Nitrogen Mineralization Rates & Leaching

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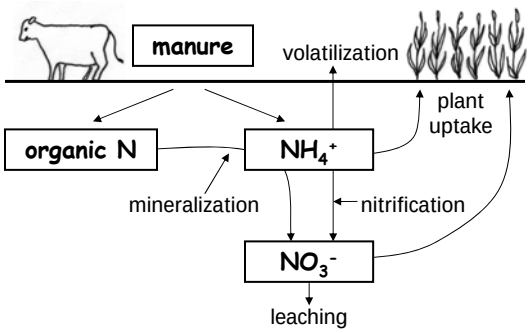
Abbreviated Nitrogen Cycle



Poor predictability of PAN due to wide variations in the concentrations of N forms in biosolids (PA, 1993-1997)

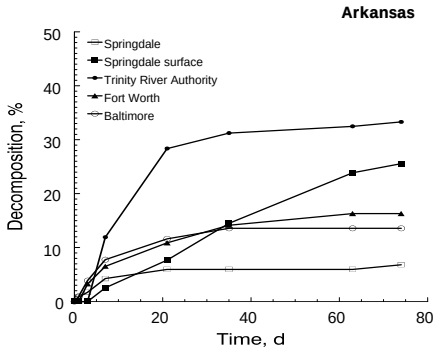
Nutrient	Total N[b]	NH_4 N	Organic N	Total P	Total K
	----------%----------				
Mean	4.74	0.57	4.13	2.27	0.31
Variability[c]	1.08	0.30	1.03	0.89	0.27

[a] Concentrations are on a dried solids basis.
[b] Determined as total Kjeldahl nitrogen.
[c] Standard deviation of the mean.

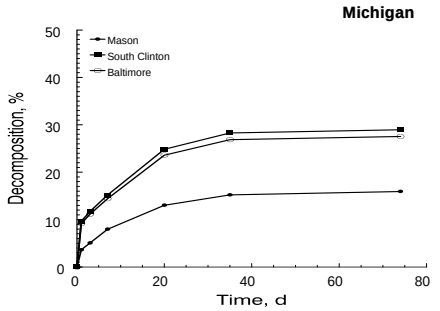
Stehouwer, R.C., A.M. Wolf, and W.T. Doty. 2000. Chemical monitoring of sewage sludge in Pennsylvania: Variability and application uncertainty. J. Environ. Qual. 29:1686-1695.

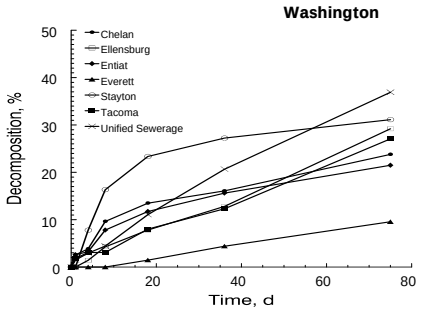
How is N mineralization rate calculated?

- Laboratory incubation to calculate organic matter decomposition
- Greenhouse and field bioassay studies to calculate PAN
- Modeling (*Decomposition* – Gilmour and Clark, 1988)
- Combination of all above



Laboratory incubation decomposition studies:
Mean biosolids decomposition = 24±5%

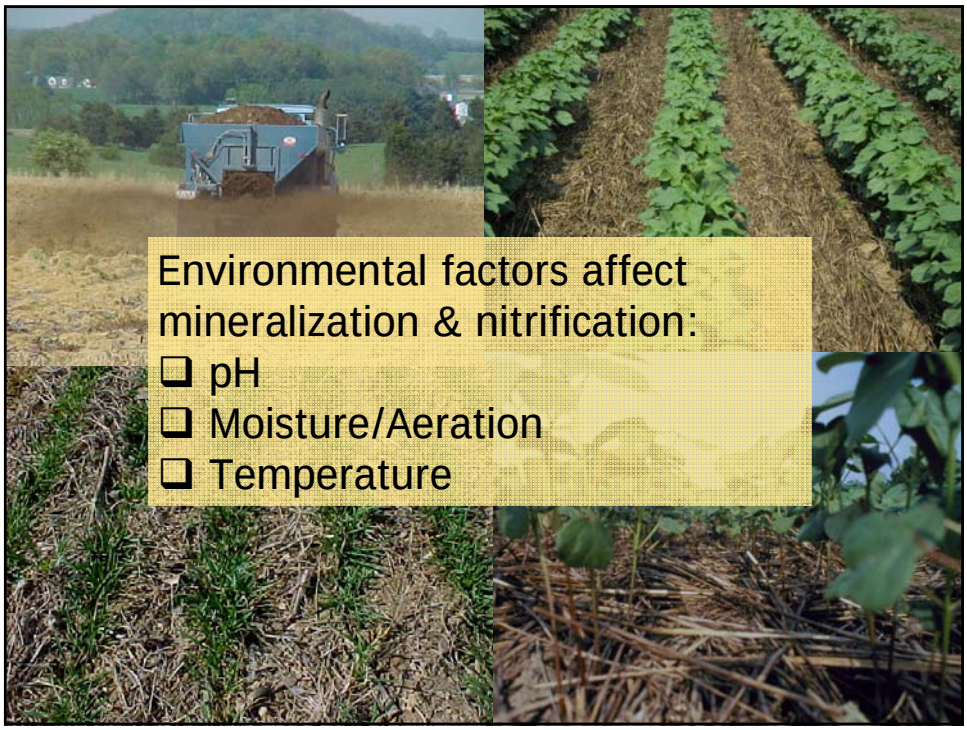




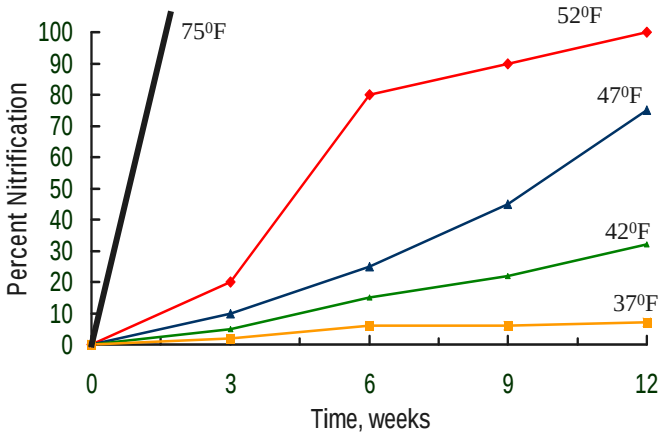
Estimating N mineralization and PAN via calibrated plant N uptake

Organic N Mineralization Rates Recommended by EPA

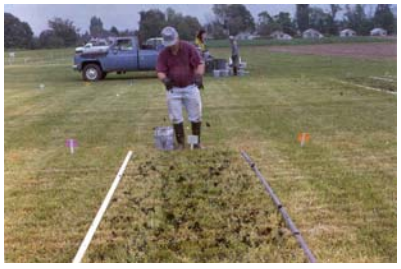
Treatment	Yr 1	Yr 2	Yr 3
Lime Stabilized	0.30	0.15	0.08
Aerobically Digested	0.30	0.15	0.08
Anaerobically Digested	0.20	0.10	0.05
Composted	0.10	0.05	0.03

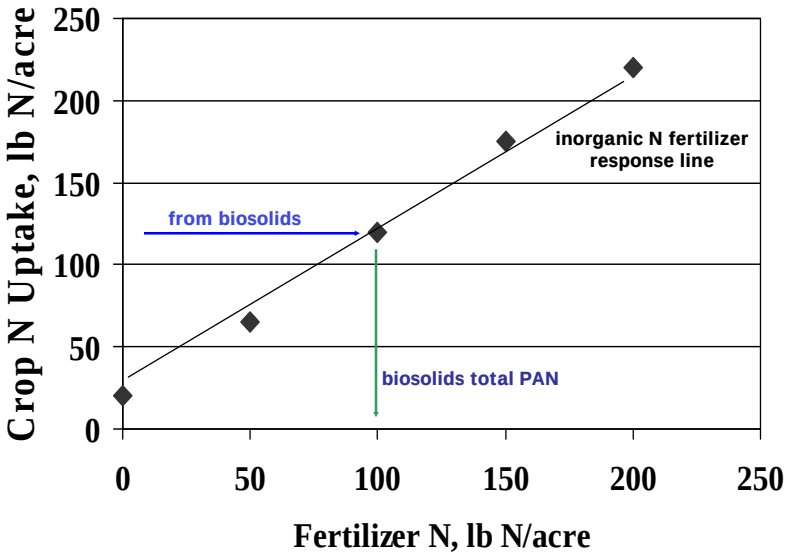


Nitrification rate increases with soil temperature.

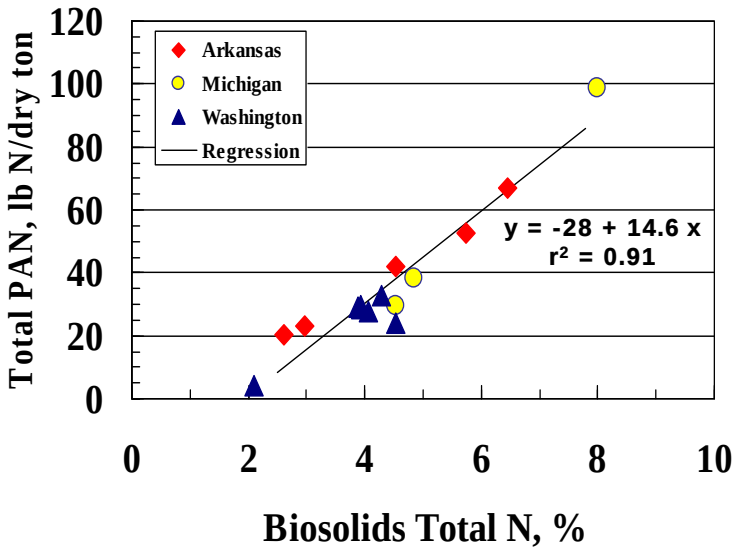


Estimation of mineralization rate using field studies to calculate fertilizer N equivalent

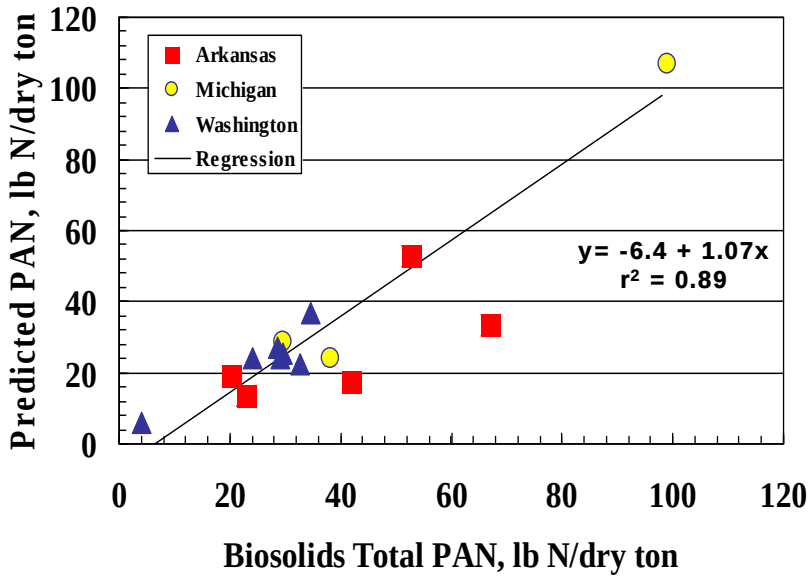




Biosolids total PAN during the growing season was directly related to biosolids total N content.



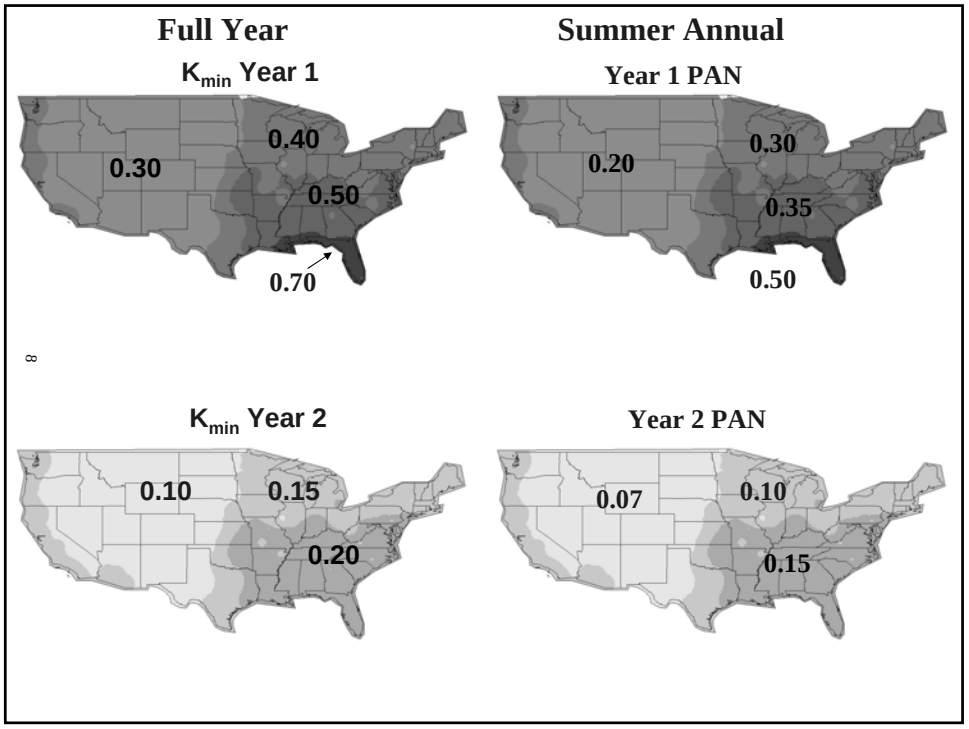
Decomposition model (Gilmour and Clark, 1988) predicted PAN accurately.



Summary

PAN can be estimated using a constant mineralization factor for a *given location* plus *actual biosolids analytical data*.

Exceptions are biosolids which have been stabilized by *composting or lagoon storage,* which contain very stable C forms.



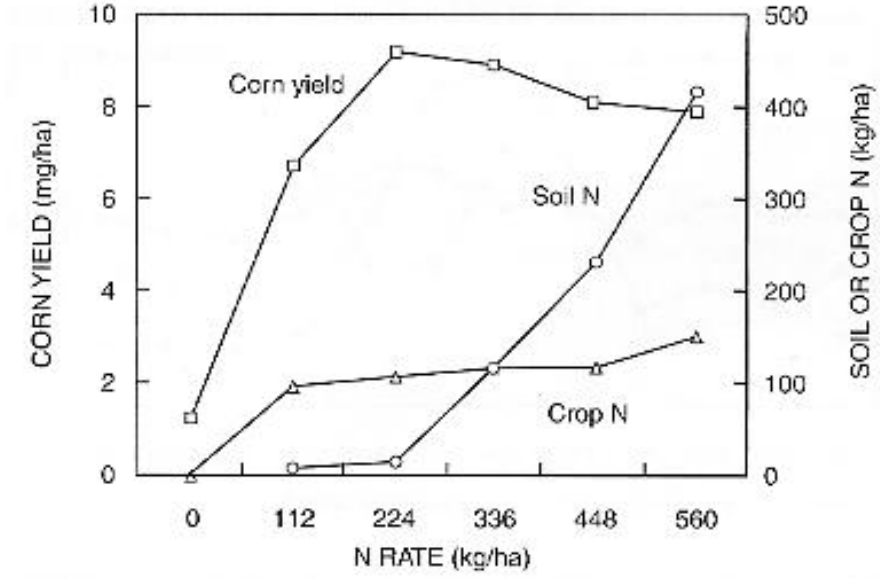
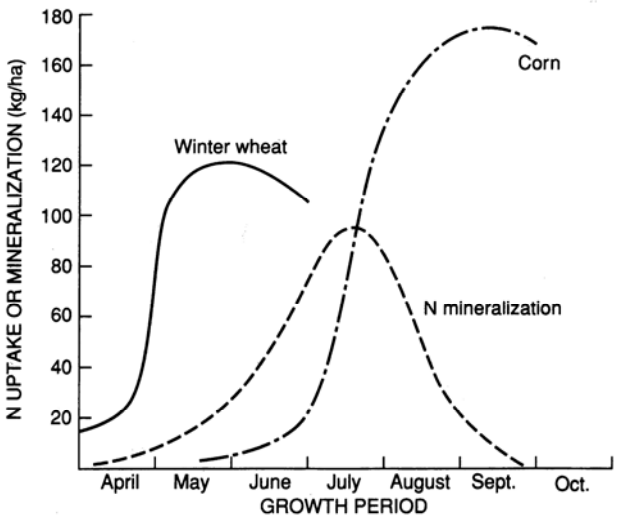
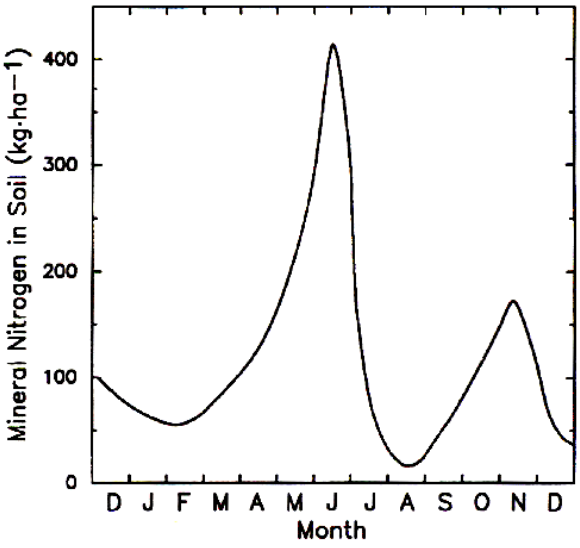


Figure 4-25 Typical relationship between N rate, crop yield, and N accumulation in the soil profile.

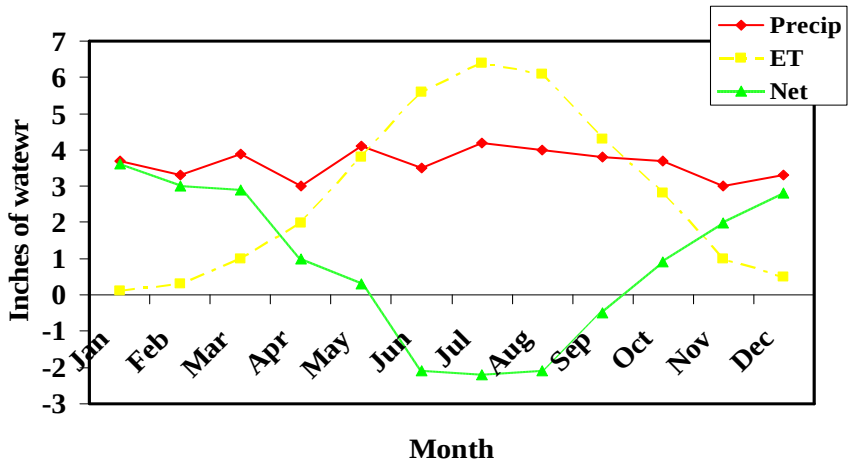
Non-synchrony between soil N mineralization and crop N uptake (Havlin et al., 1999)



Soil nitrate-N (surface 90 cm) under N-fertilized corn (Simon et al., 1988) available for winter leaching.



PPTN>E-T during late fall to mid spring (weather station data from Virginia).

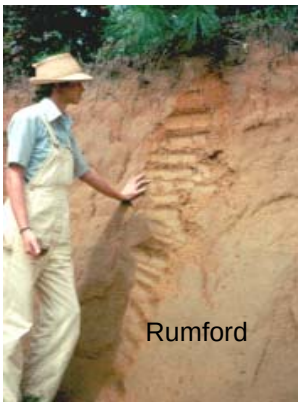


Biosolids Application Timing and Soil Texture Affect Leaching

Evanylo. 2003. Effects of biosolids application timing and soil texture on N availability for corn. CSSPA 34:125-143.

- Biosolids were commonly applied to coarse-textured soils in winter for spring N needs.
- Leaching was a concern due to low plant N uptake and pptn >> ET.
- Biosolids application & rate timing study made to soils of varying hydrologic soil groups.

Typical profiles of Rumford, Bojac, and Pamunkey soil series



Coarse-loamy, siliceous, subactive, thermic Typic Hapludults

HSG A: Ksat>10 in/hr

Coarse-loamy, mixed, semiactive, thermic Typic Hapludults

HSG B: Ksat=4-10 in/hr

Fine-loamy, mixed, semiactive, thermic Ultic Hapludalfs

HSG B: Ksat<4 in/hr

Environmentally Sensitive Sites for Excessive Leaching

- High leaching potential soils (based on soil texture or excessive drainage)
- Karst terrain (fractured limestone)
- Subsurface tile drains
- High lateral flow potential soils (based on texture and drainage)

Summary

- Mineralization rate is a gross estimate based on organic amendment composition and climatic region.
- Excessive N leaching occurs when:
  - PAN is inaccurately calculated
  - Amendment application is mistimed
  - Extra N remains in the soil after crop uptake
  - Amendment is applied to sensitive sites