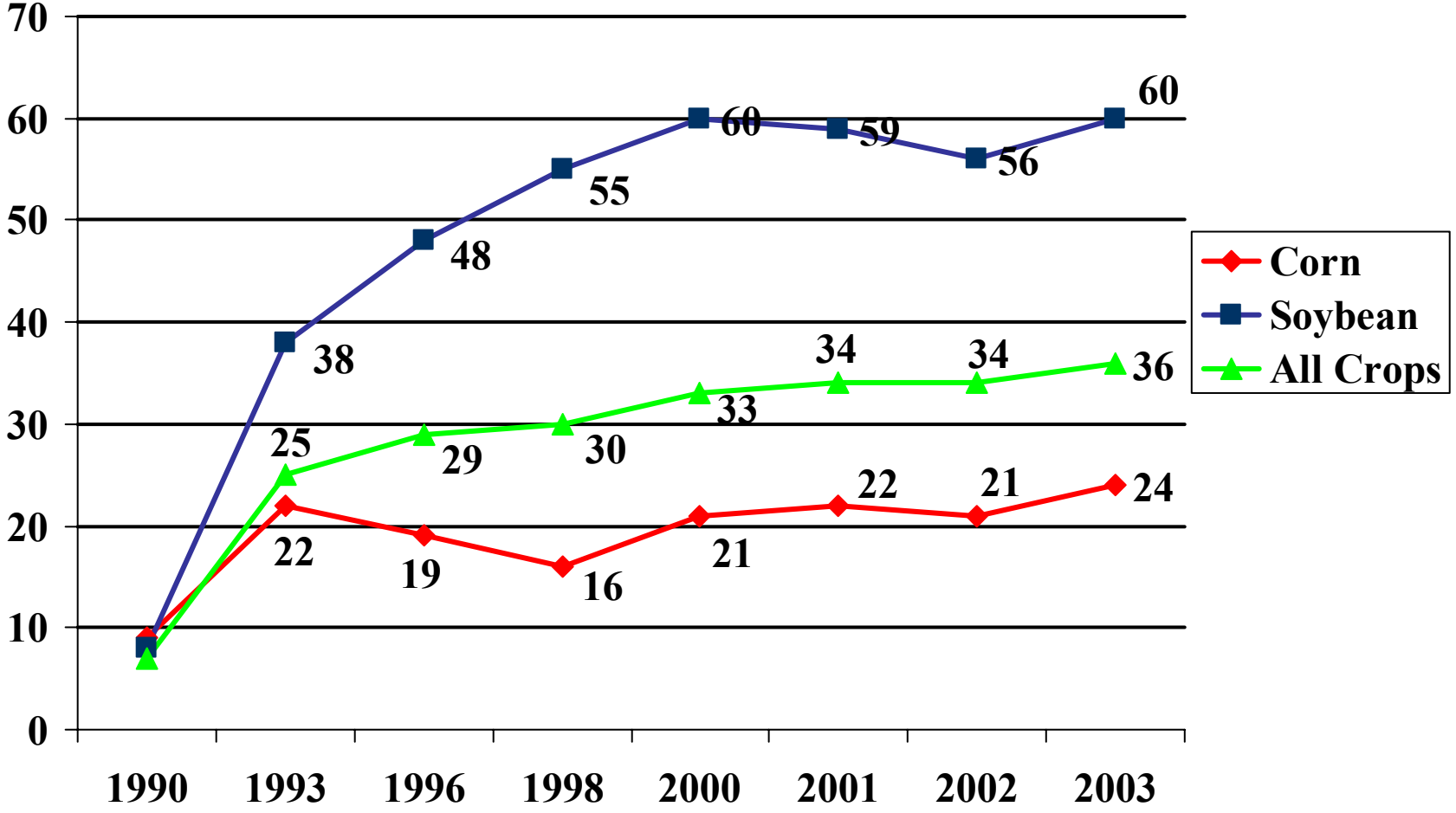
No-Till and Strip-Till: A Closer Look From Both Sides

Tony J. Vyn,
with assistance from farmers, graduate students, technicians, and colleagues

PURDUE
UNIVERSITY

Indiana Tillage Data, 1990-2003

(percent of total cropland for specific crop in a no-till system)



Source: Purdue University-Transect Data

2002 Indiana Cropland Tillage Map

Percent of all Corn Fields planted using No-till

2002 Indiana Average is 21%

- < 20%
- 20–30%
- 30–40%
- 40–50%
- 50–60%
- > 60%
- No data available

Source: Purdue University-Transect Data

So What is Problem?

Planting Date?

Nutrient Availability?

Pests?

Yields?

Maturity?

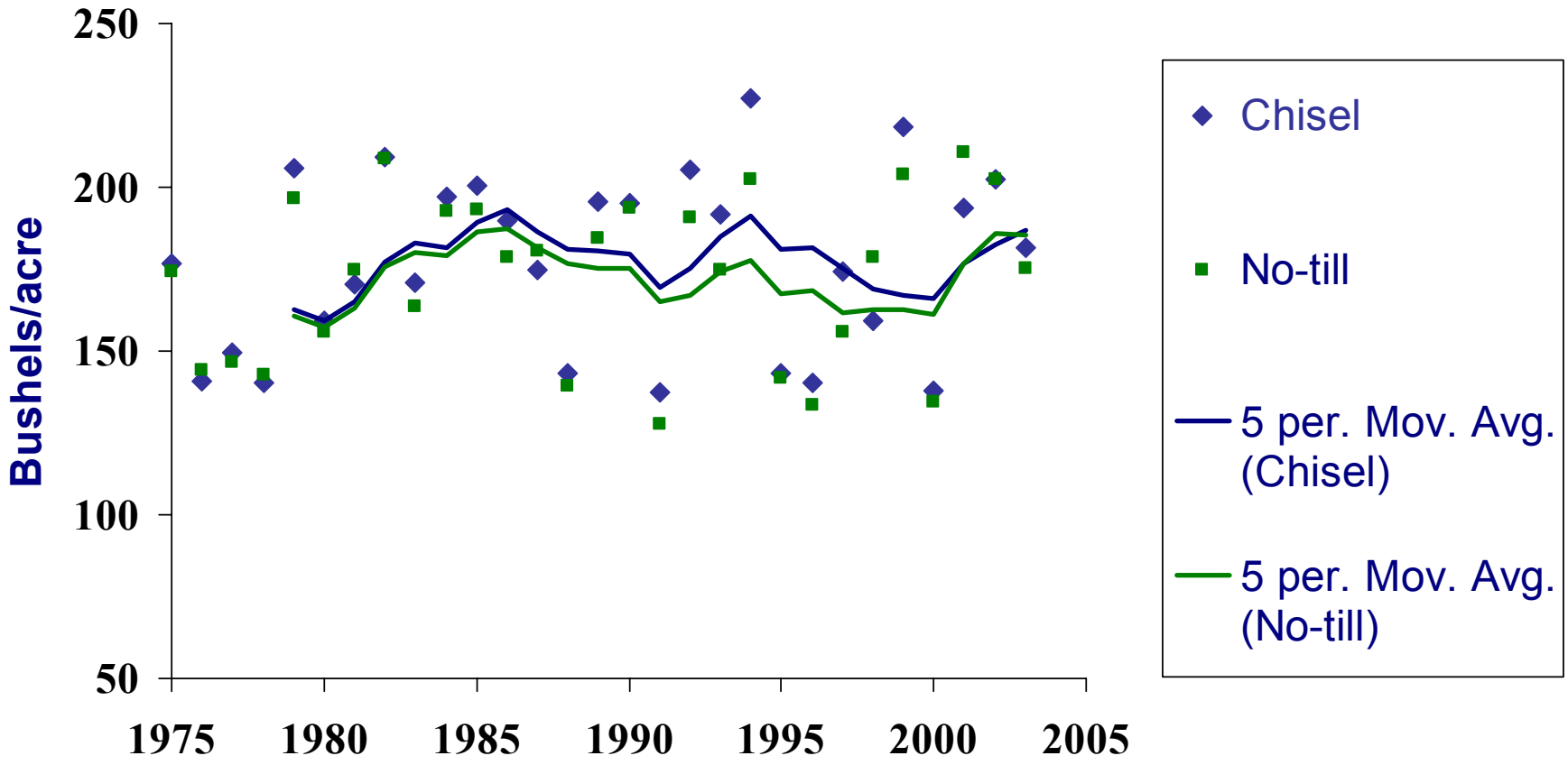
Poor Stand Establishment?

Corn Response to Tillage and Rotation

West Lafayette, IN, (1975-2003)

Tillage	Corn/Soybean		Continuous Corn		Yield Gain for Rotation
	Bu/ac	% of plow yield	Bu/ac	% of plow yield	%
Plow	176	- - -	169	- - -	5
Chisel	177	100	164	97	8
Ridge*	182	103	167	99	9
No-till	173	98	146	87	18

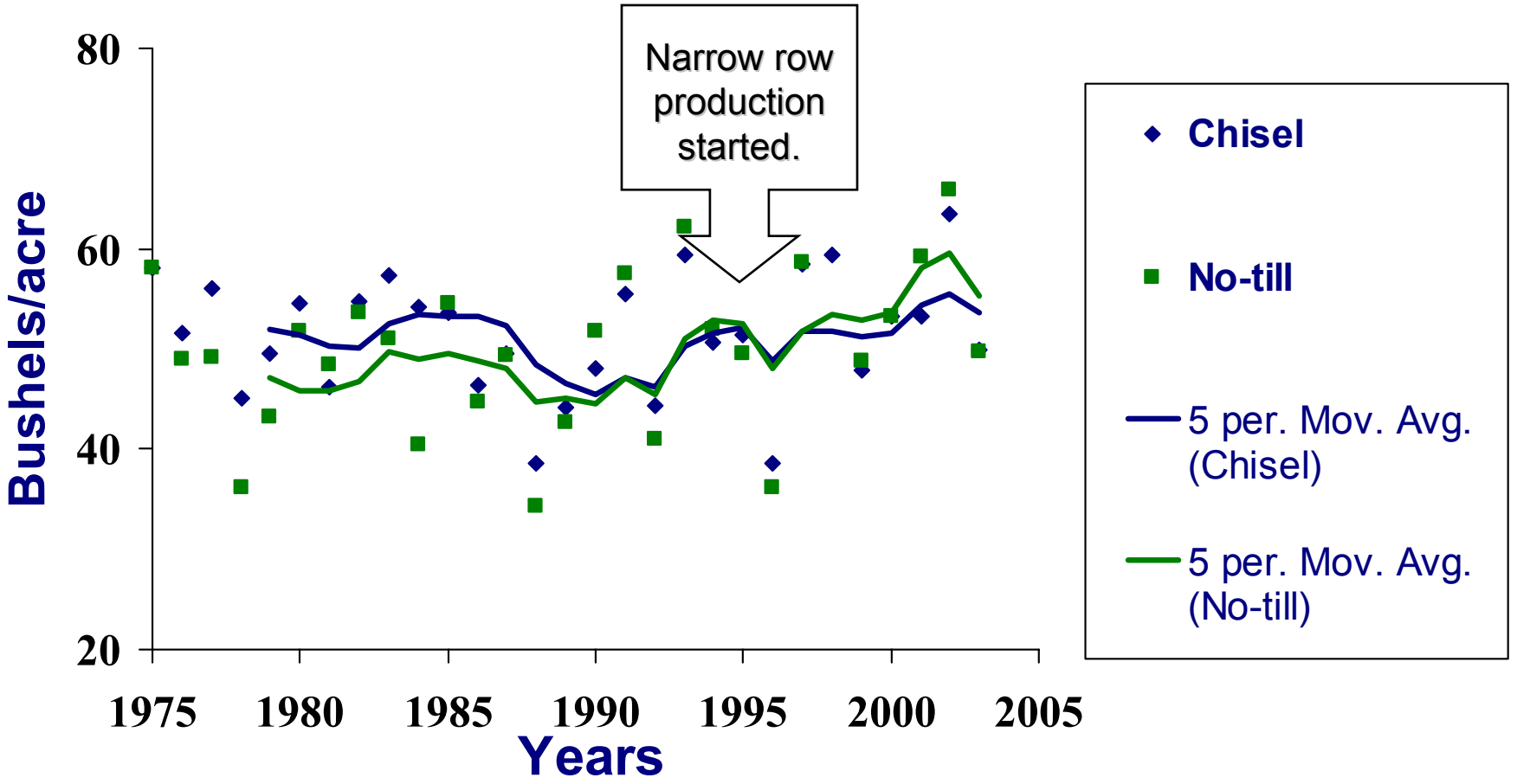
Corn Yields Following Soybeans, Chisel Vs. No-till, West Lafayette, IN, 1975-2003.



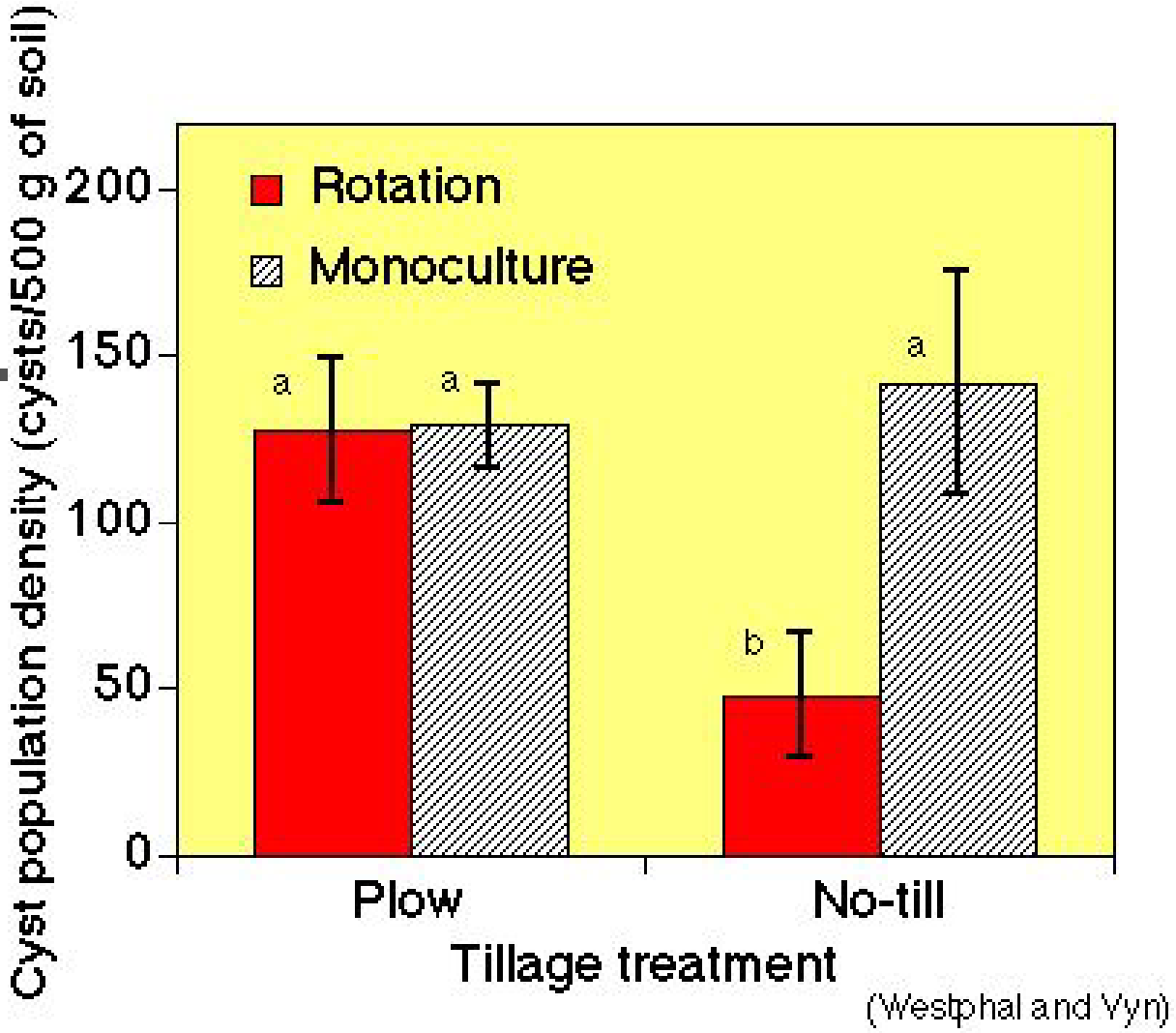
Soybean Response to Tillage and Rotation, West Lafayette, IN (1975-2003)

Tillage	Corn/Soybean		Continuous Soybean		Yield Gain for Rotation
	Bu/ac	% of plow yield	Bu/ac	% of plow yield	%
Plow	53	- - -	48	- - -	10
Chisel	52	97	46	95	12
Ridge *	51	96	45	93	13
No-till	50	95	46	96	9

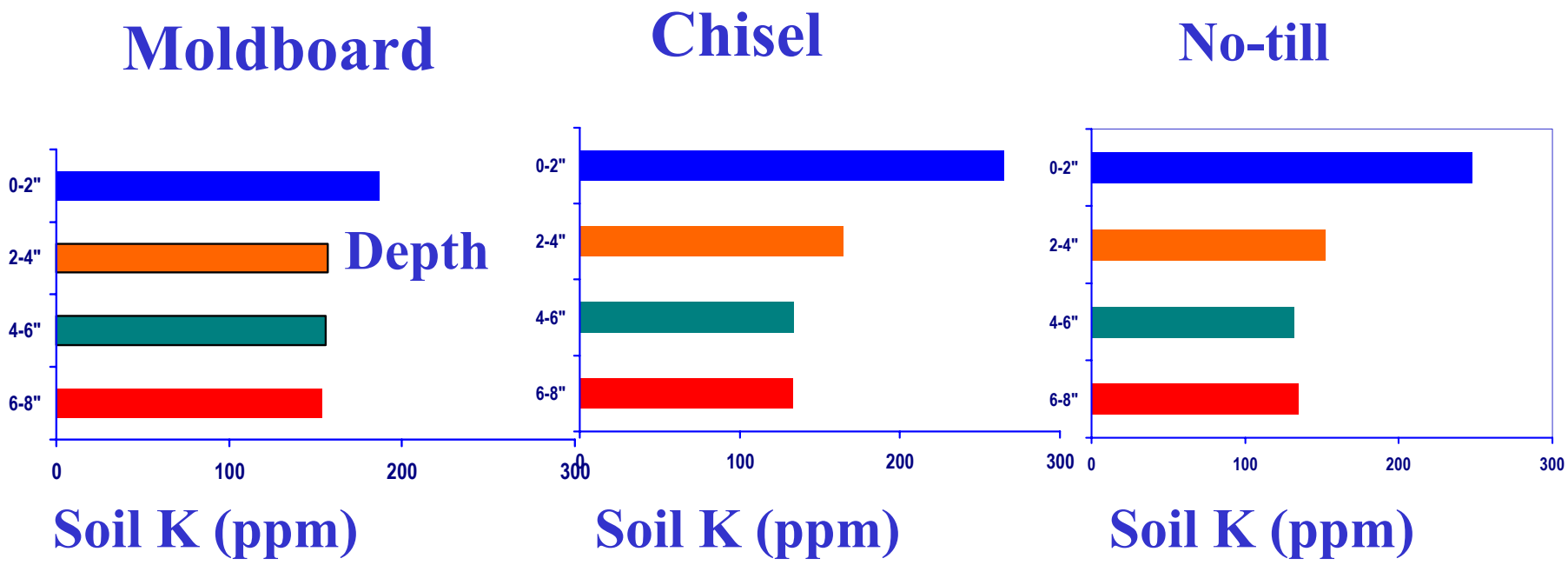
Soybean Yields Following Corn, Chisel Vs. No-till, West Lafayette, 1975-2003.



Population densities of Soy. Cyst Nematode under different crop sequences and tillage



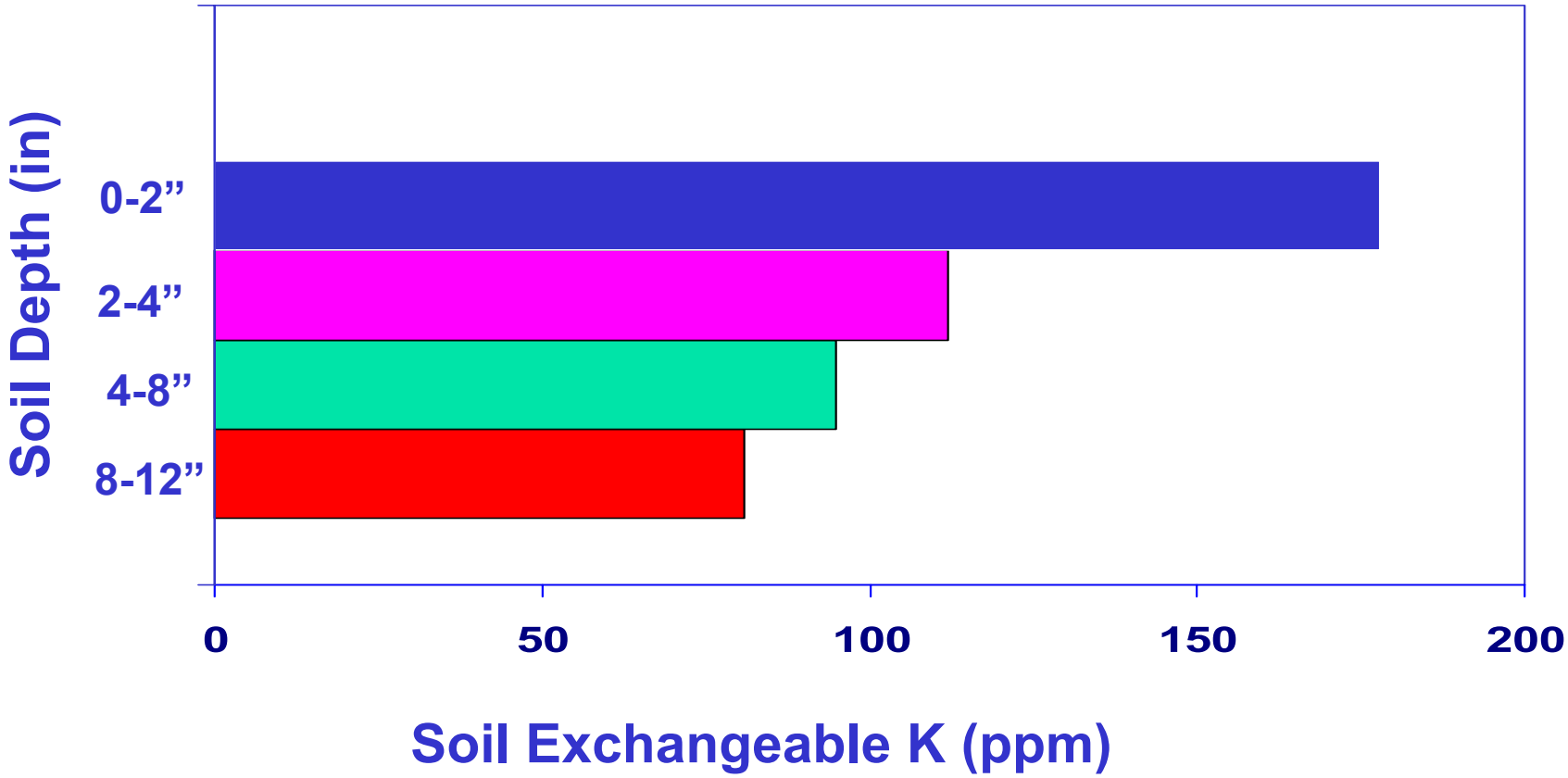
Potassium Stratification
Long-Term Tillage (IN, 1975-94)



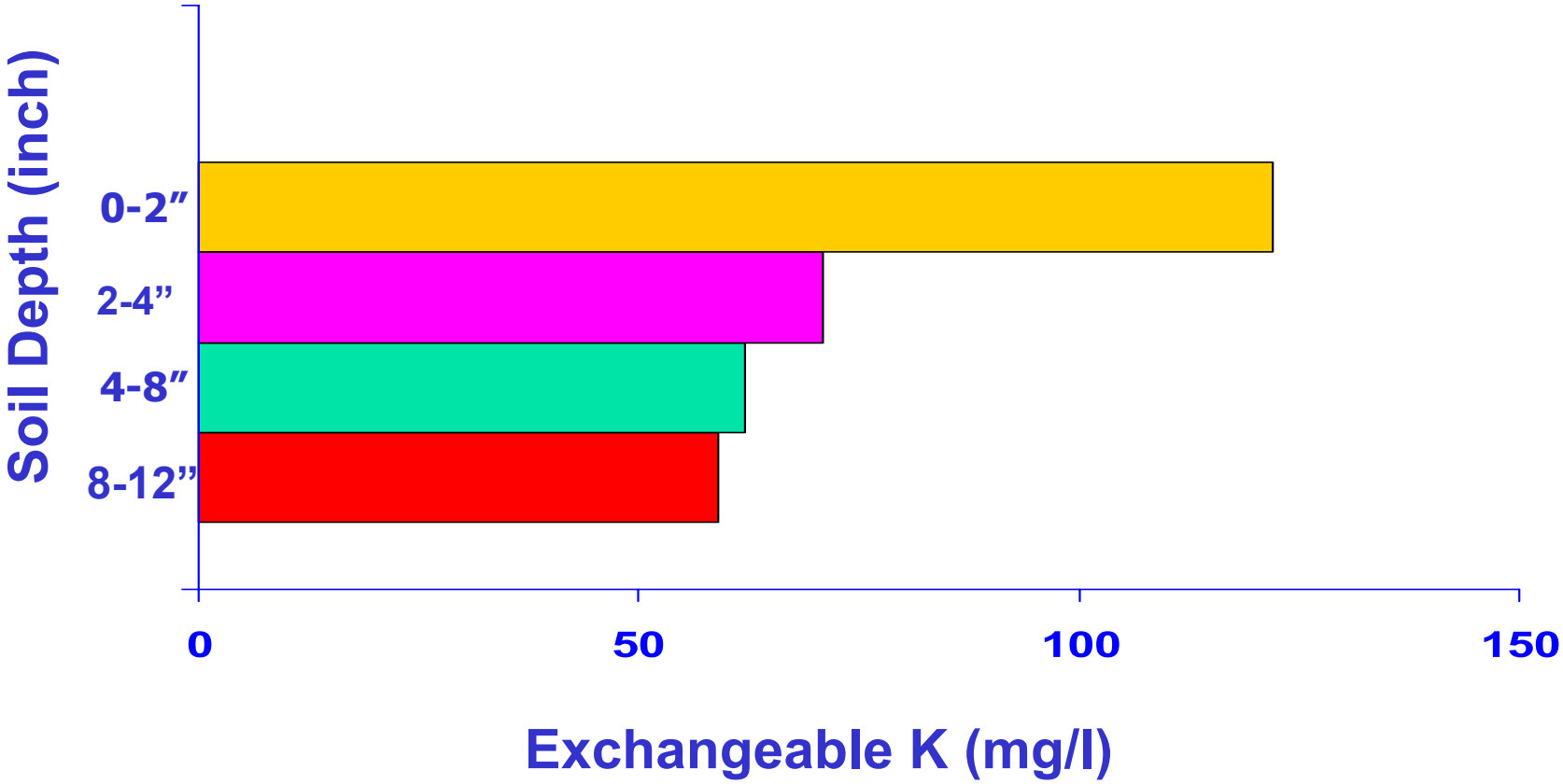
Source: Holanda et al. (1998)

Conservation Tillage Doesn't Alter K distribution appreciably

Vertical soil K stratification averaged over years (1998-2000) at Strathroy

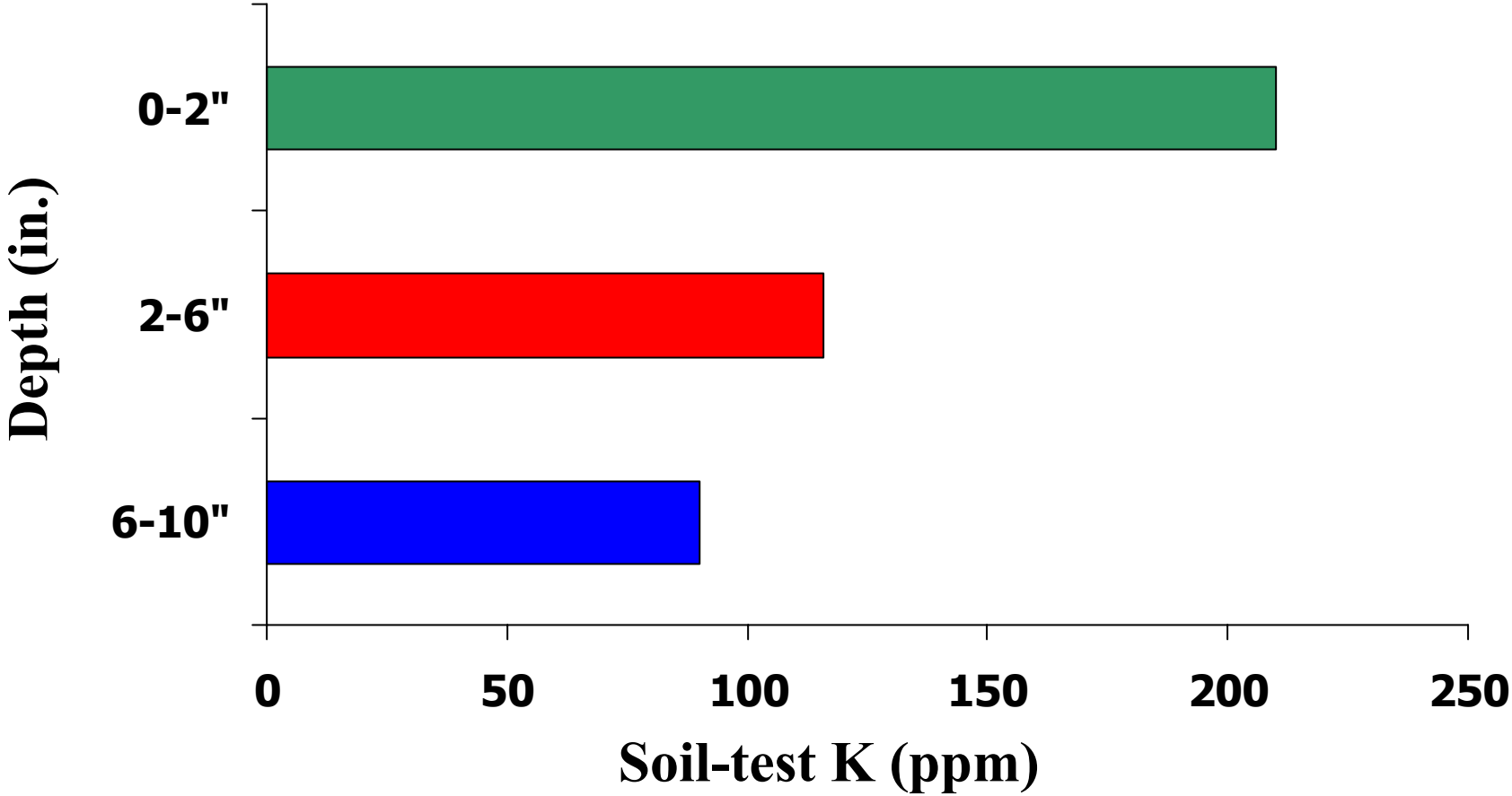


Vertical soil K stratification averaged over years (1998-2000) at Kirkton



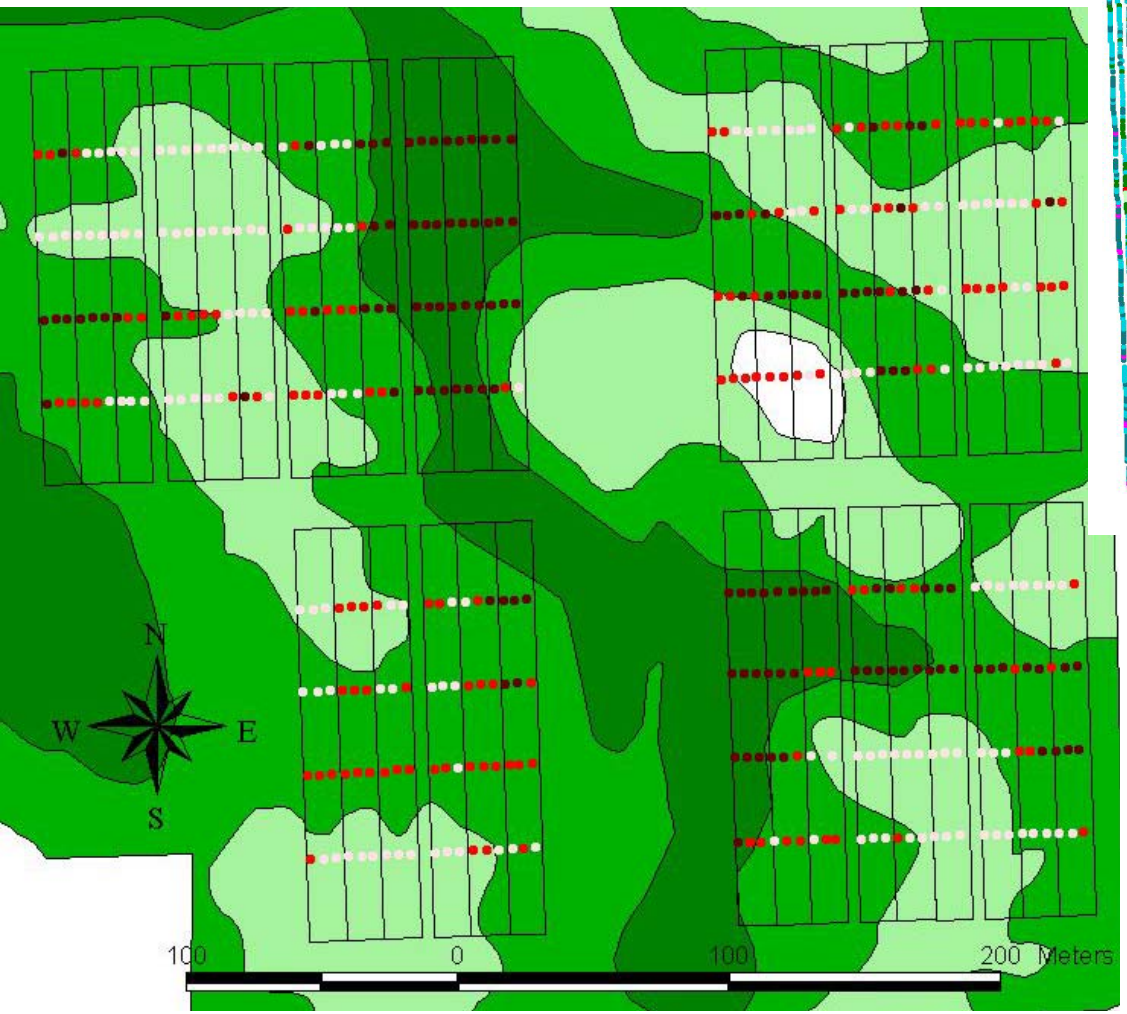
Planter Setup and Nutrient Banding?

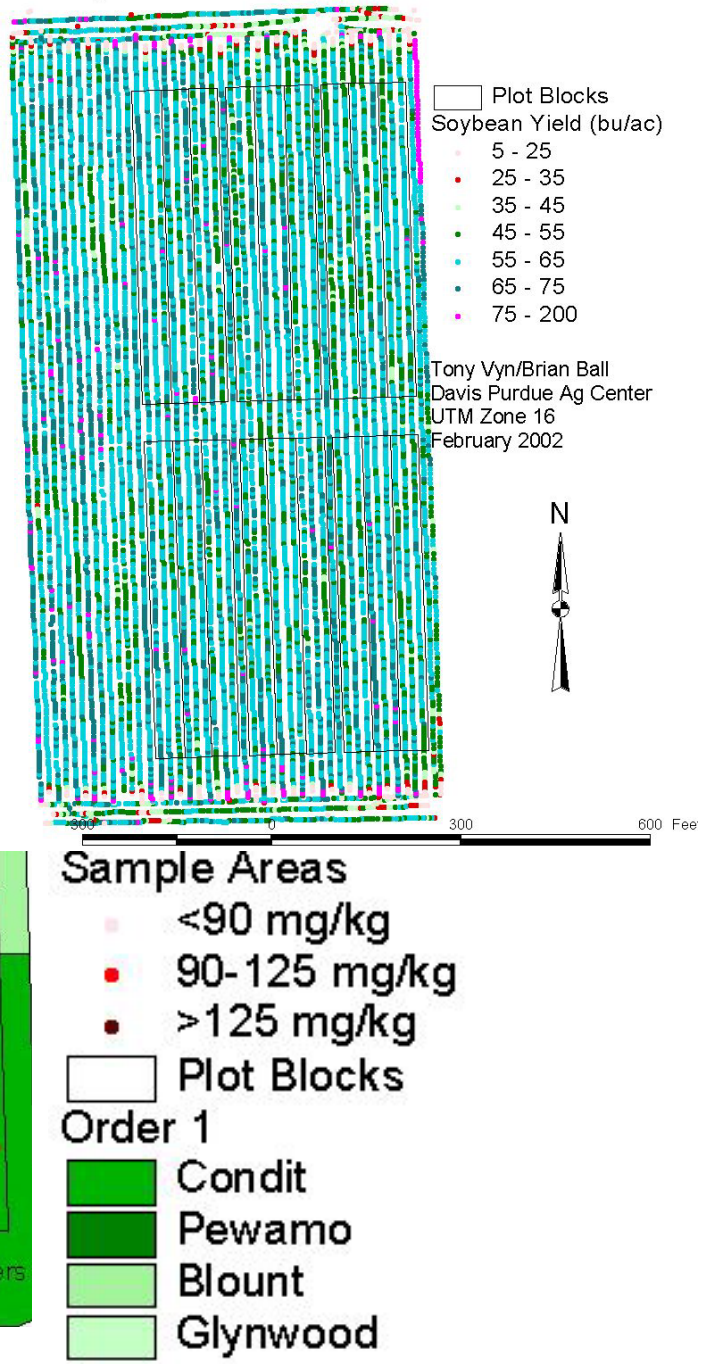
Mean Soil-test K Stratification at Davis, EC Indiana



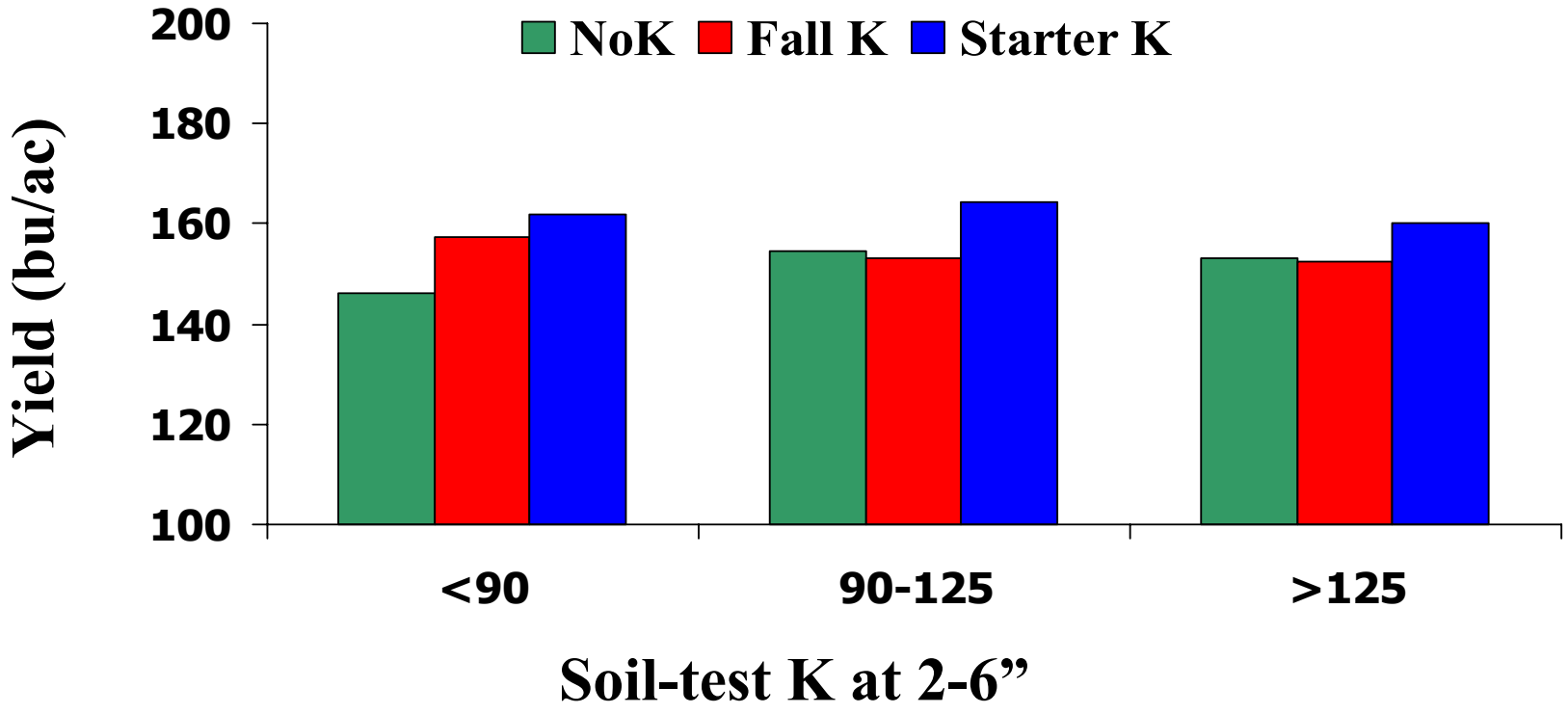
Source: Vyn et al., Better Crops #4, 2002

Soil K variability



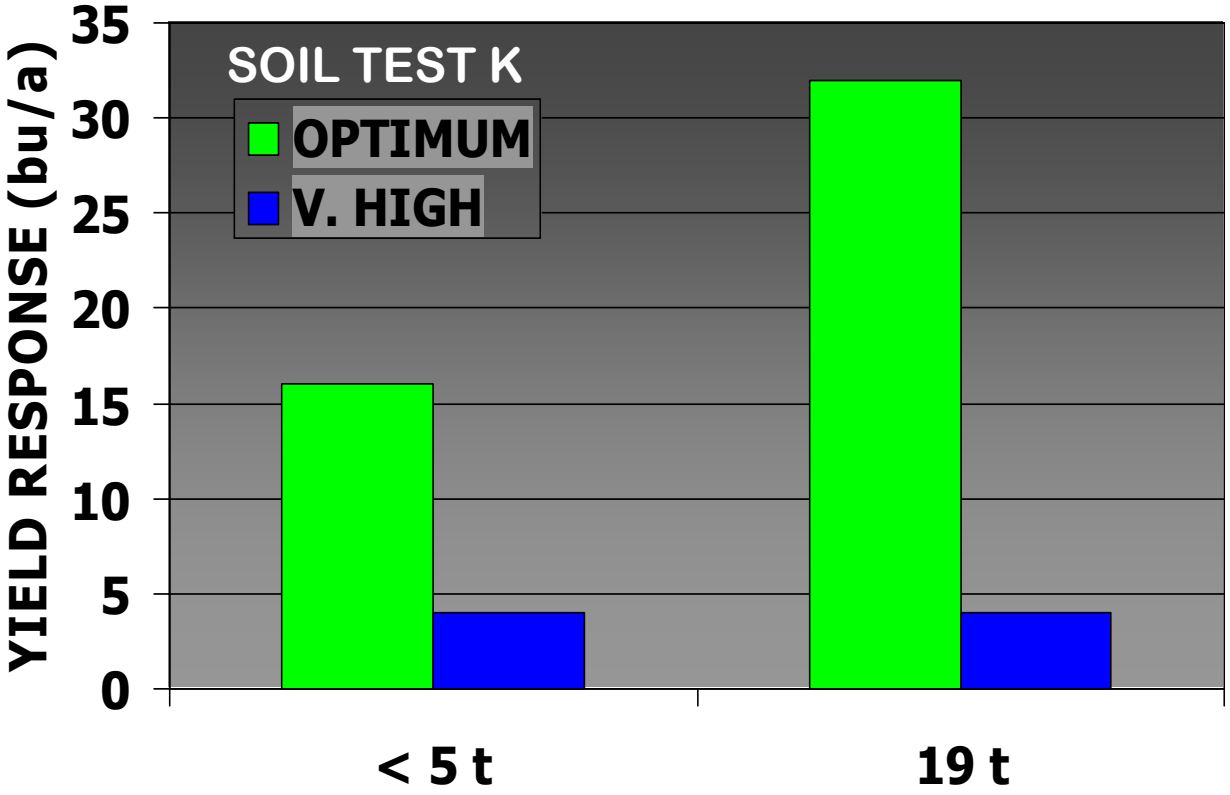


High oil corn yields in response to K placement (EC Indiana, 2000-01)



Source: Vyn et al., Better Crops #4, 2002

RESPONSE OF CORN TO ROW-APPLIED K ON A SILTY CLAY LOAM SOIL (3 yr. avg.)

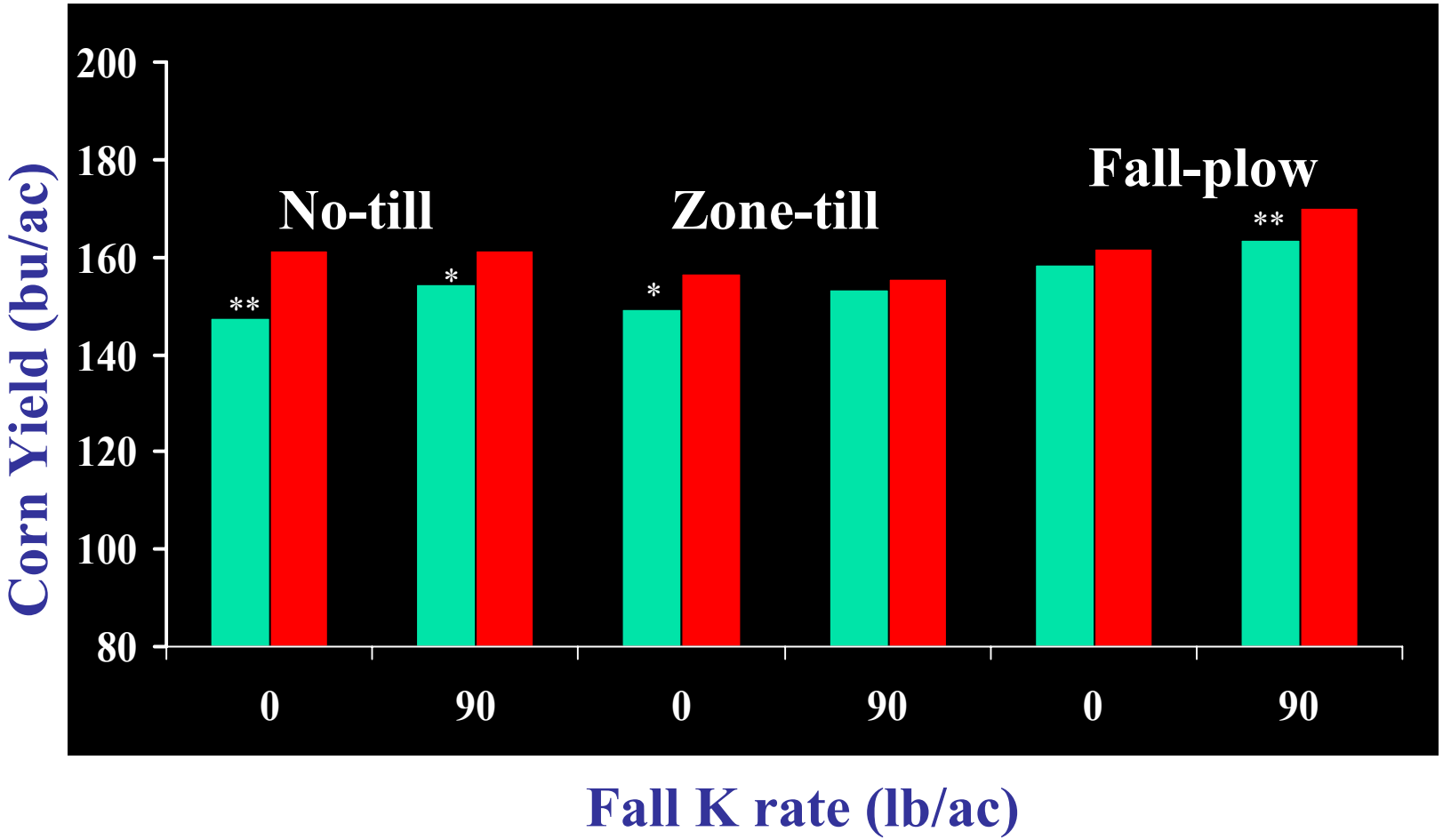


Dr. Wolkowski, UW, Oshkosh, Wis. (45 lb $K_2$0/a)

Corn Yield Response to K Fertilizer Placement at Kirkton, Ontario (1996-98)

Starter K rate:

Low 0-9 lb/ac High 45-54 lb/ac



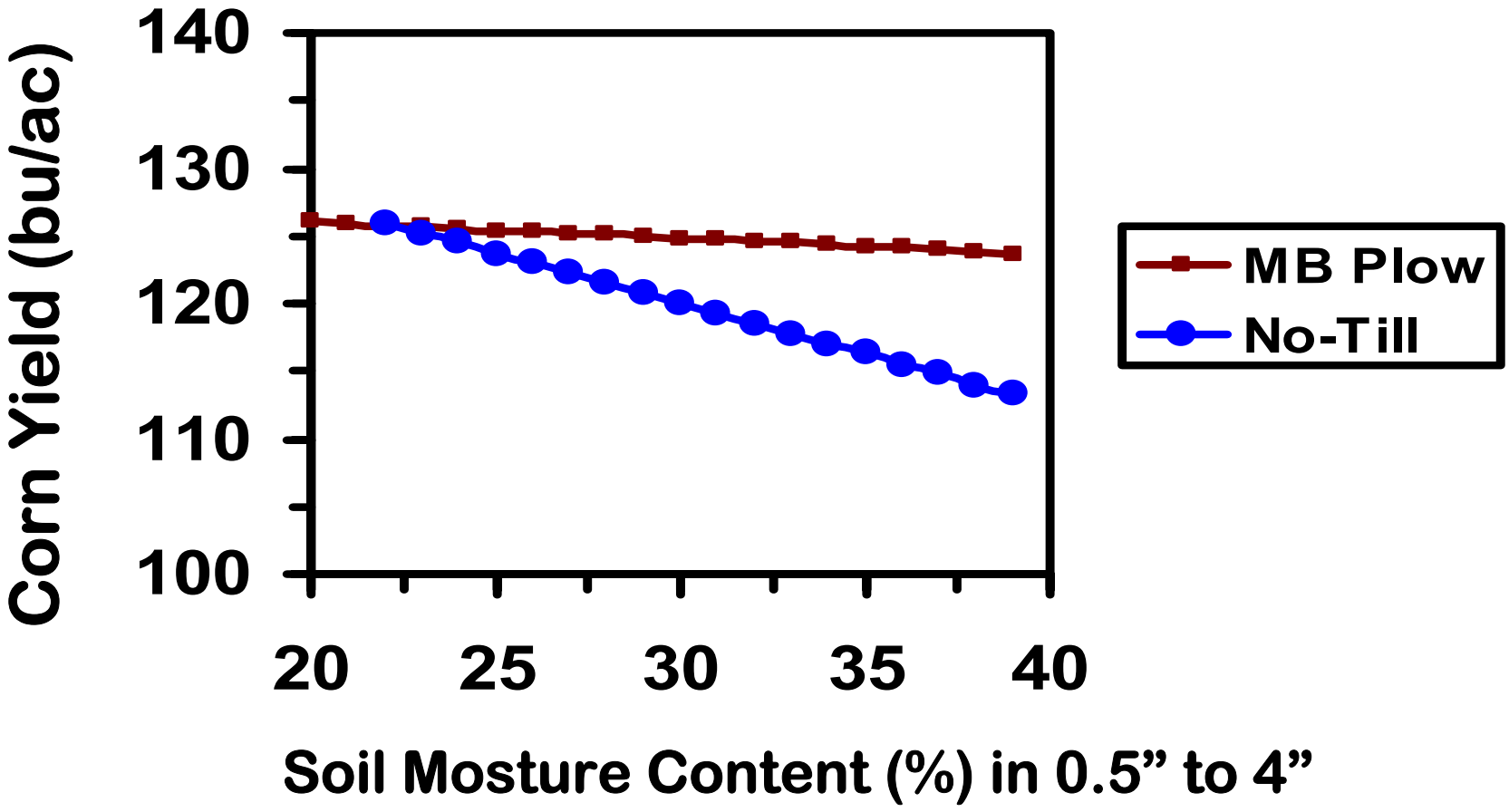
Vyn et al. 2001. Agron. J. 93: 487-495

Hybrid and Seasonal Effects on K Response to Banding

Most response to K banding with dry June and avg. soil K below 150 ppm.

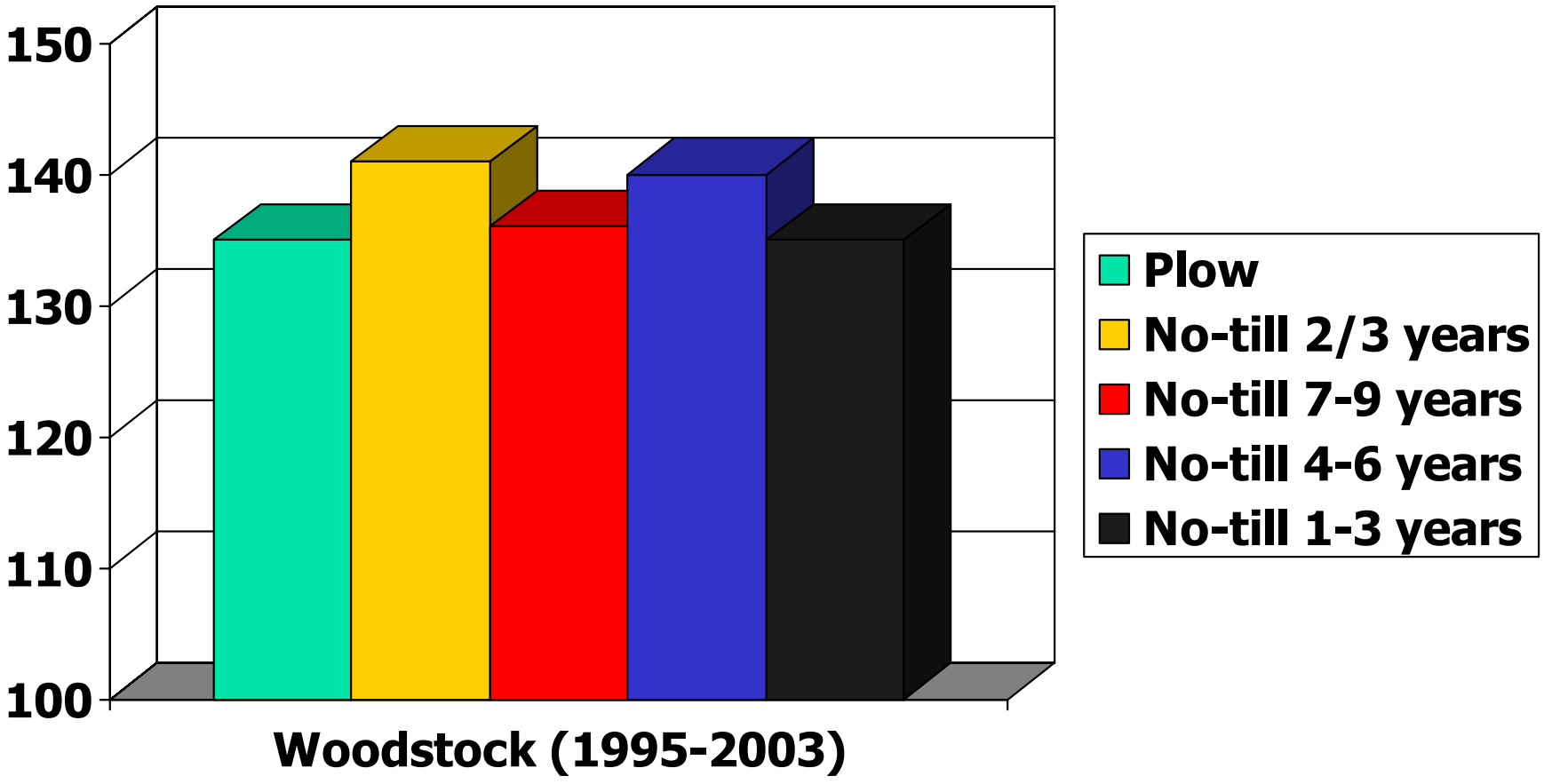
No-till Yield Reductions in Corn?
Soil temperature versus soil moisture?

Tillage Effects on Corn Yield Response to Average Soil Moisture Contents During Early Growth



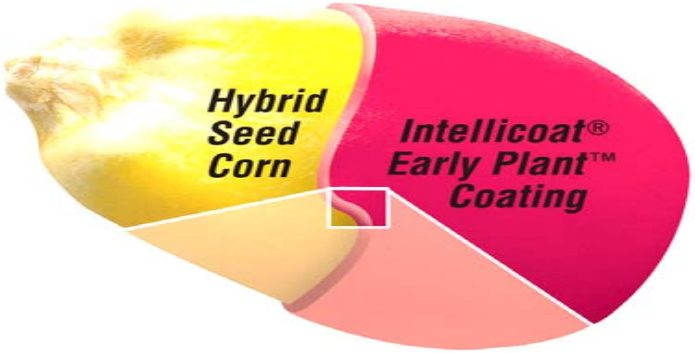
Short-term vs. Long-term No-till?

Woodstock Corn Yields 2001-2003 (Bill Deen)

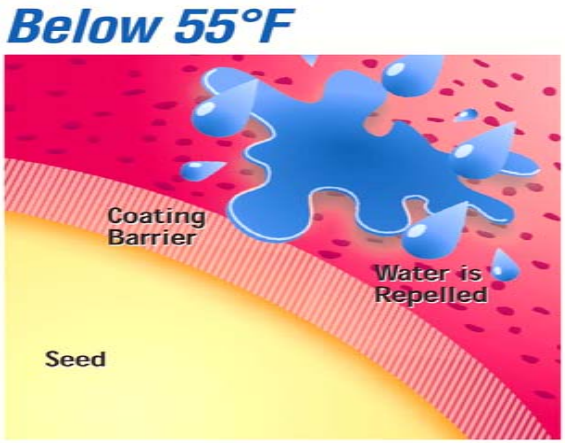


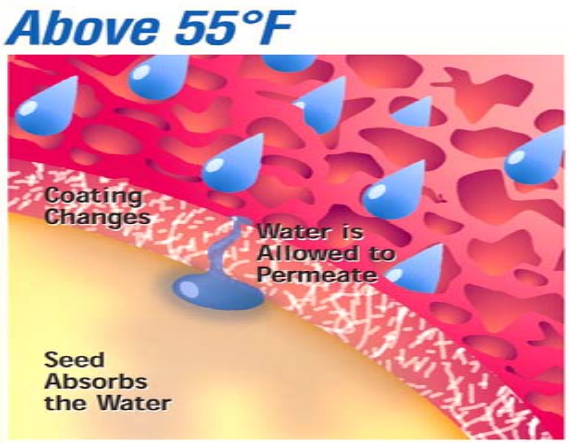
Polymer Seed Coatings for Early Planting of No-till Corn in Indiana?

Early Plant™ Technology



It knows when to grow !



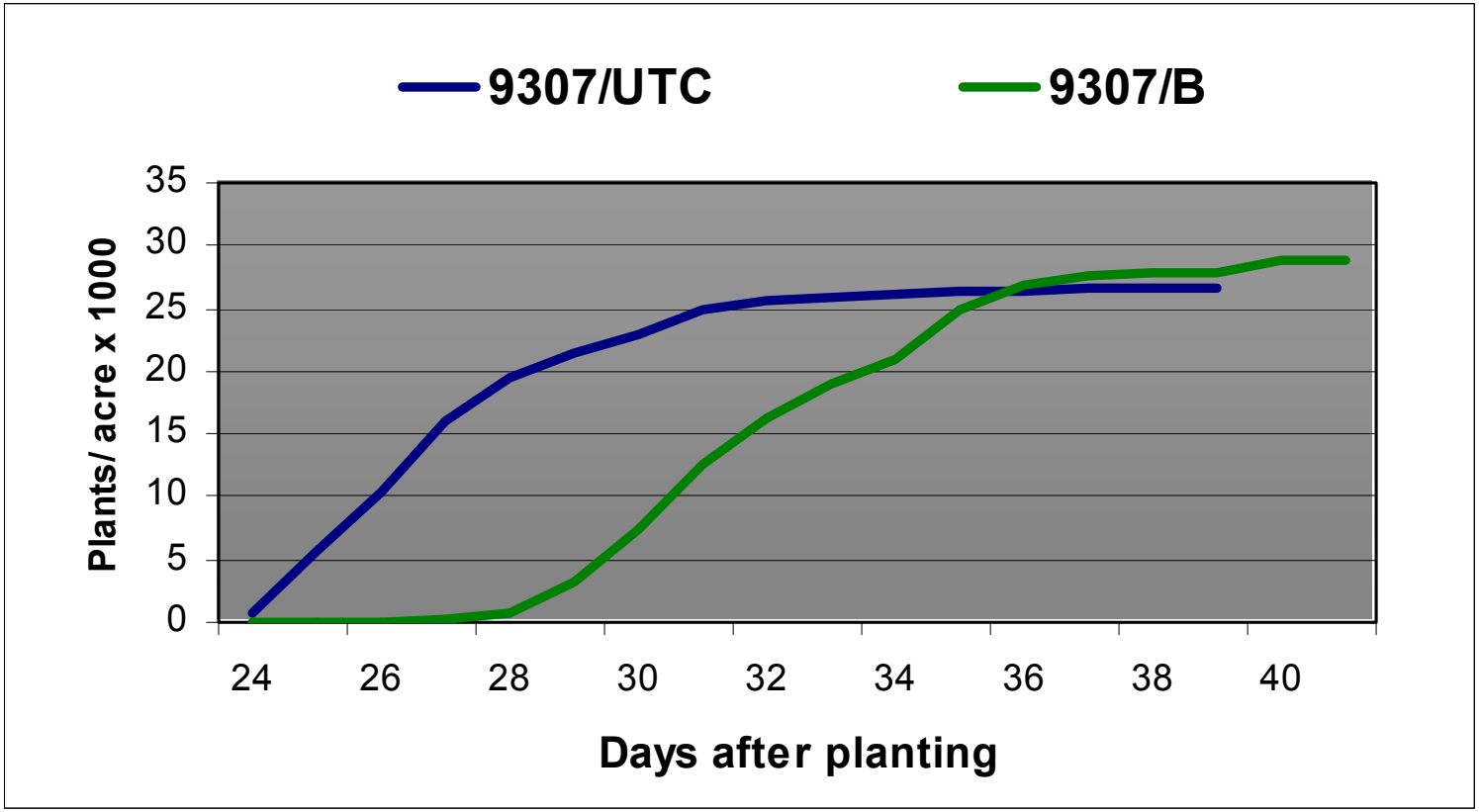


IntelliCoat

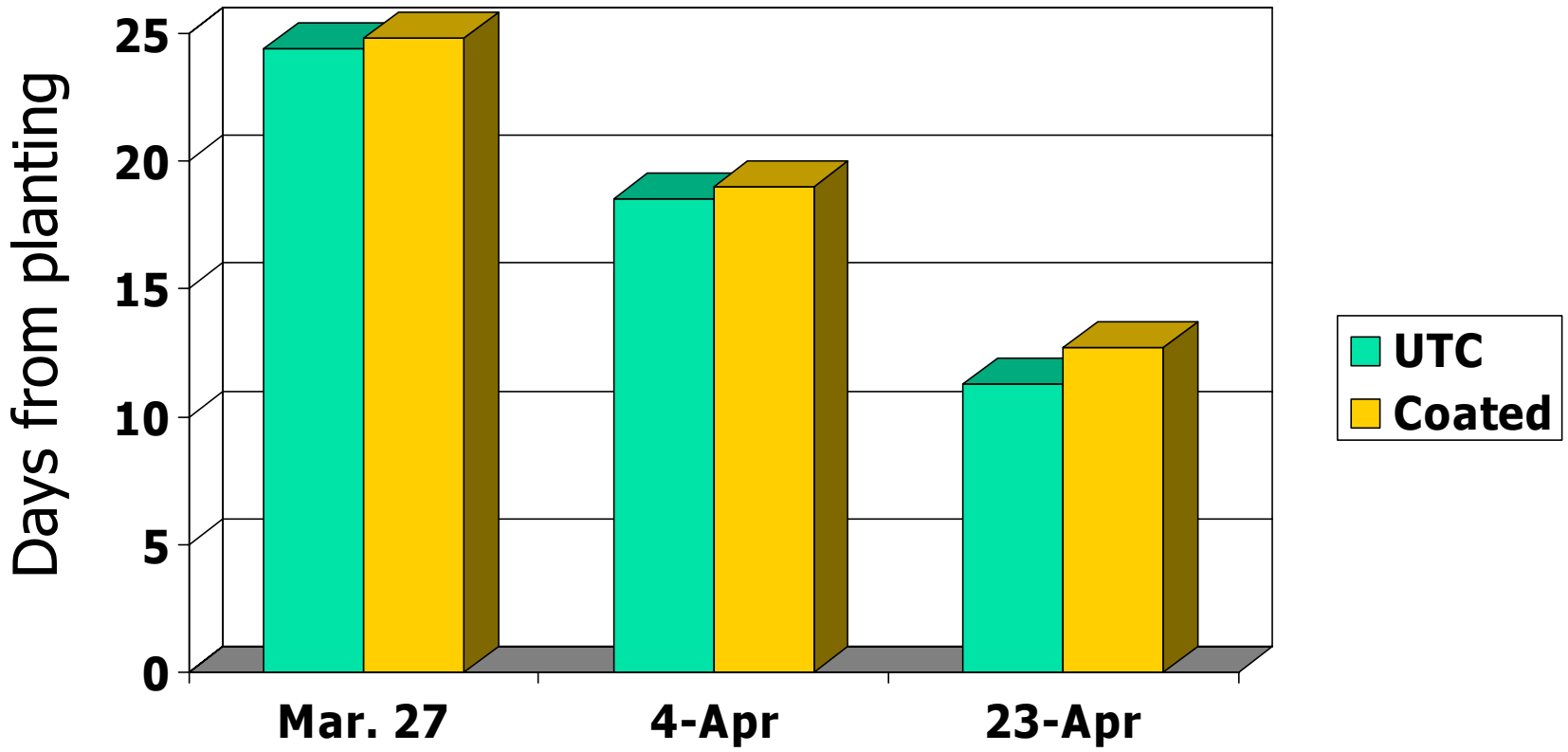
LANDEC Ag Inc
Seeds of Innovation

Emergence Profile (2000)

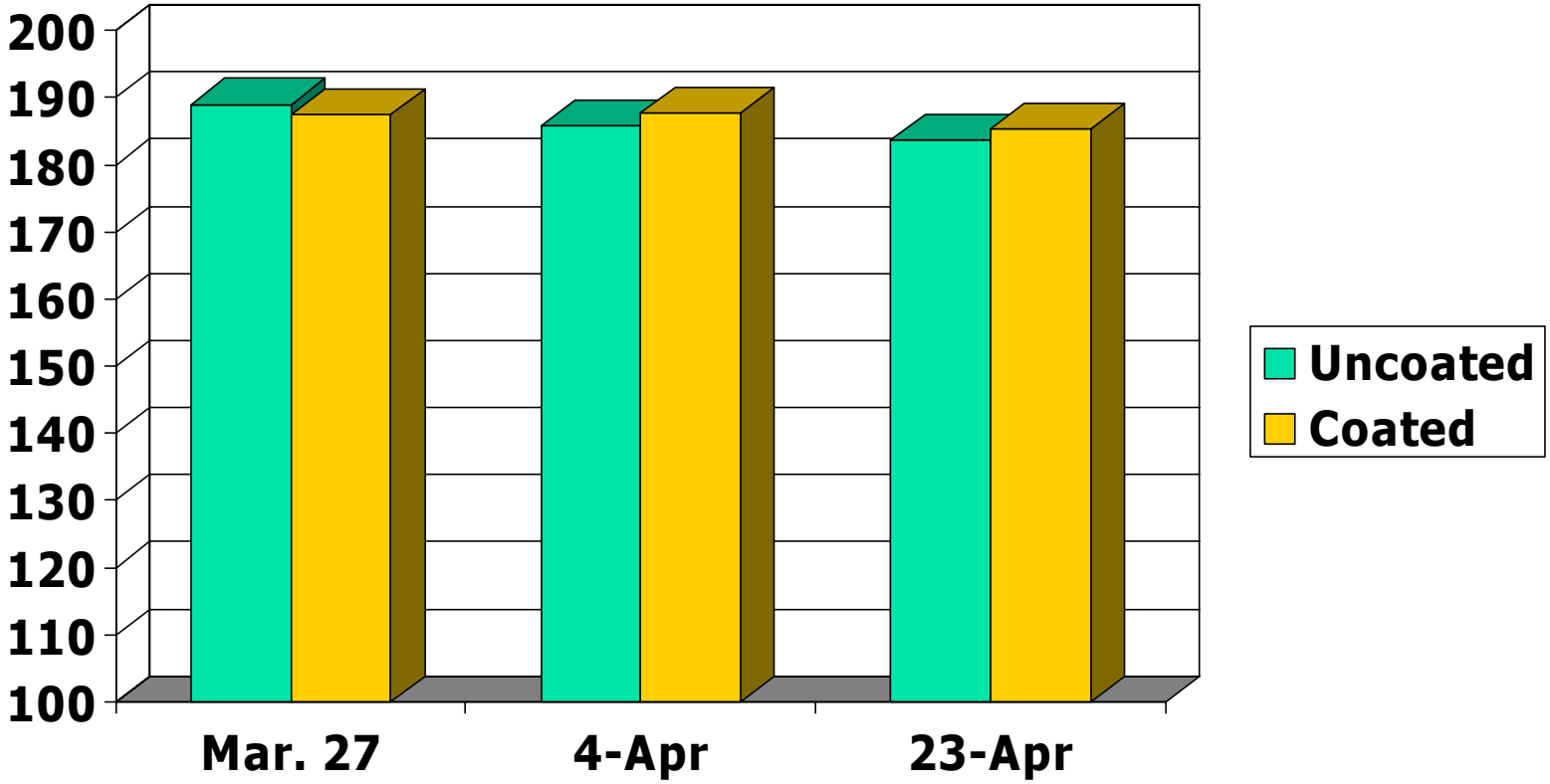
Planting Date: March 28



Coatings and Emergence Time in 2003 (average of 3 hybrids at West Lafayette)

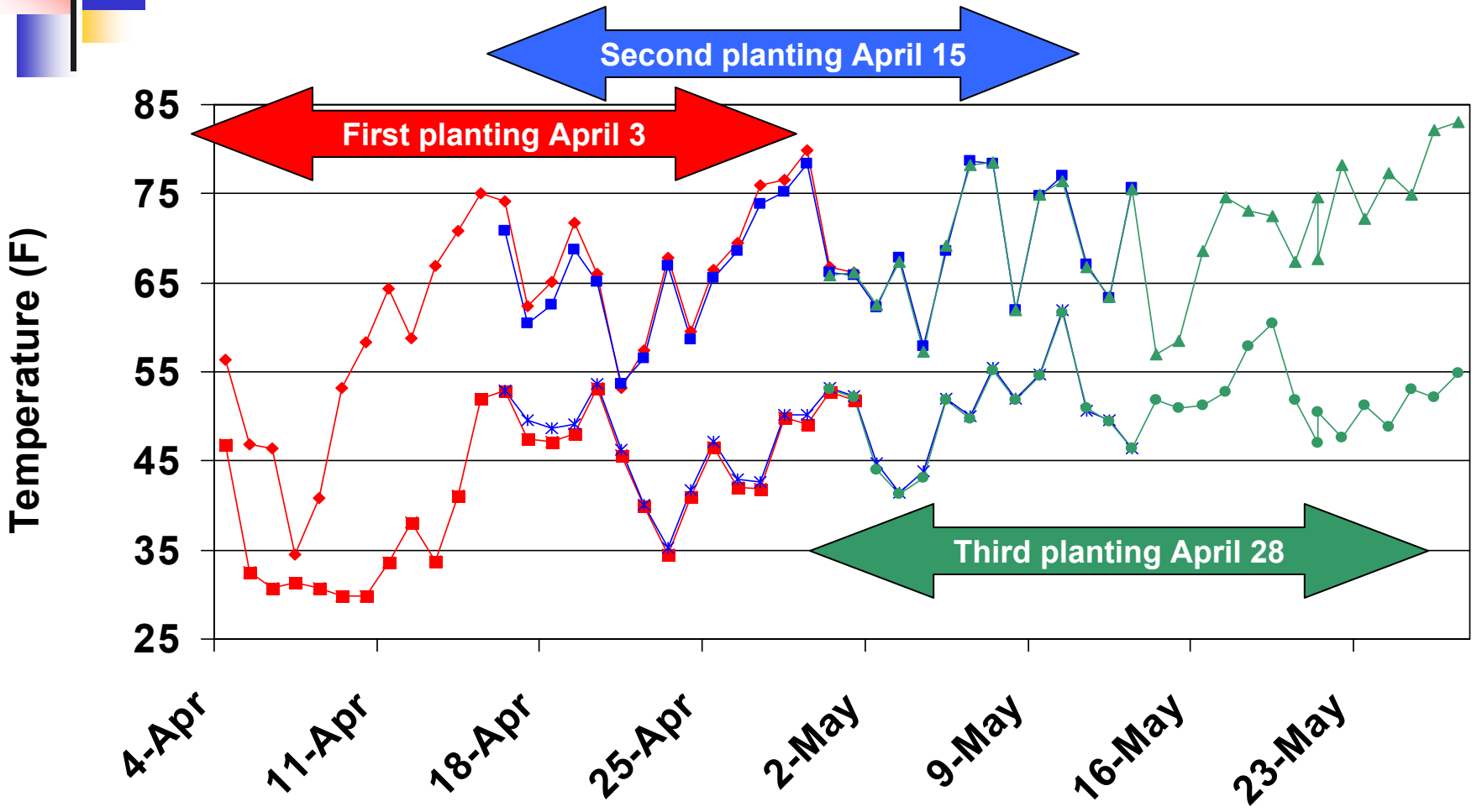


Coating Effects on Corn Yield in 2003 (mean of 3 hybrids at West Lafayette)



Maximum and minimum soil temperatures after planting,

Polymer Corn Study, Wanatah, 2003



Going Deeper??

Strip Tillage for Corn

Fall Strip-till Option?

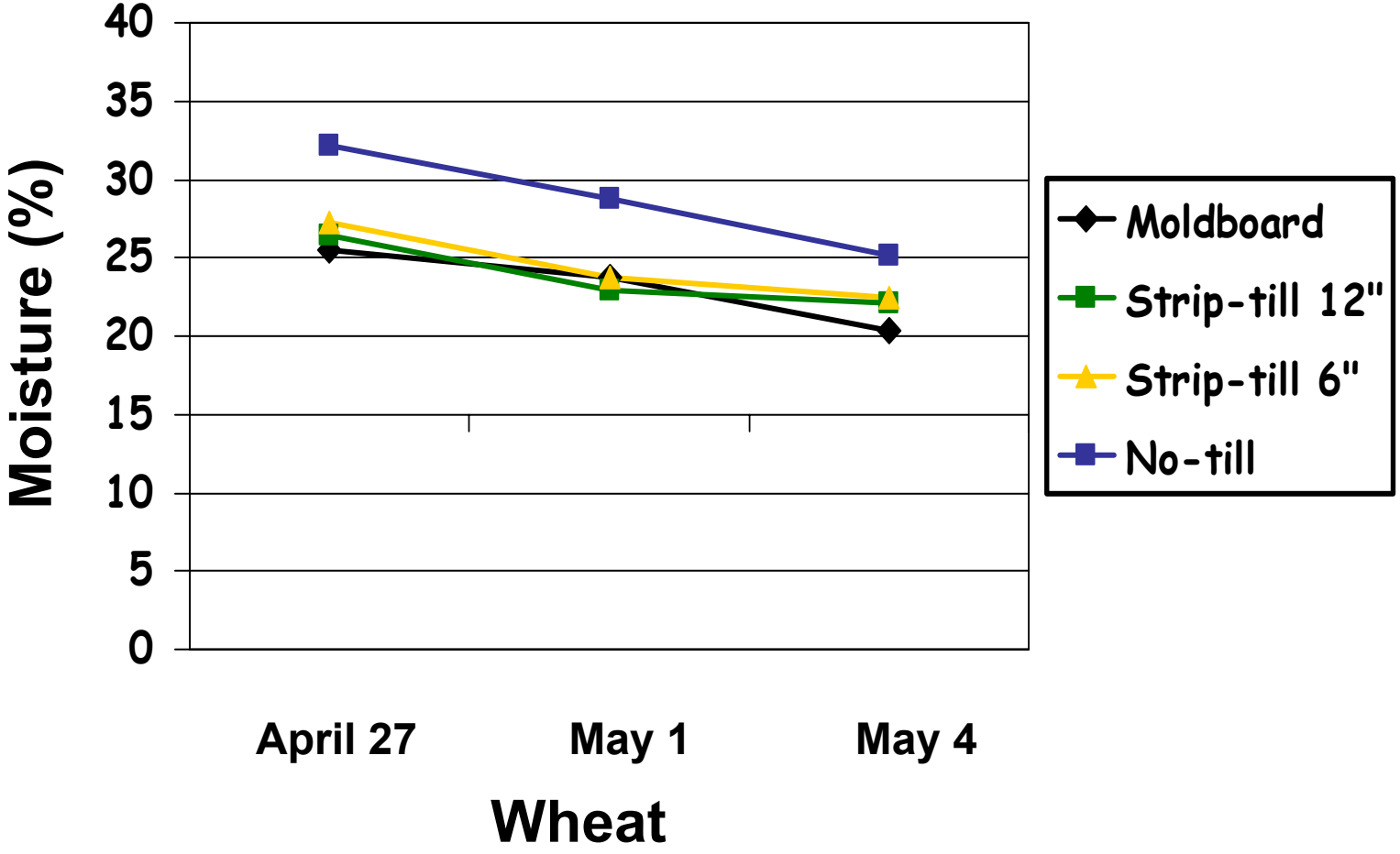
Strip Tillage with Fertilizer Banding

What are we after with strip-till?

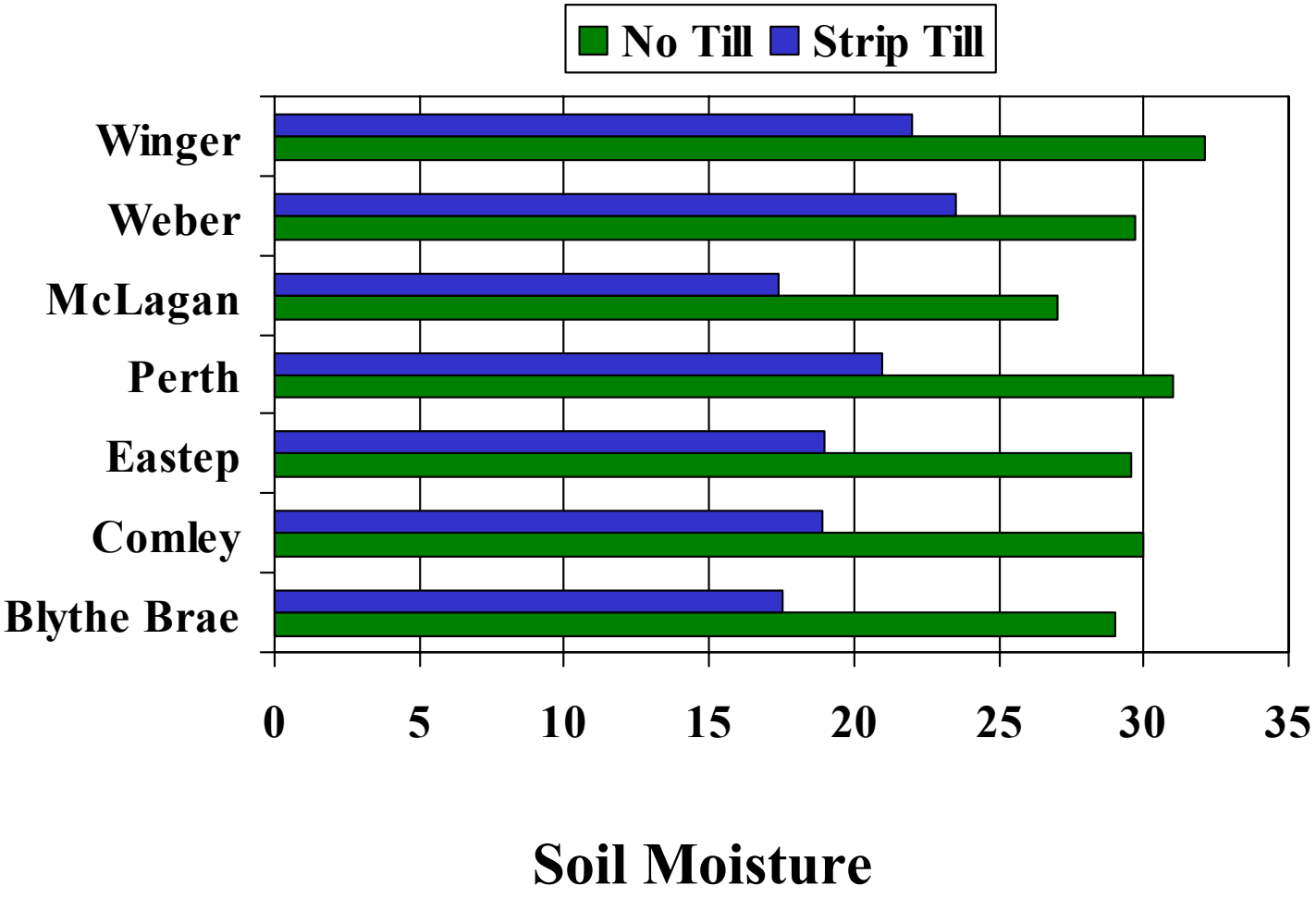
- **Yields**
  (relative to no-till; stability)
- **Planting Timeliness**
  (pre-plant soil conditions)
- **Fertilizer Placement Efficiencies**
  (systems approach)


Spring

Soil Drying Pattern (0-6”) after Wheat (ON, 1999)



2002 Soil Moisture
In-row, pre-plant measurements

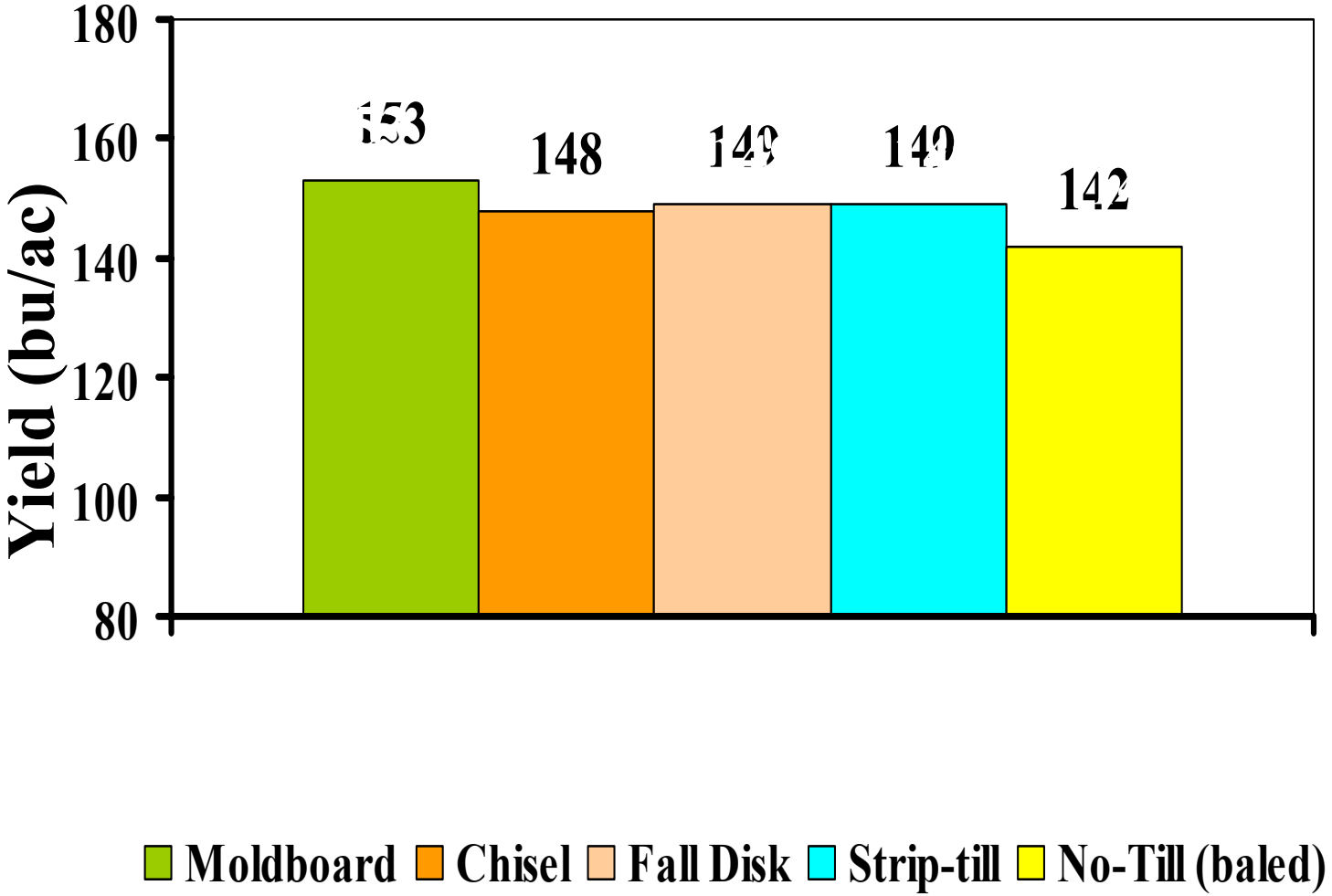


Strip-till versus No-till Corn after Wheat (Belmont, ON)

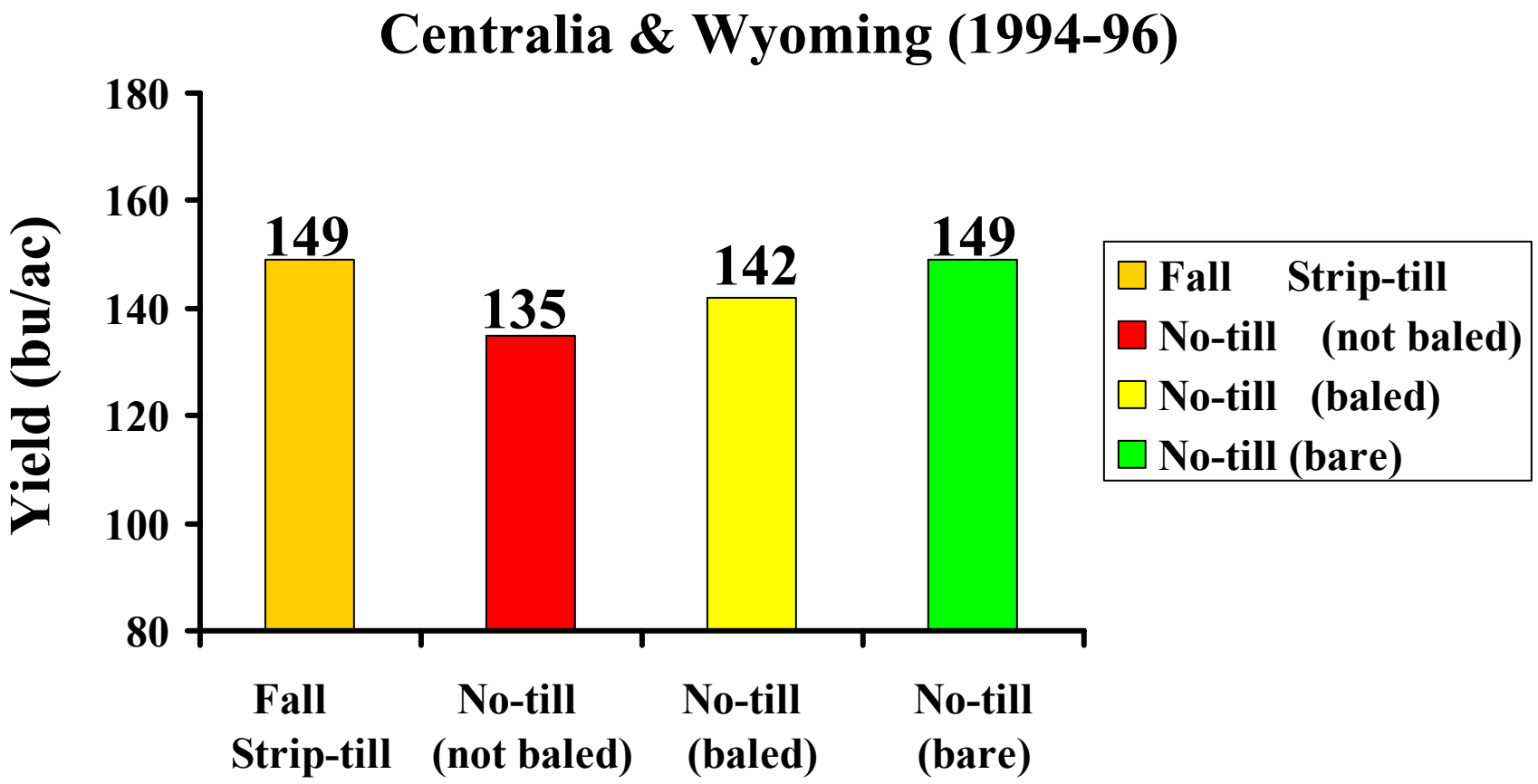
Strip-till on left, no-till on right

Tillage Effects on Corn Yield After Wheat

Centralia and Wyoming, ON (1994-96)



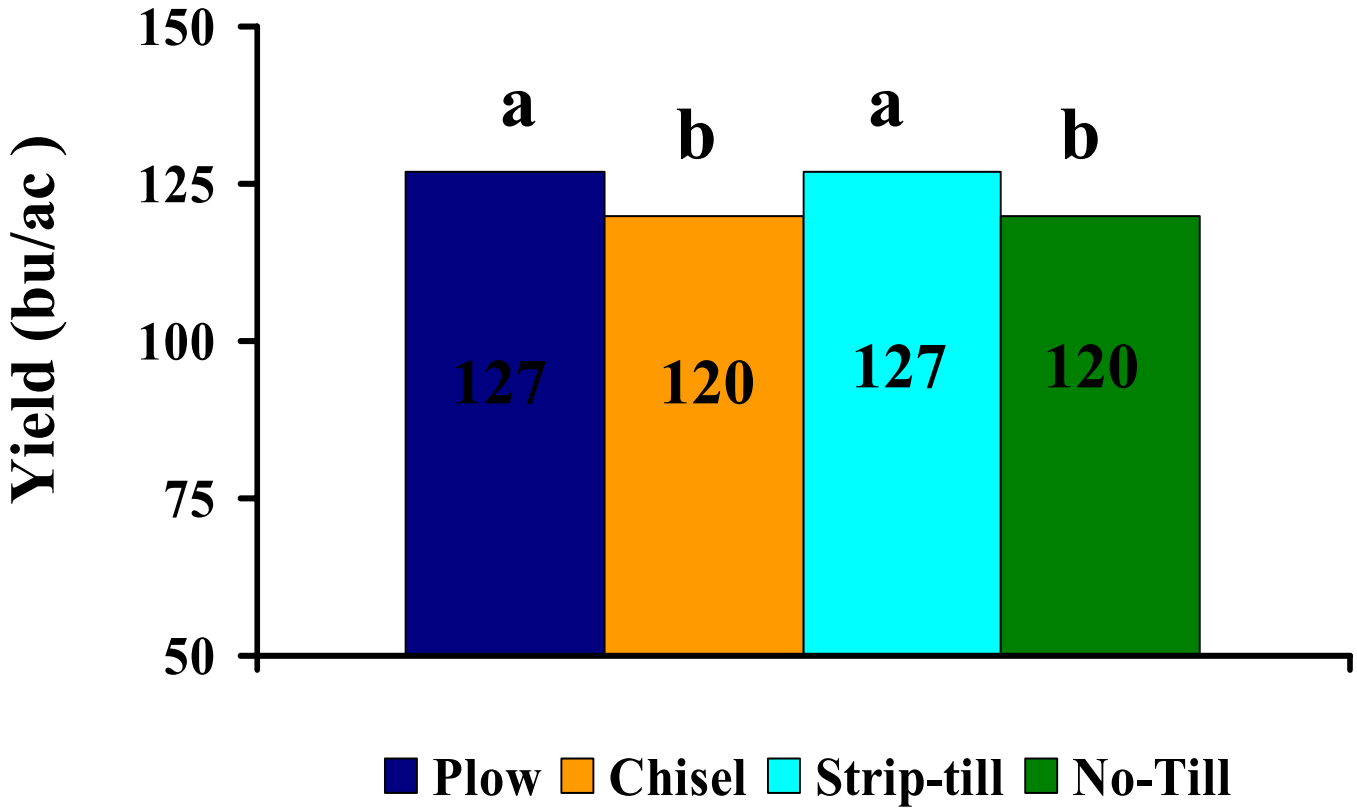
Wheat Residue Effect on No-till Corn Yields



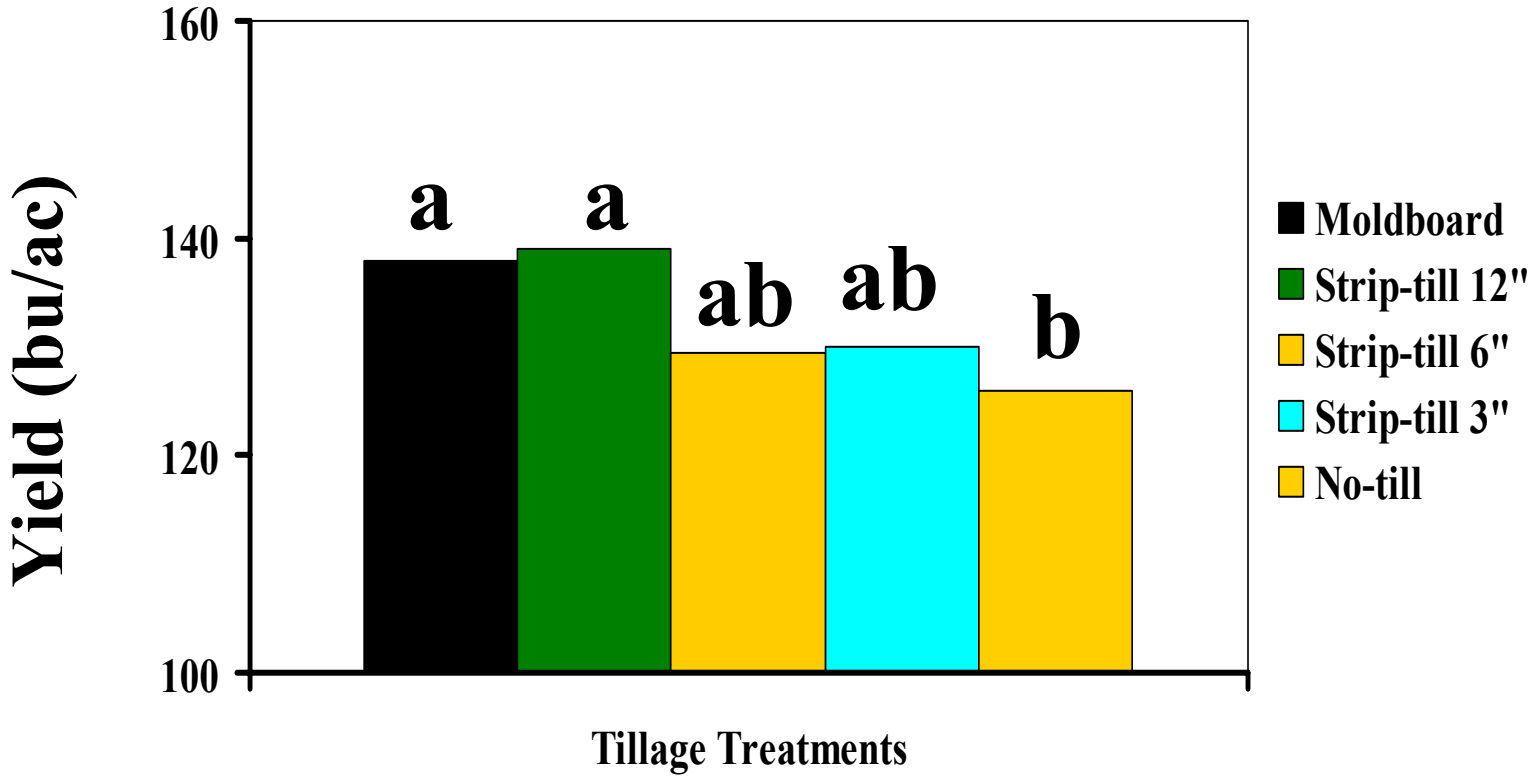
Opoku, Vyn & Swanton (Agron. J. 89:549)

Tillage Effects on Corn Yields After Soybeans

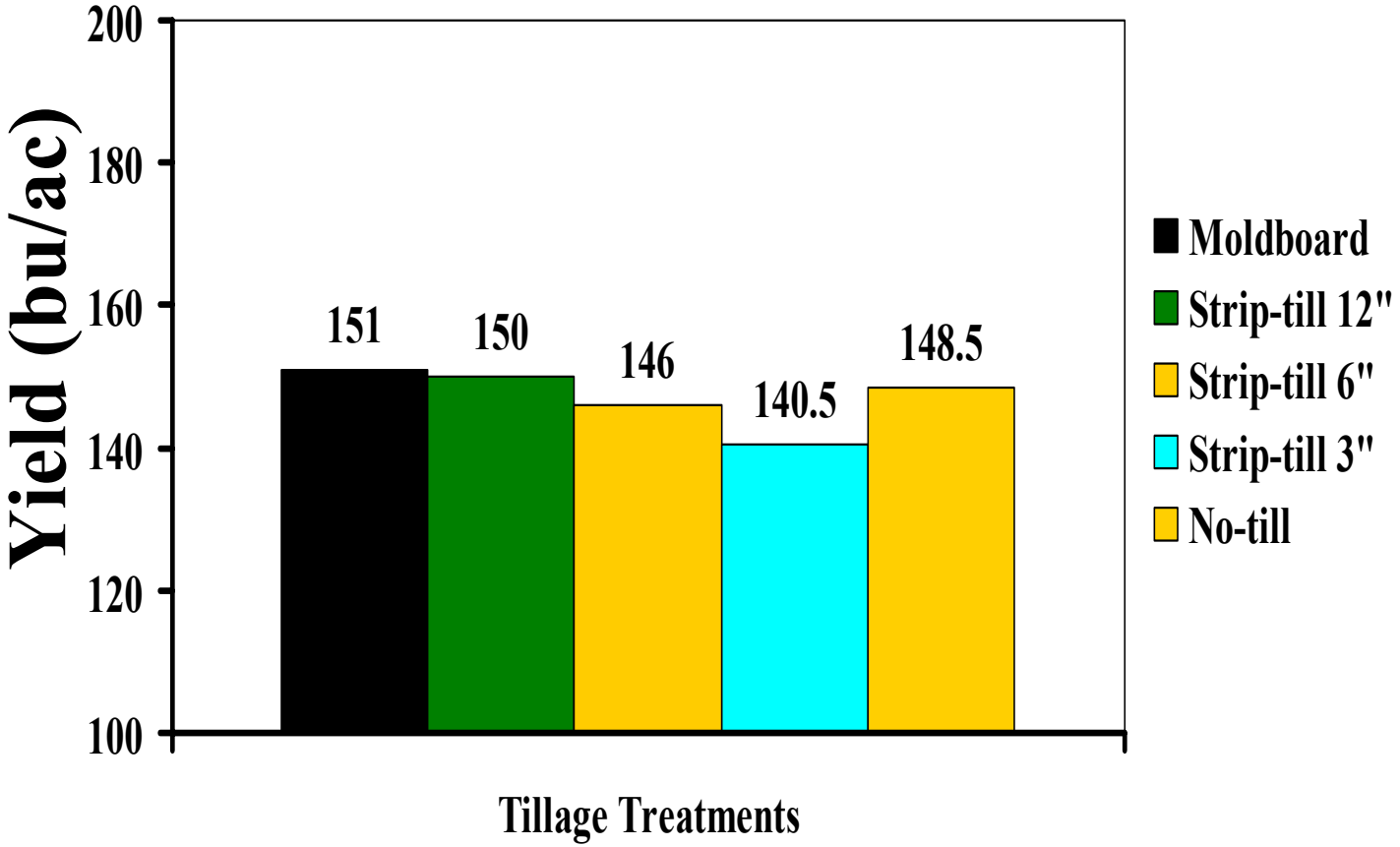
(Hooker, Avg. of Alvinston and Fingal, ON, 1994-96)



Fall tillage effects on corn yield after soybeans (averaged 1998-00) in Ontario.



Fall tillage effects on corn yield after wheat (averaged over 98-00) in Ontario.



Corn yields in Indiana following soybeans in Indiana (1999-2001)

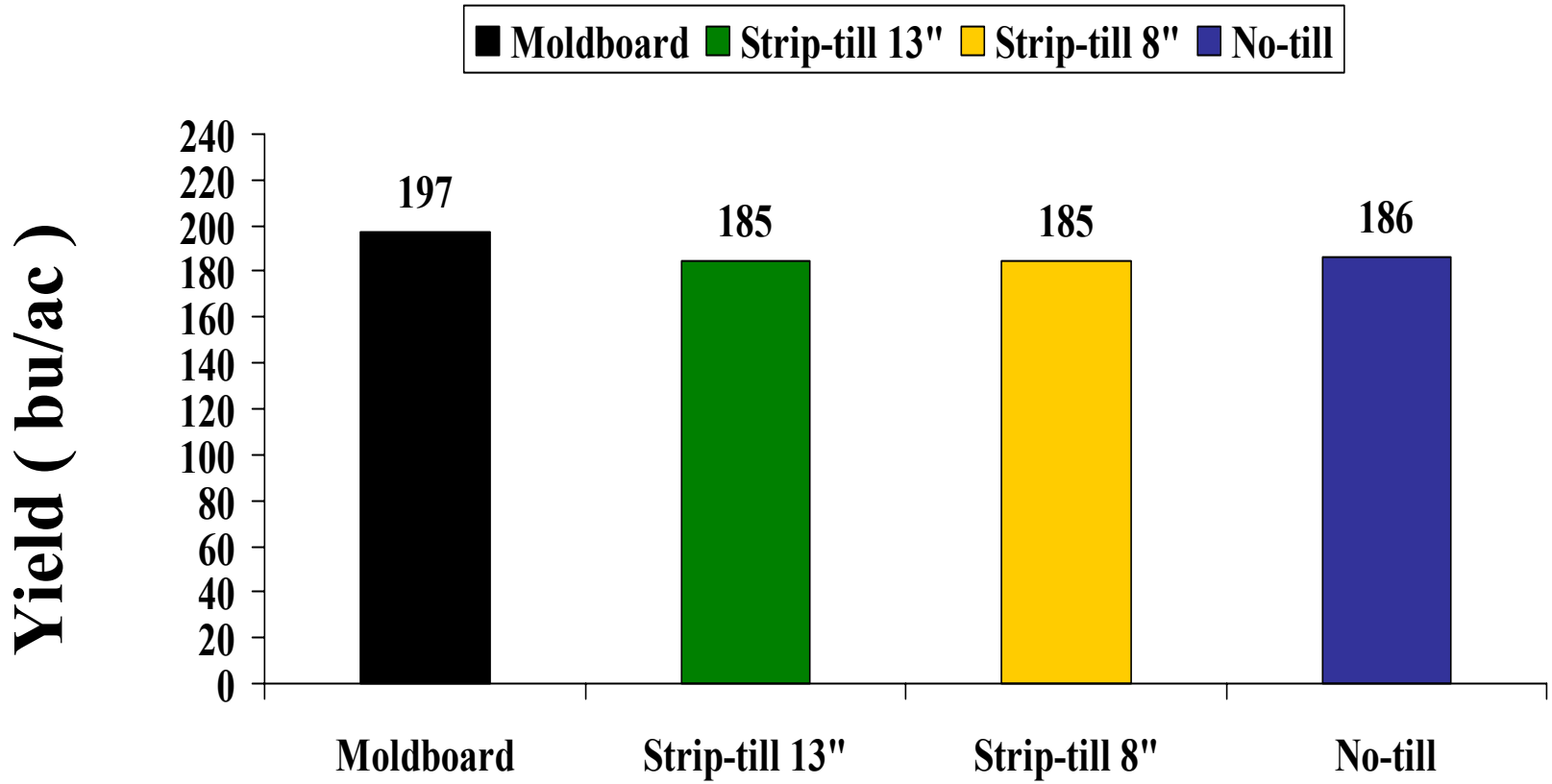



Photo Credit: Greg Stewart

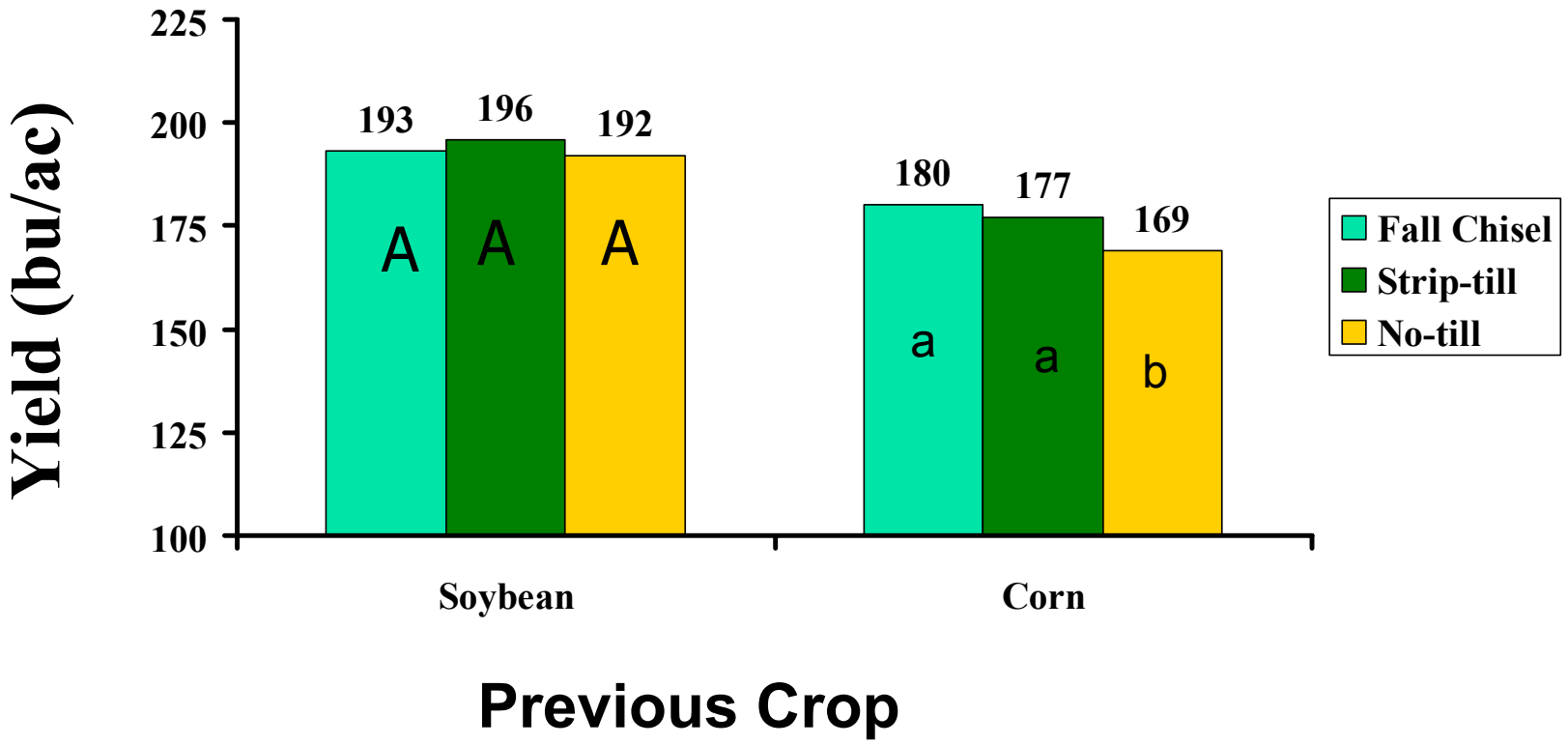
2001-2003 Ontario Yield Summary (courtesy of Greg Stewart, 2004)

Year	PLOW	FALL STRIP	NO-TILL
2001	100	101	100
2002	105	102	100
2003	103	103	100
AVE.	**103**	**102**	**100**

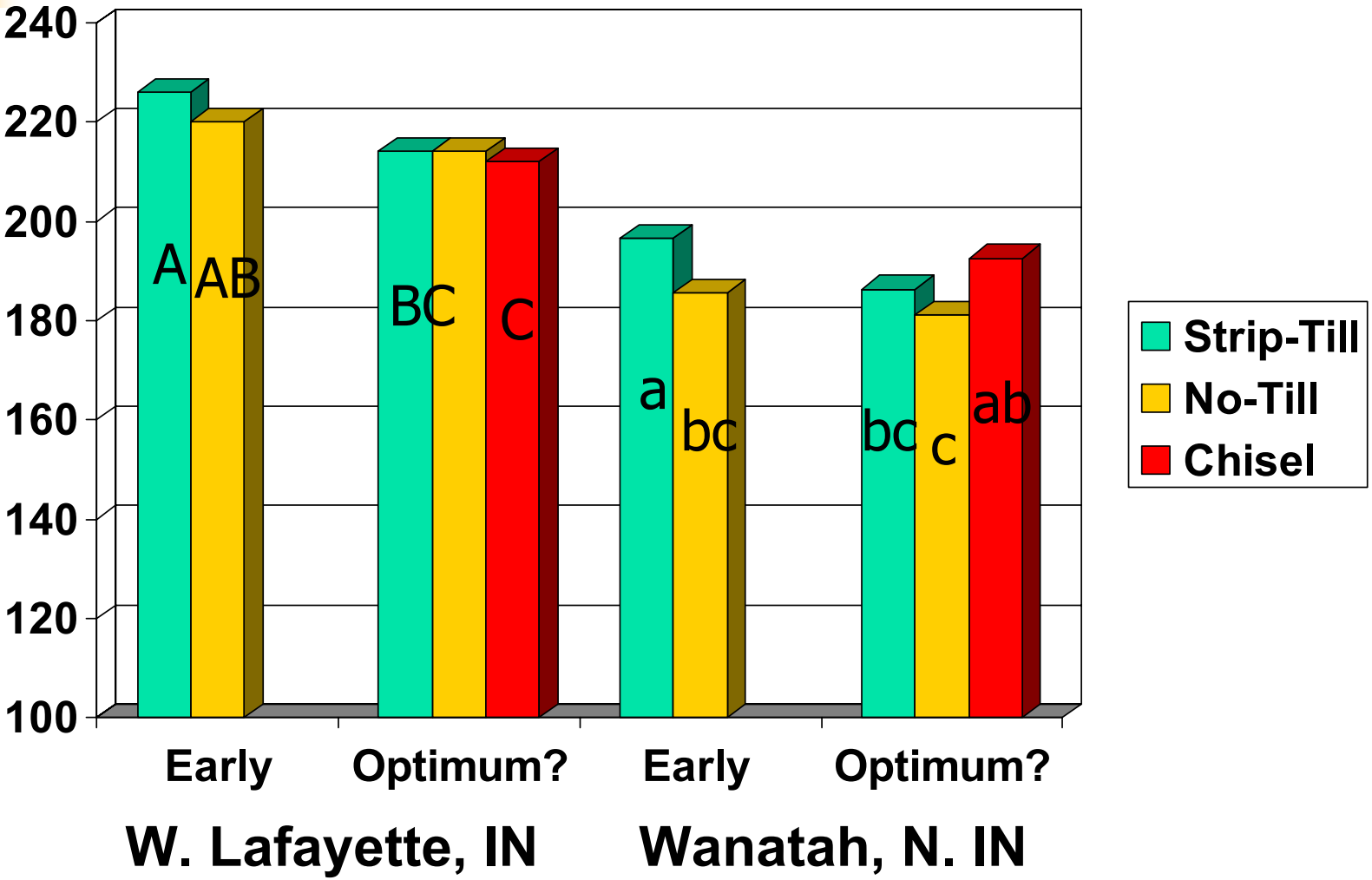
Represents 38 site/year comparisons over the three years.

Strip Tillage for Corn after Corn?

Strip Tillage for Corn in N. Indiana, Loam (2001-03)



Planting Date Effects in 2003



Fall Strip-till 8” depth

DMI 2500
with Mole Knife

Recent Strip Tillage Options

Impact of P & K placement in corn?

Soybean Harvest and No-till Double-crop Corn: Brazil Style

Conclusions

1. No-till corn adoption higher in Indiana, but reservations on increased adoption are the same.

2. Technology changes have improved success rate.

3. Strip tillage for increased planting flexibility and opportunity for fertility placement.

4. Nutrient management needs more attention in no-till and strip-till corn.

Thanks!

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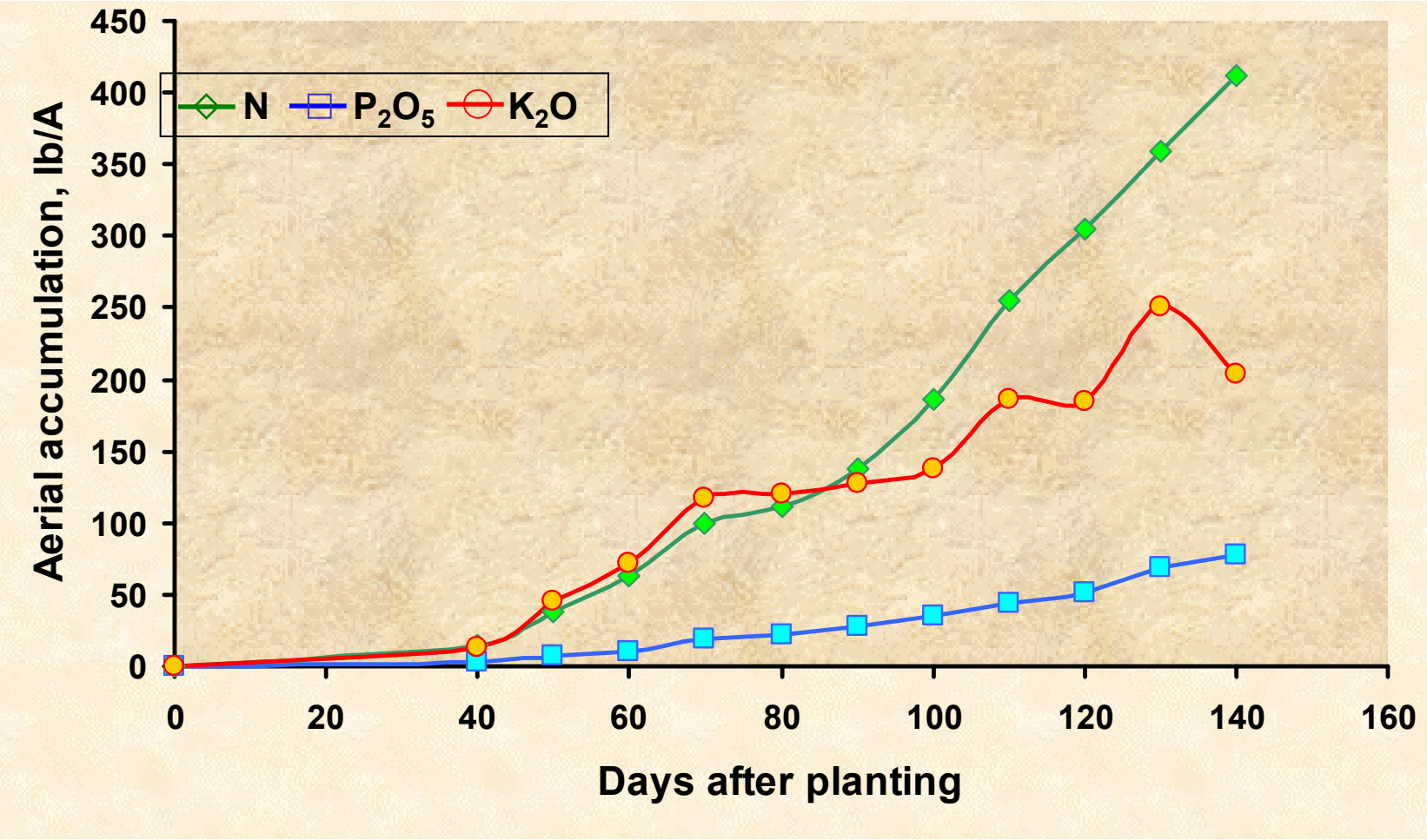
home page: //www.agry.purdue.edu/staffbio/vyn

Soybean K Fertility Issues?

Aerial accumulation of N, P, and K by soybean (80 bu/A)

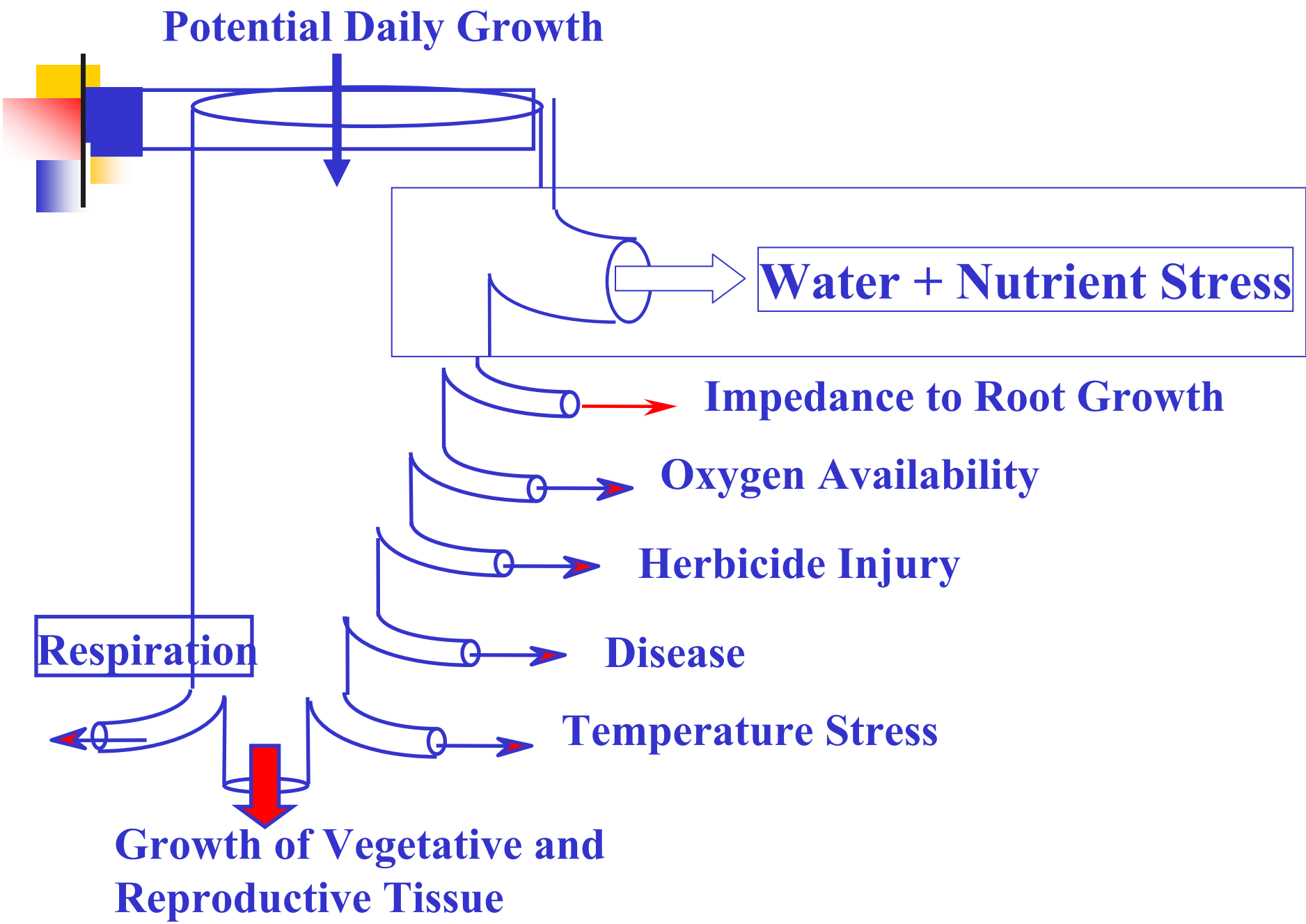


Source: Henderson, J.B., and E.J. Kamprath. 1970. Tech. Bull. 197. NC Agric. Exp. Stn., Raleigh. NC

1. Does K placement Matter?
2. Implications for Row Width?

Narrow-Row Soybeans Following Corn with Alternate K Placement

1. Extent of vertical and horizontal soil exchangeable K distribution
2. Actual soybean row widths
3. Environment and genetic impacts on root system distribution


Potential Daily Growth
Water + Nutrient Stress
Impedance to Root Growth
Oxygen Availability
Herbicide Injury
Disease
Temperature Stress
Respiration
Growth of Vegetative and
Reproductive Tissue

Soybean Yield Responses to K fertilizer Placement in Ontario (1998 to 2000)

Location	Initial Soil K	Zero K	Broadcast	Band
	mg L^{-1}	----------	bu ac^{-1}	----------
Paris	42	35.6b	36.2b	39.2a
Kirkton	85	43.5a	43.7a	43.6a
Strathroy	128	47.2b	48.6ab	49.8a

K fertilizer rate: 89 lb a^{-1}

Tillage: no-till for Paris,

: no-till, fall zone-till, and fall disk for Kirkton and Strathroy

Source: Yin and Vyn, 2002

Comparison of no-till with zone-till and fall disk systems

No-till
Narrow row (15”)
Fall broadcast
(no incorporation)

49.1

Zone-till
Wide row (30”)
Fall band
(6” deep)

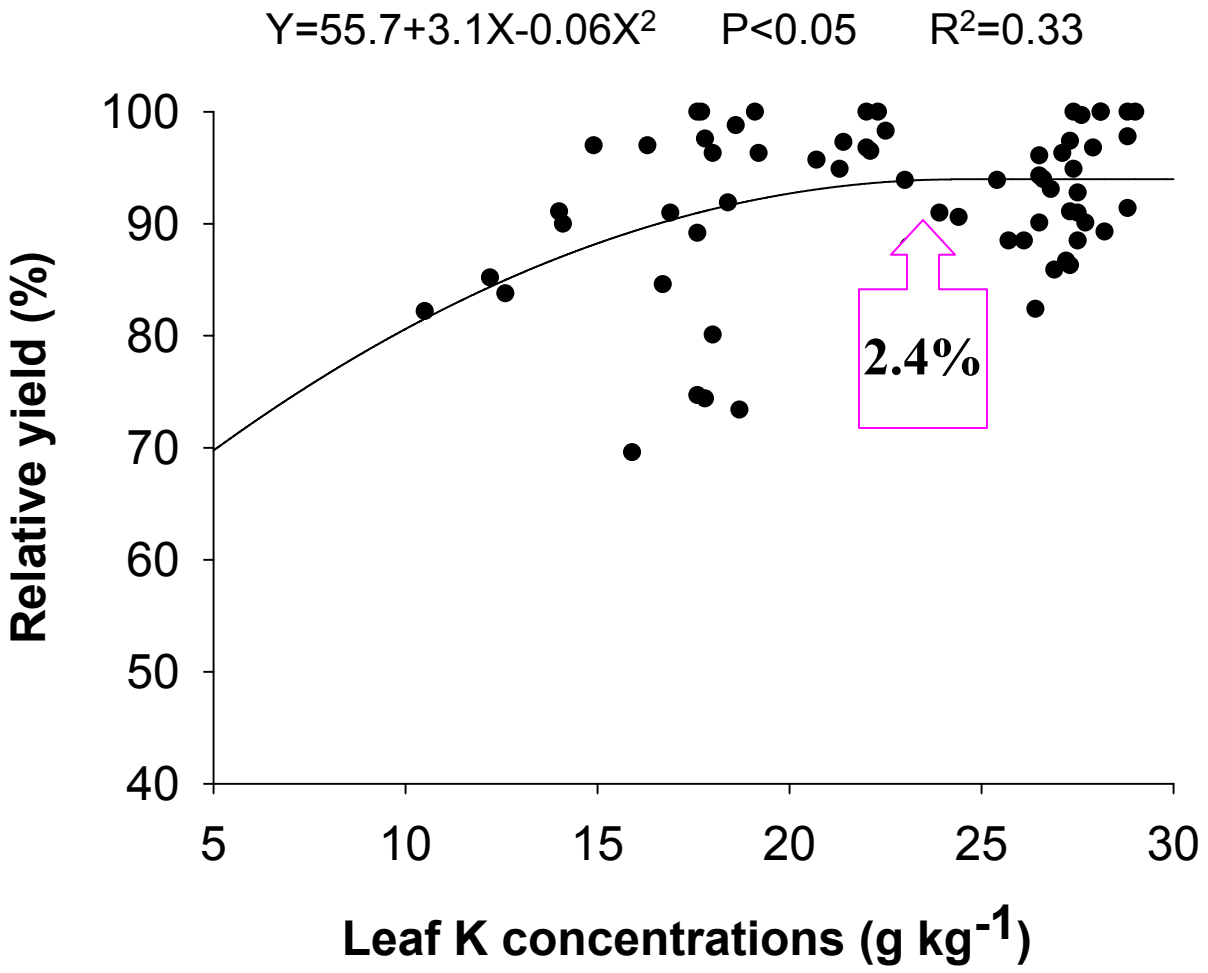
40.7

Fall disk
Narrow row (15”)
Fall broadcast
(incorporation)

49.5

Yin and Vyn, Agron. J.. 2002

Soybean Trifoliate Leaf K at R1 ?



Source: Yin and Vyn, 2003