



Nitrogen in the Soil

Nitrogen Mineralization from Soil Organic Matter



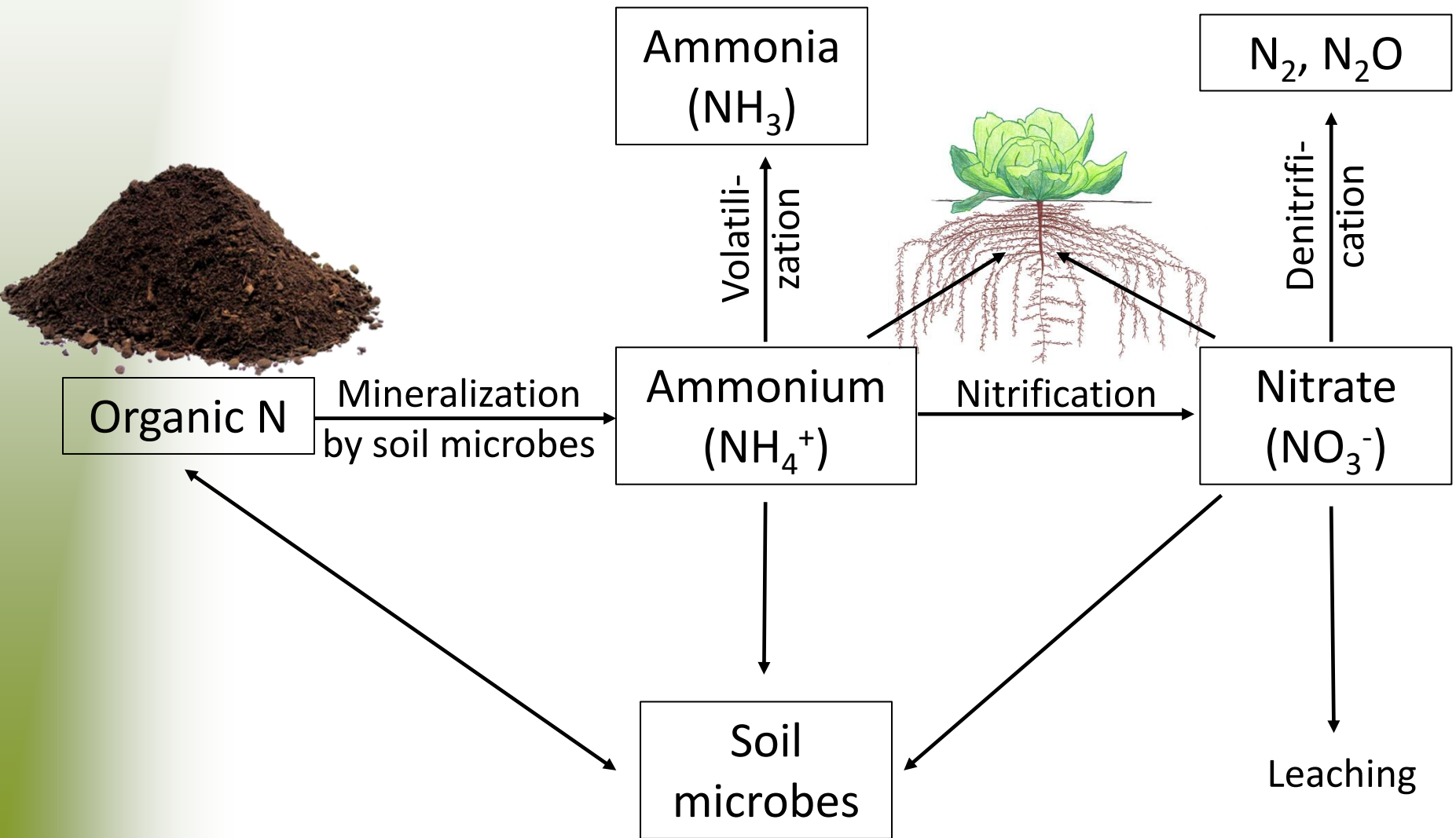
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Organic N Management Workshop
March 2, 2021



Nitrogen pools and turnover in soil





Factors affecting decomposition and N mineralization

- Soil temperature
- Soil moisture
- Quality of organic source
 - Nitrogen content
 - C to N ratio
 - Availability of C and N
- Management

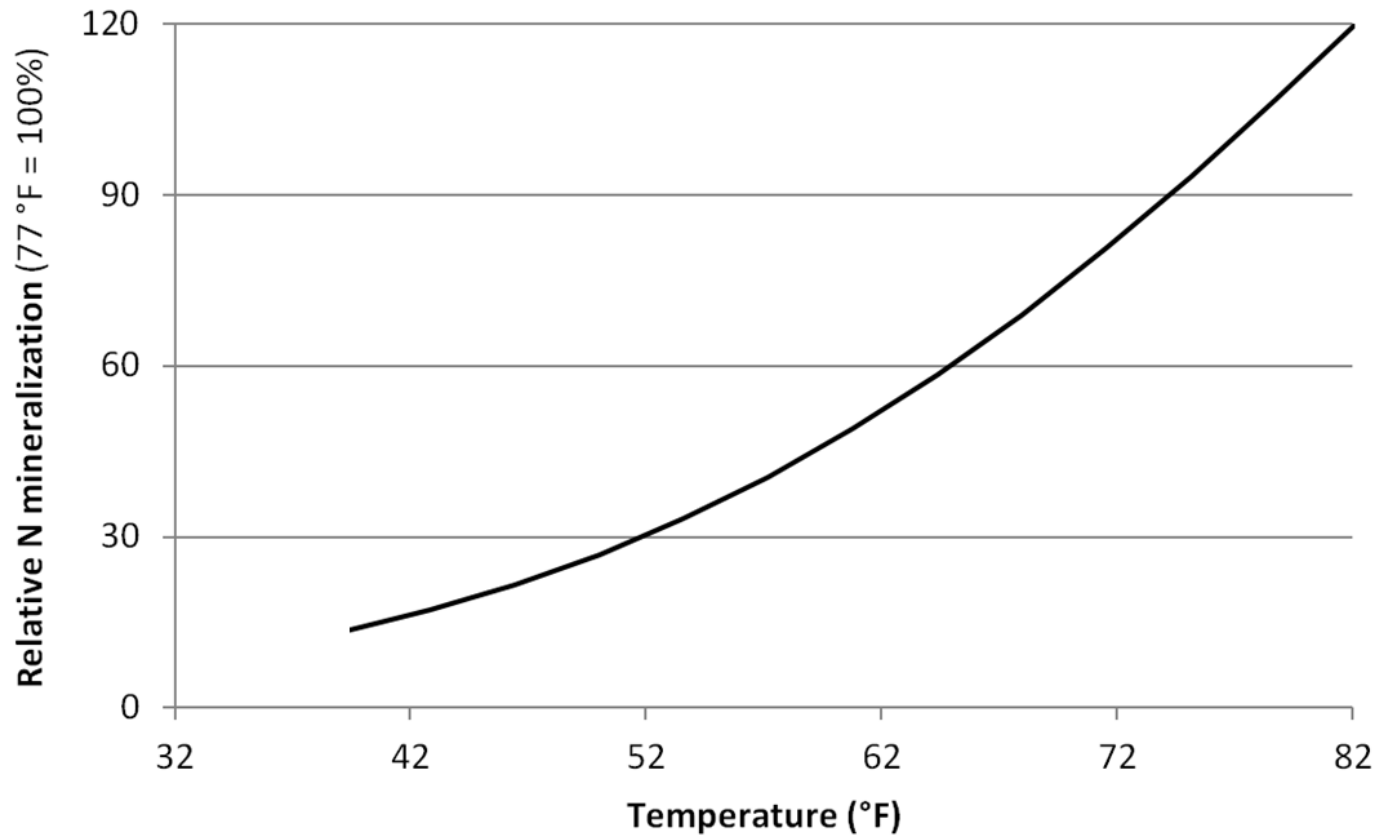


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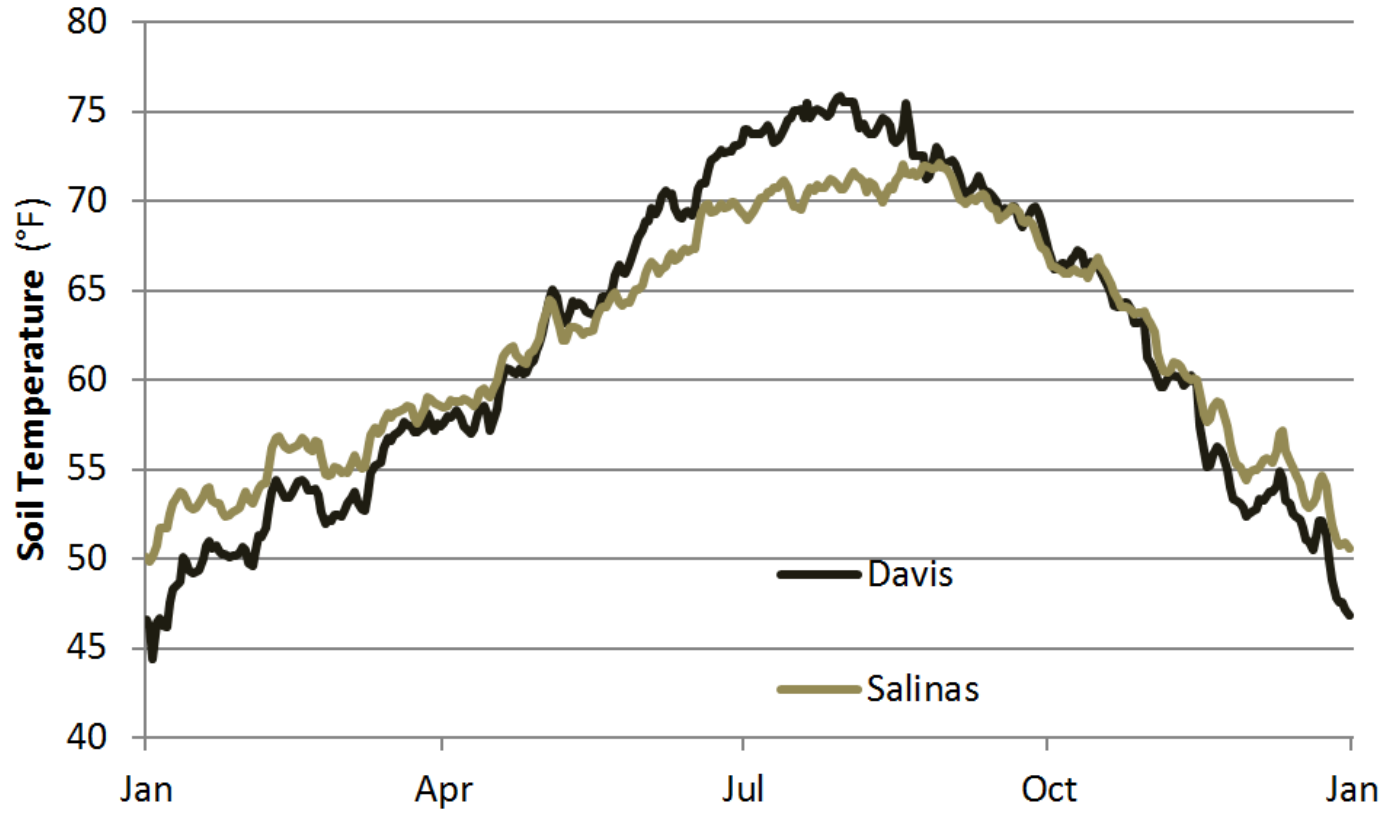
Effect of temperature on N mineralization





Soil temperature

Measured at a depth of 6 inches



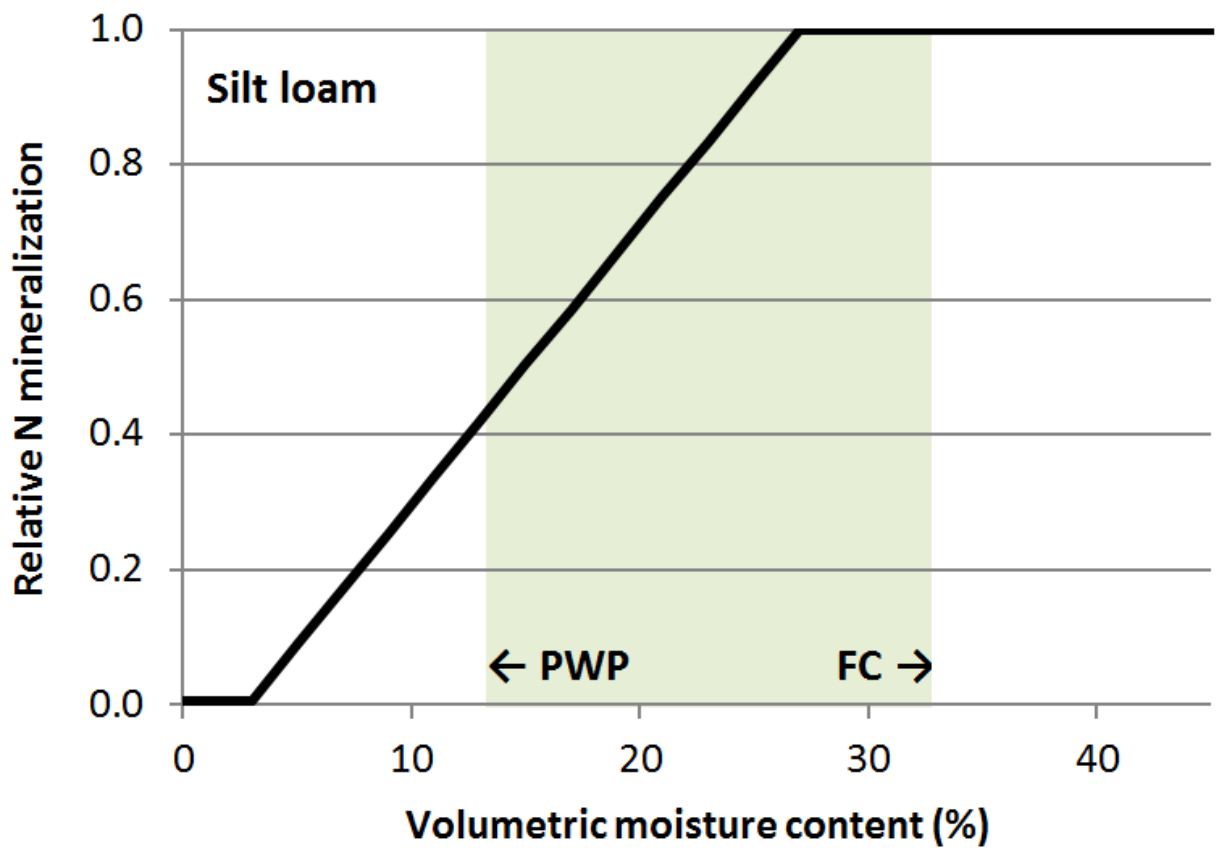


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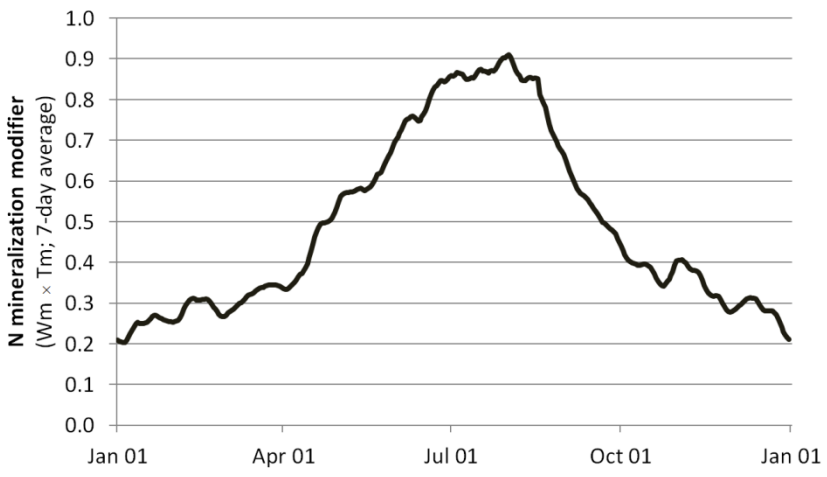
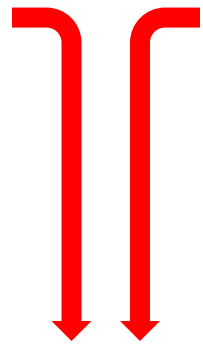
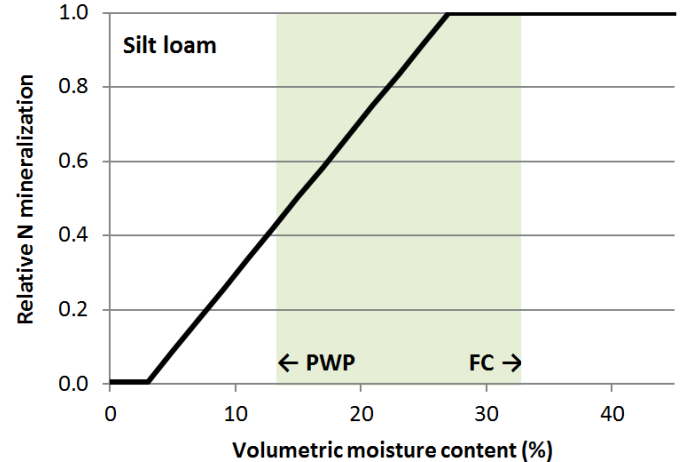
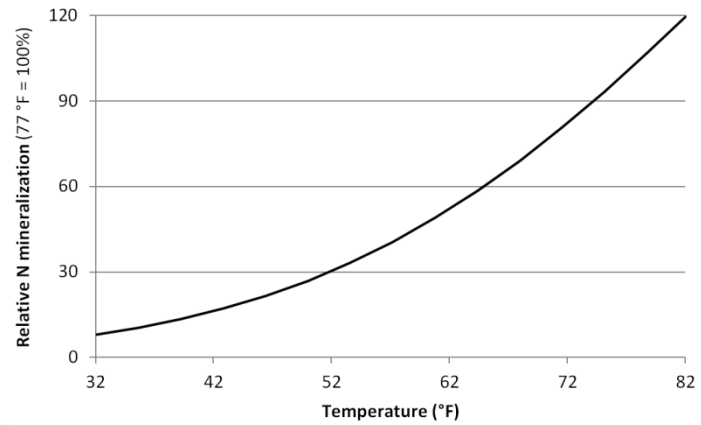


Effect of soil moisture



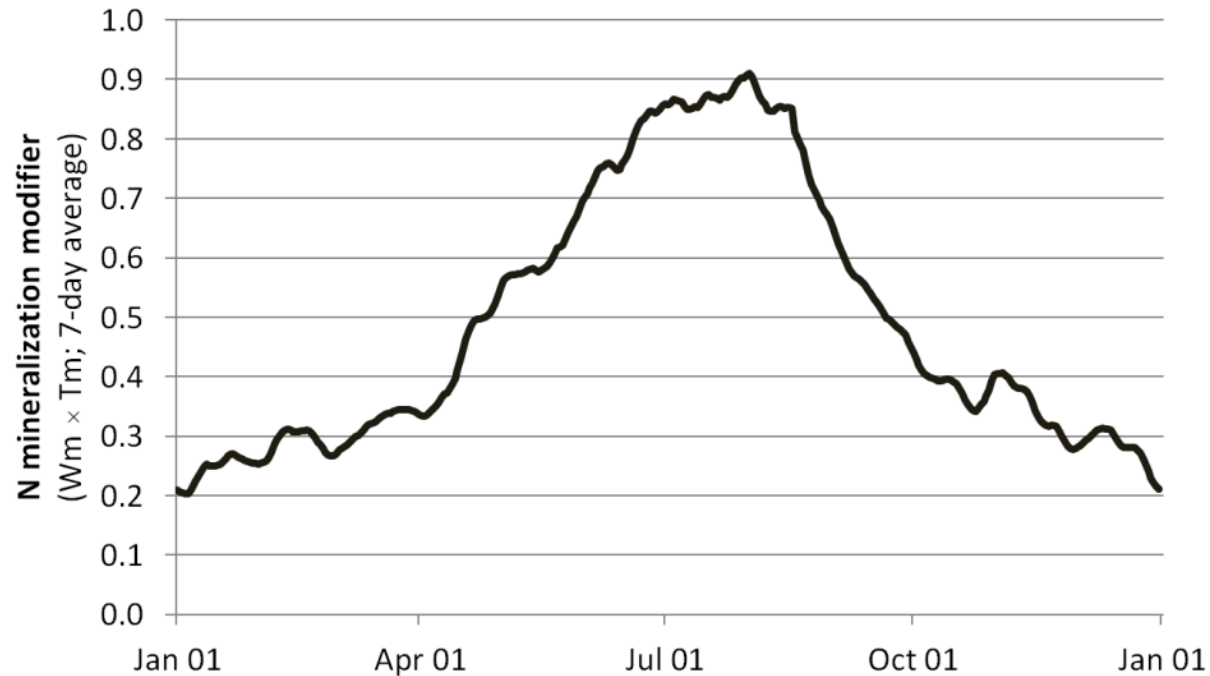


Temperature and moisture effects





Temperature and moisture effects



- Winter, spring: temperature is limiting
- Fall: if the field is fallow, moisture is limiting

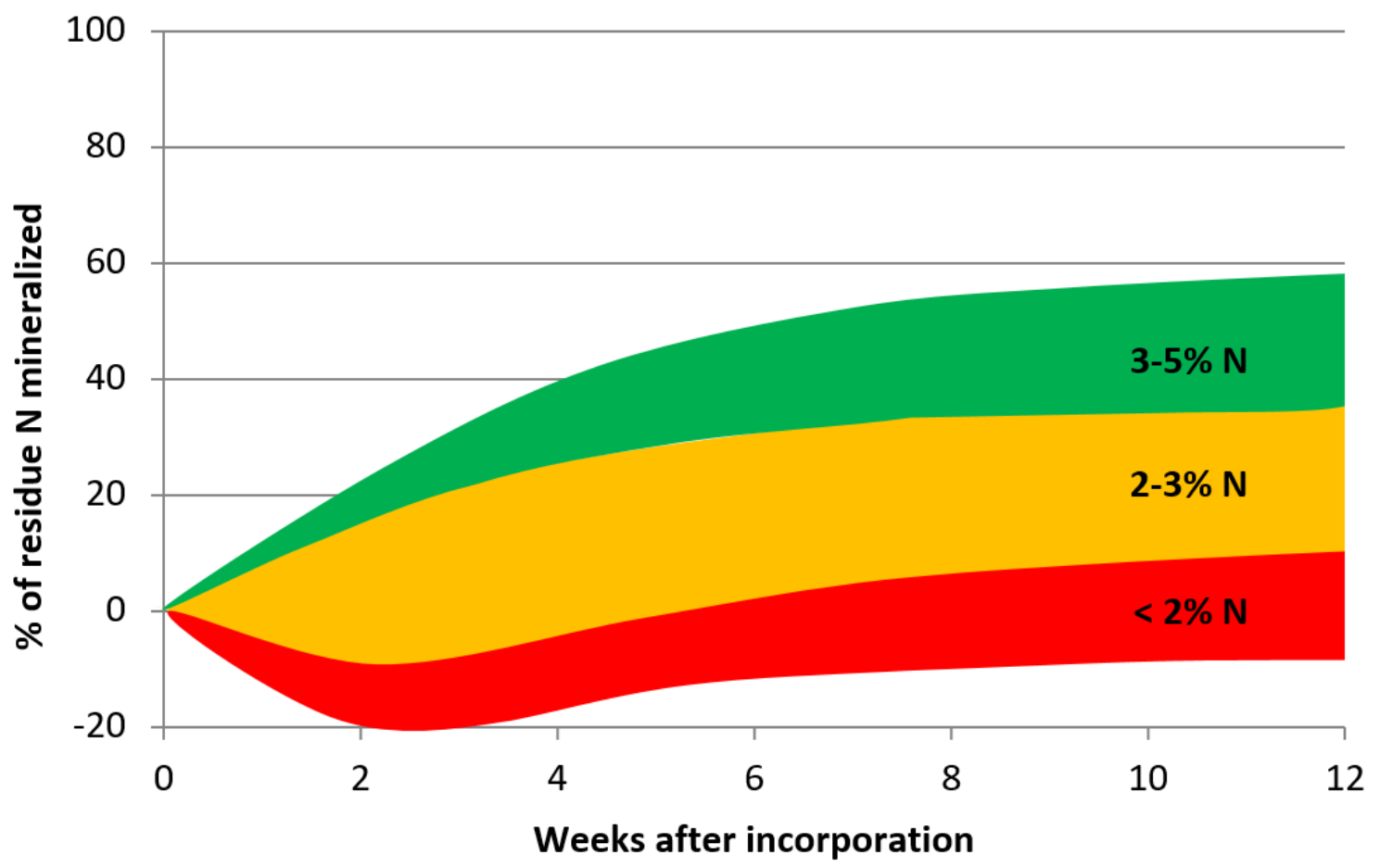


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Factors affecting N mineralization: N content





Nitrogen mineralization

- Soil microorganisms decompose residue
- 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



Net mineralization or immobilization?

- Depends mainly on the C/N ratio of the organic substrate
 - $C/N < 20$: Net mineralization
 - $C/N > 30$: Net immobilization

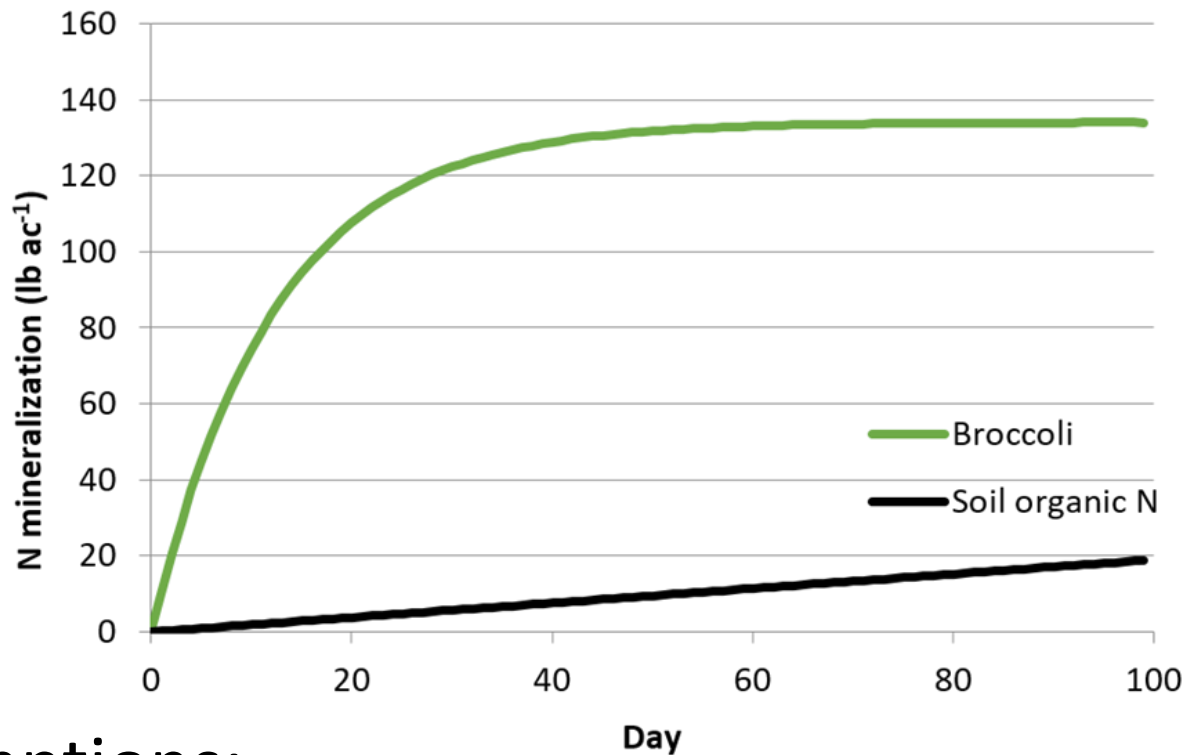


Factors affecting decomposition and N mineralization

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Availability of C and N



Assumptions:

Broccoli: C/N ratio = 10; 210 lb N/acre

Soil organic matter: C/N ratio = 10; 2 % in top foot (3,500 lb N/acre)



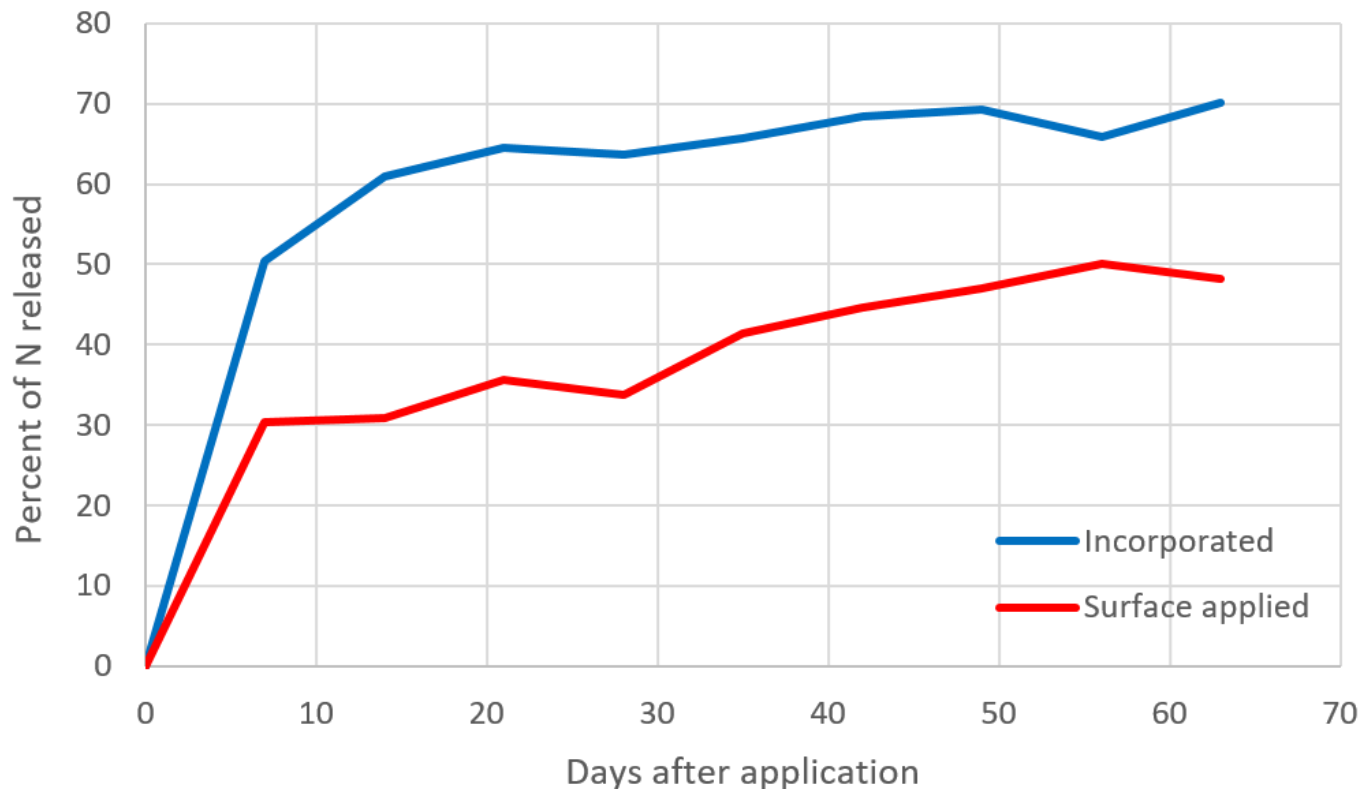
Factors affecting decomposition and N mineralization

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- **Management**



Management effects

Application of a pelleted organic fertilizer
(4-4-2 \Rightarrow 4% N, 4% P_2O_5 , 2% K_2O)





Nitrogen in soil organic matter



Soil with organic matter content of 2%:

⇒ **2 tons N/acre in top foot**

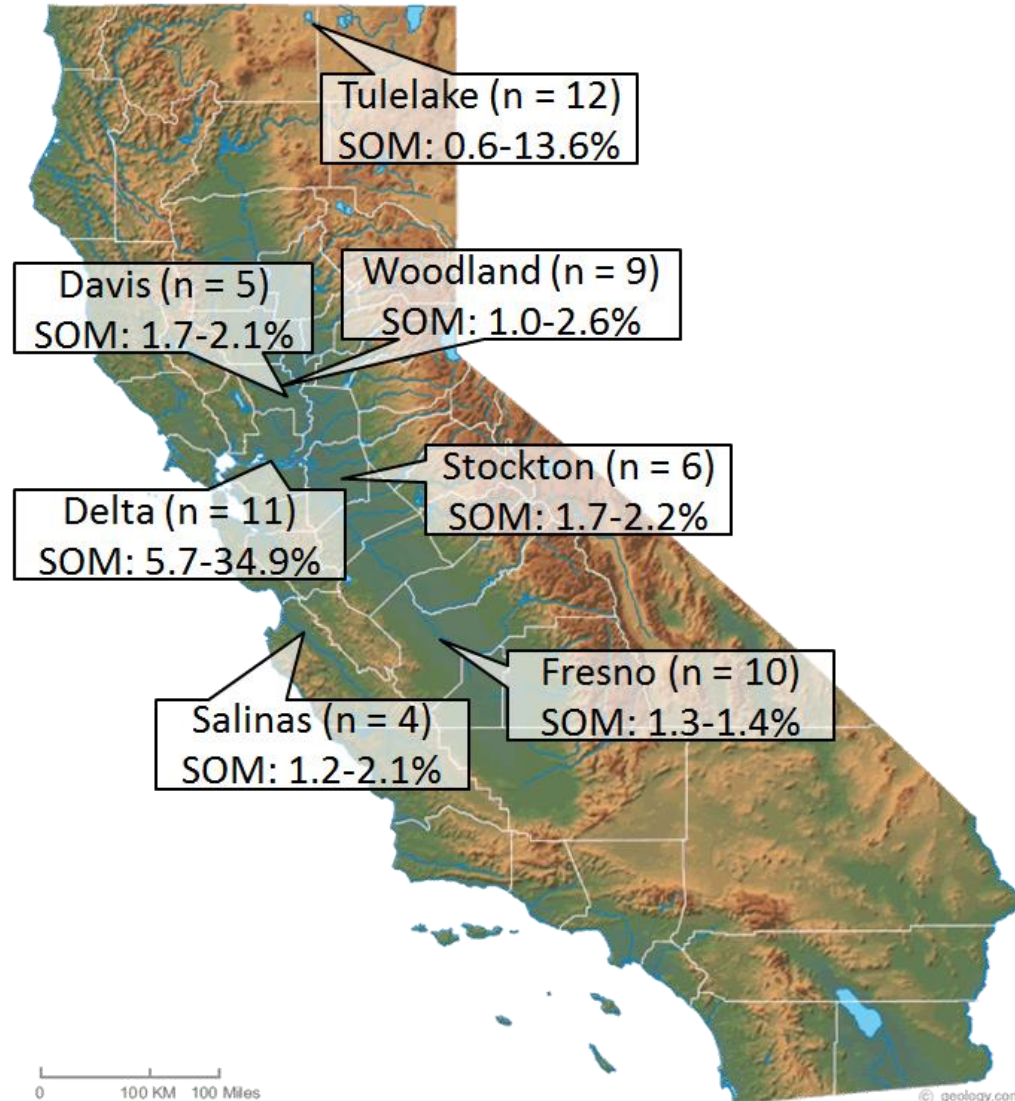


Our study

- Undisturbed soil cores were sampled in spring 2016 and 2017 from 57 fields
- Additional samples for soil analyses were taken right next to the cores
- Cores were kept at optimal moisture content and 41, 59, or 77 °F for 10 weeks
- Increases in ammonium and nitrate during these 10 weeks were determined

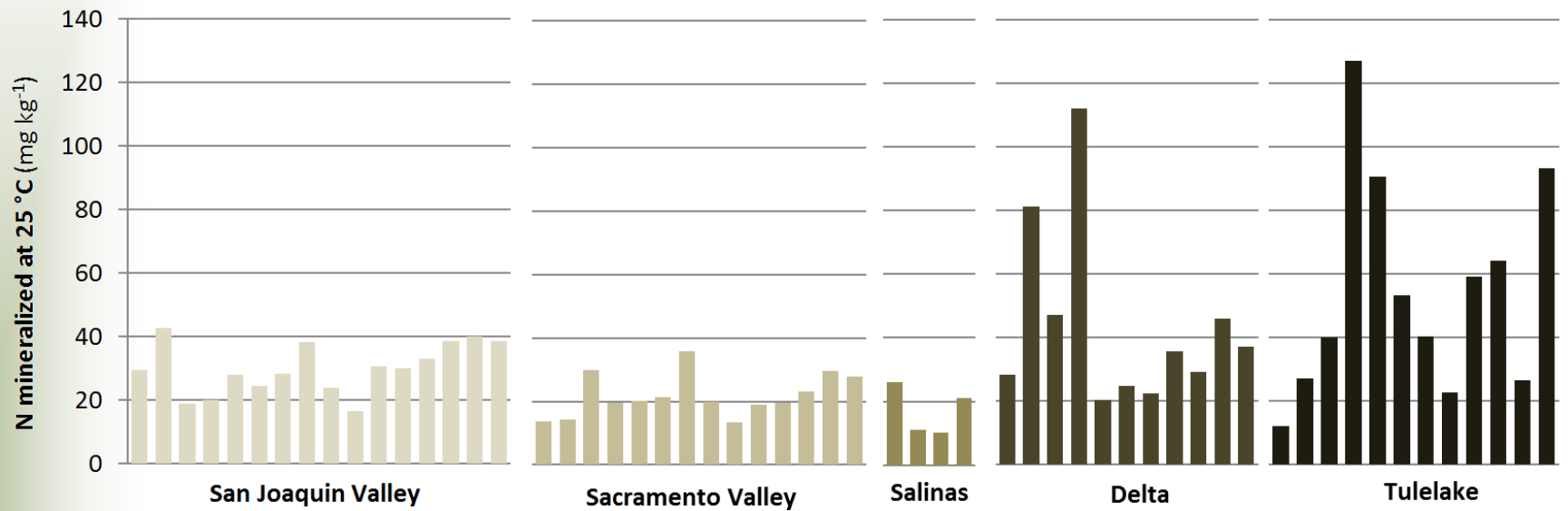


Study locations





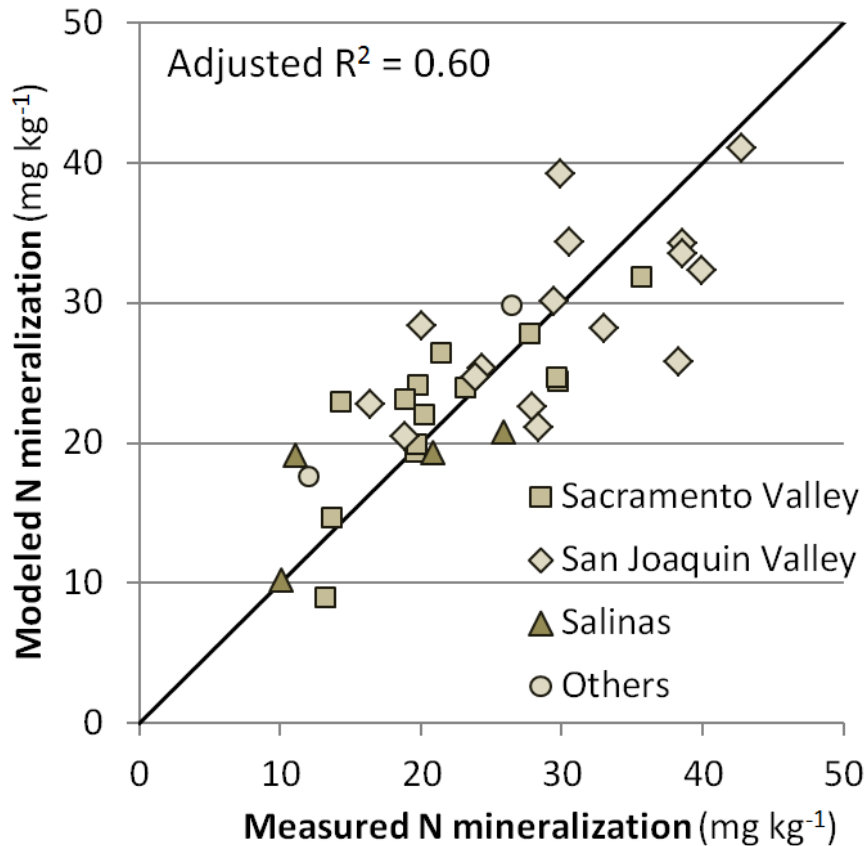
N mineralization rate in undisturbed soil cores



The cores were kept at 77 °F and a soil moisture content near field capacity for 10 weeks



Soil properties and N mineralization: Central Valley, Central Coast soils



Relevant soil
properties:

- Total carbon
- FDA hydrolysis
- Silt



Sources of mineralizable N

- Plant residues
- Roots
- Root exudates
- Degradation of soil organic matter (SOM)
- ~~Organic amendments~~



Organic N inputs to Central Valley soils

N source	lbs N/acre per year
Average annual N input with roots and residues:	70
Rhizodeposition	23
Input with decreasing soil organic matter content:	17
Total organic N input:	70-110

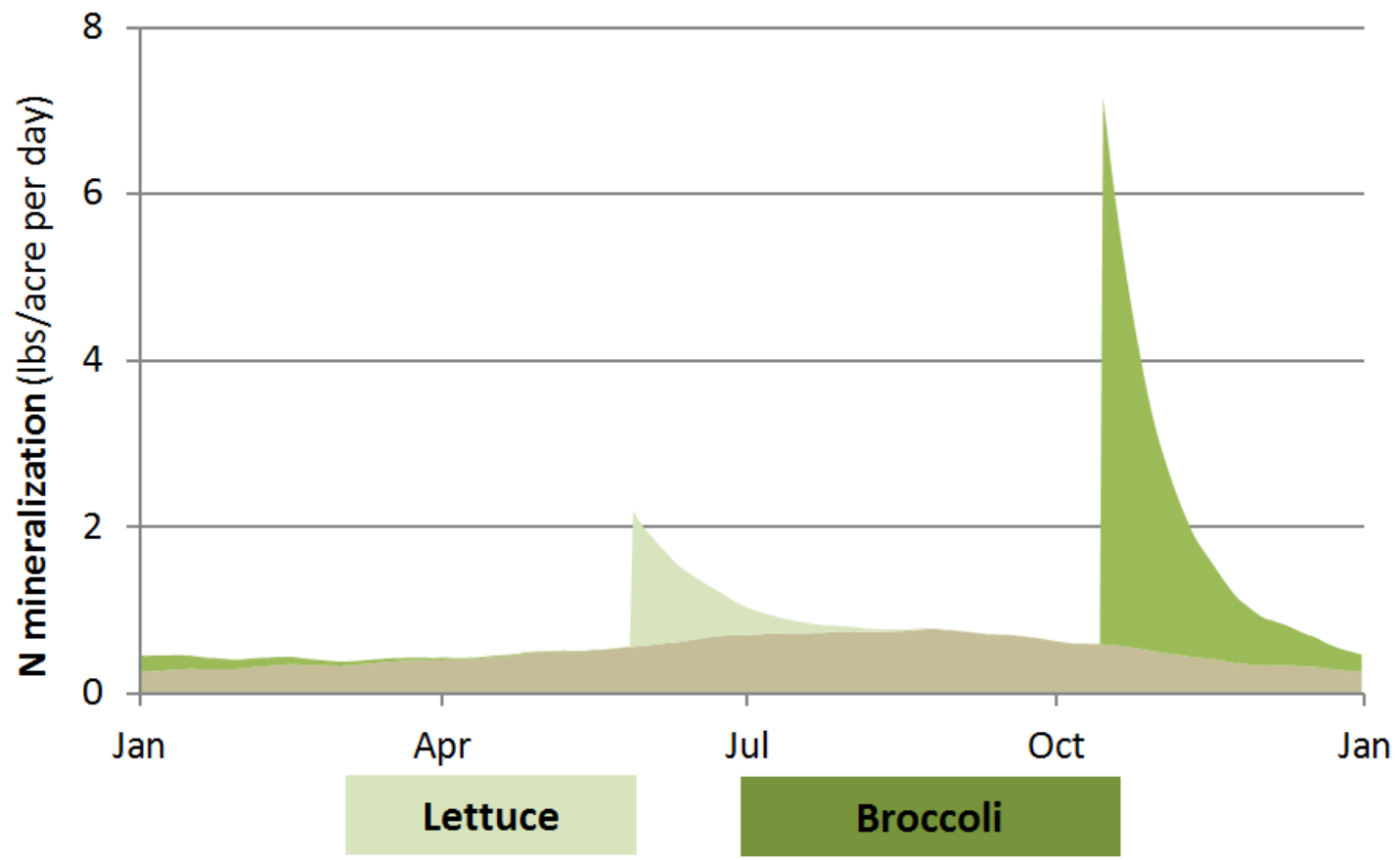


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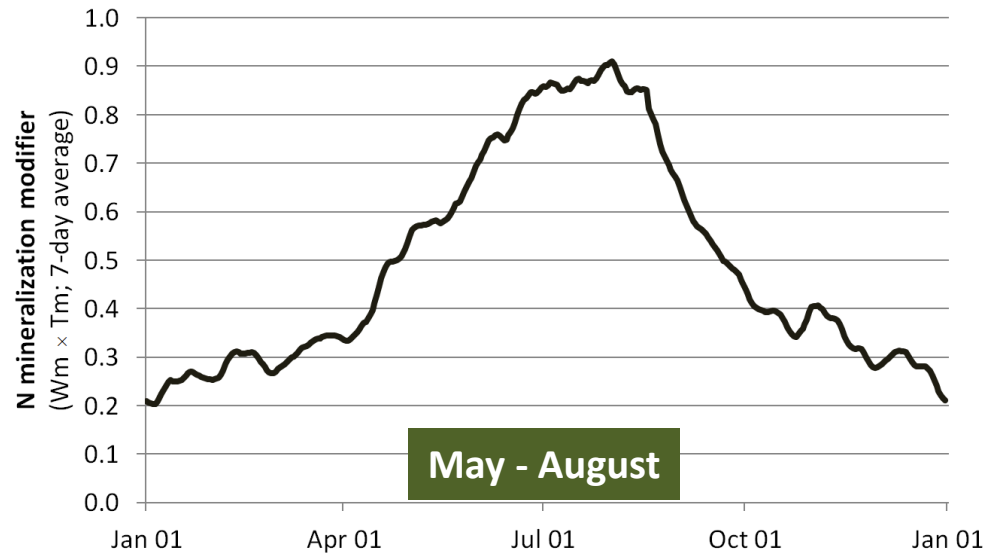


Seasonal N mineralization pattern in Central Coast soil





N mineralization throughout the year



- In the Central Valley, the annual N mineralization likely ranges from 70-110 lbs/acre in fields with no history of legume cover crops and manure applications
- About half of the annual N is mineralized during a 4-month growing season



N mineralization throughout the year

Month	Central Coast		Sacramento Valley		Imperial Valley	
	SOM	1.5%	3.0%	1.5%	3.0%	0.75%
lb N acre ⁻¹ month ⁻¹ (top 12 ")						
January	3	6	2	5	2	3
February	3	6	2	5	2	3
March	4	7	3	6	2	5
April	5	9	4	8	3	6
May	6	11	6	11	4	8
June	6	12	7	14	5	10
July	7	14	9	17	6	12
August	7	15	8	17	6	13
September	7	13	7	14	5	10
October	6	11	5	11	4	8
November	4	8	3	7	3	5
December	3	6	2	5	2	4