

KERNZA DUAL-USE = DOUBLE THE FUN

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Kernza Barriers

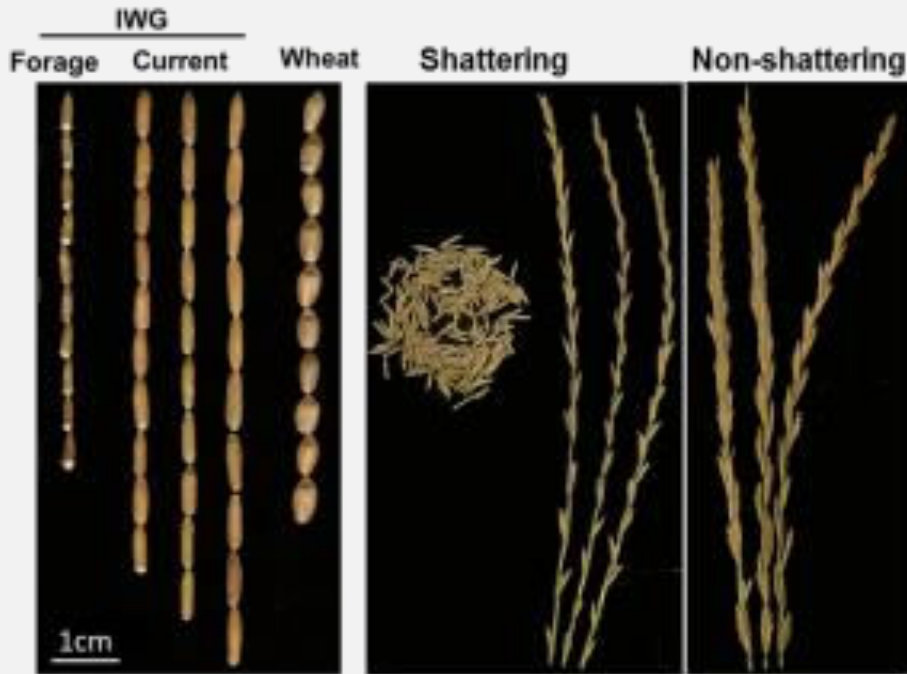


Photo by U of Minnesota

- Lower seed yield relative to annual wheat
- Decline in seed yield over time

Problems create an economic barrier to adoption

A Dual-Use Solution

- Provides two sources of income
- Could help mitigate decline in grain yields with age



**Kernza has yet to be rigorously evaluated
for its potential as a dual-use crop**

Kernza Agronomic Research Questions

- *Can we offset the low grain production with added value of forage? Can it support both grain and forage?*
- *How do we mitigate declining grain yields and productivity over time? Through grazing or disturbance?*

Overarching Research Goals

1) Multi-site Study

Evaluate Kernza's performance across a wide range of regions and environments for:

- Realistic estimates of productivity
- Feasibility of dual-use management

2) Ohio Root Study

Determine effects of dual-use management on root biomass and soil health indicators

1) Multi-Site Study Locations

Site	Location	Institution	PI/ Point Person	Year Planted	Factors Examined
<u>2014</u>					
CO	Fort Collins	Colorado State	Meagan Schipanski	2014	Defoliation, Nitrogen
KS	Salina	Land Institute	Tim Crews and Lee DeHaan	2014	Defoliation, Nitrogen
MD	Beltsville	USDA	Jude Maul	2010	Defoliation, Varieties
MN	St. Paul	U of Minnesota	Jake Jungers and Craig Sheaffer	2014	Defoliation & Row Spacing
NY	Ithaca	Cornell University	Matt Ryan	2014	Defoliation, Nitrogen
OH-Western	S. Charleston	Ohio State	Mark Sulc	2014	Defoliation
OH-Wooster	Wooster	Ohio State	Steve Culman	2014	Defoliation, Nitrogen
<u>2015</u>					
IA	Ames	Iowa State	Mary Wiedenhoeft	2015	Defoliation
WI	Madison	U of Wisconsin	Valentin Picasso	2015	Defoliation, Nitrogen
SD	Brookings	SDSU	Chris Graham	2015	Defoliation
Alberta	Lethbridge	Ag-Canada	Jamie Larsen	2015	Defoliation

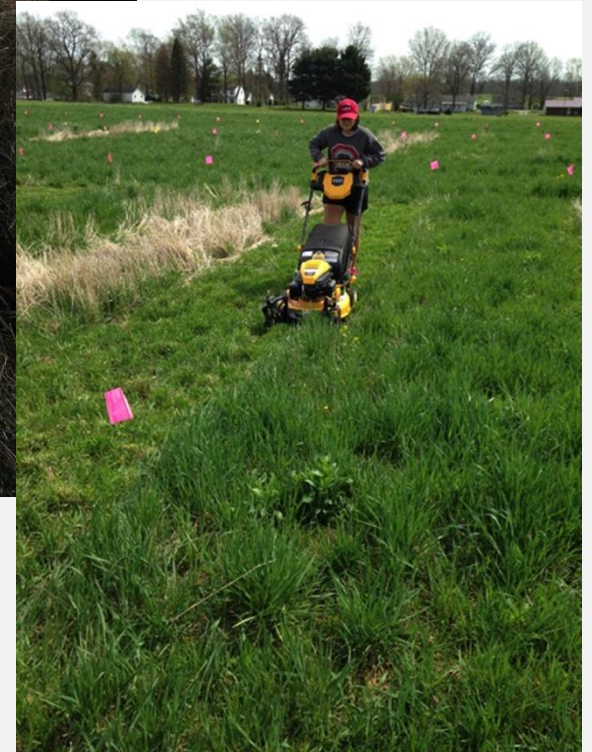
Experimental Design

- Treatments
 - Spring and Summer Cut
 - Summer Cut
 - Summer and Fall Cut
 - No Cut (control)
- Measurements
 - Plant height
 - Forage biomass
 - Seed head counts
 - Grain yield
- Analyses: Year x Site x Defoliation management

Grain Harvest = All Treatments



Defoliation = Mechanical Forage Harvest



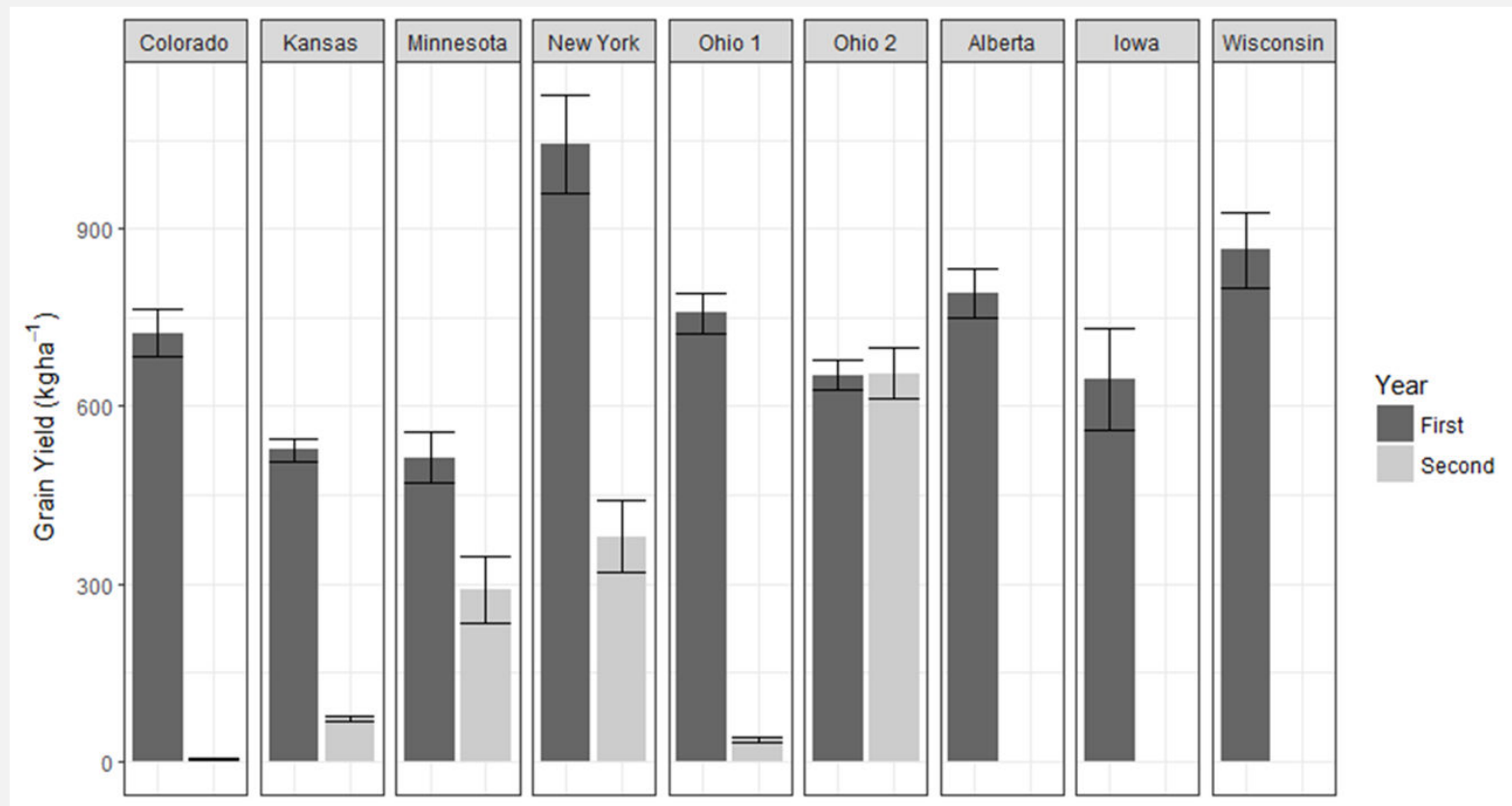


Close up of No Cut at Summer Harvest



Kernza Grain and Forage Yields (averaged over defoliation treatments)

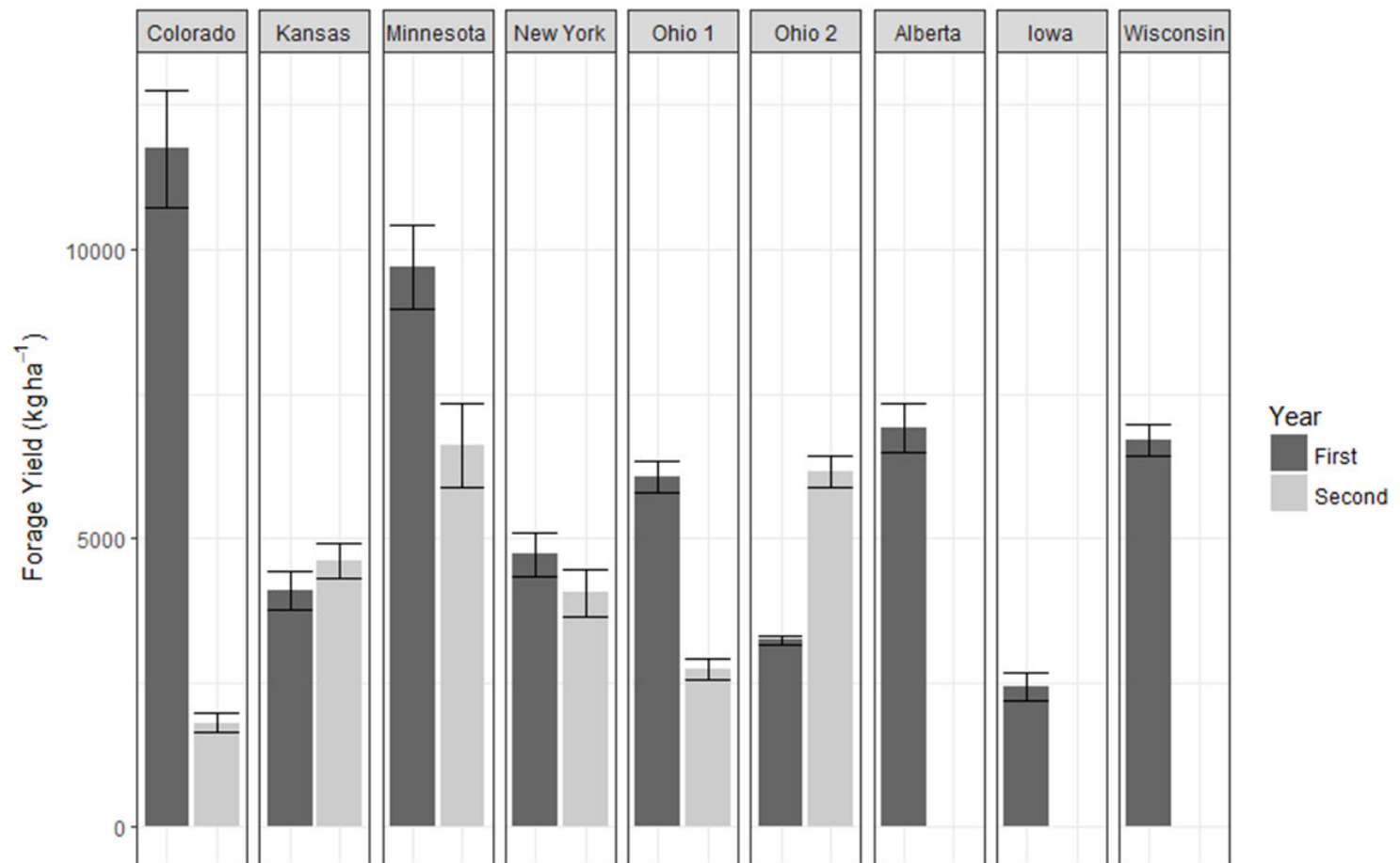
Kernza Grain Yields Across Sites



1st year: $\sim 500 - 1000 \text{ kg ha}^{-1}$

2nd year: $\sim 3 - 650 \text{ kg ha}^{-1}$

Kernza Forage Dry Matter Across Sites



1st year: $\sim 4 - 12 \text{ Mg ha}^{-1}$

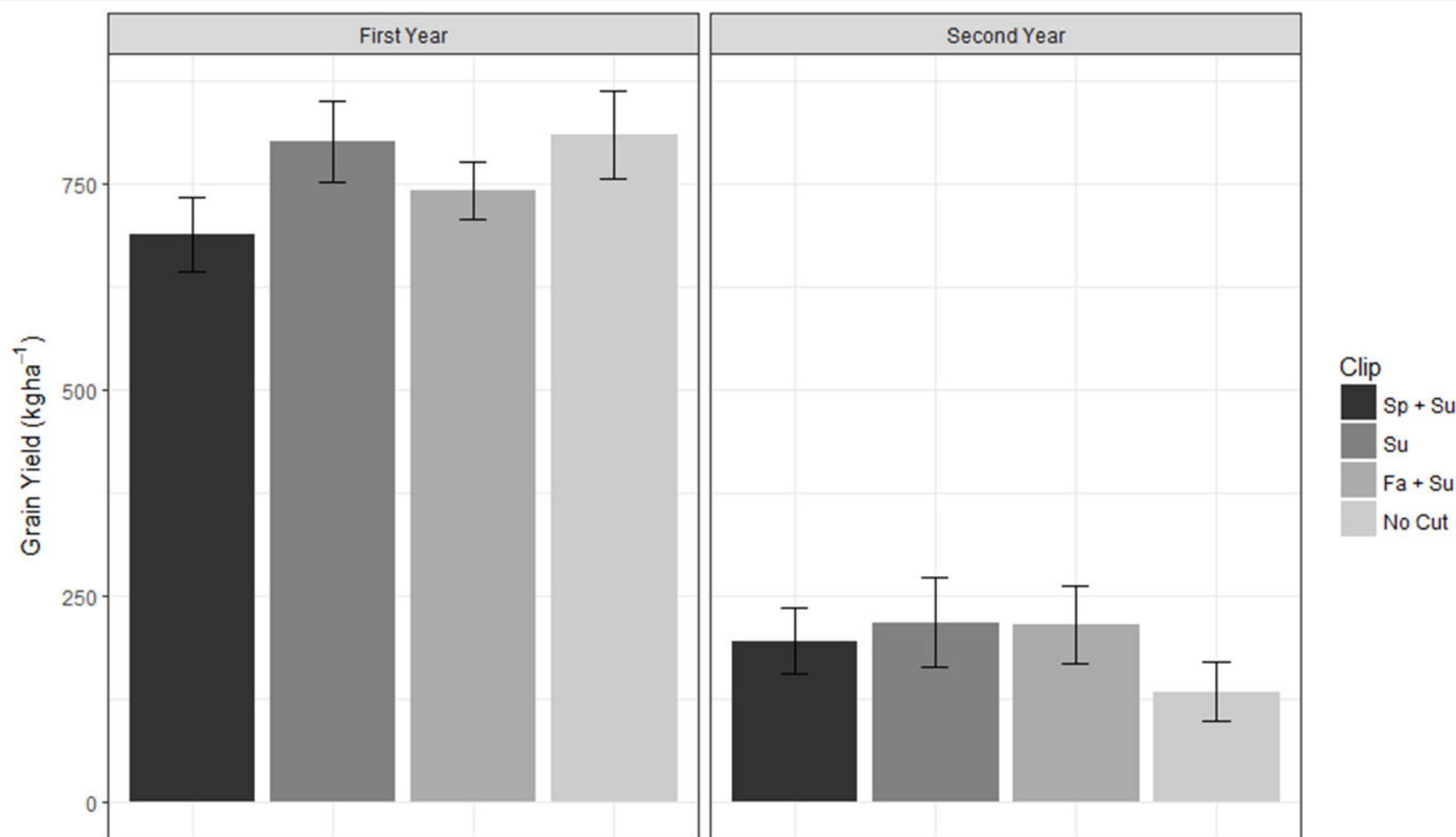
2nd year: $\sim 2.5 - 9 \text{ Mg ha}^{-1}$

Kernza Grain and Forage Yields (by defoliation treatments)

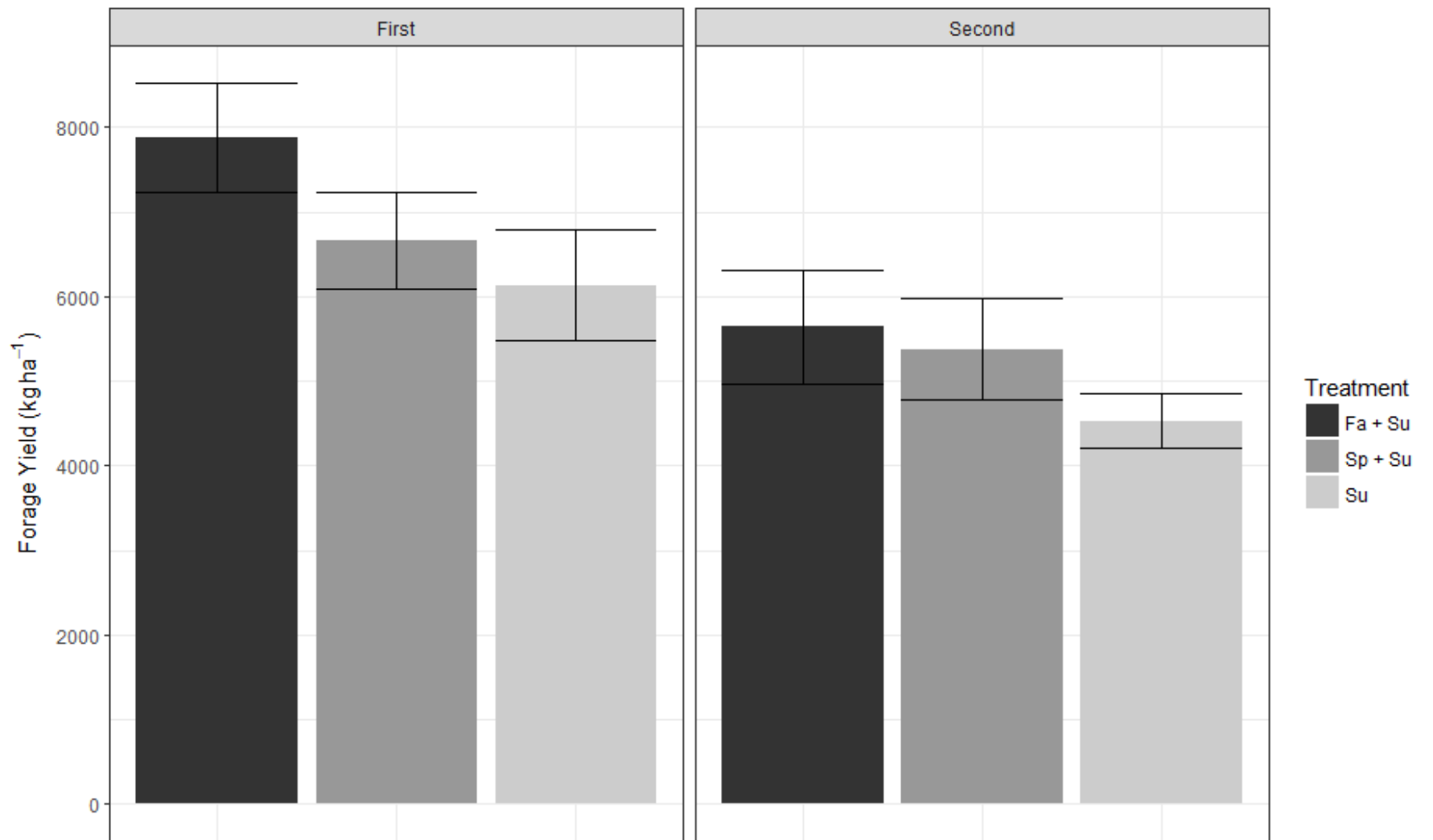
Ahhh...NOVAs

Harvest	Summer		
	<i>Forage Yield</i>	<i>Grain Yield</i>	<i>SHC◇</i>
	First and Second Year		
Site (S)	23.66 ***	15.73 ***	406.9 ***
Year (Y)	75.05 ***	227.27 ***	642.53 ***
S x Y	53.82 ***	22.85 ***	628.72 ***
Management (M)	13.05 ***	0.99	0.34
S x M	0.86	2.16 **	0.58
Y x M	0.36	1.68	0.69
S x Y x M	0.88	0.52	0.84
	First Year		
Site (S)	38.58 ***	7.26 ***	474.01 ***
Management (M)	3.84 **	1.48	0.56
S x M	0.91	1.12	0.66
	Second Year		
Site (S)	31.04 ***	141.11 ***	69.92 ***
Management (M)	23.26 ***	7.52 ***	7.67 ***
S x M	0.82	5.36 ***	1.2

Kernza Grain Yield Under Dual-Use



Kernza Annual Forage Yields Under Dual-Use



Take Home Points After 2 Years

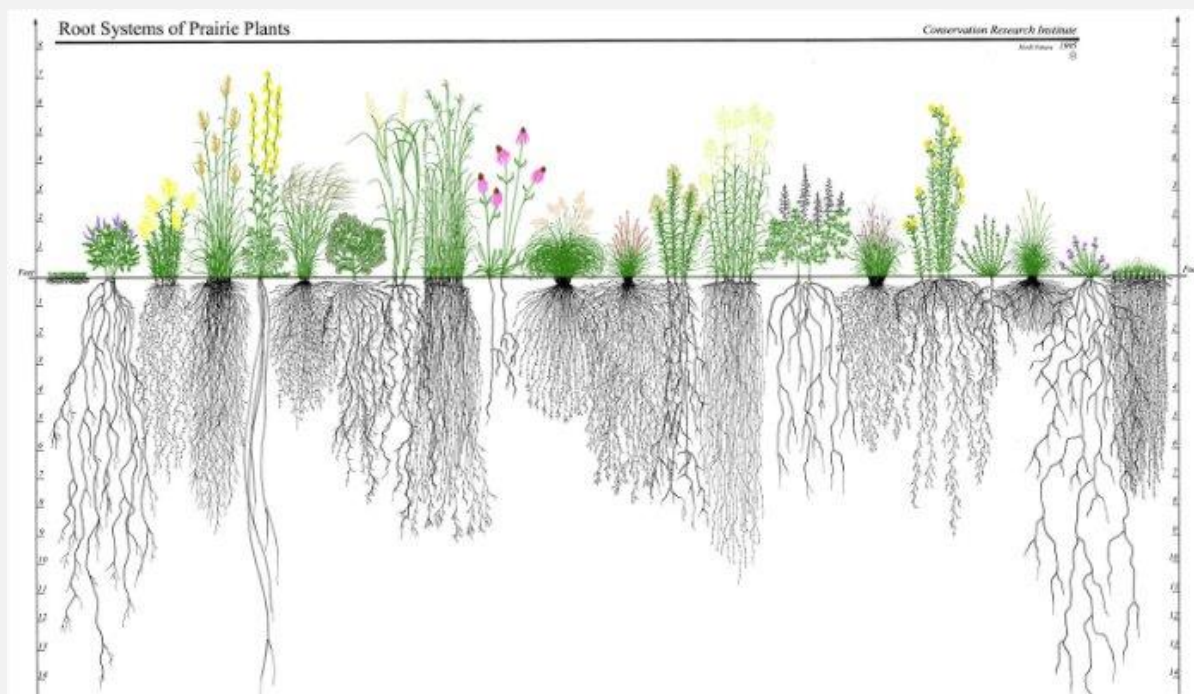
- Greater Kernza grain production in Northeast and greater forage production in the Great Plains and Upper Midwest
- Kernza produced more grain under dual-use management compared to managing Kernza for grain only (control)
- Kernza grain yields were not affected by defoliation frequency or timing, as grain yields were similar between all dual-use strategies

Ohio Root Study

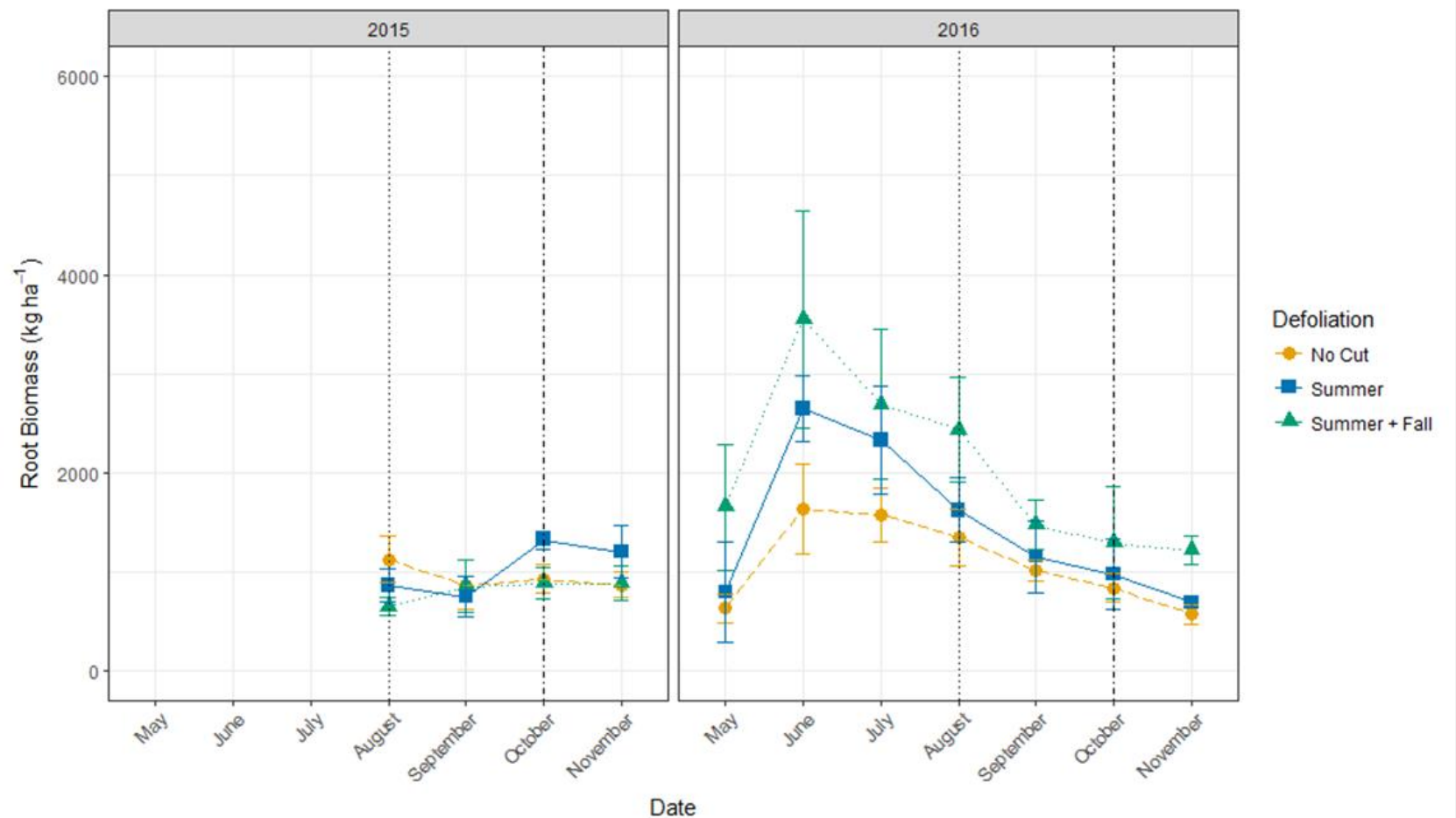
How Does Defoliation Impact Roots?

- Literature has yielded widely varying results
- Variability in effects can be caused by differences in:

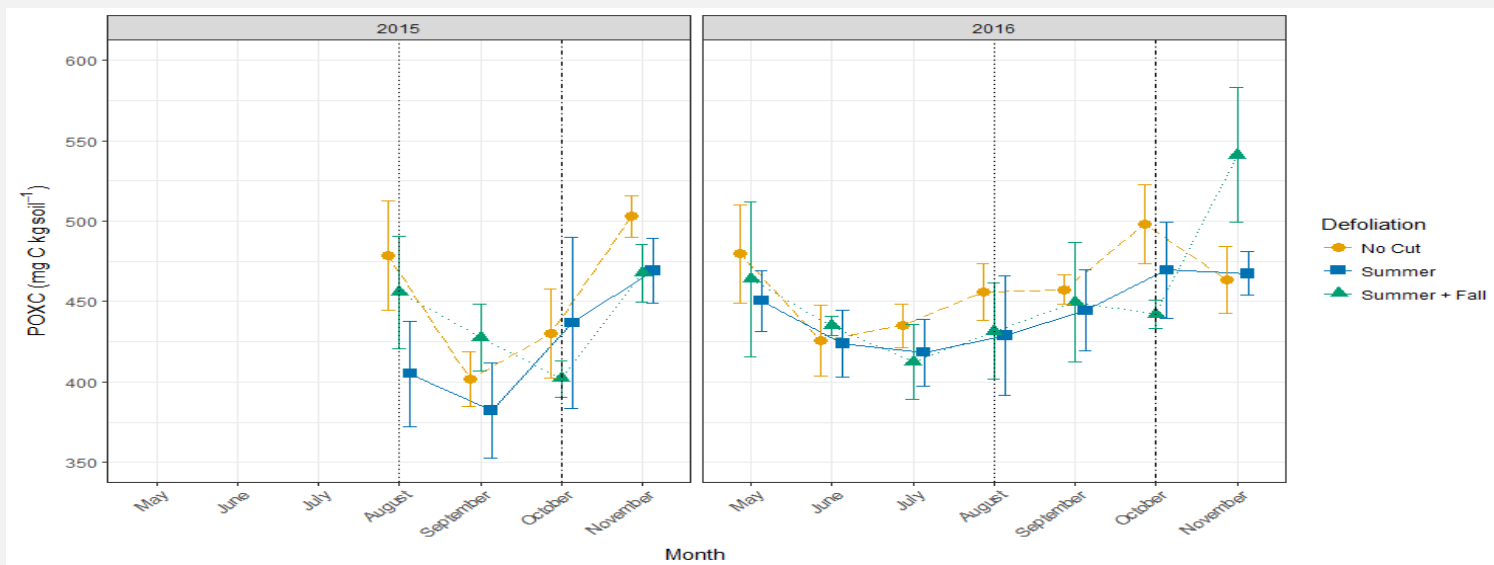
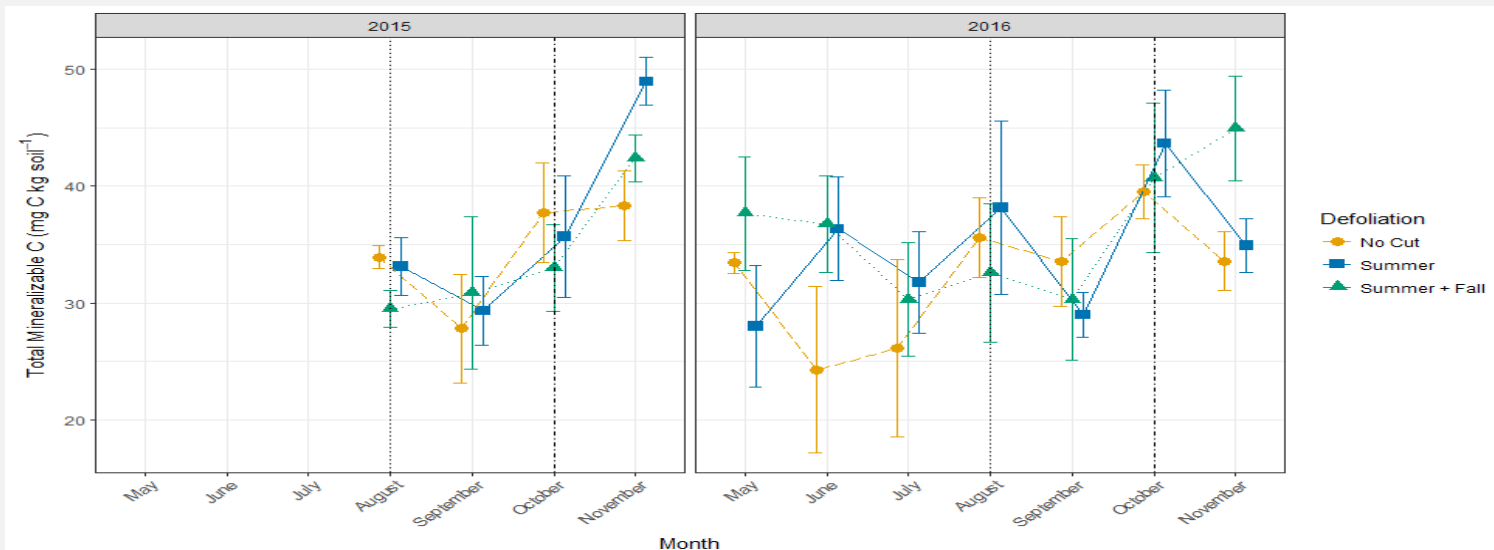
- ❖ plant species
- ❖ stand composition
- ❖ frequency
- ❖ intensity
- ❖ method
- ❖ timing



Did Defoliation Affect Roots?



Did Defoliation Affect Soil Health?



Did Defoliation Affect Soil Health?

	No Cut	Summer	Fall + Summer
POXC (mg/kg)	459 a	443 a	454 a
Protein (g/kg)	4.42 a	4.31 a	4.30 a
Respiration (mg/kg)	32.3 b	34.5 a	36.2 a

*****Mean 2nd year values across all samplings***

- Dual-use management increased root biomass in 2nd year
- Dual-use increased respiration only, which indicates greater short-term nutrient availability and cycling

Overall Conclusions

- No evidence that defoliation negatively impacts Kernza grain yields
- Increased defoliation = greater forage production
- Preliminary data shows defoliation increases root biomass and perhaps nutrient cycling at 1 site

Future Directions

- 2017 will be 3rd (or 2nd) and final year of multi-site study
- Forage quality analysis on multisite study is next

