Nutrient management irrigated corn

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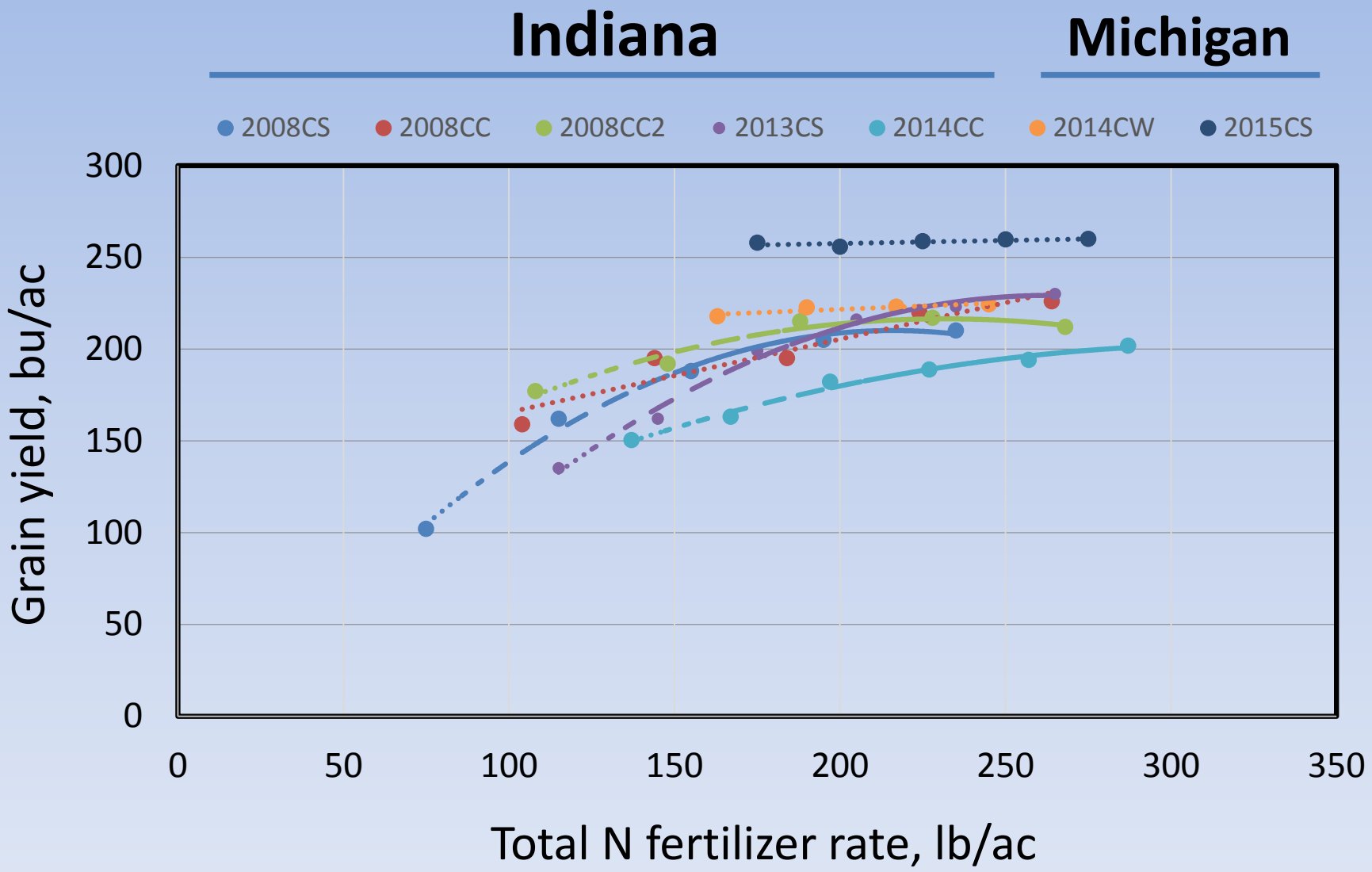
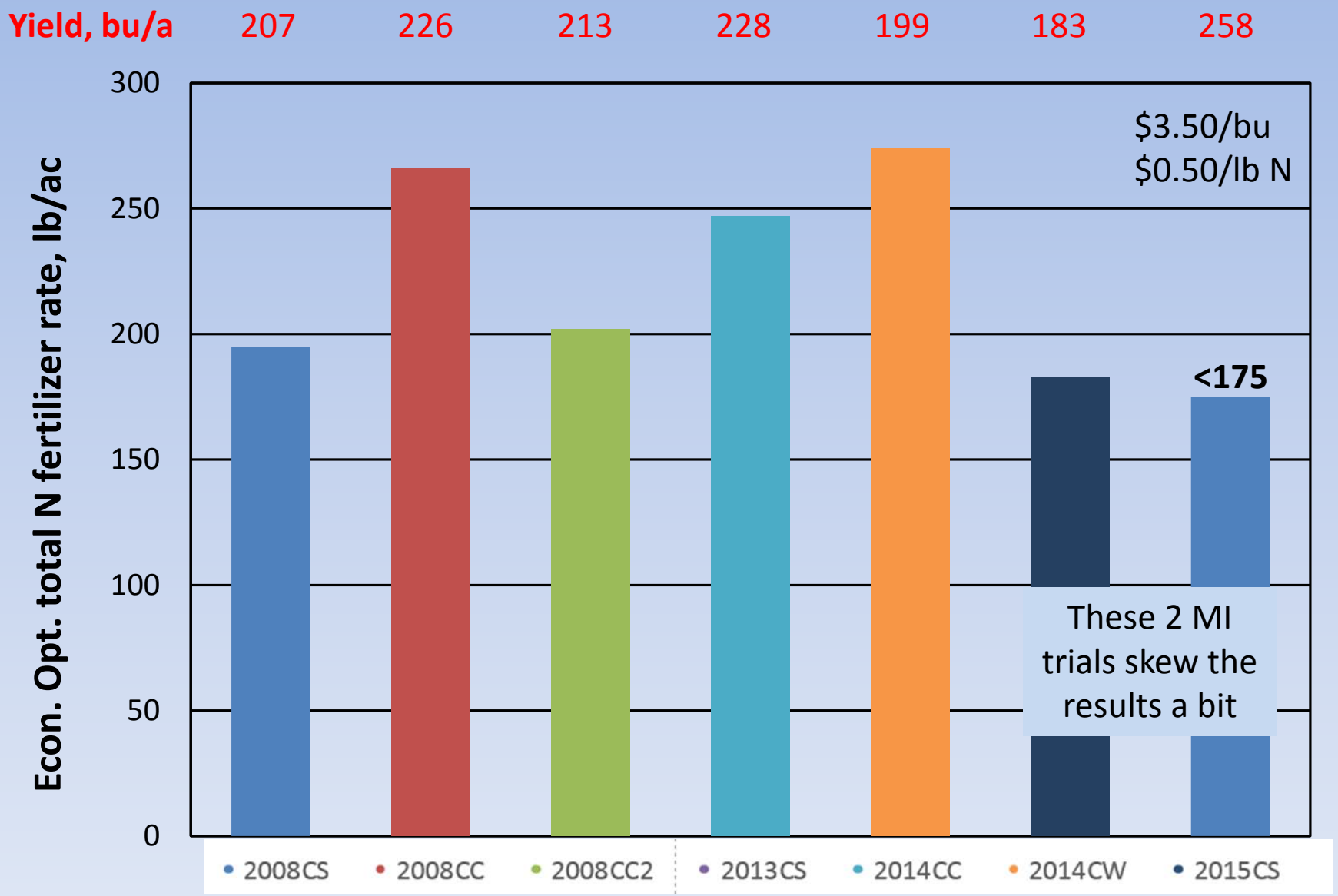
Nitrogen rate response trials

- Purdue and farmer fields
- 4-6 N rates replicated 4-6 times
- Calibrated yield monitor
- Yield response fit with equation to determine opt. N rate and yield

Irrigated corn response to N



Economic optimum N rate varies



WISCONSIN DATA

Finding the Maximum Return To N and Most Profitable N Rate

A Regional (Corn Belt) Approach to Nitrogen Rate Guidelines

State: Wisconsin – Irr. Sands
Number of sites: 4
Rotation: Corn Following Soybean
Non-Responsive Sites Not Included

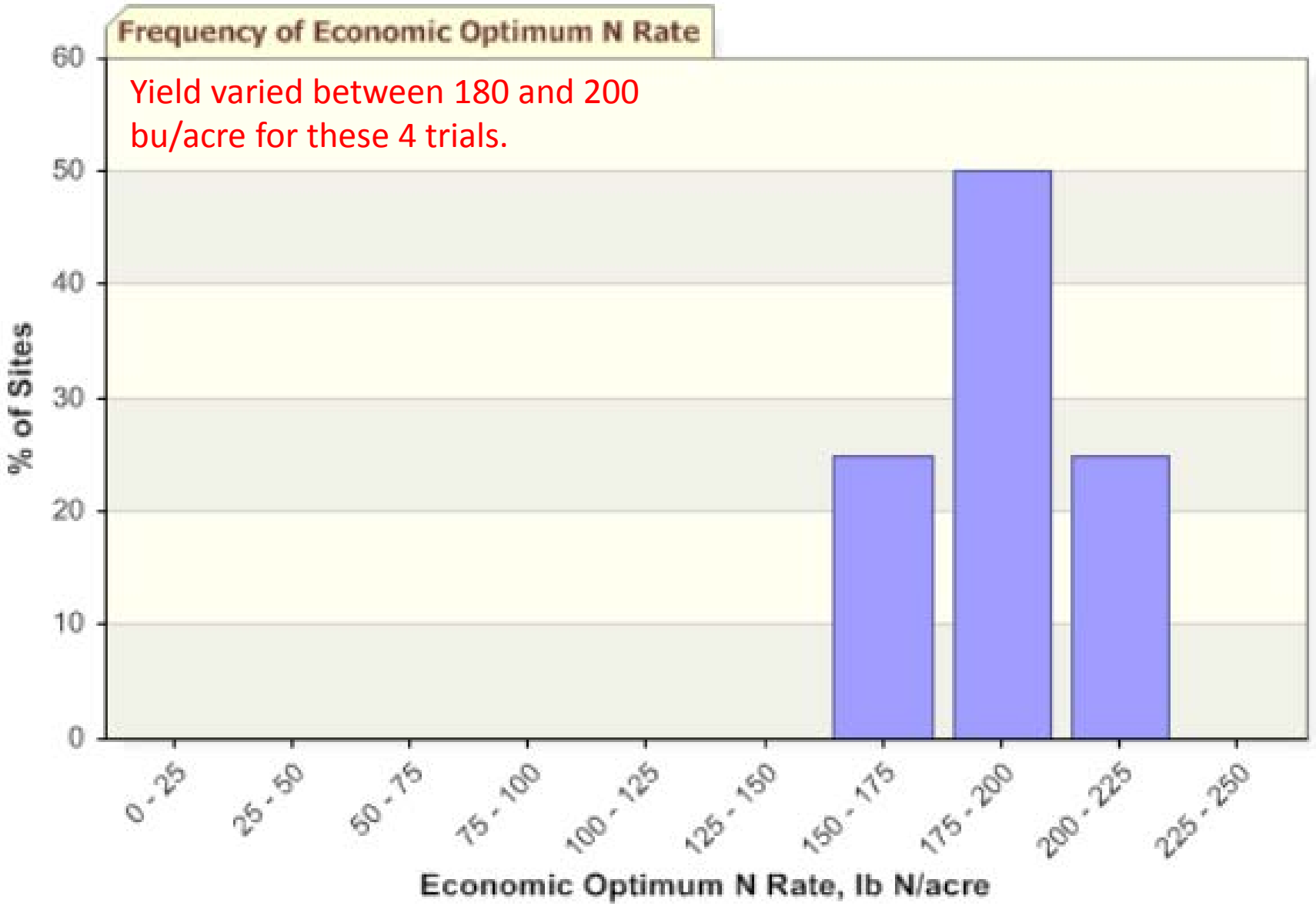
Nitrogen Price ($/lb): 0.50
Corn Price ($/bu): 3.50
Price Ratio: 0.14

MRTN Rate (lb N/acre):	**186**
Profitable N Rate Range (lb N/acre):	175 - 197
Net Return to N at MRTN Rate ($/acre):	$283.00
Percent of Maximum Yield at MRTN Rate:	98%
UAN (28% N) at MRTN Rate (lb product/acre):	664
UAN (28% N) Cost at MRTN Rate ($/acre):	$93.00

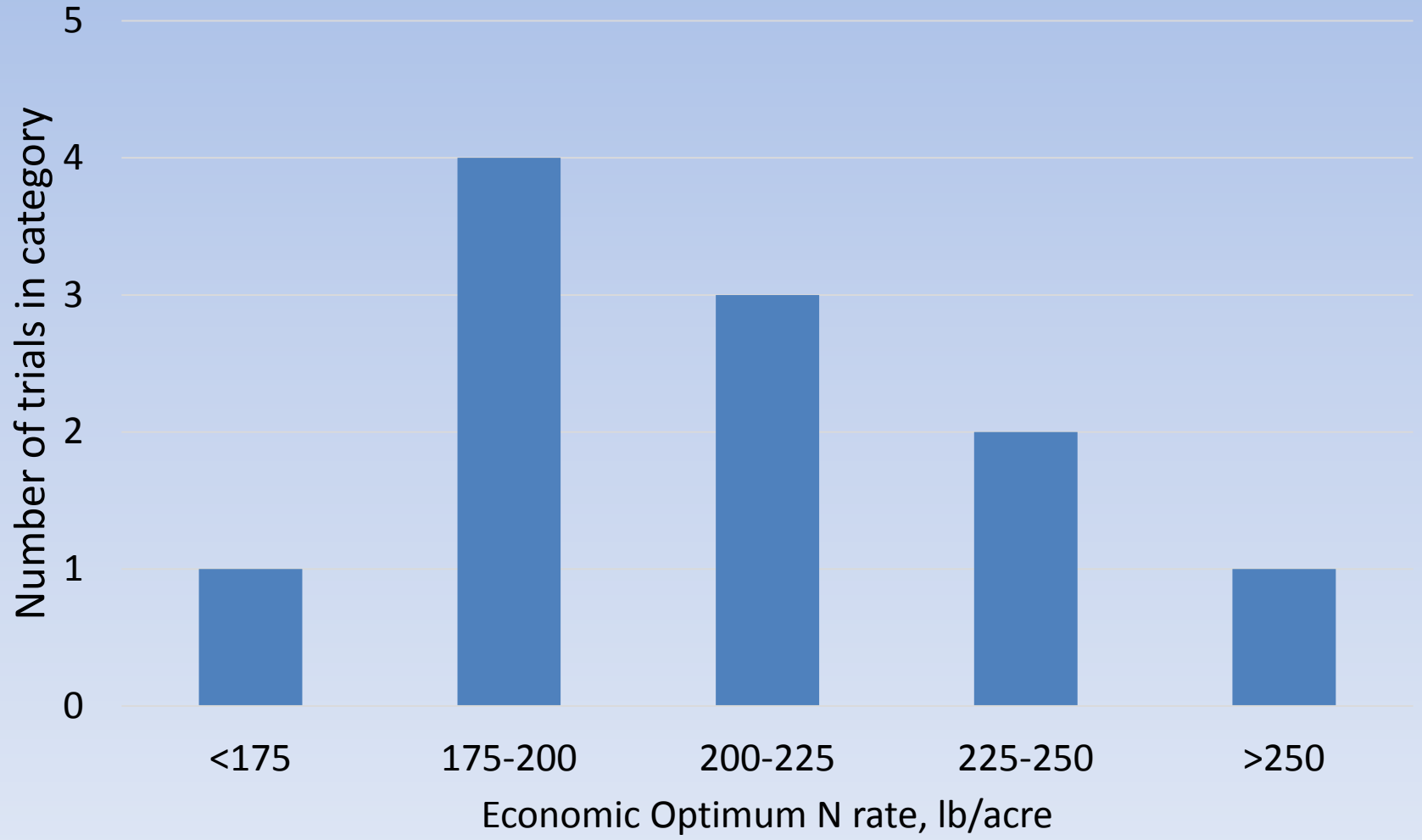
Most profitable N rate is at the maximum return to N (MRTN).
Profitable N rate range provides economic return within $1/acre of the MRTN.

I have an email into Wisconsin to see if this was corn after soybean or corn after corn. The N rate calculator gives the same result regardless of whether C/S or C/C is chosen.

WISCONSIN DATA



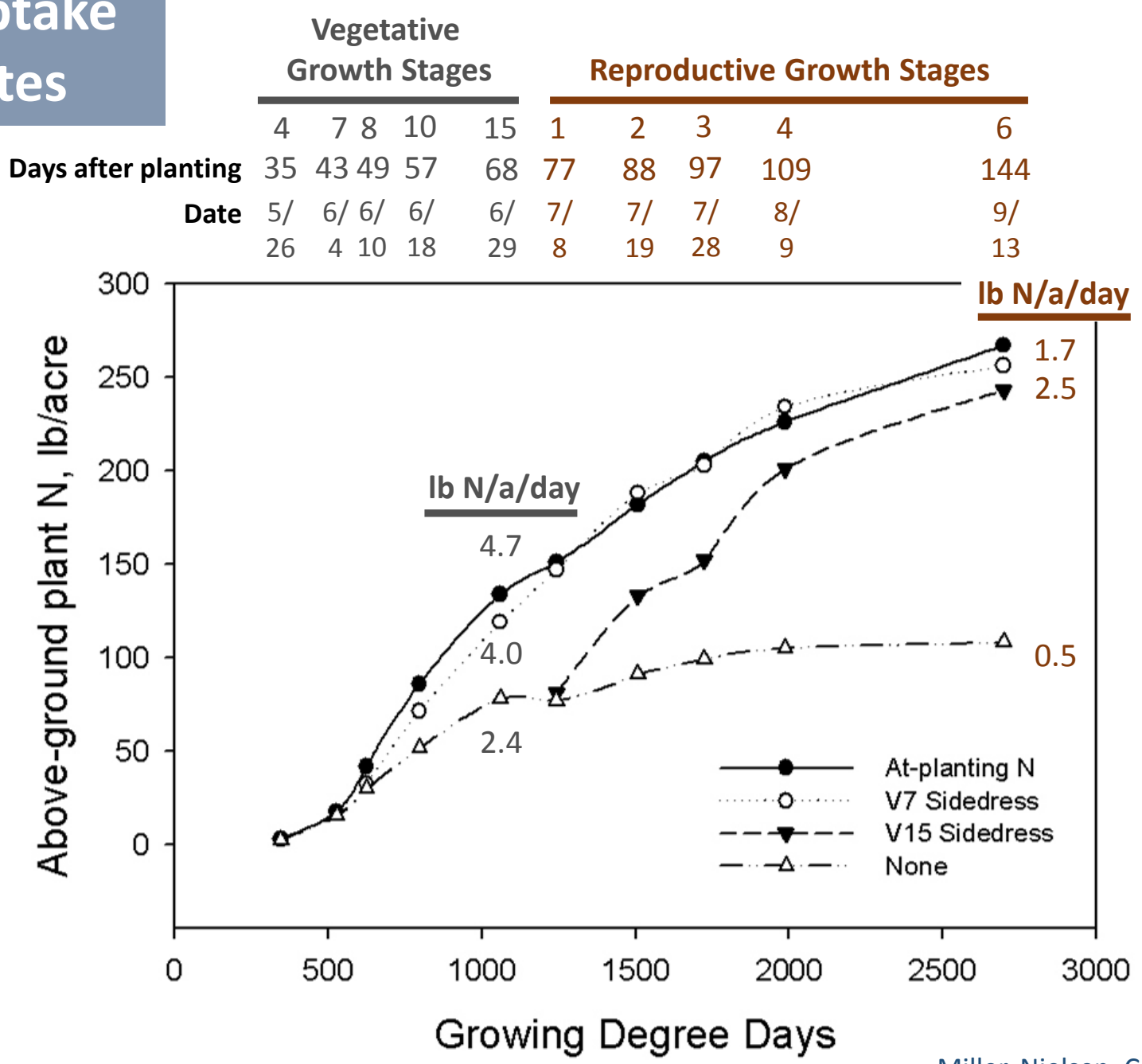
EONR for IN&MI and WI trials combined



IN&MI aggregated data

- Based on the 6 responsive sites (I need to know more about 2014 C/W and 2015 C/S)
- Economic optimum N rate is between 195 and 225 lb N/acre with the calculated optimum at 205 lb N/acre
- >$9/acre losses occur at <185 lb N/acre and >255 lb N/acre
- Based on a very limited data set if I grew corn I would apply around 205-225 lb N/acre to avoid the downside risk

N uptake rates



Miller, Nielsen, Camberato, 2010

Nitrogen fertilization to feed the crop

- Provide N early
  - N accumulated rapidly during vegetative growth, about 5 lb N/ac/day
  - Normally 2/3 of total
- Ensure N availability late
  - N accum. at similar rate per GDD as during veg. growth
  - Normally about 1/3 of total
  - Crop can accum. N faster if crop is N deficient

Irrigated corn N suggestions

- pH, P, K, S, and micronutrients and everything else provided at sufficient levels
- Minimize preplant N
- Use starter N – 25-40 lb N/ac, 10-15 lb P_2O_5/ac, plus S or Zn if needed (K?)

Irrigated corn N suggestions

- If 3 or more applications are planned
  - Sidedress V4-V7 to target N rate minus 30-50 lb N/ac
  - include strip at target +30 in several fields
- Apply remainder of N with irrigation by V12-V14

Other essential nutrients

- Based on a representative recent soil test
  - pH, magnesium - Mg
  - Zinc - Zn
  - Phosphorus - P
  - Potassium - K
- Sulfur – S
- Boron

Proper pH is fundamental

- Should add lime to keep soil pH
  - 6.0-6.5 in mineral soils
  - 5.2-5.5 in organic soils
- If magnesium is low use dolomitic limestone, otherwise base on quality and price

Magnesium Deficiency

- Yellow to white interveinal striping or beaded streaking of dead, round spots.
- Older leaves may become reddish purple and tips and margins may die.

Conditions favoring Mg deficiency

- **Soil test** Mg < 50 ppm (<100 lb/a) and/or low %Mg (5-10% of CEC)
- Sandy soils - low CEC and OM content
- Often occurs at low soil pH, but may occur at high pH with calcitic lime or hen manure
- High Ca, K, and anhydrous ammonia application can exacerbate Mg deficiency

Zinc deficiency

Conditions favoring zinc deficiency

- High soil pH and calcareous soils
- Low soil OM, eroded areas
- High soil P induces Zn def. when Zn avail. marginal
- Cloudy cool weather

Soil test Zn and pH determine sufficiency

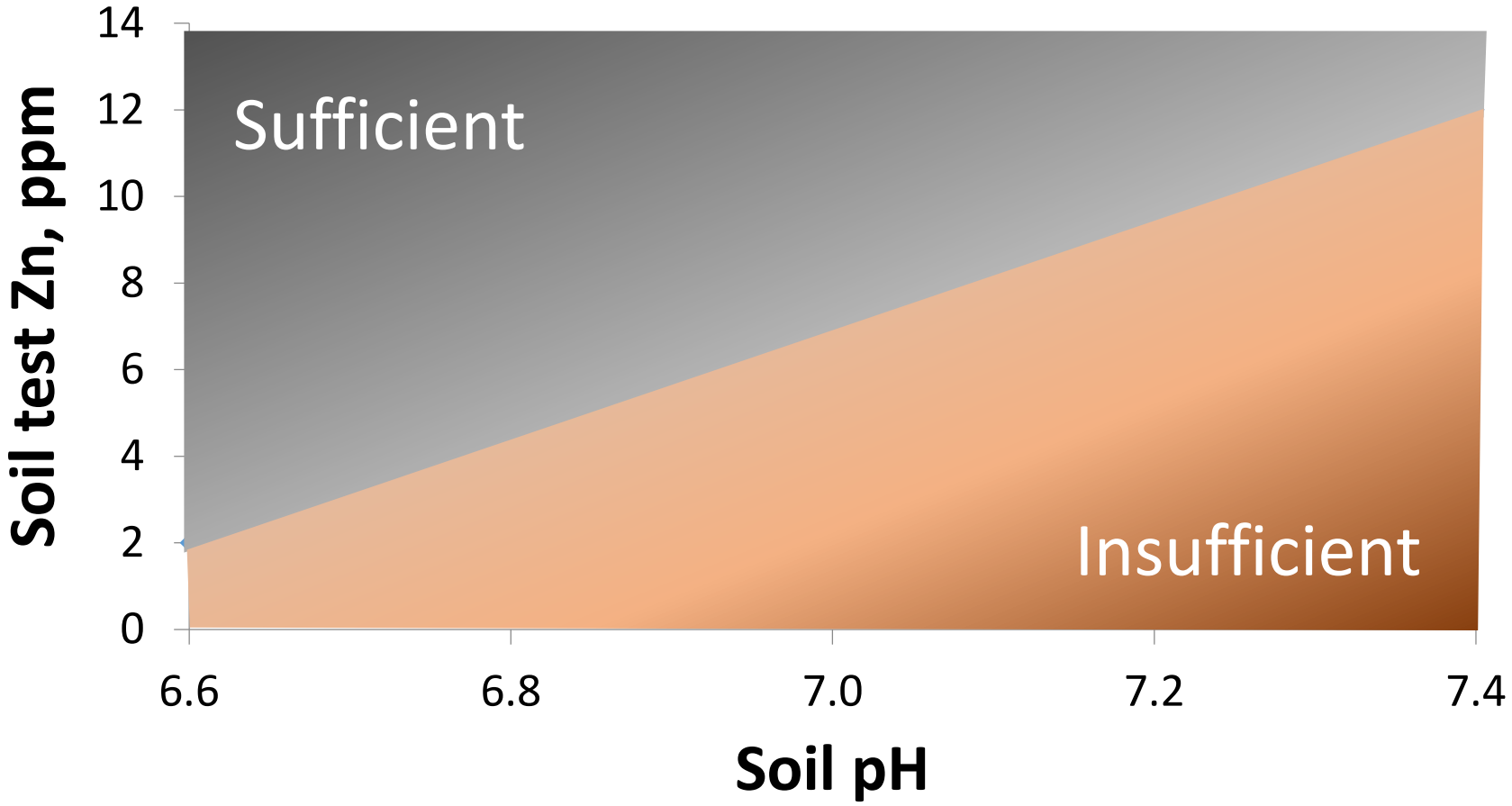


Table 28.

ZINC FERTILIZER RECOMMENDATIONS FOR RESPONSIVE CROPS GROWN ON MINERAL AND ORGANIC SOILS.[1]

Soil test Zn^2	Soil pH					
	6.6	6.8	7.0	7.2	7.4	7.6+
ppm	*lb Zn per acre*[3]					
1	1	2	3	4	5	6
2	0	1	2	3	4	5
4	0	0	1	2	3	4
6	0	0	1	2	3	4
8	0	0	0	1	2	3
10	0	0	0	0	1	2
12	0	0	0	0	0	1

Recommendations are for band applications of soluble inorganic Zn sources. **>40-50% WS**
Synthetic Zn chelates may be used at one-fifth this rate. **EDTA 2-5x more effective**
For broadcast applications, use 5 to 10 lb Zn/acre.

Tri-State Fertilizer Recommendations, Extension Bulletin E-2567

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Sulfur deficiency

- General yellowing of foliage (more so in new foliage than with N deficiency)
- Partially mobile in plant?
- Striping may occur

Conditions favoring S deficiency

- Low soil S
- Sandy, low organic matter soils
- Cold, wet, no-tillage fields, C/C
- Areas of low atmospheric S dep.
- Soil supply may vary with depth – transient deficiency

Sulfur fertilizer rate and timing

- If S is needed:
  - 15 – 30 lb S/acre
  - Applied in the spring especially on sandy soils because the sulfate-S will leach out of the profile if fall-applied

Fertilizer	Sulfur
Ammonium thiosulfate	26%
Ammonium sulfate	24%
K-mag or Sul-po-mag	23%
Gypsum	20%
Potassium sulfate	18%

Starter fertilizer

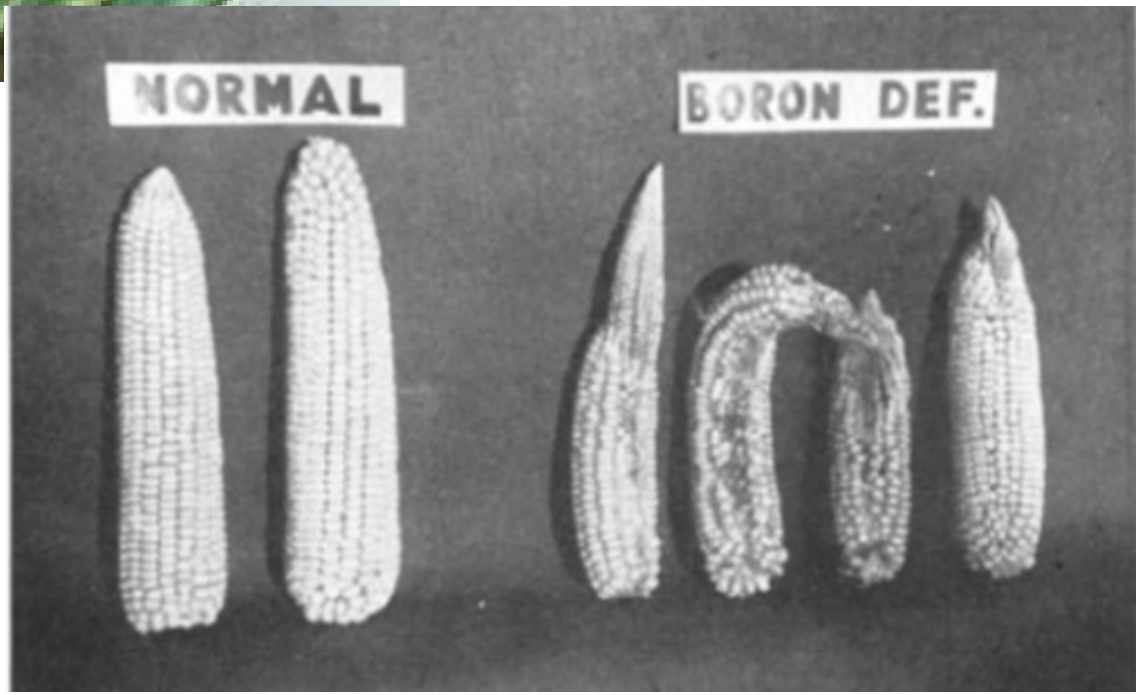
- Frequently increase early growth
- Accelerate development rate
- Most likely to increase yield in:
  - irrigated, high yield environment
  - no-till, heavy residue
  - early planting
  - low nutrient soils
- Hastens maturity 7-10 days (lower grain moisture at harvest)

Starter fertilizer

- 2x2 placement gives most consistent benefits
- 30-40 lb N/acre is likely optimum for yield
- 10-20 lb P_2O_5/acre is enough for starter response
- Maybe S, Zn, B, and/or K may be benefical

Boron Deficiency

Leaf tissue boron >4-10 ppm is adequate



Conditions for B deficiency

- Boron can be limiting with high yield corn particularly in sandy low organic matter soils with high pH and when irrigated

Role of B in plants

- Cell division in growing points
- Pollination and seed development
  - Poor tassel emergence, spikelet deformation, absence of anthers, barrenness
  - Germination of pollen and growth of pollen tubes

Boron-deficiency symptoms

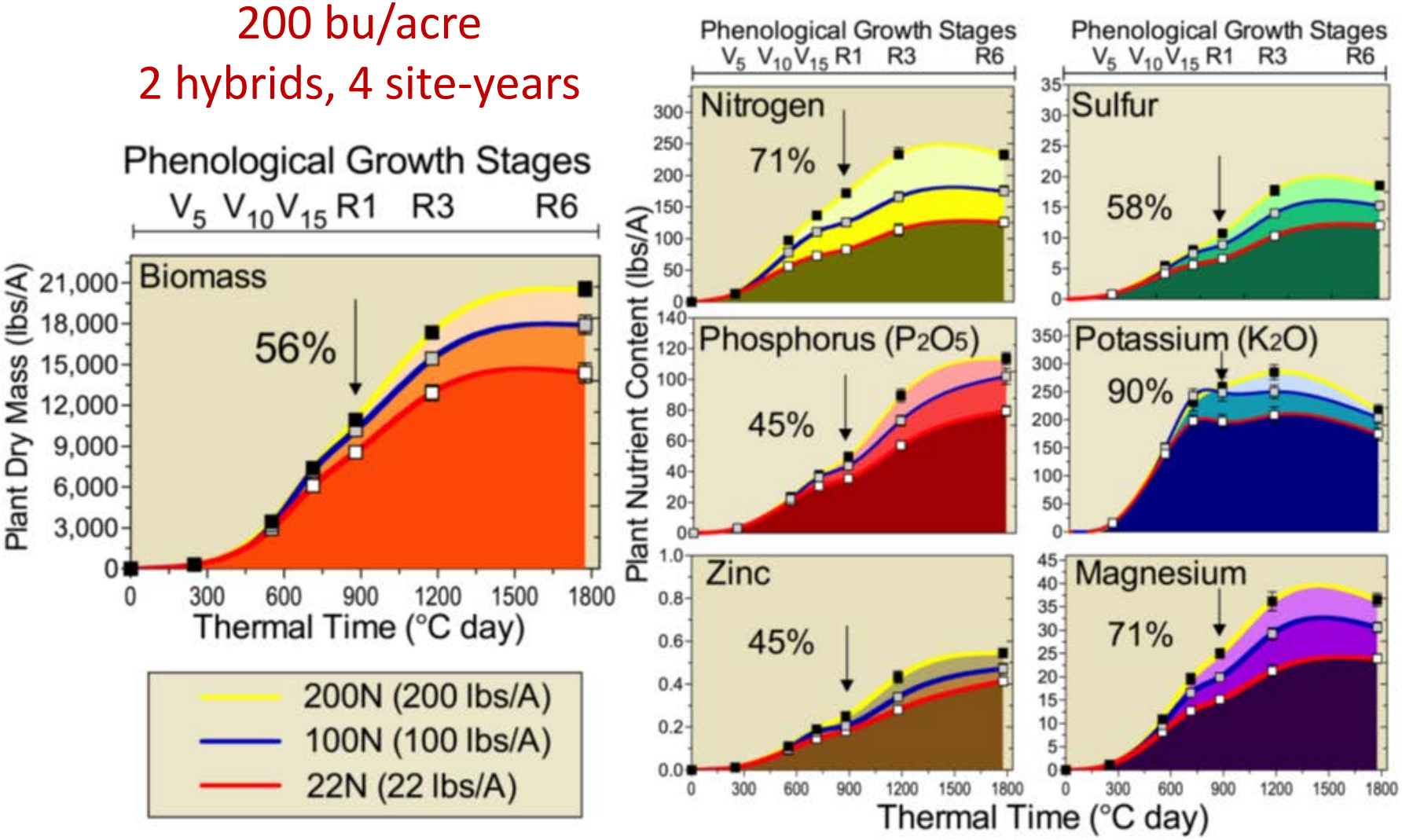
- Normal plant growth requires a continuous supply of B - B is not translocated from old to new tissue
- Therefore, B-deficiency symptoms are first expressed in young tissue and growing points

Boron fertilization

- Soil applied B - 0.5-1.0 lb B/acre
- Post-planting applications are better than pre-plant applications, foliar applications of 0.1-0.3 lb B/acre

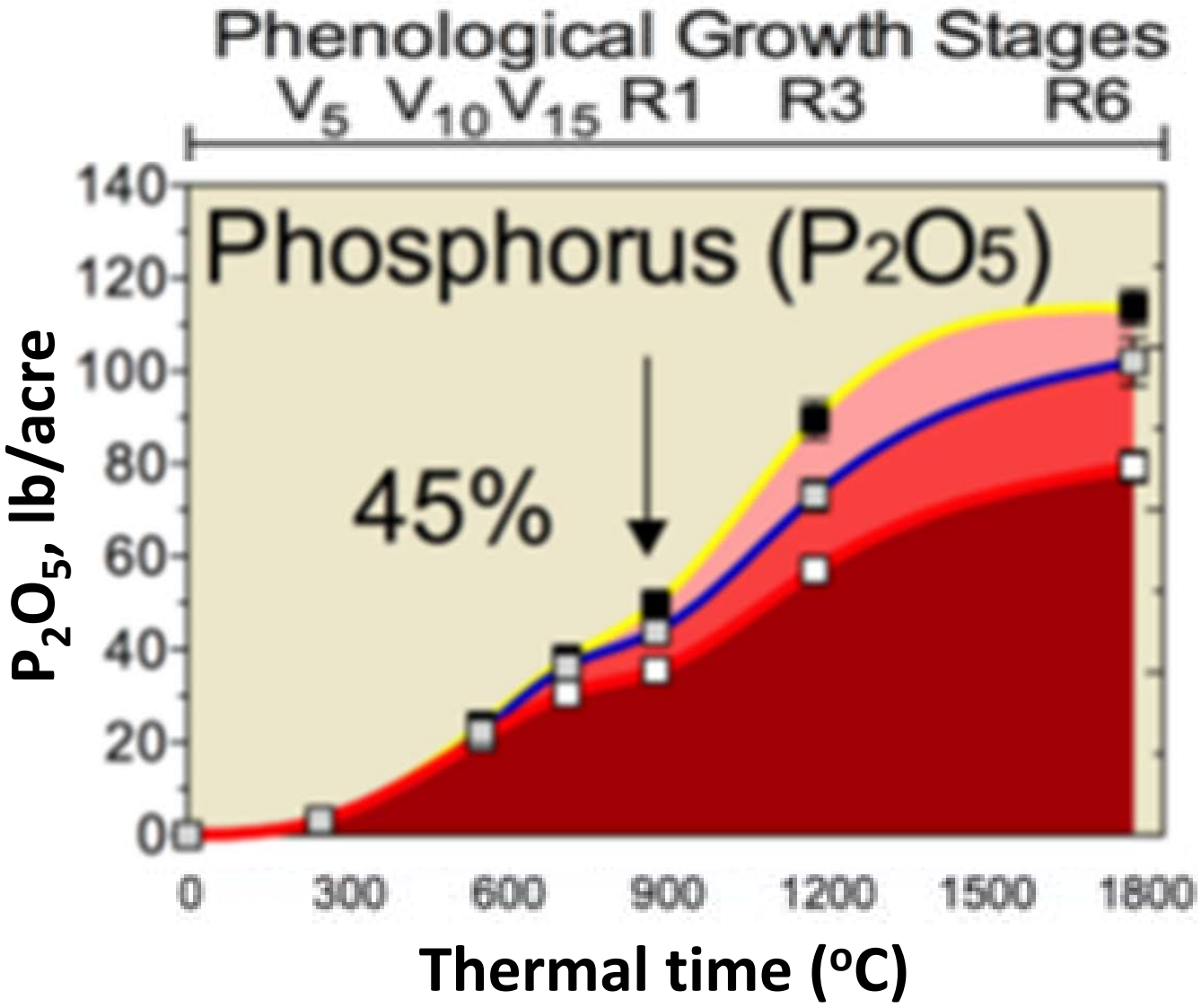
Nutrient uptake patterns over time

200 bu/acre
2 hybrids, 4 site-years



Ciampitti and Vyn, 2013, Crop Management, DOI 10.2134/CM-2013-0022-RS

Phosphorus uptake over time



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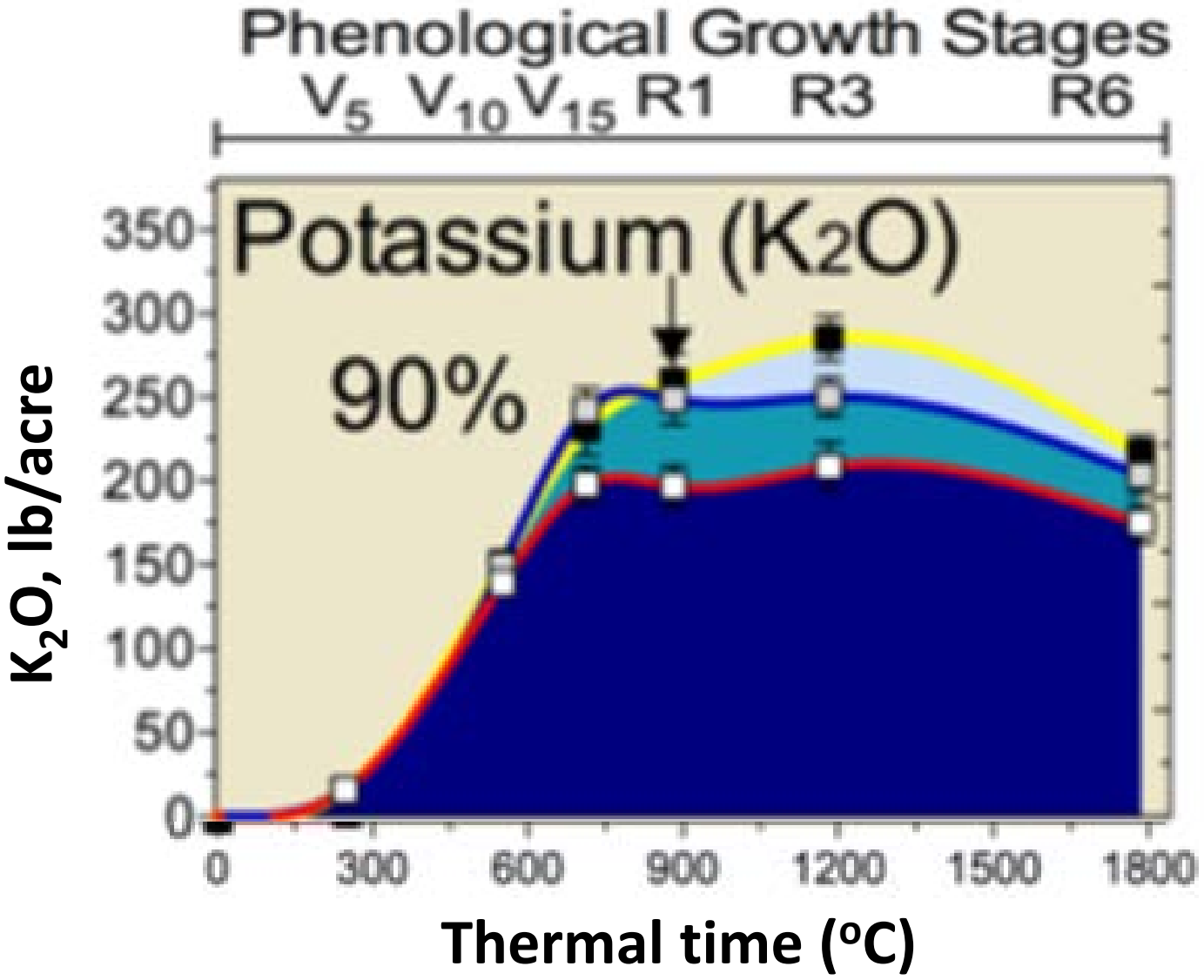
Potassium uptake over time



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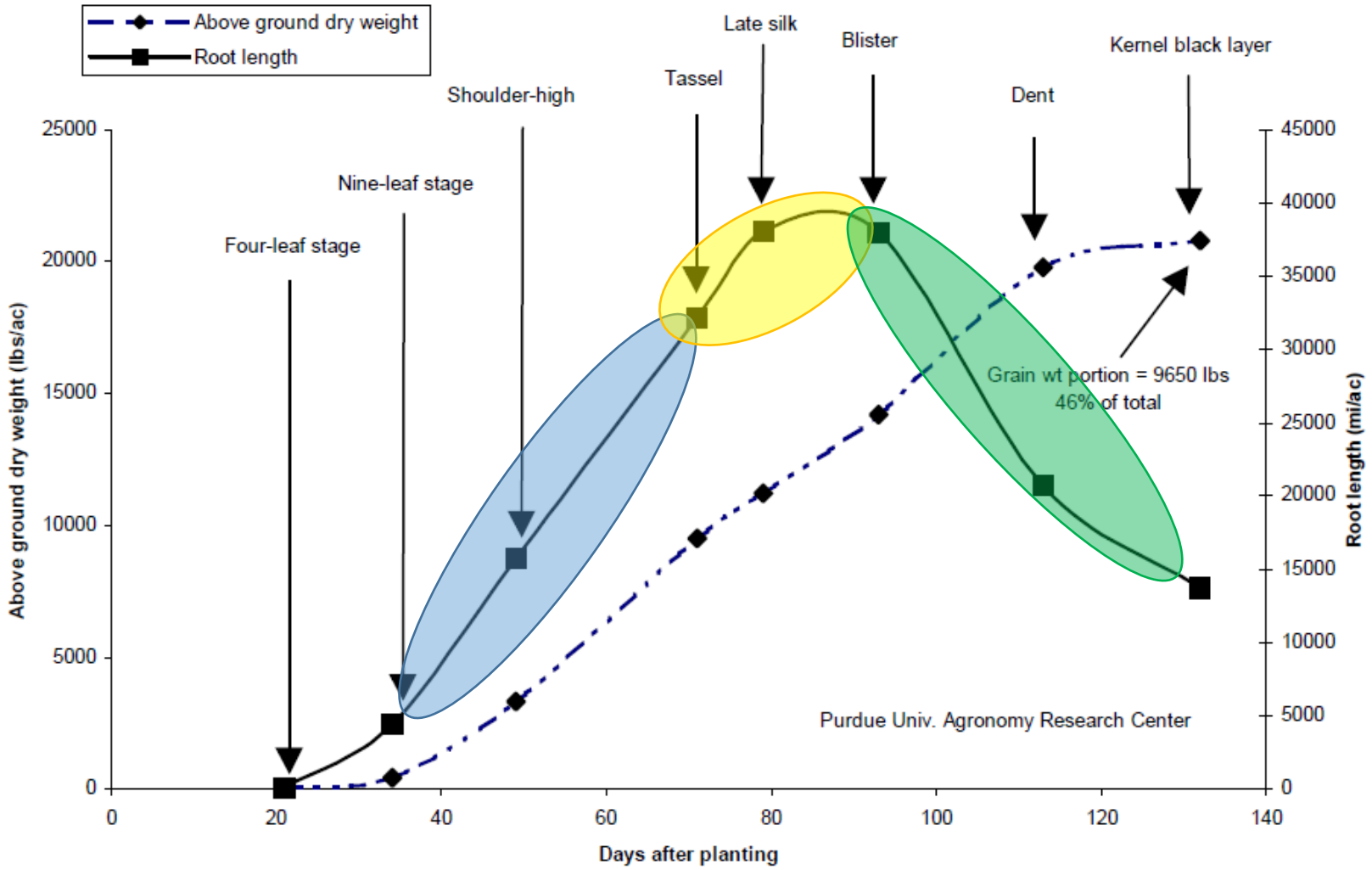
General findings

- “Modern” compared to “old” hybrids
  - Accumulate more nutrients (yield more)
  - Take up proportionally more nutrients during grainfill (maintain leaf tissue later into grainfill period)

What does it all mean?

- Do “modern” compared to “old” hybrids require:
  - Higher soil test levels or higher rates of fertilization to reach potential
  - Different timing of nutrient application (does the optimum timing differ among nutrients)

Amount of roots changes substantially throughout season



From: Nielsen-AGRY97-07, 2000 based on: Mengel-AGRY95-08, 1995

P3369A, 21,700 pl/ac, 204 bu/ac, roots to a depth of 30”

Uptake per unit root diminishes during the season

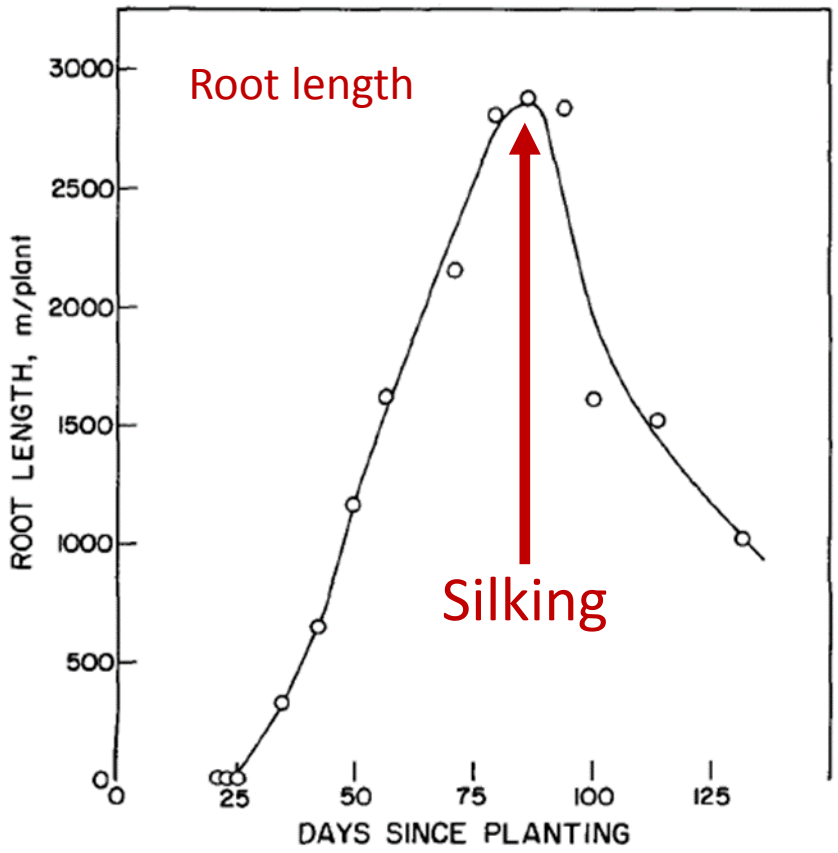


Fig. 3. The relation between root length and plant age for corn grown in 1971.

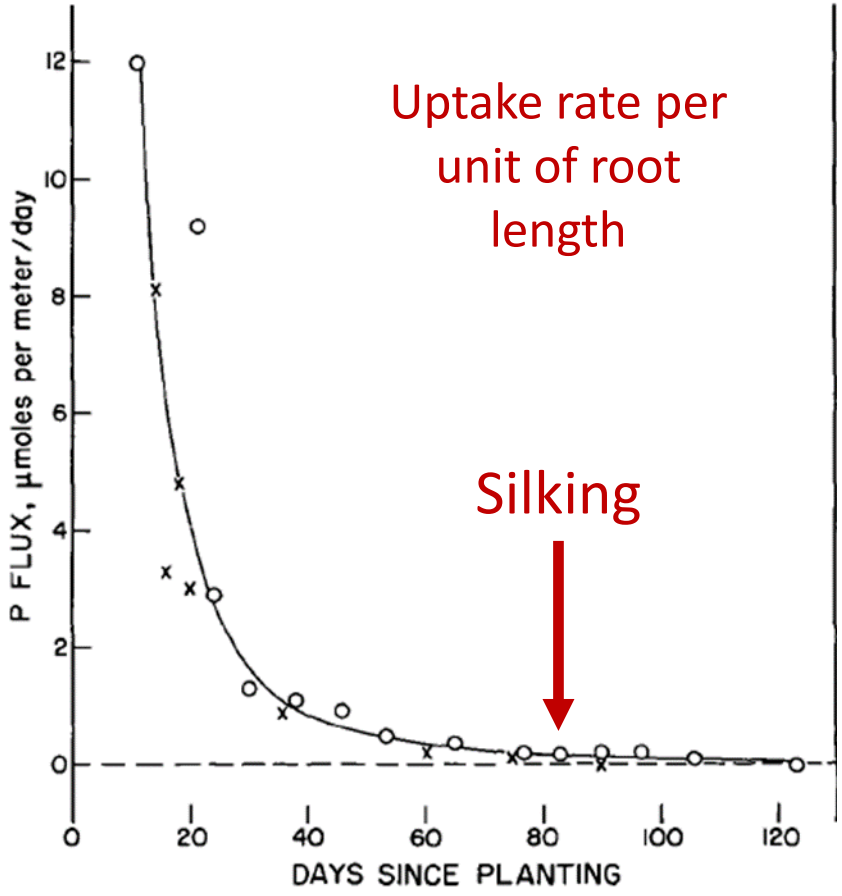
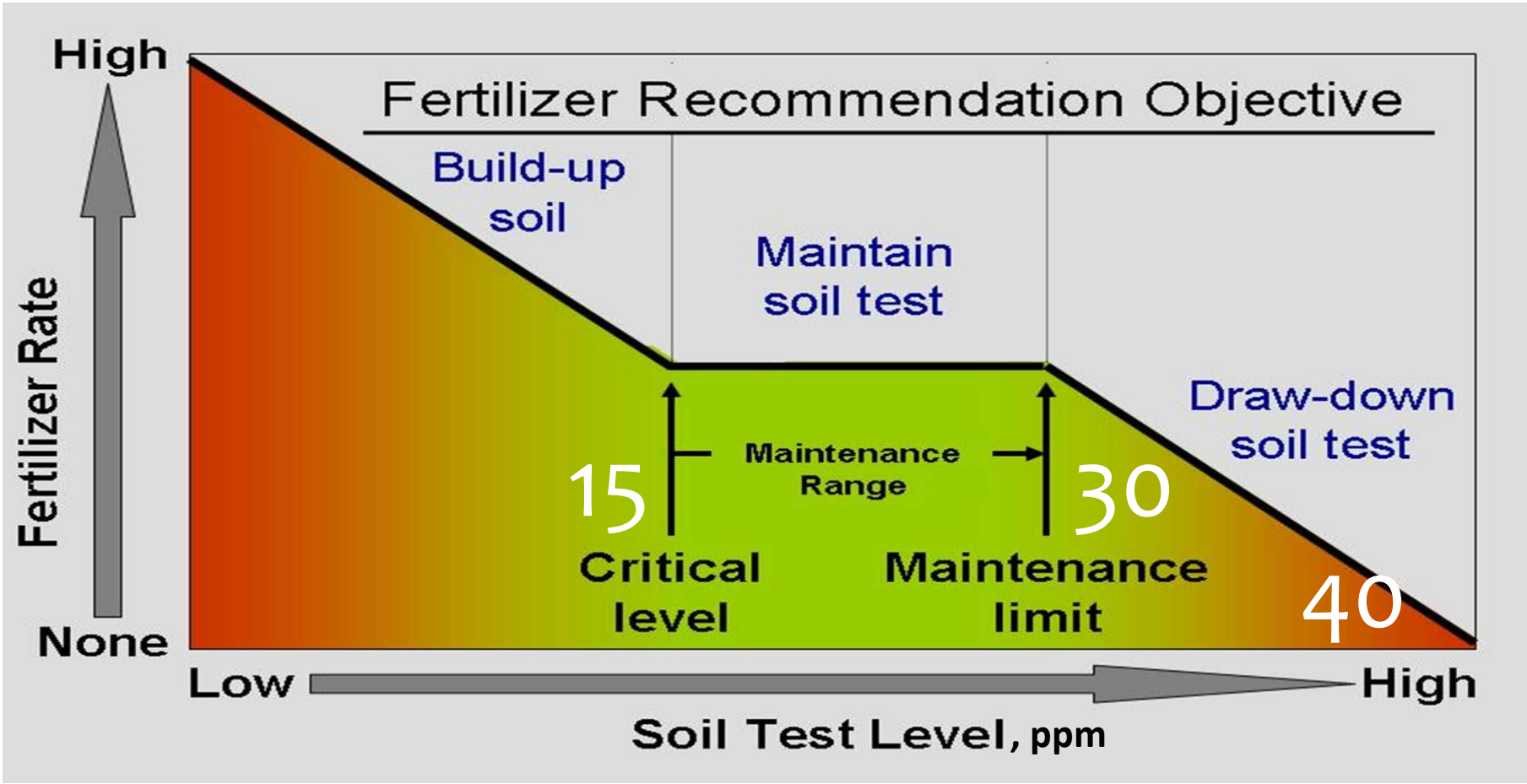


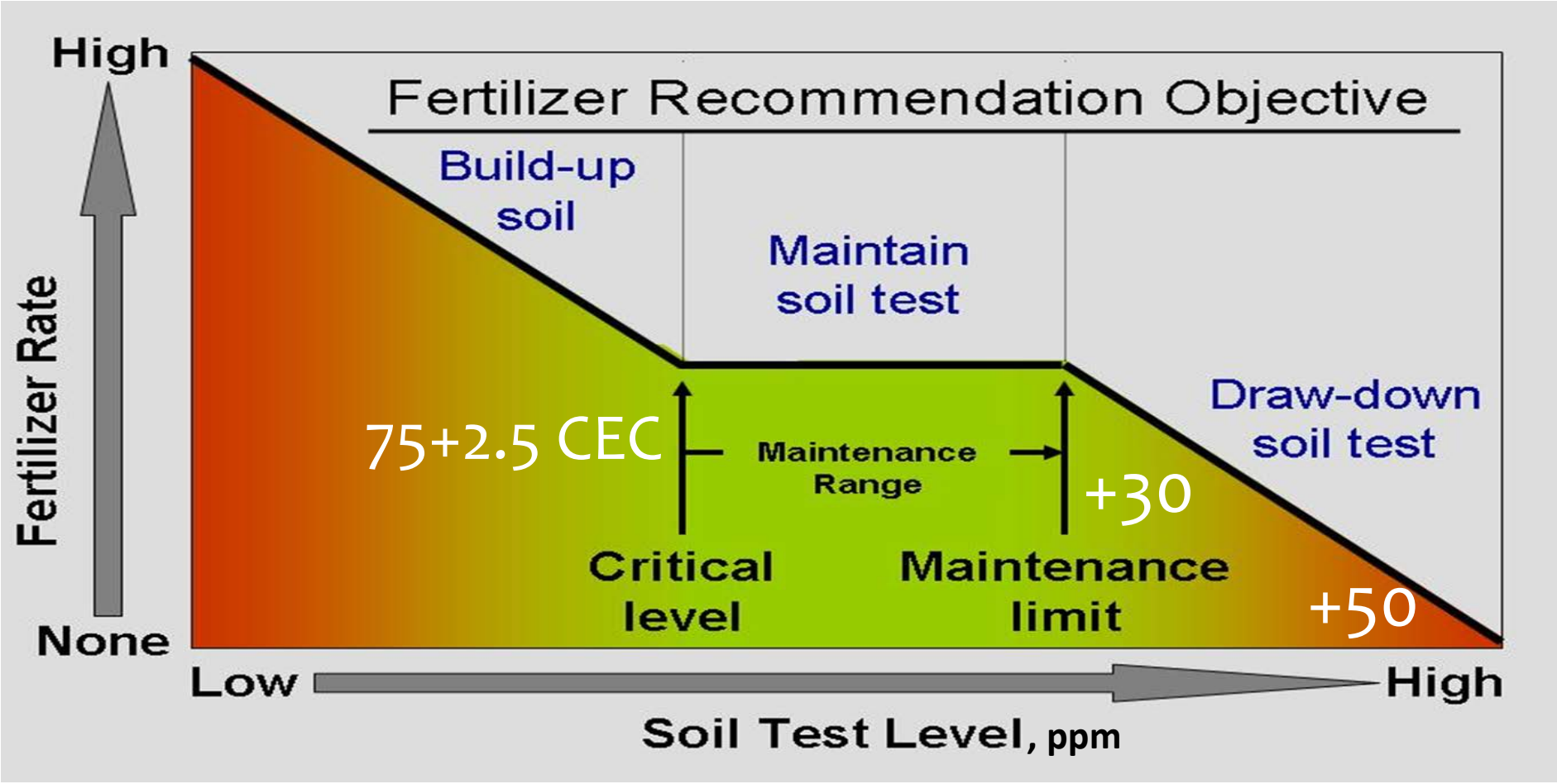
Fig. 4. The relation between P flux into the root per unit root length and plant age for corn grown in 1970 and 1971

Mengel and Barber,1974, AJ 66:399-402.

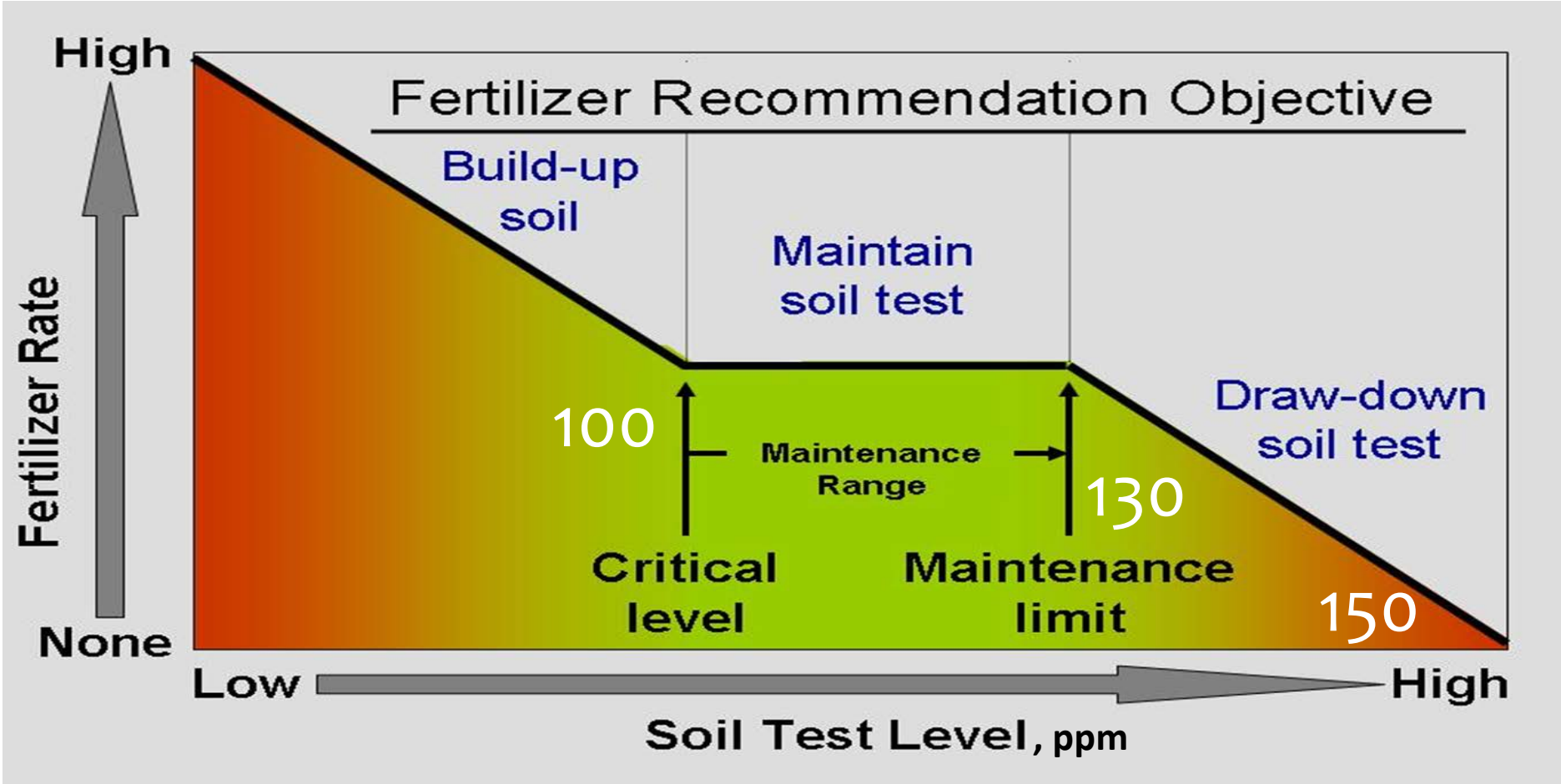
Soil test P levels for corn and soybean



Soil test K levels for corn and soybean



Soil test K levels at CEC=10



P and K fertilization

- Existing critical levels should be sufficient for high yielding irrigated corn
- Application rates should be set to maintain soil test levels in the mid- to high-maintenance range

Questions?