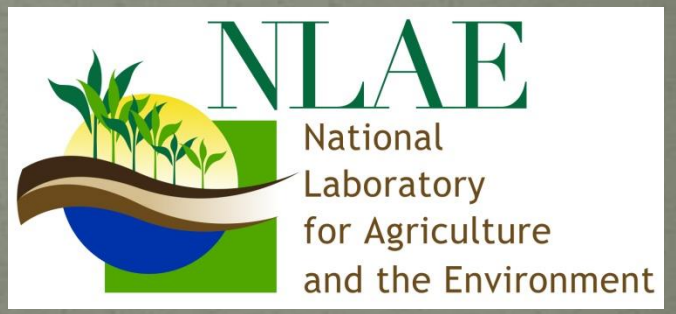
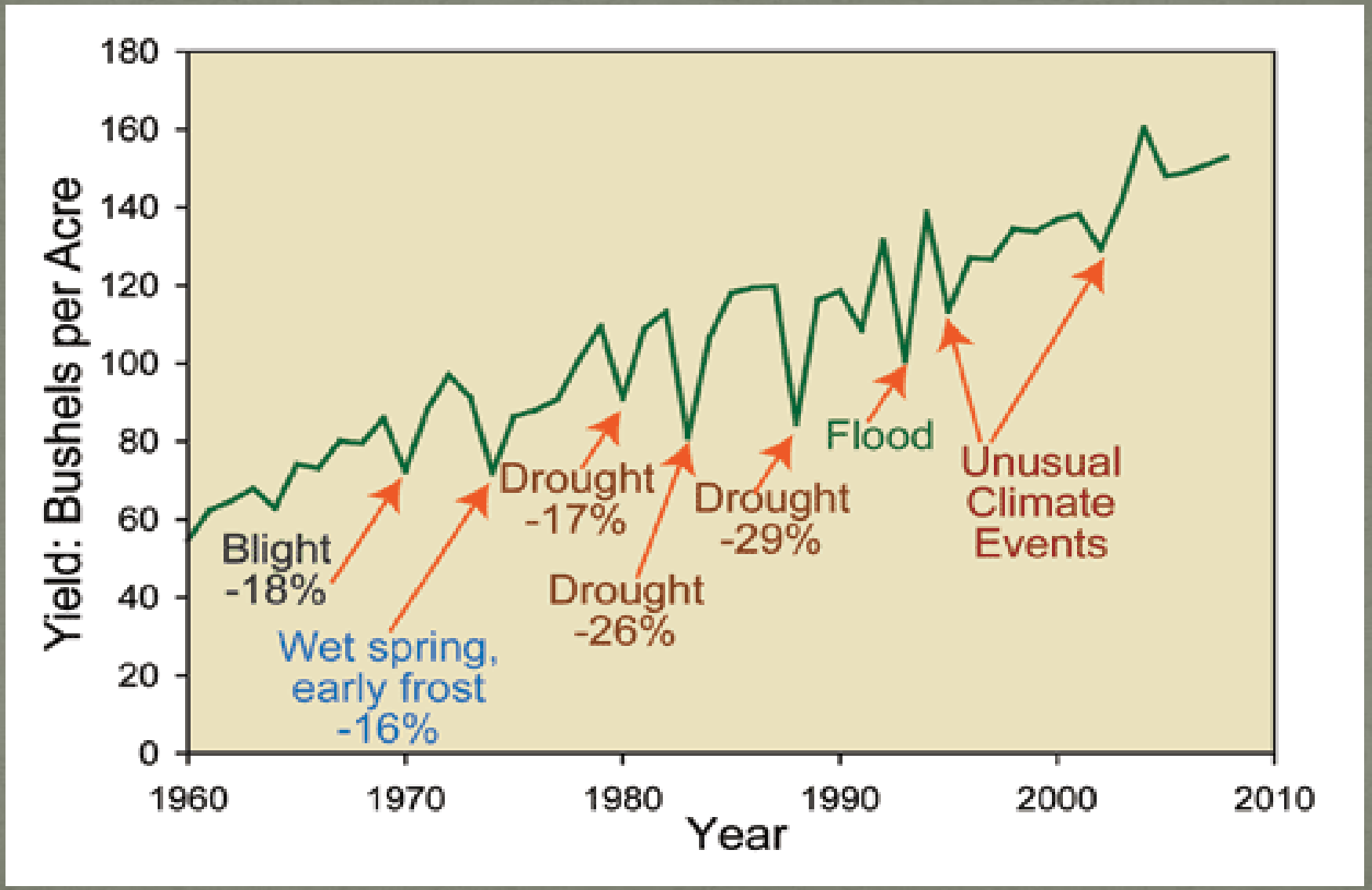
Starters: Value of N-P-K-S-Zn in Current Production Systems

John Kovar
USDA Agricultural Research Service
National Laboratory for Agriculture and the Environment (NLAE)



Impacts on US Corn Yields



Hatfield, 2010

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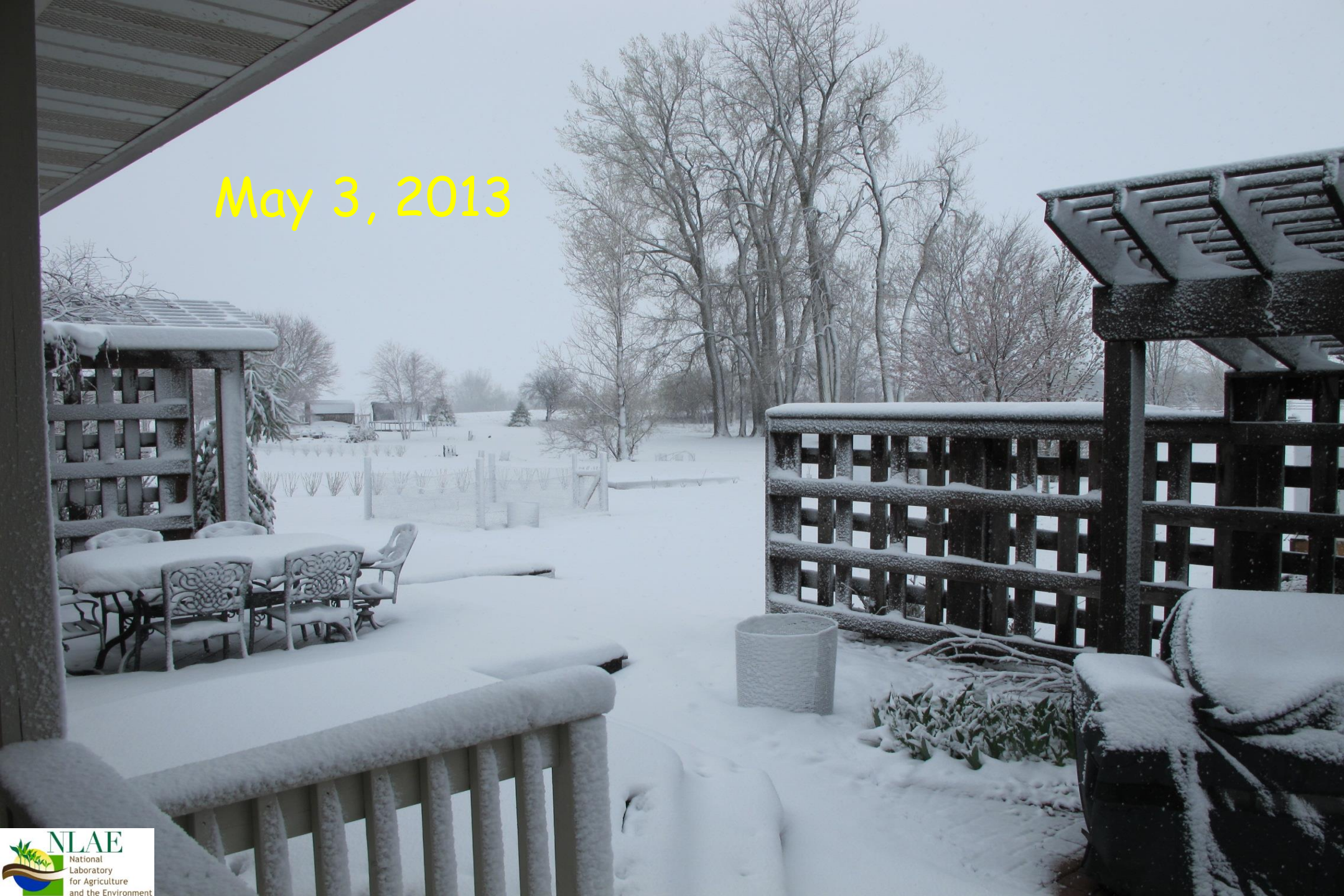

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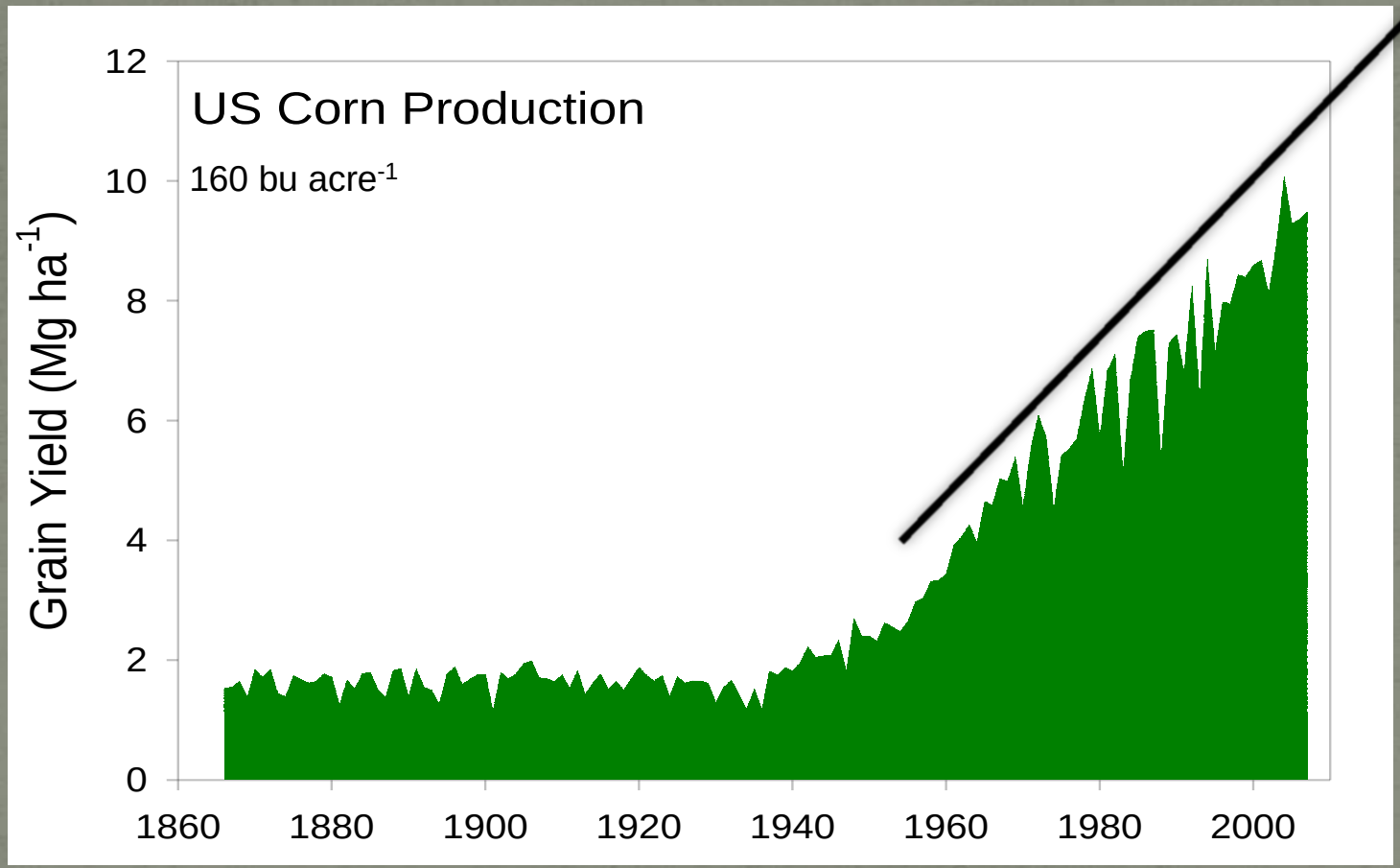
Optimism of US Corn Production



Expect yields to continue to increase

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Goal: Capture Yield Potential

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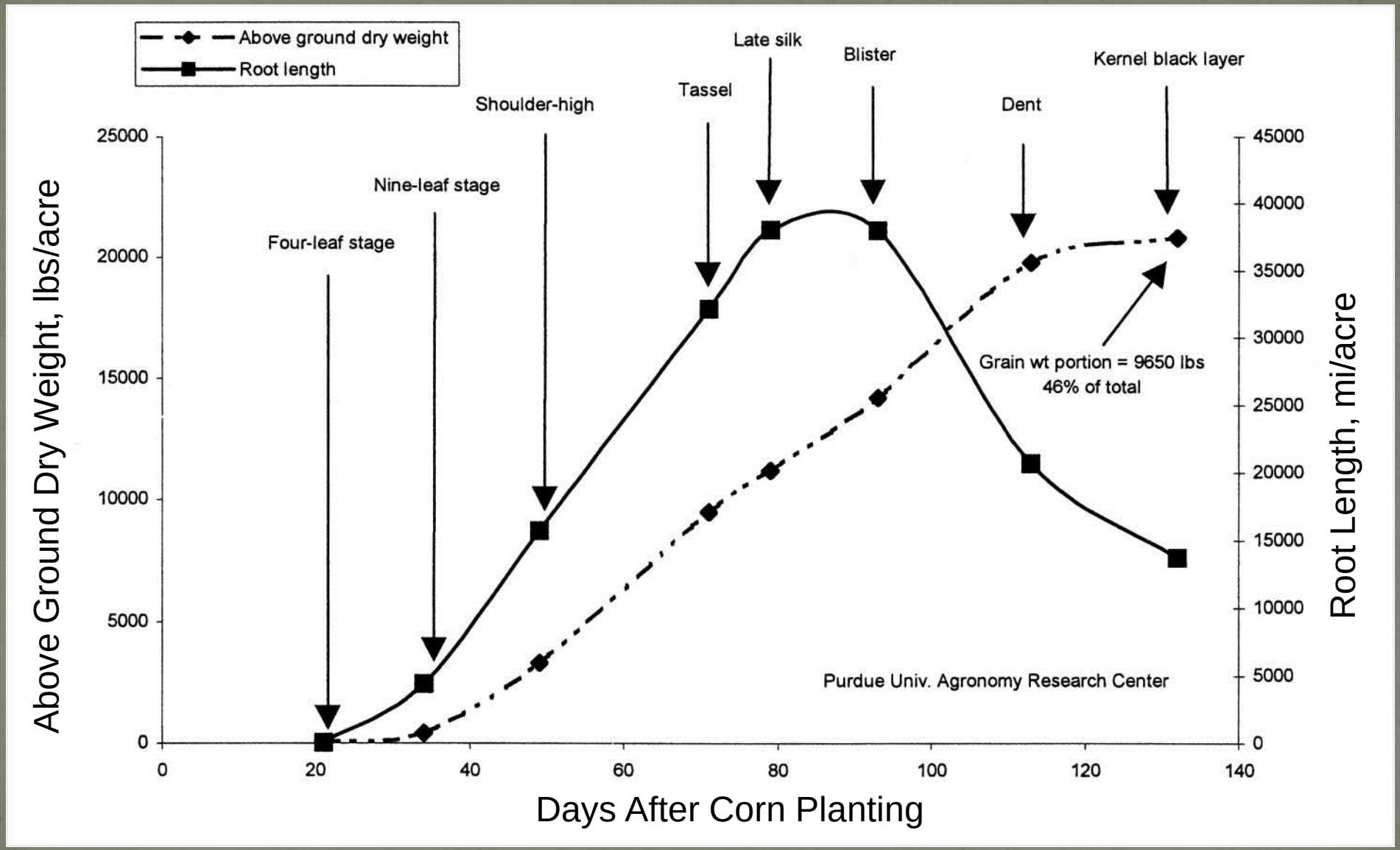

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Response to Starter Fertilizer

- soil supply of N, P, and/or other nutrients must increase
- crop root system must take advantage

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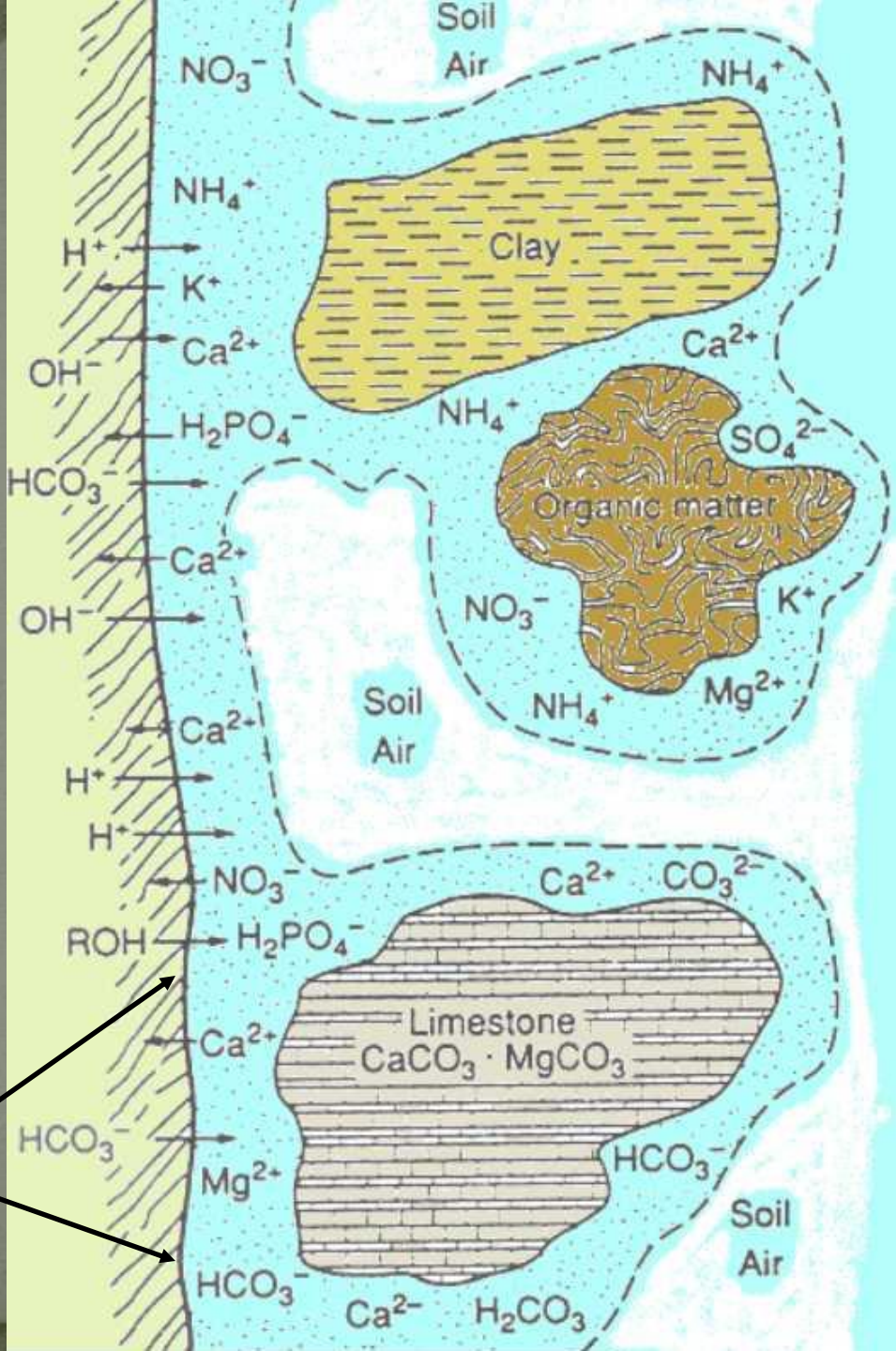
Soil Supply of Nutrients

- Root interception
- Mass flow
- Diffusion



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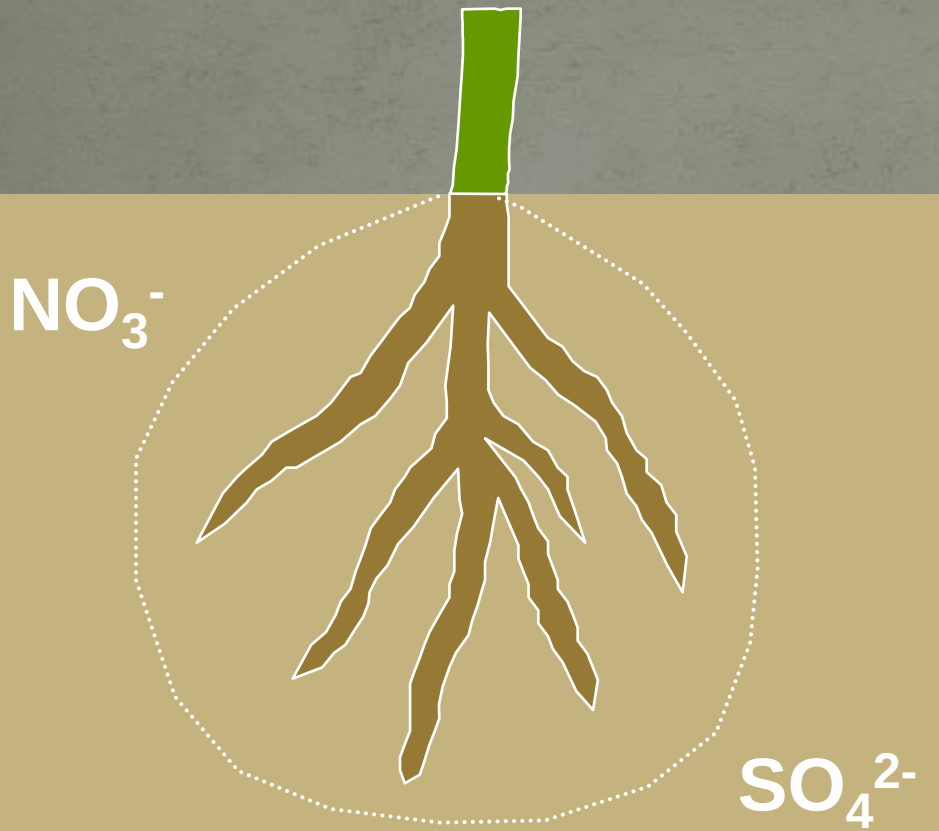
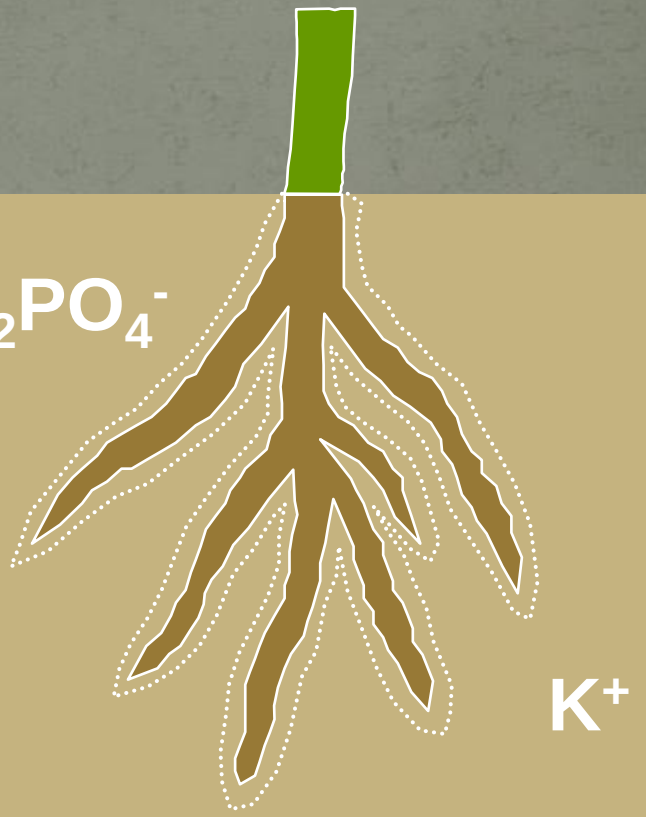
Soil Nutrient Supply Zones



Mobile Nutrients



Immobile Nutrients

Blaylock, 2003

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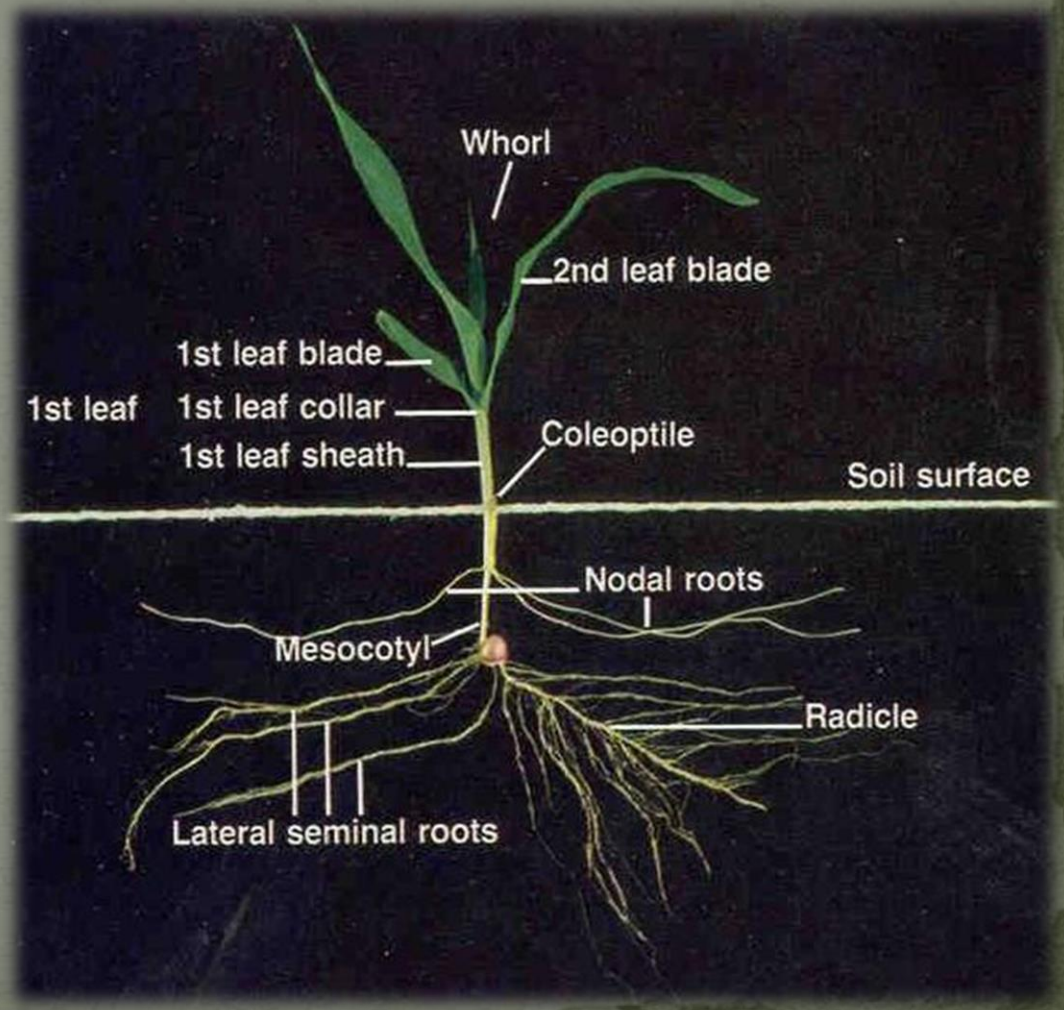
Factors Affecting Root Growth

- soil water content
- soil temperature
- soil physical properties



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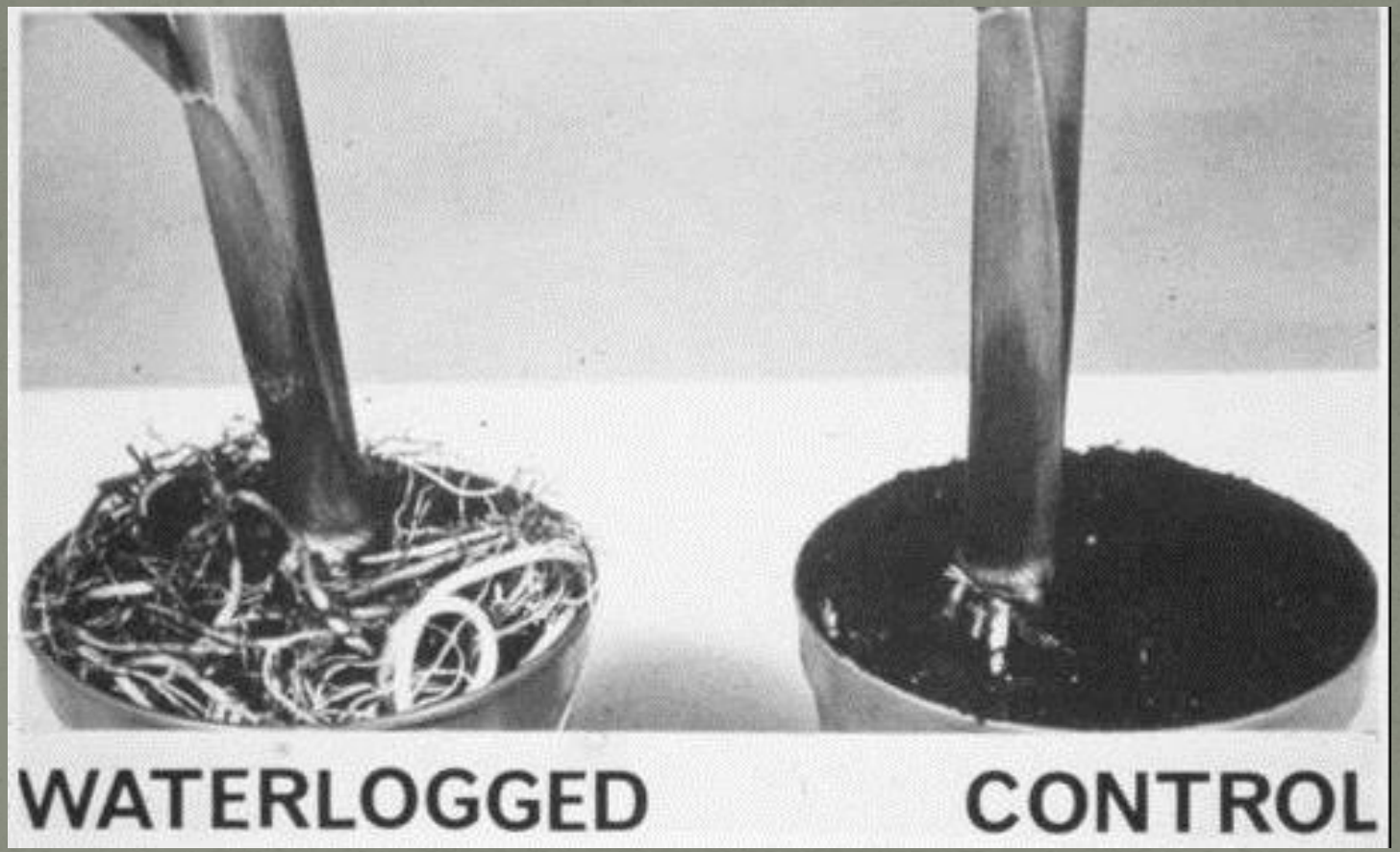
Corn Root Growth in Saturated Soil



Kovar and Kuchenbuch, 1994

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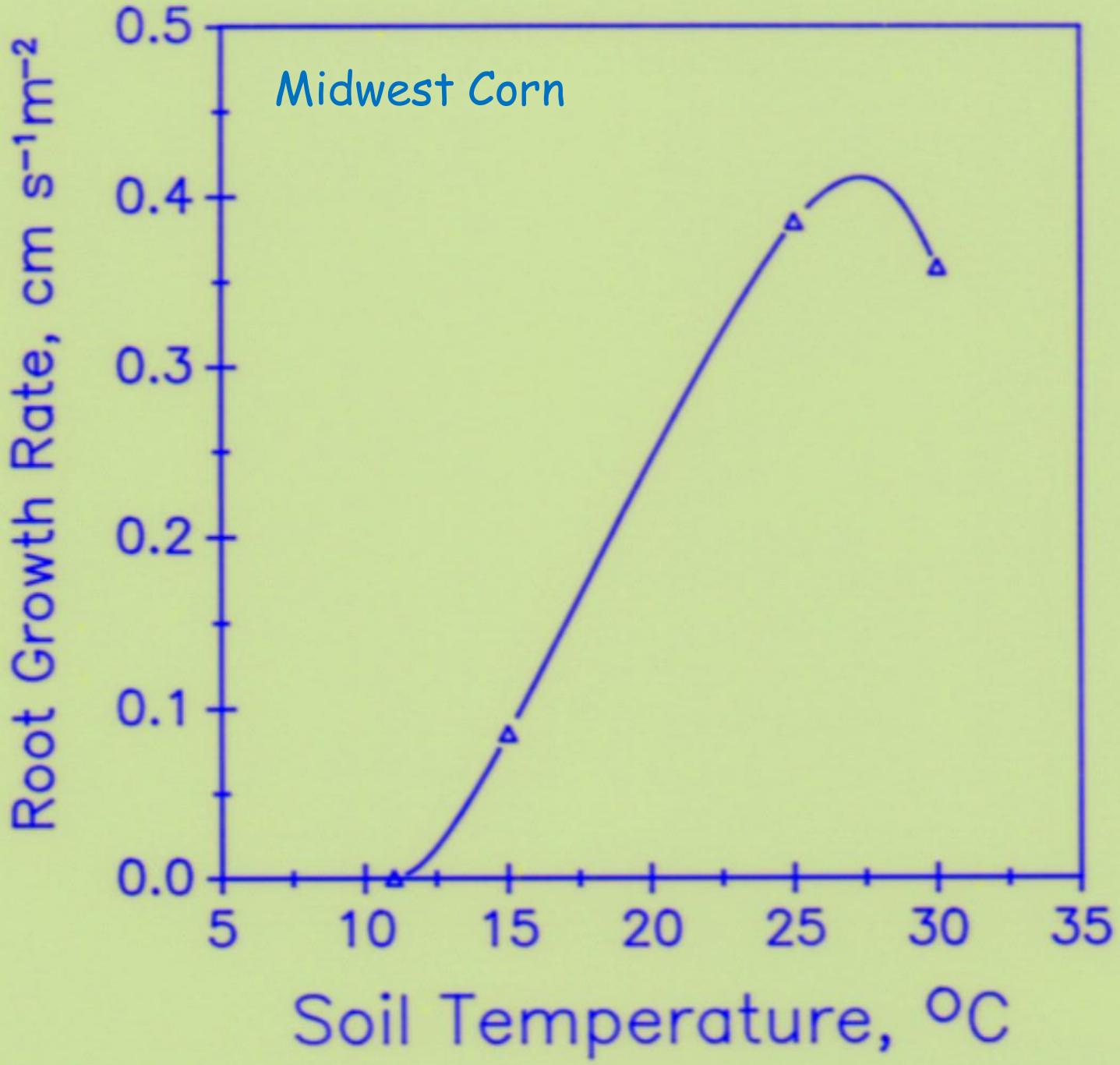

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Optimum Soil Temperatures for Root Growth of Several Crop Species

Crop	Optimum Temperature
Canola	73°F (23 C)
Corn	79°F (26 C)
Cotton	91°F (33 C)
Perennial Ryegrass	62°F (17 C)
Rice	87°F (31 C)
Soybean	77°F (25 C)

McMichael and Burke, 1996

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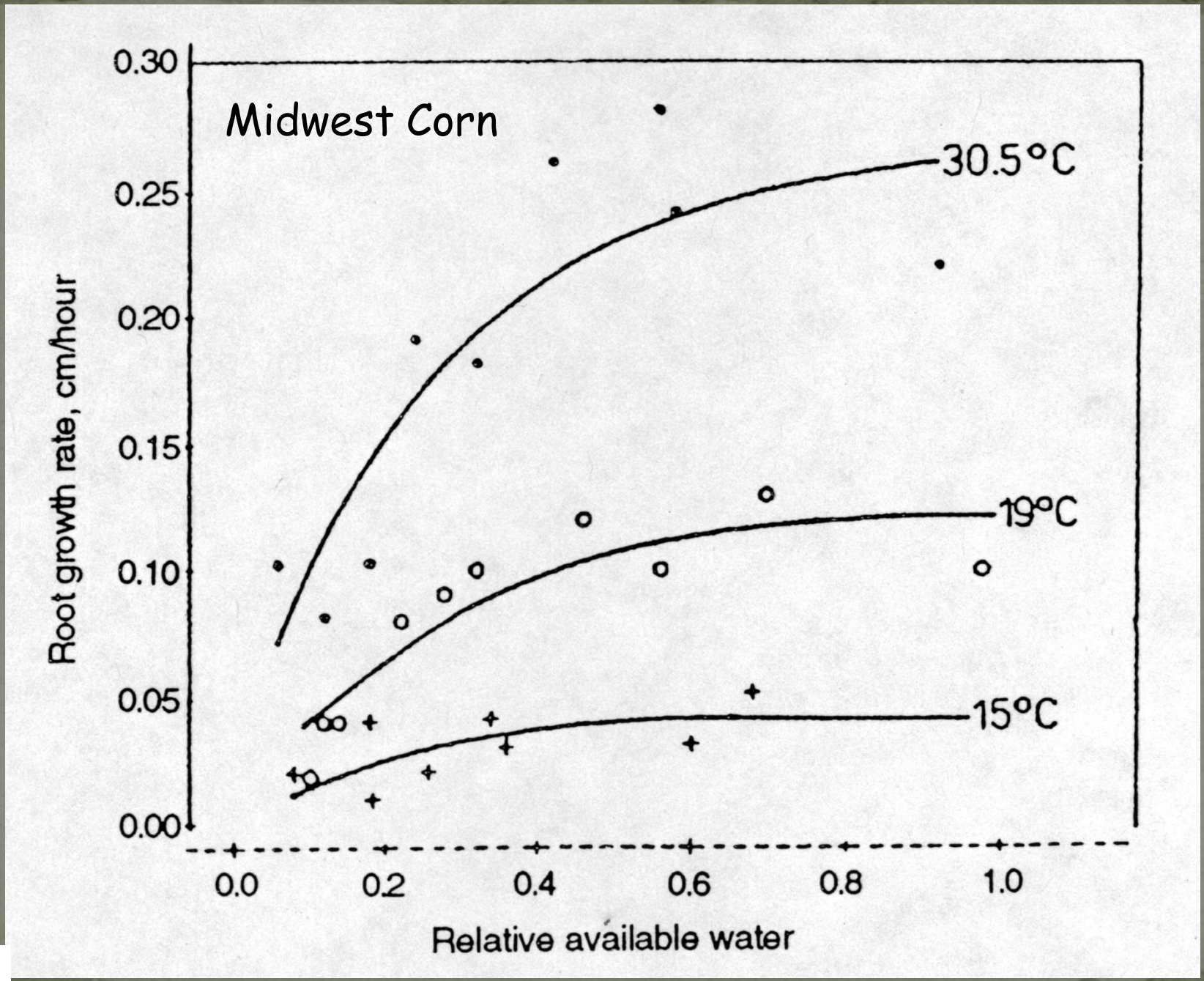

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McMichael and Burke, 1996


Wheel Traffic = Compacted Soil
Photo by T.C. Kaspar, USDA-ARS

Response to Starter Fertilizer

- starter placement?
- starter composition?

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Starter Placement Options

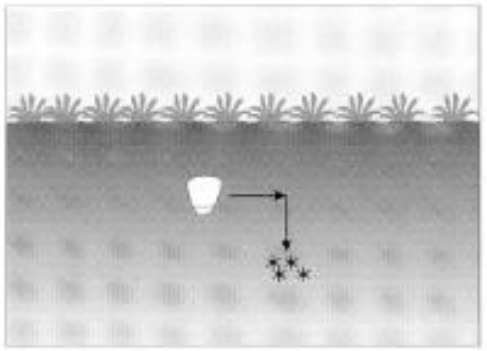

Figure 2a. Two-by-two placement.

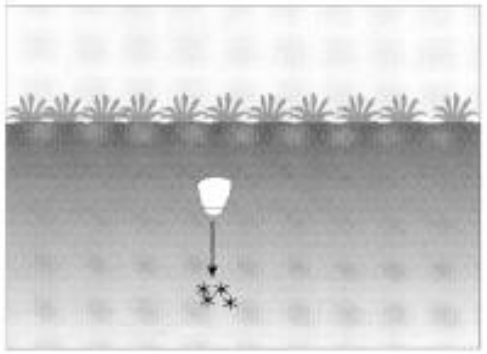

Figure 2b. Below-seed placement.

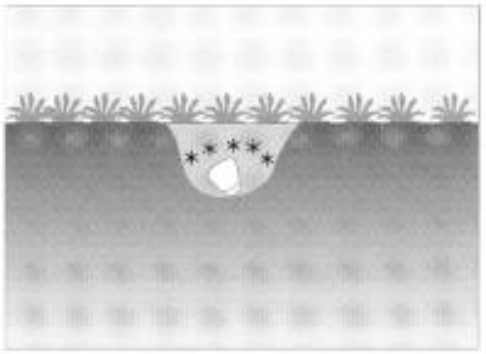

Figure 2c. In-row or "pop-up" placement.

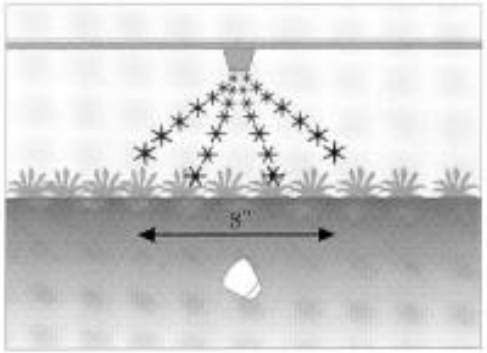

Figure 2d. Over-the-row banding.

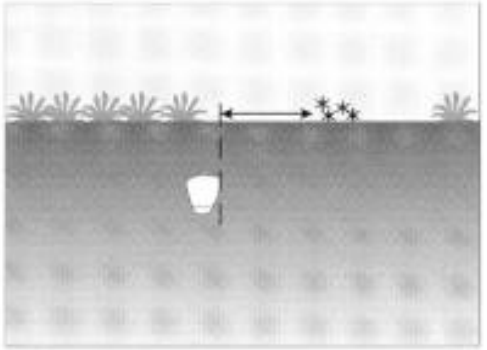

Figure 2e. Surface-dribble placement.

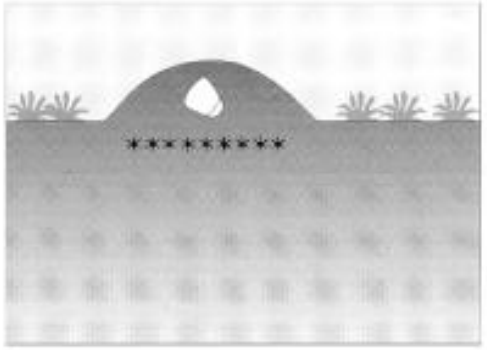

Figure 2f. Banding under the row.

http://www.soil.ncsu.edu/publications/Soilfacts/AG-439-29/

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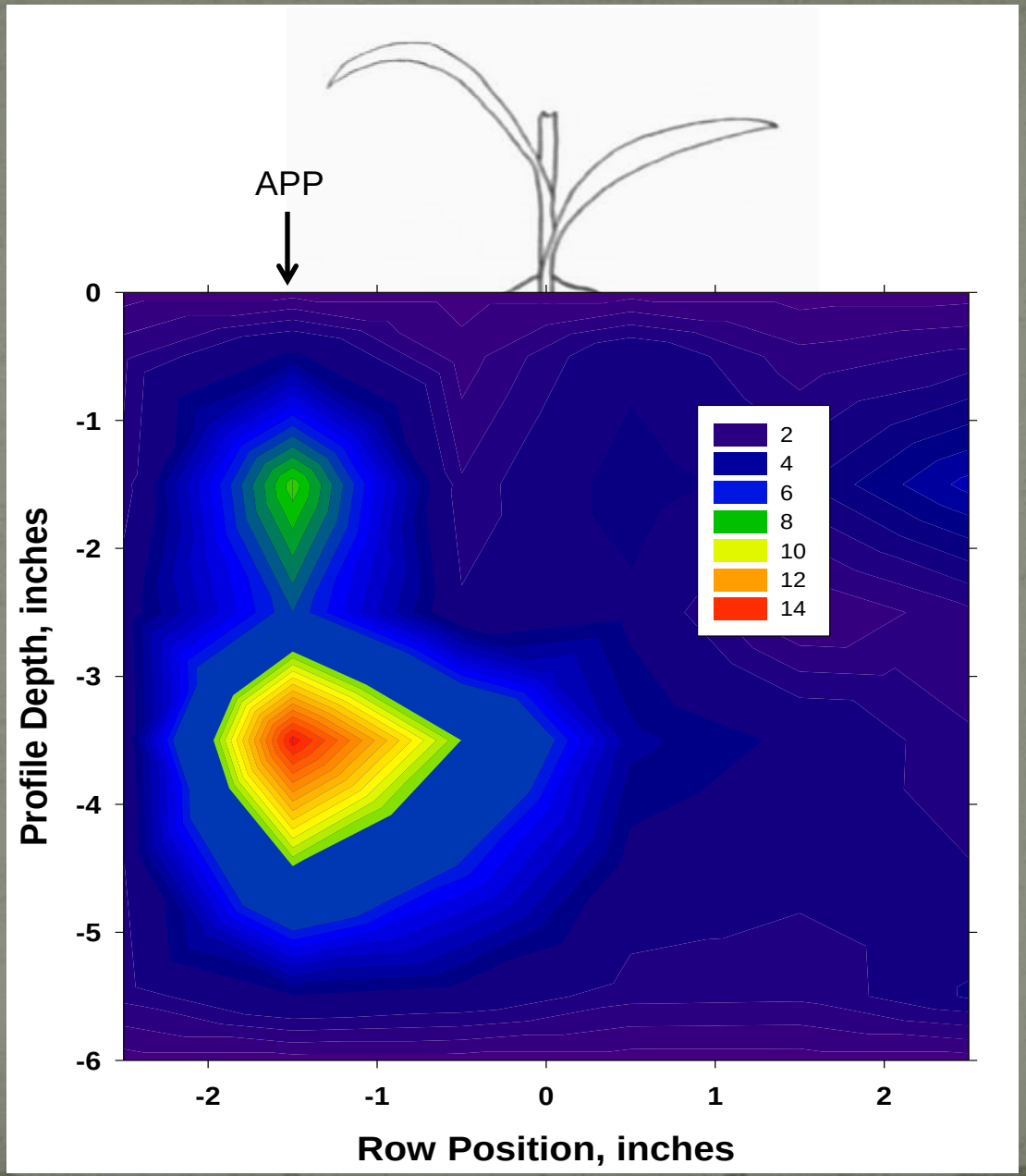
Pounds Actual P x 10^{-8} per $inch^2$



Kovar, 2002

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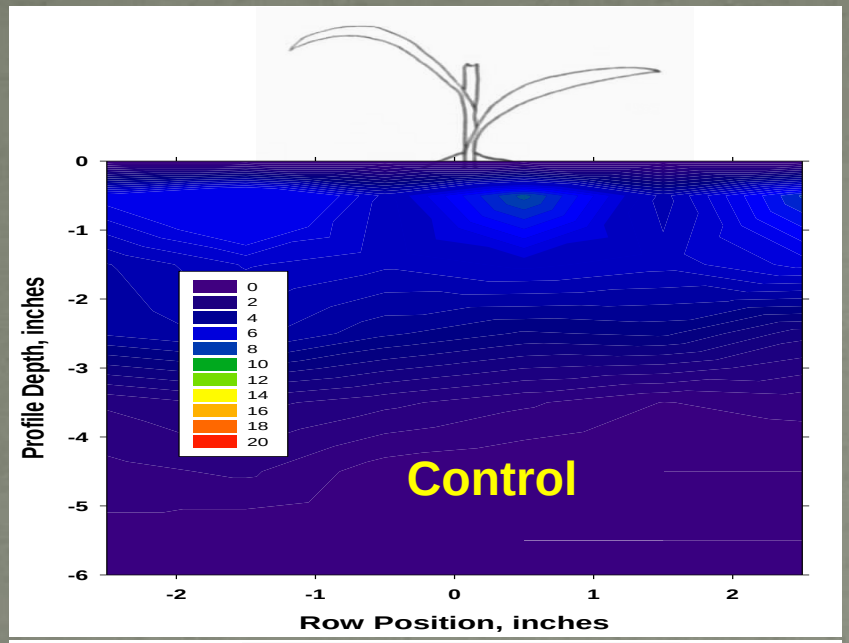
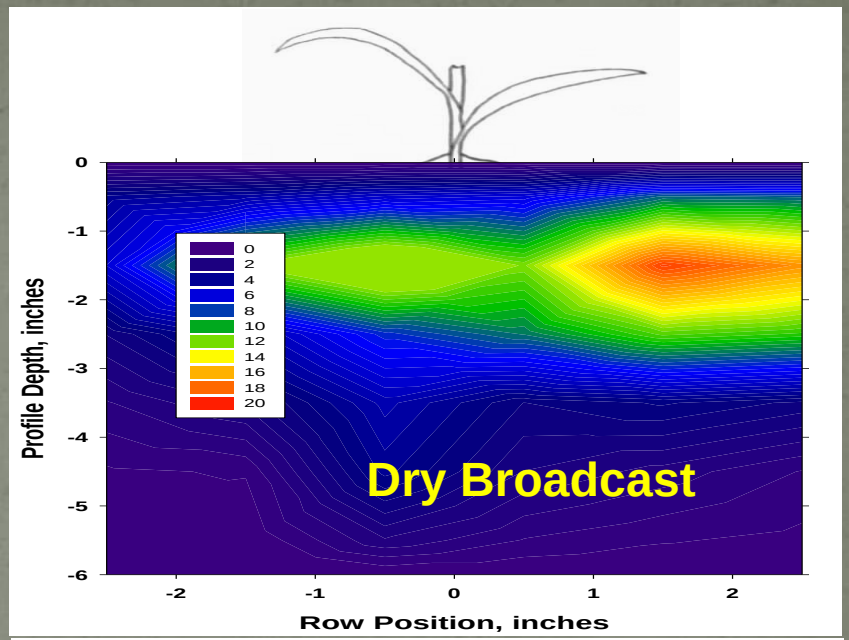
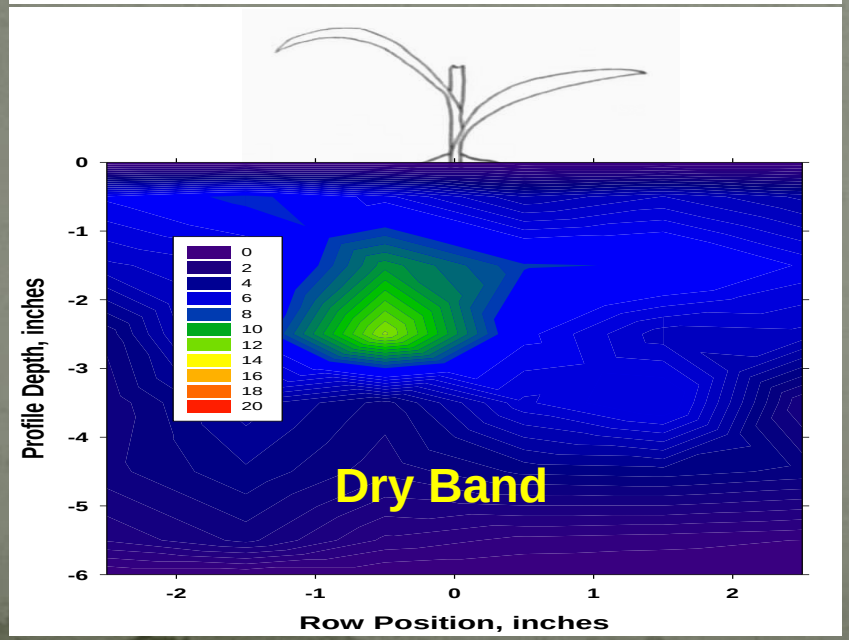
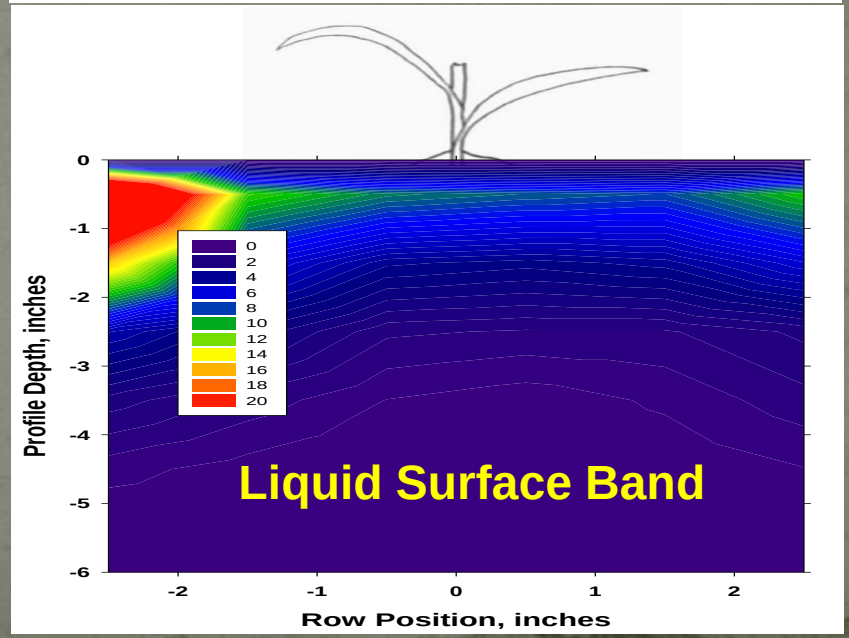
Pounds Actual K x 10^{-8} per $inch^2$









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Karlen and Kovar, 2005


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Photo by T.C. Kaspar, USDA-ARS

Starter Fertilizer Treatments (Iowa Corn)

Check

5 gal/A 10-34-0, in-furrow

8.7 gal/A 7-21-7, in-furrow

12 gal/A 10-34-0, surf. band

21 gal/A 7-21-7, surf. band

15-30-10; 0x0, 2x0

30-30-10; 0x0, 2x0

45-30-10; 0x0, 2x0

60-30-10; 0x0, 2x0

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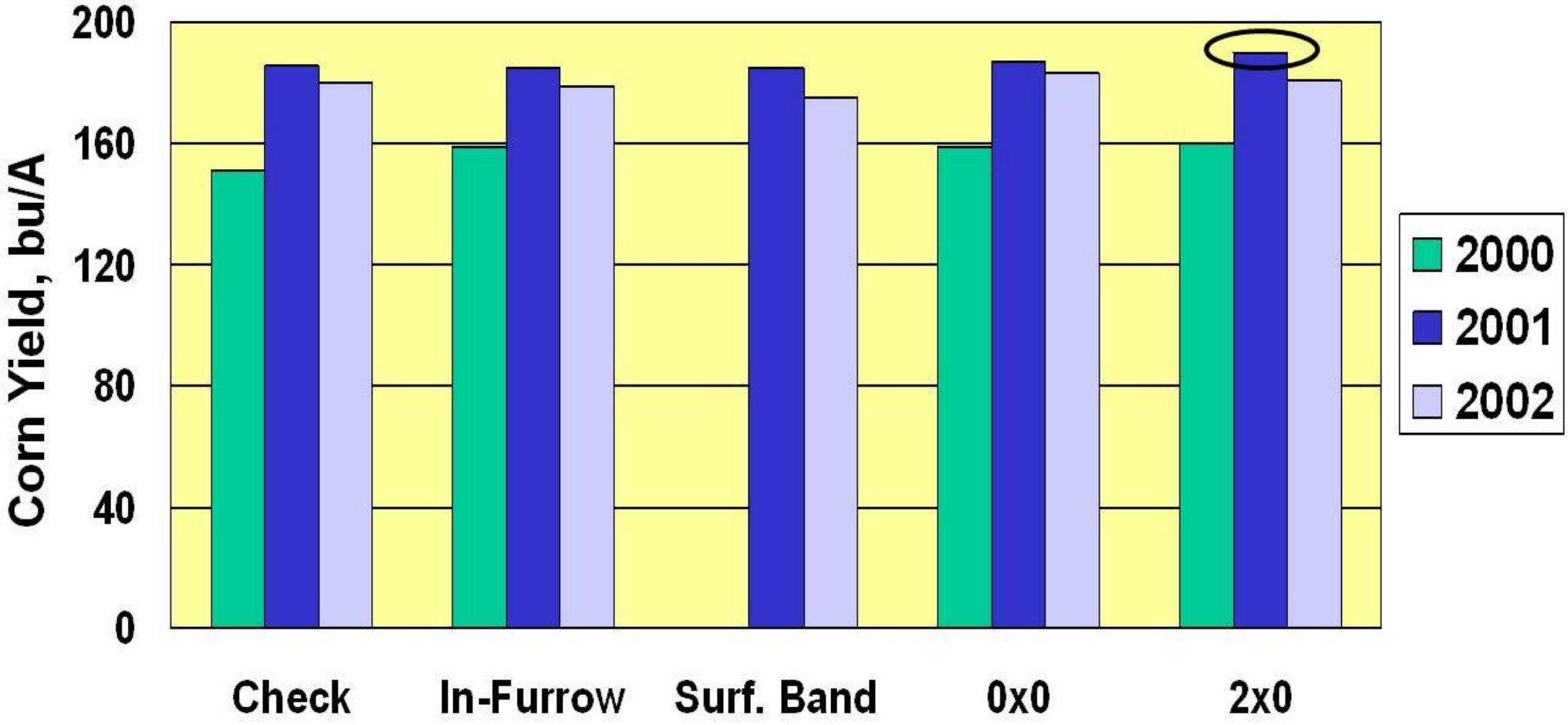
Effect of Starter Placement on Corn Grain Yields during Three Growing Seasons (Iowa)



Kovar, 2003

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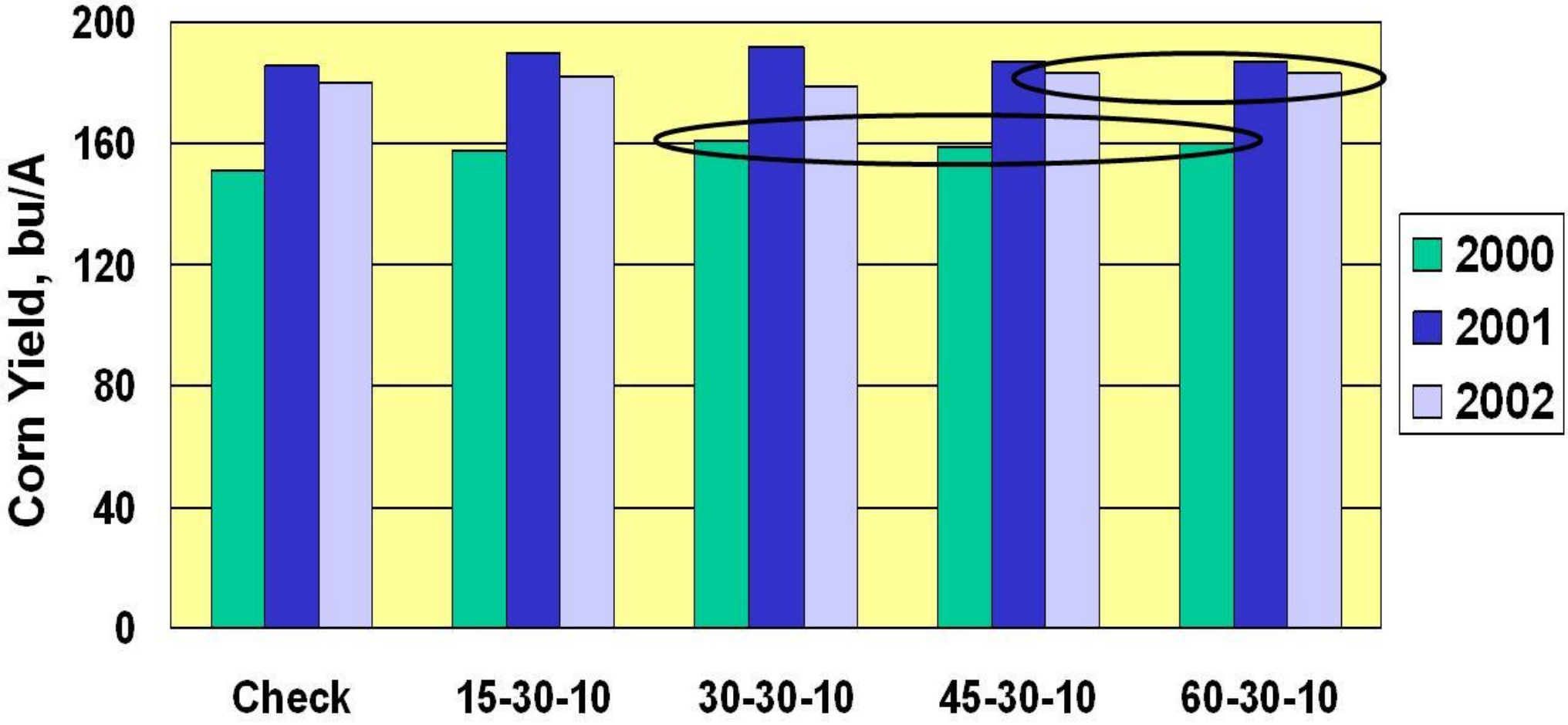
Effect of Starter Composition on Corn Grain Yields during Three Growing Seasons (Iowa)



Kovar, 2003

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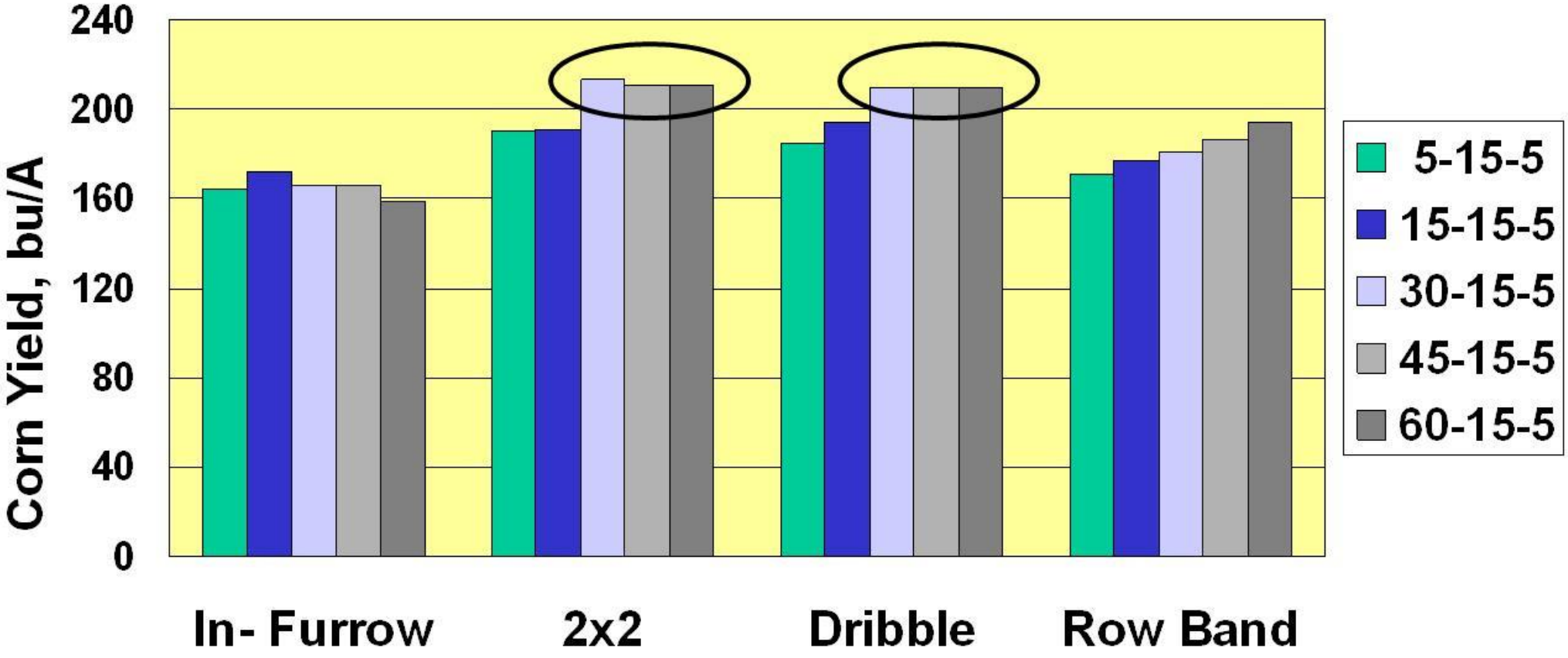
Effect of Starter on Ridge-Till Corn Yields (Kansas)



Gordon and Whitney, 2001

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Corn Grain Yield Response to In-Furrow Starter (Iowa)

Site	Control	3-18-18†	0-0-30†
1	161a	182b	185b
2	159a	176c	171b
3	179	183	173
4	171a	172a	175a
5	169a	184b	184b
6	129a	147b	154b

†K applied at 15-22 lb K_2O/Ac

Mallarino et al., 2010

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Key Points

- Surface dribble (2x0) applications work as well as 2x2
- Starters with high N to P_2O_5 ratios (1:1 or greater) work well in high–residue systems
- Starter K alone seldom increases early corn growth or grain yield

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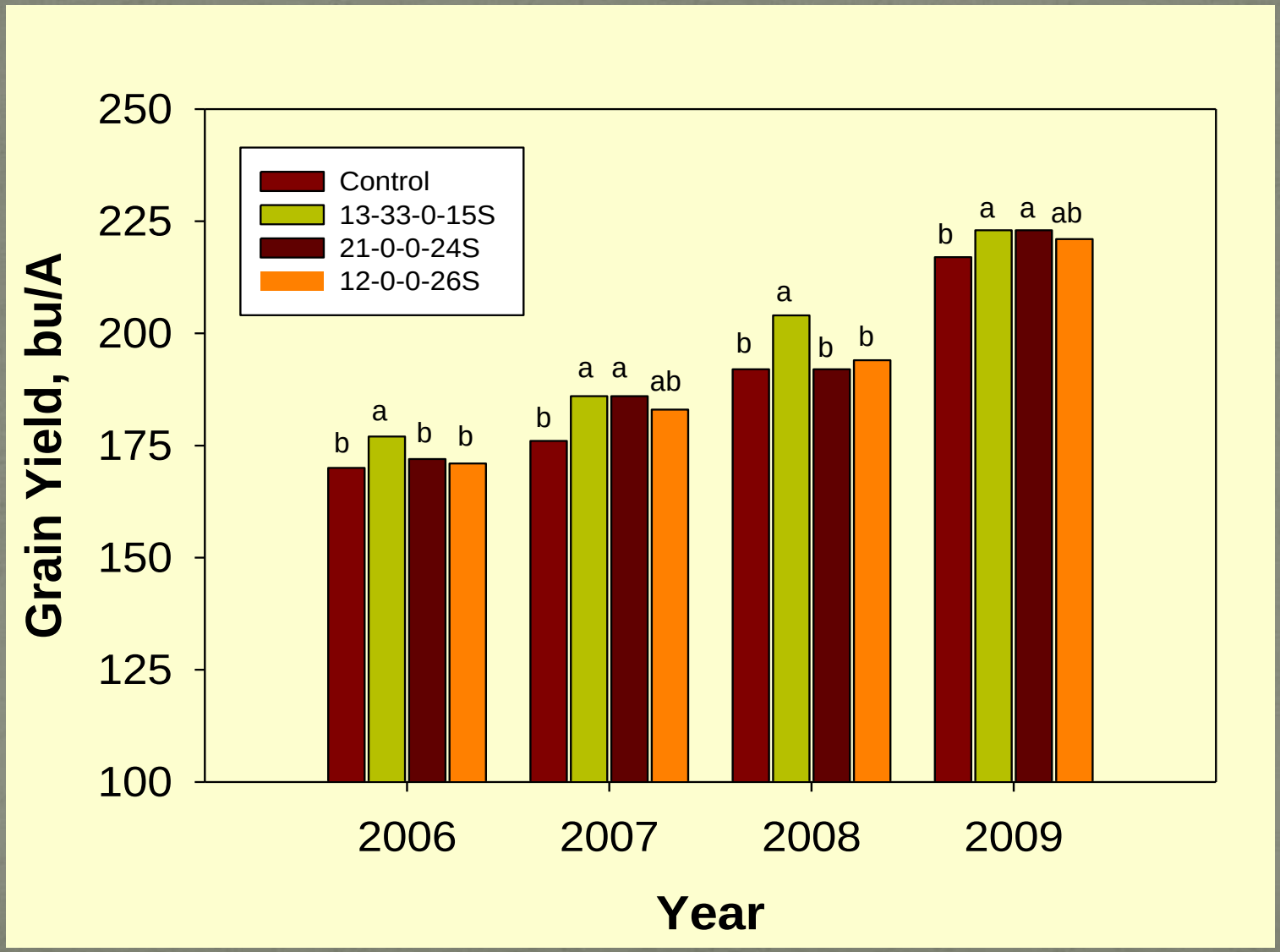
Effect of 30 lb S/A on Corn Grain Yield



Kovar and Karlen, 2010

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Sulfur Deficiency

http://www.sdstate.edu/ps/extension/soil-fert/corn-deficiency-photos.cfm

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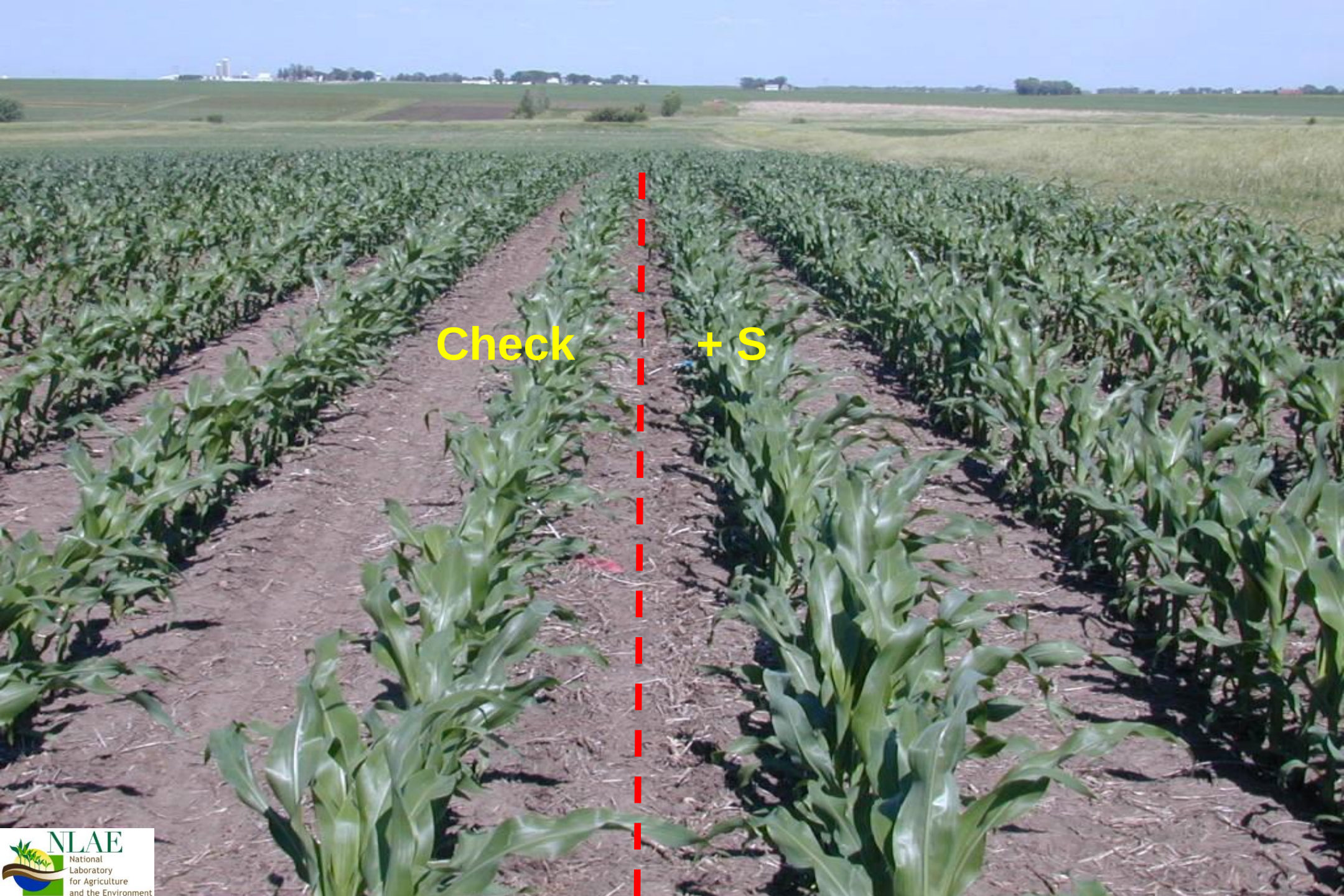

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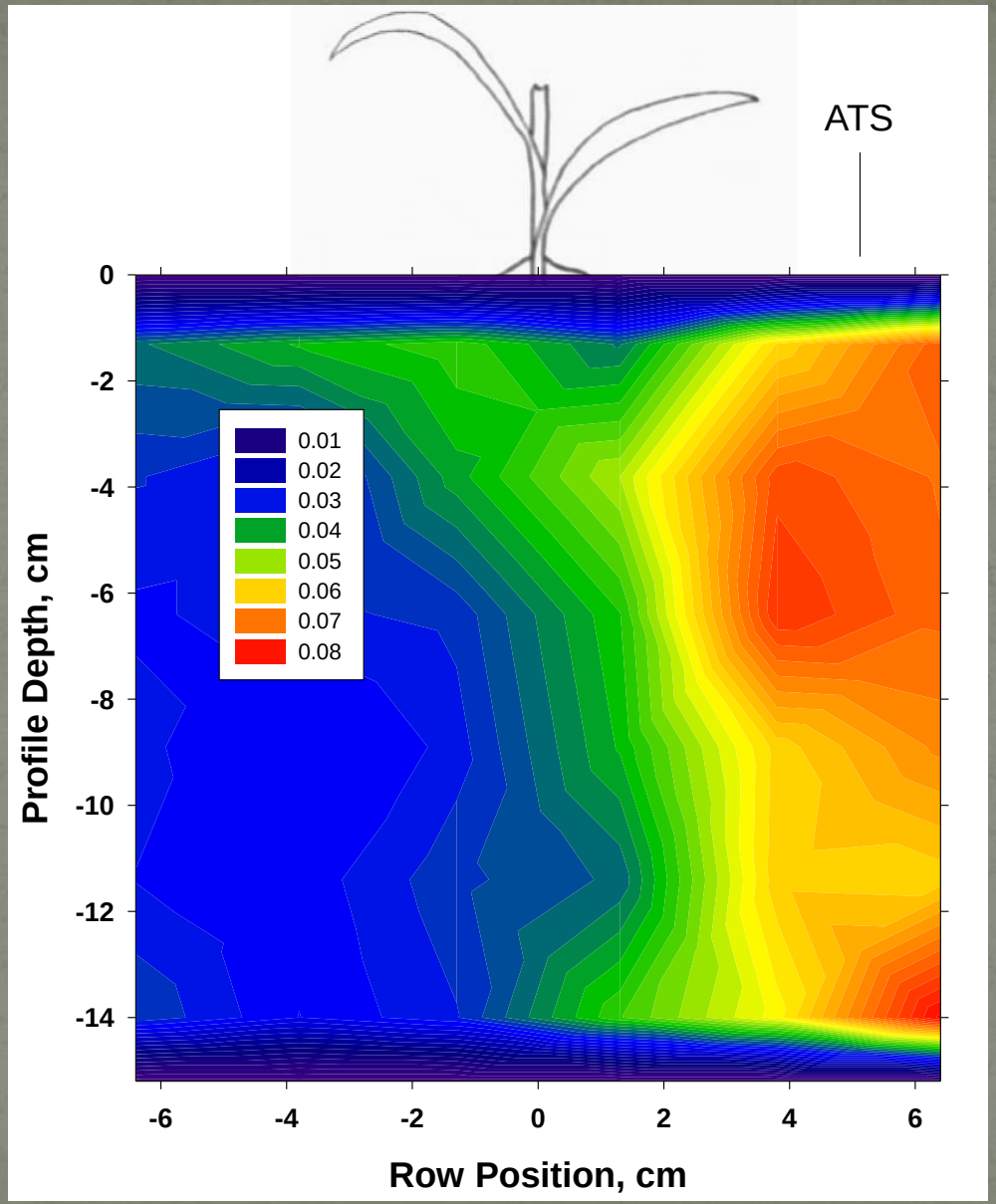
Micrograms SO_4-S per cm^2 Soil; 26 Days



Kovar and Grant, 2011

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Corn Grain Yield Response to Starter Placement and Composition (MN)

Trmt	$N+P_2O_5+K_2O+S$	Placement	Source	Yield
	lbs/Acre			bu/A
1	0+0+0+0	None	None	209
2	6+20+0+0	in-furrow	APP	215
4	20+20+6+4	2x0	APP+UAN+KTS	233
5	20+20+6+4	2x2	APP+UAN+KTS	221
10	20+20+10+10	2x0	APP+UAN+KTS+ATS	231
11	20+20+10+10	2x2	APP+UAN+KTS+ATS	224

Randall, 2008

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Zinc Deficiency

http://www.sdstate.edu/ps/extension/soil-fert/corn-deficiency-photos.cfm

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Key Points

- Sulfur responses becoming more common, S in starter has provided mixed results
- Starter S responses more likely in sandy or low organic matter soils, under cool soil temperatures
- Current research suggests that addition of Zn to starters will not provide a consistent yield response

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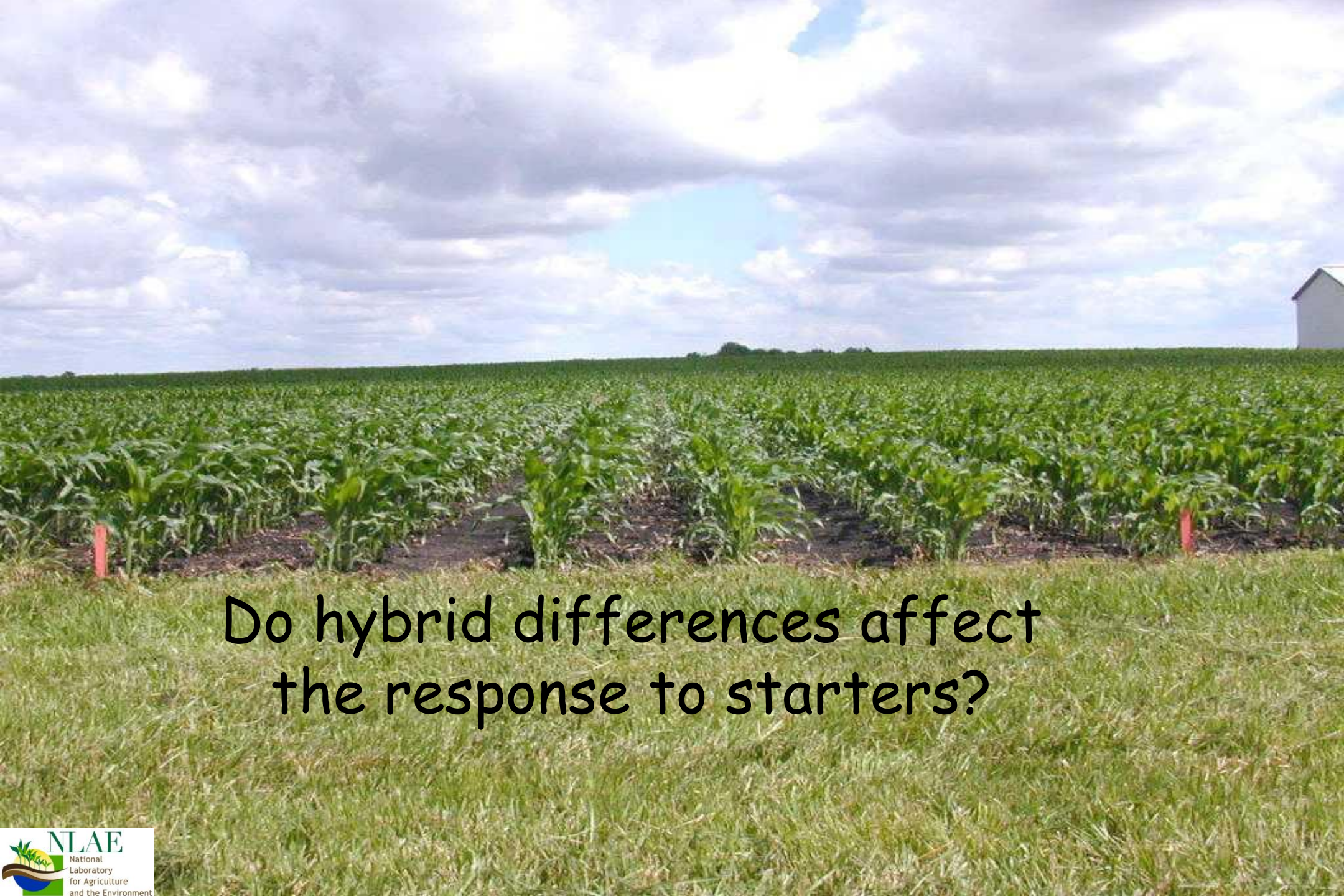

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Starter Fertilizer x Hybrid Interaction (Florida)

- Surface band, 10 gal/A 10-34-0
- 28 hybrid varieties
- Positive response: 46%
- No response: 29%
- Negative response: 25%

Teare and Wright, 1990

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Starter Fertilizer x Hybrid Interaction (Florida)

- Responsive hybrids have slow root growth rate, increased by starter
- Root growth rate higher in non-responsive hybrids
- Early-season shoot growth increased by 92% in response to starter
- Response to N in starter was greater than response to P

Rhoads and Wright, 1998

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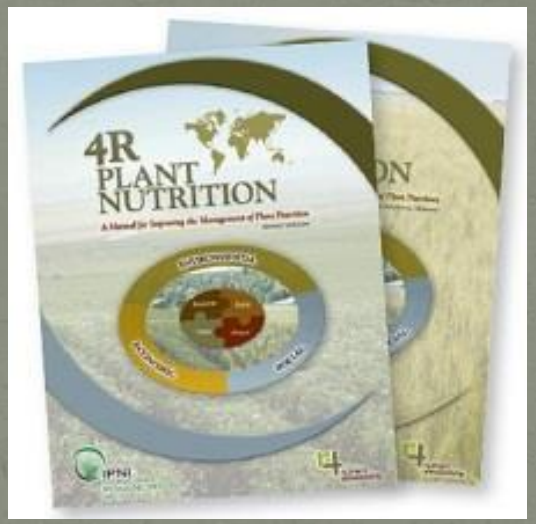
Know Your Fertilizer Rights

- Right Source
- Right Rate
- Right Time
- Right Place



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