Top Management Factors Driving Yields
-Rosholt Research Findings

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Prairie Lakes Coop
CHS SERVICE CENTER

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Acknowledgements

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2. Mosaic Team (Matt Wiebers, Dean Fairchild, Matias Ruffo)
3. U of IL (Dr. Fred Below)
4. Cargill Team

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From Good to Great

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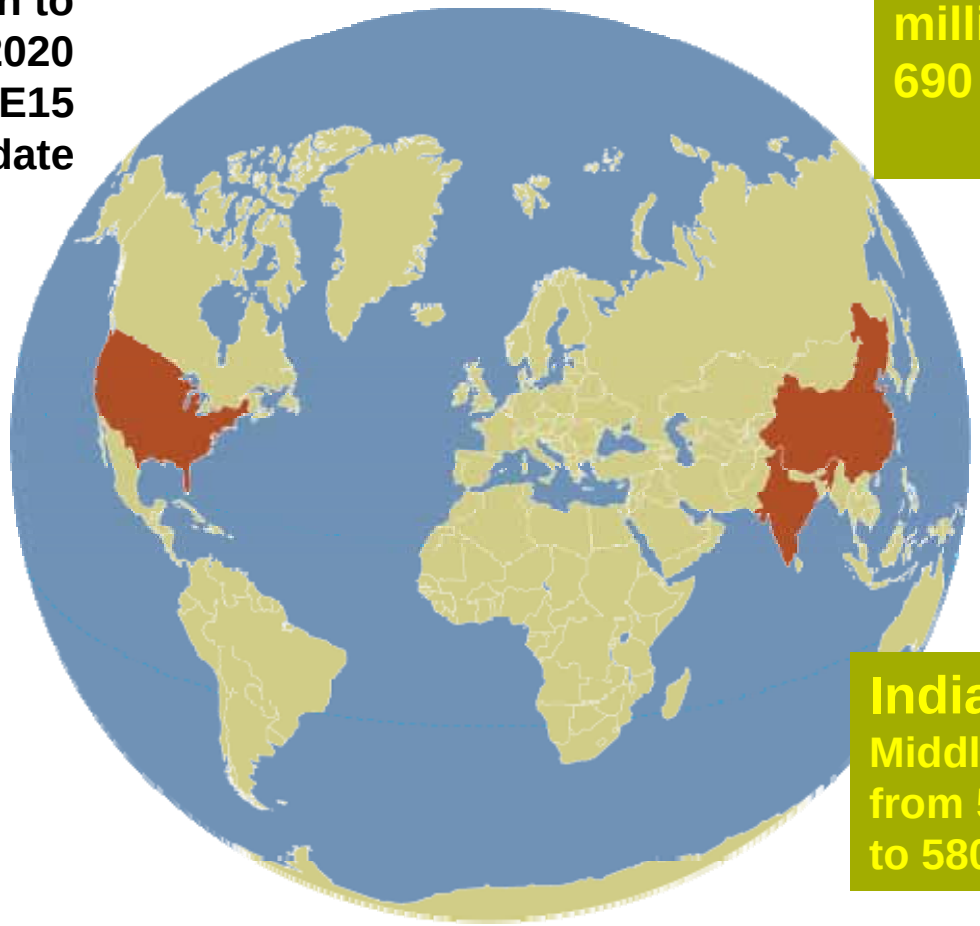
Key Global Drivers

USA:
Ethanol growth to 20 billion gallons by 2020
Going from E10 to E15 blend mandate

China –
Middle Class Growth from 130 million in 2005 to 690 million in 2025



75 MM people/year

1B hungry people

India –
Middle Class Growth from 50 million in 2005 to 580 million in 2025

Source: McKinsey & Company

Asia: 1.1 B growth of middle class people from 2005 to 2025

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Past Times

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Present Times

The Answer is… Agronomy/Crop Nutrition

If this apple were the earth, this tiny slice would be all the farmland available to feed the world.

By 2050, our world's population will be around 9.3 Billion people.

How will farmers produce enough food when only 3% of the earth is suitable for farming?

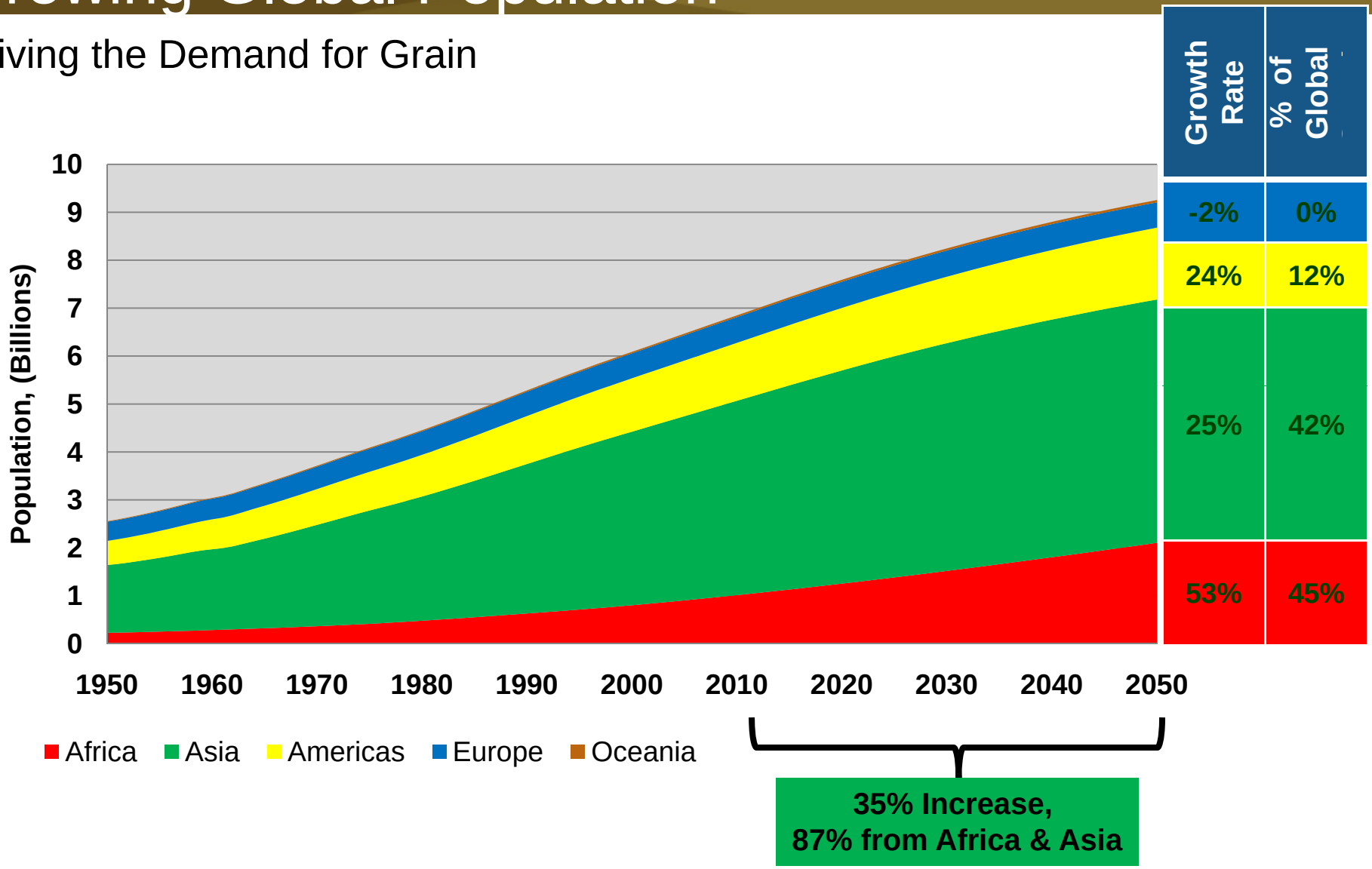
The Pressure to Achieve Higher Yields

- Agricultural fundamentals are strong.

- Consider the following statistics by the Food and Agricultural Organization of the United Nations:
  - By 2050, the world's population will reach 9.3 billion, 34% higher than today
  - Income levels will be much higher than what they are today, particularly in developing world economies
  - To feed this population, food production must increase by 70% net of volume with same acreage.

Growing Global Population

Driving the Demand for Grain



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Minnesota Corn Yield Trend-1948-2008

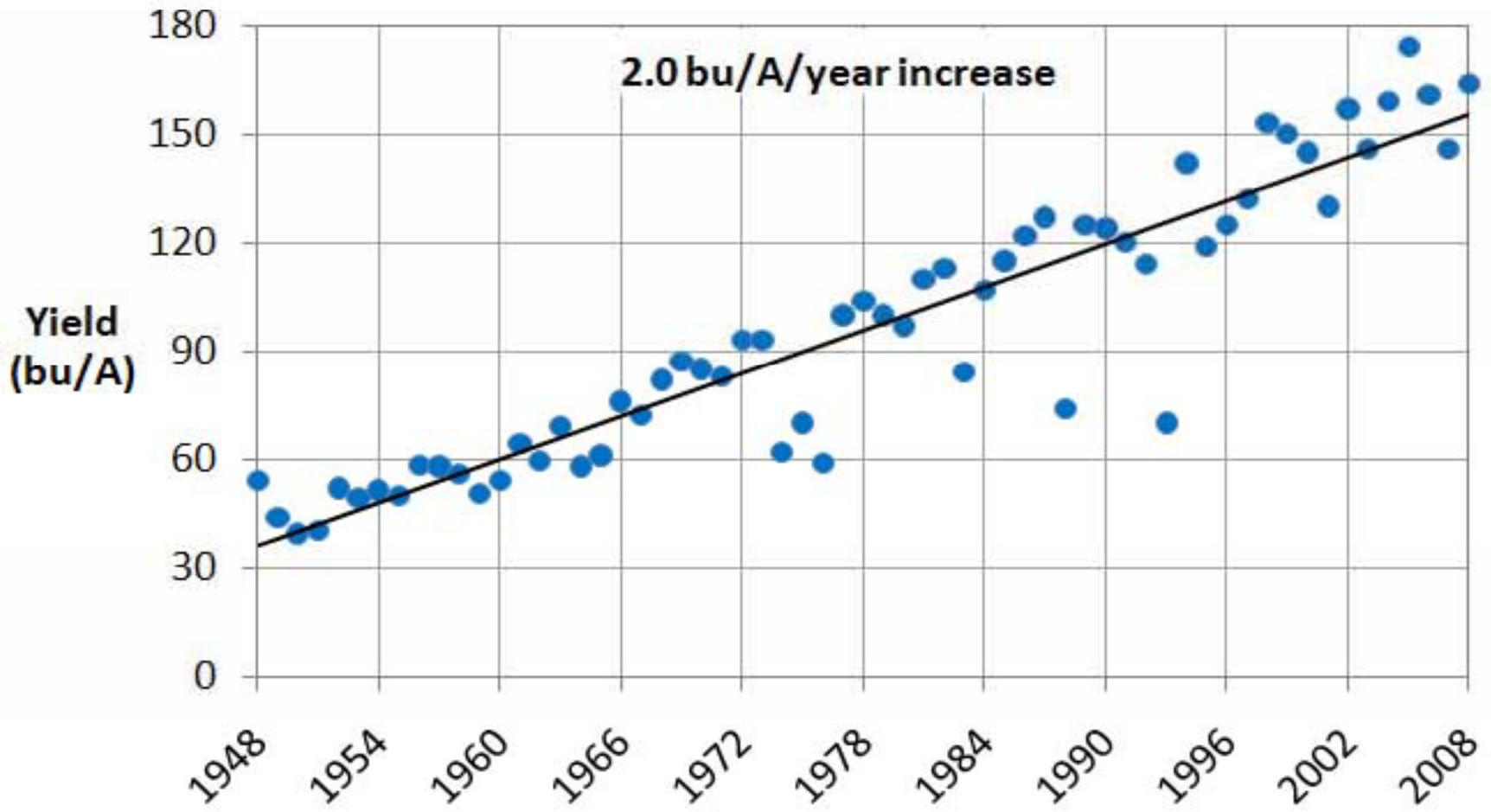


Figure 1. *Average Minnesota corn yields from 1948 to 2008. Source: USDA-National Agricultural Statistics Service.*

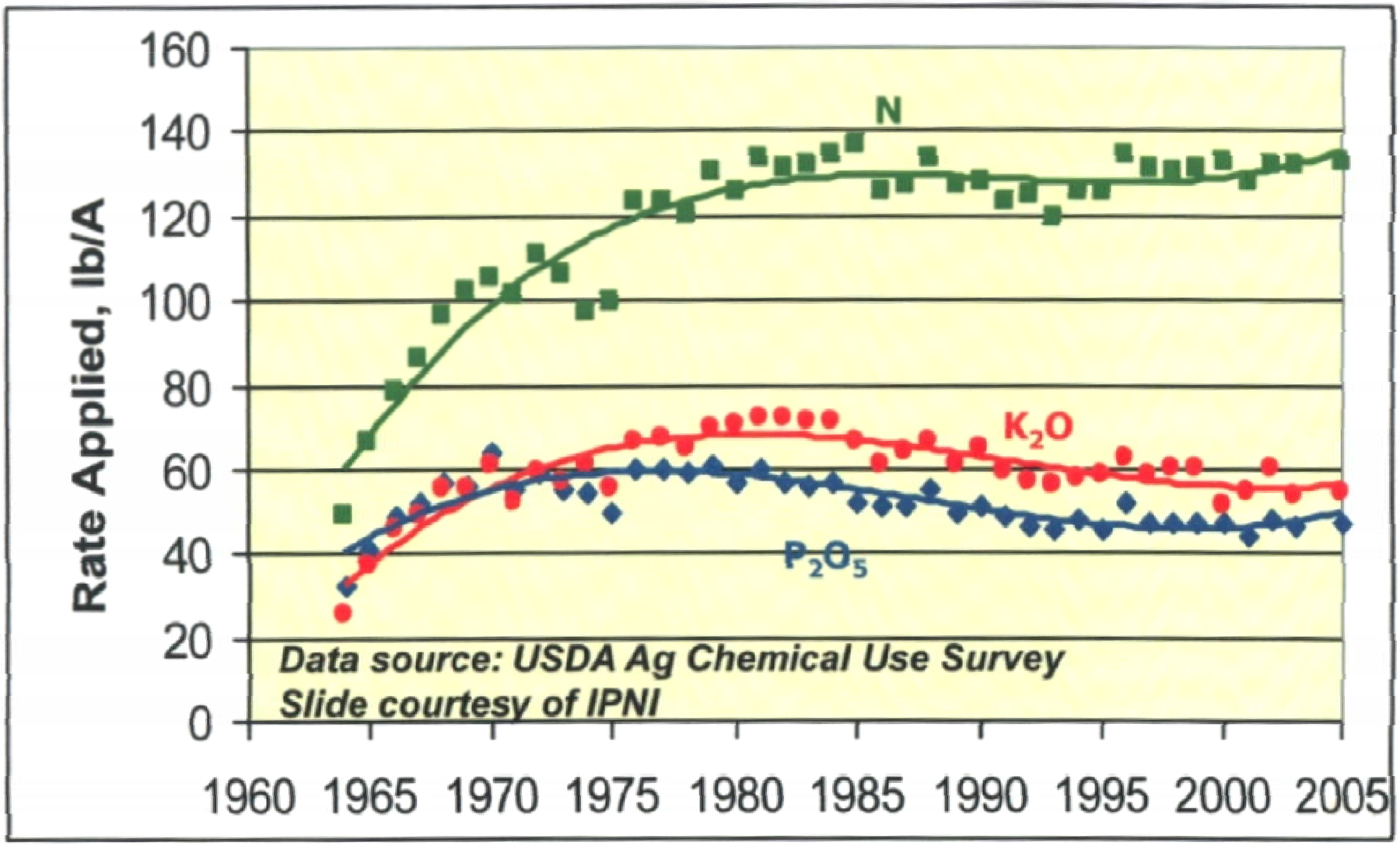
Importance of Crop Nutrition

Effect of different crop management practices on corn yield

Practices	Yield Contribution (%)
Fertilizer application	**39.4**
Crop rotation	22.2
Hybrid selection	13.5
Use of appropriate seed rate	13.5
Pest control	11.4

Source: Iowa State University

U.S. Fertilizer Use On Corn



The Mosaic Company

- Fertilizer producer (headquarters in Plymouth, MN) that provides fertilizer products to your local retail dealer.
- Manufacture – 18-46-0, 11-52-0, 0-0-60, MicroEssentials and K-Mag.
- Mine and manufacture approximately 20 million tons/year.
- 50% of North America Share

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Mosaic Fertilizers

- 40 – 60 percent of yield increases are result of crop nutrition

- **Mosaic's Mission:** ***to help the world grow the food it needs for years to come***

Fertilizer Decisions-4Rs

1. Right Rate (Soil Test, Yield Goal, Crop Removal, Tissue Test, Crop Inspection and VRT)

2. Right Placement (App Method, Applicator, Calibration)

3. Right Time (App Timing, Slow/Controlled Released Techn)

4. Right Source (balanced fertility, nutrient form)

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High Soil Test P Essential for Maximum Corn Yield and Profits

Dr. Gyles Randall
University of Minnesota

- Three year corn **193 bu/ac** on High-P soils and **167 bu/ac** on Low P- soils with 50 lbs P205/ac banded.

- Soybeans **49 bu/ac** on High-P soil and **39 bu/ac** on Low–P soil

- **This 26 (corn) and 10 bu (soybeans)** yield advantage for High P sites clearly points out **the economic penalty with low-P soils even when P fertilizer is applied!**

Nutrient Removal Rates

	N	P_2O_5	K_2O	S
Corn (1bu.)	**0.90**	**0.39**	**0.25**	**0.10**
Corn (200 bu.)	**180**	**76**	**50**	**20**
Corn (300 bu.)	**270**	**114**	**75**	**30**

Values are in Pounds per Bushel

Nutrient Uptake per Day *

- Peak daily nutrient uptake – 150 bu

7.5	lbs. N/ac/day
0.90	lbs P205/ac/day
8.5	lbs.K20/ac/day

- Peak daily nutrient uptake 308 bu

11.0	**lbs N/ac/day**
2.85	**lbs P205/ac/day**
15.3	**lbs K20/ac/day**

*Source – Rutgers Univ. 308 bu/ac

Grain Yield is a Product Function of Yield Components

Yield = (plants/acre) x (kernels/plant) x (weight/kernel)

200 bushels = 32,000 plants/ac x 550 kernels/plant x 250 mg/kernel

250 bushels = 36,000 plants/ac x 600 kernels/plant x 255 mg/kernel

300 bushels = 45,000 plants/ac x 565 kernels/plant x 260 mg/kernel

Seven Wonders of the Corn Yield World

- Ranks those factors that each year can have a positive (and sometimes negative) impact on corn yield

- Gives each factor an average bushel per acre value

How to Get 300 Bushels?

- Provide better prerequisites, especially mineral nutrients

- Try to optimize each of the seven wonders and their positive interactions

Crucial Prerequisites to High Yields

- Drainage
- Pest/Weed Control
- Proper soil pH
- Adequate levels of P & K, S and micronutrients based on soil tests

Factors for Standard Practice

Fertility	**No P or K based on soil test**
Nitrogen	**180 lbs pre-plant as UAN**
Genetics	**RR Hybrid (DKC 61-22) with soil insecticide at planting**
Population	**32,000 plants/ac final stand in 30 inch rows**
Fungicide	**No Fungicide**

Factors for High Tech Package

Fertility	**100 lbs P_2O_5 as MESZ supplies P, S, and Zn**
Nitrogen	**100 lb extra N as SuperUrea as sidedress to assure available N**
Genetics	**Triple stack (DKC 61-19) with soil insecticide at planting**
Population	**45,000 plants/ac final stand in 30 inch rows**
Fungicide	**Strobilurin at flowering Headline or Quilt**

Seven Wonders of the Corn Yield World

Rank	Factor	Value	
		bu/acre	
1	Weather	70+	
2	Nitrogen	70	
3	Hybrid	50	
4	Previous Crop	25	
5	Plant Population	20	
6	Tillage	15	
7	Fungicides	10	260 bu

Given key prerequisites

Twin-Row Demonstration-2009

Fertility	**At Planting (mg/planted plant)**	
	N	**225**
	P_2O_5	**595**
	K_2O	**212**
	S	**50**
	Zn	**5**
Population	**35, 45, 55 x 1000 plants/ac all in 7.5” centered twin rows**	
Fungicide	**Strobilurin at flowering with and without Headline**	

DKC 64-24, 180 lbs N/acre pre-plant as UAN, mulch tillage, planted May 22

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AGCO-White Research Twin Row Planter

Champaign, IL 2009

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Seedling Emergence

Champaign, IL 2009

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Plant Spacing with Twin Rows

35,000 plants/acre

55,000 plants/acre

Champaign, IL 2009

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Vegetative Growth

Champaign, IL 2009

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Late Vegetative Growth

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High Yield Systems - Mosaic

- Started project with University of Illinois – 2008-09 to grow 300 bu. corn

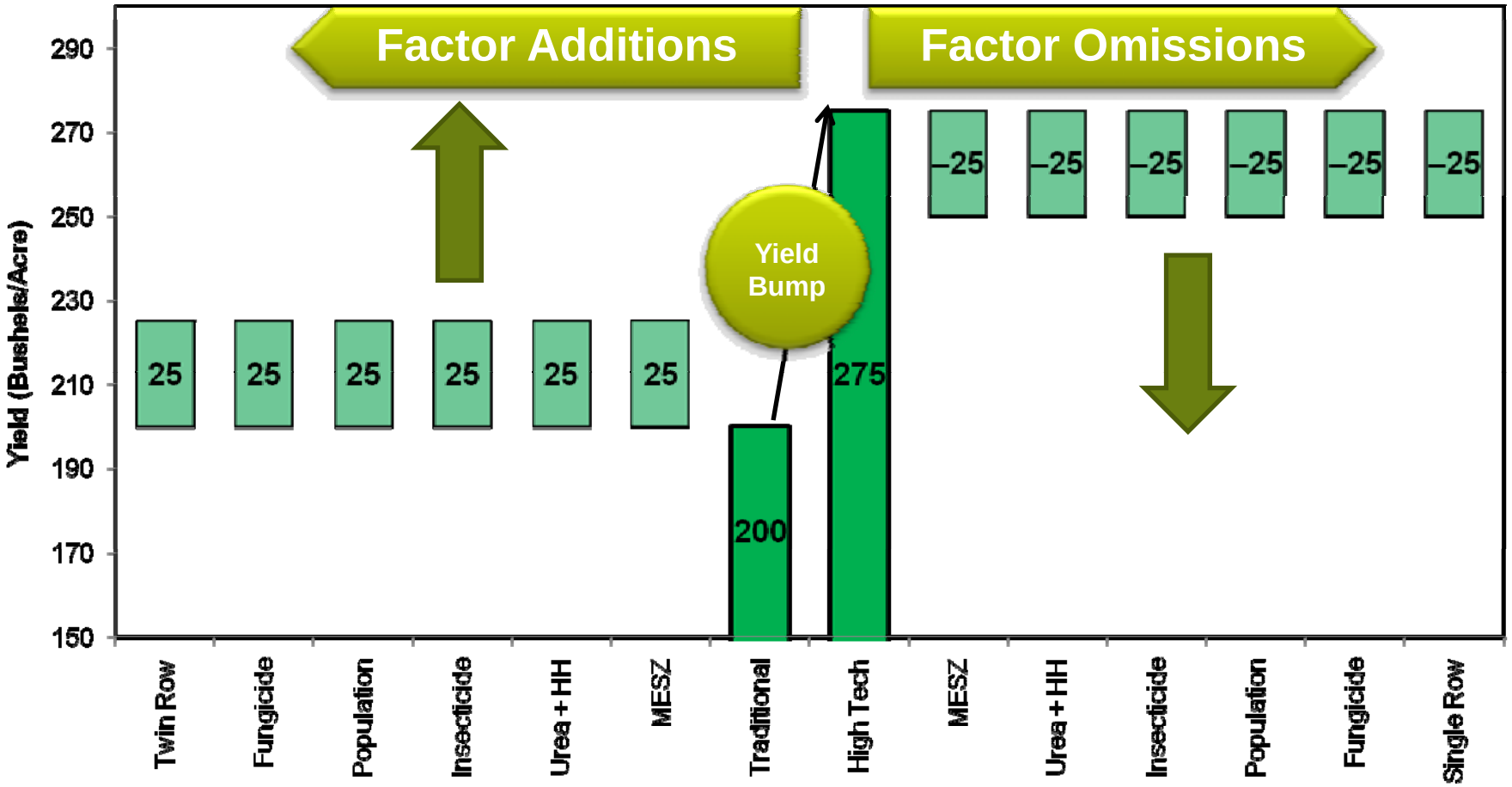
- Expanded to additional sites in 2010 –

Indiana	Illinois
Iowa	Nebraska
Kansas	**Minnesota**
North Dakota	

300 Bushel Corn Omission Trials

Variable Under Testing	Standard Treatment	High Tech Treatment
Fertility	Maintenance	100 lbs P_20_5 as MESZ
Nitrogen	180 lbs preplant as urea	Base plus100 lbs side dress urea at V5
Row Spacing	30 inch	Twin Row
Population	32,000 – 35,000	45,000
Fungicide	None	6 oz Quadris at V5 + 10.5 oz QuiltXcel at VT
Insecticide	None	8 fl oz Force CS in furrow at planting

Data Format Example-Omission Plots



Total Yield (bu/ac)	225	225	225	225	225	225	200	275	250	250	250	250	250	250

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High Tech Package vs. Traditional

Champaign - 2009

High Technology Package **Traditional Practice**

Pictures Courtesy of Dr. Fred Below, U of Ill

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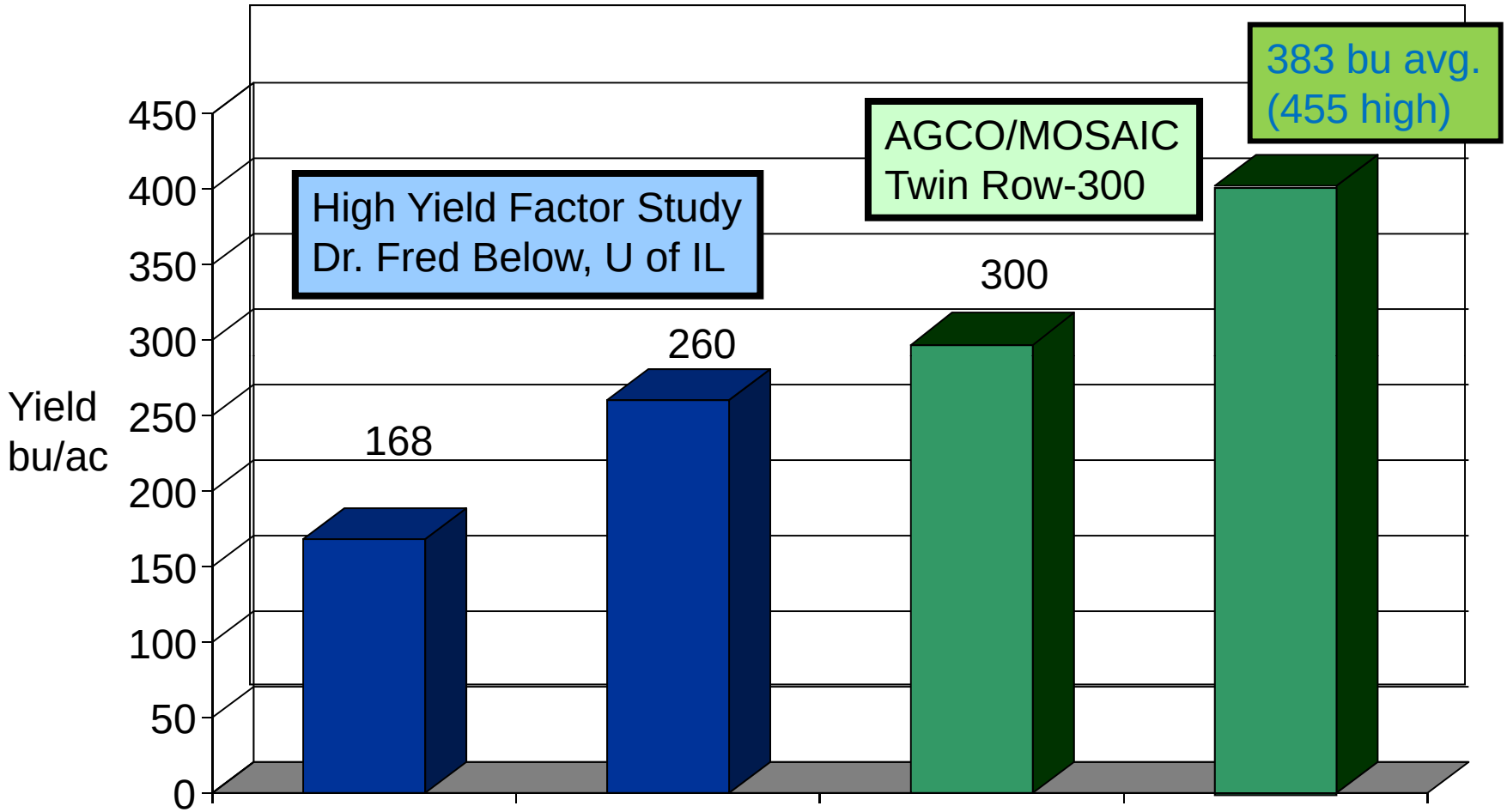
2009 Corn Yield Results, U of IL-Several Systems



Mosaic-U of IL
High Corn Yield Studies

Lessons Learned in the Last Five Years

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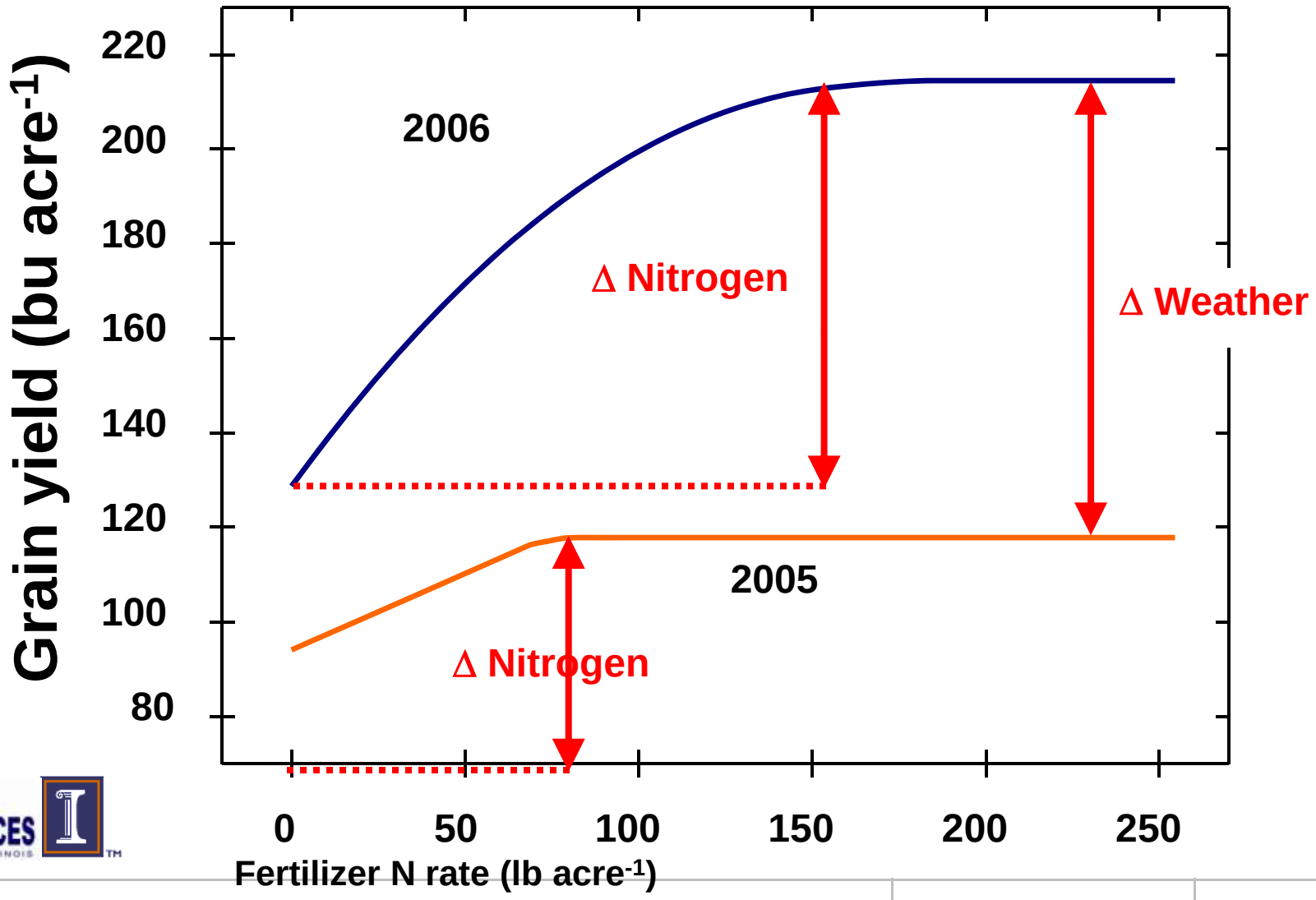
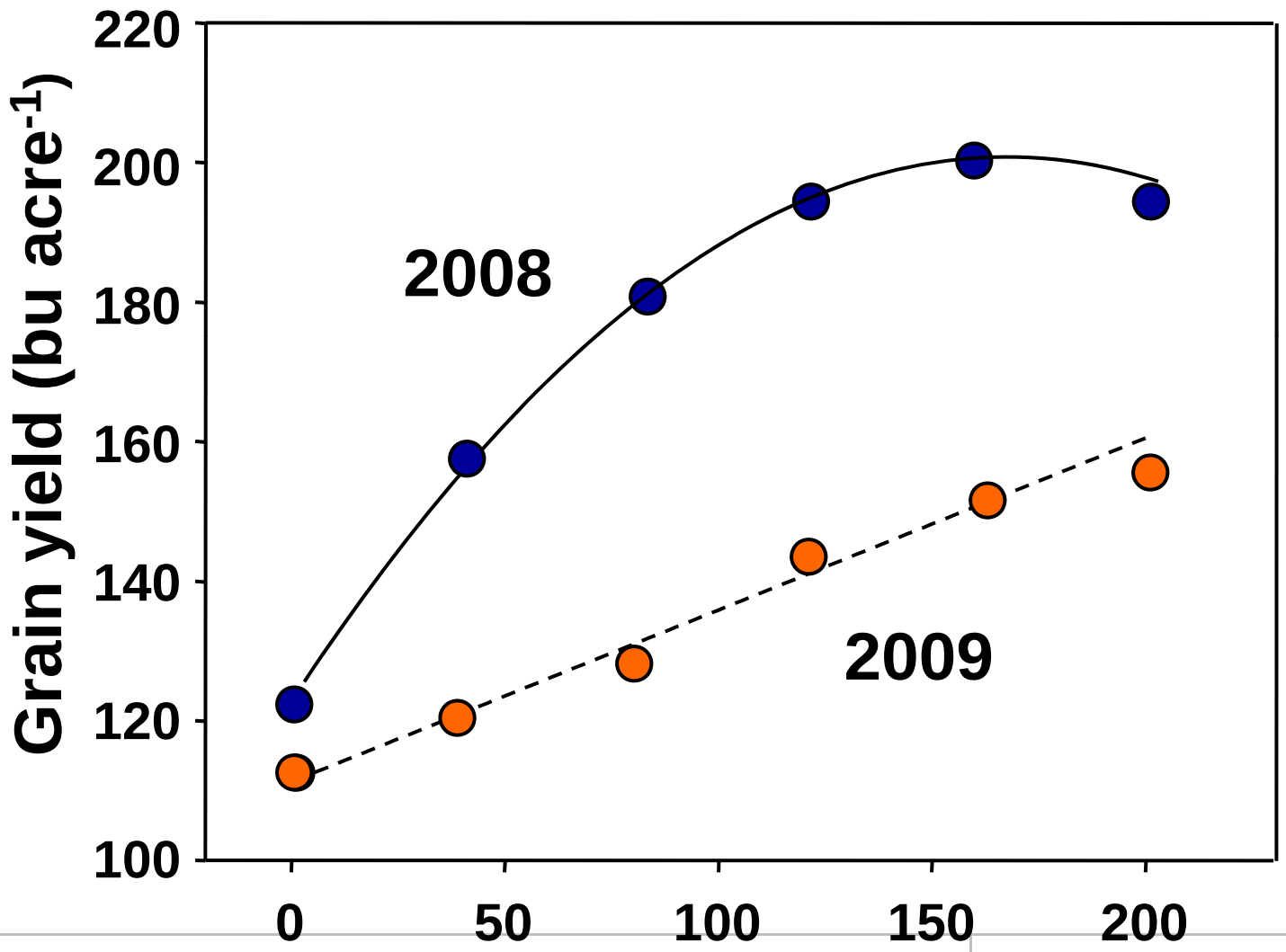
Weather and Nitrogen



Same site – Champaign, IL

Weather and Nitrogen

Same site – DeKalb, IL

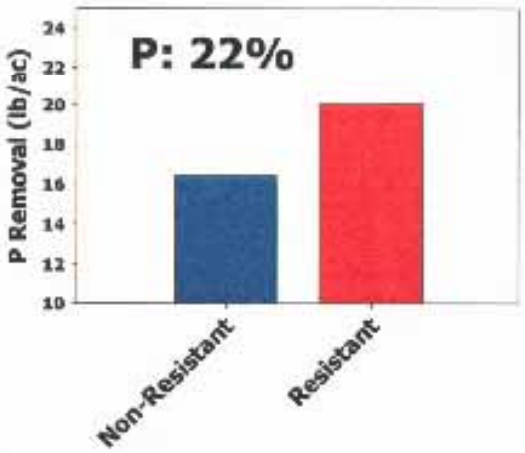


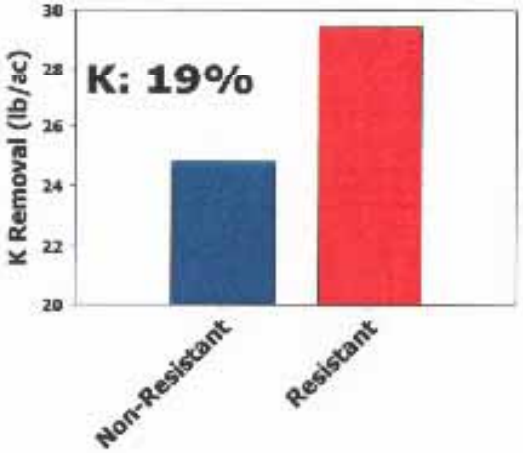
Better N use from Biotechnology Traits

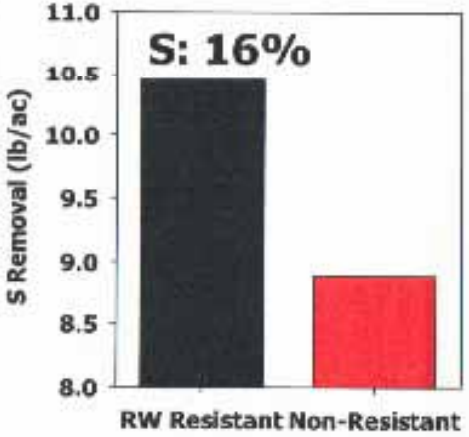
Hybrid	NUE	Uptake	Utilization
	kg/kg N	%	kg/kg N
RW-Bt	25.9*	71*	36.4
Non-RW	17.0	52	33.1
RW-Bt	31.7*	71*	44.6
Non-RW	22.4	56	40.1

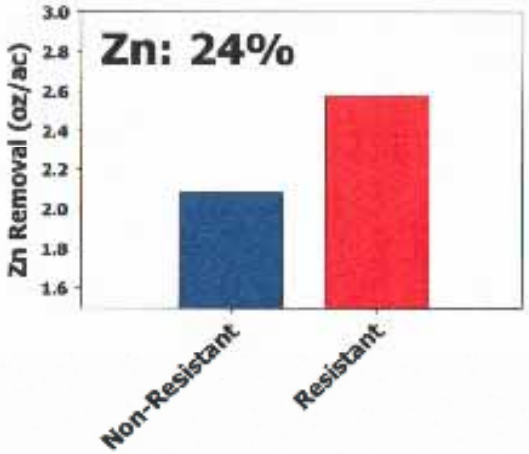
*different from non-RW counterpart P< 0.05

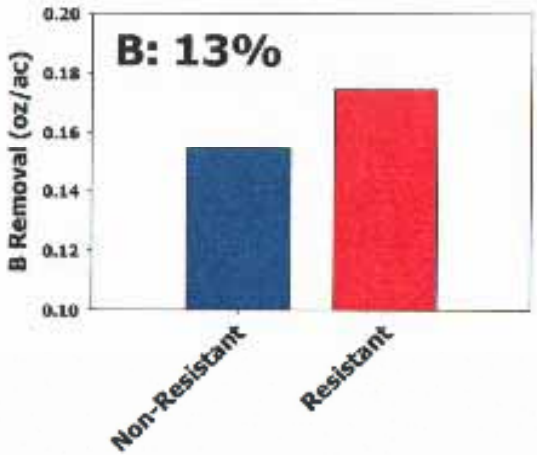
Increased nutrient removal with corn rootworm trait











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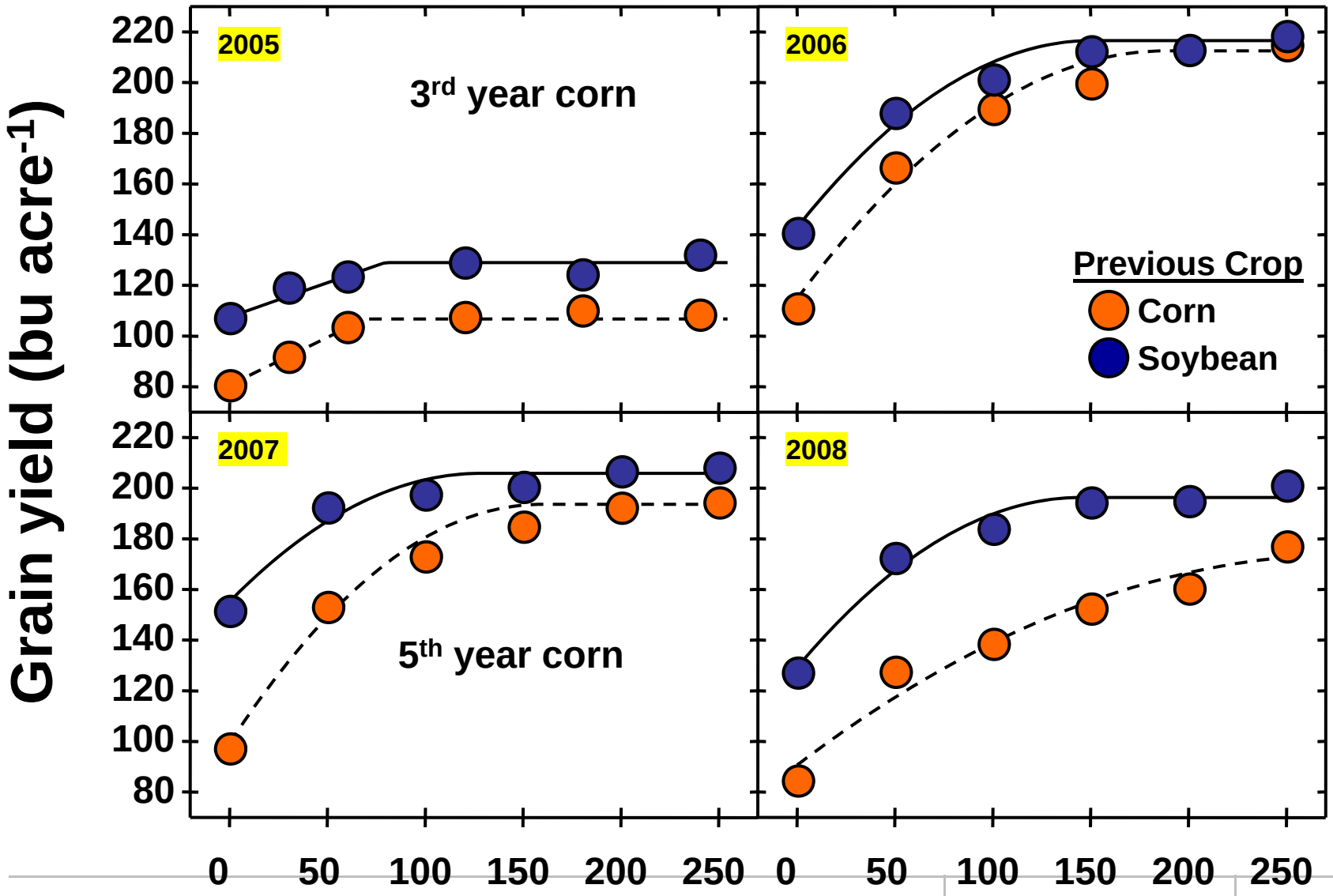
Continuous Corn needs more N



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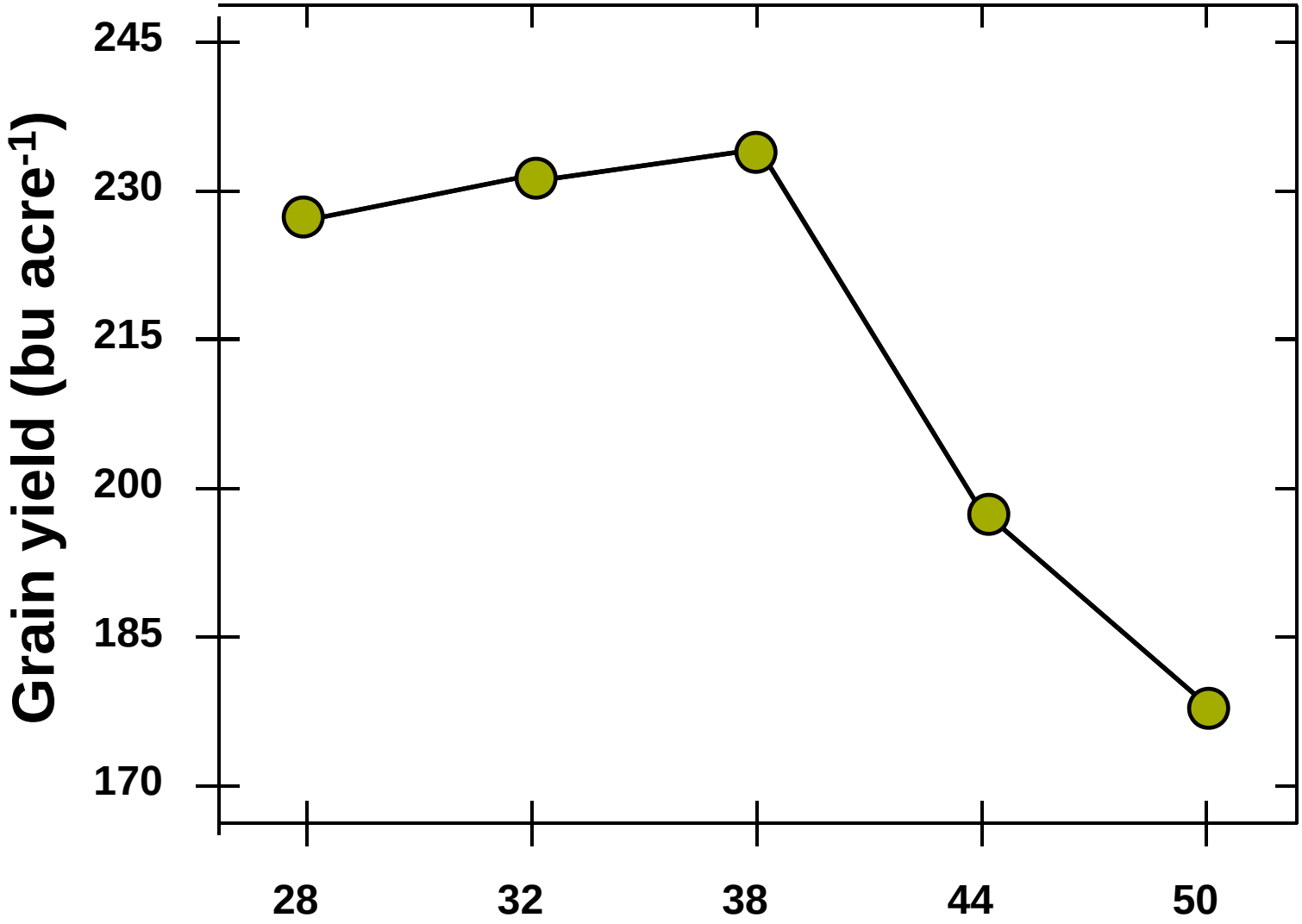
Plant population can decrease yield if fertility and plant distribution are not considered

Champaign, IL 2009



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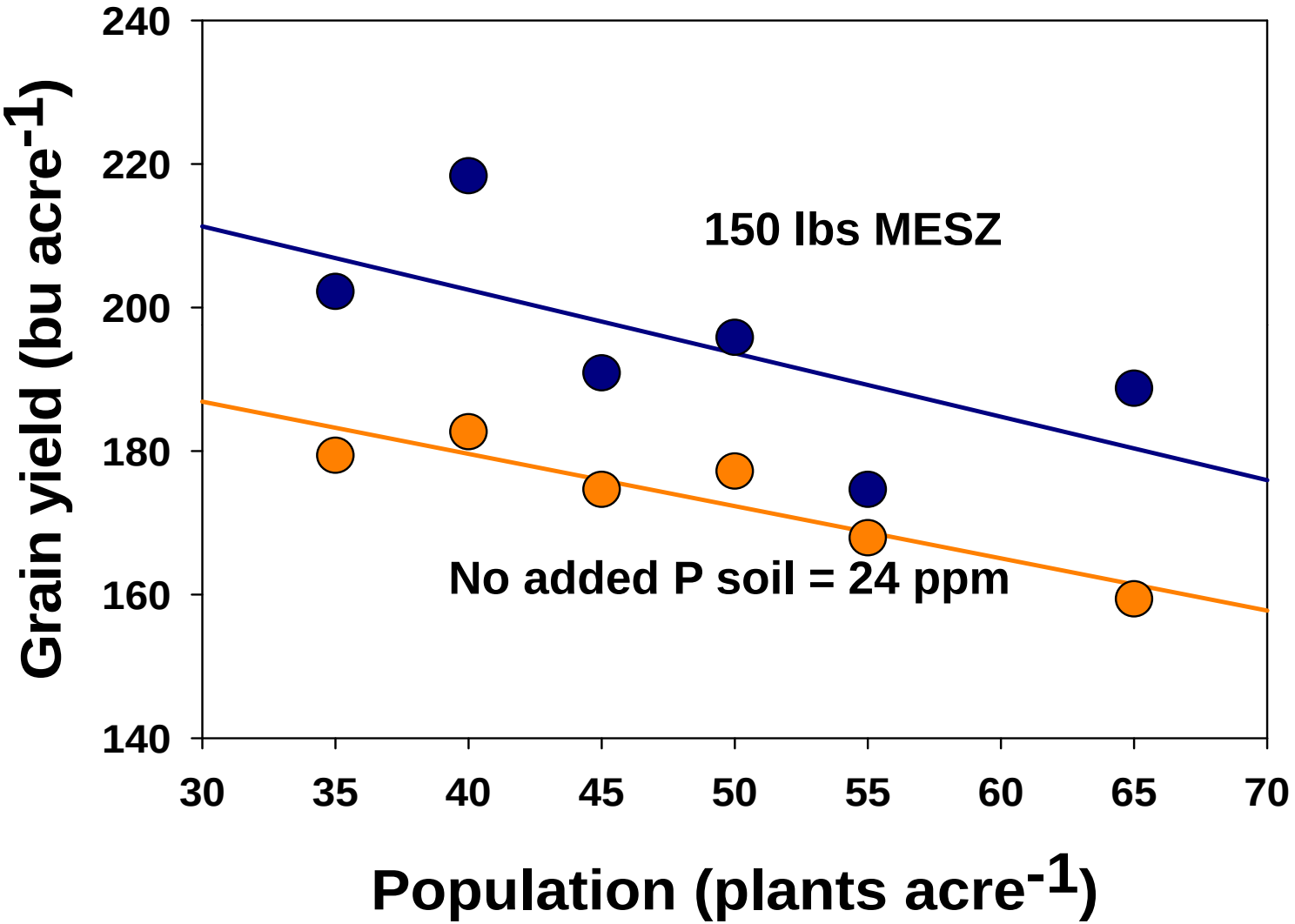
Managing Plant Populations with MESZ



For 30 inch rows, Fairholme Farms, IN, 2010

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High Tech Package vs Traditional Champaign-2009

High Tech Package

Traditional

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Pictures taken at R5

Conclusions

- Big yield gains are possible from crop management that provides better Fertility along with packages of optimized Yield Wonders (High-Tech)

- The High-Tech system either protects or pushes yield depending on the weather

Conclusions

- The yield value of an individual factor is magnified in the High-Tech system

- Increasing plant population may be the foundation for pushing higher yields, <u>but it must be managed with the other Yield Wonders</u>

Mosaic-PLC High Yield Studies

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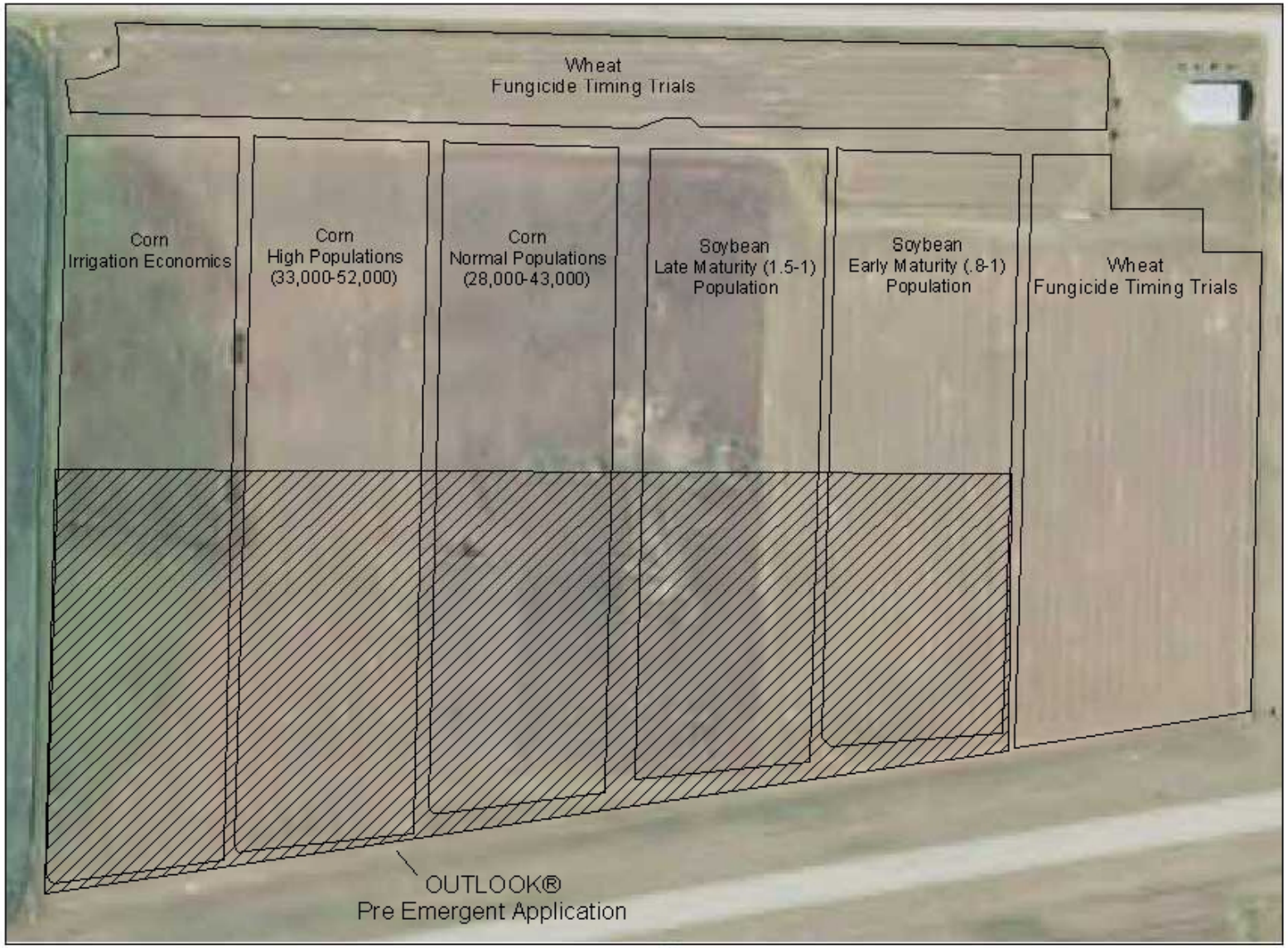
2009 Rosholt Research Farm



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N

2010-Corn Fertility Program

Fertilizer Recommendations: Used crop removal to support 220 bpa corn
2009 Soil Test: Bray P1=23ppm and K=78 ppm

Nutrient	Requested %	Actual %	Requested lbs/Acre	Actual lbs/Acre
Total N	19.67%	19.67%	160	160
Ammoniacal N	0.00%	4.81%	0	39
Water Sol Org N	0.00%	14.86%	0	121
Phosphate	12.29%	12.29%	100	100
Potassium	24.59%	24.59%	200	200
Chloride	0.00%	19.50%	0	159

Broadcasted Pre-plant 160N-100P-200K

Out of the 160 lbs N/ac, 40% was applied as ESN and 60% straight urea

Fertility Plan

2. At Planting time on 04/05/10

CORN TREATMENTS

Treatment	Row	Blend	Population	Rate	Analysis	Nutrients Applied
1	Single	MESZ+KMAG	35K	0	5-16-12-16S-0.4Zn	
2	Single	MESZ+KMAG	35K	125	5-16-12-16S-0.4Zn	6N-20P205-15K20-20S-0.5Zn
3	Twin	MESZ+KMAG	45K	0	5-16-12-16S-0.4Zn	
4	Twin	MESZ+KMAG	45K	250	5-16-12-16S-0.4Zn	12N-40P205-30K20-40S-1Zn

3. Another 80 lbs N as urea applied on 06/2810

Total nutrients:Check: 240N-100P-200K

Low rate: 246N-120P-215K-20S-0.5Zn

High rate: 252N-140P-230K-40S-1.0Zn

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Westport Corn Hybrid

Croplan 3514VT3

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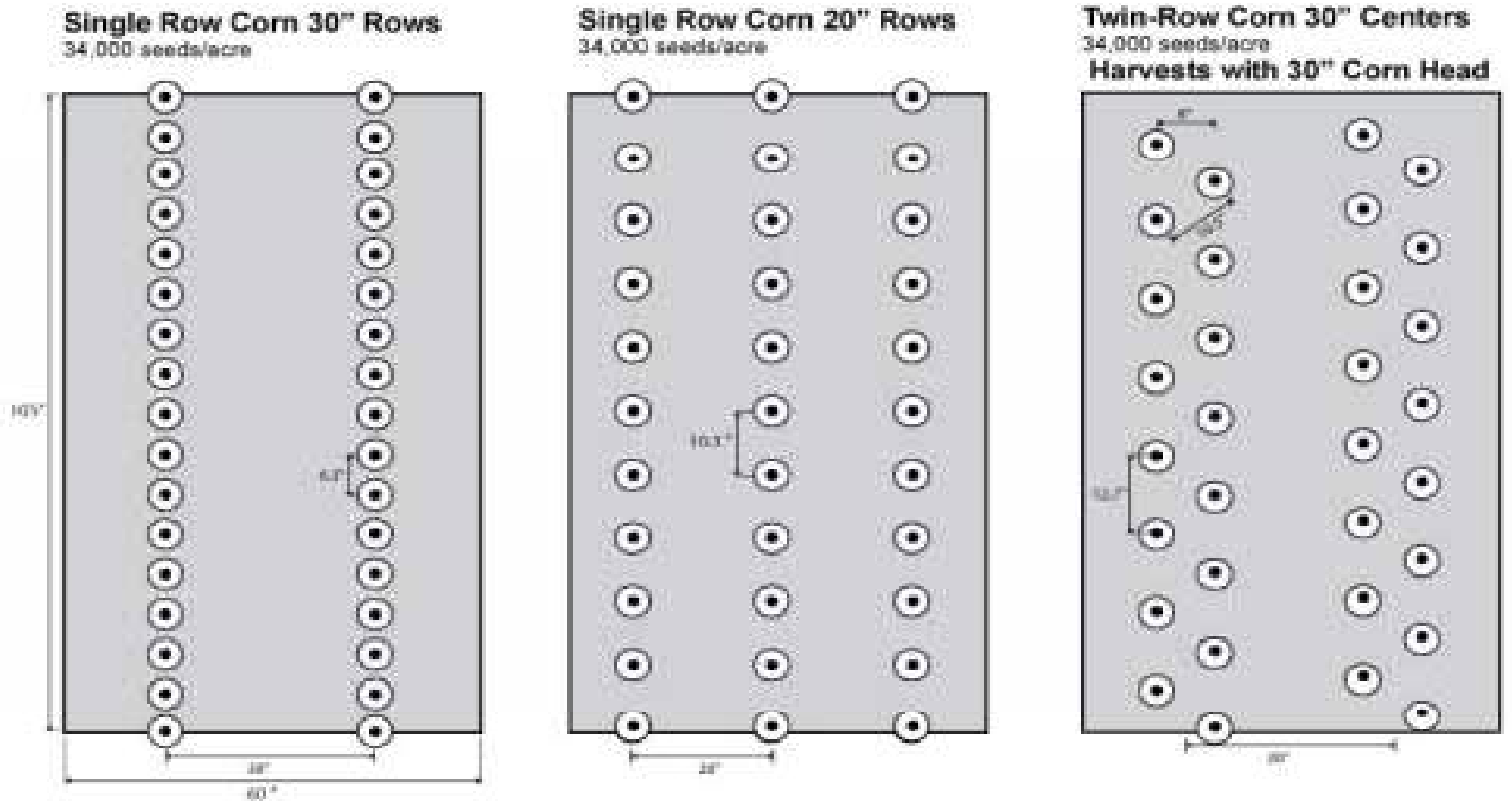
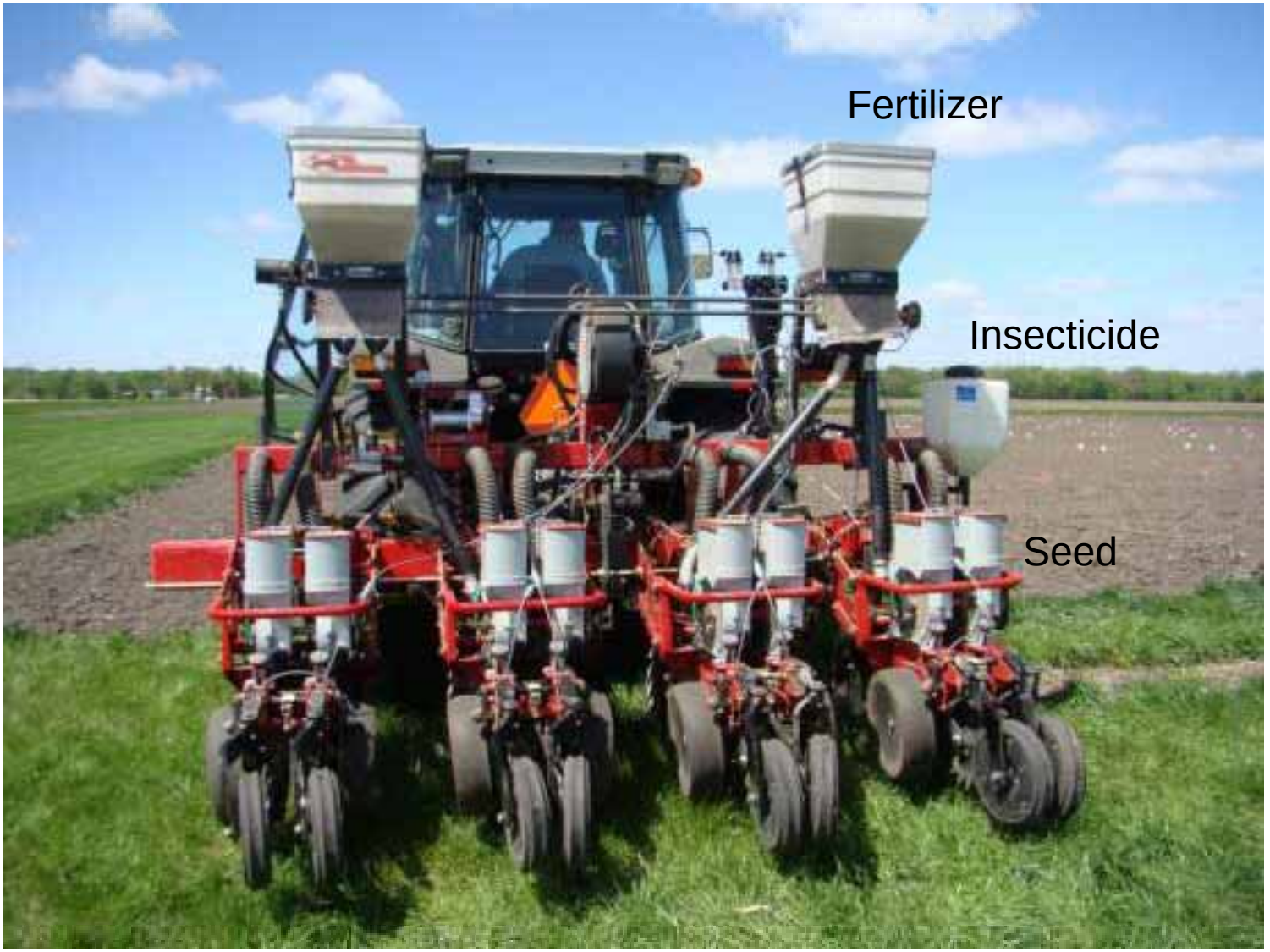
Row Configuration

Drawn to Scale;
Row Spacing with Population Comparison
Ideal Spacing of Corn Seeds with Rootmass of 5" Radius / Stalk of 1" Radius
on 1/1000 Acre (60"x105") plot
at 34,000 Seeds per Acre (34 per 1/1000 acre)



Source: Monosem Inc.

Twin Row Planter



Hybrid: CG 3514 VT3

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Single Rows vs. Twin Rows

Pictures Courtesy of Dr. Fred Below, U of Ill

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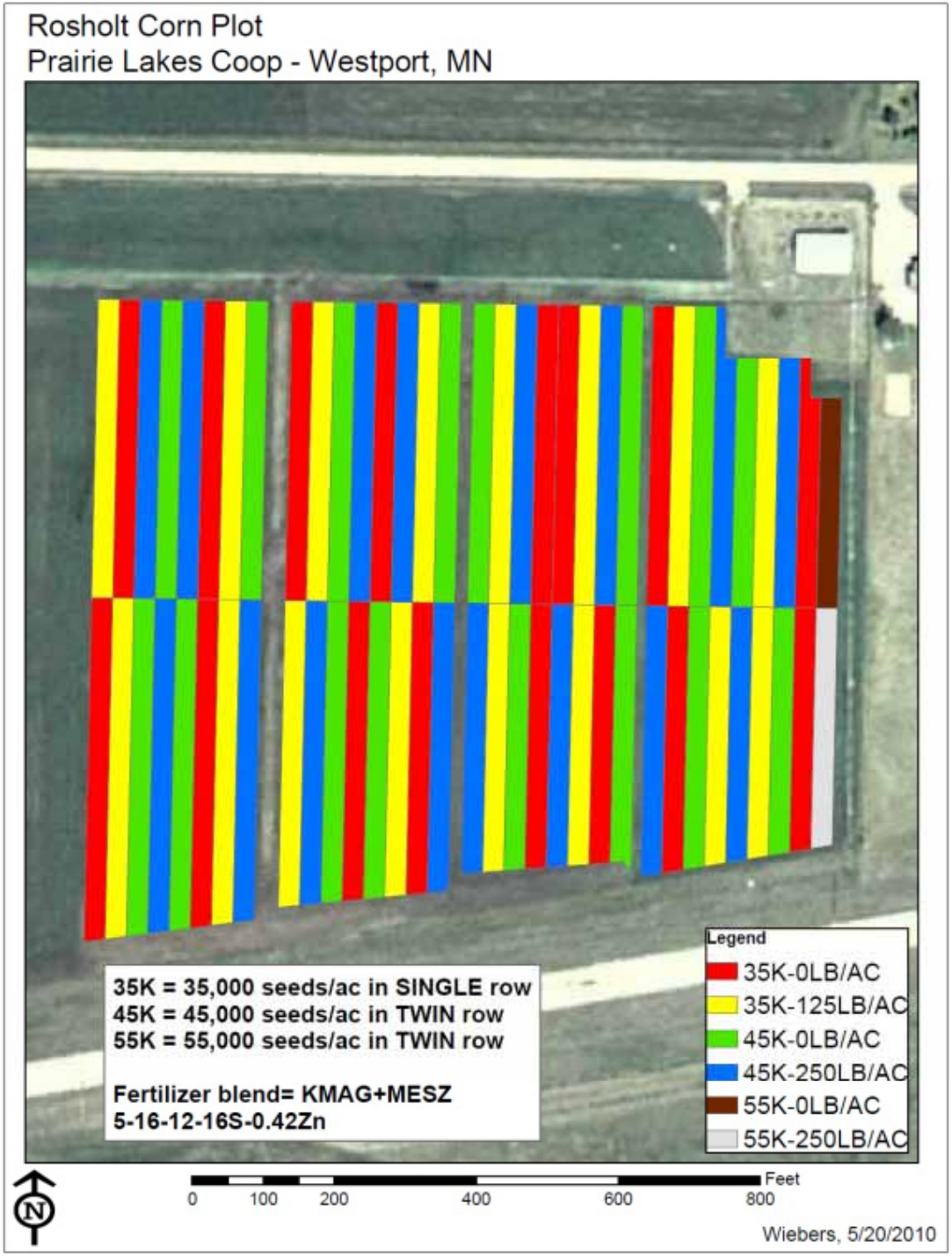
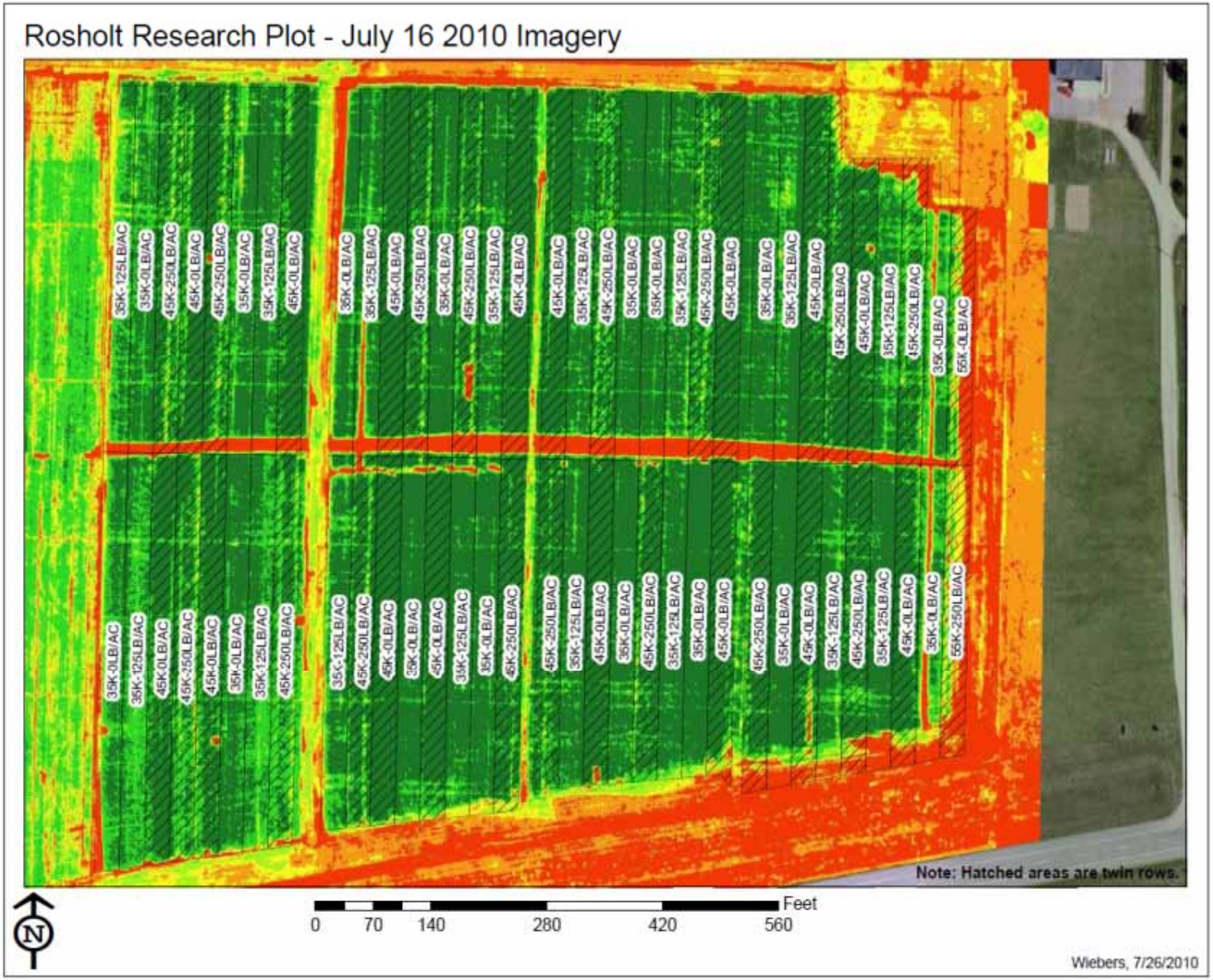
2010 - Rosholt Farm Plan Rev2

Westport Plot Design

2010 Corn Plot Design



Aerial Photo – July 16 - Westport



Plant Population Effect (1Variable)

Treatment	Yield (bu/ac)
35,000 pl/ac Single Row	226.3 B
45,000 pl/ac Twin Row	252.6 A
Yield Difference	26.3

Fungicide Effect (1 Variable)

Treatment	Yield (bu/ac)
Fungicide	249.4 B
No Fungicide	229.4 A
Yield Difference	20

Fungicide x Previous Crop (2 Variables)

Fungicide	Previous Crop		
	Corn	Soybean	Wheat
No Fungicide	208.3	242.2	237.9
Fungicide	242.9	250.0	255.4

The response to fungicide was extremely large for corn (34.6 bu/ac), intermediate for wheat (17.5 bu) and smallest for soybean (7.8 bu) as previous crops.

Fungicide reduced the yield penalty associated with corn as previous crop.

Previous Crop x Fungicide x Population (3 variables)

Population Row	Previous Crop	Fungicide	Yield (bu/ac)
35	Corn	No	196.2
35	Corn	Yes	221.4
35	Soybean	No	226.0
35	Soybean	Yes	241.9
35	Wheat	No	229.5
35	Wheat	Yes	243.0
45	Corn	No	220.4
45	Corn	Yes	264.5
45	Soybean	No	258.3
45	Soybean	Yes	258.1
45	Wheat	No	246.3
45	Wheat	Yes	267.9

Fertilizer response at 35K (4 variables)

Population / Row	Planter Fertilizer	Previous Crop	Fungicide	Yield	
35K Single	0	Corn	No	189.1	
35K Single	0	Corn	Yes	211.3	
35K Single	0	Soybeans	No	224	
35K Single	0	Soybeans	Yes	237.2	
35K Single	0	Wheat	No	223.8	
35K Single	0	Wheat	Yes	242.1	
35K Single	125	Corn	No	203.3	**14.2**
35K Single	125	Corn	Yes	231.5	**20.2**
35K Single	125	Soybeans	No	228	**4**
35K Single	125	Soybeans	Yes	246.6	**9.4**
35K Single	125	Wheat	No	235.1	**11.3**
35K Single	125	Wheat	Yes	243.8	**13**

Fungicide help to get better fertilizer response

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Fertilizer response at 45K (4 variables)

Population / Row	Planter Fertilizer	Previous Crop	Fungicide	Yield	
45K Twin	0	Corn	No	179.2	
45K Twin	0	Corn	Yes	226.2	
45K Twin	0	Soybeans	No	227.2	
45K Twin	0	Soybeans	Yes	232.9	
45K Twin	0	Wheat	No	224.6	
45K Twin	0	Wheat	Yes	244.5	
45K Twin	250	Corn	No	261.5	**82.3**
45K Twin	250	Corn	Yes	302.7	**76.5**
45K Twin	250	Soybeans	No	289.4	**62.2**
45K Twin	250	Soybeans	Yes	283.3	**50.4**
45K Twin	250	Wheat	No	268	**43.4**
45K Twin	250	Wheat	Yes	291.2	**46.7**

C-C showed best fert response

Fungicide wasn't critical on soybeans due to plant distribution

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Reaching the 300 bpa mark

Population / Row	Planter Fertilizer	Previous Crop	Fungicide	Yield
45K Twin	250	Corn	Yes	302.7
45K Twin	250	Wheat	Yes	291.2
45K Twin	250	Soybeans	No	289.4
45K Twin	250	Soybeans	Yes	283.3
45K Twin	250	Wheat	No	268
45K Twin	250	Corn	No	261.5
35K Single	125	Soybeans	Yes	246.6
45K Twin	0	Wheat	Yes	244.5
35K Single	125	Wheat	Yes	243.8
35K Single	0	Wheat	Yes	242.1
35K Single	0	Soybeans	Yes	237.2
35K Single	125	Wheat	No	235.1
45K Twin	0	Soybeans	Yes	232.9
35K Single	125	Corn	Yes	231.5
35K Single	125	Soybeans	No	228
45K Twin	0	Soybeans	No	227.2
45K Twin	0	Corn	Yes	226.2
45K Twin	0	Wheat	No	224.6
35K Single	0	Soybeans	No	224
35K Single	0	Wheat	No	223.8
35K Single	0	Corn	Yes	211.3
35K Single	125	Corn	No	203.3
35K Single	0	Corn	No	189.1
45K Twin	0	Corn	No	179.2

High Population, Planter Fertilizer, Fungicide

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Westport-2010 Conclusions

- Plant population has positive effect on yield
- Twin Row Planters need to be studied further
- Fungicide plays a key role in increasing yields, particularly under C-C rotation
- Fungicide becomes more important on previous crops rotation of corn and wheat, not too key on soybean rotation
- Starter Fertilizers responded under normal plant population (35K), but they showed excellent performance under high plant population.
- **Yes, we can increase the yield mark!**

Bottom Line

Act Locally!!!

Think globally!

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Every field has to be a Profit Center!

Thanks!

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