Effects of Deficit Water Supply on Sugarbeet: Summary of ARS Research

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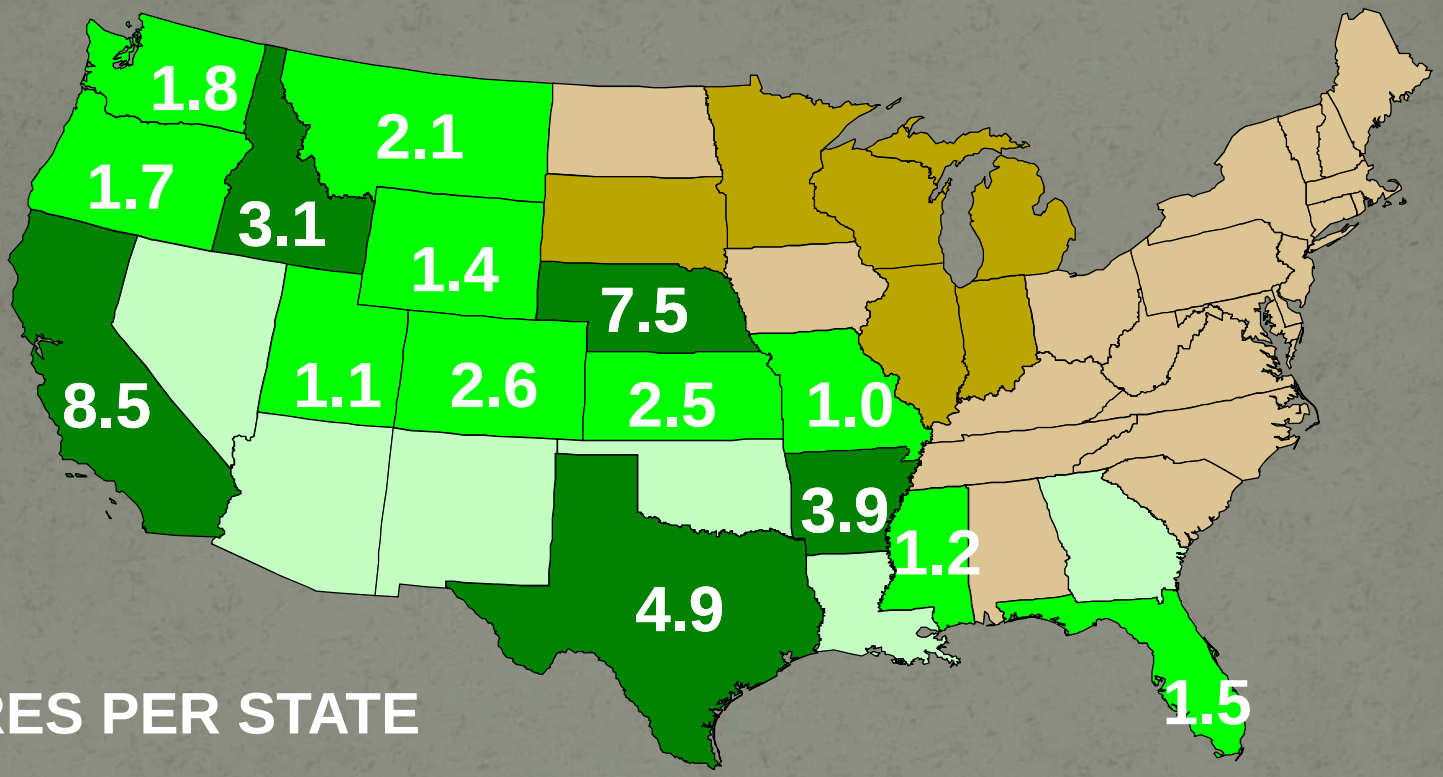
Drought


BROOKINS RICHMOND TIMES-DISPATCH 8/02
IT'S NOTHING TO BE AFRAID OF... IT'S CALLED RAIN...

Area of Irrigated Land in 2002



ACRES PER STATE

- *< 0.25 million*
- *0.25 - 0.5 million*
- *0.5 - 1 million*
- *1 - 3 million*
- *> 3 million*

Irrigation supply shortages become a major concern

Crop ET (Water Requirement) – Annual Averages (inches)

Crop	Nampa	Twin Falls	Aberdeen
Alfalfa (Mean)	41.3	39.0	37.0
Spring Grain	26.8	23.2	23.7
Sugar Beets	**33.8**	**30.4**	**28.7**
Potatoes	27.4	25.2	24.7
Dry Beans	20.6	17.8	--
Field Corn	26.6	25.0	24.8

Data Set Summary

- 3 studies
- 6 years (2008-2013)
- 7 site years
- 8 sugarbeet varieties
- 44 crop ET variations
  - 14% - 124% of crop ET based on Kimberly-Penman ET model.
  - Crop ET water supplied by precip.+ irrigation (Treatments applied evenly over entire season).
  - Soil water was not accounted for
  - **Average ET = 32.1 in.**

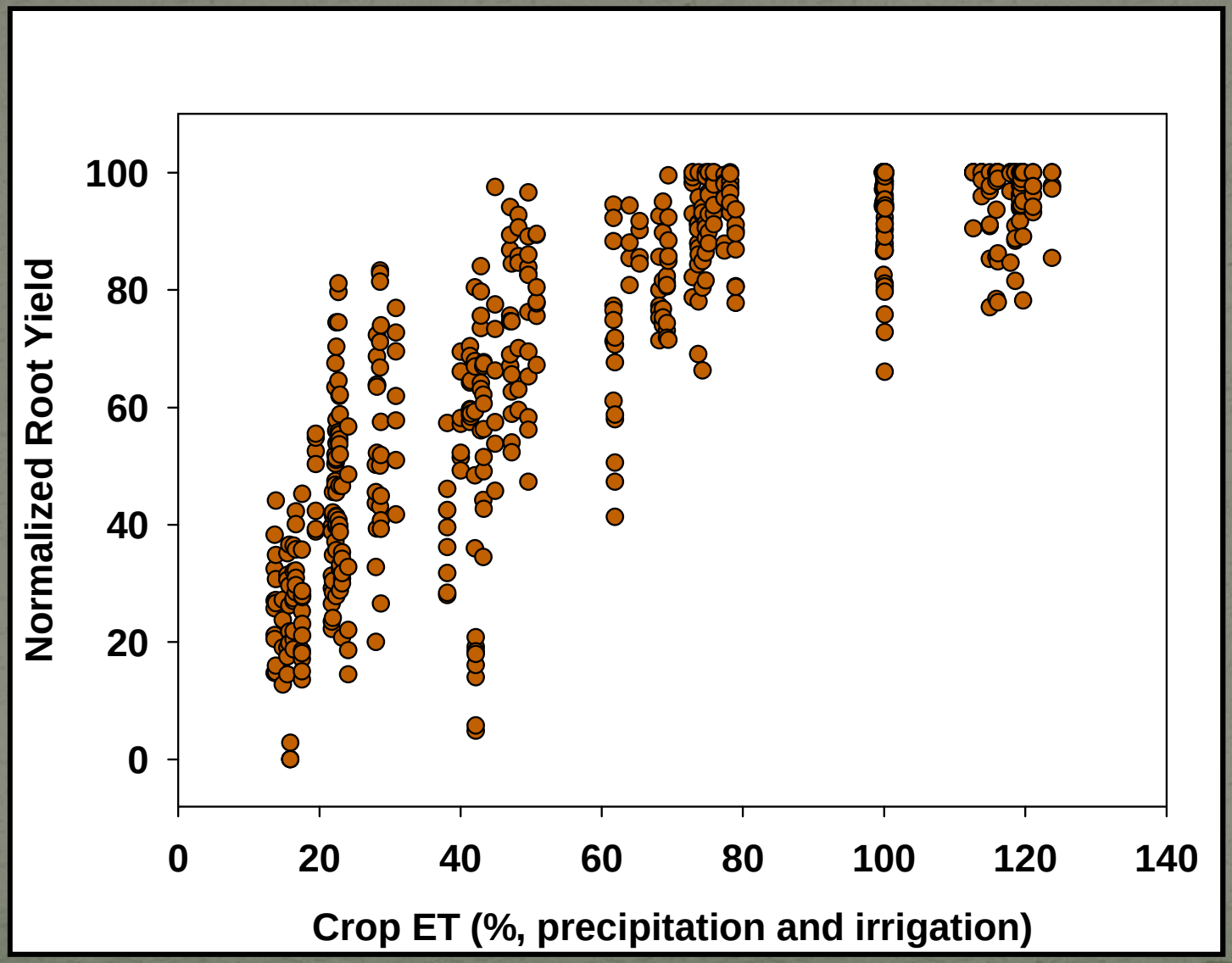
Data Set Summary Cont.

- Treatments all replicated 4 times
- 550 data points (plots)
- Silt loam soil
- 68 - 150 feet of row in harvest areas
- All beets in harvested area weighed
- 50-100 lbs beet samples sent to Tare Lab for sugar and quality analysis
- Root yield and Estimated Recoverable Sucrose (ERS) determined

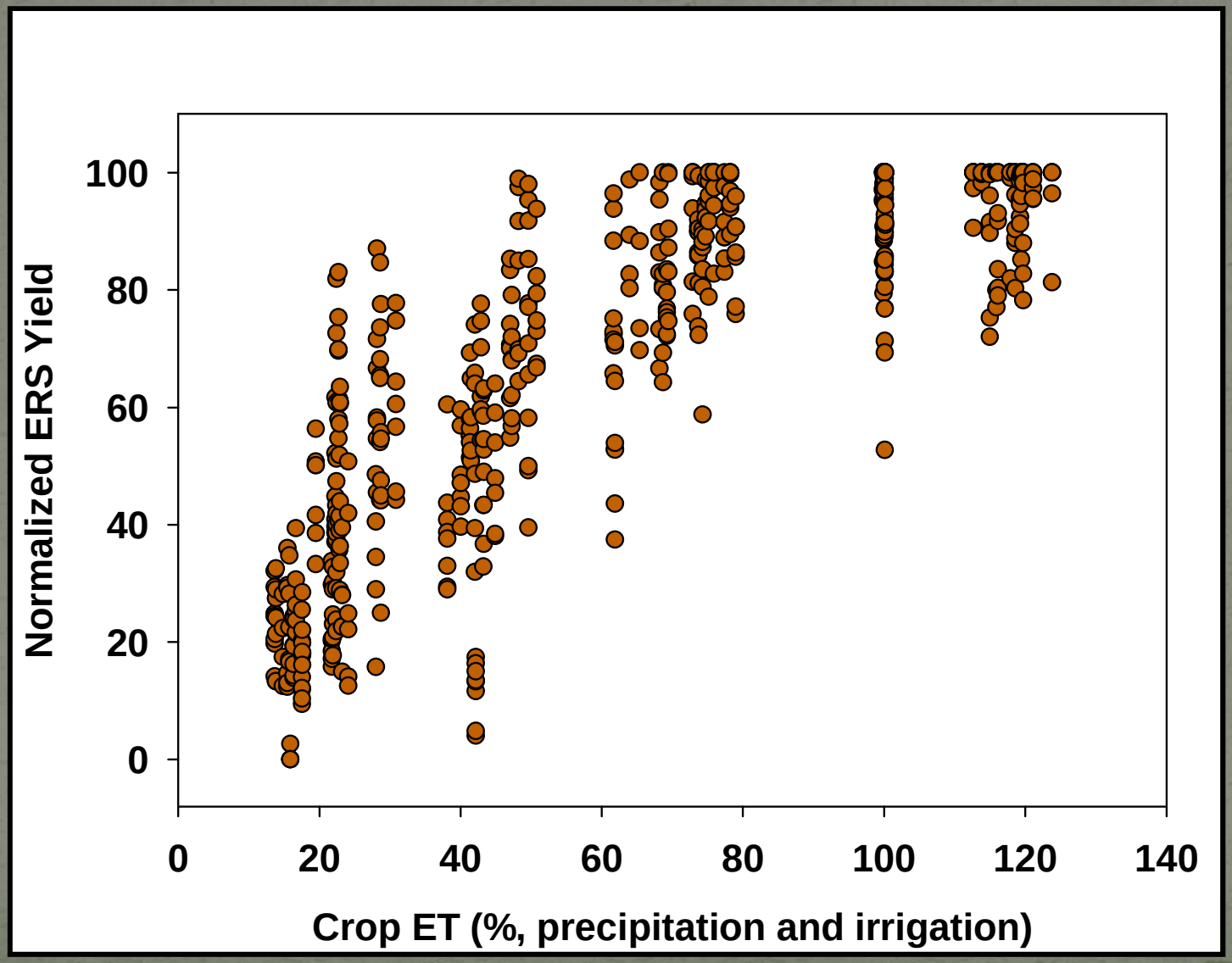
Data Normalization

- Done on a site by site basis
- Yield/Maximum Yield
- Adjusting measured values (yield, % sugar, etc.) on different scales to a common scale.
- Allows comparison of data from one study to another.
  - Different Years
  - Different Locations
  - Different Varieties

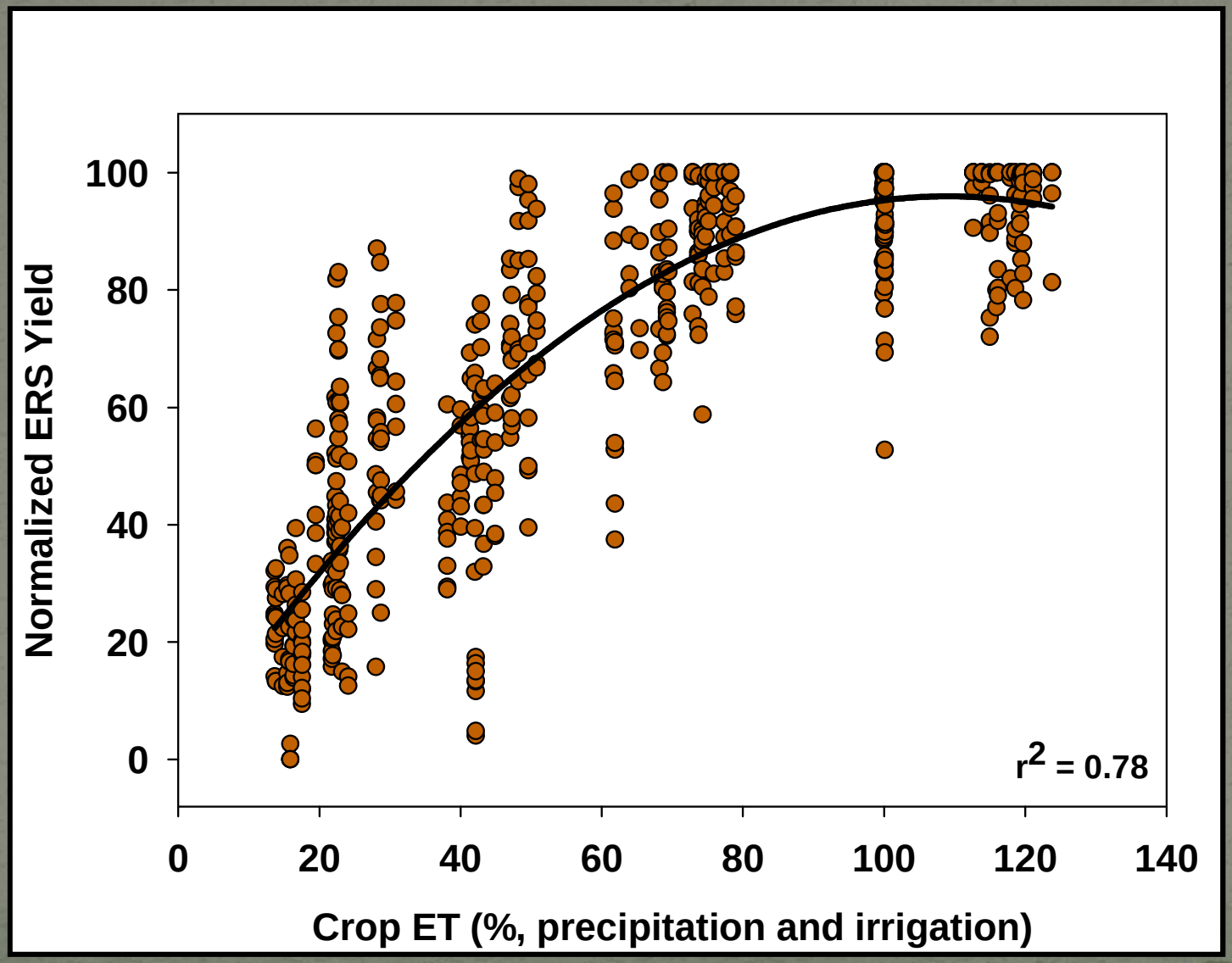
Normalized Root Yield, % of Maximum



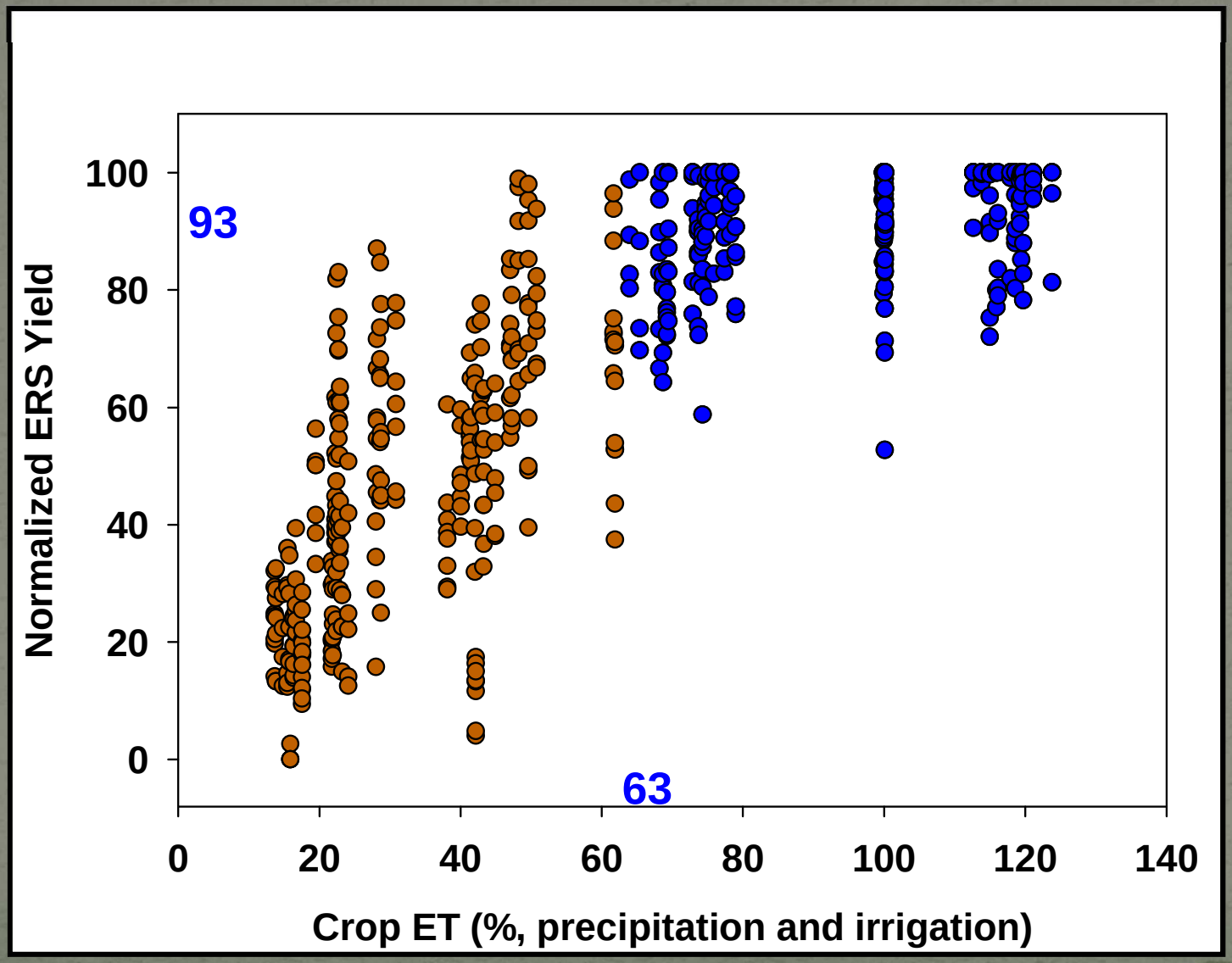
Normalized ERS Yield, % of Maximum



Normalized ERS Yield, % of Maximum



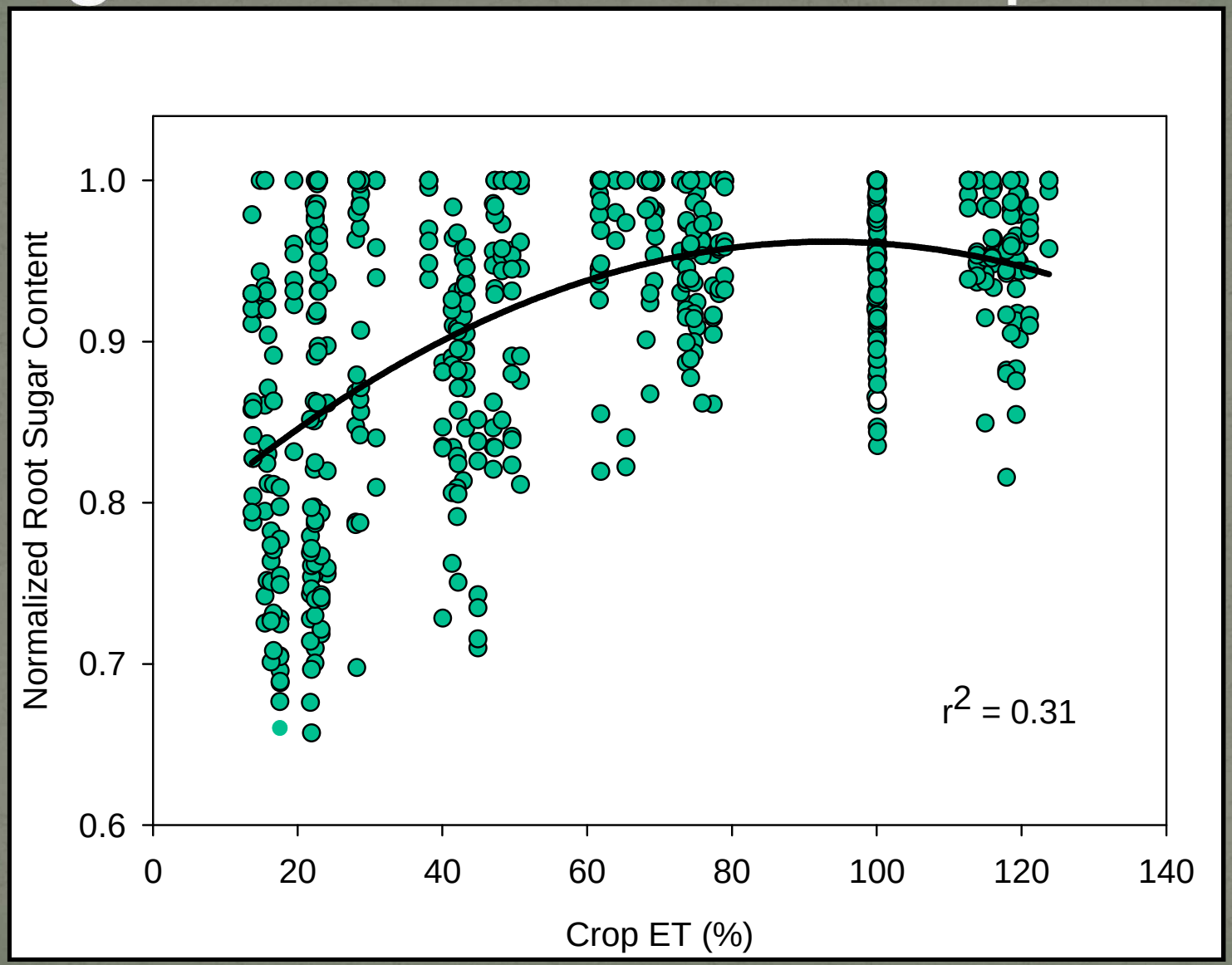
Normalized ERS Yield, % of Maximum



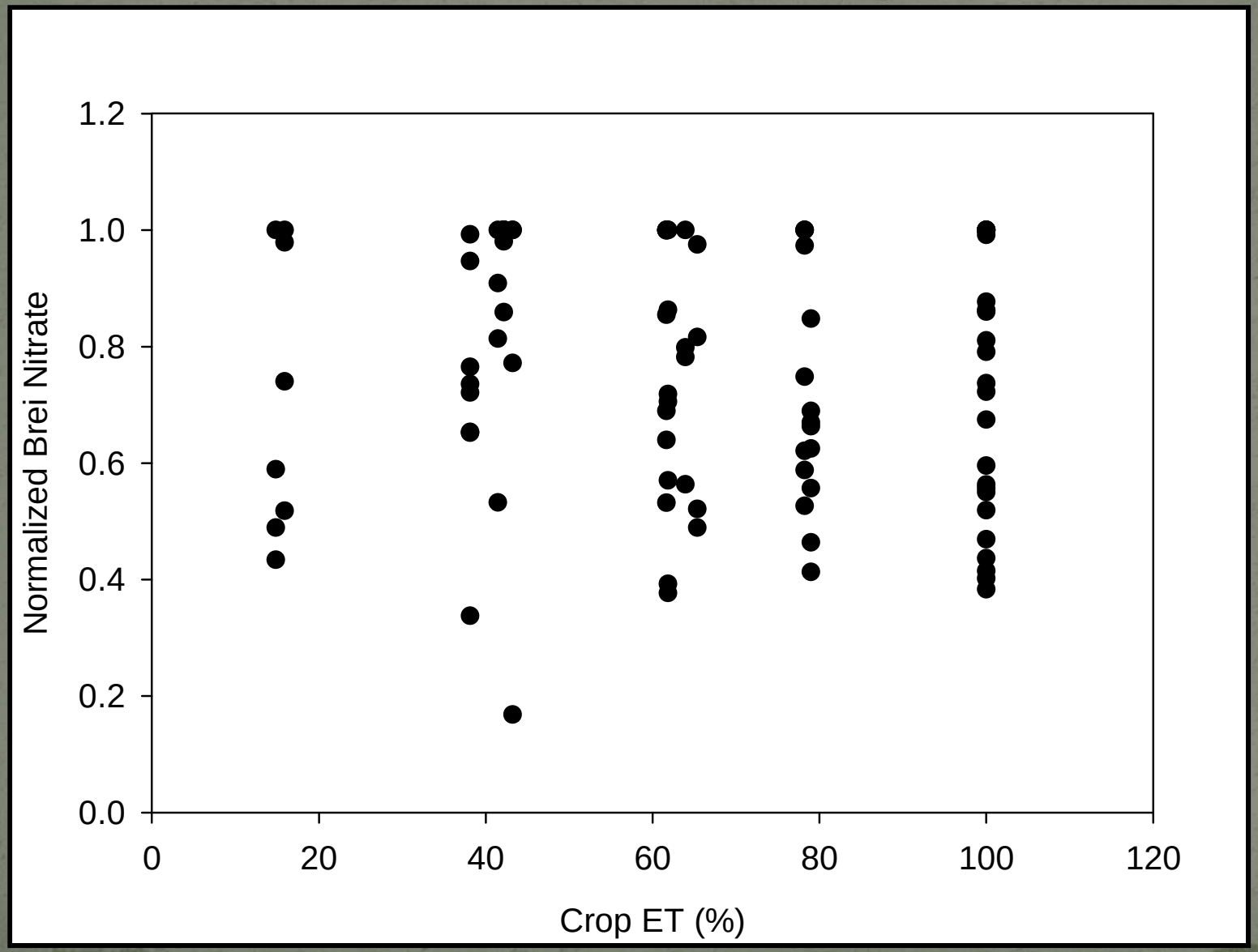
Water Reductions Relative to 100% Crop ET (32in) to Achieve Same ERS Yield

% Crop ET	Water Reduction (in)	Water Reduction (%)
63	12	37
70	10	30
75	8	25
80	6	20
85	5	15
90	3	10
95	2	5

Sugar content versus Crop ET



Brei Nitrate versus Crop ET



Summary

- Compared to “full irrigation”:
  - Reducing water inputs by approximately 37% (12 in) did not affect ERS yields.
  - Over irrigating by 20% (6 in) did not reduce ERS yields.
- Understanding soil water storage/availability status is important to understand potential effects on yields.
  - Under full irrigation soil water often does not change significantly, but under deficit conditions it becomes an important source.
  - “Rainy Day Fund”

Thank You

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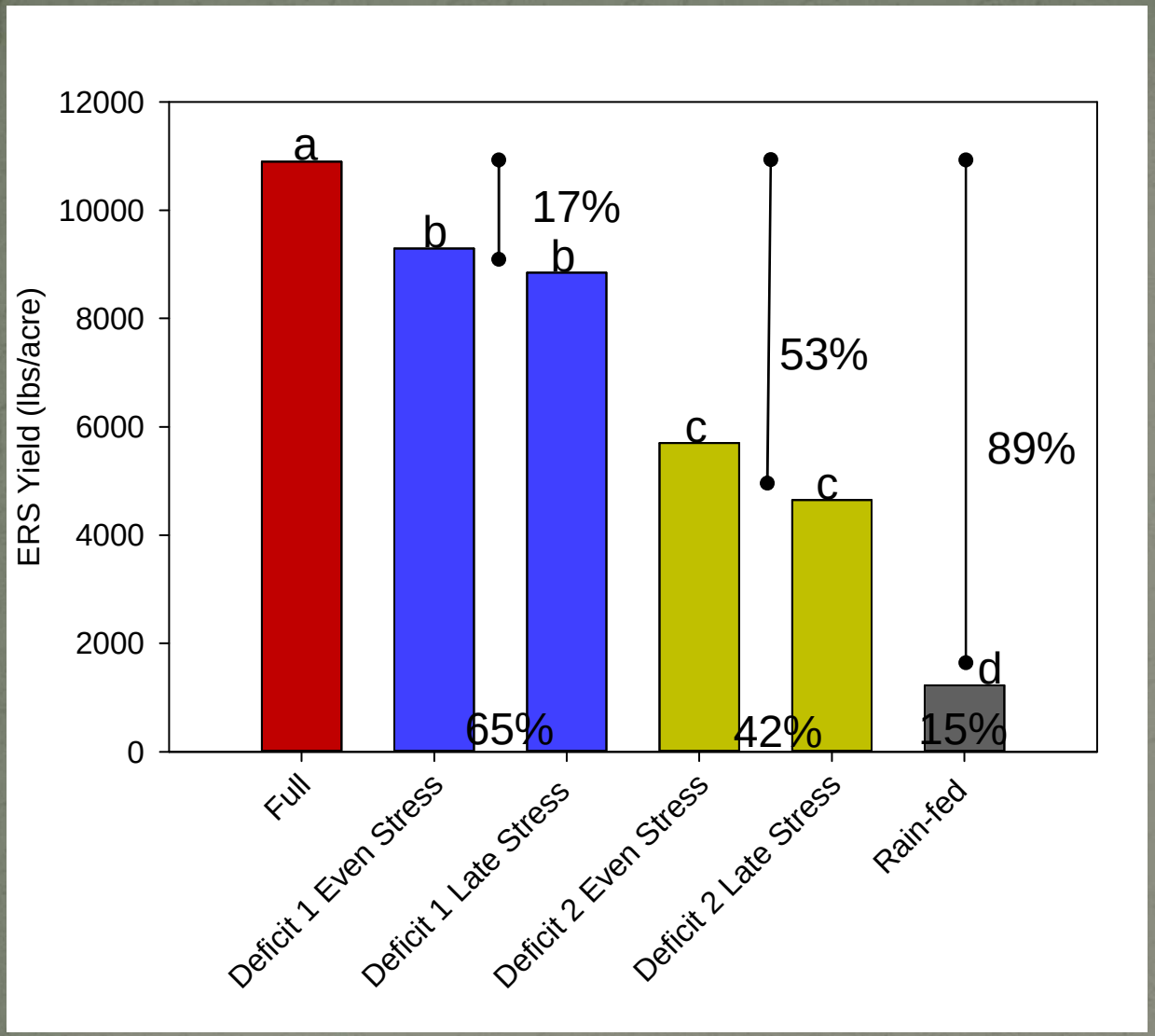
Effects of Deficit Irrigation on Sugarbeet Production

- Deficit Irrigation scenarios:
  - Reduced allocation of irrigation all season or until water is gone
  - Full irrigation allocation as long as water lasts (cutoff or reduced)



Tarkalson, ARS Study 2011 and 2012

Full – 100% crop ET

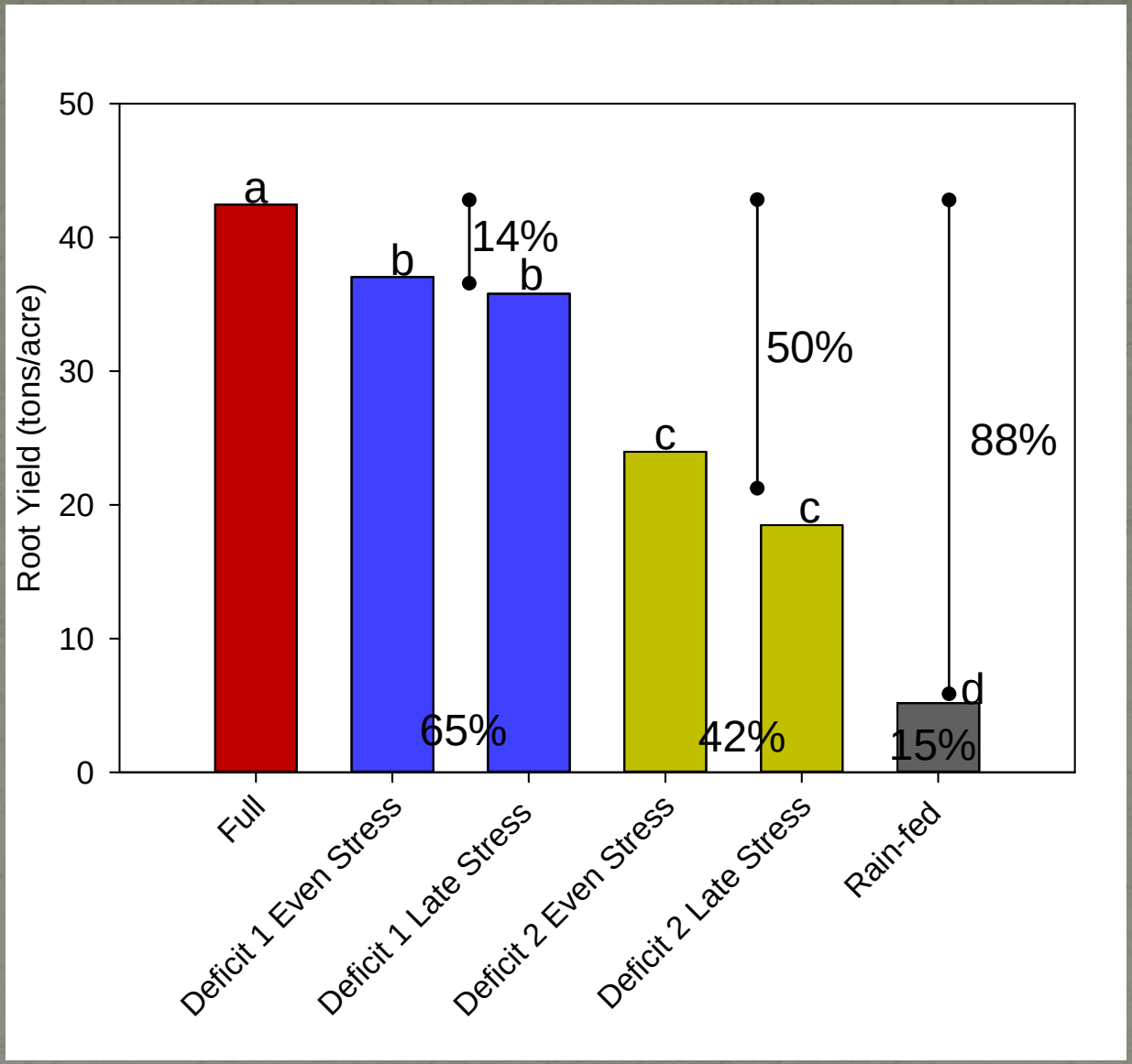
Deficit 1 Even Stress- 65% ET

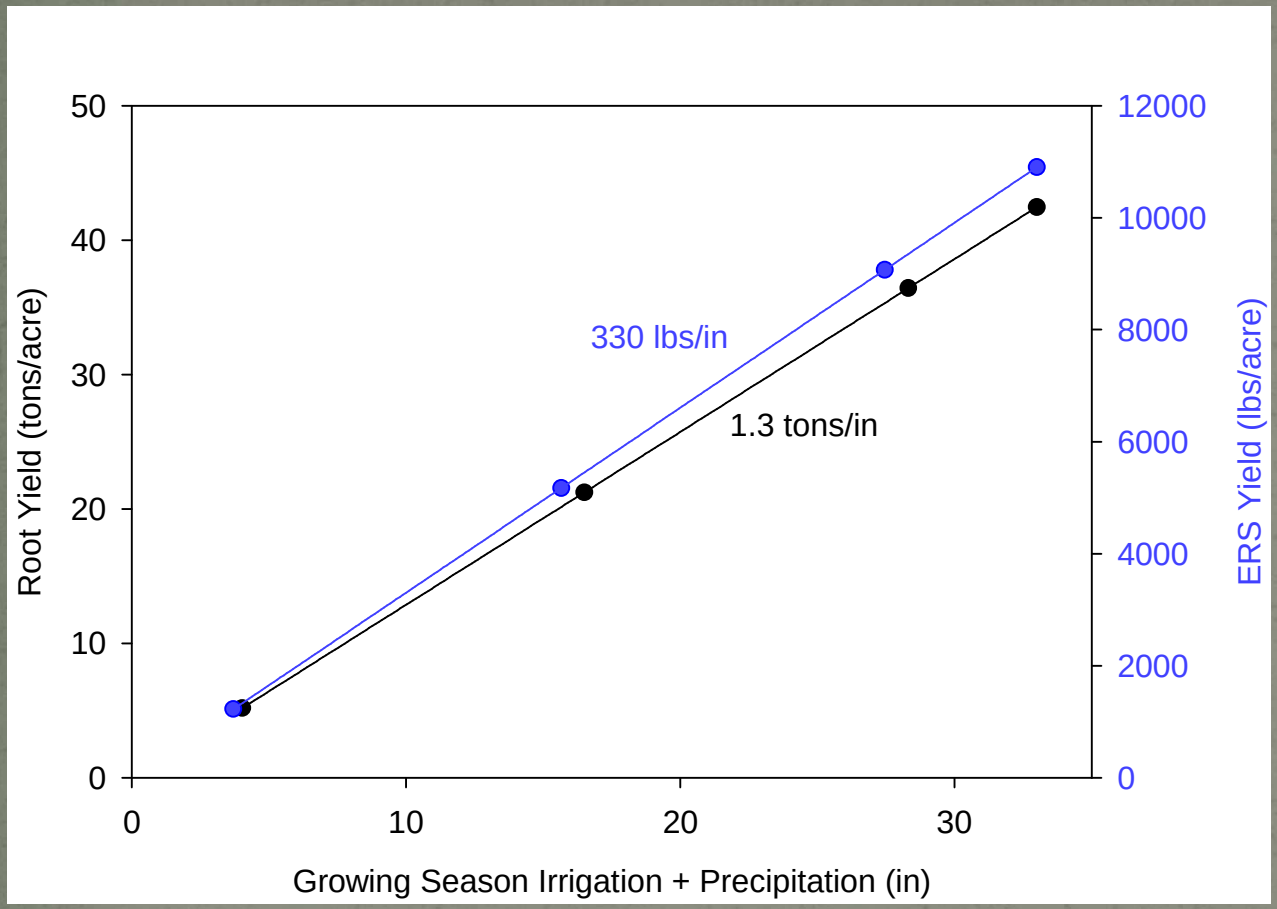
Deficit 1 Late Stress- 100%/55% (6/29) - 65% ET

Deficit 2 Even Stress - 42% ET

Deficit 2 Late Stress- 100%/25% (6/29) – 42% ET

Crop ET	Crop ET Reduction (33 in)	Mean Root Yield Reduction		Mean ERS Reduction		Net Value to Grower Reduction ($0.14/lbs Sugar)
%	in	%	tons/acre	%	lbs/acre	$/acre
100	0	0	0	0	0	$0
95	2	5	2	5	590	$83
90	3	6	2	7	750	$105
85	5	8	3	8	950	$133
80	7	10	4	10	1,200	$168
75	8	12	5	13	1,490	$209
70	**10**	**15**	**6**	**16**	**1,840**	**$258**
60	**13**	**22**	**8**	**23**	**2,660**	**$372**
50	16	30	11	32	3,660	$512
40	20	40	15	42	4,860	$680


Root Yield (tons/acre)
50
40
30
20
10
0
a
b
b
c
c
d
14%
65%
50%
42%
88%
15%
Full
Deficit 1 Even Stress
Deficit 1 Late Stress
Deficit 2 Even Stress
Deficit 2 Late Stress
Rain-fed



Tarkalson, ARS Study 2011 and 2012

At planting soil held 1.4 inches of AW/ft = 5.6 inches in 4 ft.

At FC the soil could have held 2 in/ft = 8 inches in 4 ft.

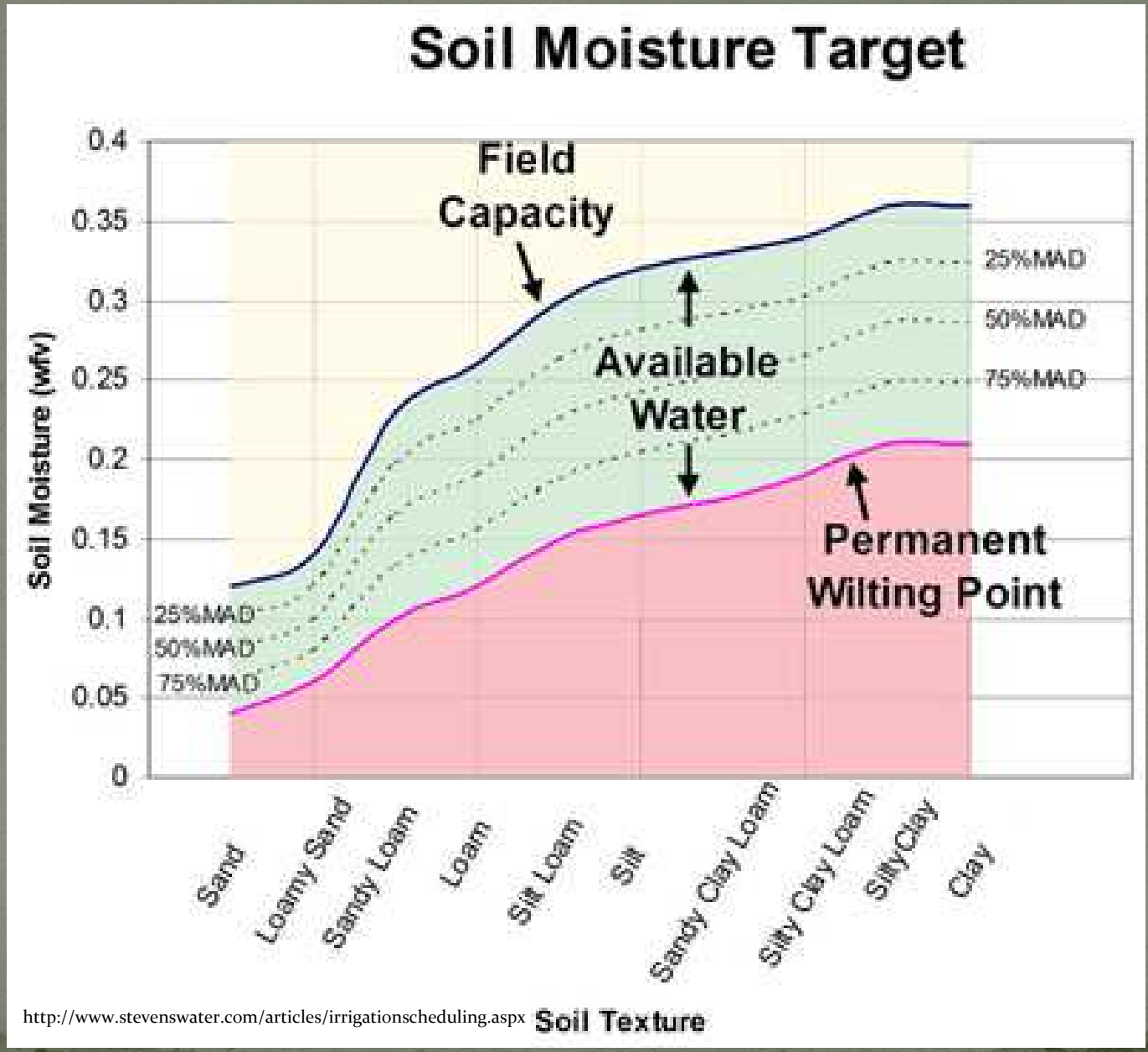
With no stress until 50% of AW, this means that at FC the soil would have 4 extra inches

5.6 in – 4 in = 1.6

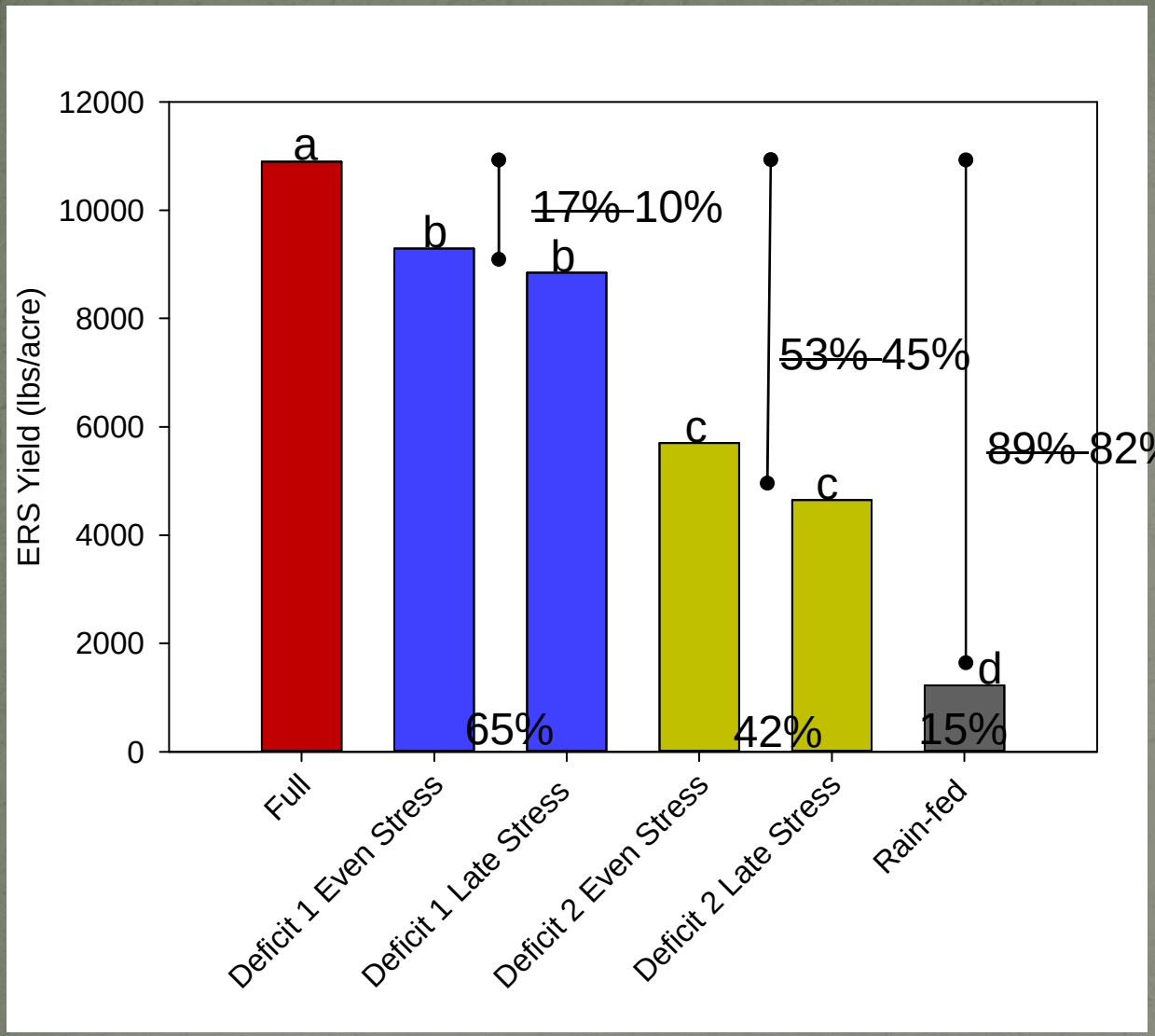
4 in – 1.6 in = 2.4 inches less.

RY – extra 3.1 tons

ERS – extra 790 lbs/acre



http://www.stevenswater.com/articles/irrigationscheduling.aspx



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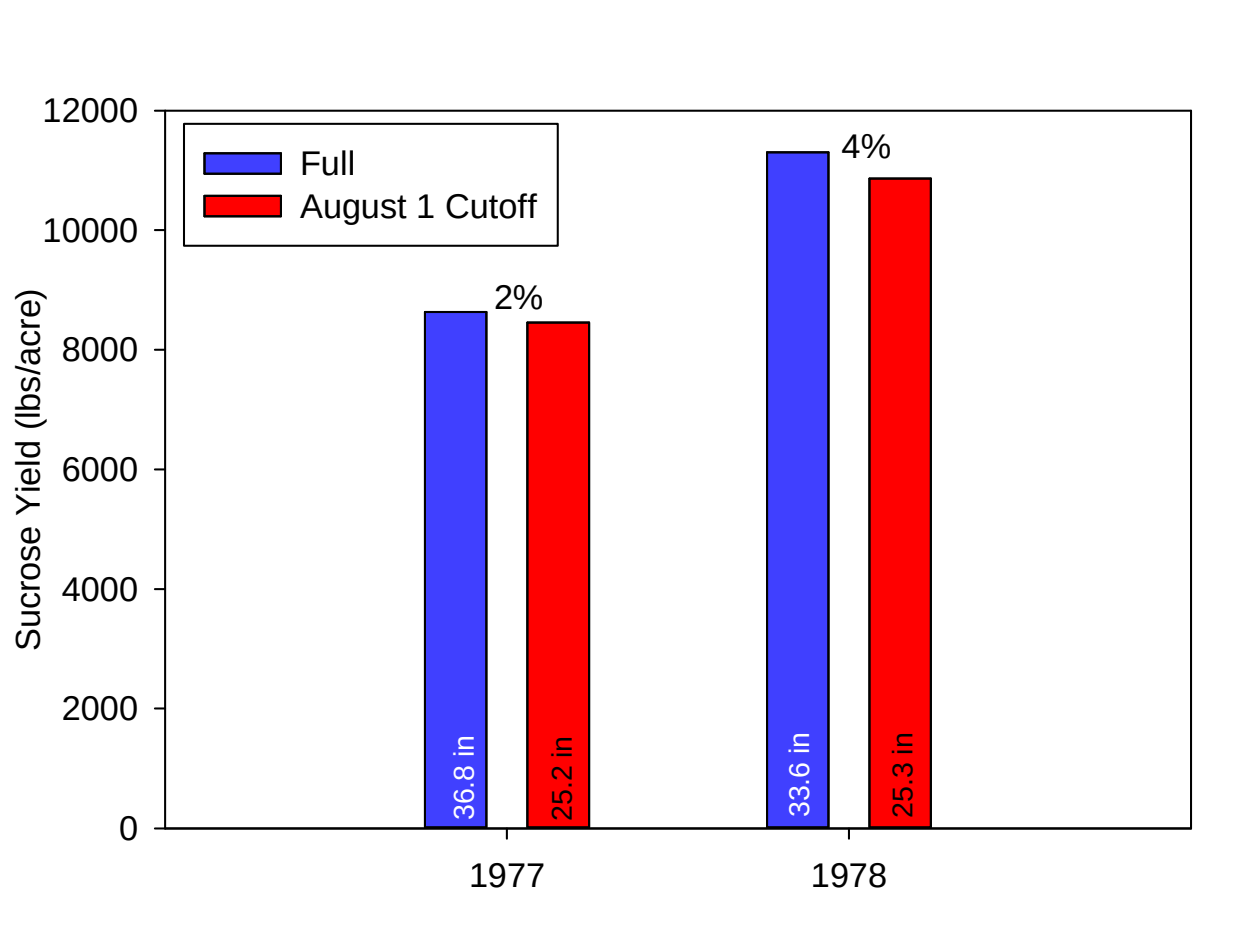


Furrow irrigation likely filled entire profile with water prior to cutoff: Assume 4 ft rooting depth, 2 in/ft = 8 in available water, no stress until 50% used so 4 in available before any stress,

1977 and 1978 = 25+4 = 29 in.

Carter et al.

Soil: Silt loam

Irrigation: Furrow

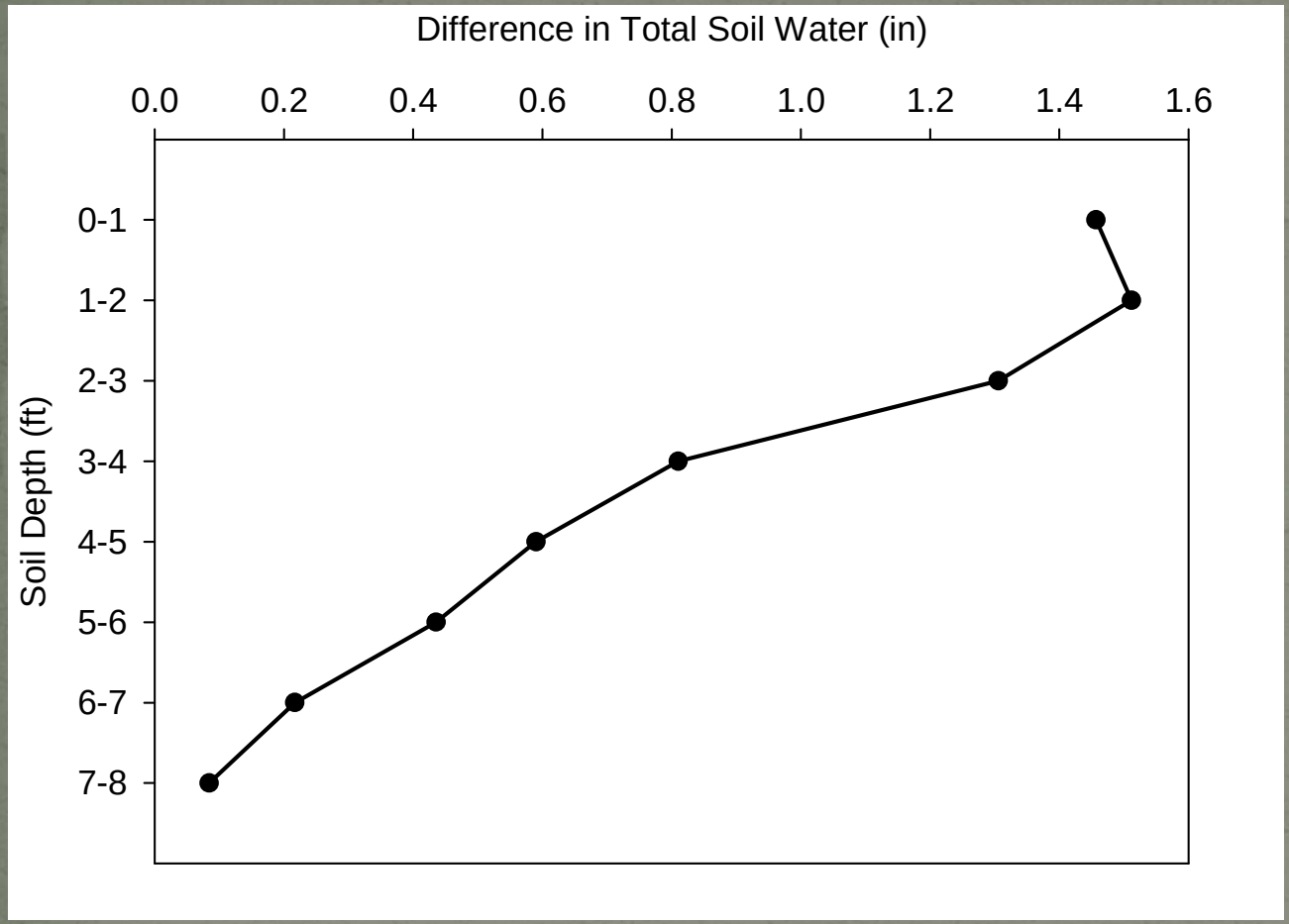
Both treatments irrigated at 100% ET until 8/1.

August 1 cutoff treatments

1977-68% ET (based on irrigation + precipitation)

1978 - 75% ET (based on irrigation + precipitation)

Total Soil Water Difference (Beg – End)



2013 Data – ARS-Kimberly

Soil: Silt loam

Irrigation: Linear Move

Average data from deficit irrigation treatments (25%, 50%, and 75% ET)

Irrigation treatments imposed over whole season.

Summary

- At equivalent crop ET levels, sugarbeet handle deficit water supply similar when receiving reduced water all season vs full water early with a reduction or cutoff later in season.
- Understanding soil water storage is important to understand the effects of deficit water supply on sugarbeet.
- Under full irrigation soil water often does not change, but under deficit conditions it becomes an important source.
- Irrigation water supply scenarios will dictate how water resources will be allocated to deal with irrigation supply shortages.

Thank You

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