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Department of
LAND, AIR AND WATER RESOURCES
University of California, Davis
Climate Change • Sustainable Agriculture
Environmental Quality • Landscape Processes

Site specific nitrogen management in processing tomatoes

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South Sacramento Valley Processing Tomato Production Meeting, Woodland

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Data collection in commercial fields in 2016

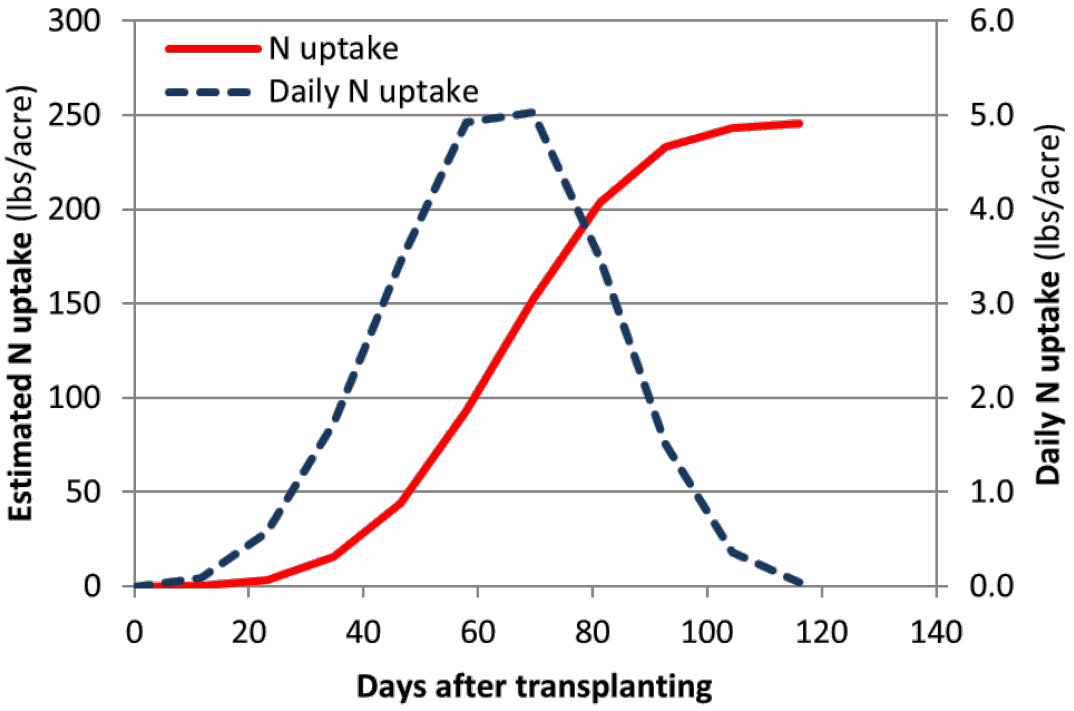
- Sites: - 2 sites near Woodland
  - 3 sites near Stockton
  - 1 site near Huron
- Data: - Canopy development (infrared camera)
  - ET estimates from Tule stations
  - N uptake (repeated plant sampling)

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 ⇨ 45.4 lbs/acre
  - 2nd foot: 7.7 ppm ⇨ 27 lbs/acre
- Assumption: 50% of nitrate in 1st foot and 90% in 2nd foot are available

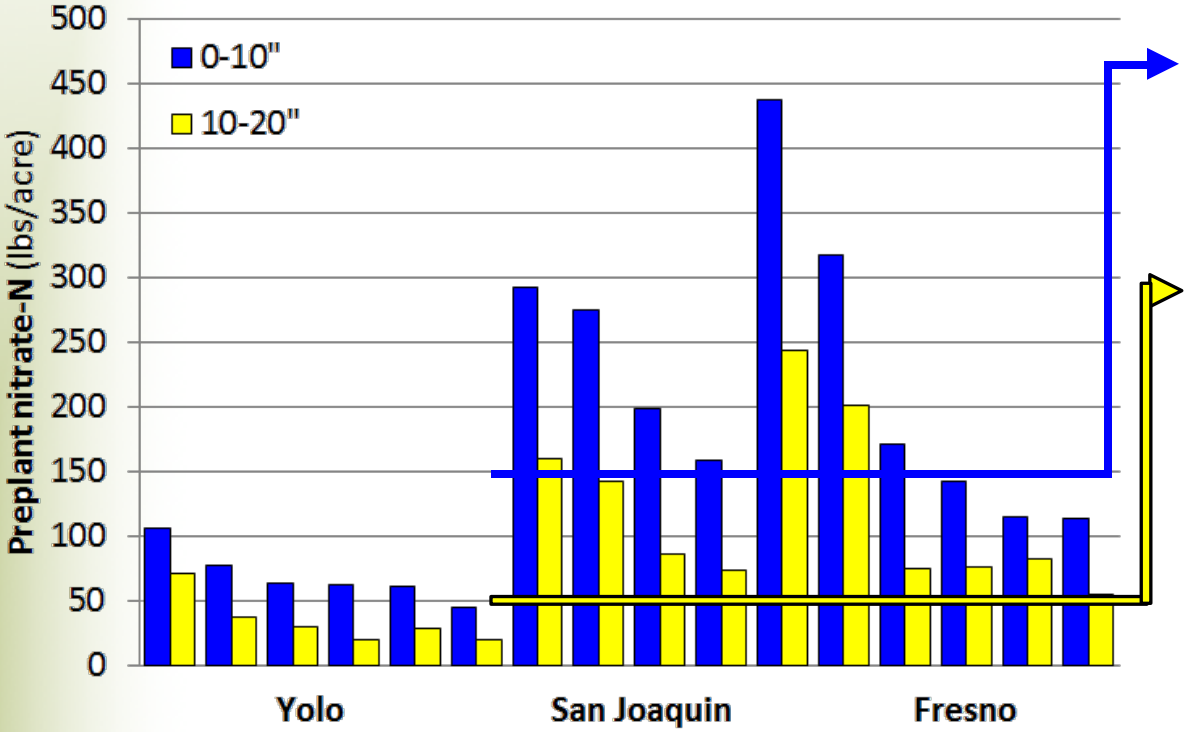
⇨ Available soil nitrate: 47 lbs/acre

⇨ 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 lbs/acre * 50%
= 75 lbs/acre

50 lbs/acre * 90%
= 45 lbs/acre

Total credit:
120 lbs/acre

Lazcano et al., 2015

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

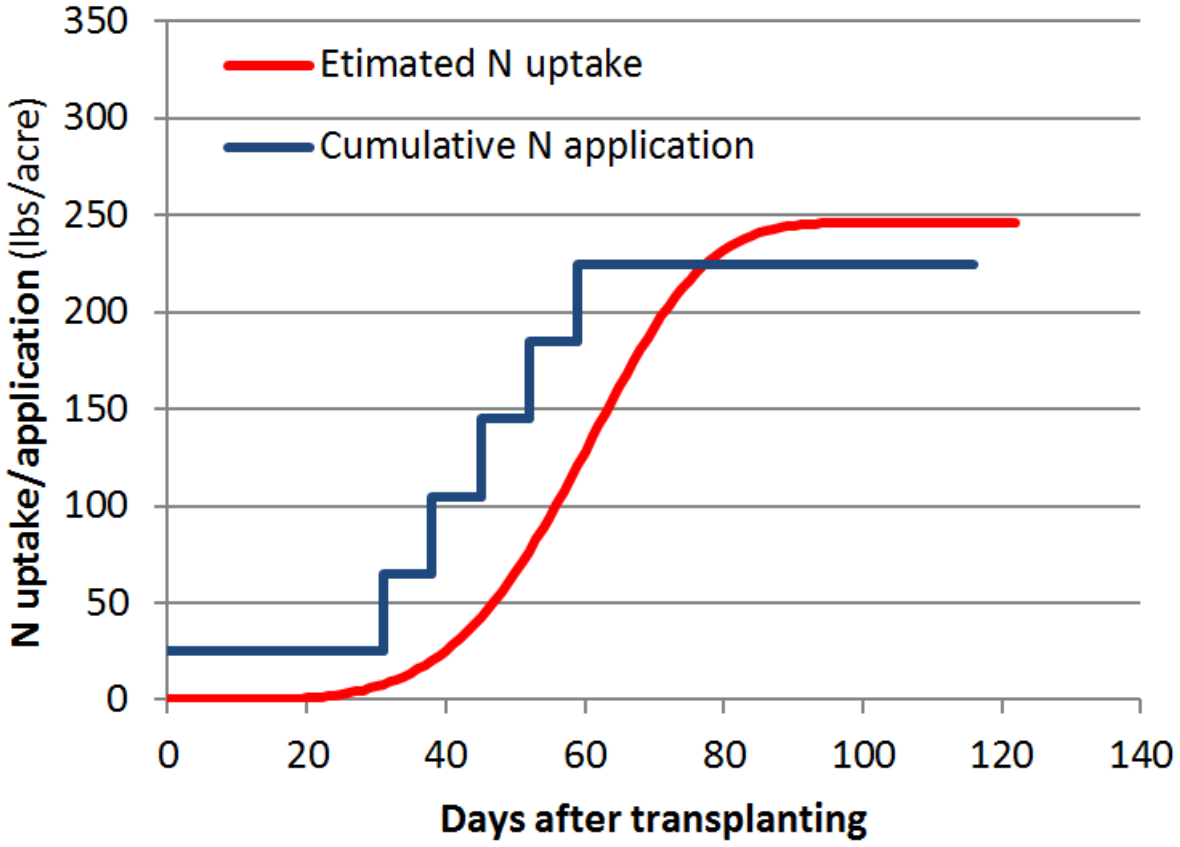
Replicated trial at UC Davis

- 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

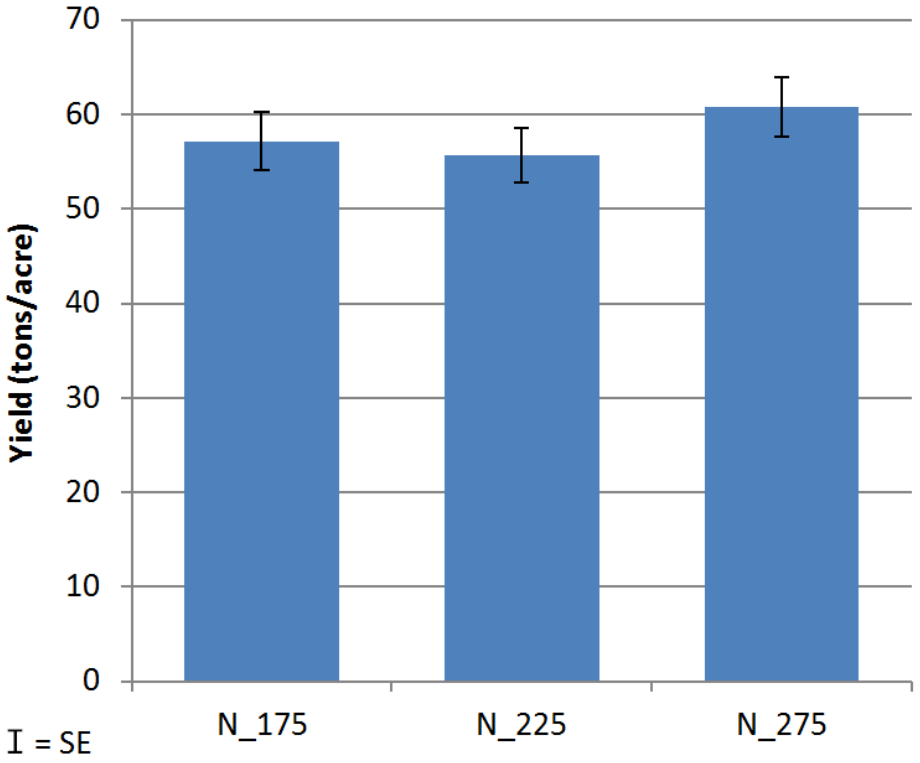
Fertilization program



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?

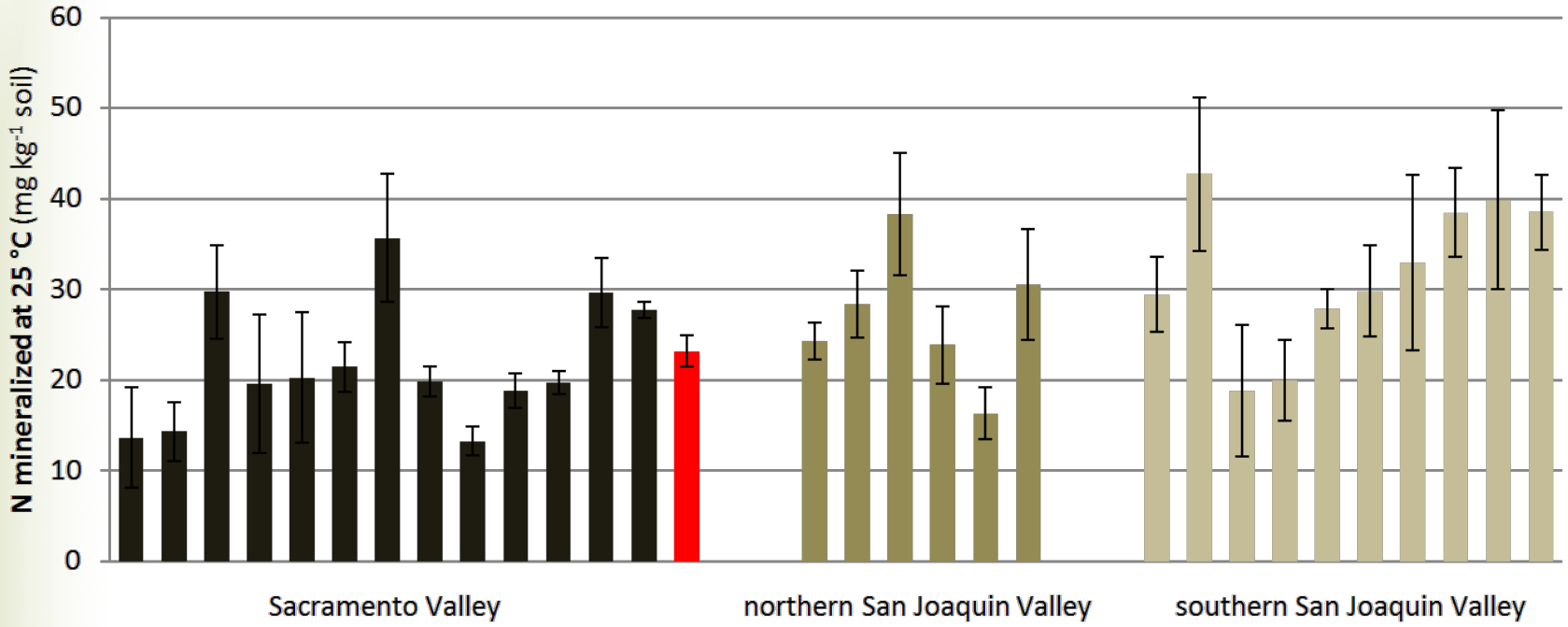
- We may have overestimated N uptake
- We did not account for N mineralization during the growing season

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

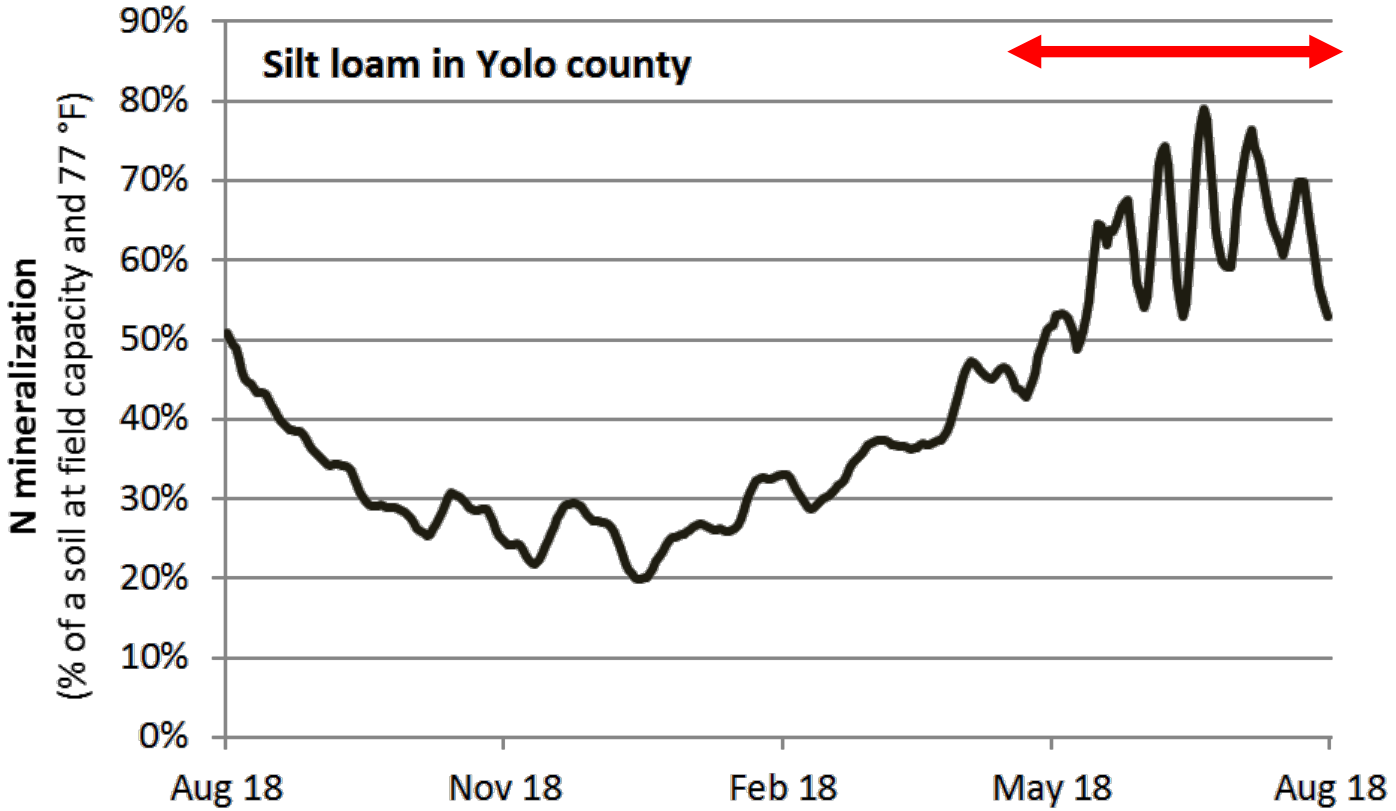
Incubation: 10 weeks at 77 °F and optimal moisture content



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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