Irrigation and Nitrogen Management in Strawberry

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Regulations on N management have become stricter

Table C.1-3. Compliance Dates for Nitrogen Discharge Targets and Limits

	Compliance Date		
Compliance Pathway 1 $A_{FER} + (C \times A_{COMP}) + (O \times A_{ORG}) + A_{IRR} - R =$	Target	500	12/31/2023
	Target	400	12/31/2025
	Limit	300	12/31/2027
	Limit	200	12/31/2031
	Limit	150	12/31/2036
	Limit	100	12/31/2041
	Limit	50	12/31/2051

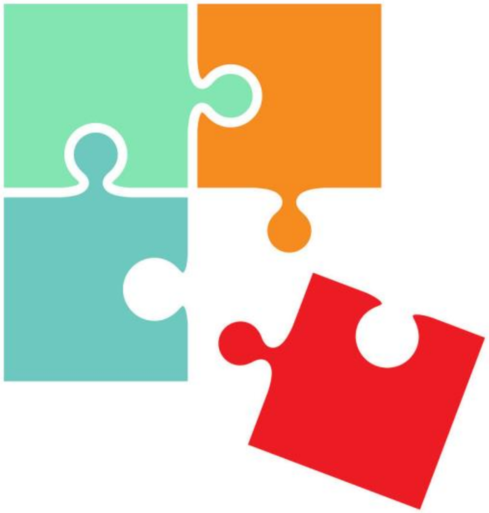
Account for all sources of nitrogen

- Residual mineral N in soil (Nitrate and ammonium)
- N in irrigation water
- Nitrogen mineralization from soil, amendments, and previous crop residues

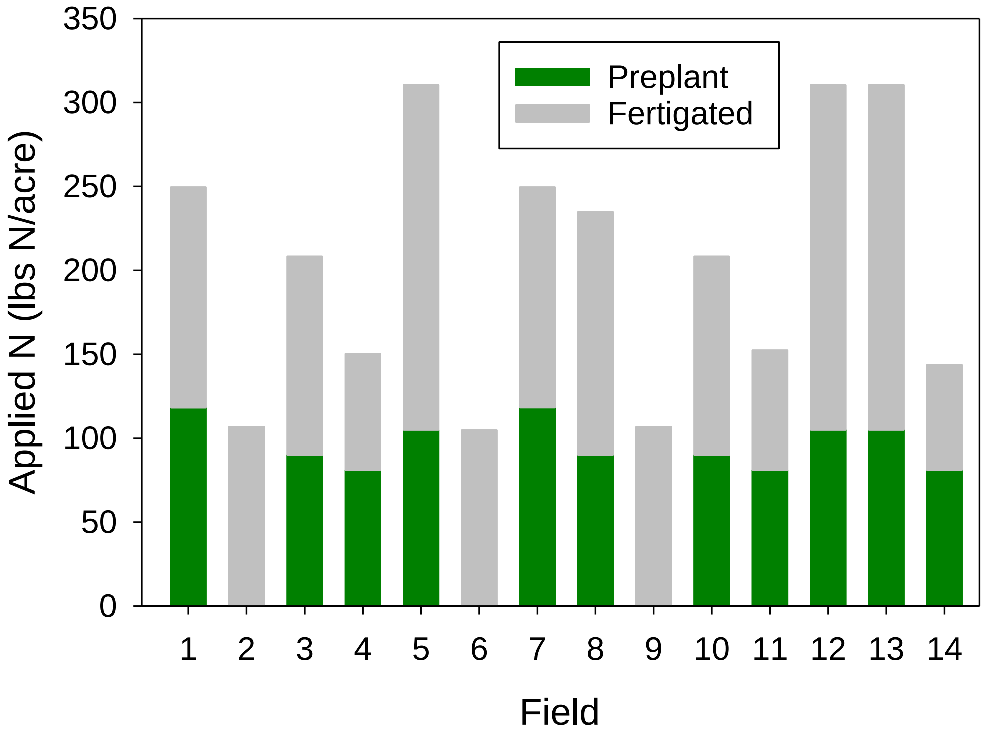
soil

water

crop residue



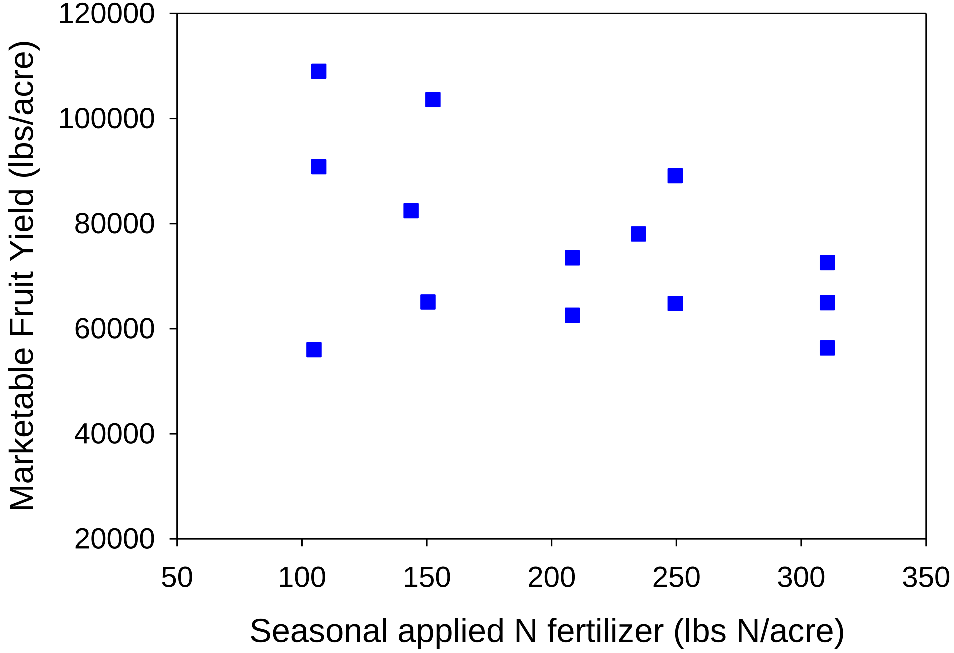
Seasonal Nitrogen Fertilizer Applied in Strawberry (Salinas/Watsonville 2017)



- ✓ **Fertilizer programs are often similar among fields within the same grower operation**
- ✓ **Reliance on preplant fertilizer**

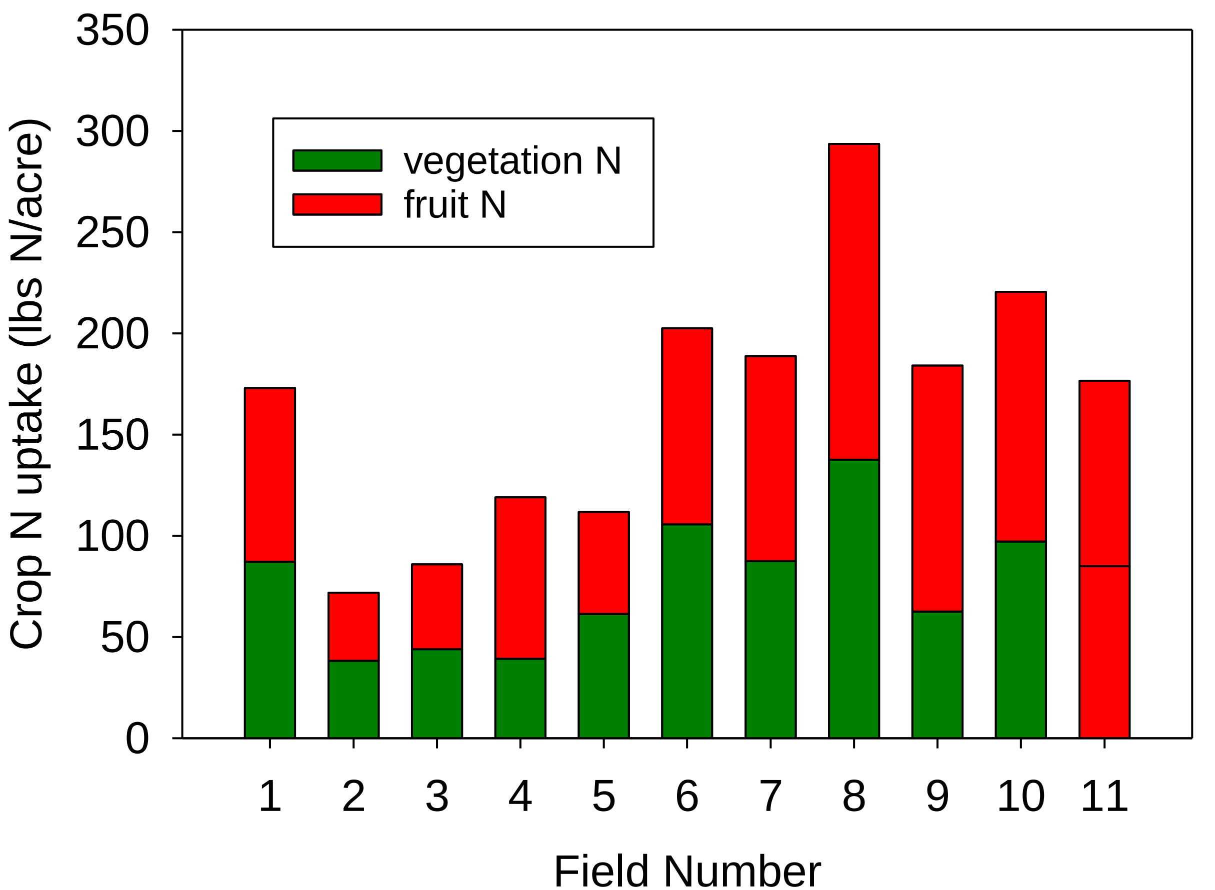
Seasonal Nitrogen Fertilizer Applied in Strawberry (Salinas/Watsonville 2017)

Marketable fruit yield was not correlated with applied N fertilizer



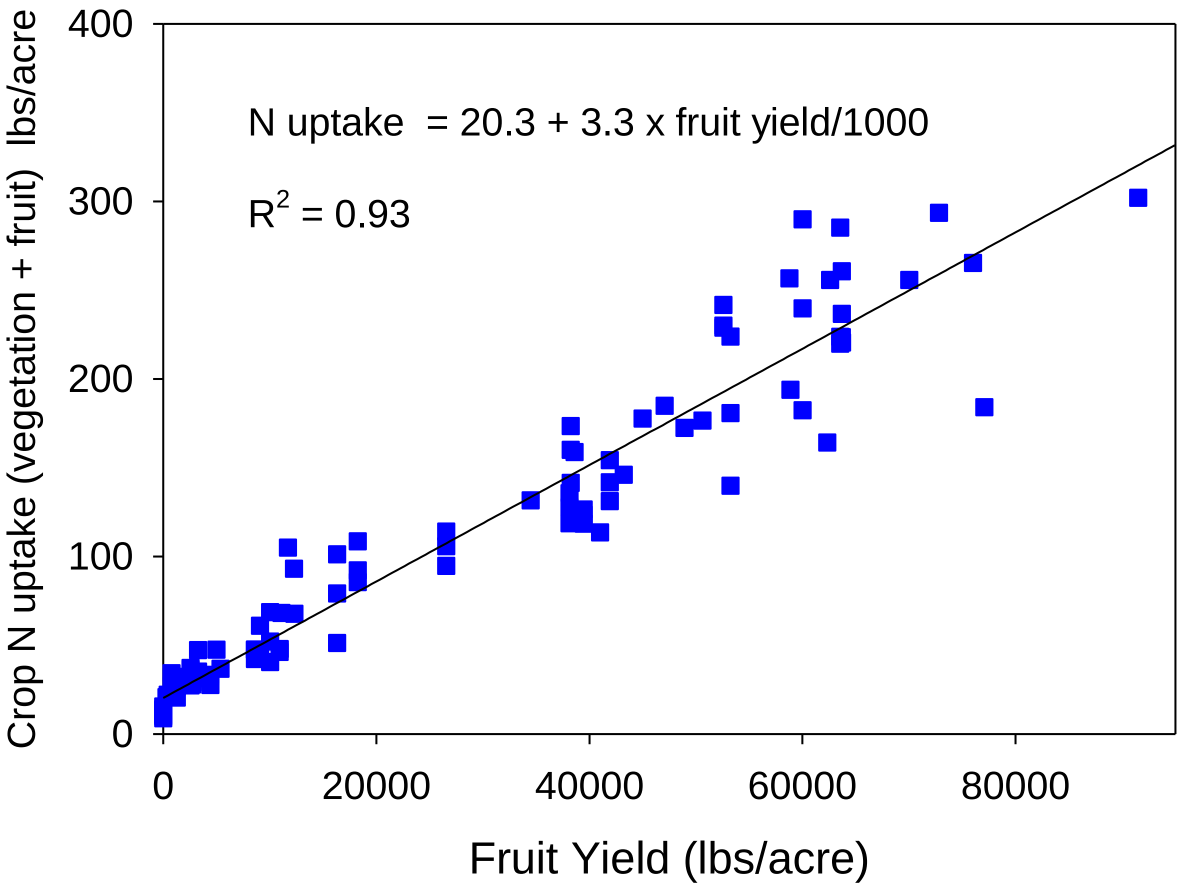
- **Fields can have high yields with low rates of N fertilizer**
- **Applied N can be much lower than the amount of N crop takes up**

About half of the nitrogen taken up by strawberry is in the Fruit

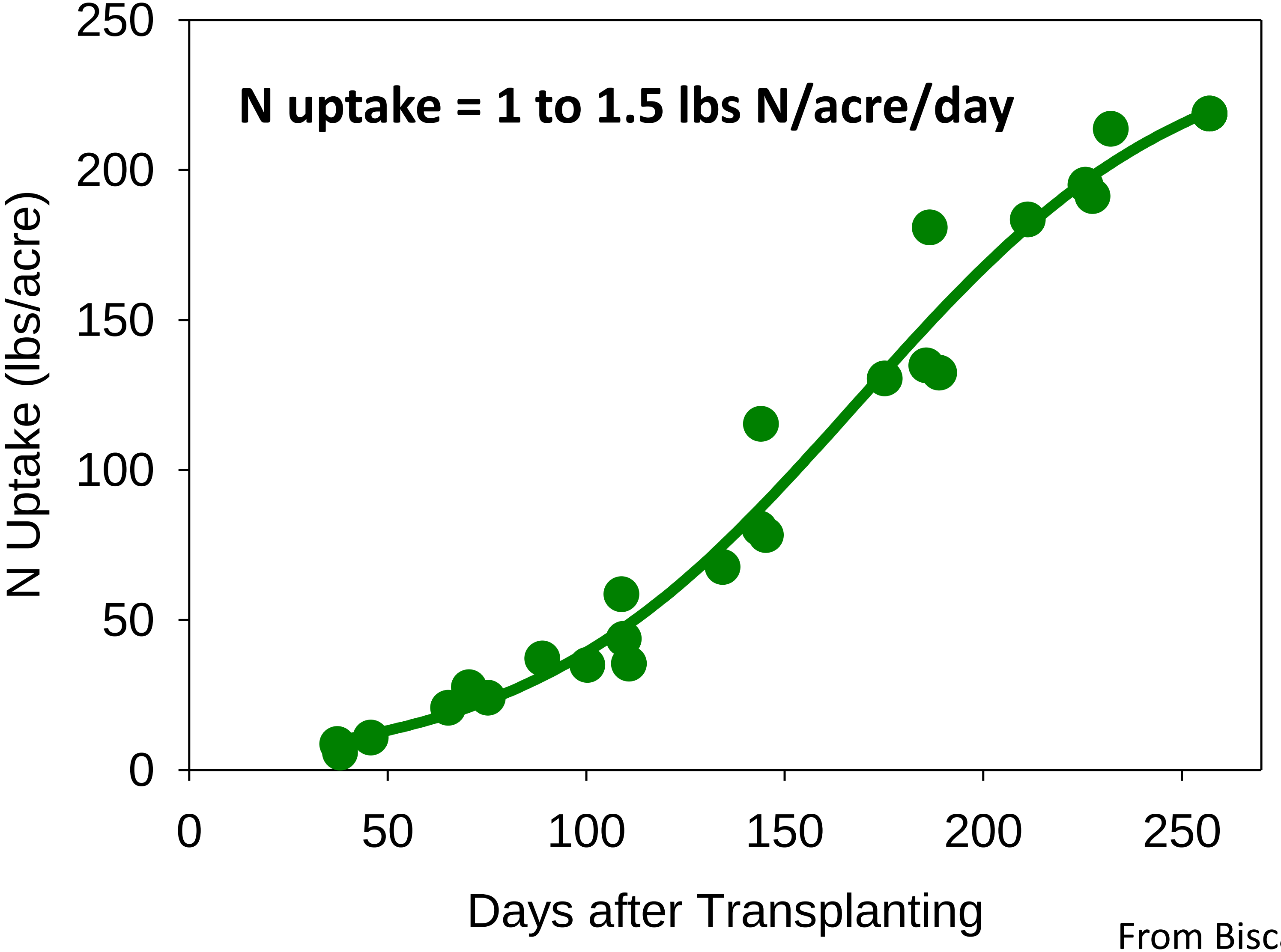


Crop N needs can be estimated from fruit yield

Total N uptake = 3.3 lbs N per 1000 lbs of fruit production



Crop Nitrogen Uptake Pattern in Strawberry



From Biscaro 2014

Previous Crop Residues

Soil Nitrogen Mineralization

Soil	% Organic Matter	Estimated N mineralization (lbs N/acre/day)
Placentia sandy loam	0.9	0.5
Chualar loam	1.2	0.7
Cropley silty clay	1.3	0.9
Metz fine sandy loam	1.4	0.6
Mocho silty clay loam	2.0	1.0

Soil Organic Amendments

Soil Nitrate Quick Test

What is a sufficient soil nitrate-N value for strawberry?

- 10 to 15 ppm Nitrate-N adequate in early season (40 to 60 lbs N/acre)
- Many productive fields have soil nitrate levels < 10 ppm N during the main fruiting period
- Soil nitrate levels may be affected by irrigation management

Nitrogen available in irrigation water

Well water
(2 to 70 ppm Nitrate-N)

Recycled water
(15 to 30 ppm N as Ammonium + Nitrate)

Calculating N applied from irrigation water:

Applied water (inches) x NO_3-N conc. (ppm) x 0.227

= lbs N/acre

Example:

- ✓ **Applied water = 1.1 inch per week**
- ✓ **Nitrate-N concentration = 20 ppm**

1.1 inches/week x 20 ppm NO_3-N x 0.227

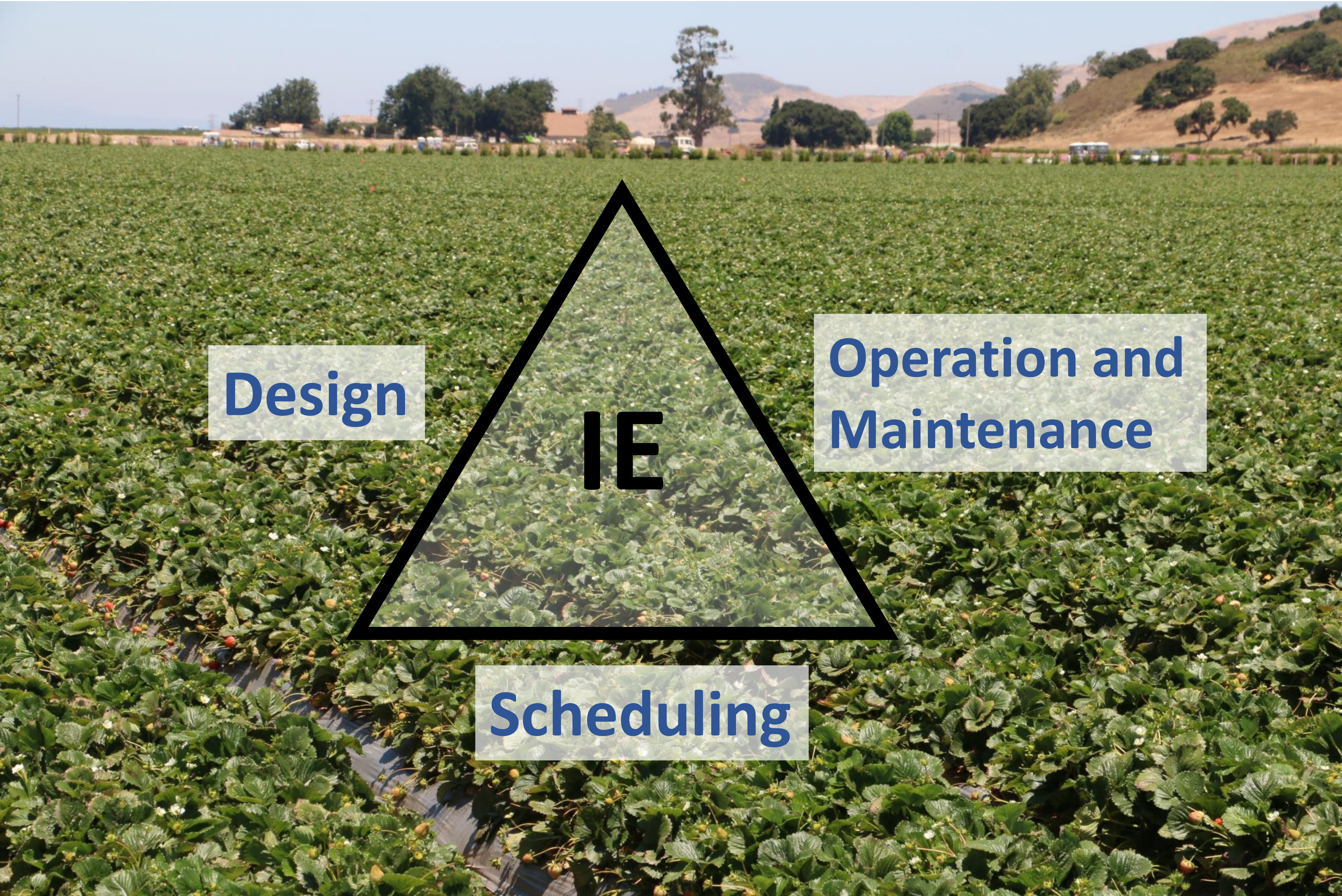
= <u>5.0 lbs N/acre/week</u>


Water management will be critical as N fertilizer rates are reduced

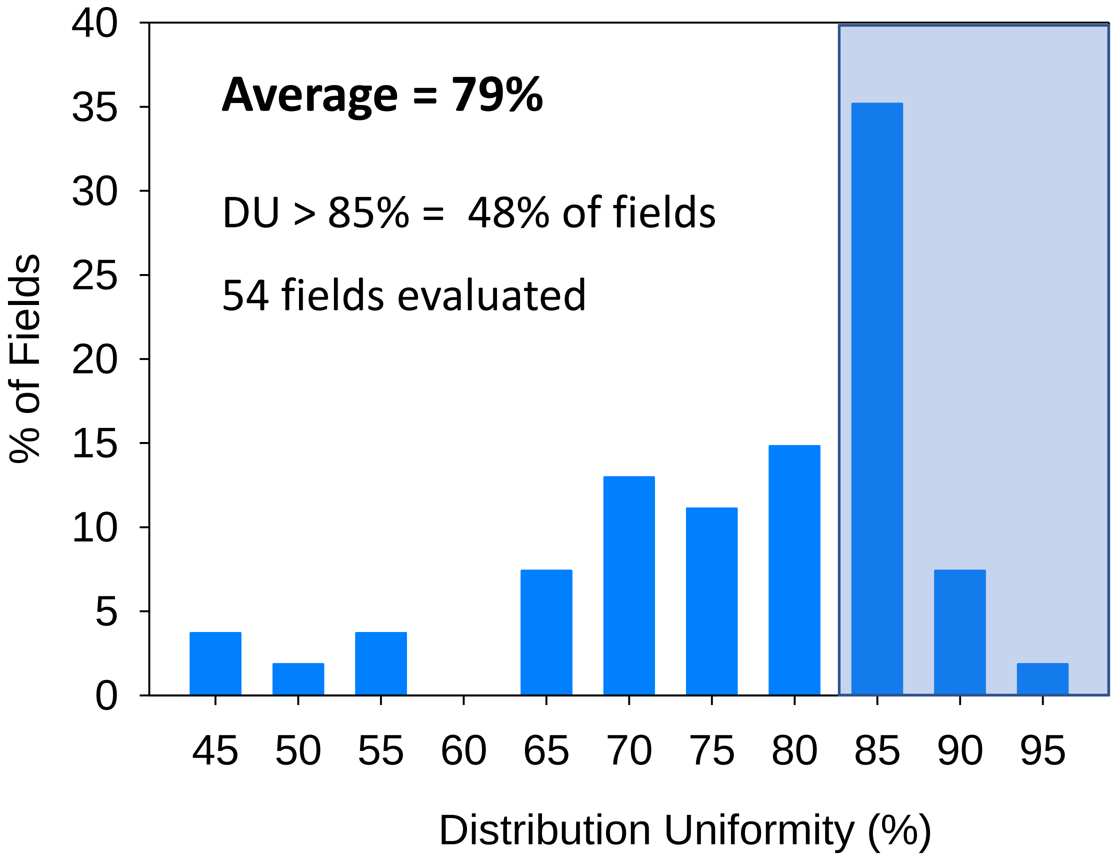
Benefits of a High Irrigation Efficiency

- **Minimize nutrient losses**
- **Fertigate uniformly**
- **Conserve water**
- **Improved salinity management**
- **Better yield and quality**
- **Save money**

3 Sides to Achieving High Irrigation Efficiency



Application uniformity of strawberry drip systems (2012-2016)

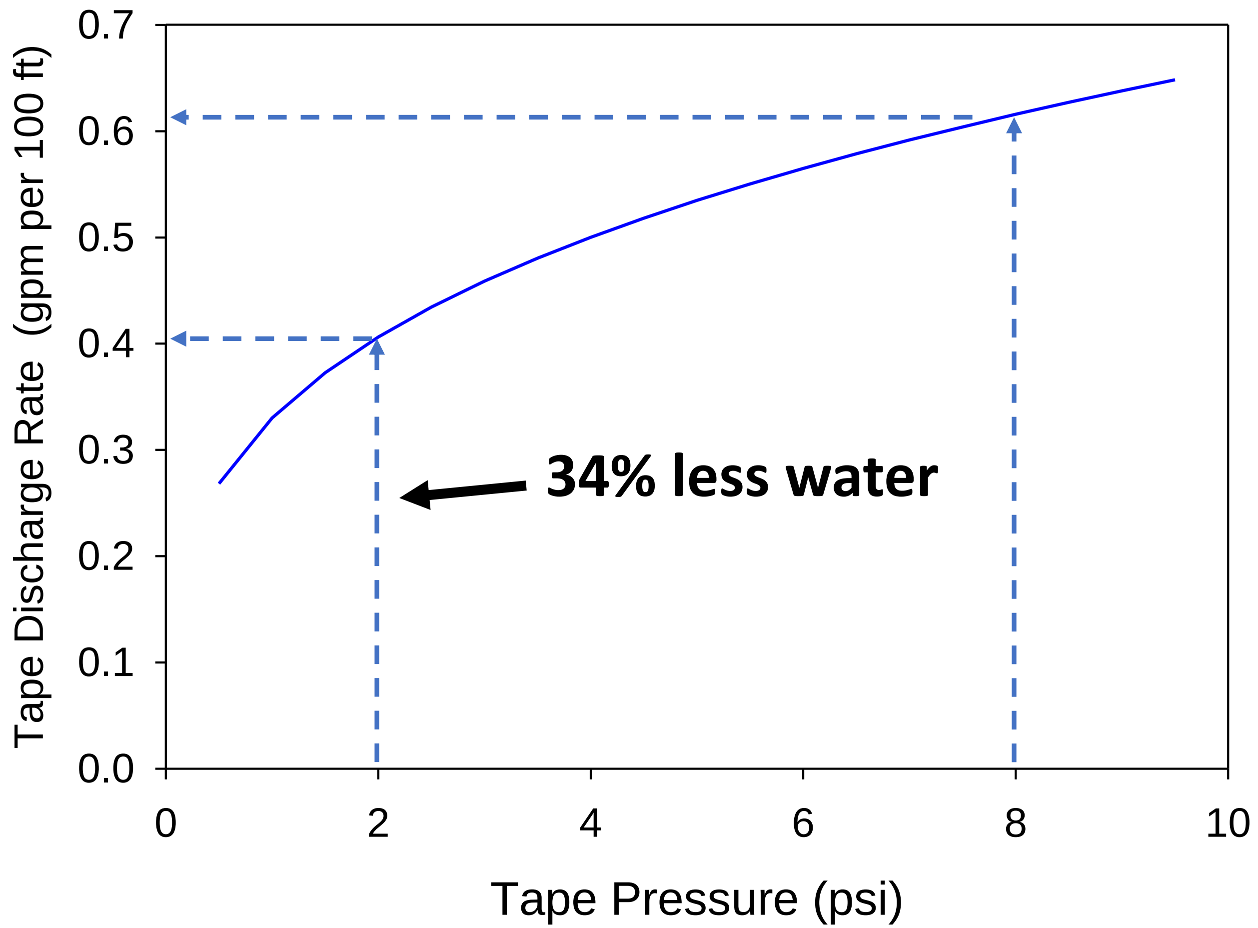


Design problems identified in Strawberry

- Excessive pressure loss across hose leads
- Hose leads are different lengths
- Excessive pressure loss along submains
- Diameter of submain was too small for flow rate
- Mix of tape with different flow rates within block
- Block area too large for flow rate
- Low area of field excessively wet

Uniform pressure is the key to drip

Discharge rate of drip tape varies with pressure



Factors that increase pressure variation

ELEVATION CHANGE

UNDERSIZED FITTINGS AND PIPE

PRESSURE LOSS IN DRIP LATERALS

Undersized connections between the main and submain can cause excessive pressure loss

Pressure Loss in Mains and Submains (psi loss per 100 ft)

Pipe Diameter (inches)	flow rate (gal/min) 25	50	75	100	125	150	175	200	300	400	500
1.5	3	13	27	--	--	--	--	--	--	--	--
2.0	1	3	7	11	17	24	--	--	--	--	--
2.5	0	1	2	4	6	8	11	14	29	--	--
3.0	0	0	1	2	2	3	4	6	12	20	31
3.5	0	0	0	1	1	2	2	3	6	10	14
4.0	0	0	0	0	1	1	1	1	3	5	8
5.0	0	0	0	0	0	0	0	0	1	2	3
6.0	0	0	0	0	0	0	0	0	0	1	1

Connections between submain and drip tape

1 to 3 psi loss across the polyethylene leads (spaghetti) is typical

- **Large diameter lead minimizes pressure losses**
- **All leads should have a similar length**
- **One lead per drip line**

Monitoring pressure is more complicated than it seems

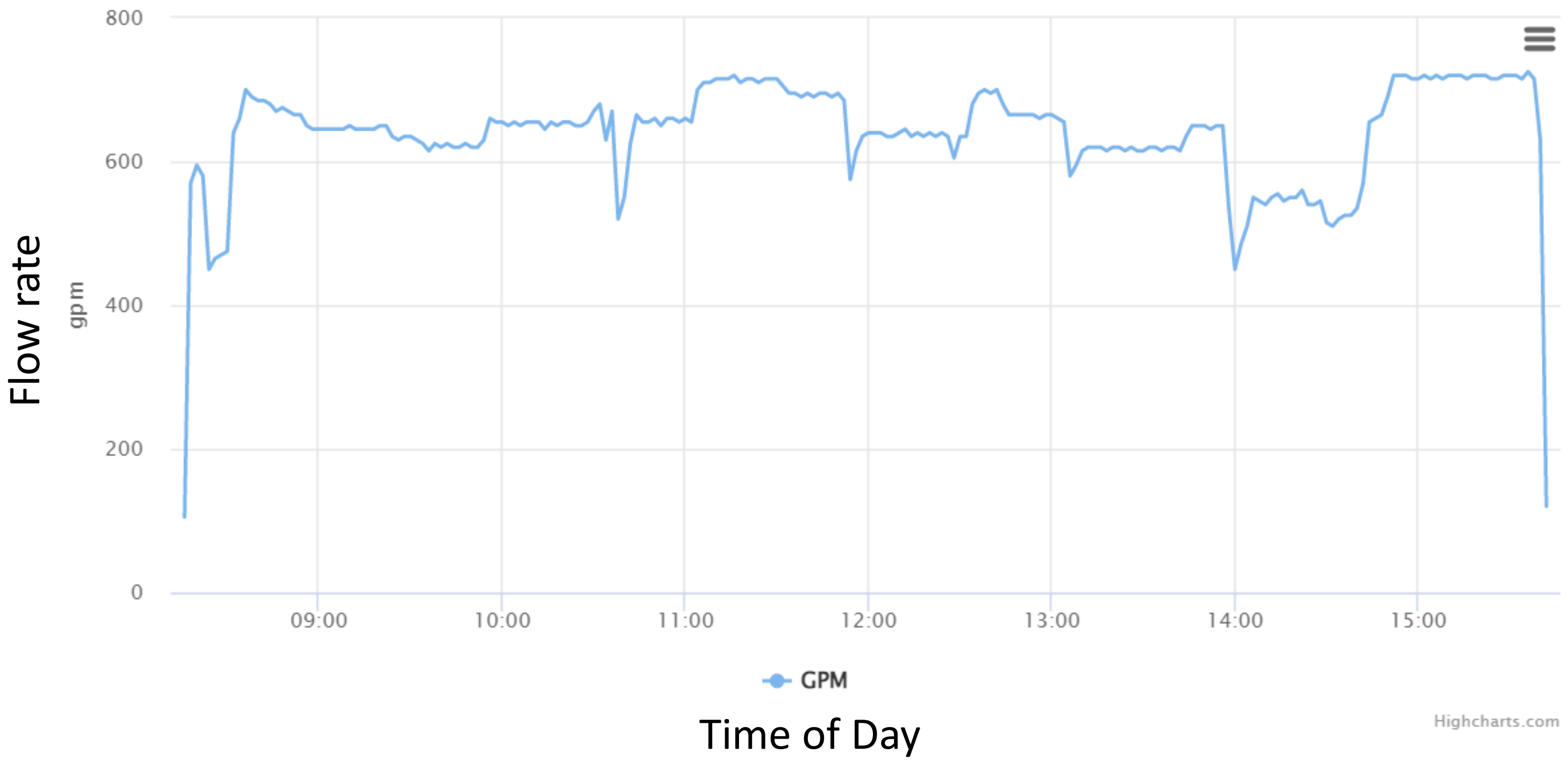
- Mechanical pressure gauges on an irrigation system are often inaccurate, in the wrong location, or broken.
- New mechanical pressure gauges may be inaccurate by as much as 1 to 2 psi (10% to 20% error for tape at 10 psi).


psi


psi
GONZALES
Irrigation Systems

Many irrigators regulate pressure of drip systems using a valve

If pressure varies at the pump, then the flow rate of the drip system will vary



Use pressure reducing valves to automate pressure regulation

- ✓ Install at main-submain connections
- ✓ Size for flow rate and pressure range
- ✓ Need sufficient upstream pressure (5 psi > downstream psi)
- ✓ Maintenance and training needed

What is the best approach for irrigation scheduling of berries?

Soil moisture:
when?

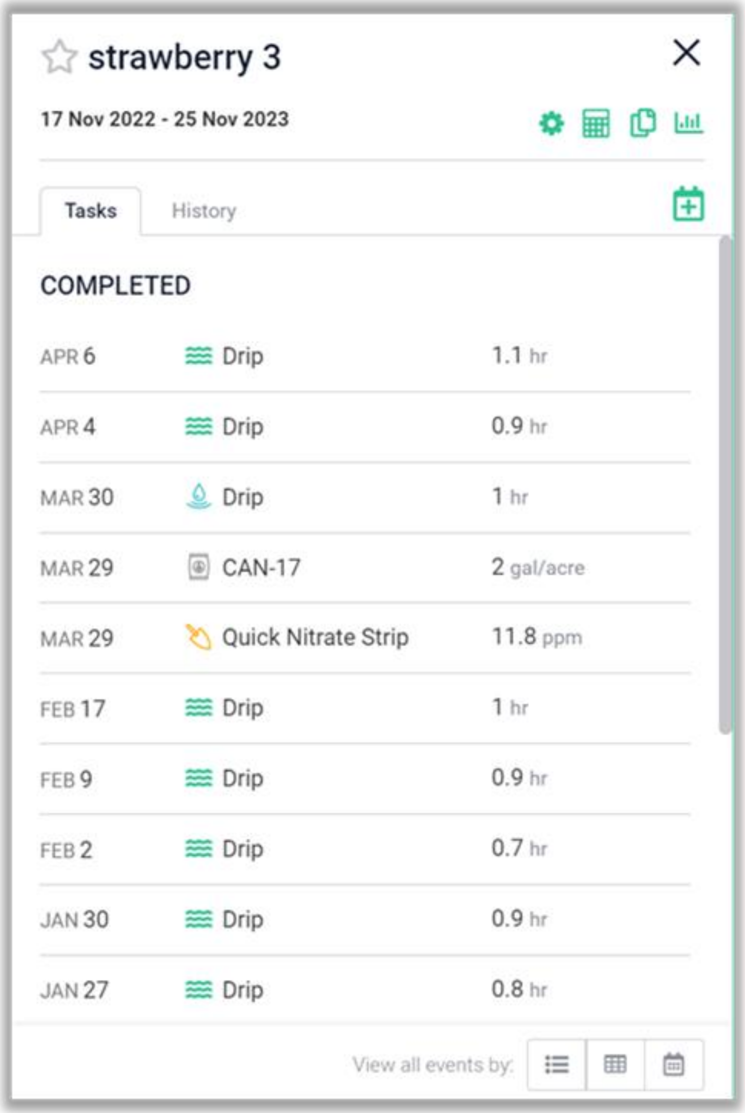
Weather-based:
how much?

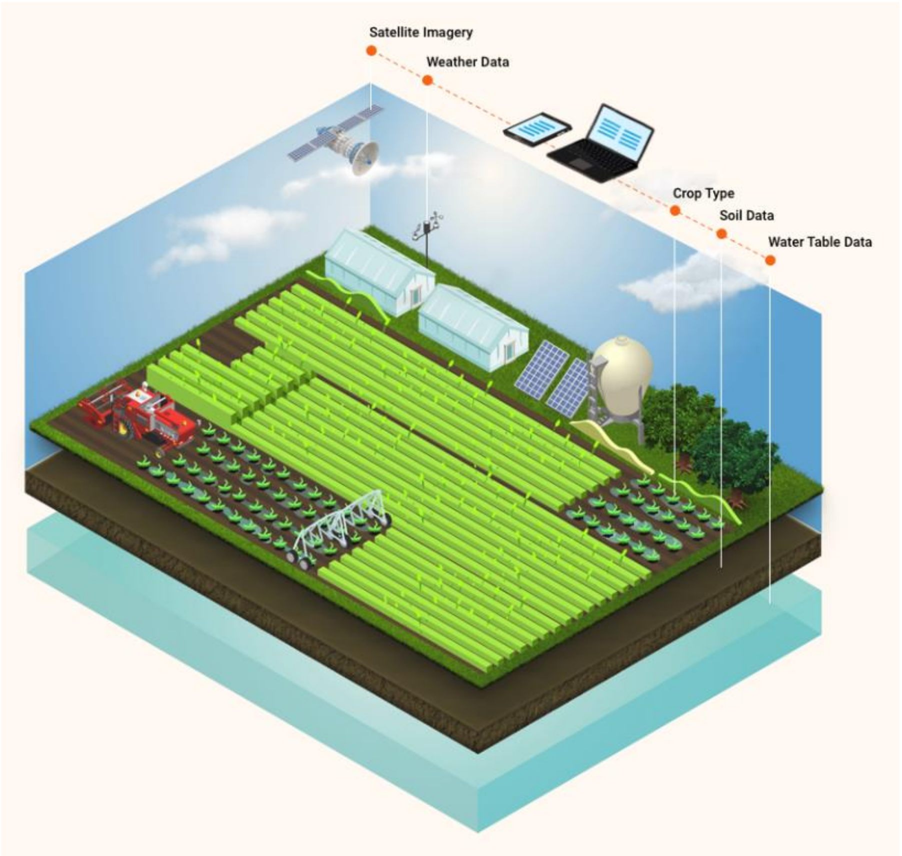
Tensiometers measure the energy that plants require to pull water from the soil pores (tension)

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

Ten Minute Tensiometer

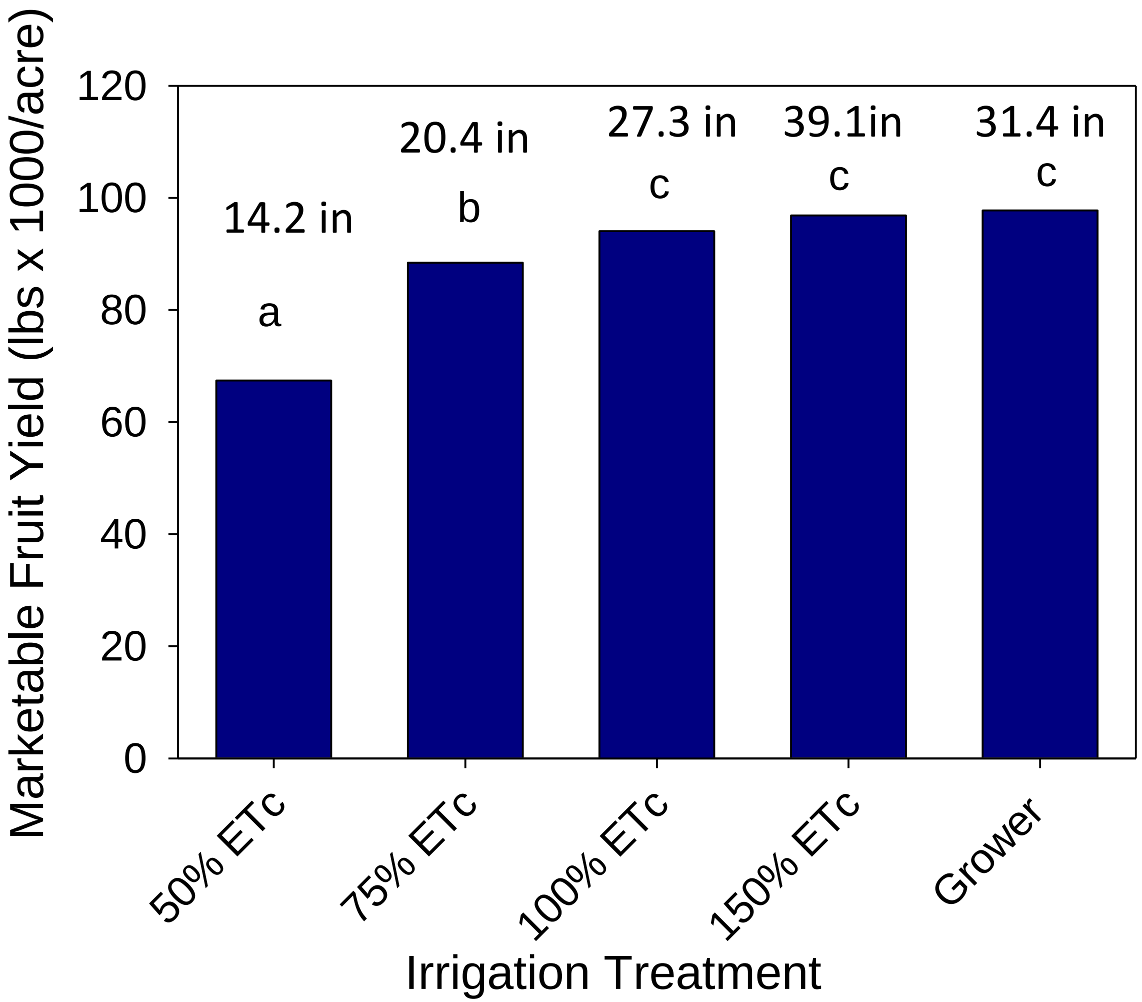
CropManage: Online irrigation and nitrogen management decision support





cropmanage.ucanr.edu

Irrigation Effects on Marketable Fruit Yields



Difficult to identify water stress early

Summary

- Growers will need to become more efficient in water and nitrogen management in the upcoming years
- Need to credit all sources of N (residual soil N, soil organic matter, organic amendments, irrigation water) which can supply much of the N needs of a strawberry crop
- Irrigation management is key to optimizing water use and nitrogen fertilizer.
- There are many tools available that can help growers improve water and N management (Soil nitrate quick test, soil moisture sensors, pressure regulators, CropManage)