FOTC 2015 Fertilizer Outlook & Technology Conference

Fred Below

Professor
University of Illinois

U.S. Fertilizer Demand and Nutrient Use Issues Session

The Fertilizer Institute
Nourish, Replenish, Grow

Fertilizer Industry Round Table

U.S. Fertilizer Demand and Nutrient Use Issues

Fred Below

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Fertilizer Outlook and Technology Conference
Jacksonville, FL November 10, 2015

Crop Physiology

The Corn Yield Gap

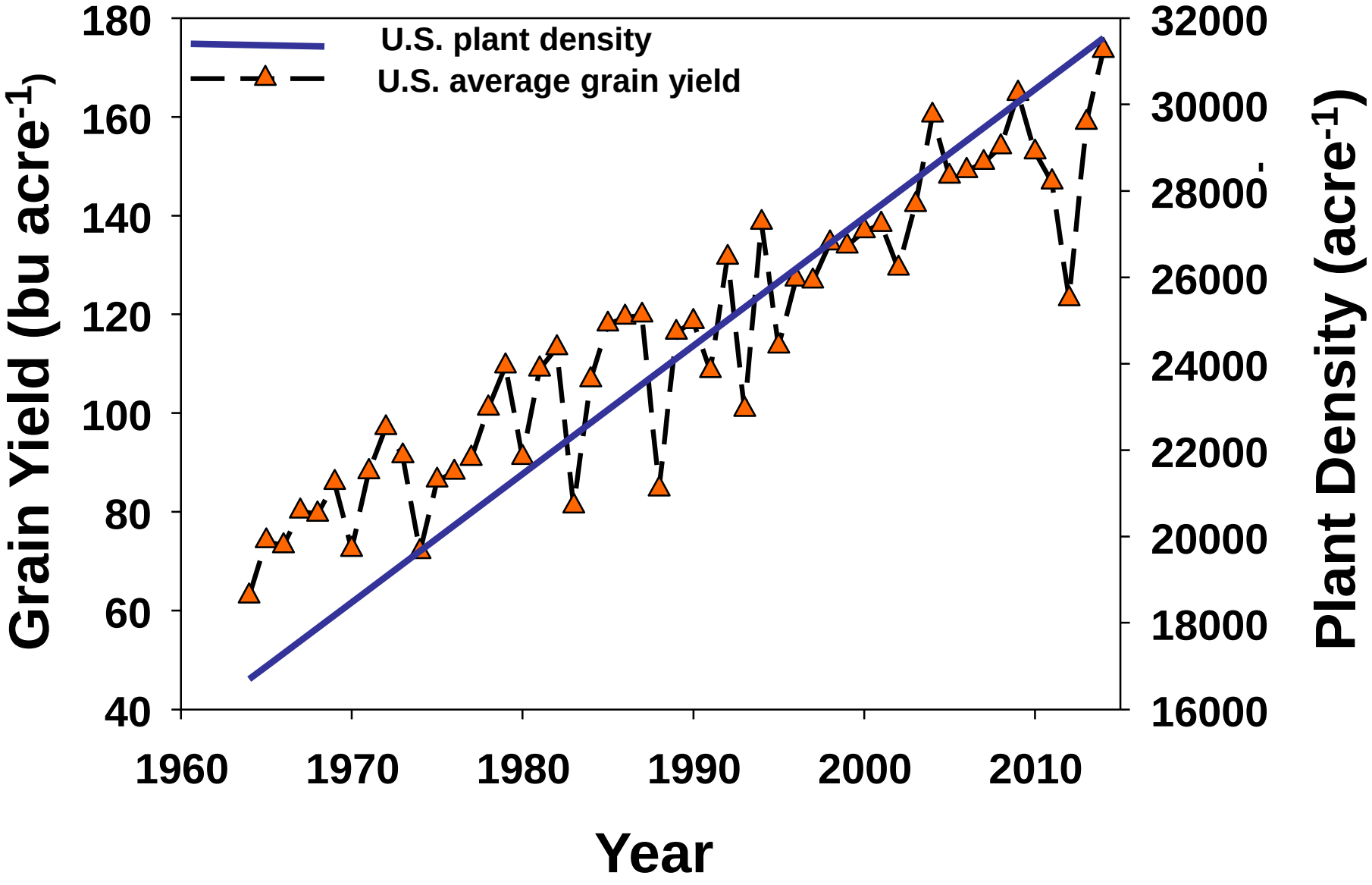
- US average corn yield of about 170 bushels per acre
- All 18 National Corn Growers Contest winners in 2014 exceeded 300 bushels, 6 exceeded 400 bushels
- New World Record of 503.7190 bushels per acre

Crop Physiology

Strategy for Winning the Corn Yield Contest

- **Feed (better plant nutrition) and protect a much higher density of plants of the best 'racehorse' hybrids**
- **Make sure the crop is never stressed**

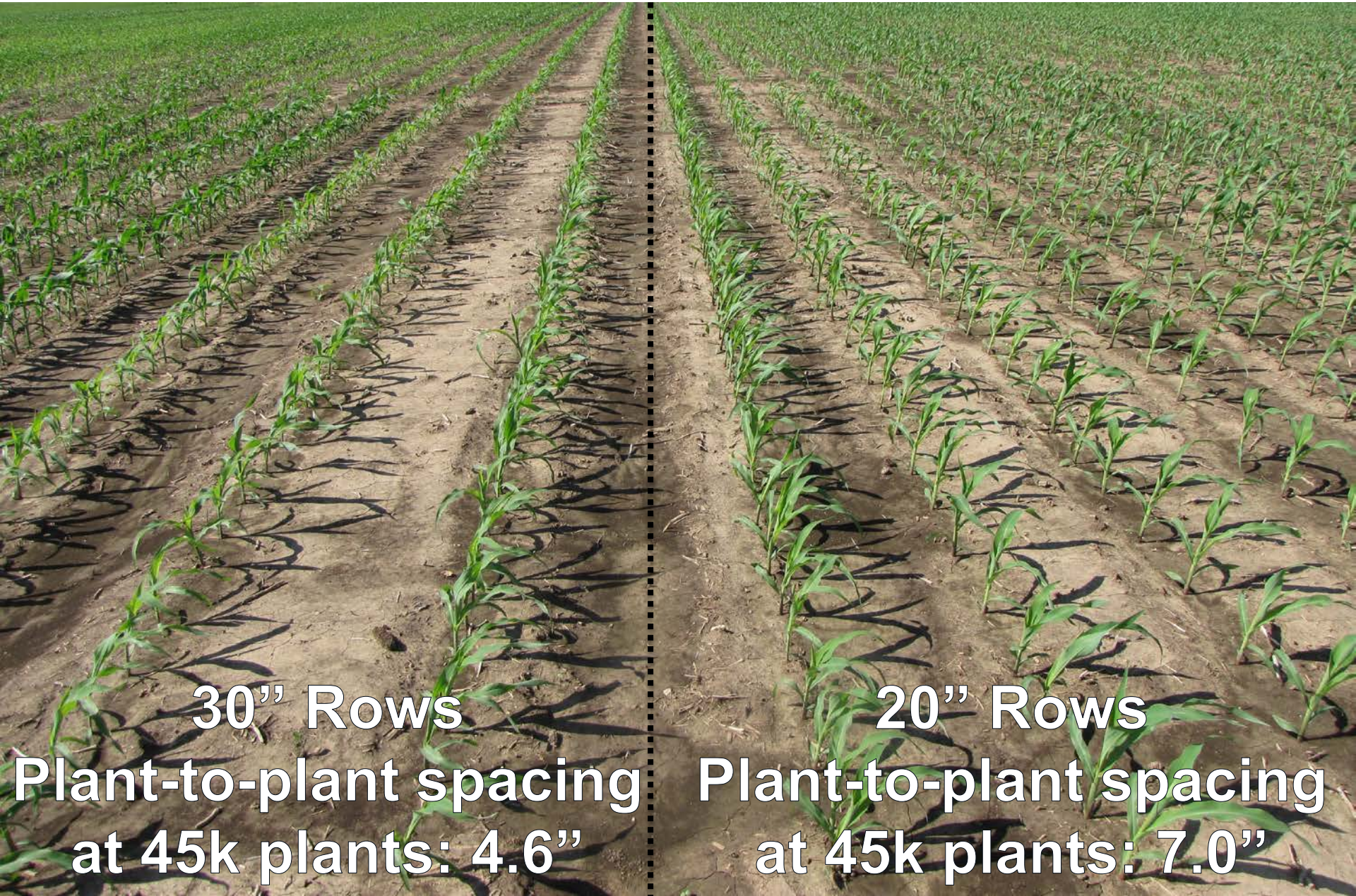
How Have Corn Yields Increased?



Source USDA

Crop Physiology

Is the Future of Corn Row Spacing 20 Inches?



High Plant Density = Smaller Roots

Normal Population
32,000 plants/acre

High Population
45,000 plants/acre

Champaign, IL 2012

Crop Physiology

Fertility Needs for Corn Based on Soil Test Data

- **Soil test values calibrated to yield in the 60's and 70's**
- **Do higher plant populations and more productive germplasm necessitate better fertilization strategies for corn?**

Corn Fertility Recommendations

- **Current = N based mostly on expected yield and P and K based on soil tests**
- **Future = 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. Agron. J. 105:161-170 (2013)

Crop Physiology

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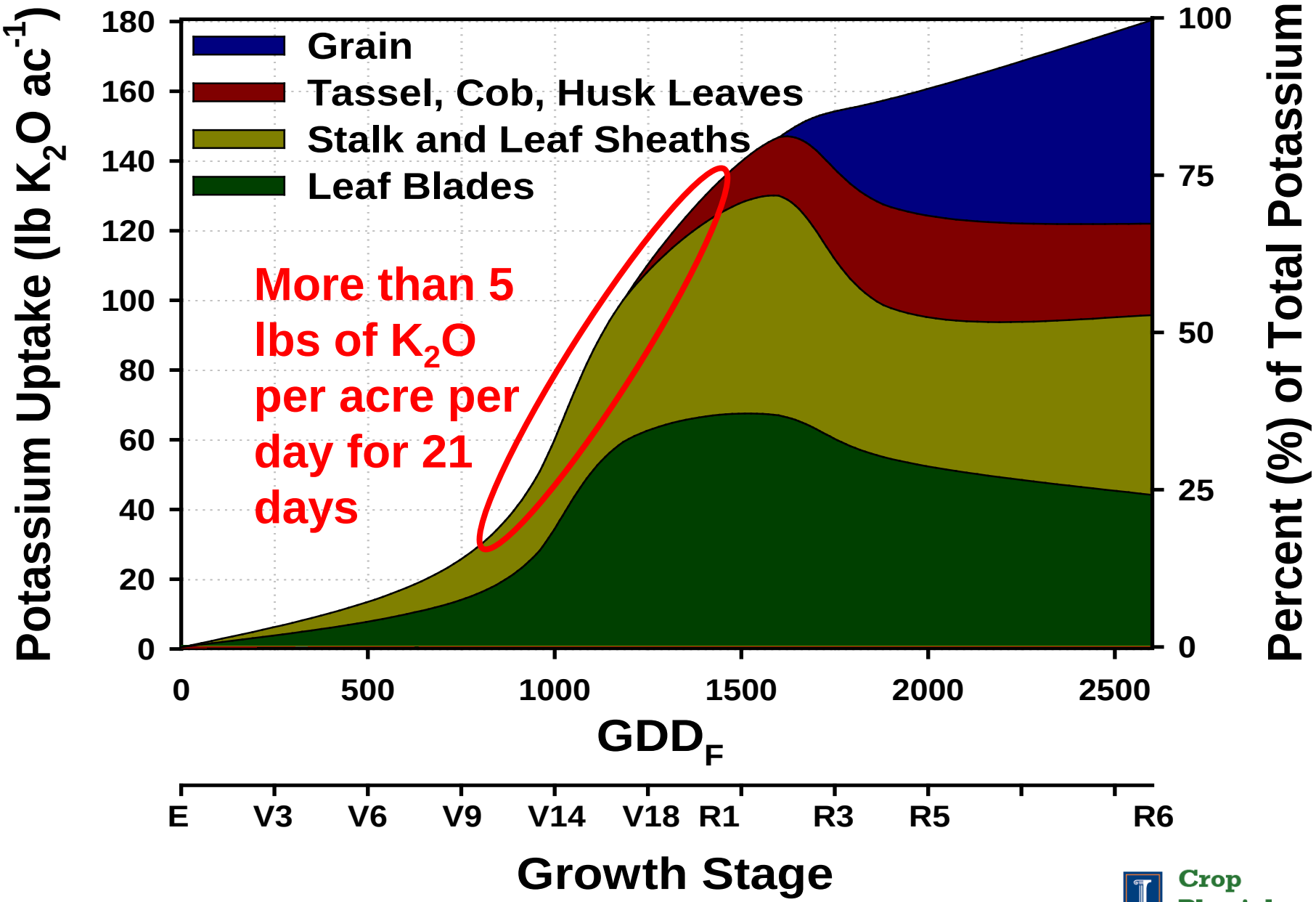
K Uptake & Partitioning for 230 Bushel Corn



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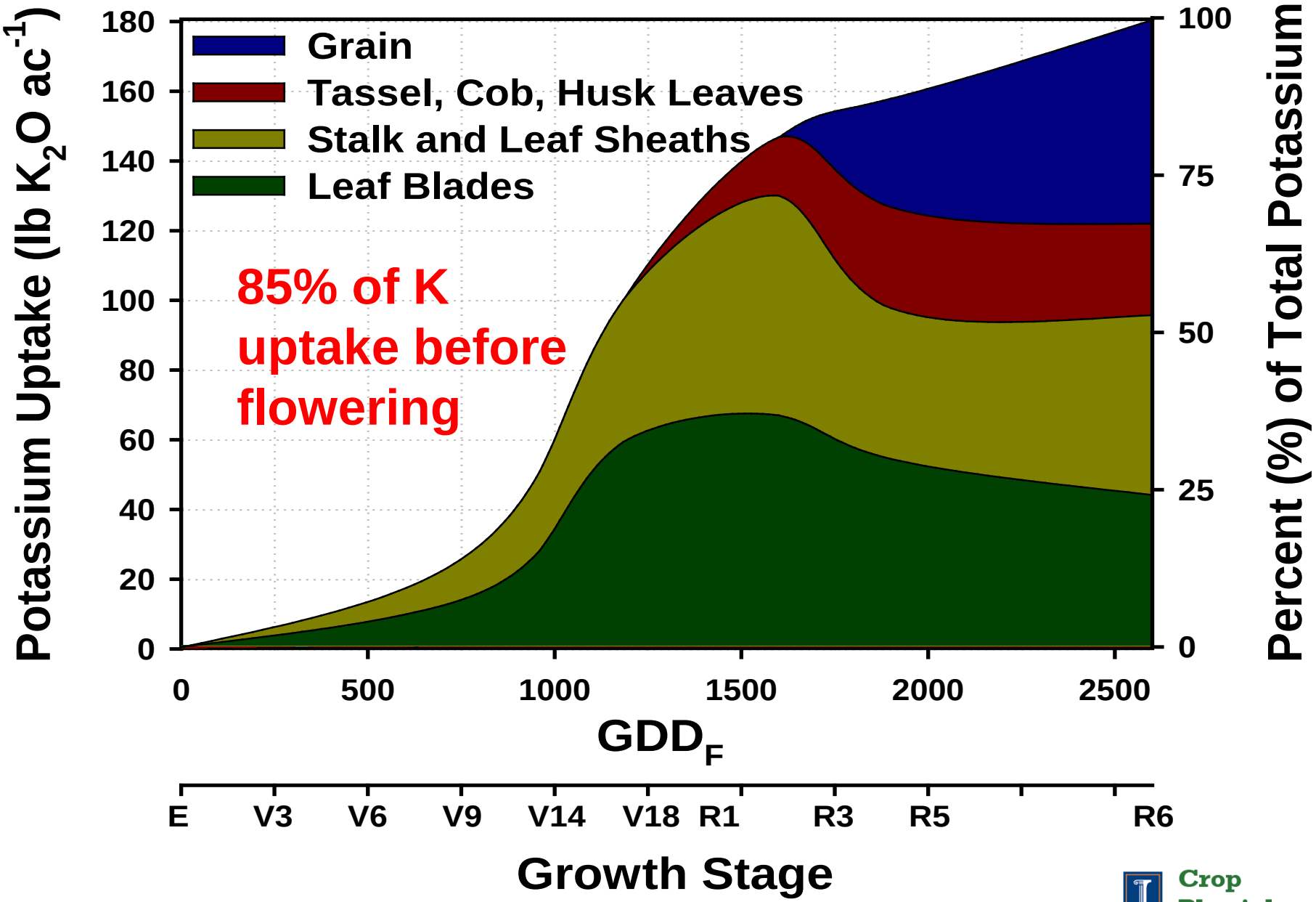

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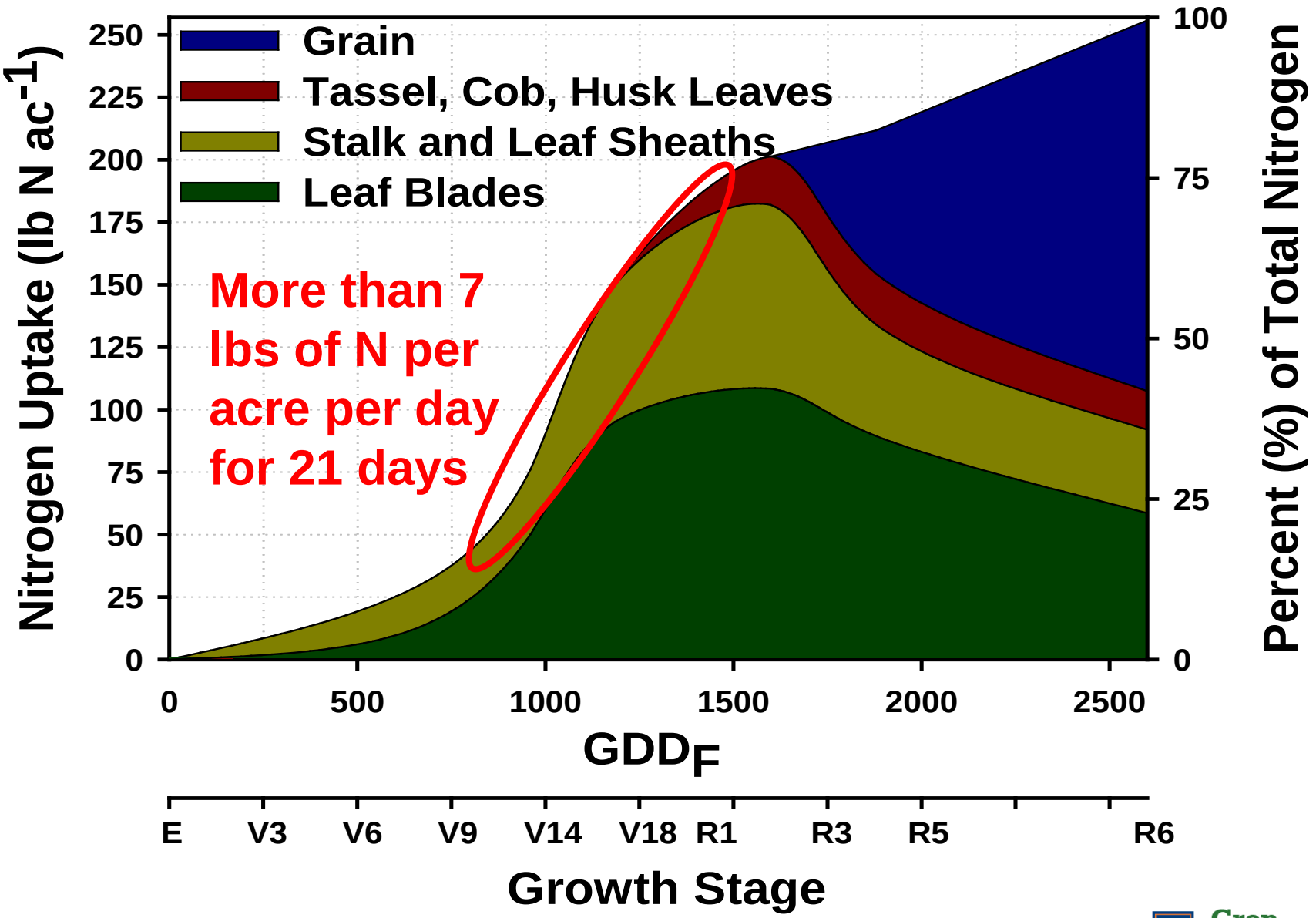

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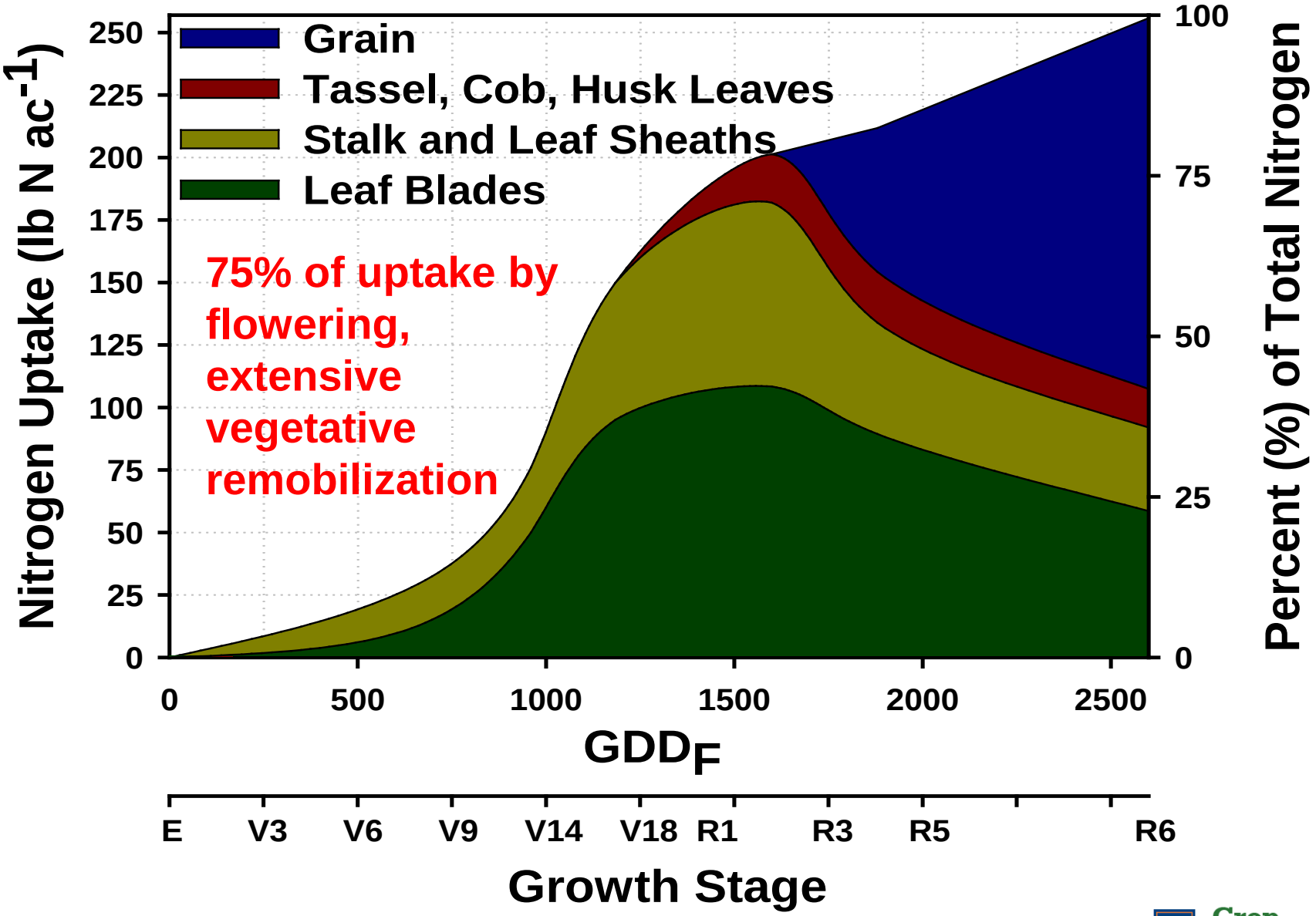

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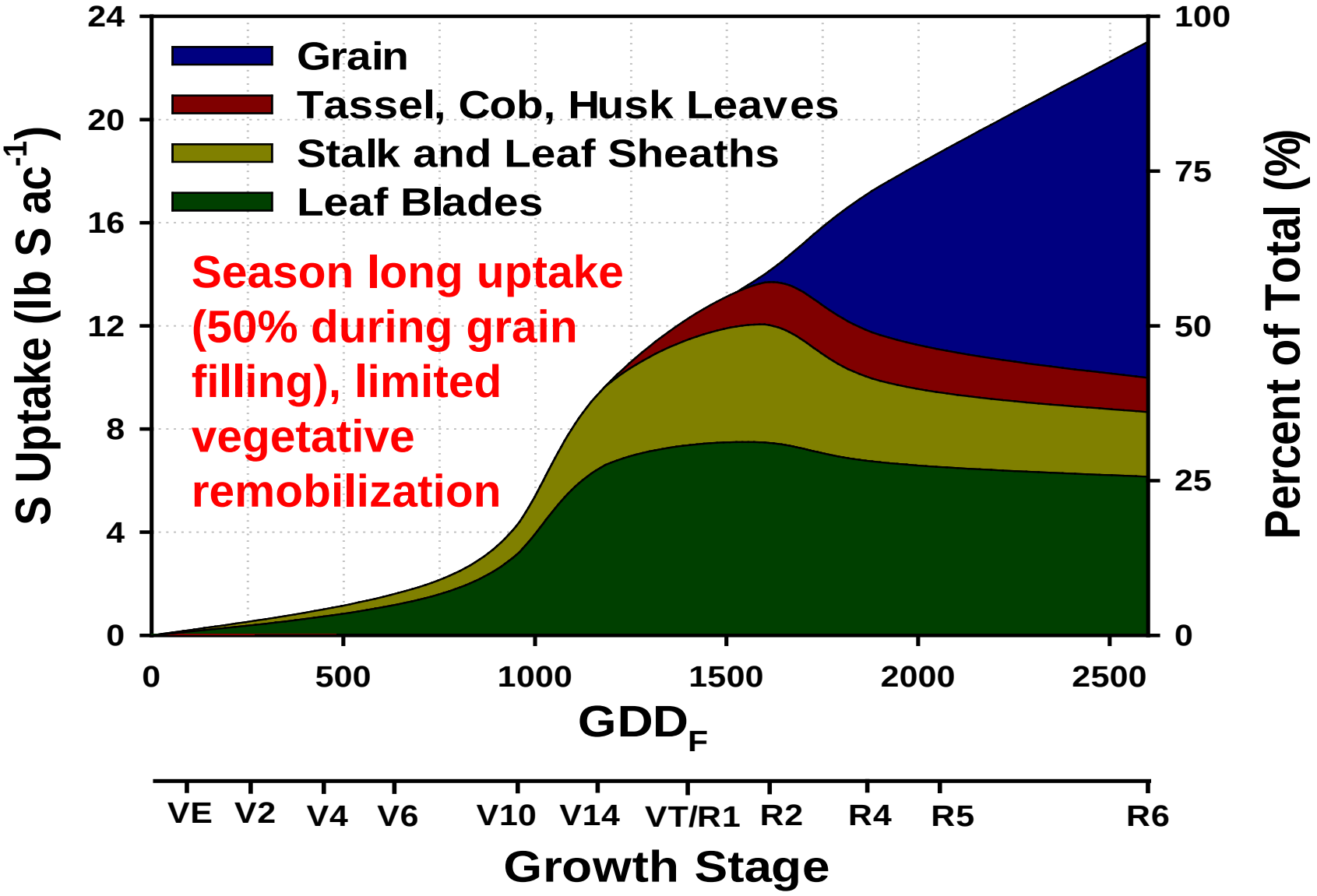

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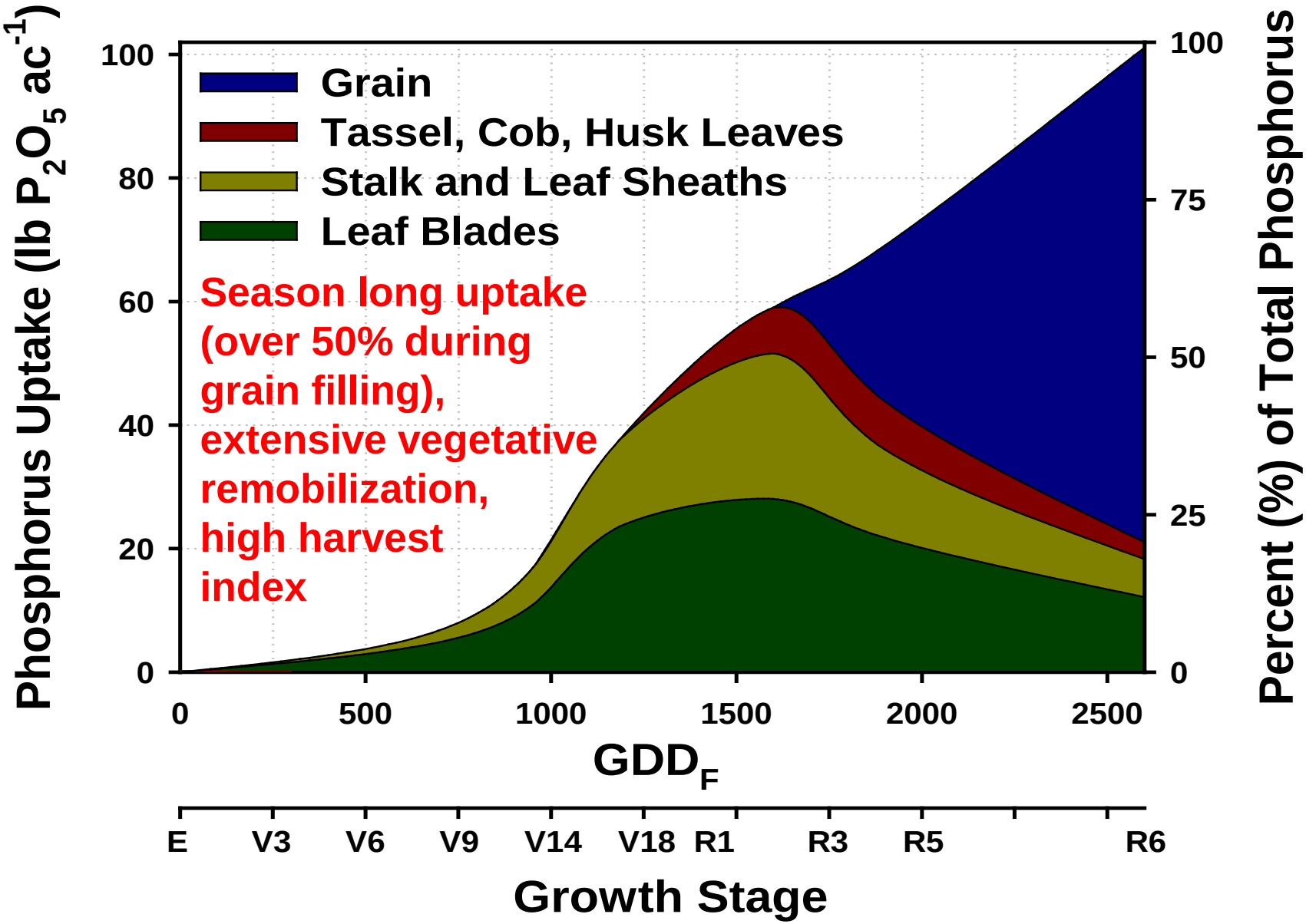
Crop Physiology

P Uptake & Partitioning for 230 Bushel Corn



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Feed the Plant Not the Soil

Better Fertilizer (Right Source)

- Supply N, P, S, Zn in a way that keeps or makes them plant available

Better Application (Right Place)

- Band apply directly under the crop row

Banding Fertilizer 4-6 Inches Deep Directly Under the Future Crop Row

Seeding Corn Crop 2 Inches Deep Directly Over the Fertilizer Band

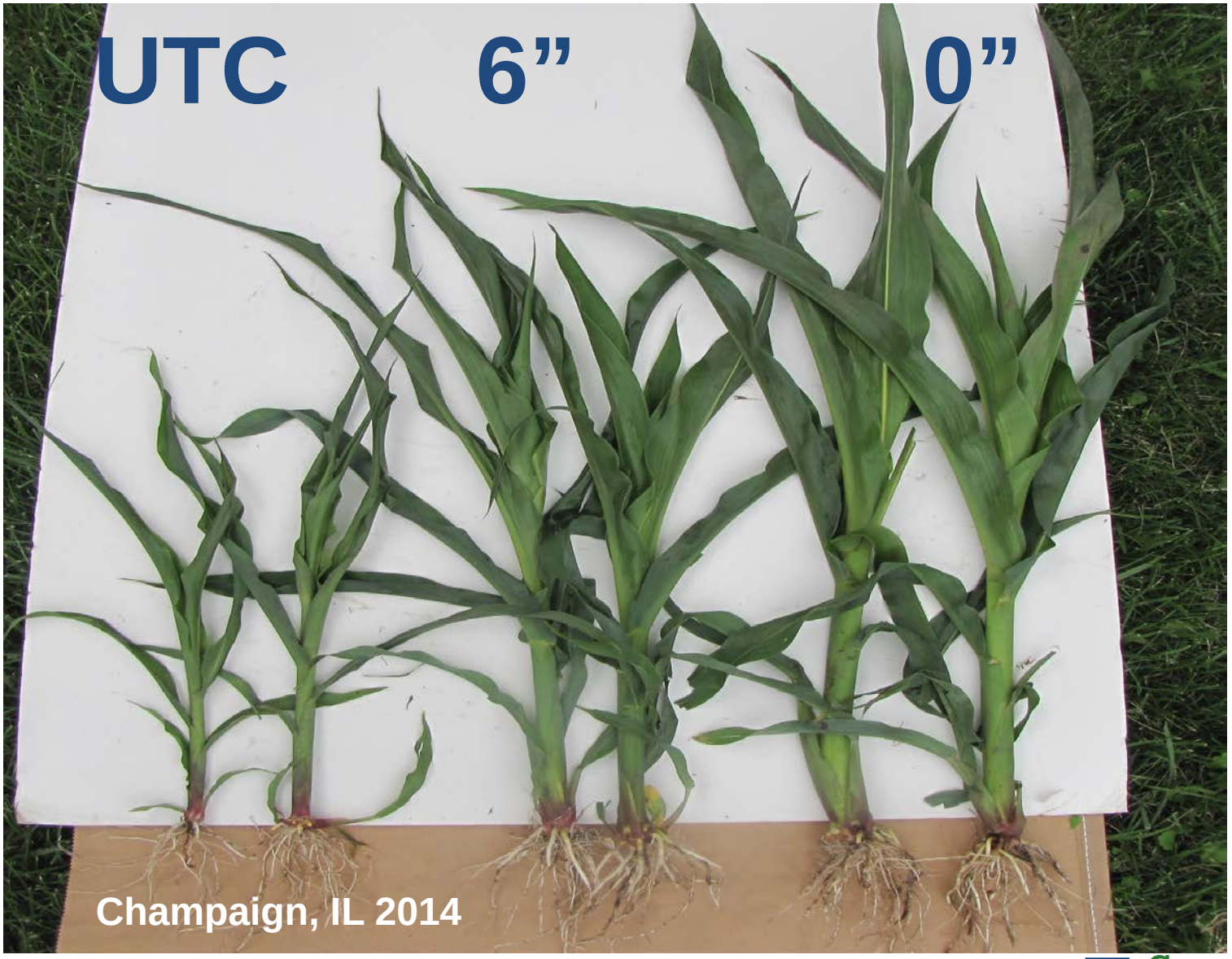
Improved Growth with Banded Fertility

250 lbs/acre MicroEssentials = 35 N, 100 P_2O_5, 25 S, and 2.5 Zn

Crop Physiology

Growth Response to Banded Fertility

V6 growth stage



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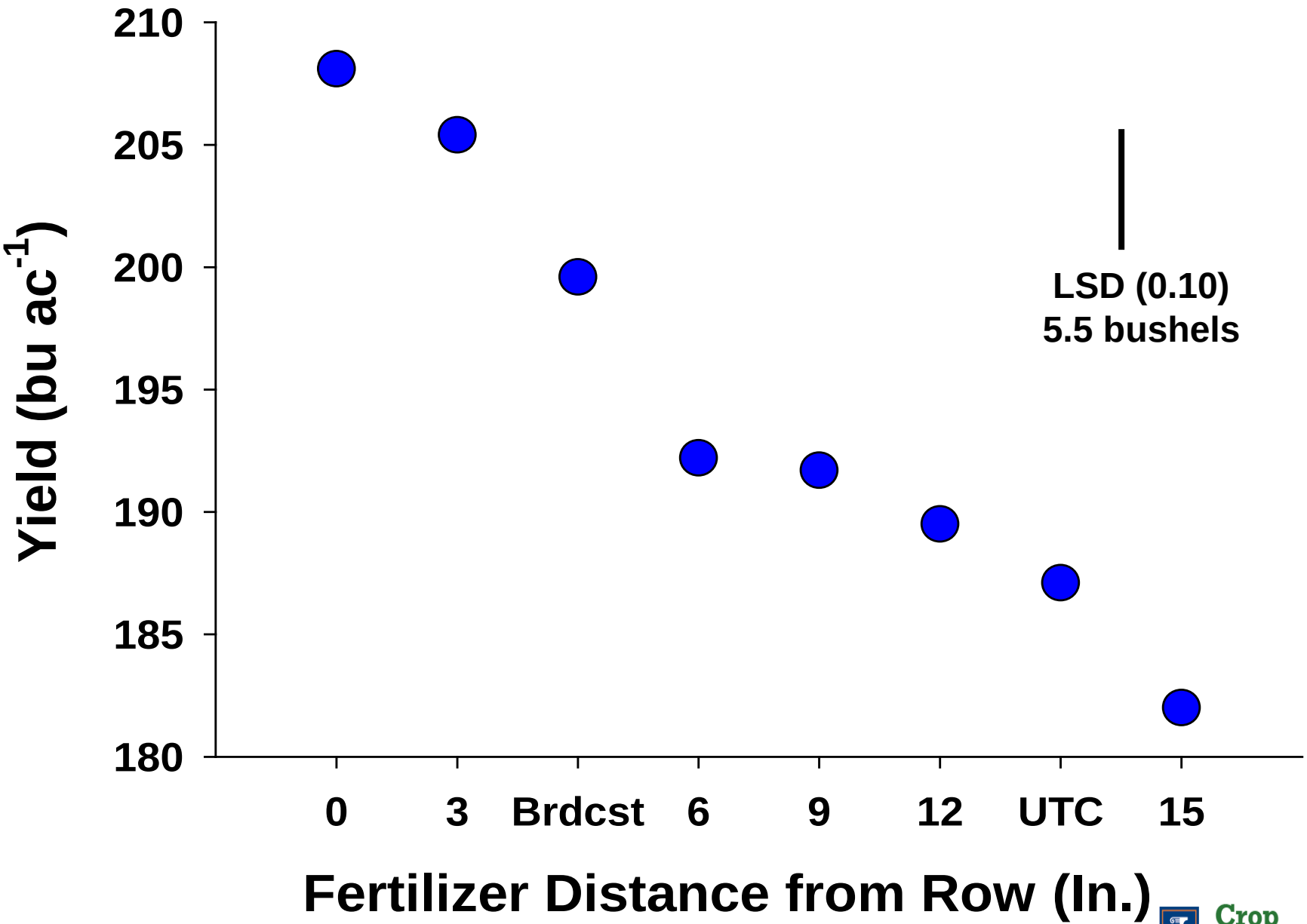
Corn Yield Response to Fertilizer Placement



Champaign, IL 2014

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Most Roots Expand Only 6 Inches Horizontally

Root System at R5, 32,000 plants/acre

Crop Physiology

Improved Growth with Banded Fertility

250 lbs/acre MicroEssentials = 35 N, 100 P_2O_5, 25 S, and 2.5 Zn

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No Corn Plant Left Behind

Champaign, IL 2011

Crop Physiology

Do Growers Adequately Fertilize Soybean?

Champaign, IL 2012

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The Soybean Yield Gap

- US average soybean yield of about 45 bushels per acre
- World record soybean yield of 161 bushels
- Illinois record of 103.95 bushels in 2014

Typical Fertilization for Corn and Soybean in Illinois

- 180 lbs N, 90 lbs P_2O_5 and 100 lbs K_2O per acre applied to corn. No S or micronutrients

- No fertilizer applied to soybean

Nutrient Uptake and Removal by 60 Bushel Soybean

Nutrient	Required to Produce	Removed with Grain	Harvest Index
	lb acre^{-1}		%
N	245	179	73
P_2O_5	43	35	81
K_2O	170	70	41
S	17	10	61
Zn (oz)	4.8	2.0	44
B (oz)	4.6	1.6	34

Data averaged across two varieties, two fertility regimes, and three site-years during 2012 and 2013.

Agron. J. 107:563-573 (2015)

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Soybean Gets Some N from Fixation by Nodules

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P and K Uptake and Removal by 60 bu Soybean vs 230 bu Corn

Nutrient	Required to Produce		Removed with Grain		Remain in Stover	
	Corn	Soy	Corn	Soy	Corn	Soy
	lb acre^{-1}					
P_2O_5	101	43	80	35	21	8
K_2O	180	170	56	70	124	100

Corn data from Agron J. 105:161-170 (2013); Soybean data from Agron. J. 107:563-573 (2015)

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Soybean Plants Respond to Fertility

25 lb N, 75 lb P_2O_5, 18 lb S, 1.8 lb Zn per acre banded at planting

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Conclusions

- **Mineral nutrients are not acquired at the same time or used in the same way**

- **Mineral nutrients with a high Harvest Index like N, P, and S, are the most important for high corn and soybean yields**

Conclusions

- **Soil test values may not be calibrated for the higher plant populations being used for corn, and the greater yield potential of modern corn hybrids and soybean varieties**

Conclusions

- **Many Illinois growers in a corn soybean rotation are removing more P and K than they are replacing**

- **There are yield opportunities in corn and soybean from fertilizing with the right source in the right place**

Acknowledgements

Personnel

- Brad Bandy
- Tryston Beyrer
- Tom Boas
- Ryan Becker
- Ross Bender
- Brad Bernhard
- Fernando Cantao
- Narjara Cantelmo
- Renato Carmargos
- Laura Gentry
- Claire Geiger
- Jason Haegele
- Andrew Harmon
- Cole Hendrix
- Adam Henninger
- Brandon Litherland
- Shelby Mann
- Jack Marshall
- Adriano Mastrodomenico
- Katie Parker
- Ellie Raup
- Alvero Santos
- Ana Scavone
- Juliann Seebauer
- Jiying Sun
- Martín Uribelarrea
- Mike Vincent
- Alison Vogel
- Kyle Vogelzang
- Wendy White

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Acknowledgements
Financial Support

- AGCO
- Agricen
- Agrium
- AgroFresh
- Albion
- BASF
- Calmer Corn Heads
- Crop Production Services
- Dawn Equipment
- Dow AgroSciences
- DuPont Pioneer
- Fluid Fertilizer Foundation
- Goemar
- GrowMark
- Honeywell
- Helena Chemical Company
- Illinois Soybean Association
- IPNI
- John Deere
- Koch Agronomic Service
- Midwestern BioAg
- Monsanto
- Mosaic
- Nachurs
- Netafim
- Orthman
- Rentech
- Syngenta
- Stoller Enterprises
- Valent BioSciences
- West Central
- WinField Solutions
- Wolf Trax
- Wyffels Hybrids

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Very Special Thanks

- Harry Vroomen
- The Fertilizer Institute

For more information:

Crop Physiology Laboratory at the University of Illinois

http://cropphysiology.cropsci.illinois.edu

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