



Site specific nitrogen management in processing tomatoes



Daniel Geisseler

Nutrient Management Specialist, UC Davis

**Northern San Joaquin Valley Processing
Tomato Meeting, Modesto**

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Data collection in commercial fields in 2016

- Sites:
 - 2 sites near Woodland
 - 3 sites near Stockton
 - 1 site near Huron
- Data:
 - Canopy development (infrared camera)
 - ET estimates from Tule stations
 - N uptake (repeated plant sampling)



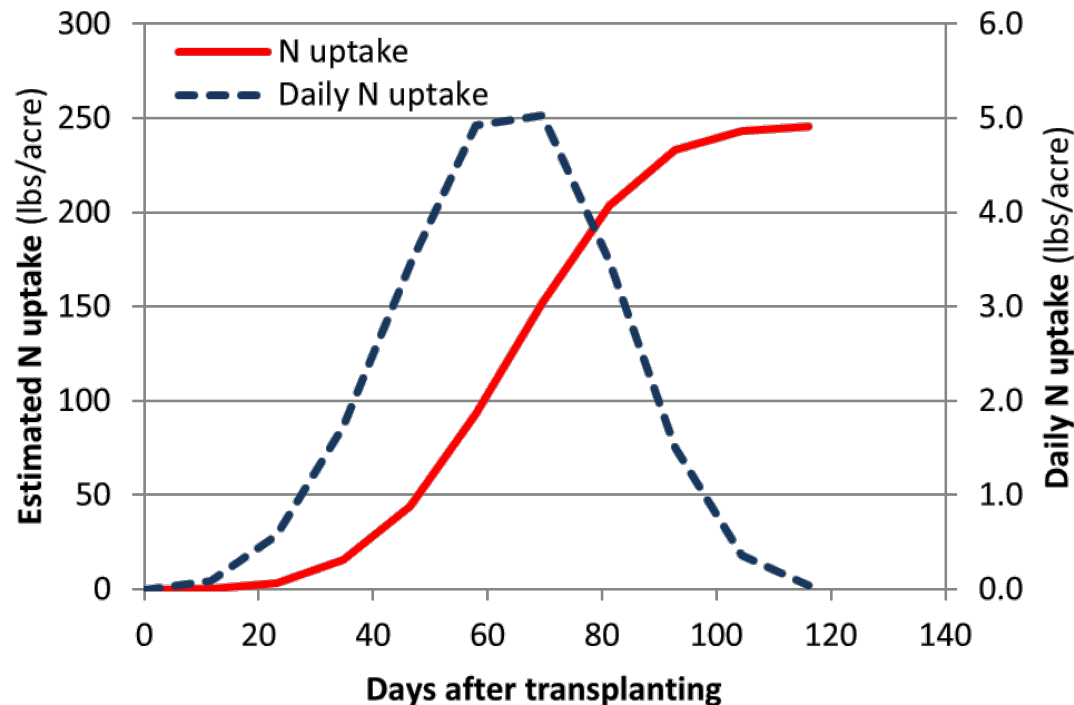


Expected N uptake

⇒ N in tomatoes: 2.99 lbs/ton

⇒ N in vines: 33% of total N

For a 55-ton total yield:





Expected N requirements

- Expected yield: 55 tons/acre
- Expected N uptake: 246 lbs/acre
 - 2.99 lbs/ton; 67% of total N in fruits
- N use efficiency: 90%
- Total N requirement: 274 lbs/acre (from all sources)

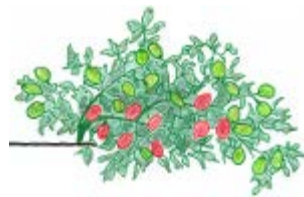




N sources at field site

- No nitrate in irrigation water
- Residual soil nitrate:
 - 1st foot: 13 ppm \Rightarrow 45.4 lbs/acre
 - 2nd foot: 7.7 ppm \Rightarrow 27 lbs/acre
- Assumption: 50% of nitrate in 1st foot and 90% in 2nd foot are available

- \Rightarrow Available soil nitrate: 47 lbs/acre
- \Rightarrow Fertilizer N needed (incl. starter): 225 lbs/acre





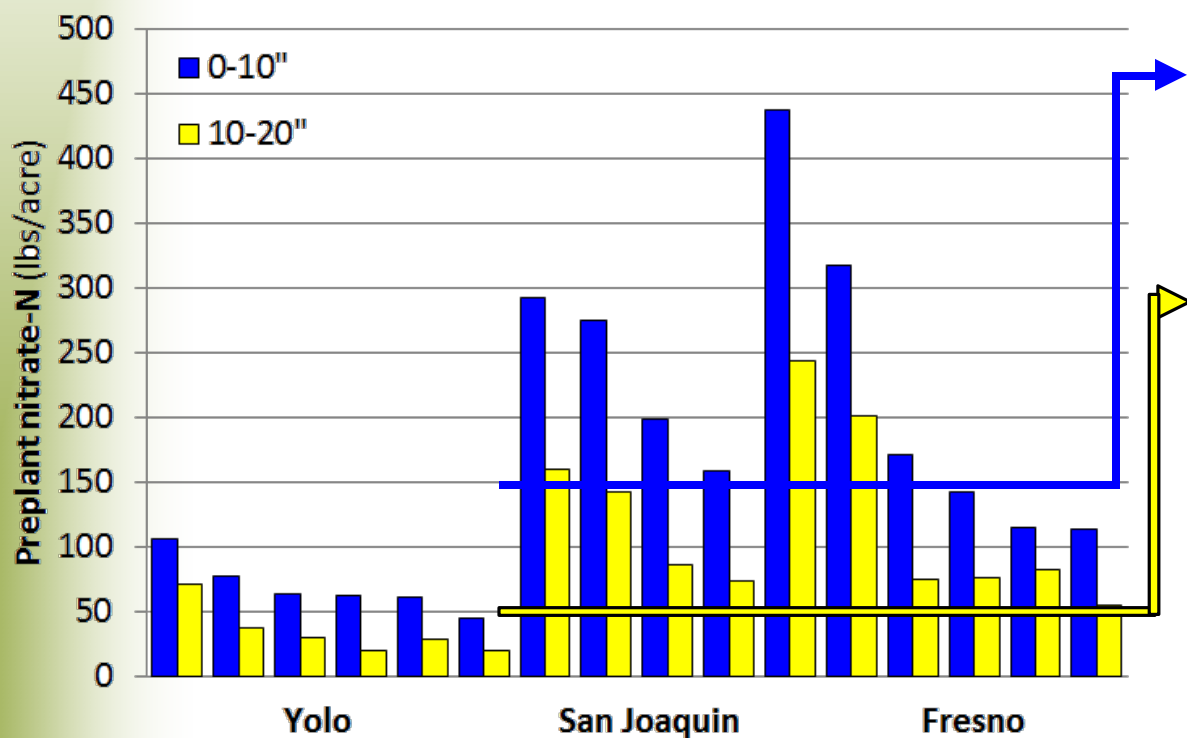
N budget for UC Davis trial

N sinks and sources	lbs N/acre
N uptake	246 lbs/acre
N efficiency	90%
N requirement	274
N in irrigation water	0 ppm
Residual soil nitrate	47 lbs/acre
N credits	47
Fertilizer application rate	227





Residual soil nitrate



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

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

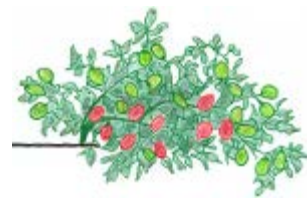
Total credit:
120 lbs/acre





N budget example I

N sinks and sources	lbs N/acre
N uptake	246 lbs/acre
N efficiency	90%
N requirement	274
N in irrigation water	0 ppm
Residual soil nitrate	120 lbs/acre
N credits	120
Fertilizer application rate	154





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





N budget example II

N sinks and sources	lbs N/acre
N uptake	246 lbs/acre
N efficiency	90%
N requirement	274
N in irrigation water	50 lbs/acre
Residual soil nitrate	120 lbs/acre
N credits	170
Fertilizer application rate	104





Replicated trial at UC Davis

- 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





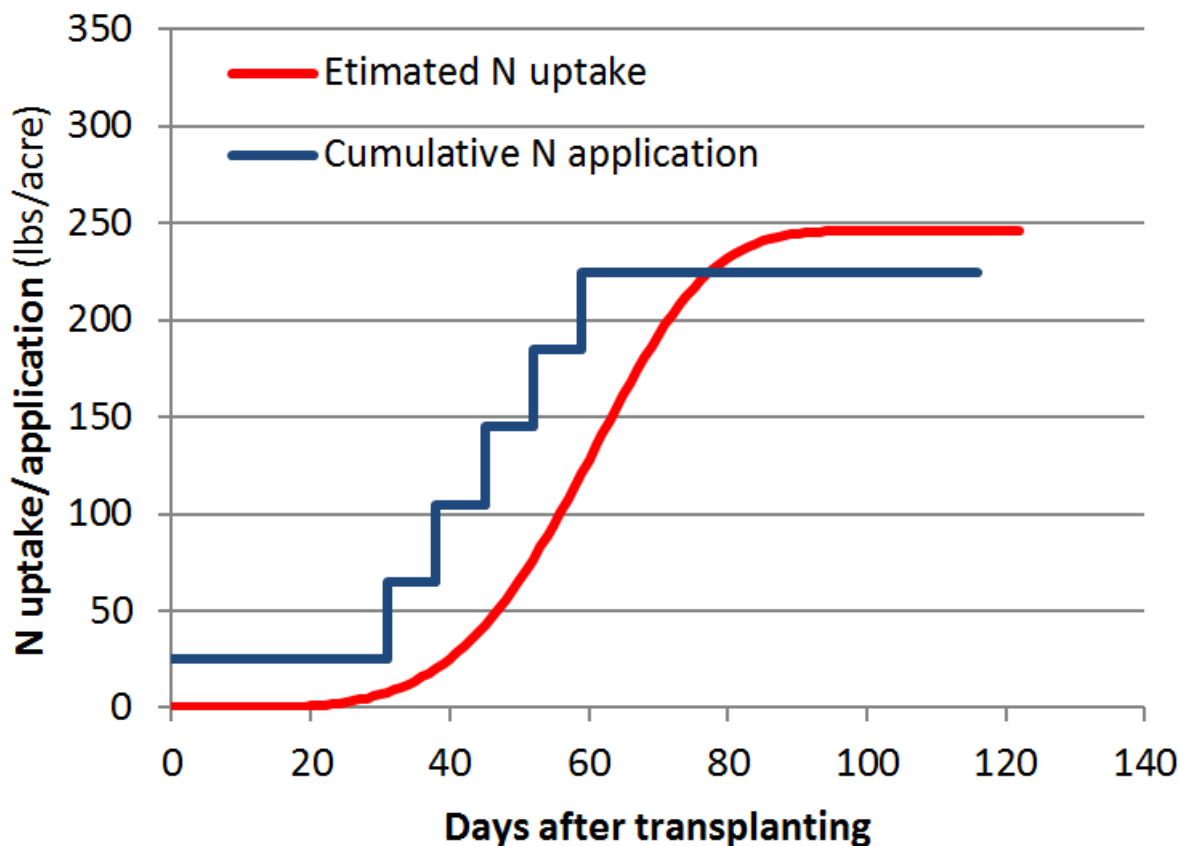
Trial management

- 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

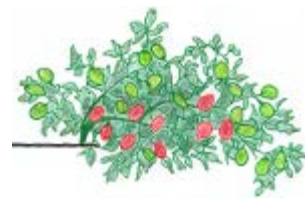




Fertilization program



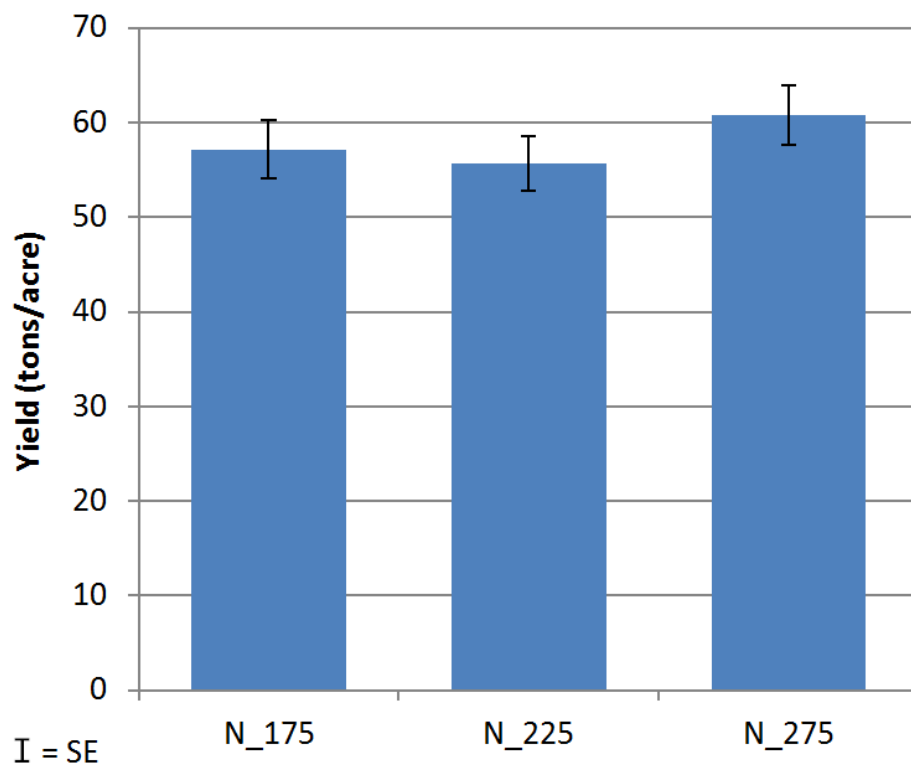
Residual soil nitrate not included





Marketable yield

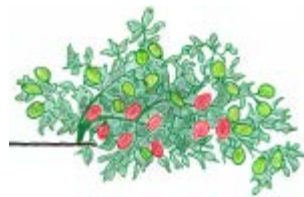
- Average marketable yield: 58 tons/acre
- No statistically significant differences among treatments





Why are there no treatment effects?

- We may have overestimated N uptake
- We did not account for N mineralization during the growing season





Measured N uptake

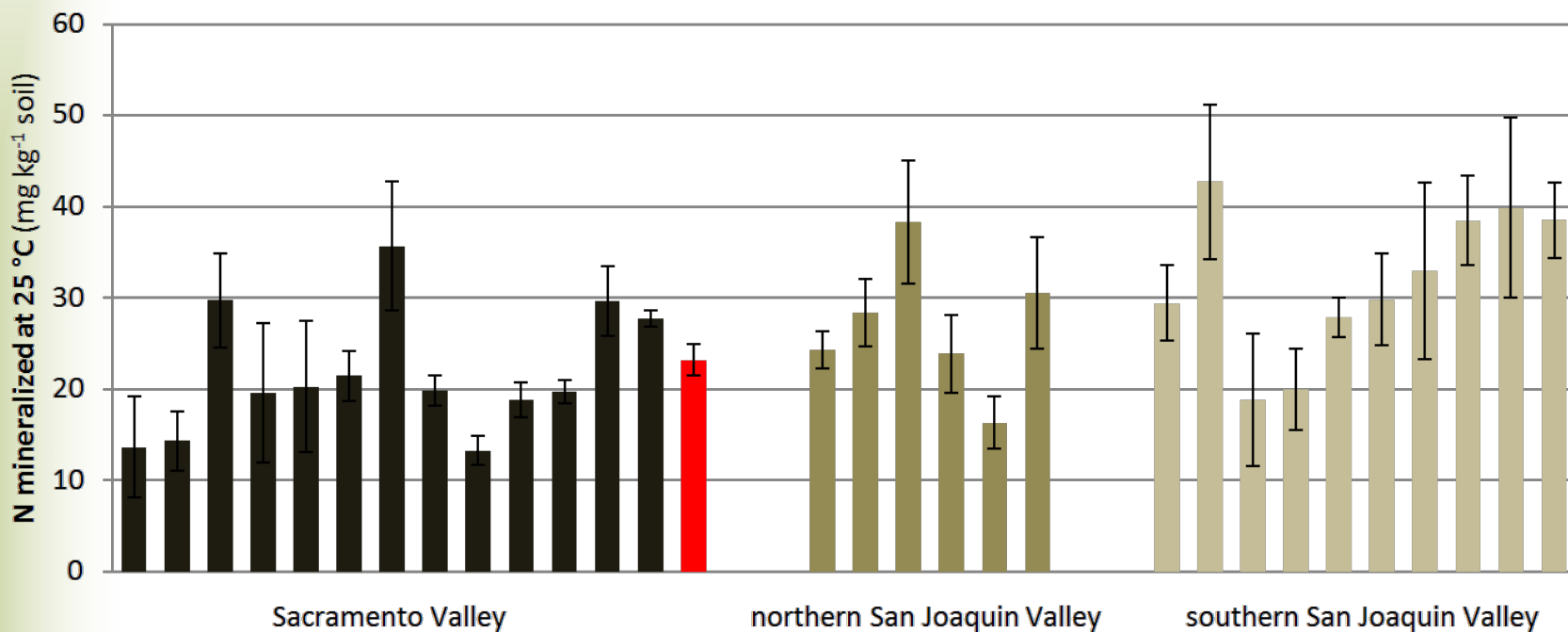
Treatment	N in fruits		N in vines		Total N
	(lbs/ton)	(lbs/acre) % of total	(lbs/acre)	(lbs/acre)	
N_175	2.59	148 39%	94	242	
N_225	2.99	166 38%	102	269	
N_275	3.07	187 42%	133	319	





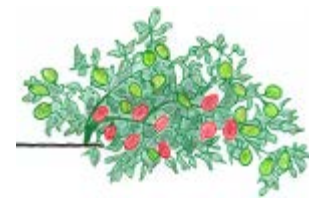
Soil N mineralization

Incubation: 10 weeks at 77 °F and optimal moisture content



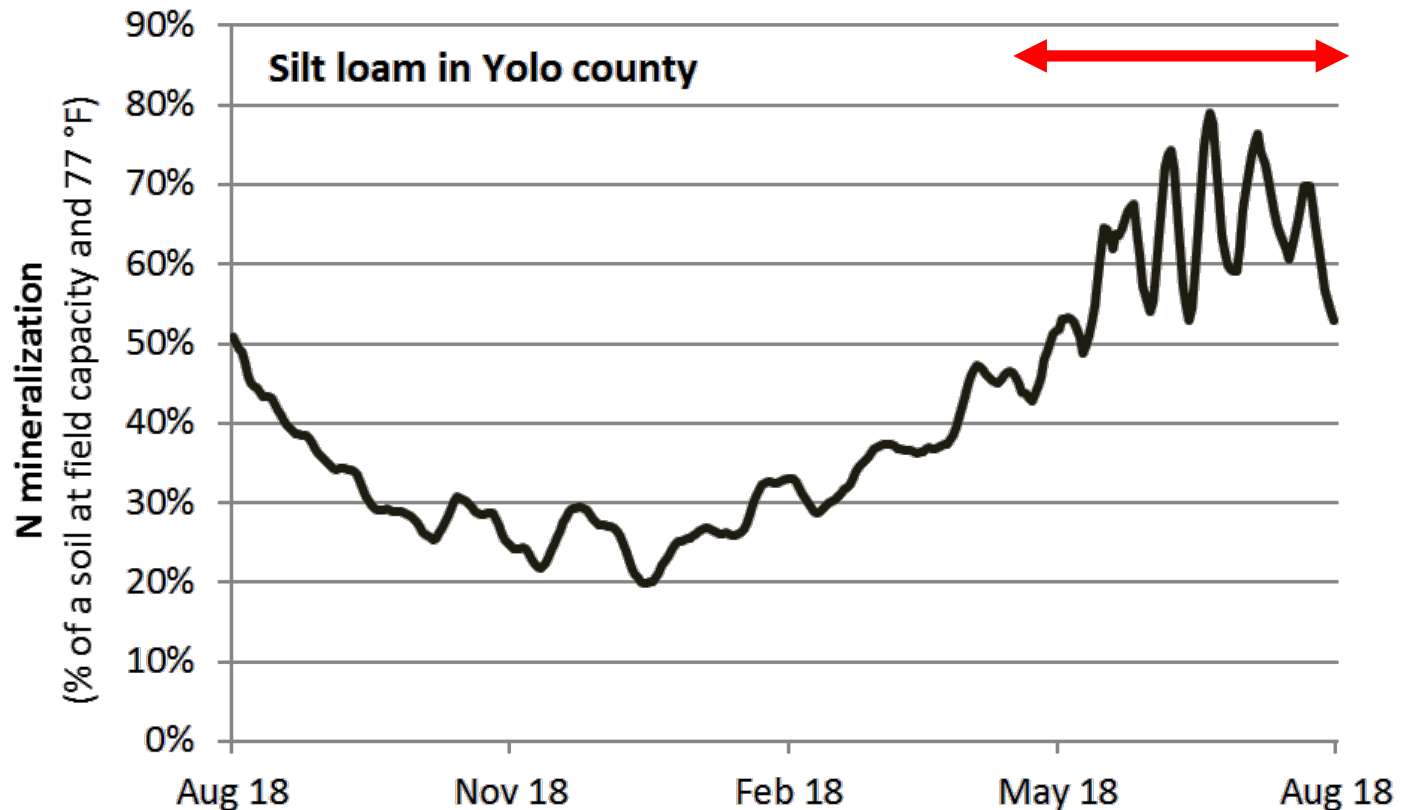
Soil Properties:

- Yolo Silt Loam
- 1.8% soil organic matter
- pH_w 7.6





Soil N mineralization



- Assumption: annual N mineralization 75-125 lbs/acre
- N mineralized during growing season: 30-50 lbs/acre



Conclusions

- At common N application rates, plants take up more N than needed (luxury consumption)
- Root access to nitrate above the drip line is a rough estimate
- Even in soils with a low soil organic matter content, N mineralization during the season contributes to N supply





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