

Economics of Nitrogen Fertilization Crop Rotation

Dr. John Sawyer

Soil Fertility Extension Specialist

Department of Agronomy

Iowa State University

Nitrogen Issues

❖ High N prices

- High natural gas price
- High crude oil price
- Shutdown of U.S. ammonia production
- Nitrogen producers finances
- Product supply “just-in-time”
- World fertilizer market
- Price spread between N products

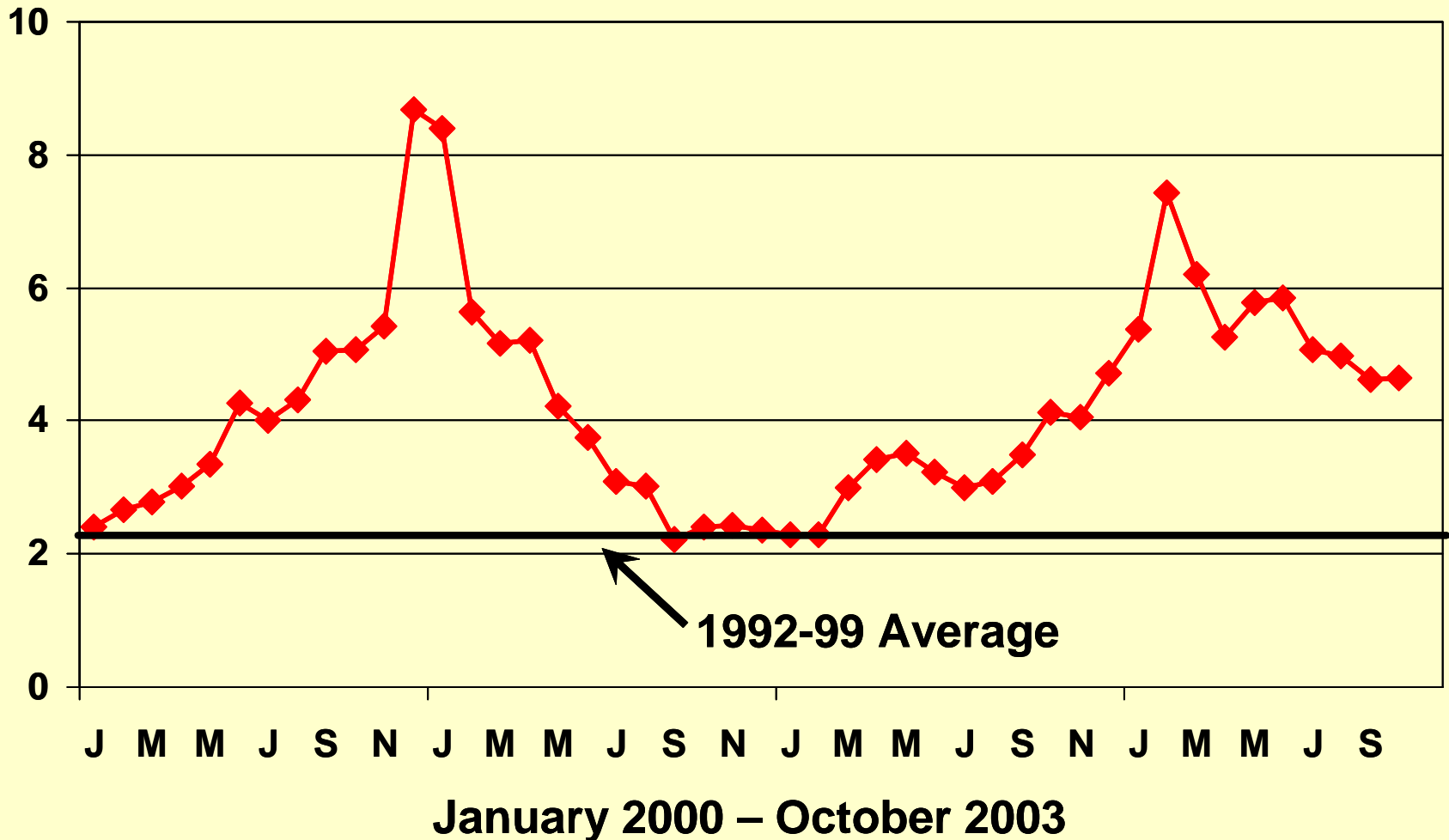
❖ Increased corn acreage

❖ Regulatory/Safety/Environment

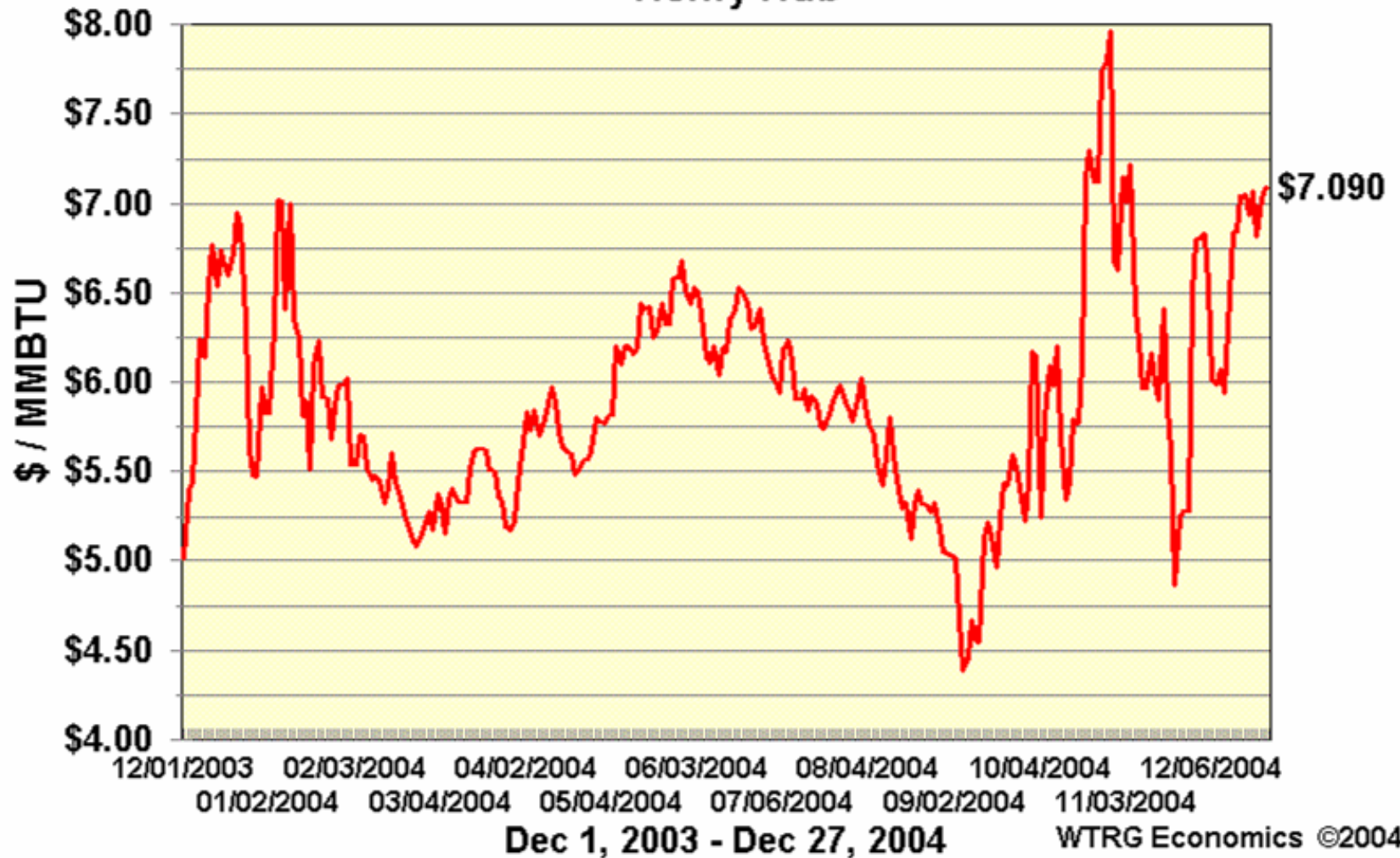
U.S. Natural Gas Prices

\$ Per MMBtu

Henry Hub Average Daily Price



Natural Gas Spot Henry Hub

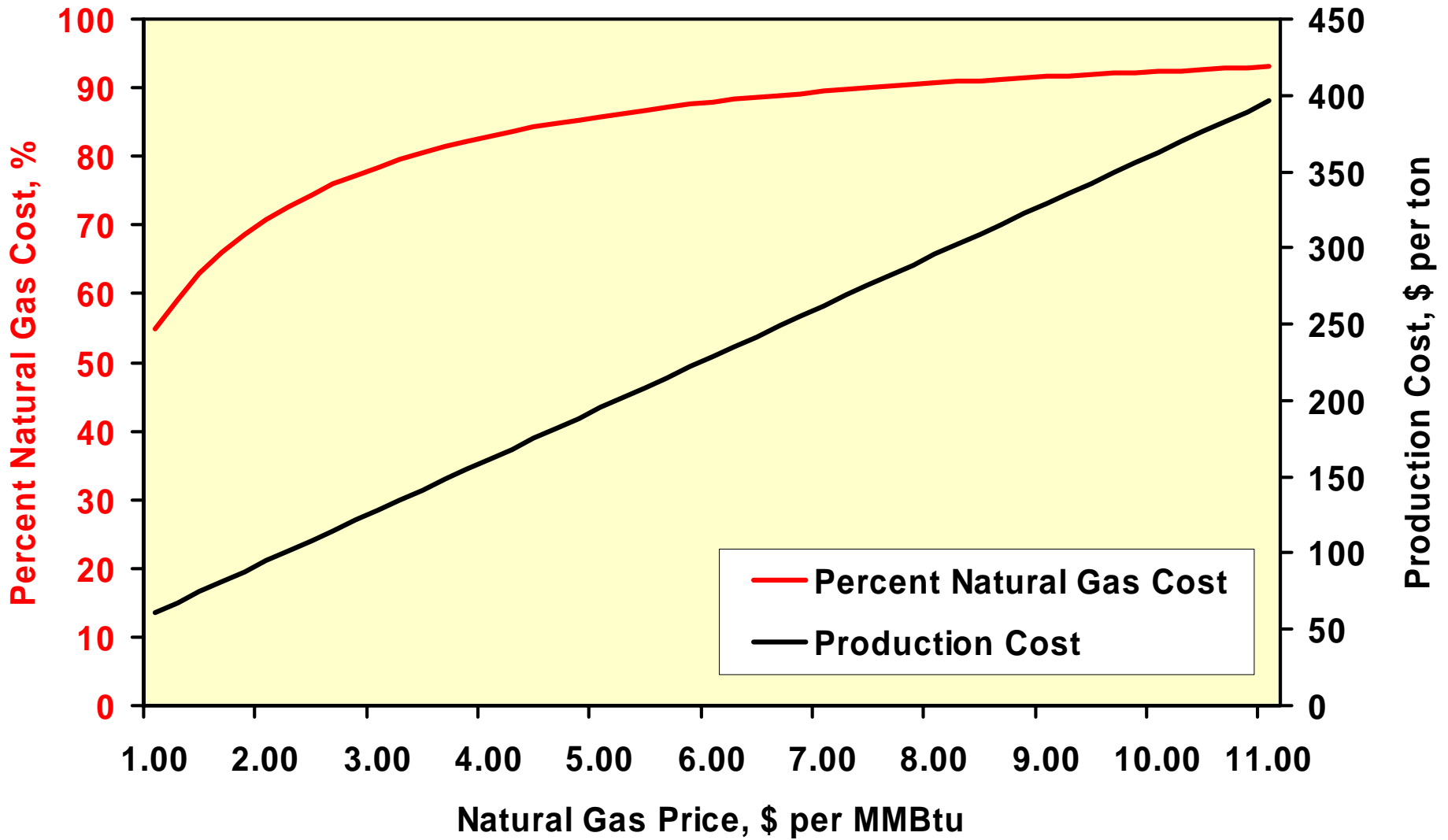


— Close

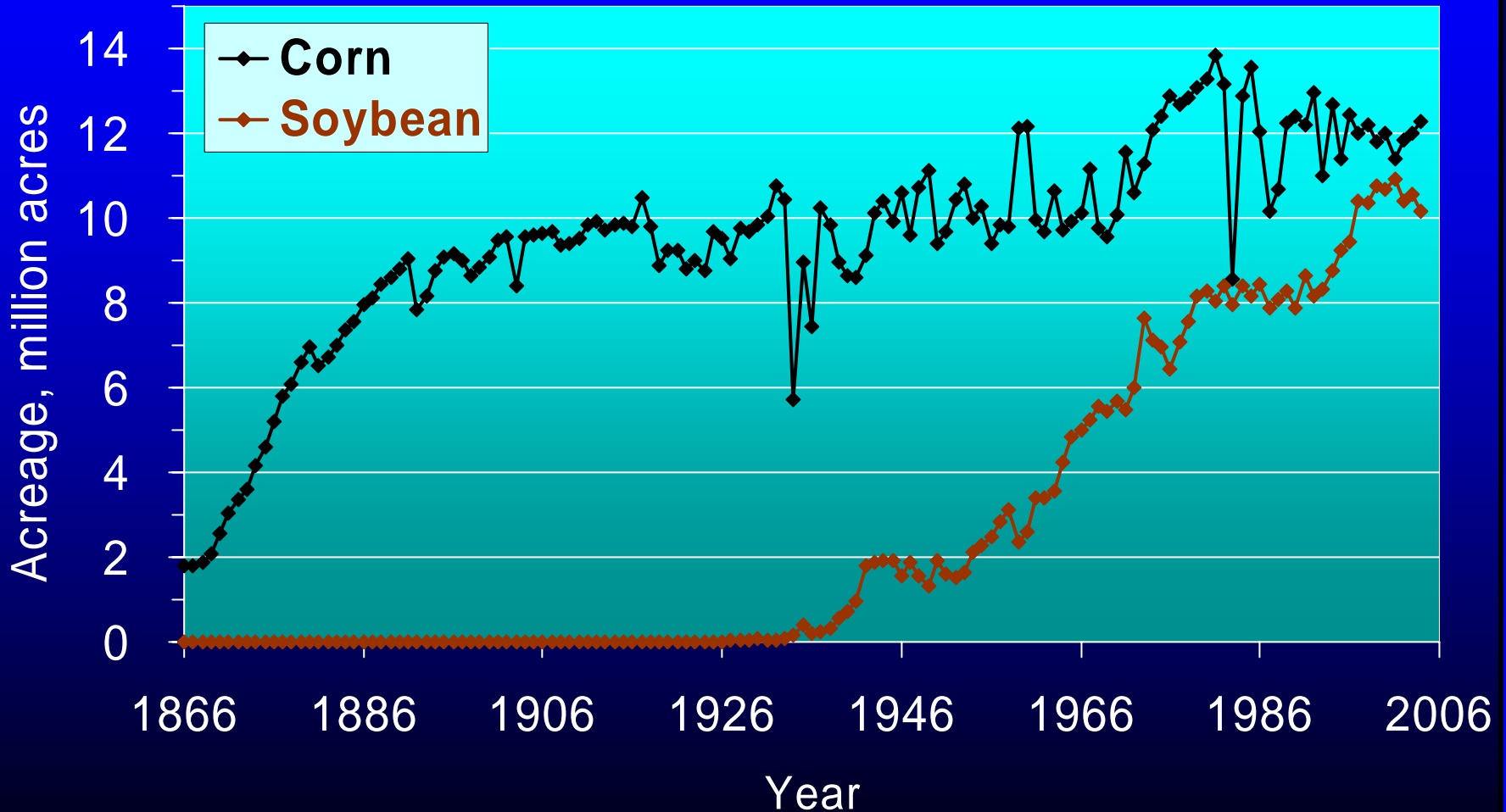
WTRG Economics ©2004
www.wtrg.com
(479) 293-4081

Ammonia Production Cost

1999 Base Year Cost: Adapted from TFI



Annual Corn and Soybean Acreage Harvested for Grain In Iowa



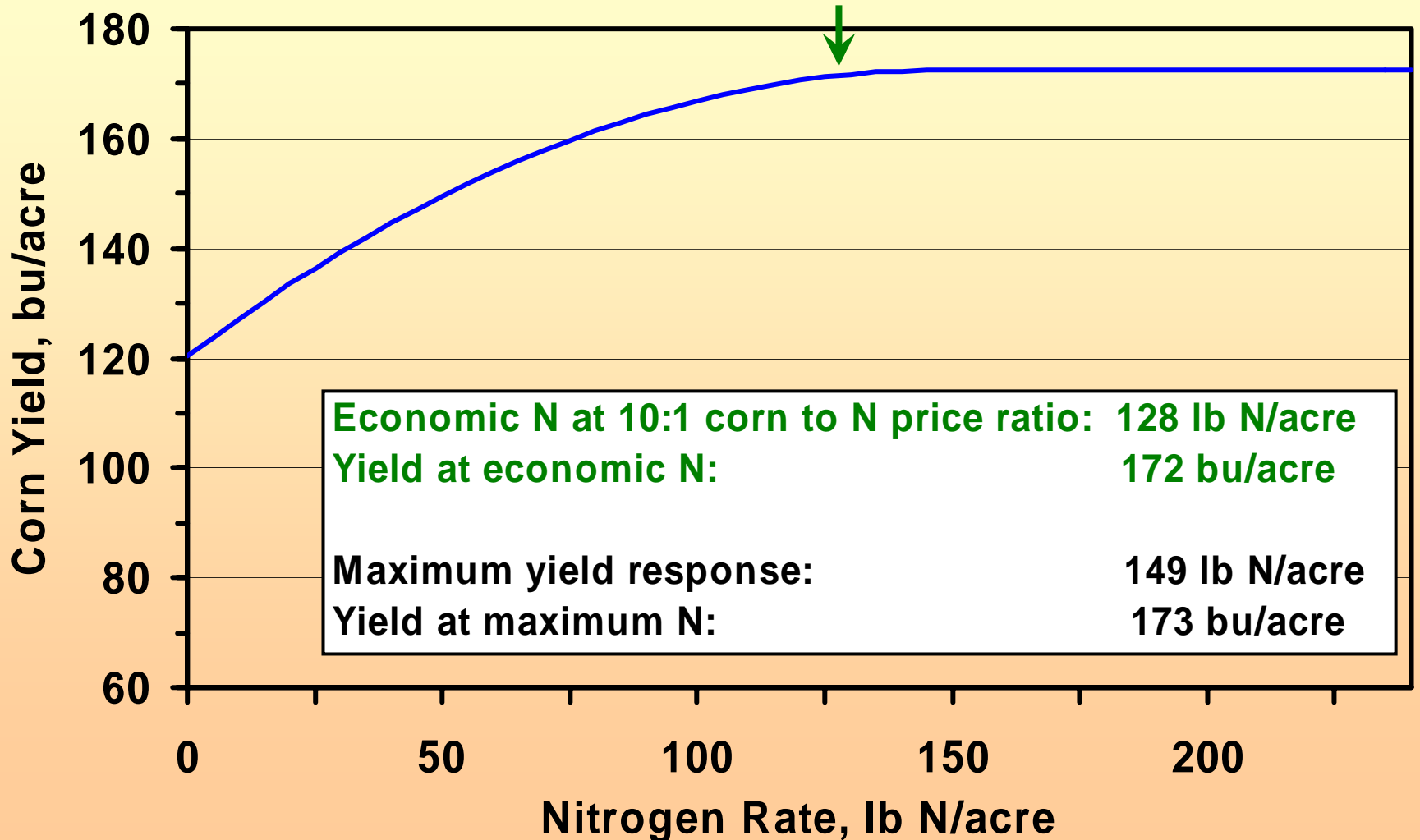
Economic N Rate for Corn Production

- ❖ **What is it?**
- ❖ **Risk management?**
- ❖ **Estimate an unknown future?**
- ❖ **Effect of N to Corn price ratio?**
- ❖ **What about high corn yielding years?**
- ❖ **Rotation effect?**

Corn Following Soybean

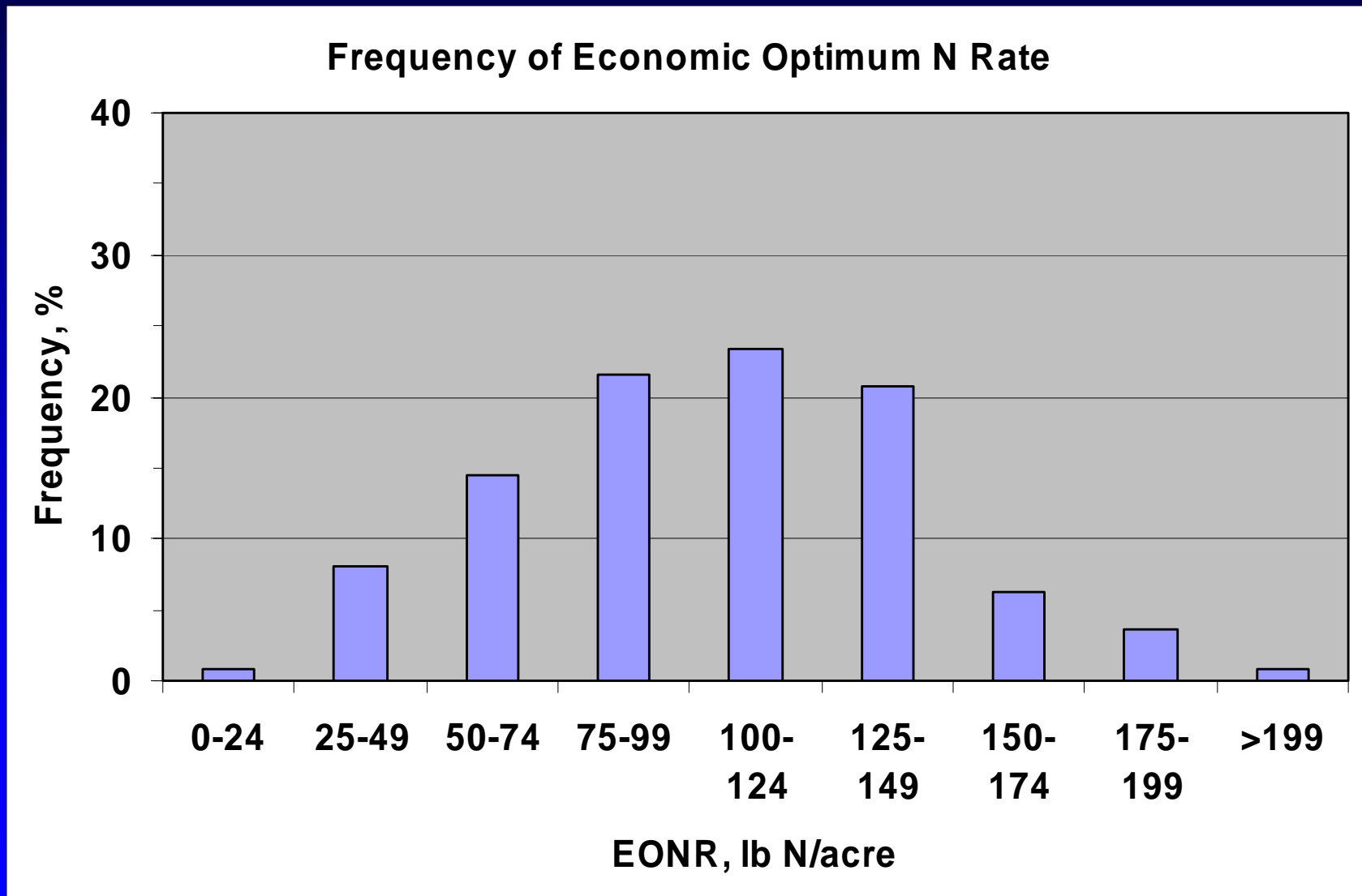
Average Economic Optimum N Rate

100 Site-Years in Iowa (1979-2004)
Corn-Soybean Rotation



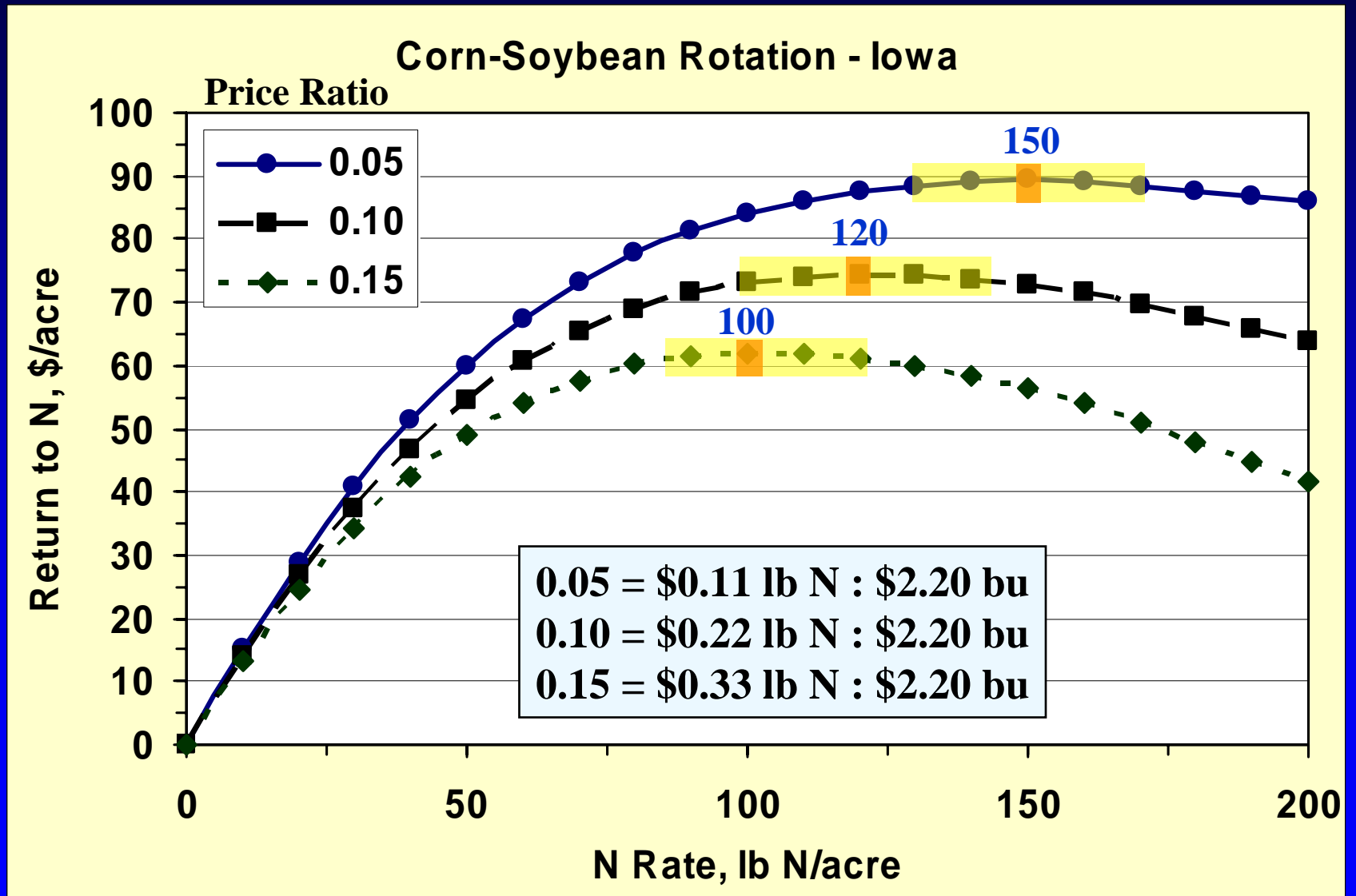
Frequency Economic Optimum N Rate

111 C-S Responsive Site-Years Across Iowa (1992-2004)



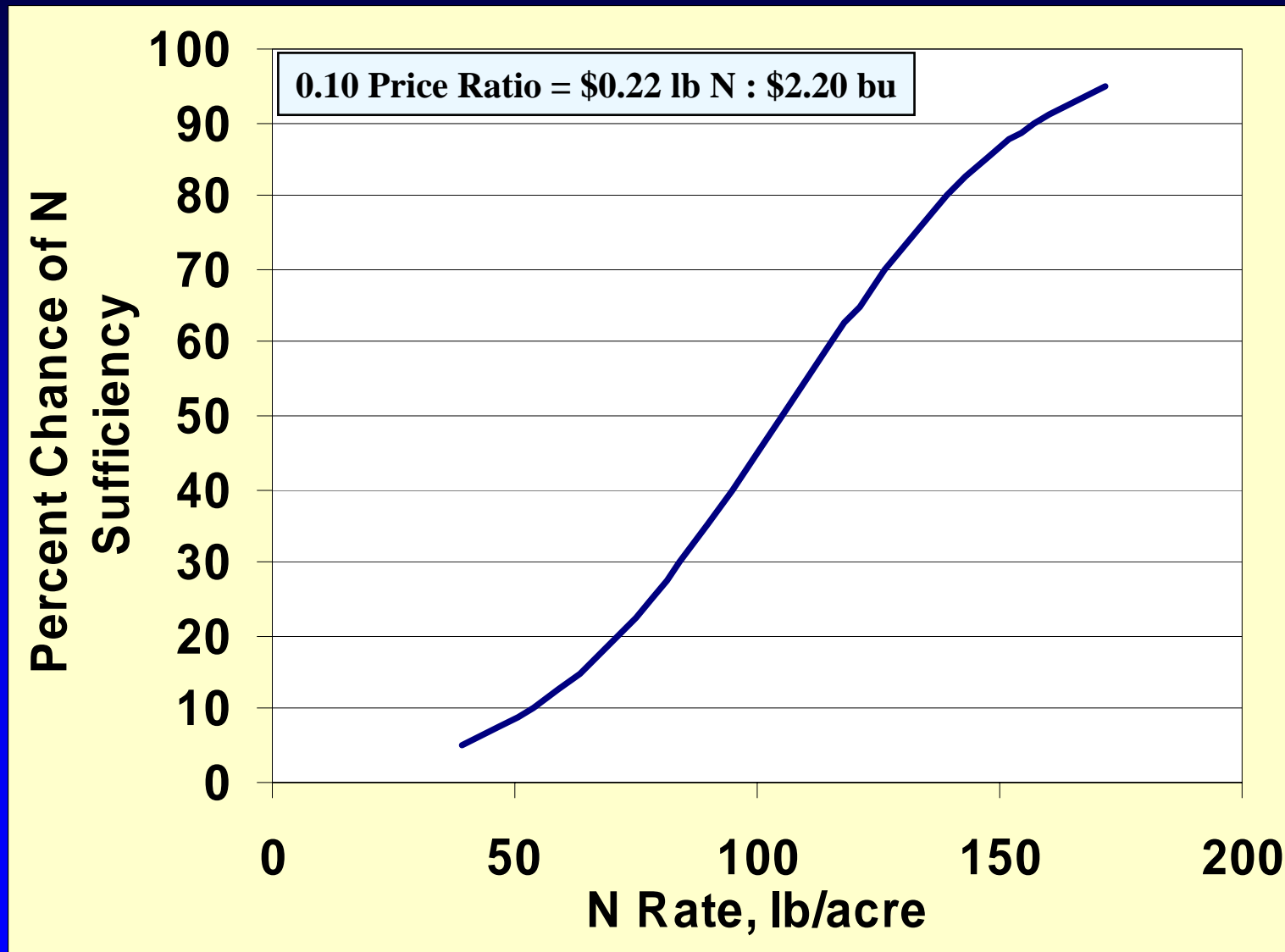
Return to N

111 C-S Site-Years Across Iowa (1992-2004)



N Rate Sufficiency

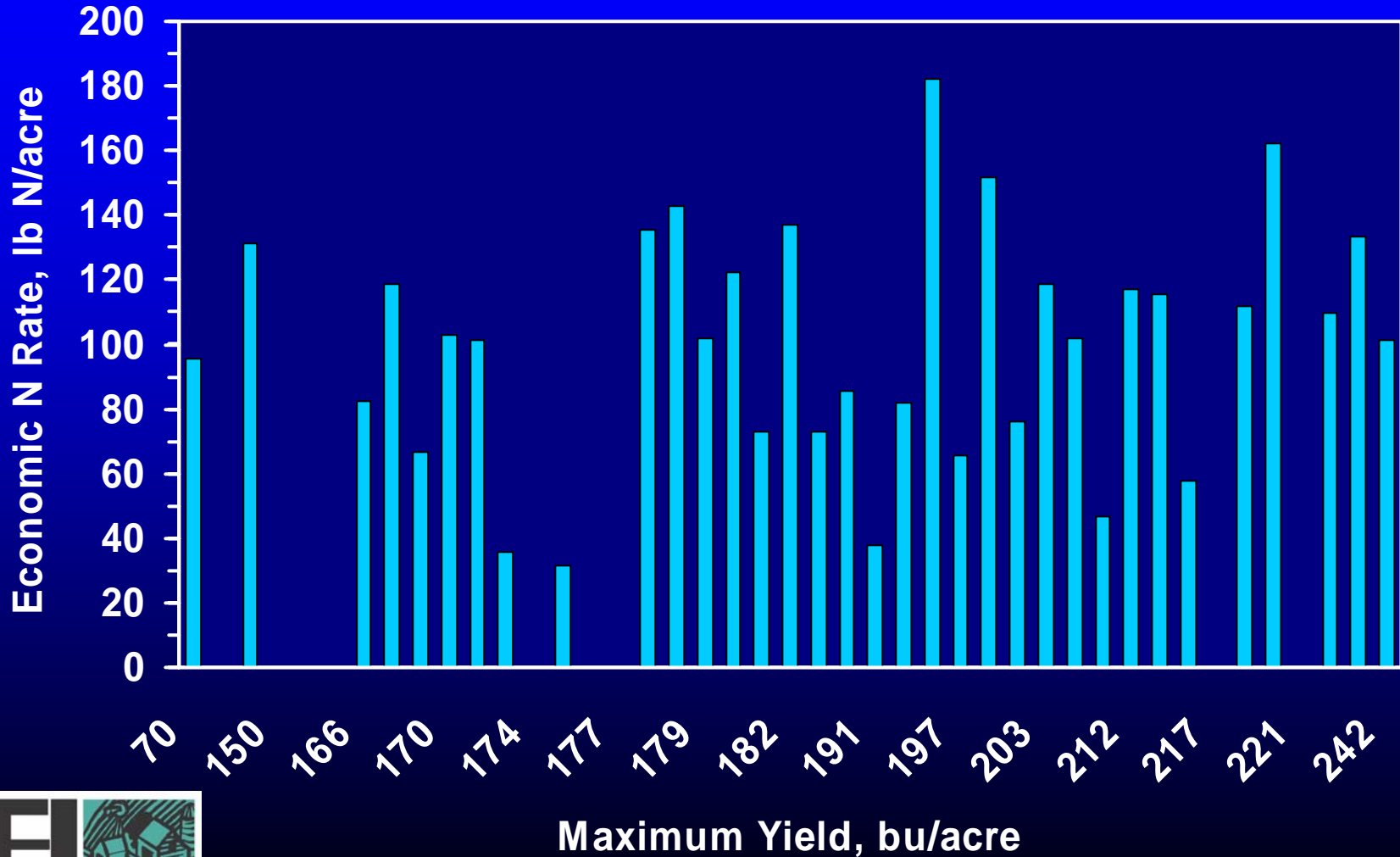
111 C-S Site-Years Across Iowa (1992-2004)



What About High Corn Yields and N Fertilization?

Soil Nitrogen and Carbon Management Project

Economic Optimum N Rate (10:1 Corn:N Price Ratio) Ranked by Site Maximum Fertilized Yield



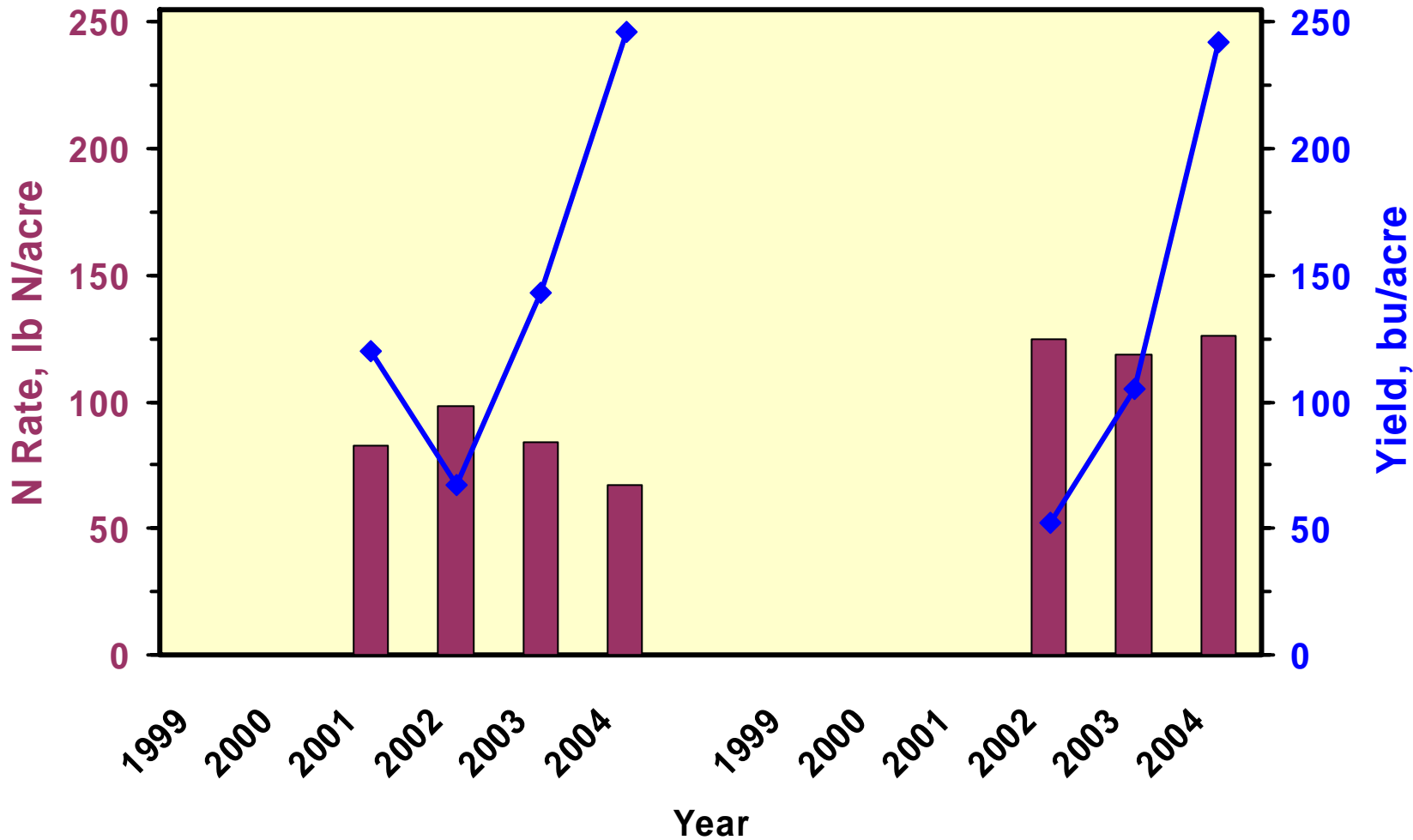
Armstrong



C-S

Rotation

C-C



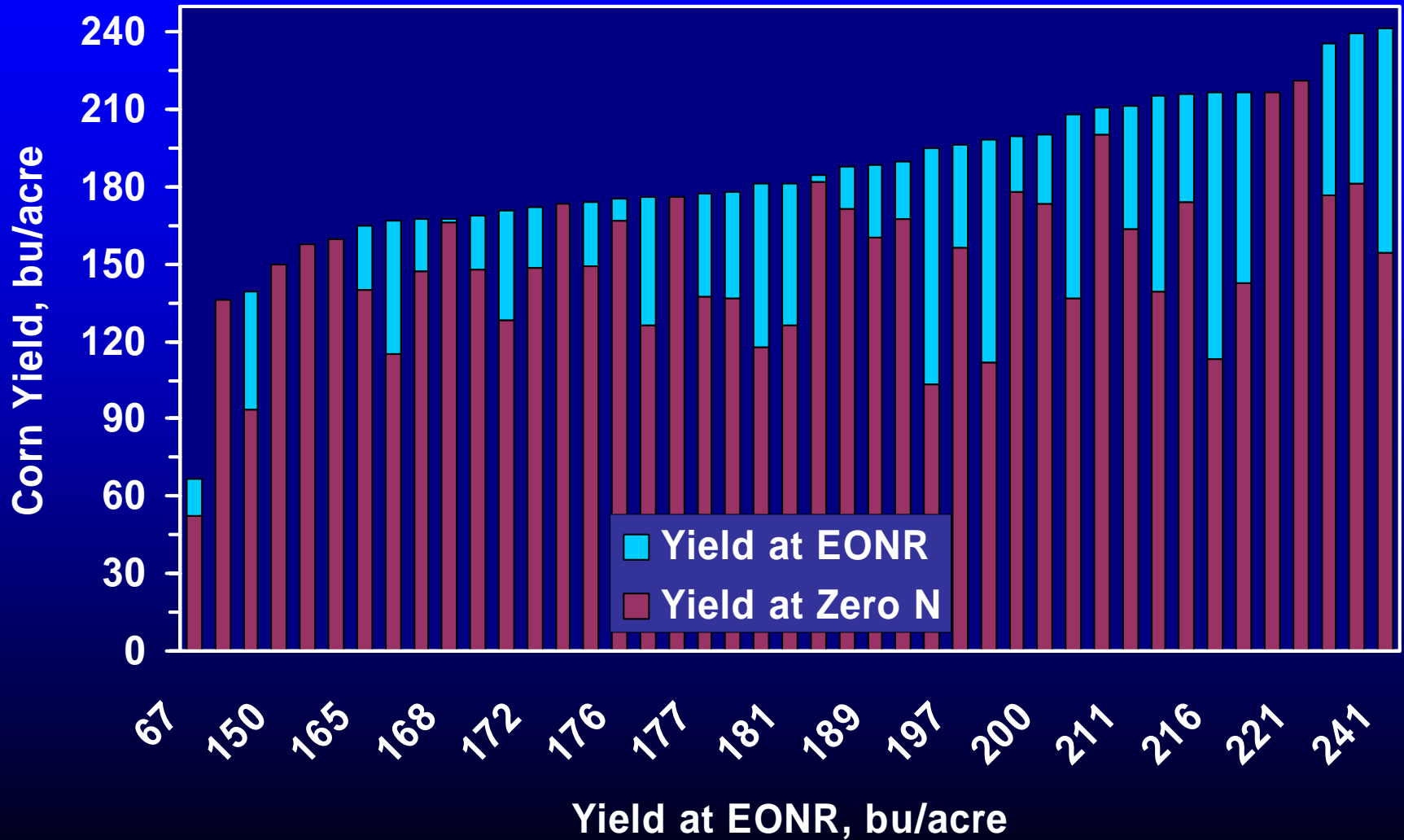
2004

Economic Optimum N Rate and Yield

Corn Following Soybean

County - Site	Grain Yield	N Optimum
	bu/acre	lb N/acre
Lyon	195	123
Cerro Gordo	241	151
Marshall	232	124
Boone	242	113
Pottawattamie	246	67
Wapello	224	75
Washington	201	197

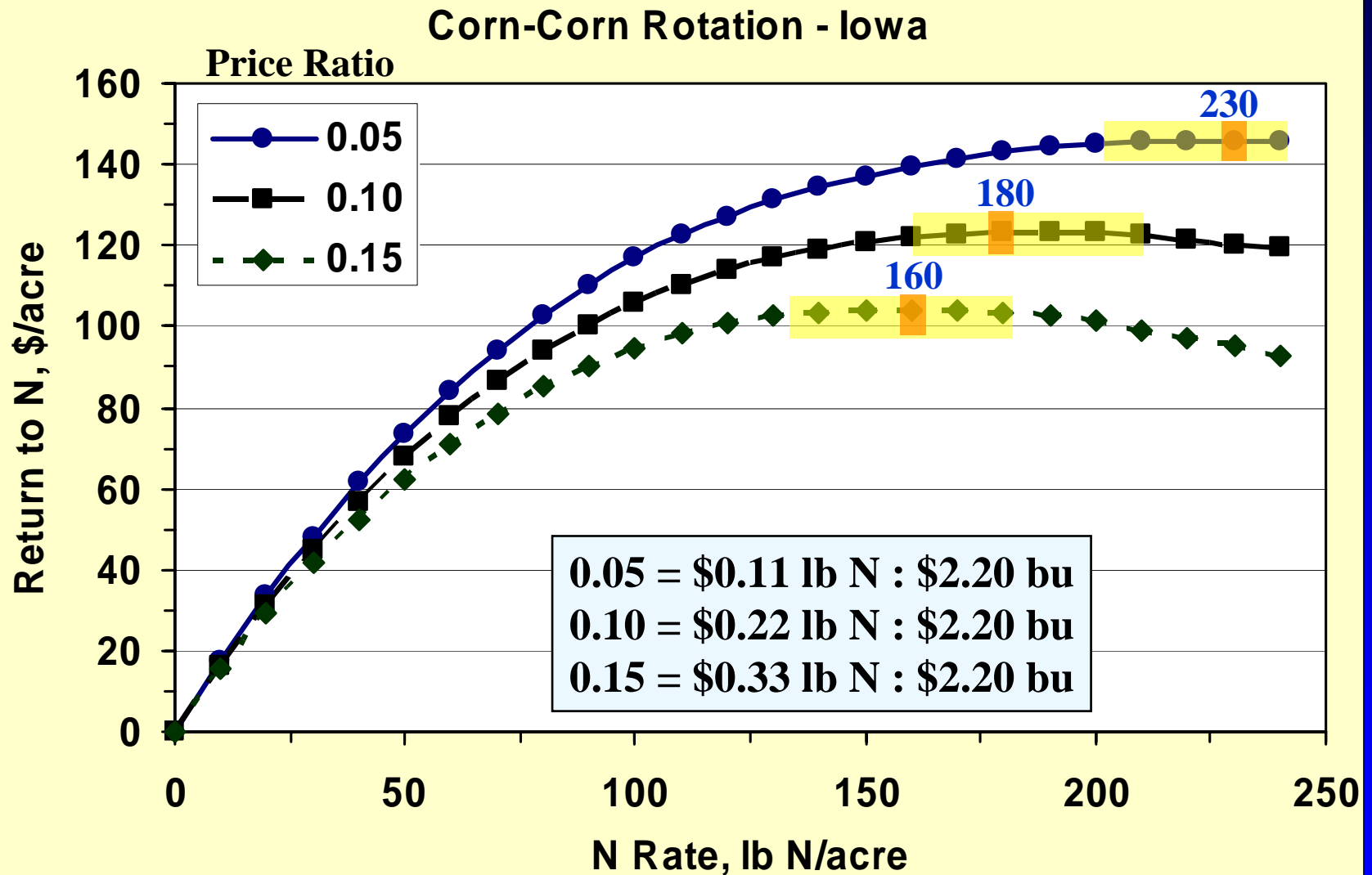
Yield At Zero Applied N and Yield at Economic Optimum N Rate (10:1 Corn:N Price Ratio) Ranked by Site EONR Yield



Corn Following Corn

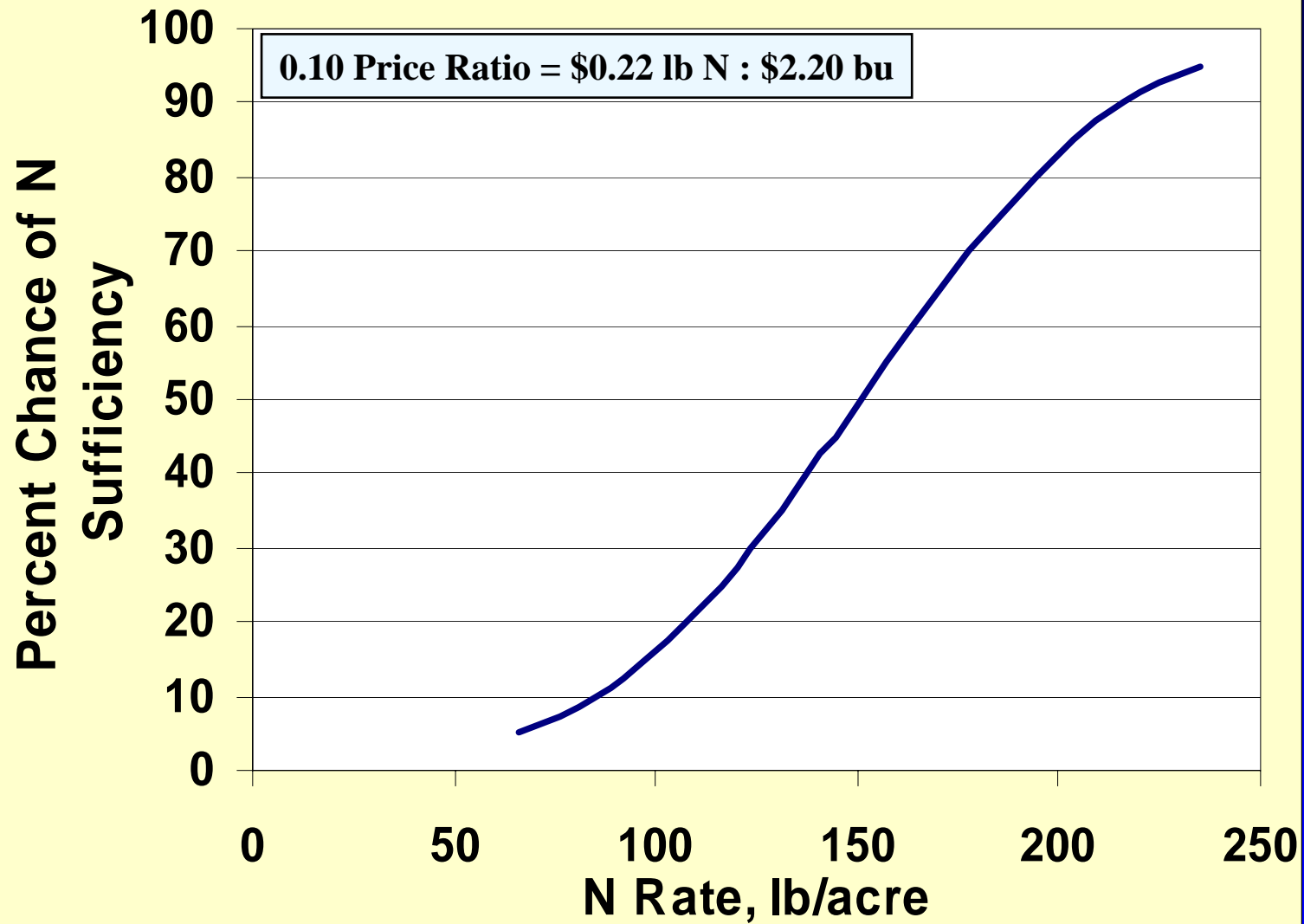
Return to N

37 C-C Site-Years Across Iowa (1992-2004)



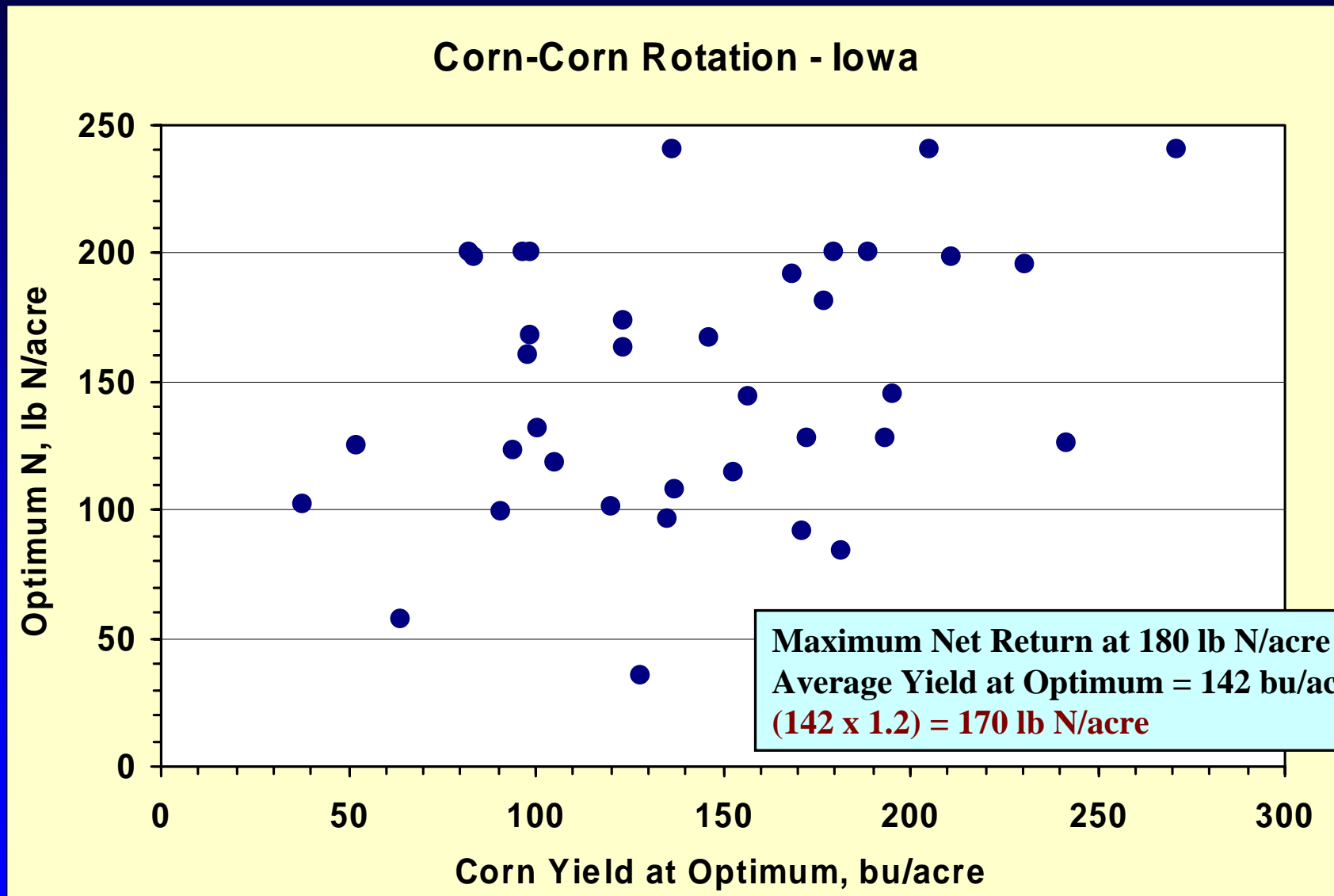
N Rate Sufficiency

37 C-C Site-Years Across Iowa (1992-2004)



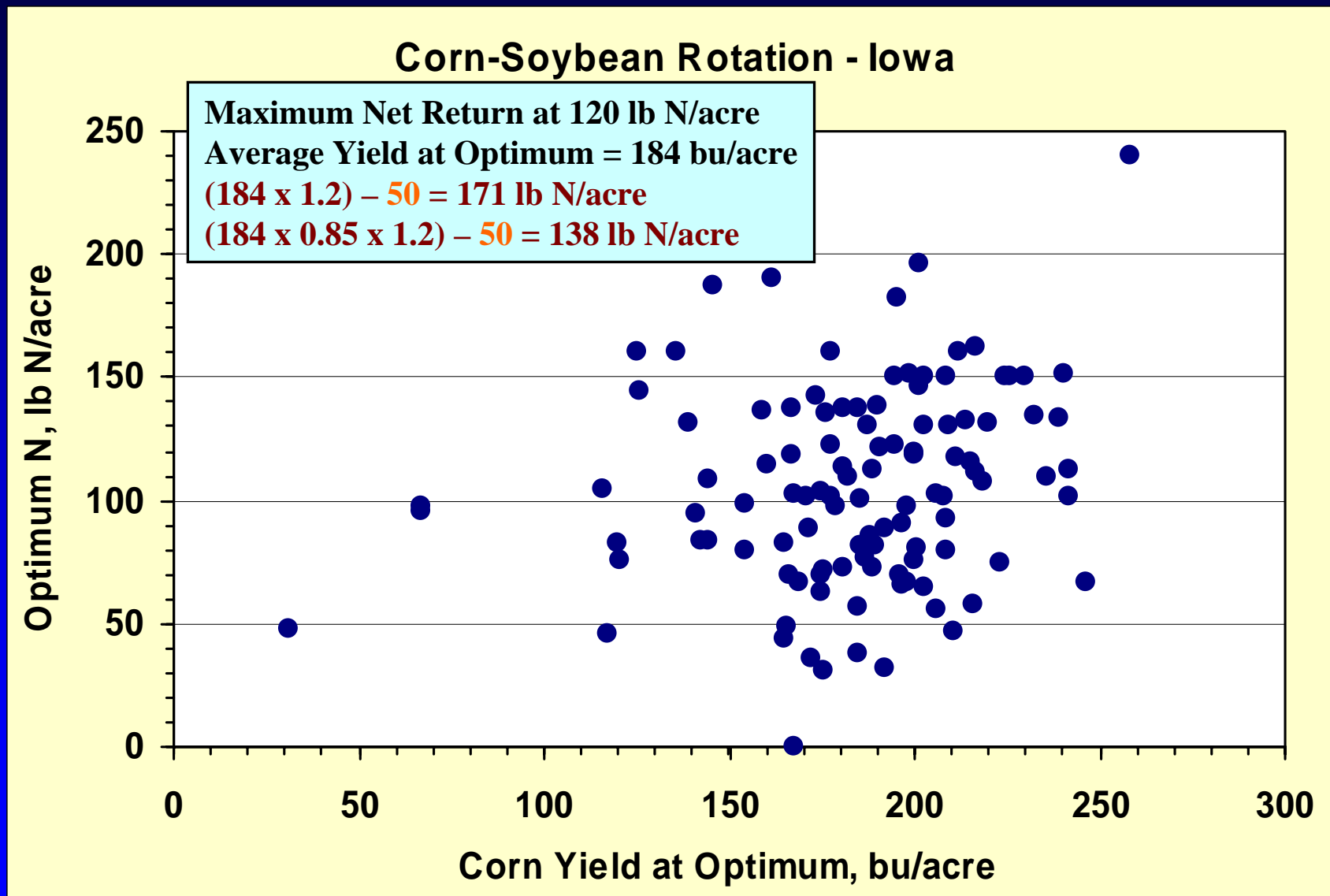
Yield Relationship to Optimal N

37 C-C Site-Years Across Iowa (1992-2004)



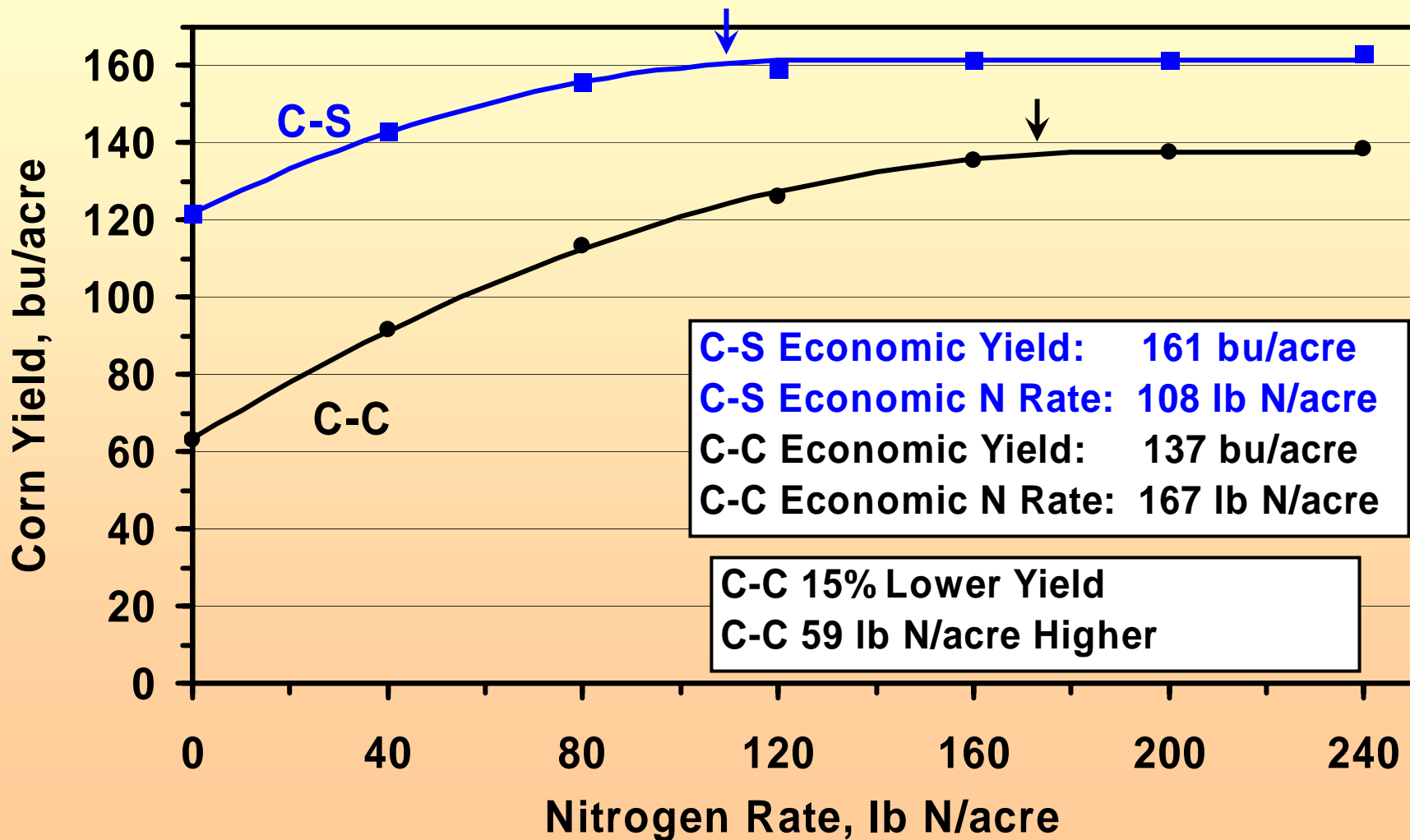
Yield Relationship to Optimal N

111 C-S Site-Years Across Iowa (1992-2004)



What About Crop Rotation Influence on N Fertilization?

Six Nitrogen Rate by Crop Rotation Sites 2000-2004 C-S and C-C Rotations



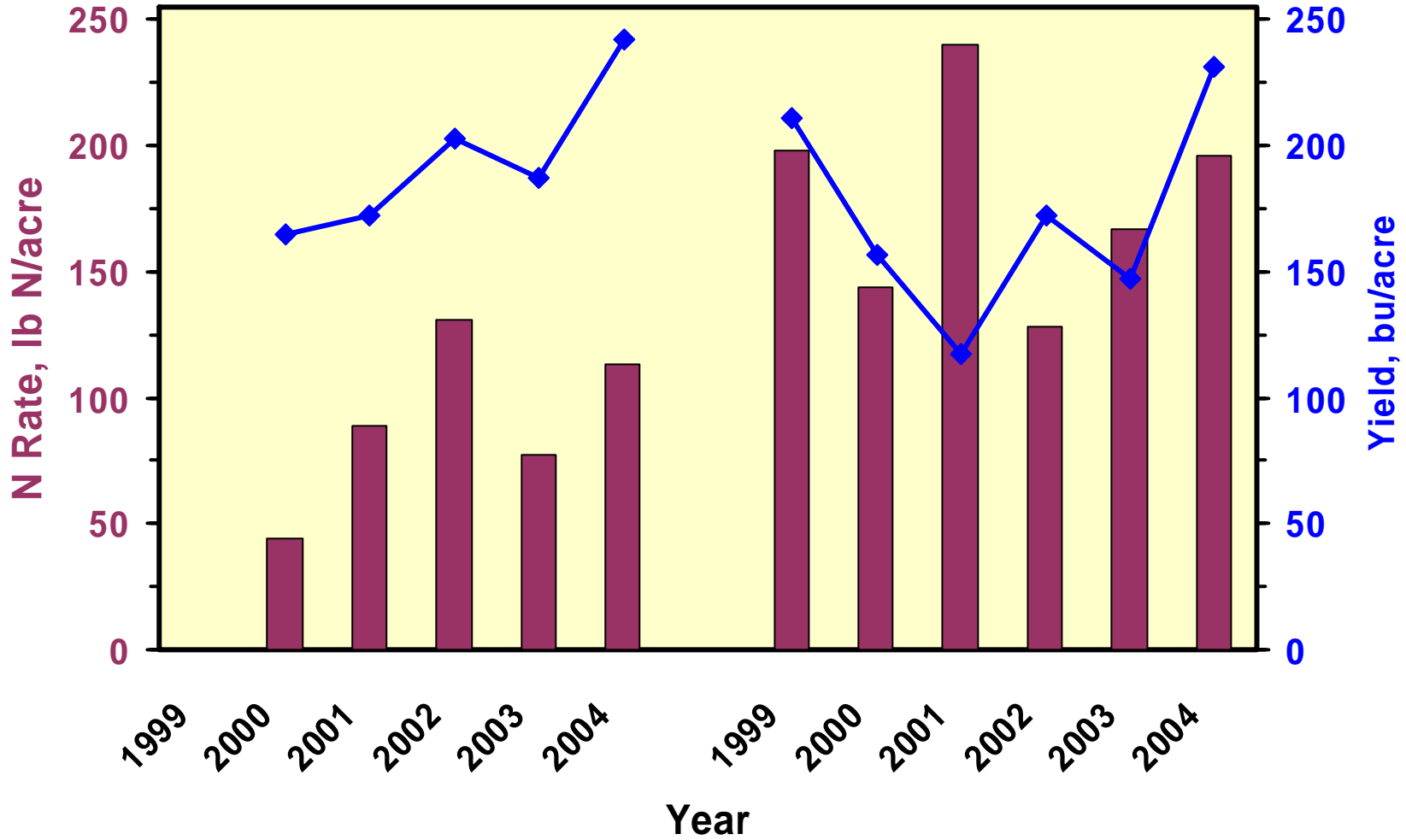
Ames



C-S

Rotation

C-C



Yield Difference Between C-S and C-C

Six Sites in Iowa, at 240 lb N/acre Application

Year	C-S	C-C	Difference	
	----- bu/acre -----			%
2000	160	156	4	2.2
2001	146	115	31	21.0
2002	152	122	30	19.7
2003	163	117	46	28.1
2004	200	204	4	2.1
Average	165	140	25	16.2

Sawyer, Iowa State University; Five sites in 2004

Frequency of Corn in Rotation

Northeast Research Farm, 1998 - 2001

Crop	N rate applied to corn, lb N/acre			
	0	80	160	240
	----- bu/acre -----			
<u>C</u>	45	105	138	152
<u>C-S</u>	93	153	172	188
<u>C-C-S</u>	97	154	179	180
<u>C-C-S</u>	41	100	135	153
<u>C-C-C-S</u>	95	146	169	177
<u>C-C-C-S</u>	39	102	133	159
<u>C-C-C-S</u>	44	92	131	150

Corn In Rotation

Northern Research and Demonstration Farm, 1985 - 1998

N rate applied to corn, lb N/acre

Crop	0	80	160	240
	----- bu/acre or ton/acre -----			
Corn, sp urea	53	108	134	146
Corn, fall urea	50	93	124	134
Corn	100	139	157	162
Soybean	42	43	43	42
Corn	153	152	160	156
Oats *	69	68	71	69
Hay	3.5	3.3	3.5	3.3
Hay	3.7	3.5	3.7	3.7

* Oats underseeded with forage legume, no harvest that year.

Nitrogen Fertilizer Guidelines for Corn In Iowa

Preplant N Applications

Crop Category	N Rate
	lb N/acre
Recently manured soils	0 to 90
After established alfalfa	0 to 30
2 nd - year after alfalfa	0 to 60
Corn after corn	150 to 200
Corn after soybean (no manure)	100 to 150

Pm-1714 Nitrogen Fertilizer Recommendations for Corn in Iowa, 1997

Pm-905 Crop Rotations, Effect on Yields and Response to Nitrogen, 1984

Remember

- ❖ **Account for all N sources**
 - **Starter**
 - **Weed and Feed UAN**
 - **DAP & MAP**
- ❖ **Manage N fertilizer products for best efficiency**
- ❖ **Account for previous crop**
- ❖ **Utilize manure nutrient sources**
- ❖ **Manage all crop production practices for optimal yield**

ISU Agronomy Extension

Soil Fertility Web Site

<http://extension.agron.iastate.edu/soilfertility>

Acknowledgements for Nitrogen Research:

IDALS, Division of Soil Conservation – IFLM Program

Iowa Corn Growers Association

Maquoketa Watershed Project

Soil Nitrogen and Carbon Management Project

ISU Research Farms

