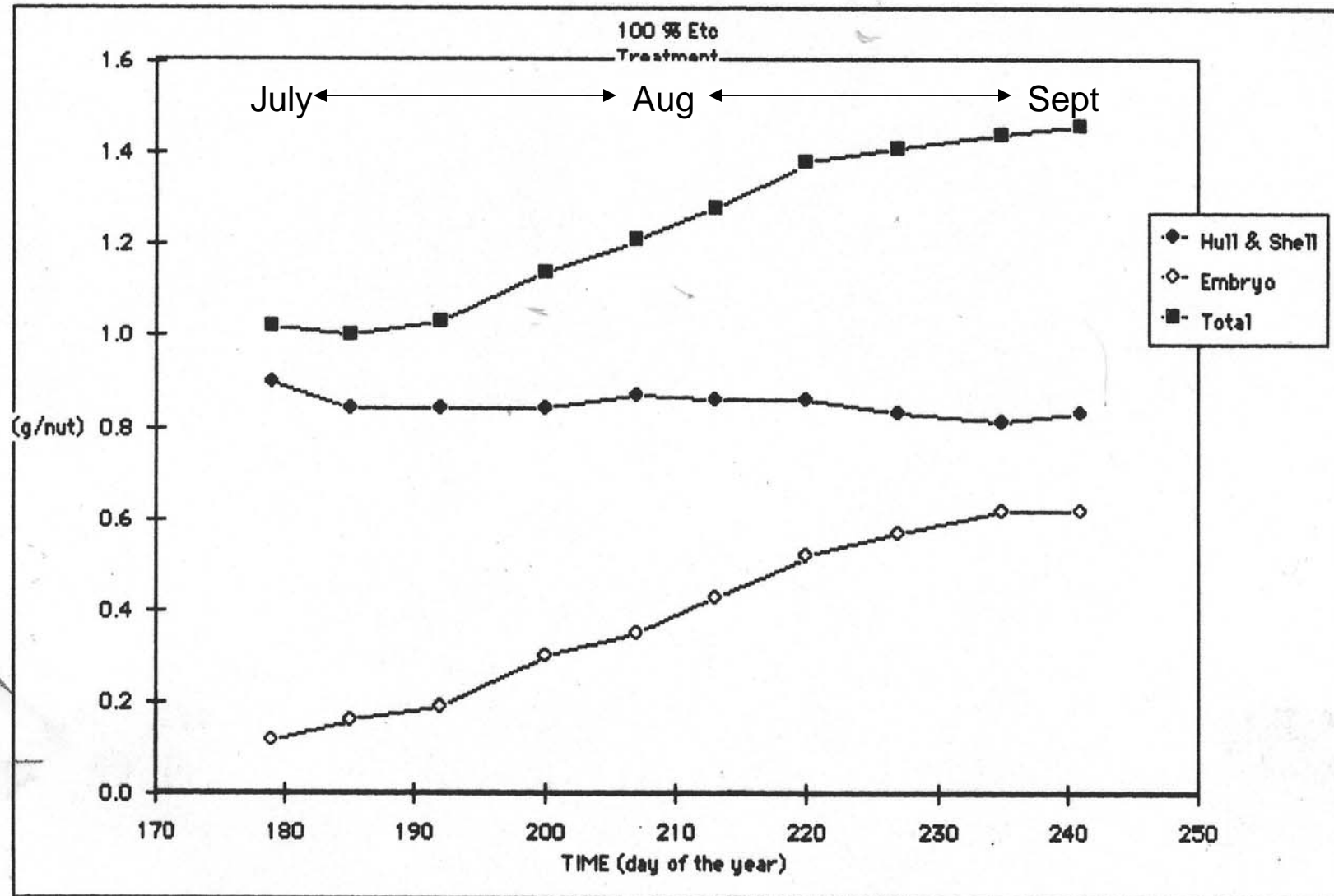
Almond Nut Growth Processes



Pistachio Growth Stages



Nut Component Dry Weights with Time











Pistachio RDI Experiments in SSJV

- Kettleman City, Atlantica, '89-'92
- Madera, Atlantica, '92-'95
- McFarland, Atlantica, '93-'96
- Lost Hills, Atlantica, '93-'96
- Parlier, Atlantica, '03-'06
- Parlier, PG1, '03-'06
- Madera, PG1, '04-Current

Kettleman Mean (1991-92) Yield and Components

Treatment	Split Nut Wt. (g/nut)	Blanks and Aborted Nuts (% nut load)	Shell Splitting (% filled nuts)	Total Nut Load (No/tree)	Removal of Split Nuts (% Split nuts)	Yield Splits 5% H2O Harvest (lbs/ac)	Yield Filled 5% H2O Harvest (lbs/ac)
0% Stage 1	1.24 b*	21.5 ab	87.8 d	12250	85.5 bc	2968 d	3261 bc
0% Stage 2	1.29 bc	22.0 ab	73.6 b	10880	91.4 bc	2350 bc	2946 bc
0% Stage 3	1.18 a	27.6 c	43.6 a	11190	72.6 a	1064 a	2266 a
0% Postharvest	1.30 bc	22.8 abc	78.8 bc	11410	88.8 bc	2632 bcd	3162 bc
50% Stage 2; 25% PH	1.30 bc	21.2 ab	81.7 cd	10870	89.5 bc	2880 cd	3317 bc
Control	1.32 c	22.5 ab	79.5 bc	11460	88.8 bc	2848 cd	3408 c

NSD

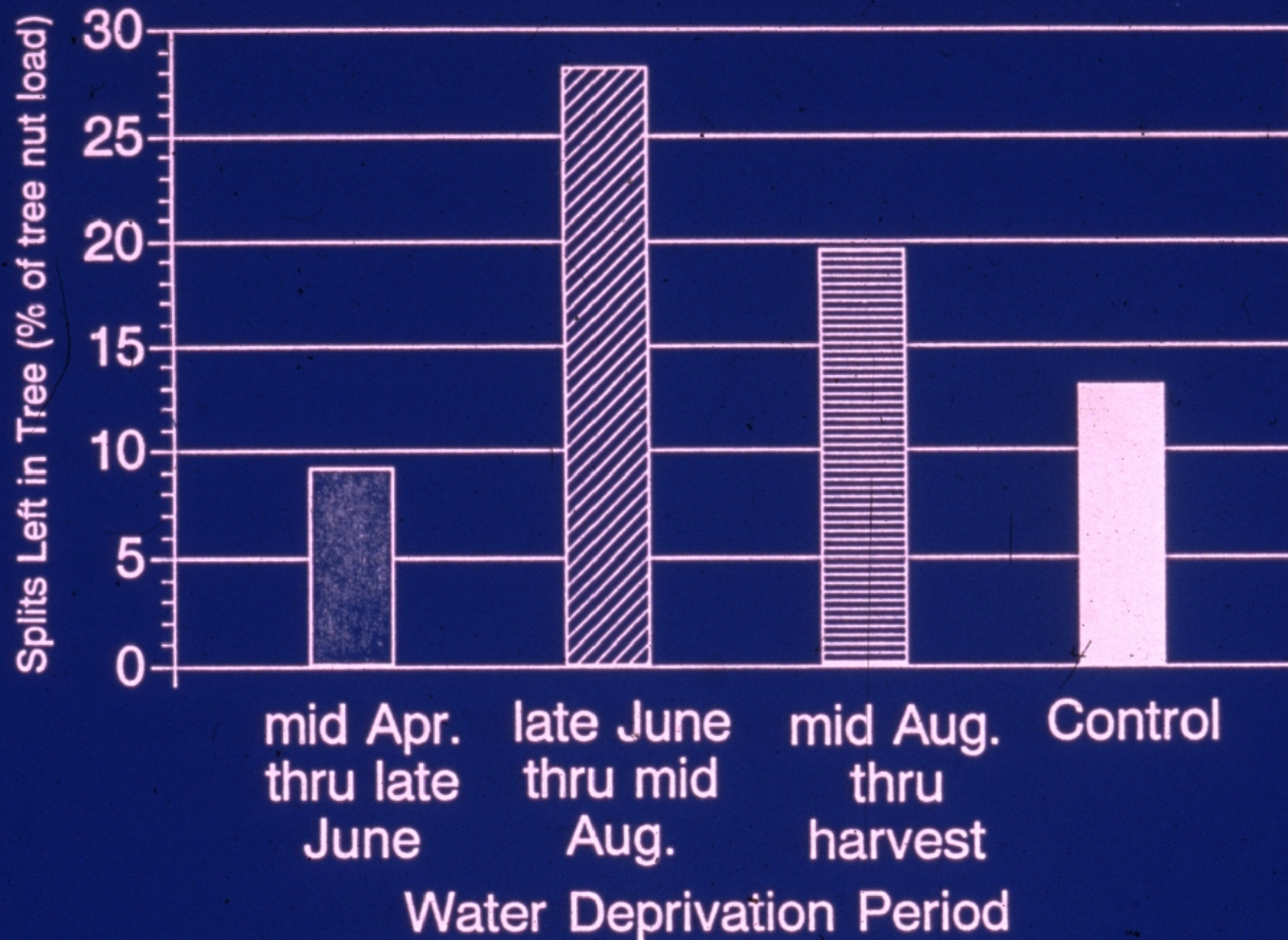
* Values followed by the same letter are not statistically different at p=0.05.

Kettleman Mean (1991-92) Water Productivity

Treatment	Yield Splits 5% H2O Harvest (lbs/ac)	Yield Filled 5% H2O Harvest (lbs/ac)	Irrigation Water Productivity Splits (lb/AF)	Irrigation Water Productivity Filled (lb/AF)
0% Stage 1	2968 d	3261 bc	1155 bc	1268 abc
0% Stage 2	2350 bc	2946 bc	1156 bc	1449 bcd
0% Stage 3	1064 a	2266 a	816 a	1737 e
0% Postharvest	2632 bcd	3162 bc	999 ab	1201 a
50% Stage 2; 25% PH	2880 cd	3317 bc	1337 c	1540 de
Control	2848 cd	3408 c	1028 ab	1230 ab

* Values followed by the same letter are not statistically different at p=0.05.

Split Nuts Left in Tree Postharvest



15.8

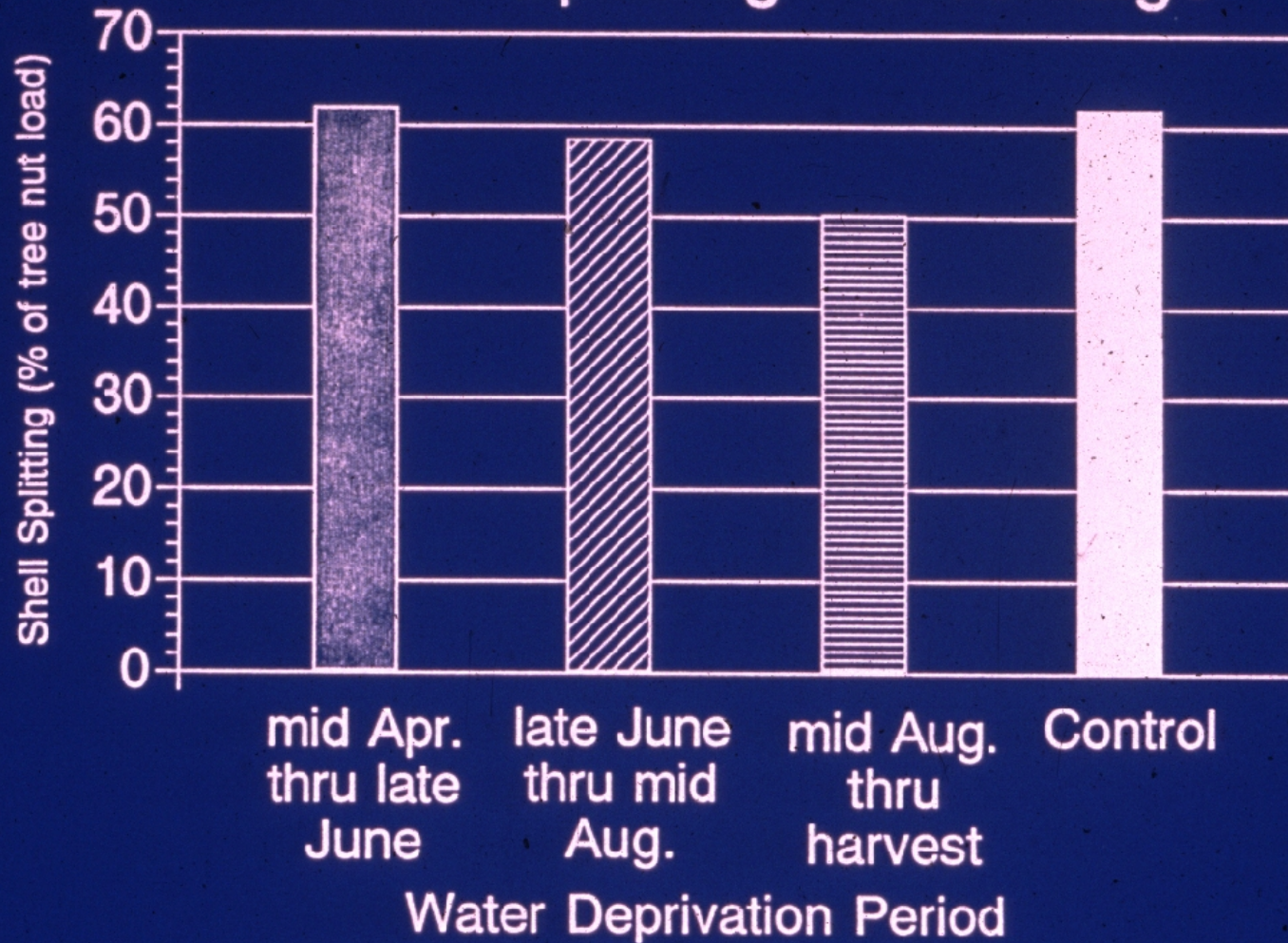
12.6

8.0

-

Irrigation Deficit (inches)

Shell Splitting Percentage



15.8	12.6	8.0	—
Irrigation Deficit (inches)			

Can we use Stage 1 stress to improve shell splitting?

RDI Regimes Evaluated

- * T1 Stage 1 stress followed by full irrigation.
- * T2 Stage 1 stress followed by 50% of potential ET_c during Stage 2.
- * Control Fully irrigated for season.

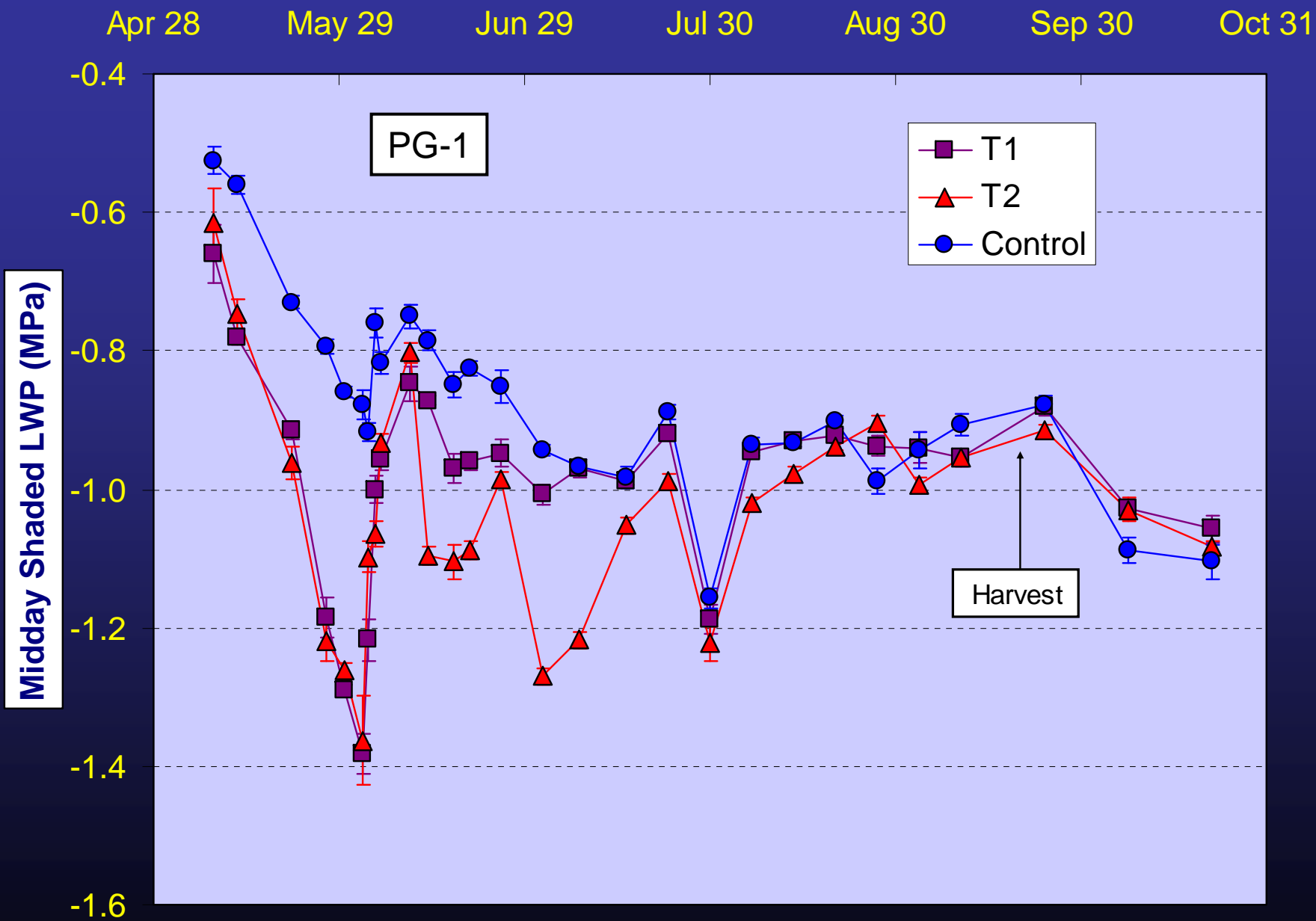


Fully Irrigated; July 9





Stressed; July 9



Control; Sept. 8, 2003



T1; Sept. 8, 2003



T2; Sept. 8, 2003





KAC Pistachio RDI; Mean 2003-4 Data

Rootstock	Irrigation Treatment	Total Seasonal Irrigation Applied (inches/yr)	Harvested Dry Split Nut Weight (g)	Total Tree Fruit Load (No.)	Total Tree Blanks and Aborts (No.)	Harvested Fresh Closed Shell Nuts (% by No.)	Removal of Split Nuts by Shaking (%)	Yield Dry Split Nuts (lbs/acre)	Irrigation Water Productivity (lbs/gal)
Atlantica	T1	40.6	1.14 a*	12000	14.6	15.3 a	99.2	2630	450 ab
	T2	34.2	1.13 a	12170	14.5	15.3 a	99.1	2690	372 a
	Control	47.0	1.23 b	11200	14.0	28.7 b	98.4	2160	524 b***
				NSD**	NSD		NSD	NSD	
PG1	T1	40.6	1.17 a	17360	15.2	17.9 a	98.2	3380	339 ab
	T2	34.2	1.19 a	16160	15.9	16.3 a	98.2	3430	282 a
	Control	47.0	1.25 b	16130	13.1	34.8 b	98.4	2860	395 b***
				NSD	NSD		NSD	NSD	

* Numbers not followed by same letter are statistically different.

** NSD means no statistically significant differences.

*** Excludes water applied for barley cover crop.





Grower Receipt Statement - By Load

2005 Pistachio Crop

Report Printed on 1/27/2006

Delivered: Grower: Goldhammer Grower RTT: 5508 Aflatoxin:
 Processed: Field Name: T4R6 Field Tag No.: 5508 Av. Oz. Count: 22.2
 Tested: 1/24/2006 Receiving Comments:

Load Analysis

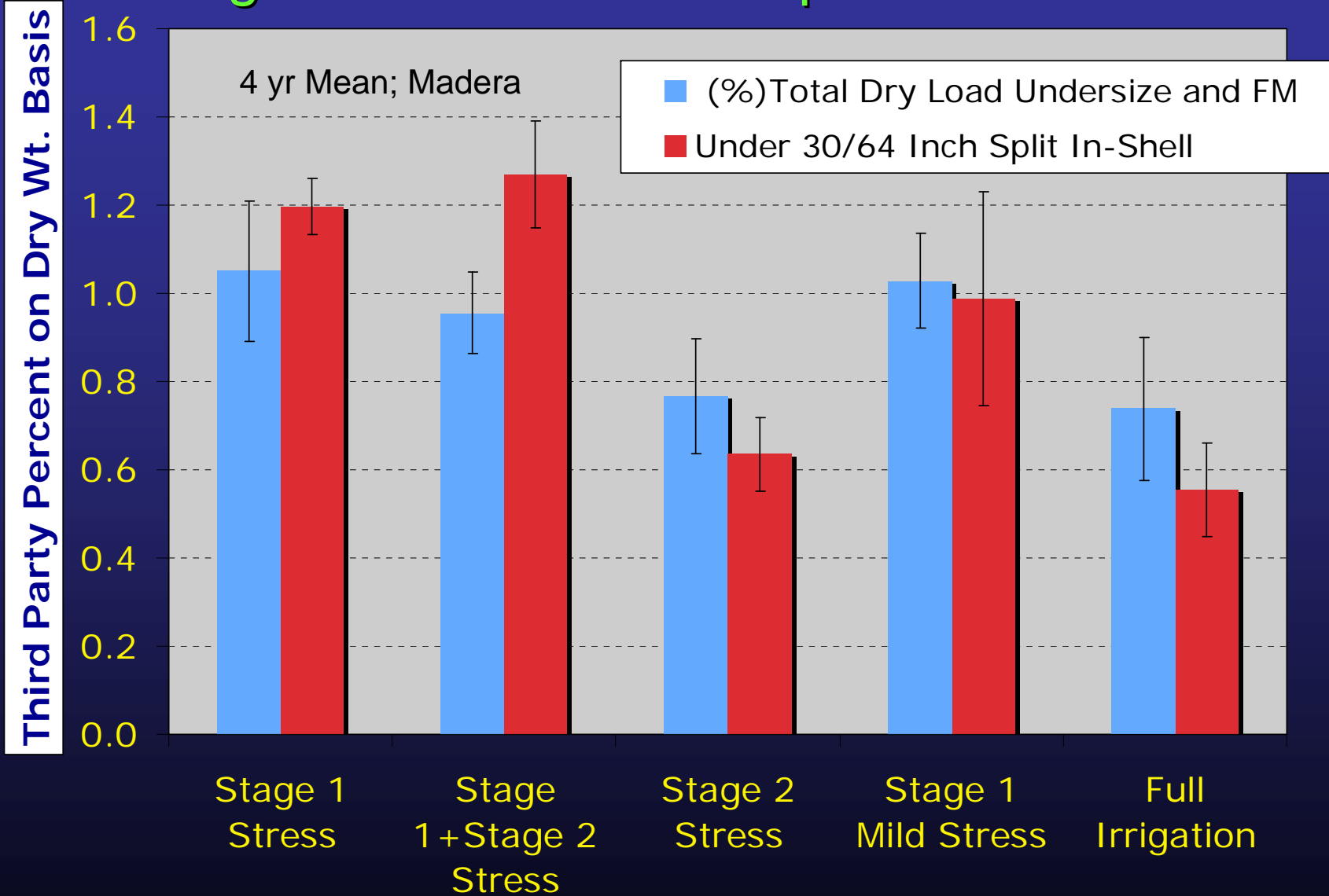
	Pounds	Percentage of Net Green Wt.	Third Party Sample	
			Lbs./ gms.	Percentage
GROSS WEIGHT:	102			
Less: tare, including:	-1			
GROSS GREEN WEIGHT: 0 Bins	101			
Less: Precleaner trash:	-1			
NET GREEN WEIGHT:	100	100.00%	12.09	
Weight after Hulling	76	76.18%	9.21	
Weight after drying to: 4.60% moisture	48	48.14%	5.82	
Weight after adjusting to: 5% moisture	48	48.33%	5.84	
TOTAL DRY LOAD	48	48.33%	500.3	100.00%
Less: Undersize and F.M.	0	-0.44%	-4.6	-0.92%
Net Dry Weight	48	47.89%	495.7	99.08%



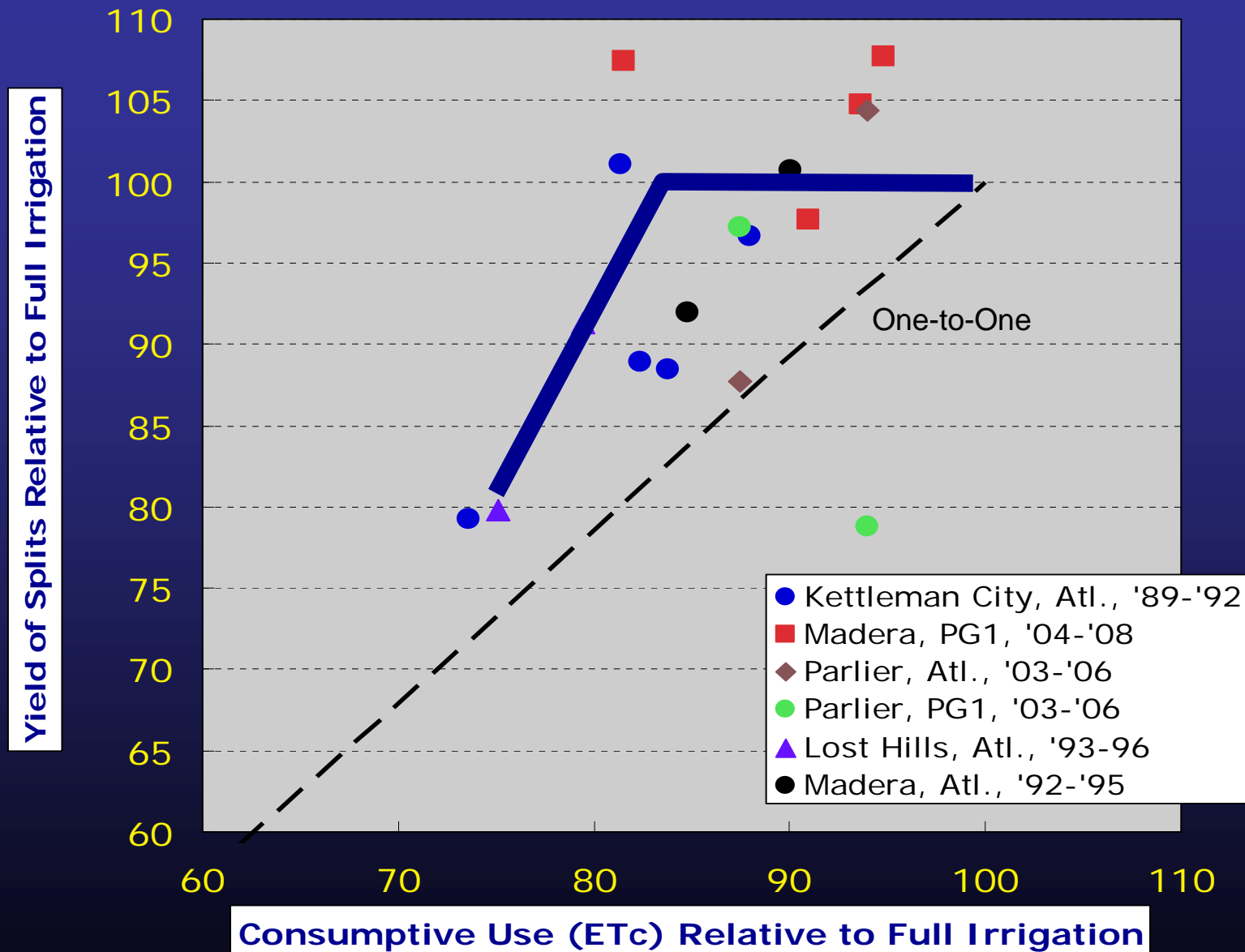
SHELLING STOCK (SPLIT)	1		1.31%	13.6	2.72%
ADHERING HULL	0		0.28%	2.9	0.58%
Less: Insect Damage	0		0.00%	0.0	0.00%
Less: Defects	0		0.00%	0.0	0.00%
Less: Shell	0		-0.15%	-1.6	-0.32%
Edible Kernels		0	0.13%	1.3	0.26%
DARK STAINED	1		0.83%	8.6	1.72%
Less: Insect Damage	0		0.00%	0.0	0.00%
Less: Defects	0		0.00%	0.0	0.00%
Less: Shell	0		-0.33%	-3.4	-0.68%
Edible Kernels		1	0.50%	5.2	1.04%
SHELL DAMAGE AND OTHER	0		0.05%	0.5	0.10%
Less: Insect Damage	0		0.00%	0.0	0.00%
Less: Defects	0		0.00%	0.0	0.00%
Less: Shell	0		-0.02%	-0.2	-0.04%
Edible Kernels		0	0.03%	0.3	0.06%
LOOSE SHELL AND KERNELS	0		0.15%	1.6	0.32%
Less: Shell	0		-0.06%	-0.6	-0.12%
Edible Loose Kernels		0	0.10%	1.0	0.20%
UNDER 30/64 INCH SPLIT INSHELL	0		0.00%	0.0	0.00%
Less: Insect Damage	0		0.00%	0.0	0.00%
Less: Defects	0		0.00%	0.0	0.00%
Less: Shell	0		0.00%	0.0	0.00%
Edible Kernels		0	0.00%	0.0	0.00%
TOTAL EDIBLE KERNELS FROM S.S.		1	0.75%	7.8	1.56%



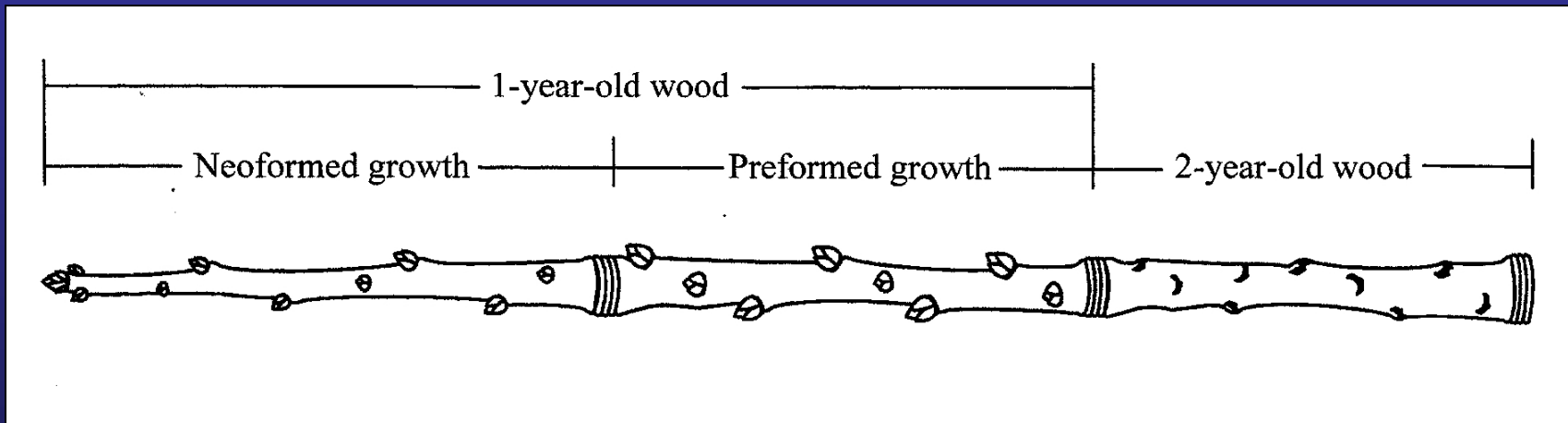
Stages 1 and 2 Stress Impacts on Undersize



Production Function with Stage 1, 2, and PH RDI

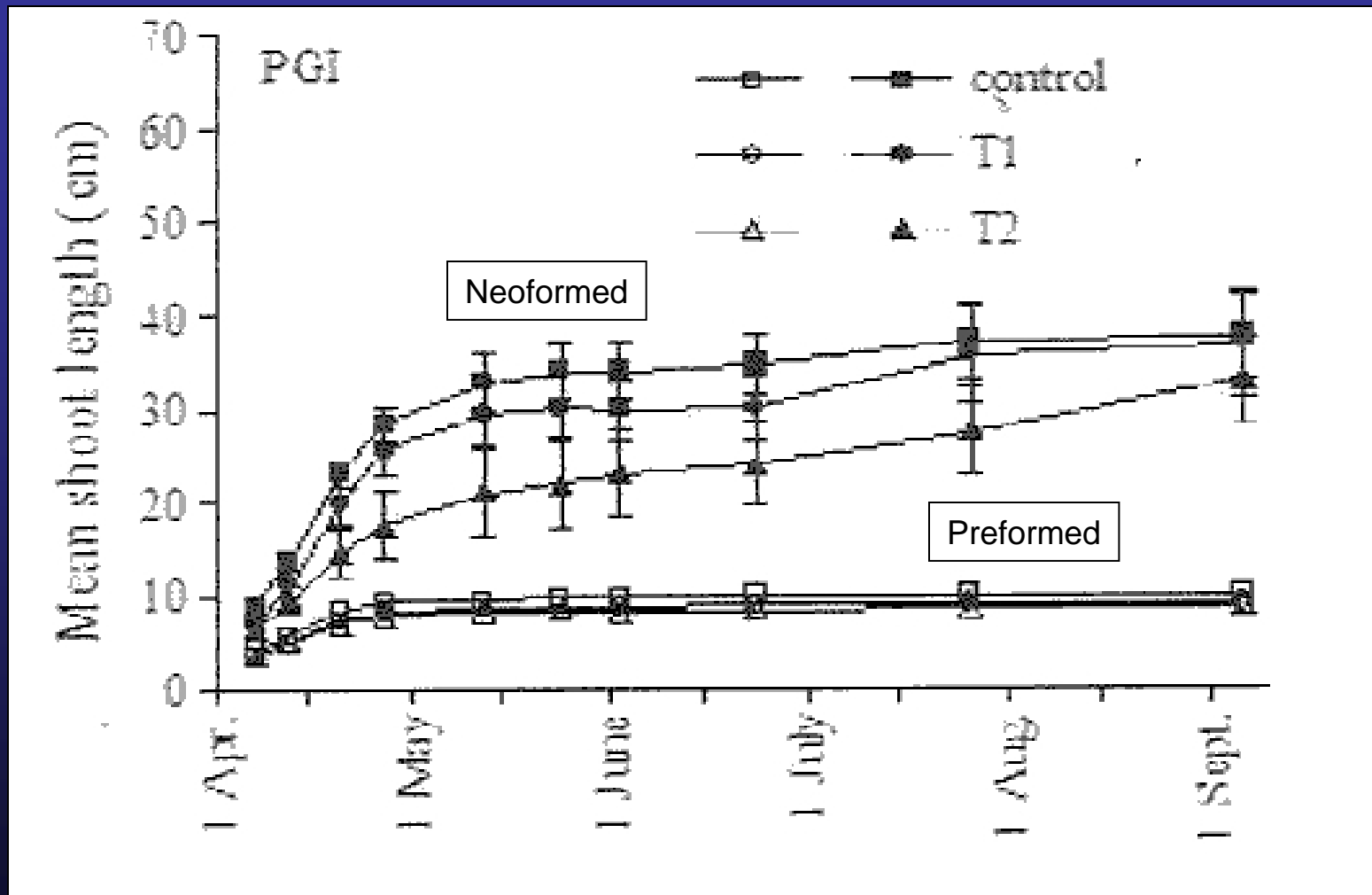


If stress reduces photosynthesis and RDI can maintain production with 15-20% less water than full ETc, what carbon-requiring tree sink is being negatively affected?



Adapted from Spann et al. (unpublished)

Shoot Growth with Time



Adapted from Spann et al. (unpublished)



Drought

Reasons

- 1) Weather
- 2) Government
- 3) Judicial

Dryland Experiment

No irrigation; only rainfall

Consumptive Use (ETc)

Year 1: 6.1 inches

Year 2: 3.0 inches

Year 3 Dryland;
Early Sept.



Three Years Dryland



Sustained Irrigation Treatments

Applied Water

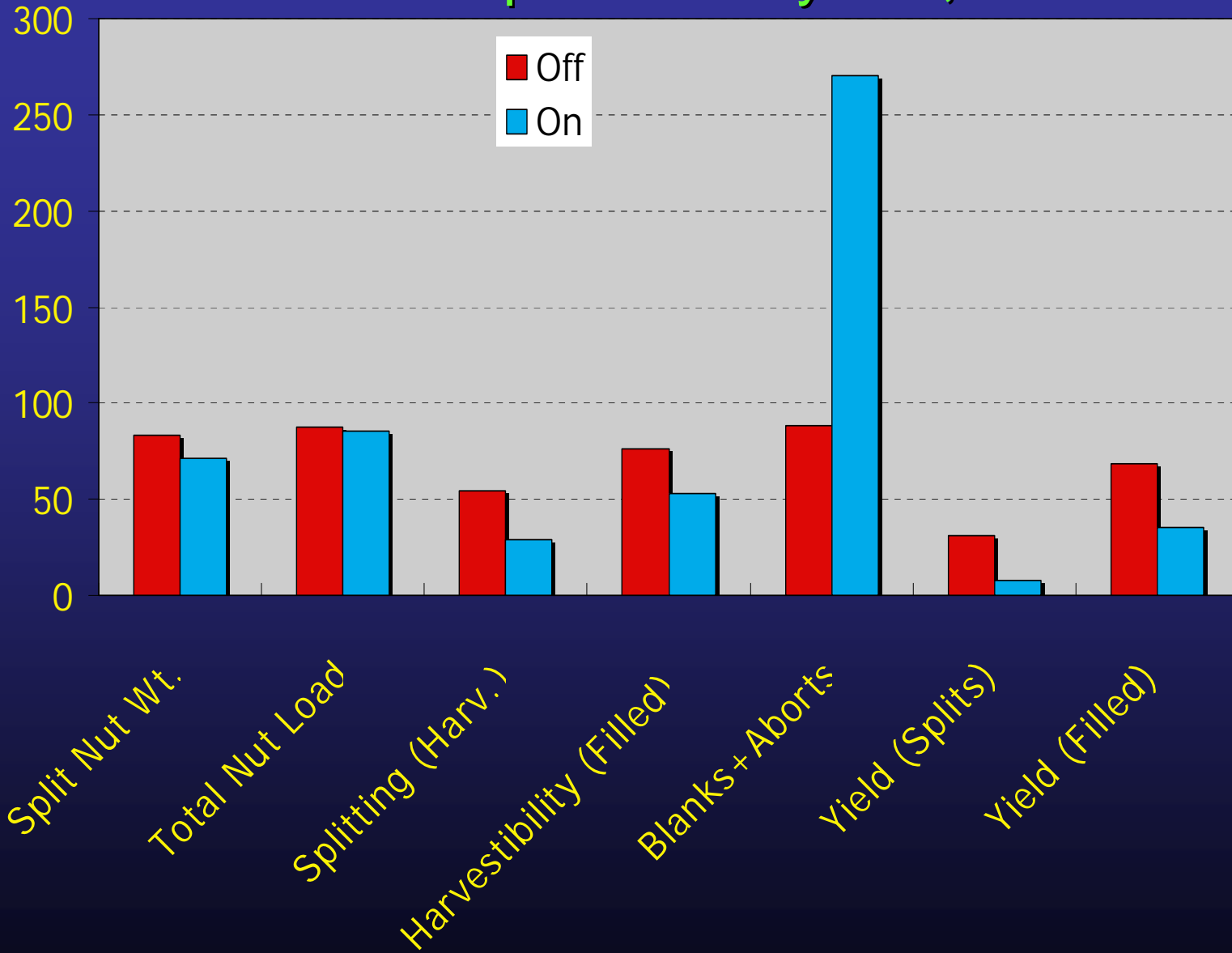
(% of full ETc)

(inches)

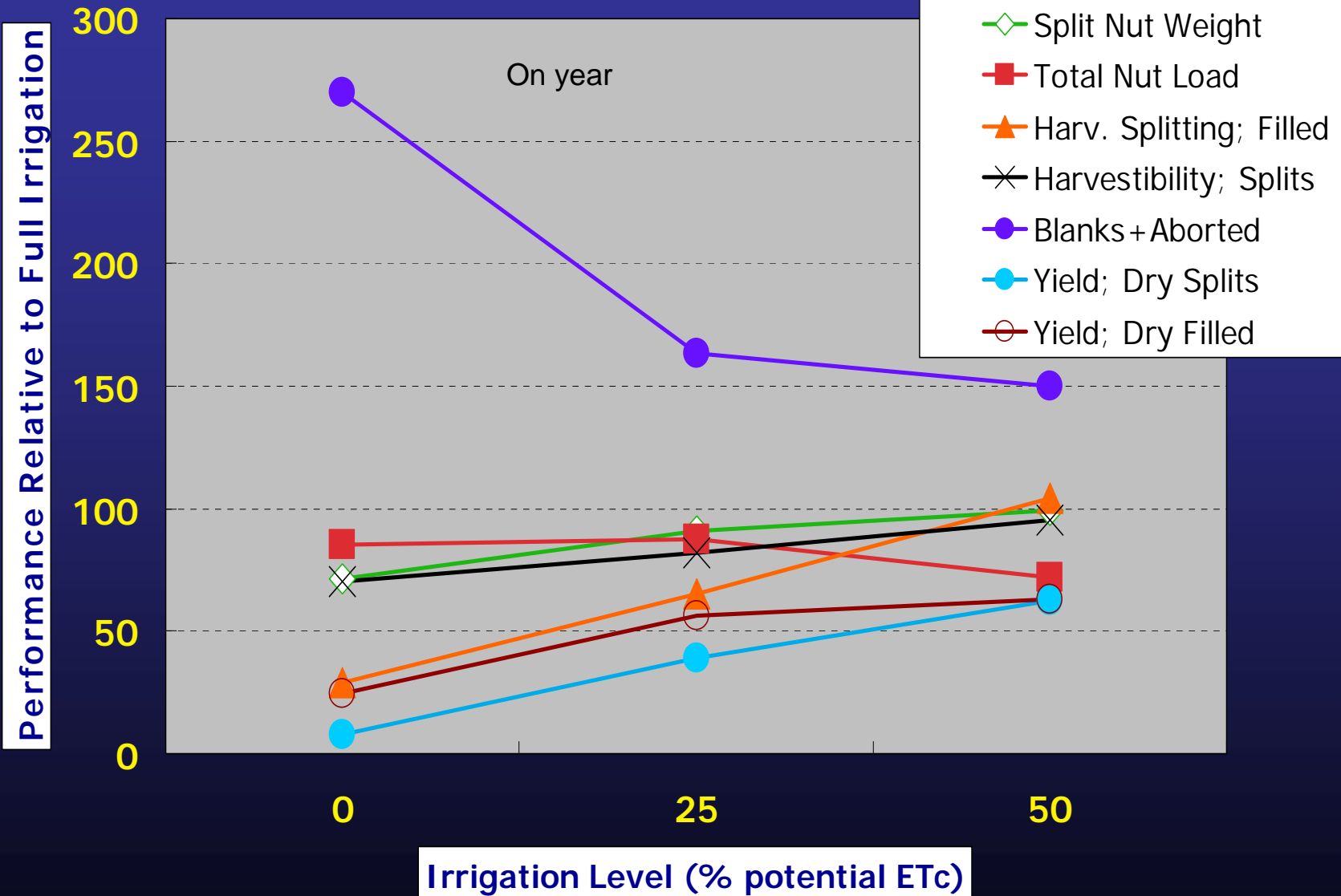
0	0
25	11.5
50	23
75	35
100	46

First Year Impacts of Dryland; On-Off

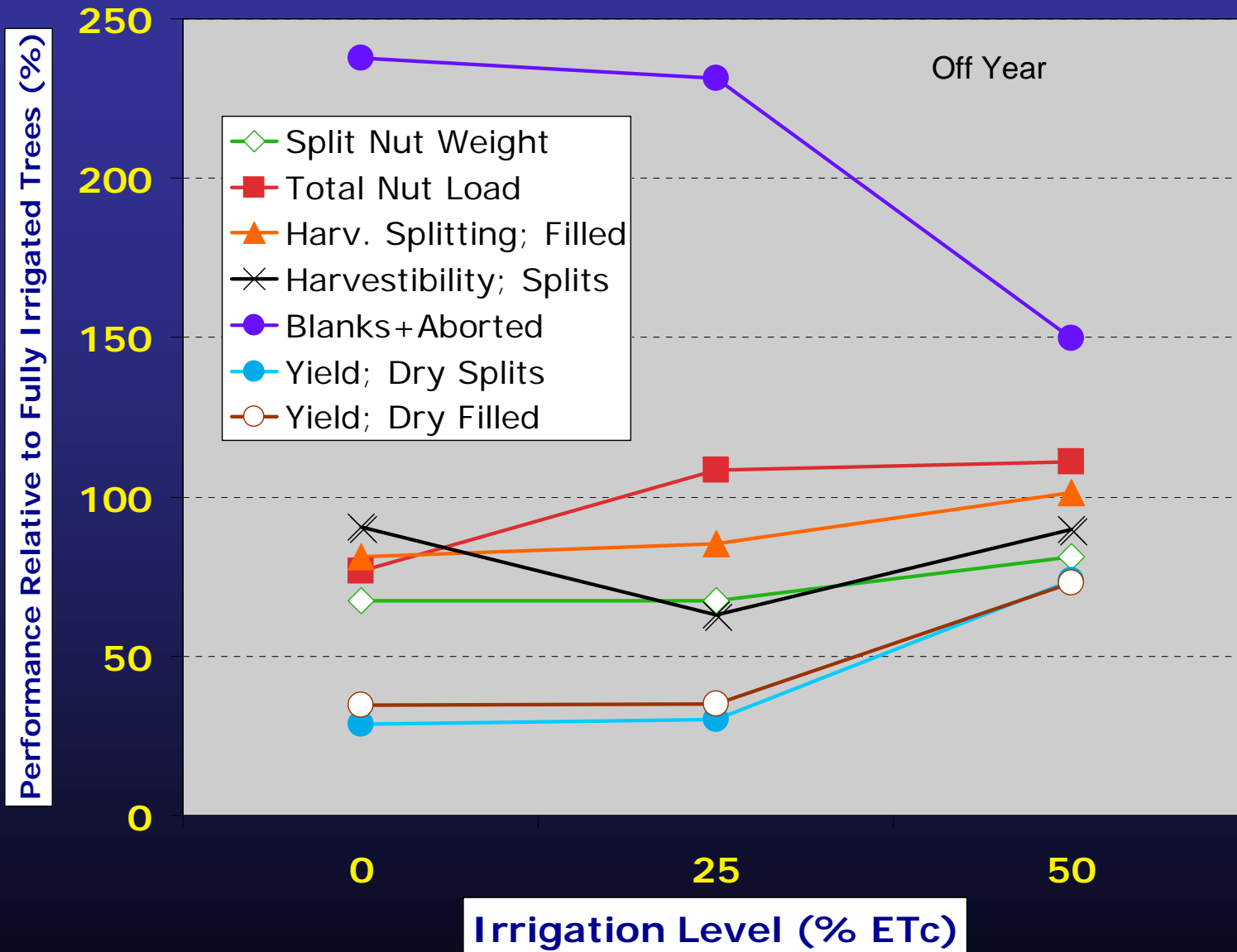
Performance Relative to Fully Irrigated



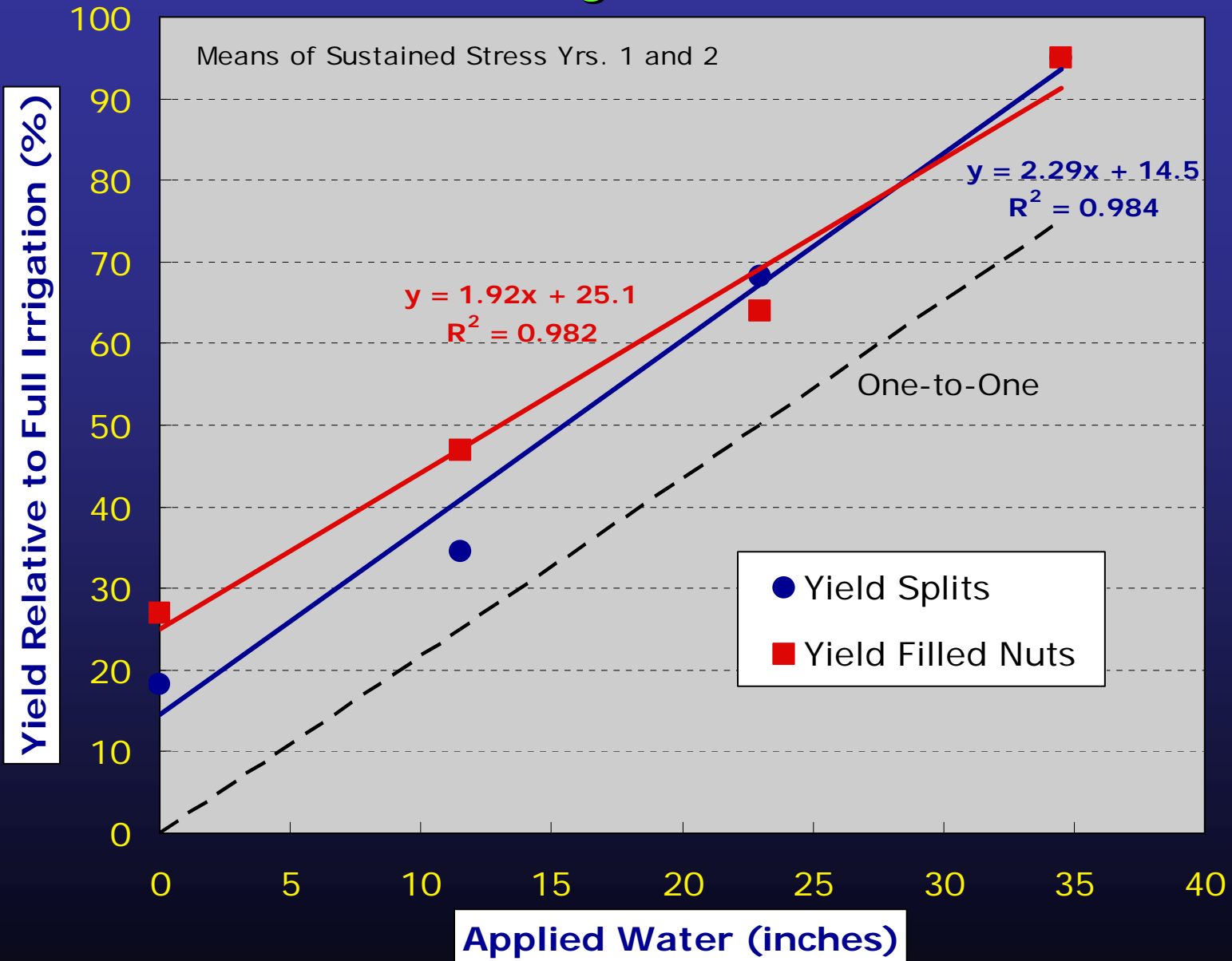
First Year Impacts of Dryland



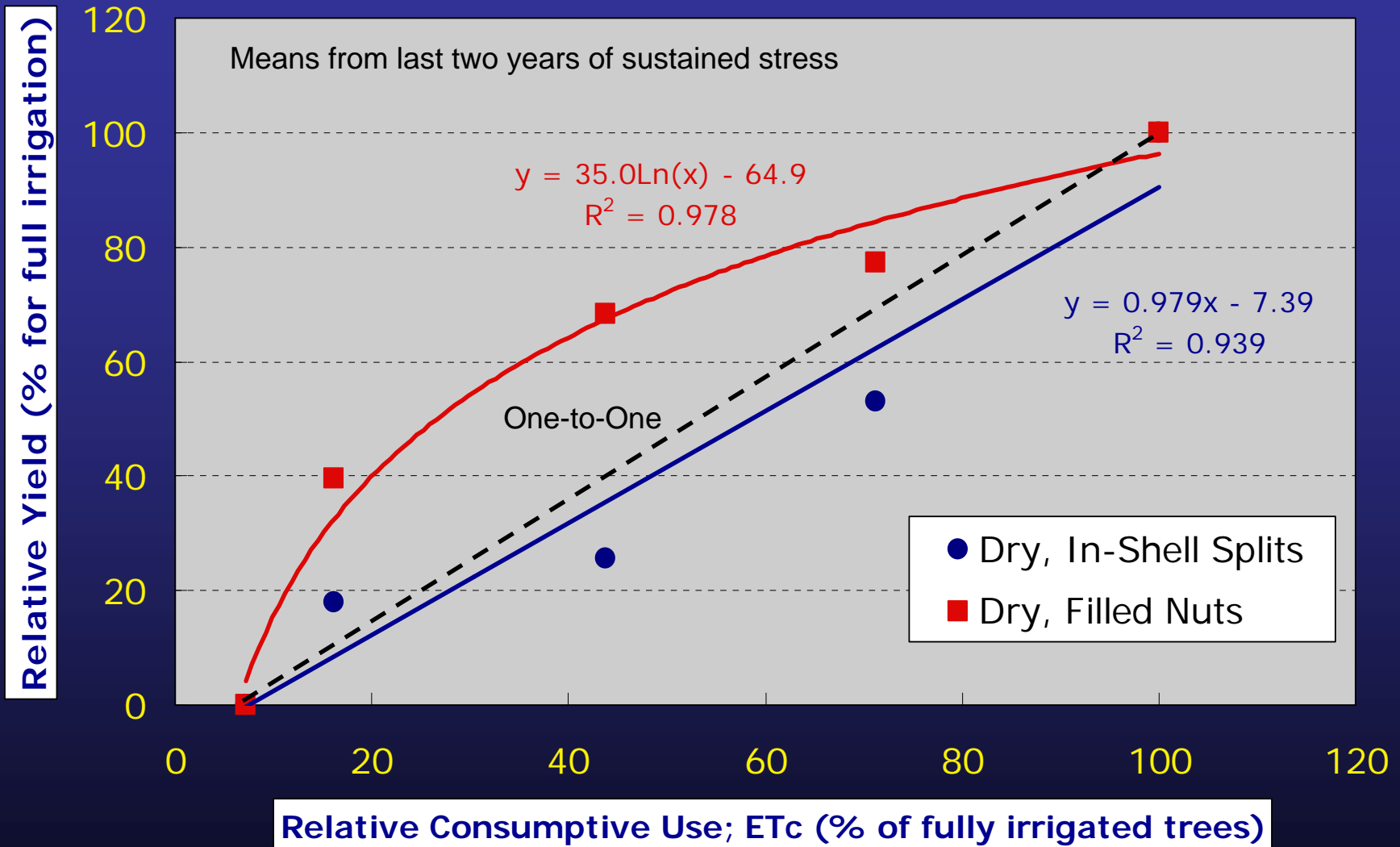
2nd Drought Year; "Off" Alternate Bearing Year



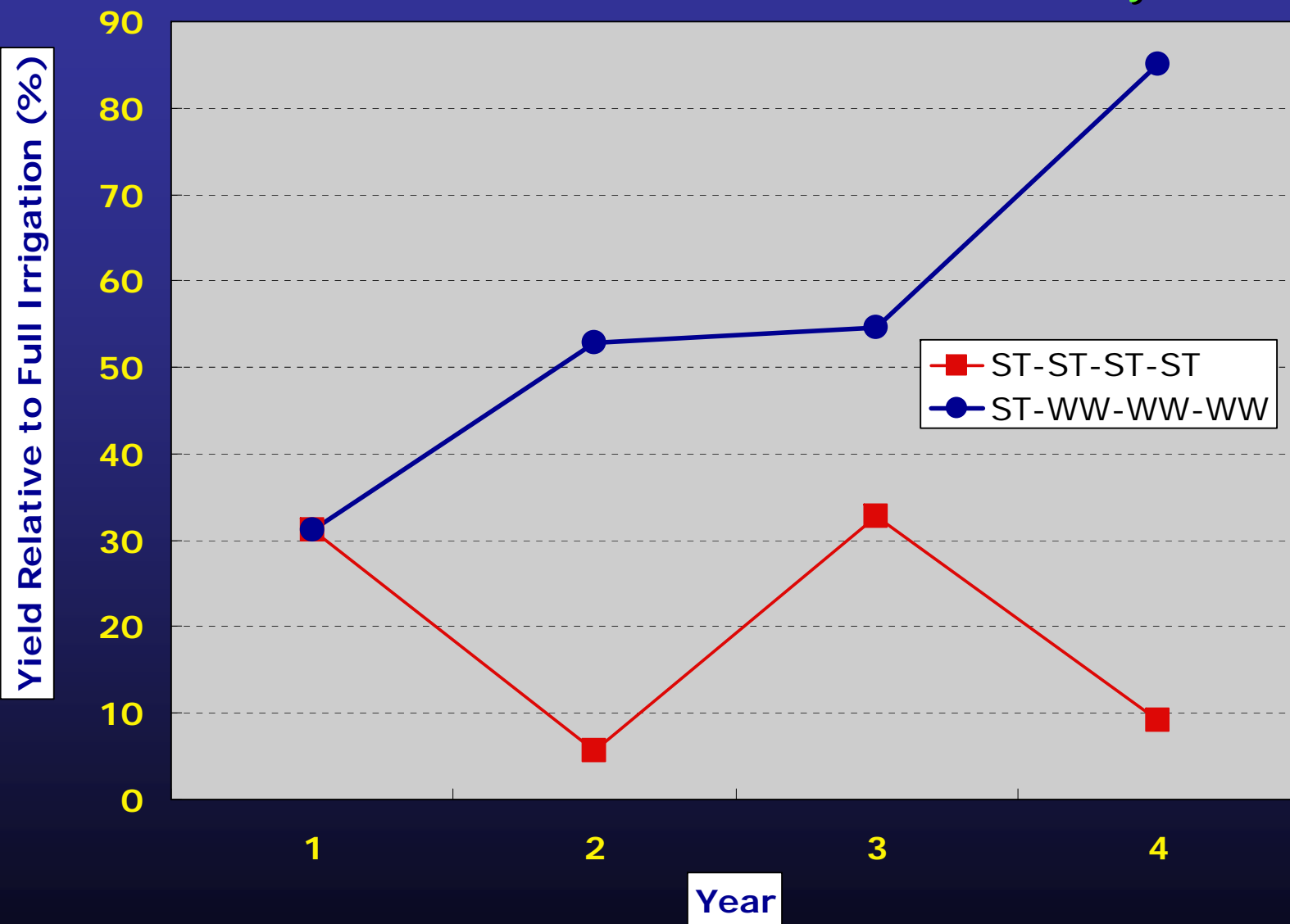
Two Year Drought Production Function



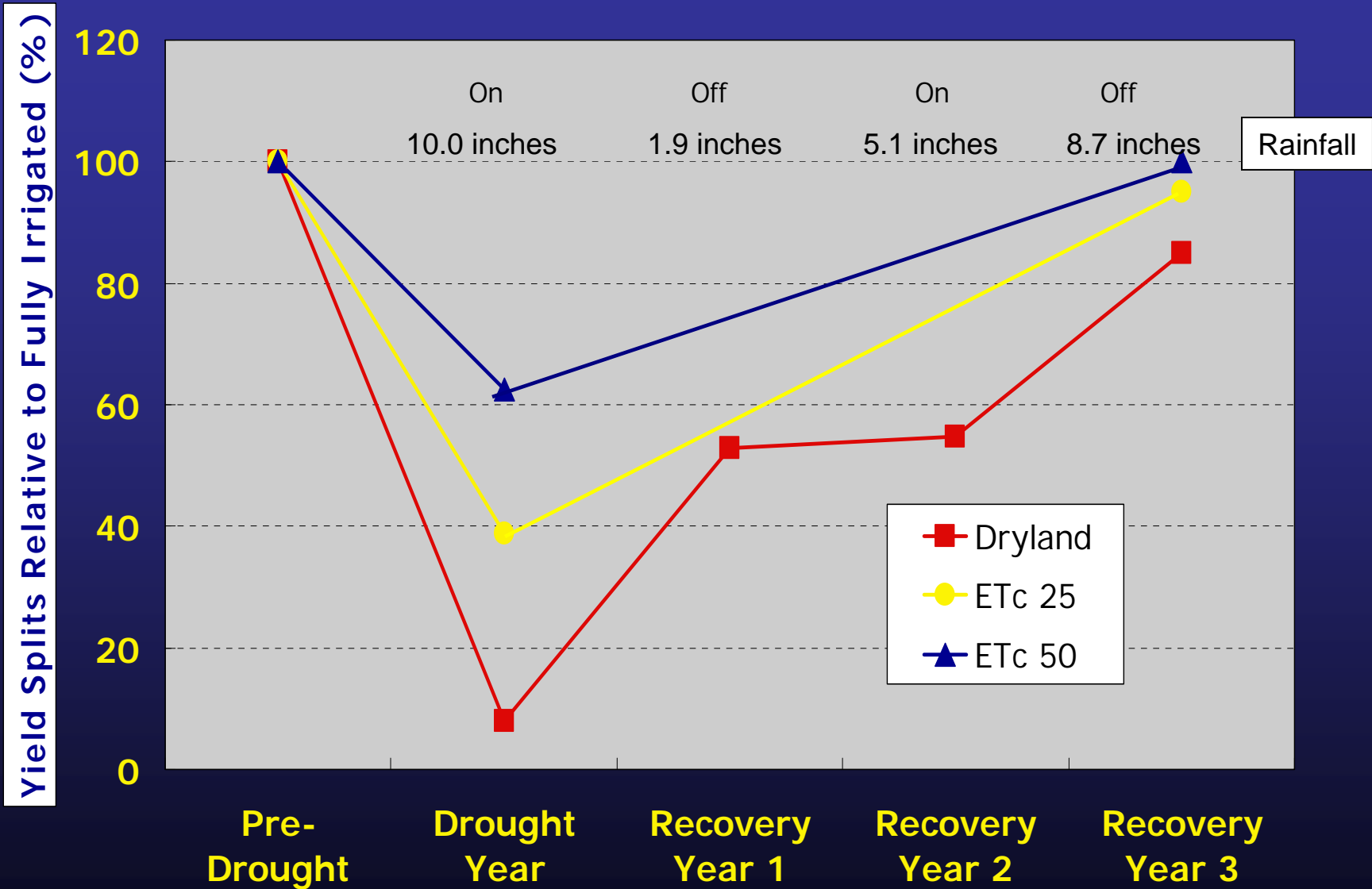
Sustained Stress Production Function



Continued Stress vs. Recover after Dryland Yr.

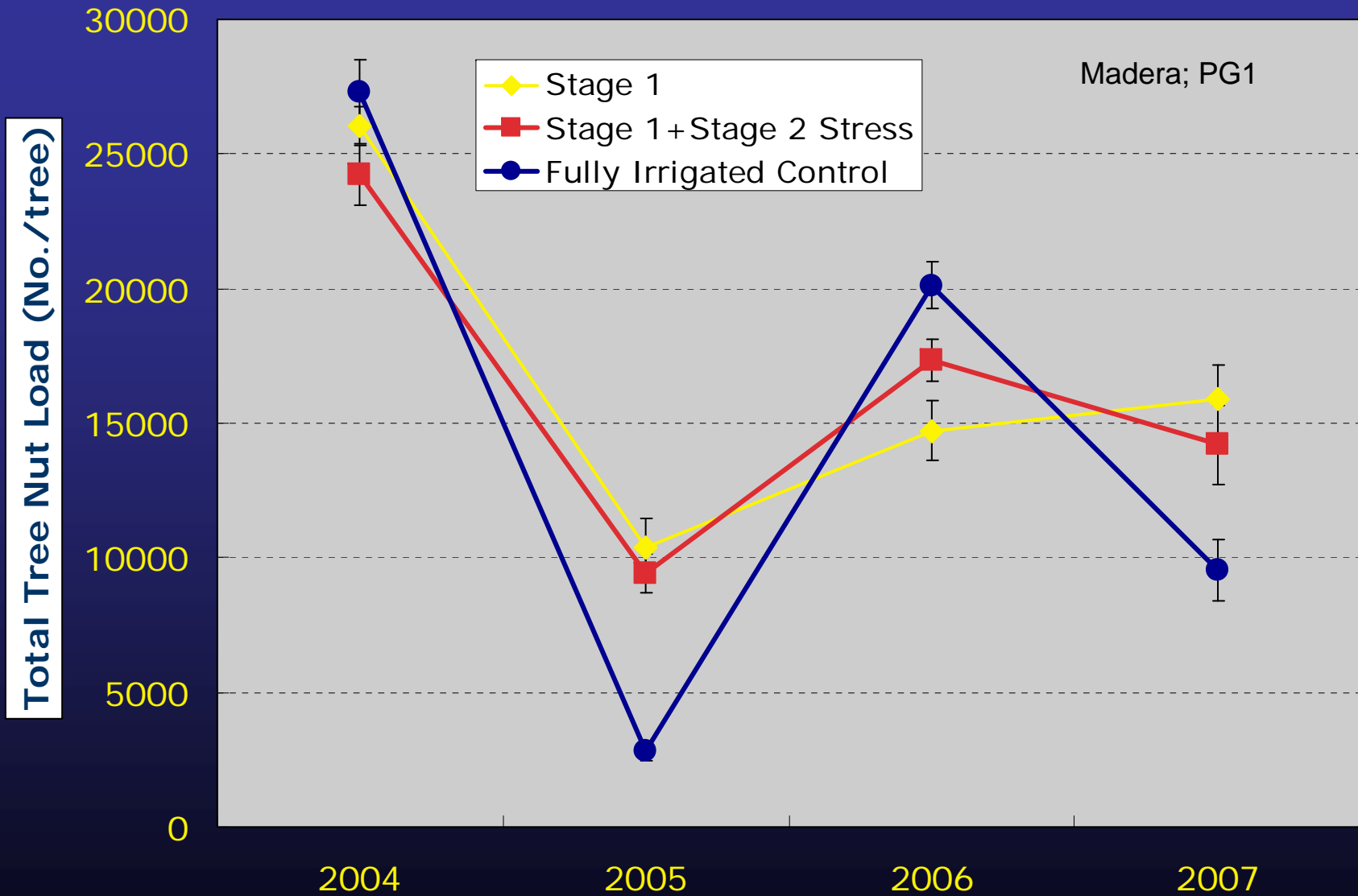


Expected Recovery Rate from Single Drought Yr.



Is it possible to affect alternate bearing with RDI?

Stage 1 Stress Impact on Alternate Bearing

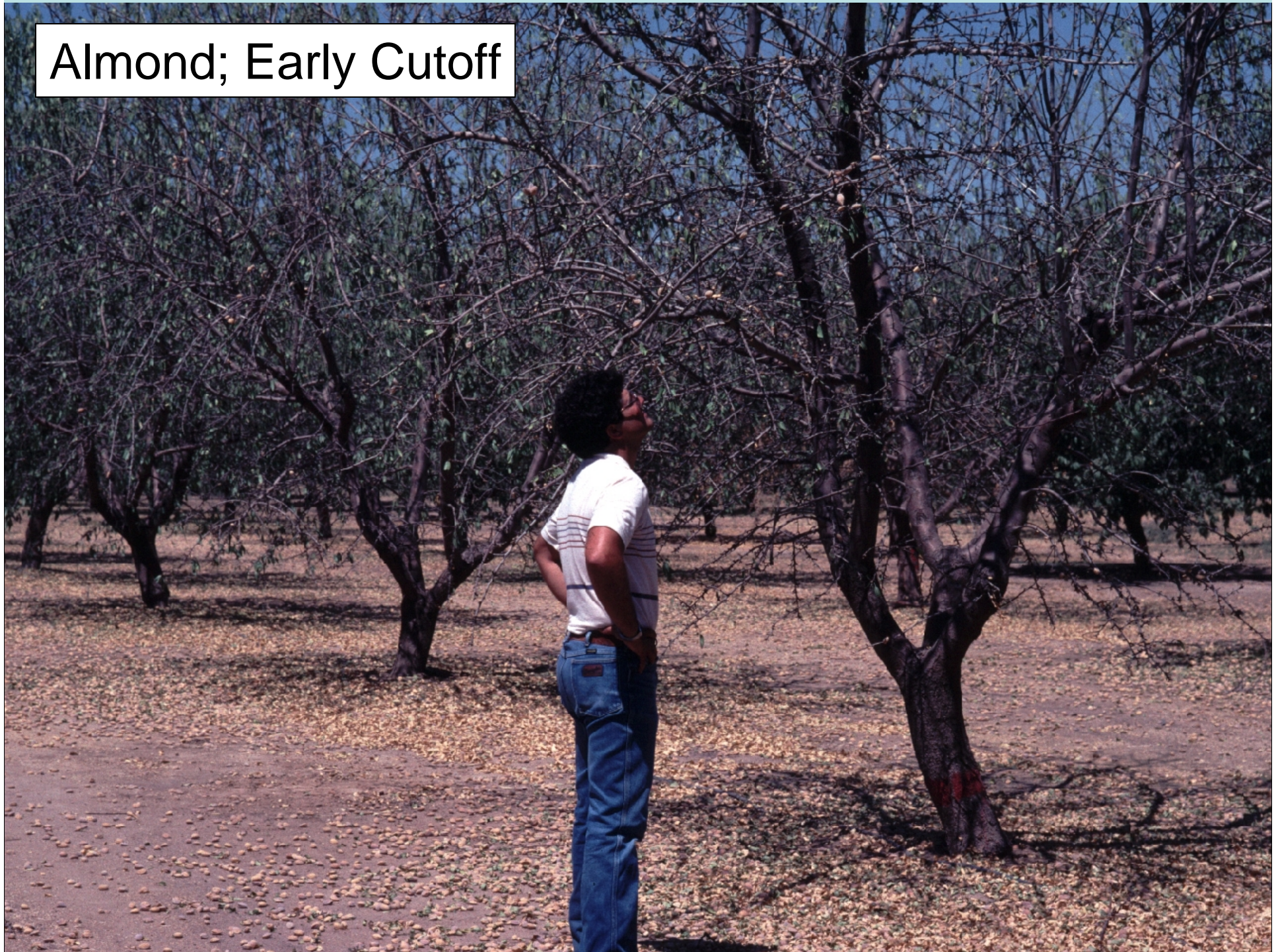


Can you kill a mature pistachio tree in the San Joaquin due to lack of irrigation?

Year 3 Dryland;
Early Sept.



Almond; Early Cutoff



Is “dehorning” an appropriate drought strategy for pistachio?





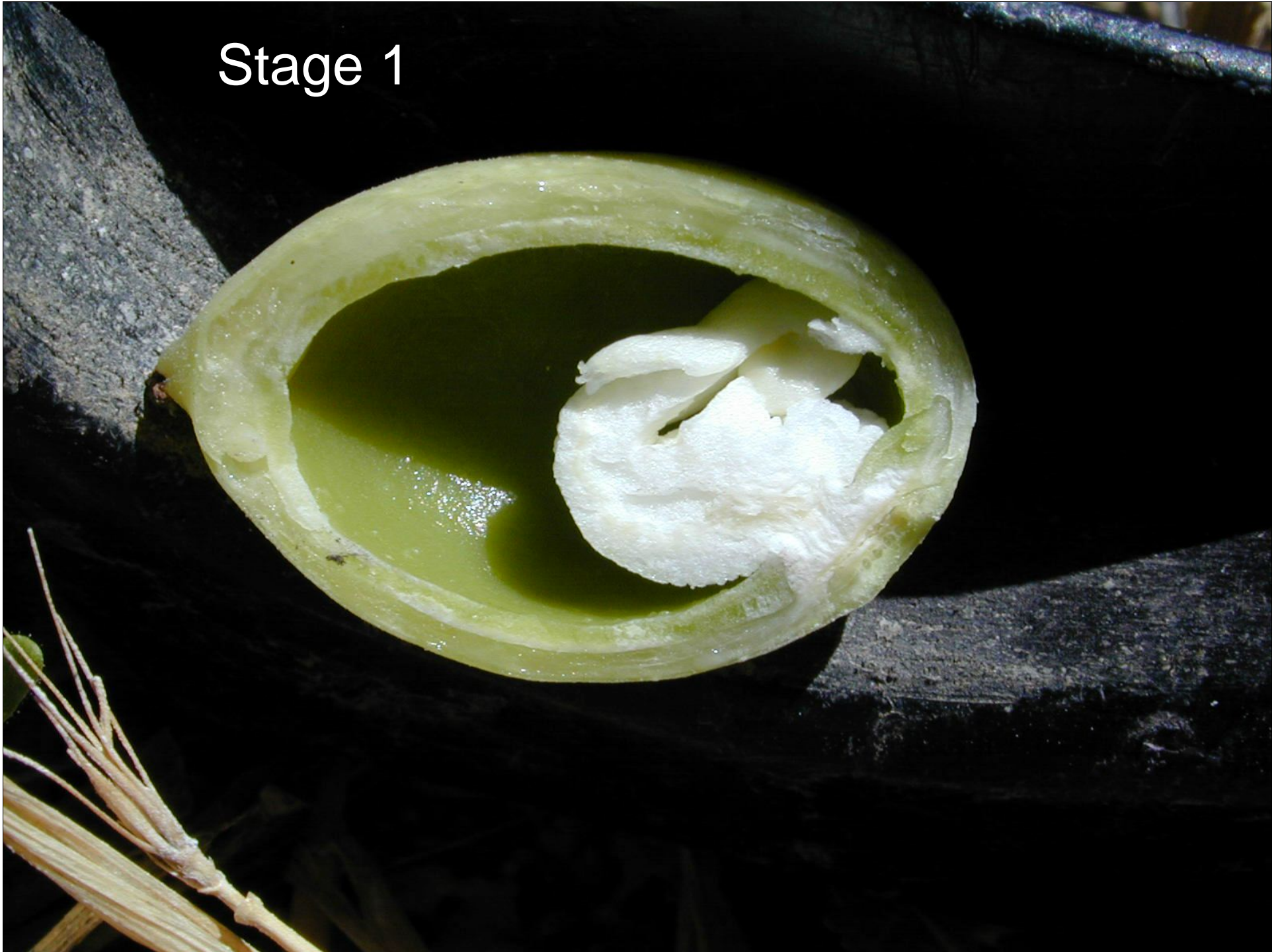
Are antitranspirants an appropriate drought strategy for pistachio?



Impacts of Stress During Growth Stages

Stage 1	Smaller fruit; reduced vegetative growth
Stage 2	Very little
Stage 3	Early. Lighter fruit; more blanks; reduced harvestability > reduced splitting Late. Lighter fruit; more blanks; reduced splitting > reduced harvestability
Postharvest	Very little; possible smaller nut size following year

Stage 1



Stage 2



Stage 3



RDI Strategies to Minimize Drought Impacts

	Date	Normal ETc in Period (inches)	36" Case RDI Factor (% ETc)	30" Case RDI Factor (% ETc)	24" Case RDI Factor (% ETc)	18" Case RDI Factor (% ETc)	12" Case RDI Factor (% ETc)
Stage 1	Apr 16-30	1.28	100	50	50	25	10
	May 1-15	2.33	100	50	50	25	10
Stage 2	May 16-31	3.58	50	25	25	10	10
	Jun 1-15	4.81	50	25	25	10	10
	Jun 16-30	5.38	50	25	25	10	10
Stage 3	Jul 1-15	5.04	100	100	75	75	50
	Jul 16-31	4.86	100	100	75	75	50
	Aug 1-15	4.90	100	100	75	75	50
	Aug 16-31	3.94	100	100	75	75	50
	Sept. 1-15	3.27	100	100	75	75	50
PH	Sept. 16-30	2.21	100	25	25	25	10
	Oct 1-15	1.39	100	25	25	25	10
	Oct 16-31	0.74	100	25	25	25	10
	Nov 1-15	0.39	100	25	25	25	10
	Seasonal ETc	44.1	37.2	28.4	22.9	17.2	11.2