UC DAVIS
UNIVERSITY OF CALIFORNIA

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

Nitrogen Budgeting for Corn Grown in the Delta

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SJC and Delta Field Crops Meeting
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Field trials

- Established zero N fertilizer plots in commercial fields
- Collected pre-plant soil samples to 4 ft., analyzed for ammonium and nitrate
- Measured nitrate in irrigation water
- Collected post-harvest soil samples to 4 ft., analyzed for ammonium and nitrate
- At harvest, analyzed plant samples for total biomass, dry matter and total N
- Collected plant samples during the growing season and at harvest from fertilized plots

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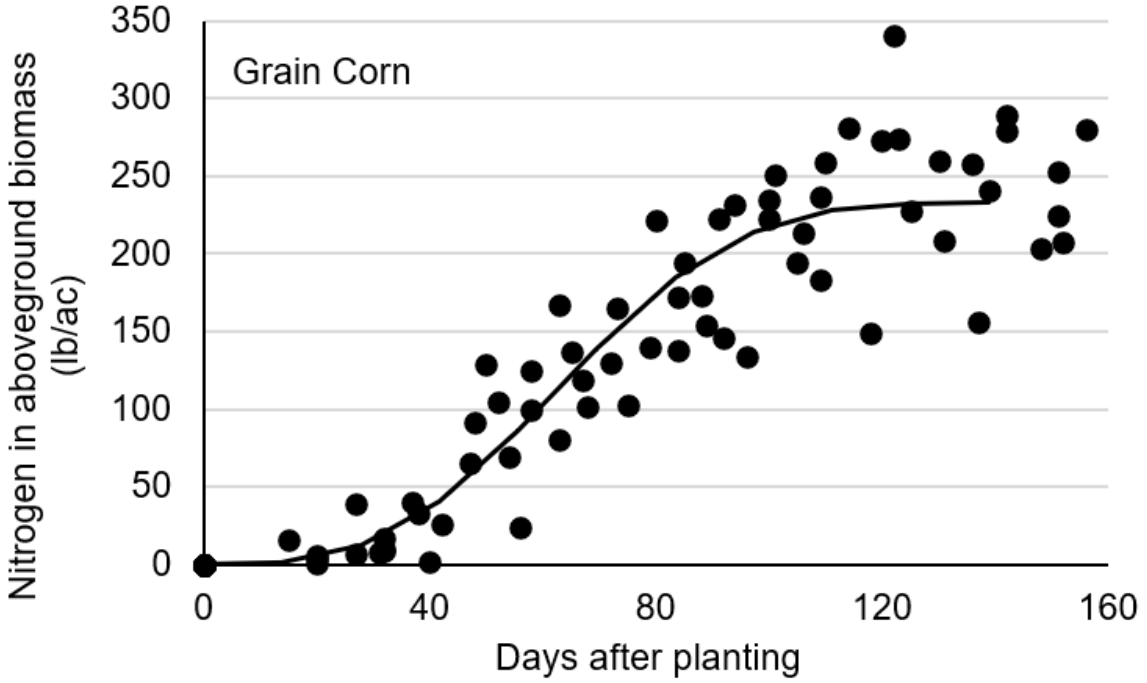
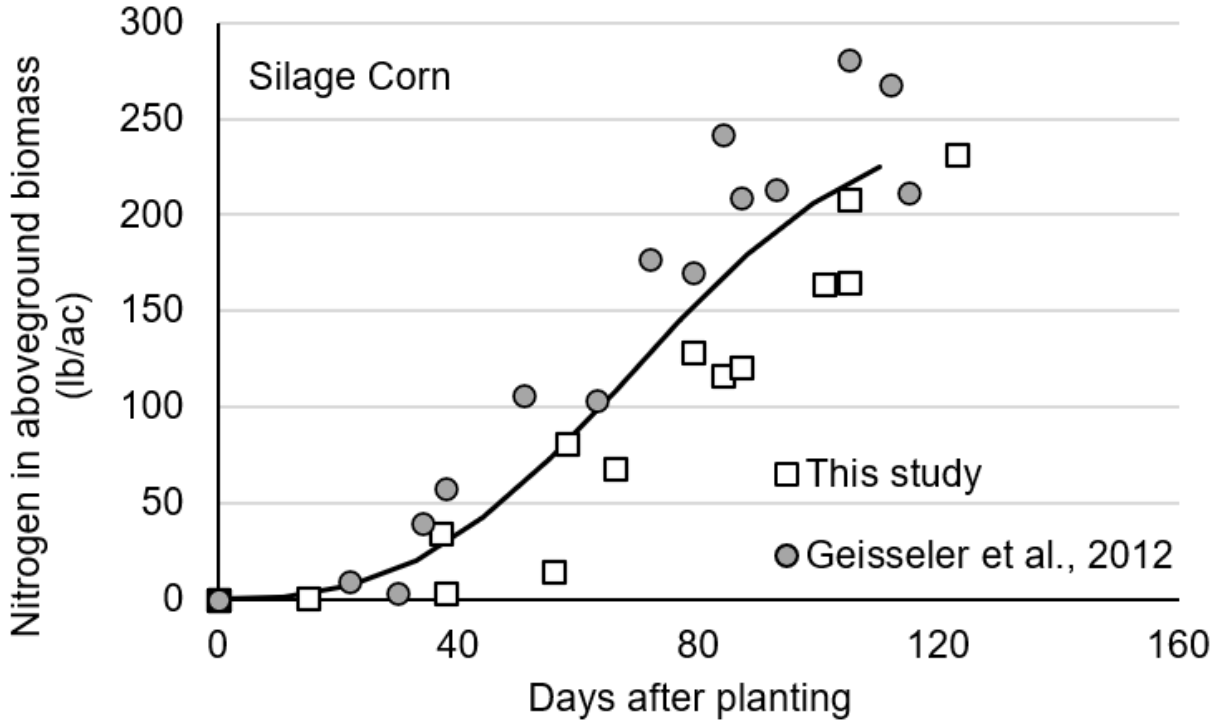
Nitrogen uptake of grain corn



N in Biomass (lb/ac) = grain yield (t/ac) × 17 + 110

Nitrogen uptake of silage corn



N in Biomass (lb/ac) = silage yield (t/ac) × 11.3 - 90

Sources of N

200-250 lb N/ac in the corn biomass

Where does it come from?

- Residual soil nitrate-N in spring
- N mineralization from soil organic matter during the growing season
- Irrigation water N
- Atmospheric deposition
- Fertilizer N

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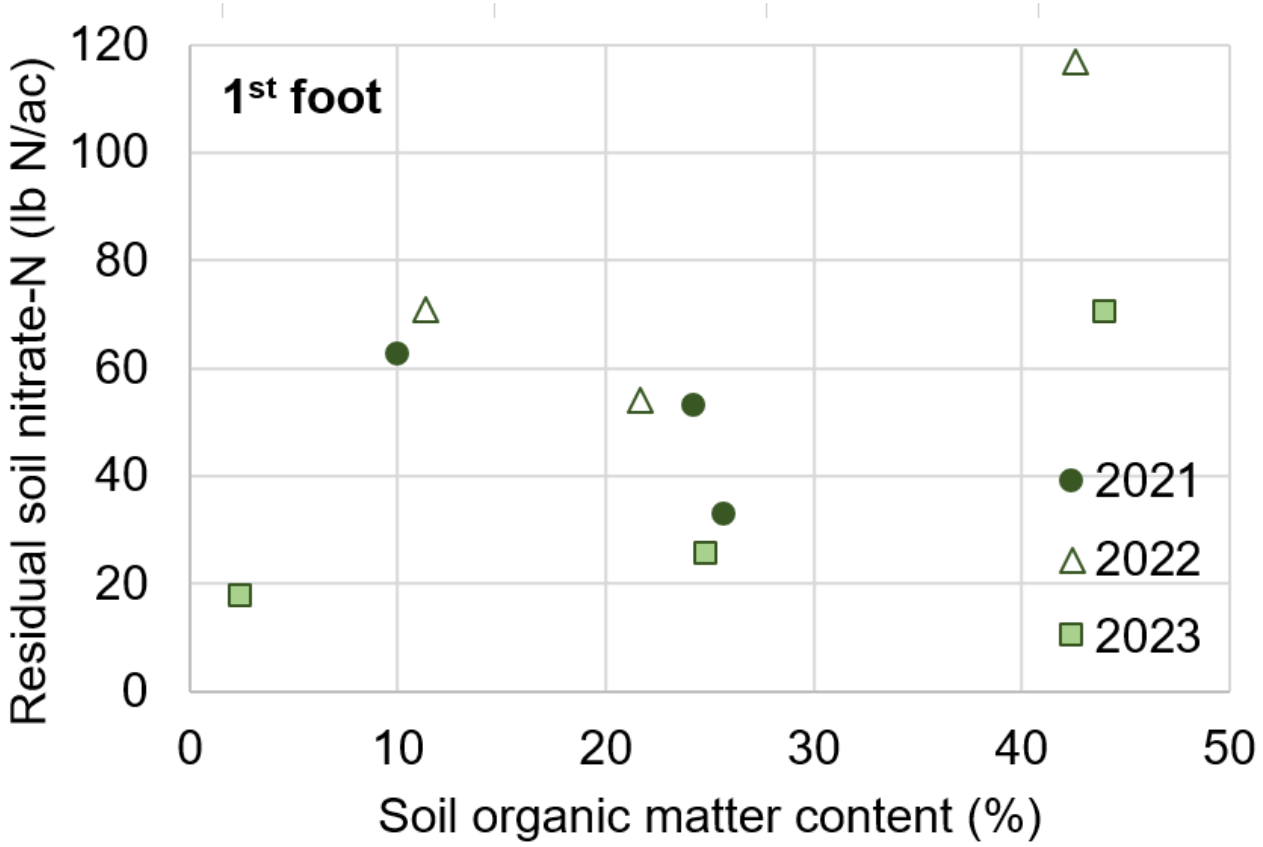
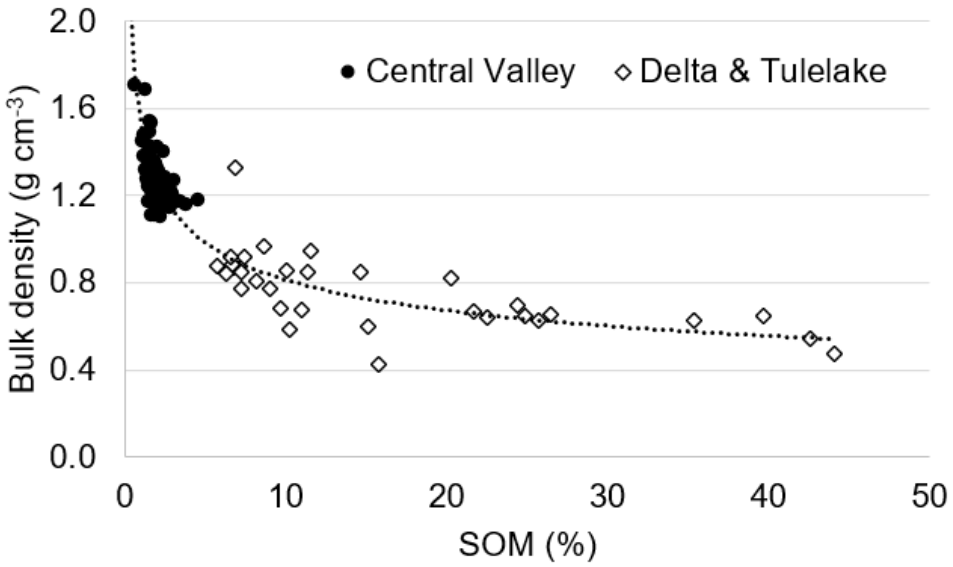
Can we predict residual soil nitrate?

Residual nitrate-N ranged from
20 to 120 lb N/acre in the top foot



Bulk density in the top foot



How to convert ppm nitrate-N to lb N/ac in top foot?

Multiply ppm by:

- 3.5-4.0 for low organic matter Central Valley soils
- 1.5-2.5 for high organic matter Delta soils

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What is N mineralization?

- Soil microorganisms decompose organic matter
- They need N and C as building blocks for their own biomass
- C is also used as energy source
- **N mineralization:** Release excess N in the form of NH_4^+ into soil solution
- **N immobilization:** Uptake of NO_3^- or NH_4^+ from soil solution and incorporation into microbial tissue

Calculating net N mineralization

Net N mineralization = N outputs – N inputs

Outputs:

- N in biomass at harvest
  (aboveground N measured; root N estimated)
- Post-harvest residual nitrate in soil profile (4 ft)
- Leaching and gaseous losses (assumed to be zero)

Inputs:

- Pre-plant residual nitrate in soil profile (4 ft)
- N fertilizer (was zero at all sites)
- N in irrigation water
- Atmospheric N deposition

N mineralization during growing season (top 2 ft.)

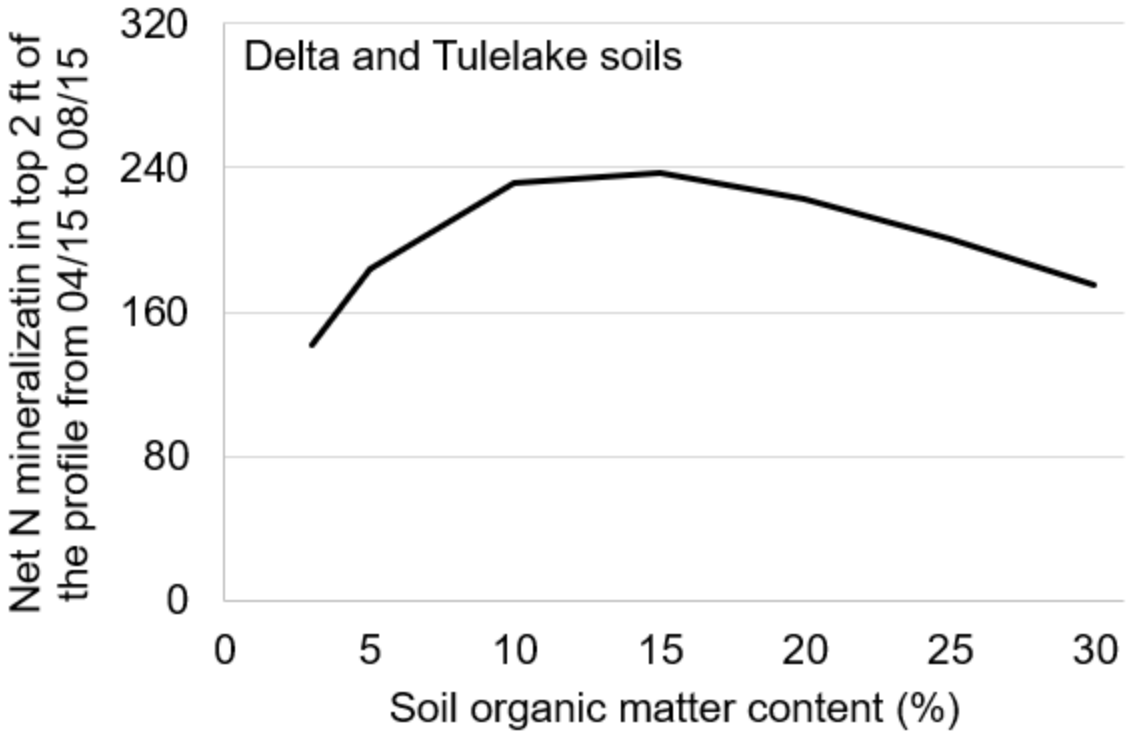
Central Valley soils:

- Average: 95 lb/ac
- Range: 35 – 190 lb/ac
- Weakly correlated with clay content

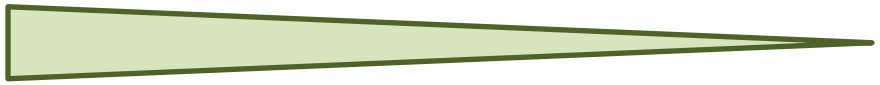
Delta soils:

- Average: 210 lb/ac
- Range: 50 – 435 lb/ac
- Correlated with soil organic matter content

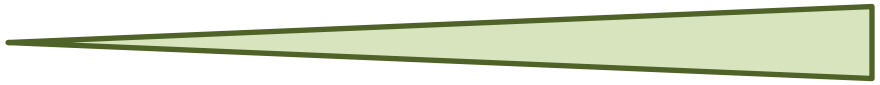
N mineralization vs. soil organic matter



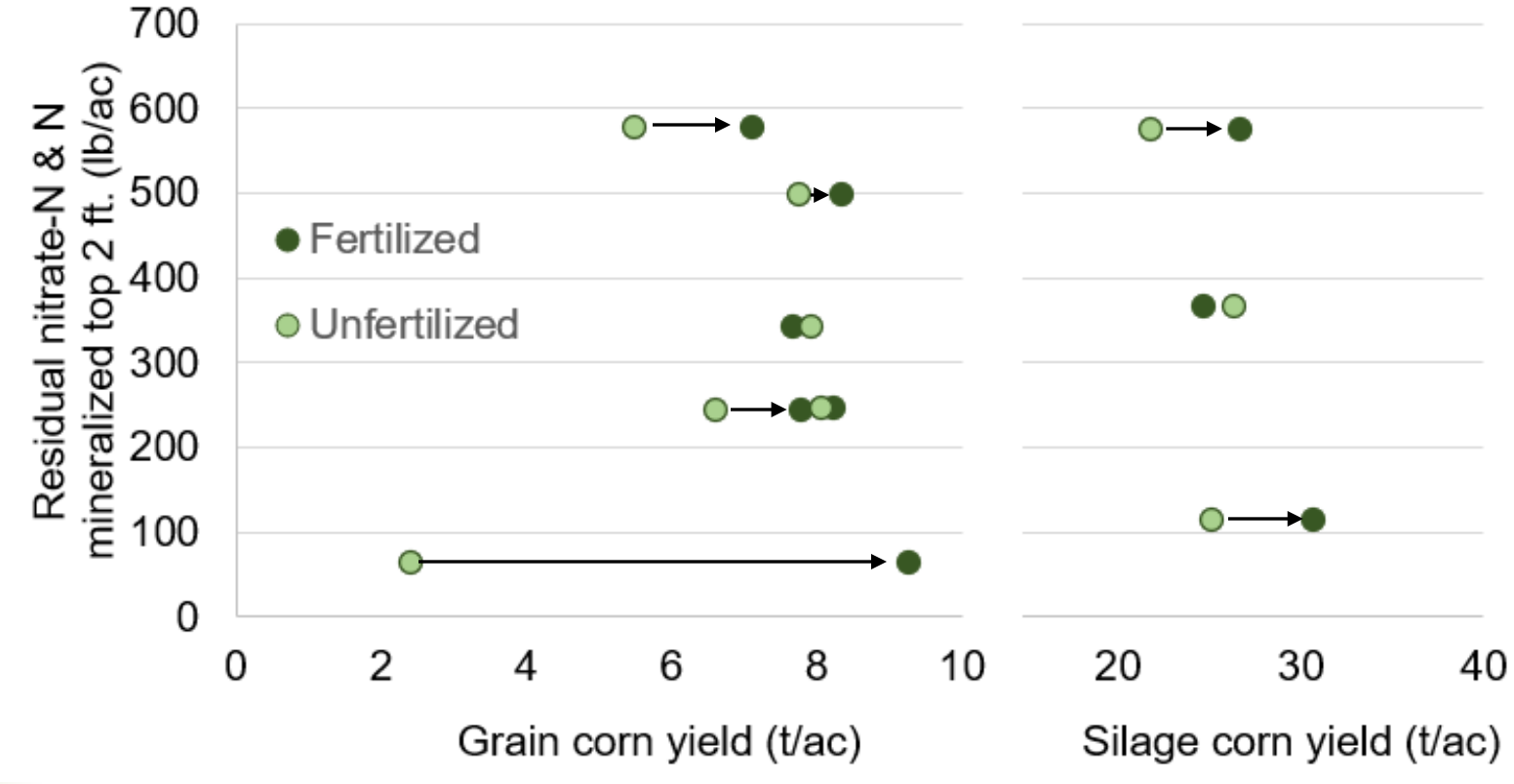
Bulk density:



Recalcitrance:



Yield:
Fertilized vs. unfertilized



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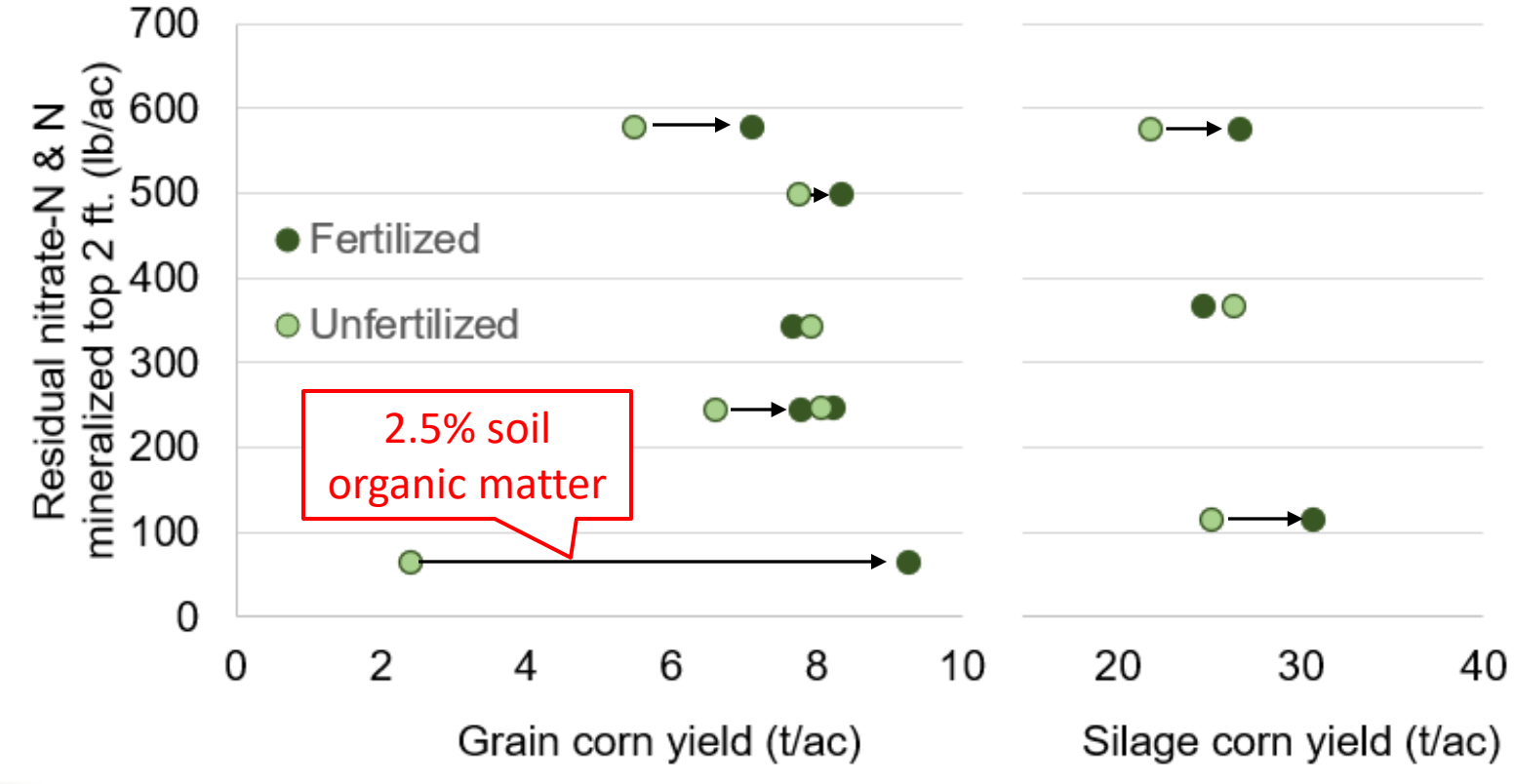
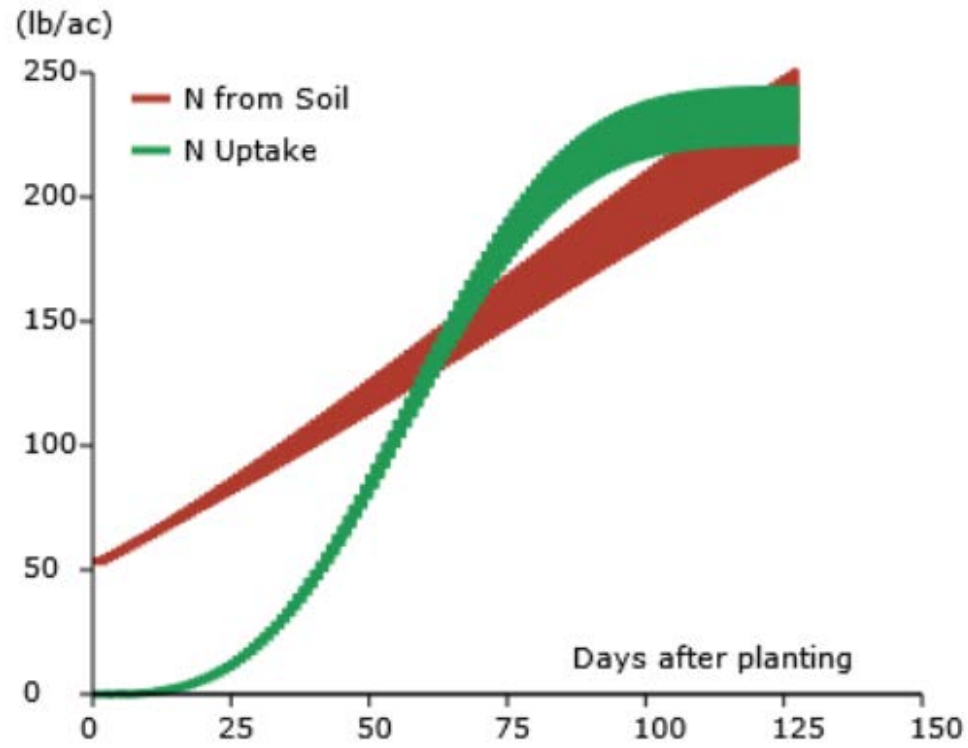


N uptake vs. available N



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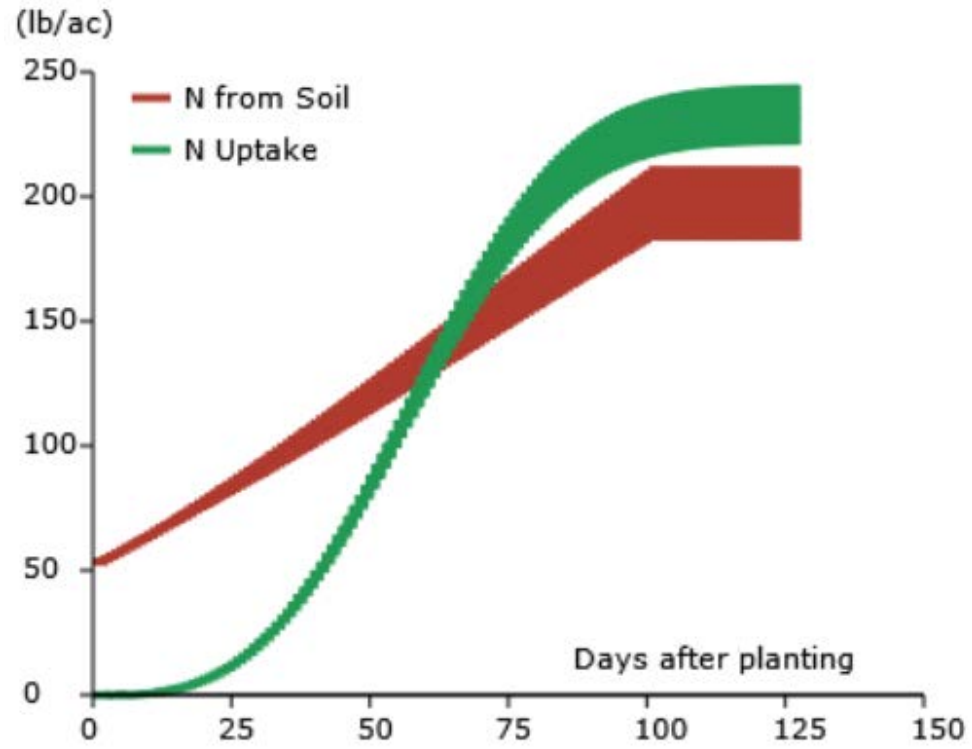

Putting it all together

Crop Nitrogen Calculator for California

This calculator was developed based on results from several studies in commercial fields in California. Information on lines marked with an * needs to be provided.

Field-Specific Input

Crop*: Corn - Grain

Region*: Sacramento Valley - Yolo

Planting date*: mm / dd / yyyy

Expected harvest date*: mm / dd / yyyy

Expected yield*: tons/ac

Residual nitrate in 1st foot: ppm Nitrate-N

Residual nitrate in 2nd foot: ppm Nitrate-N

Nitrate in irrigation water: ppm Nitrate-N

Irrigation System*: Furrow

Liquid starter fertilizer: lb N/ac

Soil organic matter*: %

Soil type*: Organic (e.g. Delta, Tulelake)

- Sandy (gritty)
- Loamy (neither sticky nor gritty)
- Clayey (sticky when wet)
- Organic (e.g. Delta, Tulelake)

Display Resu

Adjusting N fertilization to crop fertilizer needs

- Analyze soil sample for nitrate-N before fertilizer applications
- Split applications
- We are currently working on a site-specific online calculator
- Monitor field during growing season taking leaf or soil samples
- Establish strips within a field with reduced N fertilizer applications to determine the crop response to N fertilizer

Conclusions

- N in the aboveground biomass at harvest averaged 200 – 250 lb/ac
- Residual nitrate in spring is variable and hard to predict ⇨ needs to be measured
- Bulk density of Delta soils is low ⇨ affects conversion from ppm N to lb N/ac
- N mineralization is related to soil properties
- Residual nitrate-N and N mineralization (available N) exceeded N uptake in some fields
- When available N was high, yield response to fertilizer was low

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