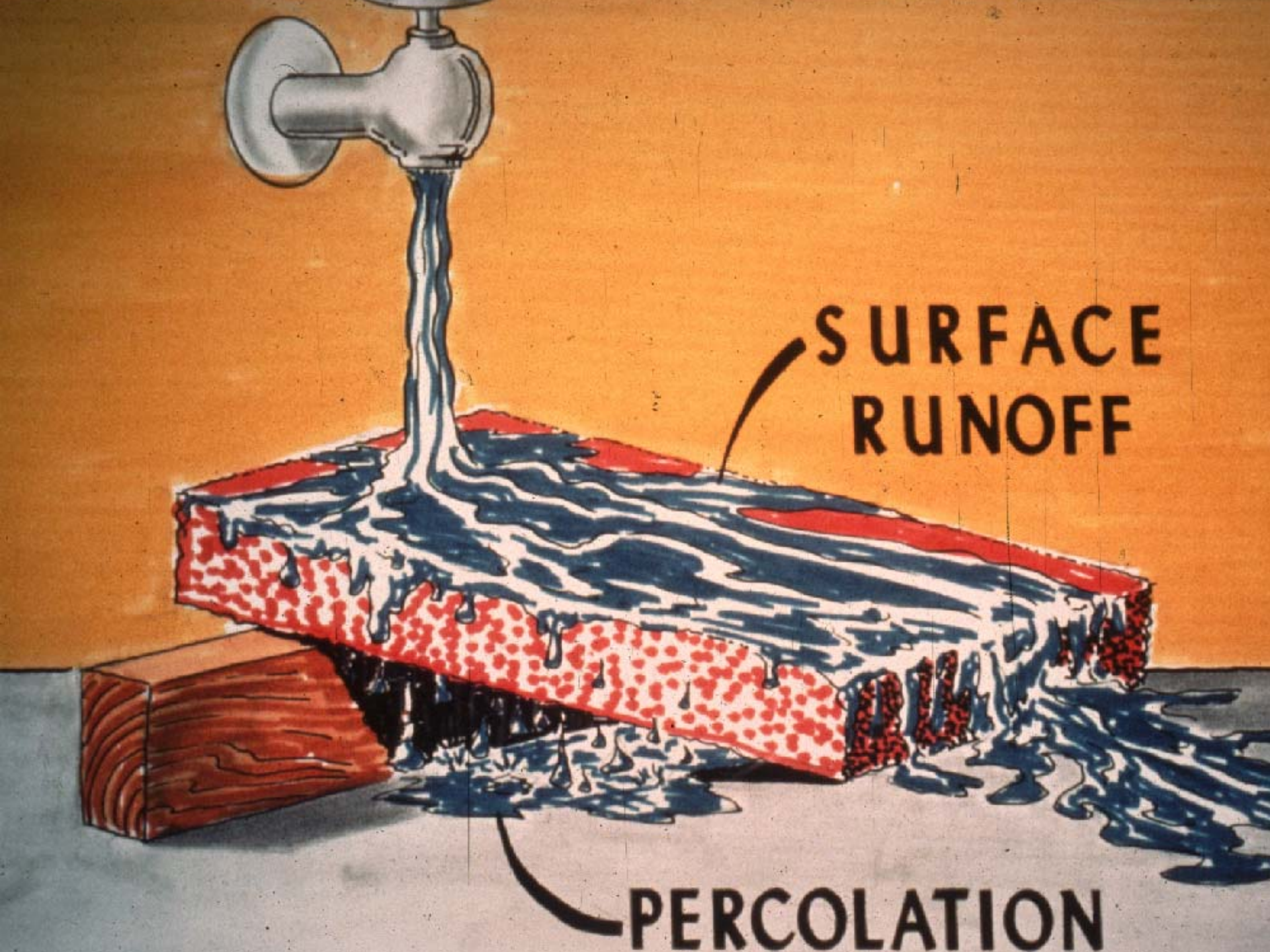
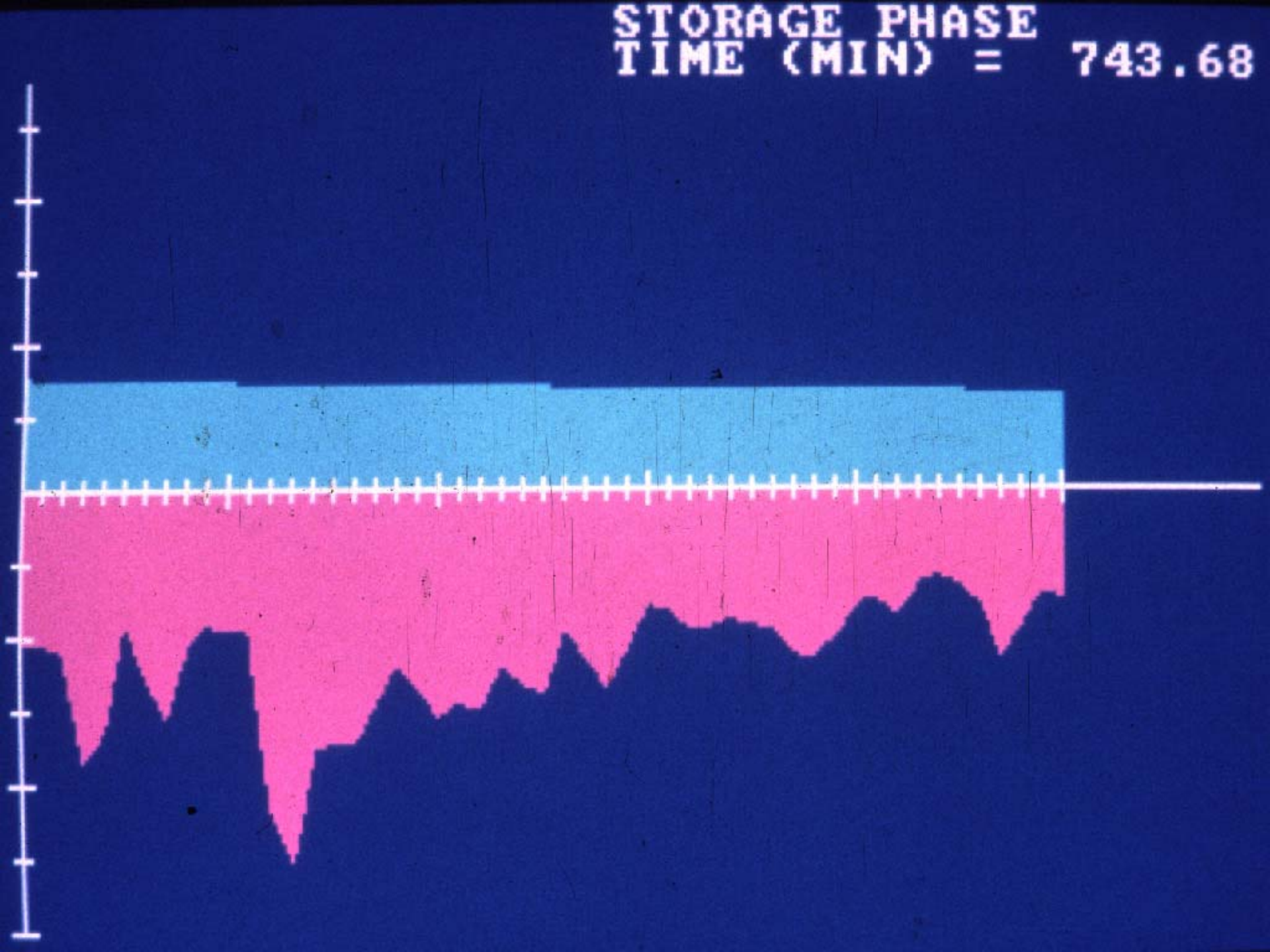
Reducing Agricultural Water Use

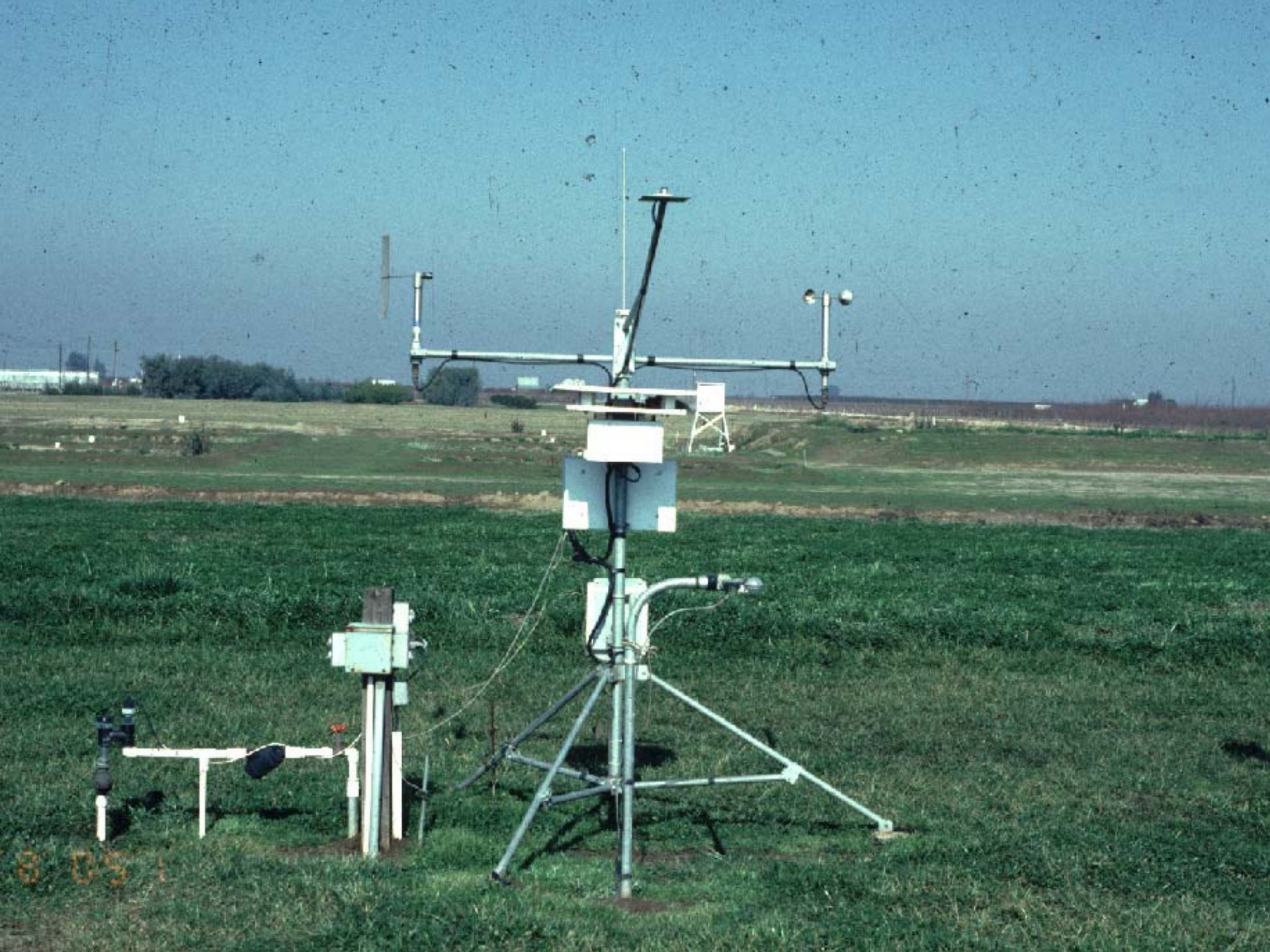
1. Changing systems.
2. Improving management.
3. Reducing consumption; evapotranspiration (ET).


SURFACE
RUNOFF
PERCOLATION

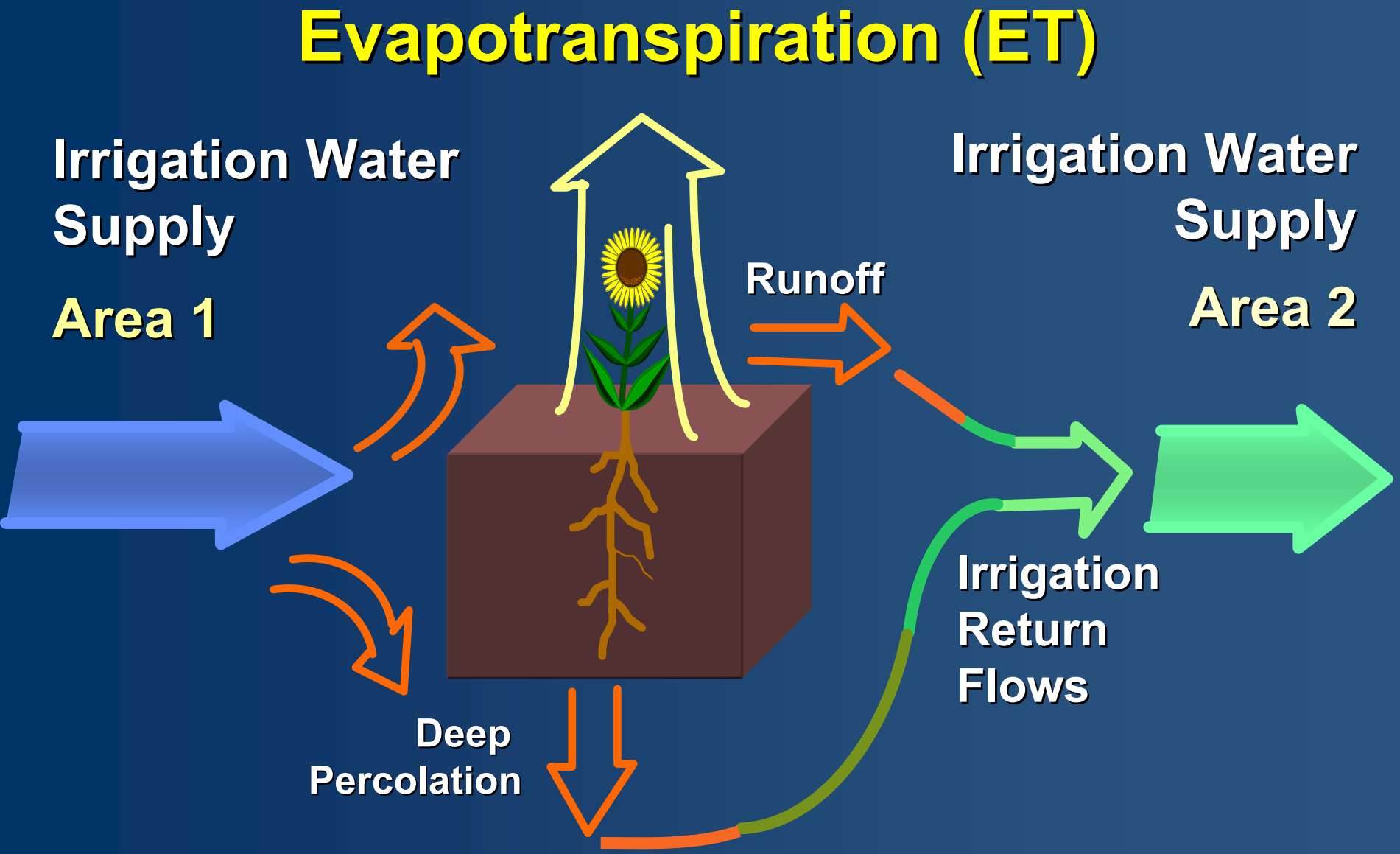

STORAGE PHASE
TIME (MIN) = 743.68

Reducing Agricultural Water Use

1. Changing systems.
2. Improving management.
3. Reducing consumption; evapotranspiration (ET)



Water Use or Water Consumption



Reducing Agricultural Water Use

1. Changing systems.
2. Improving management.
3. Reducing consumption; evapotranspiration (ET)

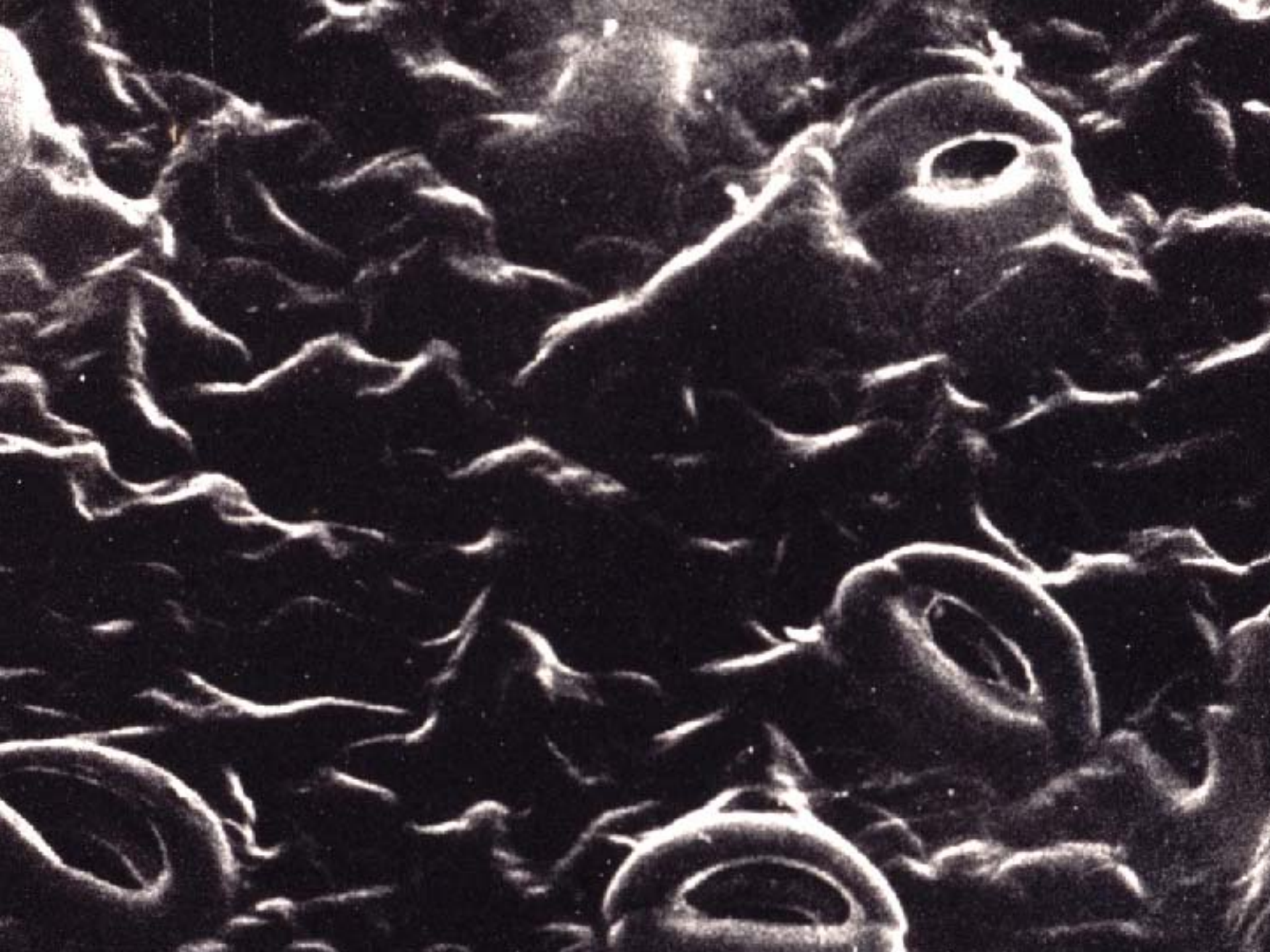
To reduce consumption, only options are:

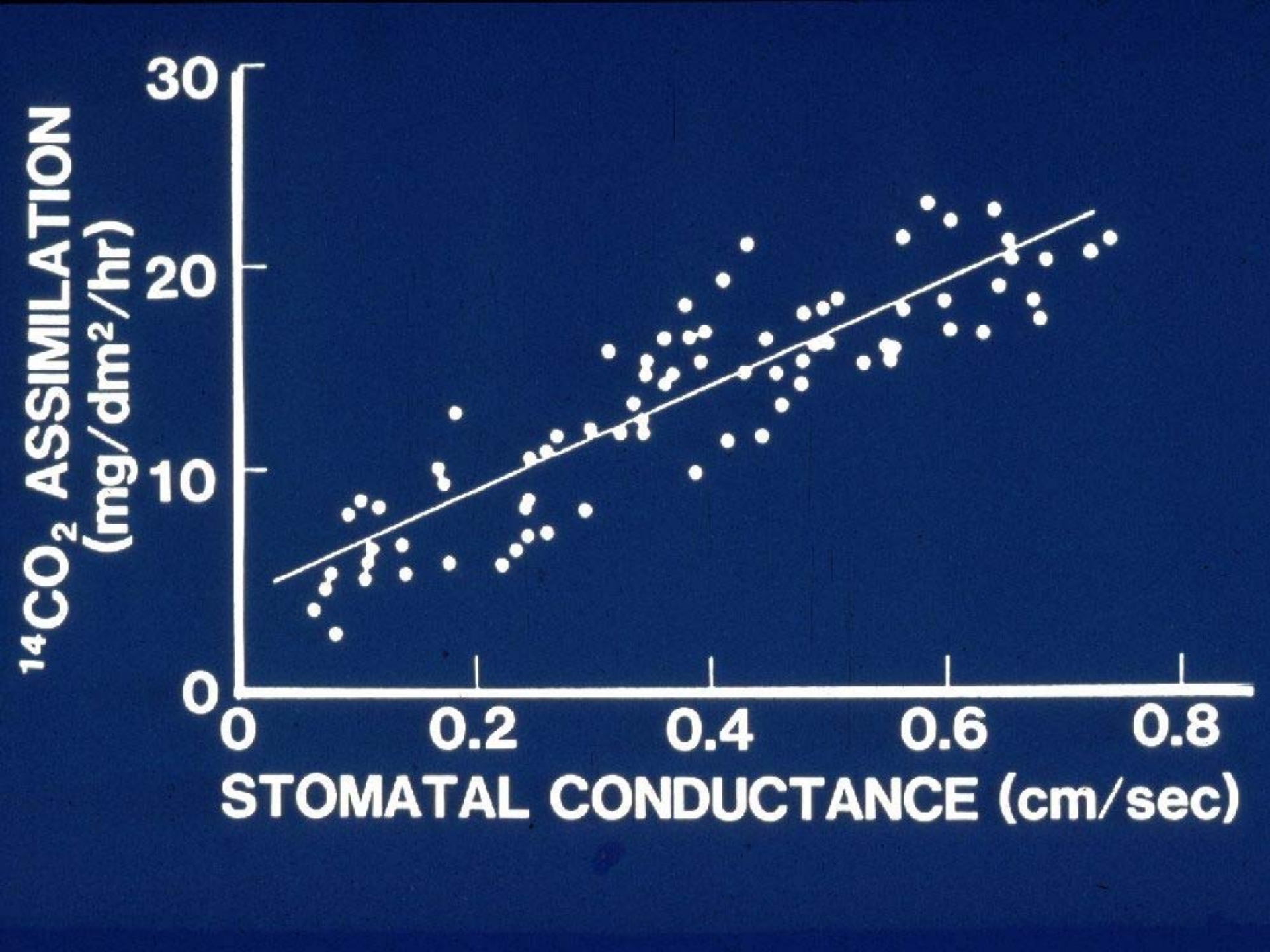
decrease

E and/or T

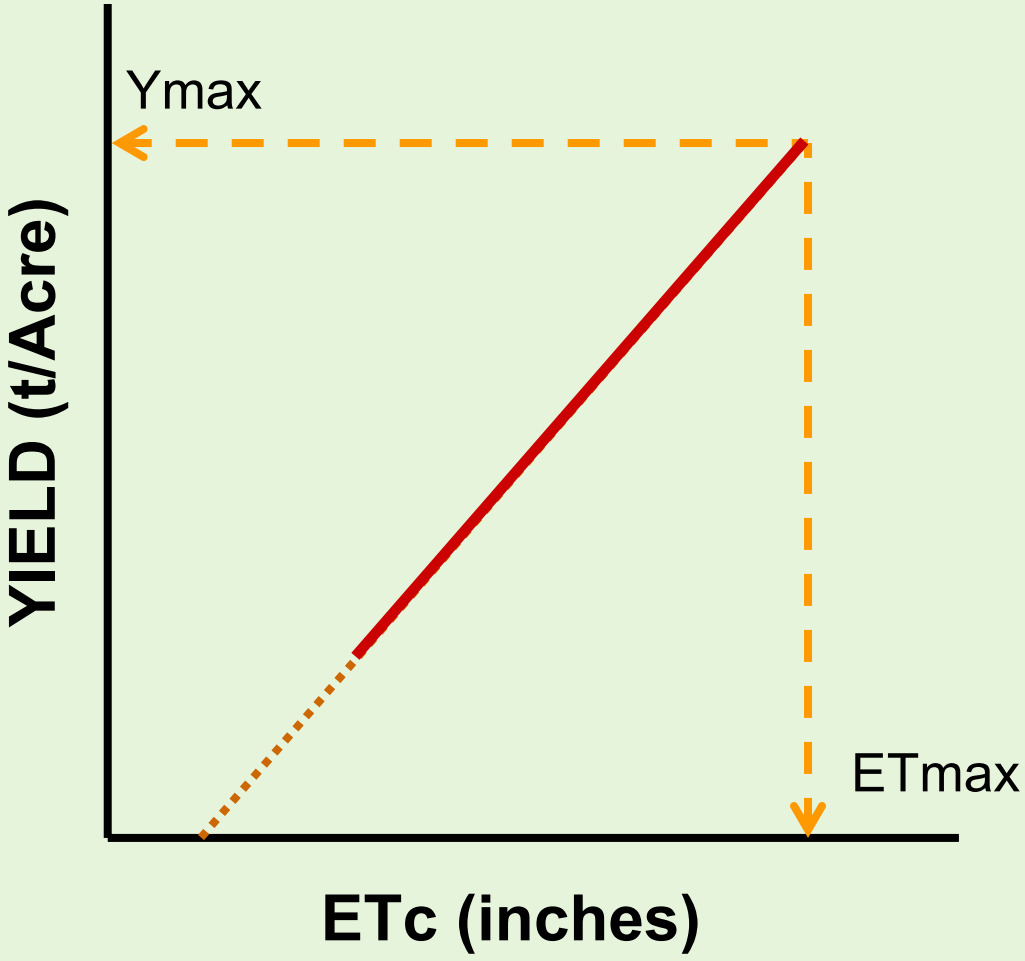
CATERPILLAR
QUINN

Can we Reduce Transpiration?




$^{14}CO_2$ ASSIMILATION
(mg/dm²/hr)
30
20
10
0
0
0.2
0.4
0.6
0.8
STOMATAL CONDUCTANCE (cm/sec)

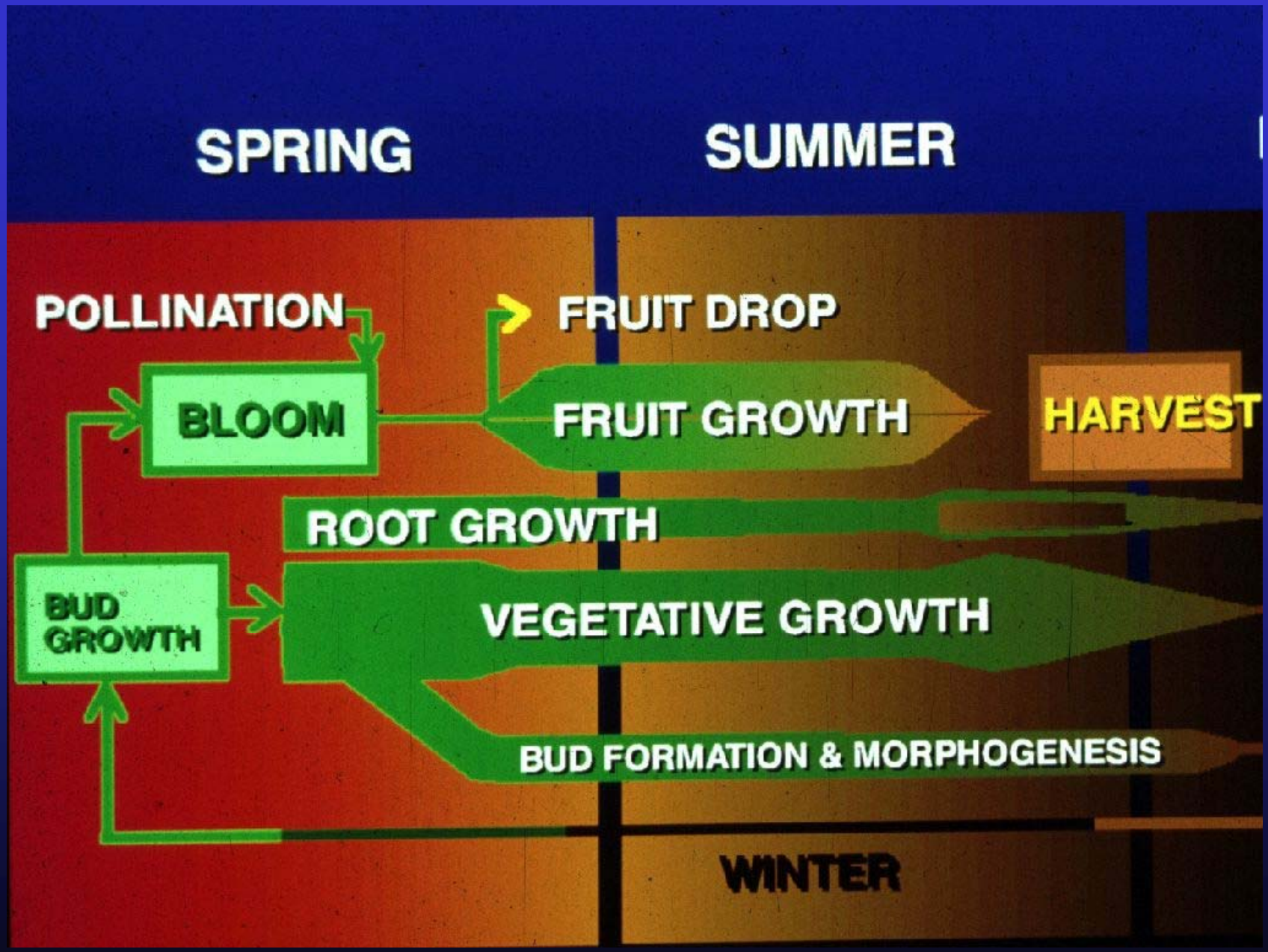
Typical Production Function
(Field &Vegetable Crops)



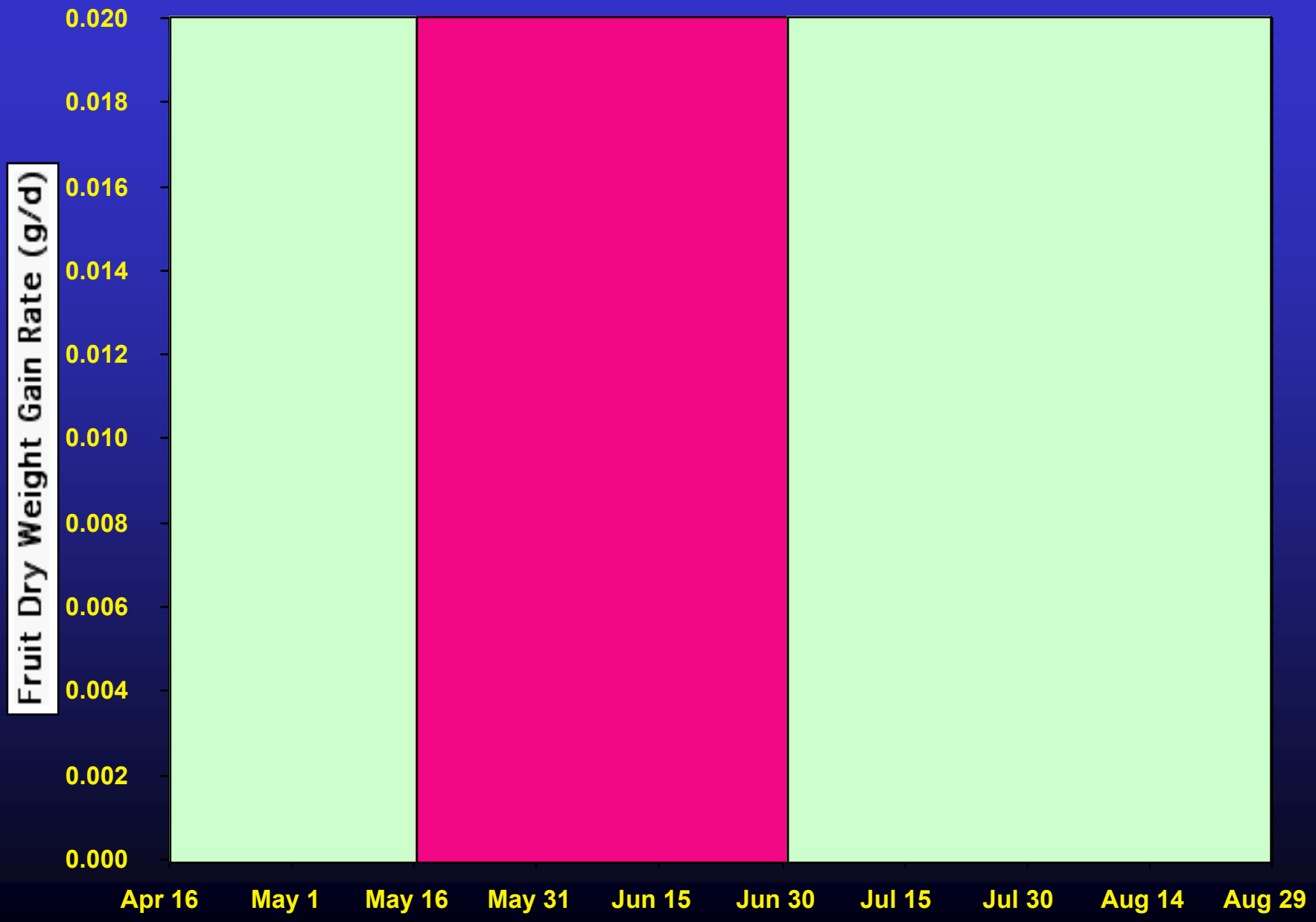
Regulated Deficit Irrigation (RDI):

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

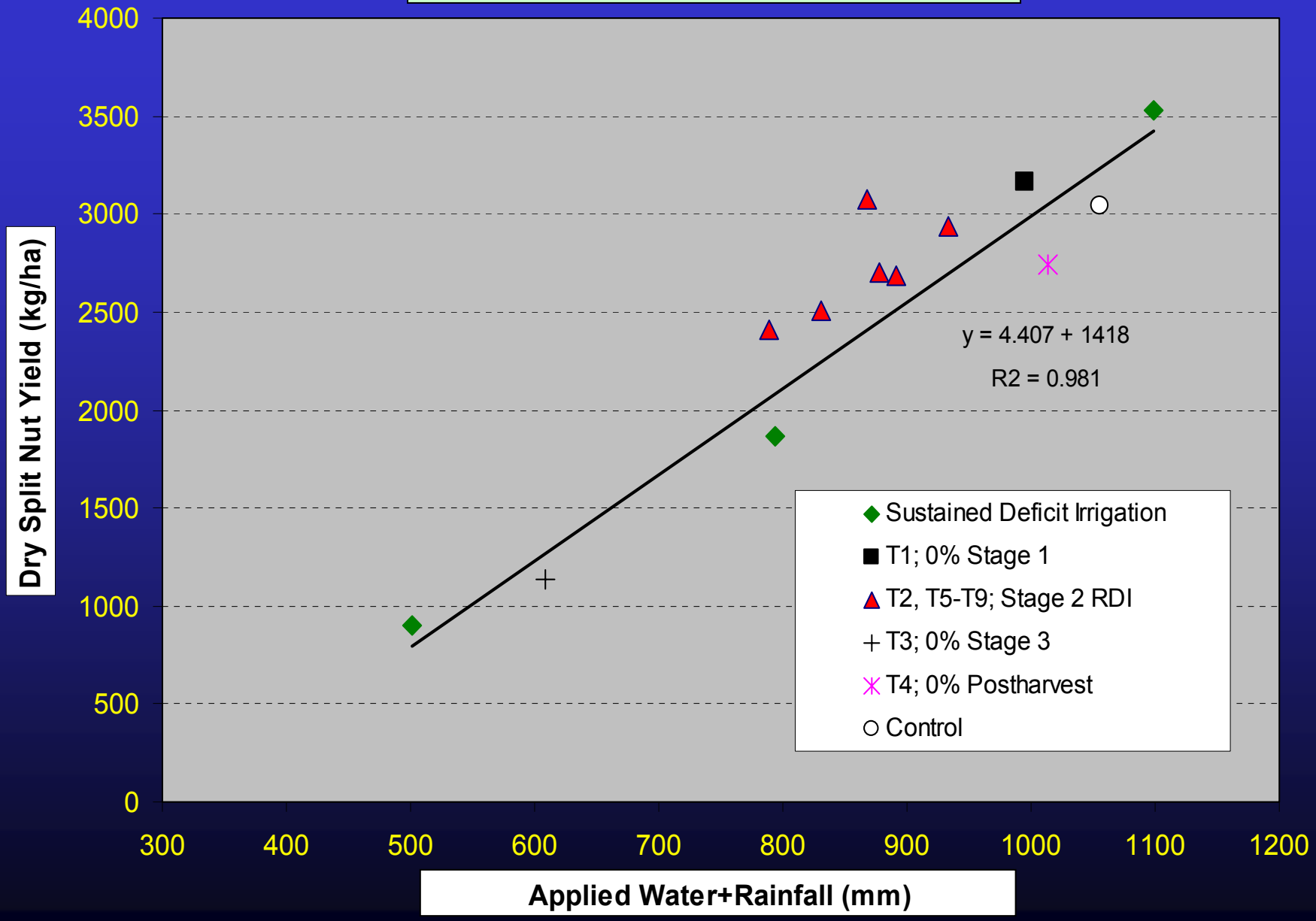
Goals: Reduced water use; higher farm profits.


SPRING
SUMMER
POLLINATION
FRUIT DROP
BLOOM
FRUIT GROWTH
HARVEST
ROOT GROWTH
BUD GROWTH
VEGETATIVE GROWTH
BUD FORMATION & MORPHOGENESIS
WINTER

Pistachio Nut Development



Pistachio Production Function

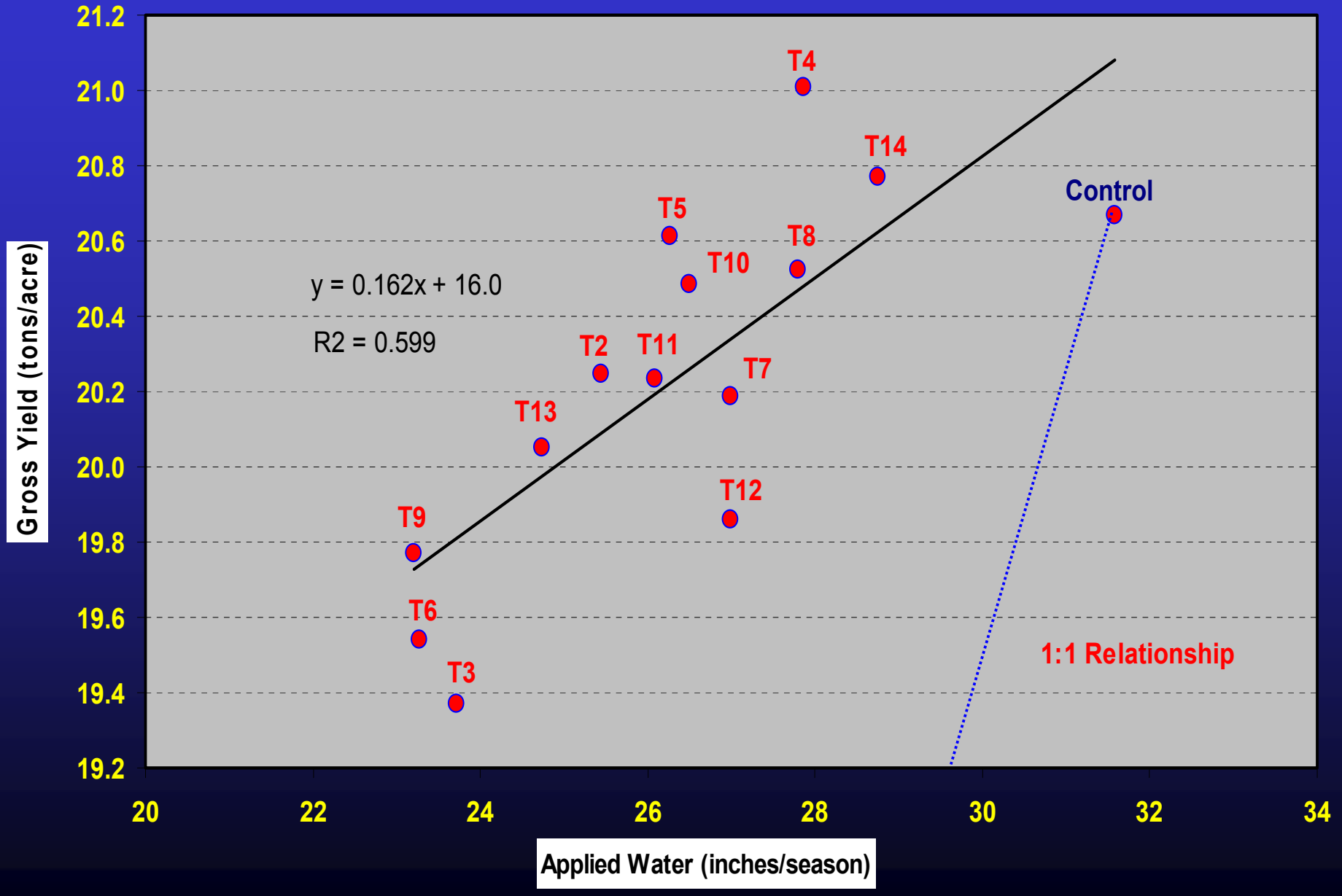


Pistachio RDI; Kettleman City; 1991-92 Mean Results (last 2 yrs. of 4 yr. study)

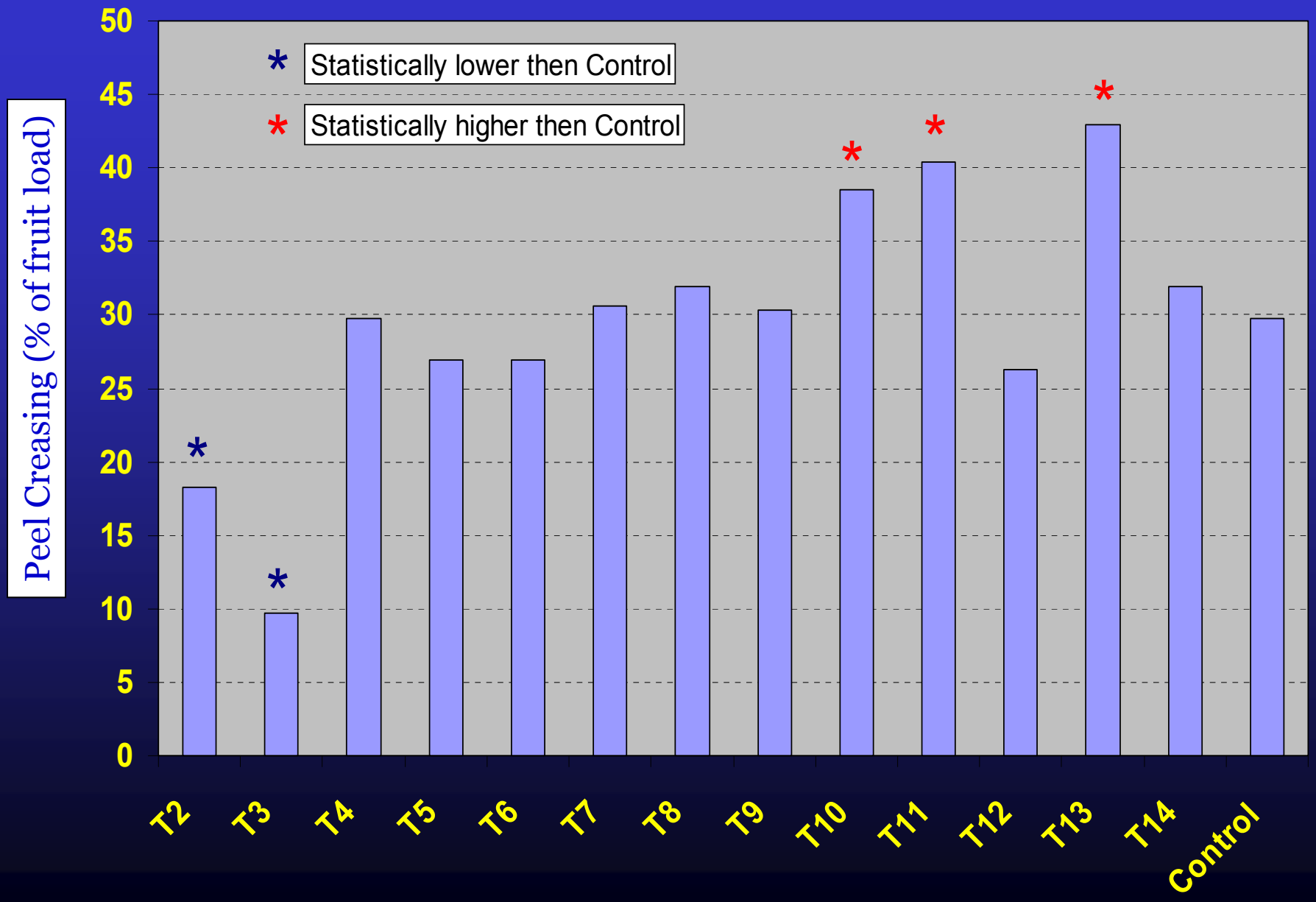
Water Deprivation Treatment	Stress Time Period	Individual Split Nut Weight	Blanks and Aborted Nuts	Shell Splitting
		(g/nut)	(% nut load)	(% filled nuts)
Stage 1	Leafout-Mid May	1.24 b *	21.5 ab	87.8 d
Stage 2	Mid May-Early July	1.29 bc	22.0 ab	73.6 b
Stage 3	Early July-Mid Sept.	1.18 a	27.6 c	43.6 a
Post Harvest	Mid Sept.-Leaf Drop	1.30 bc	22.8 abc	78.8 bc
Control	---	1.32 c	22.5 ab	79.5 bc

*Values not followed by the same letter are statistically different according to Fisher's Least Significant Difference Method (p=0.05).

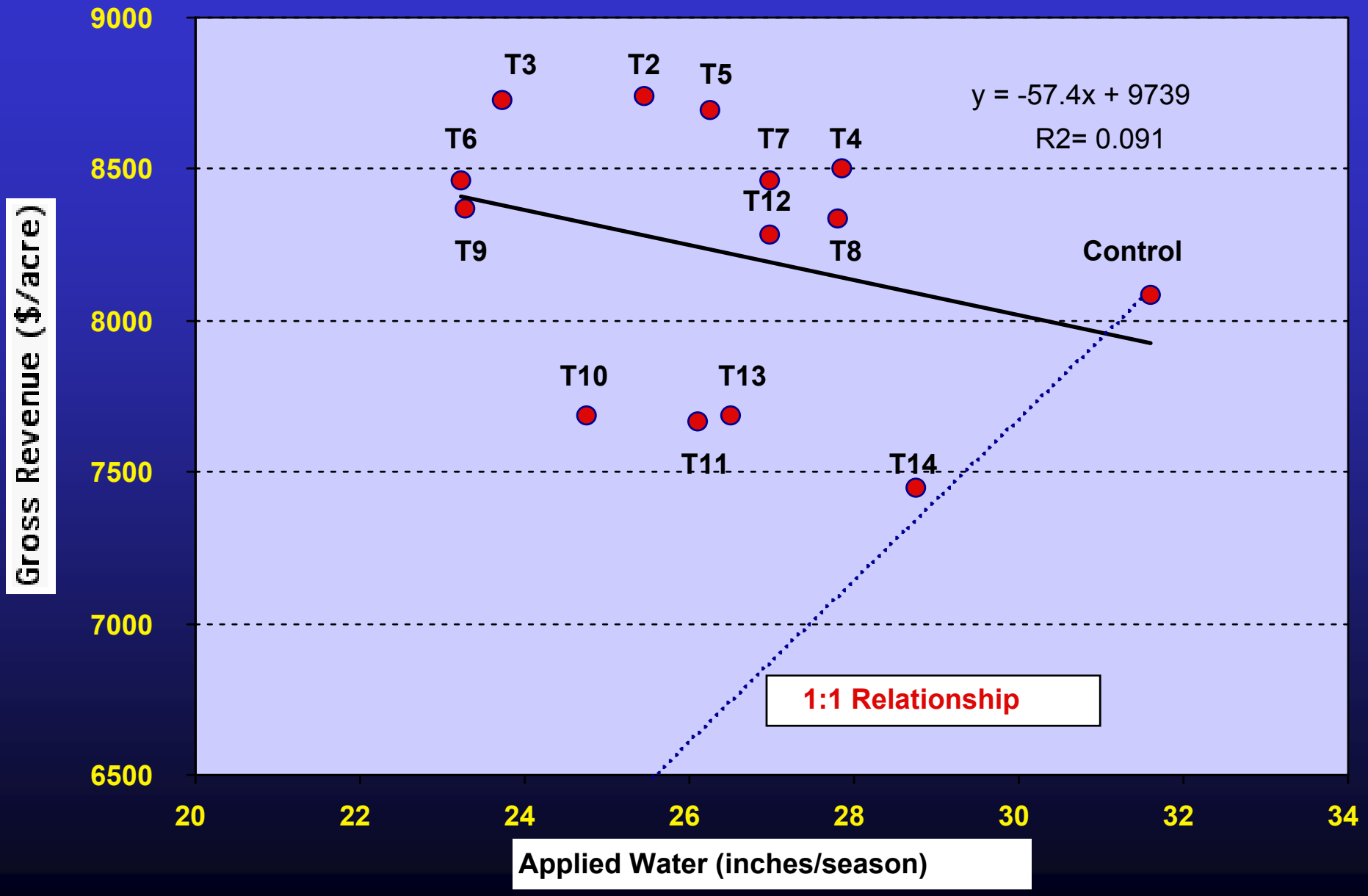
Mature Navel Oranges; San Joaquin Valley; 3 Season Mean



Peel Creasing; San Joaquin Valley; 3 Season Mean

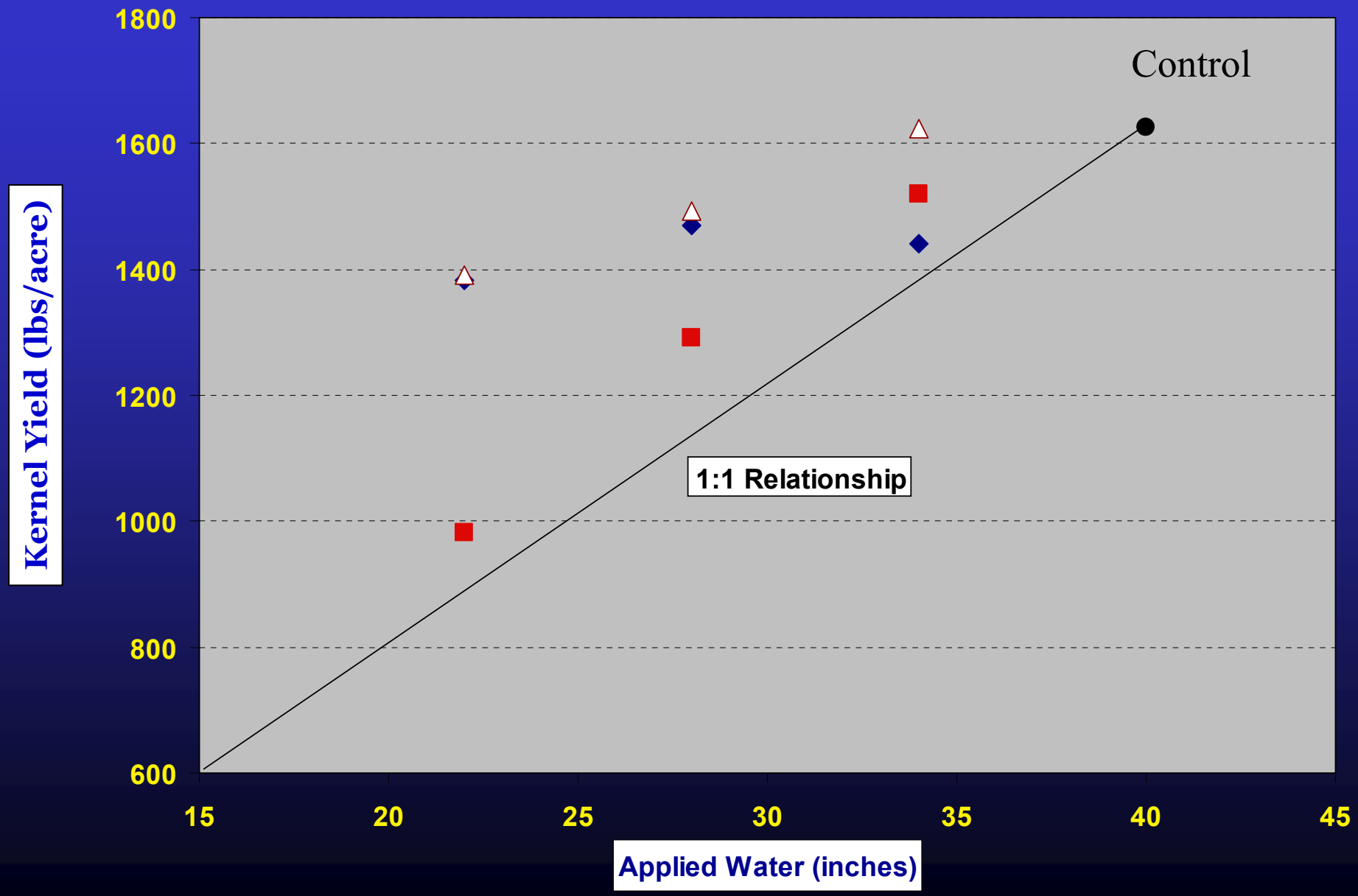


Mature Navel Oranges; San Joaquin Valley; 3 Season Mean

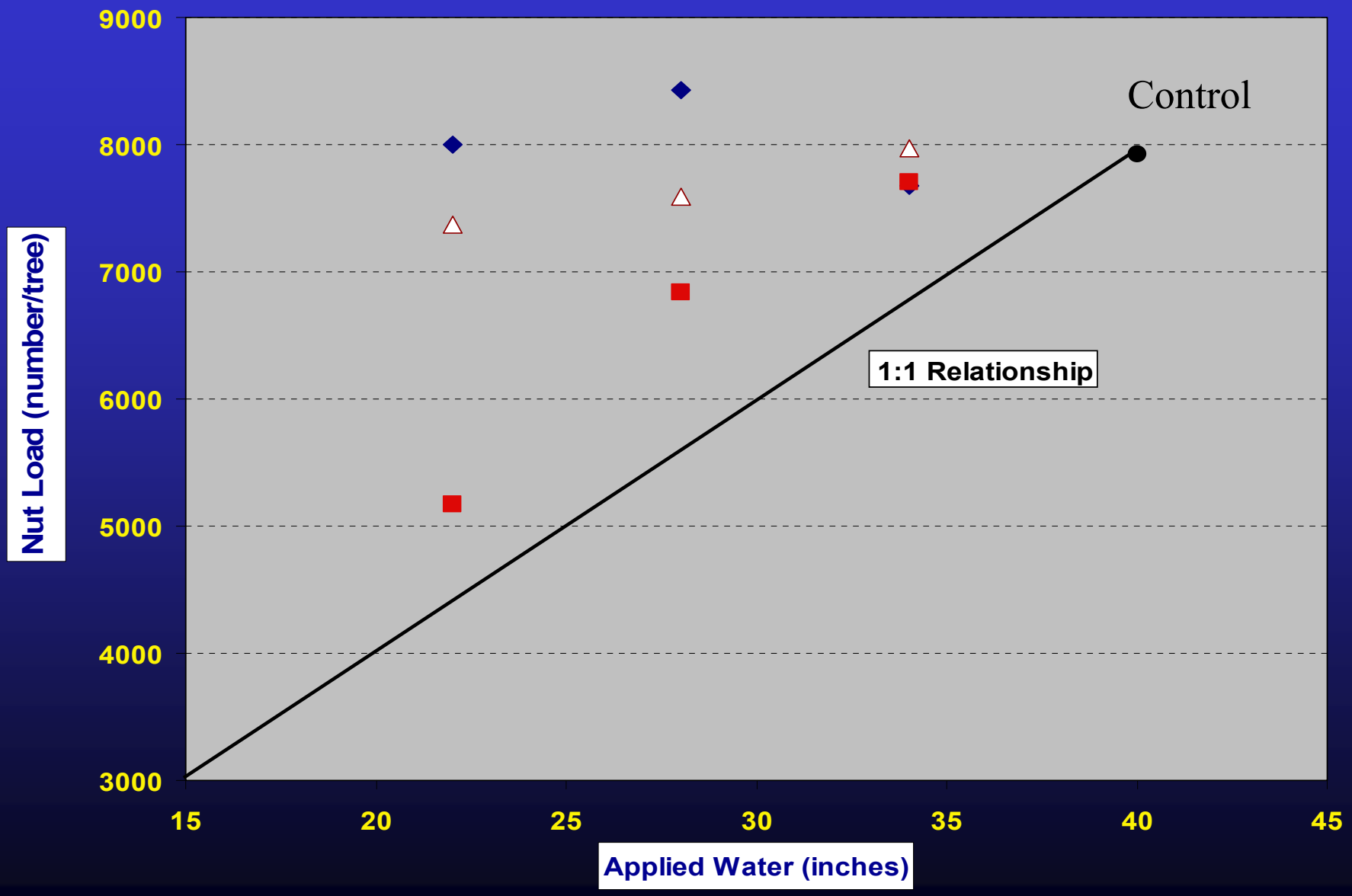


89 8 17

Almond RDI; McFarland, Mean 1995-96



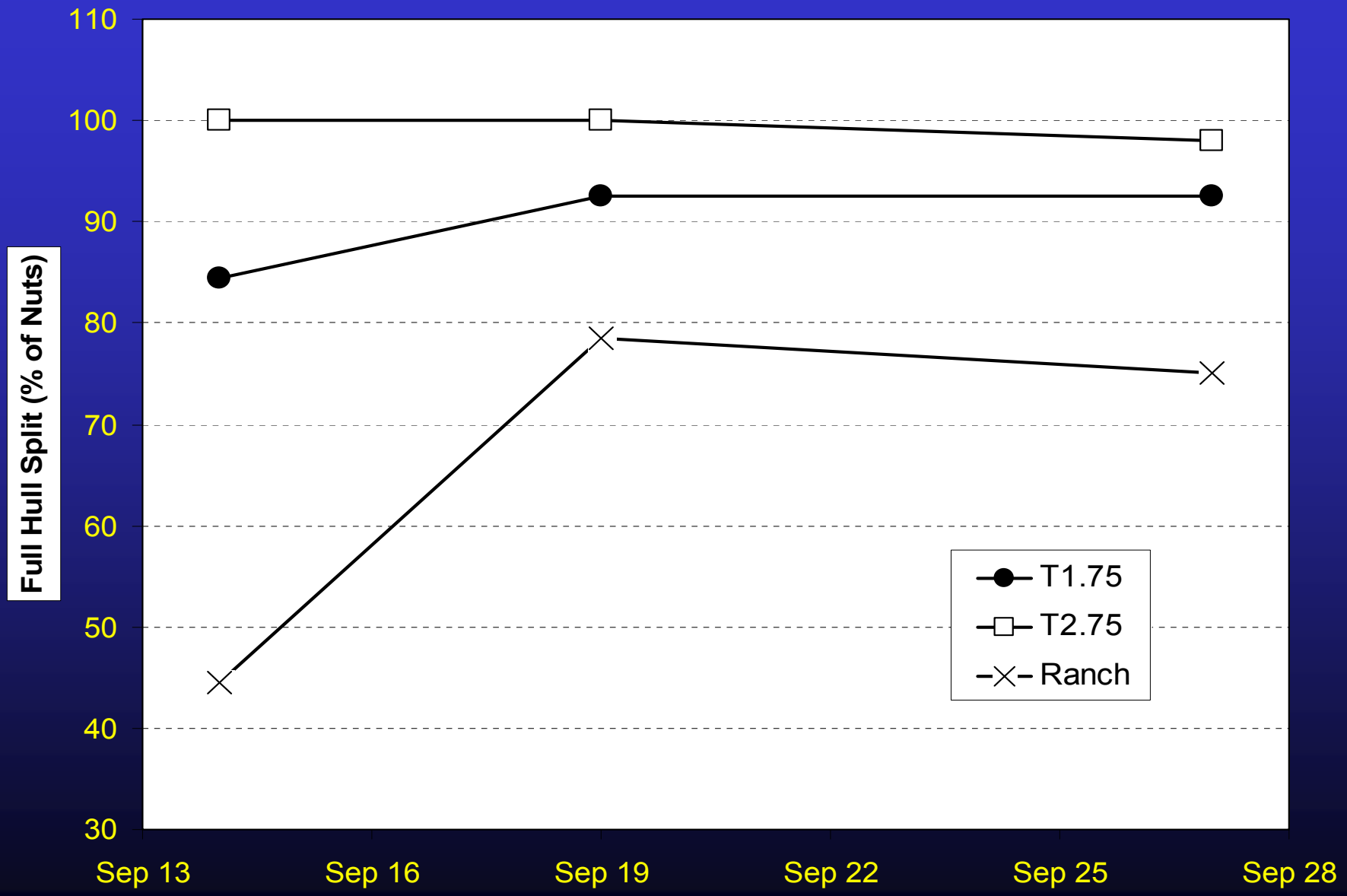
Almond RDI; McFarland, Mean 1995-96



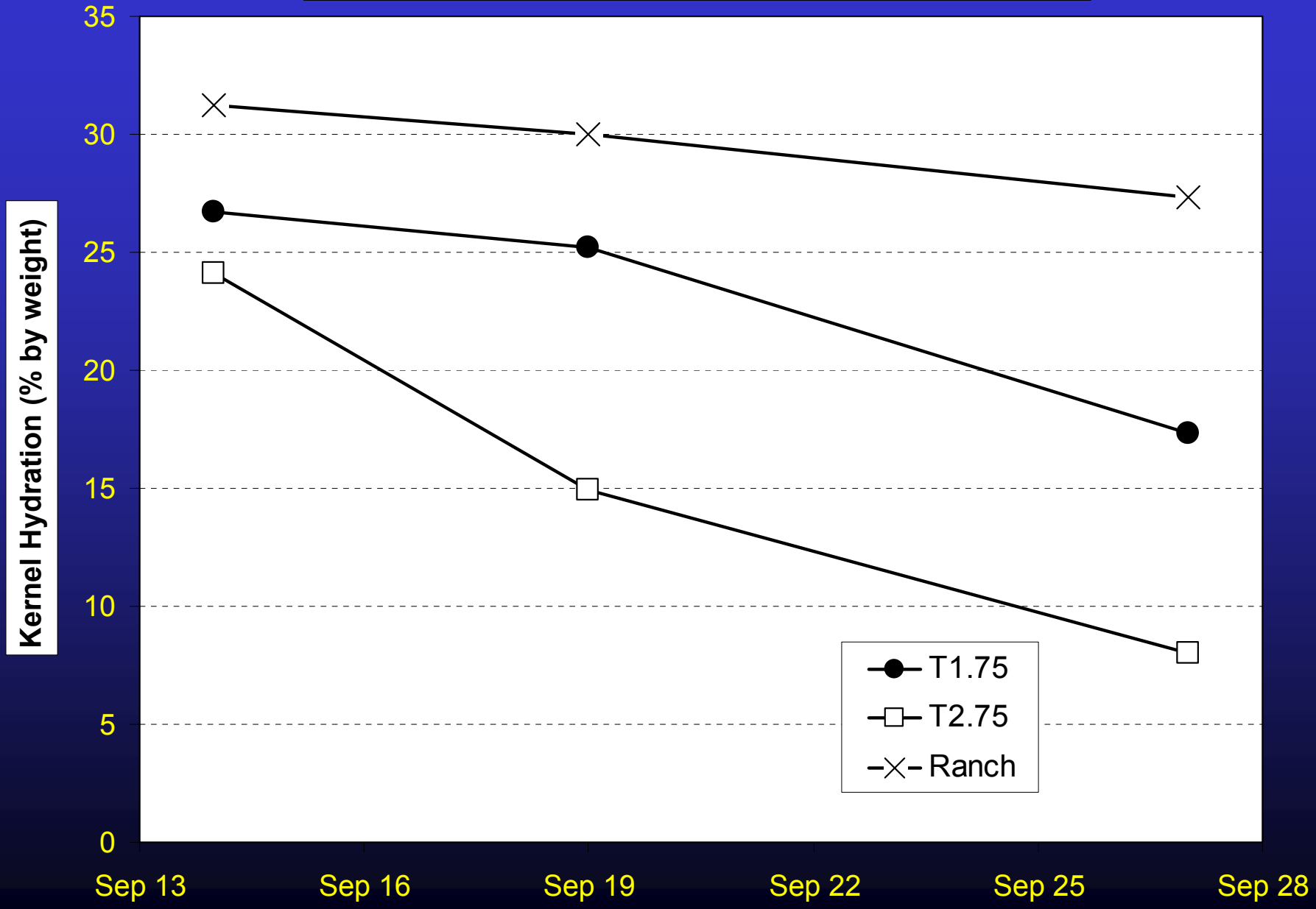
RDI Effects on Almond Hull Rot; McFarland, 1997

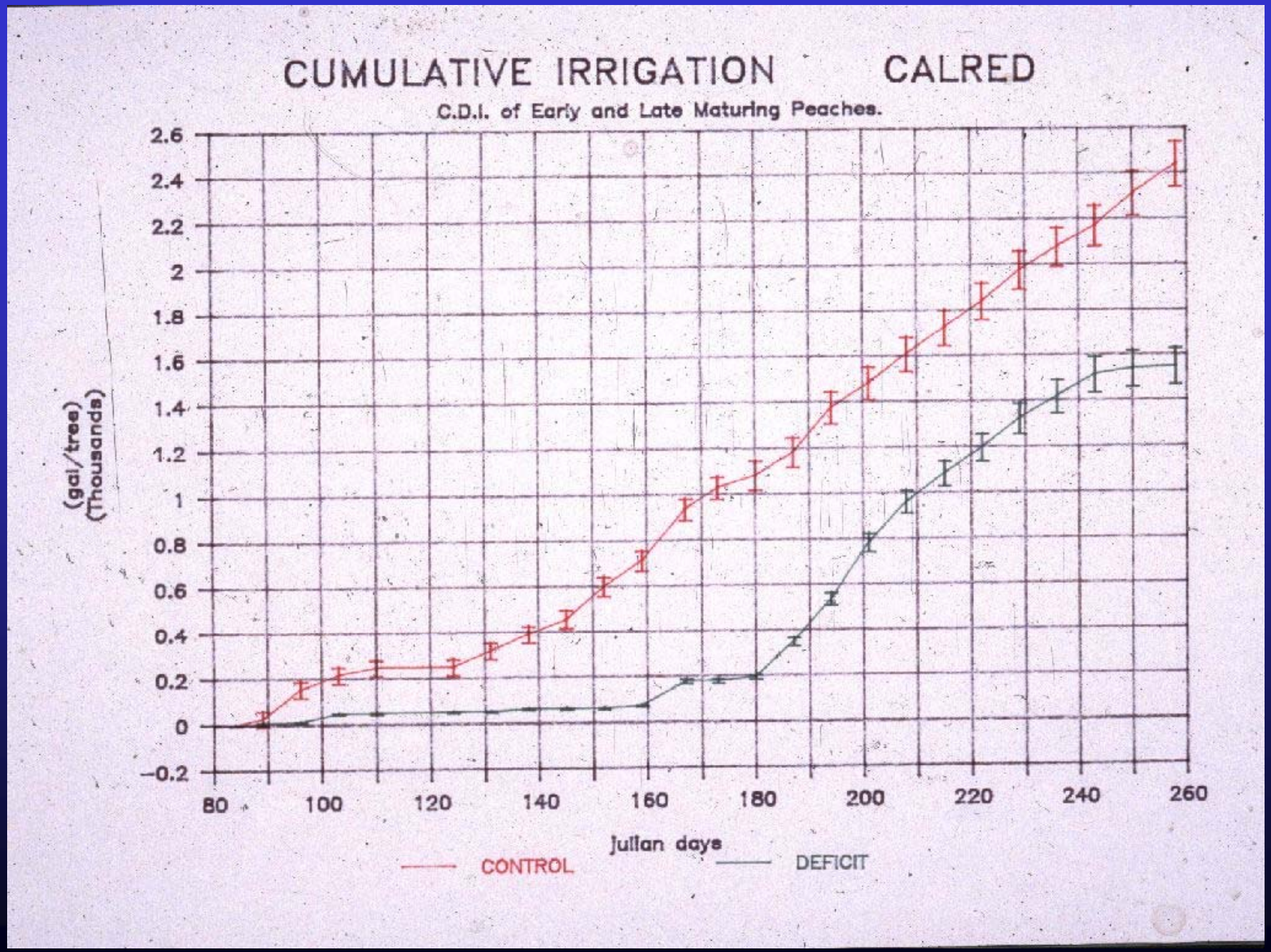
	Hull Rot Strikes (#/tree)	Dead Wood (inches/tree)	Kernel Wt. (gms)	Shell Wt. (gms)	Hull Wt. (gms)	Whole Unit Wt. (gms)
Control	297	508	1.19	0.93	4.12	6.24
RDI	49	33	1.14	0.95	4.19	6.28
RDI % Dif	-84.5	-93.5	-4.2	+2.2	+1.7	+0.6
	*	*	NSD	NSD	NSD	NSD

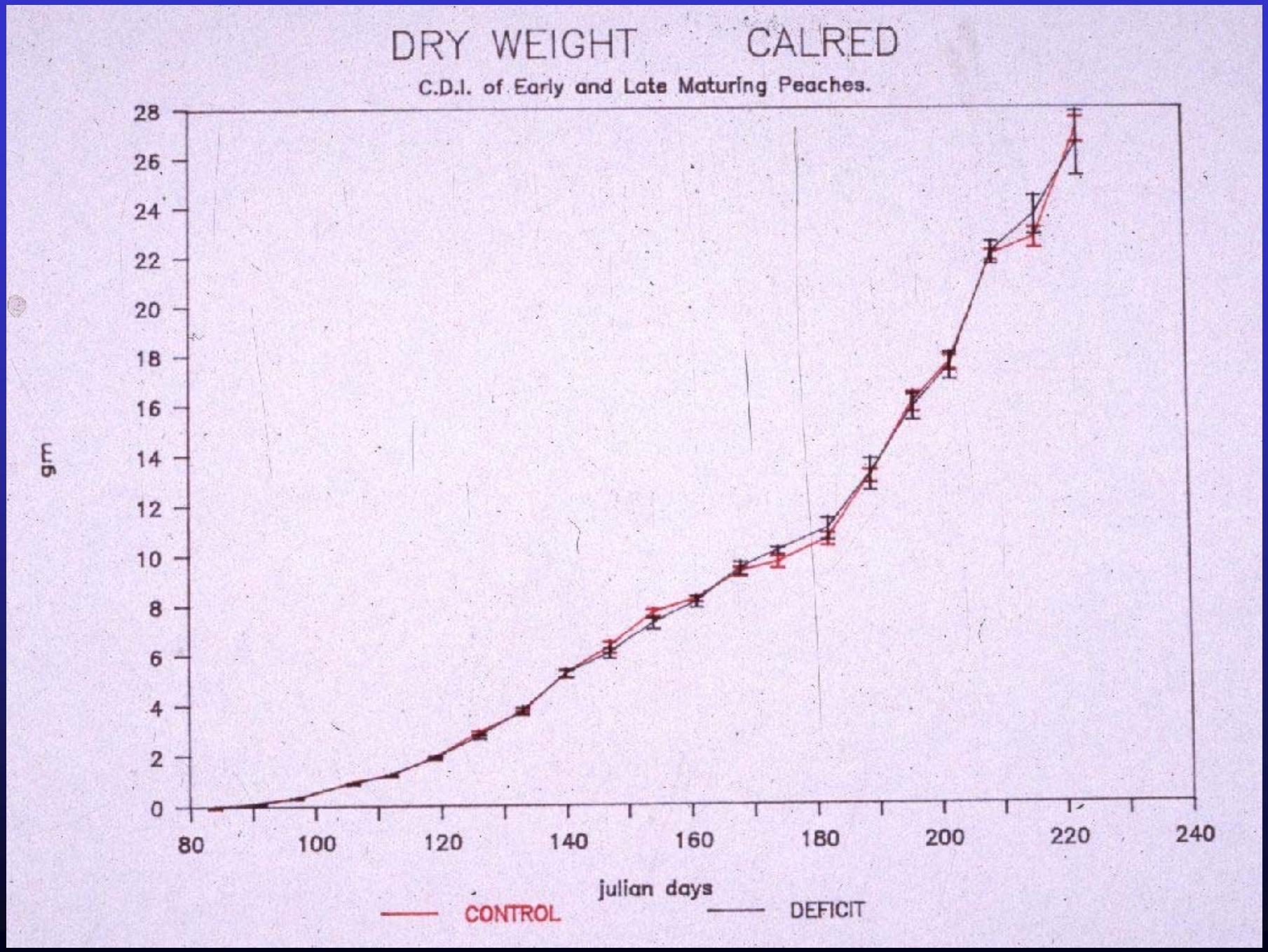
Almond RDI; San Joaquin Valley, 2001

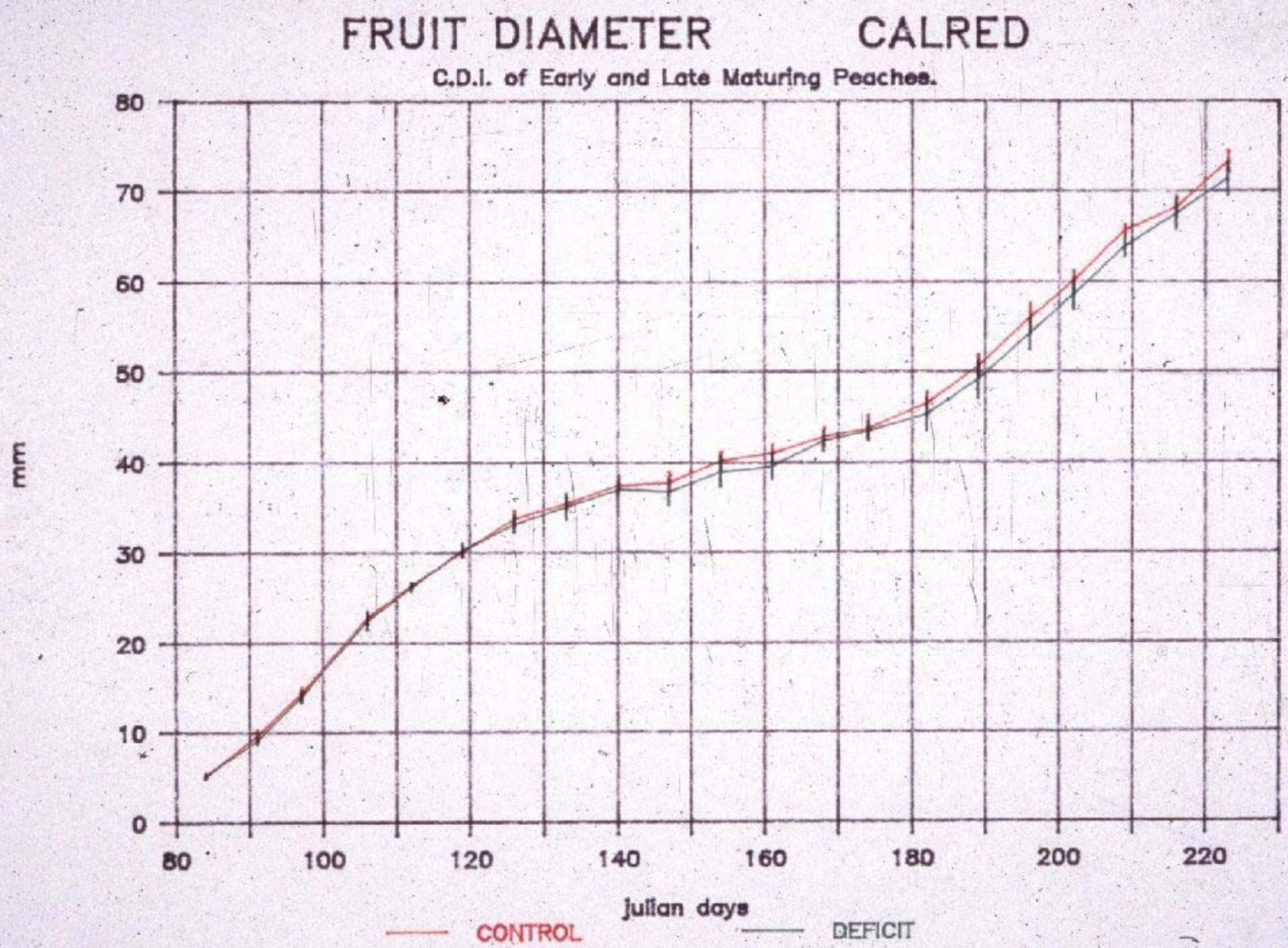


Almond RDI; San Joaquin Valley, 2001

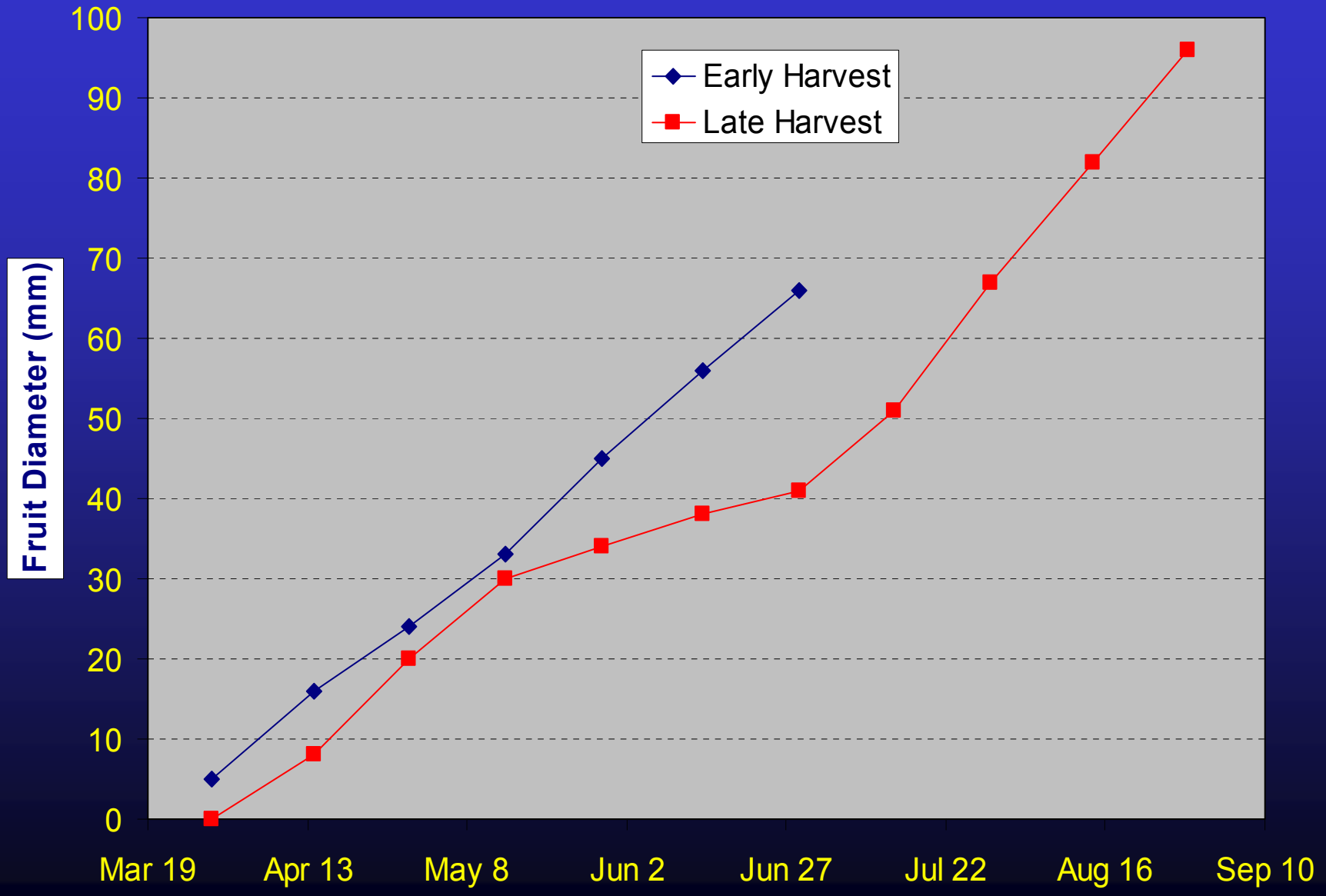



CUMULATIVE IRRIGATION CALRED
C.D.I. of Early and Late Maturing Peaches.
(gal/tree)
(Thousands)
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
80
100
120
140
160
180
200
220
240
260
Julian days
CONTROL
DEFICIT


DRY WEIGHT CALRED
C.D.I. of Early and Late Maturing Peaches.
gm
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
80
100
120
140
160
180
200
220
240
julian days
CONTROL
DEFICIT


FRUIT DIAMETER CALRED
C.D.I. of Early and Late Maturing Peaches.
mm
80
70
60
50
40
30
20
10
0
80
100
120
140
160
180
200
220
Julian days
CONTROL
DEFICIT

Peach Fruit Growth; Early vs. Late Harvest



'89 5 2

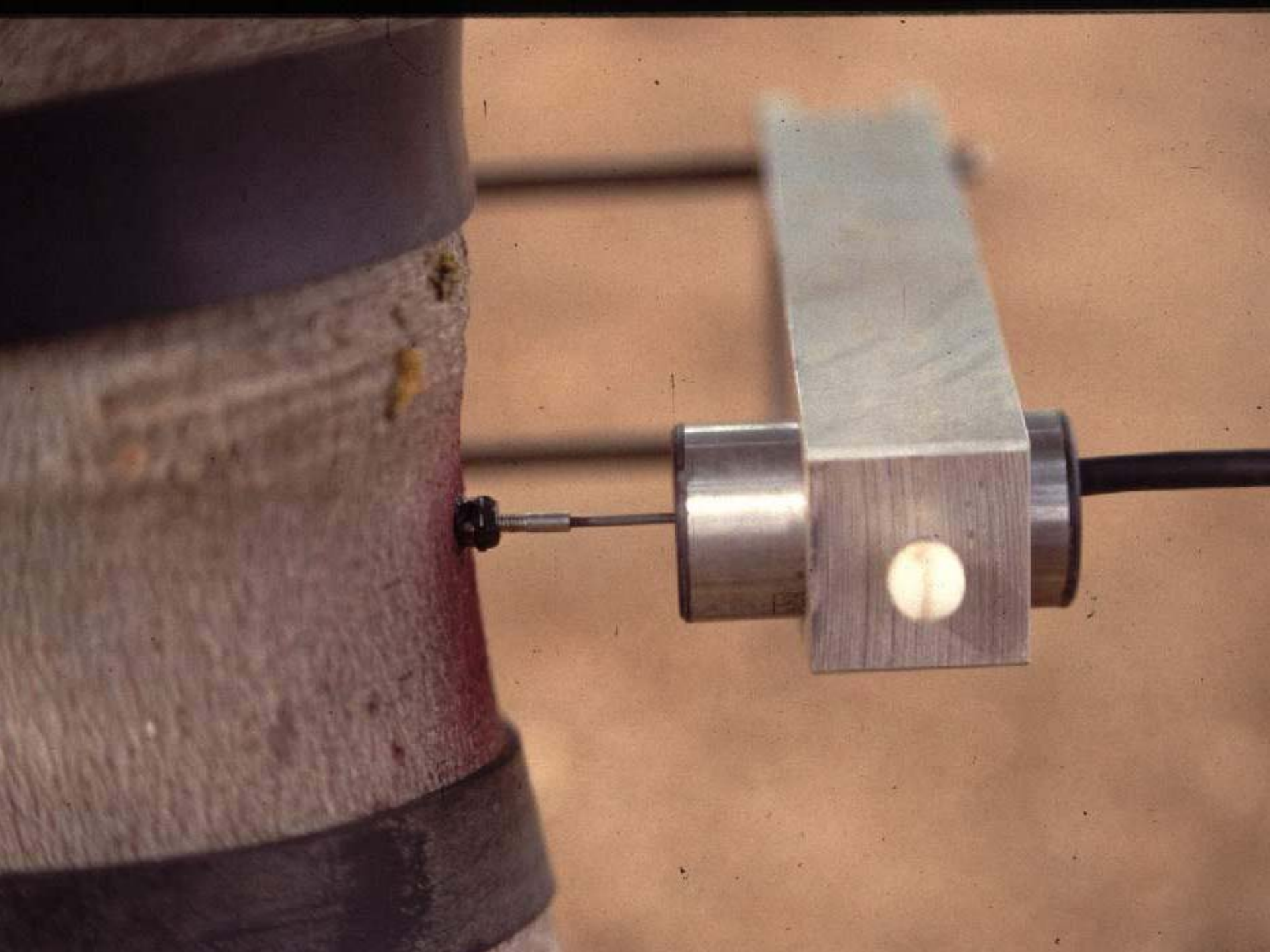
DC-PRINTER
PRINTER FOR DIGITAL
JAPAN MICROMETER MFG. CO., LTD.
FOWISO
LIMIT
MODE
NORMAL
LIMIT
POWER
OFF
ON
FEED
START
RESTART
MX-2-4V
9.86

Estimated Statewide Irrigation Water Savings Using RDI

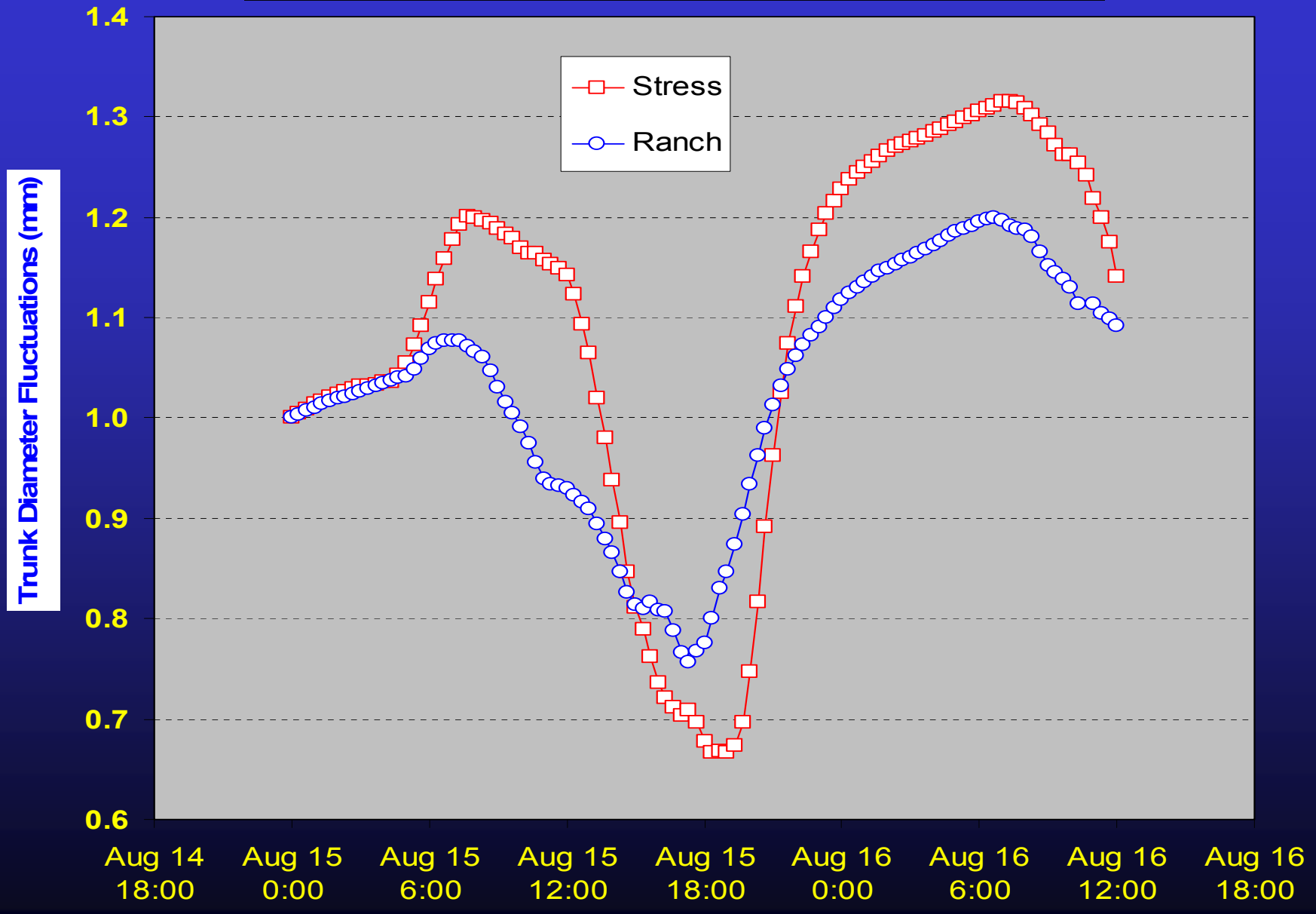
Crop	Bearing Acreage (acres)	Estimated Savings (inches)	Total Water Saved (acre-ft)
Almonds	530,000	12	530,000
Wingegrapes	480,000	6	240,000
Citrus	244,000	6	122,000
Pistachios	78,000	12	78,000
Prunes	76,000	9	56,000
Peaches	70,000	6	35,000
Olives	36,000	8	24,000
Apples and Pears	49,000	6	24,000
Walnuts	196,000	Unknown	Unknown
Total			**1,109,000**

Why isn't RDI more commonly practiced?

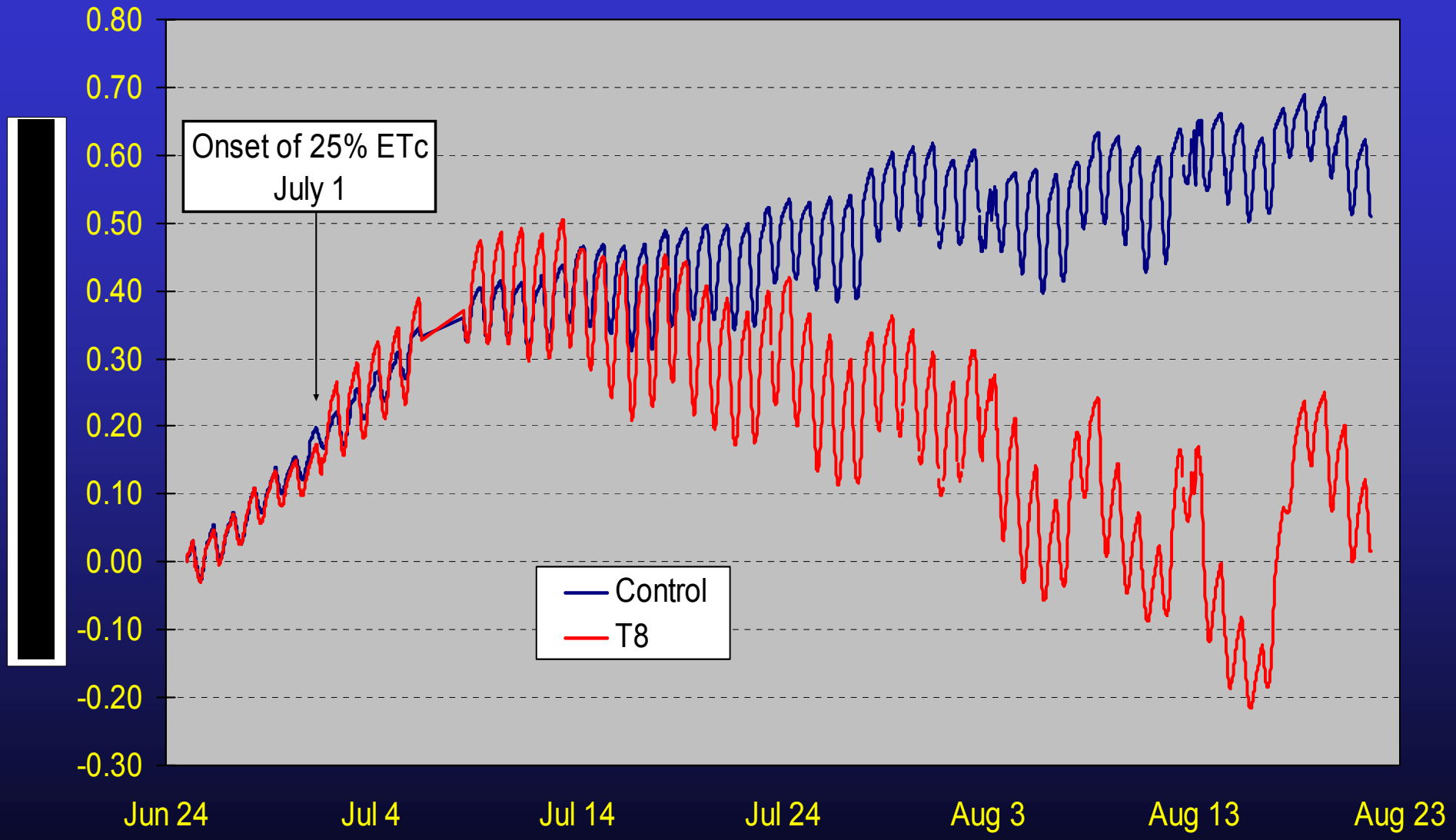
1. Real/perceived risk.
2. More complex management.
3. Holes in knowledge and technology.

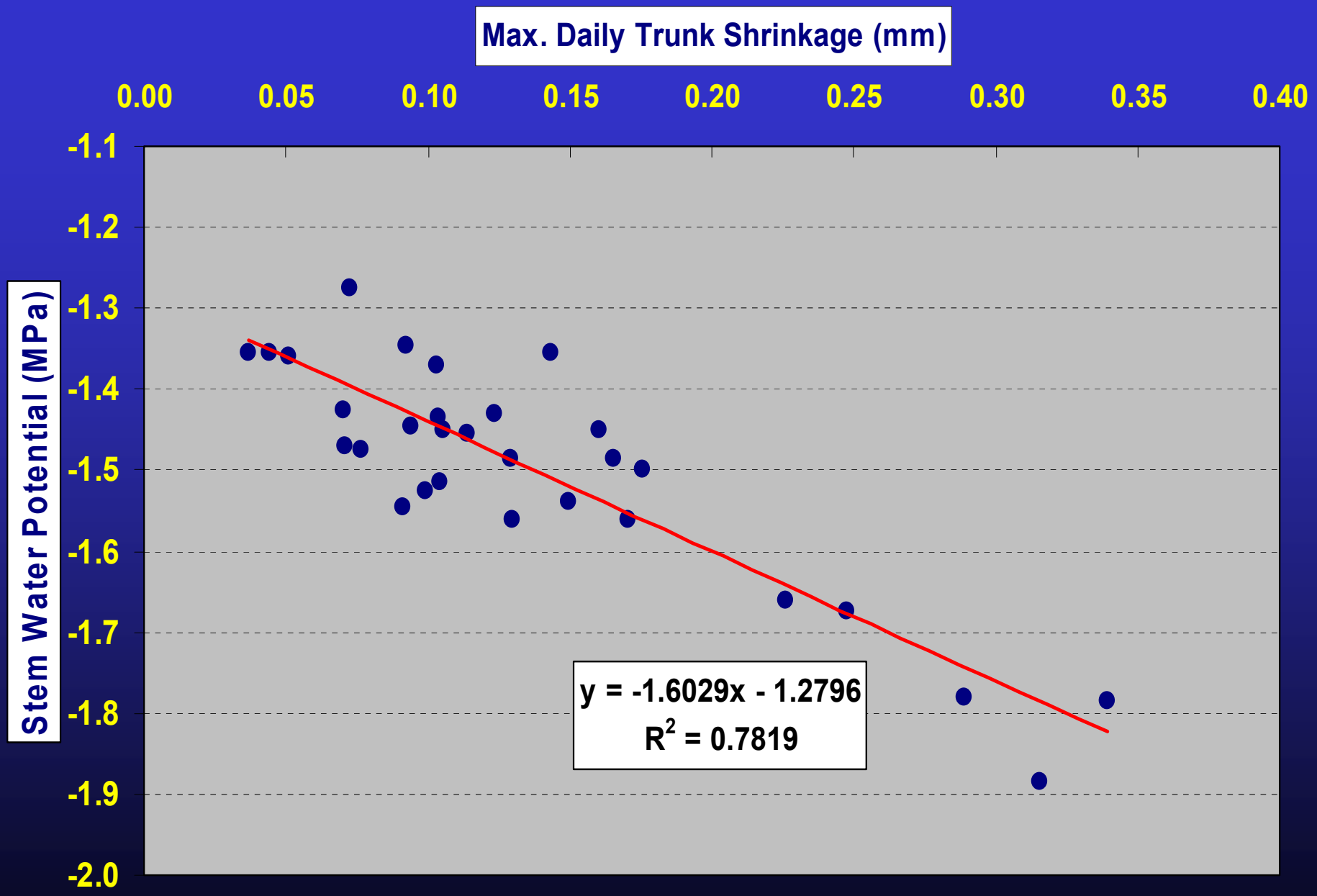


Mature Almond Trees; San Joaquin Valley



Citrus; San Joaquin Valley




Max. Daily Trunk Shrinkage (mm)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Stem Water Potential (MPa)
-1.1
-1.2
-1.3
-1.4
-1.5
-1.6
-1.7
-1.8
-1.9
-2.0
y = -1.6029x - 1.2796
R2 = 0.7819

For widespread adoption of RDI

1. Growers must be shown concrete evidence of successful application.

2. Develop proven RDI quidelines for crops lacking this information.