Evaluating automated precision fertigation effect on tomato yield and quality

Isaya Kisekka

Assistant Professor

Irrigation Engineering and Agricultural Water Management

Departments of LAWR and BAE

UC DAVIS
UNIVERSITY OF CALIFORNIA

Outline

- Justification
- Objectives
- Methods
- Results from 2018 growing season
- Proposed research for 2019 season

Justification of Proposed Research

- Constrained water supplies (Policy [SGMA] or Hydrology).
- Irrigated Lands Regulatory Program (ILRP) : Nitrate leaching.
- There is a need among growers to optimize yield and quality to enhance net profitability while minimizing nitrate leaching to groundwater.
- Can precision fertigation help processing tomato growers to improve yields and quality by applying precise amounts of fertilizers at the right time and right place?

UCDAVIS

Objectives

1. Evaluate the effect of high frequency low concentration (HFLC) fertigation and low frequency high concentration (LFHC) fertigation on yield and quality of processing tomatoes.

2. Evaluate the effect of different deficit irrigation strategies (Regulated deficit- 75% after ripening, Sustained deficit- 75%ET) on yield and fruit quality.

UCDAVIS

Precision irrigation and fertigation treatments

- T1: Full irrigation-HFLC fertigation 100% ET
- T2: Full irrigation-LFHC fertigation 100% ET
- T3: Regulated deficit-HFLC fertigation 100%ET before ripening – 75% after ripening
- T4: Regulated deficit-LFHC fertigation 100%ET before ripening – 75% after ripening
- T5: Sustained deficit-HFLC fertigation 75%ET
- T6: Sustained deficit-LFHC fertigation 75%ET

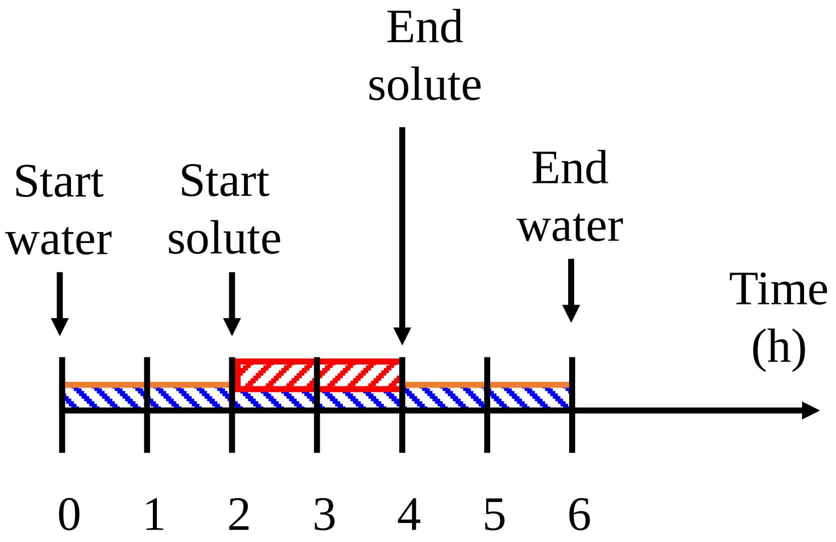
Estimating fertigation injection rates

- Injection Amount (gallons) = $\dfrac{\left(Desired\ lbs\ of \frac{N}{acre}\right) * acres * 100}{\left(Fertilizer\ density\left(\frac{lbs}{gal}\right)\right) * (\%of\ N\ in\ fertilizer)}$

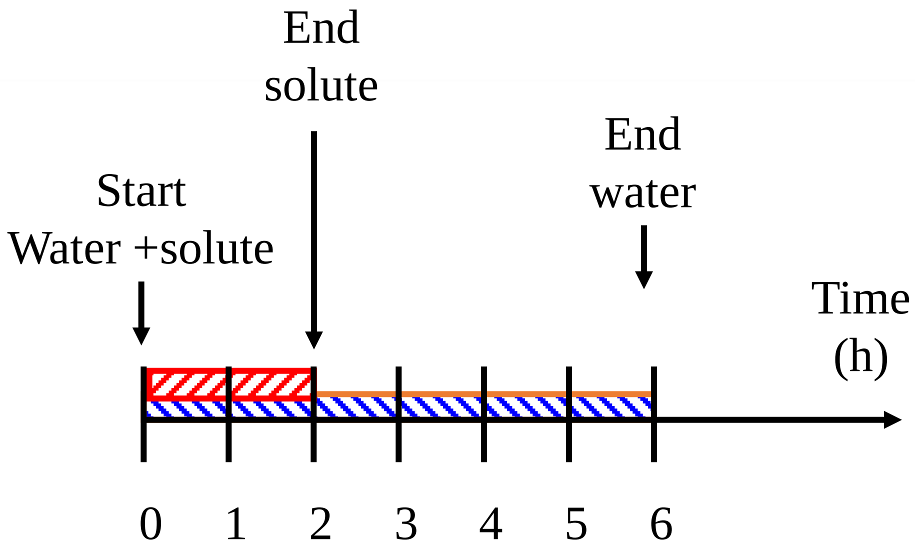
- Injection Rate (gal/hr) = $\dfrac{\left(Desired\ lbs\ of \frac{N}{acre}\right) * acres * 100}{\left(Fertilizer\ density\left(\frac{lbs}{gal}\right)\right) * (\%of\ N\ in\ fertilizer) * injection\ time\ (hrs)}$

Implementation of automated precision fertigation

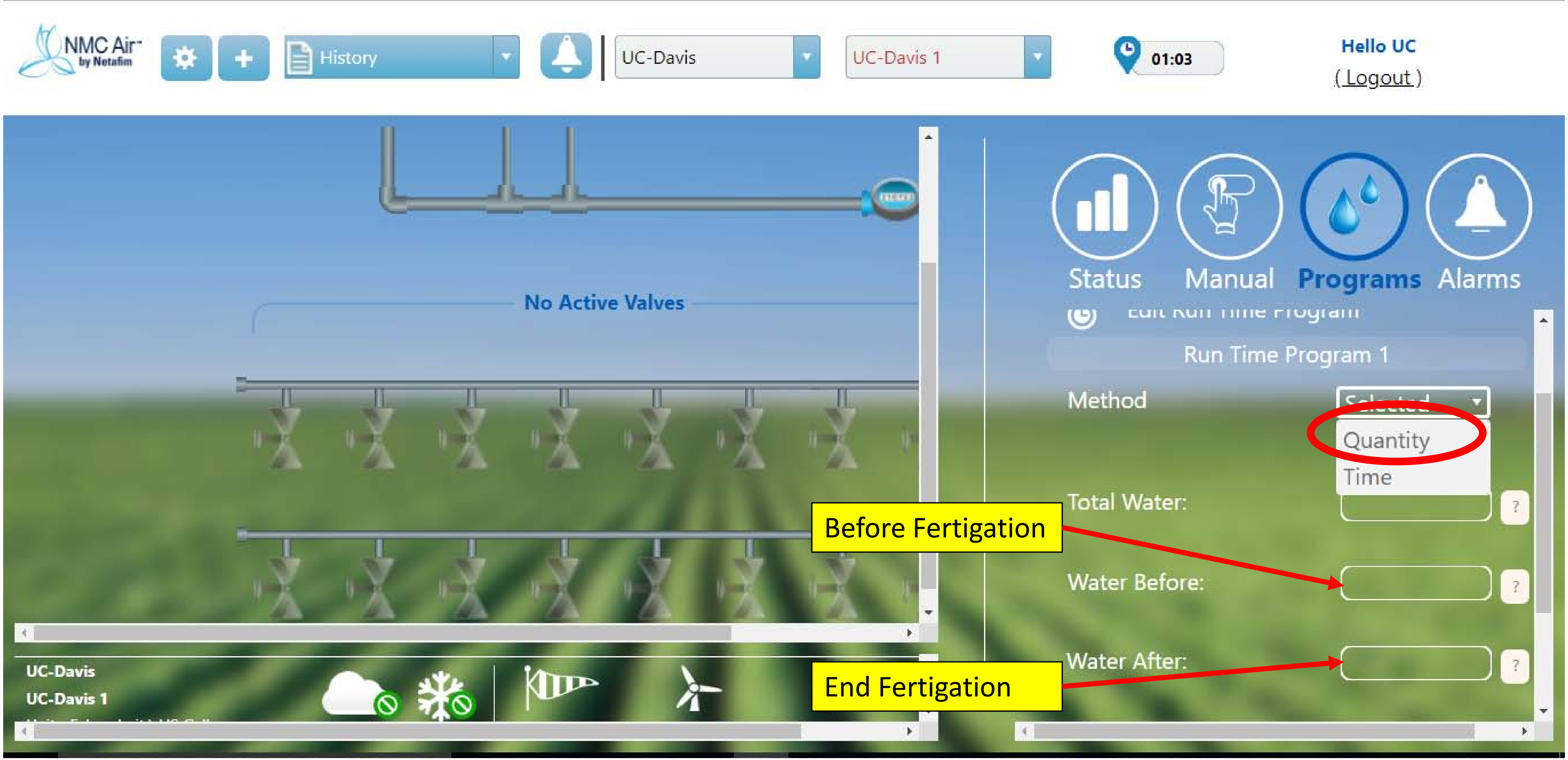
Strategy A



Strategy B

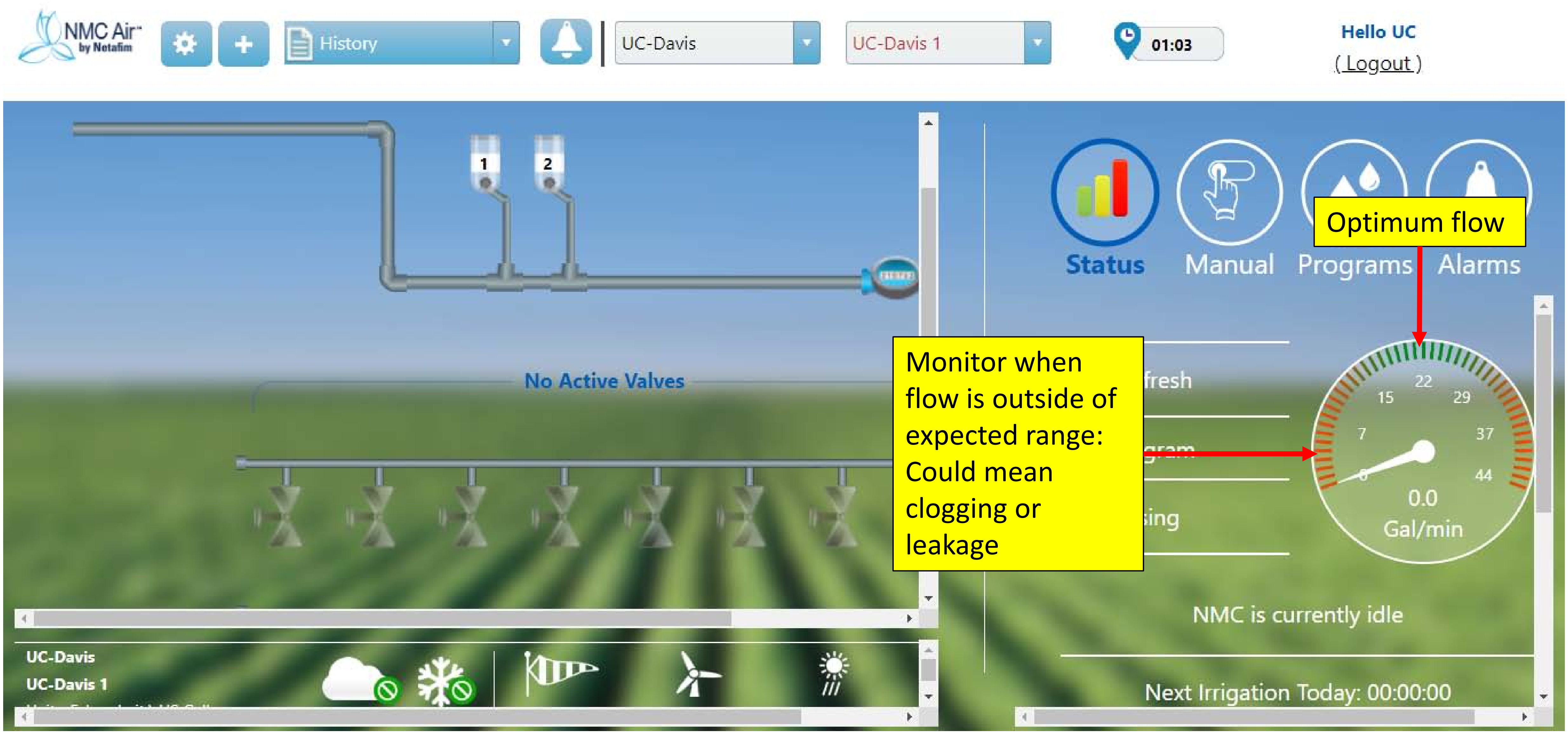


Which one of the two is a better fertigation management strategy?


NMC Air by Netafim
History
UC-Davis
UC-Davis 1
01:03
Hello UC
(Logout)
No Active Valves
Status
Manual
Programs
Alarms
Run Time Program 1
Method
Quantity
Time
Total Water:
Water Before:
Water After:
Before Fertigation
End Fertigation
UC-Davis
UC-Davis 1

UCDAVIS

Precision flow meter connected to irrigation controller can be monitored remotely

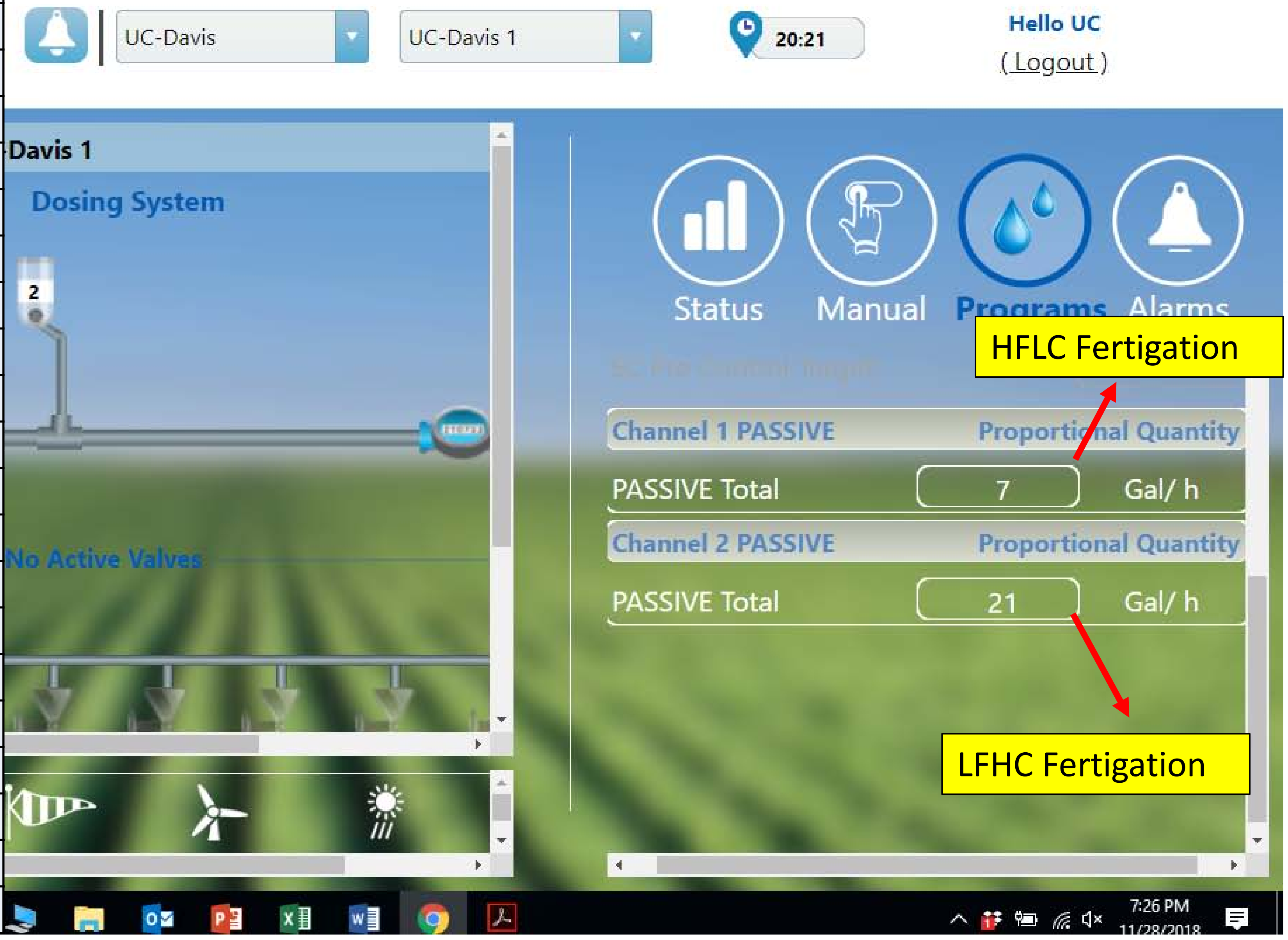


Optimum flow

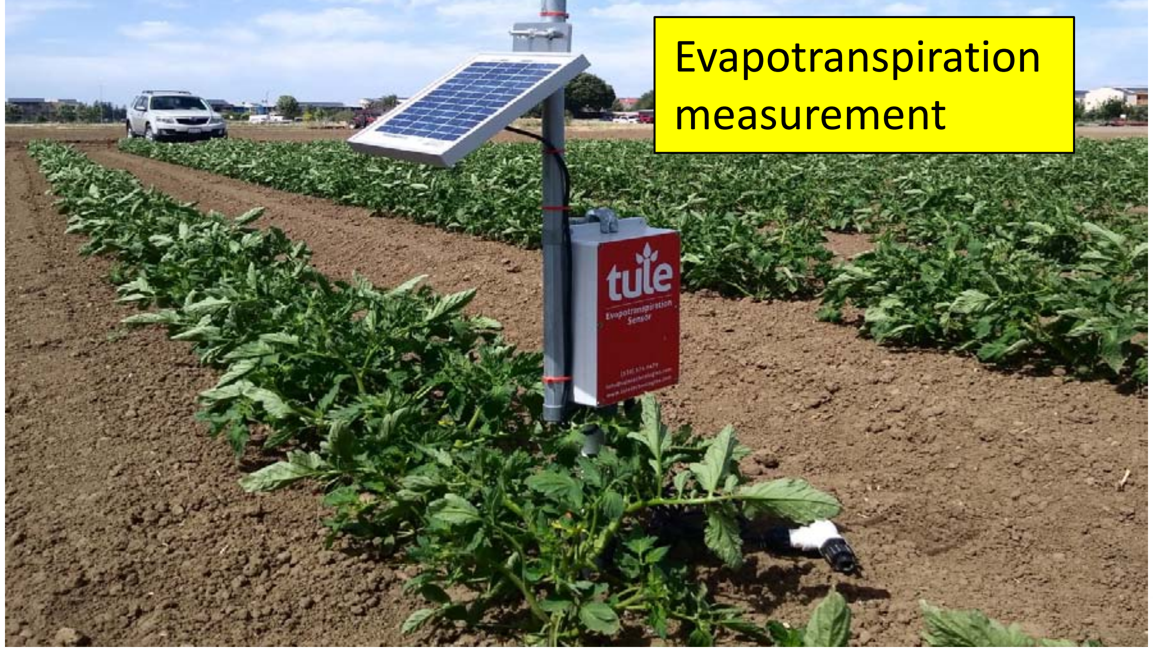
Monitor when flow is outside of expected range: Could mean clogging or leakage

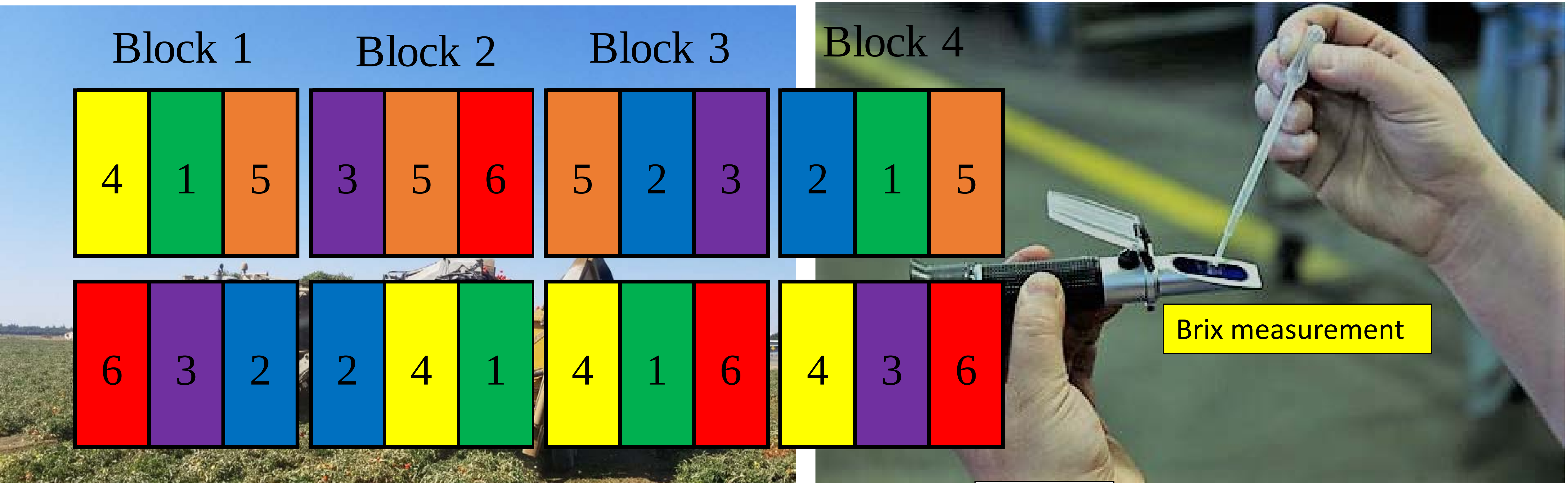
Fertigation Implementation

Date	HFLC N (lbs/acre)	LFHC N (lbs/acres)
01-May		
07-May	10	
14-May	10	30
21-May	10	
28-May	10	30
01-Jun	10	
07-Jun	10	
14-Jun	10	30
21-Jun	10	
28-Jun	10	30
01-Jul	10	
07-Jul	10	
14-Jul	10	30
21-Jul	10	
28-Jul	10	
01-Aug	10	30
07-Aug	10	
14-Aug	10	
21-Aug	10	
Total	**180**	**180**




Head control
fertigation and
pressure control


Evapotranspiration
measurement
tule


Block 1
Block 2
Block 3
Block 4
4 1 5
3 5 6
5 2 3
2 1 5
6 3 2
2 4 1
4 1 6
4 3 6
Brix measurement

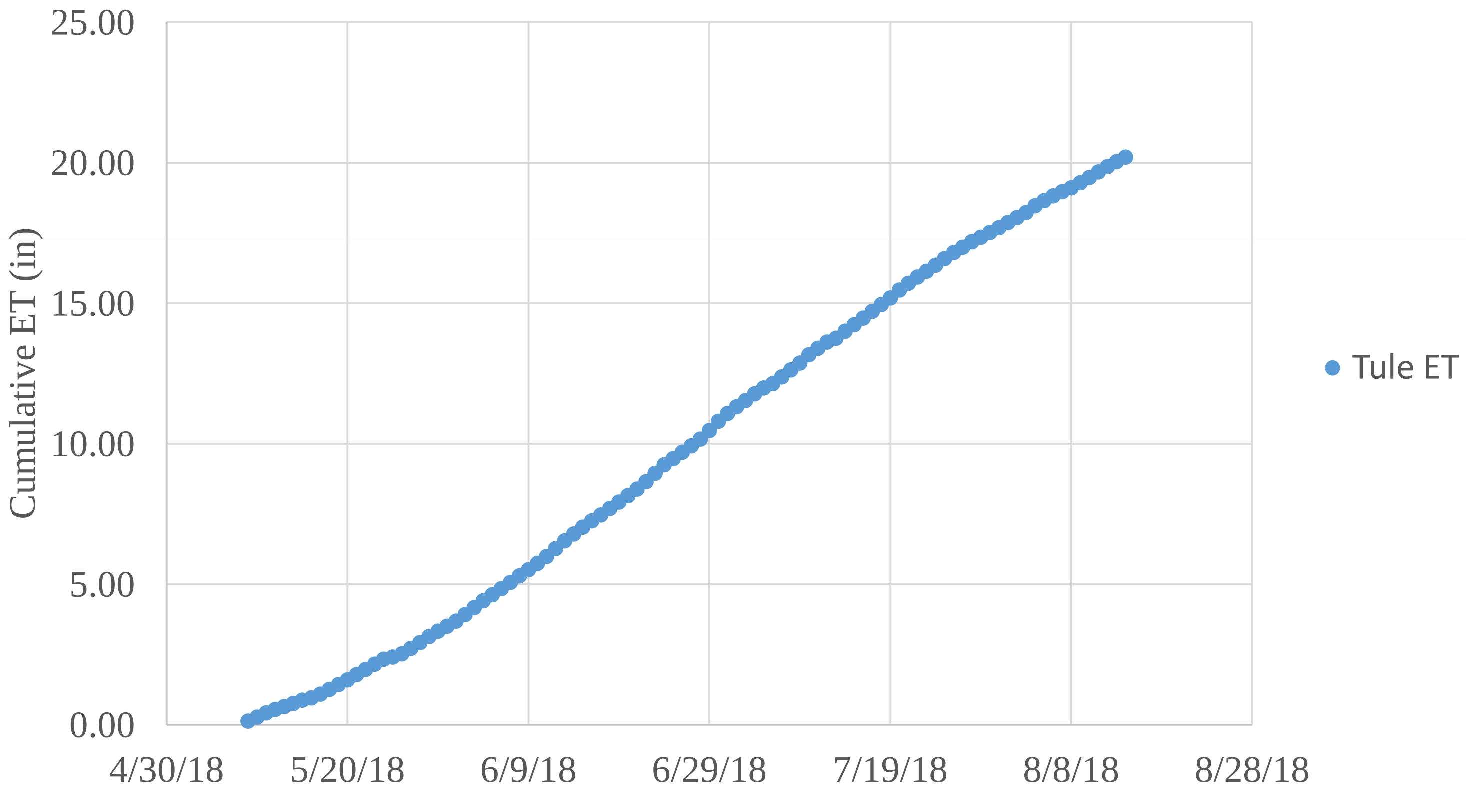
Yields from the 2018 processing tomato season

Treatment	Yield (ton/acre)	SSC (° Brix)
T1: HFLC 100% ET	71.8 a*	3.70 b
T2: LFHC 100% ET	69.2 ab	3.85 ab
T3: HFLC 100 - 75% ET	73.1 a	3.95 ab
T4: LFHC 100 - 75% ET	64.2 abc	3.85 ab
T5: HFLC 75% ET	59.5 bc	4.55 a
T6: LFHC 75% ET	57.4 c	4.58 a

Soil moisture (40 -50 cbar) monitoring and brix measurement of ripening fruit could help guide end-ofseason irrigation management

UCDAVIS

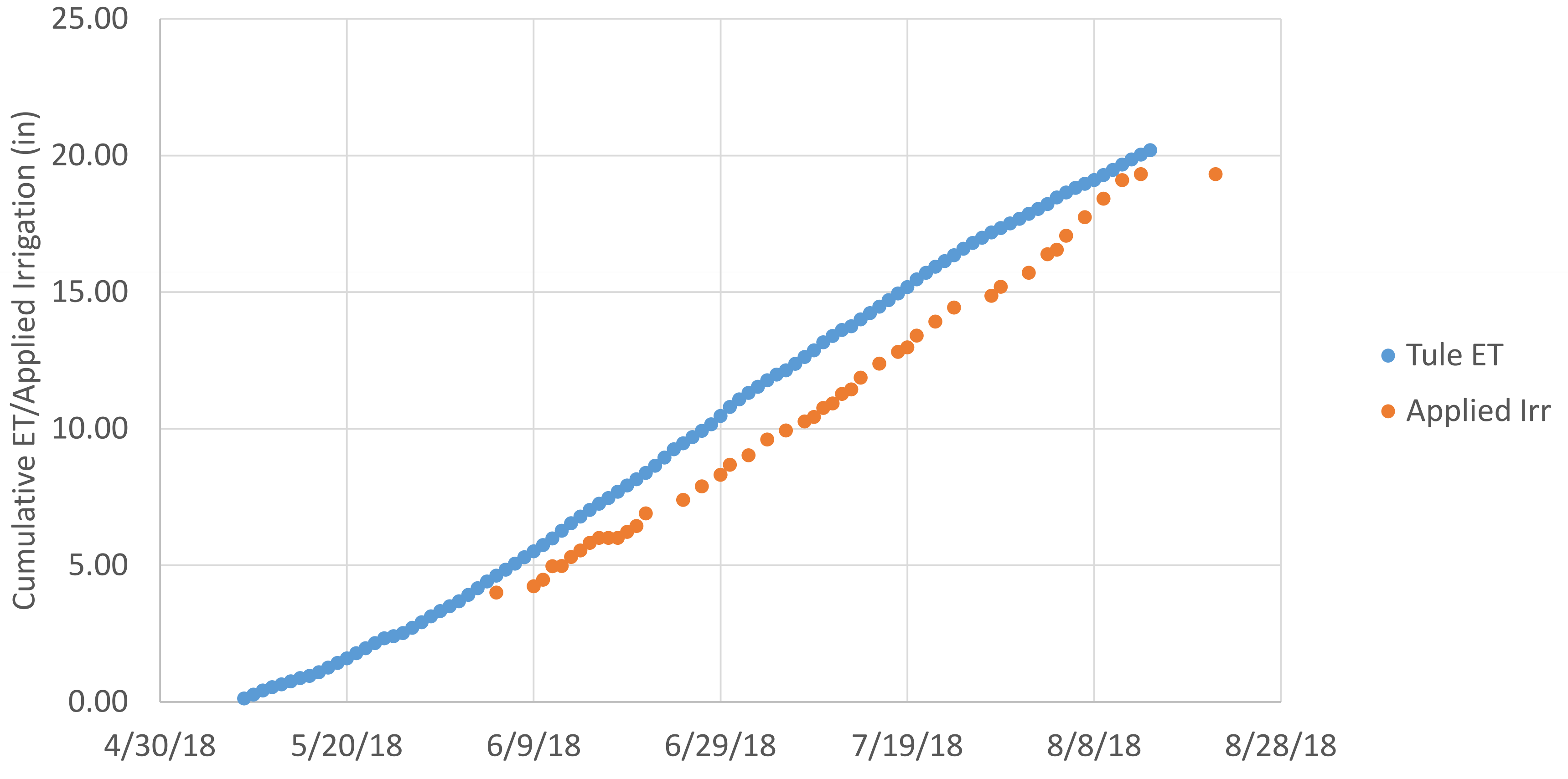
Evapotranspiration (Crop water use)



ET measured using Tule ET sensor

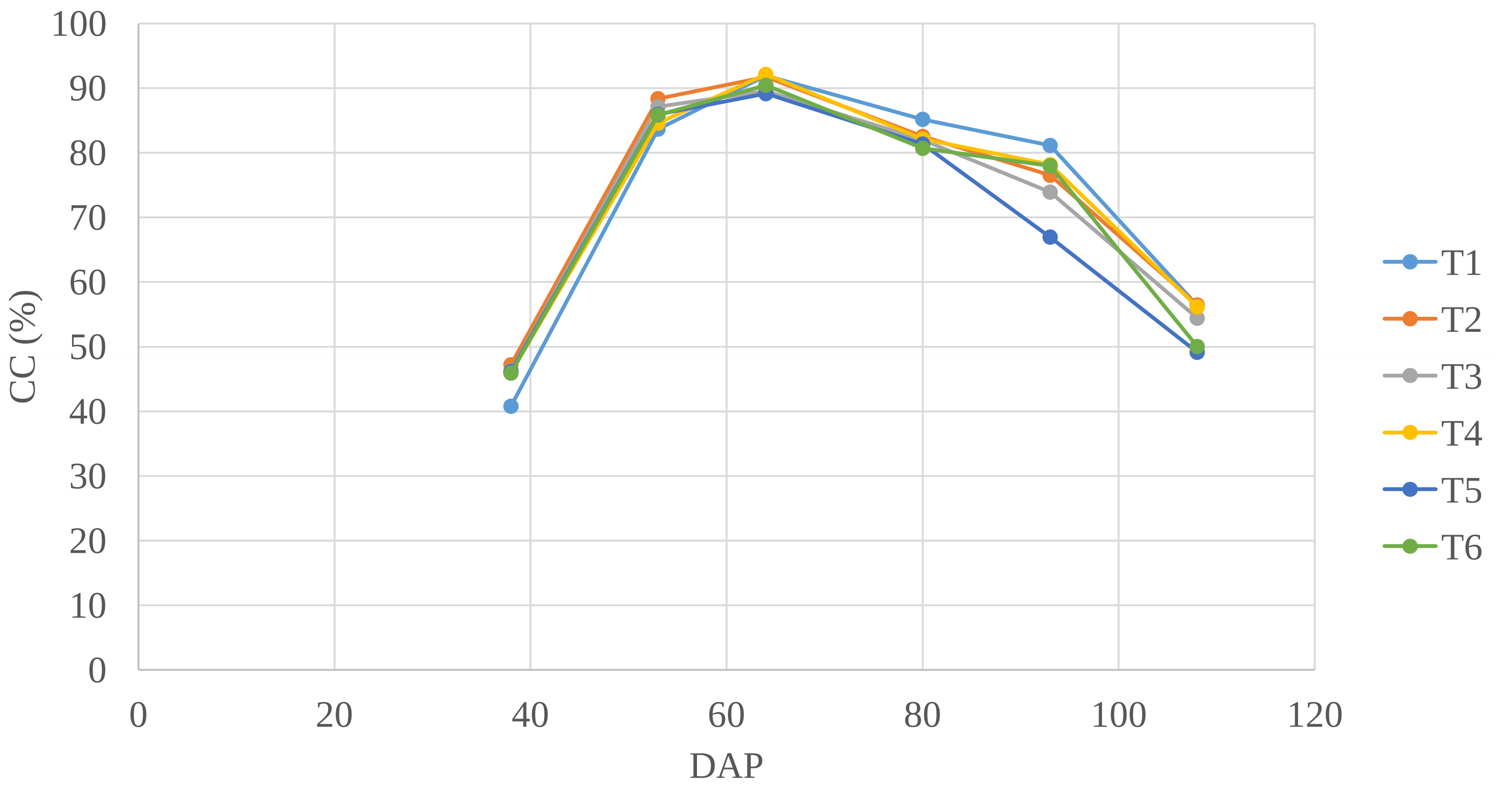
UCDAVIS

ET and Applied Irrigation



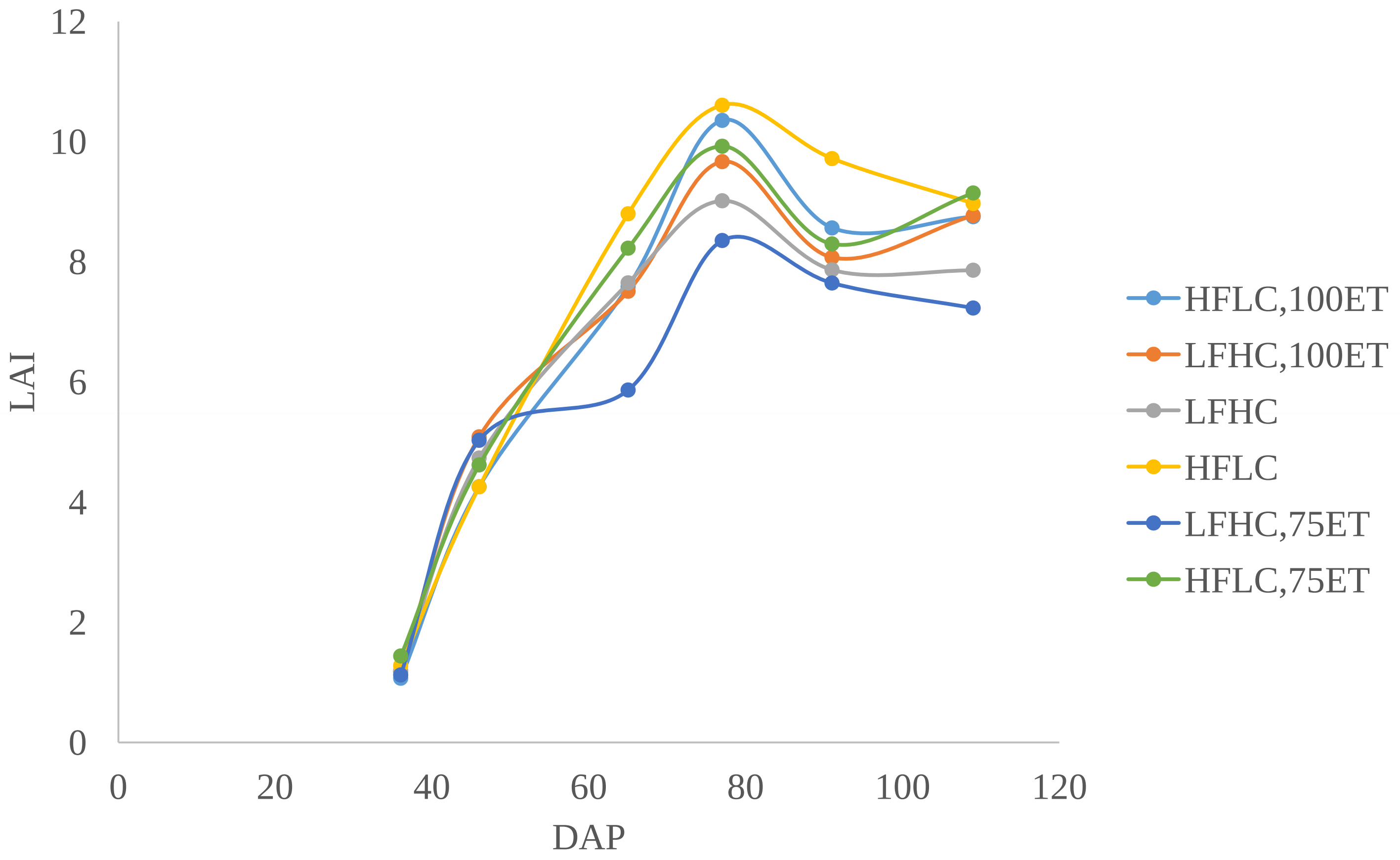
UCDAVIS

Effect of deficit irrigation and fertigation frequency on canopy cover



Most of the effects of deficit irrigation on canopy cover occurred in the last quarter of the season.
Probably explains lack of significant difference between full irrigation and regulated deficit irrigation (100 – 75 % ET)
Effect of sustained deficits on CC is substantial should be avoided.

Effect of deficit irrigation and fertigation frequency on LAI

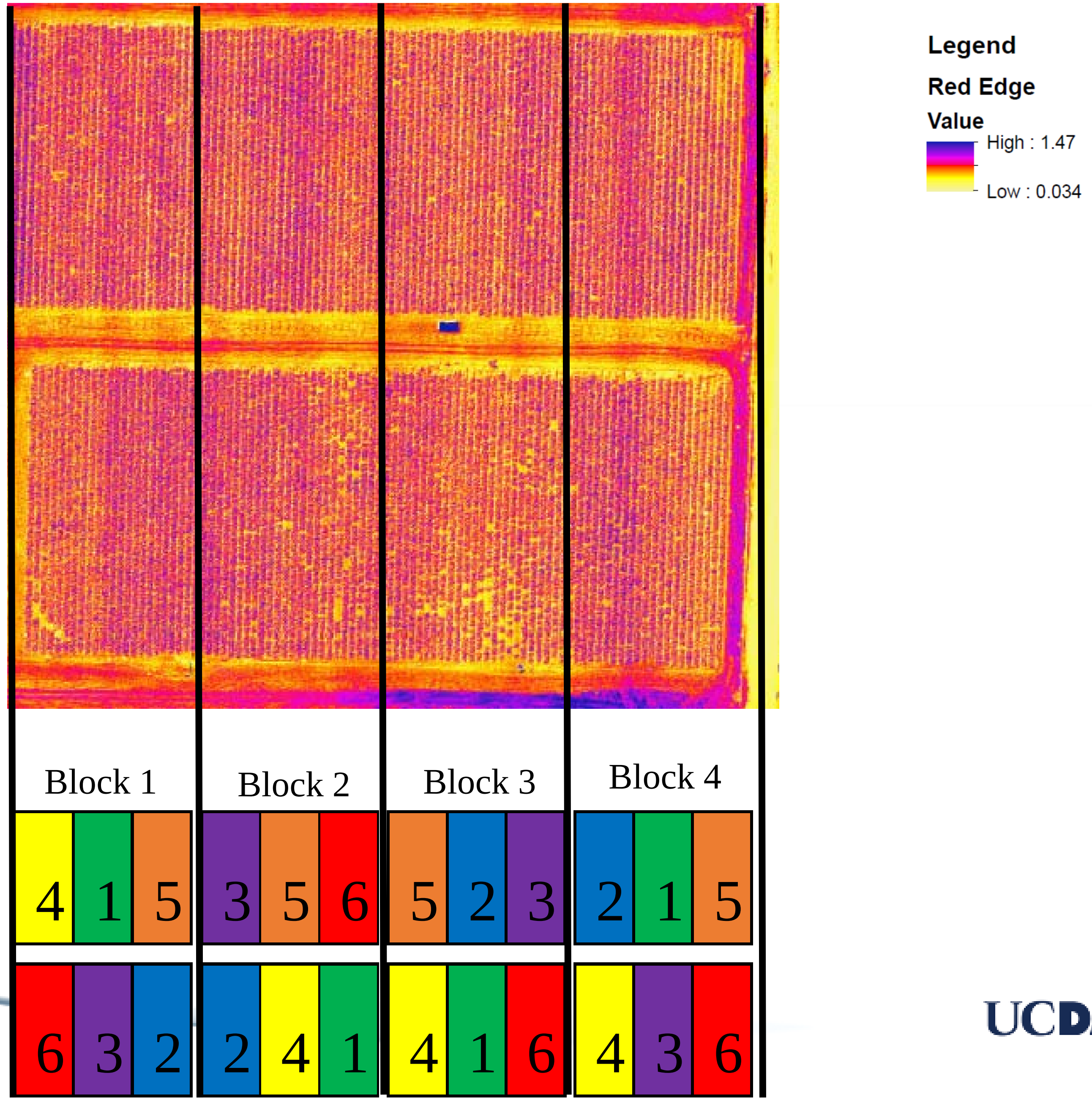


Sustained deficit irrigation affected LAI.

Even under sustained deficit irrigation, high frequency fertigation appeared to have maintained high LAI.

UCDAVIS

Remote sensing of canopy nitrogen content using red edge



UCDAVIS

Nitrate leaching was measured using pore samplers at 6.7 ft

UCDAVIS

Thank you!

Isaya Kisekka
Assistant Professor
Irrigation Engineering and Agricultural Water Management
University of California Davis
Phone: 530-379-9549
E-mail: ikisekka@ucdavis.edu

UCDAVIS