

Iowa Experience with the Illinois Soil N Test

Preliminary Results

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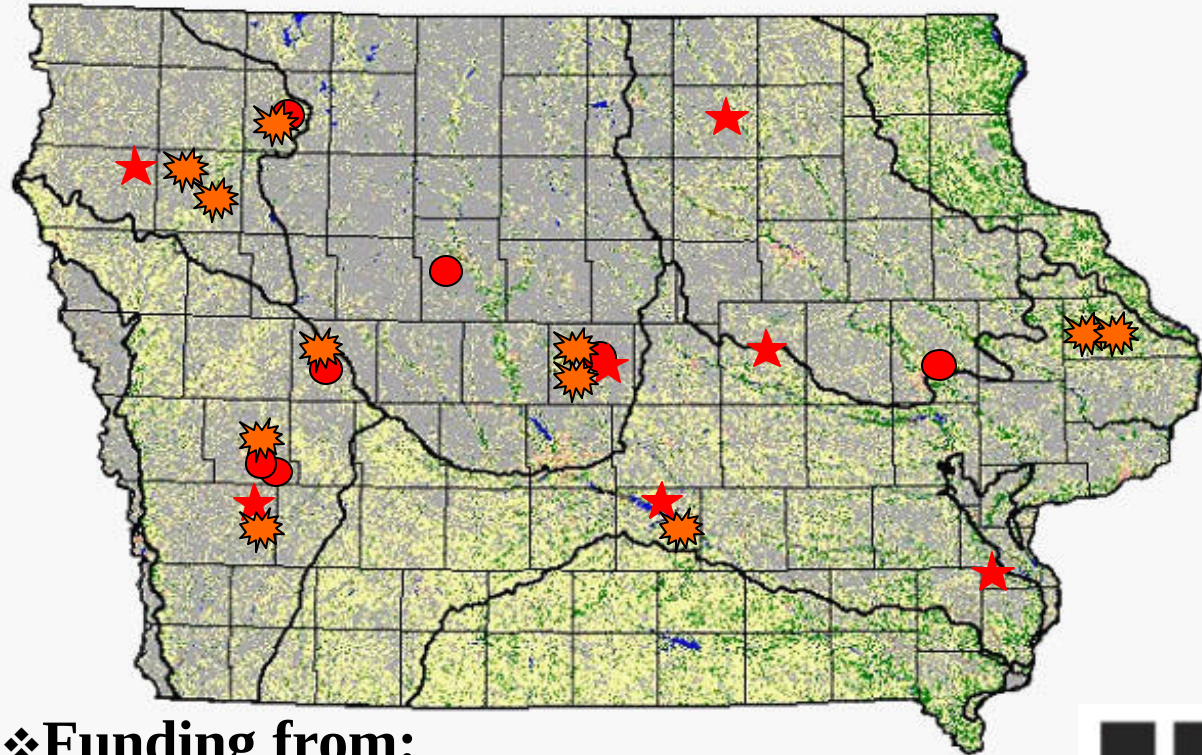
Iowa State University



IOWA STATE UNIVERSITY
University Extension

Soil Nitrogen and Carbon Management Project

25 Sites – 2001-2002



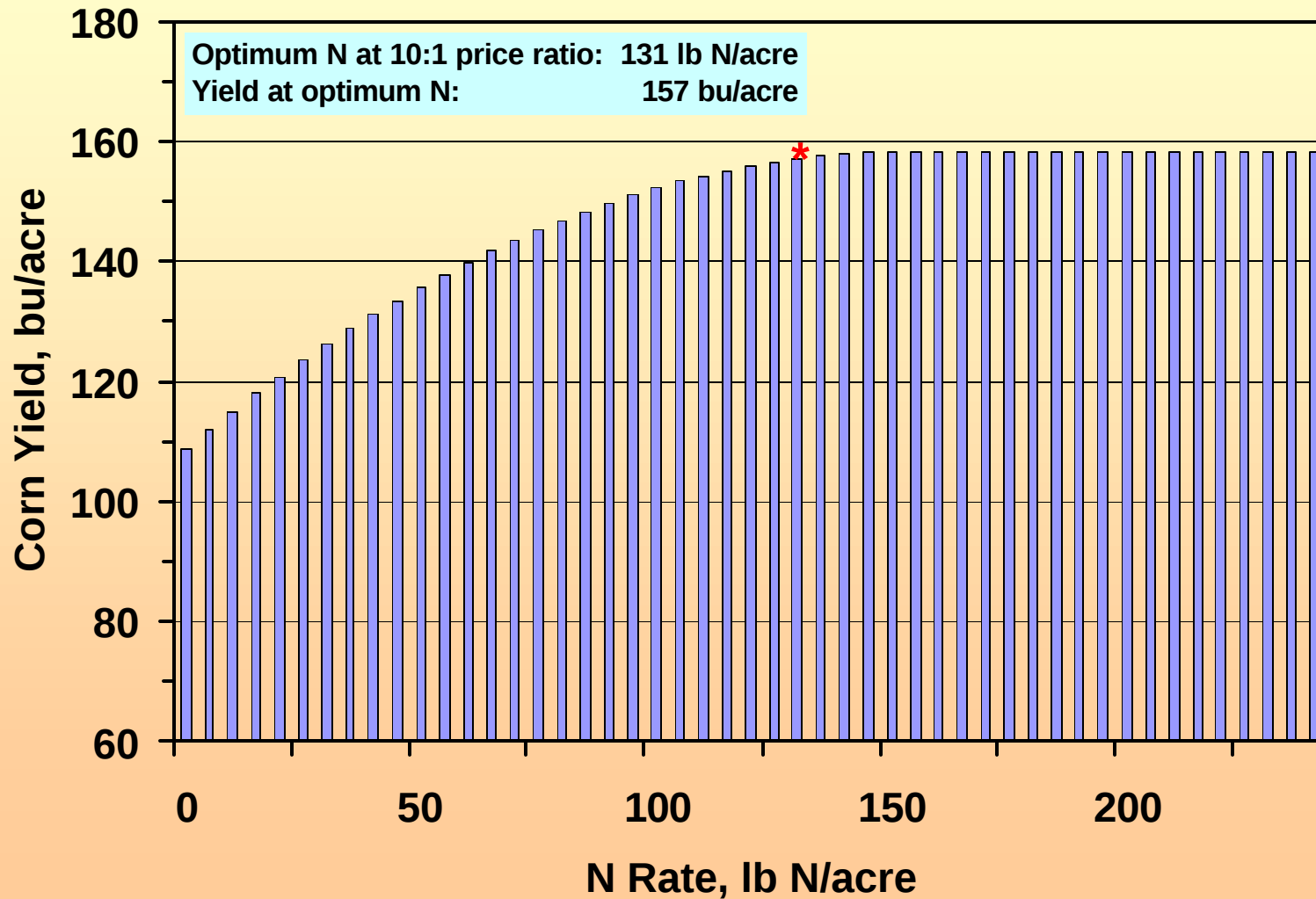
❖Funding from:

➤Iowa Department of Agriculture
Division of Soil Conservation –
Integrated Farm / Livestock
Management Program (IFLM)

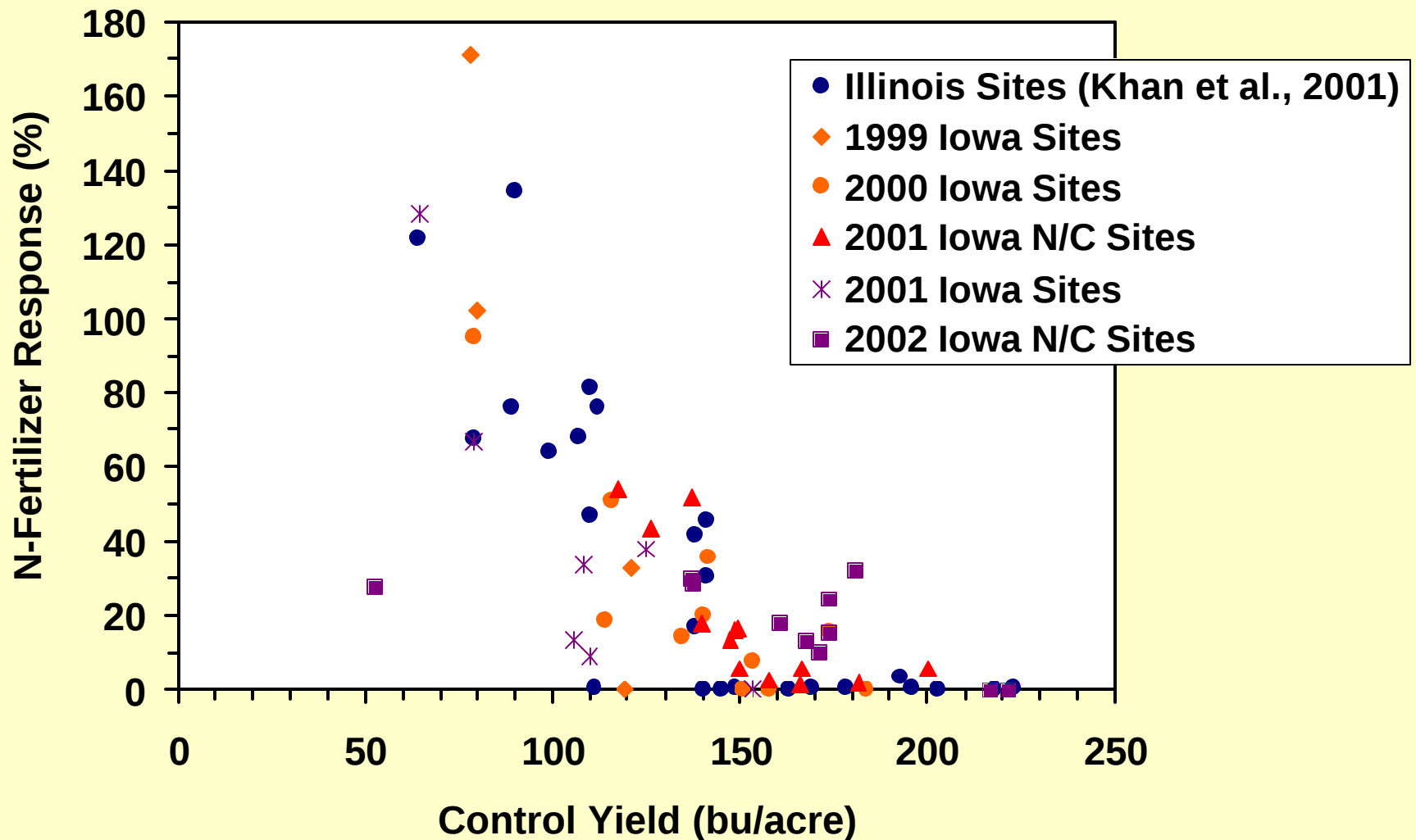


J.E. Sawyer, Iowa State Univ., 2003

59 Site-Years in Iowa Corn-Soybean Rotation



Relationship Between Yield with No Applied N (Control Yield) and Corn N-Fertilizer Response at Economic N Rate



Many Procedures Evaluated for Assessing Plant-Available N

❖ Mass balance

❖ Inorganic soil N

- Exchangeable $\text{NH}_4\text{-N}$
- $\text{NO}_3\text{-N}$
 - Profile
 - PPNT
 - PSNT / LSNT

Many Procedures Evaluated for Assessing Plant-Available N

❖ Soil N mineralization

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

Fractionation of Soil N

Based on Acid Hydrolysis

Described by Bremner (1965), Stevenson (1982, 1996)

- ❖ Heat soil with 3N or 6N HCL for 12 to 24 hours to hydrolyze soil
- ❖ Separate soil N into various fractions (usual ranges)
 - Acid Insoluble-N 20-35% of soil N
 - NH_3 -N 20-35
 - Amino acid-N 30-45
 - Amino sugar-N 5-10
 - Hydrolyzable-HUN 10-20

Amino Sugar-N Determination

❖ Steam distillation of hydrolysate with phosphate buffer at pH 11.2 and correction for $\text{NH}_3\text{-N}$

{as described by Bremner (1965), Stevenson (1982, 1996)}

- Procedure subject to serious error (not quantitative)
- Underestimated the amino-sugar fraction
 - Showed little variation due to soil, cropping, cultivation, or N – manure input history
 - Not related to soil available N supply

Amino Sugar-N Determination

Basis for Illinois Soil N Test

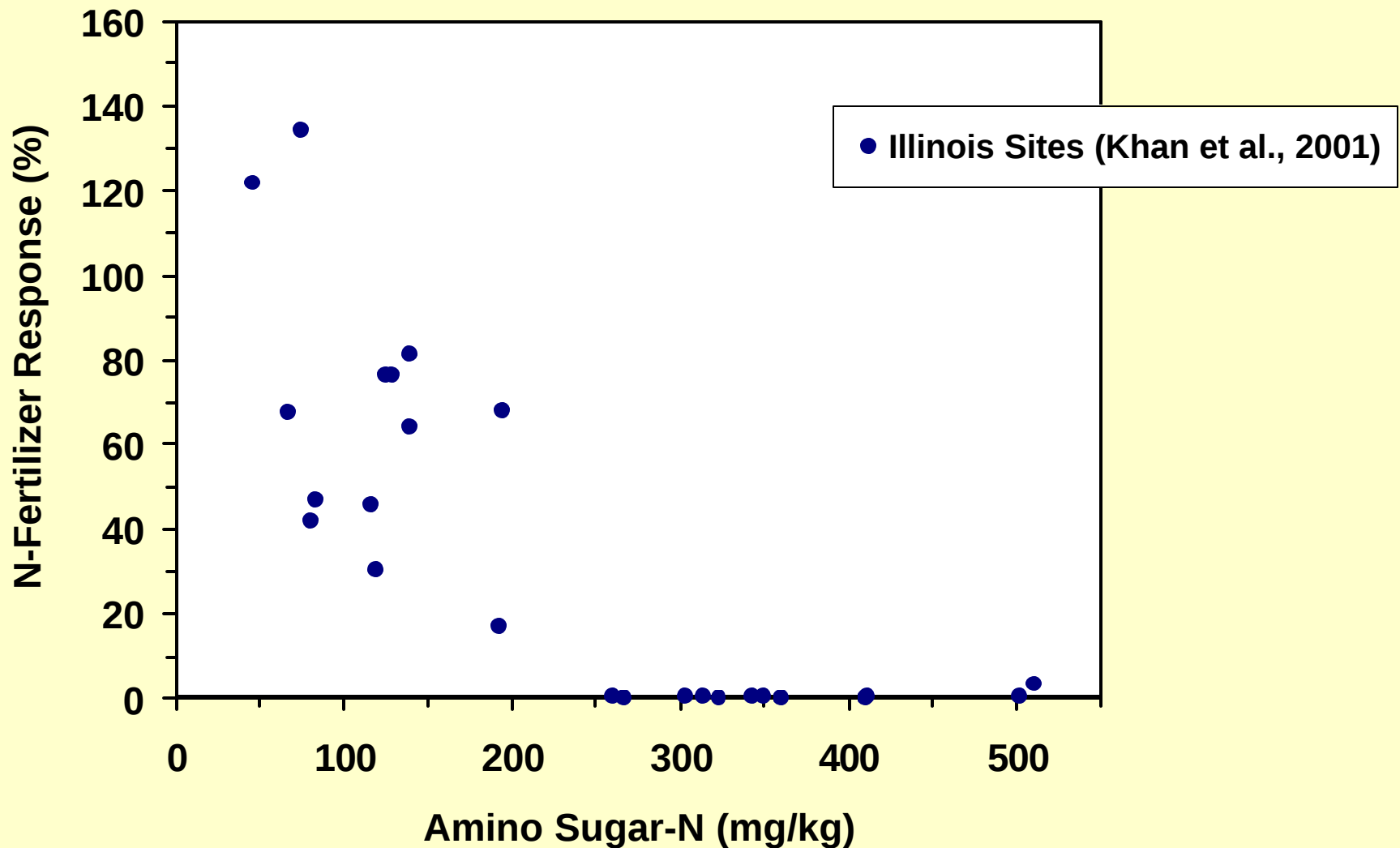
❖ Mason-jar diffusion of acid hydrolysate with sodium hydroxide and correction for $\text{NH}_3\text{-N}$

{Mulvaney and Khan, SSAJ 65:1284-1292}

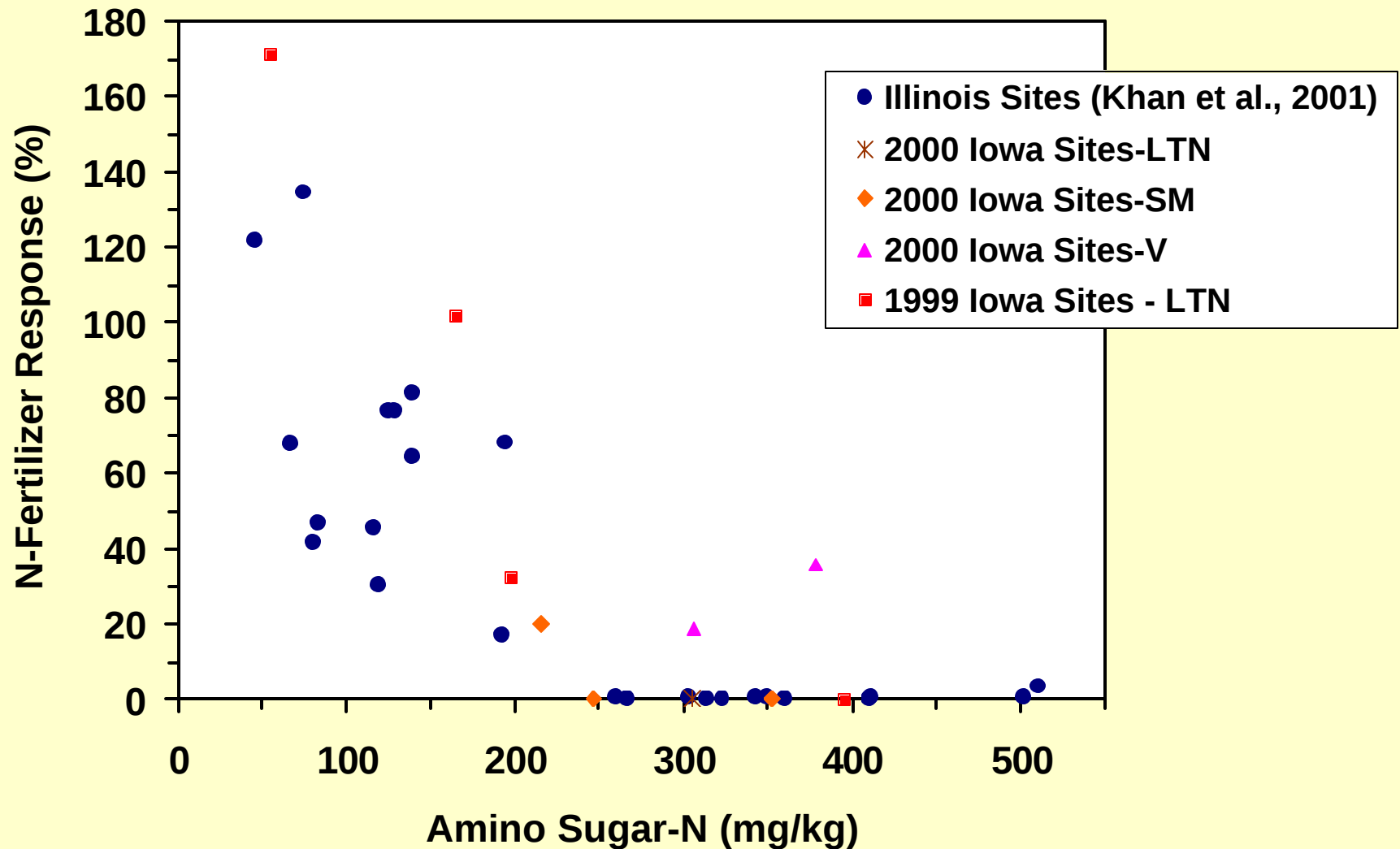
{Mulvaney et al., SSAJ 65:1164-1172}

- Improved determination of amino sugar-N fraction
- Indicated Amino Sugar-N fraction:
 - Related to soil available N supply
 - Indicated corn responsiveness to N fertilization
 - “Pool” of readily mineralizable organic-N

Relationship Between Hydrolyzable Amino Sugar-N (spring 0-12 inch soil depth) and Corn N-Fertilizer Response



Relationship Between Hydrolyzable Amino Sugar-N (spring 0-12 inch soil depth or depth adjusted) and Corn N-Fertilizer Response



Illinois Soil N Test Procedure

Khan, Mulvaney and Hoefft (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 H₂SO₄

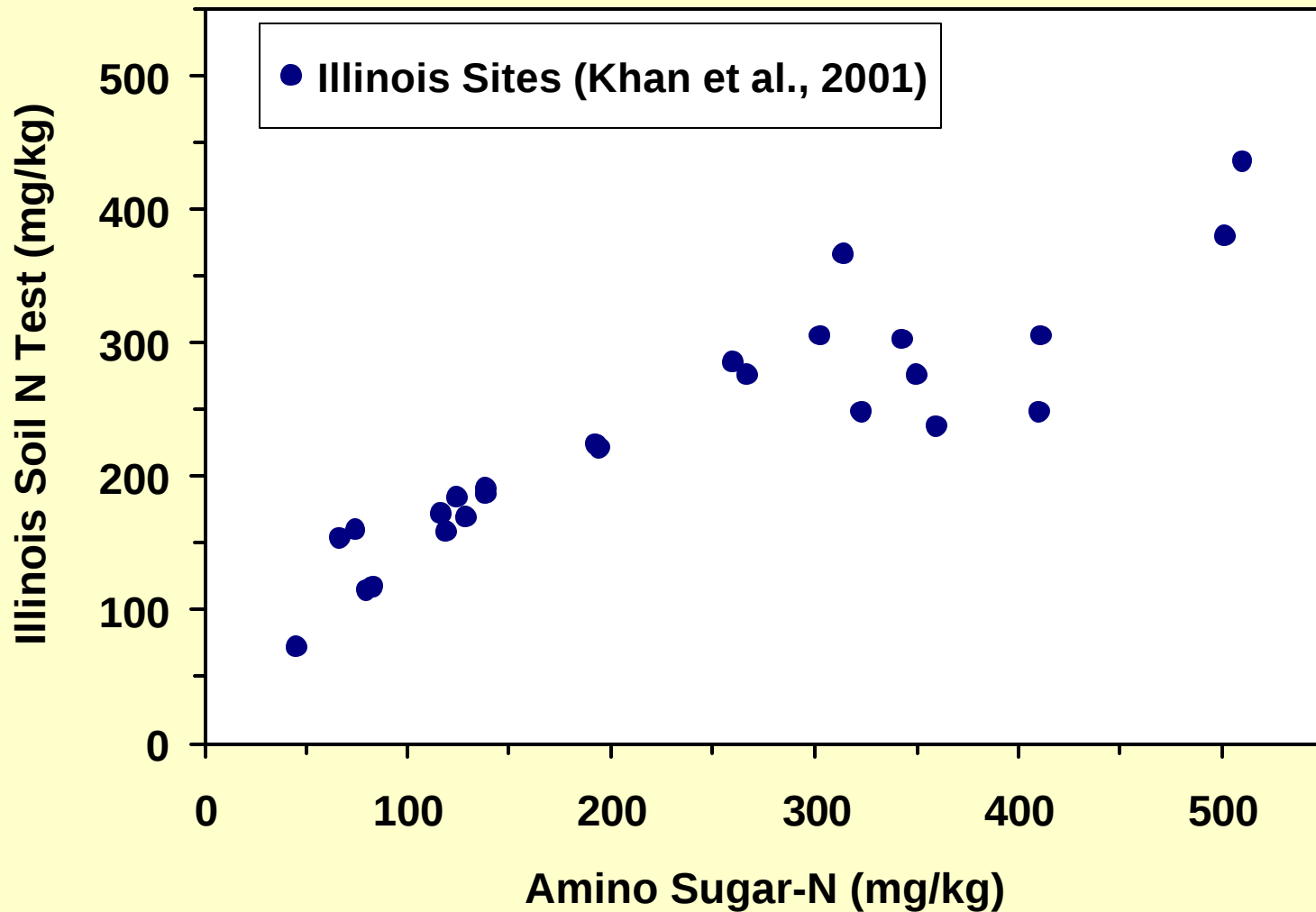




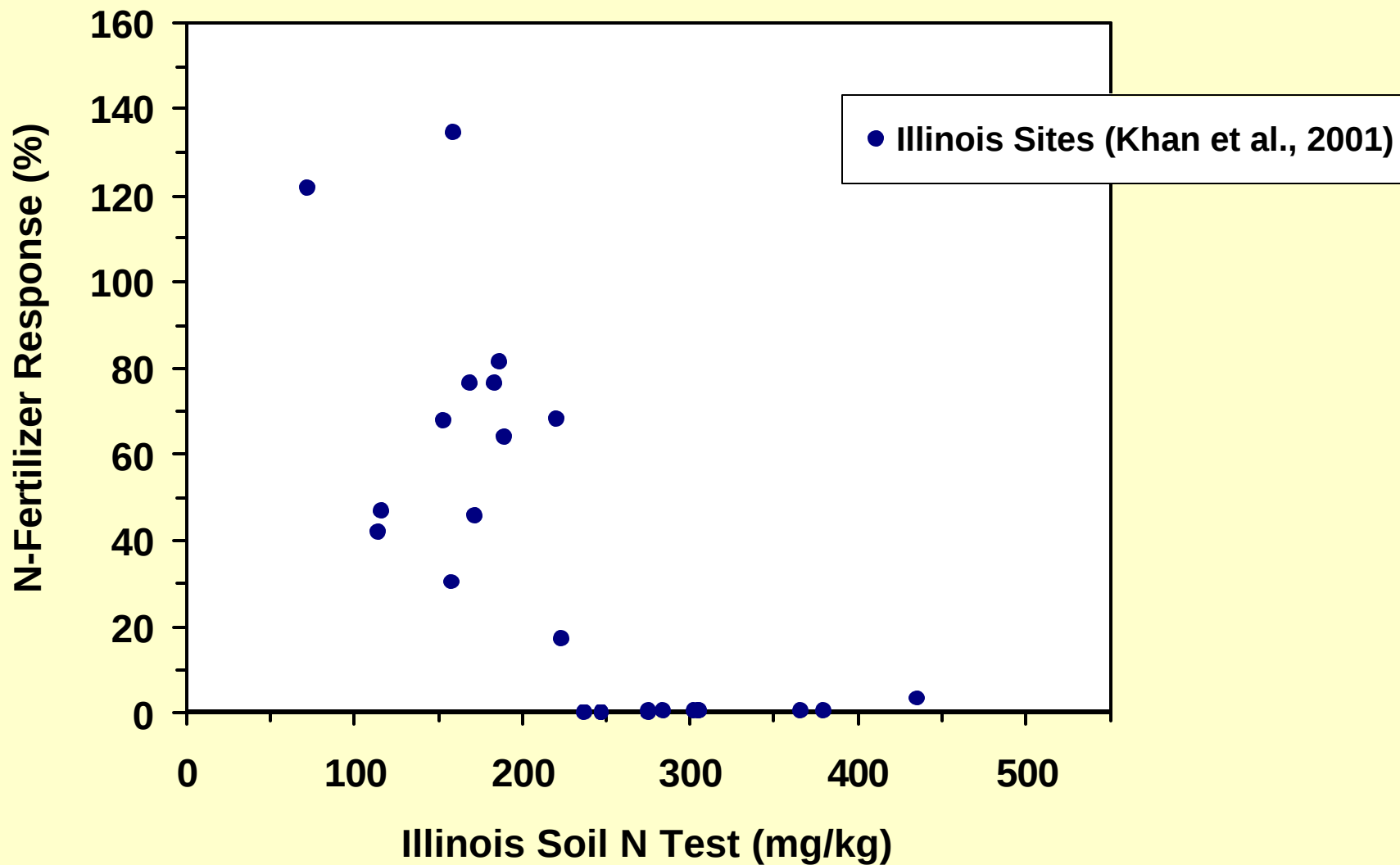
Expectations for Illinois Soil N Test

- ❖ Routine soil N test
- ❖ Assess field N responsiveness
- ❖ Determine needed N application rate
- ❖ Preplant soil sample
 - Fall or spring
 - Same soil sample used for routine soil tests

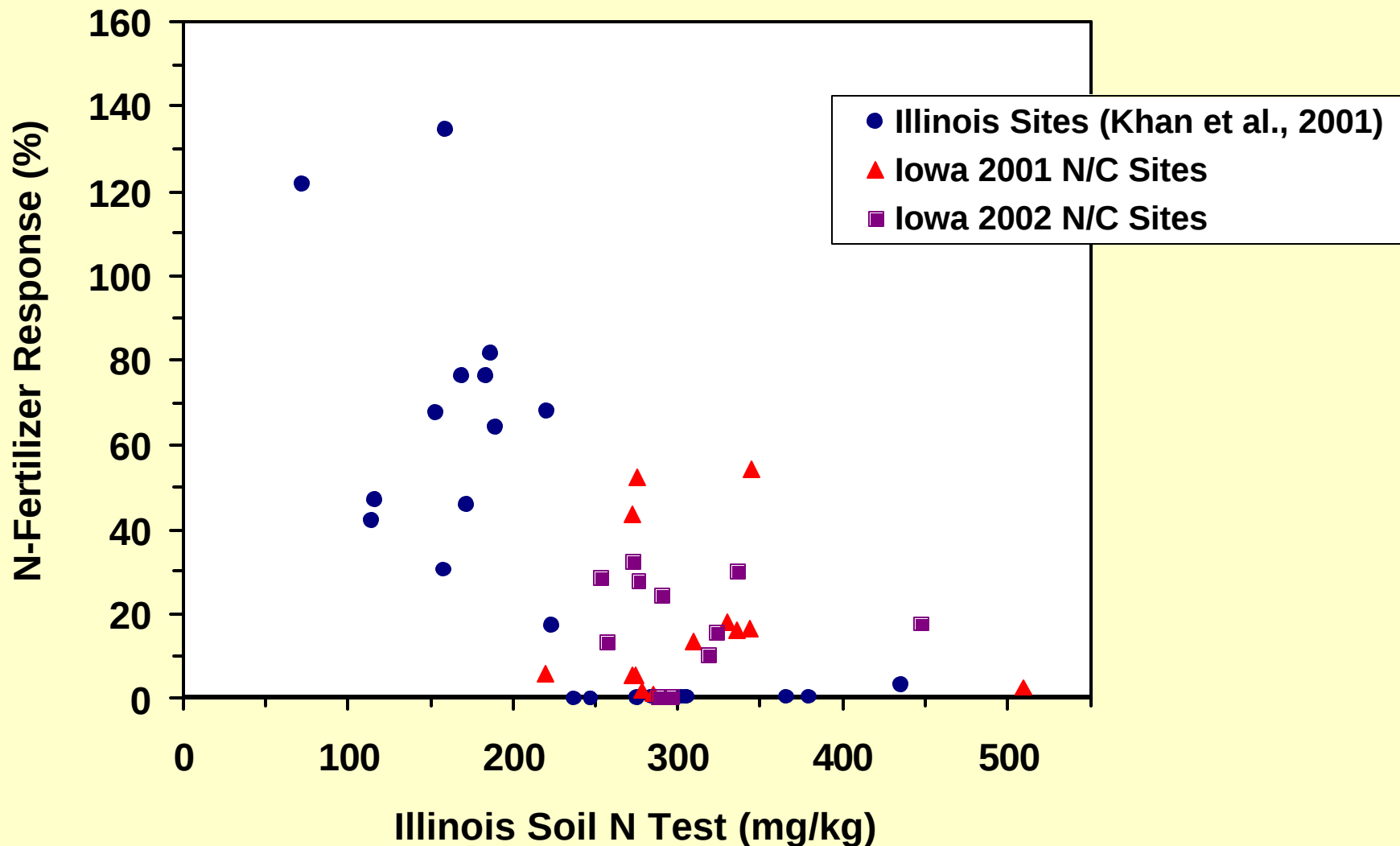
Relationship Between Hydrolyzable Amino Sugar-N (spring 0-12 inch soil depth) and Illinois Soil N Test



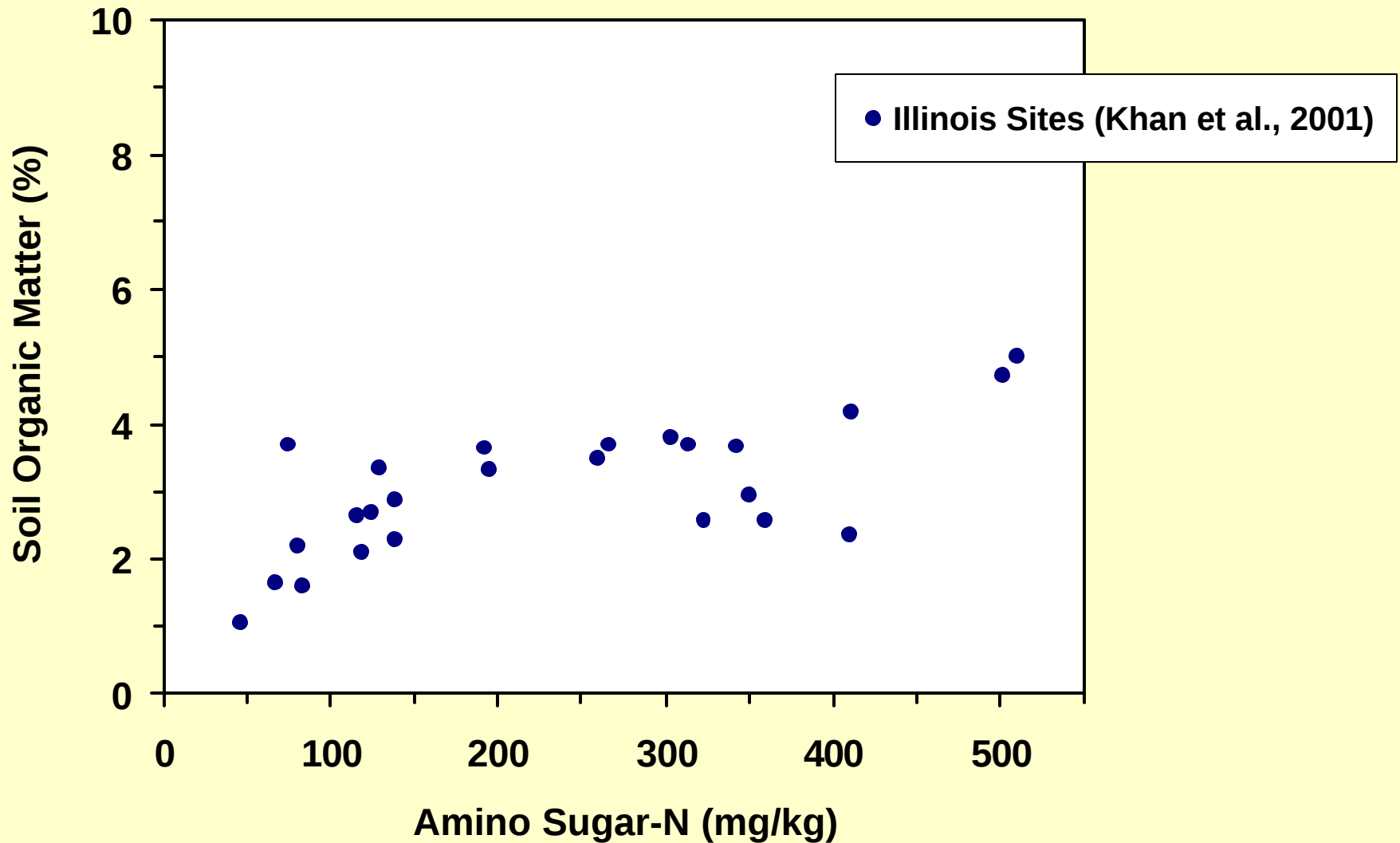
Relationship Between Illinois Soil N Test (spring 0-12 inch soil depth) and Corn N-Fertilizer Response



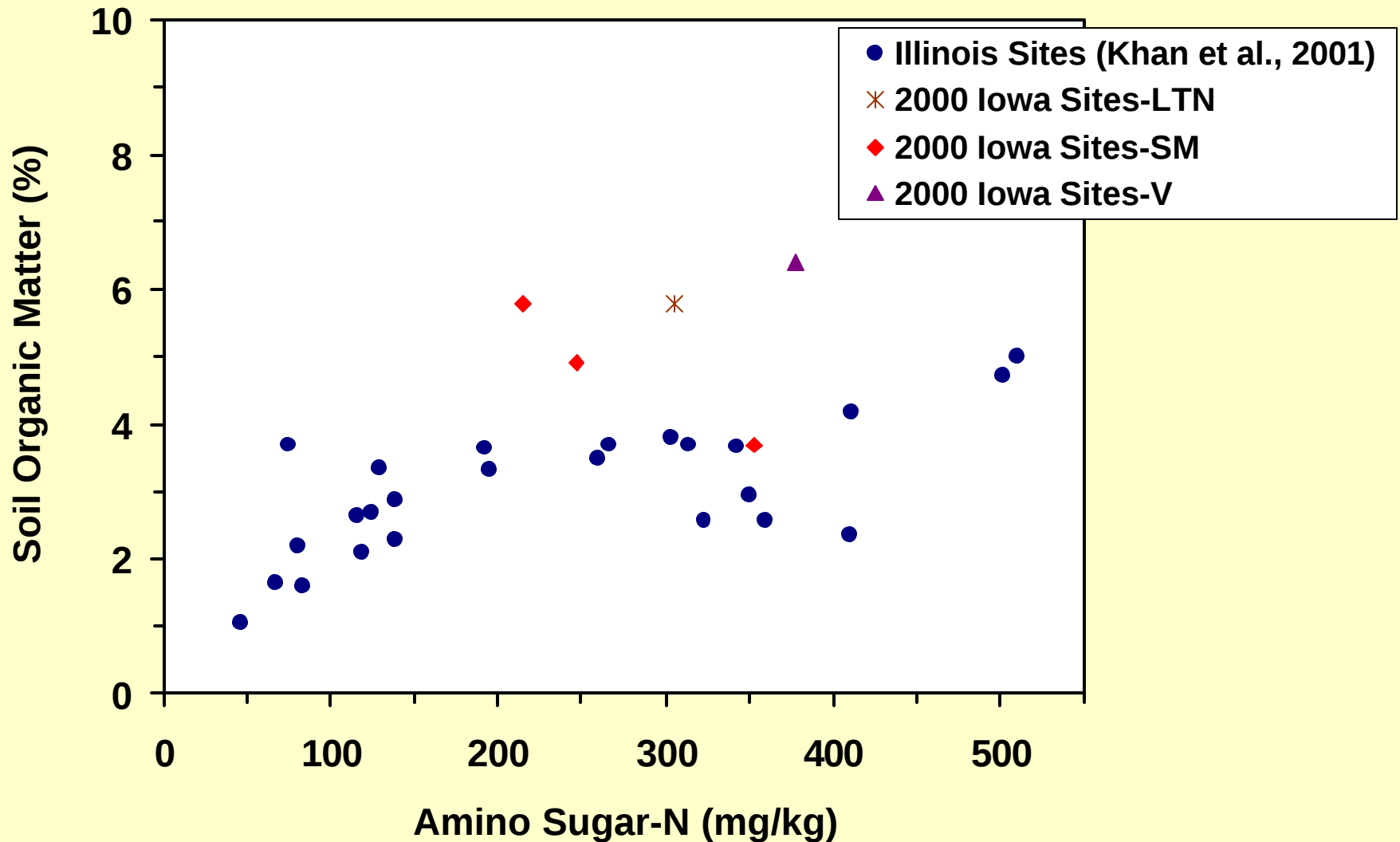
Relationship Between Illinois Soil N Test (spring 0-12 inch soil depth) and Corn N-Fertilizer Response



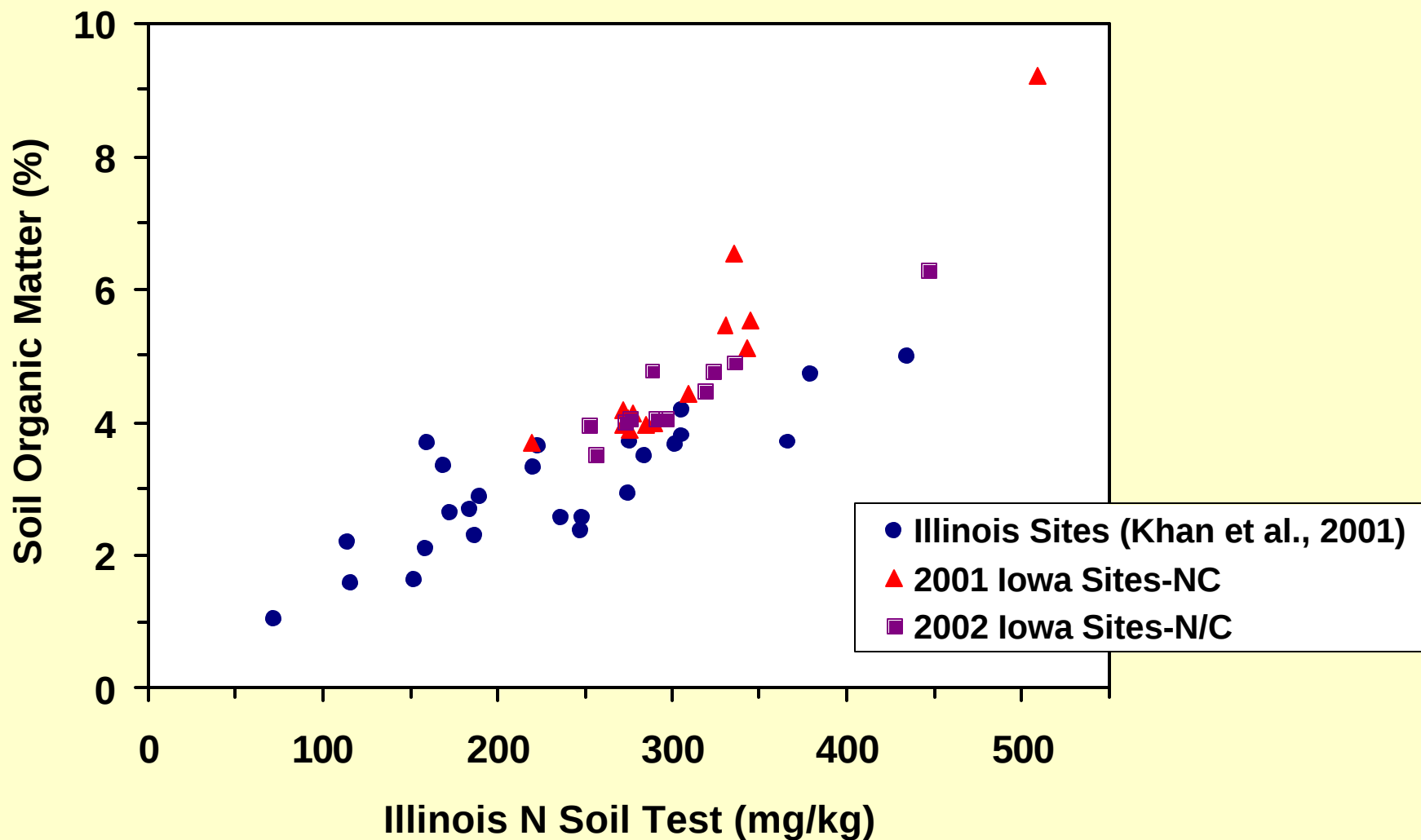
Relationship Between Hydrolyzable Amino Sugar-N (spring 0-12 inch soil depth) and Soil Organic Matter (0-6 inch soil depth)



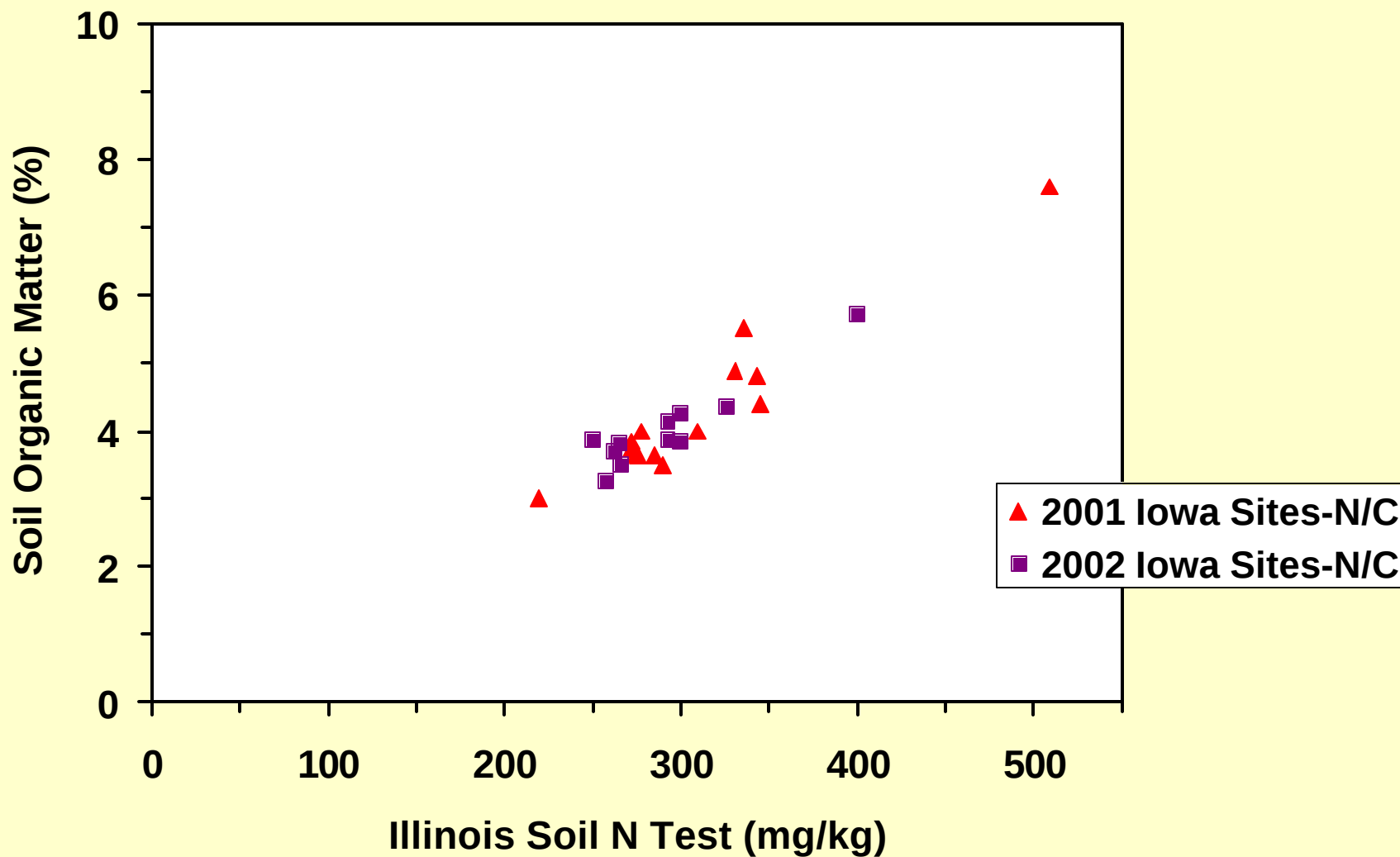
Relationship Between Hydrolyzable Amino Sugar-N (spring 0-12 inch soil depth) and Soil Organic Matter (0-6 inch soil depth)



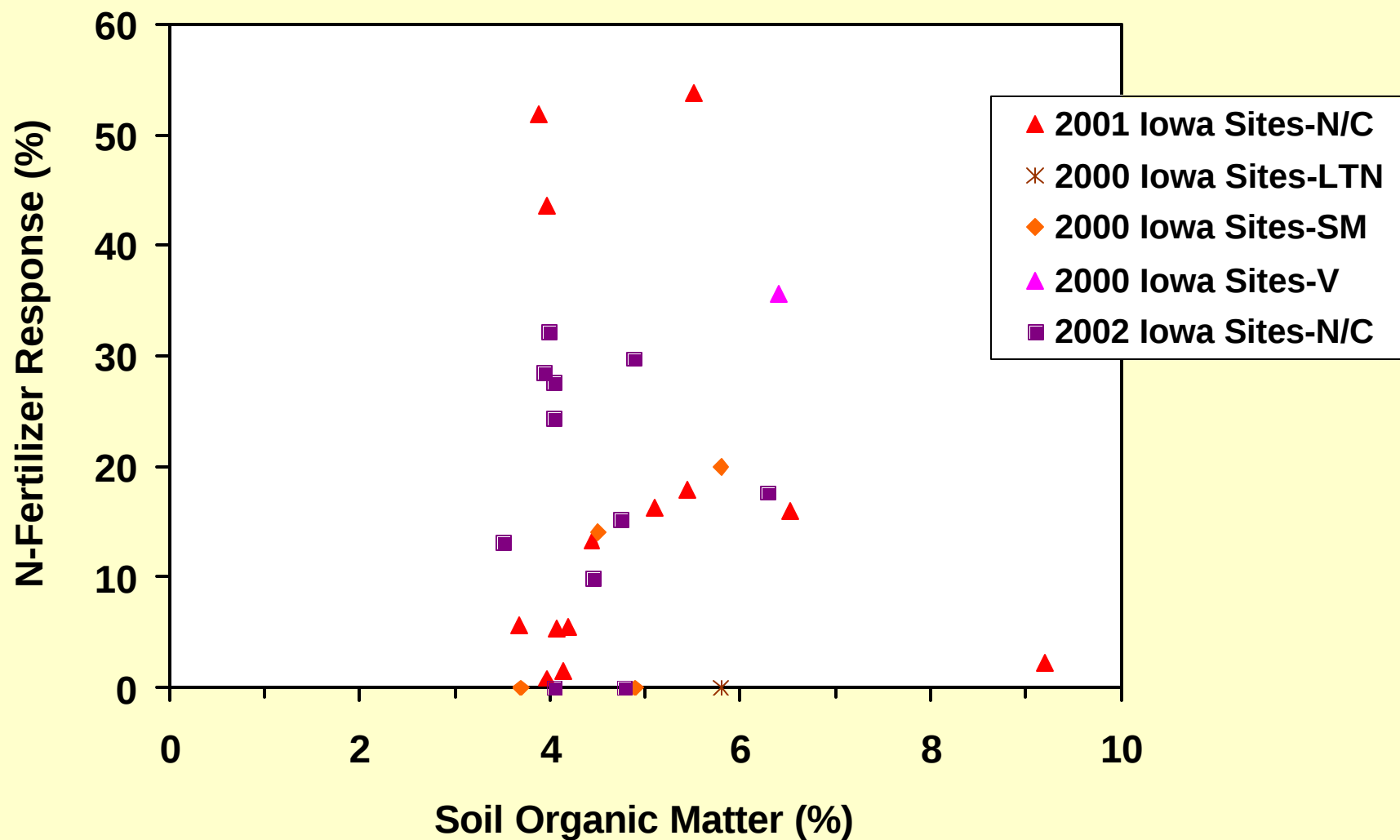
**Relationship Between Illinois N Soil Test (spring 0-12 inch soil depth)
and Soil Organic Matter (0-6 inch soil depth)**



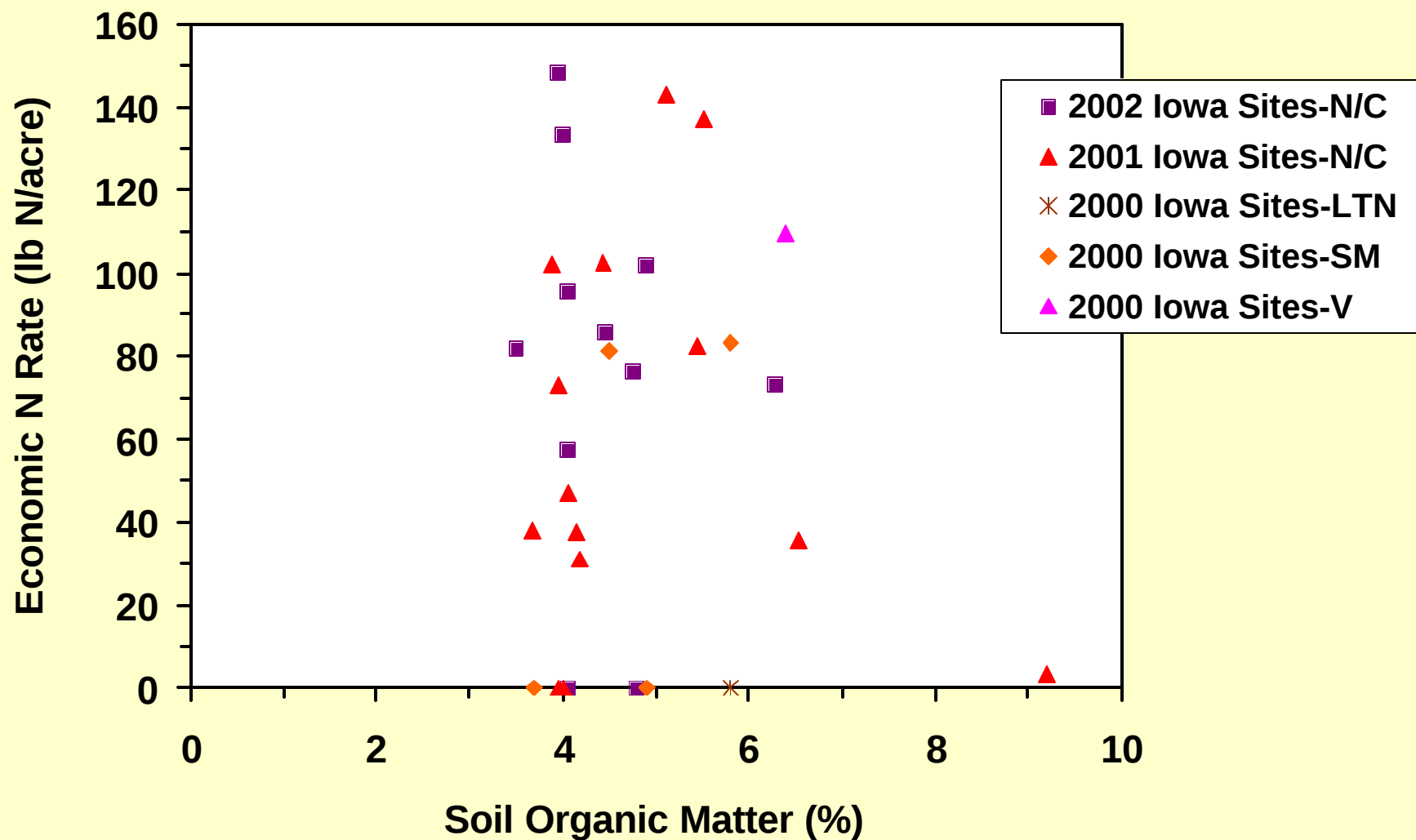
Relationship Between Illinois N Soil Test (spring/fall 0-12 inch soil depth) and Soil Organic Matter (0-12 inch soil depth)



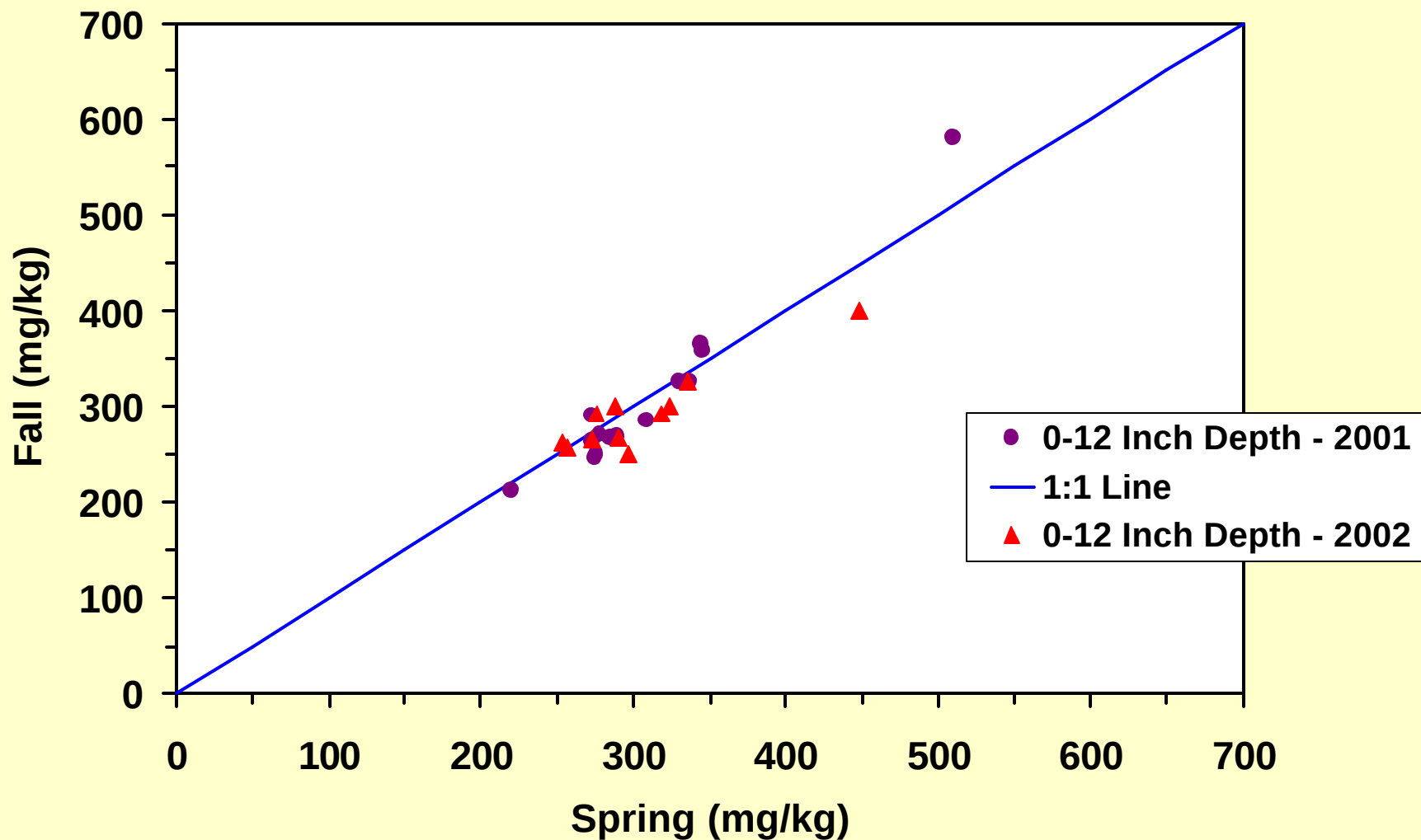
Relationship Between Corn N-Fertilizer Response and Soil Organic Matter (0-6 inch soil depth)



Relationship Between Economic N Rate and Soil Organic Matter (0-6 inch soil depth)



Fall versus Spring Sampling (Iowa N/C Sites) Illinois Soil N Test



Iowa Experience with the Illinois Soil N Test

Preliminary Results

- ❖ **Illinois Soil N Test (routine test) has not been predictive of corn response to applied N**
 - **Possibly due to general measurement of soil organic-N or multiple organic-N pools**
- ❖ **Hydrolyzable amino sugar-N basis may be correct**
- ❖ **At this time the Illinois Soil N Test is not recommended for adjusting corn N fertilization**

Iowa Experience with the Illinois Soil N Test

Preliminary Results

❖ Research Continues

- Corn N response field trials in 2003
- Illinois Soil N Test procedure evaluation
 - Laboratory evaluation
 - NC-218 committee evaluation

