Nutrient Sources, are not all Equal

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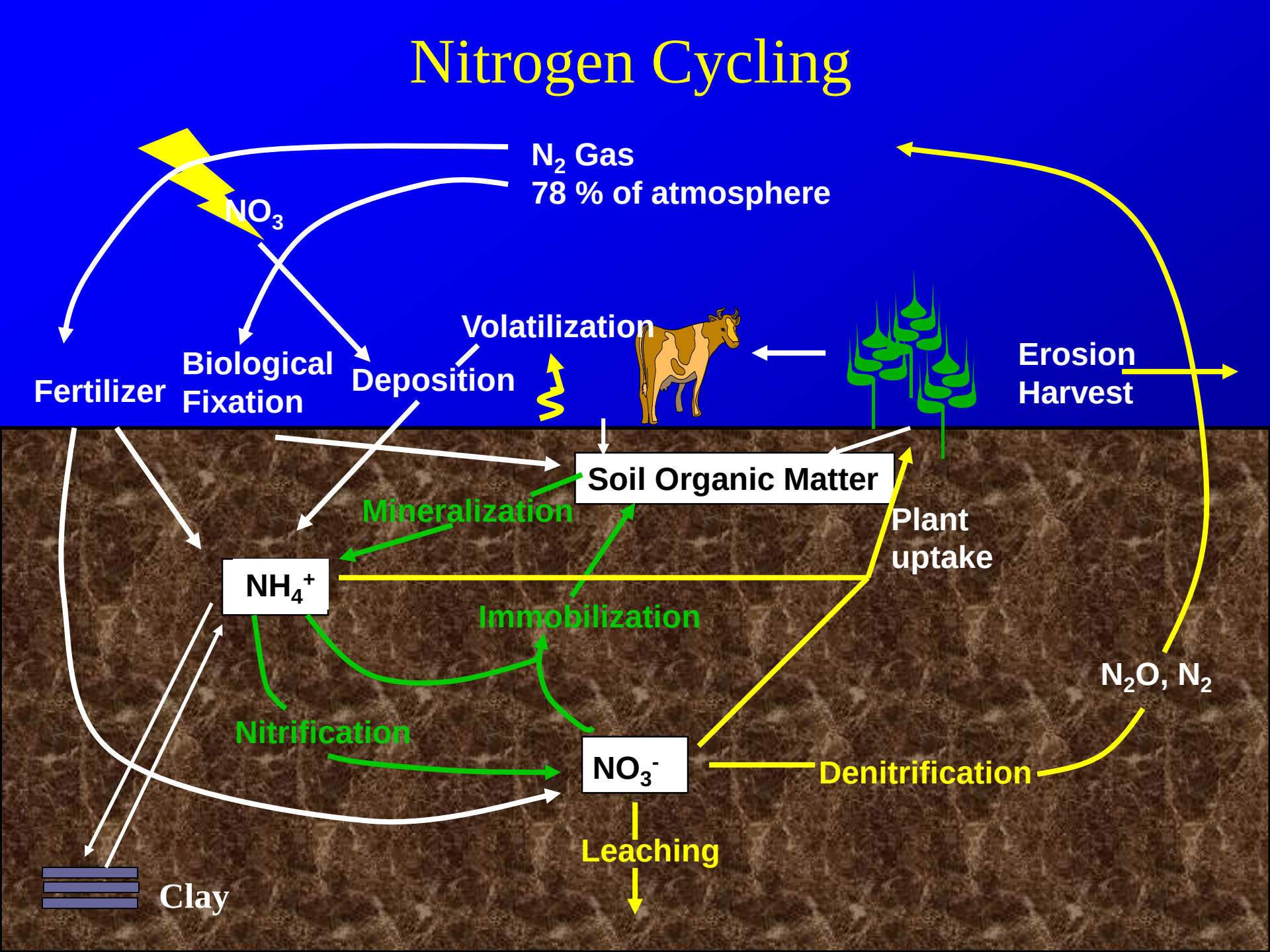
Managing Organic Sources of Nutrients

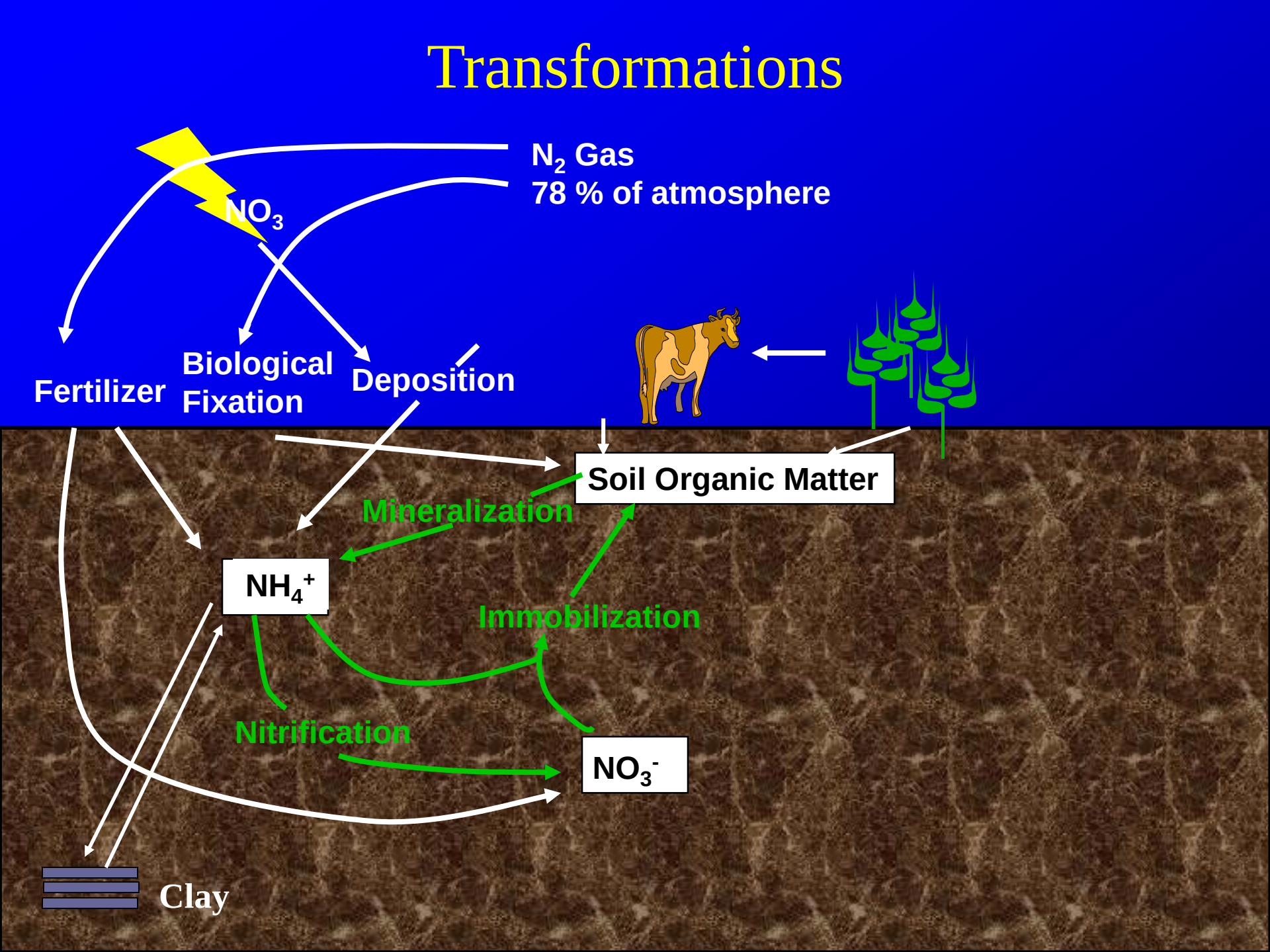
- Organic forms of nitrogen aregenerally not plant available

- Need an understanding of if, and how much plant available nitrogen will be released
- Need an understanding of when the nitrogen will be released so that we can best time the release to when the crop requires nitrogen and avoid times when nitrogen could be lost from the soil

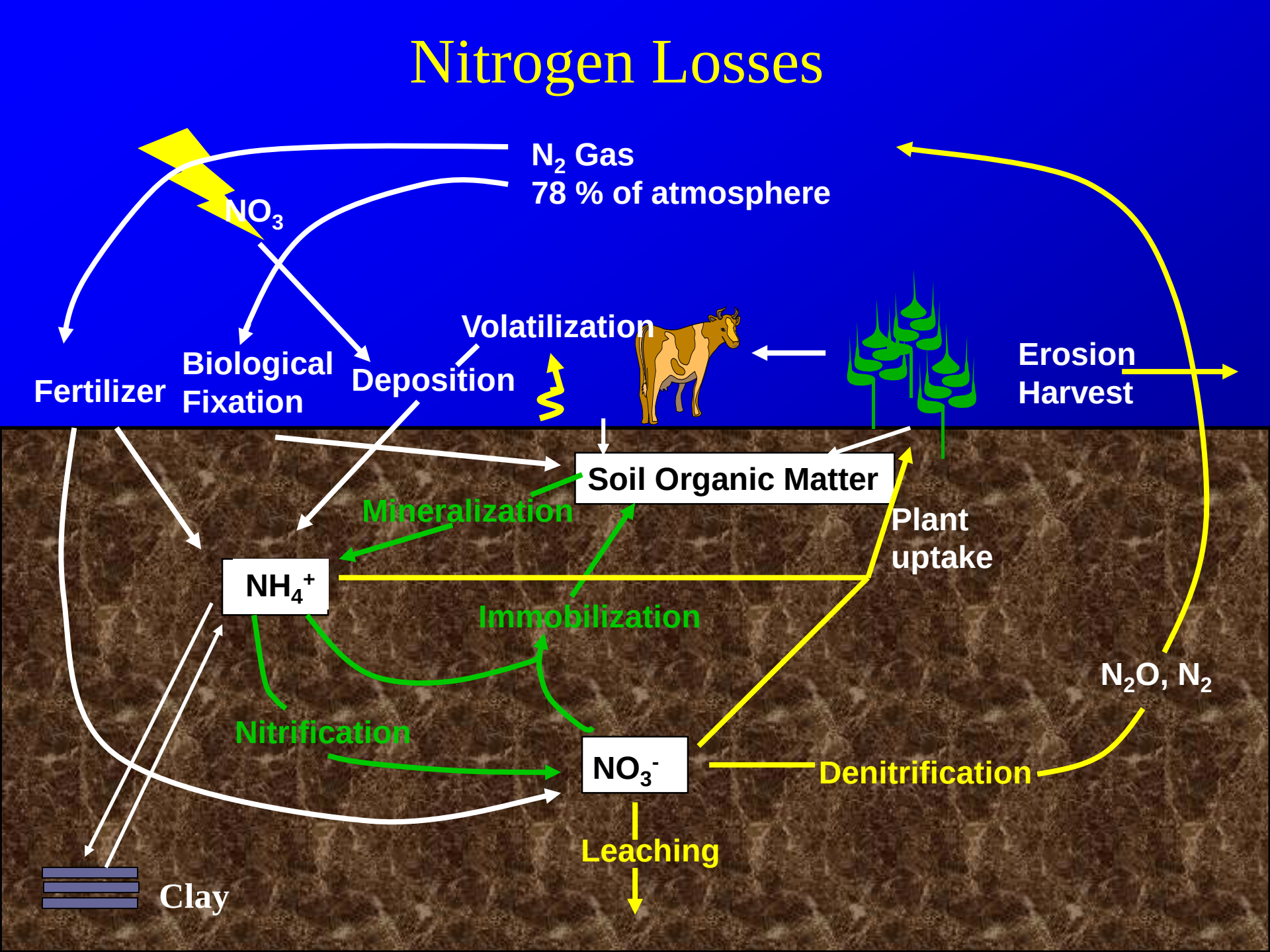
Nitrogen Cycling



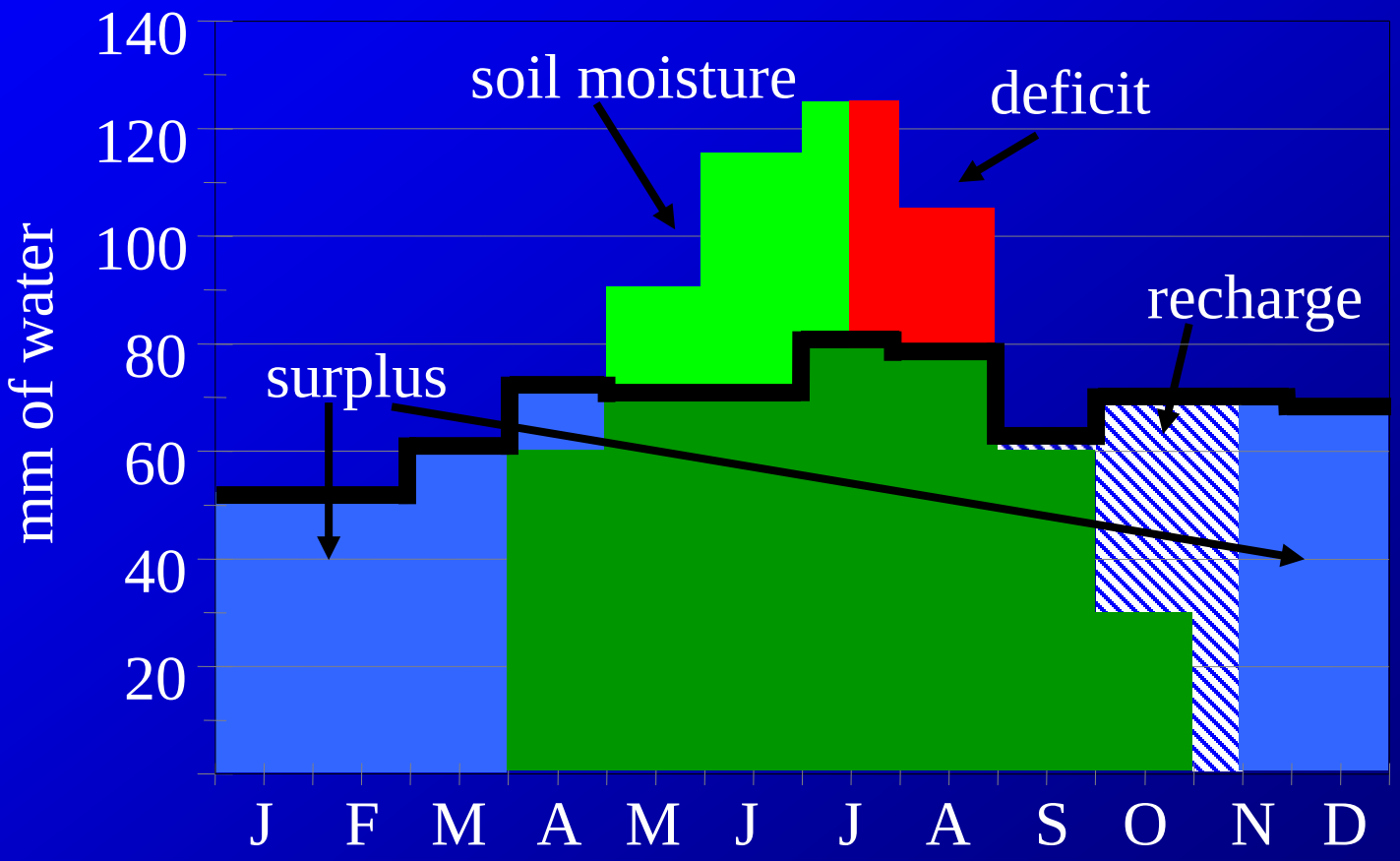
Transformations



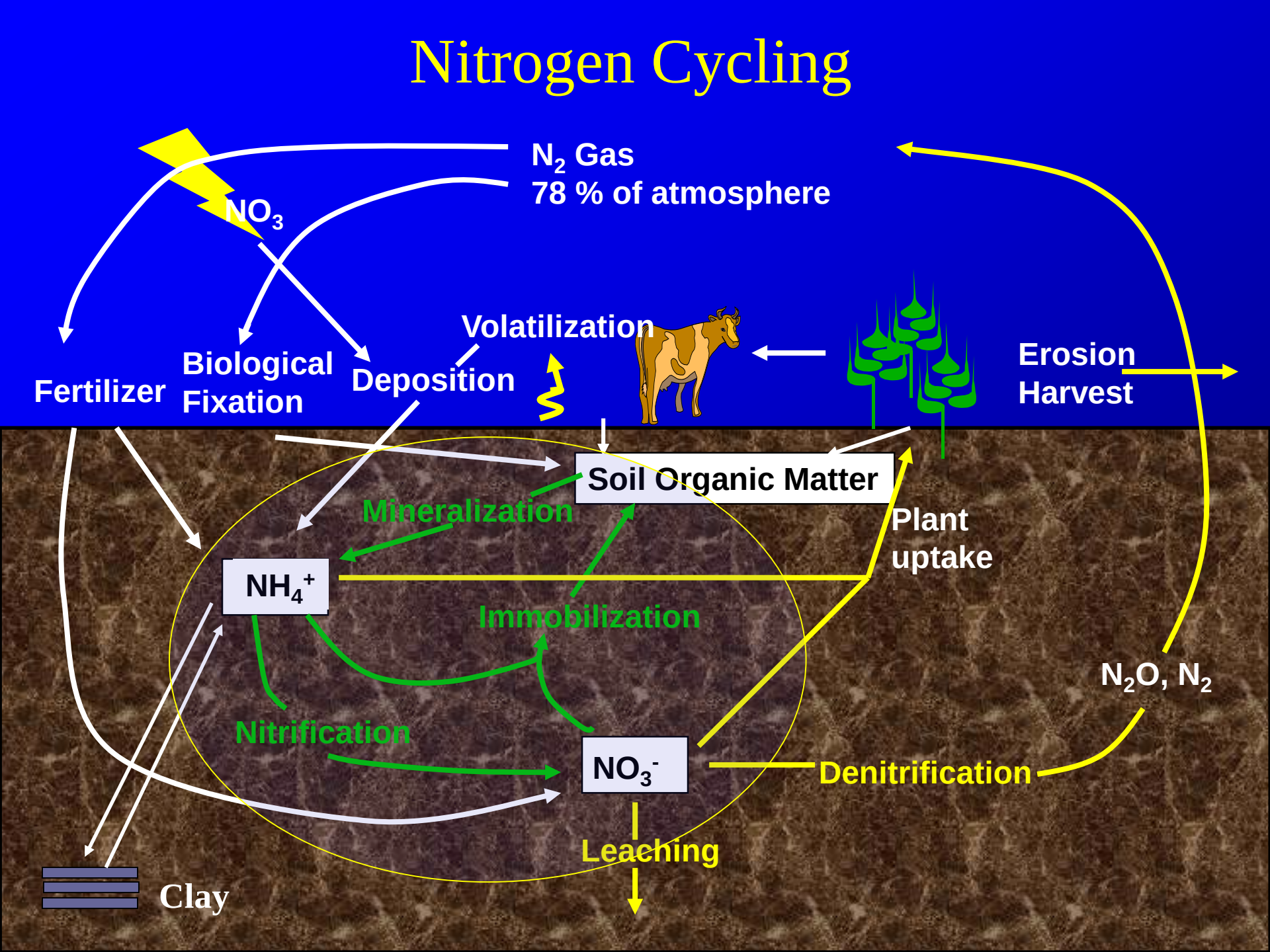
Nitrogen Losses



Typical Water Budget for Ontario



Nitrogen Cycling



Mineralization - Immobilization

When organic residues are decomposed in the soil, nitrogen can either be released (mineralization) or used from the soil (immobilization)

The Carbon/Nitrogen ratio of organic materials added to the soil largely influence which will occur during the early stages of decomposition

C:N Ratio and N Release During Early Decomposition

C:N ratio < 25:1 = mineralization

C:N ratio > 35:1 = immobilization

C:N Ratio of soil life ≅ 8:1

How can something with a C:N ratio of 8:1 get enough nitrogen from organic material with a C:N ratio of 30:1?

C:N Ratio and N Release During Early Decomposition

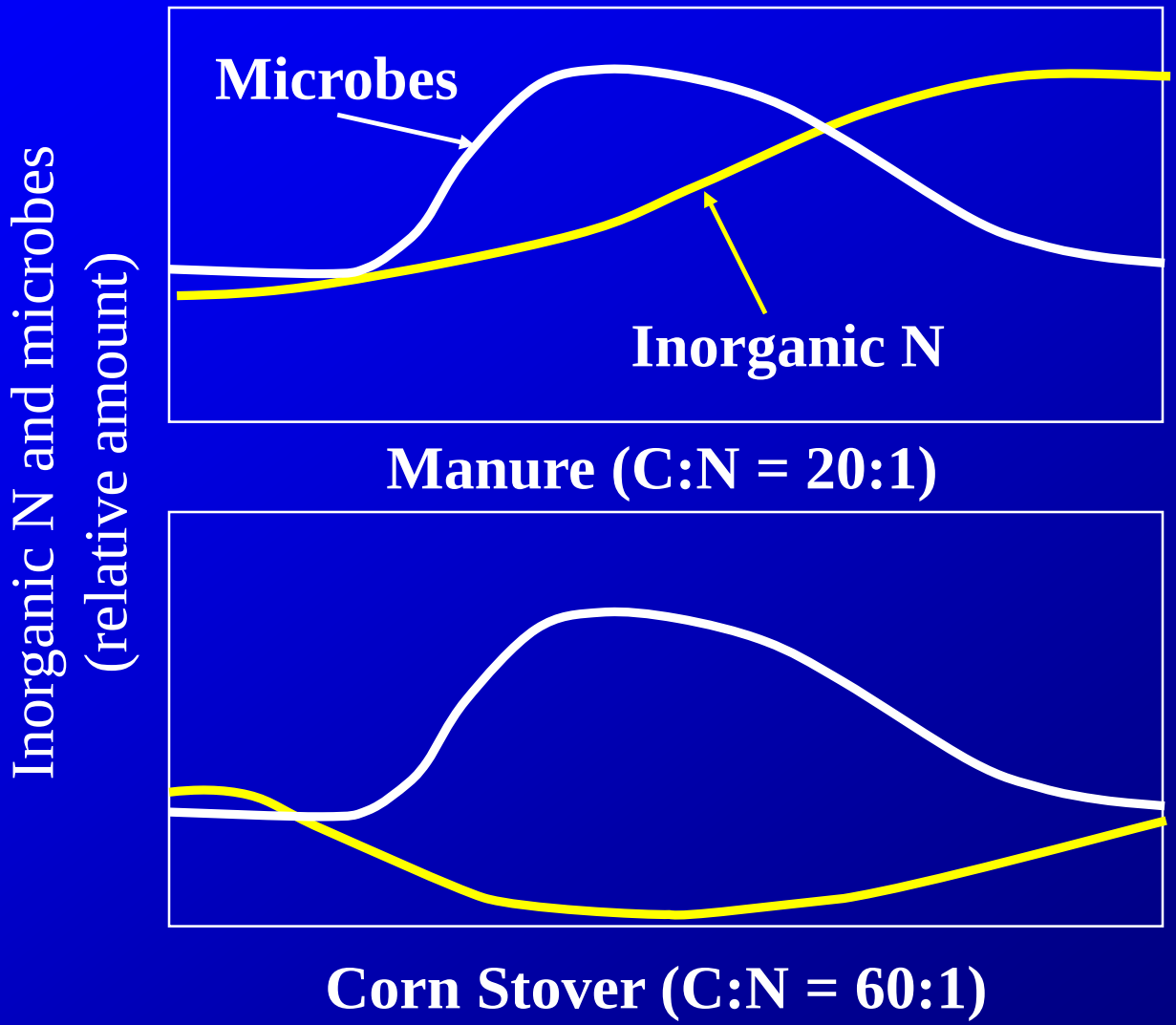
If the C:N ratio = 30:1 and 70 % of carbon is lost as carbon dioxide

If 70 % is lost as carbon dioxide then 30% of the carbon is retained

30% of 30 parts carbon = 9 parts carbon remaining

Therefore after respiration the C:N ratio is very similar to microbes
Resulting in no net mineralization or immobilization

Mineralization - Immobilization



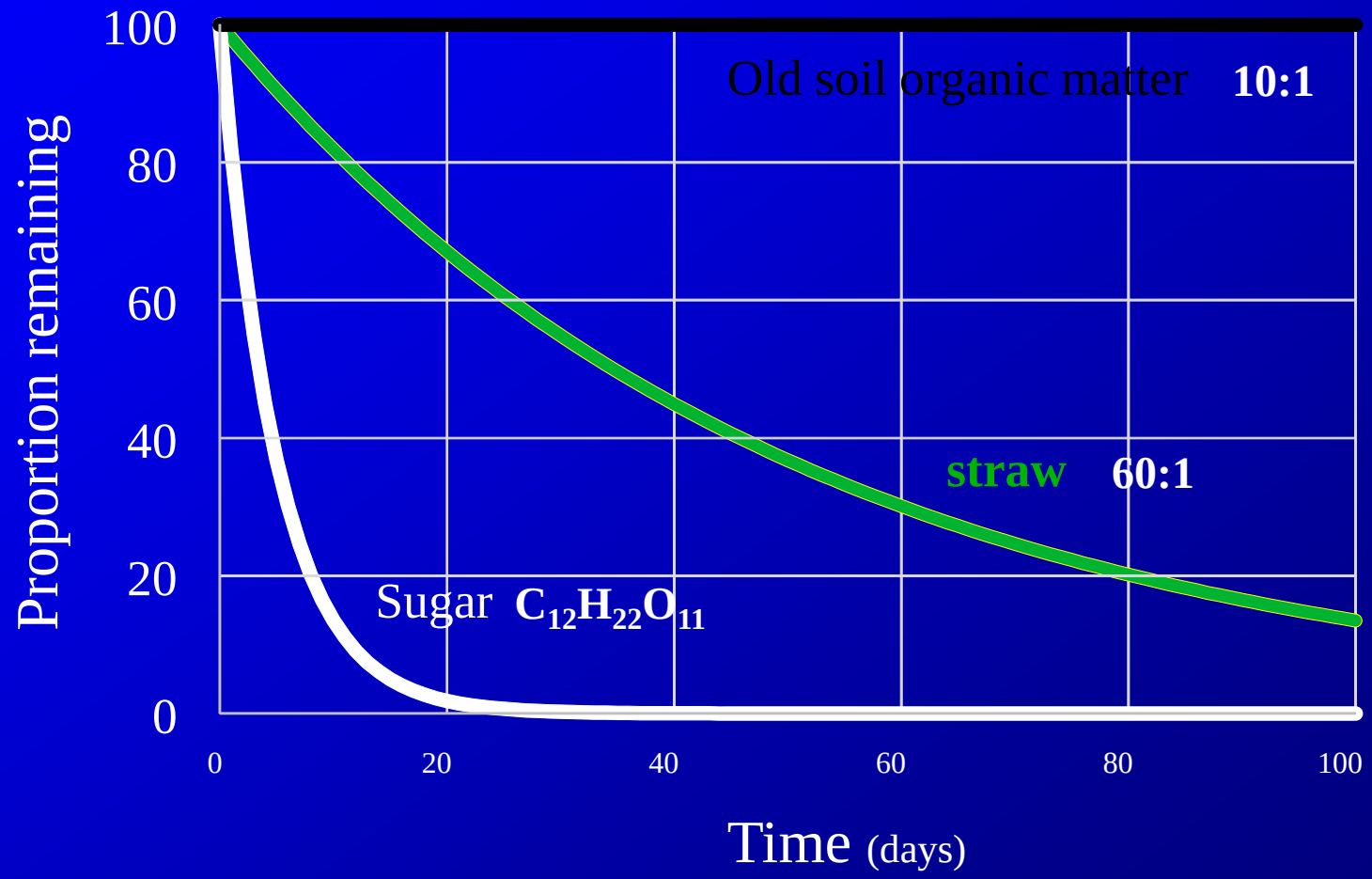
Approximate C:N Ratio Common Organic Materials

Residue	C:N ratio
Alfalfa	13:1
Manure	20:1
Corn stover	60:1
Wheat straw	80:1
Oak leaves	65:1
Pine needles	225:1
Soil organic matter	10-12:1
Saw dust	400:1

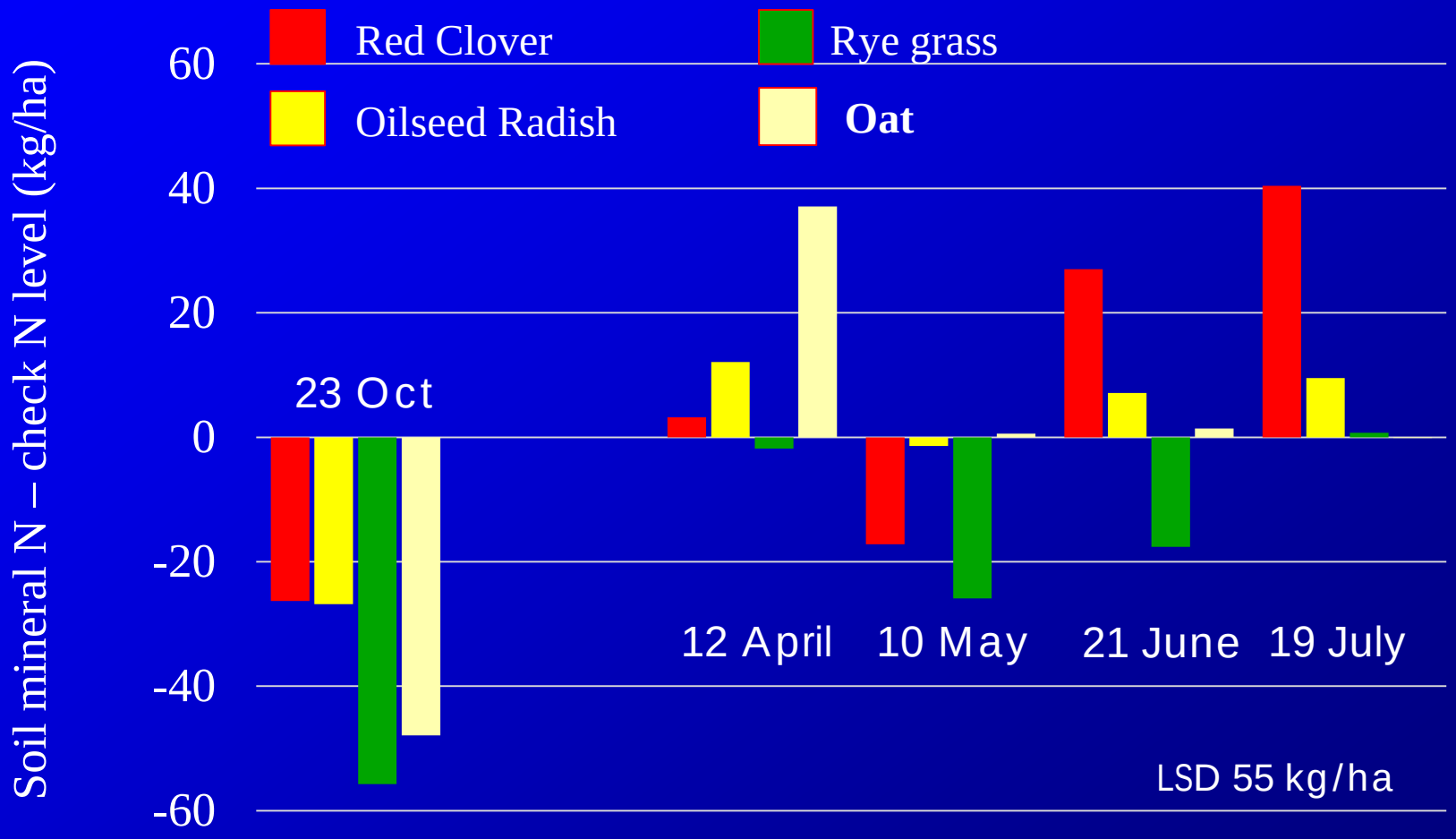
Factors Influencing the Rate of Decomposition of Organic Matter

- Type of organic matter
- Size of organic matter
- Amount of mixing in the soil
- Temperature
- Moisture
- Oxygen status
- Soil pH
- Nutrient content

Rate of Decomposition of Sugar, Straw and old Soil Organic Matter

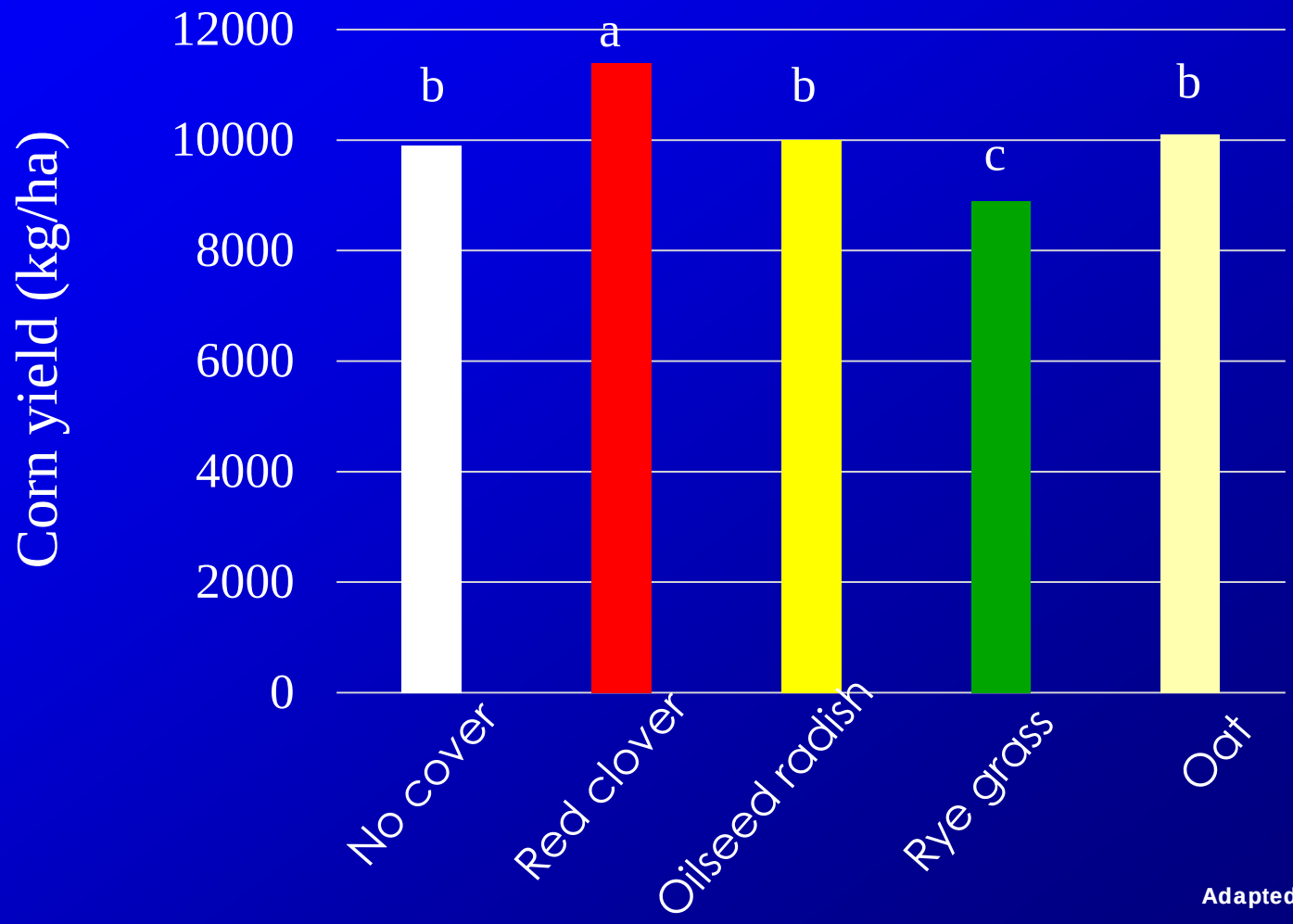


Cover Crop impact on Soil Mineral N levels Compared to a no Cover Crop Check



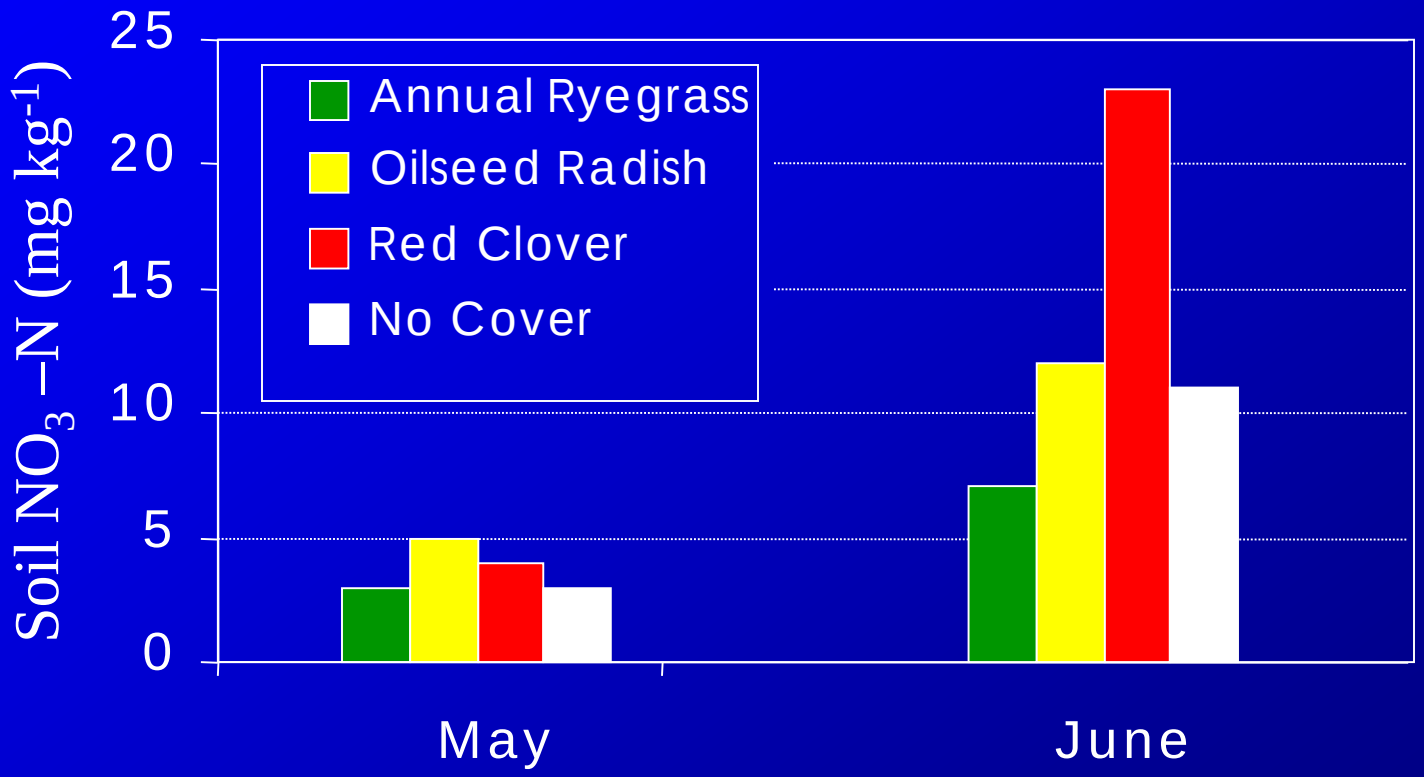
Adapted from Thilakarathna 2016

Cover Crop Impacts on Corn Yield



Adapted from Thilakarathna 2016

Cover Crop Effects on following May – June Soil NO3-N Concentrations



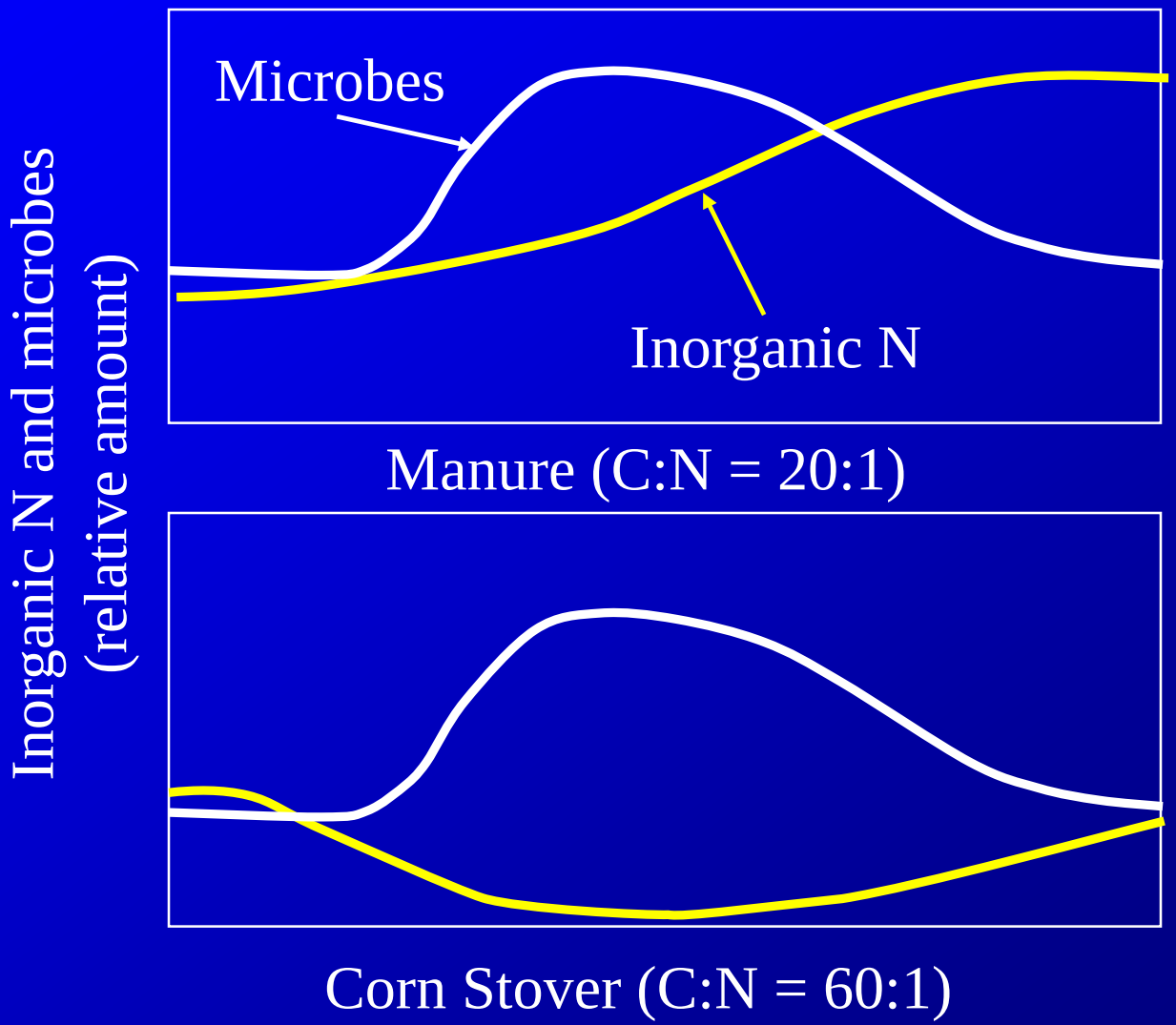
Woodstock Wheat 1991 (Vyn 1999)

Grain N content and yield as influenced by cover crop

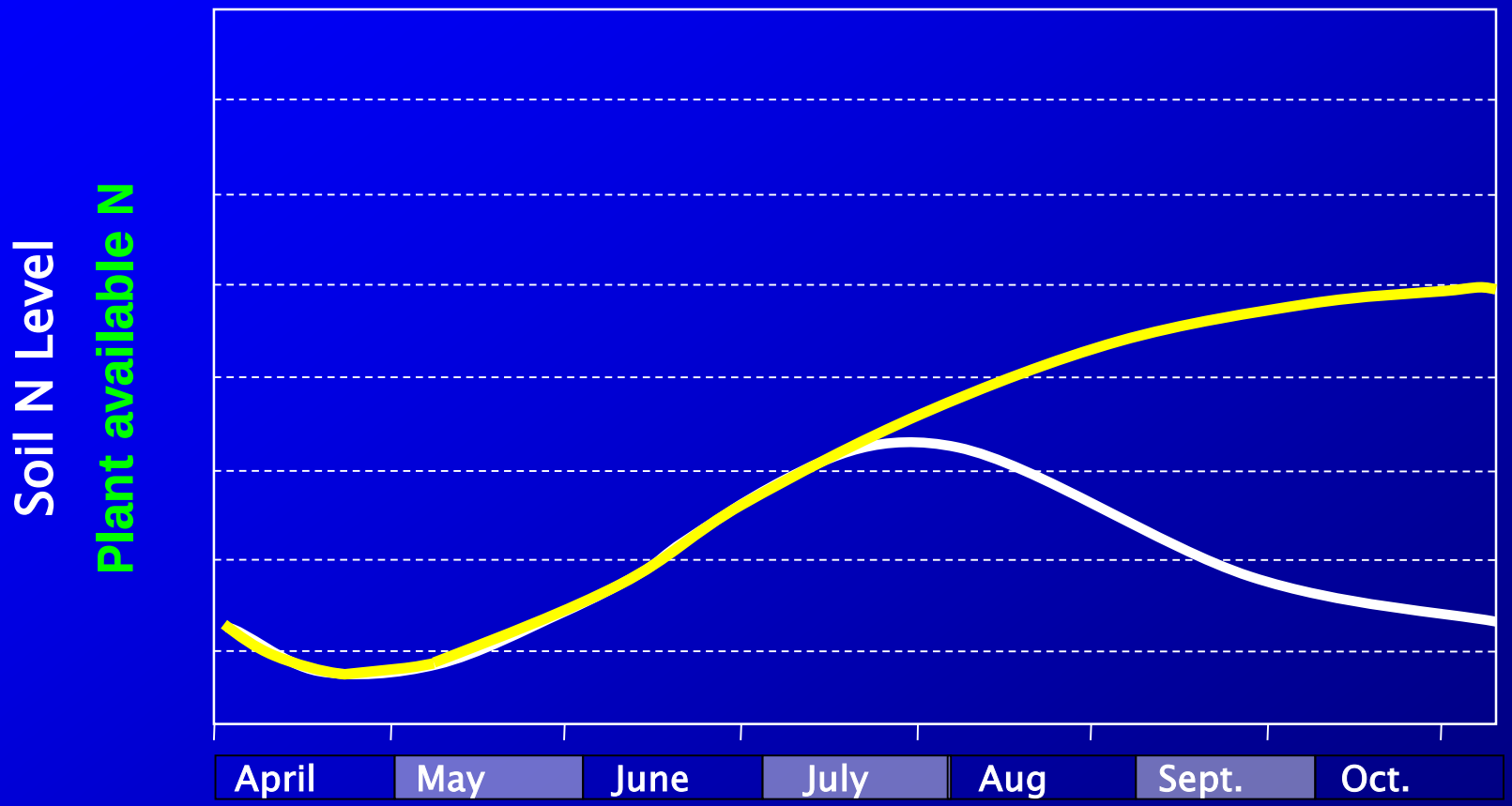
Crop	Plant N	Yield
	(kg ha^{-1})	
Annual Rygrass	63 a	6770 a
Oilseed Radish	123 b	9520 b
Red Clover	142 c	10670 c
No Cover	110 b	9130 b

Woodstock site (adapted from Vyn, 1999)

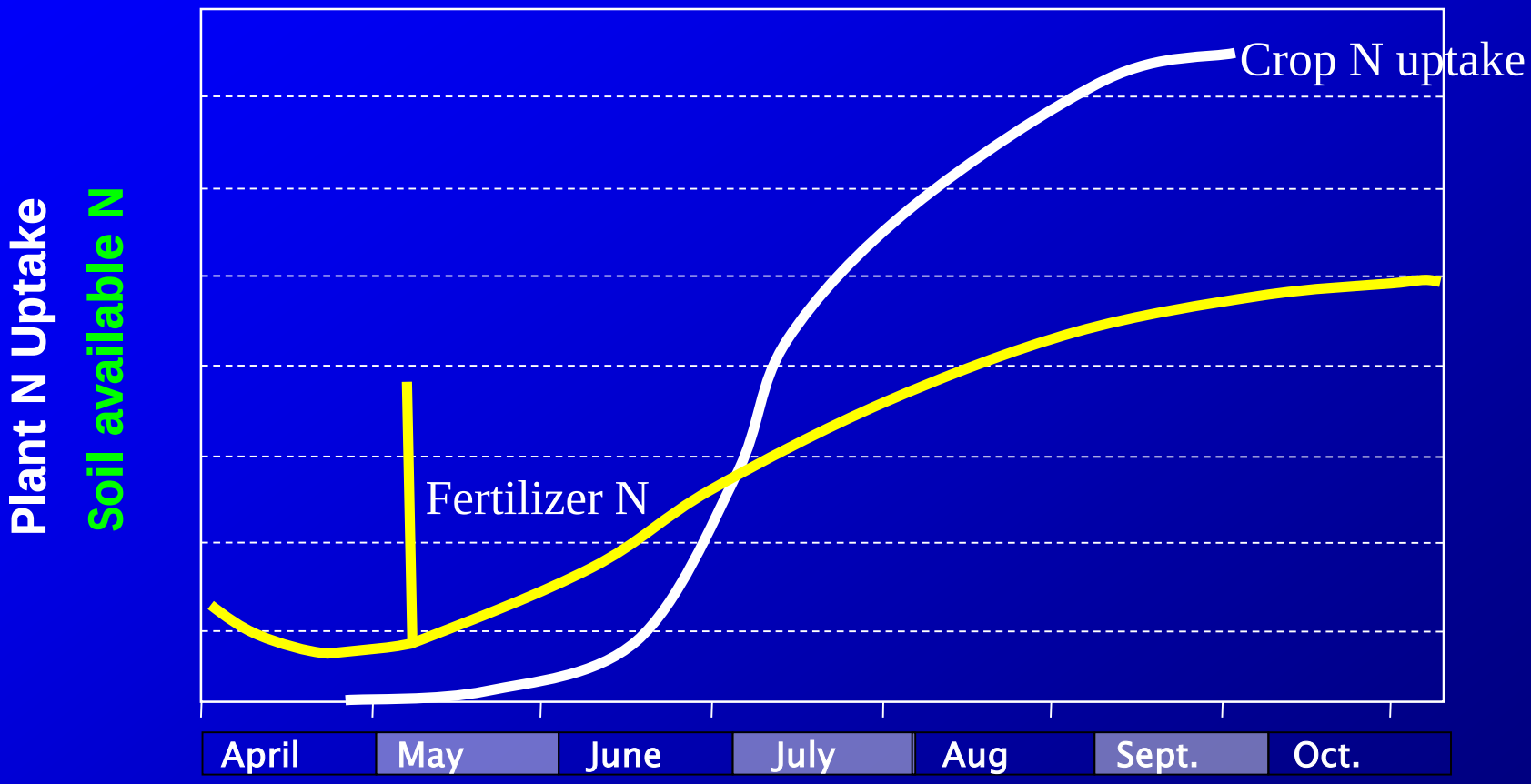
Mineralization - Immobilization



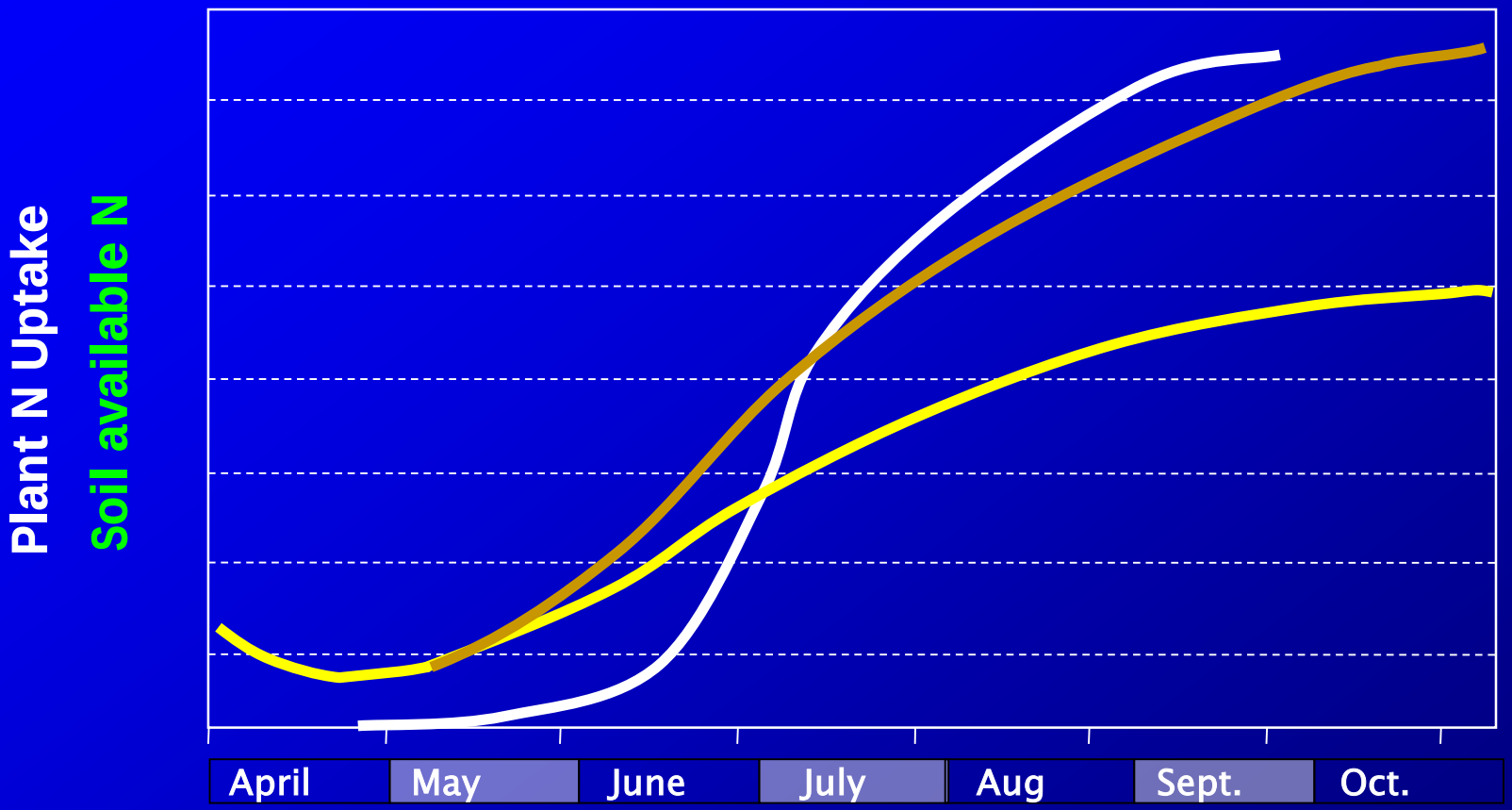
Typical Pattern of Available Soil N and Plant Available N



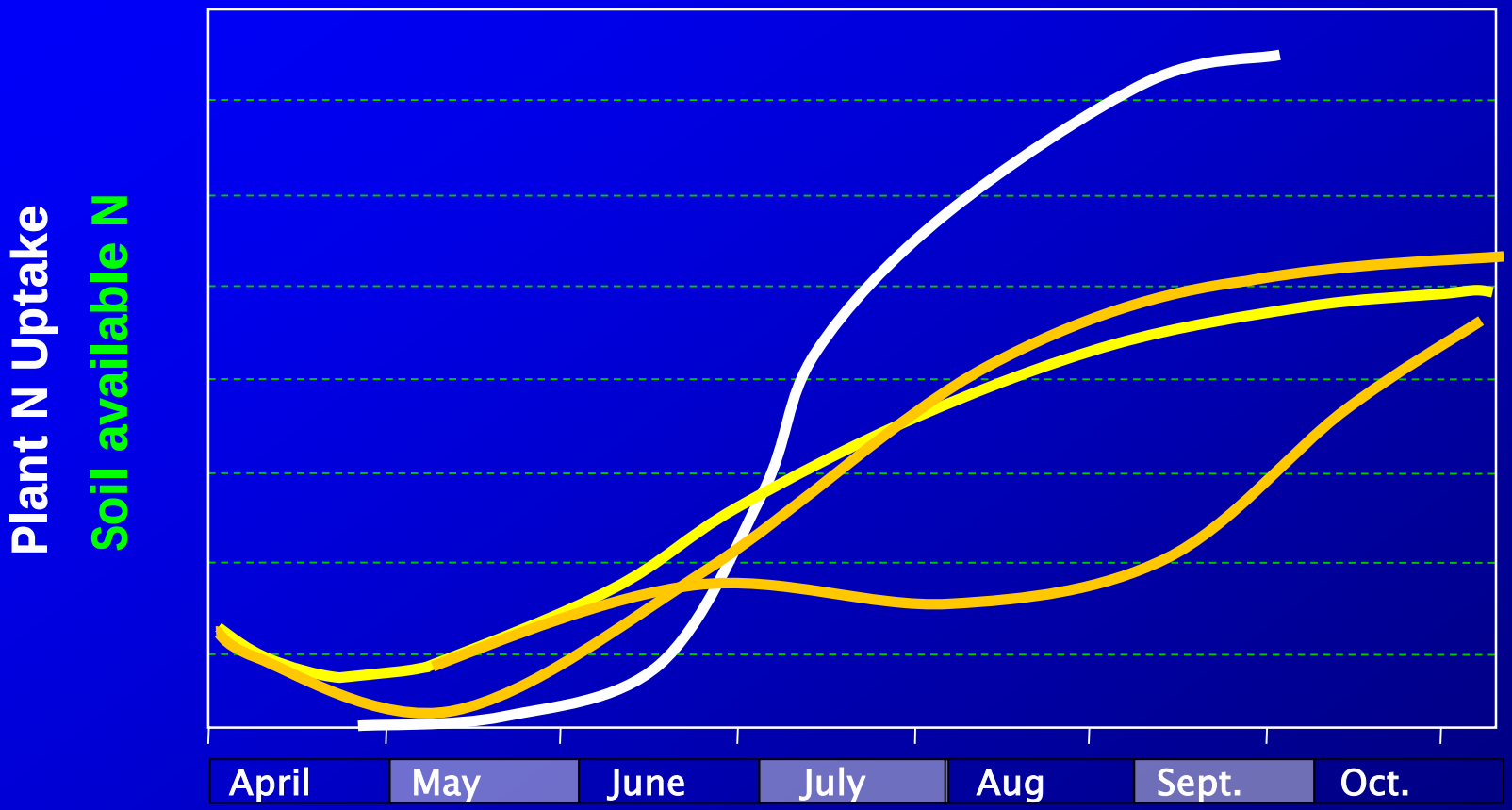
Typical Pattern of Available Soil N and Plant Uptake with Fertilizer



Typical Pattern of Plant available N with a low C:N ration organic Amendment and Plant Uptake



Typical Pattern of Plant available N with a high C:N ration organic Amendment and Plant Uptake



Impact of Manure Type and application Timing on Nitrogen Availability

Manure contains both ammonium nitrogen and organic nitrogen

Ammonium acts in the same way as fertilizer, but the organic N must be mineralized

Ammonium Levels of Different Manures

Manure Type	Ammonium Nitrogen (%)
Liquid Poultry	70
Liquid Hog	66
Liquid Beef/Dairy	55
Solid Hog	30
Solid Poultry	30
Solid Dairy	25
Solid Beef	12

Changes in Method 1 Estimates

Old Estimation	Incorporated (>24 hours)			
Mostly Organic N	Late summer	Early fall	Late fall	Preplant
	Proportion of total N available to crop			
Solid cattle/Sheep	0.27	0.26	0.30	0.34
Solid Poultry Broilers	0.33	0.35	0.35	0.38
Liquid cattle	0.29	0.36	0.41	0.44
Liquid Hog	0.23	0.33	0.48	0.56

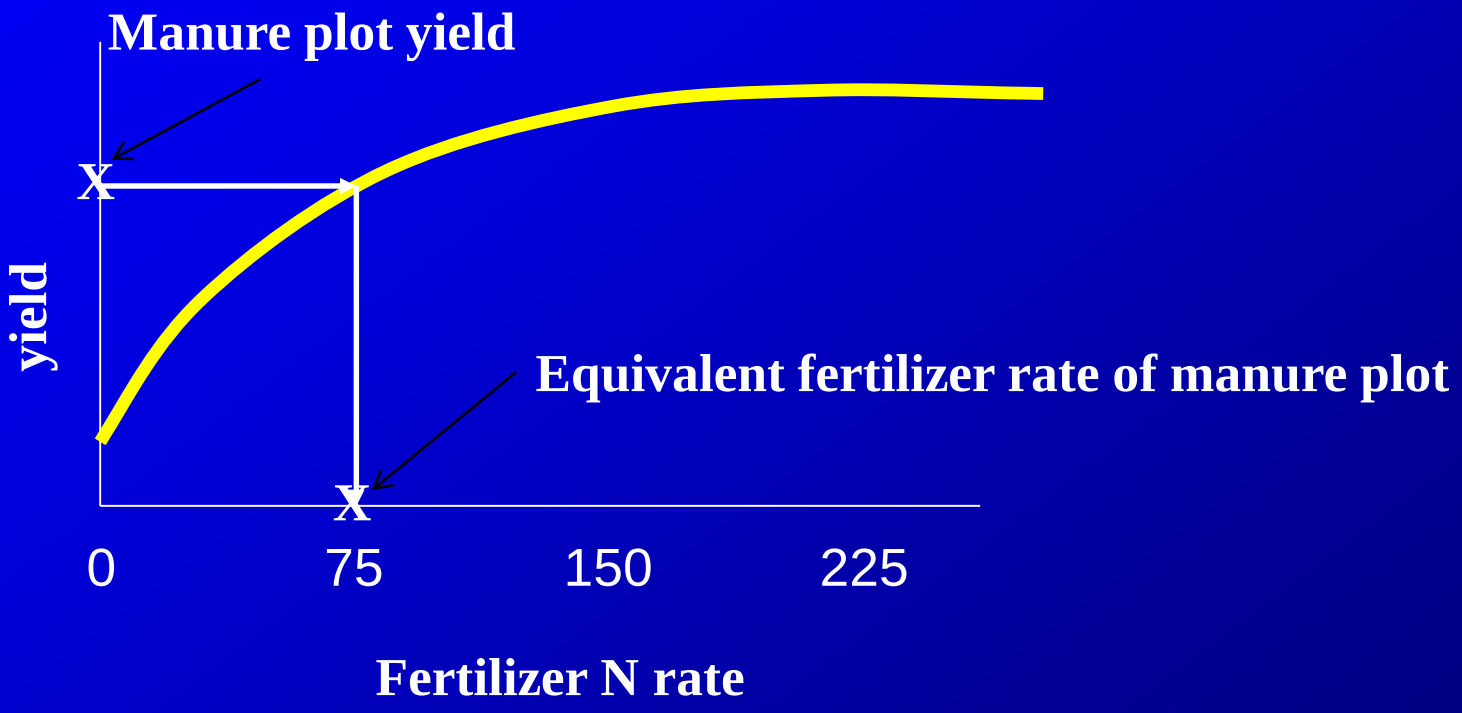
NEW Estimation	Incorporated (>24 hours)			
Mostly Ammonium N	Late summer	Early fall	Late fall	Preplant
	Proportion of total N available to crop			
Solid cattle/Sheep	0.21	0.31	0.34	0.14
Solid Poultry Broilers	0.41	0.53	0.61	0.54
Liquid cattle	Insufficient data	0.27	0.31	0.39
Liquid Hog	0.22	0.38	0.47	0.58

Summary

To manage organic amendments we need to understand

- How easily decomposable the material is
- The approximate C:N ratio of the organic material
- How time of year losses of mineral N are most likely
- The nitrogen uptake pattern of our crop

Determining Fertilizer Nitrogen Equivalency



Fertilizer equivalency used as the observed N availability

Available Nitrogen as a Proportion of total Manure Nitrogen

$$\text{Available manure N} = \frac{\text{Fertilizer N equivalency of manure}}{\text{Total Manure N applied}}$$

$$\text{Available manure N} = \frac{75 \text{ kg N ha}^{-1}}{150 \text{ kg N ha}^{-1}}$$

Available manure N = 0.50 or 50 % as available as fertilizer nitrogen