CHALLENGES IN GETTING HIGH CORN AND SOYBEAN YIELDS IN THE U.S.

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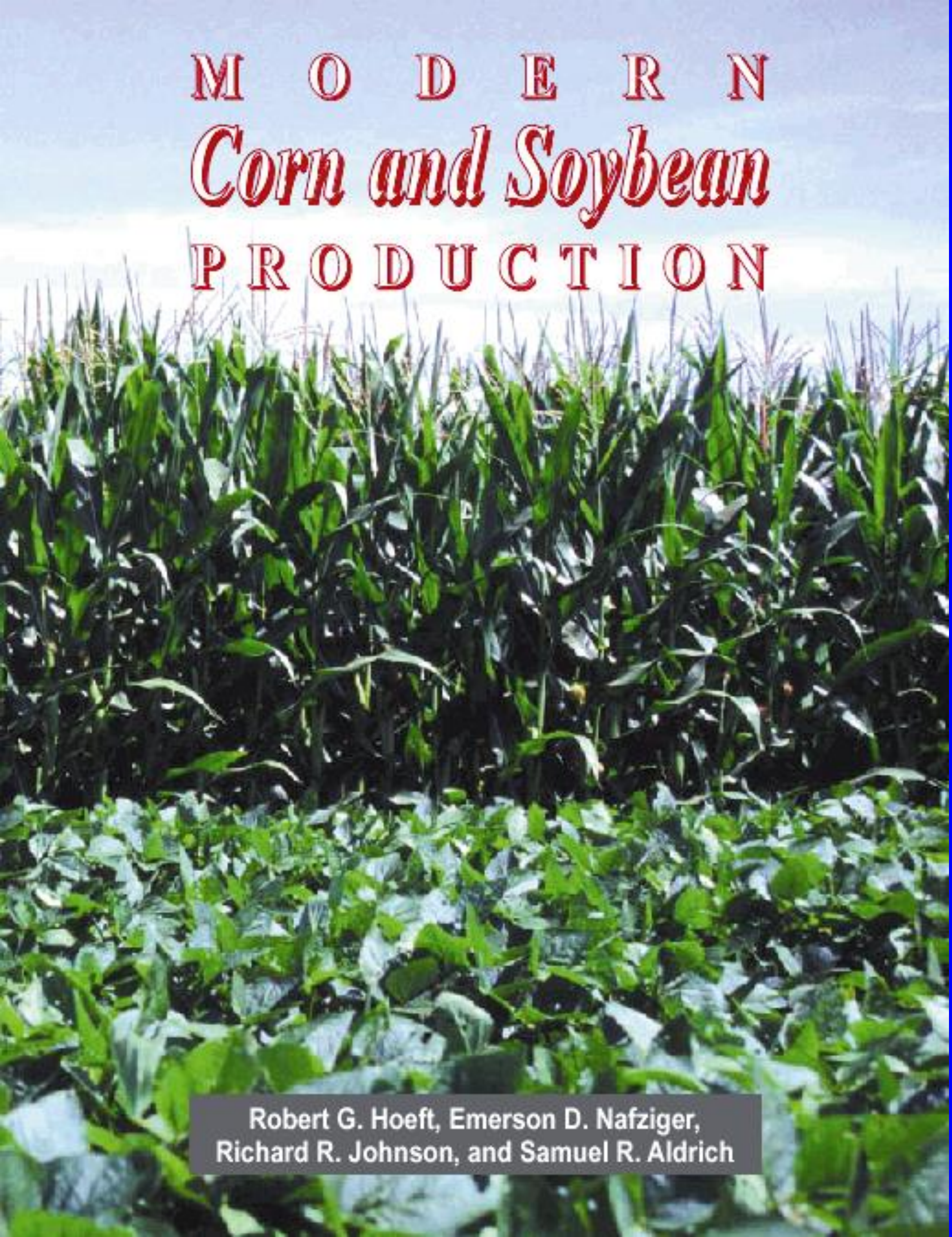
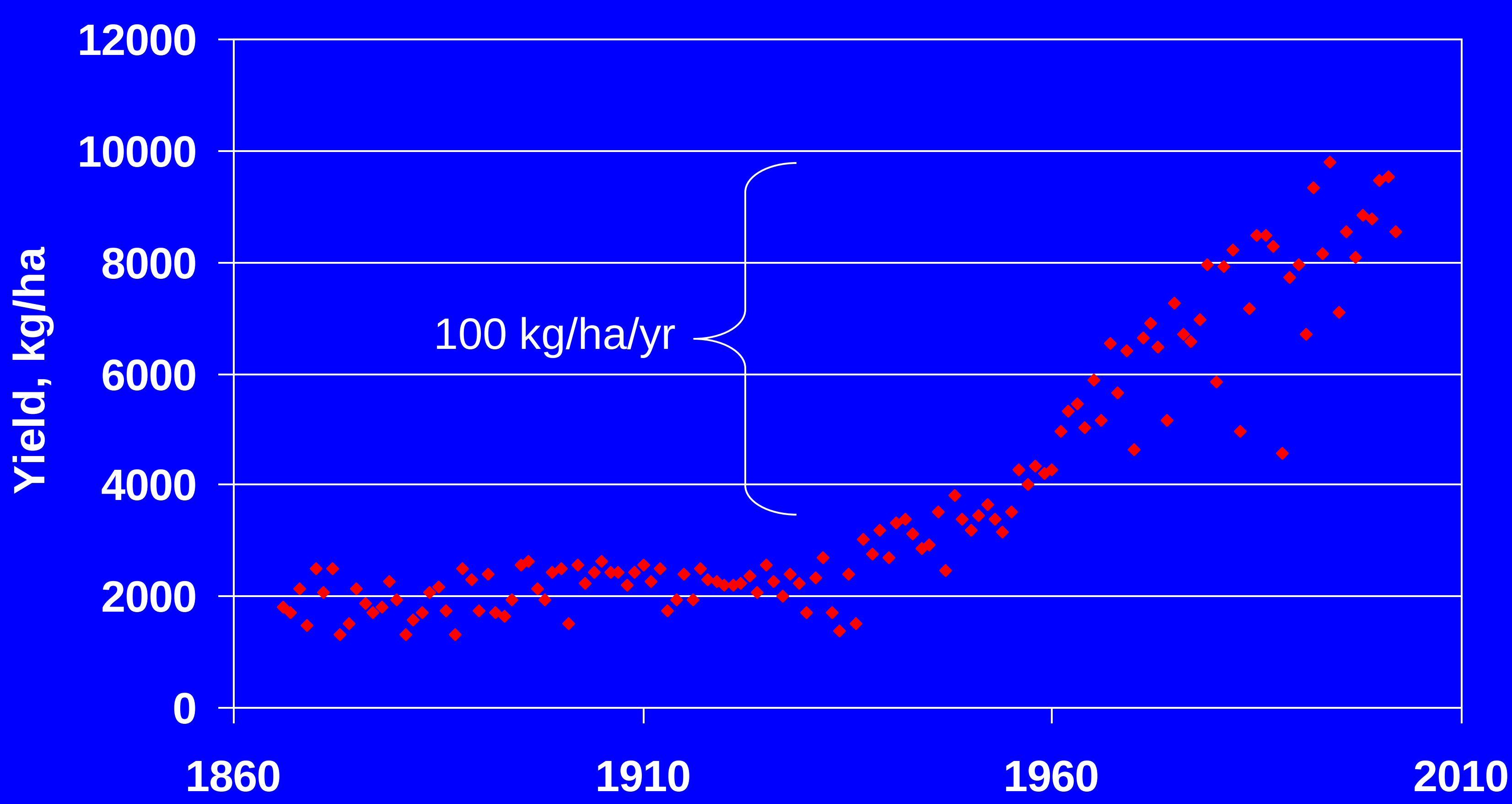


"I bought this book thinking that it would be mostly a desk reference. But I used it in the field a lot during the growing season."

– an Illinois CCA

ILLINOIS CORN YIELD



Francis Childs -New World Champion

Manchester, Iowa

1997--- 332 bu/A

1998--- 338 bu/A

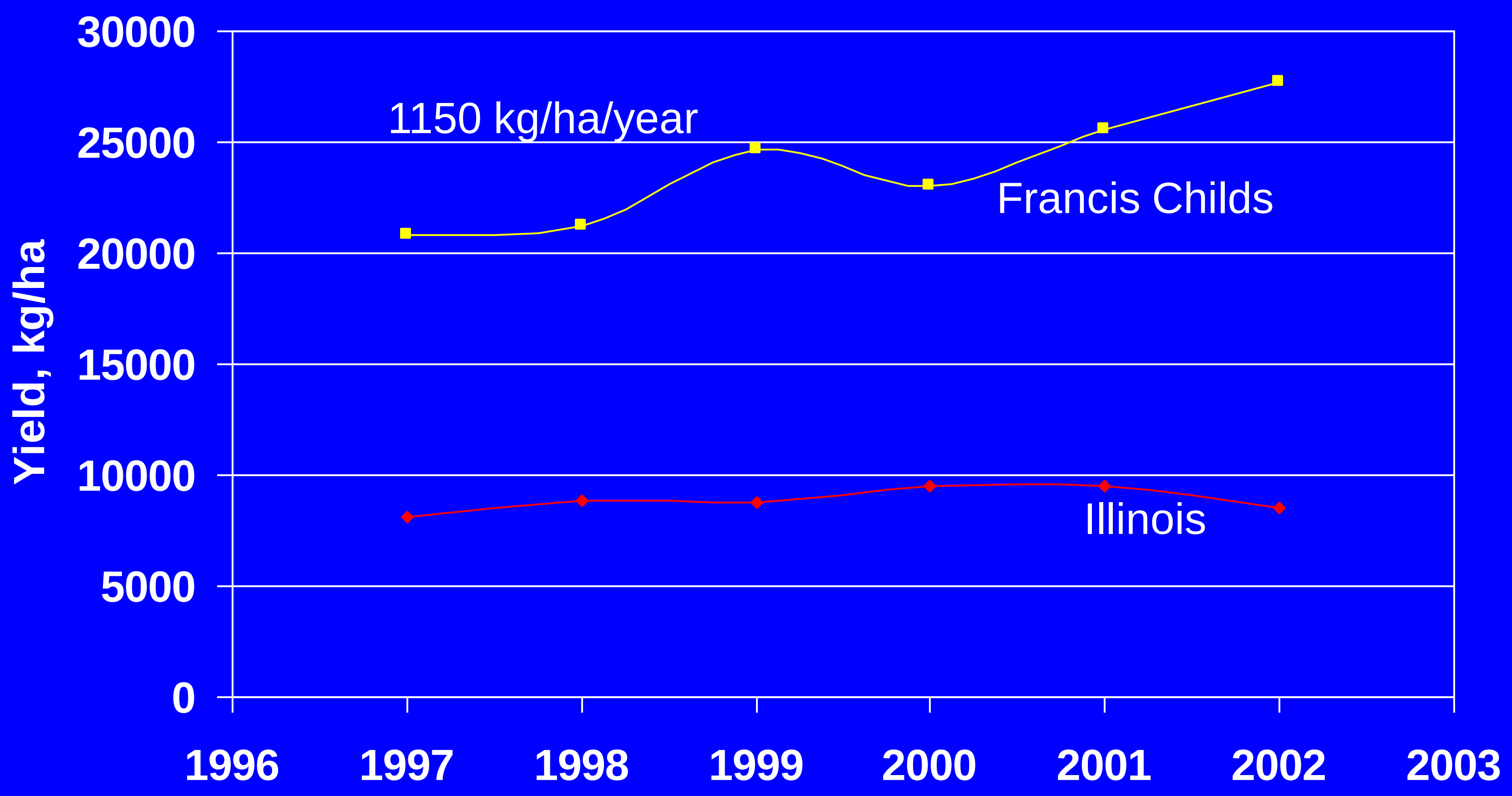
1999--- 394 bu/A

2000--- 367 bu/A

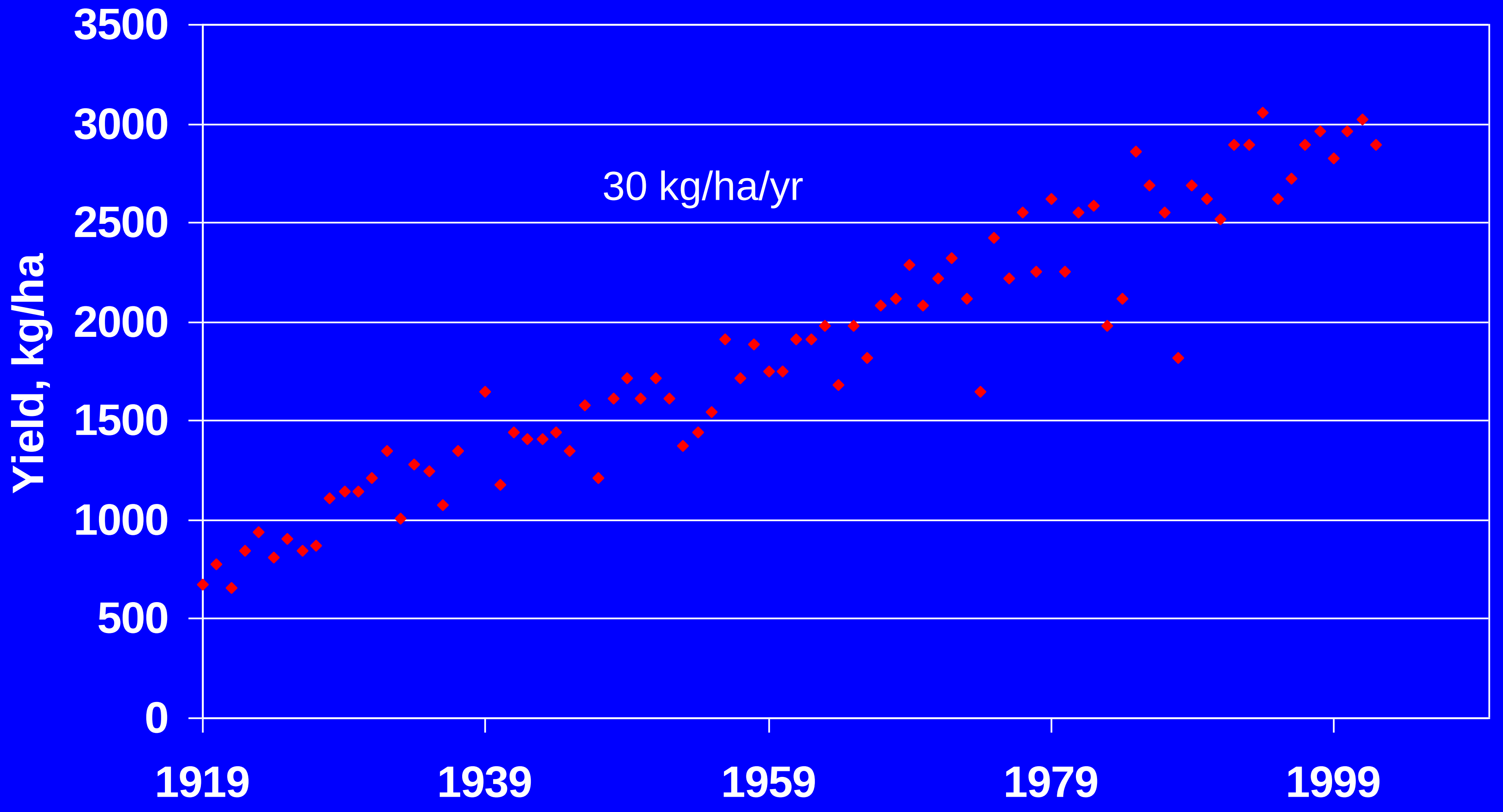
2001--- 408 bu/A

2002--- 442 bu/A

RECORD VS STATE AVG.



ILLINOIS SOYBEAN YIELD



CHALLENGES

NUTRIENT MANAGEMENT

CLIMATE

PEST MANAGEMENT

GENETIC POTENTIAL

SOIL PRODUCTIVITY/TILTH

CHALLENGES

NUTRIENT MANAGEMENT

CLIMATE

PEST
MANAGEMENT

GENETIC
POTENTIAL

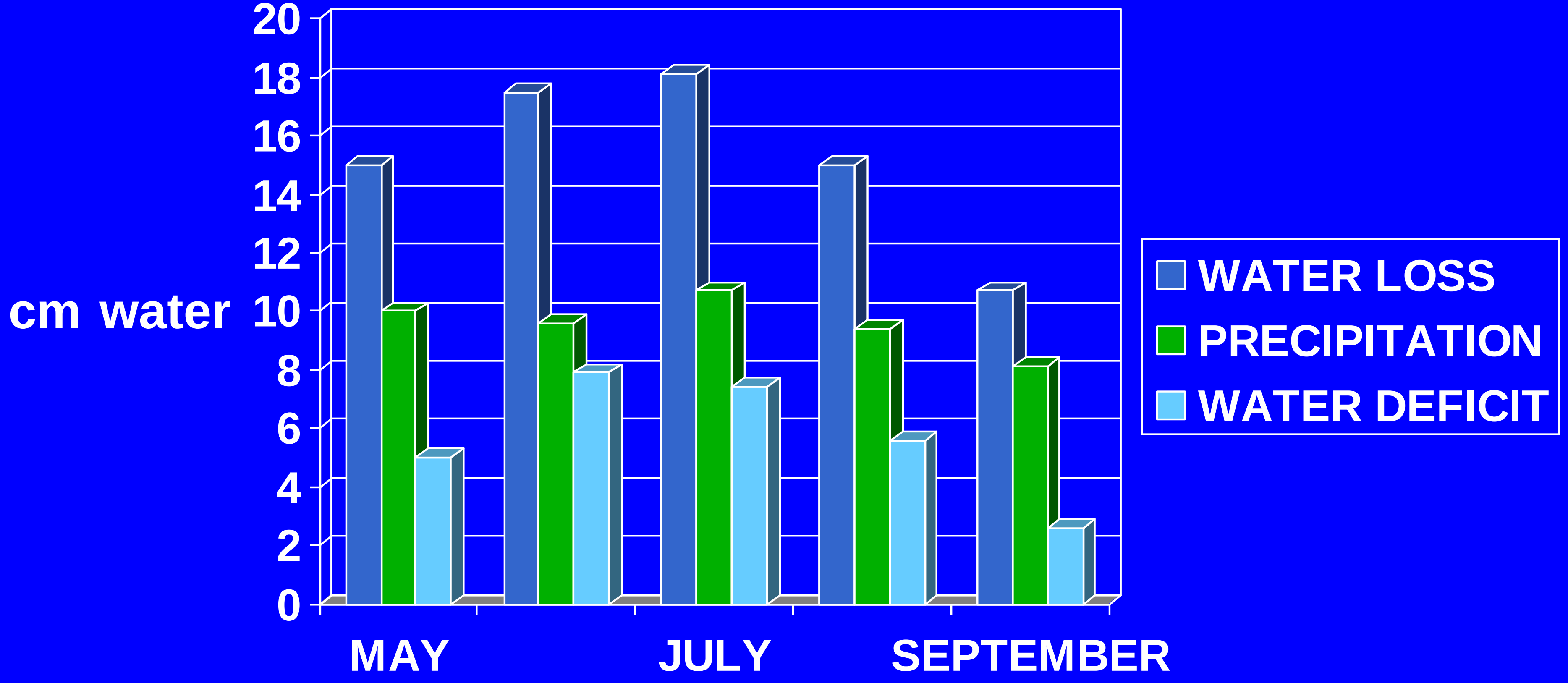
SOIL PRODUCTIVITY/TILTH

CLIMATE

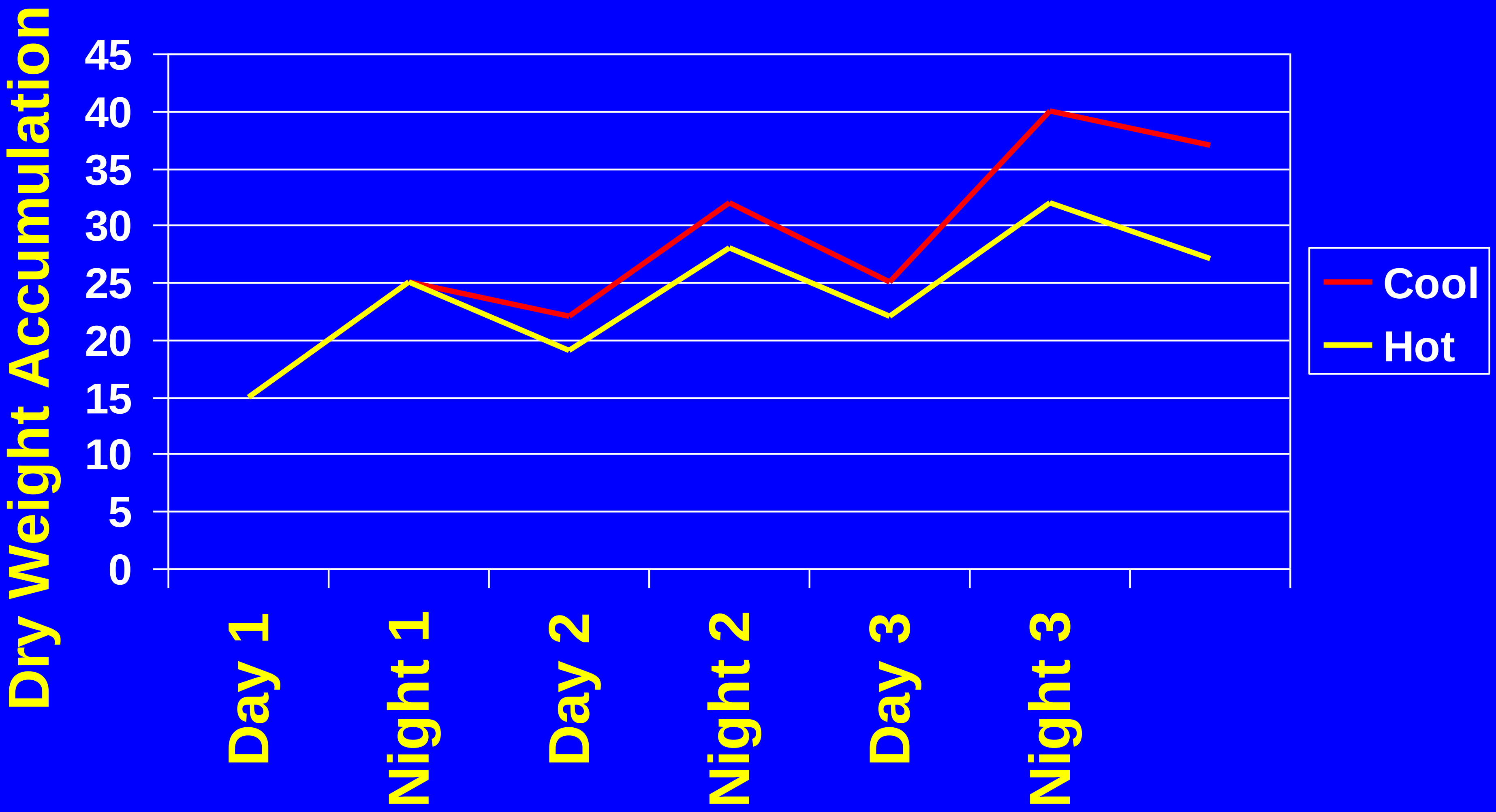
- SOIL MOISTURE
- TEMPERATURE
- LIGHT INTENSITY

TOO MUCH WATER
TOO LITTLE WATER

WATER BALANCE

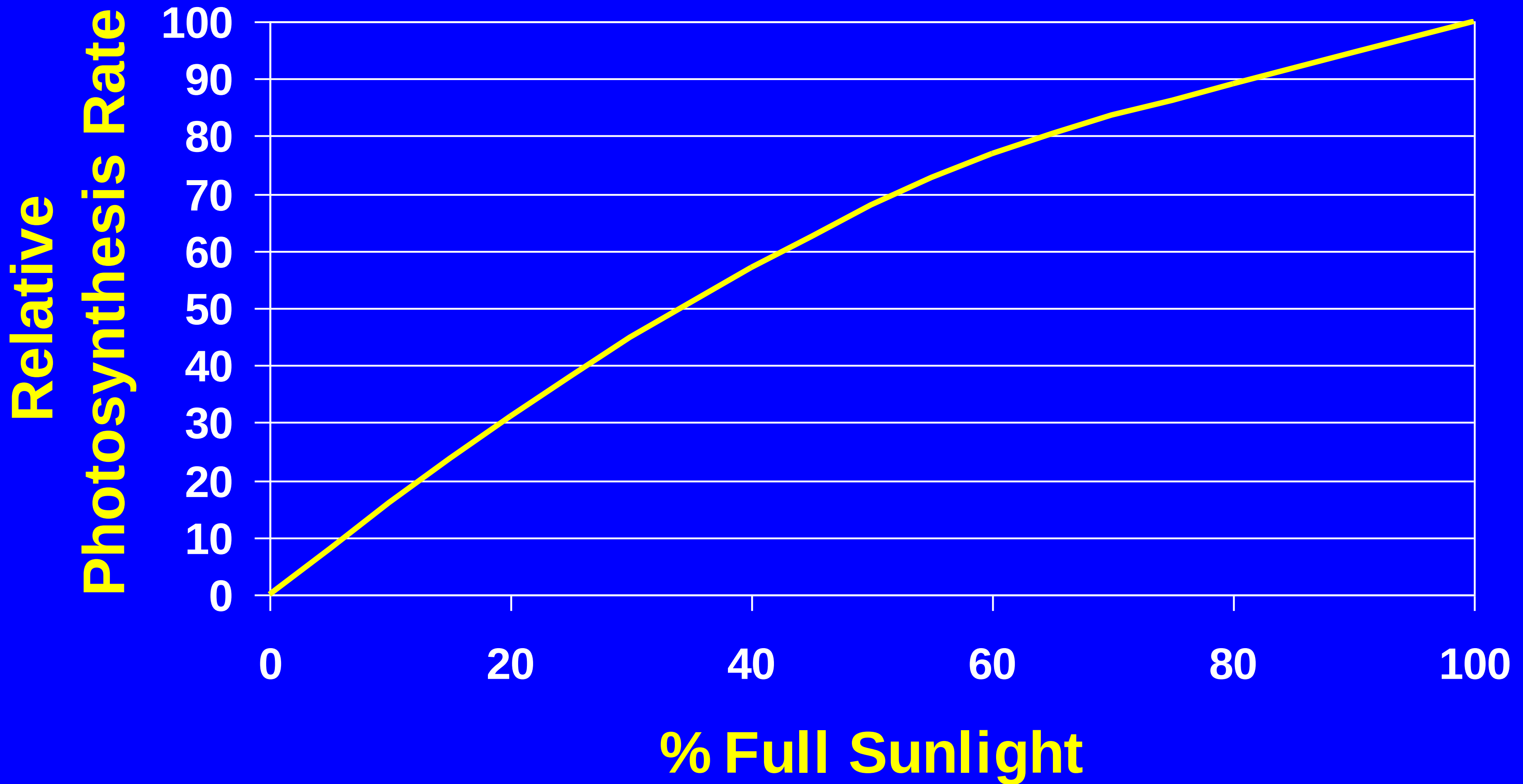


Warm Nights



Dry Weight Accumulation
45
40
35
30
25
20
15
10
5
0
Day 1
Night 1
Day 2
Night 2
Day 3
Night 3
Cool
Hot

Treatment	Avg. Night Temp. ^{0}C	Grain Yield kg/ha
Natural air	18	10535
Cooled	16.6	10160
Heated	29.4	6270



Relative
Photosynthesis Rate
100
90
80
70
60
50
40
30
20
10
0
0
20
40
60
80
100
% Full Sunlight

CHALLENGES

NUTRIENT MANAGEMENT

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SOIL PRODUCTIVITY/TILTH

NUTRIENT MANAGEMENT

- ENVIRONMENT
- PRECISION APPLICATION
  - RATE
  - TIMING

Council cites study to defend water quality

Researchers conclude that nitrate levels "is an insignificant health concern."

Lake Decatur nitrate level jumps

City begins distributing free water to parents of infants.

Officials keep hope that nitrate amounts in water will recede

EPA has given city until 2001 to cut levels, or $15 million must be spent on treatment

Report: Steps can control nitrate level in city water

Reduced fertilizer use and erosion protection key to helping Lake Decatur

Herald & Review

City weighs nitrate reduction options

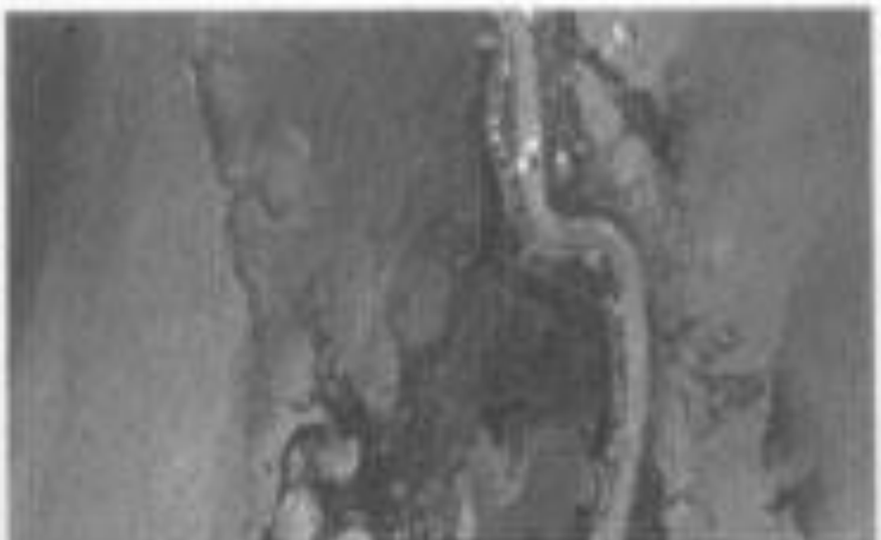
Decatur will likely see water rate increase to meet EPA standards.

Down in the Dead Zone

Shellfish are dying in the Gulf of Mexico—in a patch as big as New Jersey. Why?

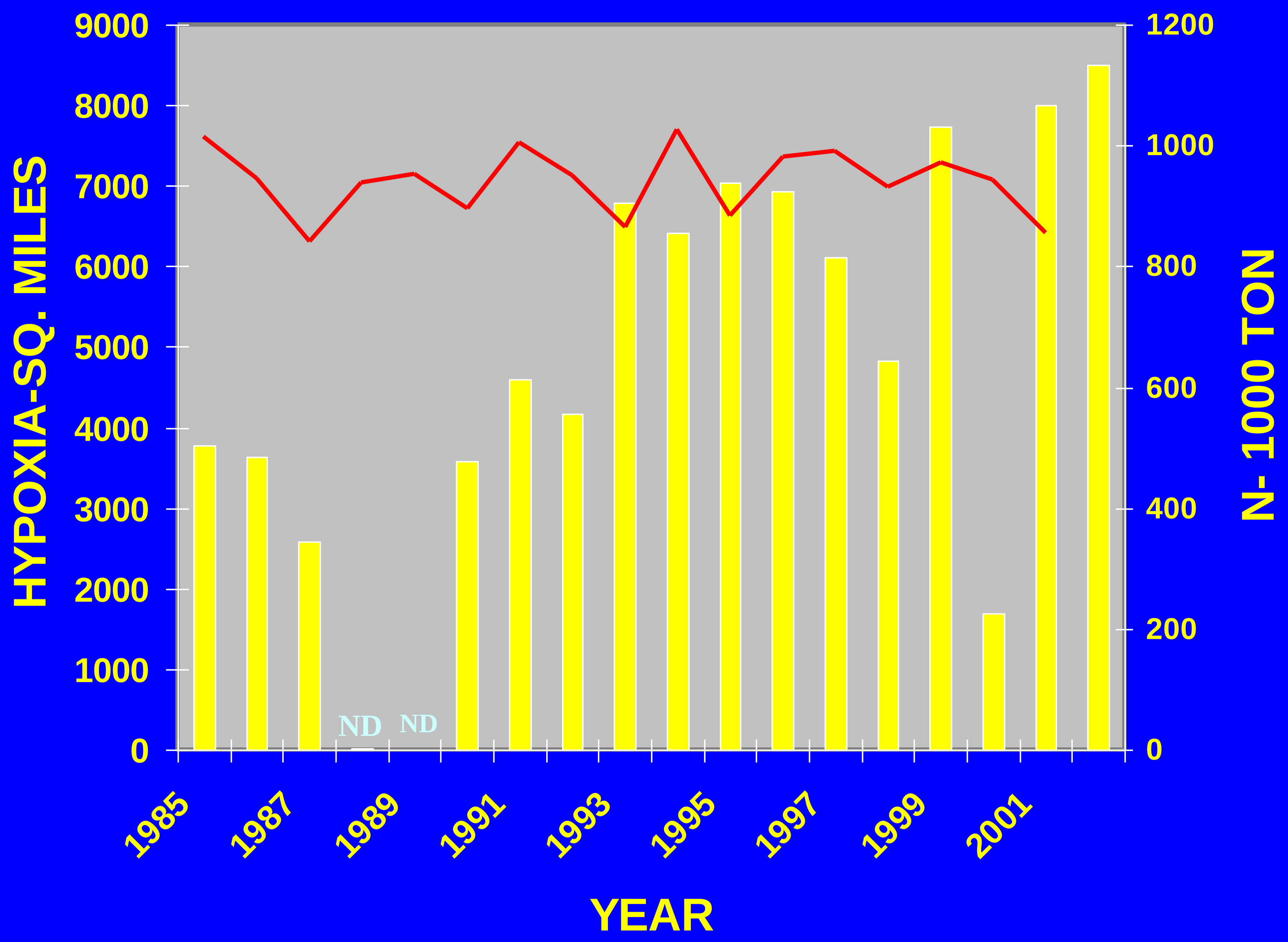
By Peter Annin

FISHERMEN CALL IT THE "DEAD zone"—a barren patch in the Gulf of Mexico where their nets come up empty and their lines never record a strike. It moves around, waxes or wanes with the seasons, but always returns. In fact, the dead zone is growing—currently 7,728 square miles, an area the size of New Jersey that's "void of baitfish, void of anything," says Johnny Glover, a former Louisiana state representative who runs a fleet of charter sport-fishing boats out of Cocodrie, La. A [illegible]

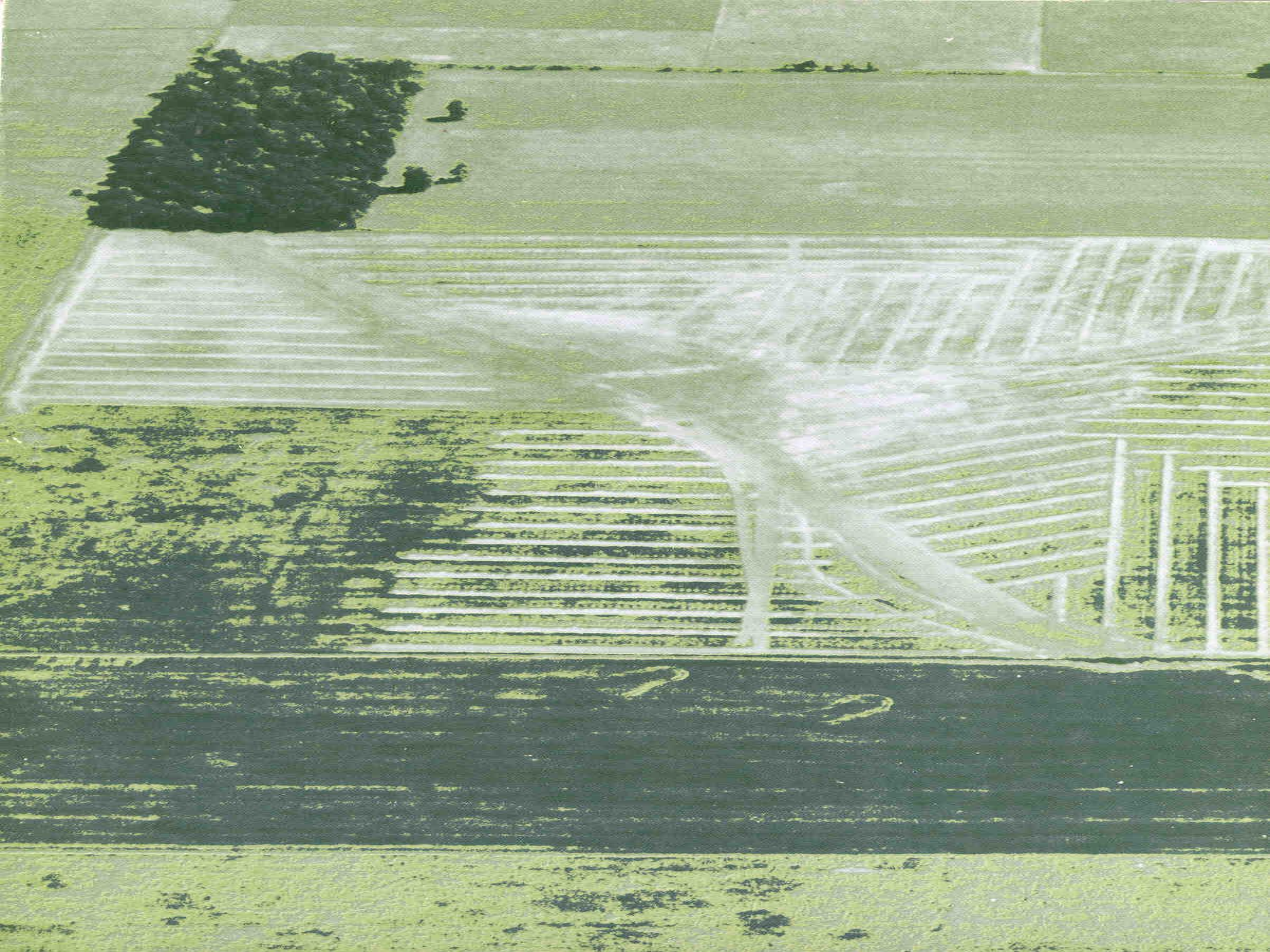


causes immense algae blooms. When the algae die, sink and decay, they steal oxygen from the water—choking off the marine ecosystem, in a phenomenon called hypoxia. Shrimp and fish can flee the suffocated area, but less-mobile animals—snails, crabs and the like—just die. The gulf's algae aren't just killing sea life—they're provoking a new civil war between the North's farmers and the South's fishermen.

It's amazing how much of America's breadbasket has been implicated. The Mississippi is, of course, the largest river system in North America, draining 31 states from Montana to Pennsylvania to North Carolina. The basin is home to more than half of America's farms, producing $98 billion worth of agricultural products annually. [illegible]

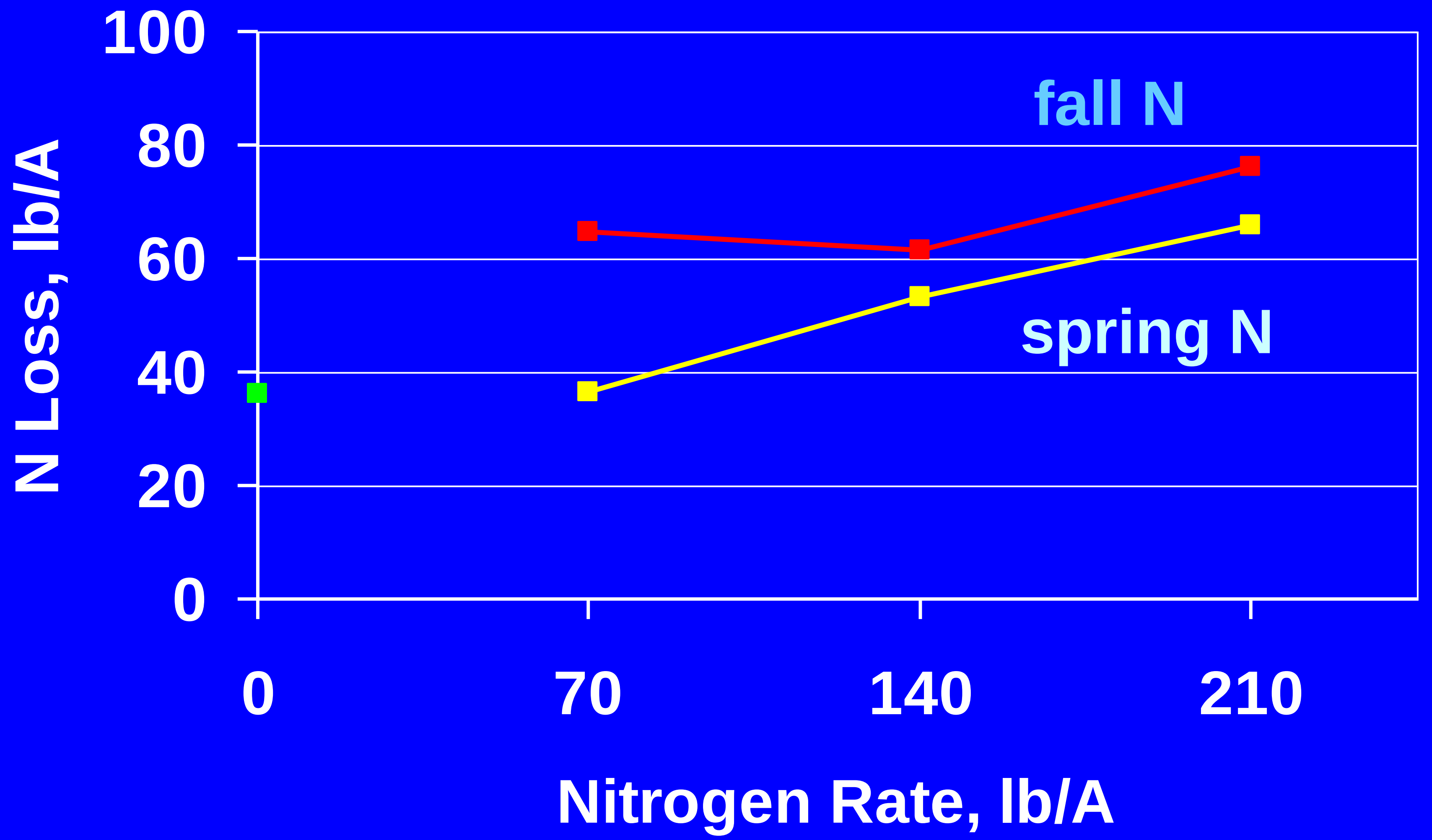


HYPOXIA-SQ. MILES
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1200
1000
800
600
400
200
0
N- 1000 TON
ND
ND
1985
1987
1989
1991
1993
1995
1997
1999
2001
YEAR



Nitrogen Loss from Tiles

2002 Corn

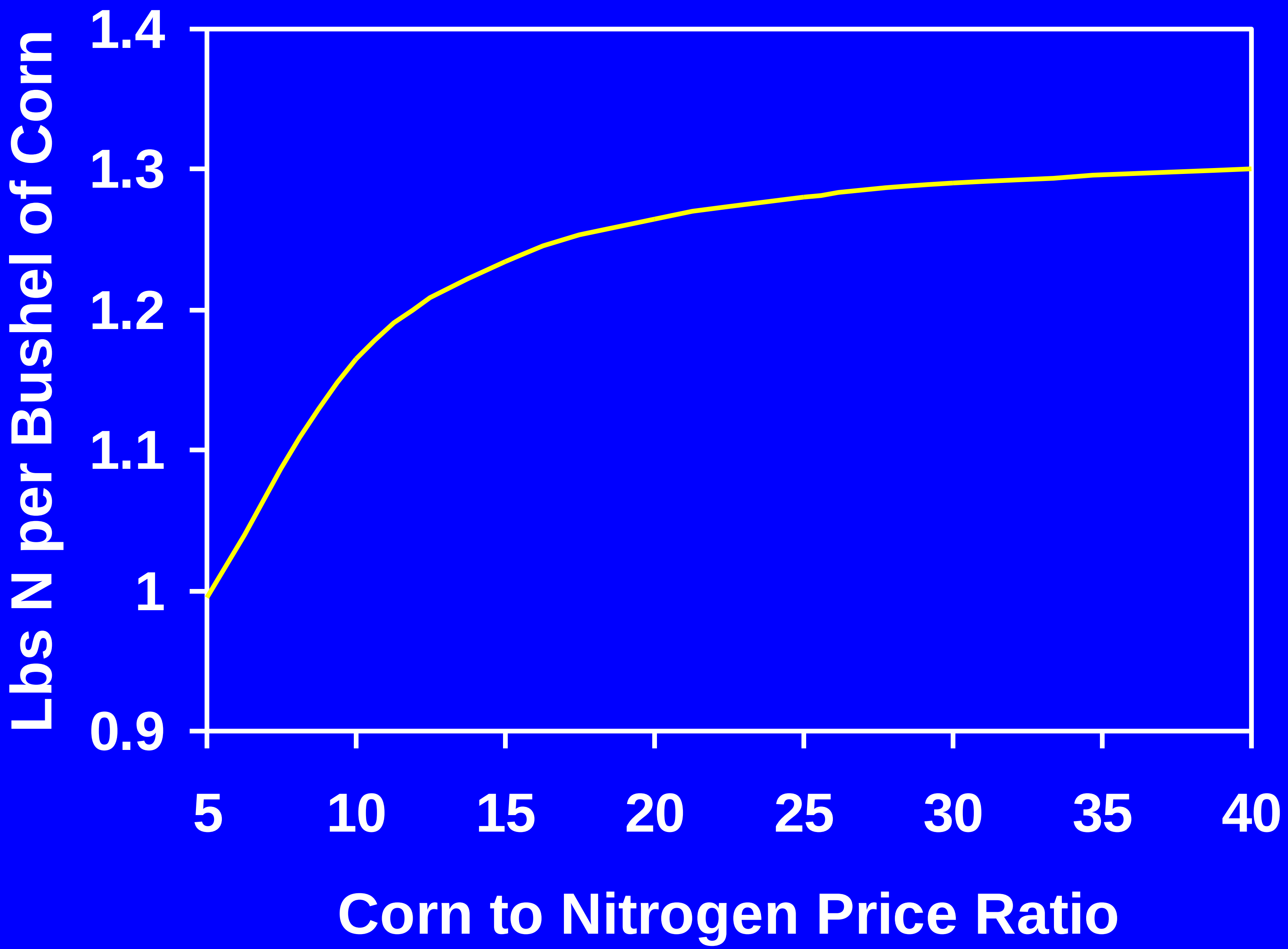


Illinois

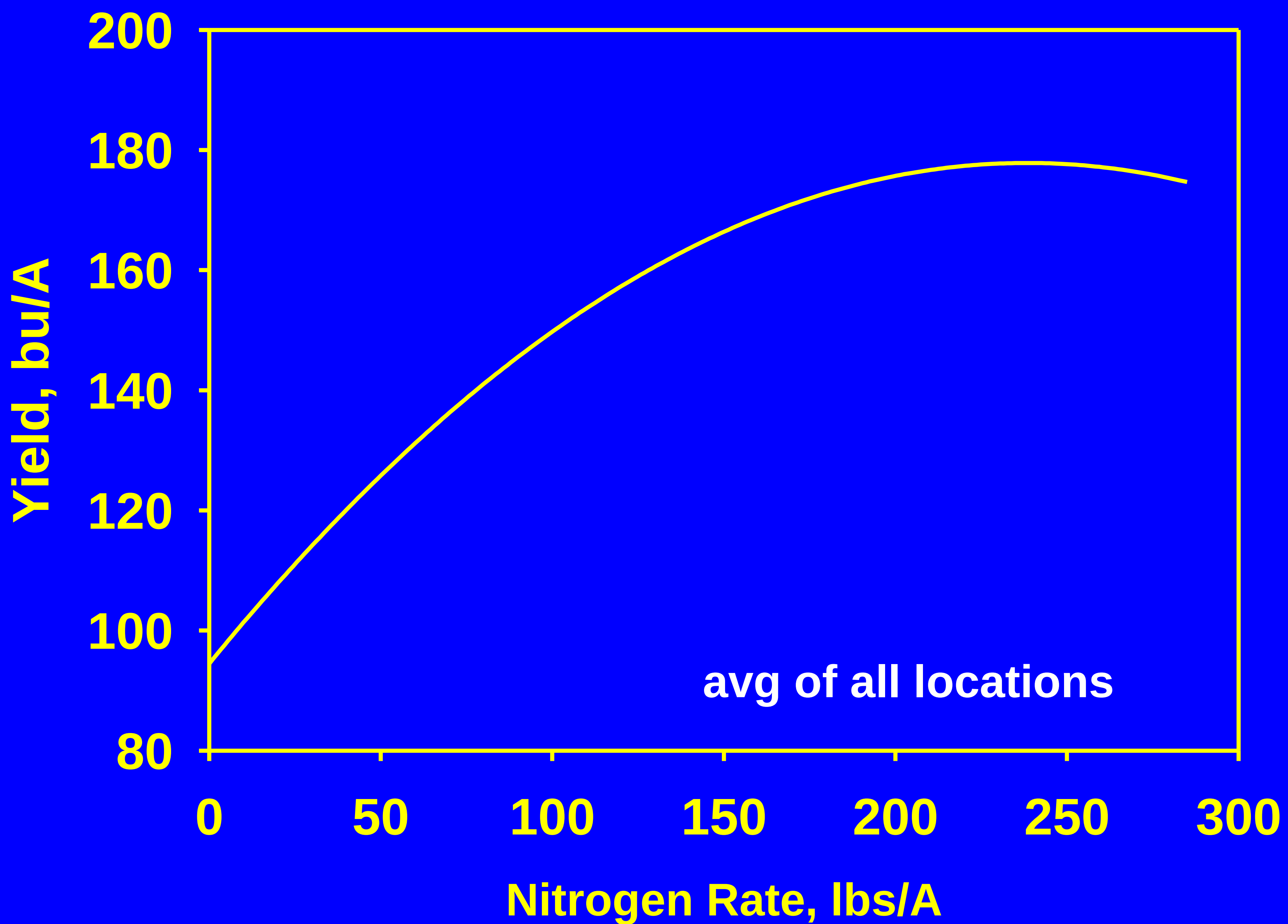
N (kg/ha) = 0.02 * Proven Yield (KG/HA) – credits for legumes, manure, etc.

Soybean credit = 45 kg/ha

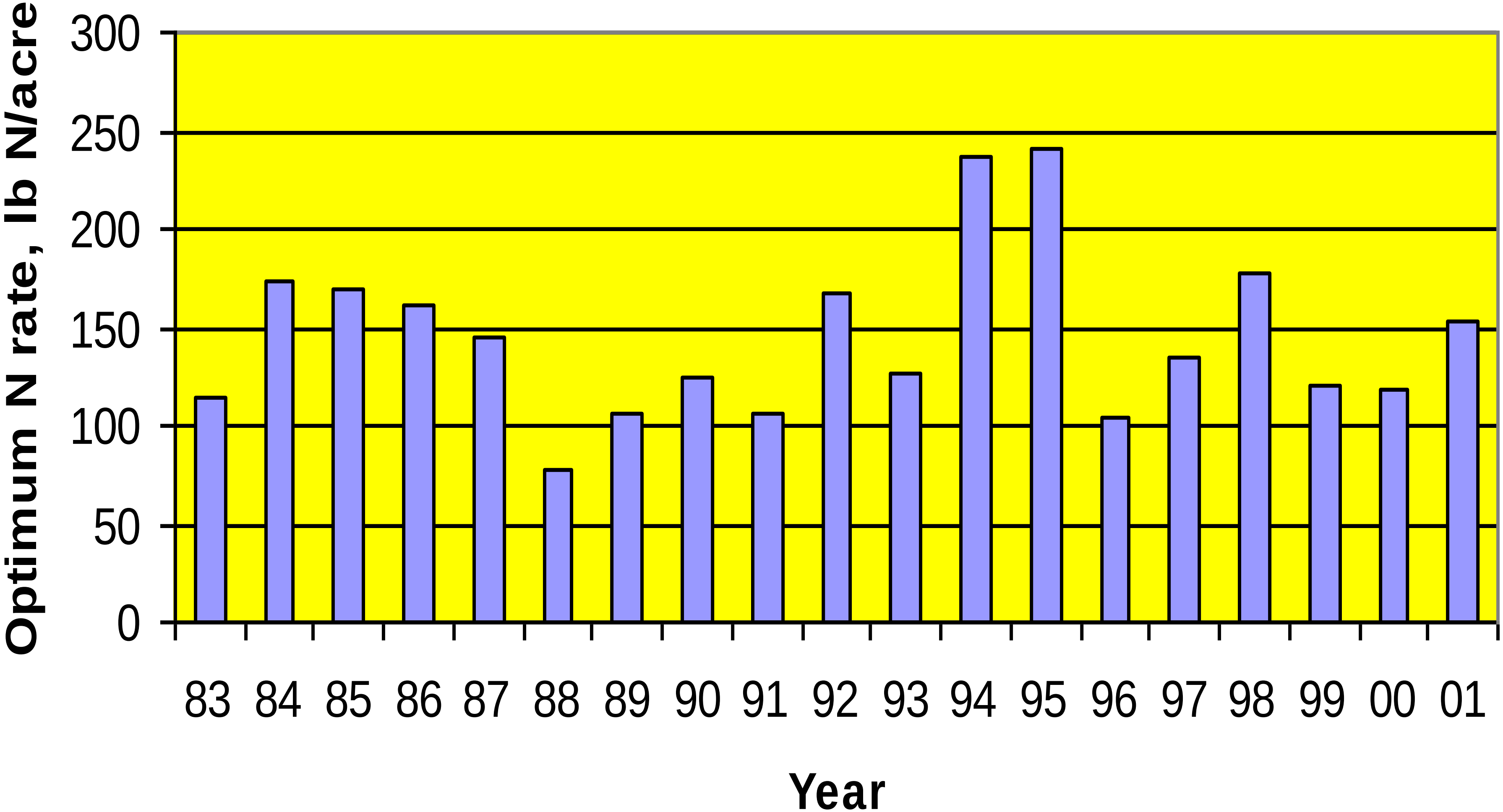
Alfalfa or clover credit = 110 kg/ha



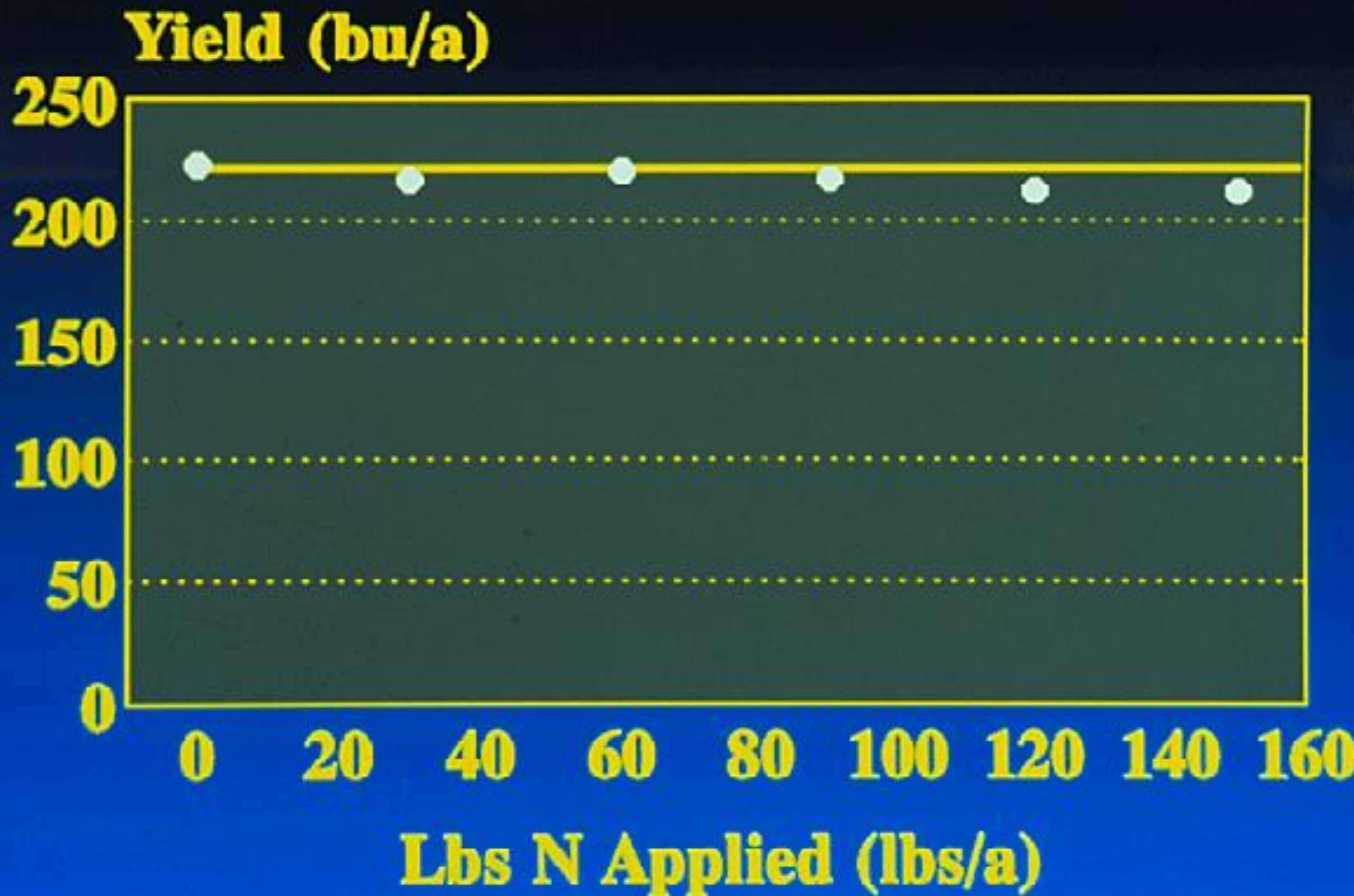
Lbs N per Bushel of Corn
1.4
1.3
1.2
1.1
1
0.9
5
10
15
20
25
30
35
40
Corn to Nitrogen Price Ratio

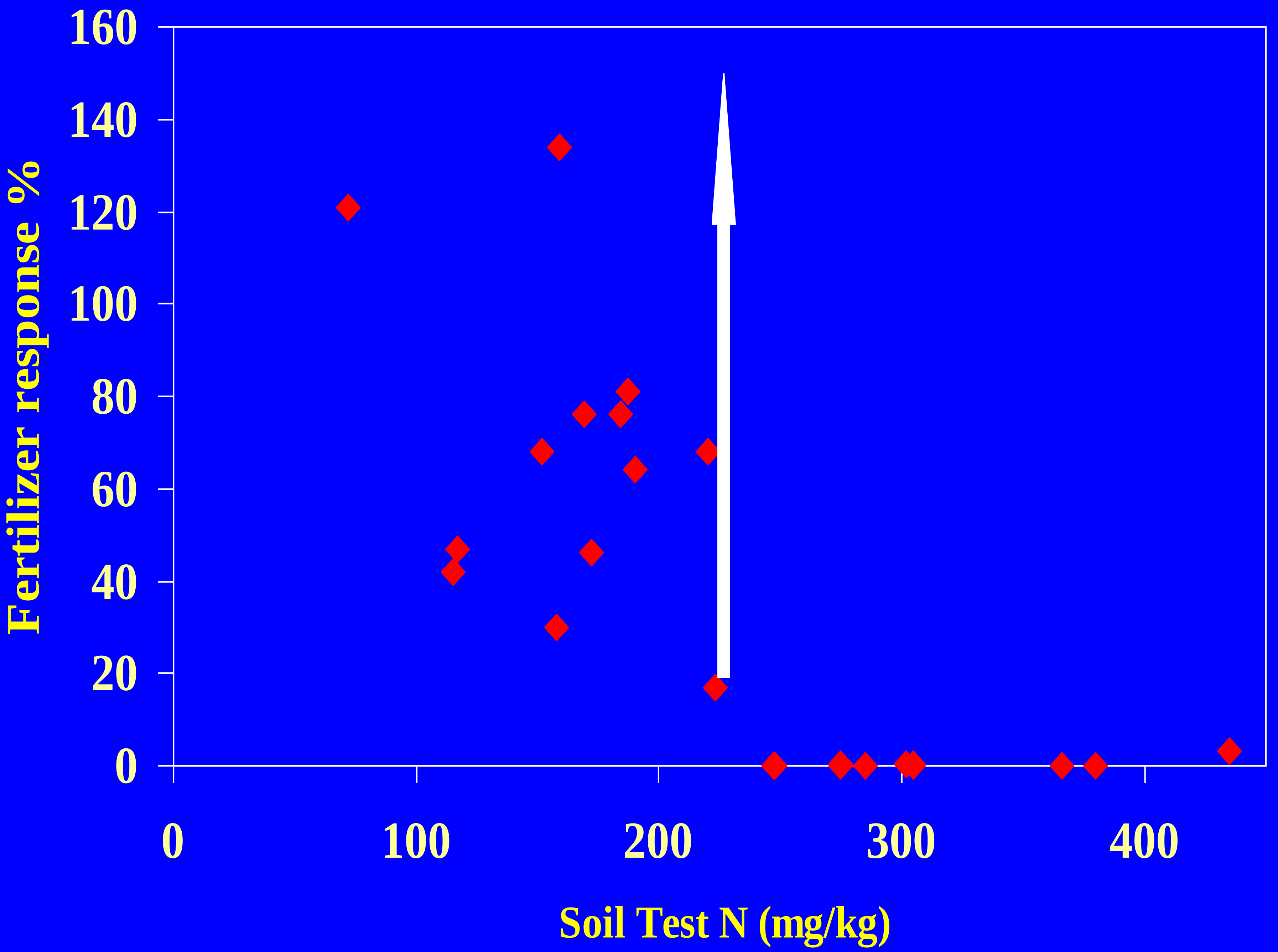

200
180
160
140
120
100
80
Yield, bu/A
avg of all locations
0
50
100
150
200
250
300
Nitrogen Rate, lbs/A

Continuous Corn, Monmouth



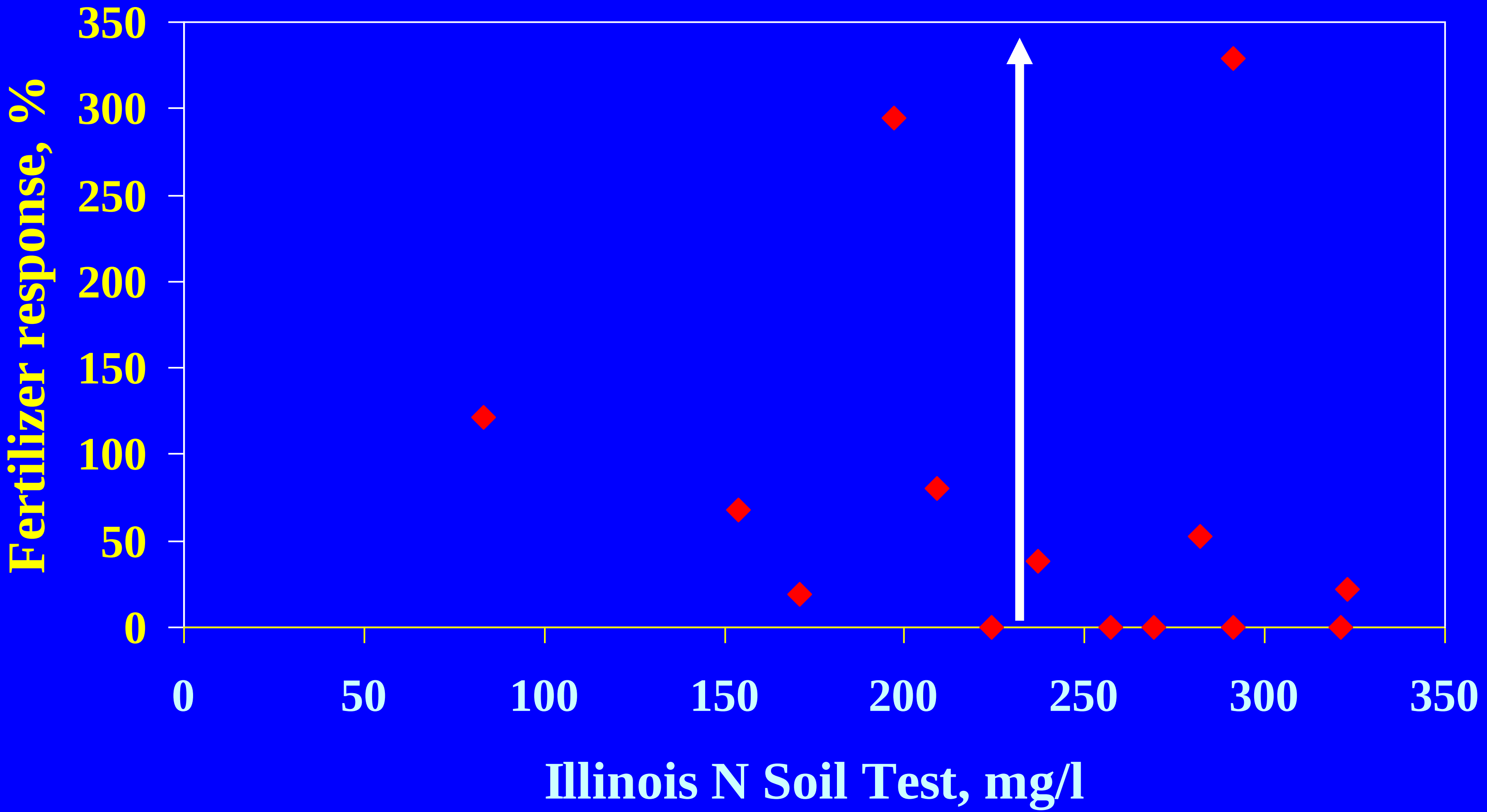
Non-responding Site





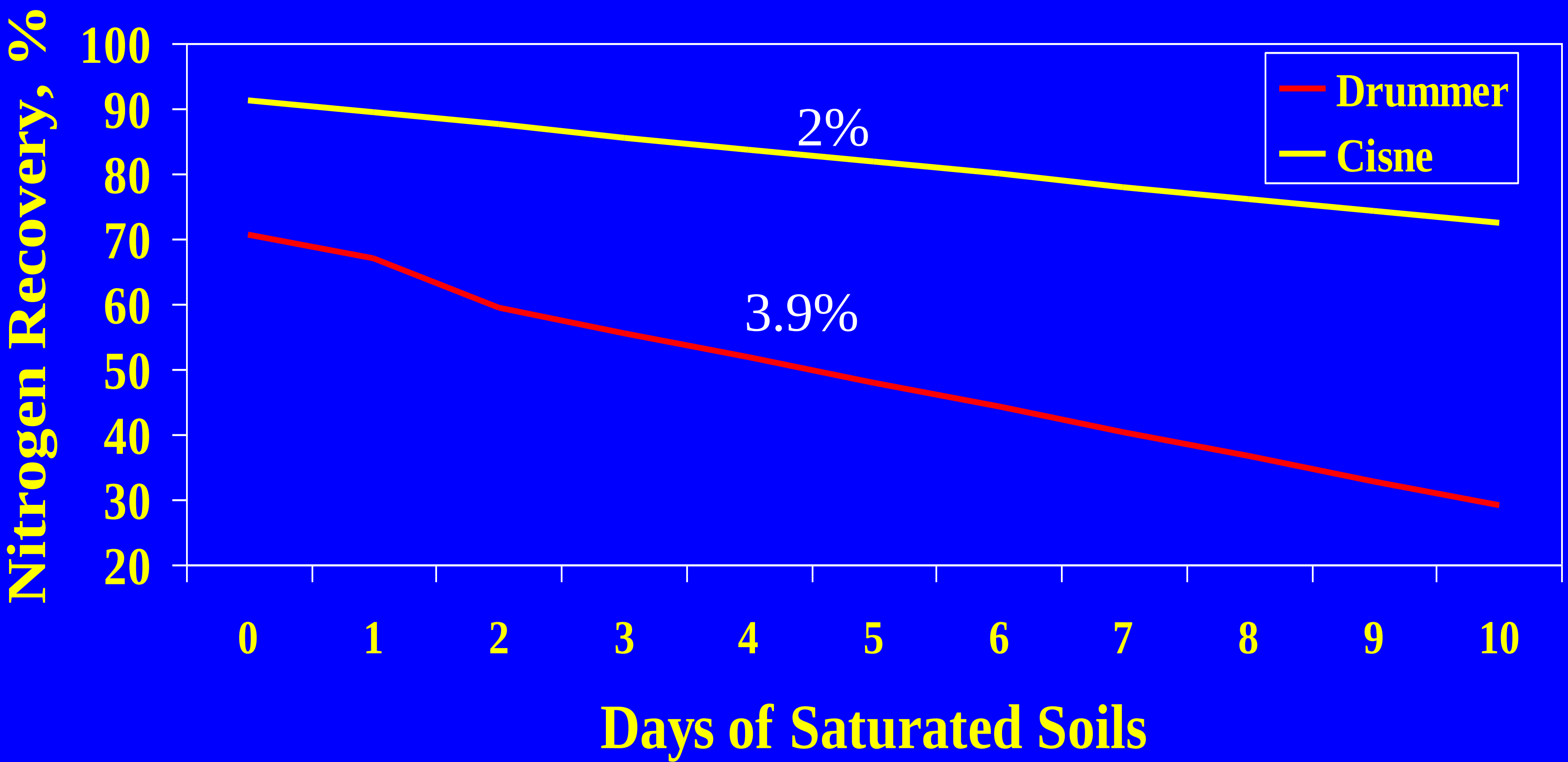
160
140
120
100
80
60
40
20
0
0
100
200
300
400
Fertilizer response %
Soil Test N (mg/kg)

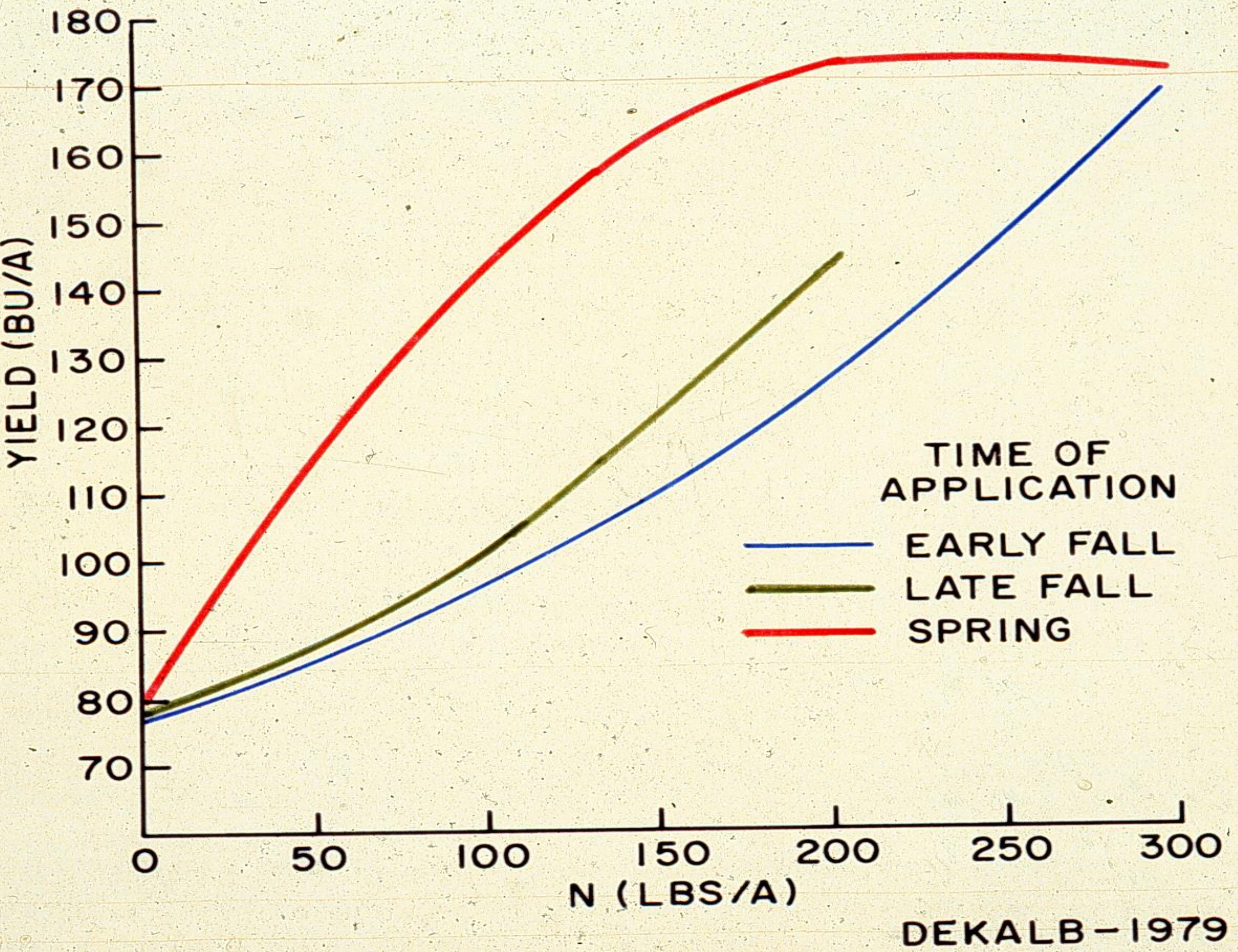
2001 DATA



Fertilizer response, %
350
300
250
200
150
100
50
0
0
50
100
150
200
250
300
350
Illinois N Soil Test, mg/l

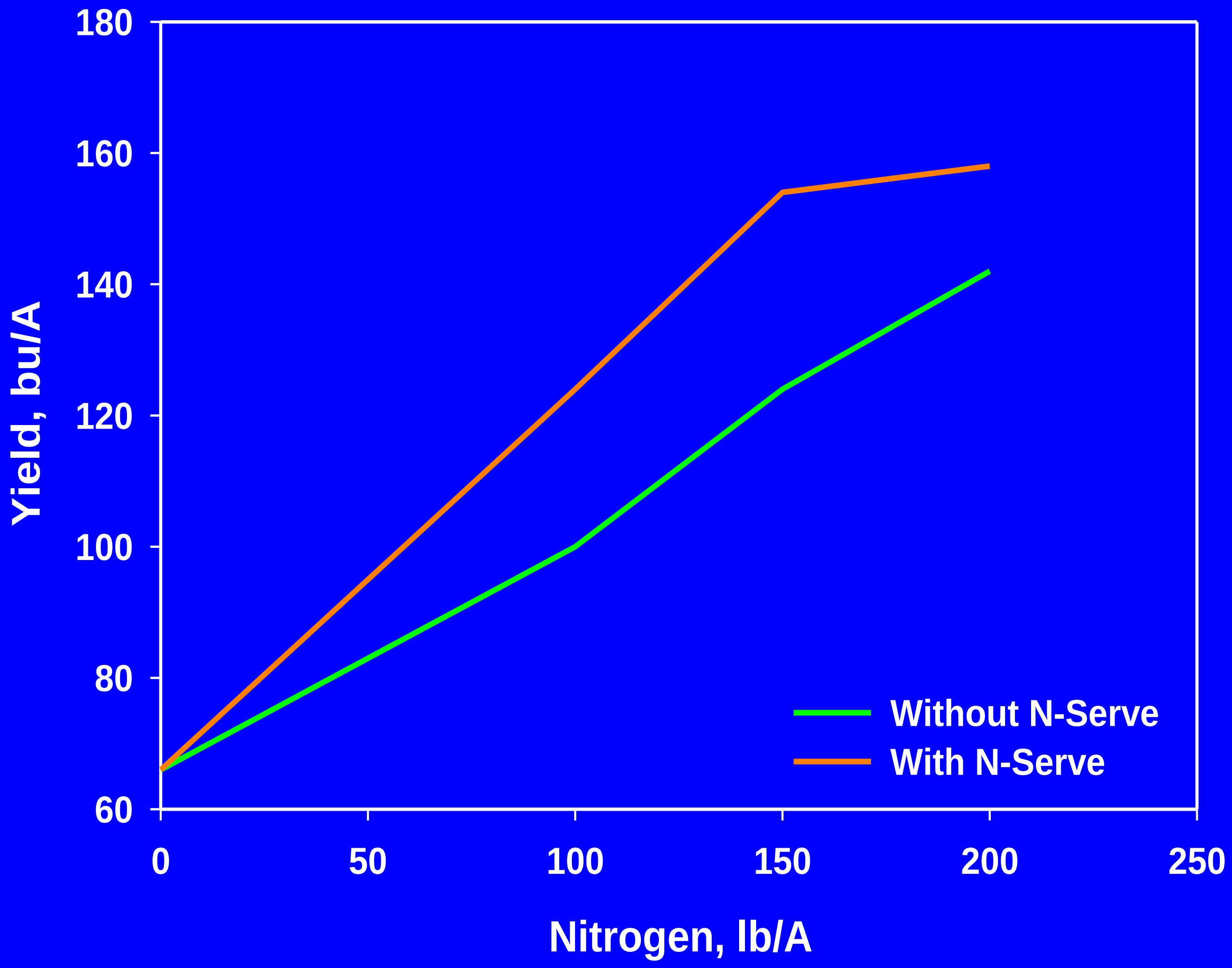
Nitrogen Loss





YIELD (BU/A)
180
170
160
150
140
130
120
110
100
90
80
70
0
50
100
150
200
250
300
N (LBS/A)
TIME OF APPLICATION
EARLY FALL
LATE FALL
SPRING
DEKALB-1979

Fall Applied N - DeKalb



WHICH ONE?

AMMONIA

UREA-AMMONIUM NITRATE

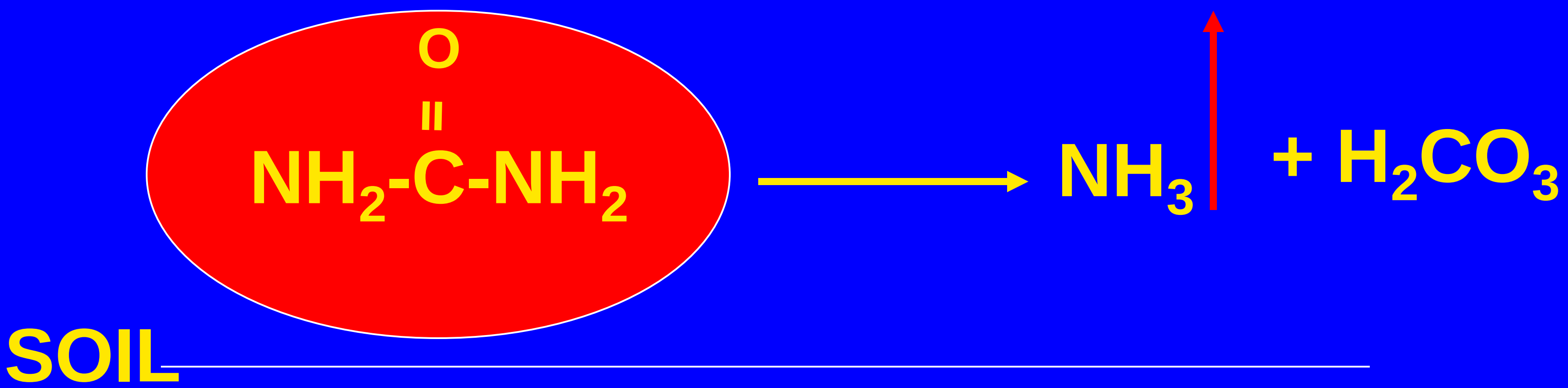
UREA

AMMONIUM SULFATE

AMMONIUM NITRATE


CAUTION
AMMONIA

UREA



SPRING UREA APPLICATION

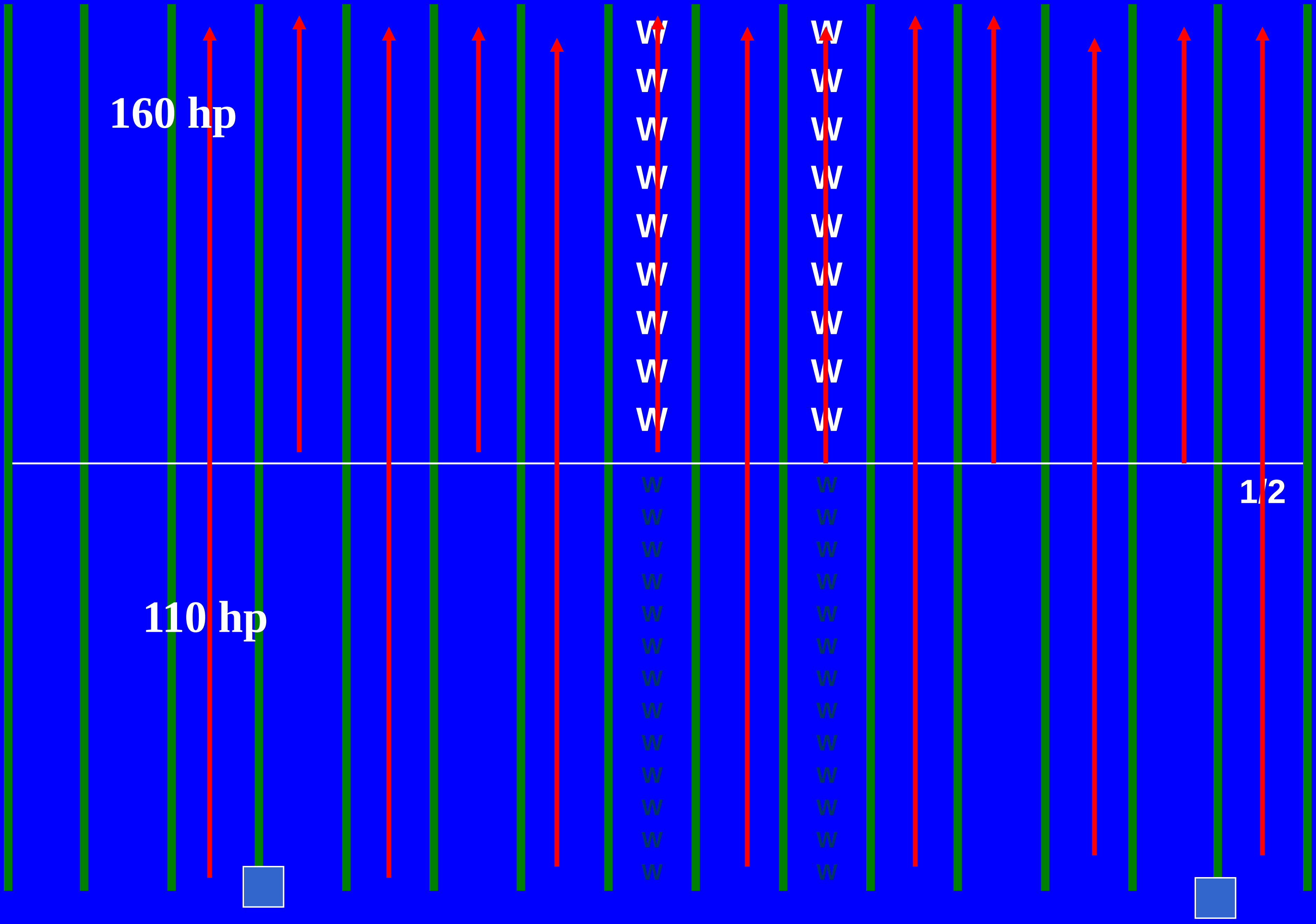
	N Source		
N, lb/acre	Ammonium Nitrate	Urea	Urea + AgrotaiN
	Yield, bu/acre		
0	60		
80	114	90	110
120	118	97	115
160	114	105	122

FALL APPLIED UREA

Time of Appl.	N Source	Yield (bu/acre) 1999	3-Yr. Avg.
---	None	108	113
Fall	Urea	134	155
Fall	Ammonia	147	170
Spring PP	Urea	184	185

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

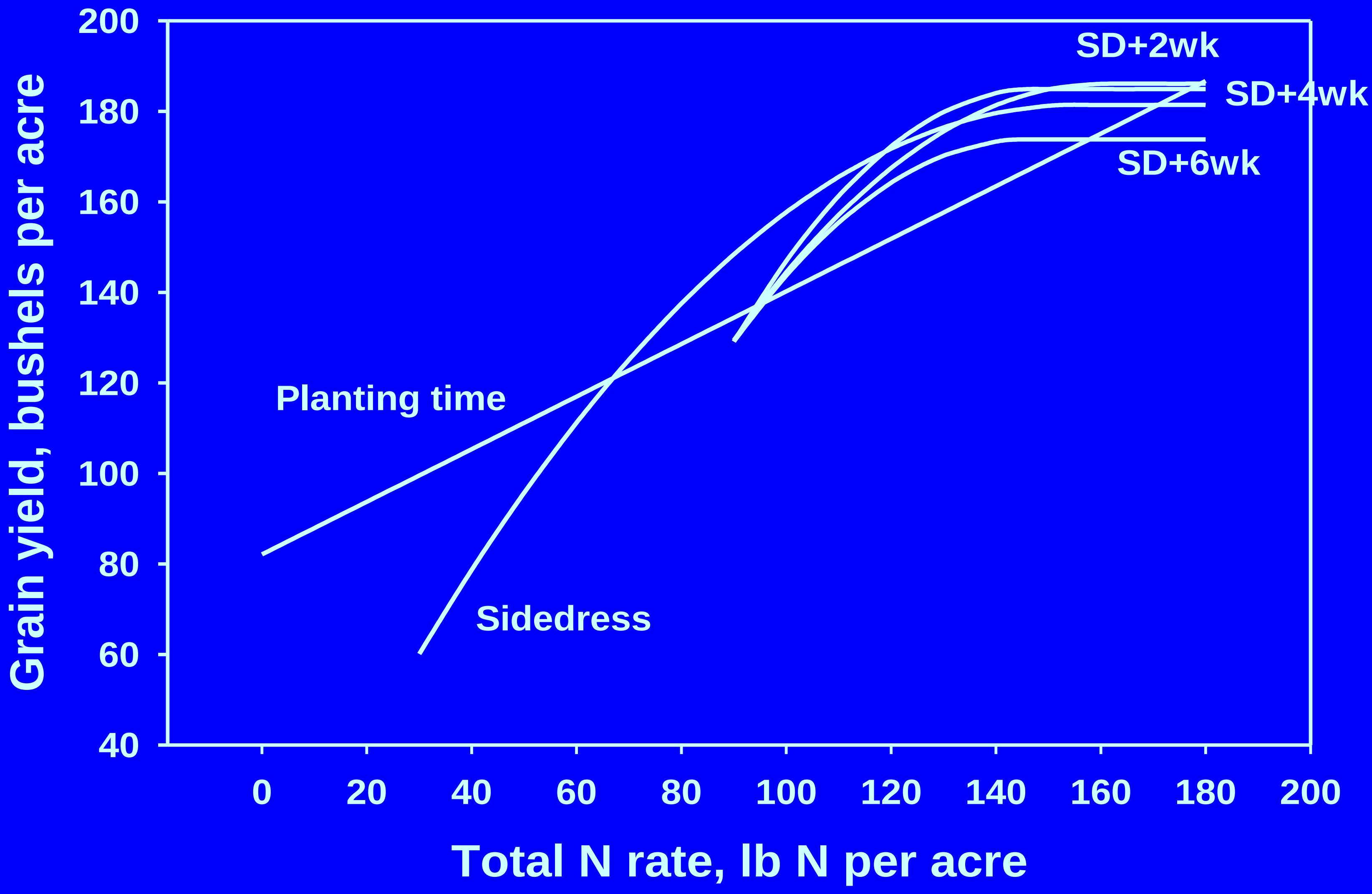

160 hp
110 hp
1/2
W

SKIP ROW AMMONIA APPLICATION

	TILLAGE			
Injector Spacing	Plow	Chisel	Disk	0-till
	Yield, bu/acre			
DeKalb				
30	159	157	163	146
60	158	157	157	143
Elwood				
30	--	119	121	118
60	--	117	125	121


NTech

Figure 1. Yield responses from N applied at different times, Urbana 1997



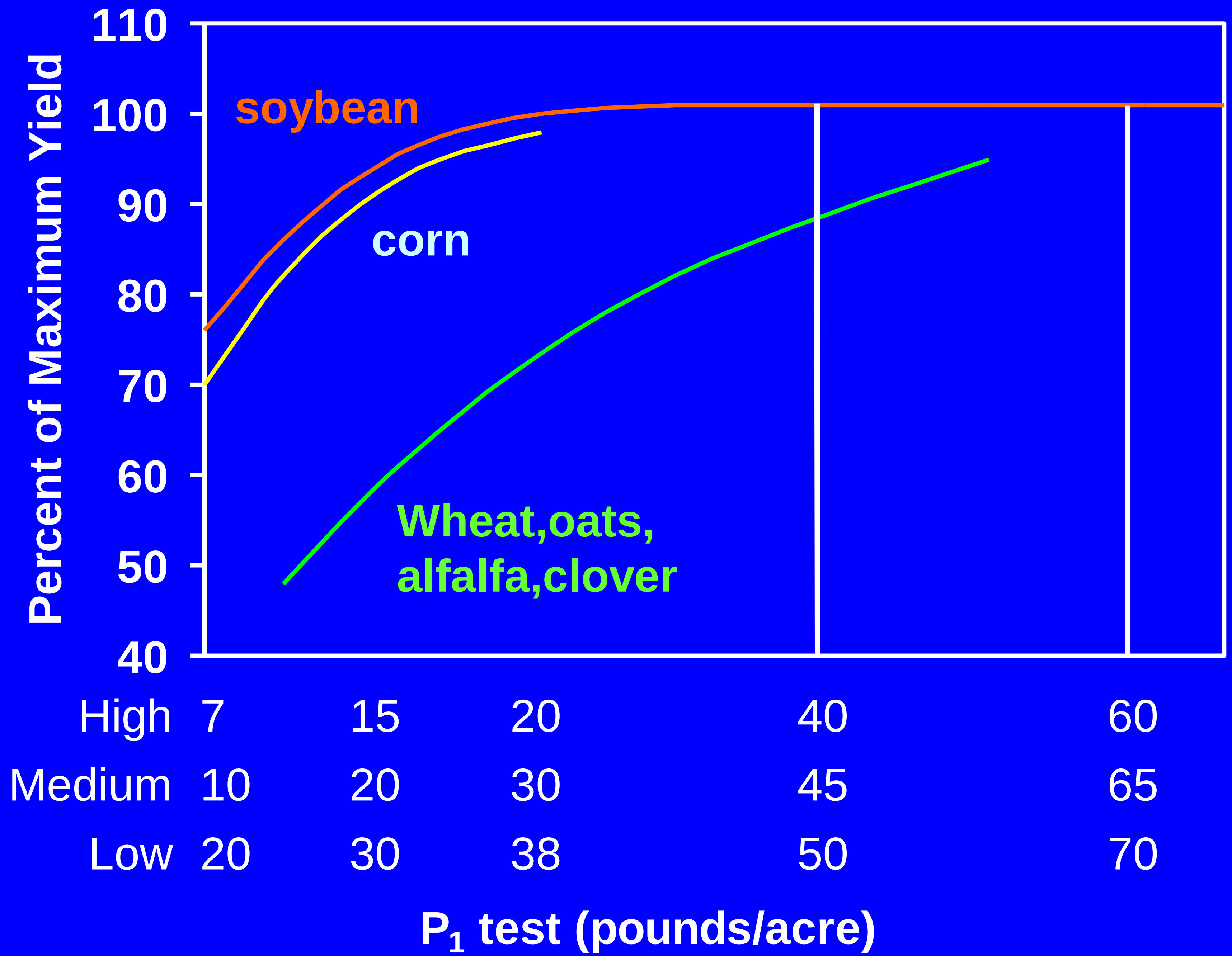
SOIL TEST

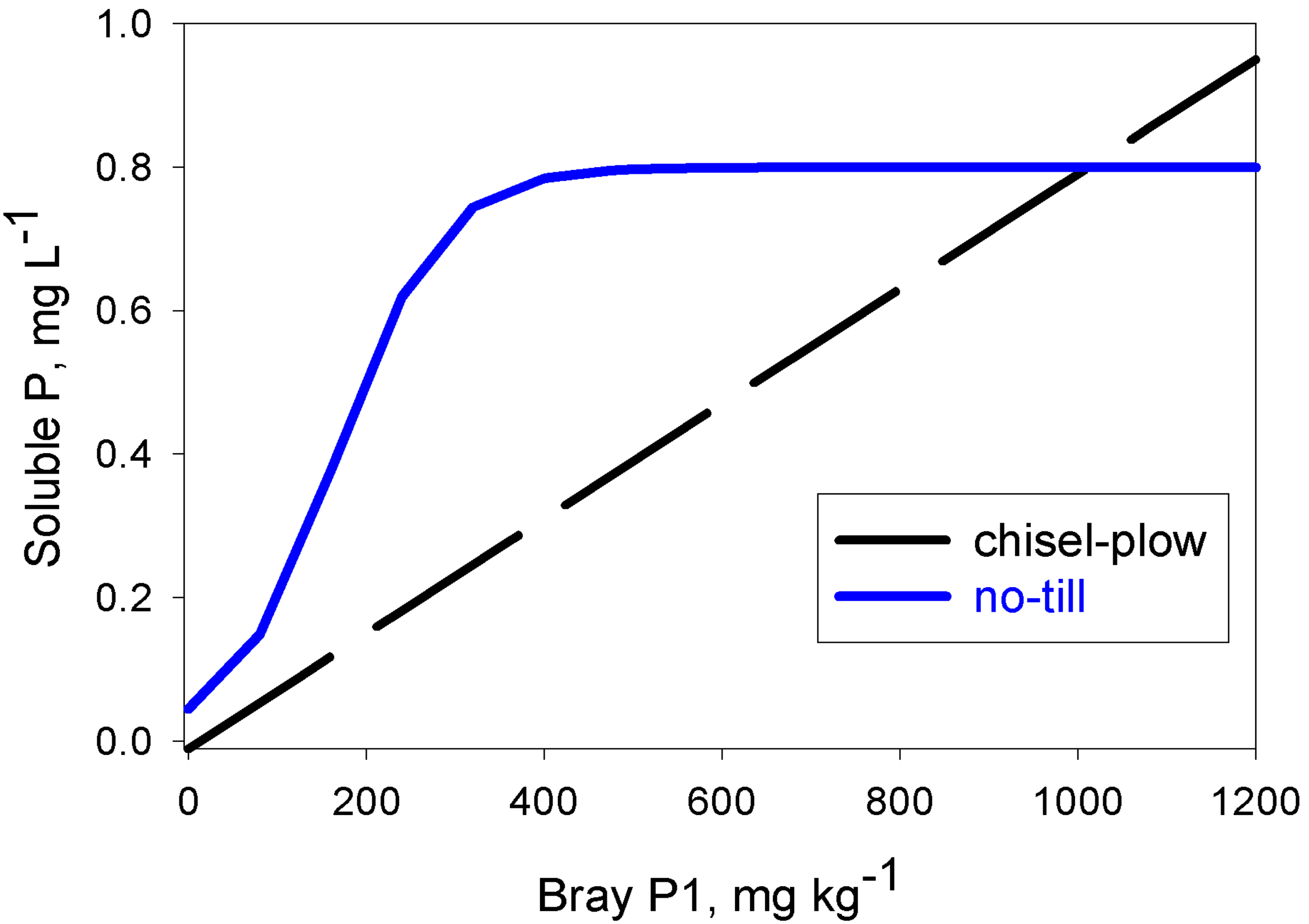
SOIL SAMPLE

- EVERY 4-YEARS
- 1 SAMPLE PER 2.5 ACRES
- SAMPLE DEPTH 0-7 INCHES

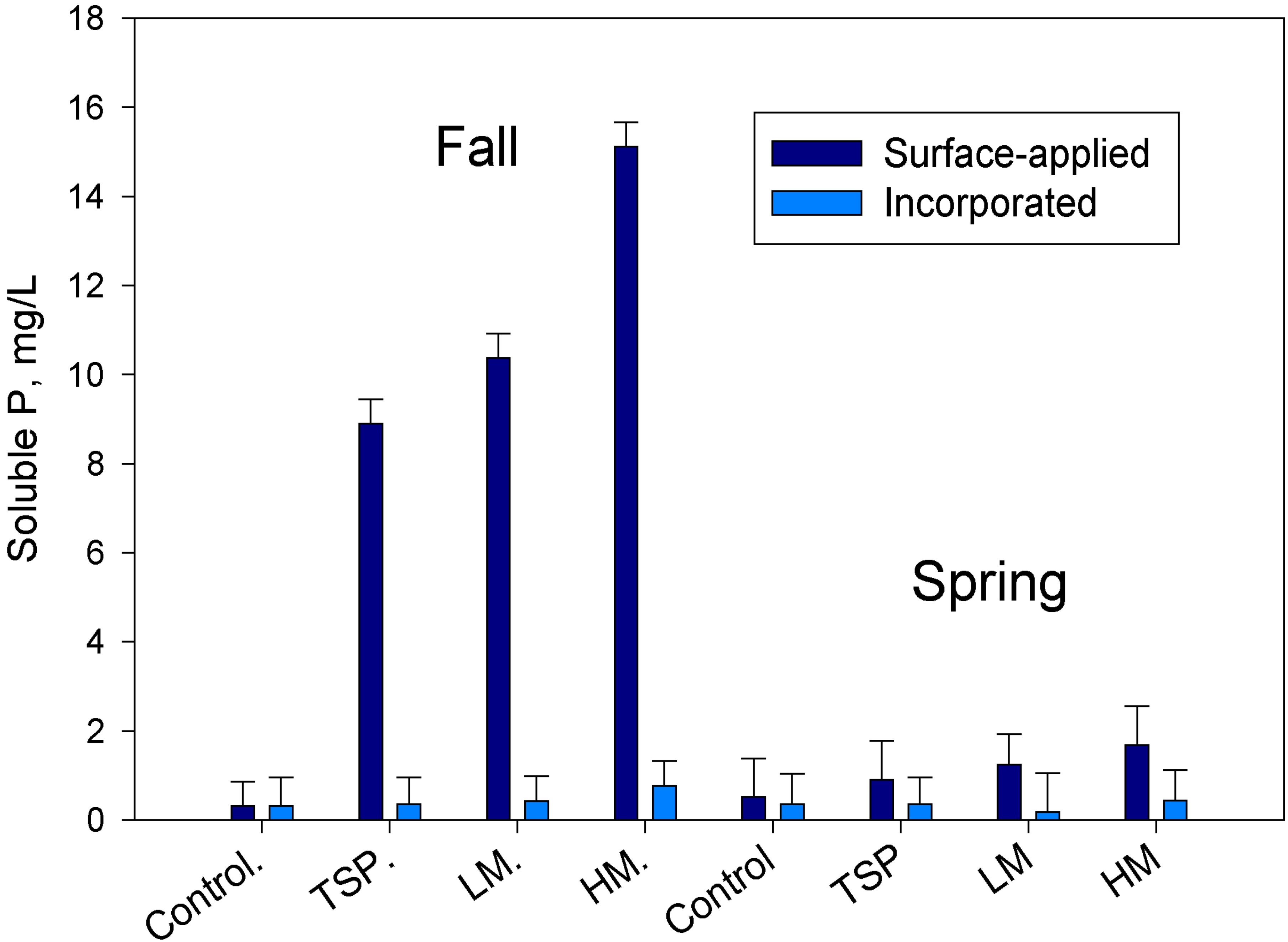
Peck's Scale of Reliability, Usefulness, Cost Effective Rating

Soil test	Rating	Soil Test	Rating
pH	100	Calcium	40
Phosphorus	85	Magnesium	40
Potassium	70	Sulfur	40
CEC	60	Zinc	45
Boron	60	Manganese	40
Boron (corn)	10	Copper	5


110
100
90
80
70
60
50
40
Percent of Maximum Yield
soybean
corn
Wheat,oats,
alfalfa,clover
High 7 15 20 40 60
Medium 10 20 30 45 65
Low 20 30 38 50 70
P1 test (pounds/acre)



Soluble P, mg L-1
1.0
0.8
0.6
0.4
0.2
0.0
0
200
400
600
800
1000
1200
Bray P1, mg kg-1
chisel-plow
no-till



Soluble P, mg/L
0
2
4
6
8
10
12
14
16
18
Fall
Spring
Surface-applied
Incorporated
Control.
TSP .
LM.
HM.
Control
TSP
LM
HM

MINNESOTA RIDGE TILL

TREATMENT	YIELD, BU/ACRE
0 K/ACRE	154
110 LB 7-21-7 (STARTER	154
5-26-100 BAND IN RIDGE	171
STARTER + BAND IN RIDGE	173

No-Till Starter			1993-1995		
N	P_2O_5	K_2O	Ashton	Gridley	Oblong
			Yield (bushels/acre)		
0	0	0	131	120	152
25	0	0	141	123	161
25	30	0	147	129	165
25	30	20	146	137	165

TILLAGE	P & K PLACEMENT		
	NONE	BROADCAST	DEEP BAND
		BU/A	
MOLDBOARD	122	119	116
CHISEL	110	111	111
NO-TILL	102	107	104

P = H; K = H - 200-57-90 Nashua, Iowa (81-83)


72

CHALLENGES

NUTRIENT MANAGEMENT

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PEST MANAGEMENT

GENETIC POTENTIAL

SOIL PRODUCTIVITY/TILTH

Where Do We Look for High Yields?

- **One hypothesis:**

  The key to producing 400 bu/acre of corn is to find and maintain, rather than create, the right soil environment

To Borrow a Phrase:

- **The key to 400-bushel corn:**
  - Location
  - Location
  - Location

“Special” Fields

- May have a history of unusual or unusually high inputs of materials that might enhance plant nutrition or growth
  - In F. Childs field, no recent additions except fertilizer, but may be a history of “organic” additions
- In H. Warsaw field, developed topsoil had washed in over time, to a depth of several feet

CHALLENGES

NUTRIENT MANAGEMENT

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PEST MANAGEMENT

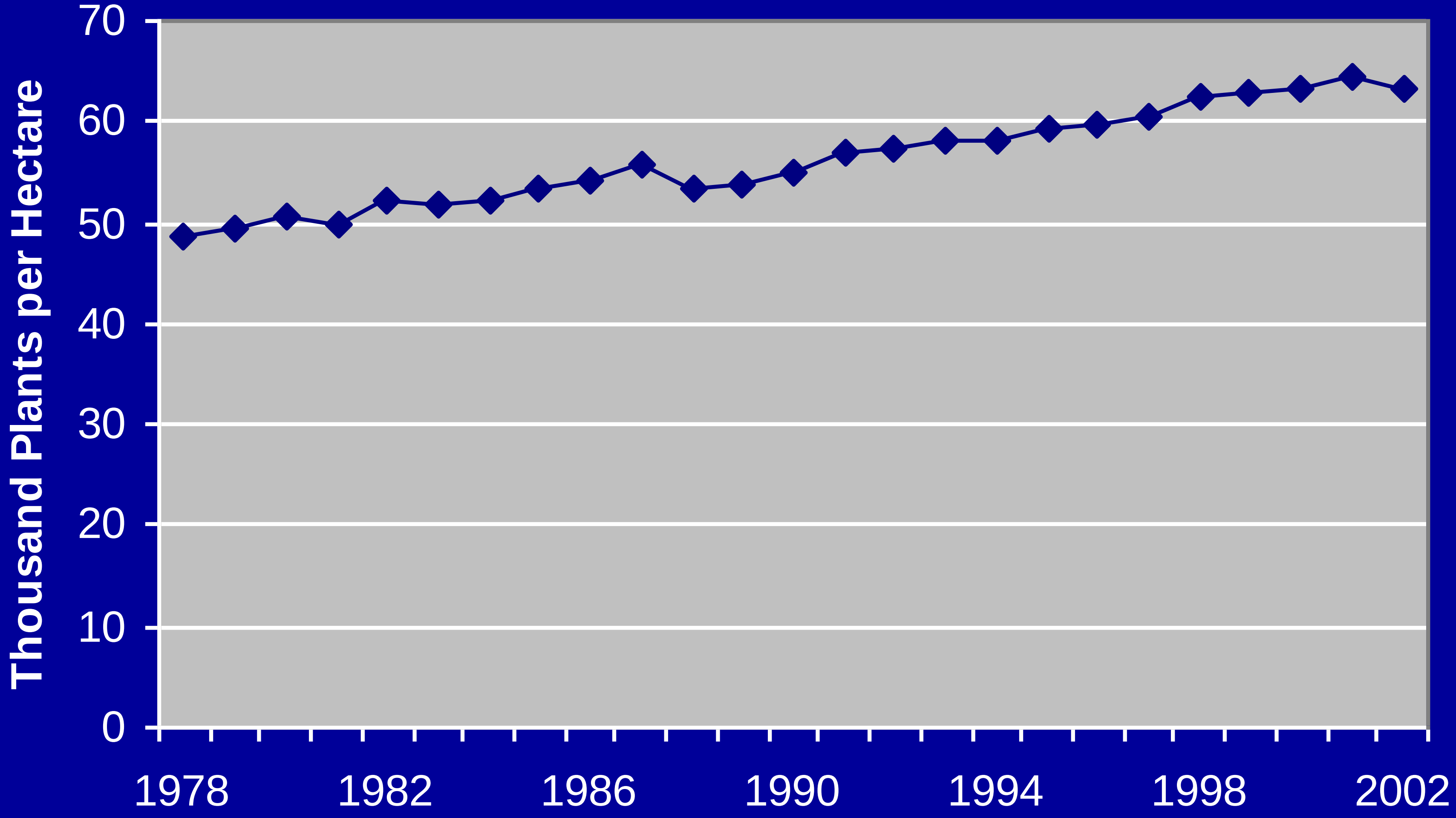
CULTURAL PRACTICES

SOIL PRODUCTIVITY/TILTH

VARIETY SELECTION

	TOP 10 OF 143 VARIETIES	BOTTOM 10 OF 143 VARIETIES
YIELD RANGE	227-233	198-205
AVG.	230	202

US Corn Harvest Populations



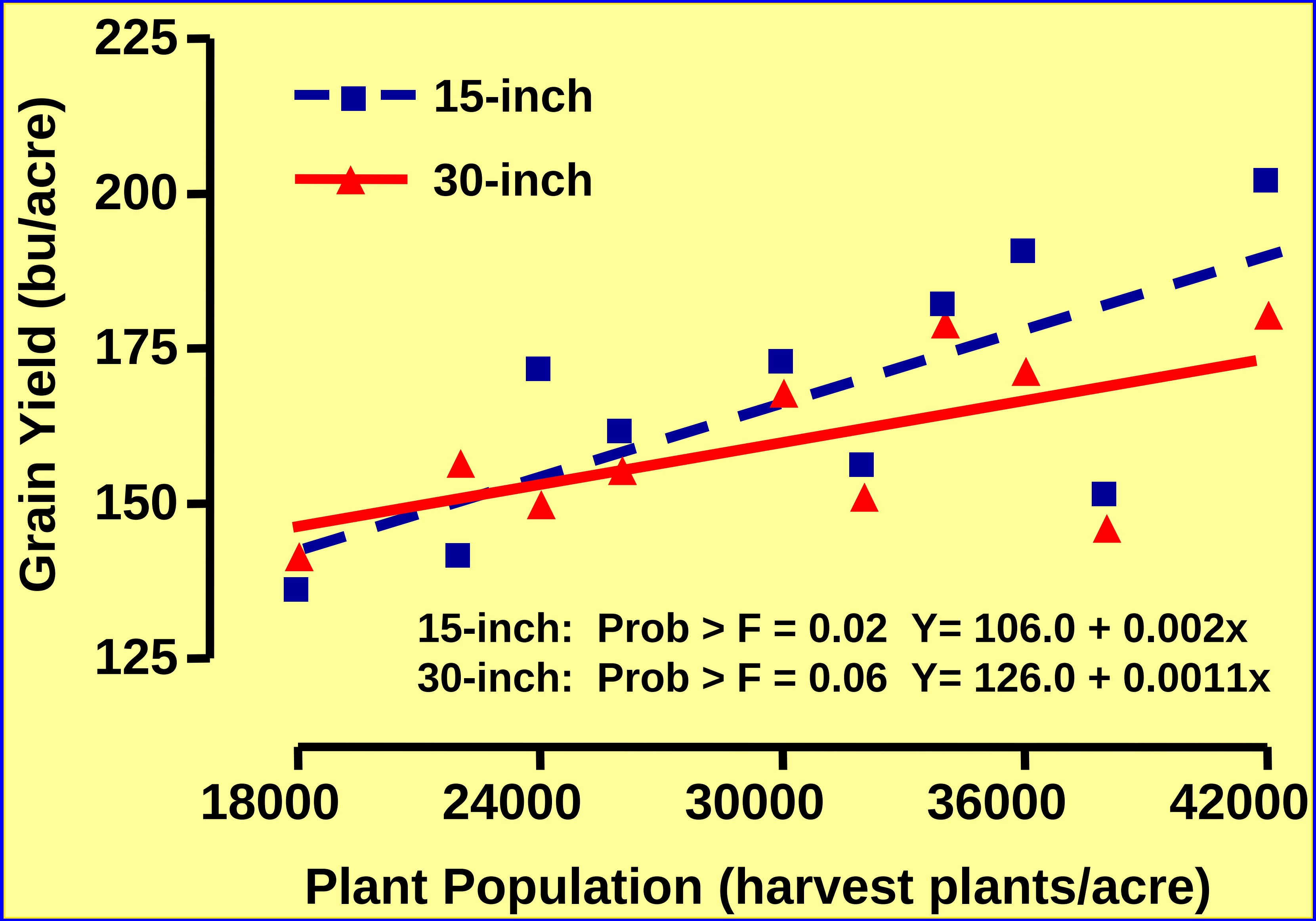
PLANT POPULATIONS-2002
STATE CONTEST WINNERS

STATE	SEED DROP	YIELD, BU/ACRE
IOWA	46,000	442
WASHINGTON	40,000	304
VIRGINIA	40,000	304
ILLINOIS	38,000	296
TEXAS	38,000	281
CALIFORNIA	37,000	288
NEW MEXICO	35,000	306
WISCONSIN	32,000	282

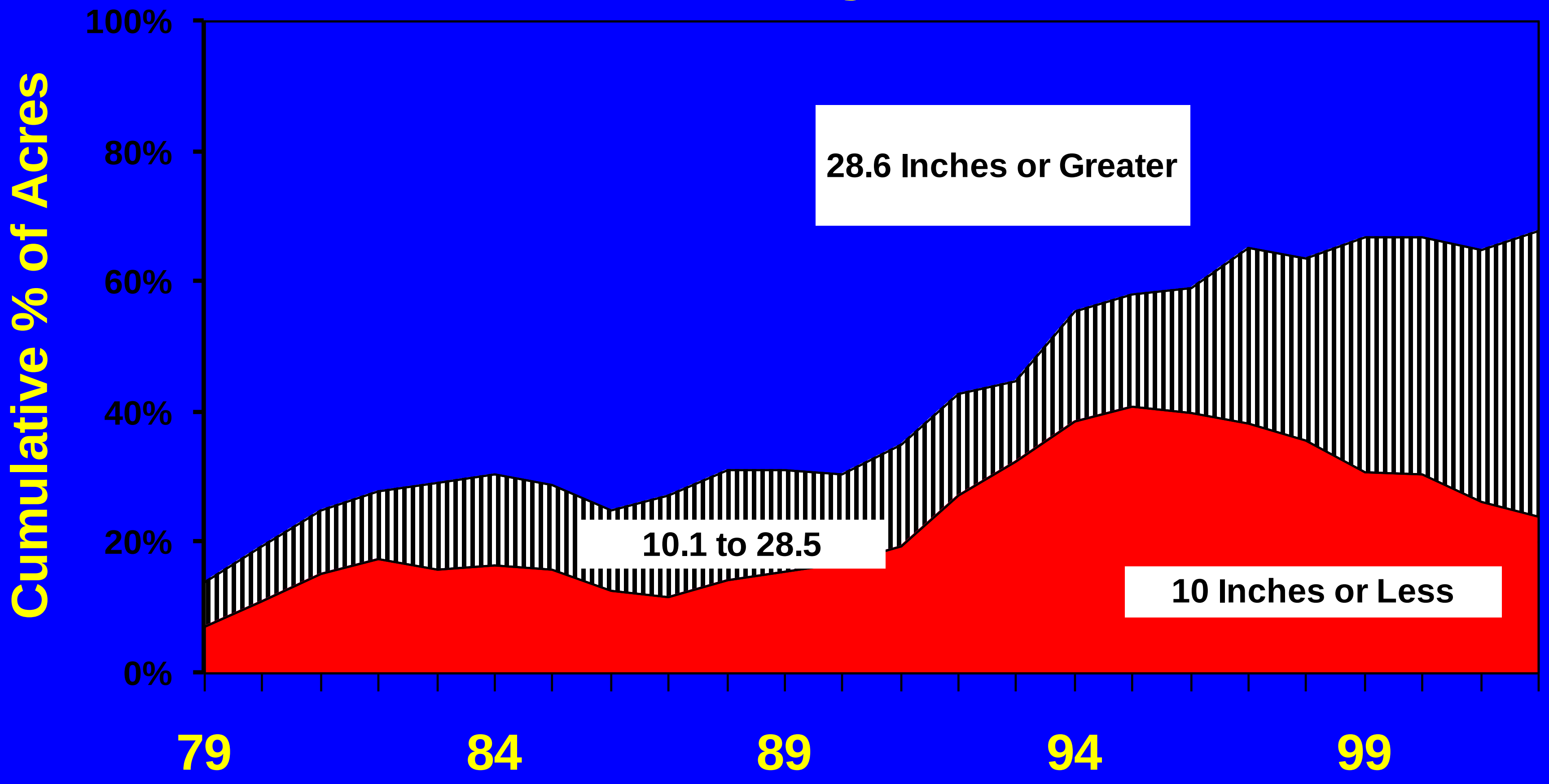
ROW WIDTH

ROW WIDTH	U.S. AVG	ROW WIDTH	CONTEST WINNERS
cm	% acres	cm	% acres
< 52	.9	<76	6.6
52-77	65.1	76	84.4
77-88	15.9	91	4.6
> 88	18.2	96	3.7

Grain yield response to row width and plant population across 17 central-west environments, 1992-99.



U.S. Soybean



Cumulative % of Acres
100%
80%
60%
40%
20%
0%
28.6 Inches or Greater
10.1 to 28.5
10 Inches or Less
79
84
89
94
99

CHALLENGES

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GMO Concerns of US Farmers

✗ More concern in corn at present

- List of events/hybrids that EU and US processors will not accept
- All RR, some LL, some Bt not approved for export to EU
- Burden to keep track is on farmers
- Bt value hard to determine

GMO Concerns of US Farmers

- ✗ Concern growing in soybean:
  - Labeling requirement, and some refusal to accept, in the EU
  - Negative publicity by organic producers: herbicide promotion
  - Premiums now offered by ADM for STS (="non-GMO") soybeans

Glyphosate to the Rescue!

- 1996 – commercialization of glyphosate-resistant soybean varieties
- In 2002, GMO varieties were grown on approximately 75% of the US soybean acres[1]
- Glyphosate has become the most widely used active ingredient for soybean weed control
  – used on 72% of Illinois soybean acres[2]
- Many advantages: broad-spectrum product, no carryover, adjustable rates, etc.

[1]NASS June 2002 Report

[2]IL AG STATS 2002 Report

Glyphosate-resistant weeds worldwide[1]

- Horseweed/marestail (*Conyza canadensis*) - 2000
  - Delaware, Tennessee, Indiana, Maryland, New Jersey, Ohio, Kentucky
- Goosegrass (*Eleusine indica*) - 1997
  - Malaysia
- Italian ryegrass (*Lolium multiflorum*) - 2001
  - Chile
- Rigid ryegrass (*Lolium rigidum*) - 1996
  - Australia, California, South Africa

[1] Heap, I. The International Survey of Herbicide Resistant Weeds. Online. Internet. December 31, 2002

Glyphosate-resistant corn

- Changes in market share may depend upon:
  - European export approval (s)
  - Trait stacked with rootworm-resistance trait
  - Development of glyphosate-resistant weed biotypes

- Farmer willingness to use glyphosate in corn?
  - Some reluctance apparent; would rather use glyphosate in soybean and other herbicides in corn

Bt CORN

NON-Bt

Conclusions

- High yields require attention to detail
- Don’t expect to get high yield in the first year
- One must assure that all inputs are managed based on sound science
- There are many factors that affect yield and the final yield will be limited by the most limiting factor