LONG-TERM N FERTILIZATION EFFECTS ON CORN YIELD AND SOIL PROPERTIES

Larry G. Bundy
Dept. of Soil Science
University of Wisconsin

BACKGROUND

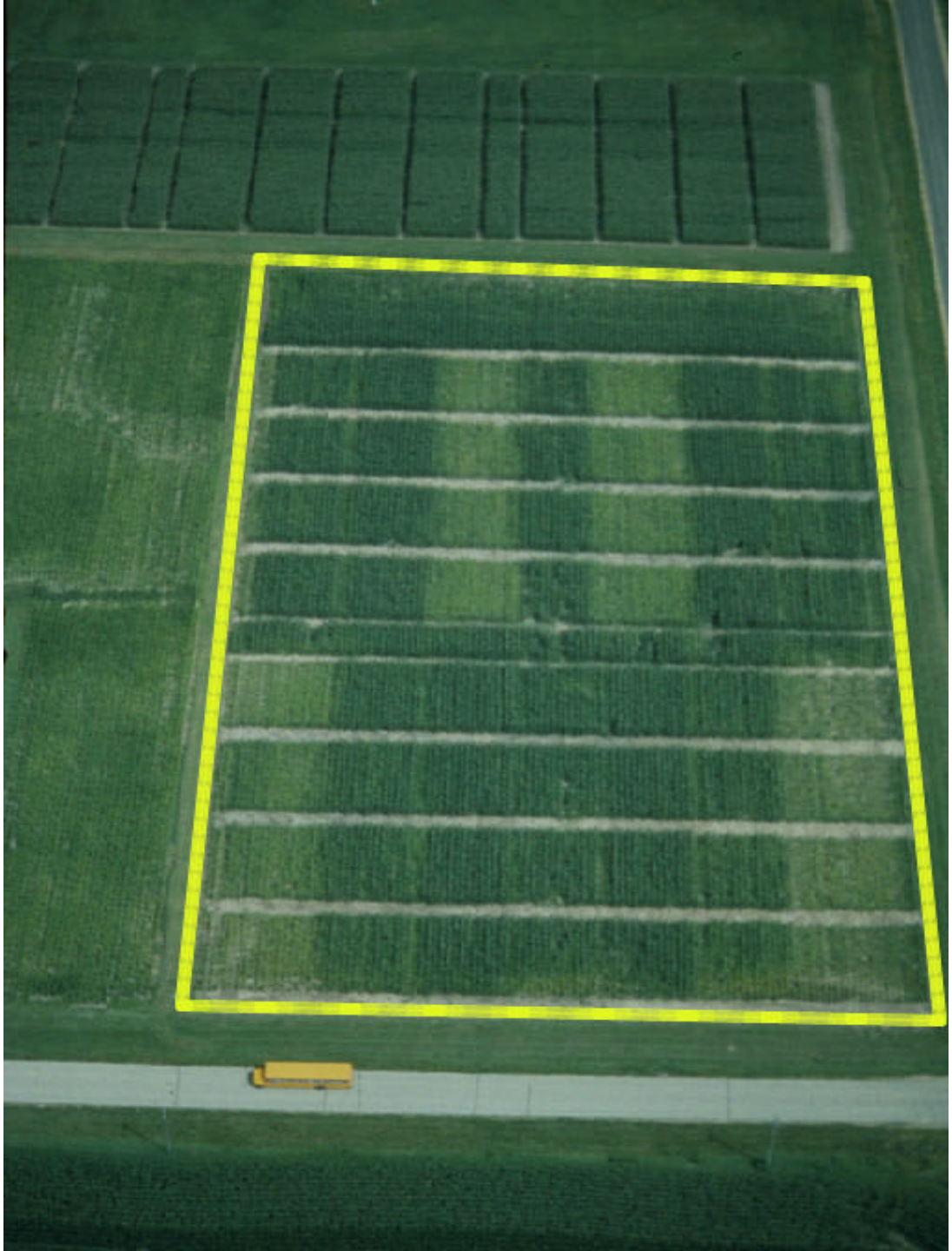
- **Experiment**: Long-Term Continuous Corn - N Rate Experiment (1958 – 2003)
- **Location**: University of Wisconsin Arlington Agricultural Research Station
- **Soil**: Plano silt loam

MANAGEMENT PRACTICES

- Corn grown annually since 1958, grain removed, residues returned
- Moldboard plow tillage
- Since 1984, 30-inch rows, 32,000-35,000 seeds/acre.
- Starter fertilizer (2-in x 2-in) annually, 200 lb/acre of 6-24-24

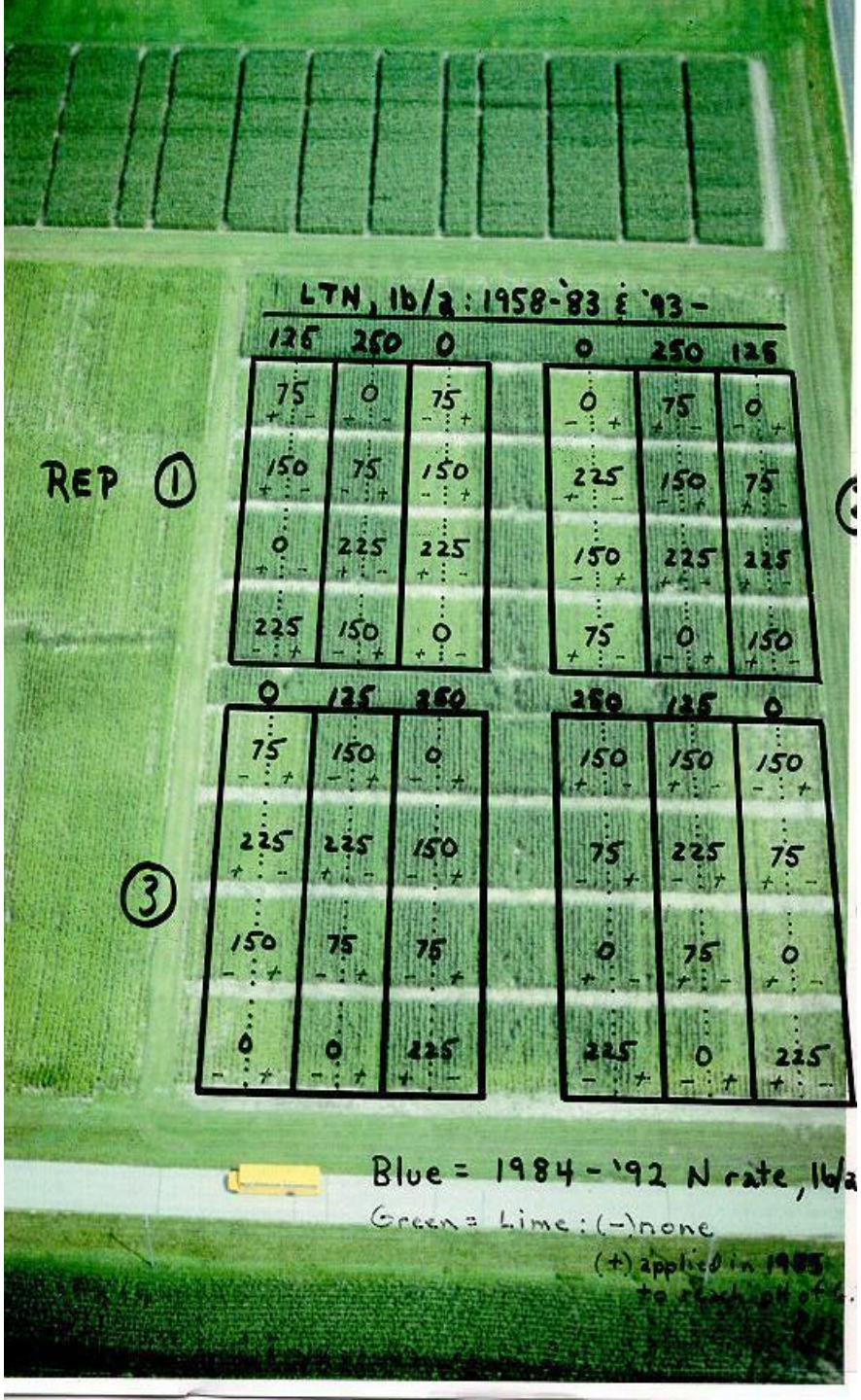
TREATMENTS

- N Rates: 1958-2002, none, medium, high (see Table for rates).
- Lime: Imposed in 1985, Lime applied to half of each long-term N plot to reach target pH range of 6.5-7.0.
- Design: Randomized complete block, four replications, split-plot treatment arrangement to accommodate lime treatments.



Nitrogen rates in long-term continuous corn experiment, Arlington WI, 1958-2002

	Long-term N fertilizer rate, lb N/acre		
Years	None	Medium	High
1958-1962	0	50	100
1963-1983	0	80-125	160-250
1984-1992	0	75-150	150-225
1993-2002	0	125	250


LTN, lb/a: 1958-'83 & '93-
125 250 0
0 250 125
REP ①
75 0 75
150 75 150
0 225 225
225 150 0
0 75 0
225 150 75
150 225 225
75 0 150
0 125 250
250 125 0
③
75 150 0
225 225 150
150 75 75
0 0 225
150 150 150
75 225 75
0 75 0
225 0 225
Blue = 1984 - '92 N rate, lb/a
Green = Lime: (-) none
(+) applied in 1985

Long-term N and lime treatment effects on total nitrogen and carbon in soil*

N rate	Lime	Total N	Total C
lb/acre		---------- % ----------	
0	yes	0.158	1.792
0	no	0.160	1.818
125	yes	0.202	2.297
125	no	0.187	2.058
250	yes	0.193	2.175
250	no	0.198	2.129

* Measured in 1997. Soil organic matter = 50-58% C

Effects of long-term N rates and lime on soil pH and CEC in continuous corn, 1999.

Location	N rate	Lime	pH	CEC
	lb/a			cmol(+)/kg
Arlington	0	No	5.64	17.78
	0	Yes	6.50	19.18
	250	No	4.91	14.19
	250	Yes	6.28	21.45

Effect of long-term N rate and lime treatments on corn grain yield, Arlington, WI, 1985 to 2002.

Long-term N rate	Lime		
	Without	With	Mean
	--------- Grain yield, bu/acre ---------		
None	63	73	68 b
Medium	163	169	166 a
High	165	175	169 a
Mean	130 b	139 a	

Effects of long-term N rates and lime on corn yields in the Arlington experiment, 1985-2002

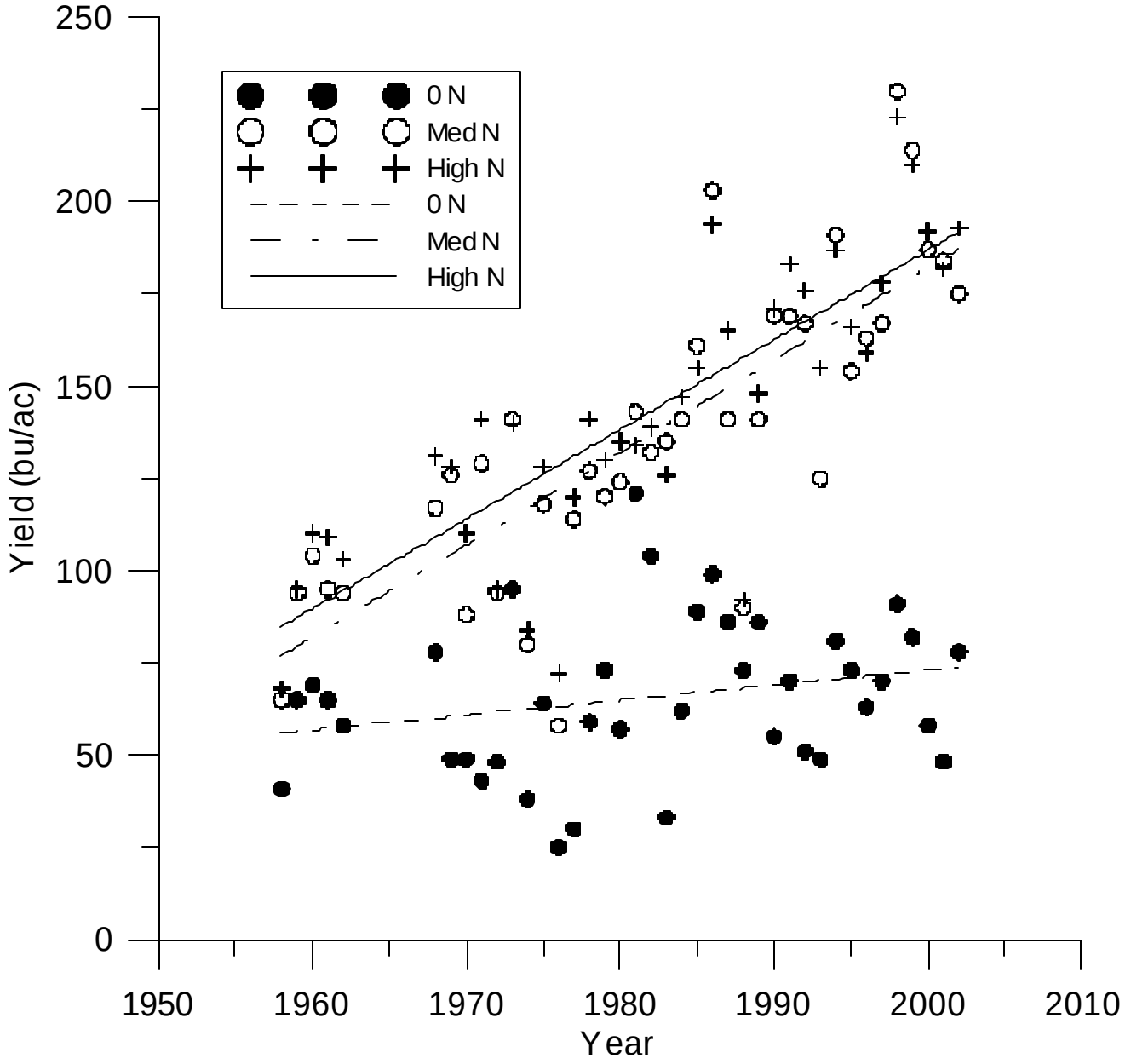
Treatment	Yield effect
N rate (N)	Increase 18 of 18 yr.
Lime (L)	Increase 12 of 18 yr.
N x L	Effect 4 of 18 yr.

Corn yields for several periods in long-term N experiment (1958-2002), Arlington, WI

Year	Long term N rate		
	None	Medium	High
	---------- Yield, bu/acre ----------		
1958-1962	60	90	97
1968-1977	52	107	115
1978-1987	78	148	153
1988-1998	65	156	162
1999-2002	60	188	186

* Yields are means of limed and unlimed treatments

Continuous corn grain yields with three long-term N fertilizer rates, 1958-2002, Arlington WI.



Summary

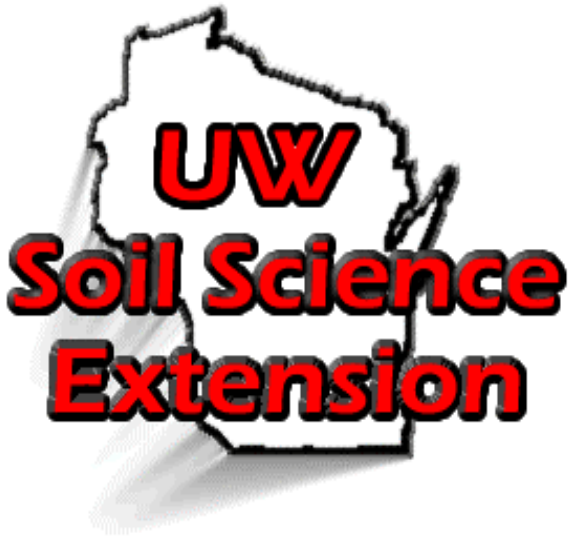
- Long-term N fertilizer use in continuous corn production increased soil organic C and N content and N availability
- Soil pH and CEC decreased in unlimed, N-fertilized treatments, but increased where recommended lime applications were made

Summary

- Corn yields were increased by applied N each year and were usually increased by liming.
- Lime and N treatments usually influenced yield independently.

Summary

- Corn yields increased dramatically over time with long-term N fertilizer additions.
- Results provide no indication of a decline in productivity after 45 years of N fertilizer use in continuous corn production.



UW Extension

Agriculture & Natural Resources

Summary

- Yields increased over time with added N
- Soil pH and CEC decreased without lime
- Soil organic C and N increased with added N
- Excess N partly immobilized in organic matter
- Higher N availability (mineralization) in N fertilized treatments

Nitrogen Recommendations for Corn

	Sands & loamy sand		Other soils	
			Yield Potential	
Organic Matter	Irrigated	Non-irrigated	Med/low	V. 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