

32nd Annual NATIONAL NO-TILLAGE CONFERENCE

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The Seven Wonders of 300 Bushel Corn Fred Below & Connor Sible



Crop Physiology Laboratory Team – 2023

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- Dr. Fred Below

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- Jared Fender

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- Sam Leskanich

Master's Students

- Darby Danzl
- Gabriela Frigo Fernandes
- Miranda Ochs
- Dalton Knerrer

Visiting Research Scholars

- Amanda Beckers
- Julia Isaac
- Pieter Schoenmaker



Trained Graduate Students are Our Product



What Are the Three Ps of Productivity?

- **Products**
- **Practices**
- **Physiology**

What is Crop Physiology?

- **Crop Production involves what, when, and where a product or practice works, while Crop Physiology is all of those and WHY it works**

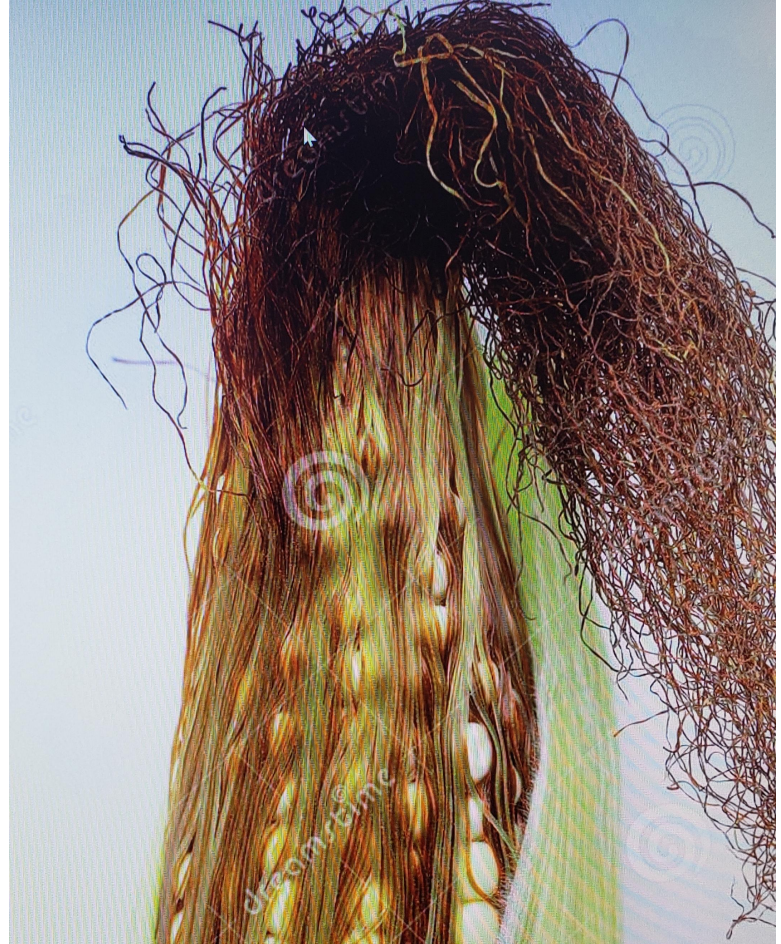
Test Your Knowledge of High Yield Corn

- How do you know if a politician likes corn?

Former President Trump Likes Corn



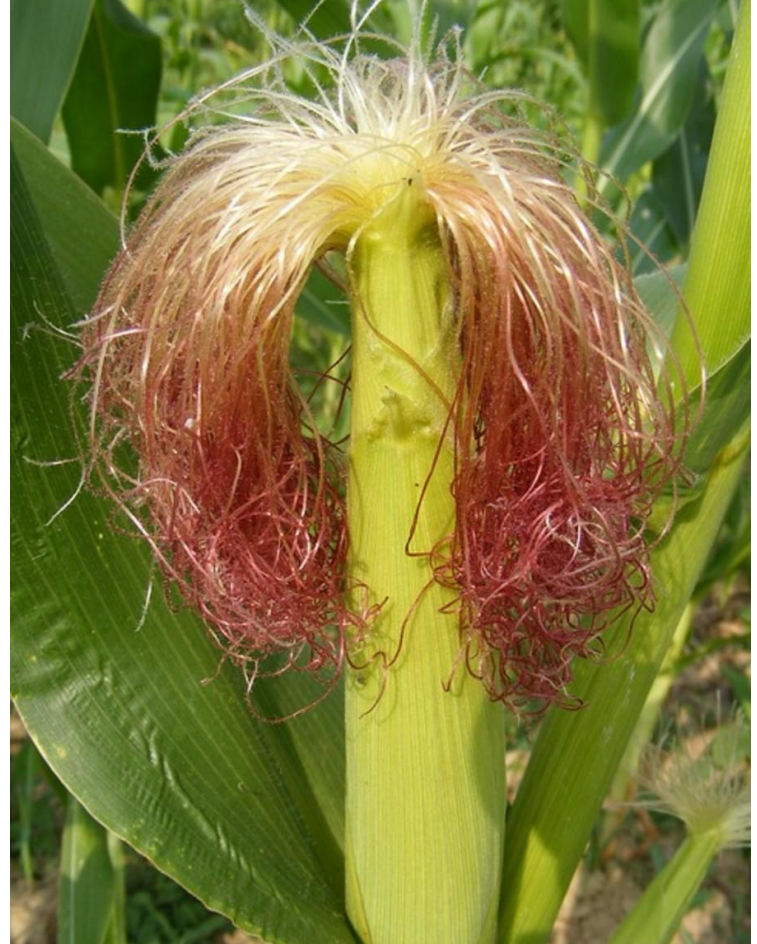
Dr. Fred Below Likes Corn



I Don't Think that President Biden Likes Corn



Presidential Candidate Nikki Haley Likes Corn



Test Your Knowledge of High Yield Corn

- **Why is 300 bushel per acre corn the target?**

The Quest for 300 Bushel Corn

- **Monsanto (2007)- US average corn yields need to double to 300 bushels per acre to feed 9 billion people**
- **World population expected to reach 9 billion by 2037**

The Seven Wonders of the Corn Yield World

The Relative Importance of Management Factors on Yield

EXCLUSIVELY FOR PIONEER CUSTOMERS

PIONEER GrowingPoint MAGAZINE

FEBRUARY 2008 / FEBRUARY 2008

YIELDING ANSWERS

NCGA winners apply lessons to their fields
PAGE 2

1950 1970 1990 2010

Integrating forage tools
Pioneer offers help with all aspects of forage management. See [mainsheet](#).

Three streams of drought data
PAGE 8

Can you survive Sudden Death?
PAGE 4

How your soil grows fertile
PAGE 10

'Seven Wonders' create corn yields
PAGE 28

commentary

By Fred E. Below
Department of Crop Sciences
University of Illinois

PGP THE 7 WONDERS

HERE'S A RANKING OF THE TOP 7 FACTORS THAT DETERMINE CORN YIELDS

To help farmers better understand the value of their crop management decisions, I developed the "Seven Wonders of the Corn Yield World." This is a tool to teach farmers (and students) the relative importance of management factors that can impact corn productivity.

The Seven Wonders ranks the top seven factors that can positively impact corn yields. It assigns an average bushel-per-acre value to each wonder. It's based on a compilation of research conducted by the Crop Physiology Laboratory at the University of Illinois over the last 10 years.

Because the bushel-values are averages of ranges, farmers could experience different values. The research for this ranking was conducted mostly in Illinois, so the relative ranking or value of a particular wonder could change slightly with geography.

Defining a wonder
Some practices are clearly important, but I don't consider them as yield wonders because they are either one-time improvements (tile drainage), they protect rather than increase yield (weed or pest control) or they involve decisions that don't need to be made every year (soil pH and nutrient levels). In my mind, good weed control, along with proper soil pH and adequate levels of phosphorus and potassium, are prerequisites for crop production. They're necessary to allow the seven wonders to express their positive impact on yield.

One nuance of the seven wonders is that they can interact with each other to either magnify or lessen a wonder's impact on yield. As a rough rule, the higher the ranking of a particular wonder, the more control it can exert over the wonders below it. Understanding a wonder's ranking, and its interaction with other wonders, gives farmers an opportunity to further increase grain yields through crop management.

Weather trumps all
Unfortunately, the first wonder of the corn yield world is the one over which farmers have the least control: the weather. Whether in the form of rainfall or temperature, weather is a major determinant of when the crop can be planted. And weather has a huge impact on grain yield.

Even with the other yield wonders optimized and constant, our research shows a 70-plus bushel variation in grain yield due to weather. Weather reacts strongly with other yield wonders, and all farmers realize weather can circumvent their best management plans.

20 PGP magazine / Jan 2008

Weather especially affects nitrogen (N) fertilization, the No. 2 wonder of the corn yield world. The ability to apply N, its availability or susceptibility to loss and its impact on grain yield are all heavily impacted by weather.

Because N fertilizer increases grain yield by an average of 70 bushels, and since most of the other yield wonders also can impact the availability or the use of N, nitrogen fertilizer management continues to receive considerable attention in the research world.

The seeds of potential
Nitrogen use also interacts strongly with the third wonder of the corn yield world, hybrid selection. There's considerable interest in improving the efficiency of N use with genetics or biotechnology.

Hybrid selection is probably the most important decision farmers make. Most don't realize the large difference in yield potential among elite commercial hybrids. Arrays of commercial hybrids, grown under conditions where the other wonders are presumed to be optimized, typically exhibit a 50-bushel range in grain yield.

Hybrid selection will become even more important in the future, when biotechnology adds stress and input traits like drought tolerance and improved N use.

The fourth wonder of the corn yield world, previous crop, is becoming more an issue lately as continuous corn acreage has steadily increased. This is despite the 25 bushel-per-acre yield penalty associated with continuous corn and the higher input cost, especially for N.

Previous crop clearly interacts with the first and second wonders. If sufficient N is available in a good growing year, the continuous-corn yield penalty can be reduced or eliminated. While it makes sense that some hybrids might perform better than others under continuous corn, our research has not shown this. We find the best hybrid on a farmer's rotated land is also the best one for continuous-corn ground.

What's maximum occupancy?
All farmers know the fifth wonder of the corn yield world, plant population, has increased steadily over the last 20 years. What they probably don't know is how well modern hybrids can flex their ear components (such as kernel number and weight) to account for differences in plant stand.

Because of this, we find similar yields between 28,000 and 40,000 plants per acre, although there is a big difference in the size of individual kernels. Thus, most of the 20-bushel yield benefit we see from plant population comes from correcting stands that are too low.

Of course, plant population interacts heavily with weather: High plant populations are particularly susceptible to unfavorable

conditions. Contrary to what many people think, however, we don't see an interaction between plant population and N. There's no need for more N fertilizer at higher plant populations.

To plow or not
The sixth wonder of the corn yield world is tillage, which comes in varying degrees or in differing times. Both degree and timing aspects interact heavily with the other yield wonders. The relative advantages or disadvantages of a particular tillage system or time depend largely on the weather. Tillage also interacts with N availability and hybrid.

The degree and timing of tillage can make a big difference with the previous crop because most of the yield penalty associated with continuous corn is due to the residue. Similarly, the tillage system can have a big impact on plant population. Overall, our research shows a 15-bushel range of yield due to the various tillage systems.

The seventh wonder of the corn yield world is a catch-all that I call chemicals. This includes plant growth regulators and compounds that exert growth-regulate-like effects that lead to a positive change in growth or yield determination.

Late-season leaf-greening from certain foliar fungicides and new technologies that make the plant less sensitive to environmental stresses fit into this category. While the overall average is a positive 10 bushels, the success of these compounds depends highly on the other yield wonders, especially weather and hybrid. This category has the widest range.

The sum total
They all add up. By optimizing all of the seven wonders, grain yields of 260 bushels should be possible. This total doesn't take into account interactions among the wonders, which in some cases could drive yields even higher. By the same token, a nonoptimized yield wonder lowers yield.

Although I realize the seven wonders concept is a vast oversimplification of all the complicated factors that make a high yielding corn crop, it should give you a better perspective on how your management decisions can impact grain yield. ☺

The Seven Wonders of the Corn Yield World
Based on PGP data, University of Illinois

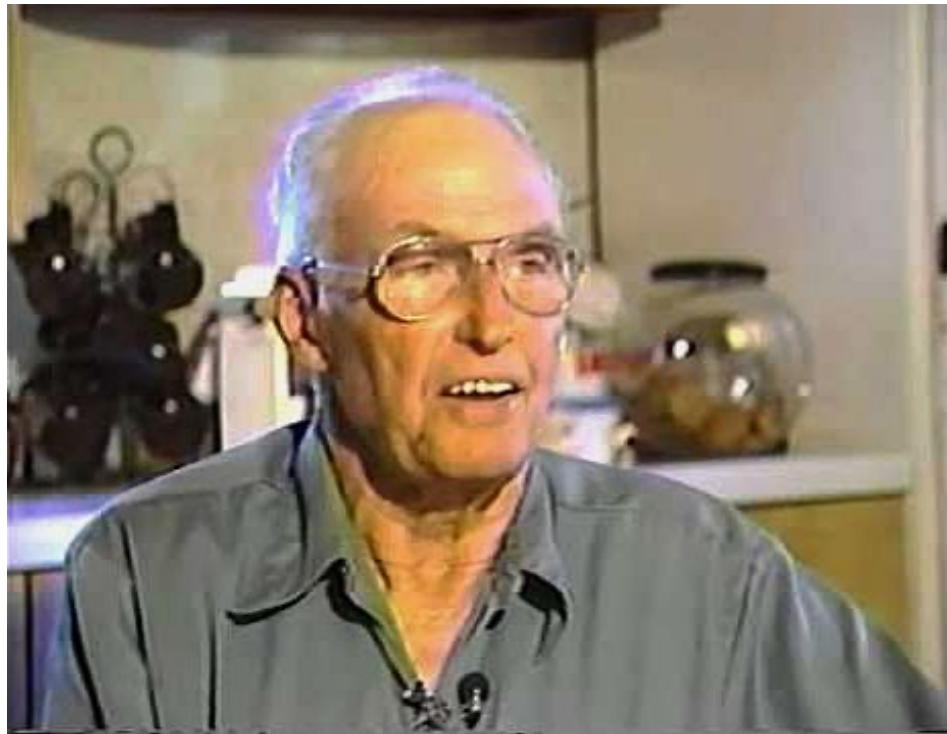
Factor	Relative Importance (Rank)
Weather	1
Nitrogen	2
Hybrid	3
Previous Crop	4
Plant Population	5
Tillage	6
Chemicals	7

PGP magazine / Jan 2008 21

Test Your Knowledge of High Yield Corn

- **How common is 300 bushel per acre corn in our research?**

Herman Warsaw Produces Record Corn Yield in 1985



- Herman Warsaw of Saybrook, Illinois produces a world record 370 bushels per acre

Research on Herman Warsaw's Farm



- Our replicated research plots on Mr. Warsaw's farm in 1985 produced 313 bushels per acre

Research on Herman Warsaw's Farm



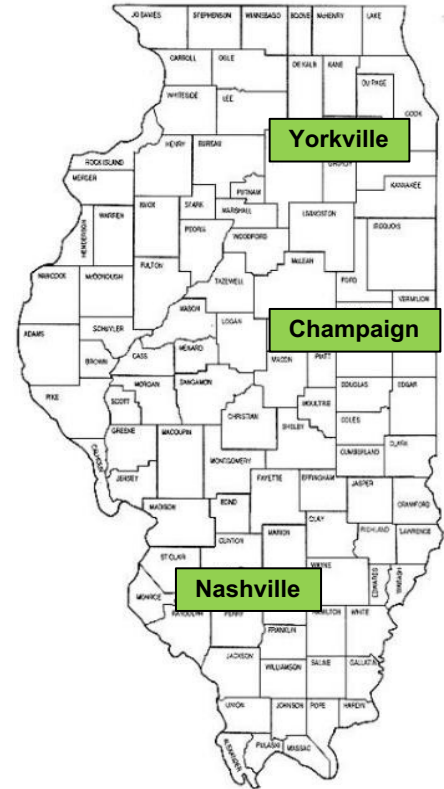
- Our replicated research plots on Mr. Warsaw's farm in 1985 produced 313 bushels per acre
- Did not see 300 bushels again for 30 years

Corn Management Yield Potential

How Hybrids Respond to Agronomic Management

Illinois Corn Management Yield Potential 2023 Hybrid Yield Report

Miranda C. Ochs, Connor N. Sible, and Fred E. Below
Crop Physiology Laboratory
Department of Crop Sciences
University of Illinois at Urbana-Champaign

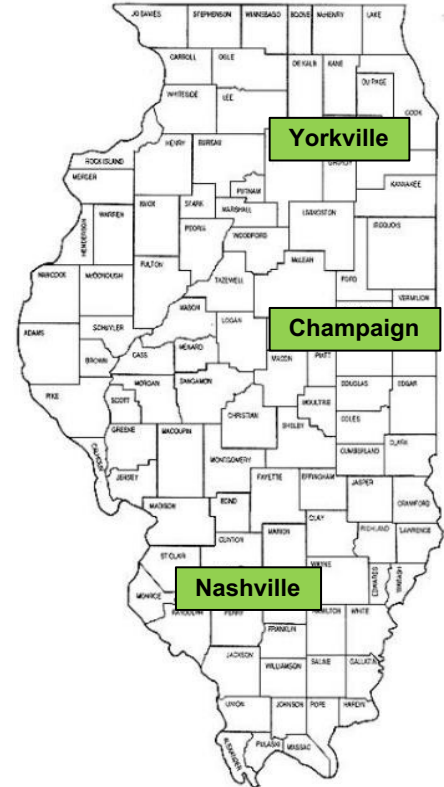


Corn Management Yield Potential

How Hybrids Respond to Agronomic Management

Average soil analysis at CPL research sites

	Location		
	Yorkville	Champaign	Nashville
OM (%)	4.8	3.7	2.2
pH	6.4	6.3	6.7
CEC	21.5	19.3	10.2
P (ppm)[†]	65	30	22
K (ppm)[†]	166	137	95



Thanks to Stewart Farms in Yorkville and Baring Farms in Nashville

Highest Yearly Yields in CPL Research Trials

Year	Location	Grain Yield
		bushels/acre
2015	Champaign	360
2016	Yorkville	327
2017	Yorkville	379
2018	Champaign	322
2019	Champaign	310
2020	Nashville	279
2021	Nashville	363
2022	Champaign	310
2023	Yorkville	343

All without irrigation and all replicated plot averages

Test Your Knowledge of High Yield Corn

- **What management factors can lead to 300 bushel per acre corn?**

The Seven Wonders of 300 Bushel Corn

- **Ranks, and gives an average bushel per acre value of those seven factors that can have a positive (and sometimes negative) impact on corn yield, and that when summed can lead to 300 bushels**
- **An update to the previous ‘Seven Wonders of the Corn Yield World’ that summed to 260 bushels**

Crucial Prerequisites, but not 300 Bushel Yield Wonders

- **Soil Structure and Drainage**

**Can soil structure be improved
from use of No-Tillage or a Cover
Crop?**

Crucial Prerequisites, but not 300 Bushel Yield Wonders

- **Soil Structure and Drainage**
- **Control of Weeds, Pests, Diseases**

Is foliar protection with fungicides (& insecticides) a prerequisite for 300 bushel corn production?



Response to Foliar Protection by Location & Year

Location	2020	2021	2022	2023
		Δ bushels acre ⁻¹		
Yorkville	4	-	5	8
Champaign	14	13	7	5
Nashville	26	12	13	7

Foliar Protection as Miravis Neo and Warrior II at VT/R1

Average of 36 hybrids at each location in 2020 & 2021, and 20 in 2022 & 2023

Yorkville site lost in 2021 to Derecho winds.

Tar Spot (*Phyllachora Maydis*) a New and Potentially Devastating Leaf Disease in the US Corn Belt



TAR SPOT. D. MALVICK



**Crop
Physiology**

Crucial Prerequisites, but not 300 Bushel Yield Wonders

- **Soil Structure and Drainage**
- **Control of Weeds, Pests, Diseases**
- **Proper soil pH & adequate 'base' levels of P & K based on soil tests**

Are Soil Tests Calibrated to 300 Bushels?

Test Your Knowledge of High Yield Corn

- **When were soil test values calibrated to corn yields?**

In the 60's and Early 70's

Crucial Prerequisites, but not 300 Bushel Yield Wonders

- Soil Structure and Drainage**
- Control of Weeds, Pests, Diseases**
- Proper soil pH & adequate 'base'
levels of P & K based on soil tests**

Seven Wonders of the 300 Bushel Corn

Rank	Factor	Value
		bu/acre
1	Weather	90+
2	Fertility	90
3	Hybrid	50
4	Plant Population	25
5	Crop Rotation	20
6	Tillage/No-Tillage	15
7	Biologicals	10

Given key prerequisites



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7	Biologicals	10

Given key prerequisites



Negative Weather Events can Seriously Decrease Yield Potential



Negative Weather Events can Seriously Decrease Yield Potential



Negative Weather Events can Seriously Decrease Yield Potential



Negative Weather Events can Seriously Decrease Yield Potential

- **Every night in August that the temperature stays above 73 degrees results in a bushel per acre loss in yield**

Planting Date is Determined by Weather



May 15th, 2019 in Champaign, IL

Non-Uniformity of Corn Due to Early Planting



Non-Uniformity of Corn Due to Early Planting



All The Wonders Interact with Each Other

Rank	Factor	Value
		bu/acre
1	Weather	90+
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3	Hybrid	50
4	Plant Population	25
5	Crop Rotation	20
6	Tillage/No-Tillage	15
7	Biologicals	10

Given key prerequisites

Test Your Knowledge of High Yield Corn

- **Does weather impact nutrient availability?**

Weather Induced Nitrogen Loss



Seven Wonders of the 300 Bushel Corn

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Given key prerequisites



Nutrition Needed for 300 Bushel Corn

Nutrient	Required to Produce	Production Coefficient	Removed with Grain	Removal Coefficient
	lbs/acre	lbs/bushel	lbs/acre	lbs/bushel
N	333	1.11	192	0.64
P₂O₅	132	0.44	105	0.35
K₂O	234	0.78	78	0.26
S	30	0.10	18	0.06
Zn (oz)	9.3	0.031	5.7	0.019
B (oz)	1.5	0.005	0.3	0.001

Test Your Knowledge of High Yield Corn

- How can we best use fertilizers to ensure adequate soil fertility for high yields?

**Better Source, Rate, Time,
and Placement**

Test Your Knowledge of High Yield Corn

- How can we best use fertilizers to ensure adequate soil fertility for high yields?

**Better Source, Rate, Time,
and Placement**

Test Your Knowledge of High Yield Corn

- **Why is better placement of fertilizers so important?**

Roots Expand Only 6-8 Inches Horizontally

Roots do Not Cross the Row



Root System at R5, 32,000 plants/acre

Methods for Better Placement of Fertilizers

- **Liquid at Planting - In-Furrow or 2 x 2**

Placement with Liquid In-Furrow Starter Fertilizer



Effect of Properly Placed Fertilizer



3 gallons 10-34-0 In-Furrow

No Starter



**Crop
Physiology**

Methods for Better Placement of Fertilizers

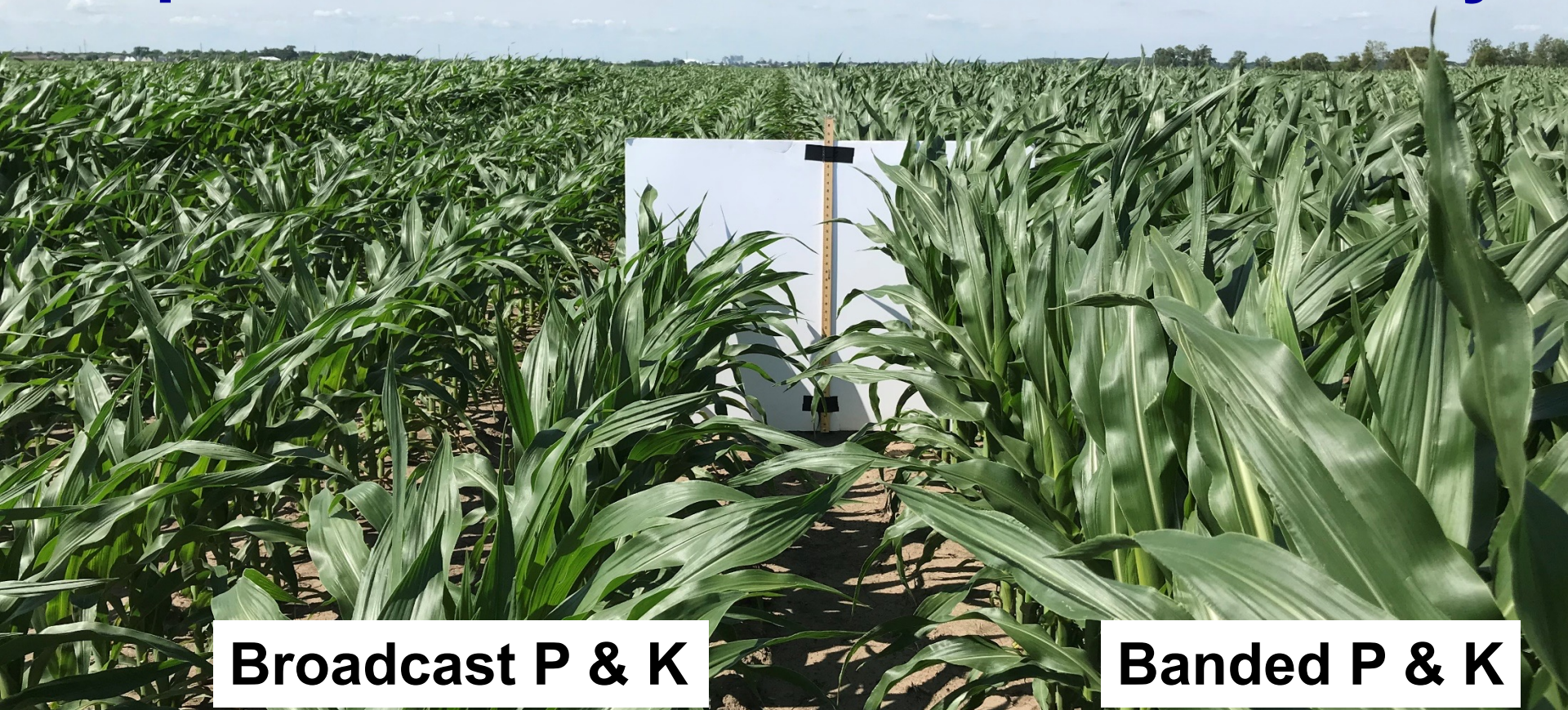
- **Liquid at Planting - In-Furrow or 2 x 2**
- **Banding directly under future crop row**

Preplant Banding Application



Fertilizer is placed 4 to 6 inches deep directly below the future crop row

Improved Growth with Banded Fertility



Broadcast P & K

Banded P & K

Same Hybrid – Same Population – Same Planting Date- Same Fertilizer Amounts

Methods for Better Placement of Fertilizers

- **Liquid at Planting - In-Furrow or 2 x 2**
- **Banding directly under the future crop**
- **In season placement adjacent to the crop row Y-Drop**

Research Scale Sidedress Toolbar Center-Row Coulter or Y-Drop



Methods for Better Placement of Fertilizers

- **Liquid at Planting - In-Furrow or 2 x 2**
- **Banding directly under the future crop**
- **In season placement adjacent to the crop row Dry-Drop**

Surface Banding of Dry Fertilizer – Dry Drop



Seven Wonders of the 300 Bushel Corn

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7	Biologicals	10

Given key prerequisites



Yield Range Among Hybrids by Location & Year

Location	2020	2021	2022	2023
		Δ bushels acre ⁻¹		
Yorkville	57	-	40	62
Champaign	48	62	49	63
Nashville	70	61	60	38

Average of 36 hybrids at each location in 2020 & 2021, and 20 in 2022 & 2023
Yorkville site lost in 2021 to Derecho winds.

Not All Hybrids are Not Created Equal - 2022

Rank	Yield bu/acre	Rank	Yield bu/acre	Rank	Yield bu/acre	Rank	Yield bu/acre
1	284	6	267	11	258	16	247
2	276	7	264	12	254	17	244
3	273	8	261	13	254	18	240
4	270	9	259	14	251	19	237
5	269	10	258	15	249	20	235

LSD (0.10) 5

Averaged across management levels at **Champaign (Central IL)**

Yield Range Among Hybrids by Location & Year

Location	2020	2021	2022	2023
		Δ bushels acre ⁻¹		
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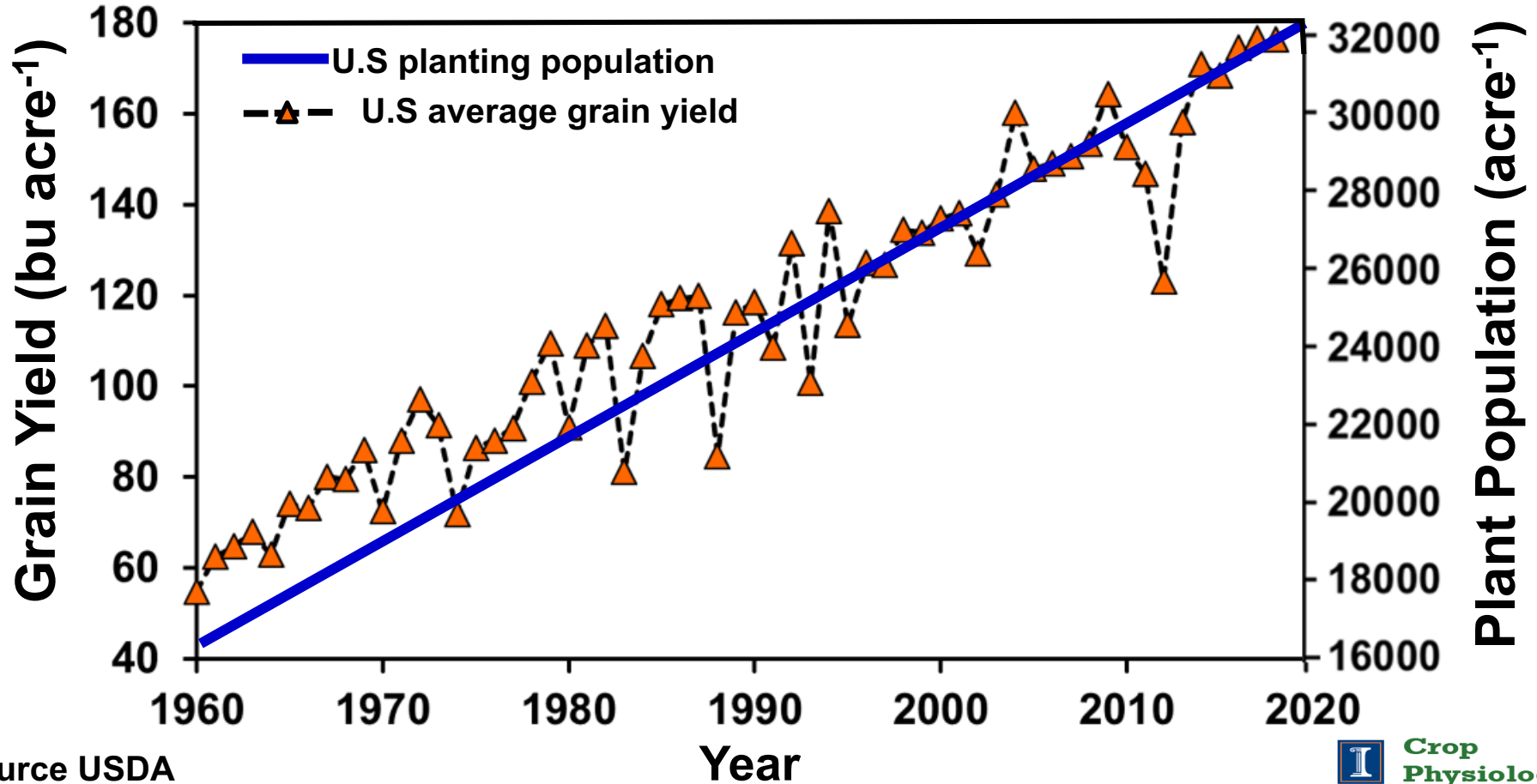
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7	Biologicals	10

Given key prerequisites

How Have Corn Yields Increased?



Corn Yield is a Product Function of Yield Components

$$\text{Yield} = (\text{plants/acre}) \times$$
$$(\text{kernels/plant}) \times$$
$$(\text{weight/kernel})$$

Corn Yield is a Product Function of Yield Components



Plants/acre



Kernels/plant



Weight/kernel

Which Yield Component Do Growers Have the Most Control Over?



Plants/acre

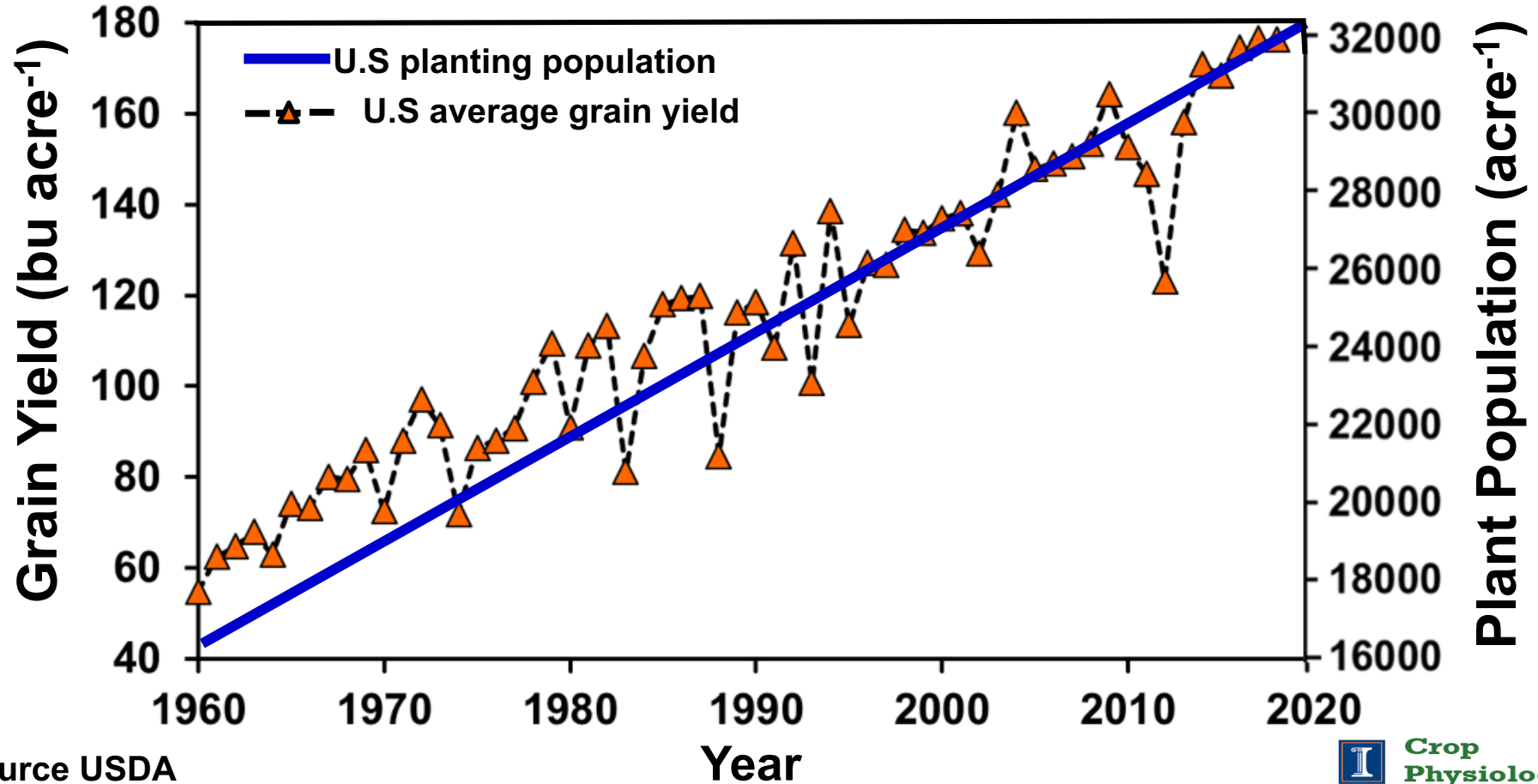


Kernels/plant



Weight/kernel

Population Increases 400 Plants per Acre per Year



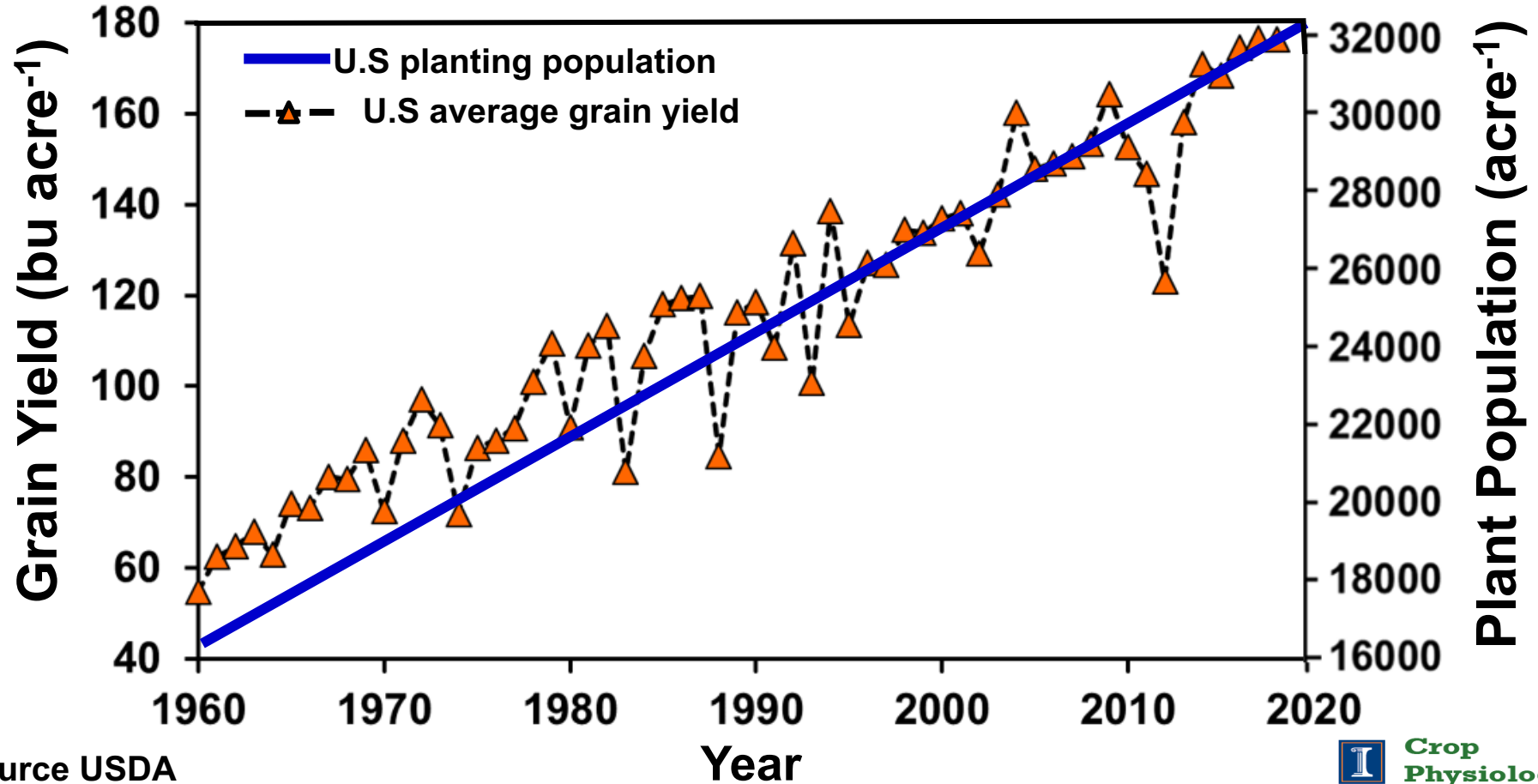
Test Your Knowledge of High Yield Corn

- What is the maximum population that corn plants can tolerate in a 30 inch row spacing?

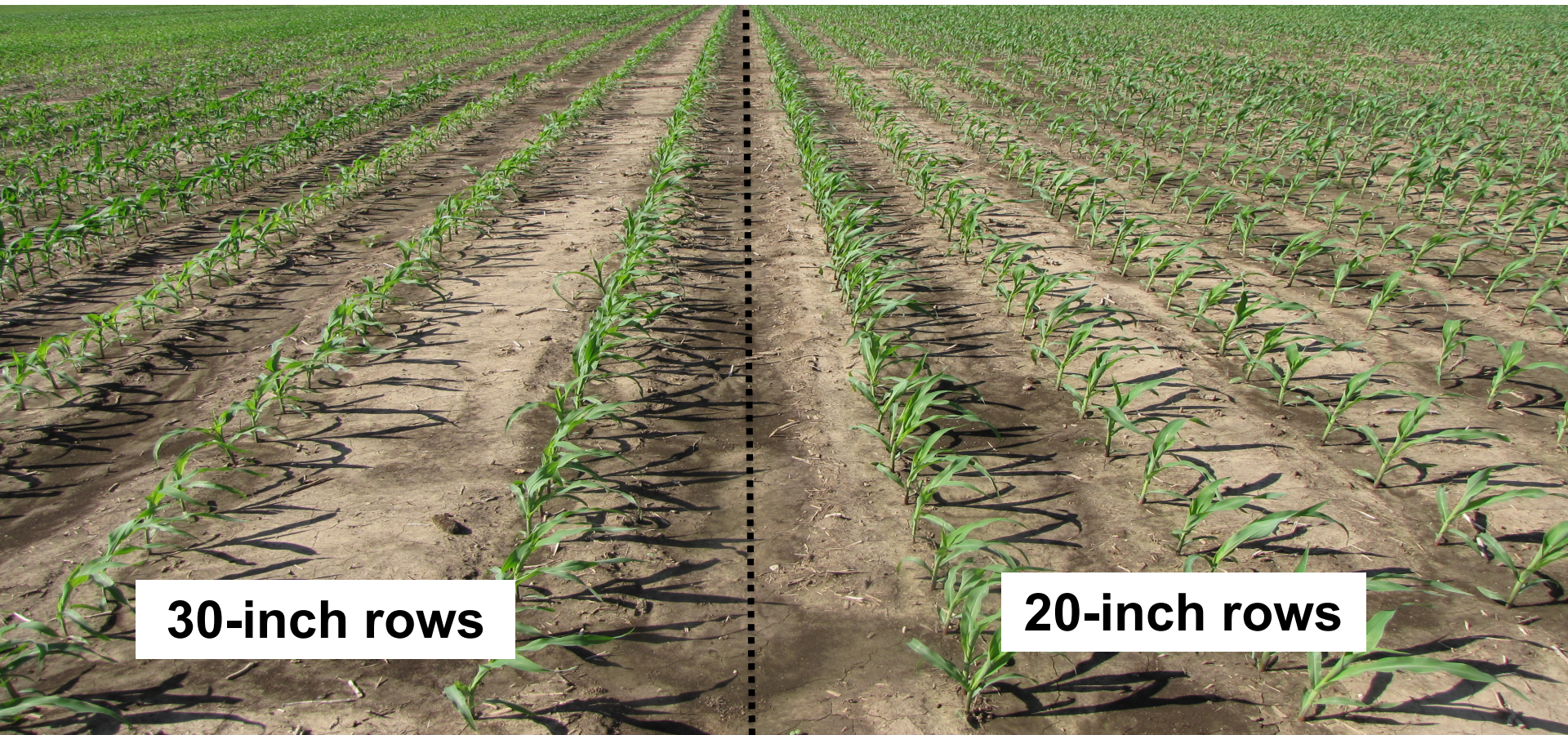
38,000 plants per acre



Population Increases 400 Plants per Acre per Year



Is the Future of Corn Higher Populations in Narrow Rows?



30-inch rows

20-inch rows

Both at 44,000 plants/acre



**Crop
Physiology**

Narrow Row Spacing Intercepts More Light



Both at 44,000 plants/acre



Narrow Rows Can Support Higher Plant Populations

Within row plant-to-plant spacing of 4.8 inches

Within row plant-to-plant spacing of 7.1 inches

30-inch rows

20-inch rows

Both at 44,000 plants/acre



Response to Narrow Rows by Location & Year

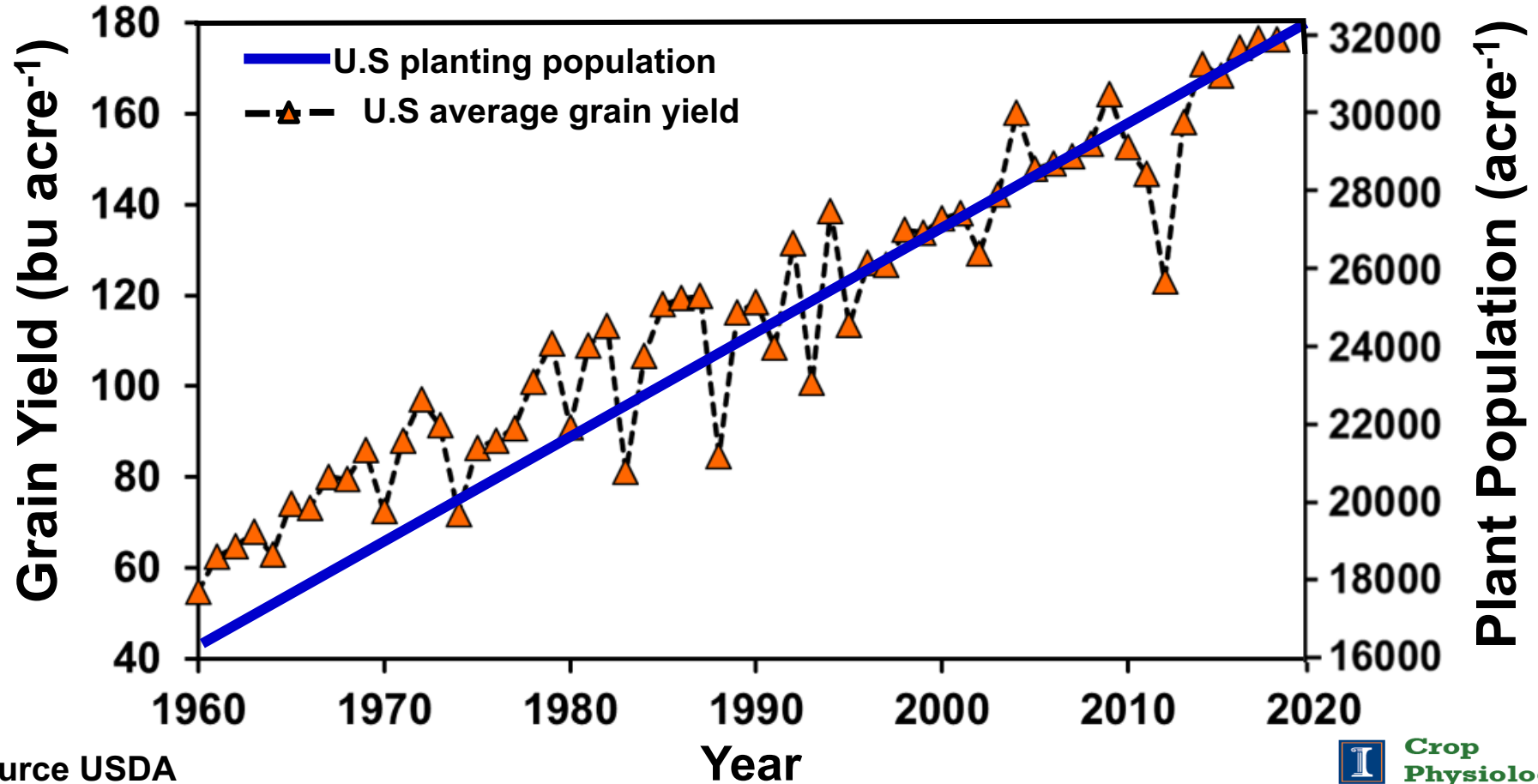
Location	2020	2021	2022	2023
		Δ bushels acre ⁻¹		
Yorkville	-7	-	16	5
Champaign	3	23	15	18
Nashville	36	9	7	3

Difference between 20 inch and 30-inch row spacing

Average of 36 hybrids at each location in 2020 & 2021, and 20 in 2022 & 2023

Yorkville site lost in 2021 to Derecho winds.

Population Increases 400 Plants per Acre per Year



Test Your Knowledge of High Yield Corn

- What happens to the size of each plant's root system as the plant population is increased?

It Gets Smaller



Root Digging/ Washing





Increasing Plant Population = Smaller Roots

30,000 plants/acre

36,000 plants/acre

42,000 plants/acre



2.5% decrease in root mass per 1,000 plant increase in population

Test Your Knowledge of High Yield Corn

- What happens to the size of each plant's root system as row spacing is narrowed from 30 inches to 20 inches

It Gets Bigger



30" 38,000



30" 44,000



30" 50,000



30" 56,000



20" 38,000



20" 44,000



20" 50,000



20" 56,000



30" 38,000



12.2 grams

30" 44,000



10.2 grams

30" 50,000



8.6 grams

30" 56,000



6.8 grams

20" 38,000



14.6 grams

20" 44,000



12.5 grams

20" 50,000



10.3 grams

20" 56,000



8.6 grams

Seven Wonders of the 300 Bushel Corn

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7	Biologicals	10

Given key prerequisites

TOTAL

300 bu



To Produce 300 Bushel Corn Yields?

- **Must have the prerequisites, soil structure, drainage, season long weed control & foliar protection**
- **Optimize each of the seven wonders, and their positive interactions**

Seven Wonders of the 300 Bushel Corn

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		bu/acre
1	Weather	90+
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4	Plant Population	25
5	Crop Rotation	20
6	Tillage/No-Tillage	15
7	Biologicals	10

Given key prerequisites

TOTAL

300 bu



Seven Wonders Impact on Residue?

Rank	Factor	Value
		bu/acre
1	Weather	90+
2	Fertility	90
3	Hybrid	50
4	Plant Population	25
5	Crop Rotation	20
6	Tillage/No-Tillage	15
7	Biologicals	10

Given key prerequisites

TOTAL

300 bu



Where does residue come from?



**Cover Crops
(cereal rye)**



**Double
Crops**



**Higher
Yields**

Where does residue come from?



**Cover Crops
(cereal rye)**

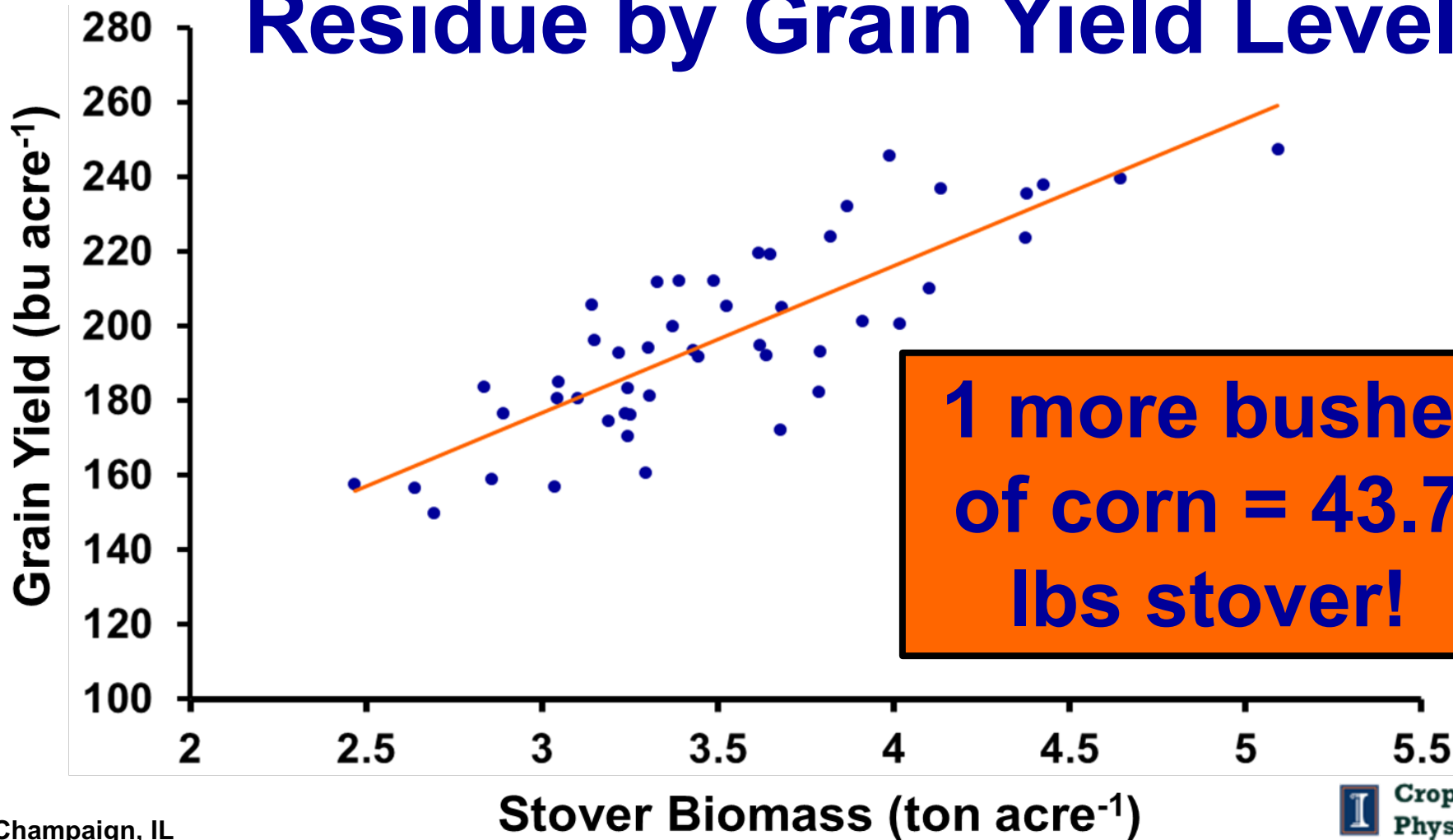


**Double
Crops**



**Higher
Yields**

Residue by Grain Yield Level



Seven Wonders of 300 Bushel Corn

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		bu/acre
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2	Fertility	90
3	Hybrid	50
4	Plant Population	25
5	Crop Rotation	20
6	Tillage/No-Tillage	15
7	Biologicals	10

Given key prerequisites

TOTAL

300 bu



Seven Wonders of 300 Bushel Corn

Rank	Factor	Value
		tons/acre
1	Weather	2.0+
2	Fertility	2.0+
3	Hybrid	1.1
4	Plant Population	0.6
5	Crop Rotation	0.4
6	Tillage/No-Tillage	0.3
7	Biologicals	0.2

Given key prerequisites

TOTAL

6.6 ton



Corn Residue by Yield Level

Stover

Grain Yield

Accumulation

bu acre⁻¹

ton acre⁻¹

180

3.9

250

5.5


300

6.6

624

13.6

Assuming a harvest index of 52%

A large field of corn residue, likely after harvest, with a semi-transparent grey box overlaid in the center. The text inside the box asks, "Is residue trash or treasure?".

**Is residue trash
or
treasure?**

Too Much Residue Can be a Problem



The Nutritional Value of Corn Residue

Nutrient

Residue

“Treasure”

lbs ton⁻¹

lbs acre⁻¹

N

20

108

P₂O₅

4

21

K₂O

23

122

Assuming grain yield of 230 bu acre⁻¹ and 5.4 tons residue acre⁻¹.
Agron. J. 105:161-170 (2013).

The Nutritional Value of 624 bushels

Nutrient

Remaining in Residue

lbs ton⁻¹

lbs acre⁻¹

N

20

272

P₂O₅

4

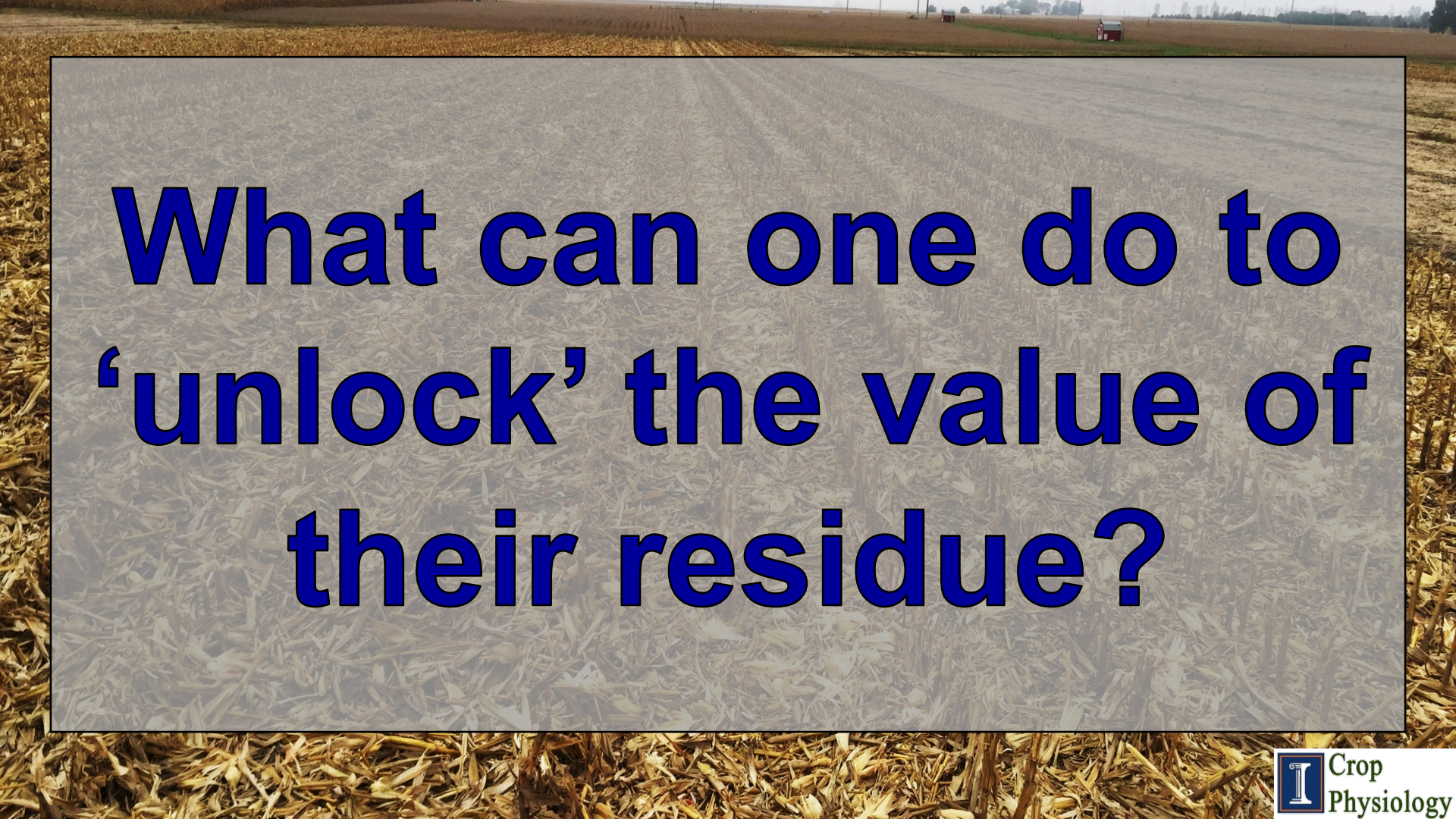
54

K₂O

23

313

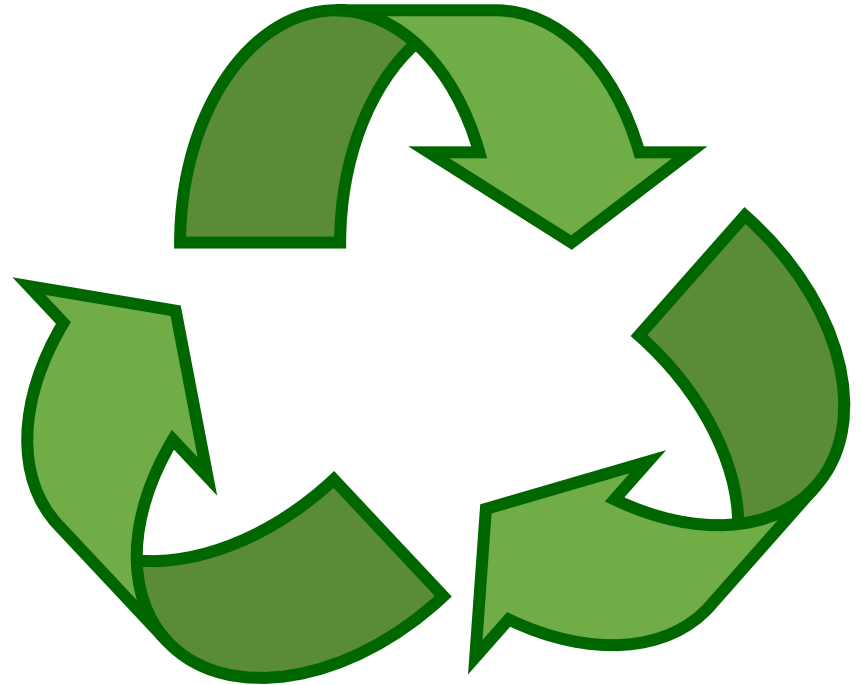
Assuming grain yield of 624 bu acre⁻¹ and 13.6 tons residue acre⁻¹.



**What can one do to
'unlock' the value of
their residue?**

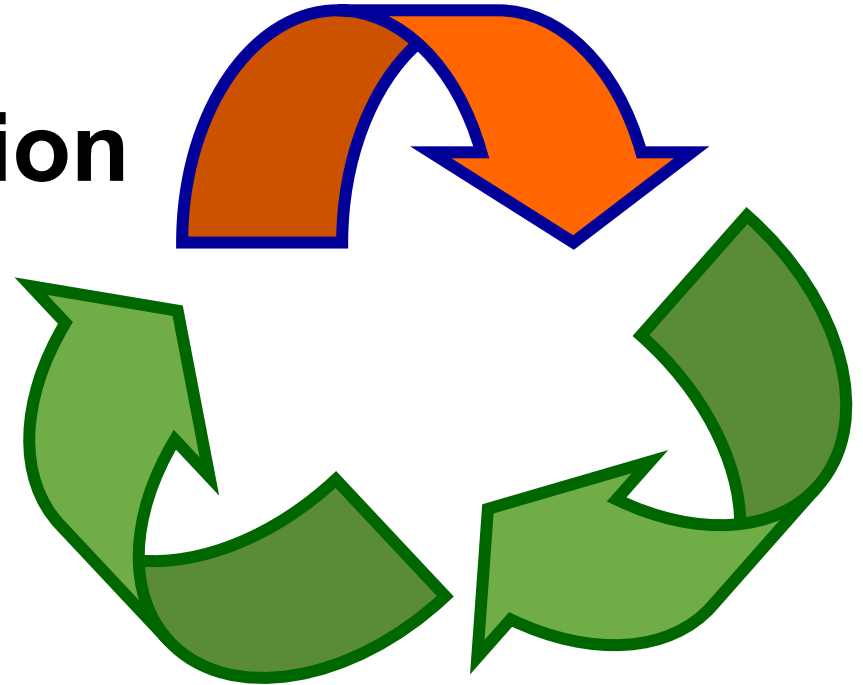
Reduce, Reuse, Recycle...

- **Reduce**
 - **Minimize Waste**
- **Reuse**
 - **Use 2x or More**
- **Recycle**
 - **Find a New Use**



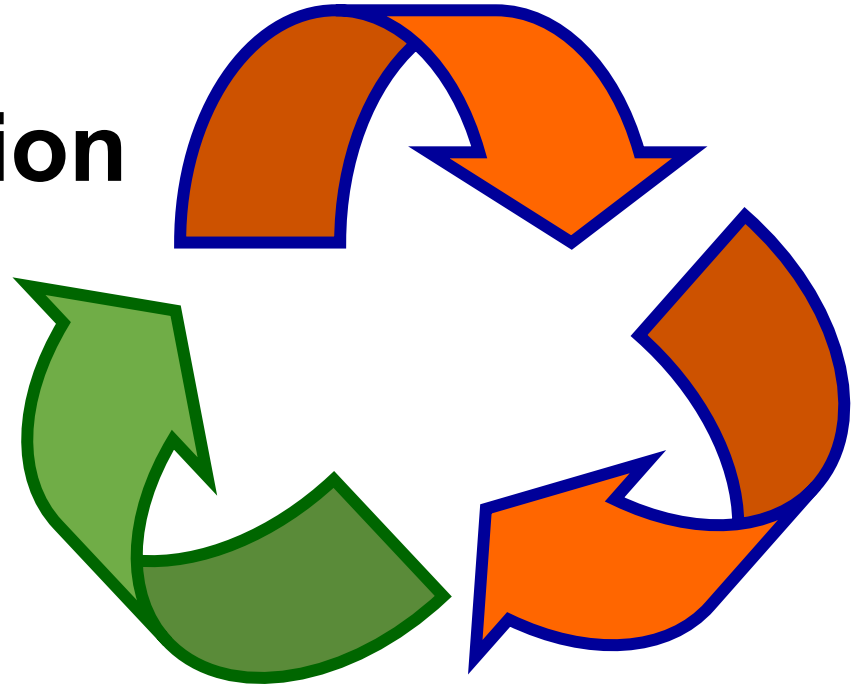
Reduce, Reuse, Recycle...

- **Reduce**
 - **Residue Degradation**



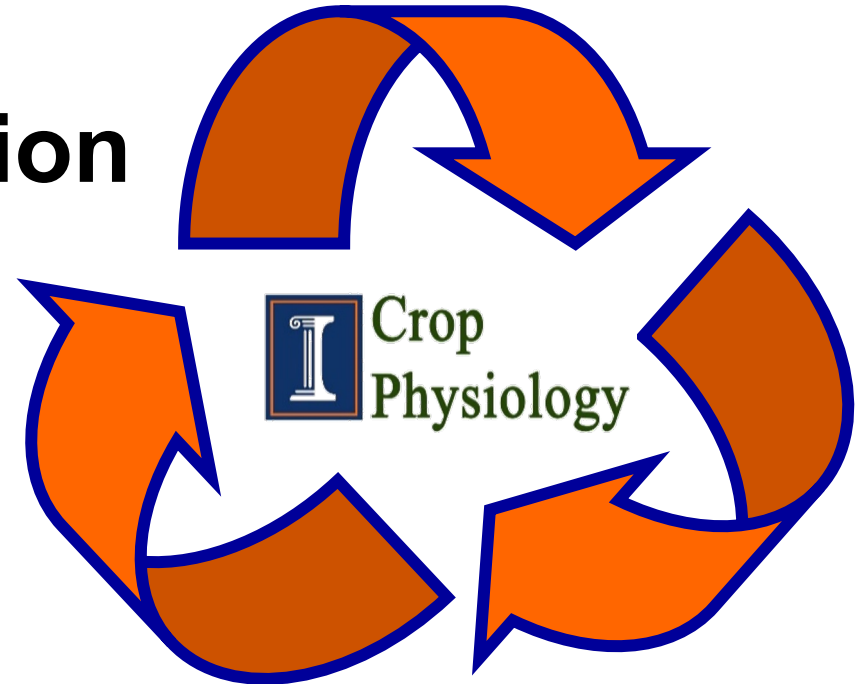
Reduce, Reuse, Recycle...

- **Reduce**
 - **Residue Degradation**
- **Reuse**
 - **Nutrient Value**



Reduce, Reuse, Recycle...

- **Reduce**
 - Residue Degradation
- **Reuse**
 - Nutrient Value
- **Recycle**
 - Increase Yield



Long-Term Continuous Corn, A Case Study

Trial Design and Site Characteristics

- **Long-term continuous corn site established in 2003**



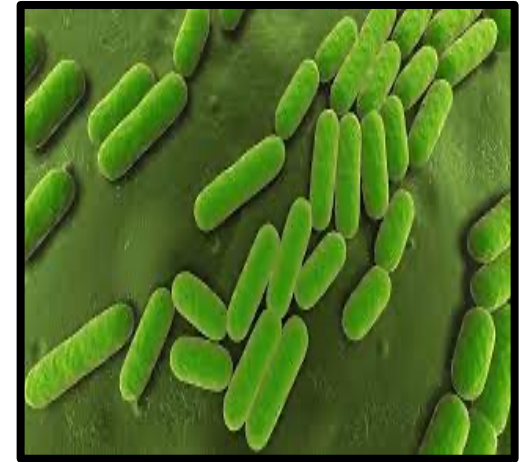
**Connor
in
2003...**

Trial Design and Site Characteristics

- **Long-term continuous corn site established in 2003**
- **Studies conducted in 2020 and 2021 on 17th and 19th year continuous corn**

2020-2021 Treatments

**Standard Stalk
Roller (Left)
Sizing Knife
Roller (Right)**



**Ammonium
Sulfate
48 lb S acre⁻¹
42 lb N acre⁻¹**

**Fall burndown
application
with a
bacterial blend**

Managing the CCYP – 2 Year Results

Management	Yield	CCYP
	-bushels per acre -	
Corn-Soybean Rotation	201	-
Long-Term Continuous Corn	153	48

Managing the CCYP – 2 Year Results

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Long-Term Continuous Corn	153	48
+ Calmer Super Choppers	166	35 + 13

Managing the CCYP – 2 Year Results

Management	Yield	CCYP
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Long-Term Continuous Corn	153	48
+ Calmer Super Choppers	166	35 + 13
+ Ammonium Sulfate (AMS)	167	34 + 1

Managing the CCYP – 2 Year Results

Management	Yield	CCYP
	-bushels per acre -	
Corn-Soybean Rotation	201	-
Long-Term Continuous Corn	153	48
+ Calmer Super Choppers	166	35 + 13
+ Ammonium Sulfate (AMS)	167	34 + 1
+ Microbial Blend	178	23 + 11

Managing the CCYP – 2 Year Results

Management

Yield

CCYP

A 52% Reduction in the CCYP

Any combination of practices was better than any individual practice by itself.

Key Takeaway

Adding fertility to the residue improves decomposition and subsequent grain yields regardless of mechanical management.

Microbes need nutrients too!

Research Conclusion

**The Seven Wonders of
300 Bushel Corn are also
the foundation of 6.6 tons
of “treasure” ...if you can
manage it**

The Crop Physiology Laboratory

Financial and Product Support for 2023

- ADM
- AdvanSix
- Agricen
- Agrocete
- AMVAC
- Anglo American
- Banded Ag
- Bayer
- BASF
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- Calcium Products
- Calmer Corn Heads
- Certis Biologicals
- Channel
- CHS
- DEKALB
- DPH
- Fluid Fert. Foundation
- FMC
- Illini FS
- Illinois NREC
- ISA
- Mosaic
- Nutrien
- Ostara
- Pivot Bio
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- USDA-NIFA

Special Thanks to National No-Till!

For More Information:

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