



Developing decision support tools for processing tomato irrigation and fertilization

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Data collection in commercial fields

- Sites:
 - 4 sites in Yolo County
 - 5 sites in San Joaquin County
 - 2 sites in Fresno County
 - 12 additional sites for canopy development
- Data:
 - N uptake
 - Available N in the root zone
 - Canopy development
 - ET estimates from Tule stations



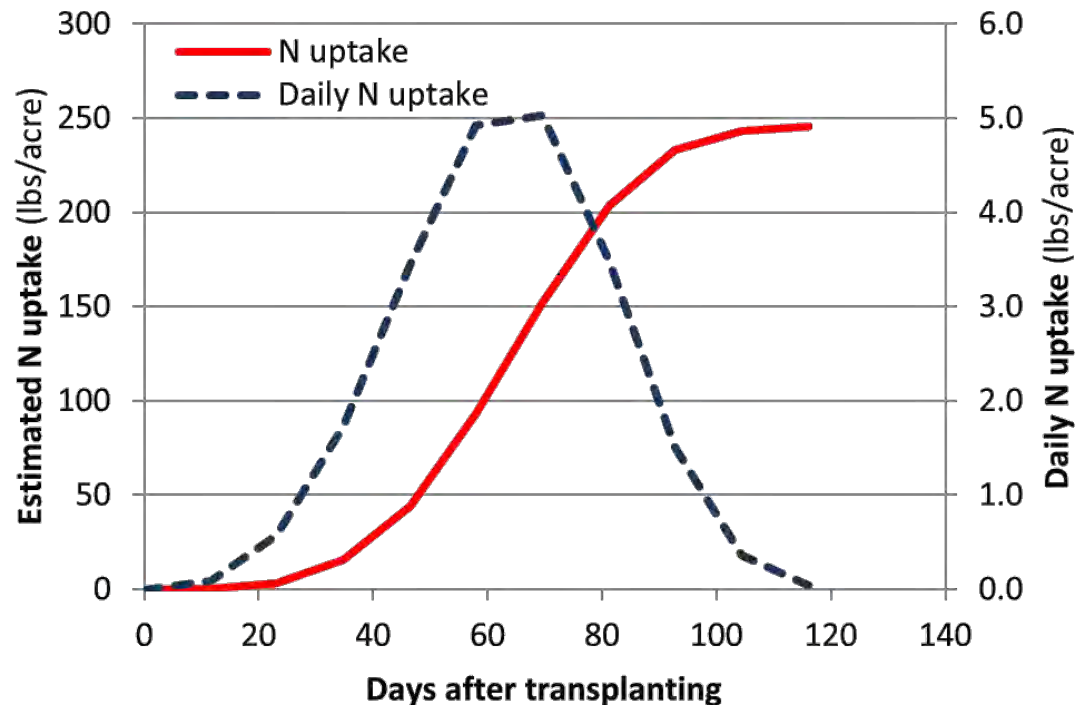


Expected N uptake

⇒ N in tomatoes: 3 lbs/ton

⇒ N in vines: 33% of total N

For a 55-ton total yield:





Field trial at UC Davis 2017

- Expected yield: 55 tons/acre
- Nitrate in irrigation water : 0 ppm
- Residual soil nitrate:
 - 1st foot: 13 ppm
 - 2nd foot: 7.7 ppm
- Assumption: 50% of nitrate in 1st foot and 90% in 2nd foot are available





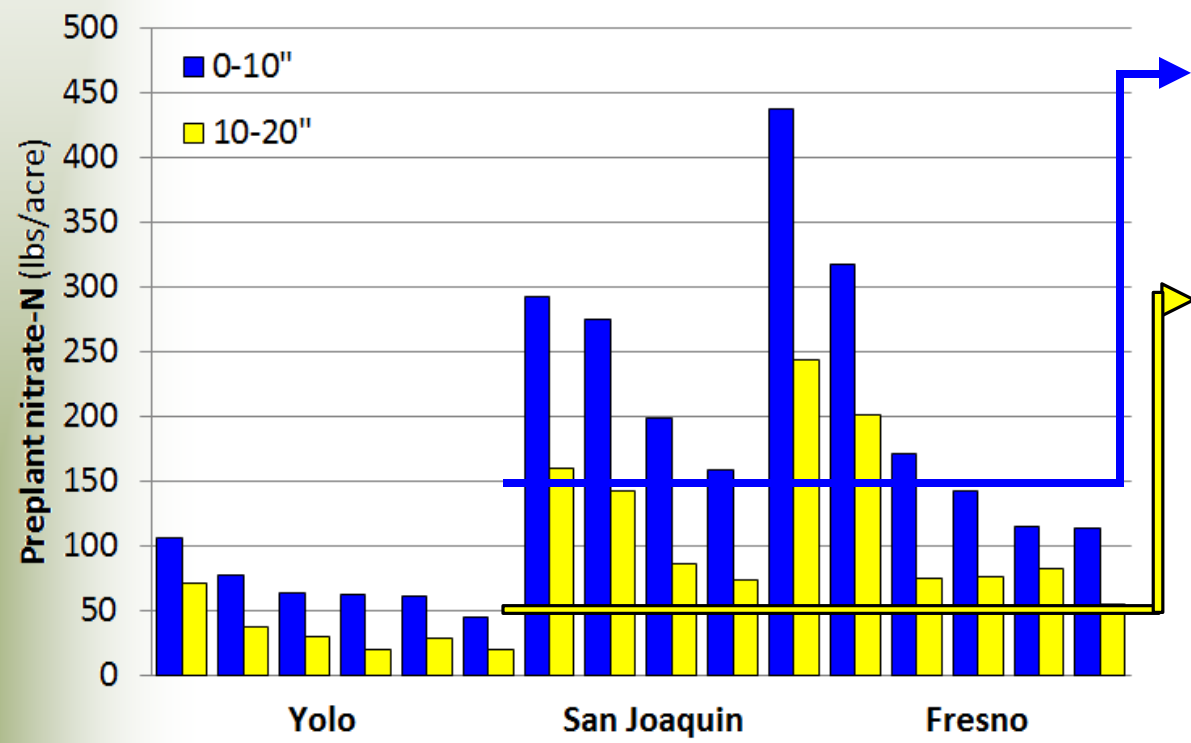
N budget for UC Davis trial 2017

N sinks and sources	lbs N/acre	
N uptake	247 lbs/acre	247
N in irrigation water	0 lbs/acre	
Residual soil nitrate	47 lbs/acre	
N credits		47
N uptake from fertilizer		200
N efficiency	90%	
Fertilizer application rate (incl. starter)		225





If N credits had been higher: Residual soil nitrate



$150 \text{ lbs/acre} * 50\% = 75 \text{ lbs/acre}$

$50 \text{ lbs/acre} * 90\% = 45 \text{ lbs/acre}$

**Total credit:
120 lbs/acre**





If N credits had been higher: Nitrate in irrigation water

1 acre-inch of water with a nitrate-N concentration of 1 ppm contains 0.227 lbs N/acre

Example:

- Irrigation water: 10 ppm nitrate-N
- Seasonal irrigation: 22 inches

⇒ N in irrigation water: 50 lbs/acre





If N credits had been higher: N budget

N sinks and sources		lbs N/acre
N uptake	247 lbs/acre	247
N in irrigation water	50 lbs/acre	
Residual soil nitrate	120 lbs/acre	
N credits		170
N uptake from fertilizer		77
N efficiency	90%	
Fertilizer application rate (incl. starter)		85





Field trial at UC Davis 2017

- 3 nitrogen treatments:
 - N_175: Optimal N minus 50 lbs N/acre
 - N_225: Optimal N
 - N_275: Optimal N plus 50 lbs N/acre
- Irrigation in all treatments was 100% ET
- 5 replicates
- Plot size: 3 beds x 200 feet





Trial management

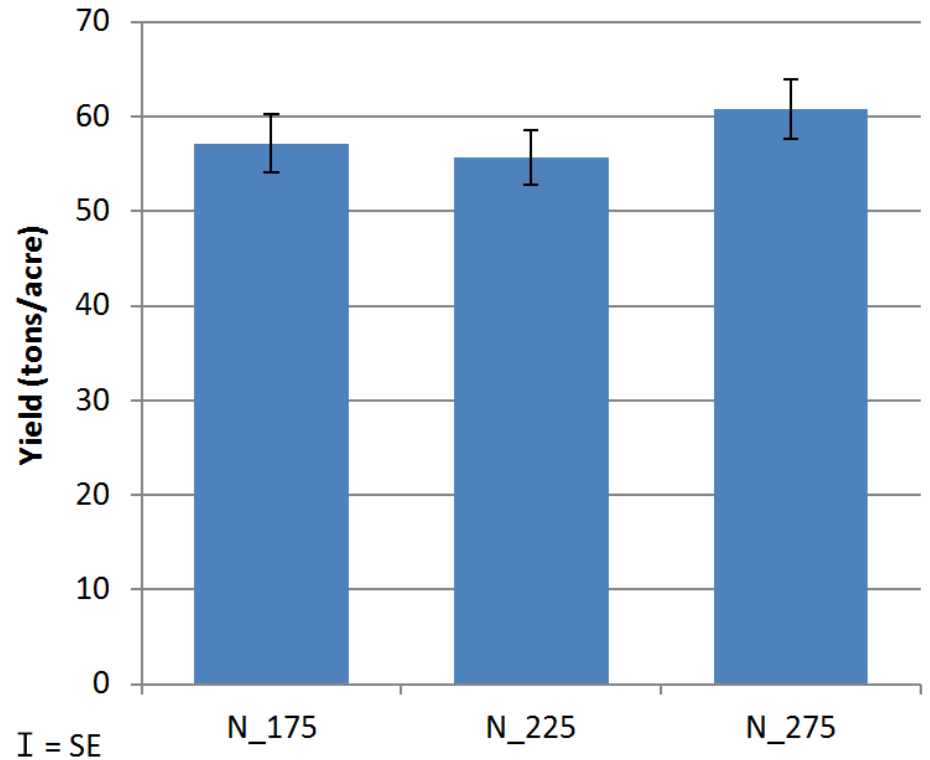
- Transplanting date: 05/01/2017
- Fertilization:
 - Starter: 30 gal/acre of 8-24-6, Zn
 - 5 weekly fertigations of UAN between 06/01 and 06/29
 - Two applications of K-thiosulfate in July (total of 100 lbs K_2O /acre)
- Harvest date: 08/25/2017





Marketable yield

- Average marketable yield: 58 tons/acre
- No statistically significant differences among treatments





Why are there no treatment effects?

- We did not account for N mineralization during the growing season
- We may have overestimated N uptake
- Uptake of residual nitrate in the dry top soil may have been higher than expected





Measured N uptake

Treatment	N in fruits		N in vines		Total N (lbs/acre)
	(lbs/ton)	(lbs/acre)	% of total	(lbs/acre)	
N_175	2.59	148	39%	94	242
N_225	2.99	166	38%	102	269
N_275	3.07	187	42%	133	319

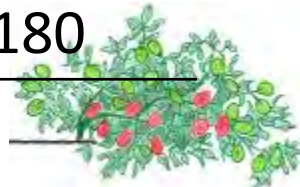




N budget for UC Davis trial 2018

Expected yield: 58 tons/acre

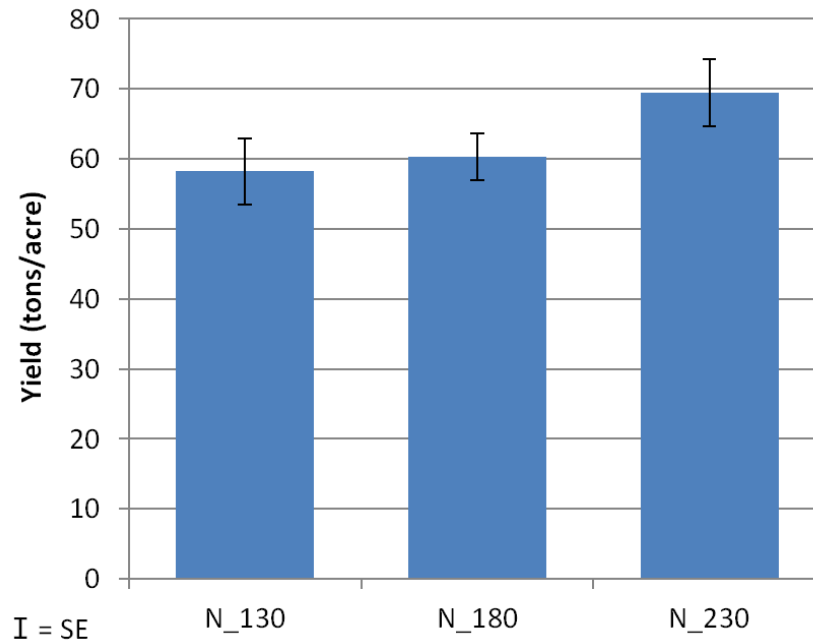
N sinks and sources		lbs N/acre
N uptake	261 lbs/acre	261
N in irrigation water	0 lbs/acre	
Residual soil nitrate	59 lbs/acre	
N mineralization	40 lbs/acre	
N credits		99
N uptake from fertilizer		162
N efficiency	90%	
Fertilizer application rate (incl. starter)		180





Field trial at UC Davis 2018

- Expected yield: 58 tons/acre
- Average marketable yield: 62 tons/acre
- No statistically significant differences among treatments





Again, no treatment effects

- ~~We did not account for N mineralization during the growing season~~
- We may have overestimated N uptake
- Uptake of residual nitrate in the dry top soil may have been higher than expected
- Uptake of N from below the top 2 feet





Conclusions

- A method to estimate N requirements was developed
- Plants first adjust N uptake to N availability before responding with lower yield
 - ⇒ Not all of the “excess” N is at risk of being leached
 - ⇒ The optimal N application rate is a range and not a specific value
 - ⇒ This facilitates N management in fields that are less uniform than our trial field
- In-season adjustments may be needed
 - ⇒ Soil and plant tissue testing recommended





Putting it all together: Online N calculator

http://geisseler.ucdavis.edu/Tomato_N_Calculator.html

Nitrogen calculator for processing tomatoes

Field-Specific Input

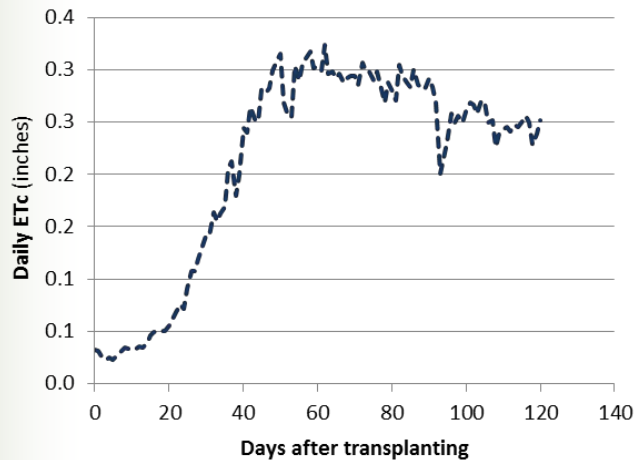
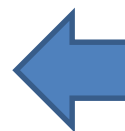
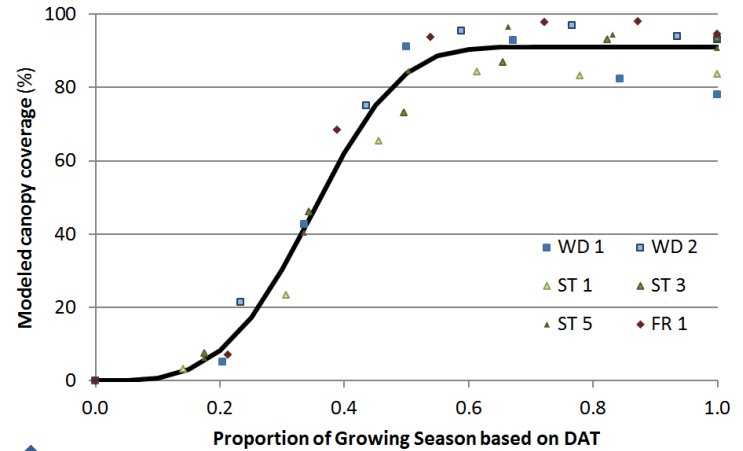
Planting date:	<input type="text" value="05 / 01 / 2018"/>
Expected harvest date:	<input type="text" value="08 / 22 / 2018"/>
Expected Yield:	<input type="text" value="55"/> tons/acre
Residual nitrate in 1 st foot:	<input type="text" value="10"/> ppm Nitrate-N
Residual nitrate in 2 nd foot:	<input type="text" value="5"/> ppm Nitrate-N
Nitrate in irrigation water:	<input type="text" value="0"/> ppm Nitrate-N
Estimated total irrigation:	<input type="text" value="22"/> acre-inches
Starter/preplant fertilizer:	<input type="text" value="30"/> gal/ac 8-24-6

Display Results/Changes





Putting it all together: Irrigation





Putting it all together: CropManage

<https://v3.cropmanage.ucanr.edu/>

The screenshot shows the CropManage web application interface. At the top, there is a dark navigation bar with a 'MENU' icon, the 'CropManage' logo, a user profile for 'Hello Daniel Geisseler', and a language selector for 'English (United States)'. Below this is a secondary navigation bar with 'Daniel Tomato', a settings gear, and tabs for 'Active Plantings', 'Favorite Plantings', and 'All Plantings', along with a green '+ Add Planting' button. The main content area is split into a left sidebar and a right main panel. The sidebar contains a search box for 'Active Plantings', a 'Filter Plantings' section with 'All Plantings' selected, and filter options for 'Lots' (CT 1) and 'Crop Type' (Processing Tomato). The main panel displays details for 'Treatment 1 Lot CT 1', including the description 'Processing tomato transplanted 60-inch bed' and the dates '1 May 2018 - 25 Aug 2018'. It features an 'Events' section with 'Add' buttons for water, fertilizer, and other actions, and a 'No Events Today' message for '15 Aug 2018 Today'. At the bottom, there is a 'View all events by:' section with list and calendar view options.





Acknowledgement

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