UC DAVIS
UNIVERSITY OF CALIFORNIA

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

Soil Organic Matter and its Contribution to Plant Available Nitrogen

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SJC and Delta Field Crops Meeting
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Plant available N in soil

Residual soil nitrate:

- Directly available form of N.
- Origin:
  - Mineralization of organic N in spring
  - Left over fertilizer N from previous crop

Potentially available N:

- Nitrogen mineralized during the season from soil organic matter and other sources
- Estimates based on:
  - Laboratory studies
  - Field trials

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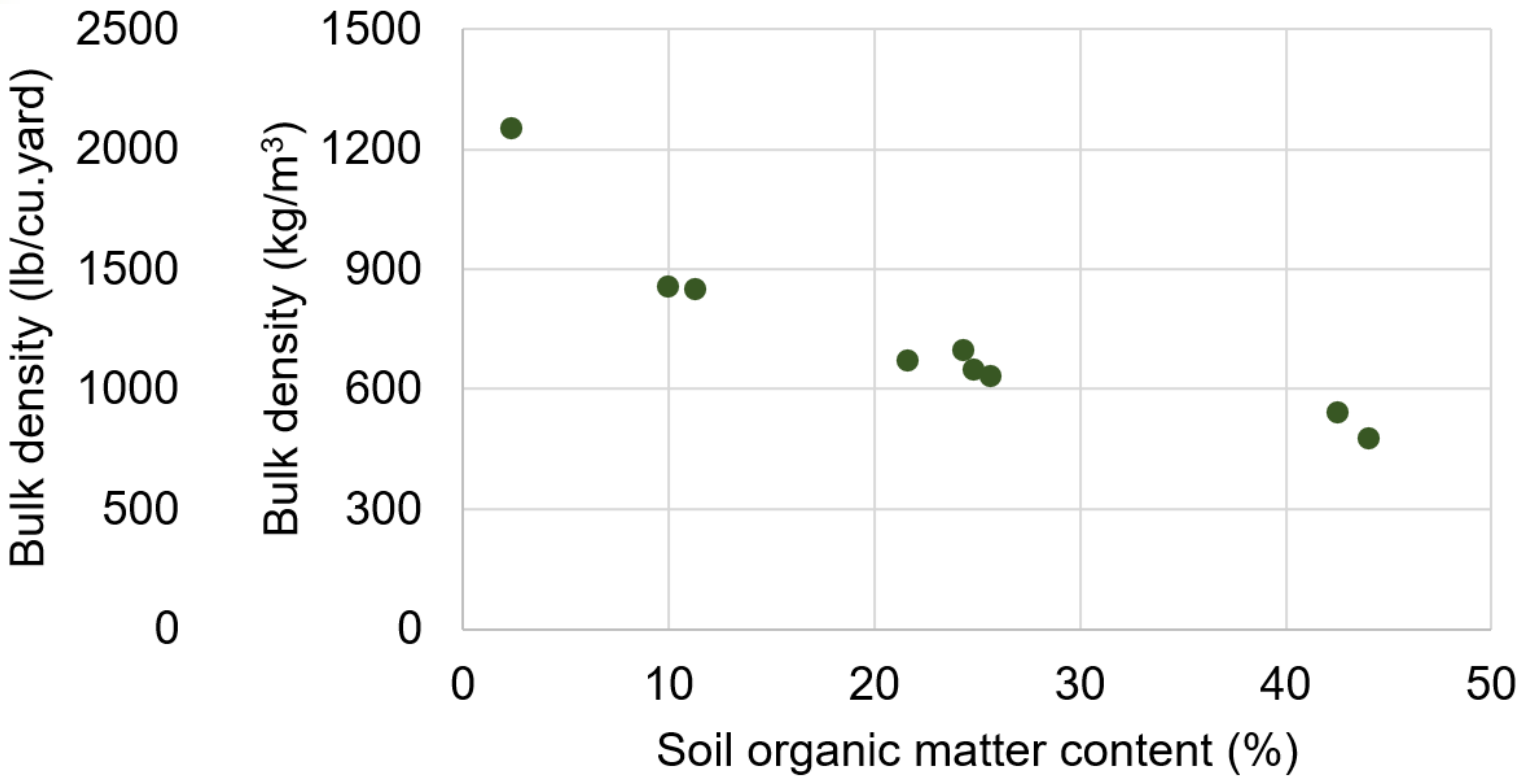
Residual soil nitrate

In soil samples taken in April, residual soil nitrate-N ranged from 5-97 ppm in the top foot.

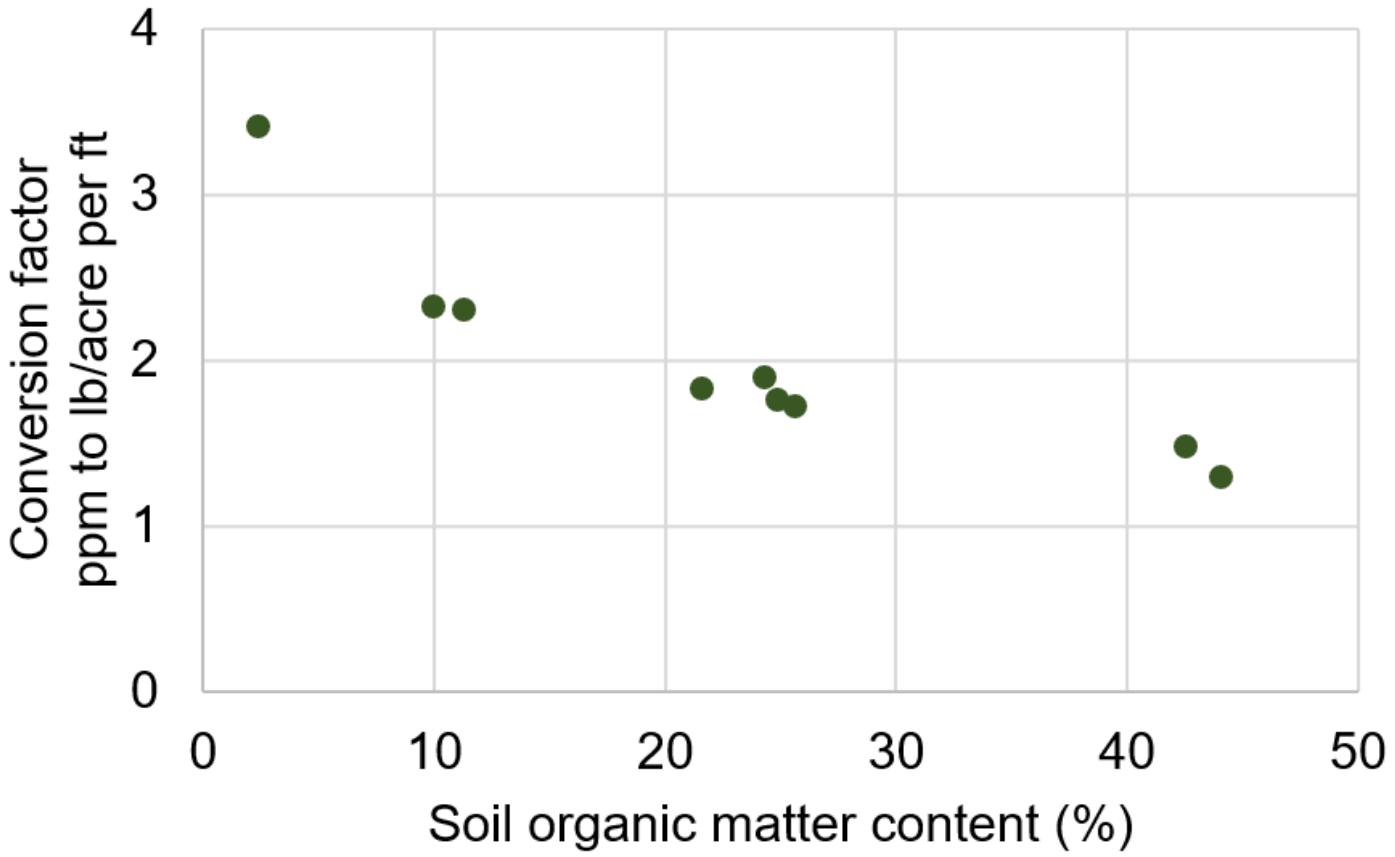
How much is that?

- A factor of 4 is often used to convert ppm to lb/ac in a 1-ft layer
- This conversion factor is too high for Delta soils with a high soil organic matter content.

Bulk density of Delta soils

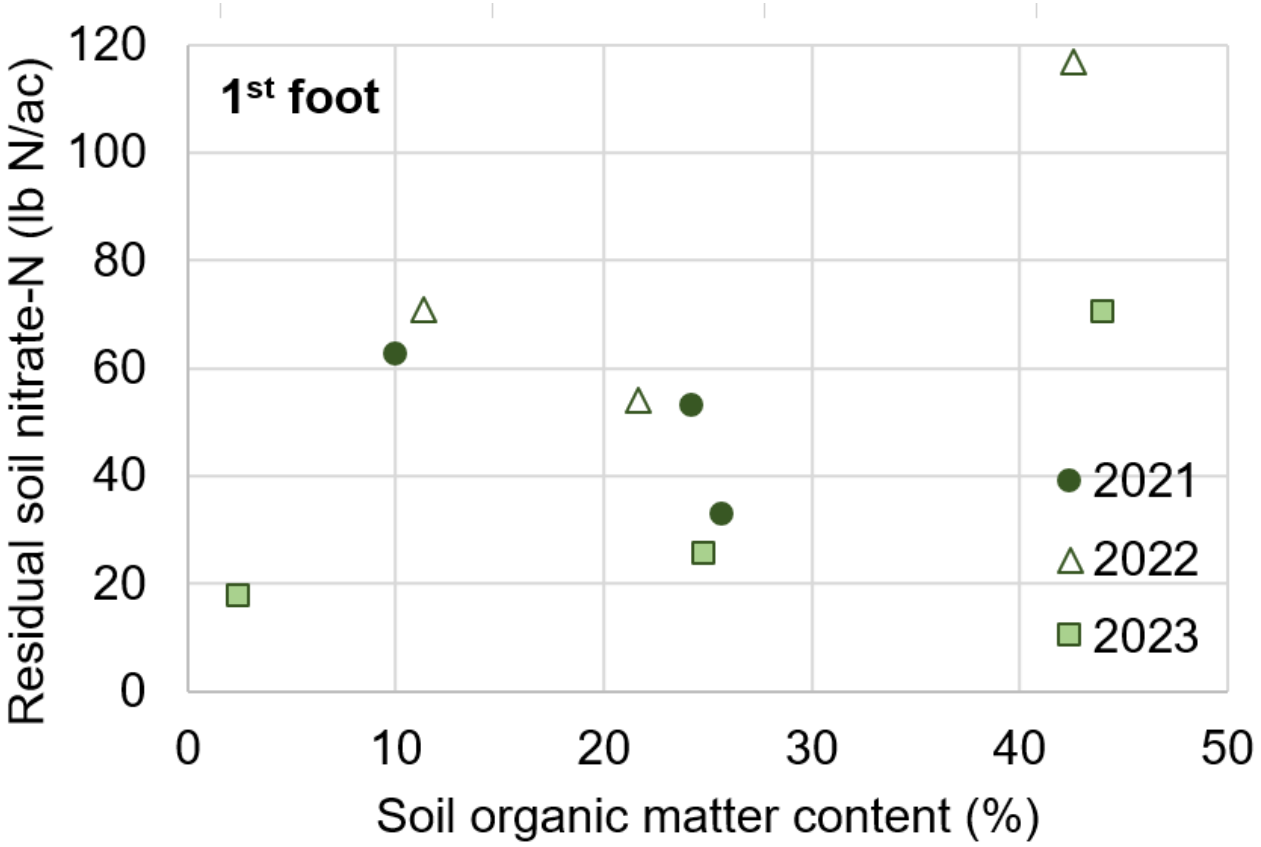


Converting ppm nitrate-N to lb N/acre per foot



Can we predict residual soil nitrate?

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



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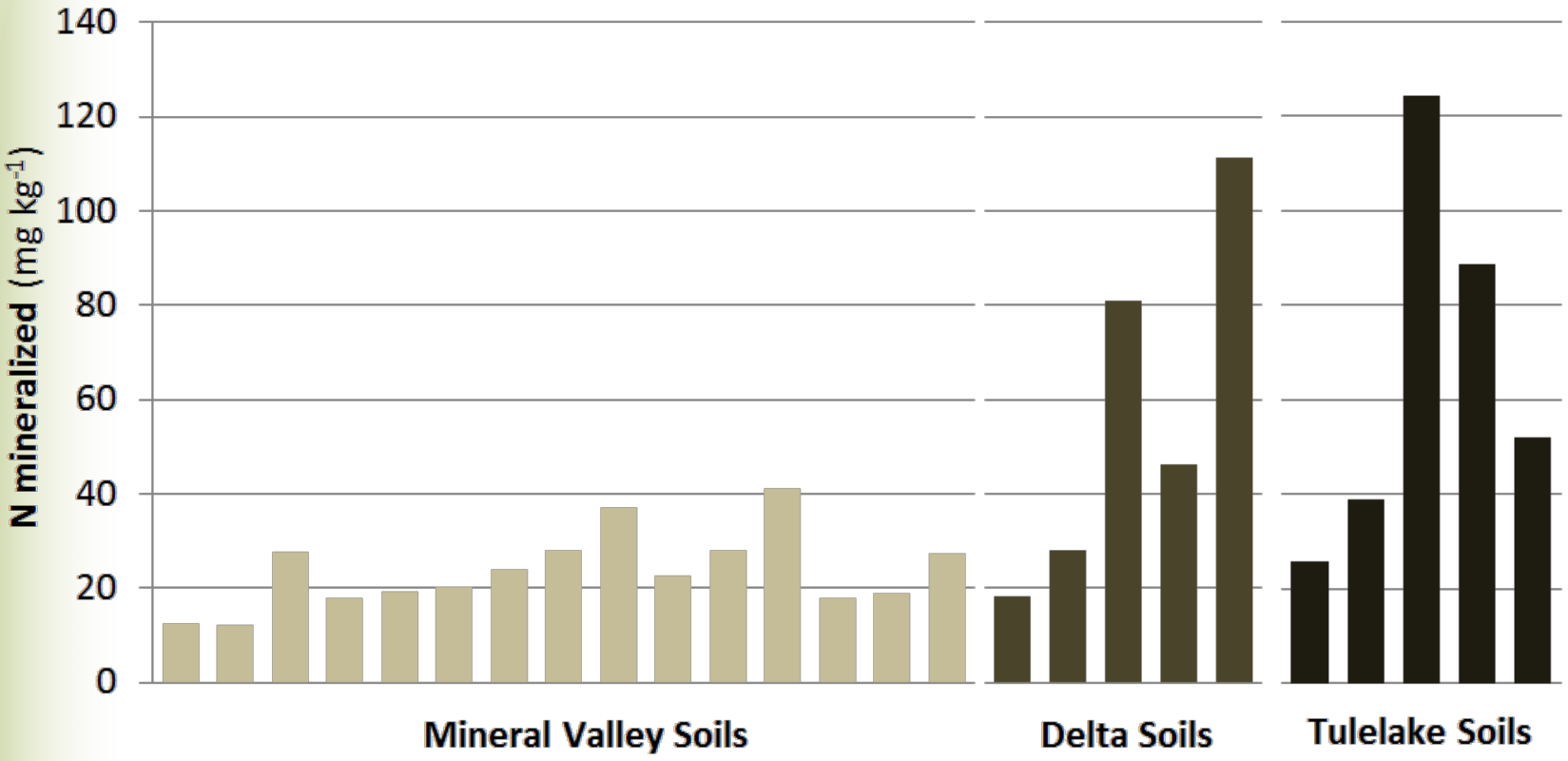
What is N mineralization?

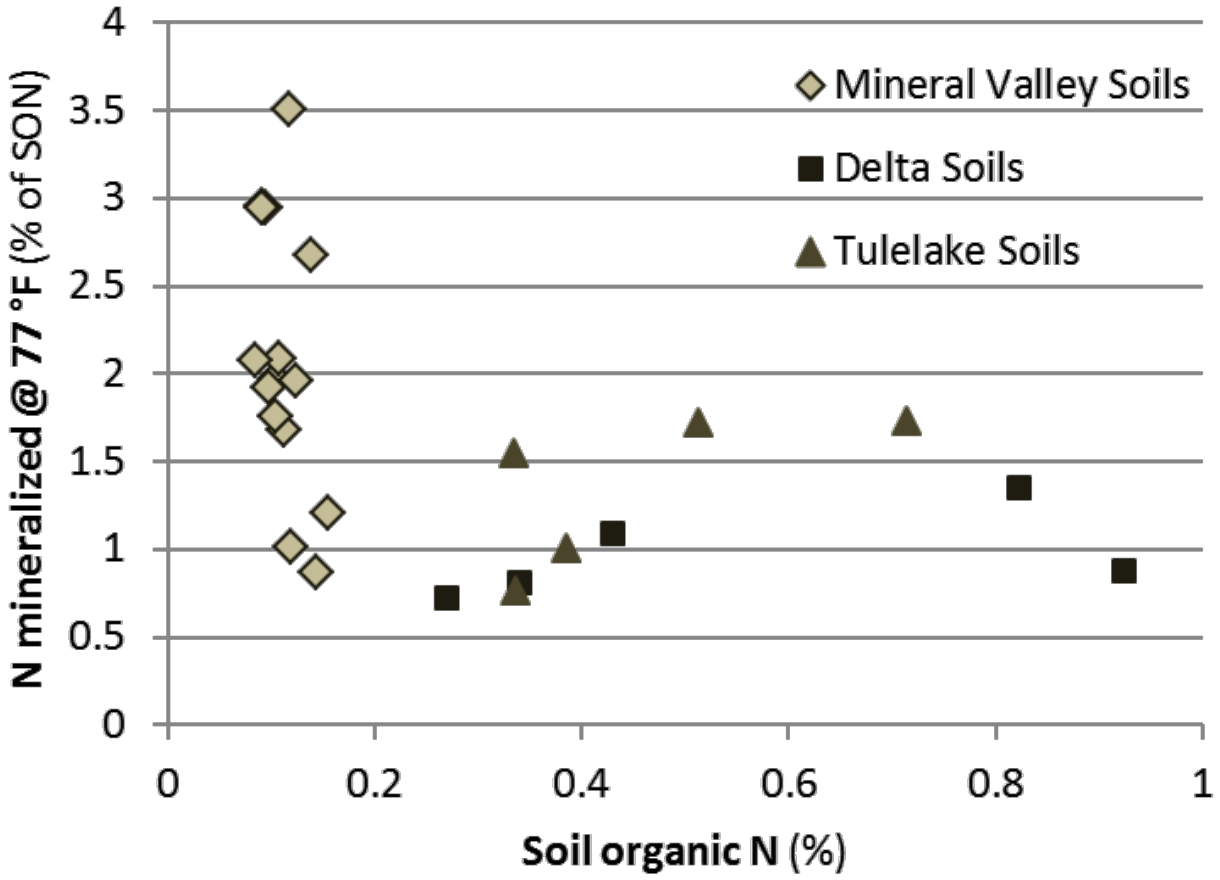
- Soil microorganisms decompose organic matter
- They need N and C as building blocks for their own biomass
- C is also used as energy source
- **N mineralization:** Release excess N in the form of NH_4^+ into soil solution
- **N immobilization:** Uptake of NO_3^- or NH_4^+ from soil solution and incorporation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

N mineralization under lab conditions

10 weeks at 77 °F and optimal moisture content



N mineralization under lab conditions

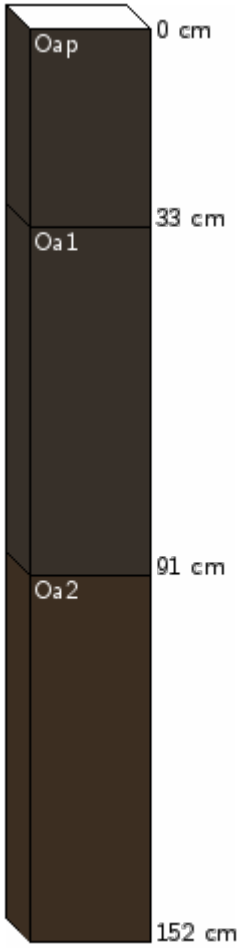


Formation of soil organic matter

Delta

Excess water

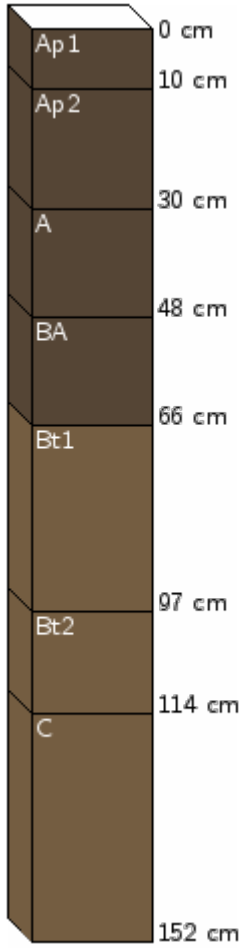
Anaerobic conditions



Valley

Water limited

Aerobic conditions



http://www.cnps.org; http://www.water.ca.gov; https://casoilresource.lawr.ucdavis.edu

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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
- Analyzed plant samples for total biomass, dry matter and total N
- Collected plant samples during the growing season and at harvest from fertilized plots

Calculating net N mineralization

Net N mineralization = N outputs – N inputs

Outputs:

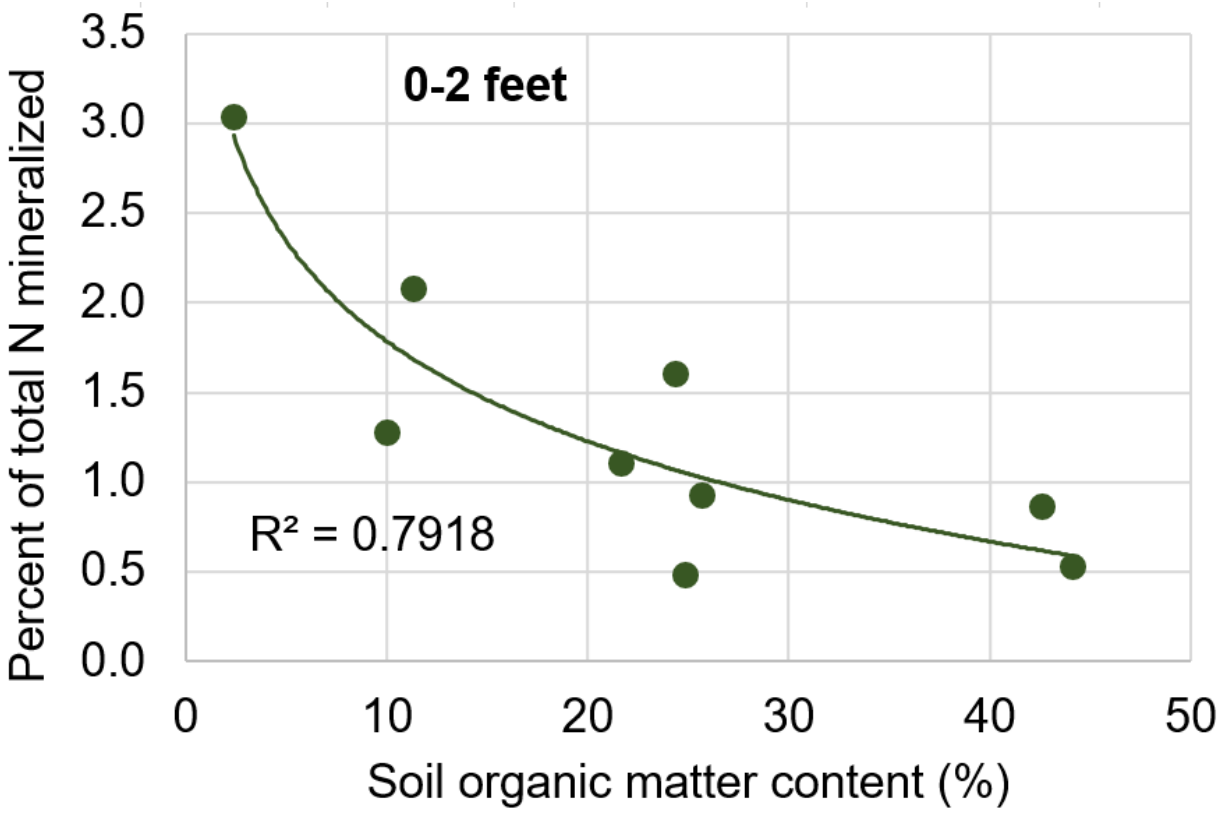
- N in aboveground biomass
- Post-harvest residual nitrate in soil profile
- Leaching and gaseous losses (assumed to be zero)

Inputs:

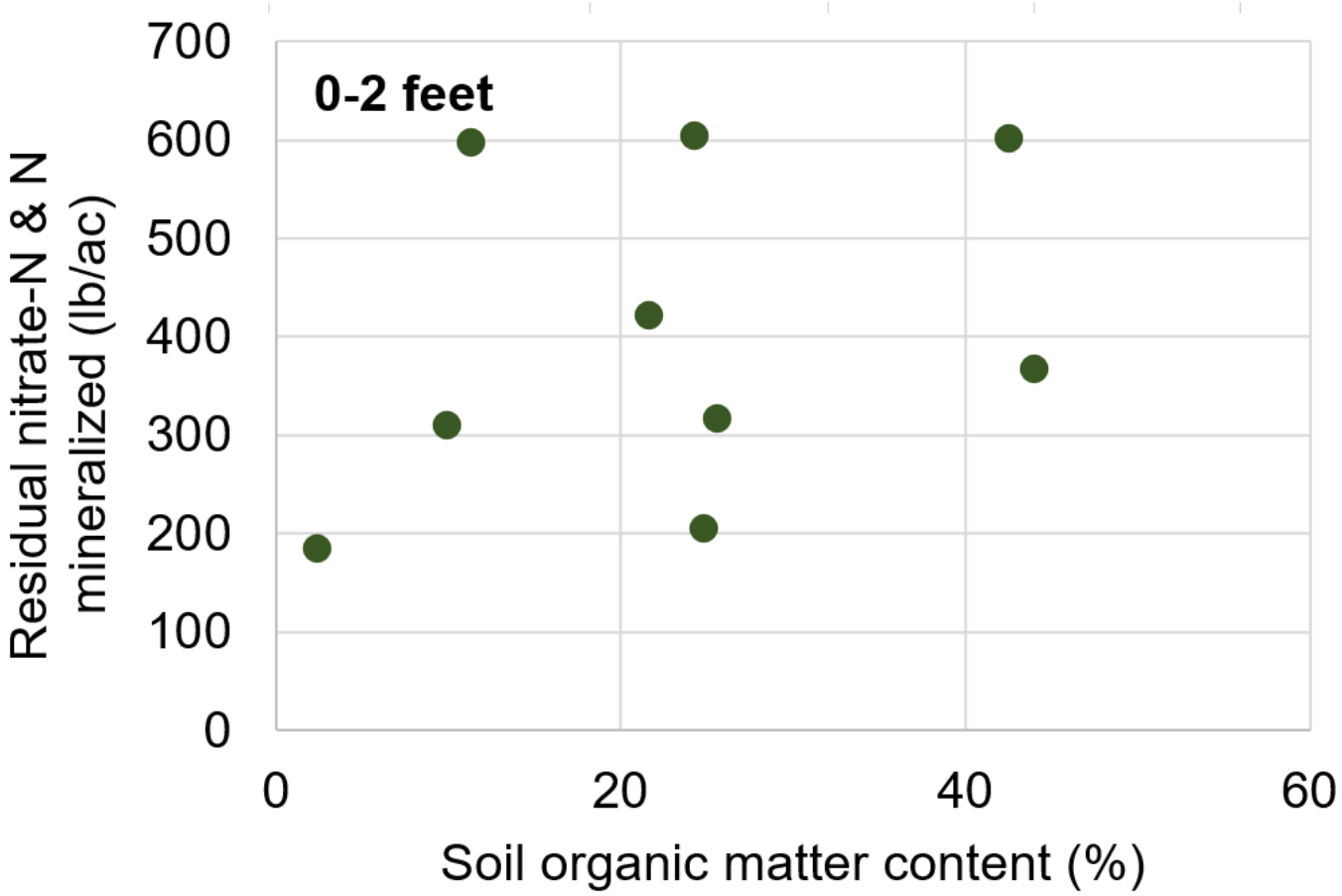
- Pre-plant residual nitrate in soil profile
- N fertilizer (was zero at all sites)
- N in irrigation water
- Atmospheric N deposition

N mineralization in the top 2 feet of the profile

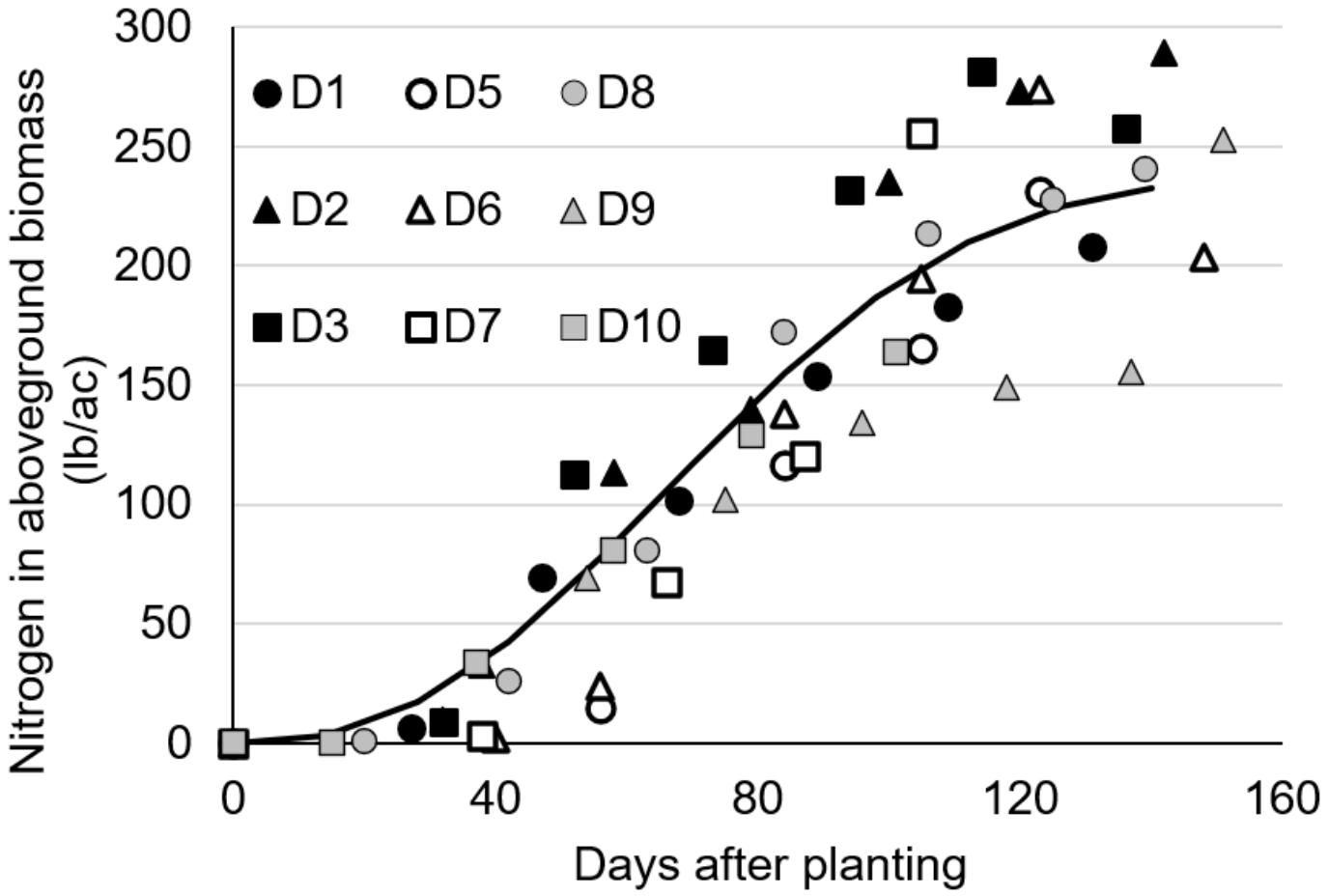
N mineralization during the corn growing season ranged from 130 to 490 lb/ac



Total available N (residual nitrate & N mineralization)



N accumulation in corn biomass



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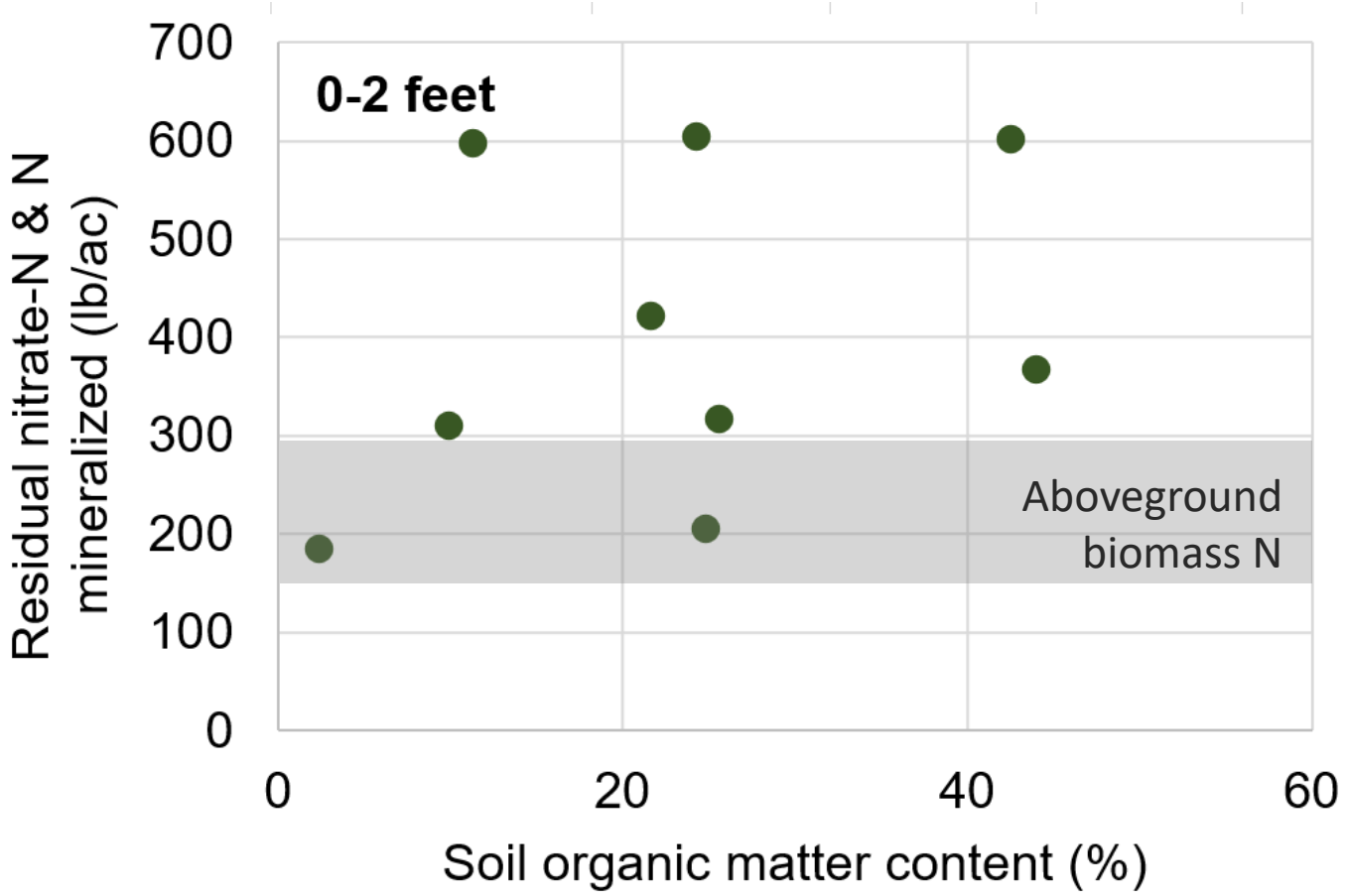
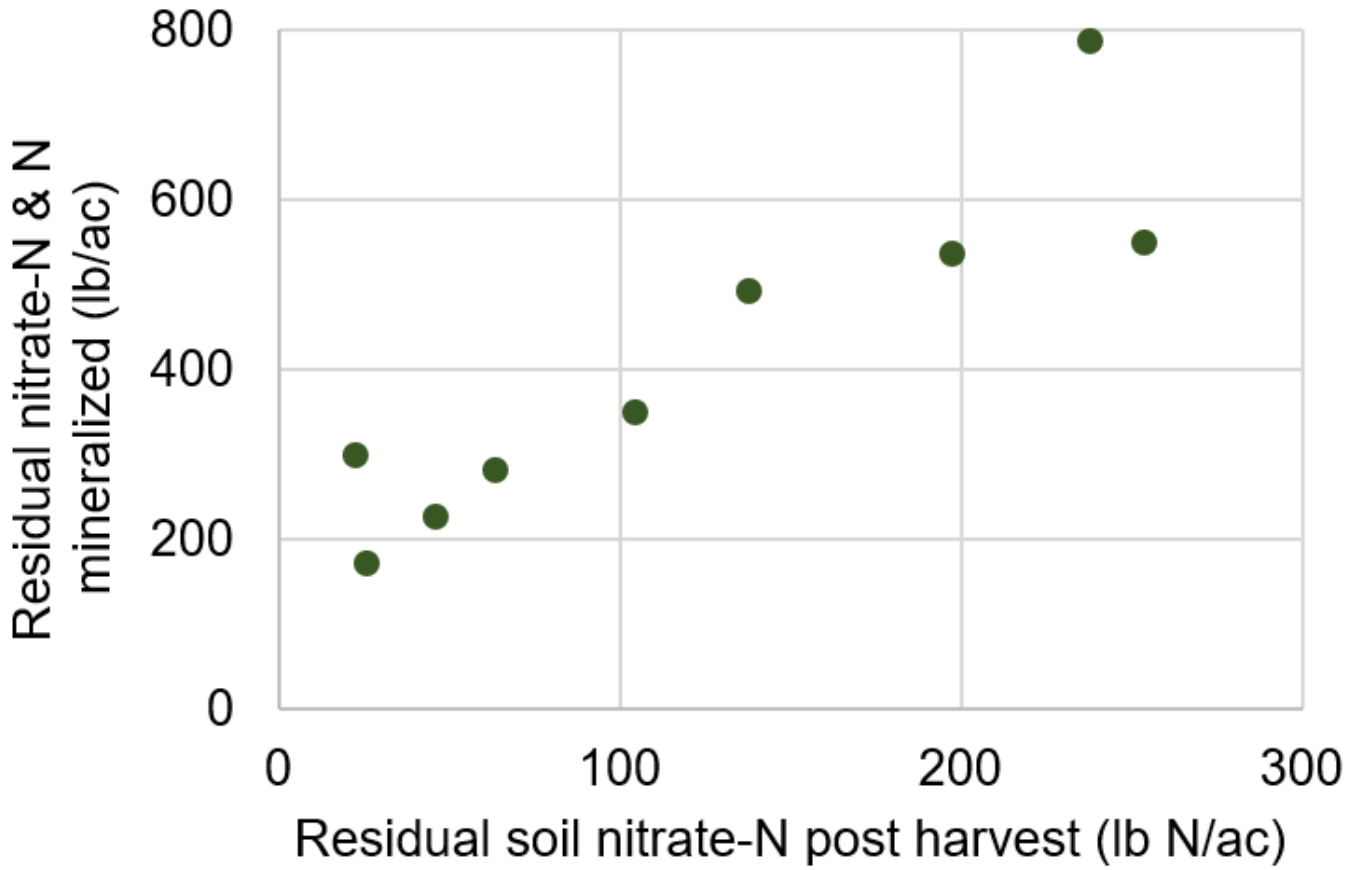
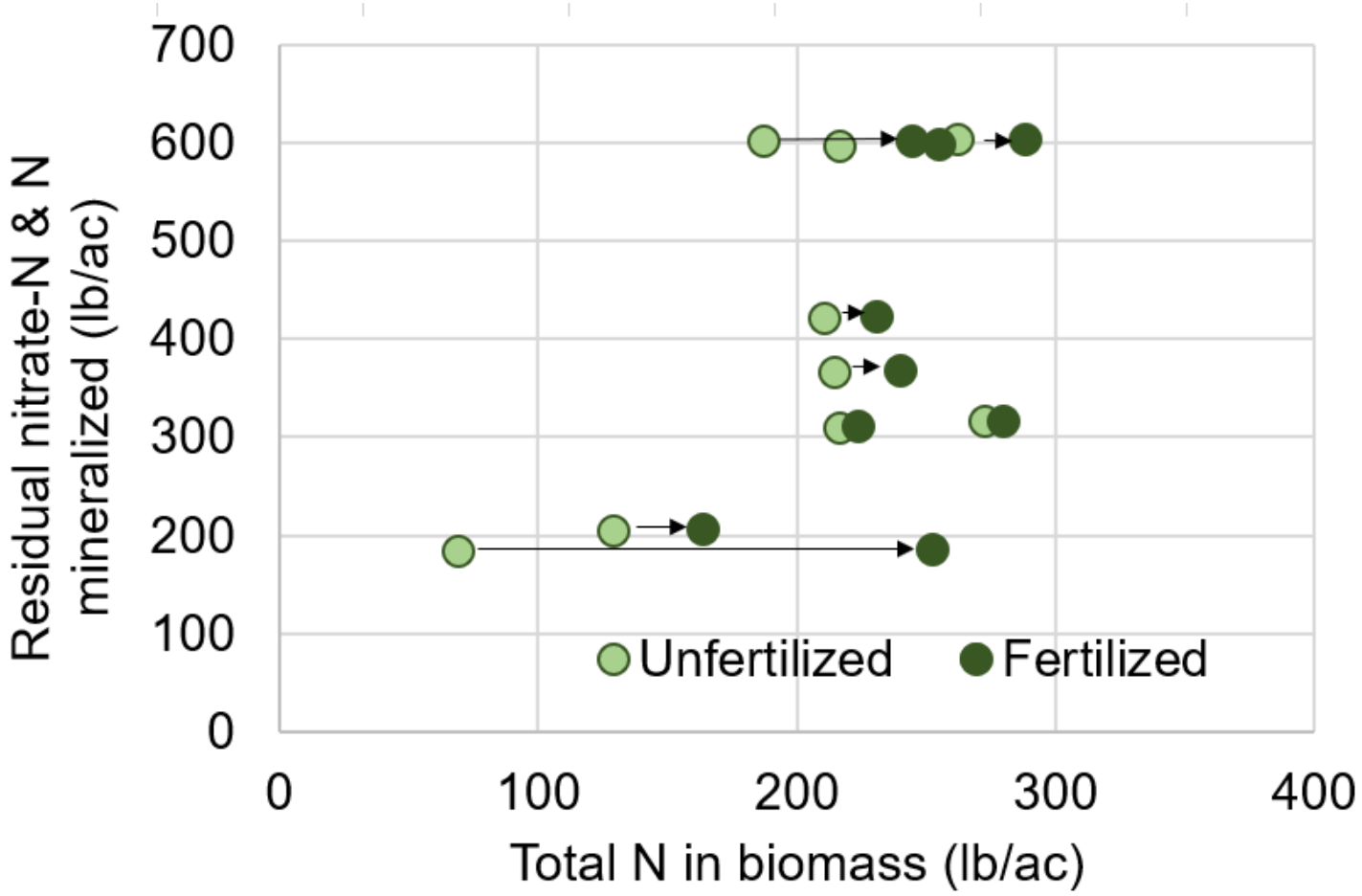


Residual N at harvest



Biomass N: Fertilized vs. unfertilized



Adjusting N fertilization to crop fertilizer needs

- Split applications
- Analyze soil sample for nitrate-N before fertilizer applications
- We are currently working on site-specific estimates for N mineralization
- Establish zero or reduced N fertilizer strips to determine the crop response to N fertilizer

Conclusions

- 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
- N in the aboveground biomass at harvest averaged 230 lb/ac
- 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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