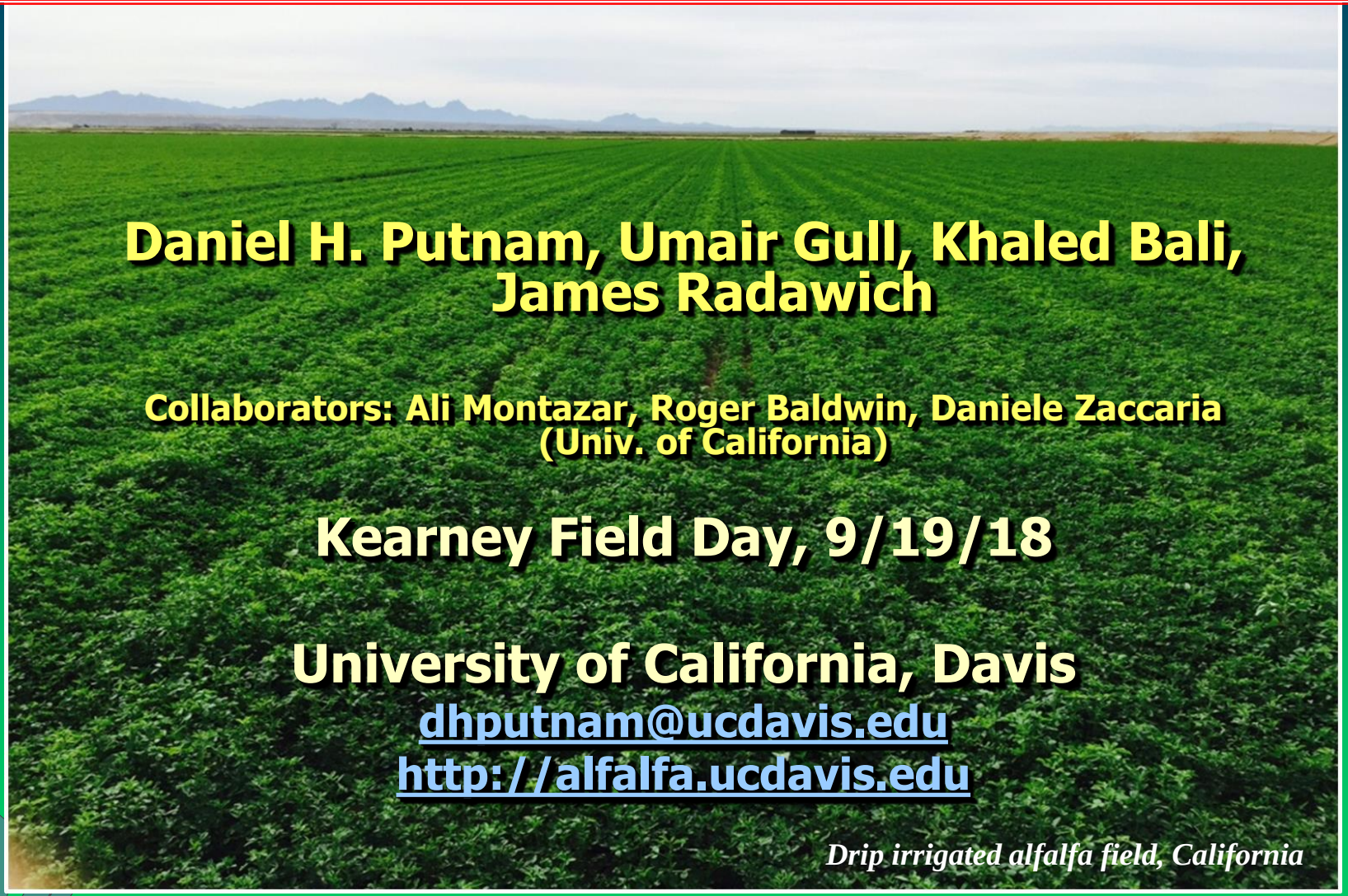
Subsurface Drip Irrigation, Deficit Irrigation Strategies in Alfalfa



Daniel H. Putnam, Umair Gull, Khaled Bali, James Radawich

Collaborators: Ali Montazar, Roger Baldwin, Daniele Zaccaria (Univ. of California)

Kearney Field Day, 9/19/18

University of California, Davis

dhputnam@ucdavis.edu

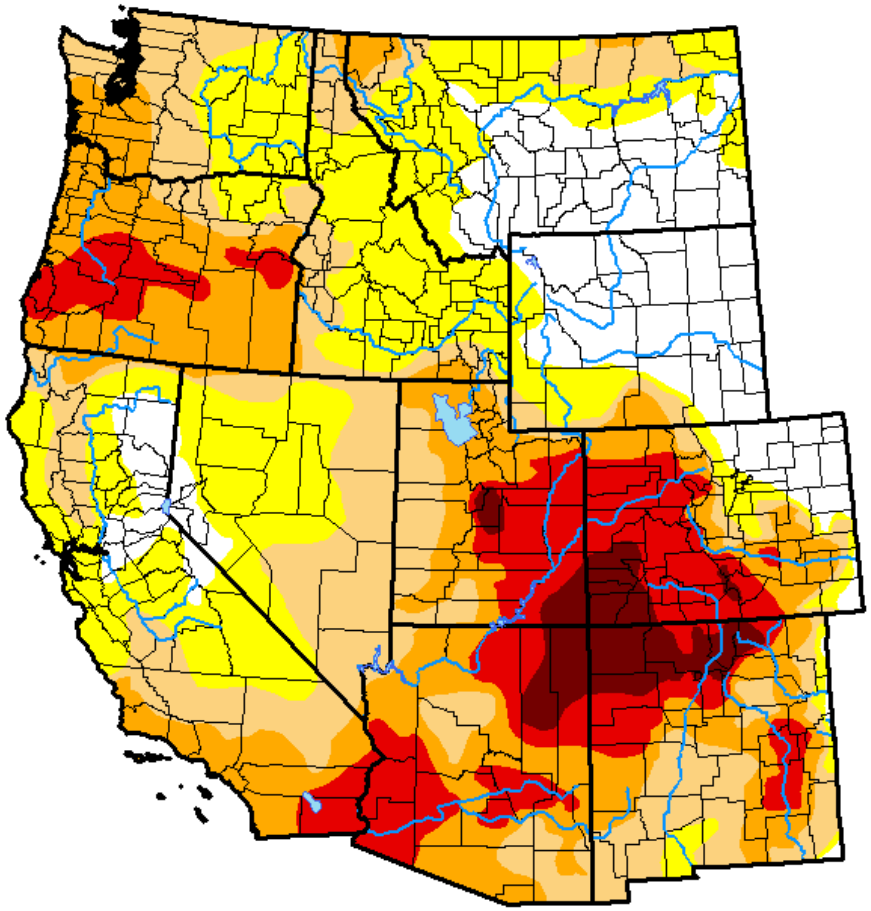
http://alfalfa.ucdavis.edu

Drip irrigated alfalfa field, California

Main Points

- Subsurface Drip Irrigation is a viable system for irrigation of alfalfa but has some important limitations
- Alfalfa is a crop well suited to 'Deficit Irrigation' (watering less than what the crop needs) to save water for other crops or for economic transfers

U.S. Drought Monitor
West



September 11, 2018

(Released Thursday, Sep. 13, 2018)

Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	15.84	84.16	59.11	37.22	16.36	3.69
Last Week *09-04-2018*	16.03	83.97	58.74	37.58	16.82	3.69
3 Months Ago *06-12-2018*	33.98	66.02	44.34	31.86	18.98	4.34
Start of Calendar Year *01-02-2018*	48.76	51.24	29.03	8.60	1.52	0.00
Start of Water Year *09-26-2017*	55.72	44.28	21.01	8.72	5.30	2.17
One Year Ago *09-12-2017*	53.28	46.72	24.11	9.34	6.18	3.22

Intensity:

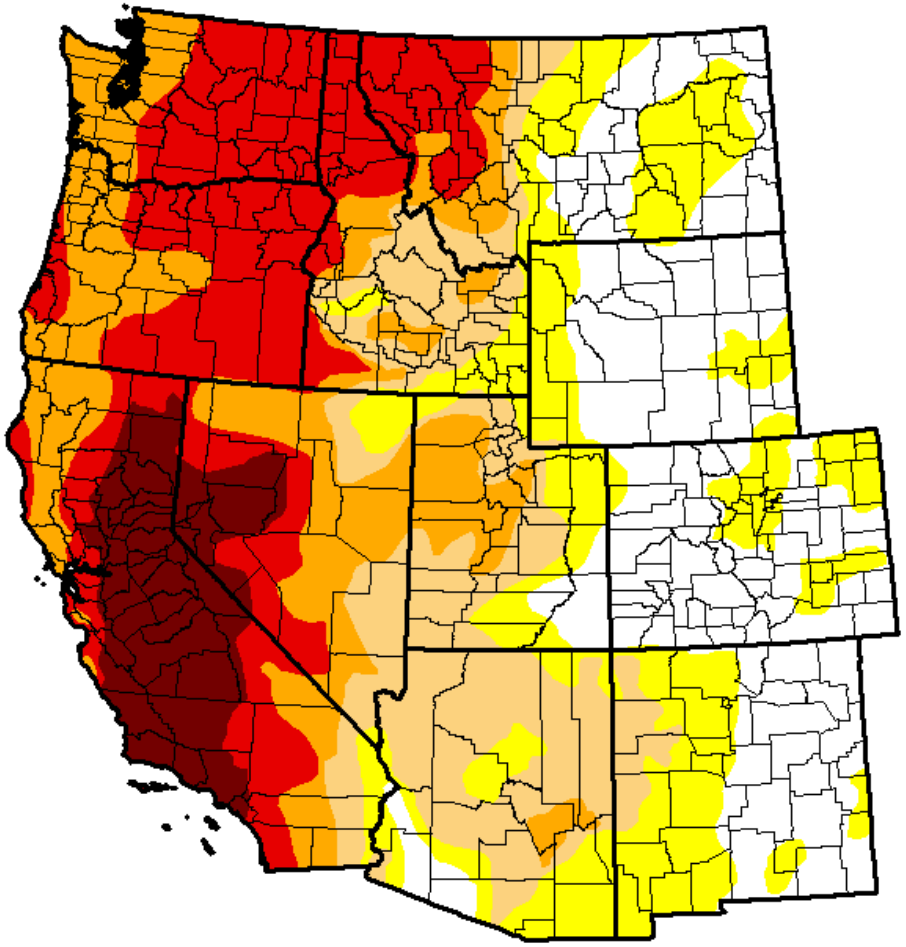
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
David Miskus
NOAA/NWS/NCEP/CPC

http://droughtmonitor.unl.edu/

U.S. Drought Monitor
West



September 22, 2015

(Released Thursday, Sep. 24, 2015)

Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	22.79	77.21	58.18	42.49	26.73	7.62
Last Week 9/15/2015	24.68	75.32	59.66	42.69	26.73	7.62
3 Months Ago 6/23/2015	23.93	76.07	57.86	35.88	17.13	7.26
Start of Calendar Year 12/30/2014	34.76	65.24	54.48	33.50	18.68	5.40
Start of Water Year 9/30/2014	31.48	68.52	55.57	35.65	19.95	8.90
One Year Ago 9/23/2014	31.18	68.82	56.42	35.96	20.00	8.90

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

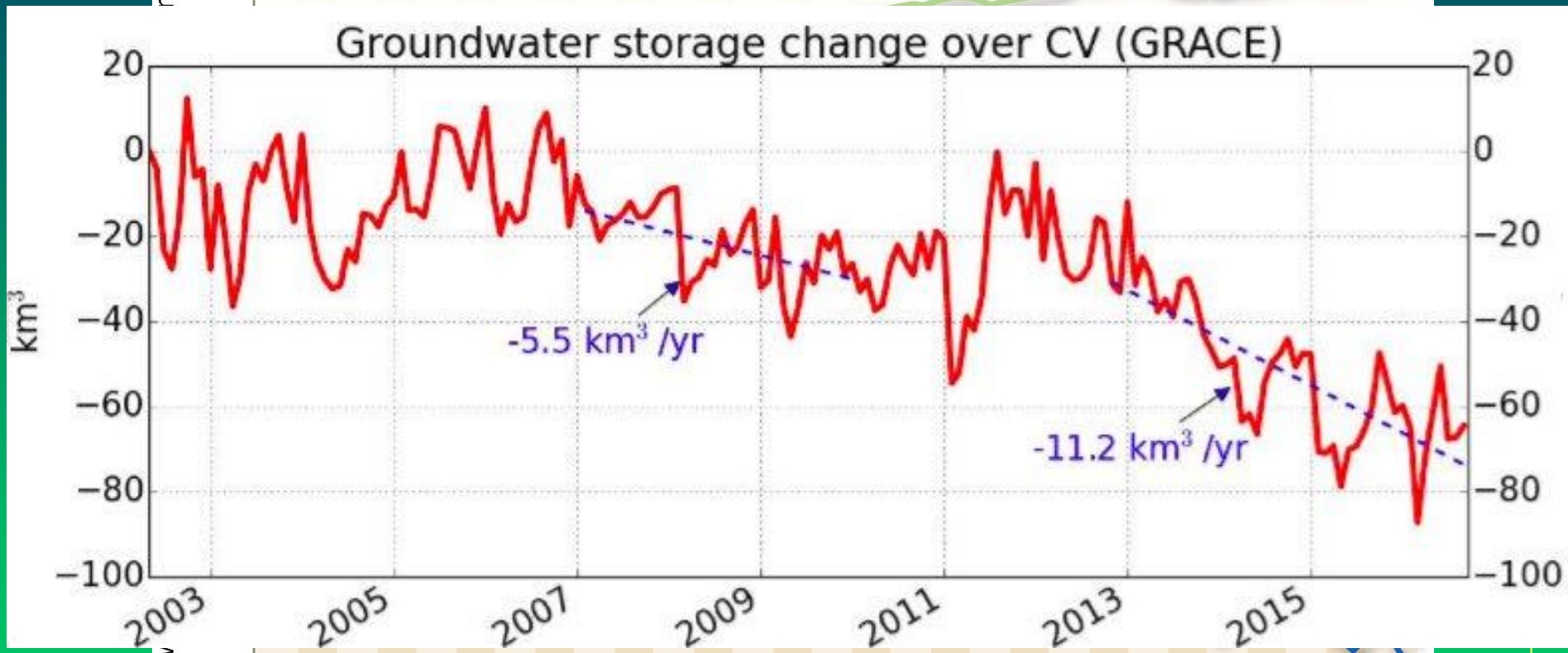
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Eric Luebehusen
U.S. Department of Agriculture

USDA National Drought Mitigation Center

http://droughtmonitor.unl.edu/

Groundwater Challenge in the Central Valley

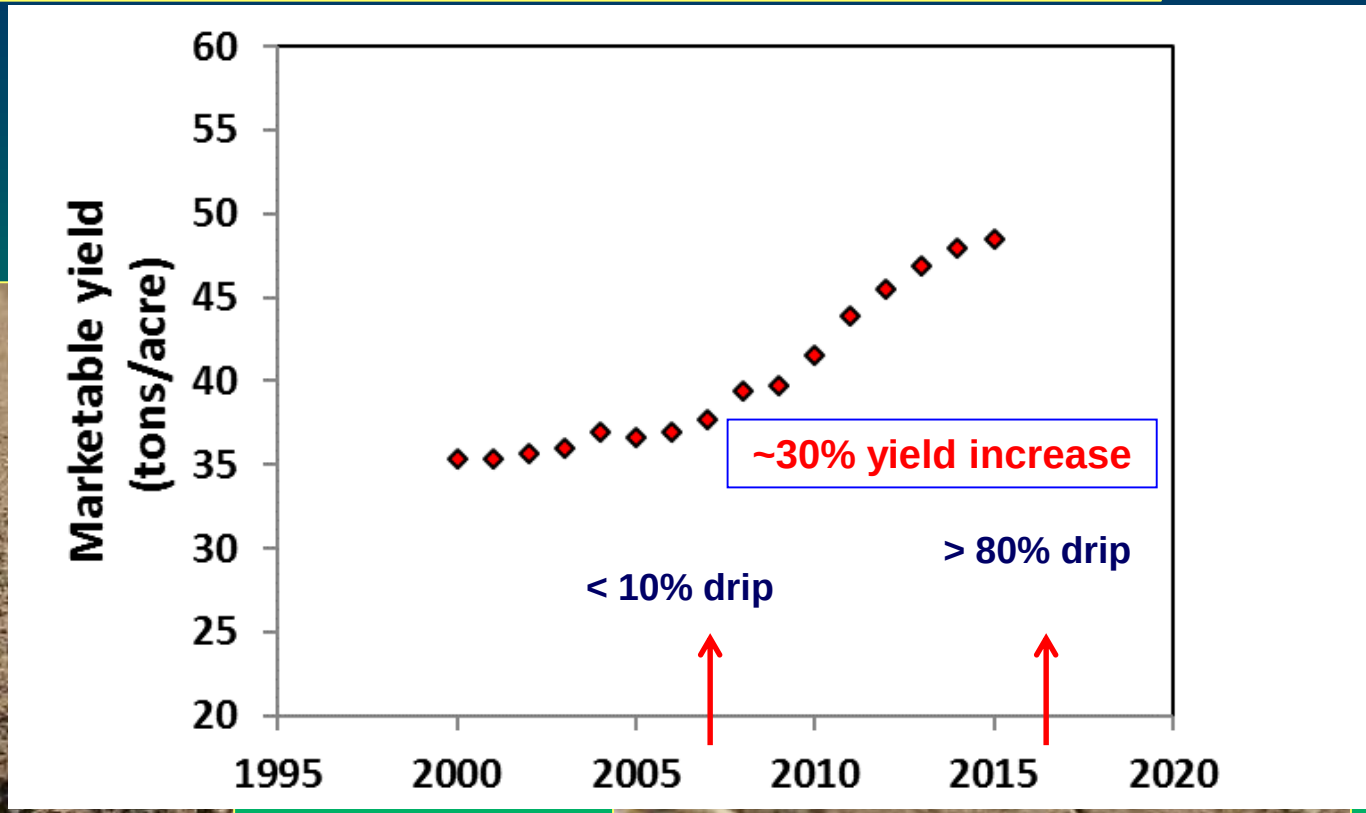


Xiao et al. Apr. 2017

Impetus:

- Periodic droughts
- Groundwater Depletion.
- Water transfers to other uses
  - Competing crops
  - Cities
  - Environmental (regulatory)
- Irrigation management is a major limiting factor for yield
  - Distribution uniformity, timing

Why Subsurface Drip (SDI)? (tomato story)



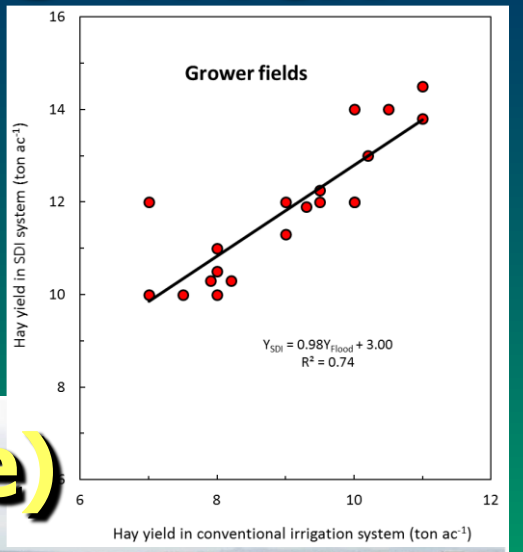
018

Overall Objectives

- Is Subsurface Drip Irrigation (SDI) a viable strategy for western alfalfa producers?
- Can Alfalfa be partially irrigated to achieve water savings and economically-viable yields?

Grower Experience with SDI

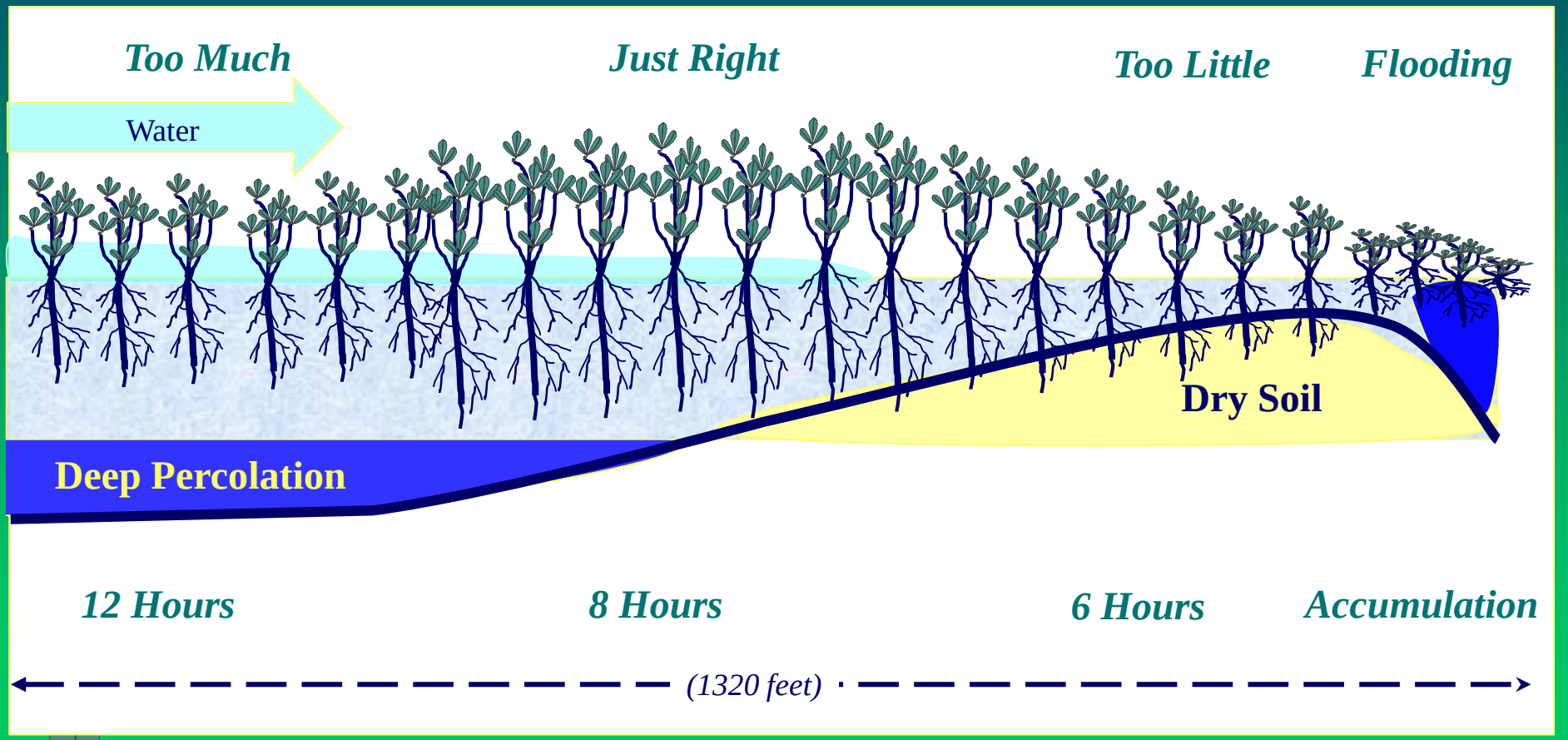
- Many Positives
- Better field distribution (DU)
- Timing (quickly fill the profile)
- Lower labor
- +yields ~2-3 t/a
- High cost
- Maintenance
- Gopher - rodents



Innate Problems with Flood Irrigation

(Distribution uniformity can be poor due to soil infiltration rate, flow, and set duration)

In a 12 hour irrigation set:



Key Factors

Superior Distribution Uniformity (in Space)

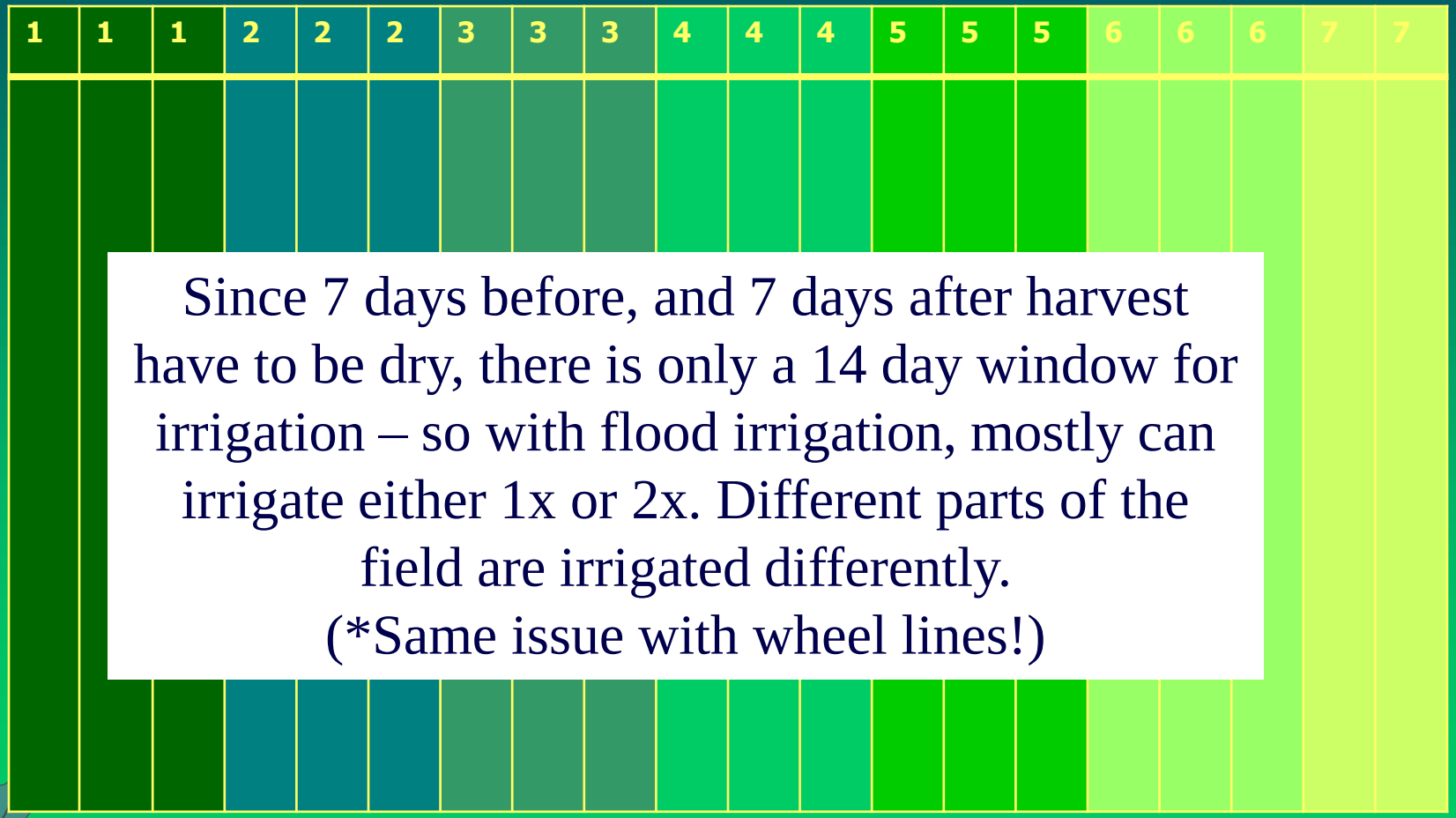
- Less difference between top and bottom of field
- Well known problems with surface systems
- Tail end management

Superior Distribution Uniformity (in Time)

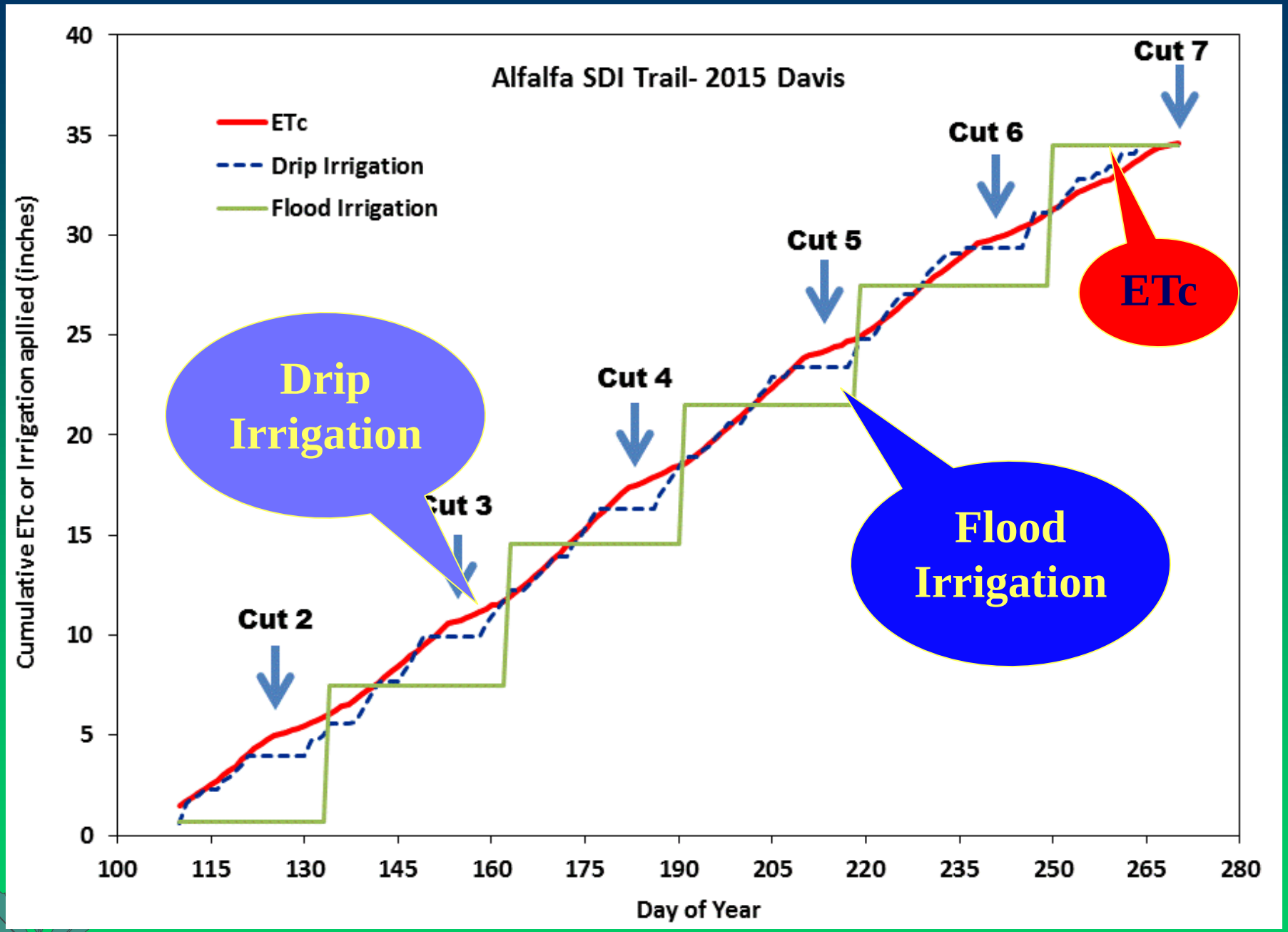
- Ability to 'charge' a field within hours, not days
- Most Flood-irrigated (and some sprinkle irrigated) fields require 4-12 days to irrigate, depending upon flow available.

Innate Problems with Flood Irrigation

In a 28 day growth cycle, some parts of the field get water 7-8 days later.

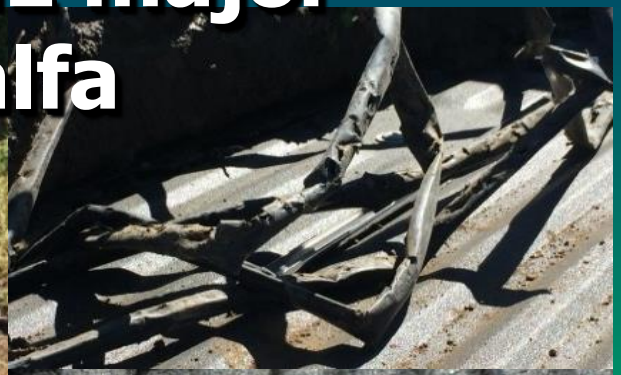


Since 7 days before, and 7 days after harvest have to be dry, there is only a 14 day window for irrigation – so with flood irrigation, mostly can irrigate either 1x or 2x. Different parts of the field are irrigated differently.
(*Same issue with wheel lines!)


Alfalfa SDI Trail- 2015 Davis
ETc
Drip Irrigation
Flood Irrigation
Cumulative ETc or Irrigation apllied (inches)
Day of Year
Cut 2
Cut 3
Cut 4
Cut 5
Cut 6
Cut 7
Drip Irrigation
Flood Irrigation
ETc
0
5
10
15
20
25
30
35
40
100
115
130
145
160
175
190
205
220
235
250
265
280

What we've learned:

- **Rodents are perhaps THE major challenge for SDI in alfalfa**



Leak Discovery Method

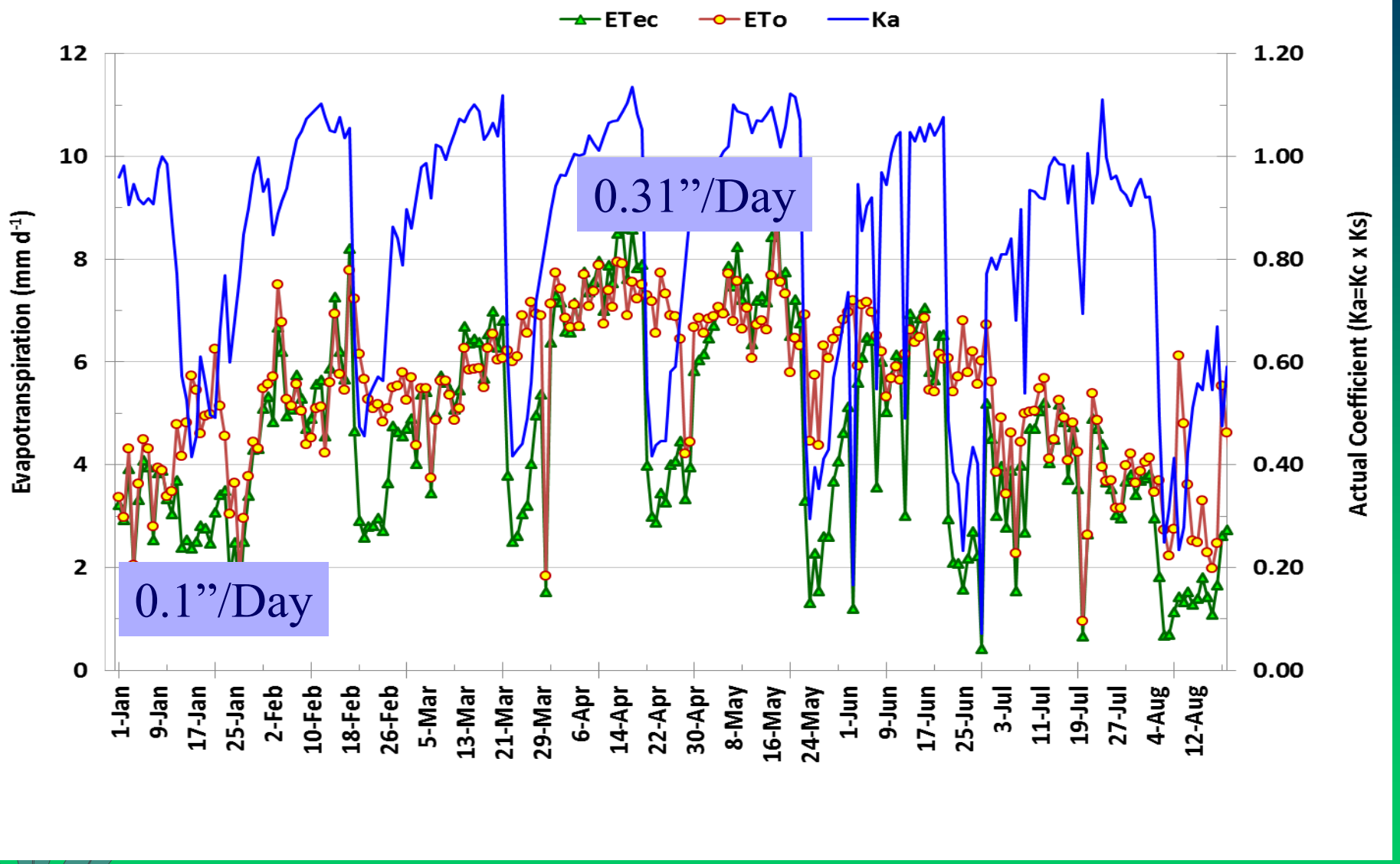
Deficit Irrigation

- Periodic Drought
- Competing Crops
- 'Regulatory Drought'
- Voluntary Water Transfer

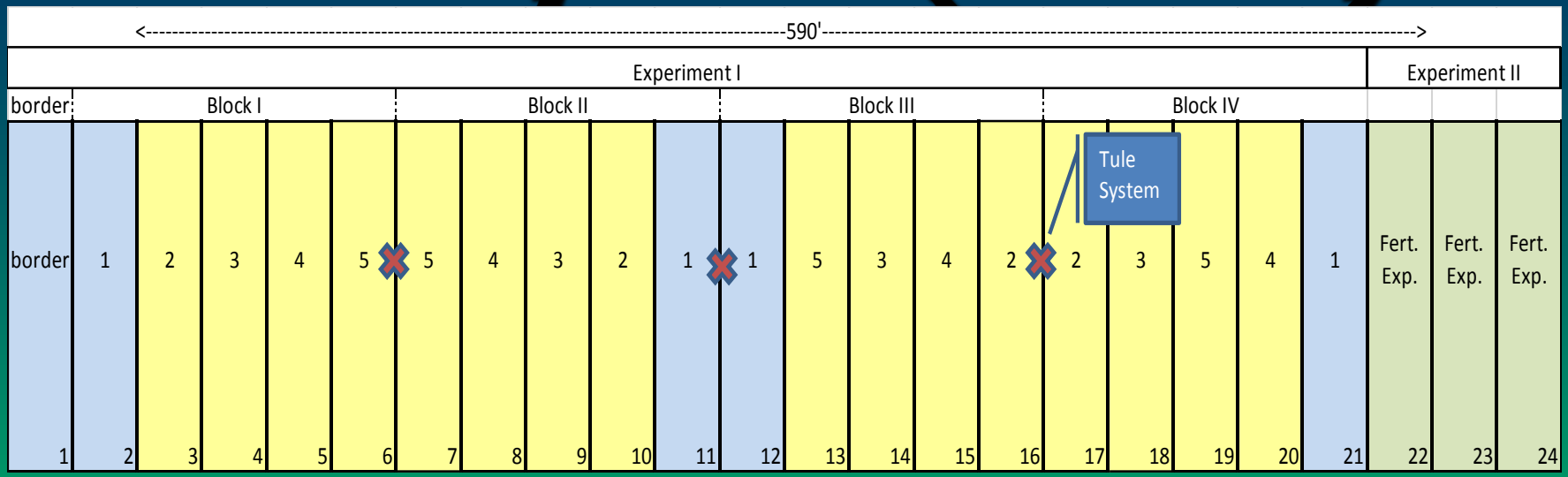
"Is partial season productivity better than fallow?"

Sustaining Forage Production during drought

Evapotranspiration (Davis)



Kearney Trial (Fresno)



- 100% ET Flood
- 100% ET drip
- 50% ET drip sudden cutoff
- 75% ET drip season-long deficit
- 75% ET drip sudden cutoff

Kearney SDI Trial (Objectives 1 & 2)

Experimental Design (Fall 2016)

- **Randomized Complete Block Design (RCBD) with 4 replications**
- **25 ft *250 ft (Total acreage 3.44 acres)**