Irrigation Management for Optimal Celery Yield

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Presentation Outline

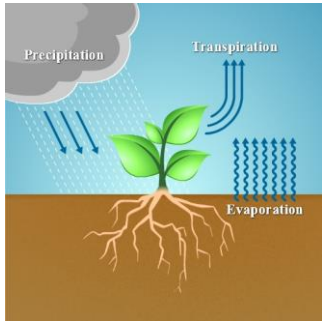
- Irrigation scheduling: ET-based and soil moisture sensors
- CropManage
- Research results – Soil moisture thresholds

*Disclosure: mention of brands and products is not a sing of support

Irrigation Scheduling

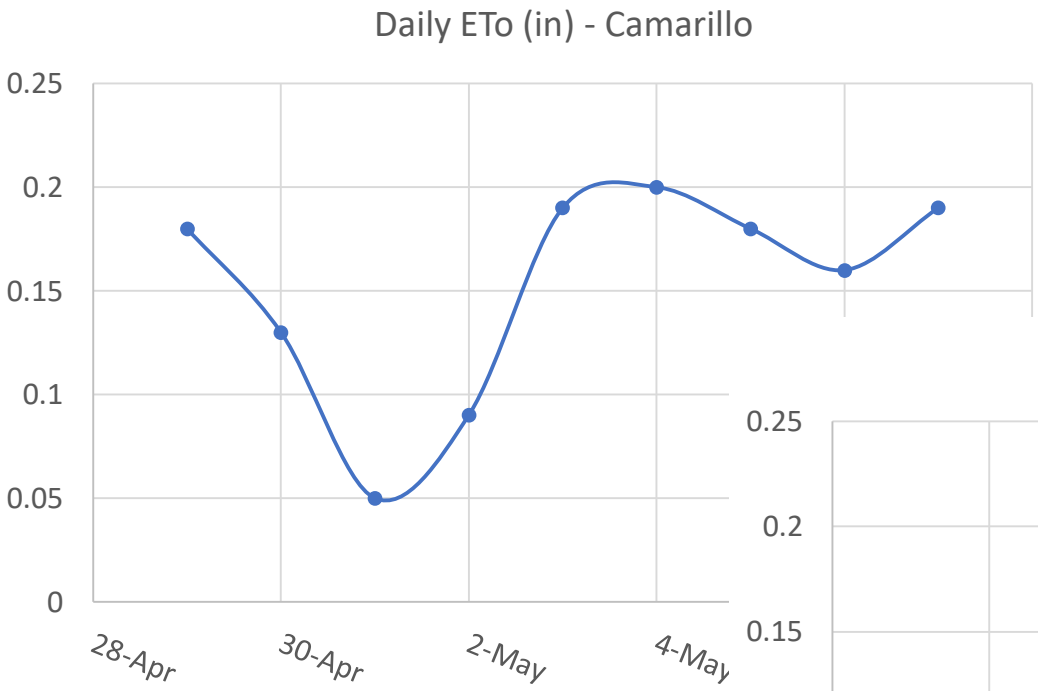
1. Deciding when to irrigate

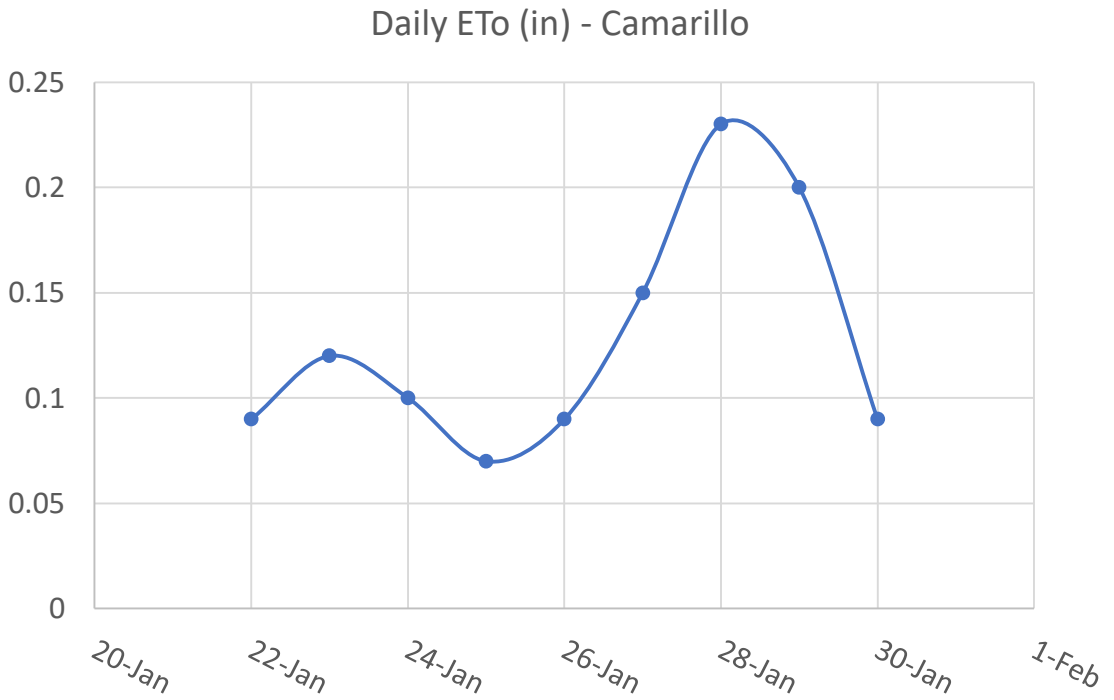
2. Deciding how much to irrigate



ET-based

Why is irrigation scheduling challenging?





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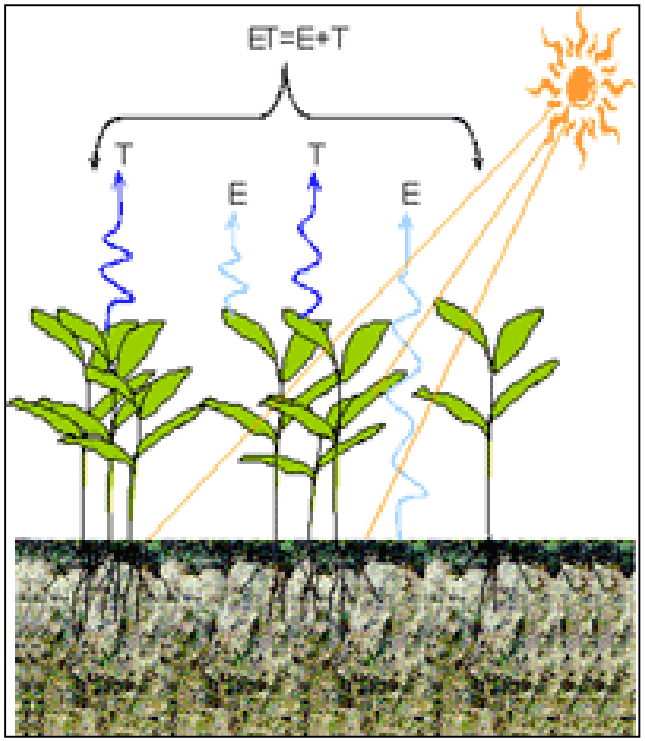
ETo

(Reference Evapotranspiration)

CIMIS – California Irrigation Management Information System

http://www.cimis.water.ca.gov/

Evapotranspiration (ET)



- Solar Radiation
- Wind Speed
- Relative Humidity
- Air Temperature

v3.cropmanage.ucanr.edu

Benefits to Growers

Based on a few simple inputs, CropManage can provide any level of irrigation and fertilization decision support in order to validate or improve your existing operation' production—and increase your overall confidence.

20% to 40% Reduction in Water and Fertilizer With Same Yields

CropManage is ground-truthed in more than 30 field trials and has produced consistent, or in many cases, improved crop yields.

Supports Irrigation AND Fertilization Recommendations

CropManage combines irrigation and fertilization recommendations that, when used together, significantly improve yields while reducing costs.

Steeped in Deep Research

CropManage is the result of years of ongoing, in-depth University of California agricultural research and crop modeling algorithms.

No Extra Equipment Required

CropManage allows growers to leverage their existing infrastructure and does not require operational changes or purchase/implementation of new equipment.

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CropManage

Database driven web application

Crop ET model

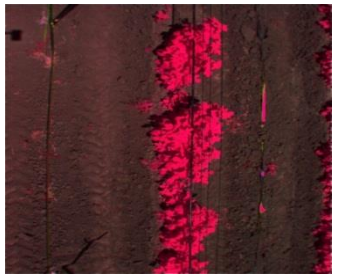
Crop N model

How Much Water?

ETo

x

Kc



Water recommendation

- ✓ Irrigation system application rate
- ✓ Irrigation system application uniformity (DU)
- ✓ Leaching fraction (water salinity)

Results Summary - Celery

Study #	County	Study type	Marketable yield	Water use	Fertilizer use
			relative to grower standard:		
1	Ventura	Replicated	5.8% higher (P=0.286)	1.2% higher	24.1% lower
2	Ventura	Replicated	0.7% higher (P=0.864)	22.0% lower	10.6% lower
3	Ventura	Replicated	13.5% higher (P=0.448)	2.1% higher	24.3% lower
4	Monterey	Replicated	2.6% higher (P=0.411)	11.1% lower	3.7% higher

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Matric potential-based irrigation management of field-grown strawberry: Effects on yield and water use efficiency

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Tensiometer

ABSTRACT

Effective and adapted criteria for irrigation scheduling are required to improve yield and water use efficiency (WUE) and reduce the environmental impacts associated with water and nutrients losses by runoff and leaching. In this study, field-scale experiments were conducted at four commercial strawberry production sites with contrasting soil and climatic conditions. Within each site, the influence of different soil matric potential-based irrigation thresholds (IT) on yield and WUE was evaluated. Matric potential-based irrigation management was also compared with common irrigation practices used by producers in each site's respective areas. At Site 1 (silty clay loam; humid continental (Dfb) climate), an IT of −15 kPa improved yields by 6.2% without any additional use of water relative to common irrigation practices. At Site 2, with similar soil and climatic conditions, the irrigation treatments did not affect yield and the matric potential-based management decreased WUE relative to common practices. However, the results suggested that maintaining the soil matric potential lower than −9 kPa could induce stressing conditions for the plants. At Site 3 (sandy loam; Mediterranean (Cs) climate), the best yield and WUE were obtained with an IT of −8 kPa and suggested that WUE could be further improved by implementing high-frequency irrigation. At Site 4 (clay loam; Mediterranean (Cs) climate), results suggested that an IT between −10 and −15 kPa could optimize yield and WUE, and matric potential-based irrigation considerably reduced leaching under the root zone relative to common practices. Considering the results from all sites, an IT of −10 kPa appears to be adequate as a starting point for further optimizing irrigation under most field conditions.

1. Introduction

Many studies have shown that evapotranspiration (ET)-based irrigation management could be efficient for strawberry produc-

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Assessment of Soil Water Potential Thresholds for Optimum Yield and Quality of Celery

Andre Biscaro, Kamille Garcia, Nathan Bradford

University of California Cooperative Extension

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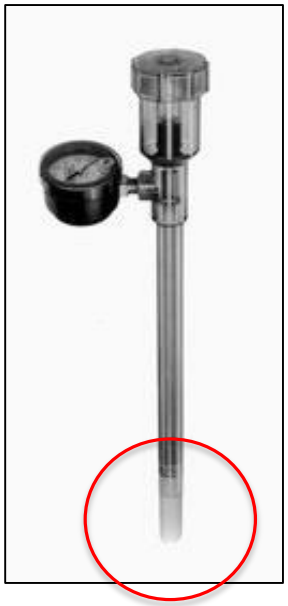
Soil Water Potential sensors monitor the matric potential of the soil

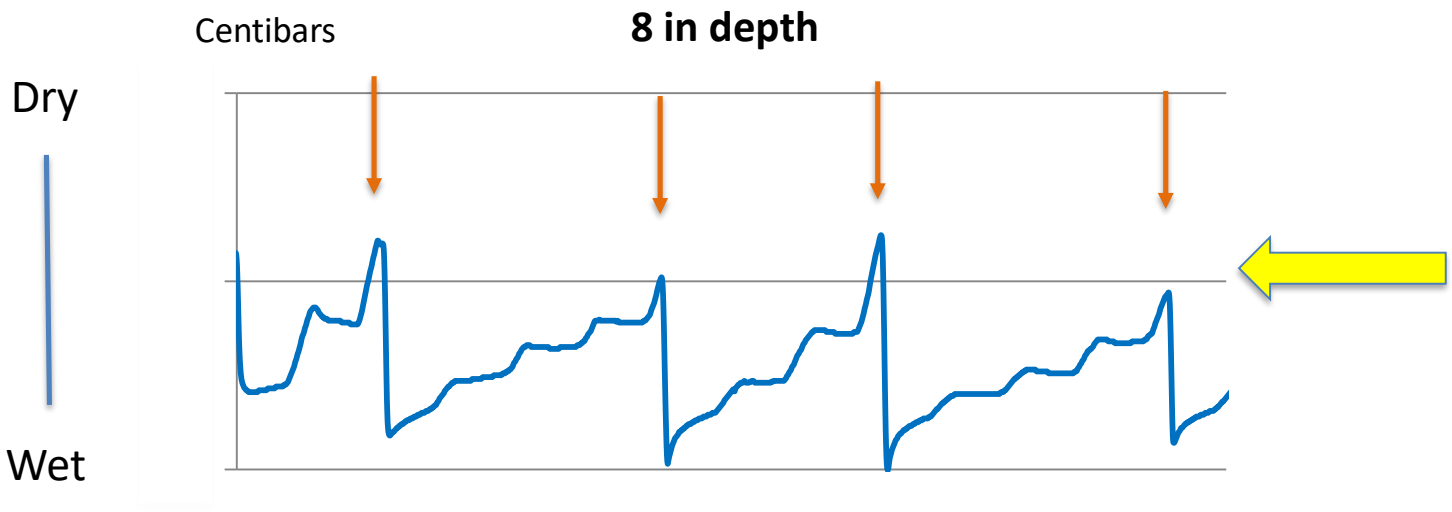


Measurement of soil moisture that is most related to water status in a plant

Treatments

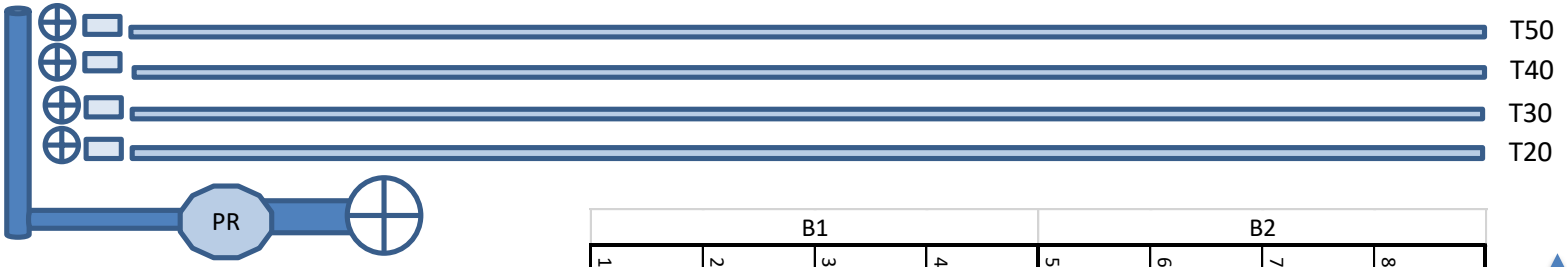
T-20 = 20 centibars
T-30 = 30 centibars
T-40 = 40 centibars
T-50 = 50 centibars

*at 8in depth



Irrigation amounts: ET method + 30% LR

Study Design



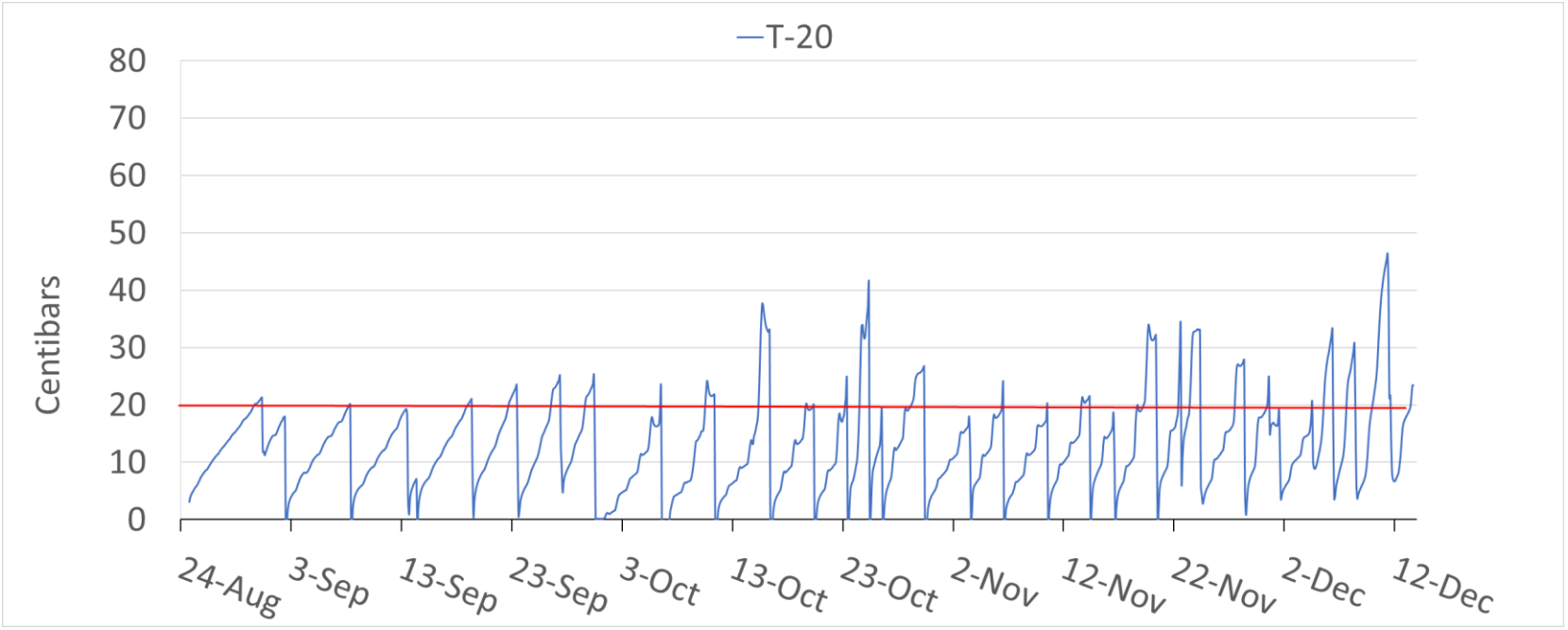
- Treatments were replicated four times within a randomized complete block design

B1				B2			
1	2	3	4	5	6	7	8
T30	T40	T20	T50	T20	T30	T40	T50
9	10	11	12	13	14	15	16
T40	T30	T20	T50	T30	T50	T20	T40
B3				B4			

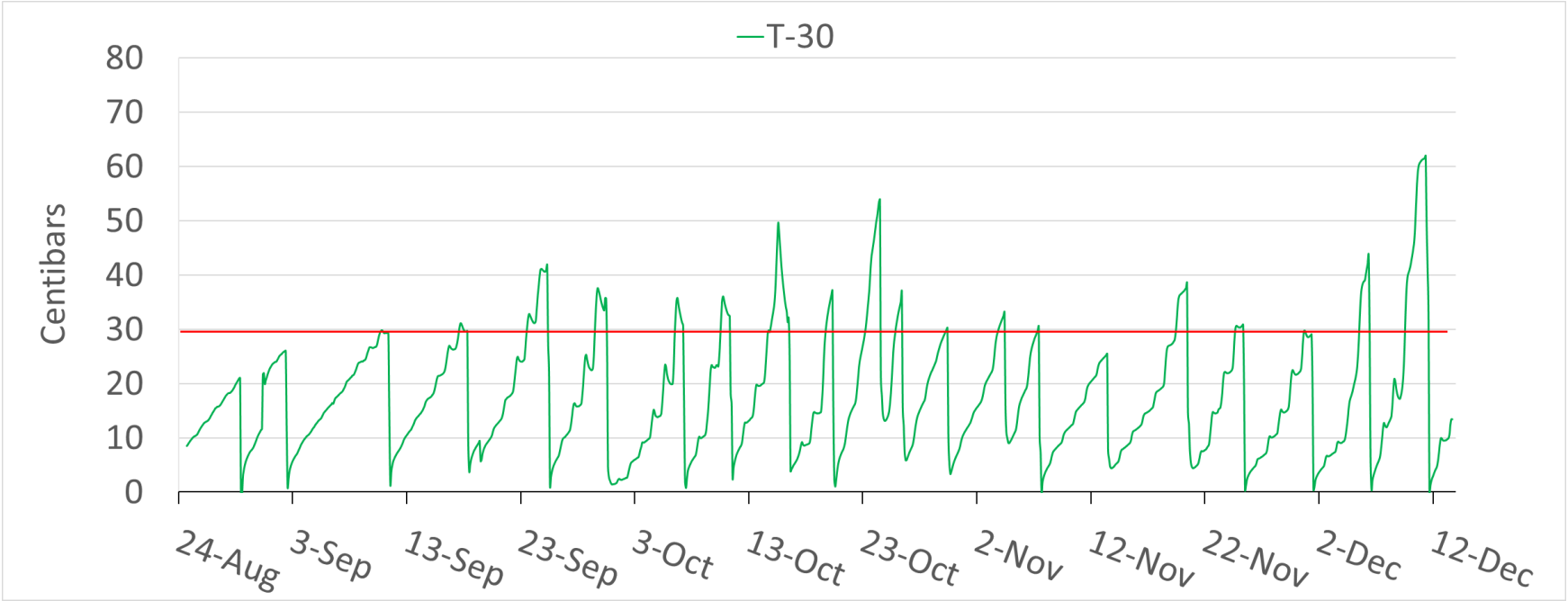
75ft

- Sensors: Hortau® TX4 Field Monitoring Stations
- Depths: 8 and 18 in; actionable depth = 8 in
- Fall 2017
- Soil type: Camarillo sandy loam
- Yield and quality data were collected in the center 20ft of the middle bed of each plot

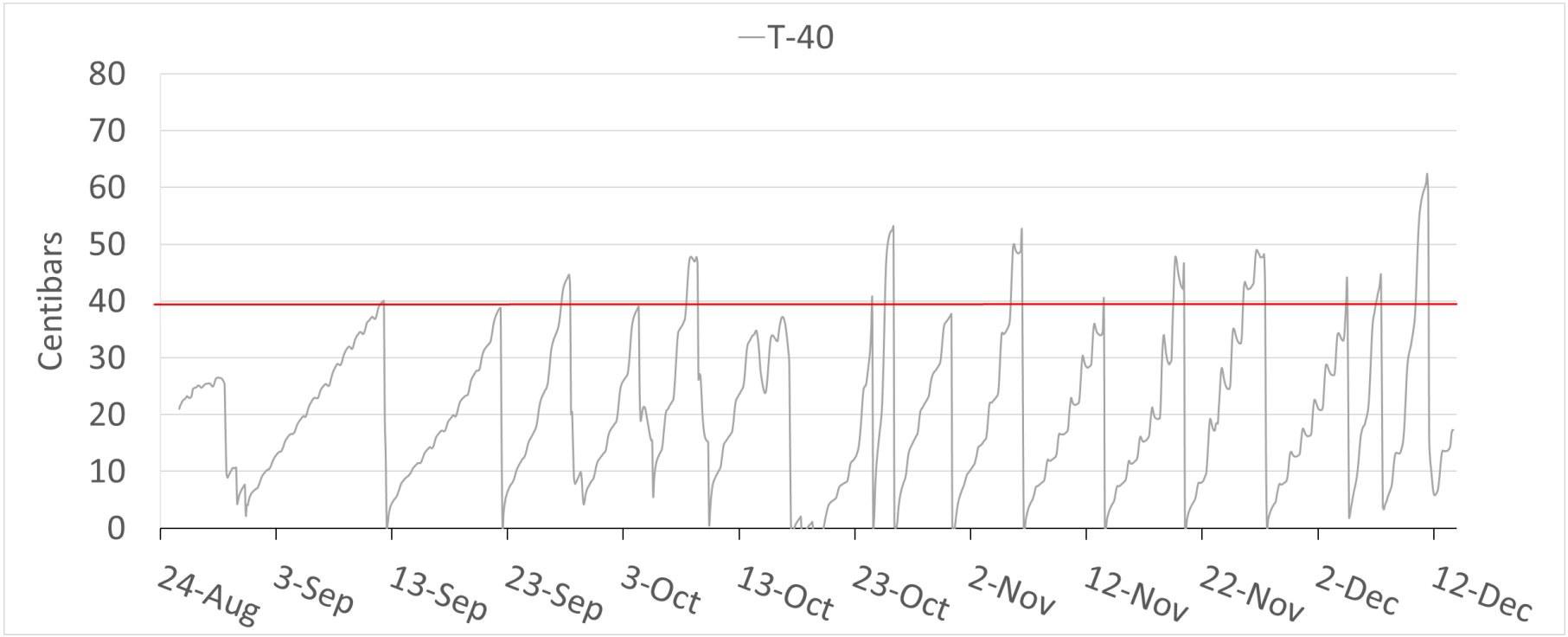
Avg: 12.7 cb
Avg high: 25.9 cb
30 irrig.



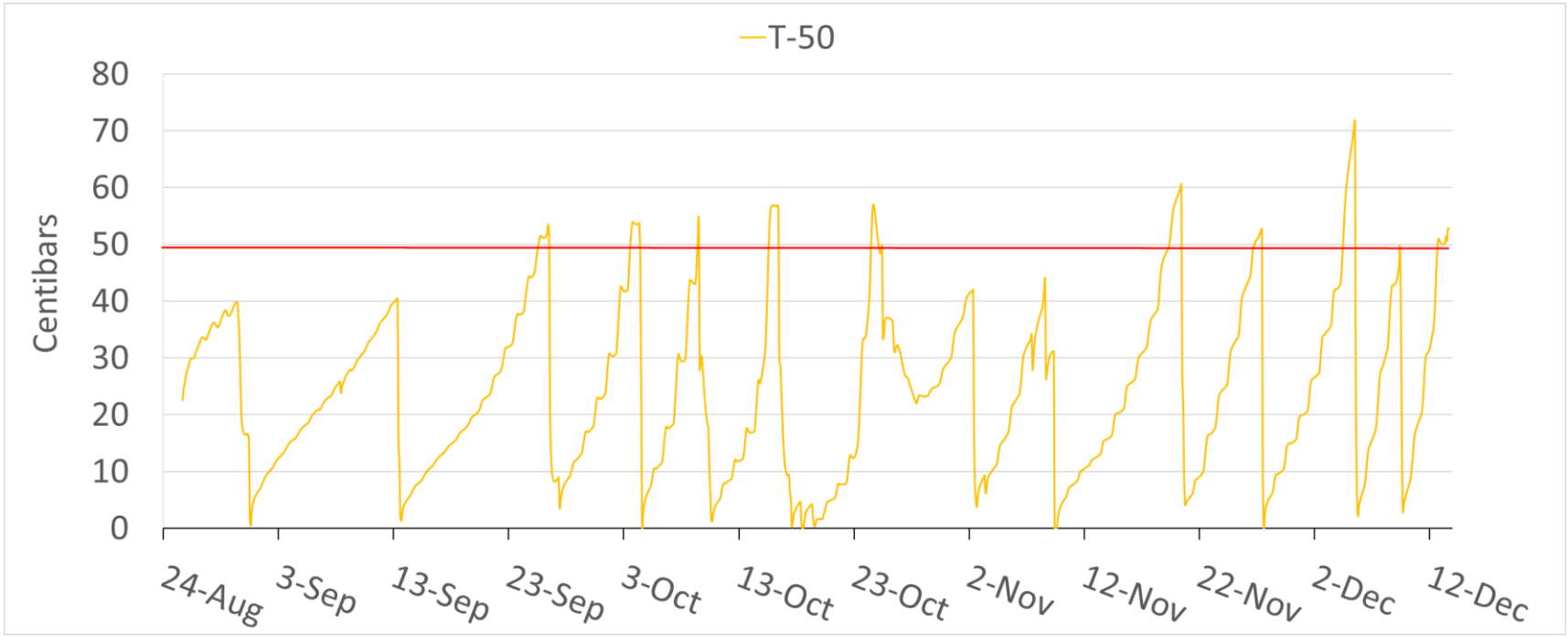
Avg: 17.4 cb
Avg high: 36.2 cb
21 irrig.

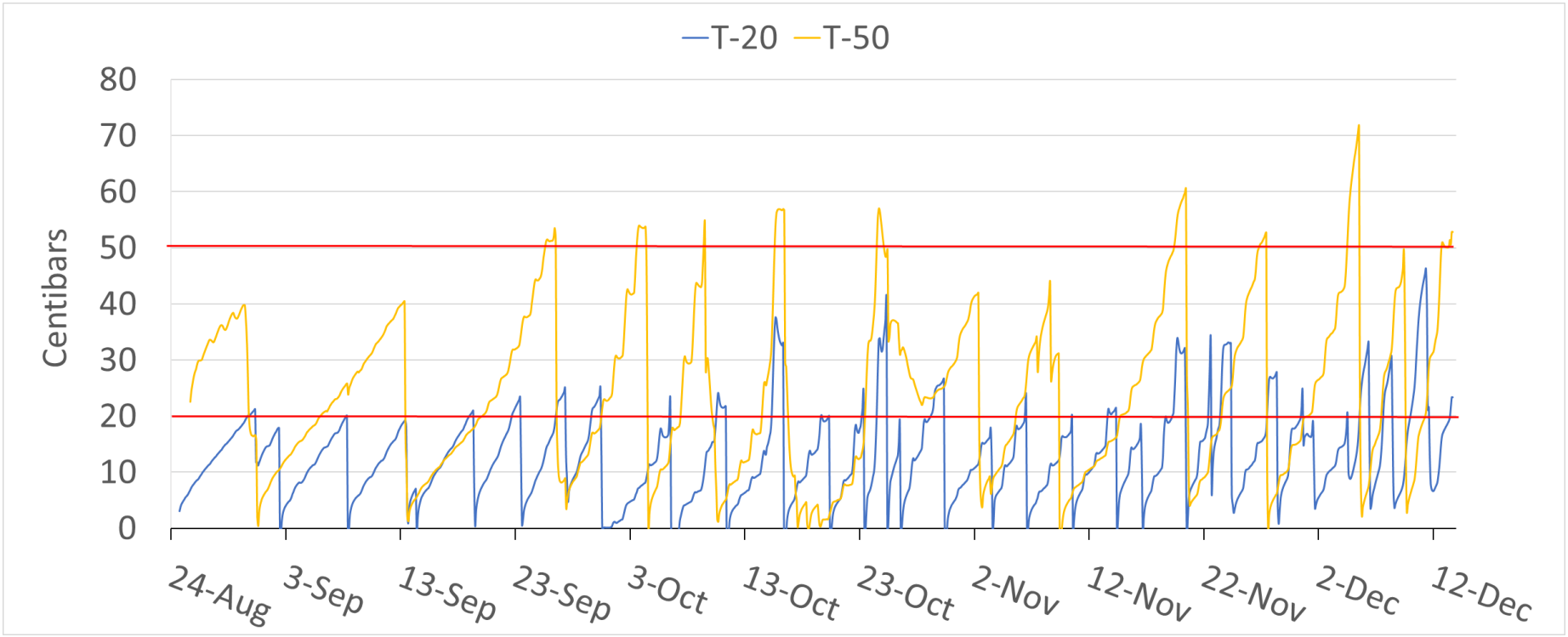


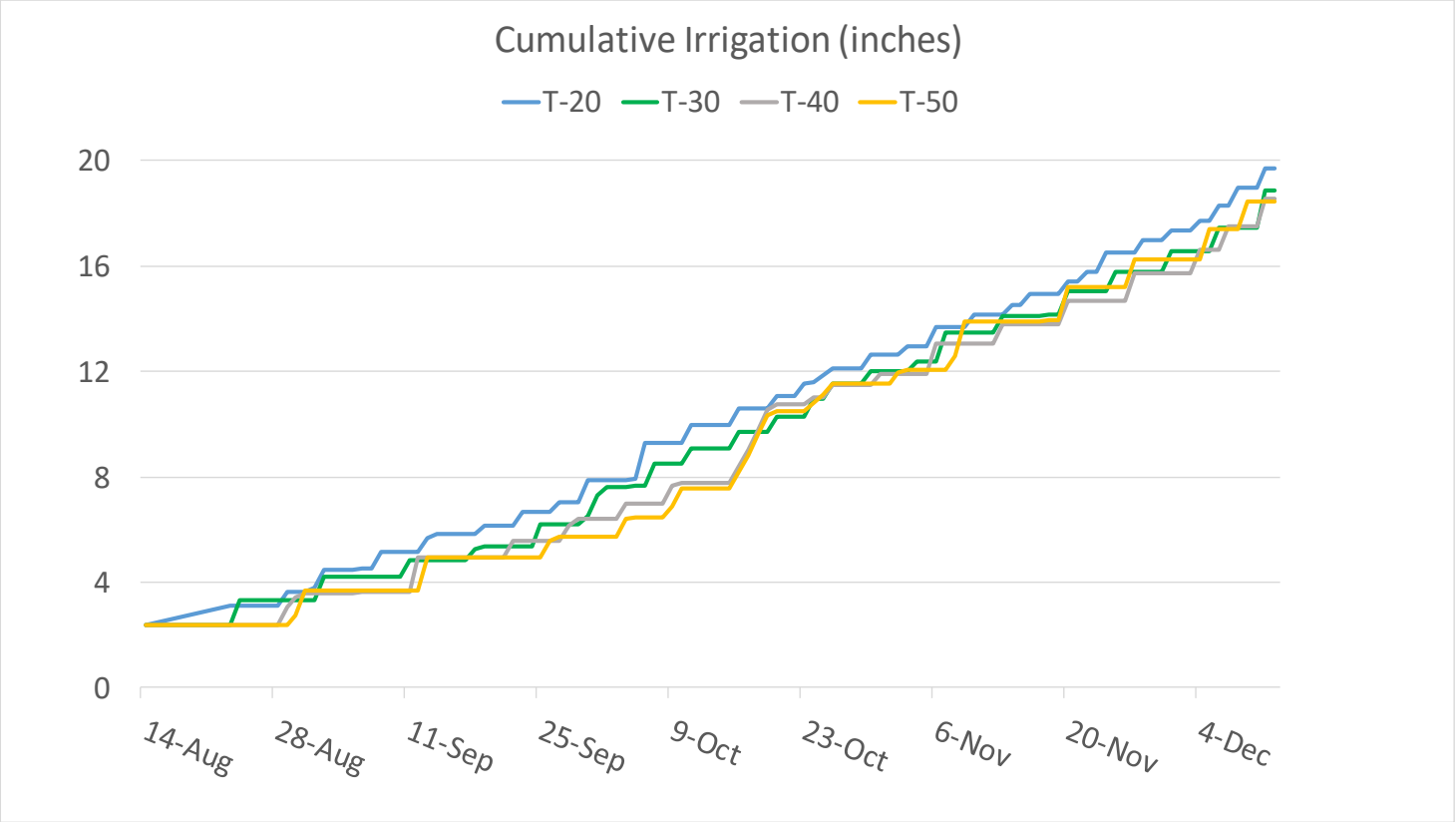
Avg: 20.4 cb
Avg high: 43.7 cb
17 irrig.



Avg: 24.0 cb
Avg high: 52.0 cb
13 irrig.

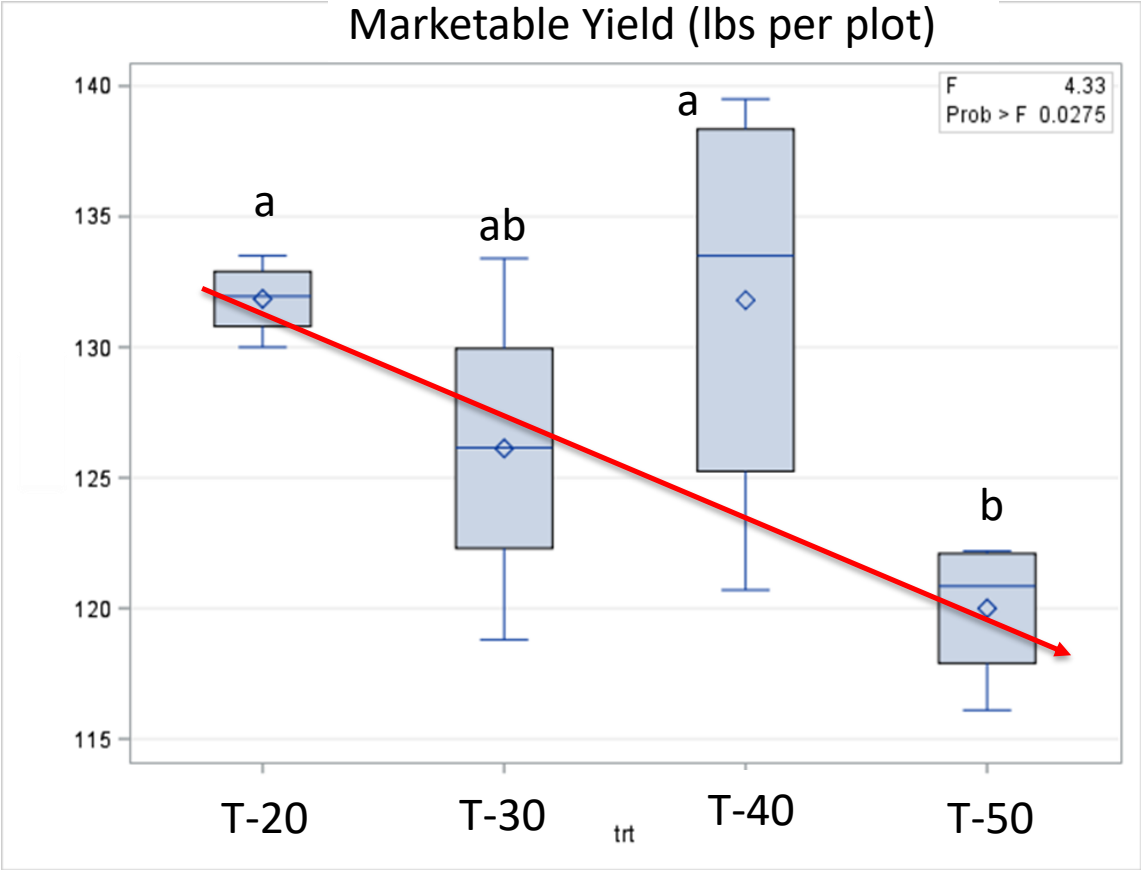


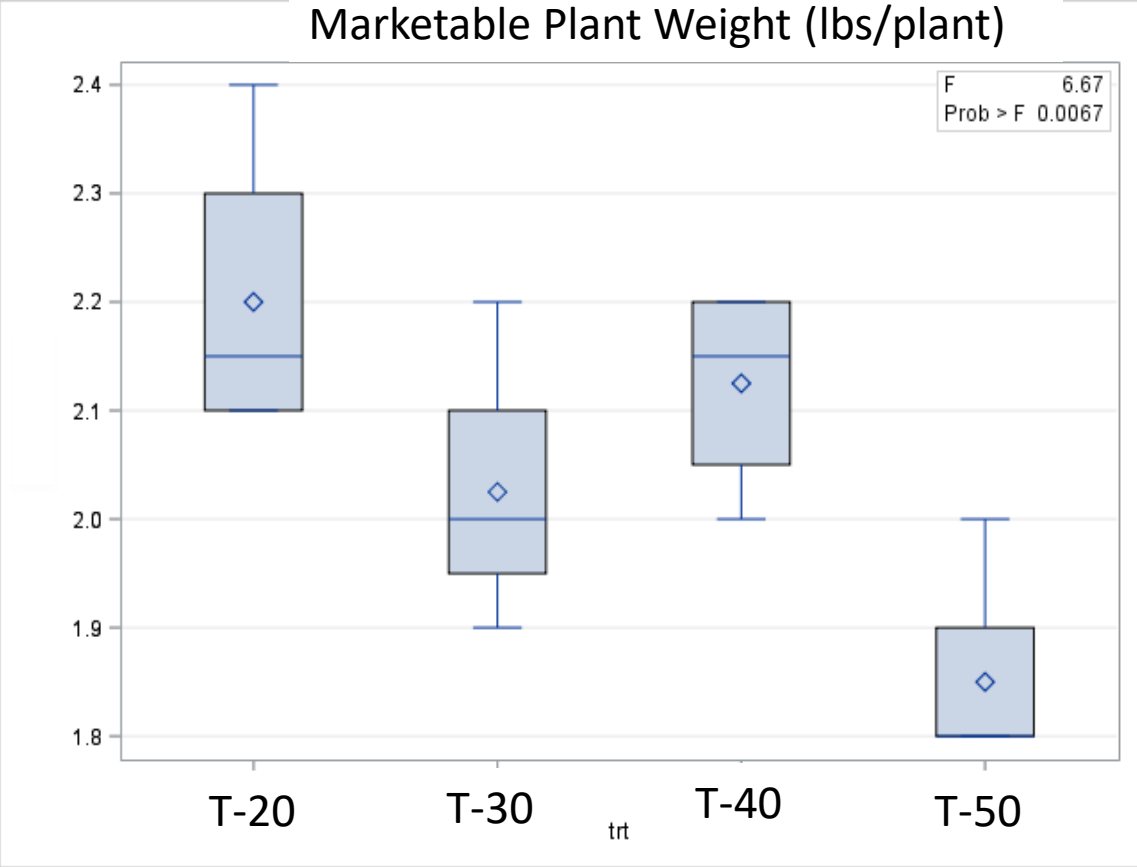

T-20
T-50
Centibars
80
70
60
50
40
30
20
10
0
24-Aug
3-Sep
13-Sep
23-Sep
3-Oct
13-Oct
23-Oct
2-Nov
12-Nov
22-Nov
2-Dec
12-Dec

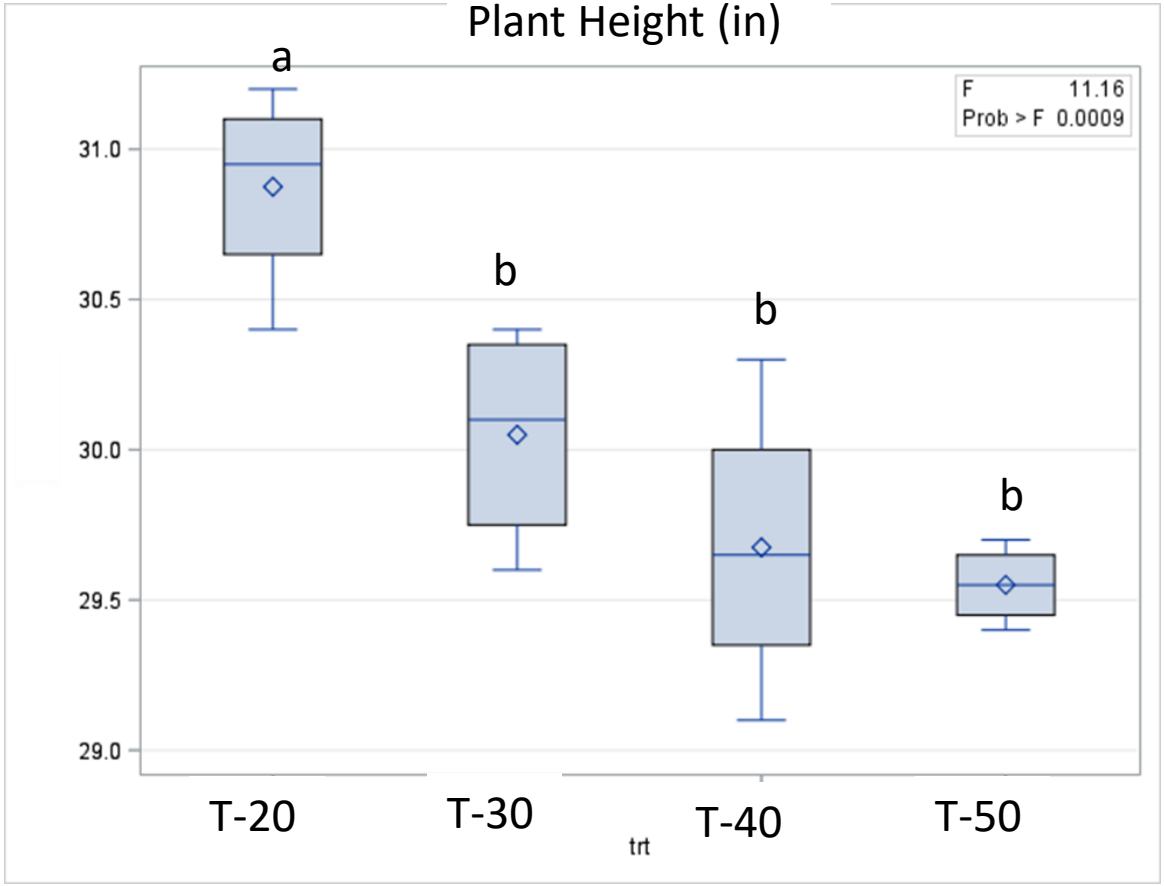

Cumulative Irrigation (inches)
T-20
T-30
T-40
T-50
20
16
12
8
4
0
14-Aug
28-Aug
11-Sep
25-Sep
9-Oct
23-Oct
6-Nov
20-Nov
4-Dec

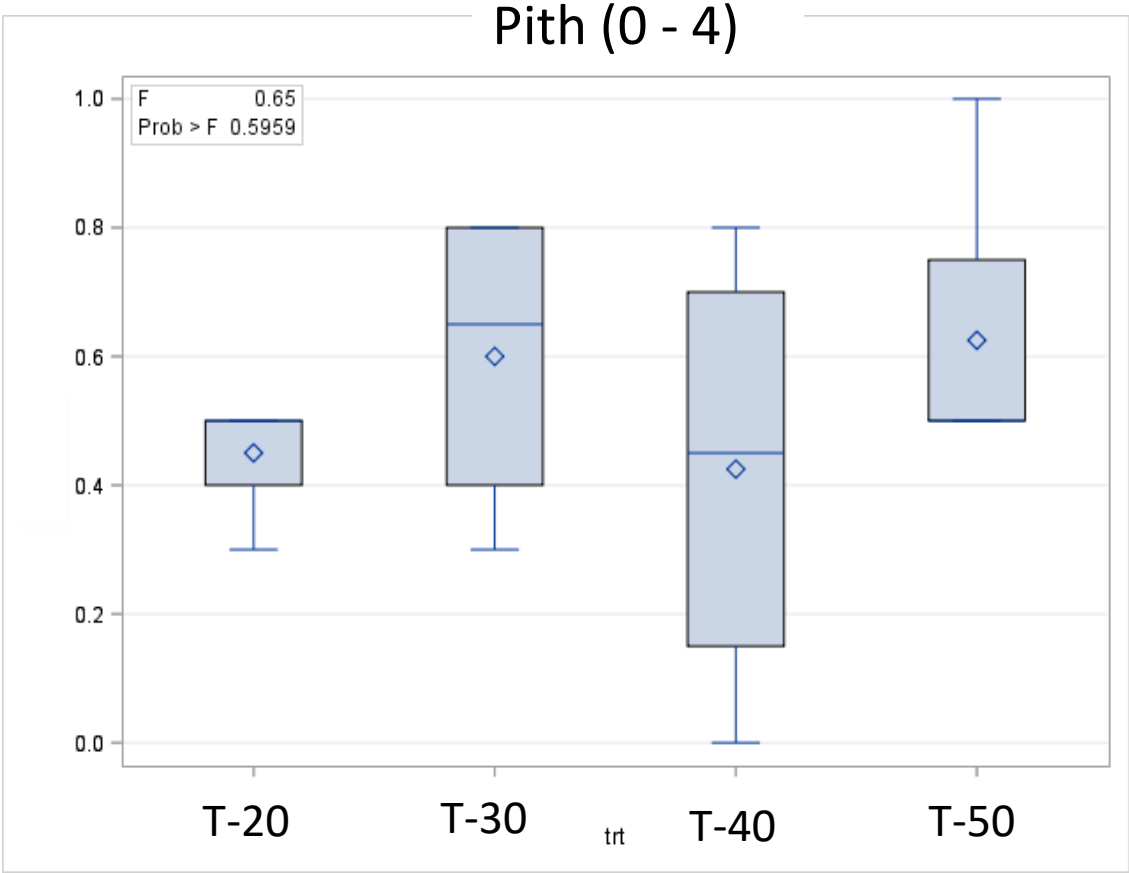
Results

				Stem	Plant			
	Yield (lb/20ft)		Marketable	length	height	Pith	Plant weight (lb)	
Treatment	Total	Marketable	plants/20ft	(inches)		(1-4)	Total	Marketable
T-20	195.4 a	131.8 a	60 a	9.7 a	30.9 a	0.4 a	3.0 a	2.2 ab
T-30	186.9 ab	126.1 ab	62 ab	9.7 a	30.0 b	0.6 a	2.8 ab	2.0 abc
T-40	187.3 ab	131.8 a	62 ab	9.4 a	29.6 b	0.4 a	2.8 ab	2.1 b
T-50	173.2 b	120.0 b	65 b	9.5 a	29.6 b	0.6 a	2.5 b	1.8 c


Marketable Yield (lbs per plot)
F 4.33
Prob > F 0.0275
140
135
130
125
120
115
a
ab
a
b
T-20
T-30
T-40
T-50
trt


Marketable Plant Weight (lbs/plant)
F 6.67
Prob > F 0.0067
2.4
2.3
2.2
2.1
2.0
1.9
1.8
T-20
T-30
T-40
T-50
trt


Plant Height (in)
a
b
b
b
F 11.16
Prob > F 0.0009
31.0
30.5
30.0
29.5
29.0
T-20
T-30
T-40
T-50
trt


Pith (0 - 4)
F 0.65
Prob > F 0.5959
1.0
0.8
0.6
0.4
0.2
0.0
T-20
T-30
T-40
T-50
trt

Plant and Soil Nutrients at Harvest

Plant Tissue Analysis

	T-20	T-30	T-40	T-50
	--------- % ----------			
N	2.43	2.33	2.50	2.46
P	0.39	0.39	0.40	0.40
K	2.99	2.99	2.95	3.20

Very similar ECe, pH, P and K

Soil Analysis

	T-20	T-30	T-40	T-50
	---- ppm NH4-N -----			
0-12	4.3	4.1	4.3	4.1
12-24	3.8	3.6	3.7	3.7
	---- ppm NO3-N -----			
0-12	11.7	12.4	13.1	9.9
12-24	21.5	17.6	35.1	13.4

Summary

- ✓ Initiating irrigation at soil water potential greater than 20 centibars gradually decreased celery yield
- ✓ Pith did not increase with increasing threshold from 20 to 50cb

Two most common types of sensors

Tension

Volumetric

→ 0.20 Volumetric Water Content

Tension sensors

Advantages

- Direct measure of tension
- Can interface with data logger
- No salinity interference
- Responsive at high moisture
- Contents independent of soil texture

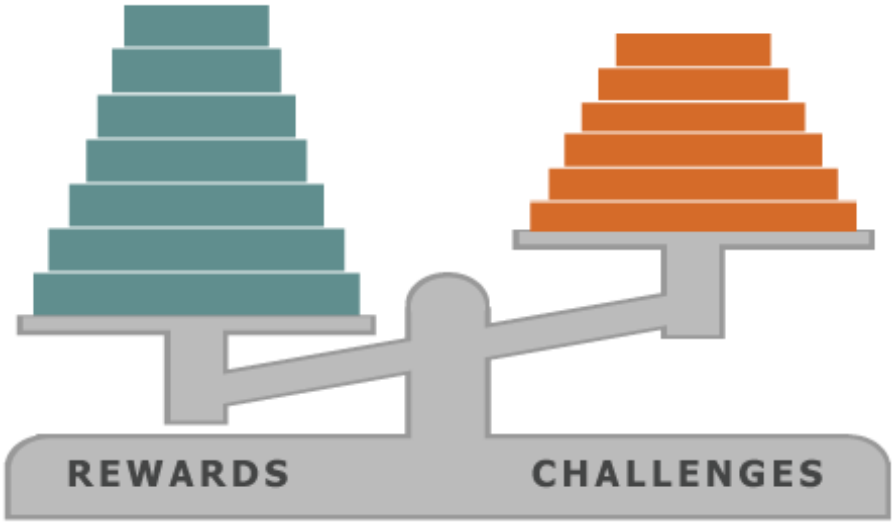
Disadvantages

- Requires good contact with soil
- Limited moisture range (0-70 cbar)
- Requires frequent maintenance

Data Access Levels

- Silver: Field observation
- Gold: Field observ. + recording (datalogger)
- Platinum: Field observ + recording + remote access

Challenges with the adoption of each technology/technique/tool



- Learning curve
- Costs
- Time investment
- Maintenance
- Troubleshooting

Summary

- Technology/technique adoption: consider rewards and challenges
- Successful validation of techniques and tools:
  - ET-based irrigation
  - CropManage
  - Soil moisture sensors

Acknowledgements

- Cooperating growers: Dany Pereira, Rio Farms
- California Celery Research Board
- Hortau®: equipment and technical support

CropManage

CropManage Hands-on Workshop

Wednesday, June 06, 2018

1pm – 4:30pm

Location: University of California Cooperative Extension
669 County Square Drive, Suite 100, Ventura, CA 93003

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Strawberry Salinity Field Day

June 7th

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Questions/comments?

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