Potassium Placement Strategies for Optimum Nutrient Balance in Modern Corn Hybrids

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Purdue University

Purdue Agronomy
crop, soil, and environmental sciences

Presentation Overview

1. Modern Corn Hybrids (K uptake and partitioning)?

2. Nutrient Balance (K:N, and grain yield relationships to leaf concentrations)?

3. K placement considerations and strategies?

Study of Dekalb Corn Hybrids from 1967 to 2005 and Their Response Changes to Nitrogen and Plant Density Management (2013-2014)

Dekalb Hybrid Era Experimental Design

Location:

ACRE (West Lafayette, IN)

PPAC (Wanatah, IN)

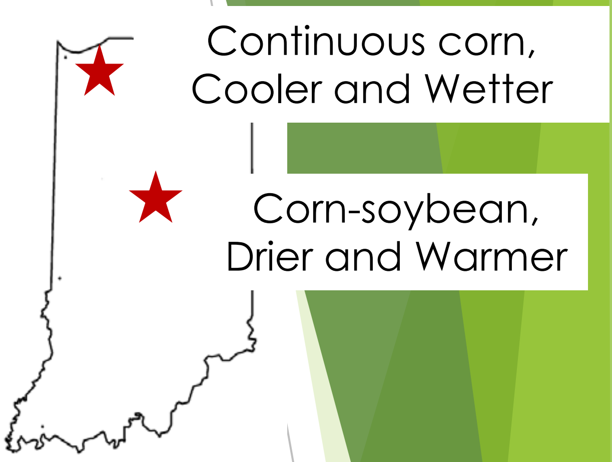
Years: 2013, 2014

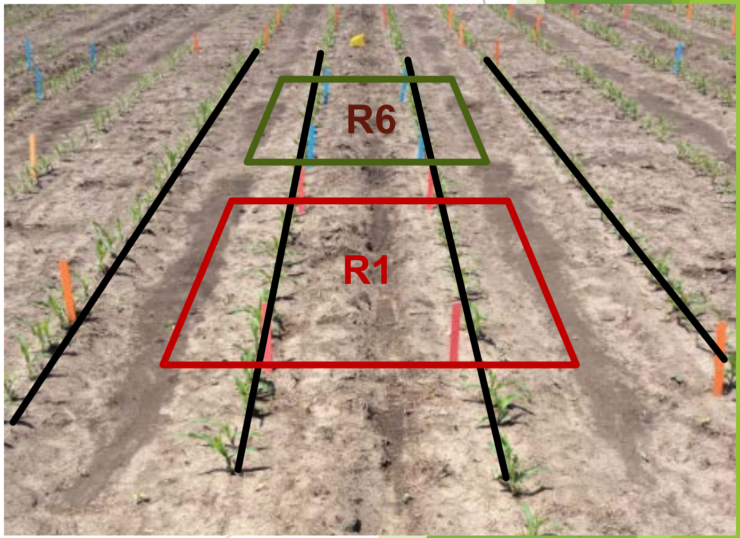
N fertilizer rate: 55 kg ha^{-1}; 220 kg ha^{-1}

Plant density:
54,000 plants ha^{-1}

79,000 plants ha^{-1}

104,000 plants ha^{-1}



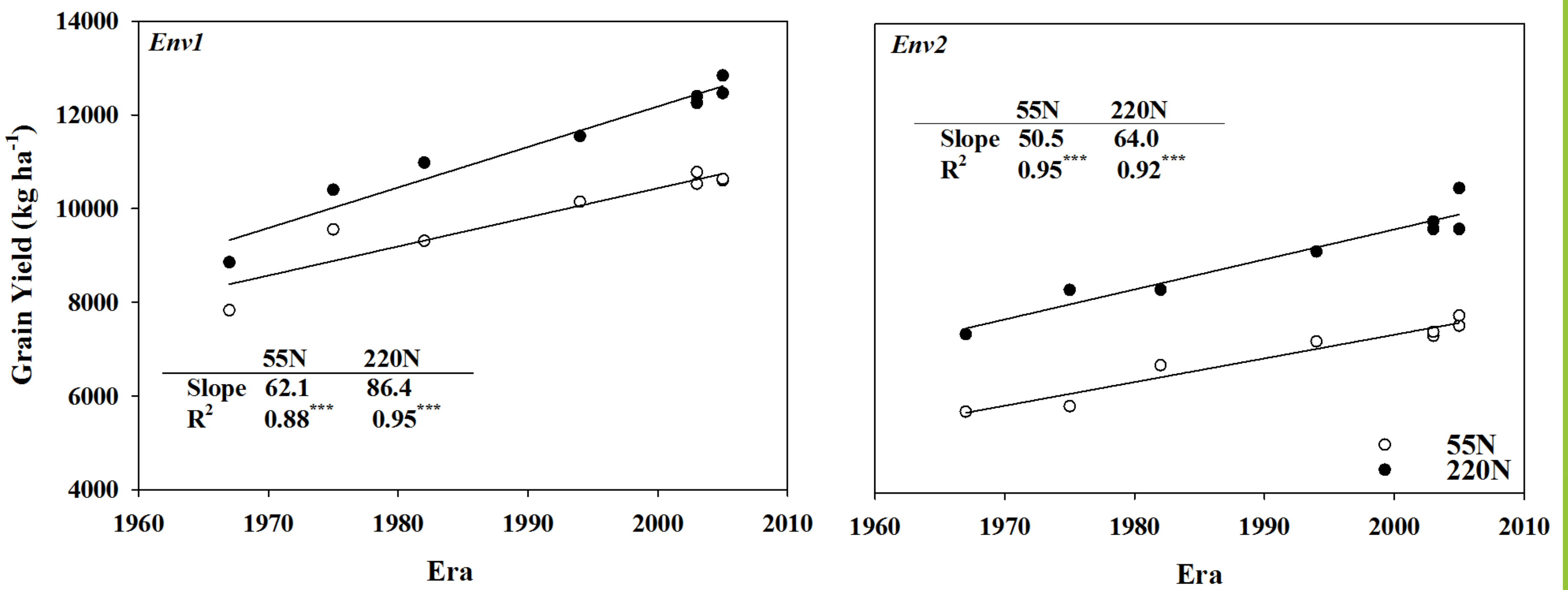


Average Soil-Test P (0-20cm): 35
Average Soil-Test K (0-20 cm): 140

Dekalb Hybrids in 2013-2014

Cultivars	Commercial Release (yr)	Type of Cultivars	Cultivar Characteristics	Relative Maturity Days (d)
DKC61-69	2005	VT3	Corn rootworm, European corn borer and glyphosate resistant	111
DKC61-72	2005	RR2 (Roundup Ready™)	Glyphosate resistant	111
RX752	2003	VT3	Corn rootworm, European corn borer and glyphosate resistant	112
RX752RR2	2003	RR2 (Roundup Ready™)	Glyphosate resistant	112
RX730	1994	Conventional	Not resistant	111
DK636	1982	Conventional	Not resistant	113
XL72AA	1975	Conventional	Not resistant	115
XL45	1967	Conventional	Not resistant	115

Dekalb Hybrid Yield Gains from 1967 to 2005 at Two N Rates in Two Indiana Locations (2013-2014)

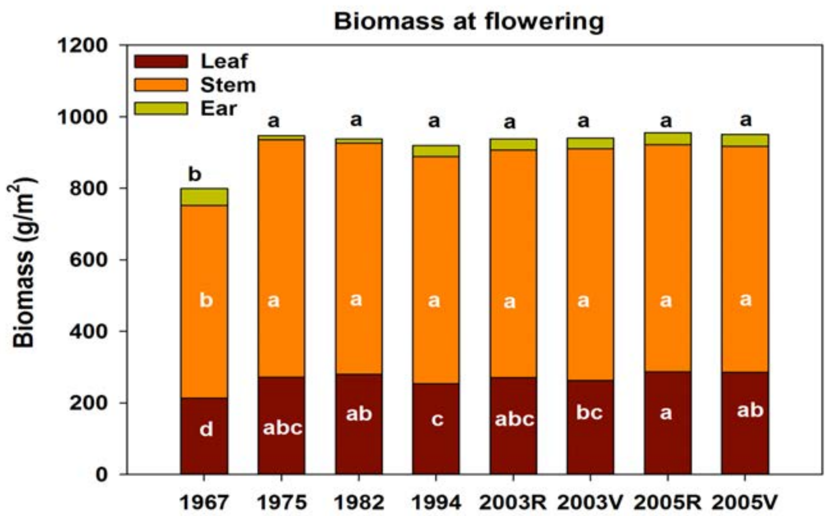


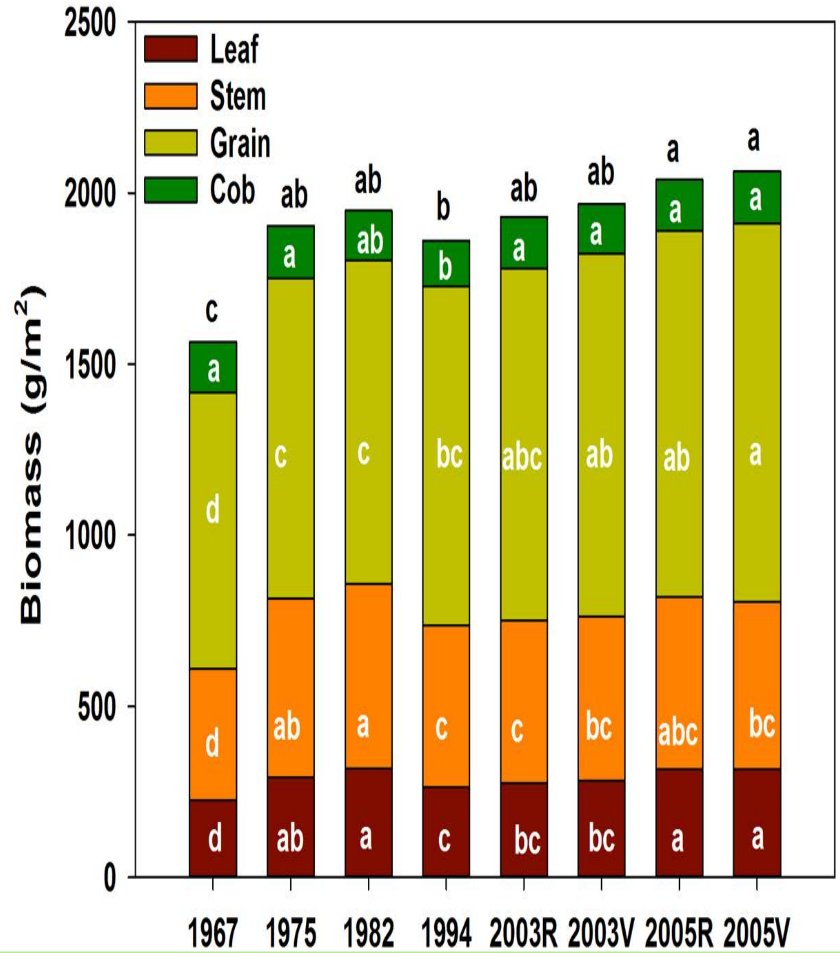
Source: Keru Chen et al., Field Crops Research, 2016

Whole-plant Sampling at Flowering and Maturity

1. Sampling from field; 2. Weighting fresh weight; 3. Select five sub-sample and separate sub-samples into leaf, stem (with husk), ear-shoot (R1); 4. Chopping; 5. Bagging; 6. Weighting all fresh weights

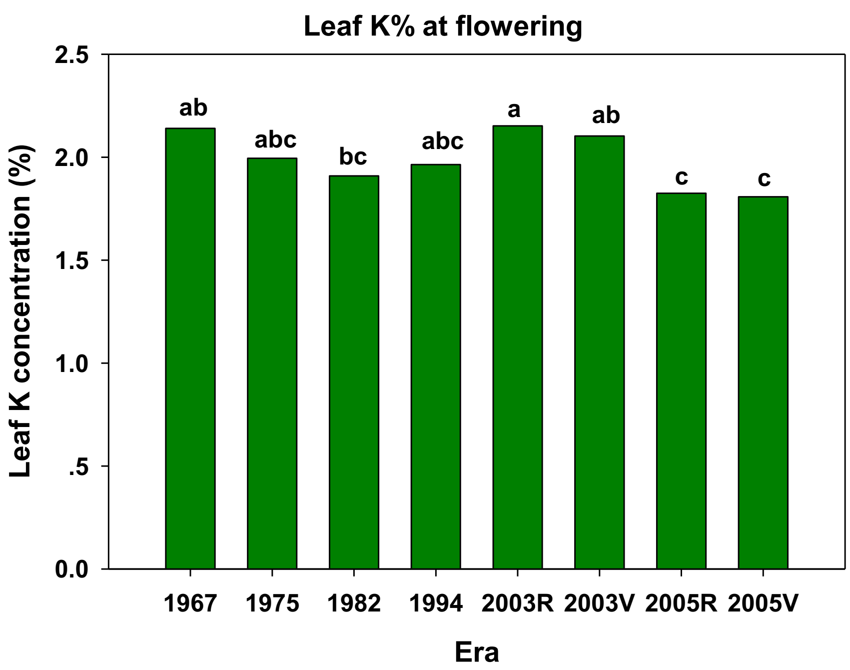
Corn Hybrid Era effect on Average Biomass at Flowering and Maturity (2013-2014)

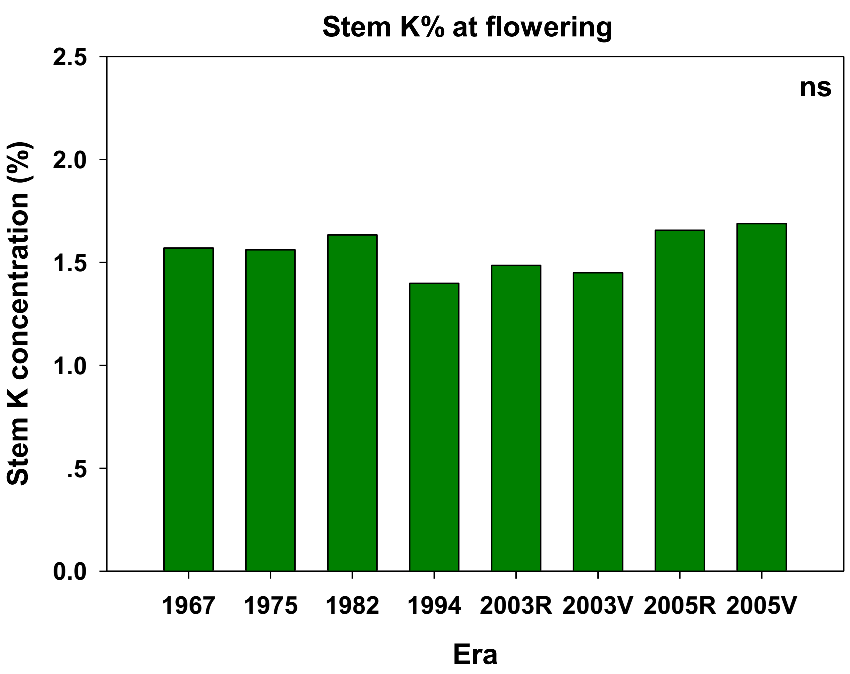




Except for 1967 hybrid, no change in biomass at R1; Total Dry Matter at R6 increased ~80 kg ha^{-1} year^{-1}

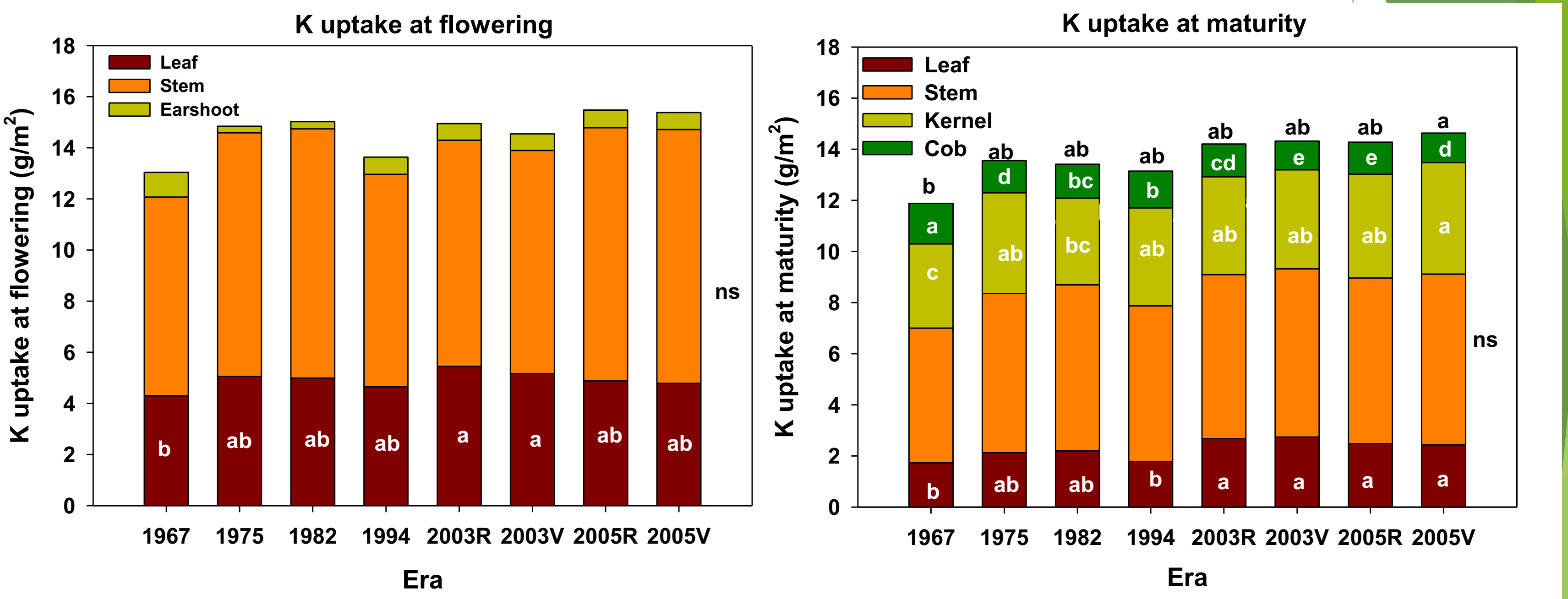
Leaf versus Stem K concentrations at flowering





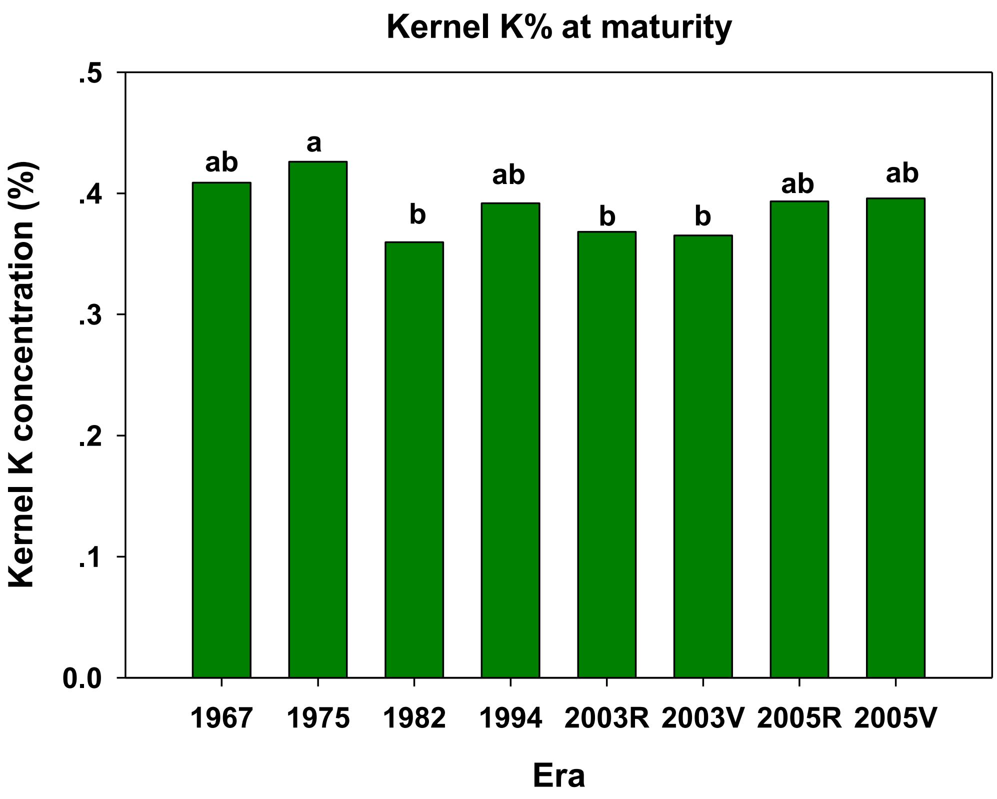
No Era trend in leaf or stem K concentrations at flowering

Hybrid Era Influence on Internal Plant K Distribution at Flowering and at Maturity



Tendency for more total K content retained in leaves at R6

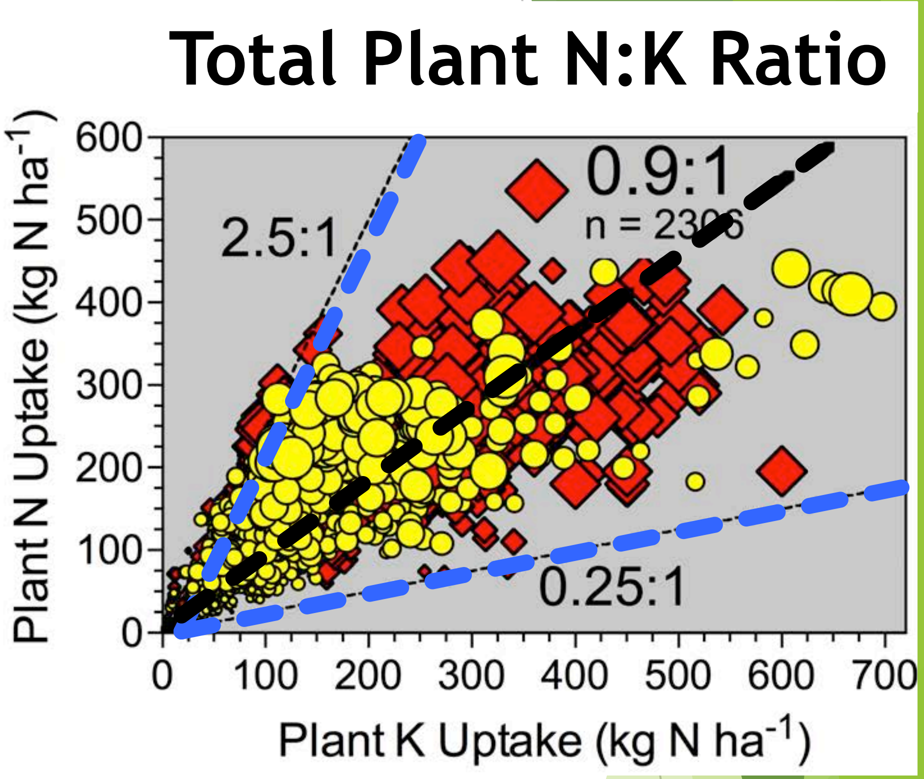
Grain K concentrations at maturity



No trend over time in grain K concentrations

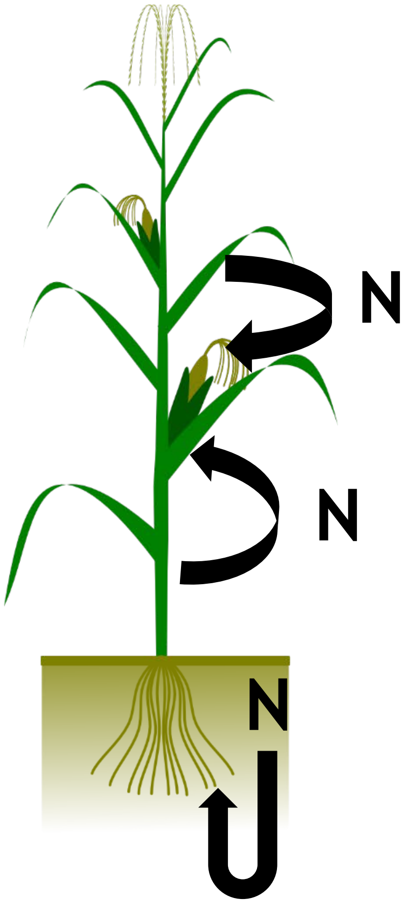
Is high-yielding corn related to balanced nutrition?

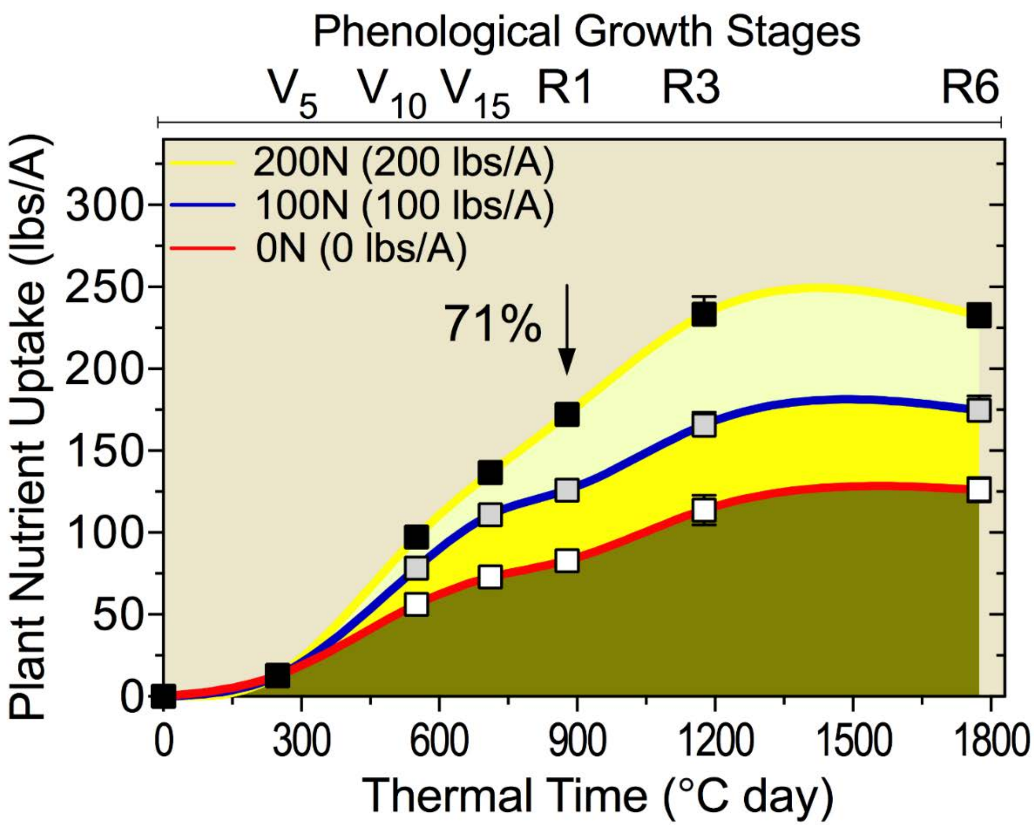
2006-12 yrs	USA (10 Mg/ha)	WORLD (6 Mg/ha)
Data Points	253	341
N:P	4.9	5.3
N:K	1.1	1.3



Source: Ciampitti and Vyn, 2014, Agron. J.

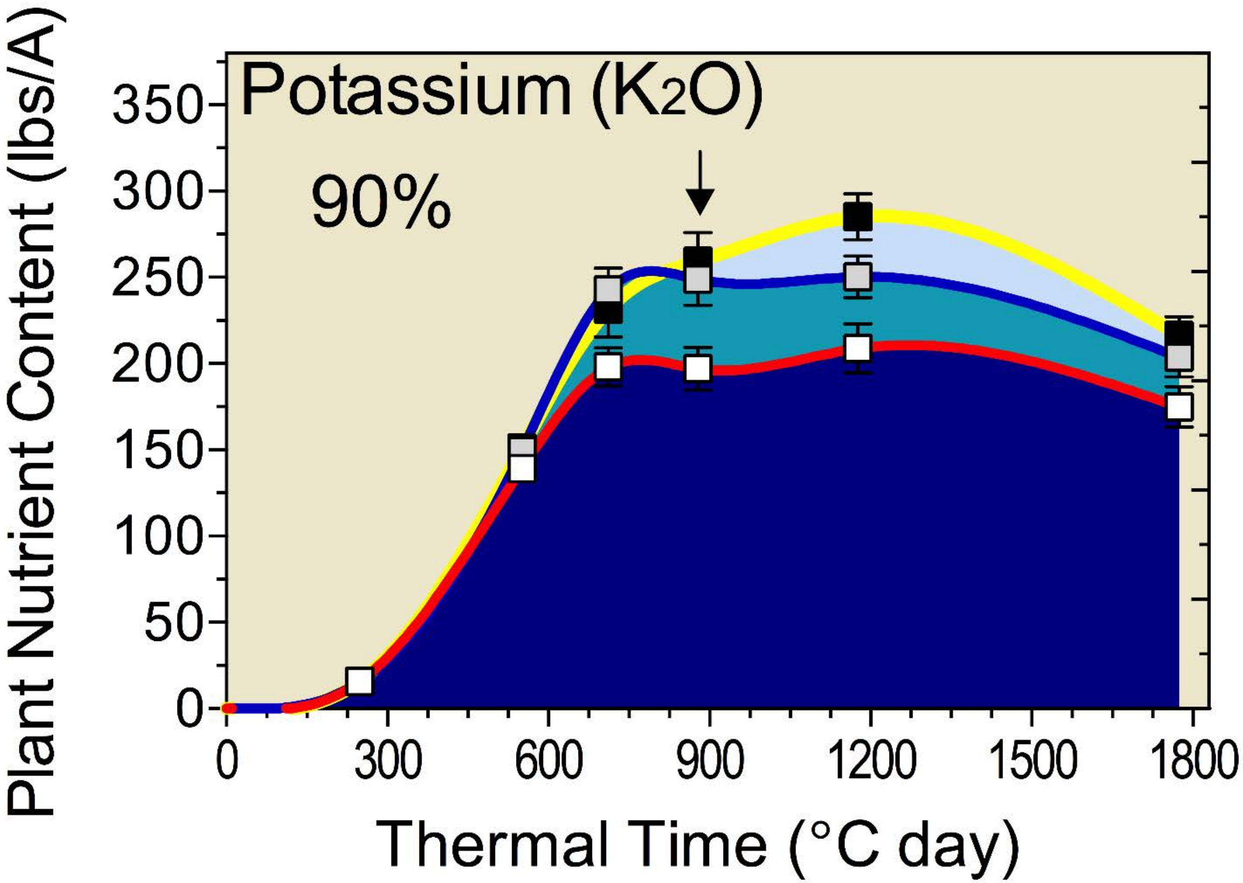
Timing and Source of N Uptake by Plants and Grain





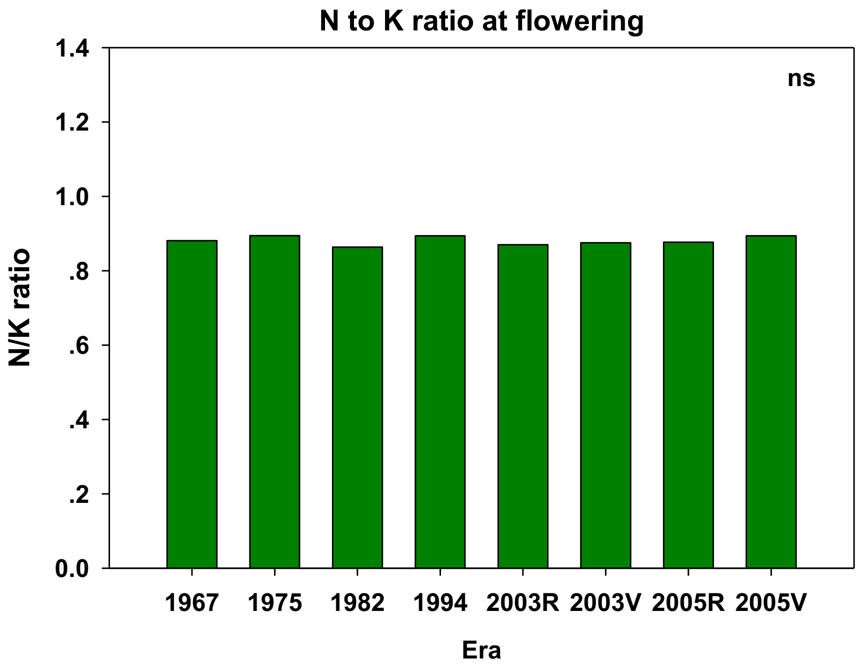
Ciampitti et al., 2013 Agronomy Journal

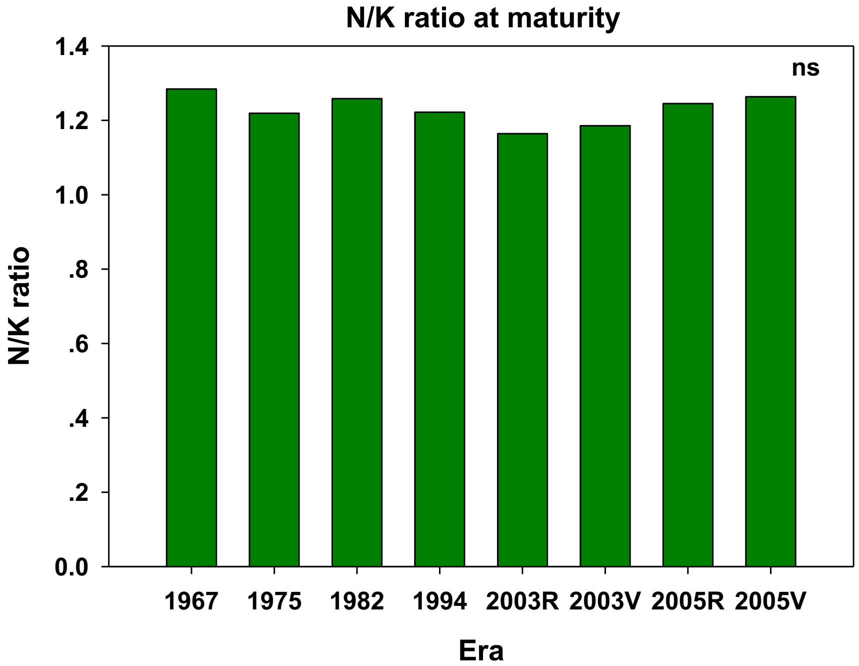
Potassium Uptake in Growing Season Over Time in Corn at Three N Rates



Ciampitti et al., 2013 Agronomy Journal

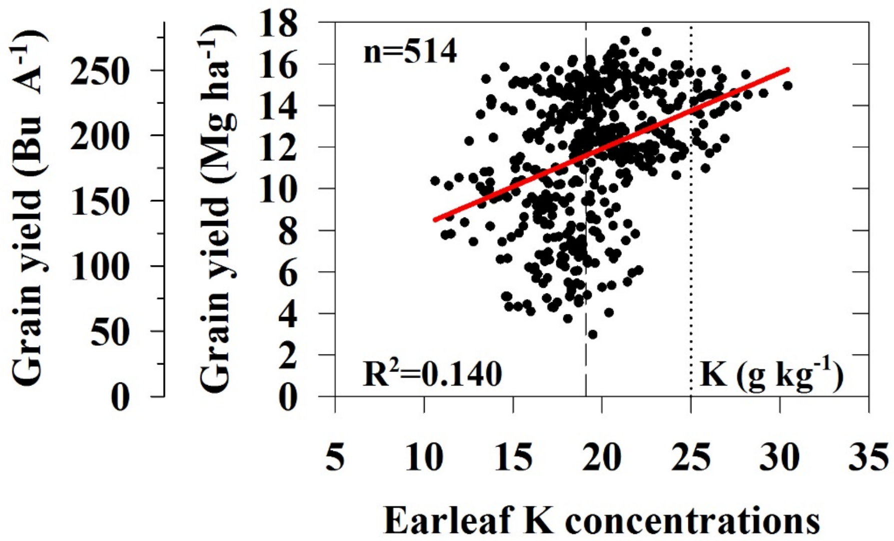
Hybrid Era Impacts N to K ratios at Flowering and Maturity



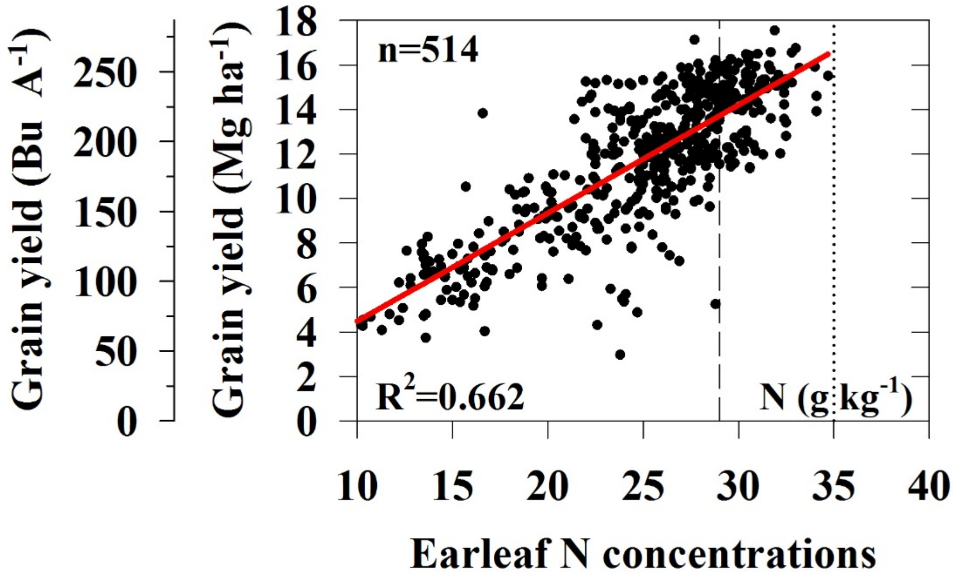


Source: Chen and Vyn, unpublished

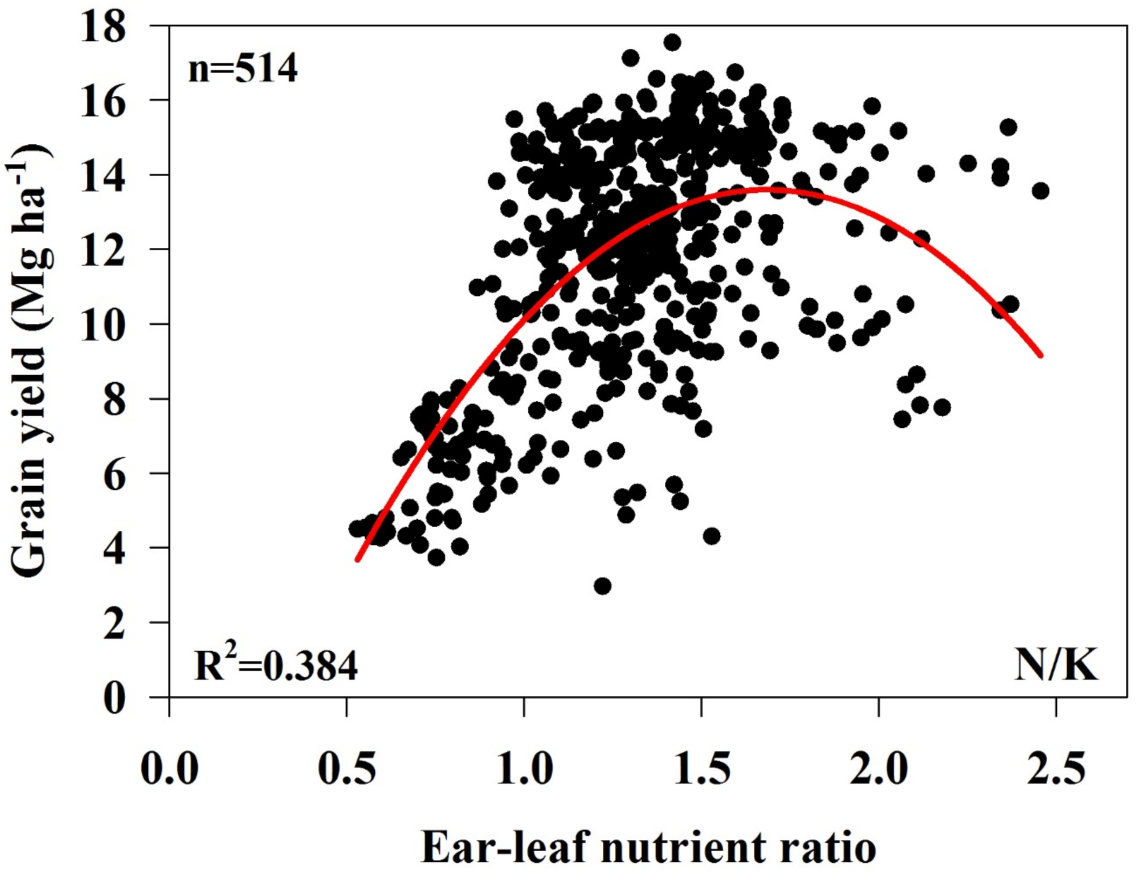
Ear-leaf K, N Relationships to Final Grain Yield in Indiana



Source: Kovacs and Vyn, unpublished



R1 Stage Ear-leaf N to K Ratio Relationship to Final Yield



Source: Kovacs and Vyn, unpublished

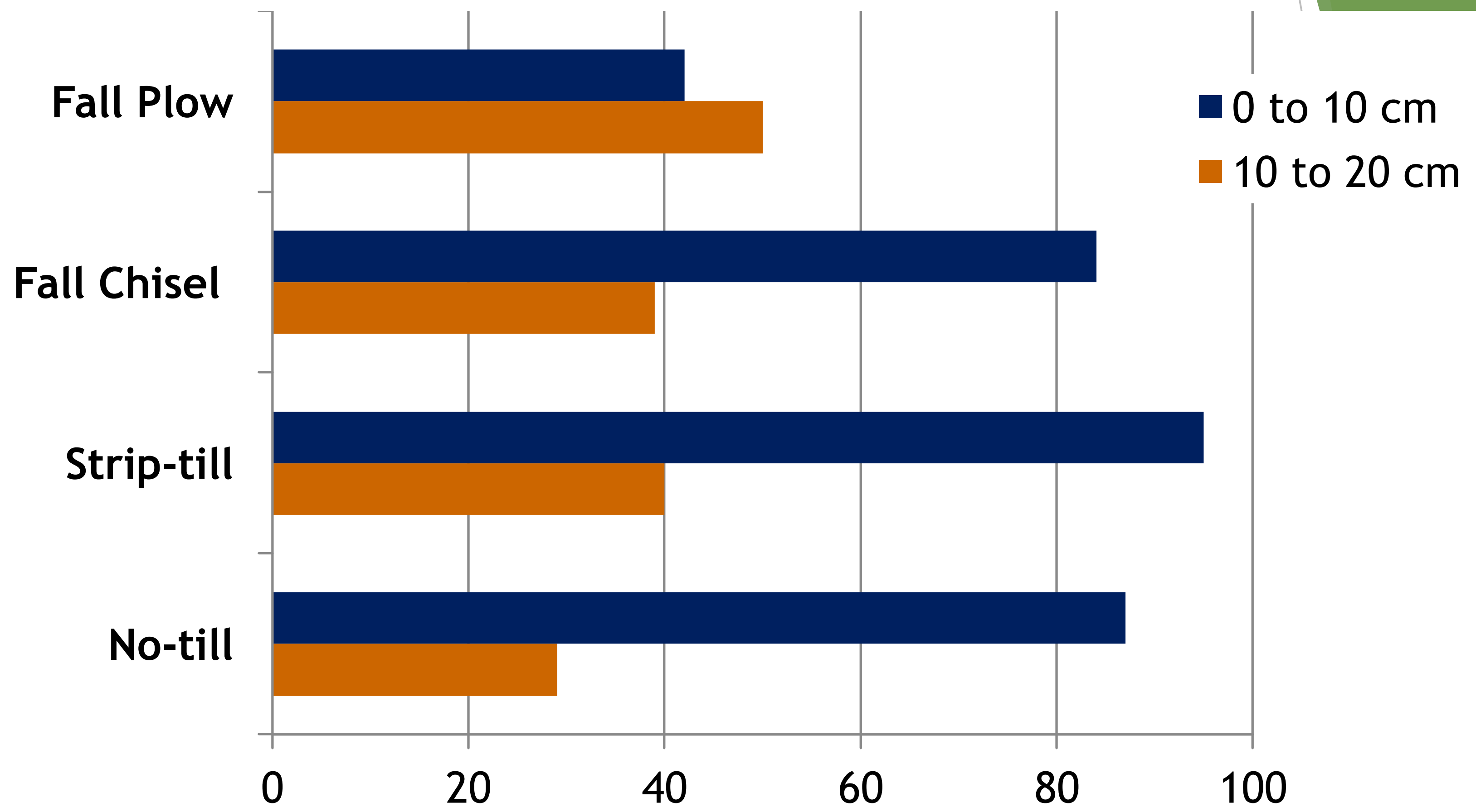
Long-Term Tillage/Rotation Study (1975-present)

Moldboard plowed

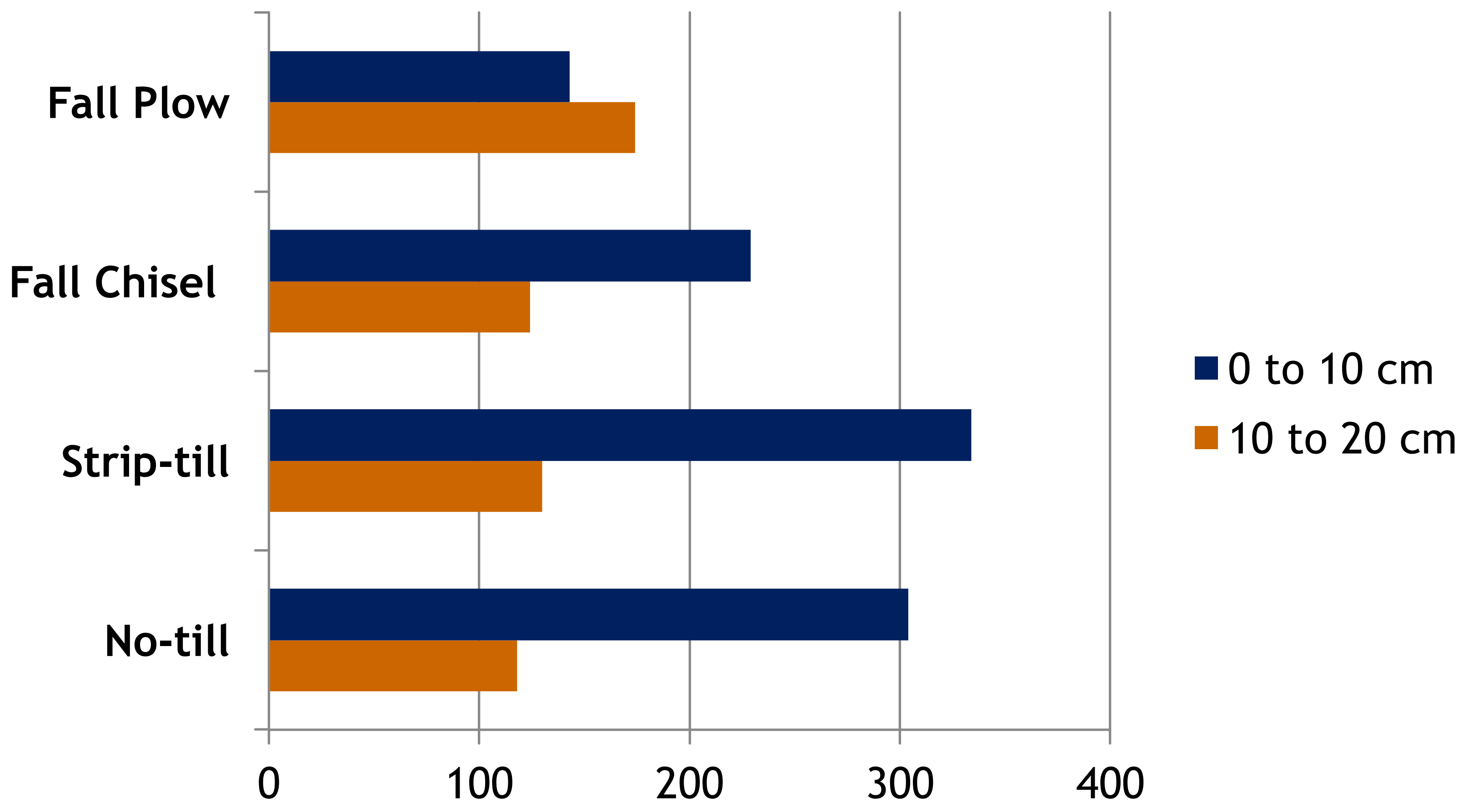
Chisel plowed

Fall Strip-Till

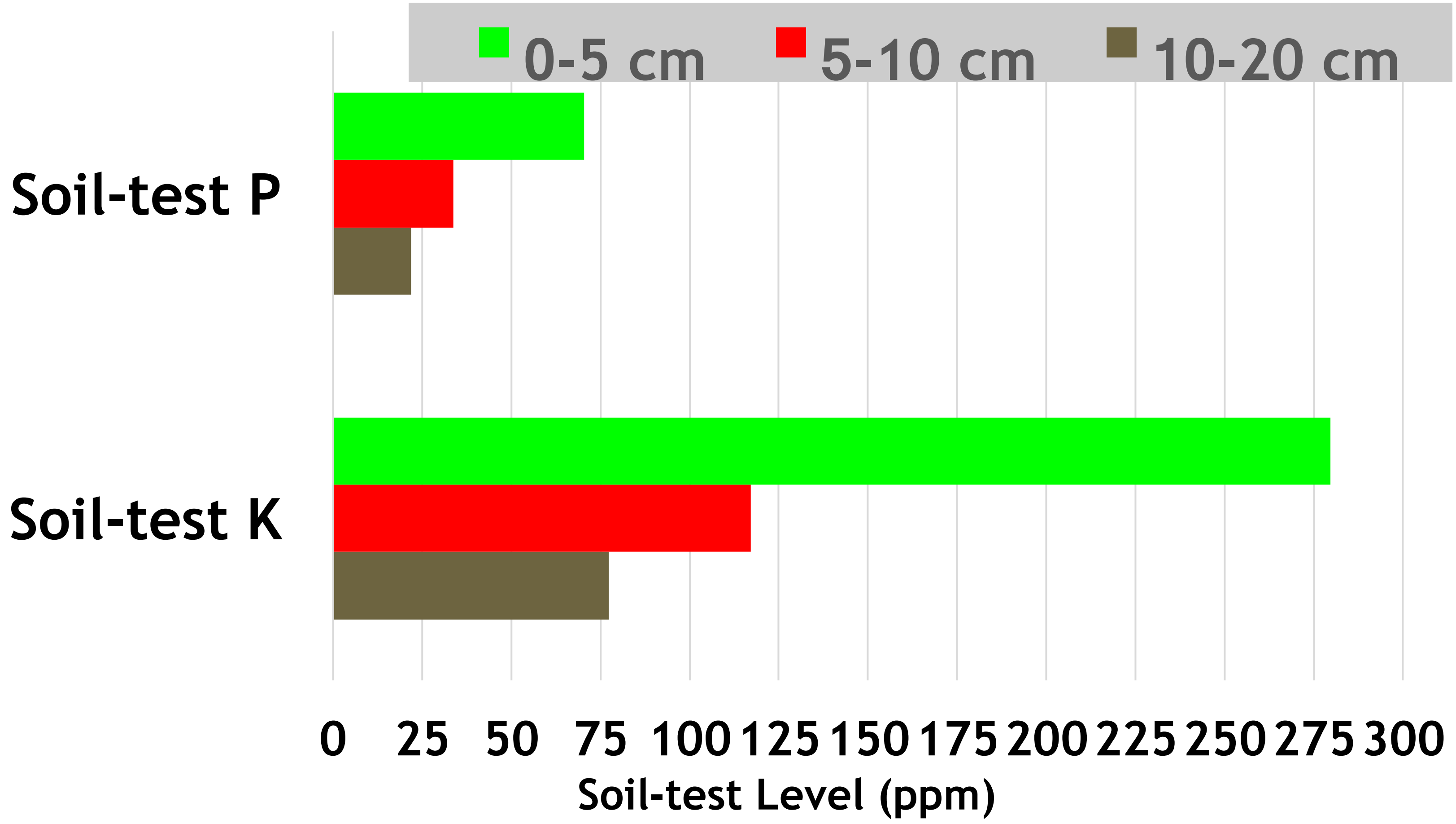
Long-term Tillage Influence on Soil-test P (ppm)



Long-term Tillage Influence on Soil-test K (ppm)



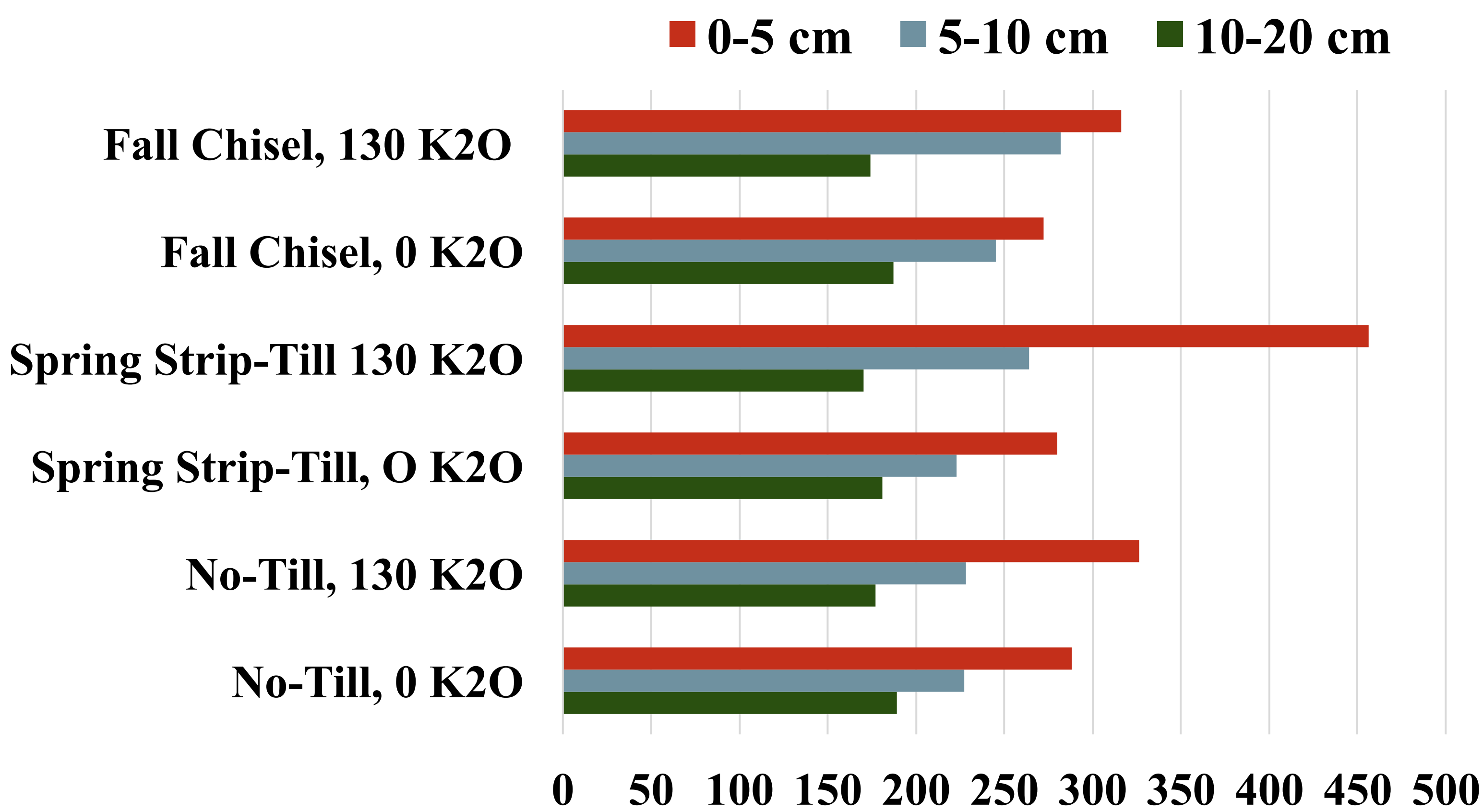
Stratification for P and K in Strip-till Corn and No-till Soybean Rotation with only Starter P (corn) and no Broadcast P or K in 4 Years



Source: Global Maize Trial, West Lafayette, 2014

Strip Tillage and Nutrient Placement Research

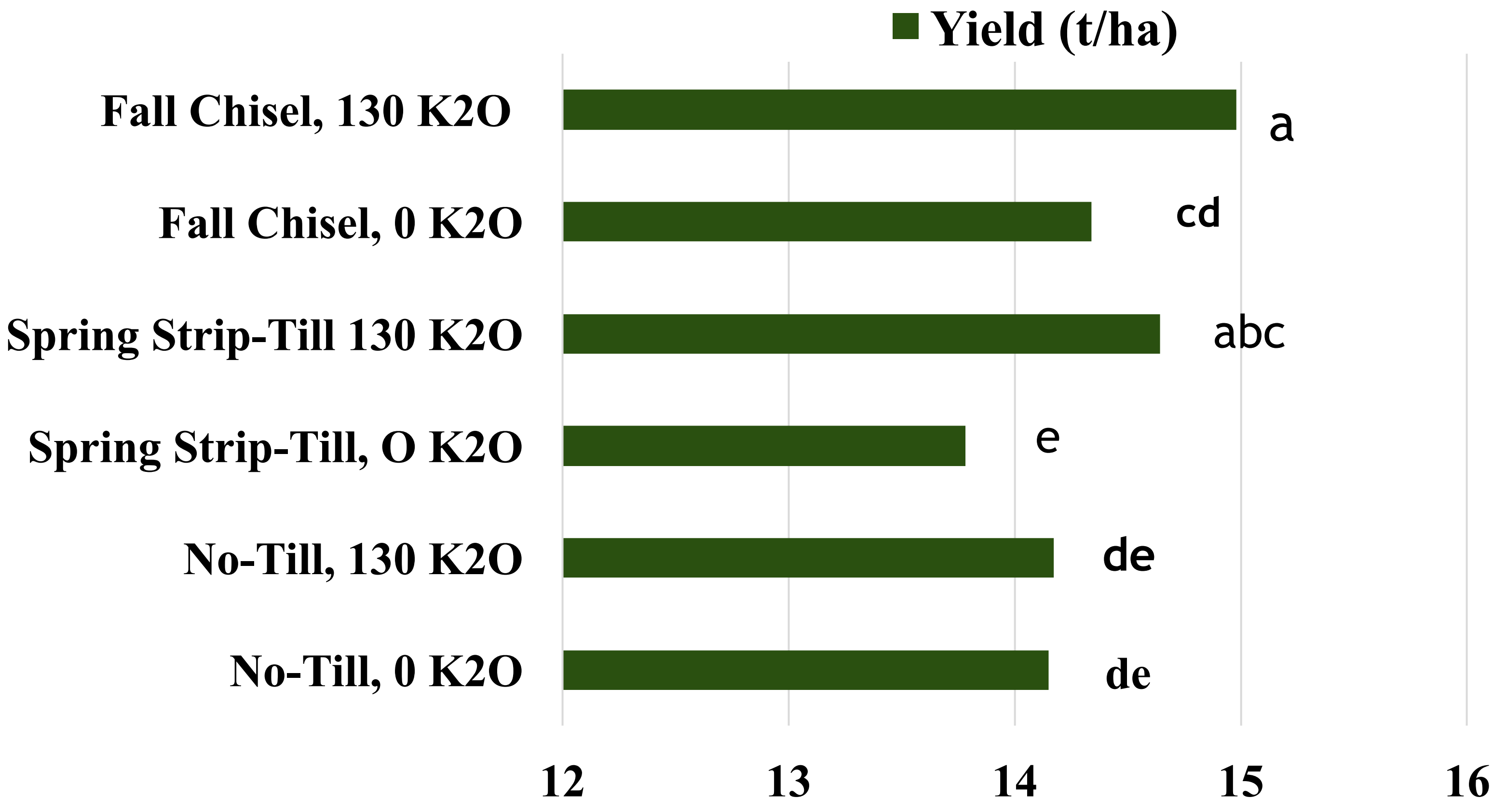
Tillage and K_2O Rate Consequences for In-row Soil-test K at 3 depth increments (West Lafayette, IN, 2016)



Source: Vyn, 2016, unpublished

K Source: Aspire (58% K_2O, 0.5% B)

Tillage and K_2O Rate Consequences for In-row Soil-test K at 3 depth increments (West Lafayette, IN, 2016)



Source: Vyn, 2016, unpublished

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Conclusions

- **Modern hybrids take up more total K because they yield more, but uptake timing and distribution is little affected when planted at the same density.**
- **Optimum tissue K concentrations, and N to K nutrient balance ratios, vary with time in corn growth.**
- **Nutrient stratification in conservation-till can complicate soil exchangeable K availability. More placement/timing etc. research needed.**

Acknowledgments

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John Deere Cropping Systems Unit

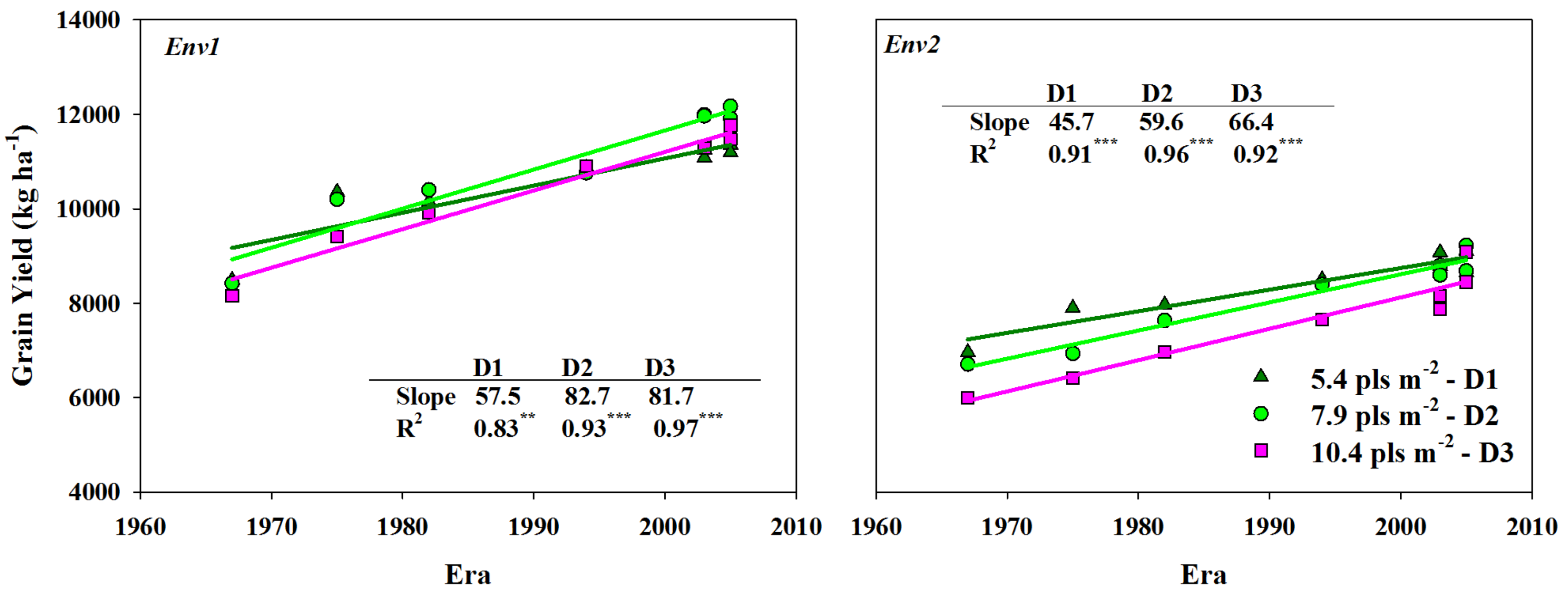
Environmental Tillage Systems

Seed:

Pioneer Hi-Bred, Int’l.
Monsanto
Dow AgroSciences

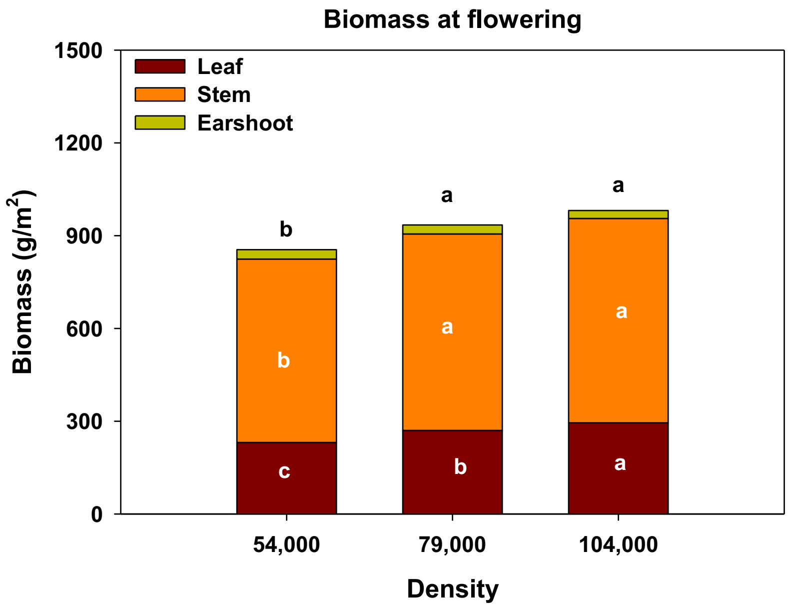

Questions?

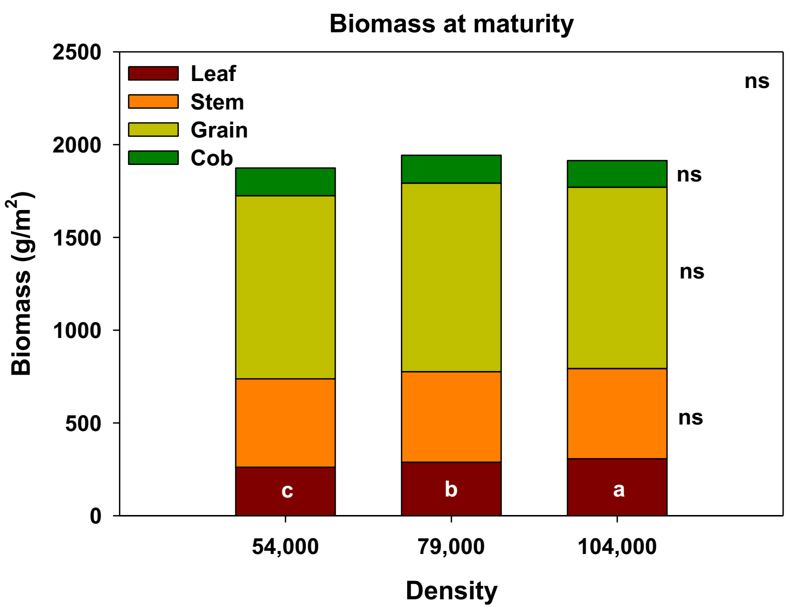
Dekalb Hybrid Yield Gains from 1967 to 2005 at Three Densities in Two Indiana Locations (2013-2014)



Source: Keru Chen et al., Field Crops Research, 2016

Plant Density Effects on biomass (averaged across 8 hybrids and 2 N rates)





(note: the scale is different for flowering and maturity)