Fluid Fertilizers for Sustainable Residue Removal in High-Yielding Corn Production Systems

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2013 Fluid Fertilizer Forum, Feb. 18-19, Scottsdale Resort, Scottsdale, AZ

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Study Objectives

- Evaluate the combined effects of **residue removal in continuous corn**, **N and non-N** (P, S, and Zn) fertility, and tillage on **corn yields**
- Assess the effect of partial residue removal on corn **root biomass**, soil fertility levels, and soil organic matter levels in high-yielding CC systems
- Evaluate the effects of management decisions (rotation, tillage, stover removal) on **nitrogen use efficiency**.

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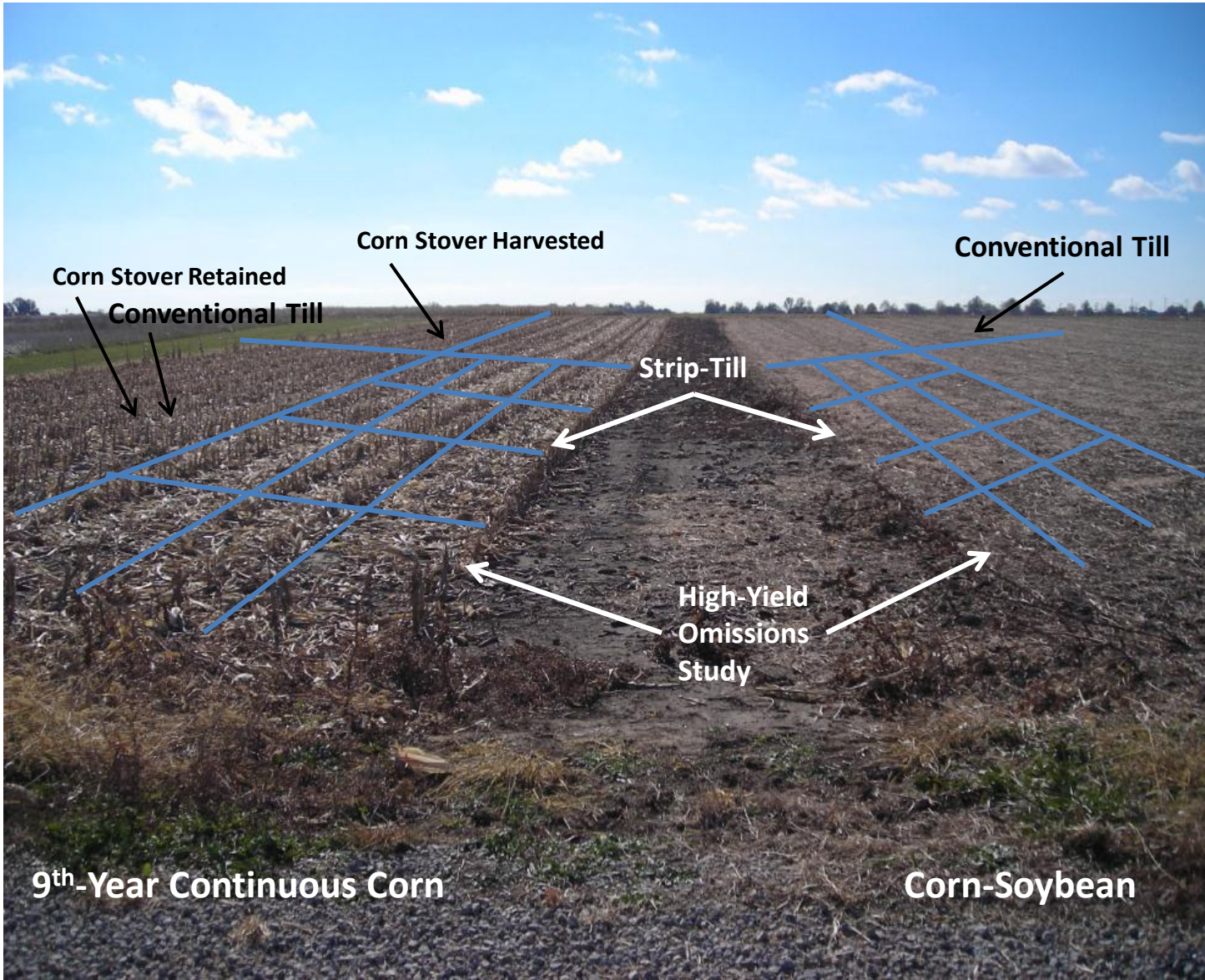
One Full Replication

- 9th Year CC vs. Corn after Soybean
- Corn Stover Retained vs. 50% Harvested
- Strip Tilled vs. Conventional Tillage
- Addition/Omission Study



Standard vs. High Tech 2011-2012

Fertility	No P, S, or Zn based on soil test 100 lbs P_2O_5 as MESZ (N, P, S, & Zn)
Nitrogen	180 lbs pre-plant as UAN 60 lbs extra N sidedress as stabilized urea
Genetics	RR Refuge Hybrid Triple stack Hybrid
Population	32,000 plants/ac vs. 45,000 plants/ac
Fungicide	No Fungicide Strobilurin (@ R1)

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Addition/Omission Design

		FACTORS				
	TREATMENT	Fertility	Nitrogen	Genetics	Population	Fungicide
	HIGH TECH	MESZ	Base + Slow release	Triple stack	45,000	Strobilurin
Remove Technology	-Fertility	No P S Zn	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
	Traditional	No P S Zn	Base	Refuge	32,000	none
Add Technology	+Fertility	MESZ	Base	Refuge	32,000	none
	+Nitrogen	No P S Zn	Base + Slow release	Refuge	32,000	none
	+Genetics	No P S Zn	Base	Triple stack	32,000	none
	+Population	No P S Zn	Base	Refuge	45,000	none
	+Fungicide	No PS Zn	Base	Refuge	32,000	Strobilurin

2011 Yields

	9th-Year Cont. Corn		Corn After Soybean
Technology	Stover Retained (bu acre^{-1})	Stover Removed (bu acre^{-1})	Stover Retained (bu acre^{-1})
High Tech	**166**	**185**	179
HT-FERT	169	147	175
HT-N	158	165	158
Tr			
TR			
T			
LSD (within rotat			
LSD (P<0.10) (btn rotation trts)			

When stover is retained in HT-CC system, reducing N application reduced yields in CT.
By removing stover: 1) N fertilizer requirement could be reduced by 60 lb N/a relative to the stover-retained yield and 2) the system became more N responsive.

2012 Yields

	9th-Year Cont. Corn		Corn After Soybean
Technology	Stover Retained (bu acre^{-1})	Stover Removed (bu acre^{-1})	Stover Retained (bu acre^{-1})
High Tech	95	113	156
HT-FERT	109	107	169
HT-N	118	109	160
Traditional	85	83	129
TRAD+FERT	91	95	137
TRAD+N	87	85	135
LSD (P<0.10) (within rotation			
LSD (P<0.10) (btn rotation trts)			

Greatest advantage of stover removal is in the high-population, high-input, system

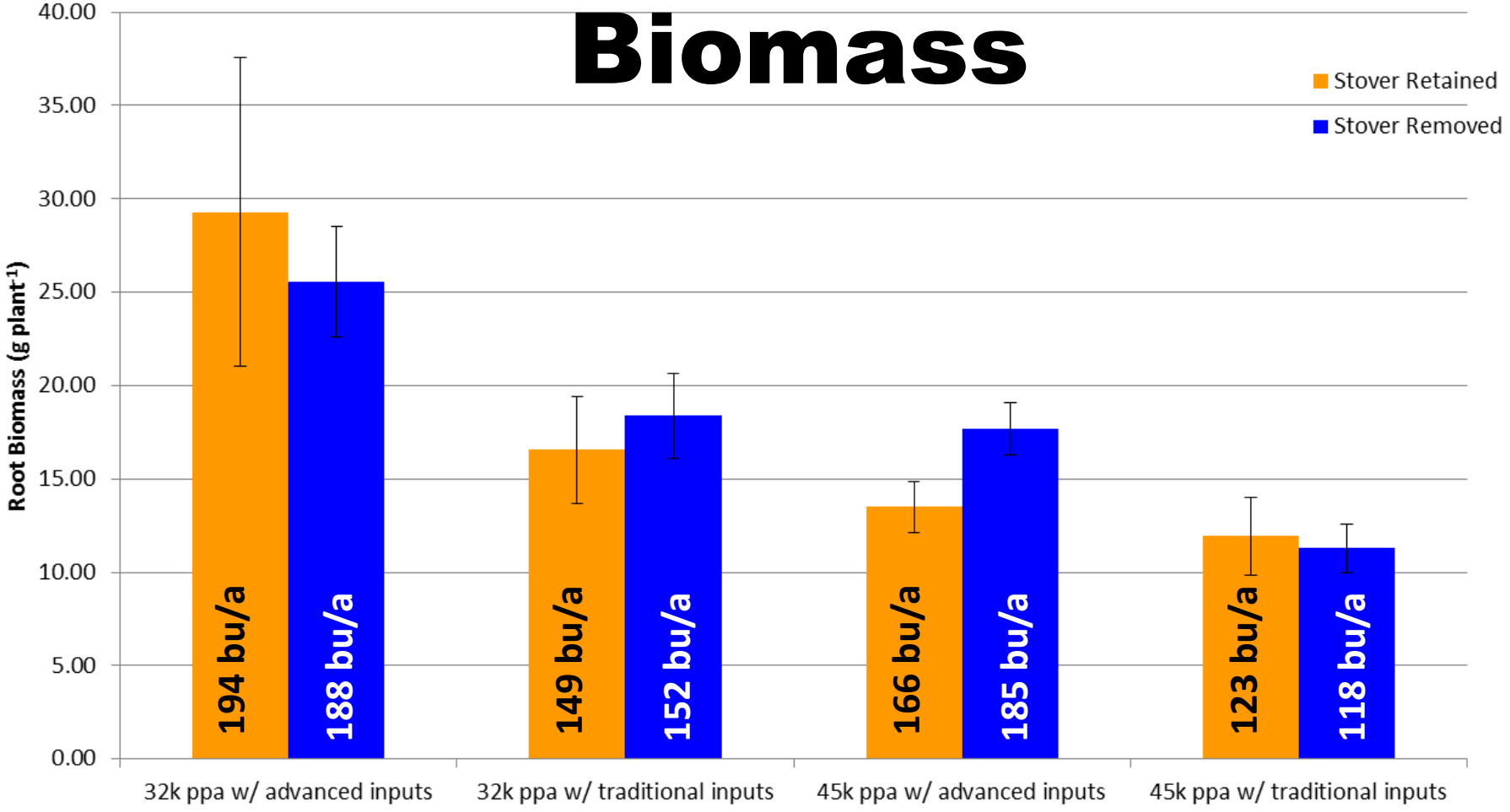
Root Biomass

- Population effect
- Input effect (N, P, S, Zn fertility, fungicide, CRW-resistant hybrid)
- Weather effect (?)

Addition/Omission Design

	TREATMENT	FACTORS: Fertility	Nitrogen	Genetics	Population	Fungicide
	HIGH TECH	MESZ	Base + Slow release	Triple stack	45,000	Strobilurin
Remove Technology	-Fertility	No P S Zn	Base + Slow release	Triple stack	45,000	Strobilurin
Remove Technology	-Nitrogen	MESZ	Base	Triple stack	45,000	Strobilurin
Remove Technology	-Genetics	MESZ	Base + Slow release	Refuge	45,000	Strobilurin
Remove Technology	-Population	MESZ	Base + Slow release	Triple stack	32,000	Strobilurin
Remove Technology	-Fungicide	MESZ	Base + Slow release	Triple stack	45,000	none
	Traditional	No P S Zn	Base	Refuge	32,000	none
Add Technology	+Fertility	MESZ	Base	Refuge	32,000	none
Add Technology	+Nitrogen	No P S Zn	Base + Slow release	Refuge	32,000	none
Add Technology	+Genetics	No P S Zn	Base	Triple stack	32,000	none
Add Technology	+Population	No P S Zn	Base	Refuge	45,000	none
Add Technology	+Fungicide	No P S Zn	Base	Refuge	32,000	Strobilurin

Population, Input, & Stover Effects on Per-Plant Root Biomass



Yield lsd (P<0.10) = 20 bu acre^{-1}

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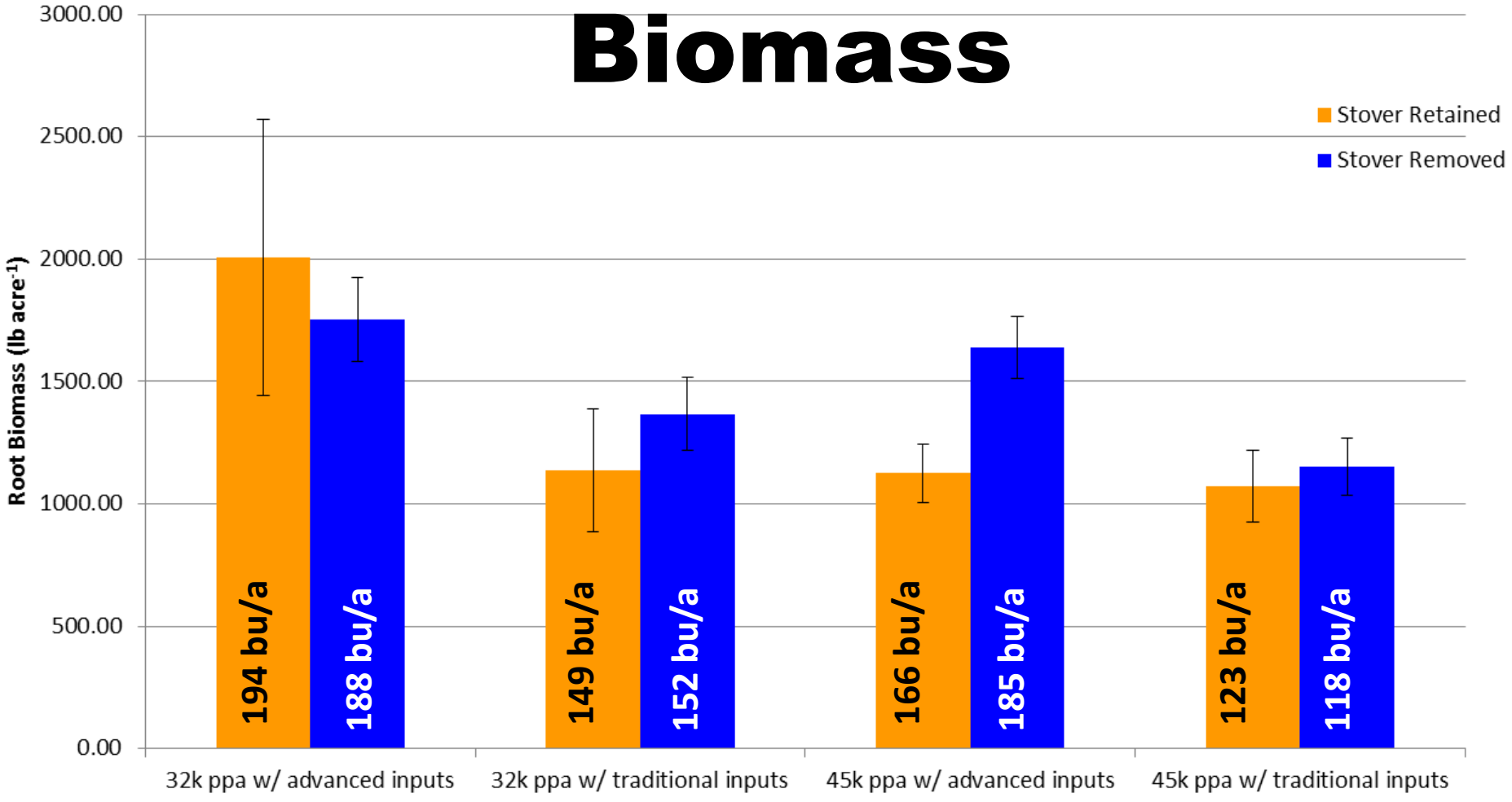
Population, Input, & Stover Effects on Per-Acre Root Biomass



Yield lsd (P<0.10) = 20 bu acre^{-1}

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Plant N Use Efficiency

	2011		2012	
	AVERAGE N FERTILIZER RECOVERY EFFICIENCY (%)			
	CC	CS	CC	CS
HIGH TECH	33	40	27	22
TRAD	33	22	28	22

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Conclusions

- Stover removal increased corn yields in CC high-population, high-input systems (18 bpa)
- In the high-population, high-input system:
  - stover removal without P, S, and Zn fertilization resulted in yield reductions
  - stover removal increased the plant-availability of N fertilizer
  - stover removal made crops more responsive to additional N fertilizer applications

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Conclusions

- Stover removal did not consistently affect root biomass
- Root biomass declined as a result of increasing plant population
- Crop inputs, and esp. P, S, and Zn fertilization, strongly & positively influenced root biomass
- N fertilizer recovery efficiency was equal or greater in high-population, high-input systems relative to more traditional farmer practices

SPECIAL THANKS!

- Fluid Fertilizer Foundation
- Dale Leikam

For more information:

Crop Physiology Laboratory at the University of Illinois:

http://cropphysiology.cropsci.illinois.edu

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