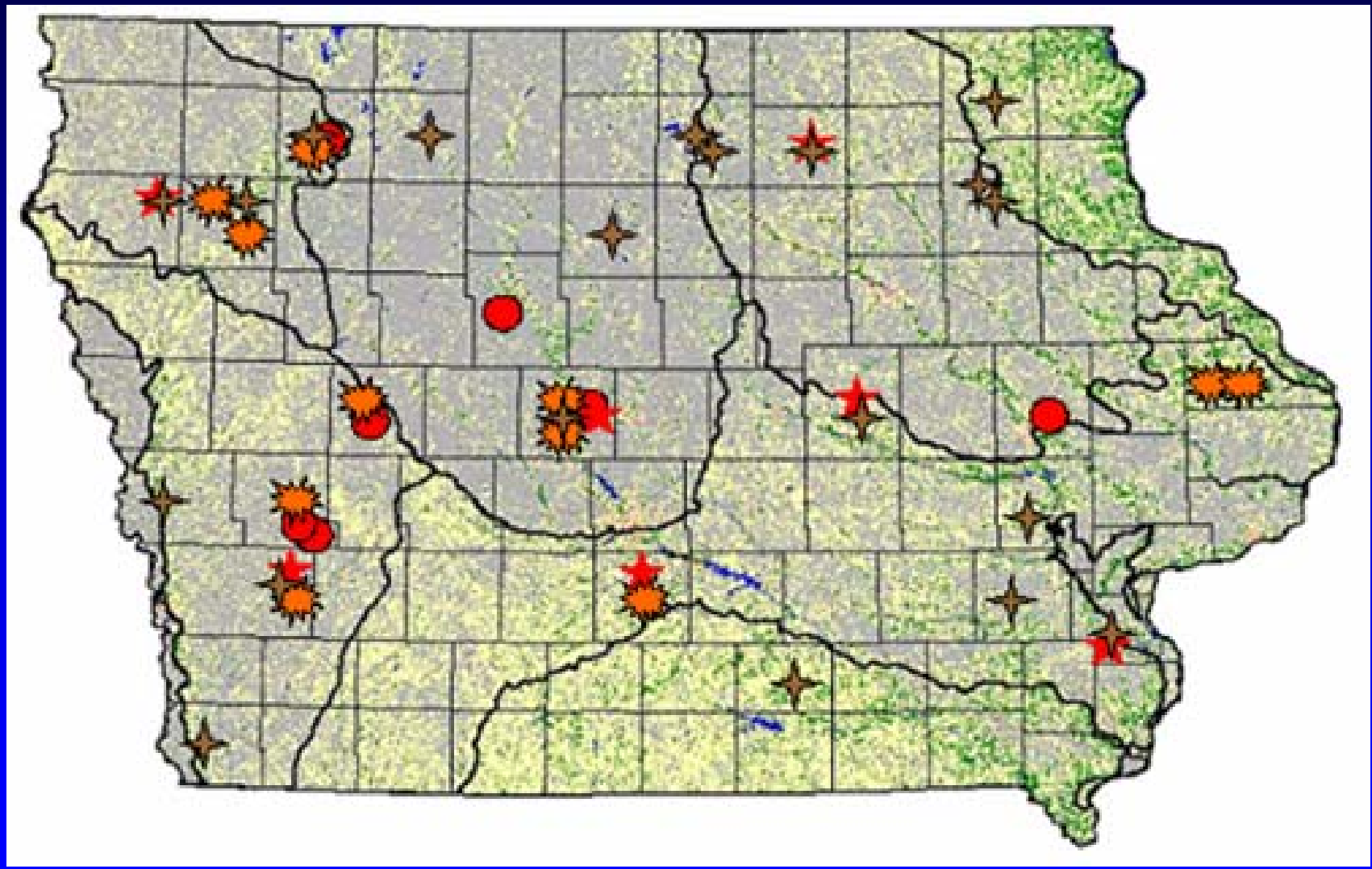
Soil Nitrogen and Carbon Management Project

John E. Sawyer
Mahdi Al-Kaisi
Daniel Barker
Marc Kruse
John Lundvall
Department of Agronomy
Iowa State University

IOWA STATE UNIVERSITY
University Extension

Soil Nitrogen and Carbon Management Project
43 Sites – 2001-2003



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Project Objectives

- Demonstrate potential of a new soil N test in Iowa corn production
- Demonstrate corn N fertilization needs in corn following soybean
- Demonstrate impact of N fertilization on short-term soil N - C change and CO_2 release

Project Methods

- **2001-2003**
  - **43 Sites on Producer Fields Across Iowa**
  - **Corn-Soybean Rotation, with First-Year of N Rate Application**
  - **0 to 200 lb N/acre in 40 lb N Increments**
  - **Determine Economic Optimum N Rate, N Fertilizer Response, Relative Yield**
  - **Monitor Corn N Status – Leaf Greenness**
  - **Multiple Soil Sampling by Depth and Time**
  - **Determine Soil N, C, and Illinois N Soil Test**
  - **Monitor CO_2 Emission Across Multiple Seasons**

Many Procedures Evaluated for Assessing Plant-Available N

- Indirect (crop rotation)
- Plant vegetation
  - Yield, total N uptake, uptake with no applied N, concentration, plant sensing
- Total soil N analysis
- Inorganic N forms
- Laboratory microbial incubation
- Chemical extraction
  - Water, strong acids or bases, neutral salts
  - Analyze extract for C, total N, distillable NH_3, ultraviolet adsorption

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Hydrolyzable Amino Sugar-N
Basis for Illinois Soil N Test

- **Mason-jar diffusion of amino sugar-N fraction of soil**

  {Mulvaney and Khan, SSAJ 65:1284-1292}
  {Mulvaney et al., SSAJ 65:1164-1172}

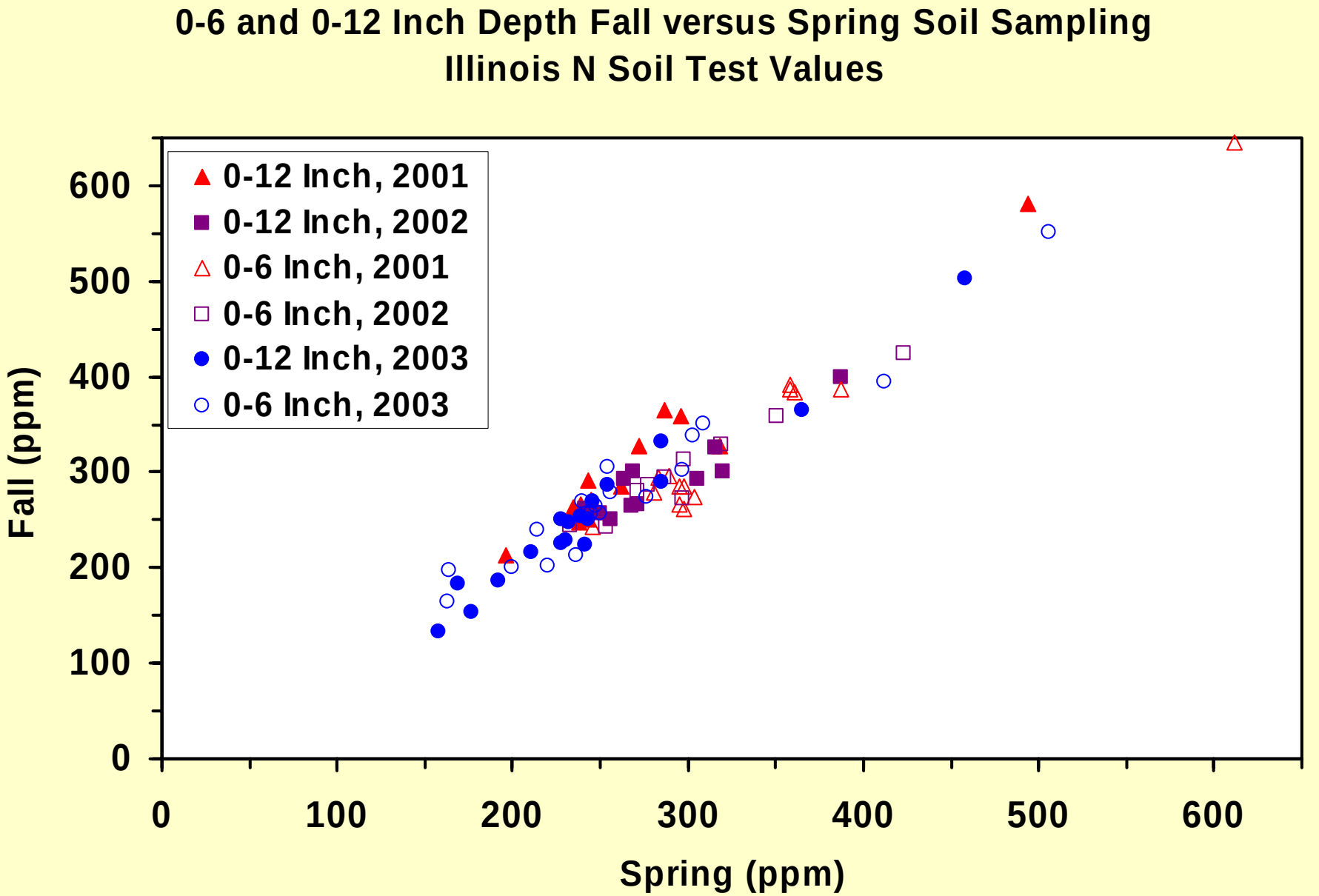
  - **Improved determination of amino sugar-N fraction**
  - **Indicated**
    - **"Pool" of readily mineralizable organic-N**
    - **Indicated corn responsiveness to N fertilization**
      - **Critical level 200 – 250 ppm (12-inch depth)**
    - **Potential for preplant soil sampling**

Illinois Soil N Test Procedure

Khan, Mulvaney and Hoeft (2001)

- Weigh a 1-g sample of air dried soil (ground < 2 mm) into a Mason jar
- Add 10 mL 2 M NaOH and swirl gently
- Seal jar with lid assembly containing petri dish with 5 ml boric acid-indicator solution
- Heat on hot-plate for 5-hr at 48-50 °C
- Titrate boric acid solution to endpoint with standardized 0.01 M H_2SO_4
- Critical level 225 - 235 ppm (12-inch depth)

Soil Test Results Same for Fall and Spring Samples



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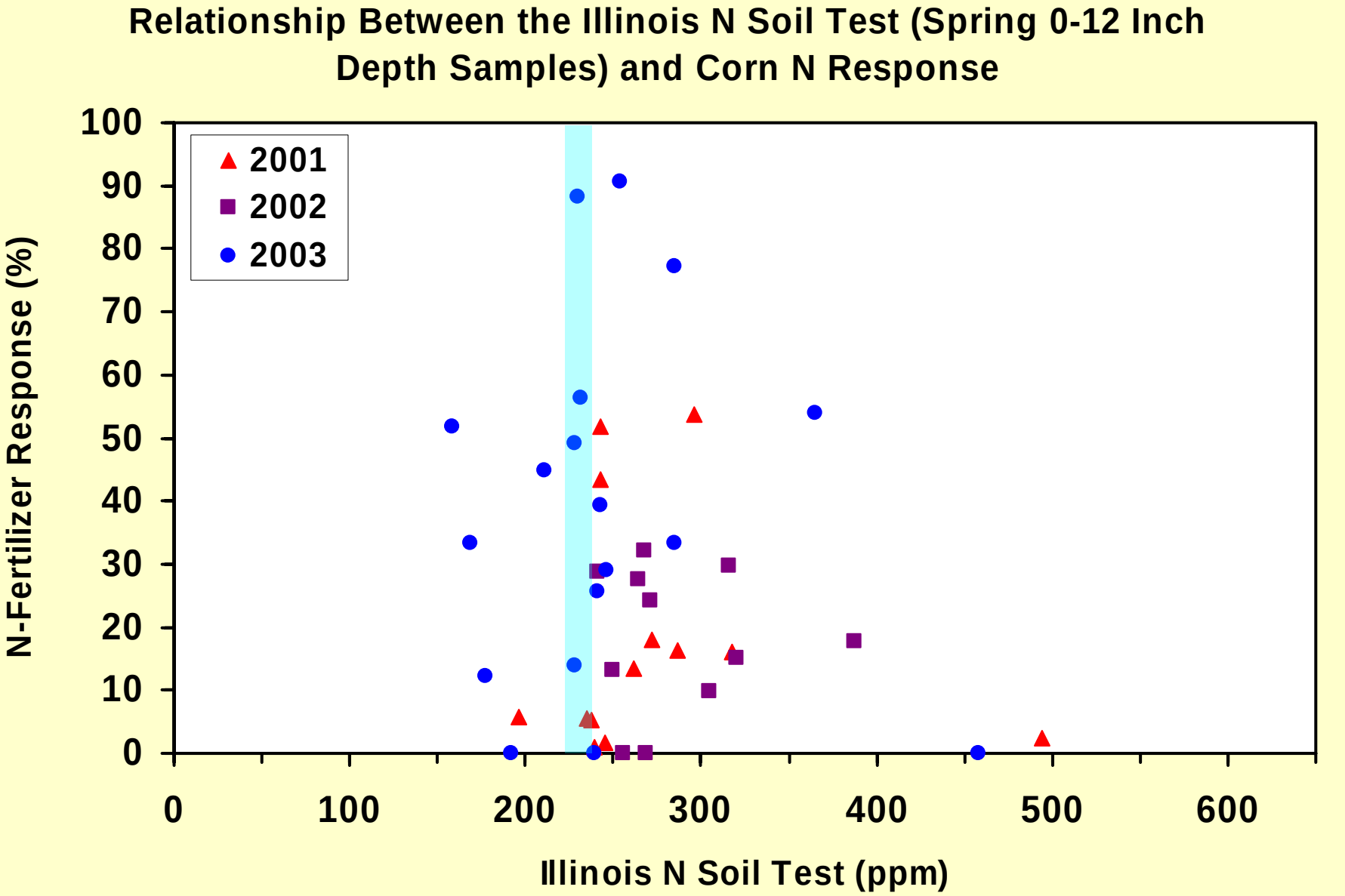
Soil Test Results Not Related to N Response



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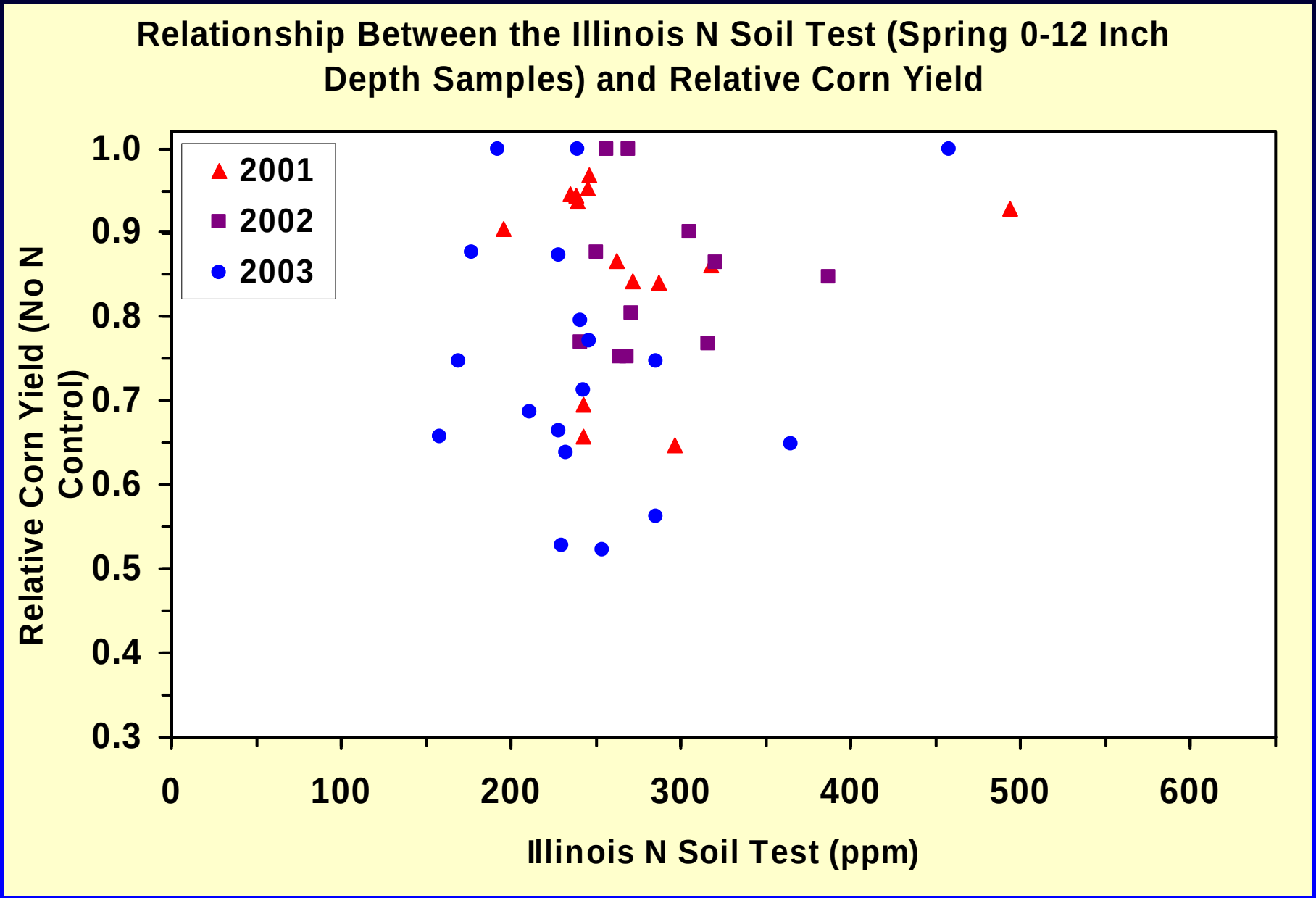
Soil Test Results Not Related to Relative Yield



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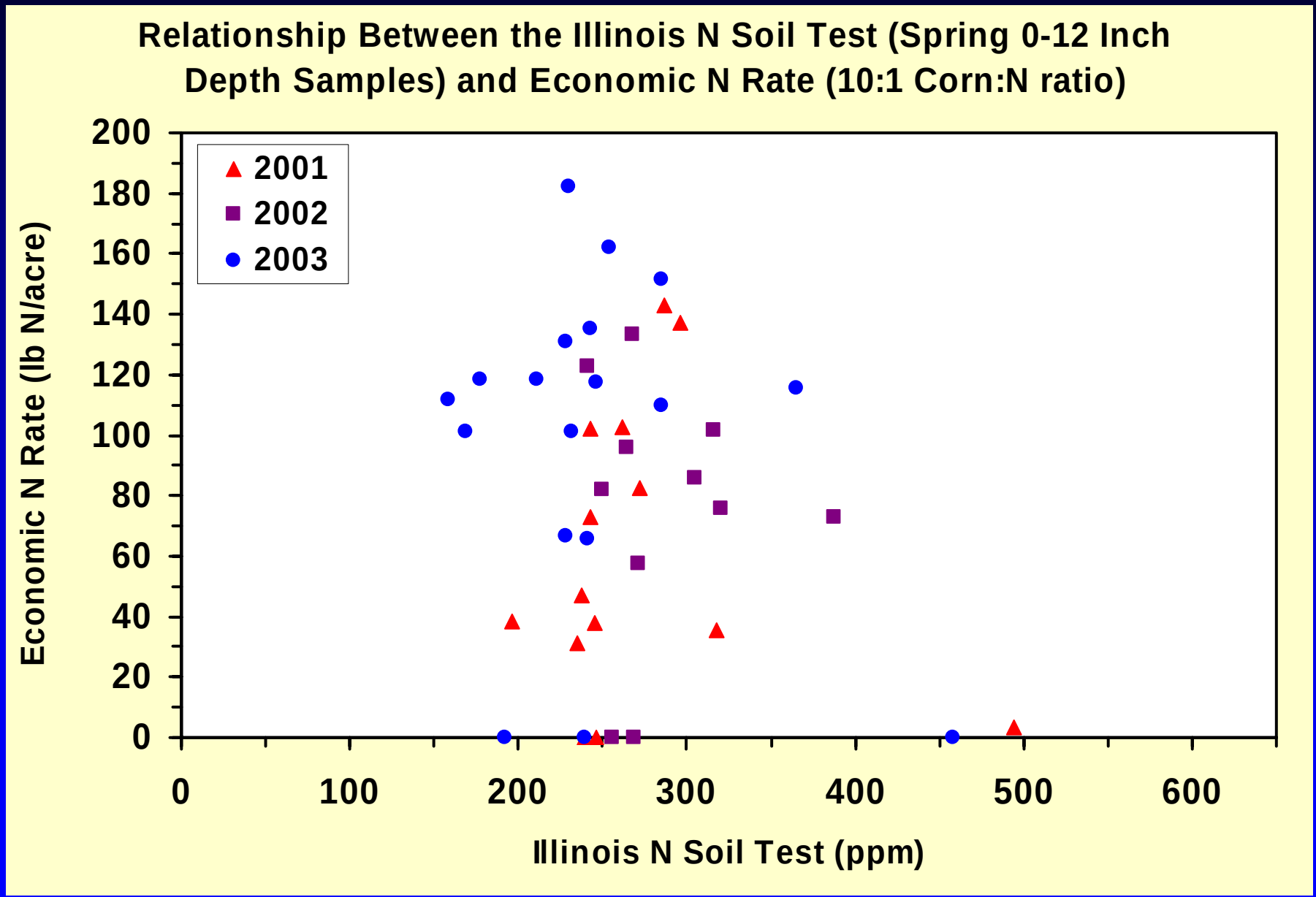
Soil Test Results Not Related to Needed N Rate



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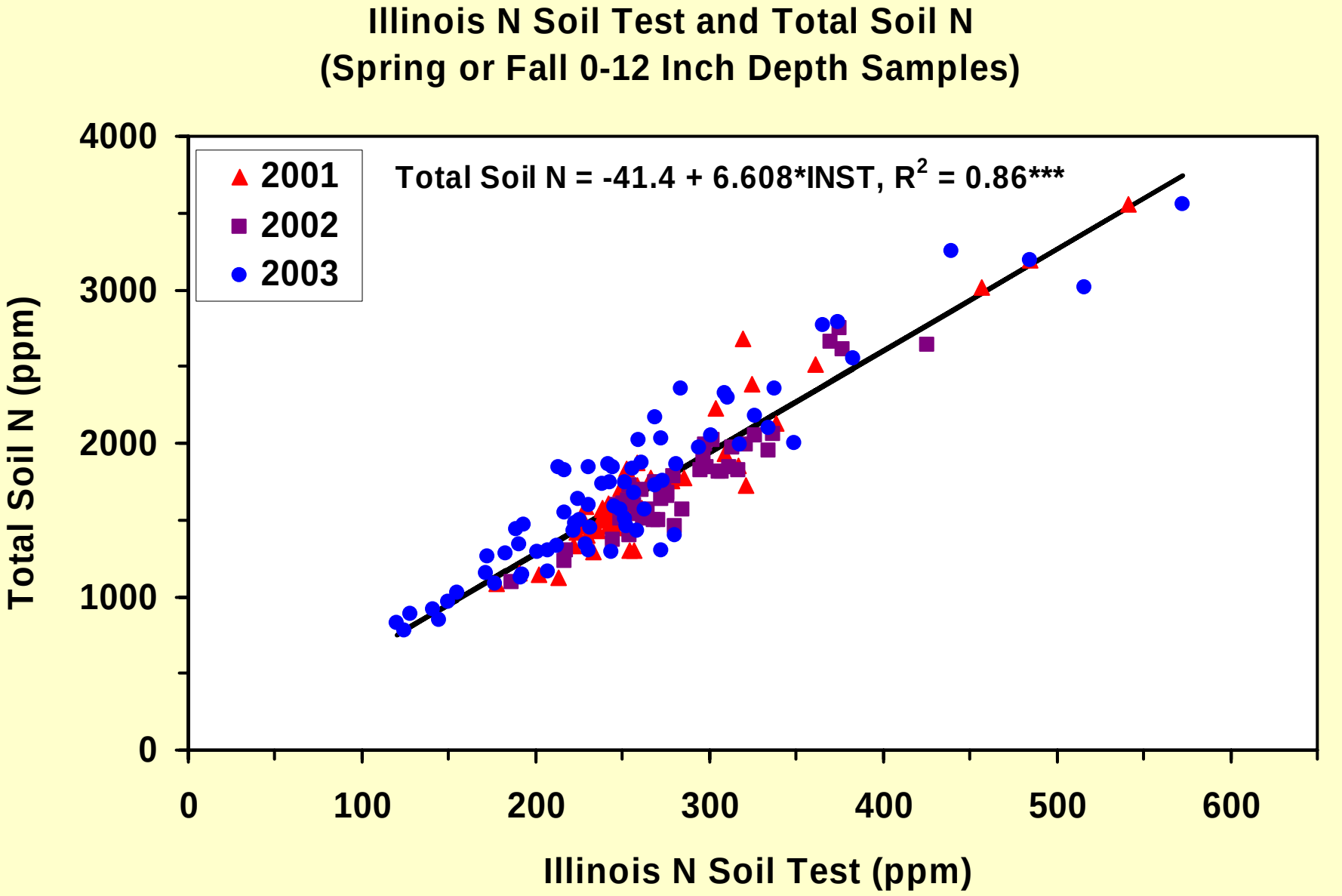
Soil Test Results Related to Total Soil N



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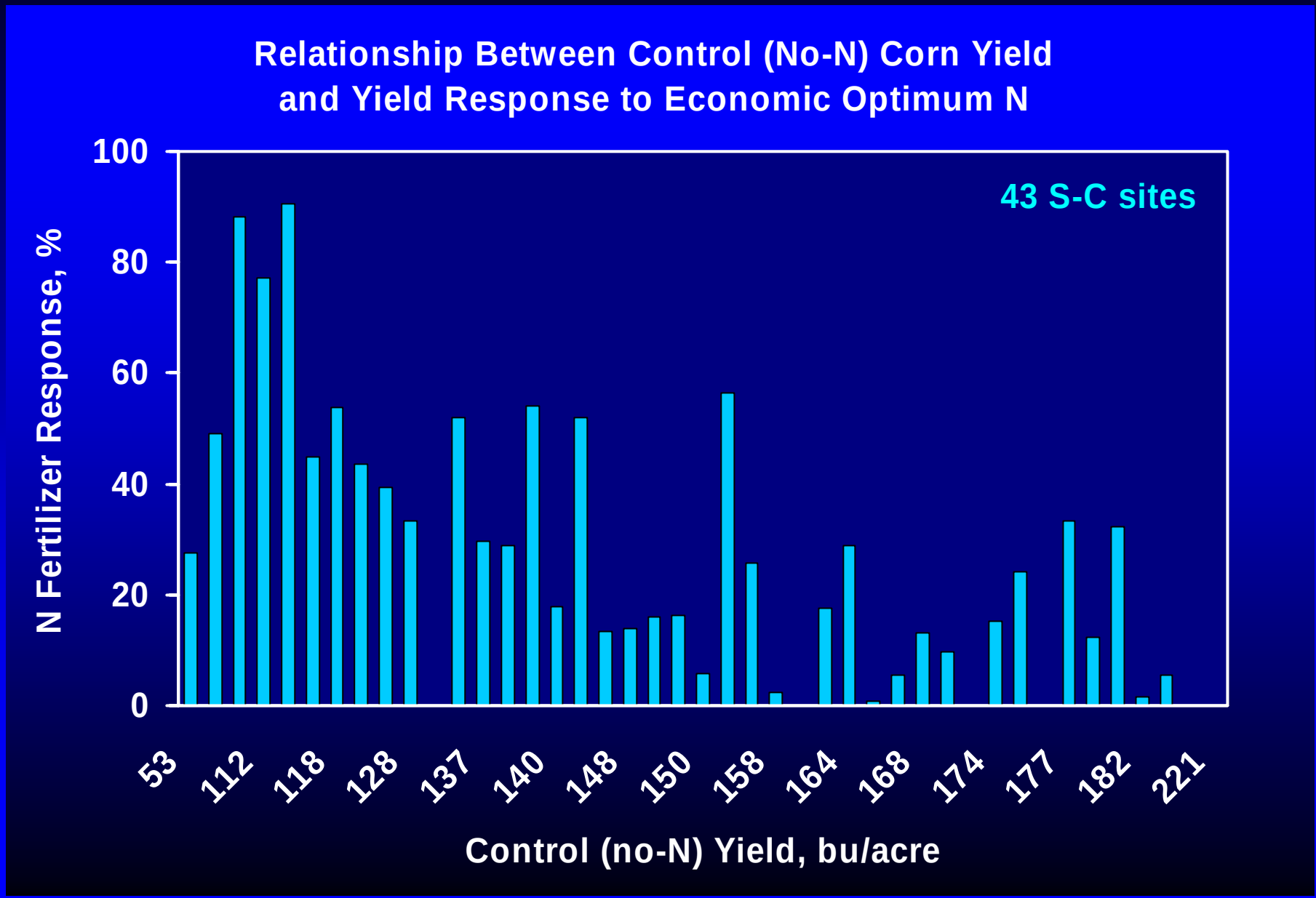
No-N (Control) Corn Yield Reflected N Response



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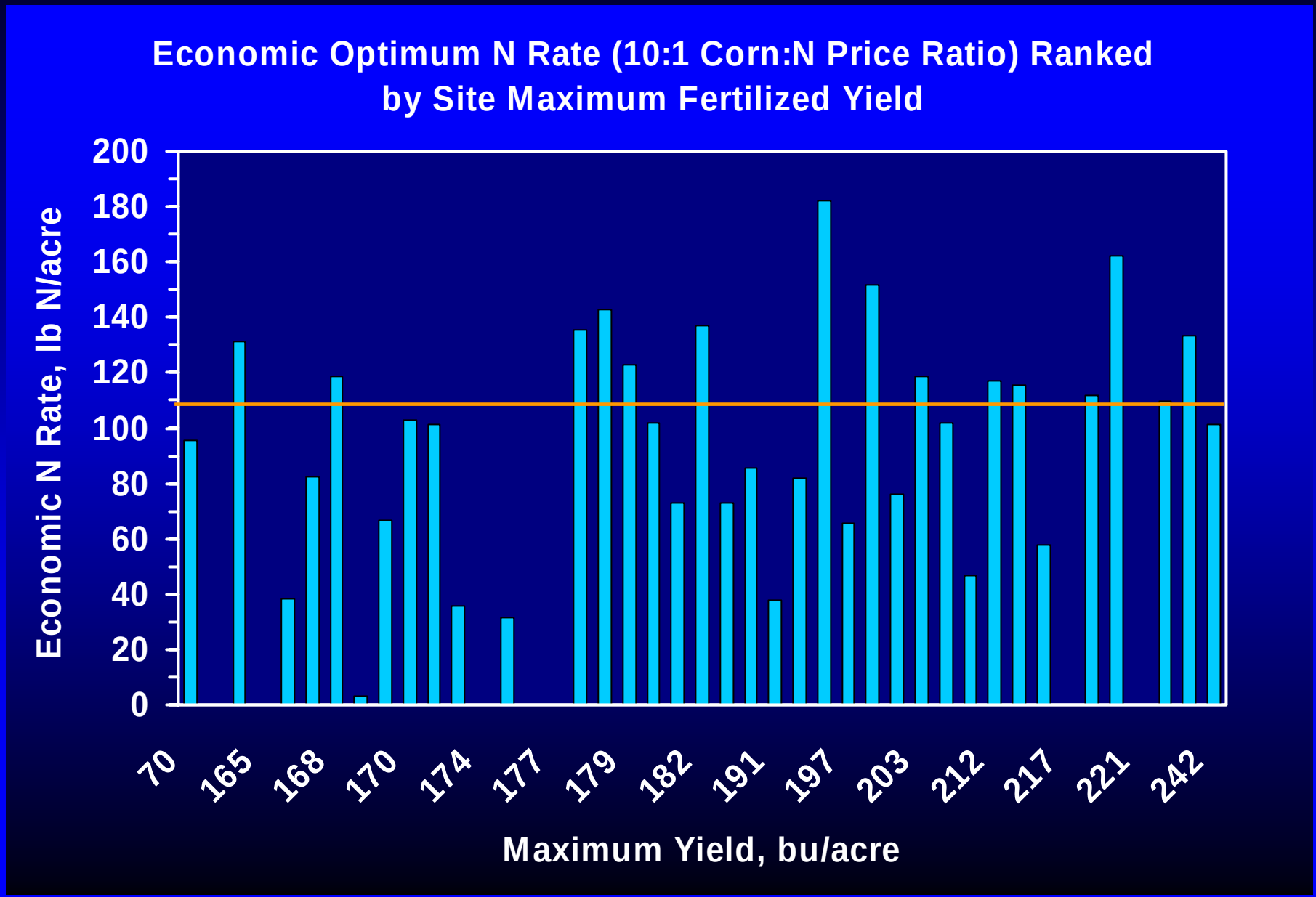
High Productivity Did Not Require High N Input



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Economic Optimum N Rate Varied Between Season

Economic Optimum N Rate at Repeat Sites			
	Year		
Site	2001	2003	Difference
	- - - - - - - - lb N/acre - - - - - - - -		
Boone-S	103	136	33
Louisa	73	117	44
Tama	38	101	63
Floyd	3	0	3
Economic optimum N rate calculated at 10:1 corn:N price ratio.			

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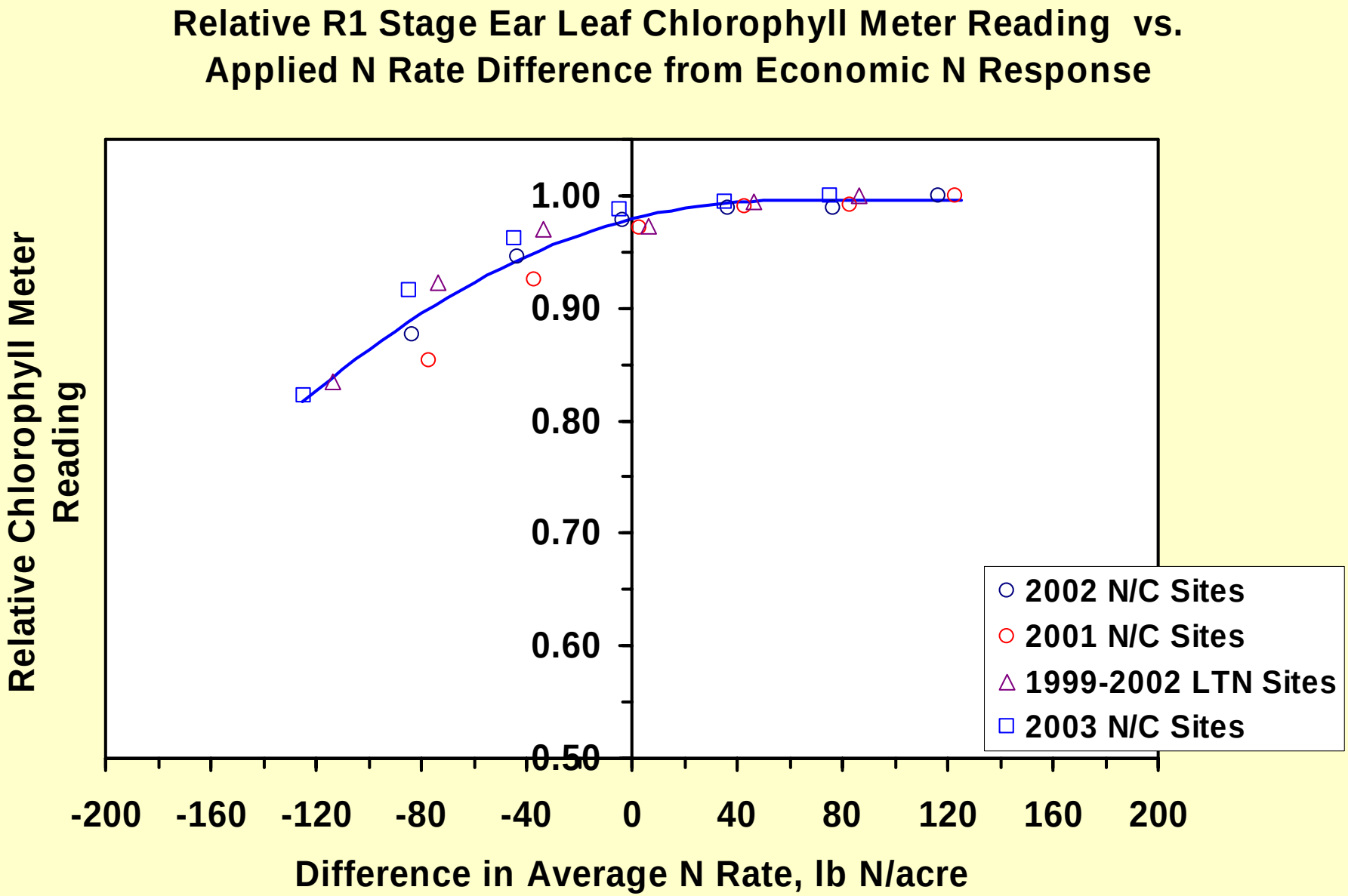
Corn Leaf Greenness Indicated N Need



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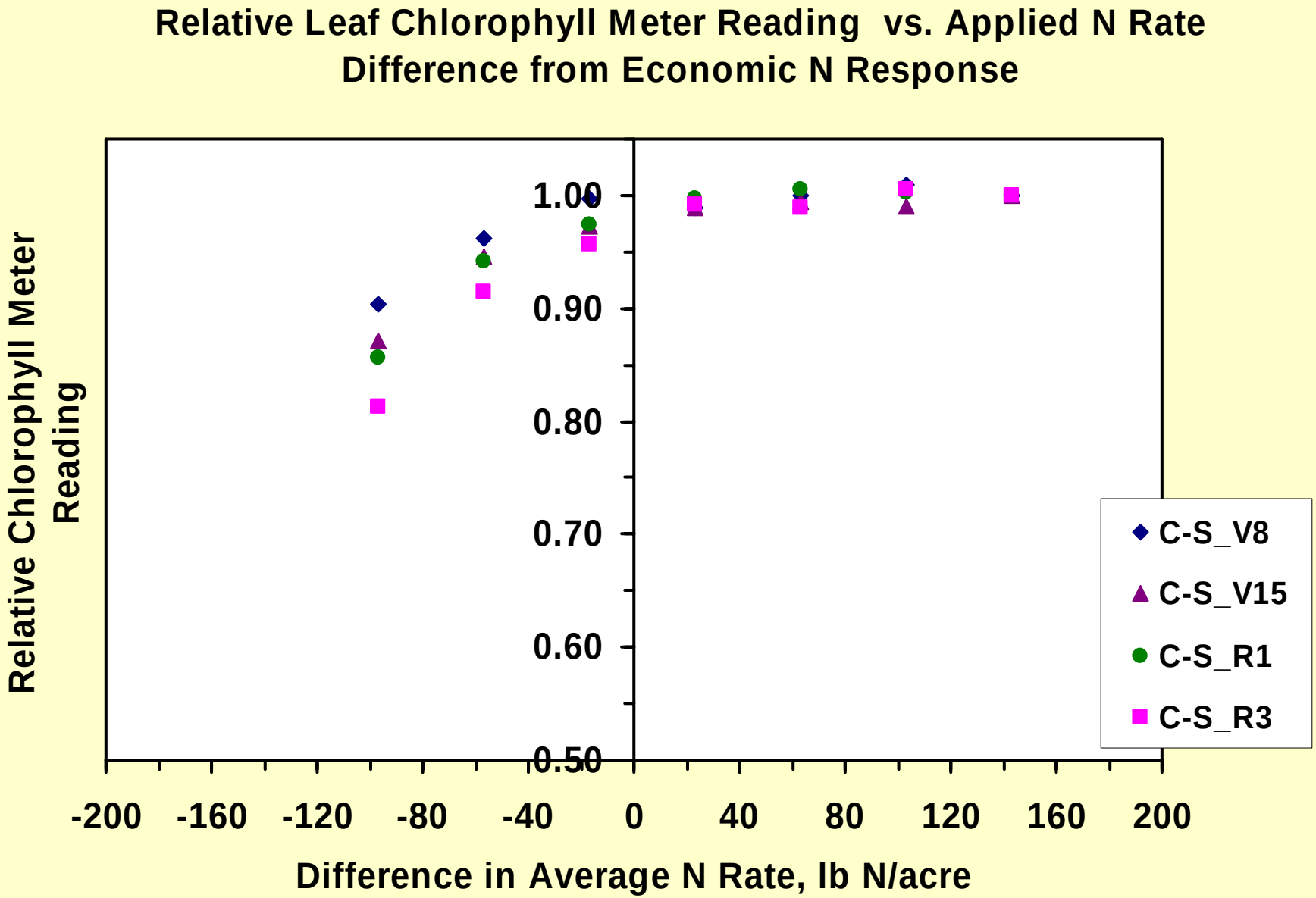
Corn Leaf Greenness Similar at V15 and R1



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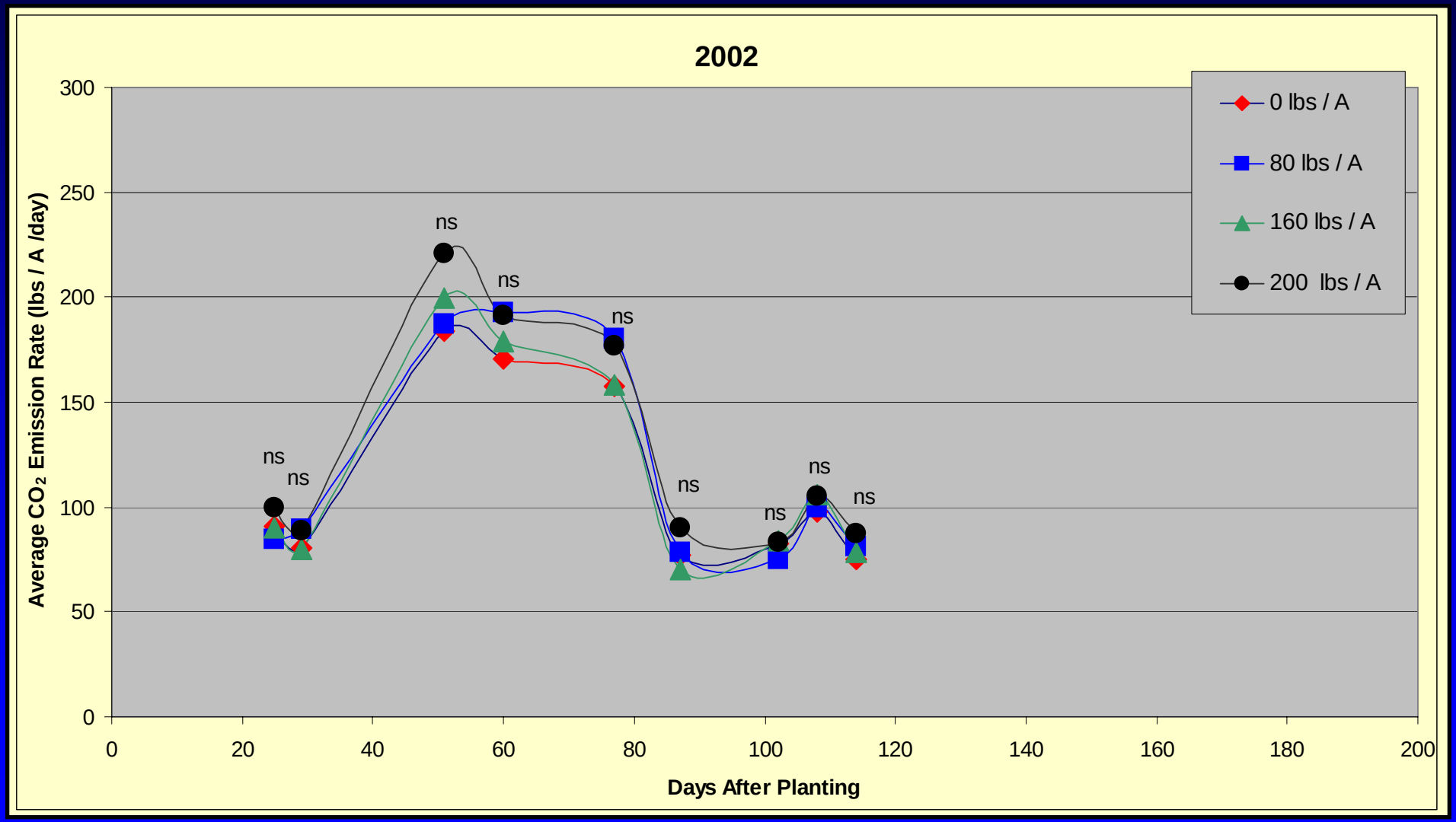
Carbon Dioxide Emission Rate Not Affected by Prior N App., Boone-S Site 2002 Soybean Crop



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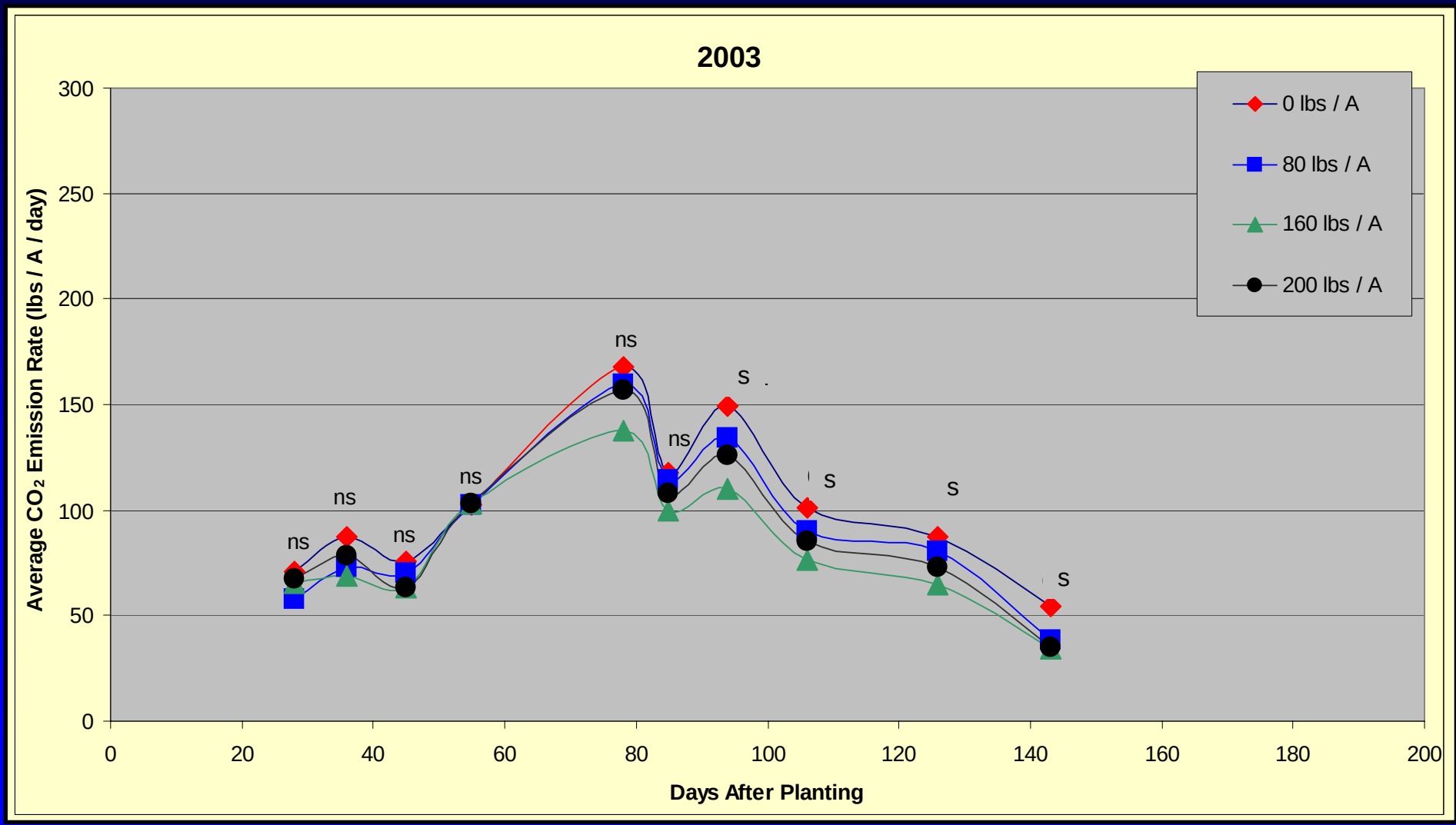
Carbon Dioxide Emission Rate Higher With No Applied N, Boone-S Site 2003 Corn Crop



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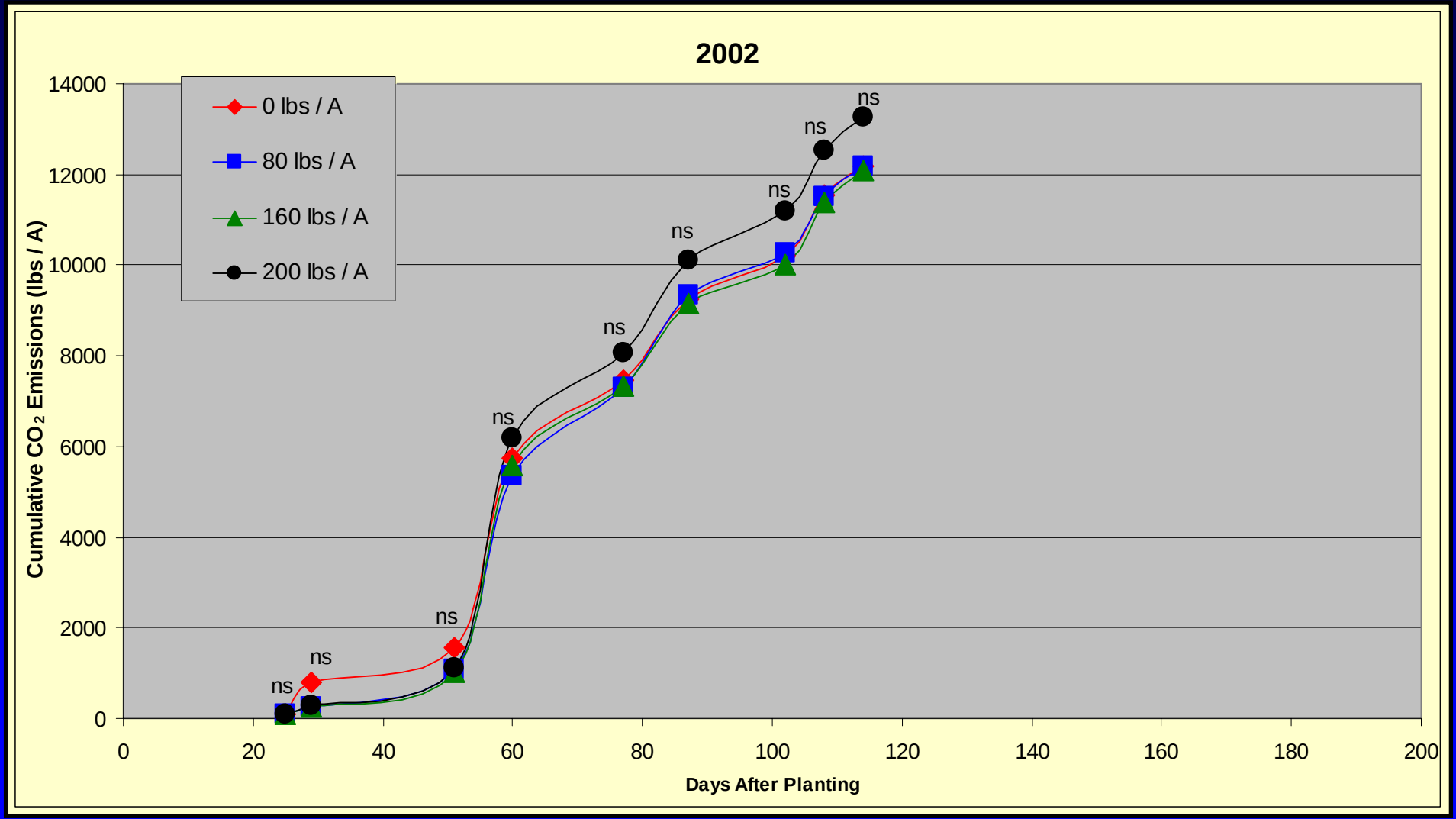
Cumulative Carbon Dioxide Emission Not Affected by Prior N App., Boone-S Site 2002 Soybean



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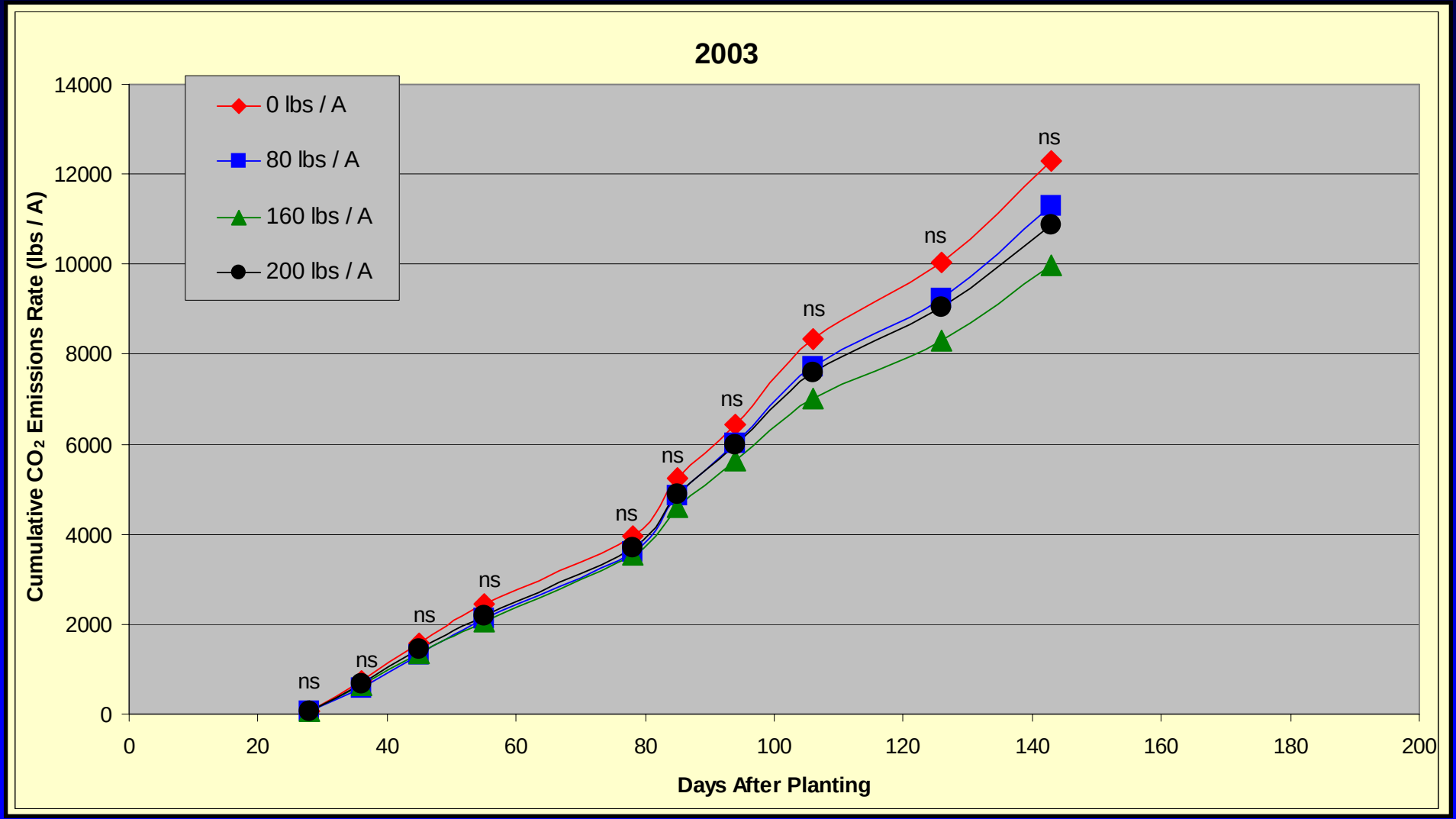
Cumulative Carbon Dioxide Emission Not Affected by N Rate, Boone-S Site 2003 Corn



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Soybean Residue C and N Input to Soil
Boone-S Site Fall 2002

N rate	Dry Matter	Total C	Total N	C:N Ratio
		lb/acre		
0	6267 a	2697 a	69 a	39 : 1
80	6025 a	2608 a	69 a	38 : 1
160	6590 a	2822 a	82 a	34 : 1
200	7385 a	3179 a	90 a	35 : 1

*Means with the same letters are not significantly different at Pr ≤ 0.05.

Summary

- Illinois N Soil Test was not predictive of corn response to applied N or economic optimum N rate, and is not recommended for adjusting corn N fertilization on Iowa soils
- Corn response to applied N varied across sites
- Economic optimum N rate was not consistent between years at repeat sites

Summary

- Corn yield with no applied N (control) generally reflected site responsiveness to applied N
- Leaf greenness indicated corn N need
- Large amounts of CO_2 were released and approximated residue carbon input

Thank you to the many cooperators and individuals who helped make the project a success.

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DEMONSTRATION PROGRAM

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