NITROGEN AND NITROGEN MANAGEMENT

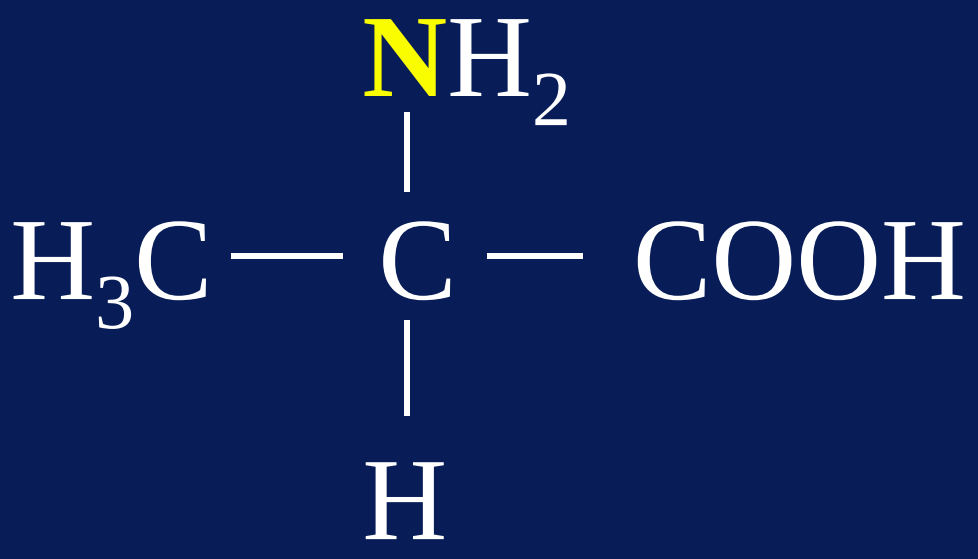
NITROGEN (N)

- Atmosphere contains 78% nitrogen gas (N_2)
- Plants cannot use this N directly
- Nitrogen from air must be converted for plant use
  - Biological fixation (*Rhizobia* and legumes)
  - Chemical fixation (fertilizers)

NITROGEN (N)

- Nutrient that most often limits yield of non-legumes.
- Role of N in plants
  - Component of amino acids
  - Amino acids → proteins

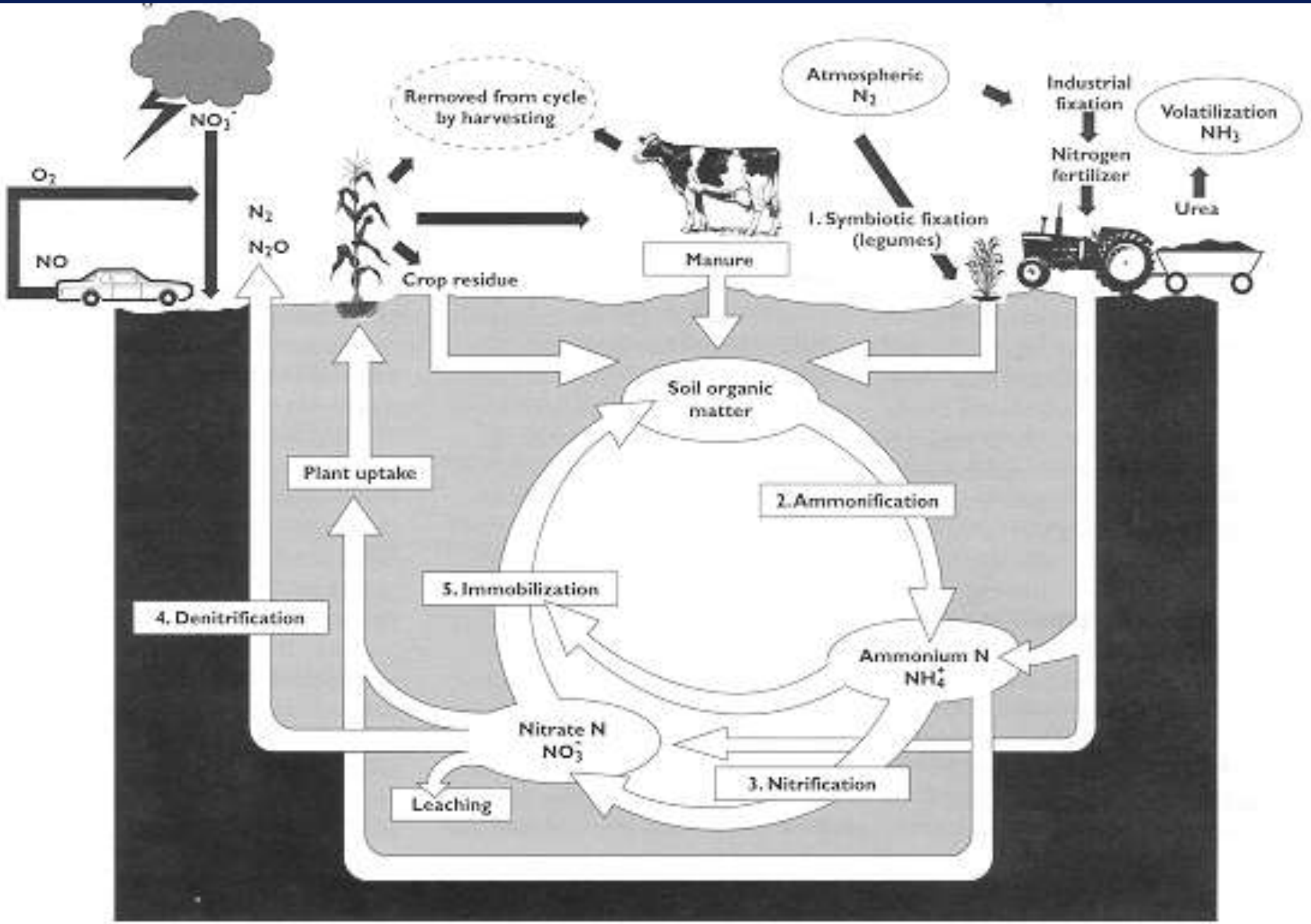
Amino Acids



Alanine

NITROGEN (N)

- Nitrogen is mobile in plants.
- Deficiency symptoms on older leaves.


NO_3^-
O_2
NO
N_2
N_2O
Removed from cycle by harvesting
Crop residue
Manure
Atmospheric N_2
Industrial fixation
Volatilization NH_3
Nitrogen fertilizer
Urea
1. Symbiotic fixation (legumes)
Soil organic matter
Plant uptake
2. Ammonification
5. Immobilization
4. Denitrification
Ammonium N NH_4^+
Nitrate N NO_3^-
3. Nitrification
Leaching

Soil Organic Matter

- Most Wisconsin soils = 1-5%
- Organic soils = 20-50+ %
- About 2-3% of OM decomposes annually

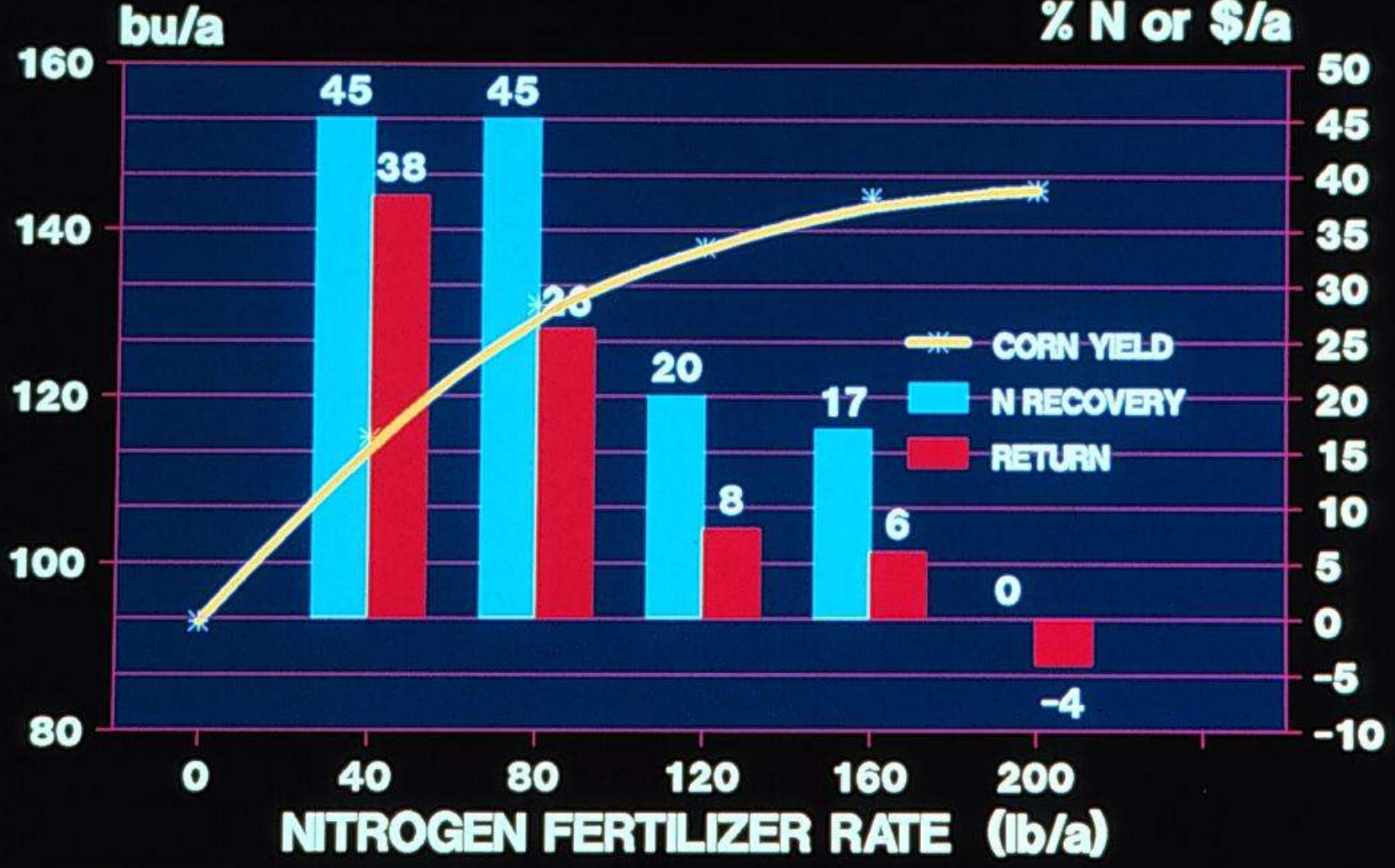
Carbon: Nitrogen Ratios of Organic Materials

Material	C : N Ratio
Soil microorganisms	8
Soil organic matter	10
Alfalfa	12
Rotted manure	20
Corn residue	60
Grain straw	80
Sawdust	300

Carbon : Nitrogen ratio effects on N release

Expected N Effect	C : N range
Release N	< 20
Depends on Composition	20 - 50
Immobilize (Tie up) N	> 50

Yield, Economic Return, & N Recovery in Corn Grain, Janesville, WI. 83-85



Prices: $0.15/lb N , $2.00/bu corn

As N rates are increased to the economic optimum:

- Economic return increases
- Crop recovery of N decreases
- Potential for N loss increases

GOALS OF NITROGEN MANAGEMENT

- Maximize economic return with optimum N rates
- Avoid environmental risks due to above-optimum N use

ENVIRONMENTAL ISSUES

- Nitrate leaching
  - Nitrate in ground water
  - Nitrate in tile drain outflow
- Nitrate contributions to Gulf of Mexico hypoxia

Sources of nitrogen fertilizer

Name of fertilizer	Chemical formula	Fertilizer analysis (%) N-P_2O_5-K_2O	% of N	
			NH_4^+	NO_3^-
Anhydrous ammonia	NH_3	82-0-0	100	0
UAN solutions	NH_4NO_3 + urea + H_2O	28-0-0	75	25
Urea	$NH_2 \bullet CO \bullet NH_2$	45-0-0	100	0
Ammonium nitrate	NH_4NO_3	33-0-0	50	50
Ammonium sulfate	$(NH_4)_2SO_4$	21-0-0	100	0

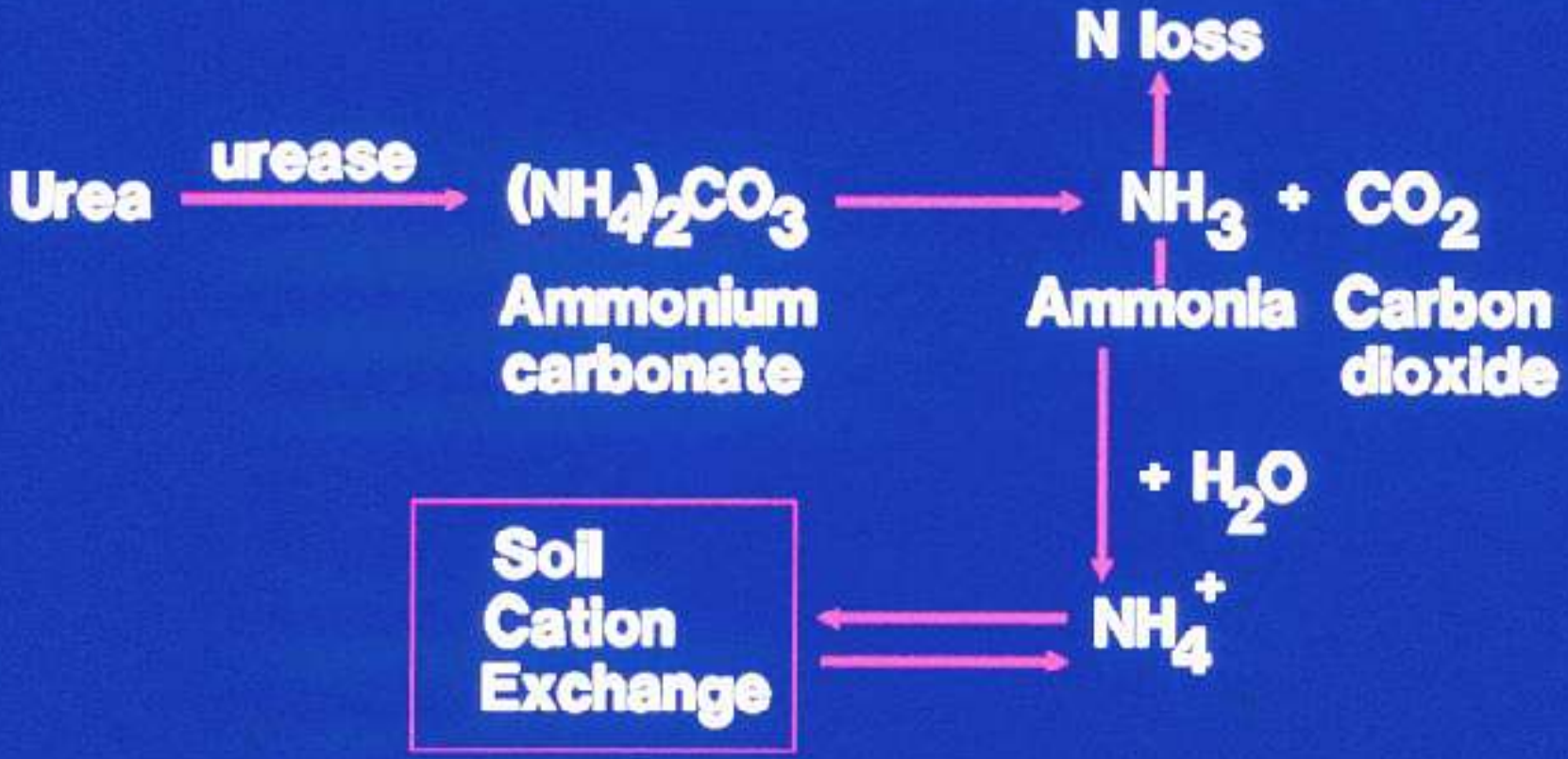
Sources of nitrogen fertilizer

Name of fertilizer	Physical form	Method of application
Anhydrous ammonia	High-pressure liquid	Injected 6 to 8 inches deep
UAN solutions	Pressureless liquid	Spray on surface or inject
Urea	Dry pellets	Broadcast or sidedress
Ammonium nitrate	Dry pellets	Broadcast or sidedress
Ammonium sulfate	Dry granules	Broadcast or sidedress

Nitrogen Sources- Are There Differences?

- ✓ Equally effective if losses are minimized
- ✓ Different susceptibility to loss processes
  - Leaching
  - Denitrification
  - Ammonia volatilization

Ammonia Volatilization



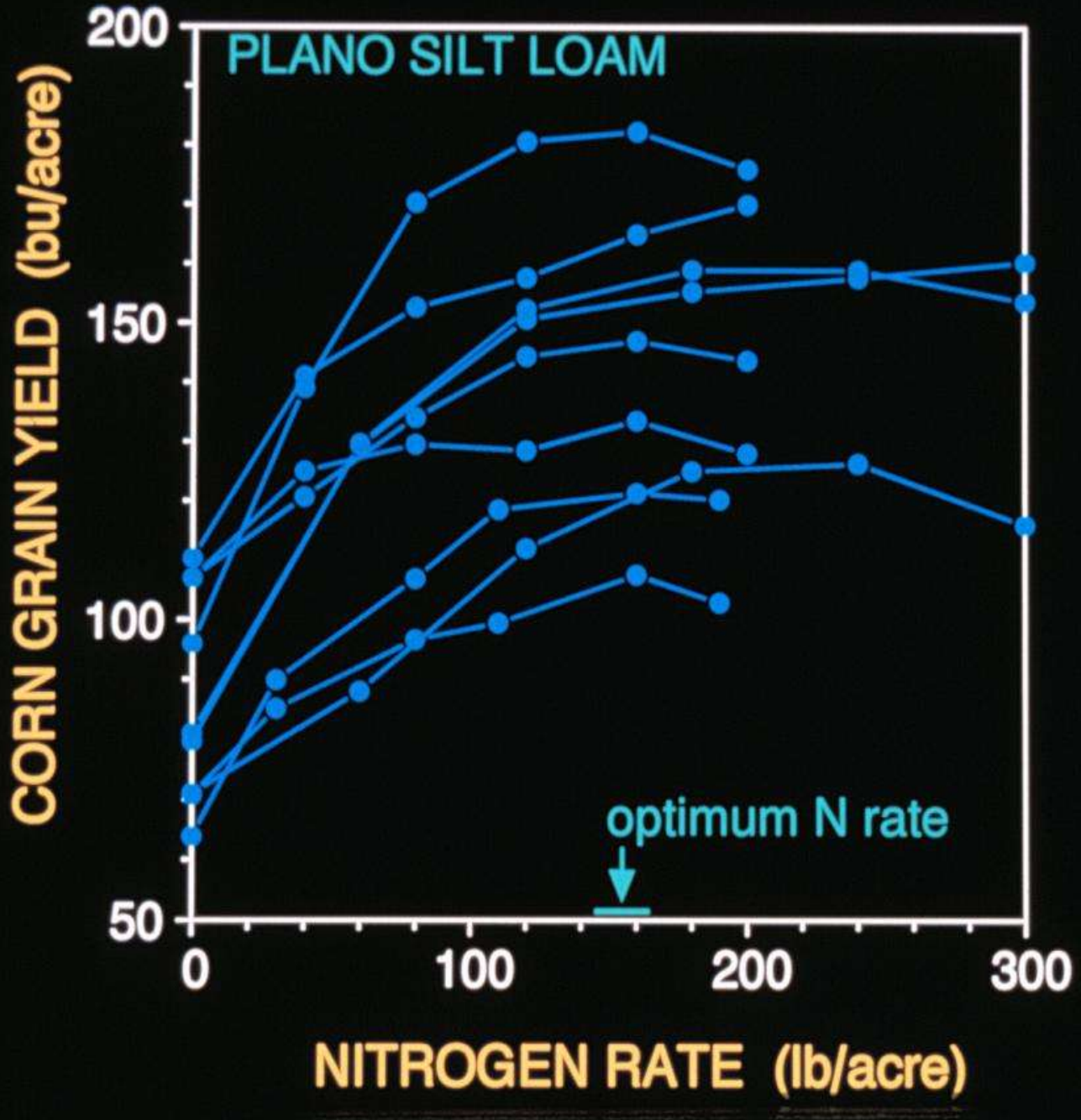
Ammonia Volatilization Losses

- Urea and urea-containing fertilizers
- Surface applications only
- Tillage or rain in 2-3 days controls loss
- Large losses are rare
- Maximum loss = 20-30 % of N

NITROGEN RECOMMENDATIONS

Optimum N Rate for Corn

- Soil-specific characteristic
- Not affected by annual variations in yield
- Year-specific adjustments for soil nitrate and organic N inputs needed


PLANO SILT LOAM
CORN GRAIN YIELD (bu/acre)
200
150
100
50
0
100
200
300
optimum N rate
NITROGEN RATE (lb/acre)

Nitrogen Recommendations for Corn

	Sands & loamy sand		Other soils	
			Yield Potential	
Organic matter	Irrigated	Non-irrigated	Med/low	Very high/ high
---%---	----------lb N/acre----------			
<2	200	120	150	180
2-9.9	160	110	120	160
10-20	120	100	90	120
>20	80	80	80	80

Adjustments to Base N Rates

- Nitrogen Credits
  - Legumes
  - Manure
- Soil nitrate tests
- Tillage/residue adjustment

Nitrogen credits for forage legumes

Based on:

- Crop
- Soil Texture
- Plant density
- Harvest management

Nitrogen Credits for Alfalfa

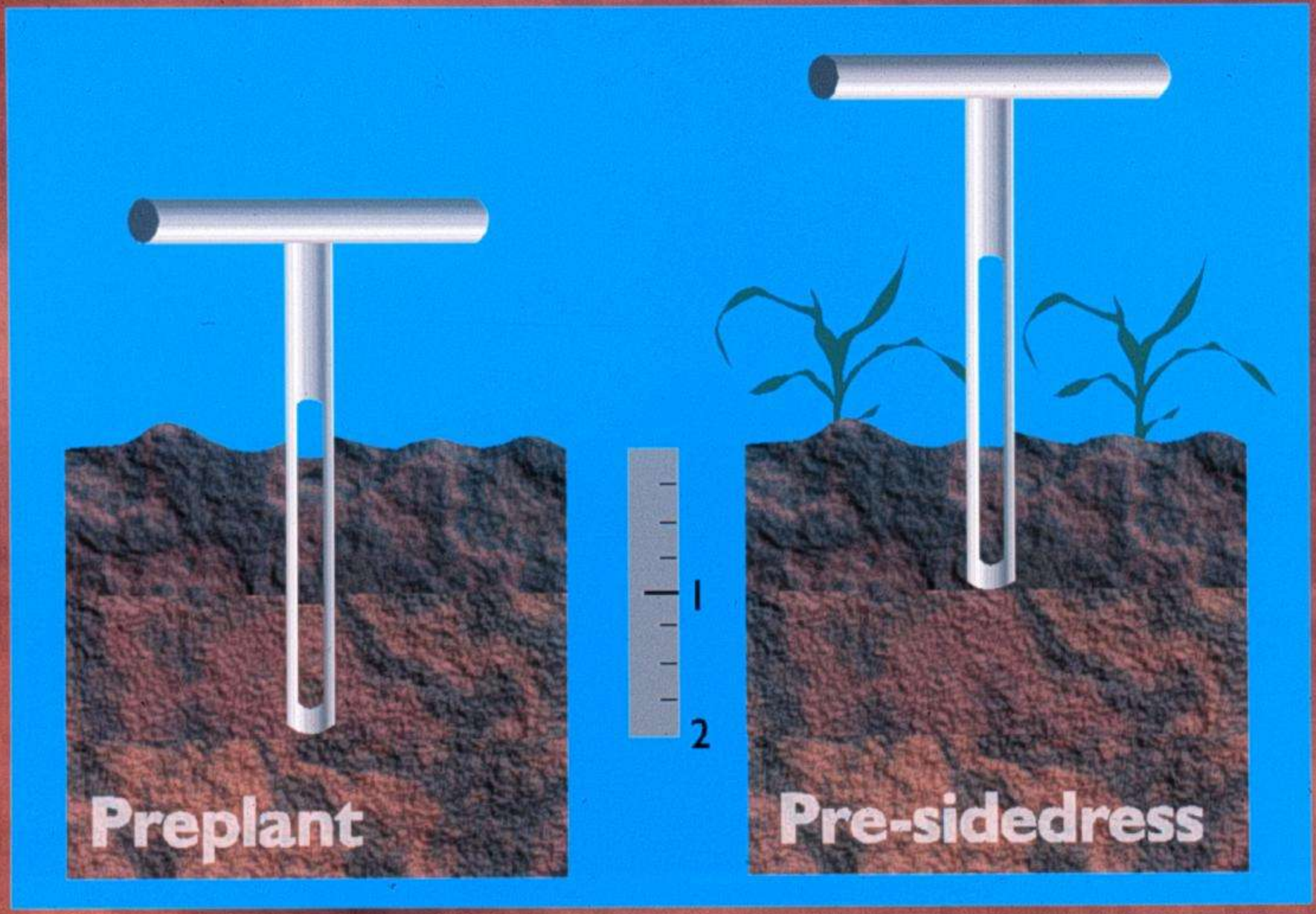
Stand density	Sandy soils		Other soils	
	Regrowth			
	≤8”	>8”	≤8”	>8”
	----------lb N/a----------			
Good	100	140	150	190
(70-100%, >4 plants/sq ft)				
Fair	60	110	110	160
(30-69%, 1.5-4 plants/sq ft)				
Poor	40	80	90	130
(0-29%, <1.5 plants/sq ft)				

NITROGEN CREDITS FOR SOYBEAN

- Credit 40 lb N/acre
- Credit varies over sites and years
- Credit not affected by soybean residue
- Use preplant soil nitrate test to fine-tune credit
- No credit on sands or loamy sands

Why Use Soil Nitrate Tests?

- Agronomic and environmental benefits
- Predict corn N needs
  - Improved accuracy
  - Site-and year-specific
- Minimize nitrate loss


Preplant
1
2
Pre-sidedress

Preplant Soil Nitrate Test (PPNT)

- Collect samples in early spring (preplant)
- Sample 0-1 ft. and 1-2 ft. depths
- Measures residual (carryover) nitrate
- Adjust Nitrogen recommendations

Pre-Sidedress Soil Nitrate Test (PSNT)

- Sample 0-1 ft when corn is 6-12 in tall
- Estimates N availability from organic N sources
- Confirms manure & legume N credits
- Direct N recommendation
- Not useful on sands, loamy sands

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