7 Wonders of Corn Yield

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Crop Physiology

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

Crucial Prerequisites, but not Yield Wonders

- Drainage
- Pest/Weed Control
- Proper soil pH & adequate levels of P and K based on soil tests

Seven Wonders of the Corn Yield World

Rank	Factor	Value
		bu/acre
1	Weather	70+
2	Nitrogen	70
3		
4		
5		
6		
7		

Given key prerequisites

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Seven Wonders of the Corn Yield World

Rank	Factor	Value
		bu/acre
1	Weather	70+
2	Nitrogen	70
3	Hybrid	50
4		
5		
6		
7		

Given key prerequisites

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		
6		
7		

Given key prerequisites

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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		
7		

Given key prerequisites

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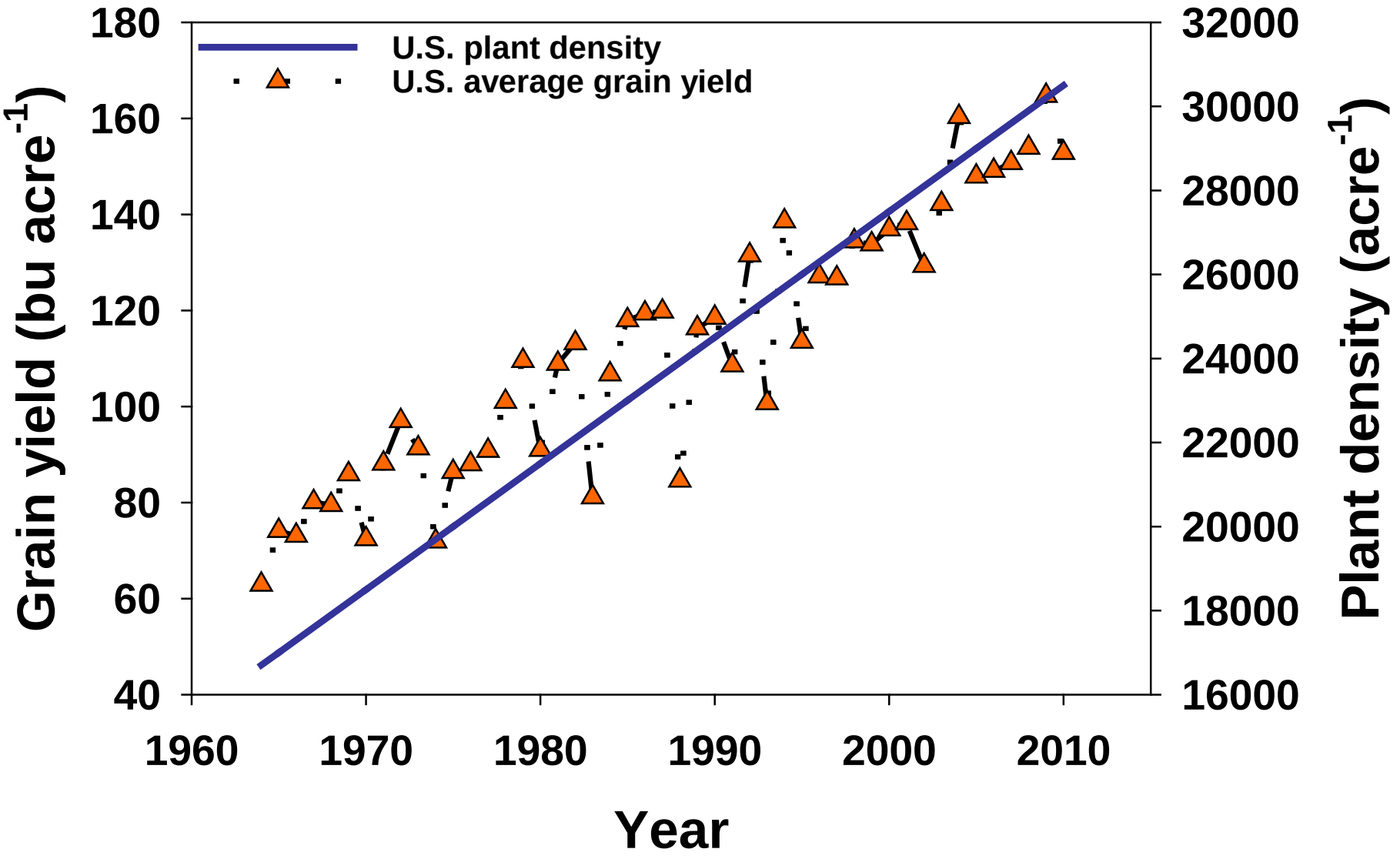
How have corn yields increased?



Source USDA

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Seven Wonders of the Corn Yield World

Rank	Factor	Value
		bu/acre
1	Weather	70+
2	Nitrogen	70
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5	Plant Population	20
6	Tillage	15
7		

Given key prerequisites

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Seven Wonders of the Corn Yield World

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7	Growth Regulators	10

Given key prerequisites

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Seven Wonders of the Corn Yield World

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6	Tillage	15
7	Growth Regulators	10
	TOTAL	260 bu

Given key prerequisites

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How to Get High Corn Yields?

- **Optimize each of the seven wonders and their positive interactions**
- **Provide better prerequisites, season long weed control & balanced fertility/nutrition**

Prerequisites for High Yields?

- **Proper soil pH & adequate levels of P and K based on soil tests**

- **Fertility- Use application and fertilizer technologies to supply required crop nutrition**

Nutrition Needed for 230 Bushel Corn

Nutrient	Required to Produce	Removed with Grain	Harvest Index
	lbs/acre		%
N	256	148	58
P_2O_5	101	80	79
K_2O	180	58	32
S	23	13	57
Zn (oz)	7.1	4.4	62
B (oz)	1.2	0.3	23

Average of 6 hybrids in Champaign and DeKalb IL in 2010.

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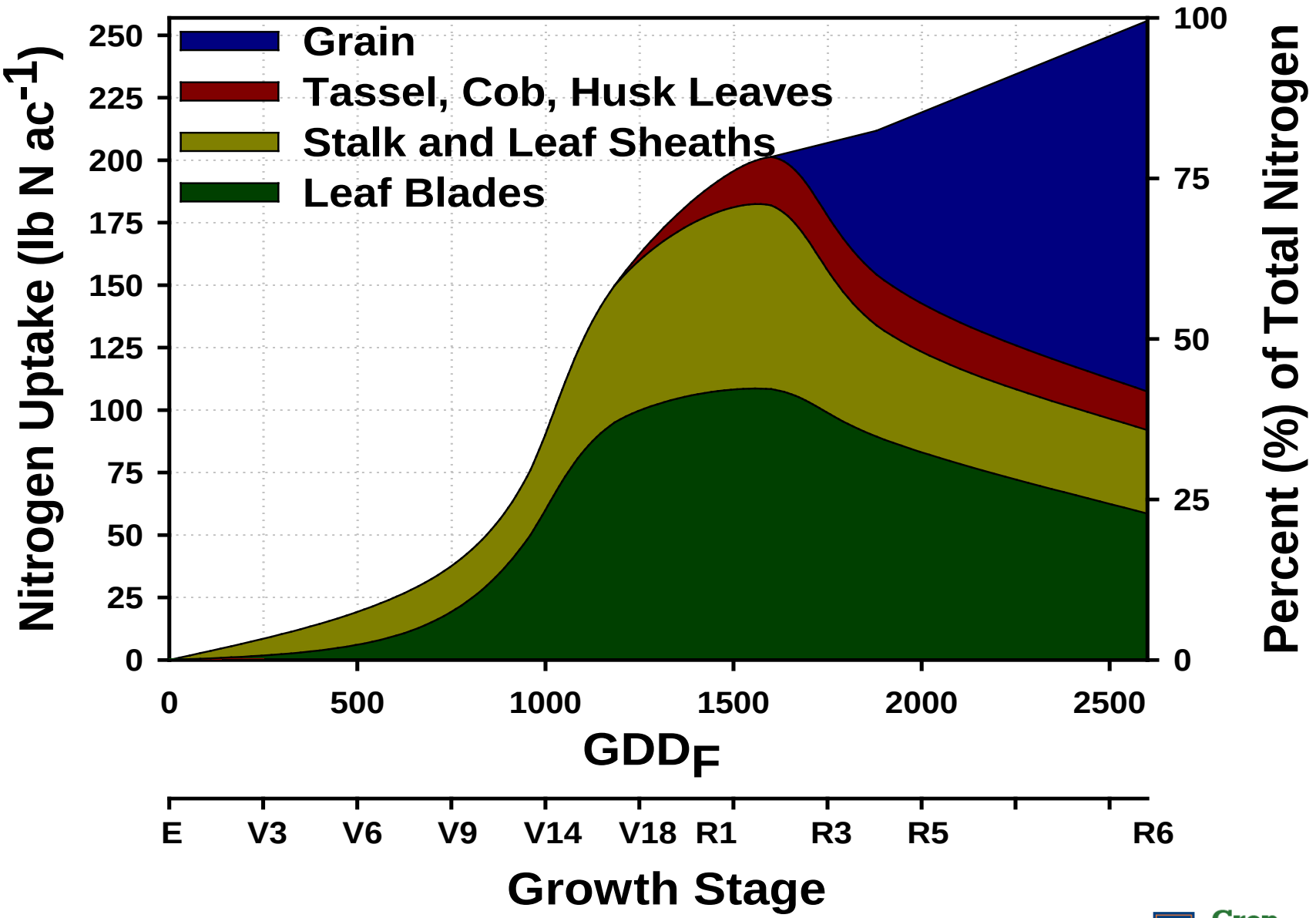
N Uptake & Partitioning for 230 Bushel Corn



Average of 6 hybrids in Champaign and DeKalb IL in 2010

Agron Journal 2013 in press

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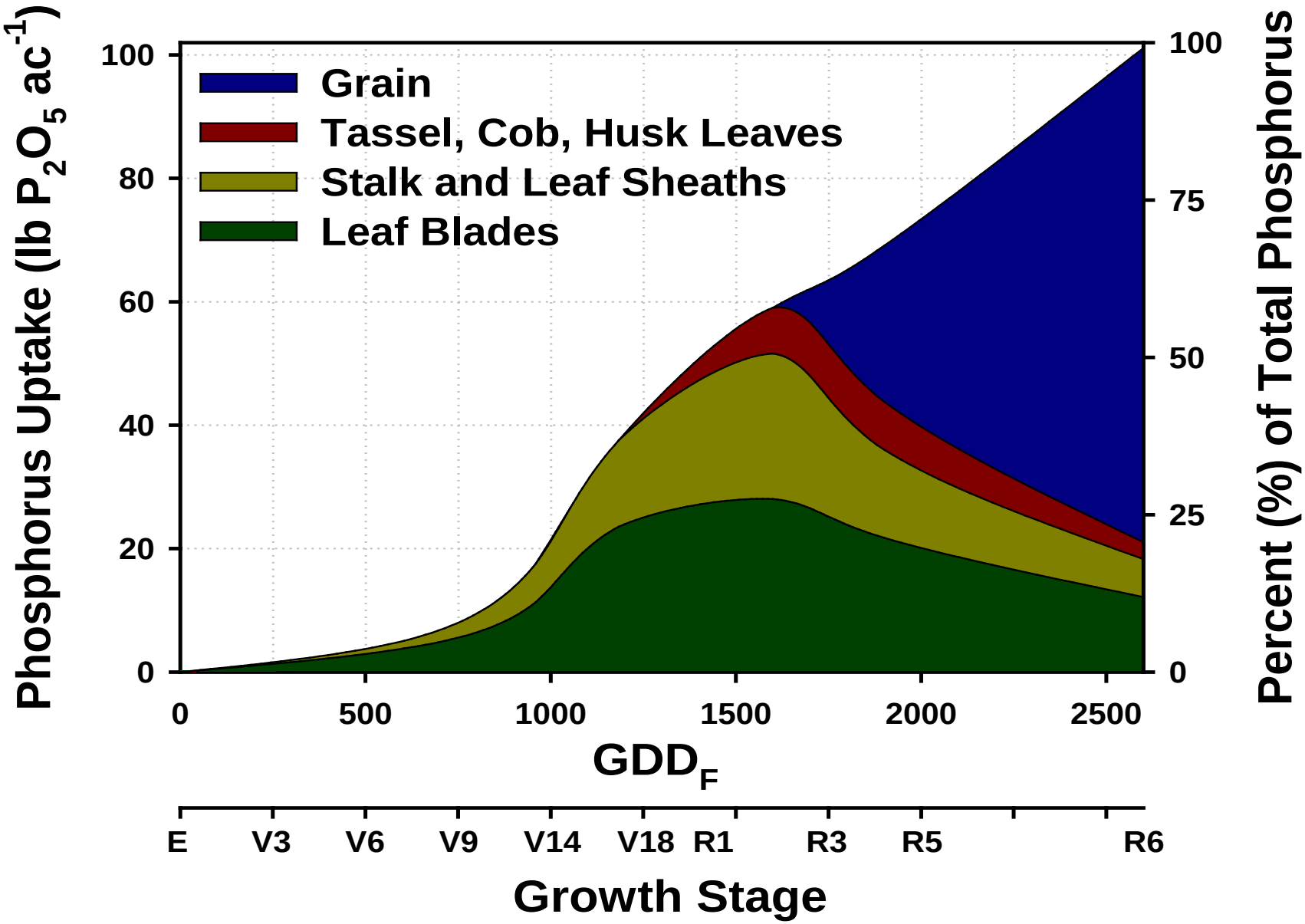
P Uptake & Partitioning for 230 Bushel Corn



Average of 6 hybrids in Champaign and DeKalb IL in 2010

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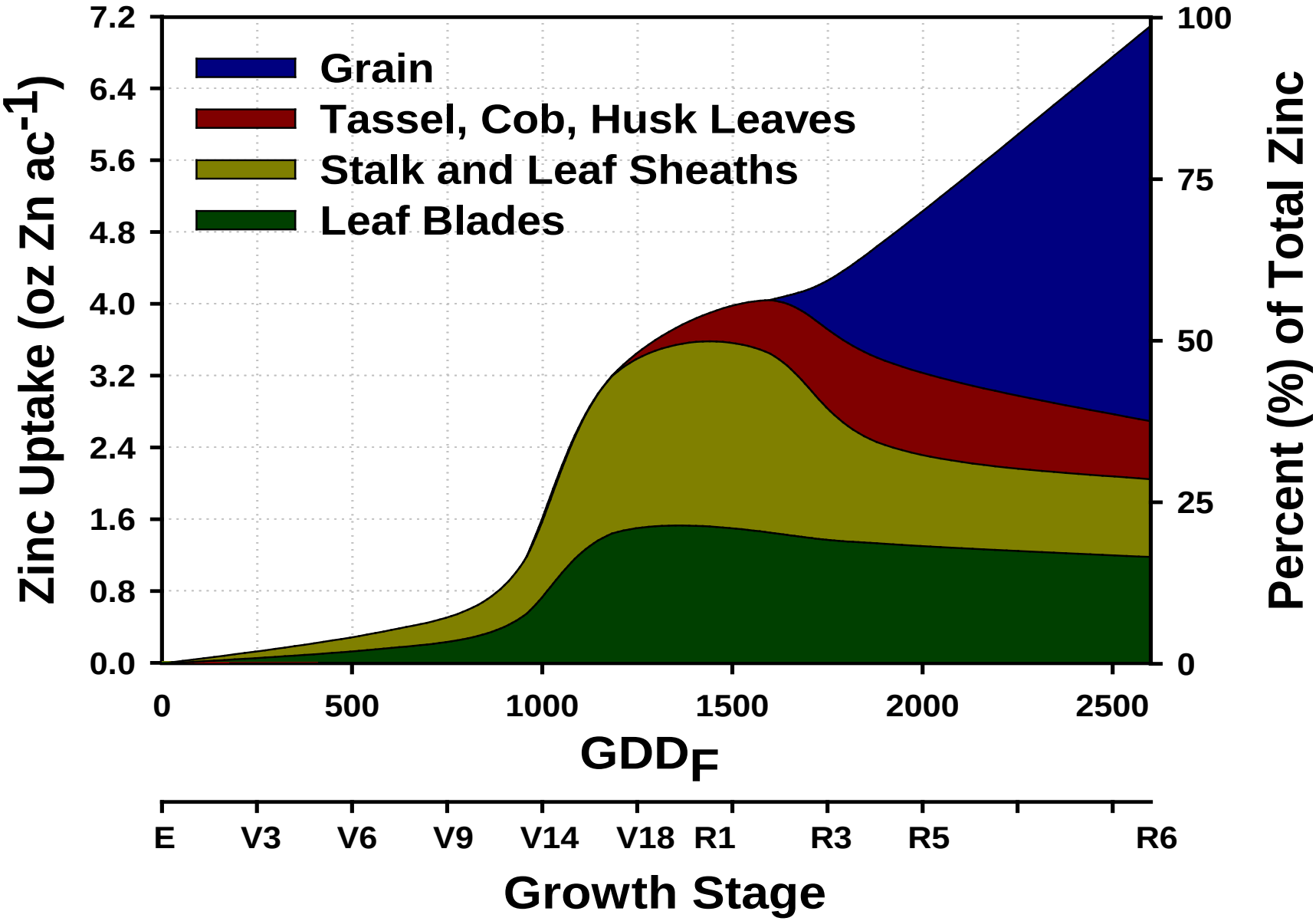
Crop Physiology

Zn Uptake & Partitioning for 230 Bushel Corn



Average of 6 hybrids in Champaign and DeKalb IL in 2010

Agron Journal 2013 in press

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Standard vs. High Tech 2009/10

Fertility

No P or K based on soil test

100 lbs P_2O_5 as MESZ (N, P, S, & Zn)

Nitrogen

180 lbs pre-plant as UAN

100 lbs extra N sidedress as Super-U

Genetics

RR Refuge Hybrid (DKC 61-22)

Triple stack Hybrid (DKC 61-19)

Both with soil insecticide at planting

Population

32,000 plants/ac vs 45,000 plants/ac

Both in 30 inch rows and twin rows in 2010

Fungicide

No Fungicide

Headline or Quilt-Xcel (@ R1)

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High Tech Package vs Traditional 2009/10

Ears from 1/1000 of an acre

High Technology Package

Standard Practice

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Omission Plot Experimental Design

		FACTORS				
	TREATMENT	Fertility	Nitrogen	Genetics	Population	Fungicide
	HIGH TECH	MESZ	Base + Slow release	Triple stack	45,000	Strobilurin
Remove Technology	Fertility	No P & K	Base + Slow release	Triple stack	45,000	Strobilurin
	Nitrogen	MESZ	Base	Triple stack	45,000	Strobilurin
	Genetics	MESZ	Base + Slow release	Refuge	45,000	Strobilurin
	Population	MESZ	Base + Slow release	Triple stack	32,000	Strobilurin
	Fungicide	MESZ	Base + Slow release	Triple stack	45,000	none
	STANDARD	No P & K	Base	Refuge	32,000	none
Add Technology	Fertility	MESZ	Base	Refuge	32,000	none
	Nitrogen	No P & K	Base + Slow release	Refuge	32,000	none
	Genetics	No P & K	Base	Triple stack	32,000	none
	Population	No P & K	Base	Refuge	45,000	none
	Fungicide	No P & K	Base	Refuge	32,000	Strobilurin

Add One Enhanced Factor to Standard Management

Add One Enhanced Factor	Standard System Yield	Δ
	bu acre^{-1}	
Standard Management	193	
+Fertility (extra N, P, S, Zn)	197	+ 4
+Nitrogen (protected from weather loss)	198	+ 5
+Genetics (biotech insect protection)	202	+ 9
+Population (45,000 plants/acre)	187	- 6
+Fungicide (strobilurin at flowering)	198	+ 5

LSD ($p<0.10$) = 6

Data from Champaign and Dixon Springs in 2009 & 2010

Crop Physiology

Omit One Enhanced Factor from High Tech System

	High Tech System	
Omit One Enhanced Factor	**Yield**	**Δ**
	bu acre^{-1}	
High Tech all Five Factors	**245**	
-Fertility (fertility from soil test)	**236**	**- 9**
-Nitrogen (unprotected from loss)	**232**	**-13**
-Genetics (-biotech insect protection)	**225**	**-20**
-Population (only 32,000 plants/acre)	**238**	**- 7**
-Fungicide (no fungicide)	**218**	**-27**

LSD ($p<0.10$) = 6 Data from Champaign and Dixon Springs in 2009 & 2010

Crop Physiology

Traditional vs High-Tech Two Years

	Traditional		High Tech	
Factor	Yield	Δ	Yield	Δ
	bu acre^{-1}			
None or All	193		245	
Fertility	197	+ 4	236	- 9
Nitrogen	198	+ 5	232	-13
Genetics	202	+ 9	225	-20
Population	187	- 6	238	- 7
Fungicide	198	+ 5	218	-27

LSD ($p<0.10$) = 6

Data from Champaign and Dixon Springs

Crop Physiology

Standard vs High Tech – 2011/12

Fertility

No or fall P or K based on soil test

100 lbs P_2O_5 as MESZ (N, P, S, & Zn)
Banded 4-6” directly under row at planting

Nitrogen

180 lbs pre-plant as urea

180 lbs pre-plant SuperU + 60 lbs sidedress urea with Agrotain

Genetics

Workhorse Management Hybrid

Racehorse Management Hybrid

Both triple-stack with soil insecticide at planting

Population

32,000 plants/ac vs 45,000 plants/ac

Both final stand in 30 inch & some twin and 20 inch rows

Fungicide

No Fungicide

Headline-Amp or Quilt-Xcel @ R1

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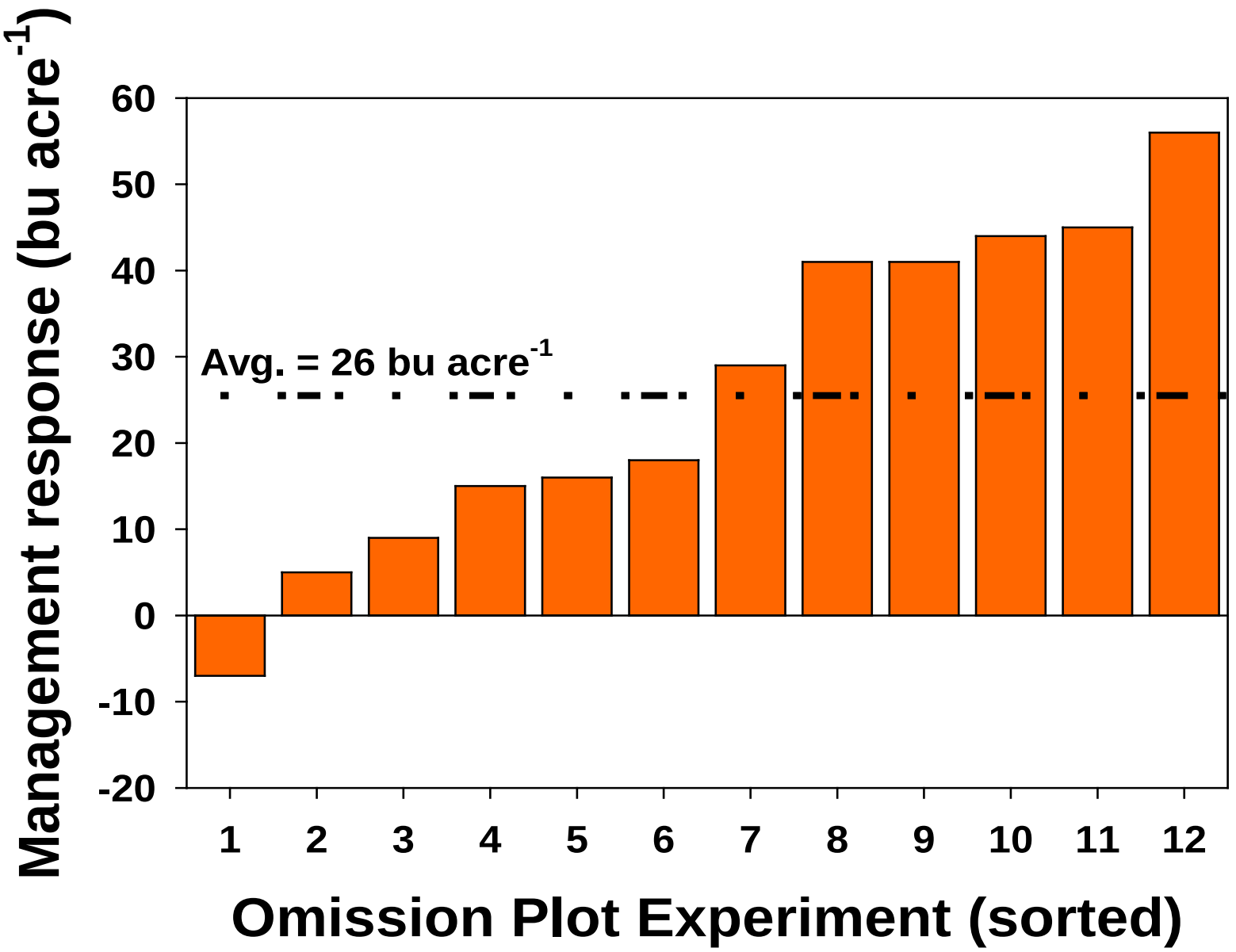
Yield Response from High-Tech Management in 2011



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Standard vs High-Tech 2011

	Standard		High Tech	
Factor	Yield	Δ	Yield	Δ
	bu acre^{-1}			
None or All	169		195	
Fertility	183	+14	178	-17
Nitrogen	177	+ 8	184	-11
Genetics	173	+ 4	186	- 9
Population	159	-10	194	- 1
Fungicide	172	+ 3	184	- 8

LSD ($p<0.10$) = 6

Average of 12 trials in Illinois In 2011

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Improved Growth with Spring-Banded MESZ

Champaign, IL 2011

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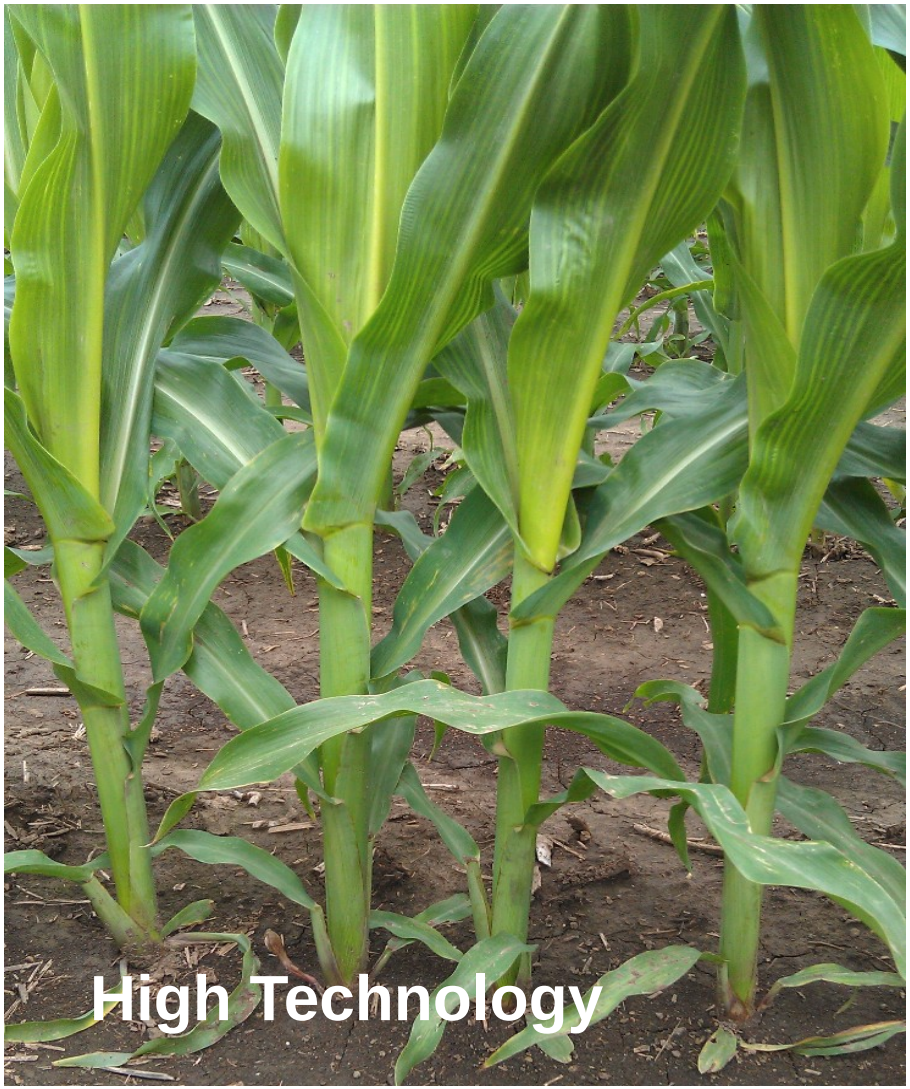
No Corn Plant Left Behind



Champaign, IL 2011

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Drip irrigation allows for precise application of water and nutrients

Seven inches supplemental water during June and July

Champaign, 2012

Crop Physiology

Add One Enhanced Factor to Standard Management

Add One Enhanced Factor	Standard System Yield	Δ
	bu acre^{-1}	
Standard Management	135	
+Irrigation (7 inches during June/July)	190	+55*
+Fertility (extra N, P, S, Zn)	138	+ 3
+Nitrogen (protected from weather loss)	132	- 3
+Population (45,000 plants/acre)	108	-27*
+Fungicide (strobilurin at flowering)	132	- 3

* Significantly different from standard at $P \leq 0.05$.

Champaign, 2012

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Omit One Enhanced Factor from High Tech System

	High Tech System	
Omit One Enhanced Factor	**Yield**	**Δ**
	bu acre^{-1}	
High Tech all Five Factors	**210**	
-Irrigation (no supplemental water)	**117**	**-93***
-Fertility (fertility from soil test)	**197**	**-13***
-Nitrogen unprotected from loss)	**209**	**- 1**
-Population (only 32,000 plants/acre)	**198**	**-12***
-Fungicide (no fungicide)	**204**	**- 6**

*** Significantly different from high tech at $P \leq 0.05$.**

Conclusions

- **Yield gains are possible from a systems approach to crop management that combines individual practices known to impact yield**
- **Increasing plant population may be the foundation for pushing higher yields, but it must be managed and protected**

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For more information:

http://cropphysiology.cropsci.illinois.edu

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