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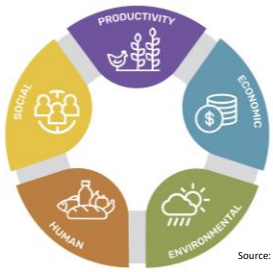
INTENSIVE WHEAT MANEGEMENT

Update on Kansas research

Dr. Romulo Lollato
Extension Wheat Specialist

@KSUWheat
KSU Wheat

Sustainability of crop production



KANSAS WHEAT

Source: K-State SIIL

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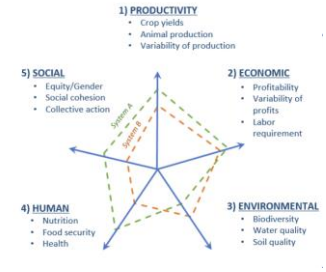
Sustainability of crop production



KANSAS WHEAT

Source: K-State SIIL

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VARIETY x MANAGEMENT:

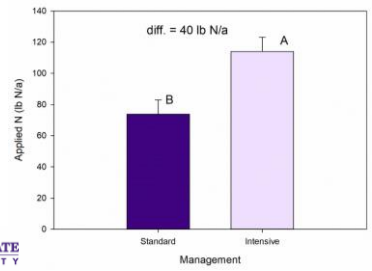
20 to 50 varieties

3 to 4 reps

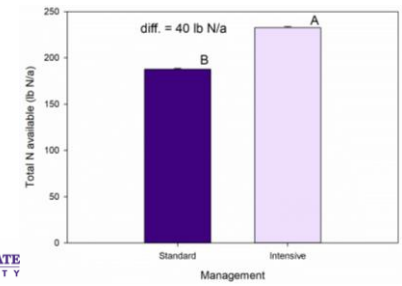
Standard
- Yield goal of 60 bu/A
- N fertilizer:
  - Soil NO_3-N + ~2 lbs N/bu/A
  - Applied Feekes 3 (late February)

Intensive
- same as standard plus:
  - + 40 lb N/A at Feekes 5 (mid-March)
  - + Jointing fungicide
  - + Flag leaf/heading fungicide

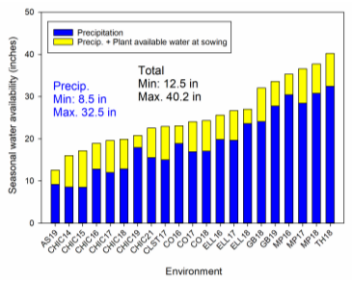
NITROGEN APPLIED

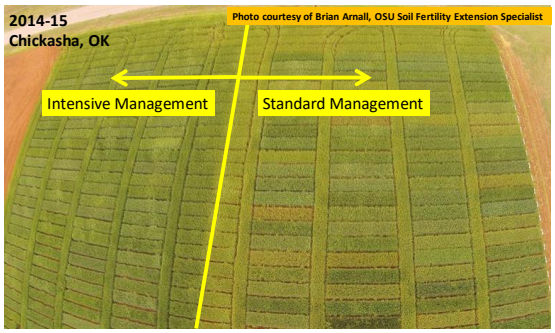


NITROGEN APPLIED



WATER AVAILABILTY





2015-16
Chickasha, OK

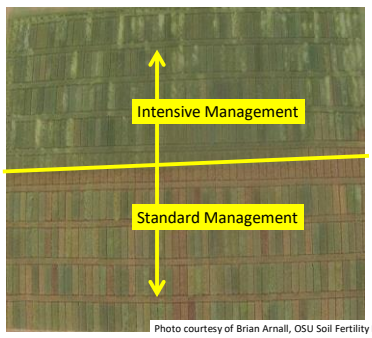
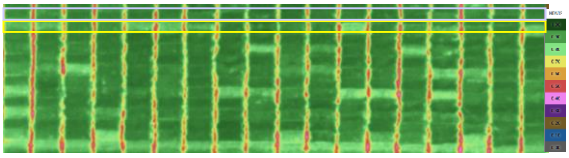


Photo courtesy of Brian Arnall, OSU Soil Fertility Extension Specialist

2015-16 Ellsworth, KS - NDVI

Image courtesy of Ray Asebedo, K-State Precision Ag

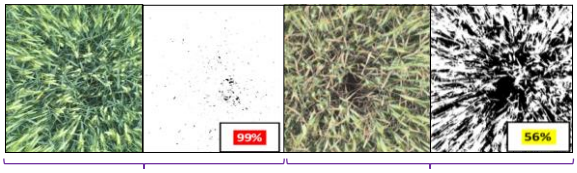


VISUAL DIFFERENCES

Photos: Amanda de Oliveira (former student)

DIFFERENCES IN GREEN COVERAGE

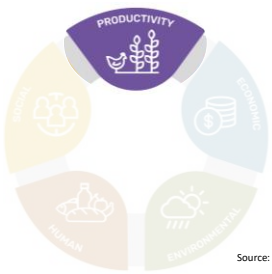
Ellsworth, 2016



Susceptible variety with Fungicide

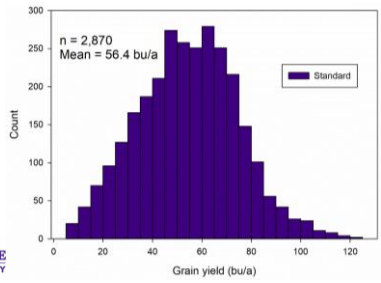
Susceptible variety without Fungicide

Sustainability of crop production

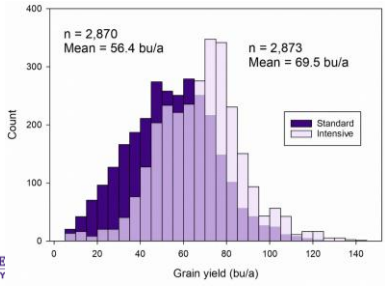


Source: K-State SIIL

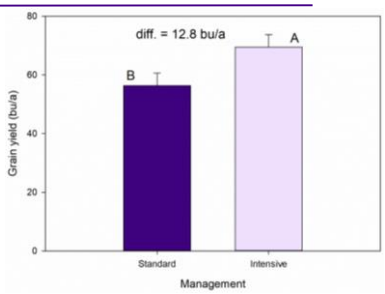
GRAIN YIELD



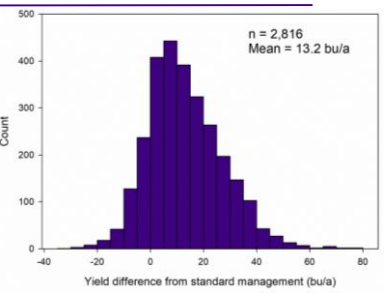
GRAIN YIELD



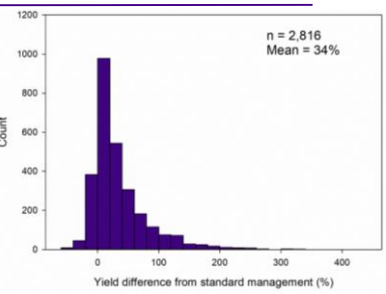
GRAIN YIELD



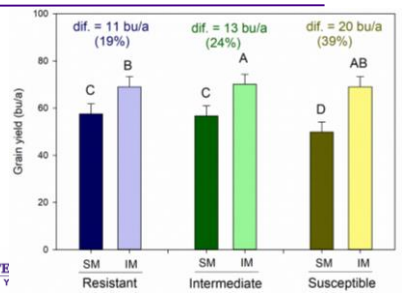
YIELD GAIN



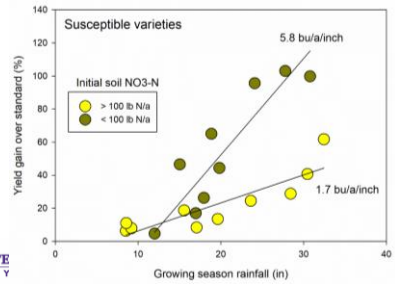
YIELD GAIN – PERCENT



YIELD GAIN – VARIETY CLASS



YIELD GAIN – VARIETY x ENVIRONMENT



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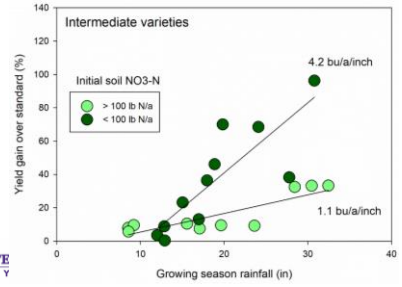

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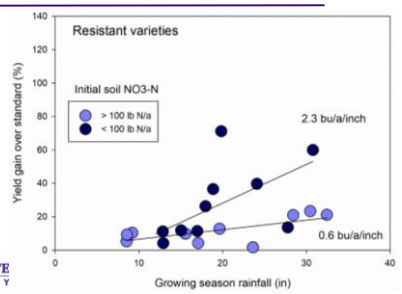
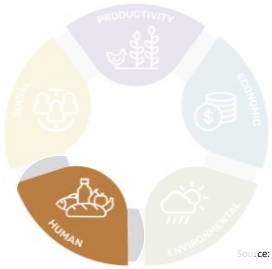
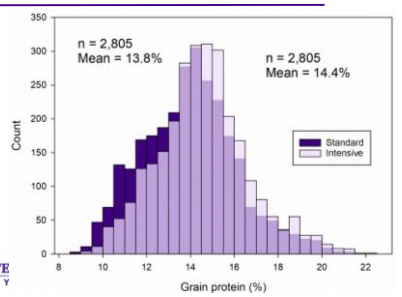


Sustainability of crop production

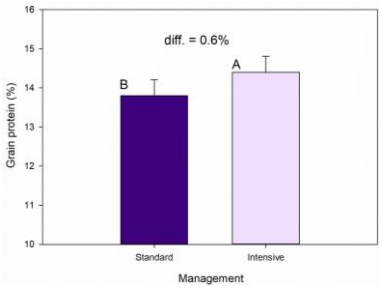


Source: K-State SIIL

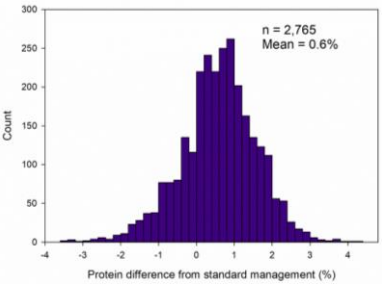
GRAIN PROTEIN



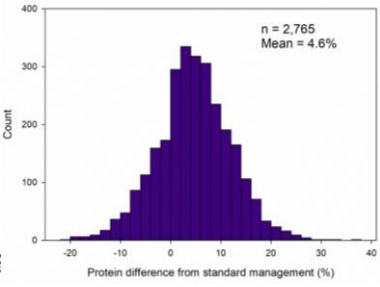
GRAIN PROTEIN



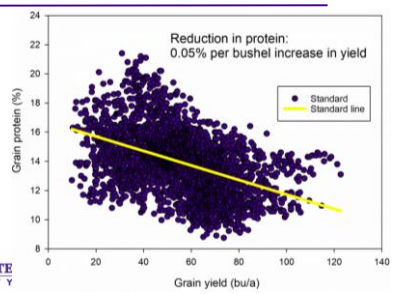
PROTEIN GAIN



PROTEIN GAIN - PERCENTAGE



YIELD-PROTEIN DILLUTION



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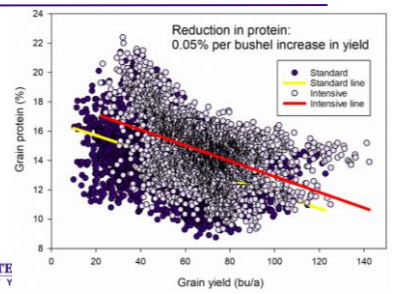

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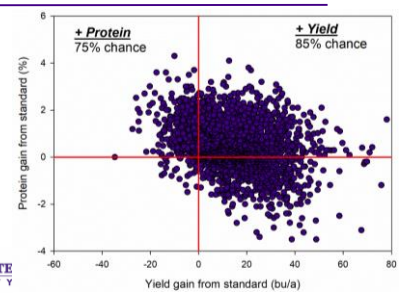
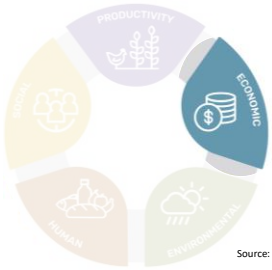


Sustainability of crop production



Source: K-State SIIL

Crop Budget

Only variable costs considered:

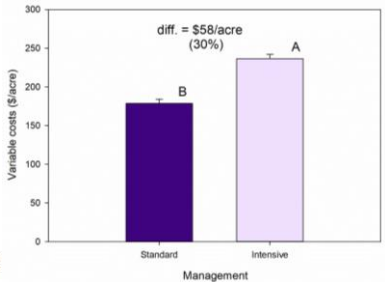
- CT: chisel, disk, cultivation, plus one in-season herbicide (product + spraying)
- NT: one pre- and one post-herbicide (products plus spraying)
- Cost of seed and drilling
- Cost of DAP
- Cost of N fertilizer plus one (SM) or two (IM) passes
- Two fungicide applications on IM (products plus spraying)
- Harvesting, hauling, and labor

Price scenarios:

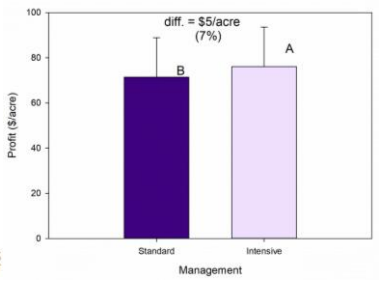
- Flat price
- 15% protein premium (12% or more)

Source: K-State SIIL

Variable costs



Profit over variable costs



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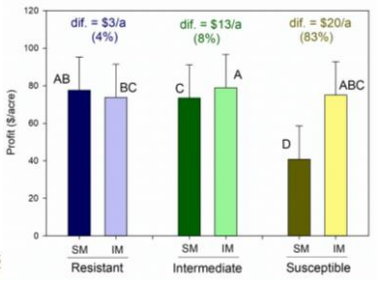
Profit depending on variety



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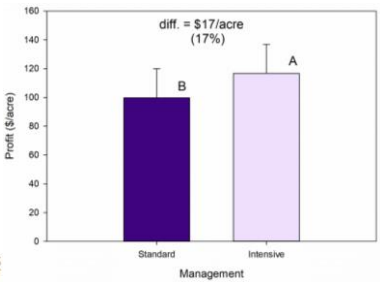
Profit – protein premium over 12%



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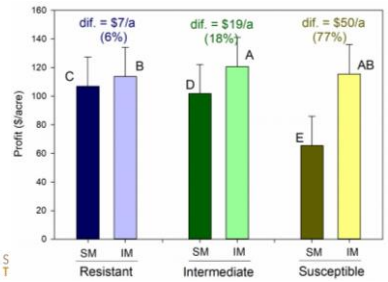
Profit – protein premium over 12%



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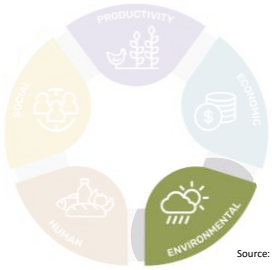
Sustainability of crop production



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Source: K-State SIIL

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Environmental impact evaluation

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Water:

- Water use efficiency

Nitrogen:

- Export from the field
- Fertilizer N use efficiency (bu/lb N fertilizer)
- Available N use efficiency (bu/lb N available)
- N balance (input – output)
- N leaching
- Yield-scaled N leaching
- N2O emissions
- Yield-scaled N2O emissions

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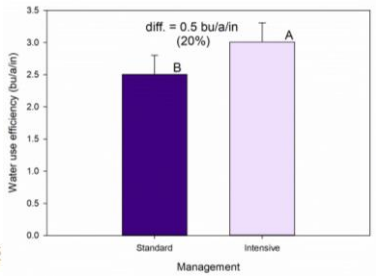
Water use efficiency



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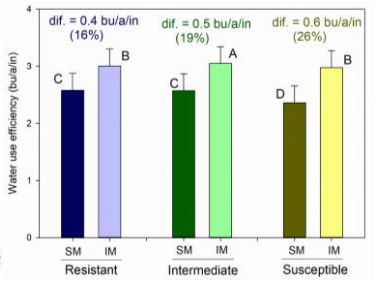
Water use efficiency



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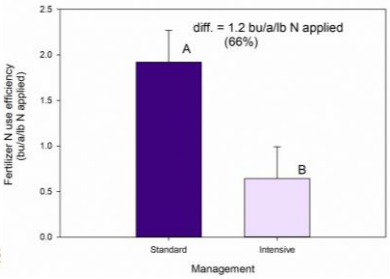
Nitrogen use efficiency



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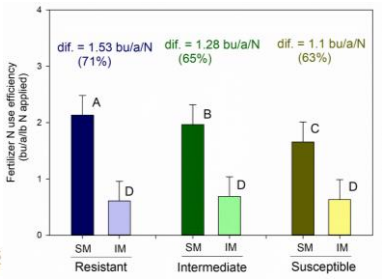
Nitrogen use efficiency



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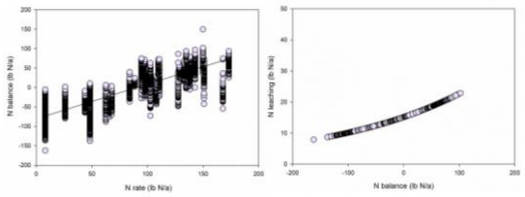
Nitrogen balance



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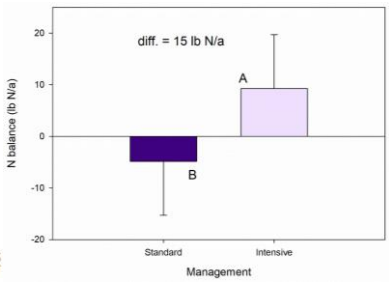
Nitrogen balance



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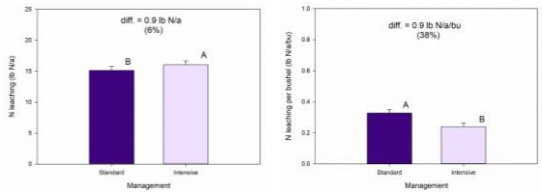
Nitrogen leaching



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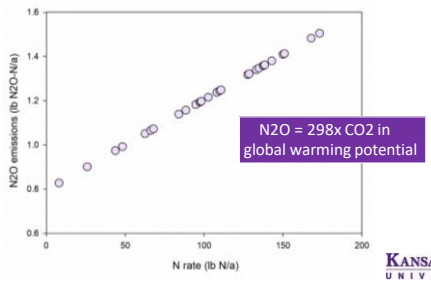
N2O emissions



N2O = 298x CO2 in global warming potential

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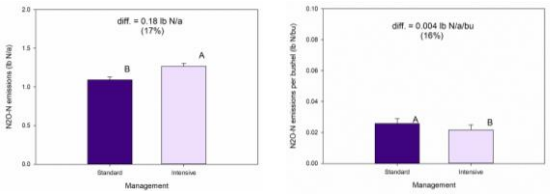
N2O emissions



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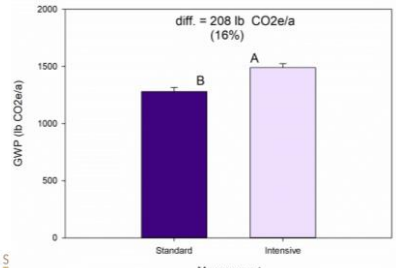
Environmental impact evaluation

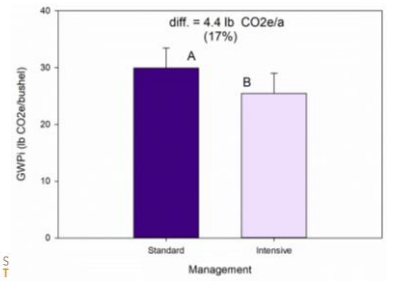
Global warming potential (CO2 equivalents for):

- Tillage operation diesel + MTR (machinery manuf., transp., and repair)
  - Moldboard plow, disk, and cultivation for Conventional Till
- Production and transport of seed used
- Planting operation diesel + MTR
- N fertilizer production and transport
- N application diesel + MTR
- P2O5 fertilizer production and transport
- Herbicide production and transport
- Herbicide application diesel + MTR
- Fungicide production and transport
- Fungicide application diesel + MTR
- Harvest diesel + MTR

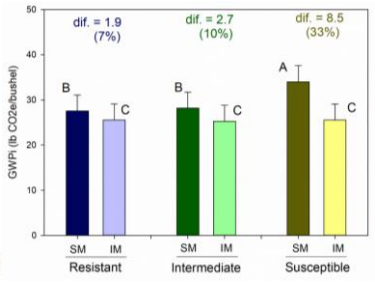
Global warming potential



Global warming potential



Global warming potential



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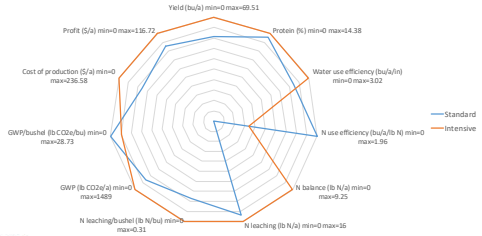
Sustainability of wheat production



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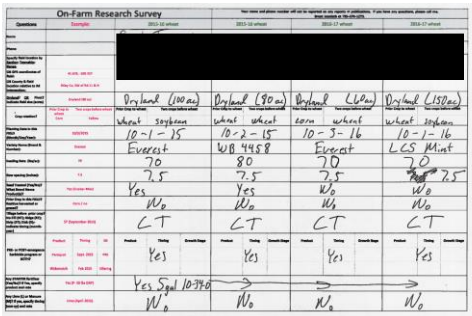
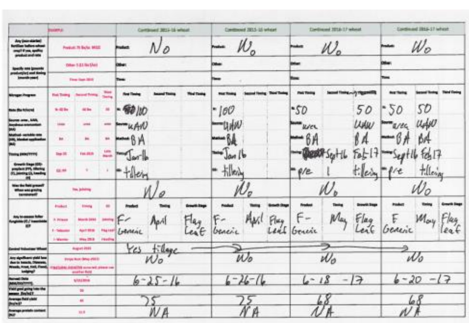


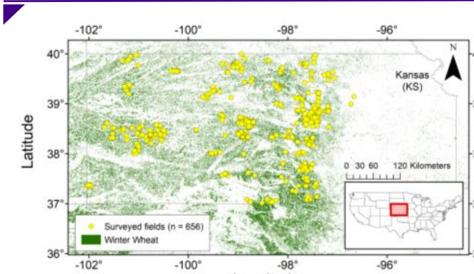
On-Farm Research Survey

Questions	Example	2015-16 wheat	2015-16 wheat	2016-17 wheat	2016-17 wheat
[illegible]	[illegible]	[redacted]			
[illegible]	[illegible]	Dryland (100 ac)	Dryland (80 ac)	Dryland (60 ac)	Dryland (150 ac)
[illegible]	[illegible]	wheat soybean	wheat wheat	corn wheat	wheat soybean
[illegible]	[illegible]	10-1-15	10-2-15	10-3-16	10-1-16
[illegible]	[illegible]	Everest	WB 4458	Everest	LCS Mint
[illegible]	[illegible]	70	80	70	70
[illegible]	[illegible]	7.5	7.5	7.5	7.5
[illegible]	[illegible]	Yes	Yes	No	No
[illegible]	[illegible]	No	No	No	No
[illegible]	[illegible]	CT	CT	CT	CT
[illegible]	[illegible]	Yes	Yes	Yes	Yes
[illegible]	[illegible]	Yes 5gal 10-34-0 →	→	→	→
[illegible]	[illegible]	No	No	No	No

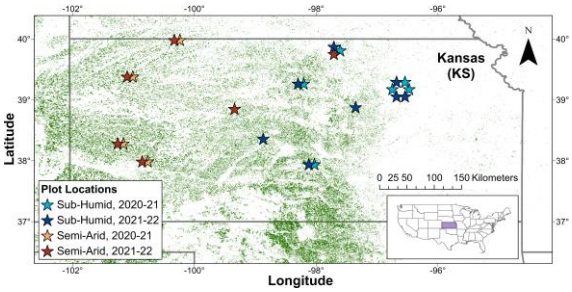


	Example	Continued 2015-16 wheat	Continued 2015-16 wheat	Continued 2016-17 wheat	Continued 2016-17 wheat
[illegible]	[illegible]	No	No	No	No
[illegible]	[illegible]	100	100	50 50	50 50
[illegible]	[illegible]	UAN	UAN	urea UAN	urea UAN
[illegible]	[illegible]	BA	BA	BA BA	BA BA
[illegible]	[illegible]	Jan 16	Jan 16	Sept 16 Feb 17	Sept 16 Feb 17
[illegible]	[illegible]	tillering	tillering	pre tillering	pre tillering
[illegible]	[illegible]	No	No	No	No
[illegible]	[illegible]	F-Generic April Flag Leaf	F-Generic April Flag Leaf	F-Generic May Flag Leaf	F Generic May Flag Leaf
[illegible]	[illegible]	Yes tillage →	No	No	No
[illegible]	[illegible]	6-25-16	6-26-16	6-18-17	6-20-17
[illegible]	[illegible]	75	75	68	68
[illegible]	[illegible]	NA	NA	NA	NA

REPLICATING GROWER'S PRACTICES



Jaenisch et al 2021



Replicated Trial

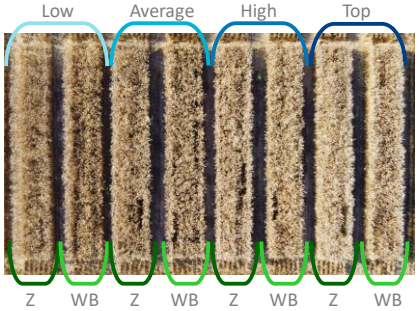
- Gathered data from on-farm survey
- Replicated management practices adopted in:
  - Lowest 20% yielding fields
  - Average yielding fields
  - Highest 20% yielding fields
  - Highest 5% yielding fields
- Wheat Varieties

Central Kansas	Western Kansas
Zenda	KS Dallas
WB4269	WB Grainfield

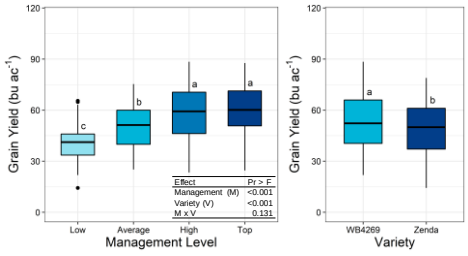
- Central Kansas: trials after soybeans (6 and 8 in 2021 and 2022)
- Western Kansas: trials after fallow (4 and 6 in 2021 and 2022)

	Central Kansas (Sub-Humid) Previous crop: Soybean				Western Kansas (Semi-Arid) Previous crop: Fallow			
Practice	**Low**	**Average**	**High**	**Top**	**Low**	**Average**	**High**	**Top**
Yield goal (bu/a)	35	55	75	95	35	55	80	95
Seeding rate (seeds/a)	1,000,000	1,200,000	1,450,000	1,450,000	750,000	900,000	1,050,000	1,050,000
Nitrogen (lbs N/a)	40	80	120	160	40	80	120	180
Phosphorus (lbs P/a)	-	20	30	35	-	-	30	30
Sulfur (lbs S/a)	-	10	10	20	-	-	10	20
Chloride (lbs KCl/a)	-	15	15	15	-	-	-	-
Seed Treatment	-	Yes	Yes	Yes	-	-	Yes	Yes
Split N Application	-	-	Yes	Yes	-	-	Yes	Yes
Flag leaf Fungicide	-	-	Yes	Yes	-	-	Yes	Yes
Jointing Fungicide	-	-	-	Yes	-	-	-	Yes
Micronutrients	-	-	-	Yes	-	-	-	Yes

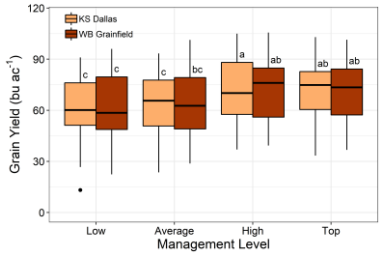


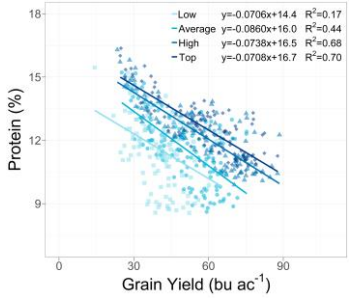

Low
Average
High
Top
Z
WB
Z
WB
Z
WB
Z
WB

Central Kansas Grain Yield



Western Kansas Grain Yield

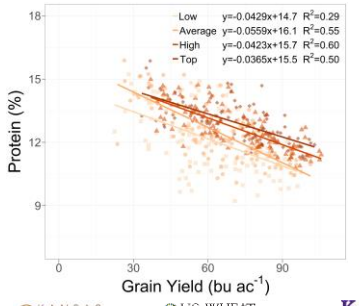




Central Kansas Protein

Management	Mean Protein (%)
Low	11.7c
Average	11.8c
High	12.4b
Top	12.7a

Letters indicate significant differences at <0.05 level

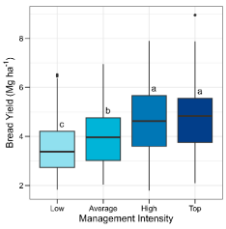


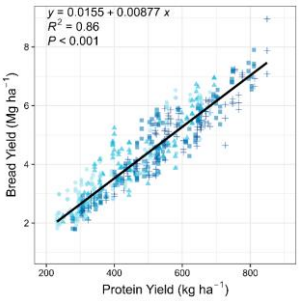
Western Kansas Protein

Management	Mean Protein (%)
Low	11.8c
Average	12.2b
High	12.6a
Top	12.9a*

Letters indicate significant differences at <0.05 level
*Significant at <0.10 level

BREAD YIELD

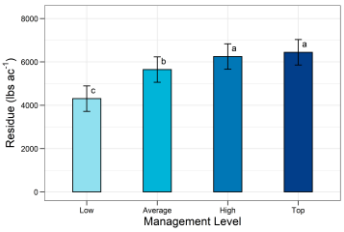




Residue returned to soil Central, KS

Management	Lbs residue / acre
Low	4305 c
Average	5647 b
High	6249 a
Top	6444 a

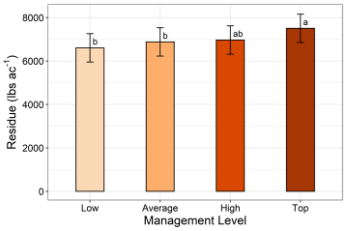
ANOVA	Pr(>F)
Management	<0.0001
Variety	0.778
MxV	0.721



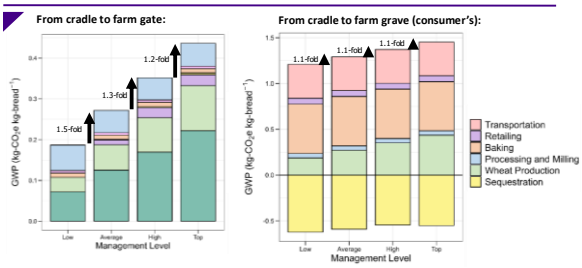
Residue returned to soil
Western, KS

Management	Lbs residue / acre
Low	6608 b
Average	6880 b
High	6967 ab
Top	7506 a

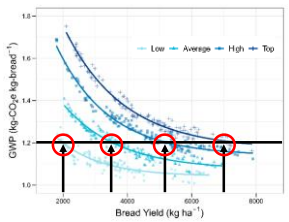
ANOVA	Pr(>F)
Management	0.0013
Variety	0.0394
MxV	0.1845



GLOBAL WARMING POTENTIAL



GLOBAL WARMING POTENTIAL



KANSAS WHEAT

NATIONAL WHEAT FOUNDATION

U.S. WHEAT ASSOCIATES

KANSAS STATE UNIVERSITY

TAKE HOME

- Increased yield and protein:
  - It is possible! Though, dilution still occurs within management..
  - Increased bread yield
  - Decreased the magnitude of increases in GWP
- Importance of E, V, and M depended on attribute evaluated
- Wheat as a Carbon sink: potential for global warming mitigation
- Huge opportunities to increase export (20% more grain at 30% more protein yield) and domestic bread yield (30% greater) with minor increases in yield-scaled global warming potential
- Efforts to improve agricultural input efficiencies could further reduce impacts, but improvements at other phases of the bread product system are also necessary as Ag represents <25% of total GWP

Questions?

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