

The Importance of Mineralization in Supplying Plant Available Nitrogen and Sulfur in Prairie Soils

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Organic Matter is the Main Storehouse of
Nitrogen (N) and **Sulfur (S)** in Soil!
Important in some soils for **Phosphorus (P)**



- Must be **mineralized** to be plant
usable!

What is mineralization?

- Conversion of organically bound nitrogen and sulfur (plant unavailable) to inorganic nitrogen (ammonium and nitrate) and sulfur (sulfate) that plant roots can absorb.

Organic N -----> ammonium, nitrate

Organic S -----> sulfate

**Estimates of typical growing season
contribution of N mineralization in
top 15 cm of prairie soil:**

**15 to 50 + lbs of N/acre
of available N released through
N mineralization in a growing season**

About 1% to 3% of organic sulfur is mineralized to plant available sulfate in a growing season.



IN PRAIRIE SOIL *5 to 15 lb S / acre made available this way.*

HIGH Soil O.M. Content = HIGH Mineralization



Spatial Influences on N Mineralization

Soil Zones

Soils with higher O.M. have greater N min.

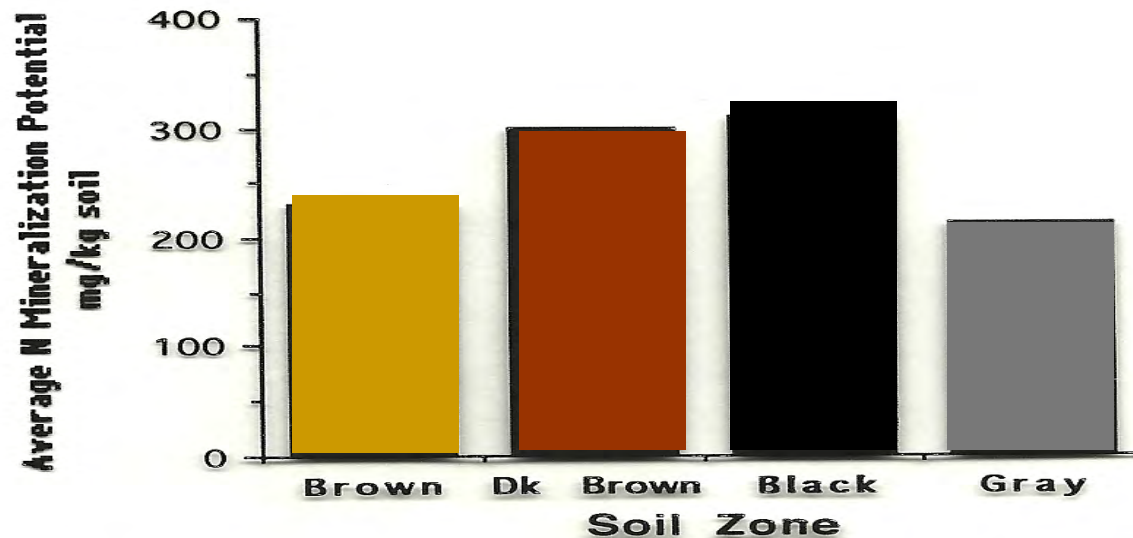


Fig.1. Average mineralization potential (No) of N in soil zones (Roberts, 1985).

Landscape Position

- N mineralization contribution greater in footslopes than shoulders, as long as not flooded. More OM, moisture.

Brown Chernozem undulating fallow field

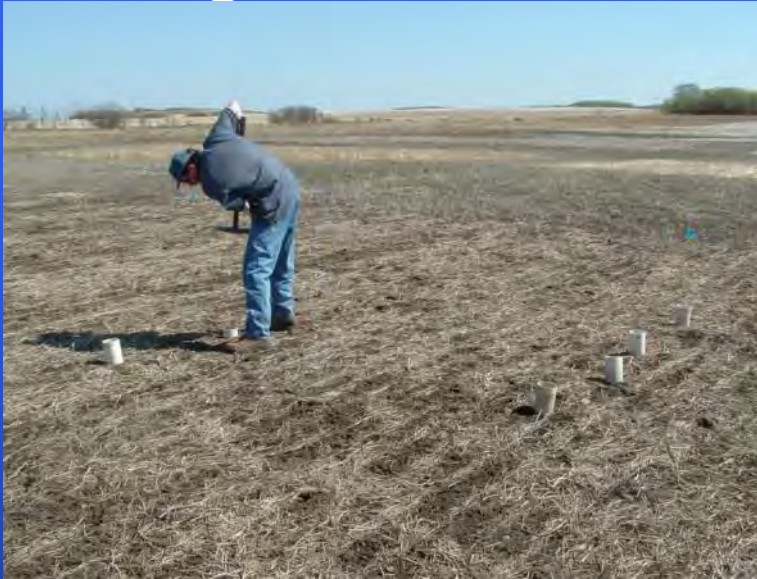


	Organic N %	H ₂ O %	N Gain Spring-Fall lbs NO ₃ -N/ac 0-15 cm
<i>Shoulders</i>	0.149	9	3
<i>Footslopes</i>	0.170	12	26

Management Influences on N Mineralization

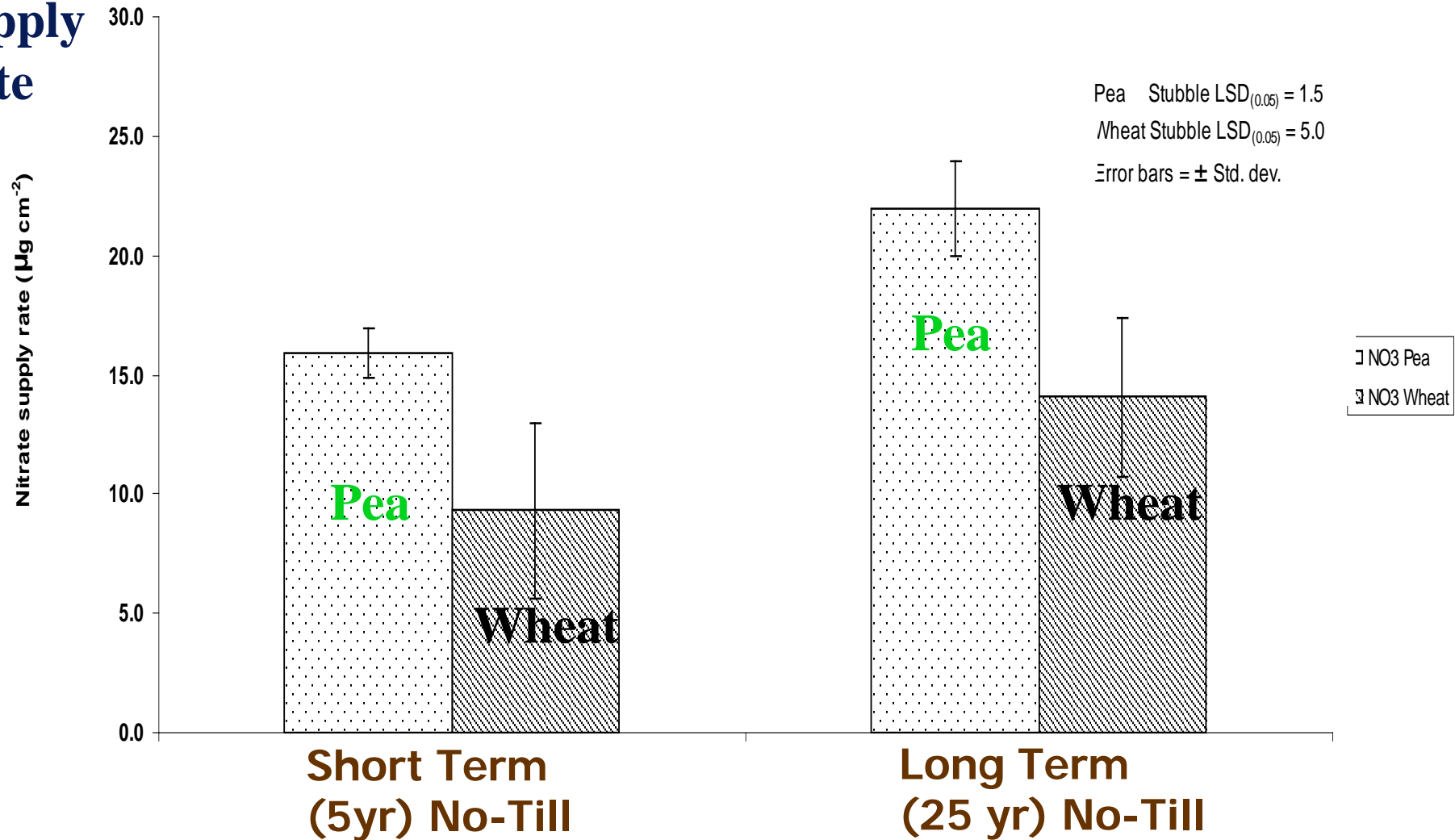
Rotation/Tillage

Legumes in rotation, zero-till enhances N mineralization



Available Nitrogen (Nitrate) Supply Rate From Mineralization At Indian Head AAFC

**NO₃
Supply
Rate**



Long-Term Cropping System

Indian Head AAFC (Black Chernozem)

Hot KCl Ammonium (Active Fraction)

mg N/kg

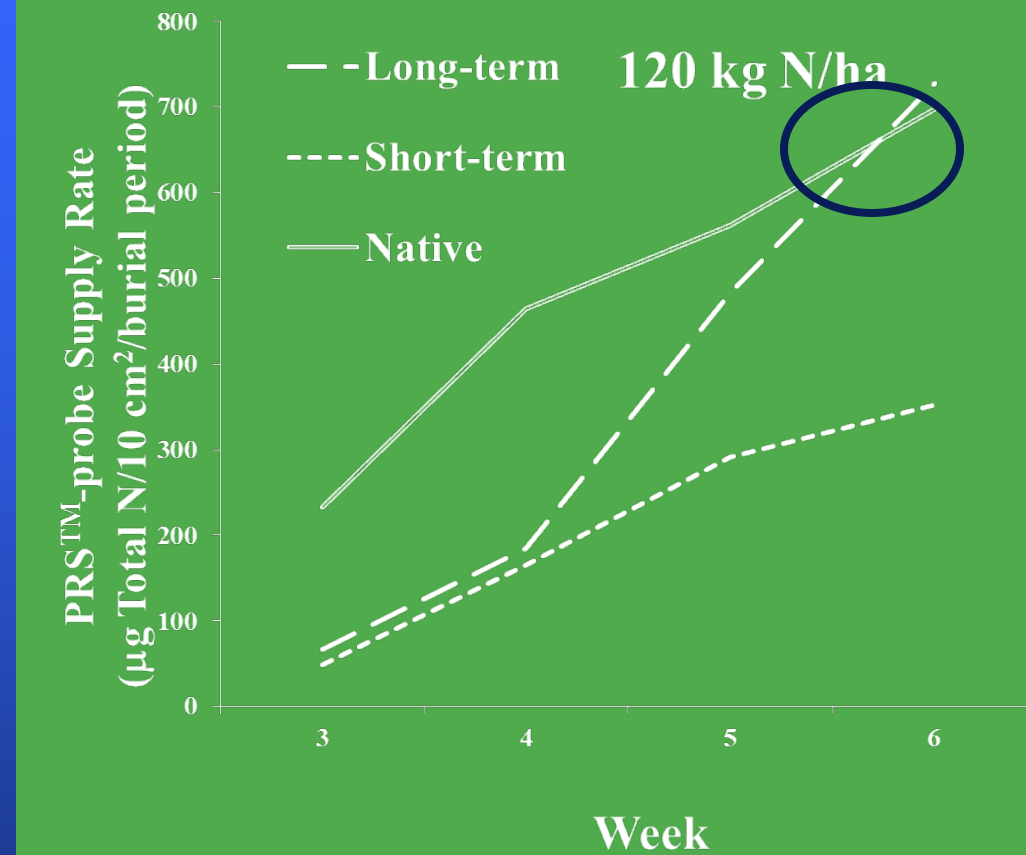
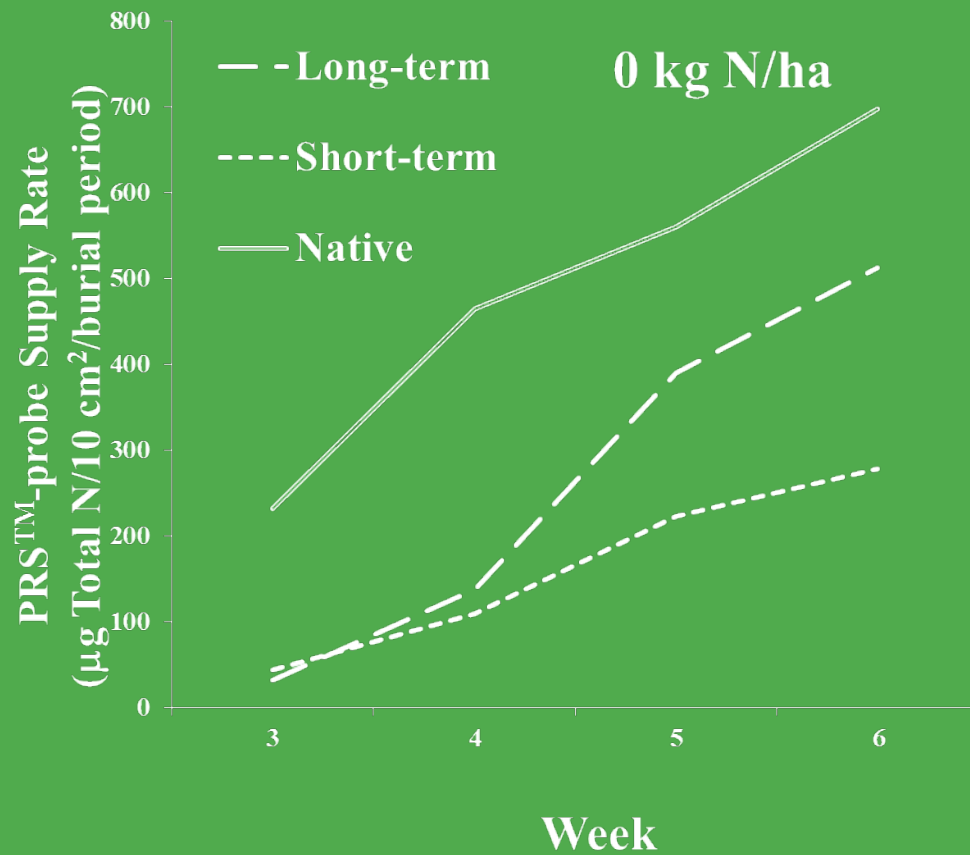
Fallow-Wheat	8.1
Continuous Wheat	10.1
Green Manure-Wheat	13.4

Fertilization

Long term use of N fertilizer at recommended rates contributes to **build-up of N supply power** by mineralization

Swift Current AAFC (Brown Chernozem)

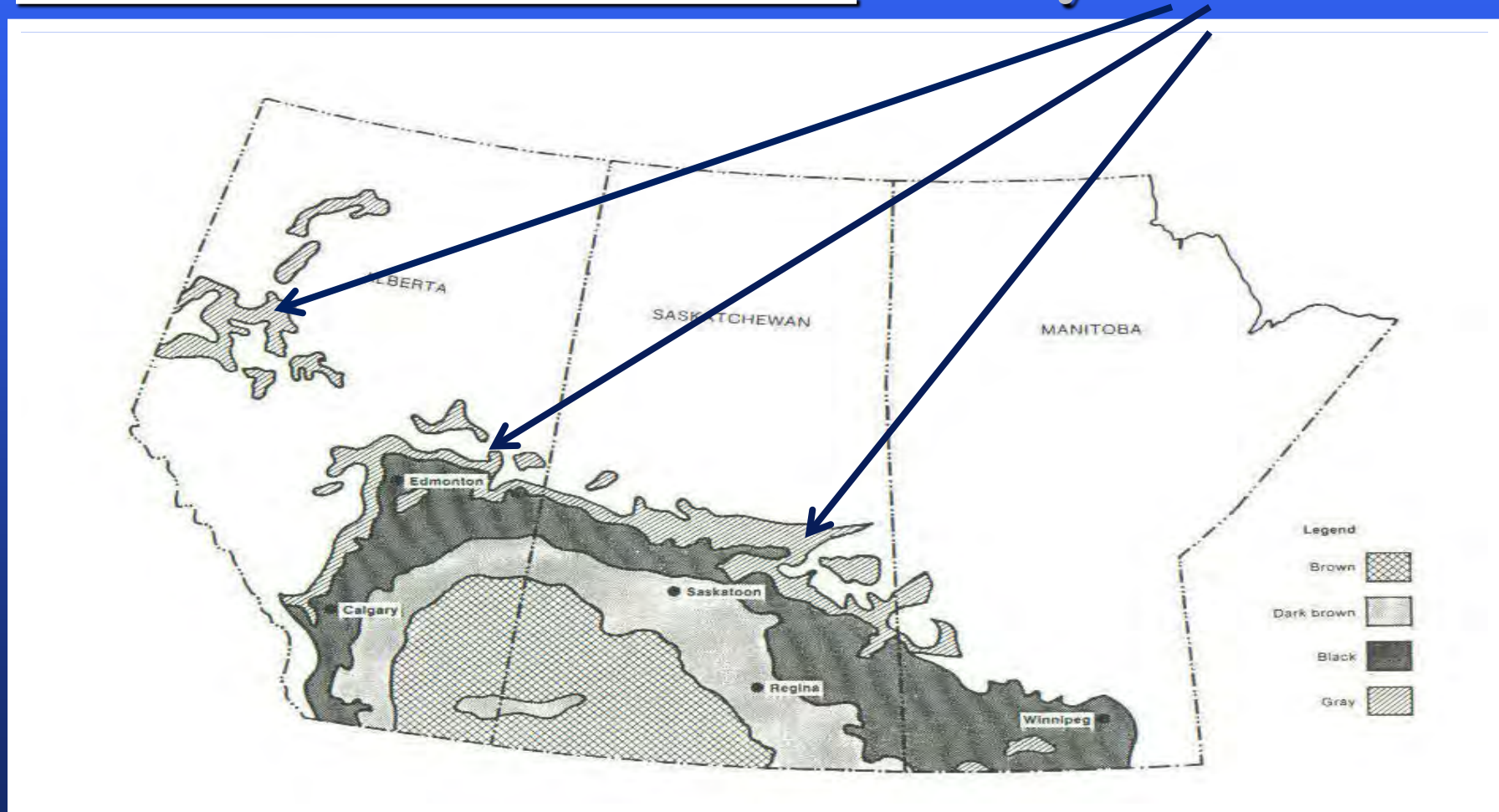
	Org N %	Hot KCl mgN/kg	Supply Rate ugN/cm ²	Plant Uptake mgN/pot
Cont. Wheat N&P	0.22	16.8	76	16.5
Cont. Wheat P only	0.20	14.5	70	14.0



Available N (Nitrate + Ammonium) Supply Rates in Long Term (32 yrs) and Short-Term (10 yrs) No-Till receiving different rates of N fertilizer for last 10 years at Indian Head (Hangs et al. 2012)

Gray soils have organic sulfur that is rather resistant to decomposition:

Low S mineralization rates in Gray Luvisol soils.



How to assess mineralization?

Predictive Models

- **Humus contribution:** make prediction of N mineralization based on **soil organic matter content, soil zone**

Example: 0-15 cm 5% OM soil contains 0.25% total N

0.25% total N = 2500 ug N / g soil. Assume 1% is mineralized over growing season = 25 ug N/g of soil = **50 lbs N/acre**



■ **Crop stubble**: prediction based on **previous crop**

Example N credit for legume:

1 lb N/acre for every bushel per acre of pea yield



■ Organic amendments:

prediction based on **C:N, C:S ratio**

Example

N release from solid manure and compost:

*C:N > 15-20, C:S > 200:1 means **limited available nutrient release over short-term***



prediction based on **amendment type**

N release from liquid swine manure organic N:

20-30% of organic N mineralized in year of application

Cattle manure: 10% to 50% of organic N mineralized.

2012: My canola yield was reduced by aster yellows, sclerotinia, hail, wind shattering. Not much crop removal. Will I get some nutrient back in 2013?



- Some of N in straw/seed will recycle into available forms next year, much of S and P, all of K.

Direct Measurement

■ Mineralization indices

Measure “active fraction” of organic matter through chemical hydrolysis

e.g. Hot KCl, Mulvaney or “Illinois” test

Measure short-term ammonium and nitrate release rate

e.g. PRSTM 24 hour sorbed nitrate and ammonium.





What you actually see depends on weather in the upcoming season!

Conclusion

- Contribution, impact of mineralization is significant and variable!

Not easy to measure or predict!

Should always be considered!

Thanks for your attention!

