NITROGEN AND PHOSPHORUS MANAGEMENT AND THE ENVIRONMENT

Robert G. Hoeft

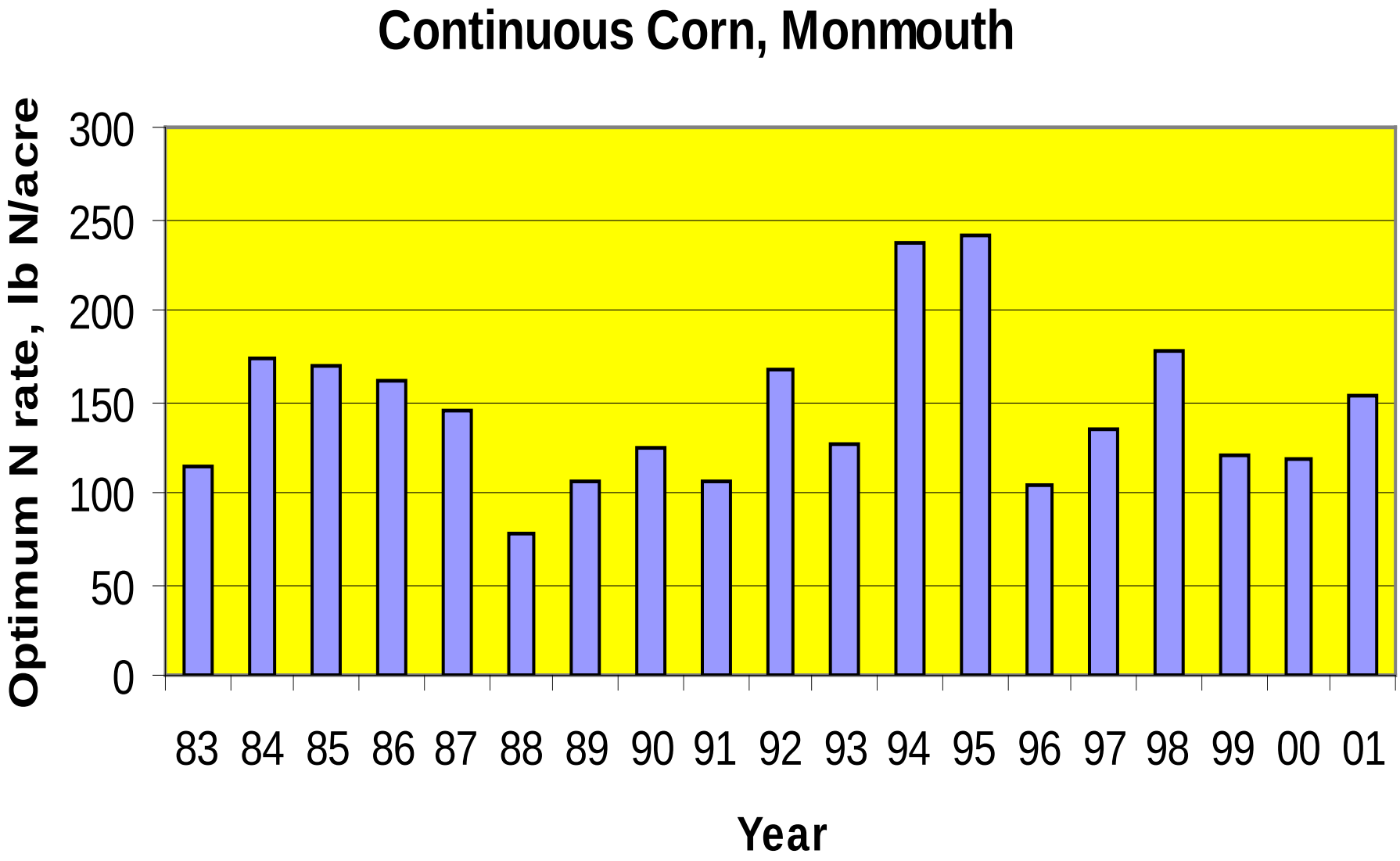
Interim Assoc. Dean and Director of Extension

University of Illinois

NITROGEN MANAGEMENT MADE SIMPLE

- RIGHT RATE
- RIGHT TIME
- RIGHT APPLICATION TECHNIQUE FOR THE MATERIAL OF CHOICE

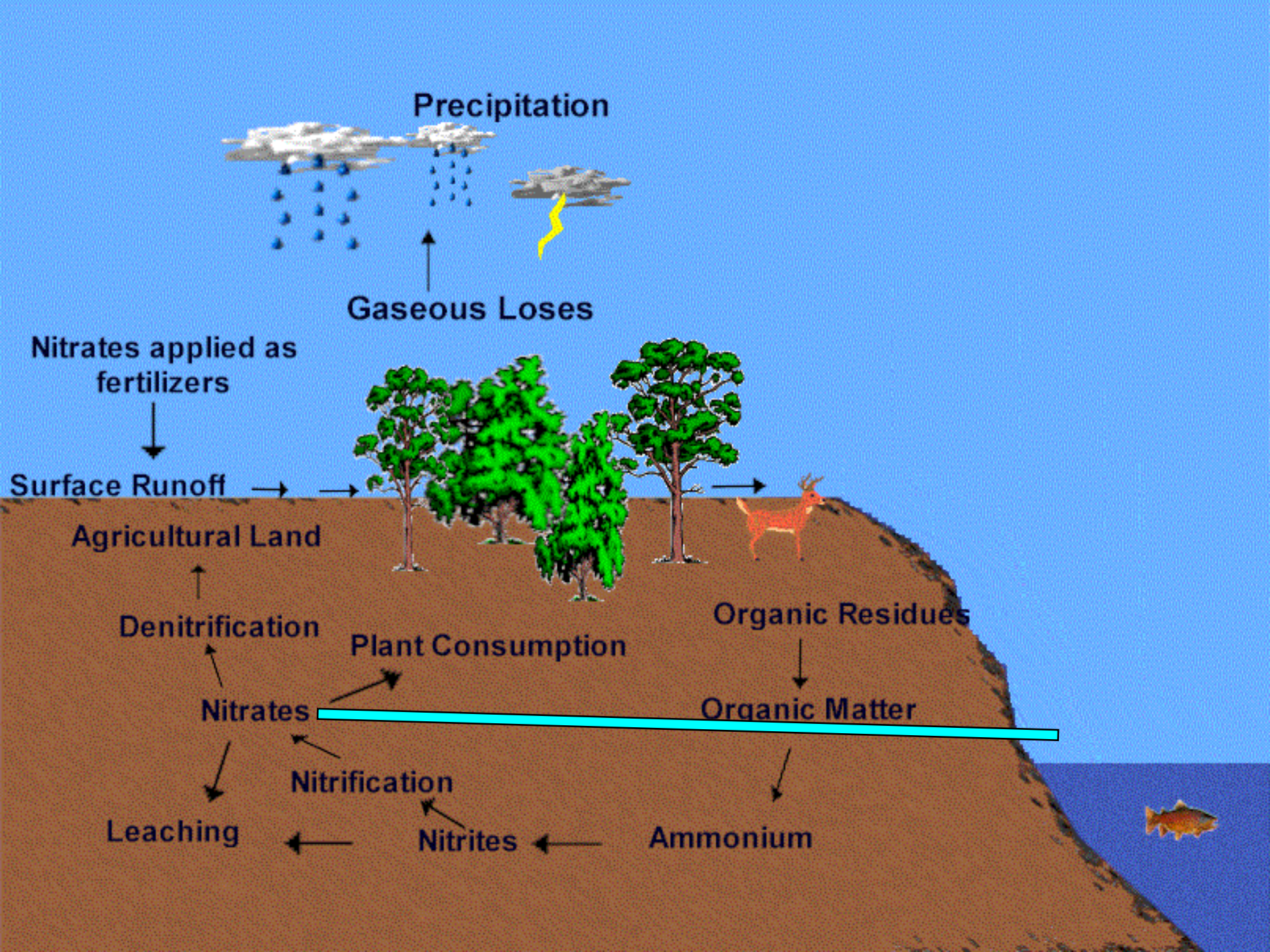
HOW MUCH NITROGEN DO YOU NEED?

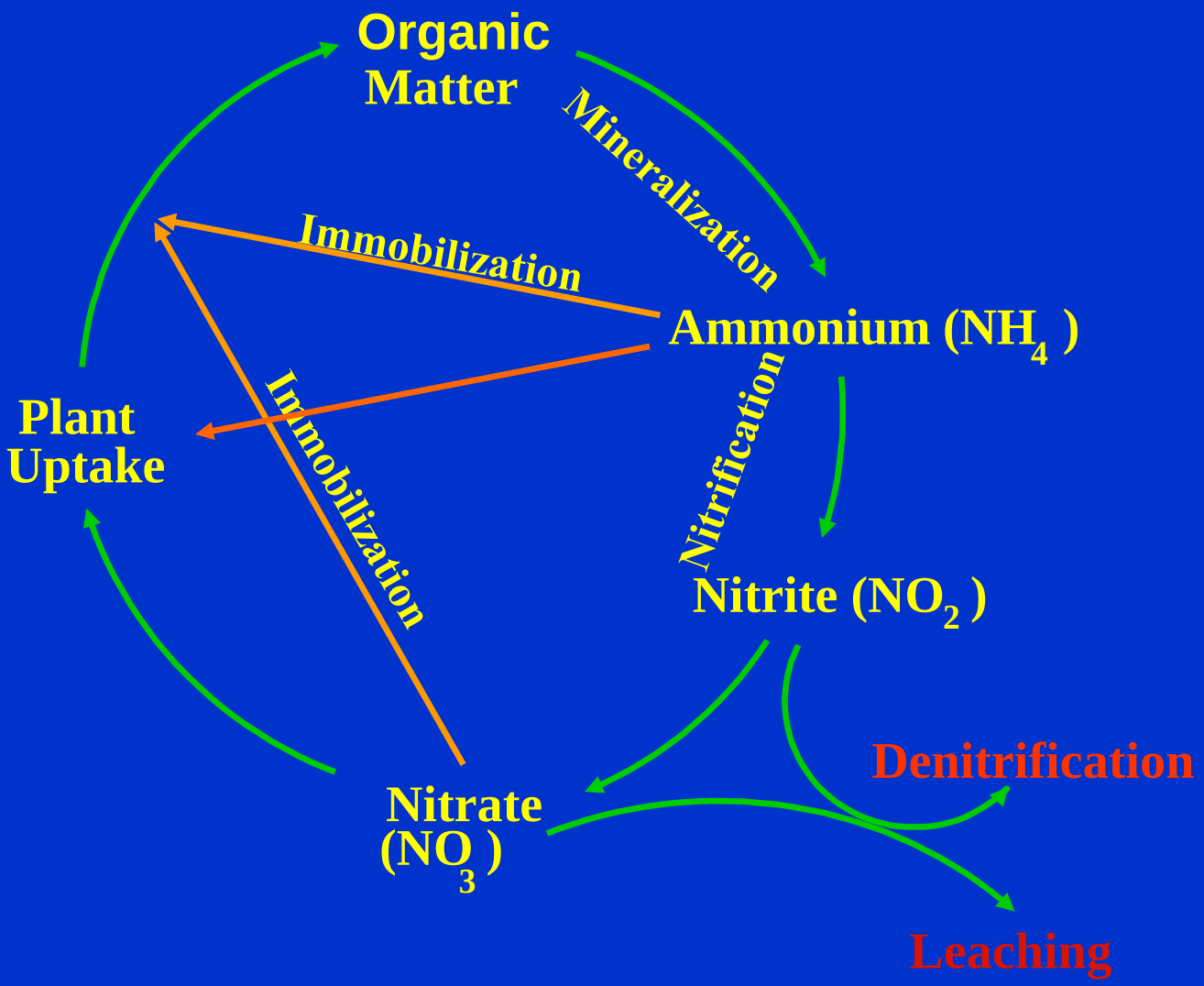

Continuous Corn, Monmouth
Optimum N rate, lb N/acre
300
250
200
150
100
50
0
83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01
Year

N (as NO_3-N) uptake in corn	lb/acre
• 160 bu/acre corn grain	120
• stover (above ground)	70
• roots	30
• Total	220

- Water transpiration by corn:
  18 inches; equals 4 million lb/acre

- Ratio NO_3-N/water = 55 ppm (mg/L)


Precipitation
Gaseous Loses
Nitrates applied as fertilizers
Surface Runoff
Agricultural Land
Denitrification
Plant Consumption
Organic Residues
Nitrates
Organic Matter
Nitrification
Leaching
Nitrites
Ammonium

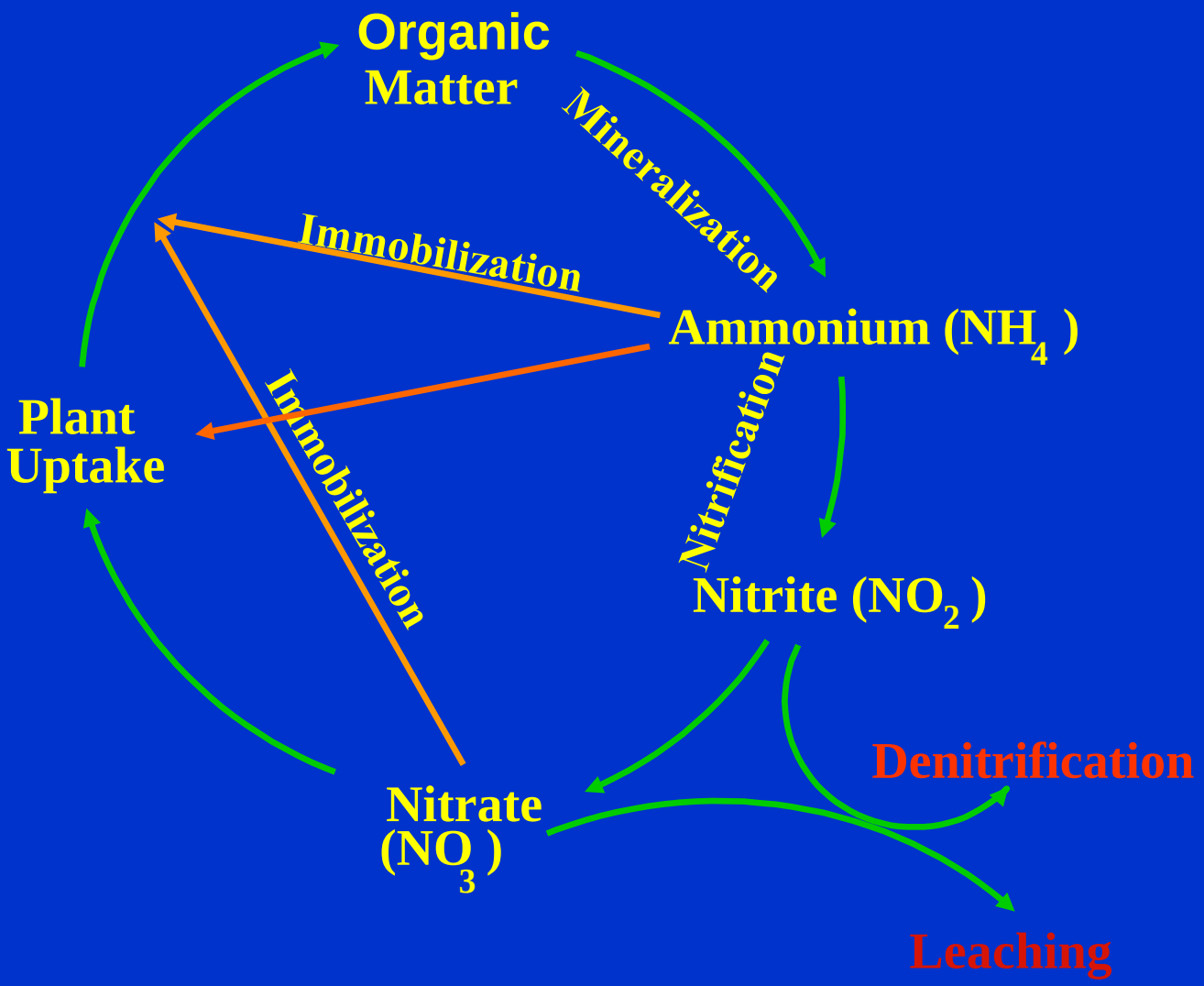

Organic Matter
Mineralization
Immobilization
Ammonium (NH_4)
Plant Uptake
Immobilization
Nitrification
Nitrite (NO_2)
Denitrification
Nitrate (NO_3)
Leaching

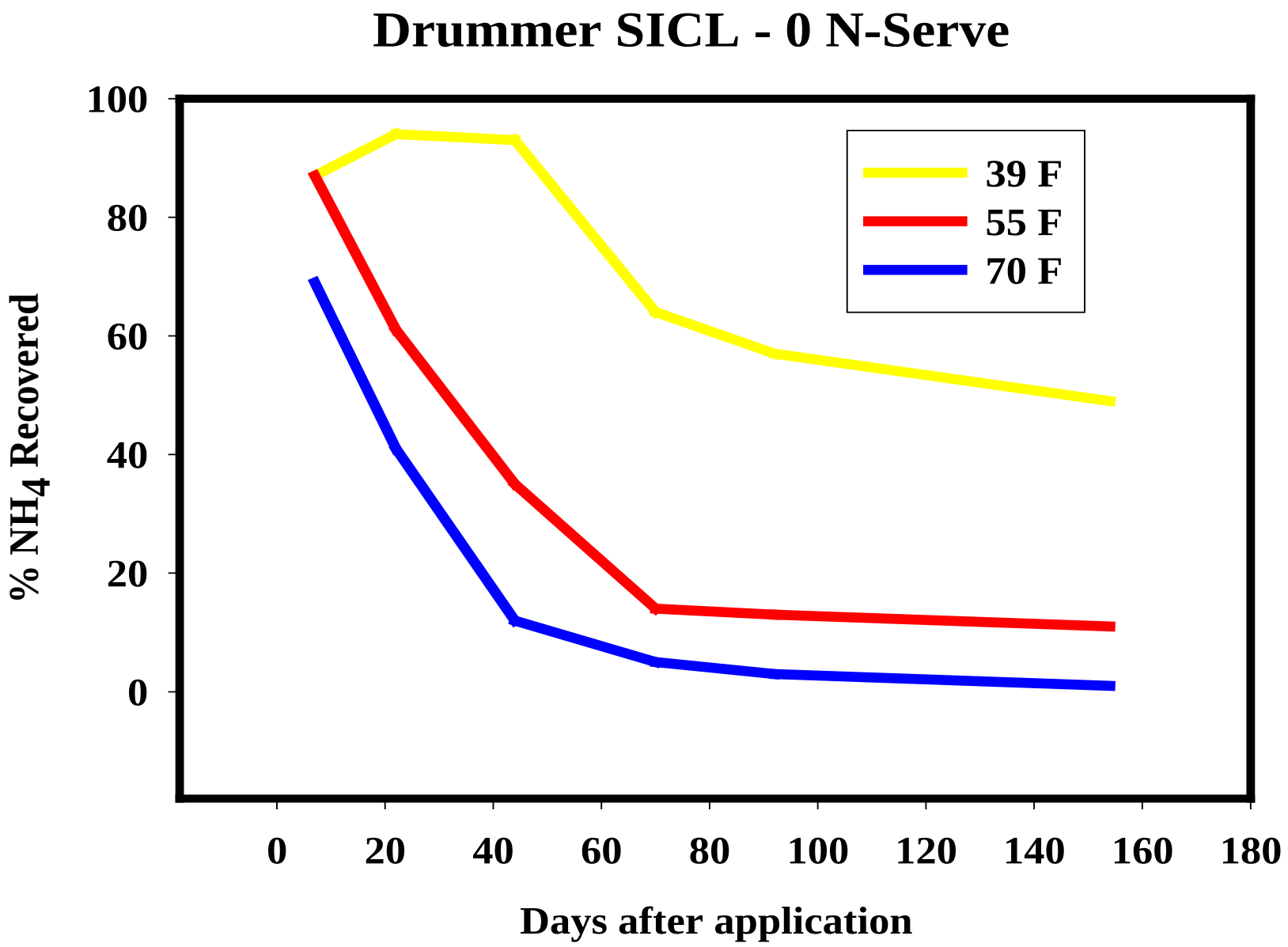
Mineralization

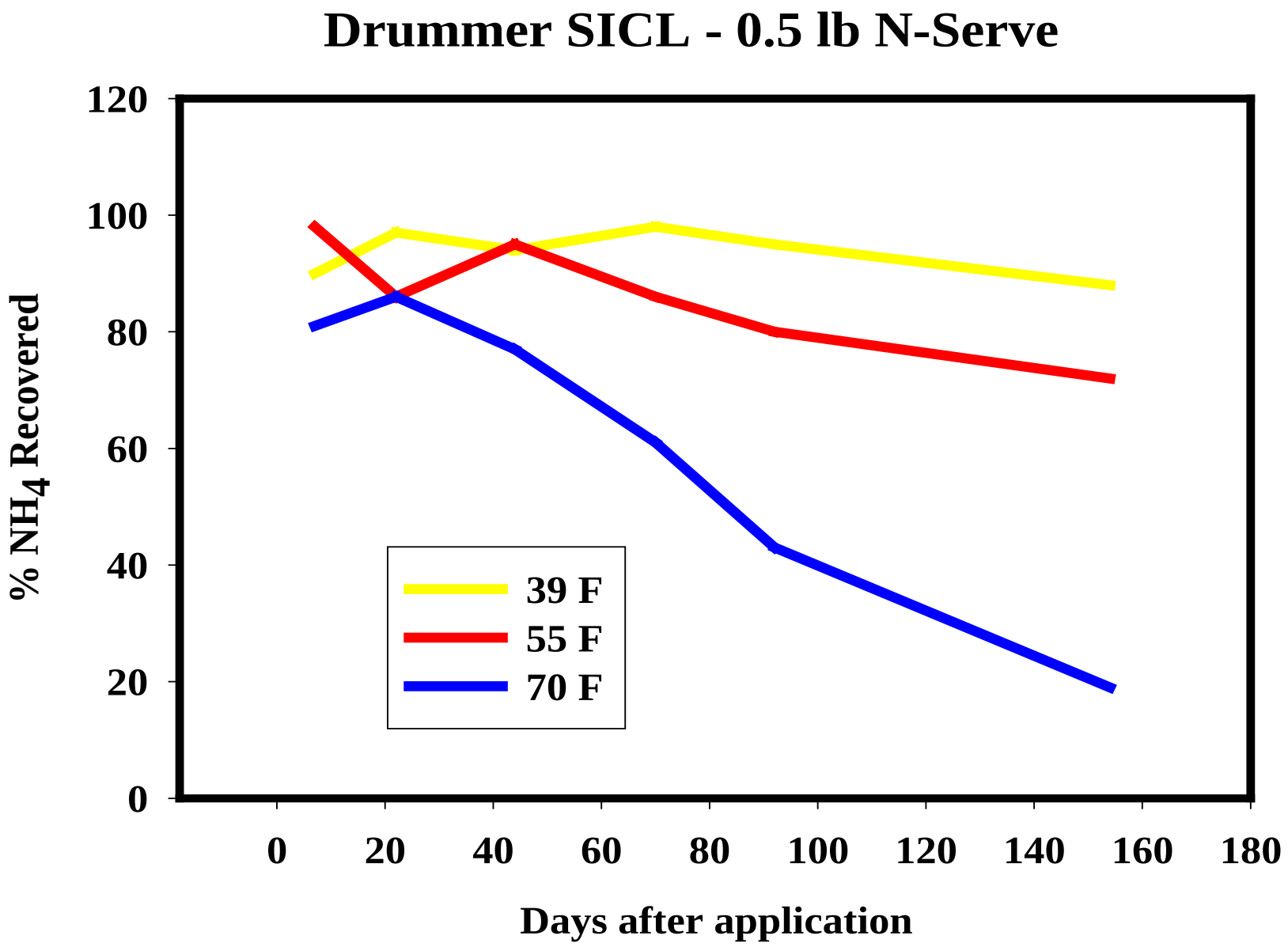
Fertilizer N, LB/ACRE

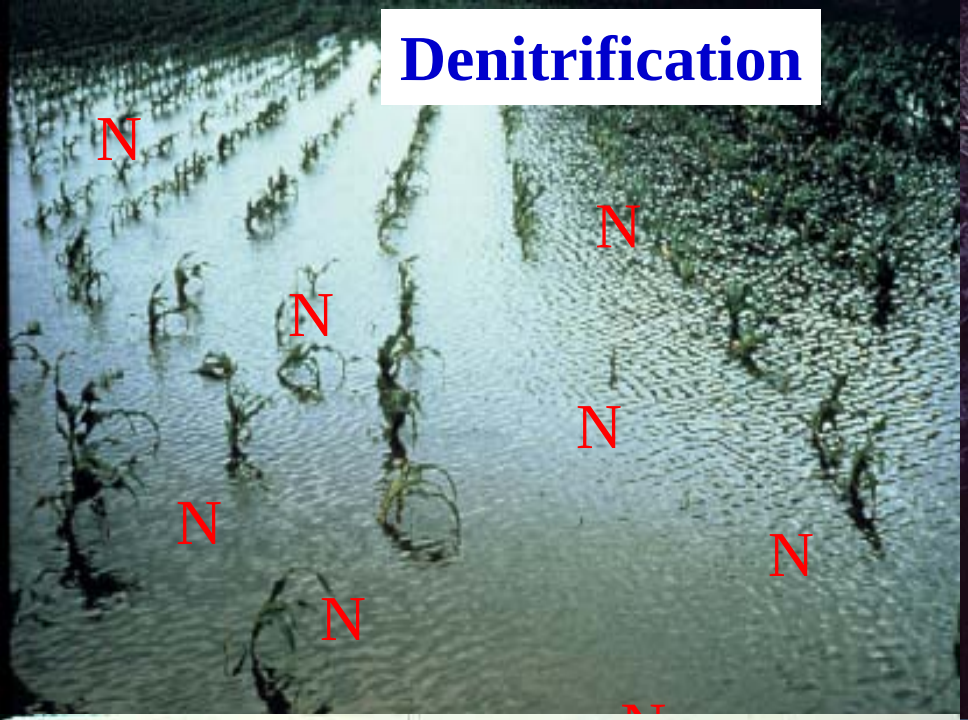
Year	0	60	120	180	240
	MINERALIZATION RATE, LB/ACRE				
1995	48	86	80	105	95
1996	70	103	119	124	166

No-Till Knowledge Is Power!
12th Annual National No-Tillage Conference
January 7-10, 2004
Des Moines, Iowa
NO-TILL FARMER


Organic Matter
Mineralization
Immobilization
Ammonium (NH_4)
Plant Uptake
Immobilization
Nitrification
Nitrite (NO_2)
Denitrification
Nitrate (NO_3)
Leaching


Drummer SICL - 0 N-Serve
100
80
60
40
20
0
% NH4 Recovered
39 F
55 F
70 F
0
20
40
60
80
100
120
140
160
180
Days after application


Drummer SICL - 0.5 lb N-Serve
% NH4 Recovered
120
100
80
60
40
20
0
0
20
40
60
80
100
120
140
160
180
Days after application
39 F
55 F
70 F

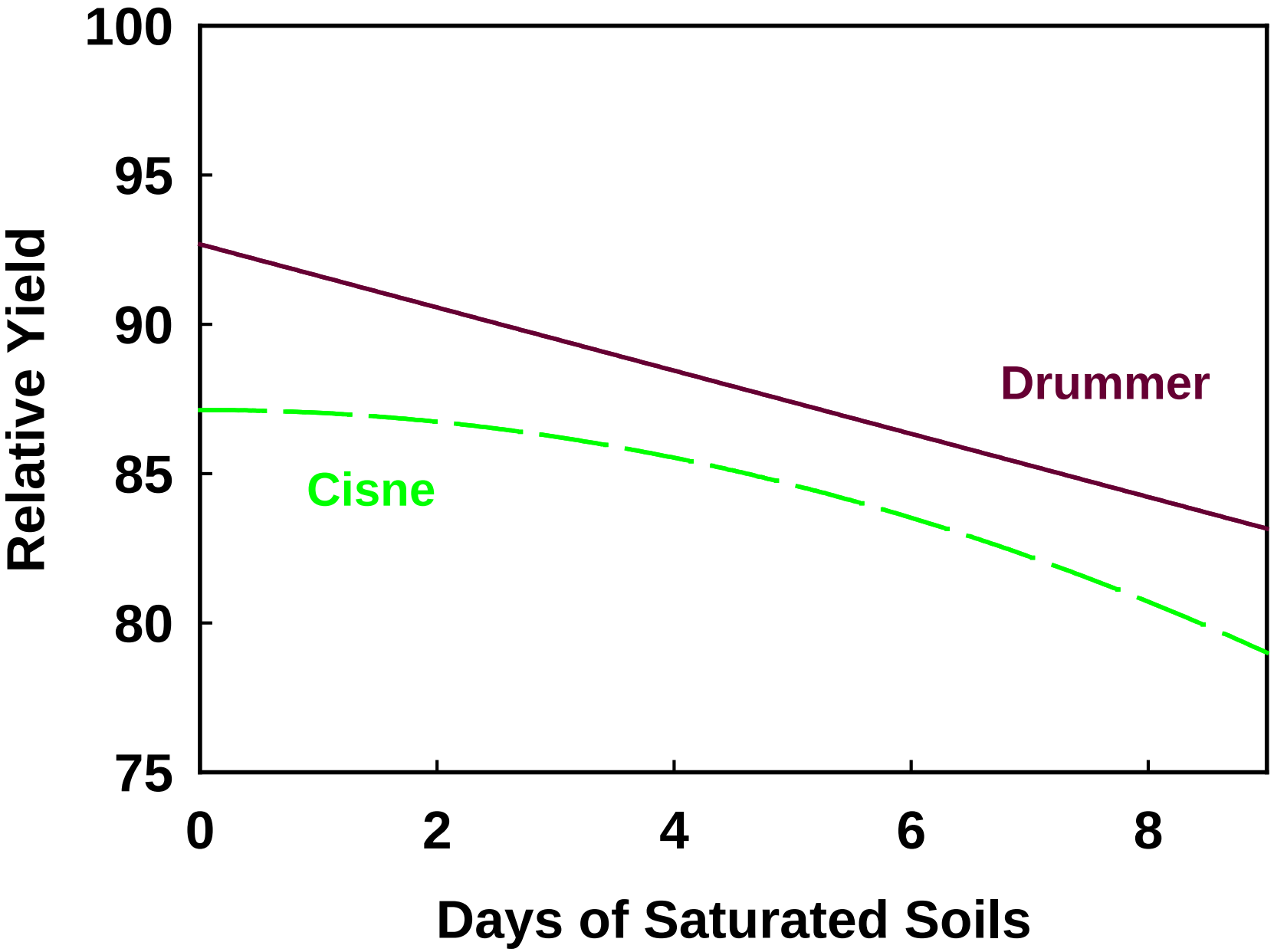

Denitrification
N
N
N
N
N
N


Leaching
NO_3
NO_3
NO_3


Volatilization


Immobilization


Denitrifiction


100
95
90
85
80
75
Relative Yield
Drummer
Cisne
0
2
4
6
8
Days of Saturated Soils

	Moisture Regime		
Depth (in.)	Ambient	Ambient + 4 in.	Ambient + 6 in.
		N (lb/acre)	
0-12	59 (22)	27 (26)	23 (19)
12-24	8	6	3
24-36	3	3	2
36-48	1	+	+
() designates organic N content			

LEACHING

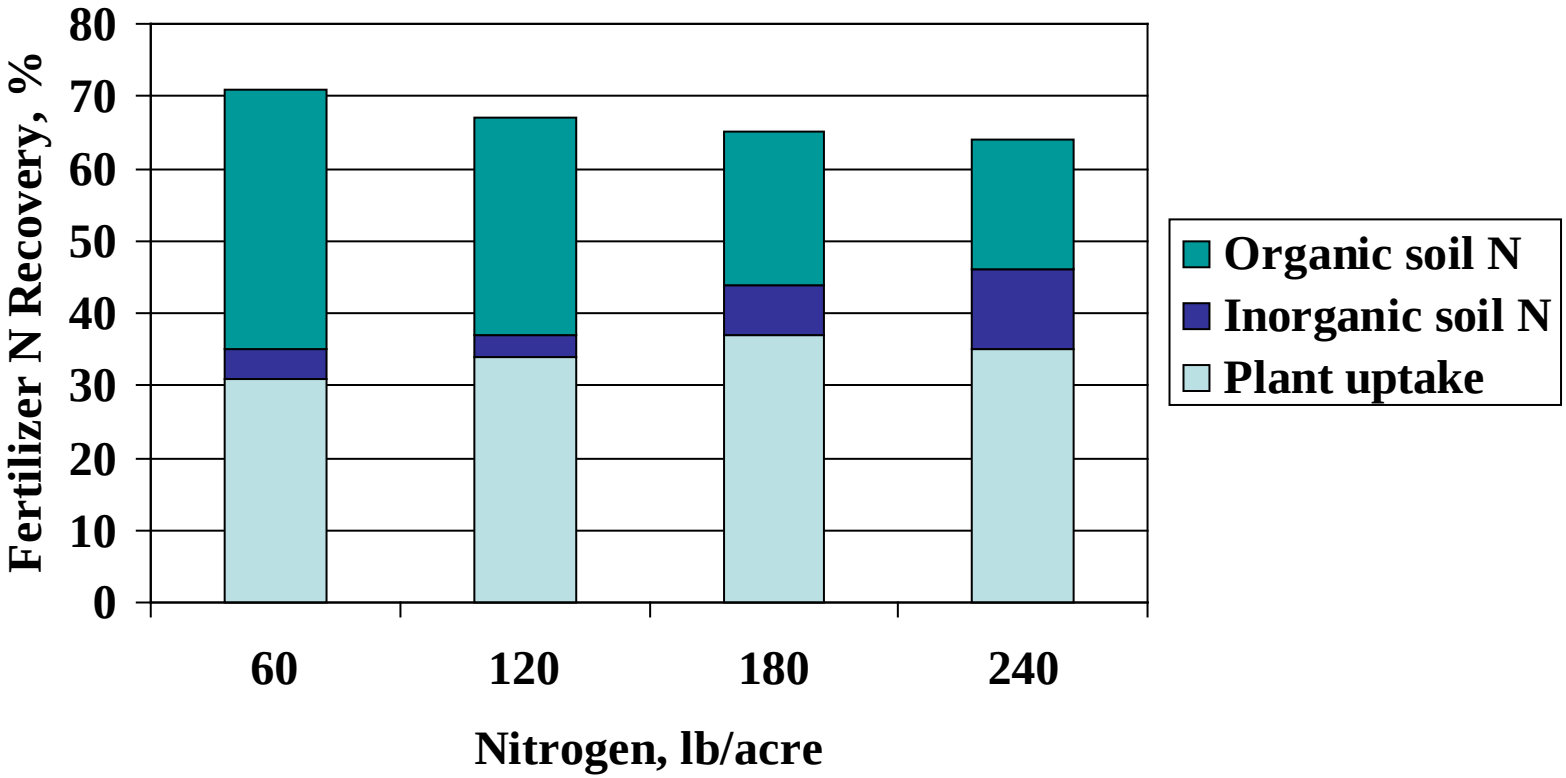
TREATMENT	2001	2002	2001	2002
	N LOSS LB/ACRE		WATER, A IN.	
0 N	7	36	2.8	19.0
140 N FALL	14	62	3.6	19.6
140 SP	10	53	3.2	22.7
210 FALL	12	80	2.8	20.9
210 SP	11	66	2.9	27.5

CORN YIELD

Treatment	2001	2002
	Yield, bu/acre	
0 N	68	91
140 N FALL	157	128
140 SP	159	147
210 FALL	169	143
210 SP	166	150

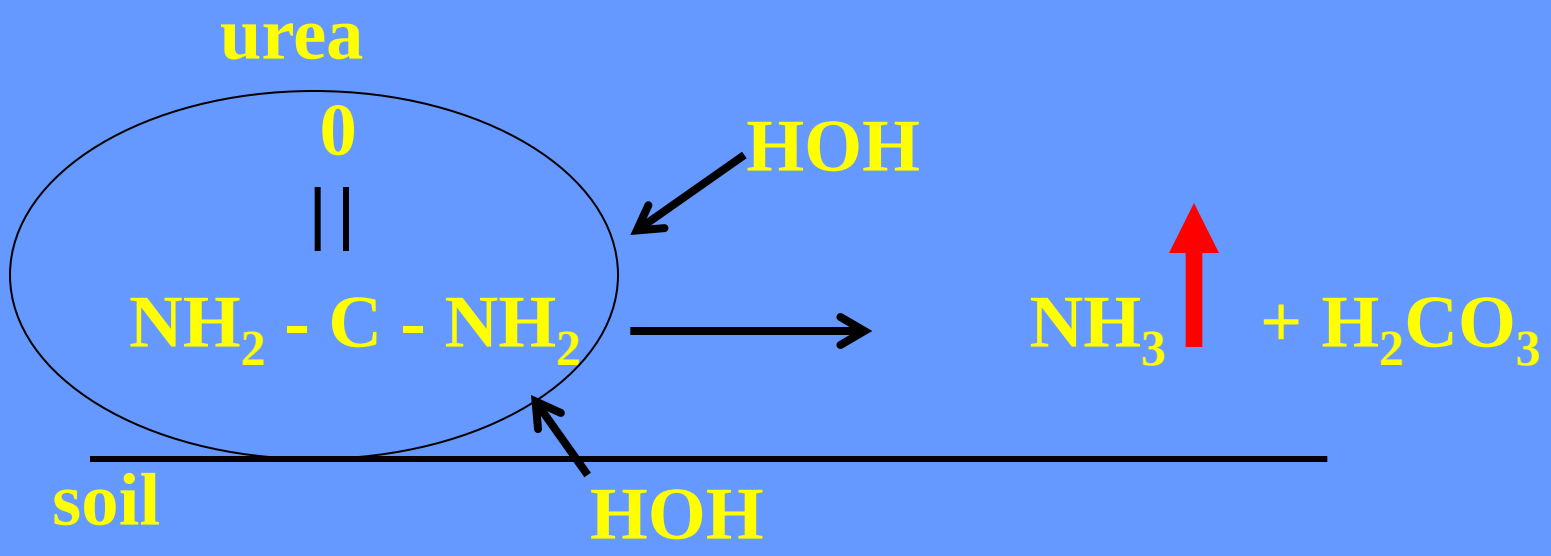

Immobilization

Fate of Fertilizer N




72
Volatilization

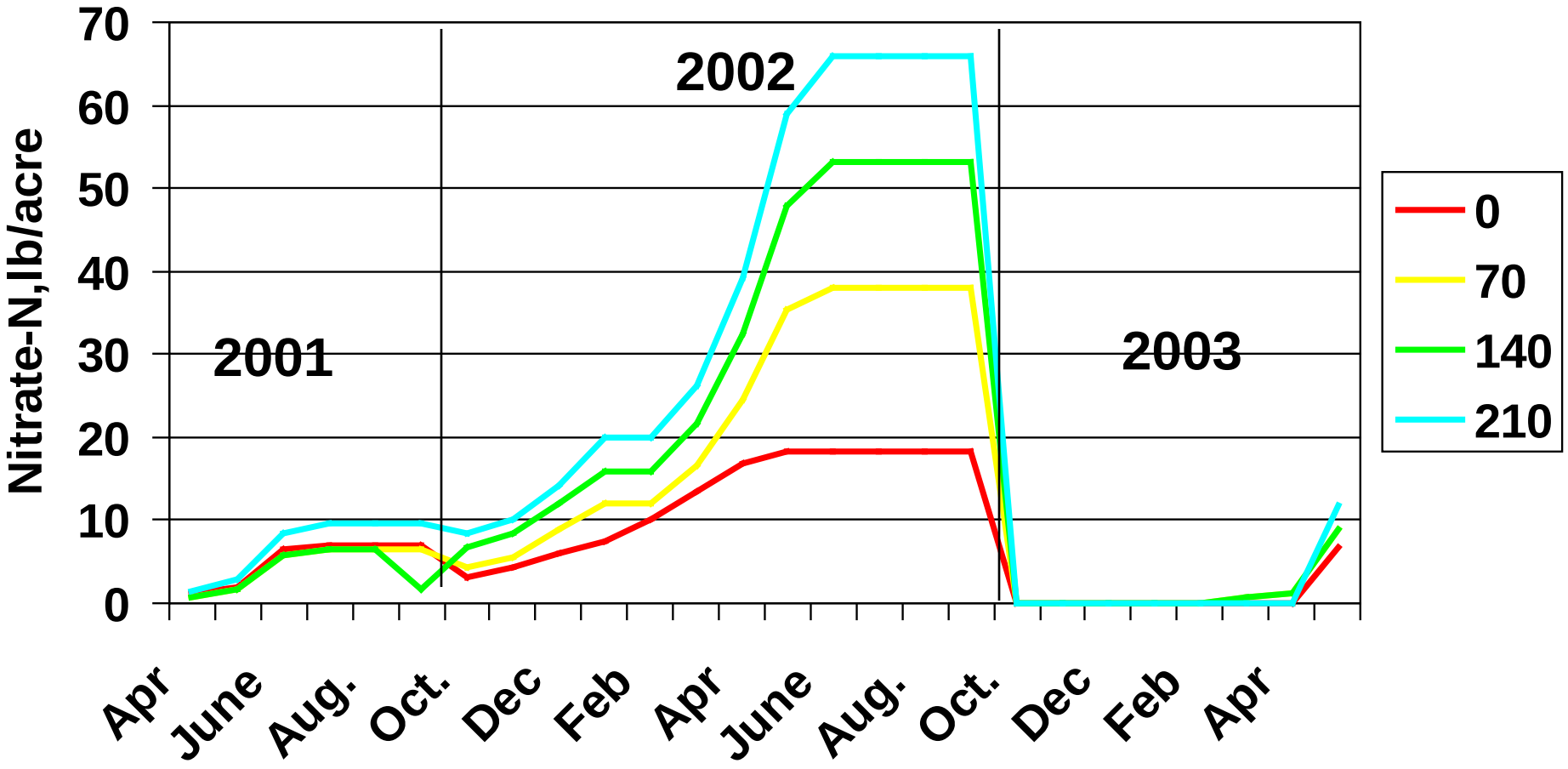
Urea Reaction



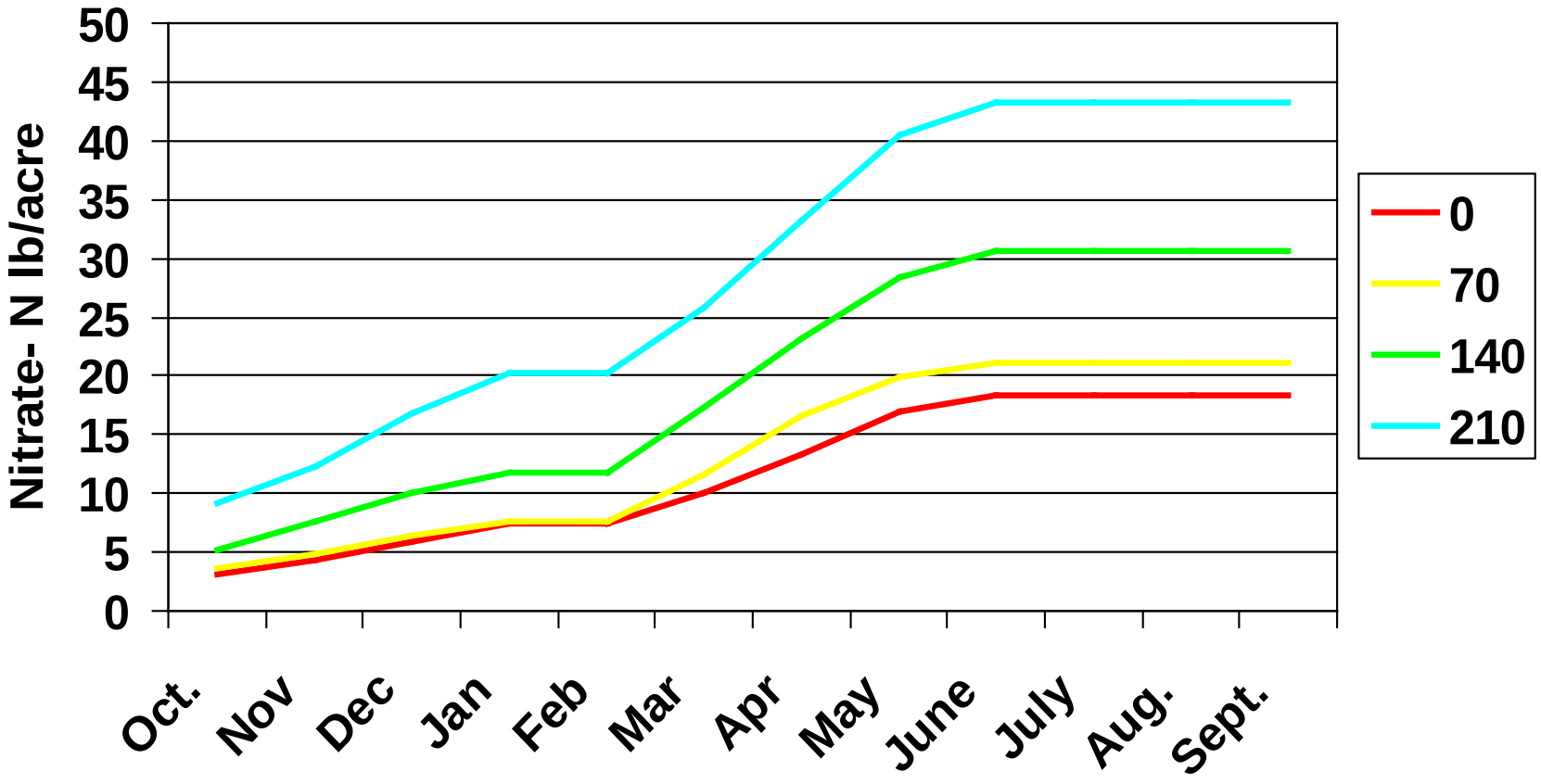
SPRING UREA APPLICATION

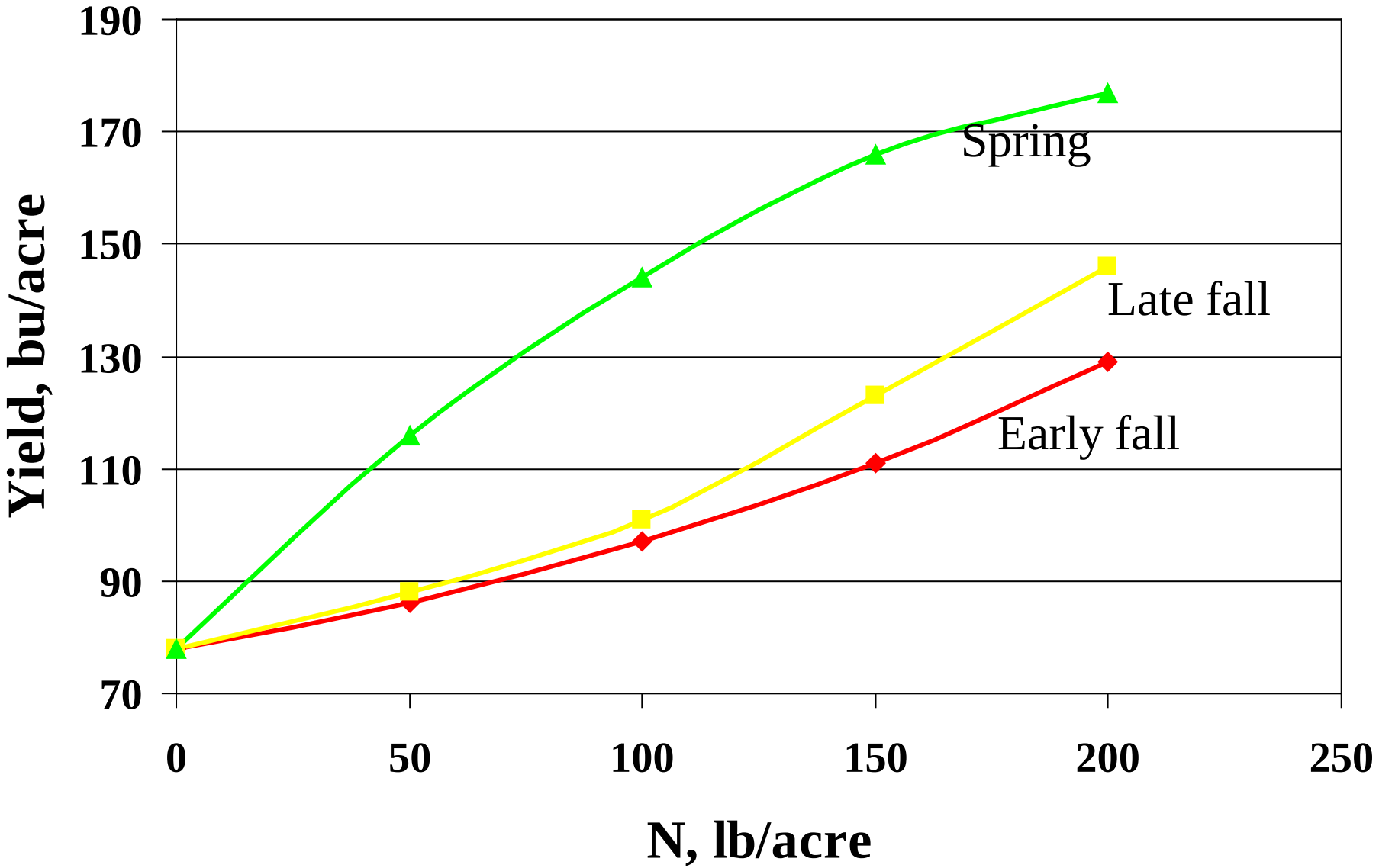
N, lb/acre	N Source		
	Ammonium Nitrate	Urea	Urea + AgrotaiN
	Yield, bu/acre		
0	60		
80	114	90	110
120	118	97	115
160	114	105	122

Spring Applied N

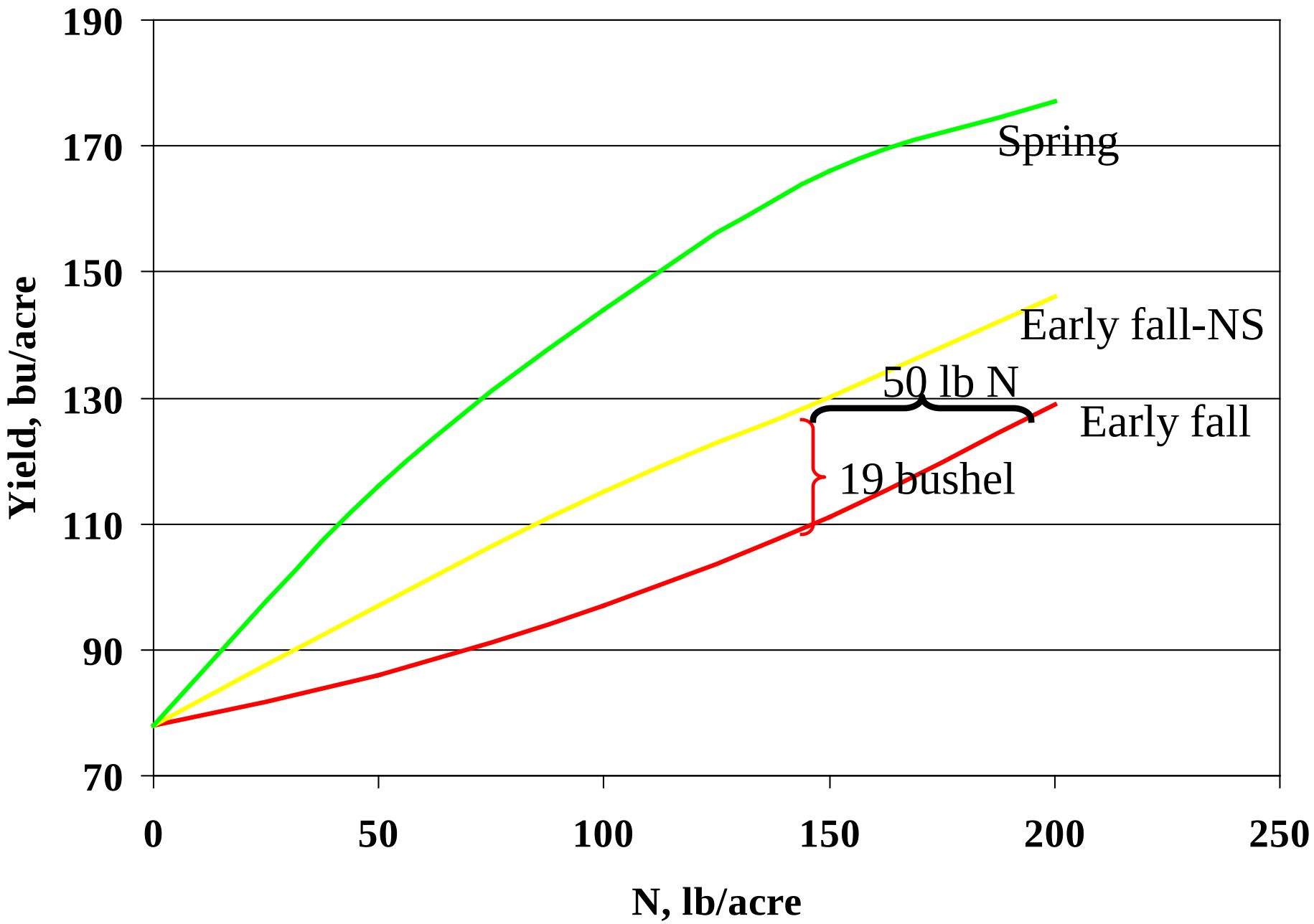


Soybean after corn




190
170
150
130
110
90
70
Yield, bu/acre
0
50
100
150
200
250
N, lb/acre
Spring
Late fall
Early fall

DeKalb 1979


190
170
150
130
110
90
70
Yield, bu/acre
0
50
100
150
200
250
N, lb/acre
Spring
Early fall-NS
50 lb N
Early fall
19 bushel

WHICH ONE?

AMMONIA

UREA-AMMONIUM NITRATE

UREA

AMMONIUM SULFATE

AMMONIUM NITRATE


CAUTION
AMMONIA

Soil Physical Properties

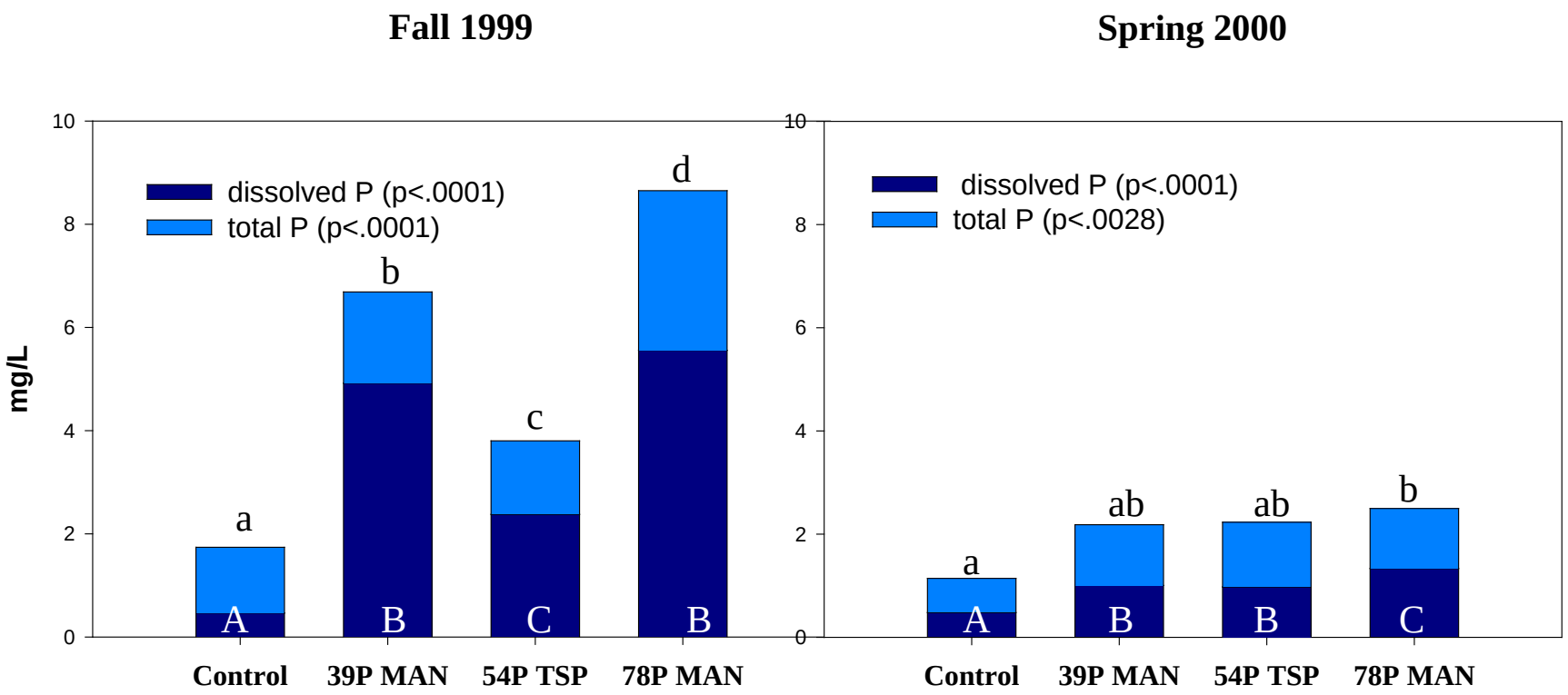
Nitrogen Source	Hydraulic Conductivity	Probe Resistance	Bulk Density
	in./hour	kg/cm^2	g/cm^3
None	2.5	8.9	1.31
Anhydrous ammonia	1.6	9.9	1.34
Ammonium nitrate	1.8	10.2	1.30
Urea	2.1	9.9	1.31
UAN	1.5	7.6	1.31

Winter Urea Application???

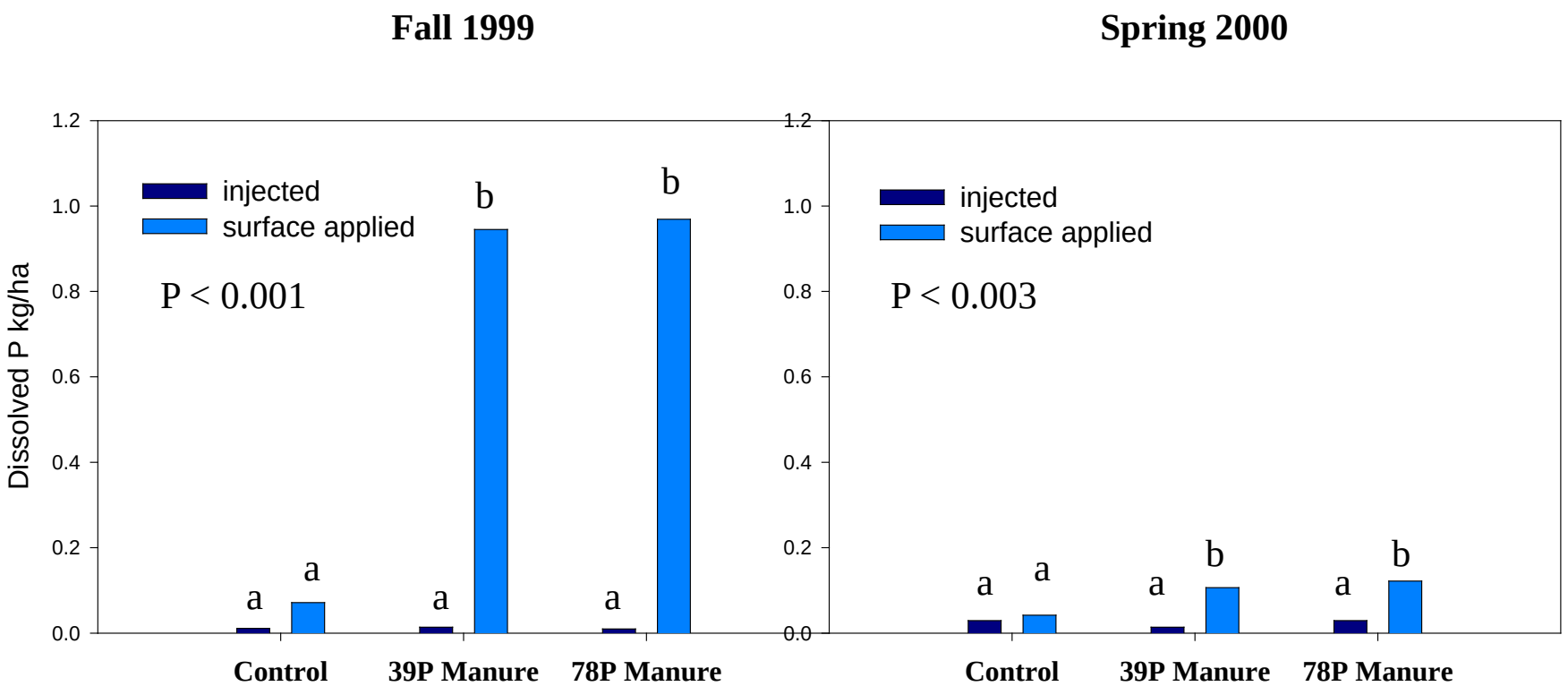
	N (lb/acre)			
Urea application	0	120	180	240
	Yield (bu/acre)			
Winter- surface	89	94	123	126
Spring-incorporated		149	157	165

Phosphorus chemistry

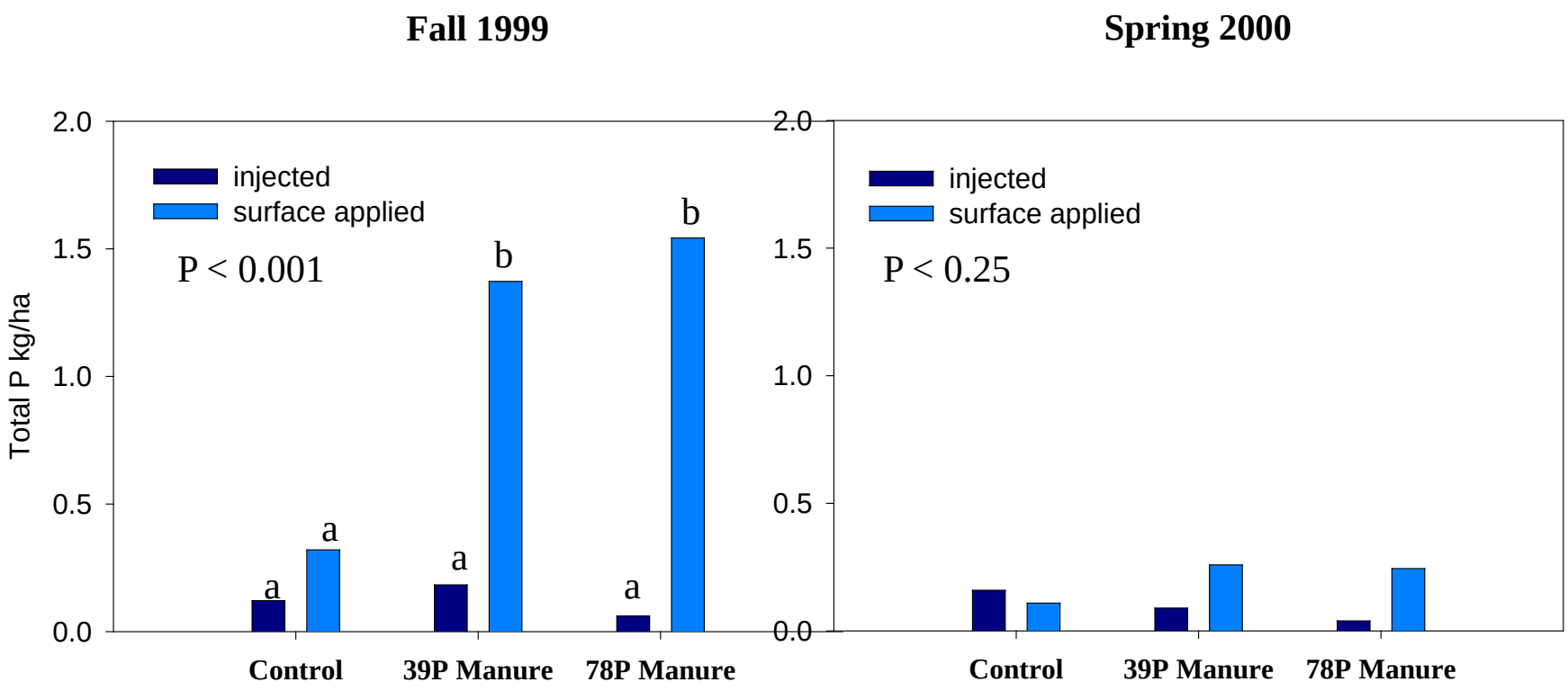
Effect of surface applied phosphorus sources on the **concentration** of dissolved and total P in surface runoff



Effect of injected and surface applied manure on the amount of **dissolved** P loss



Effect of injected and surface applied manure on the amount of **total P** loss



Results I

Comparison between surface applied fertilizer and manure:

•Both manure rates produced the highest concentrations and amounts of DP and TP in runoff in fall.

•In spring, differences between treatments decreased and so did the amounts and concentrations of P.

Injected vs. surface application on P loss:

•Injected manure was similar to the control in spring and fall

•Surface applied manure produced great amounts of DP and TP in runoff, especially in fall.

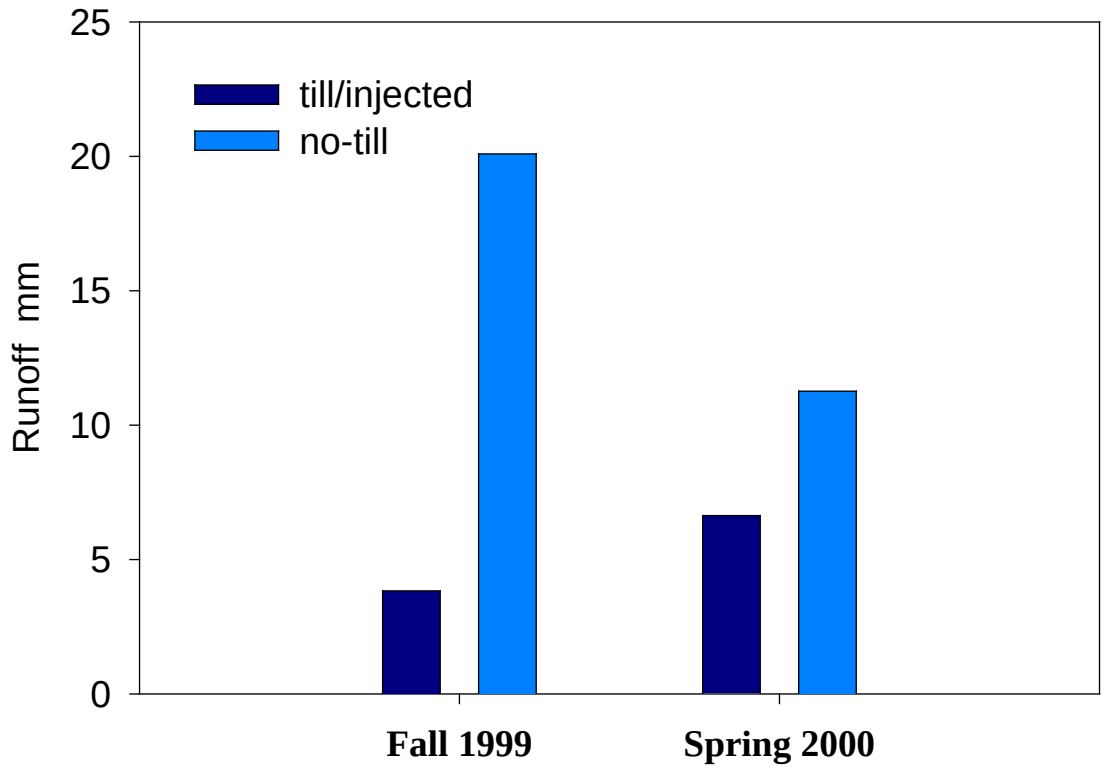
•In spring, no differences were observed for TP while there were still significant differences for DP.

Objectives II

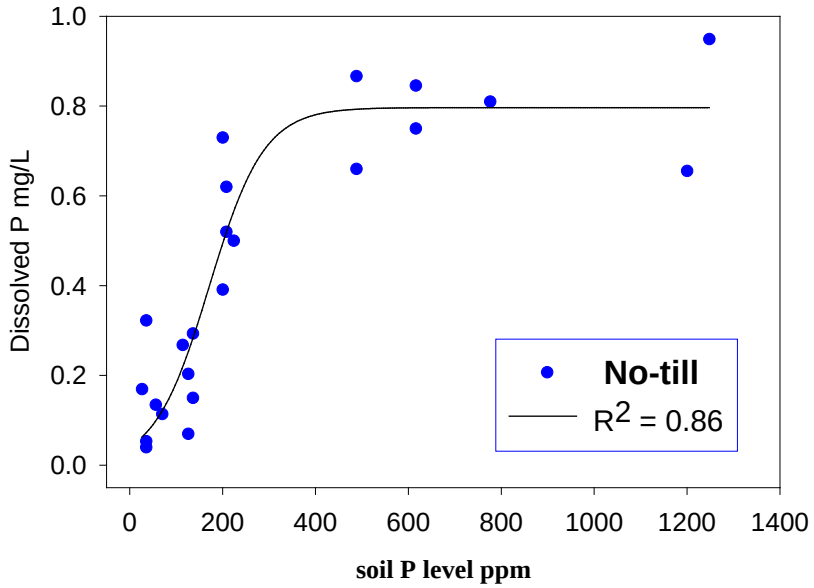
•Determine the effects of a wide range of soil P levels on the concentration and amounts of dissolved and total P loss

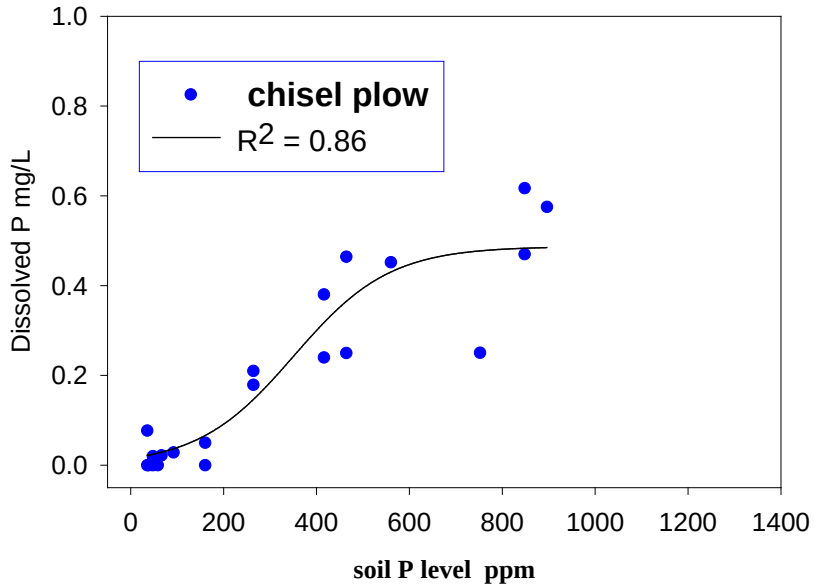
• Compare the effects of chisel plow and no till on P runoff.

Effect of tillage on volume of runoff

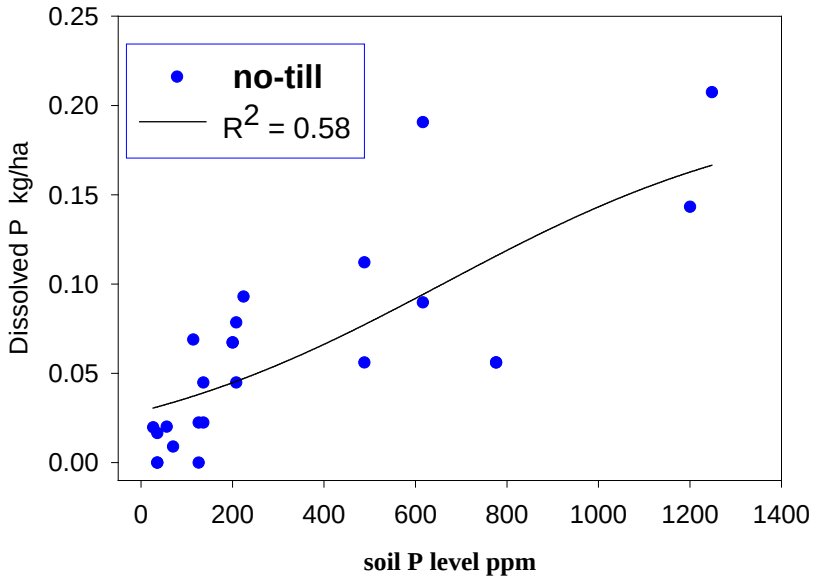


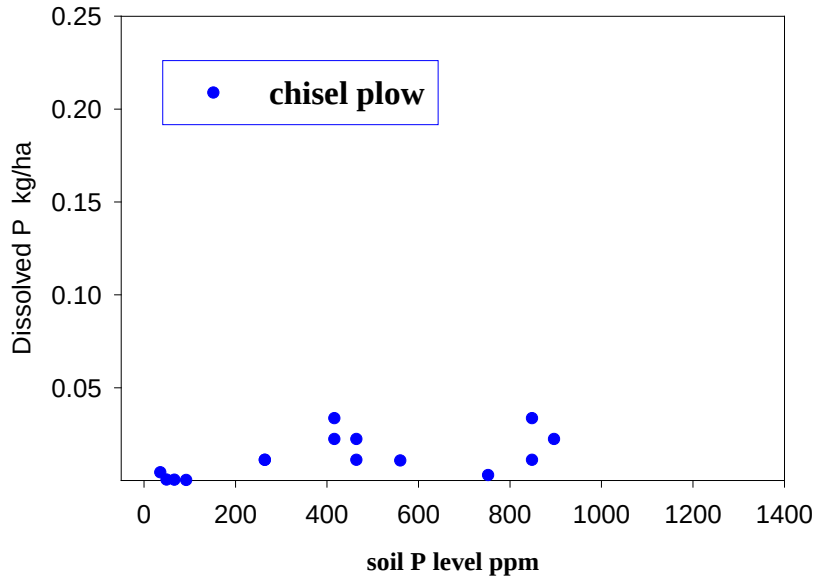
Effect of the soil P level and tillage method on the **concentration** of dissolved P in fall and spring runoff





Effect of the soil P level and tillage method on the **amount** of dissolved P in fall and spring runoff



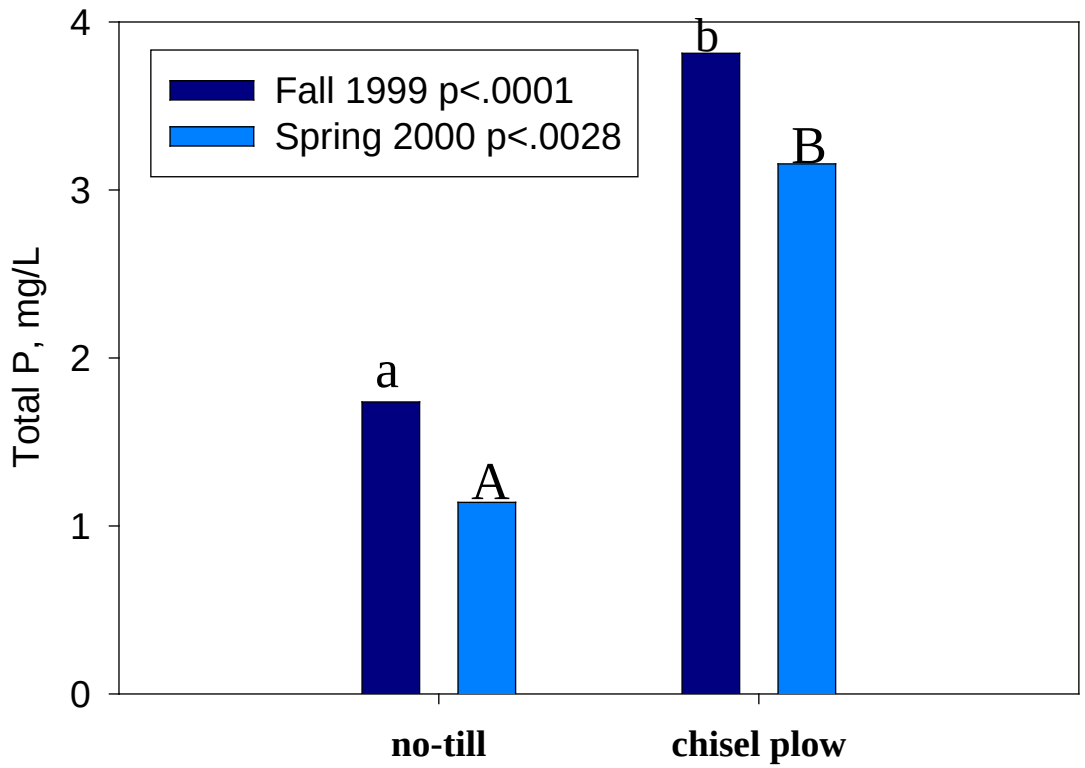


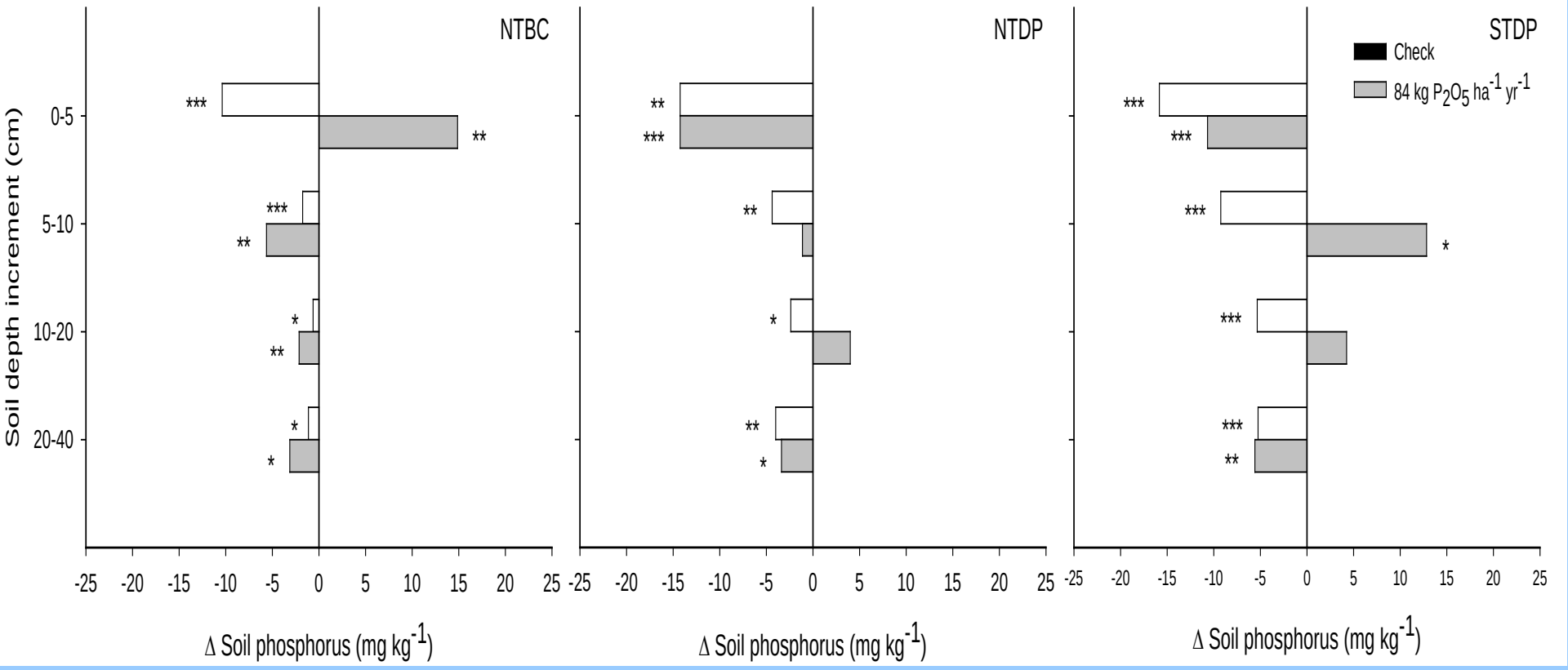
SOIL TEST P BY DEPTH ACROSS SOIL SUPPLYING POWER REGIONS 2007-2008

SAMPLE DEPTH	P SUPPLYING POWER REGION		
IN.	HIGH	MEDIUM	LOW
	MG/KG		
0-3	71	65	56
3-7	51	38	28

Fabian Fernandez

Effect of the no-till and chisel plow on the concentration of total P in spring and fall




NTBC
NTDP
STDP
Check
84 kg P_2O_5 ha^{-1} yr^{-1}
Soil depth increment (cm)
0-5
5-10
10-20
20-40
-25 -20 -15 -10 -5 0 5 10 15 20 25
Δ Soil phosphorus (mg kg^{-1})

Results II

Effect of soil P levels on the concentration and amounts of DP and TP loss

• Dissolved P concentrations and amounts were significantly correlated to the soil test P concentrations.

• No correlation between soil P levels and total P loss.

Effects of chisel plow and no-till on P runoff

• Concentrations of dissolved P were higher in runoff from no-till plots than from tilled plots in both fall and spring rainfall simulations

• Concentrations of total P were higher in runoff from chisel plow plots than from no-till plots in both fall and spring.

Summary

- Incorporation of manure or fertilizer P greatly reduces P runoff.

- Surface application of manure produces great runoff losses, more than P inorganic fertilizers when applied at the same rate.

- When no fertilizer is applied, chisel plowing the field produced less dissolved P runoff than no-till. However, total P concentration is higher from chisel plow fields compared to no-till fields.

SUMMARY

- **Use of BMP's will enhance production and maintain or enhance soil quality**
- **Maintenance of soil pH at the level that results in optimum crop production will enhance the biological activity of soils and thus enhance soil quality**
- **Preponderance of evidence indicates that use of the correct rate, time of application, and source of N fertilizer will maintain soil organic matter**
- **Failure to replenish soil nutrients, particularly N, will result in decreased soil quality**