2016 Wheat Soil Fertility Research Update & Preliminary 2017 Planning

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MICHIGAN STATE UNIVERSITY EXTENSION

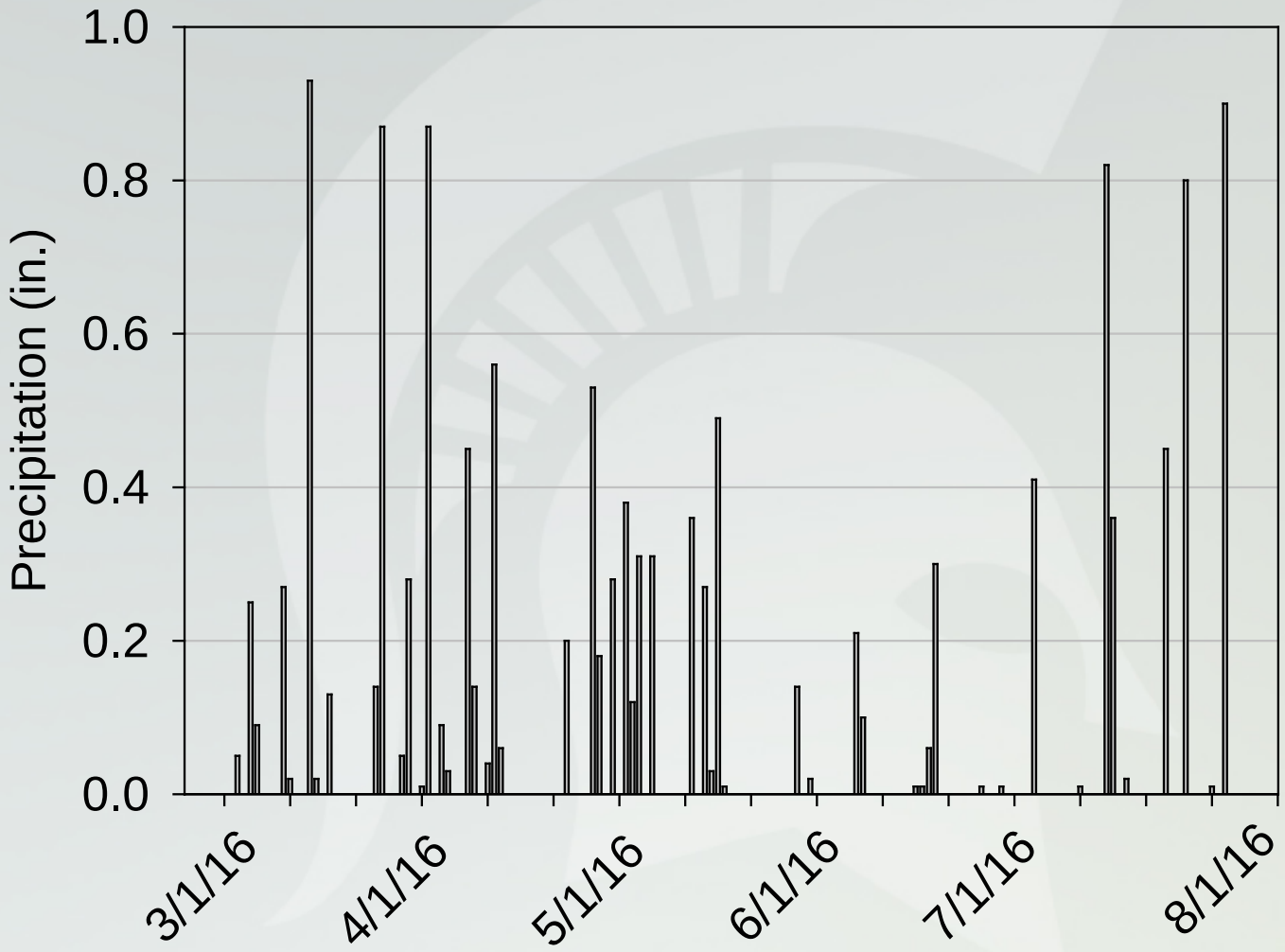
Michigan State University AgBioResearch

Overview

- 2016 Field Research Results
  - 13 studies completed and harvested
  - Discuss several today and yield only
- Soil fertility & Nutrient mgmt. program
  - Results will be on website soil.msu.edu
  - ***Beware of Company Marketing*** (Speak w/ Kurt)
  - Additional field day/tour in 2017?
- 2017 Proposed Field Research

Plot Specifics

- Planting Date: Sept 29 or Oct 1
- Variety: 'Sunburst' or 'Jupiter'
- Green-up App.: Mar 28
- G.S. 5: Apr 18
- G.S. 7: May 10
- Flag Lf.: May 23



- 13.5 in. March 1 – Aug 1 (15.9, 12.3, and 14.7 in. ’13, ’14, and ‘15)
  - 3.98 March, 2.94 April, 2.06 May, 0.71 June, 3.78 July

Maximizing Investment in Soft Red and White Winter Wheat Agronomic Inputs for Michigan (Omission Plot Studies)

Dan Quinn (M.S. student)

Location, Planting Date, Variety

Richville, MI

- Planted
  - October 1, 2015
- Variety
  - Jupiter (White)

East Lansing, MI

- Planted
  - September 29, 2015
- Variety
  - Sunburst (Red)

Inputs Evaluated

Input	Product Name	Rate Applied
Nitrogen	UAN	120 lbs/A, 144 lbs/A (White) 90 lbs/A, 108 lbs/A (Red)
Urease Inhibitor	Agrotain Advanced	1 qt/ton UAN
Nitrification Inhibitor	Instinct II	37 oz/A
Plant Growth Regulator	Palisade EC	12 oz/A
Foliar Micronutrients	Max-IN Ultra ZMB	2 qt/A
Fungicide	Prosaro	8.2 oz/A

Application Timing of Inputs

Input	Application Timing
Nitrogen	Feekes 4: Green Up
Urease Inhibitor	Feekes 4: Green Up
Nitrification Inhibitor	Feekes 4: Green Up
Plant Growth Regulator	Feekes 6: Jointing
Foliar Micronutrients	Feekes 6: Jointing
Fungicide	Feekes 10.5.1: Flowering

Enhanced System vs. Traditional System

Traditional (Low Input)

Richville, MI (White)

- N Rate – 120 lbs N/A

East Lansing, MI (Red)

- N Rate – 90 lbs N/A

- No Additional Inputs Applied

Enhanced (High Input)

Richville, MI (White)

- N Rate – 144 lbs N/A

East Lansing, MI (Red)

- N Rate – 108 lbs N/A

- All Additional Inputs Applied

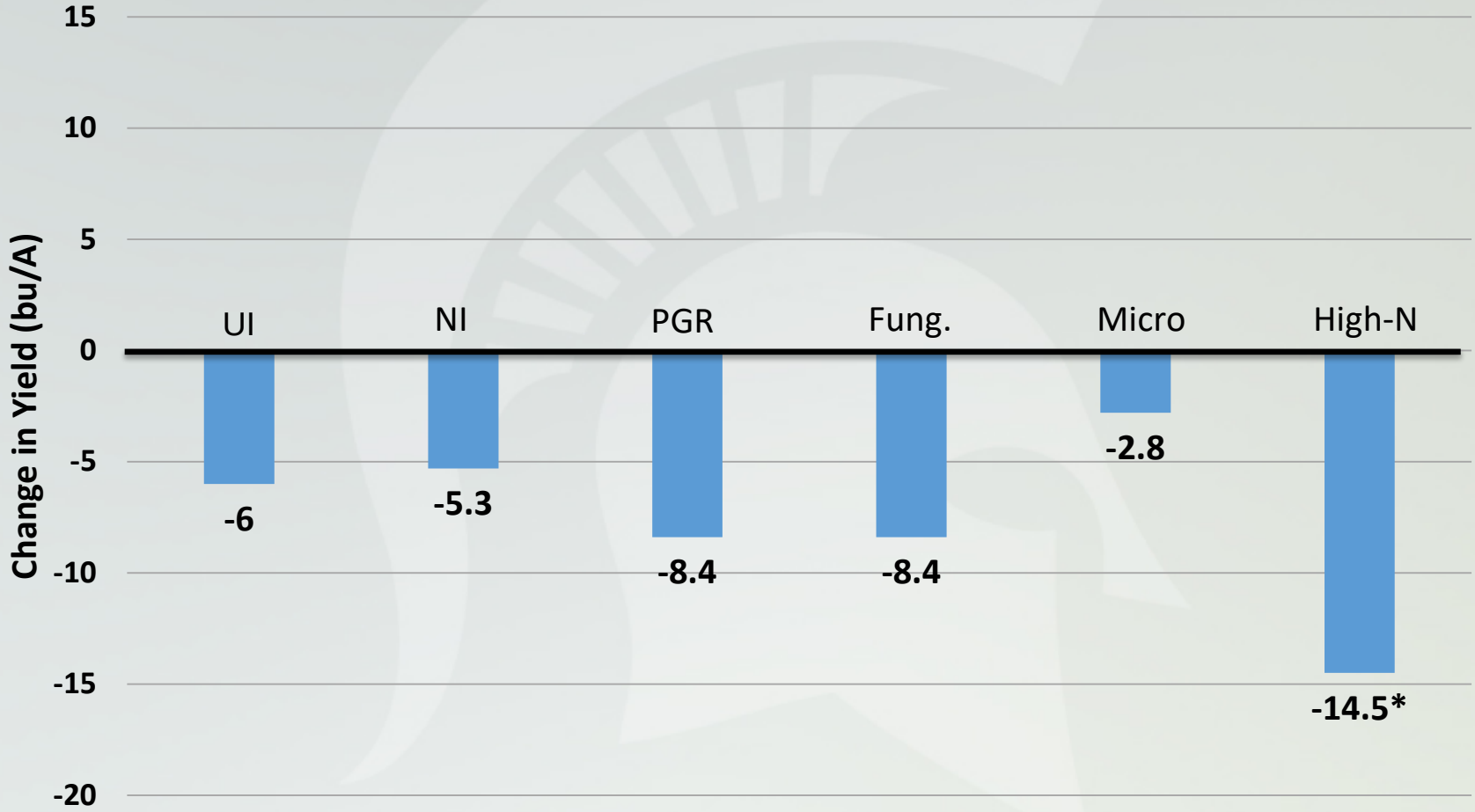
Treatment	Agronomic Inputs					
	Urease Inhibitor	Nitrification Inhibitor	Plant Growth Regulator	Fungicide	Foliar Micronutrients	Increased Nitrogen Rate
Enhanced (E)	Yes	Yes	Yes	Yes	Yes	Yes
E w/o Urease Inhibitor	No	Yes	Yes	Yes	Yes	Yes
E w/o Nitrification Inhibitor	Yes	No	Yes	Yes	Yes	Yes
E w/o Plant Growth Regulator	Yes	Yes	No	Yes	Yes	Yes
E w/o Fungicide	Yes	Yes	Yes	No	Yes	Yes
E w/o Foliar Micronutrients	Yes	Yes	Yes	Yes	No	Yes
E w/o Increased Nitrogen Rate	Yes	Yes	Yes	Yes	Yes	No
Traditional (T)	No	No	No	No	No	No
T w/Urease Inhibitor	Yes	No	No	No	No	No
T w/Nitrification Inhibitor	No	Yes	No	No	No	No
T w/Plant Growth Regulator	No	No	Yes	No	No	No
T w/Fungicide	No	No	No	Yes	No	No
T w/Foliar Micronutrients	No	No	No	No	Yes	No
T w/Increased Nitrogen Rate	No	No	No	No	No	Yes
Untreated Check	No	No	No	No	No	No

Grain Yield (bu/A) Changes from Respective Enhanced or Traditional System

Richville (White)			
Treatment	**Grain Yield (bu/A) Change**		**Treatment**
Enhanced (E)	**104.6**	**102**	**Traditional (T)**
E w/o Urease Inhibitor	-6	6.2	T w/Urease Inhibitor
E w/o Nitrification Inhibitor	-5.3	-5.2	T w/Nitrification Inhibitor
E w/o Plant Growth Regulator	-8.4	4.3	T w/Plant Growth Regulator
E w/o Fungicide	-8.4	-1	T w/Fungicide
E w/o Foliar Micronutrients	-2.8	-0.2	T w/Foliar Micronutrients
E w/o Increased Nitrogen Rate	-14.5*	-0.6	T w/Increased Nitrogen Rate

*Significantly different at α=0.1

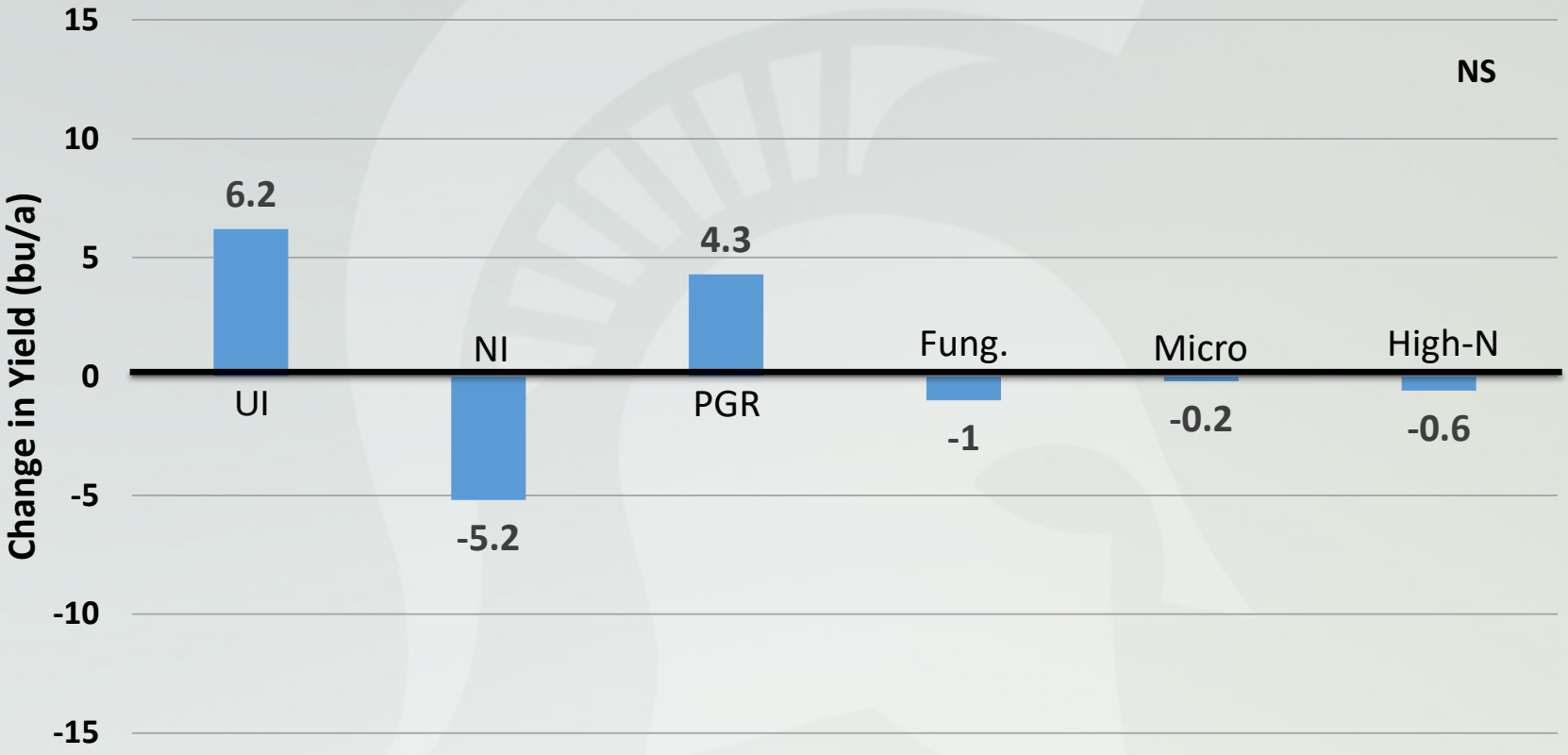
Individual Input Yield Change (bu/A) when Removed from Respective Enhanced System



Richville, MI (White)

*Significantly different at α=0.1

Individual Input Yield Change (bu/A) when Added to Respective Traditional System



Richville, MI (White)

Gross Profit ($/A) Changes from Respective Enhanced or Traditional System

Richville (White)			
Treatment	**Gross Profit ($/A) Change †**		**Treatment**
Enhanced (E)	**$289.31**	**$360.74**	**Traditional**
E w/o Urease Inhibitor	-$15.94	$28.45	T w/Urease Inhibitor
E w/o Nitrification Inhibitor	-$10.13	-$33.12	T w/Nitrification Inhibitor
E w/o Plant Growth Regulator	-$18.77	-$6.14	T w/Plant Growth Regulator
E w/o Fungicide	-$4.32	-$30.08	T w/Fungicide
E w/o Foliar Micronutrients	$1.49	-$22.32	T w/Foliar Micronutrients
E w/o Increased Nitrogen Rate	-$49.74	-$12.47	T w/Increased Nitrogen Rate

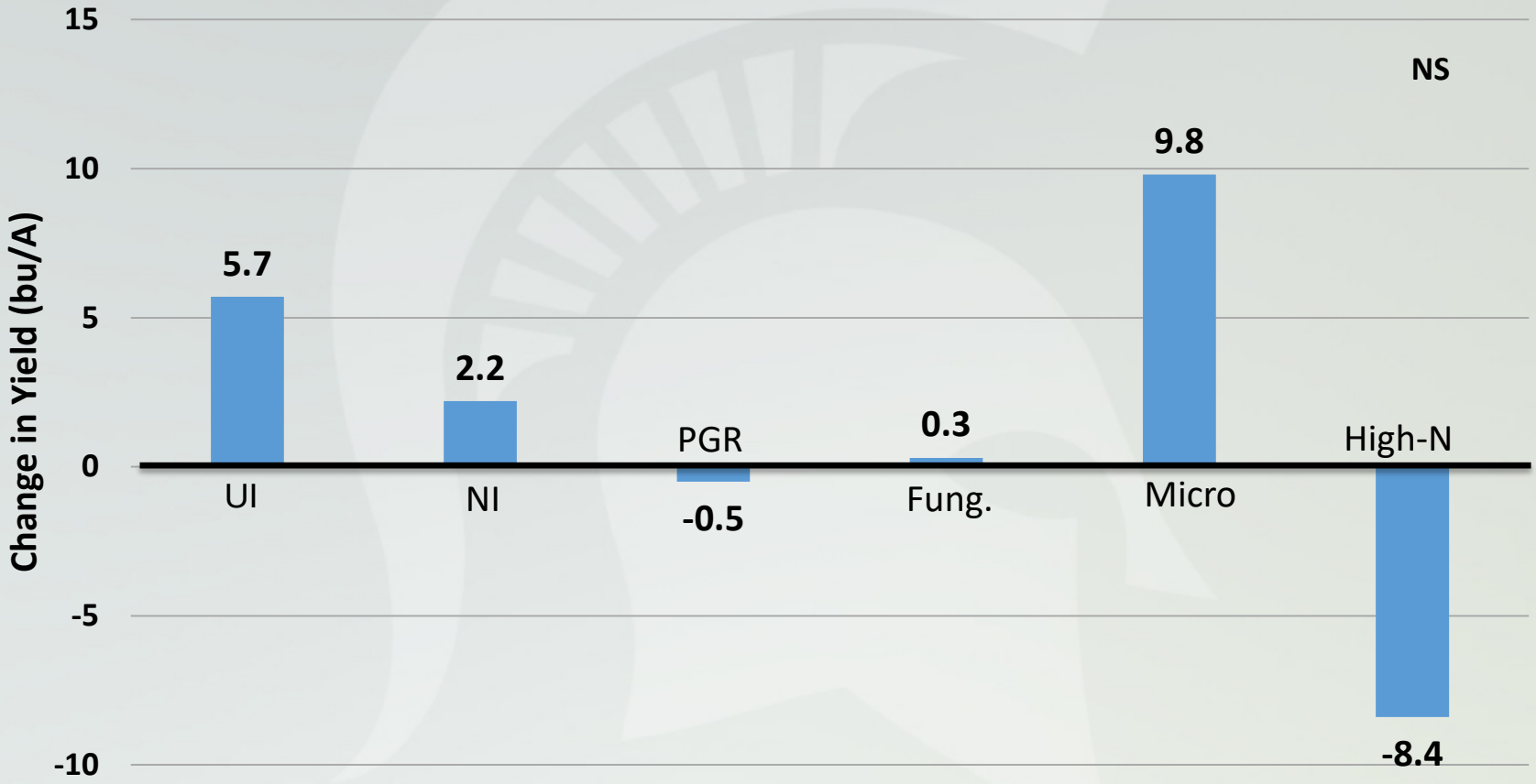
† Gross profit estimates determined from $4.12 cash price of white wheat grain multiplied by grain yield, followed by a subtraction of cost of each treatment. Each treatment cost includes retail cost of inputs applied and application cost. Product, application, and grain price estimates were from local chemical dealers and grain elevators.

Grain Yield (bu/A) Changes from Respective Enhanced or Traditional System

East Lansing (Red)			
Treatment	**Grain Yield (bu/A) Change**		**Treatment**
Enhanced (E)	**77.9**	**81**	**Traditional (T)**
E w/o Urease Inhibitor	5.7	-2.8	T w/Urease Inhibitor
E w/o Nitrification Inhibitor	2.2	3.4	T w/Nitrification Inhibitor
E w/o Plant Growth Regulator	-0.5	1.1	T w/Plant Growth Regulator
E w/o Fungicide	0.3	10.8*	T w/Fungicide
E w/o Foliar Micronutrients	9.8	7.2	T w/Foliar Micronutrients
E w/o Increased Nitrogen Rate	-8.4	4.1	T w/Increased Nitrogen Rate

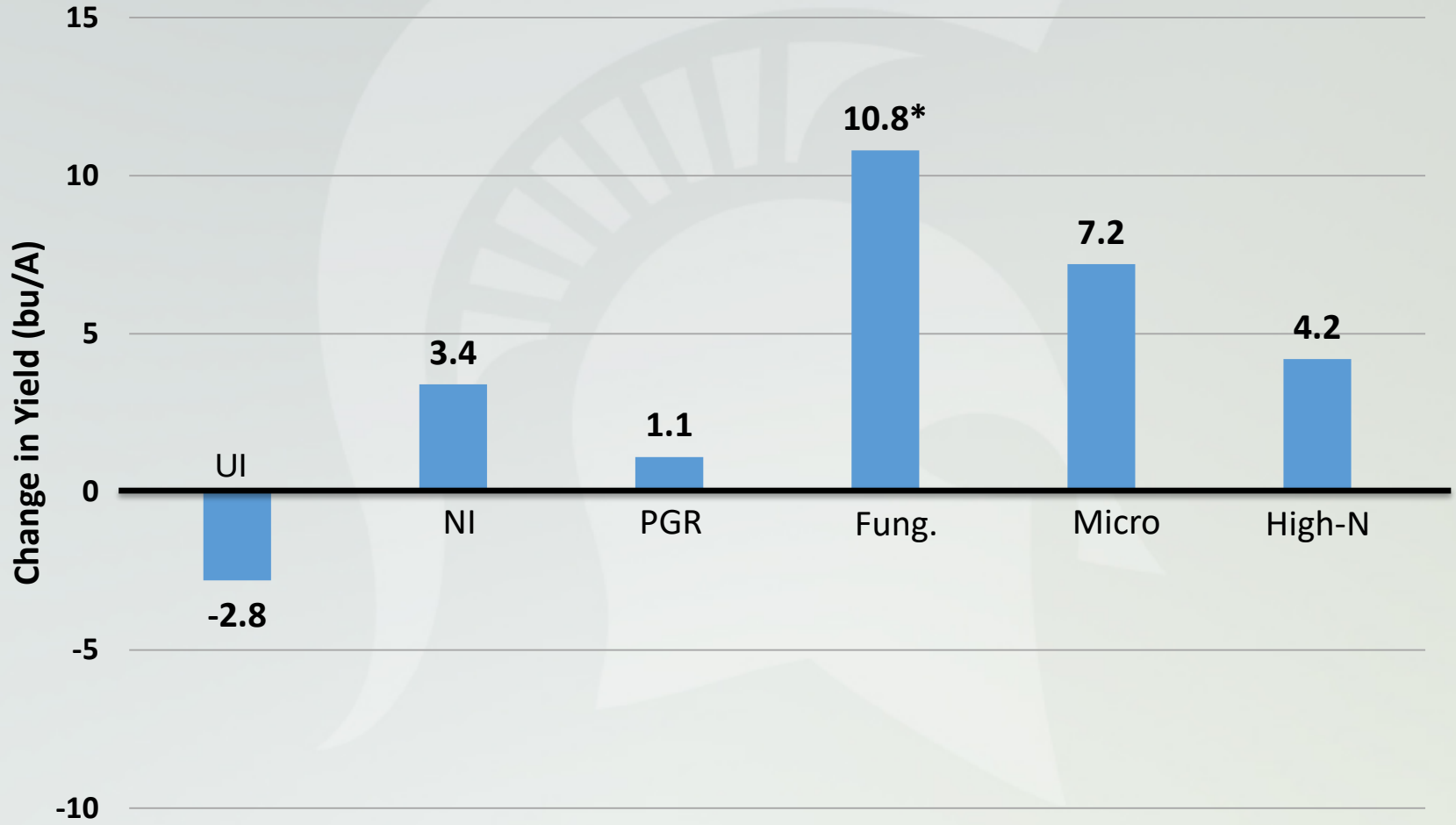
*Significantly different at $\alpha=0.1$

Individual Input Yield Change (bu/A) when Removed from Respective Enhanced System



East Lansing, MI (Red)

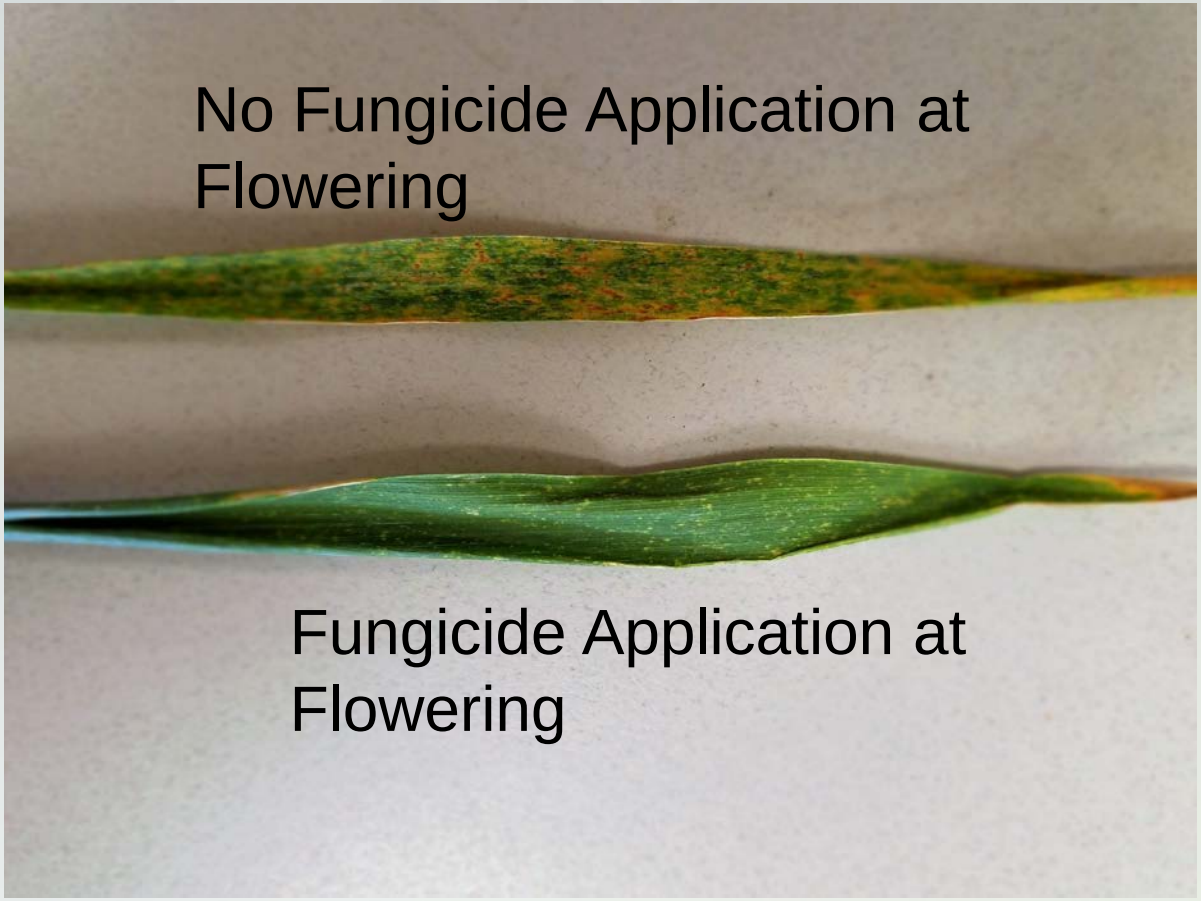
Individual Input Yield Change (bu/A) when Added to Respective Traditional System



East Lansing, MI (Red)

*Significantly different at α=0.1

Flag Leaf Disease Presence Following Fungicide Application



Height Effects from Tank-Mixed PGR and Foliar Micronutrients

- Palisade EC + Max-IN Ultra ZMB

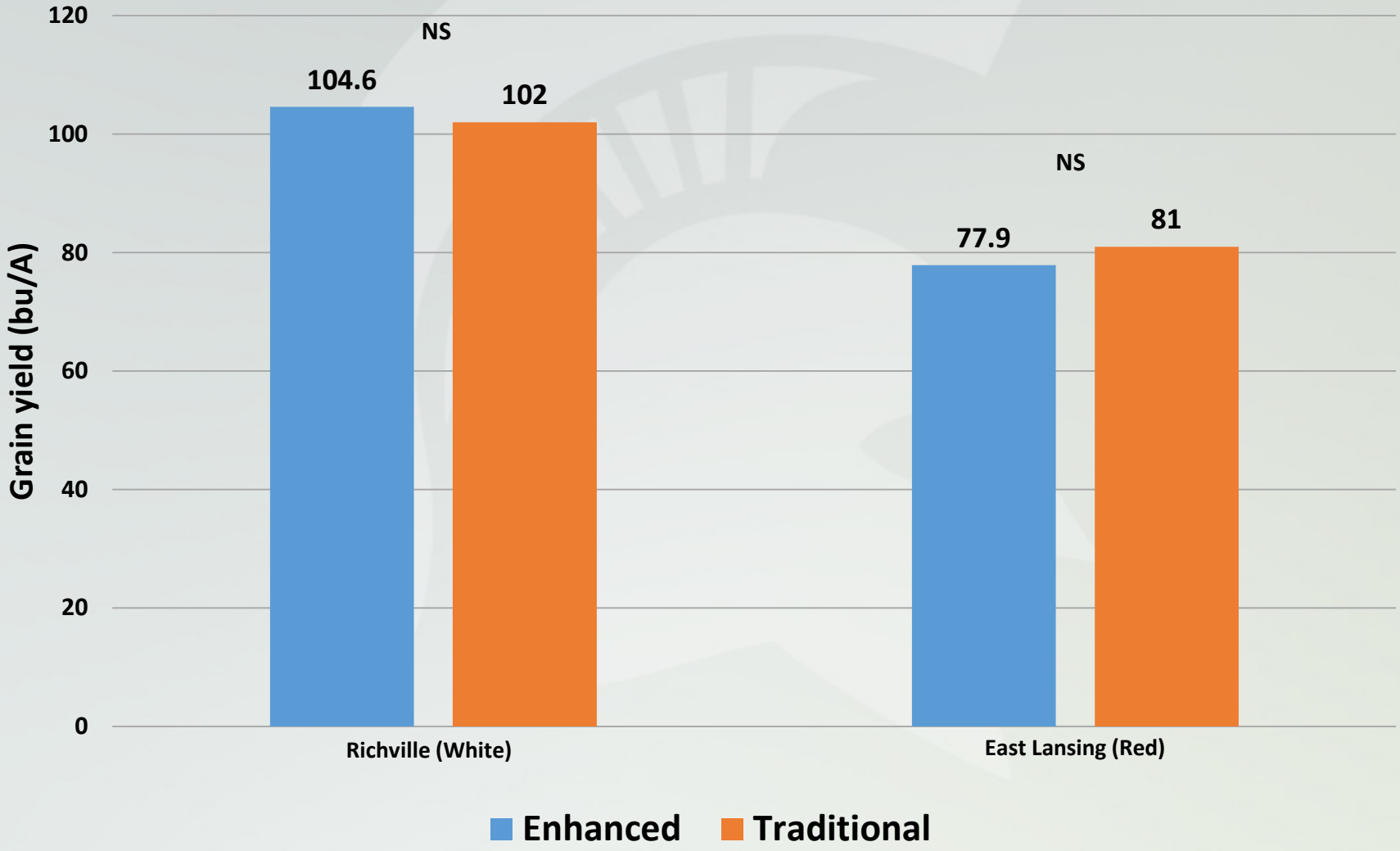
- Palisade EC Only

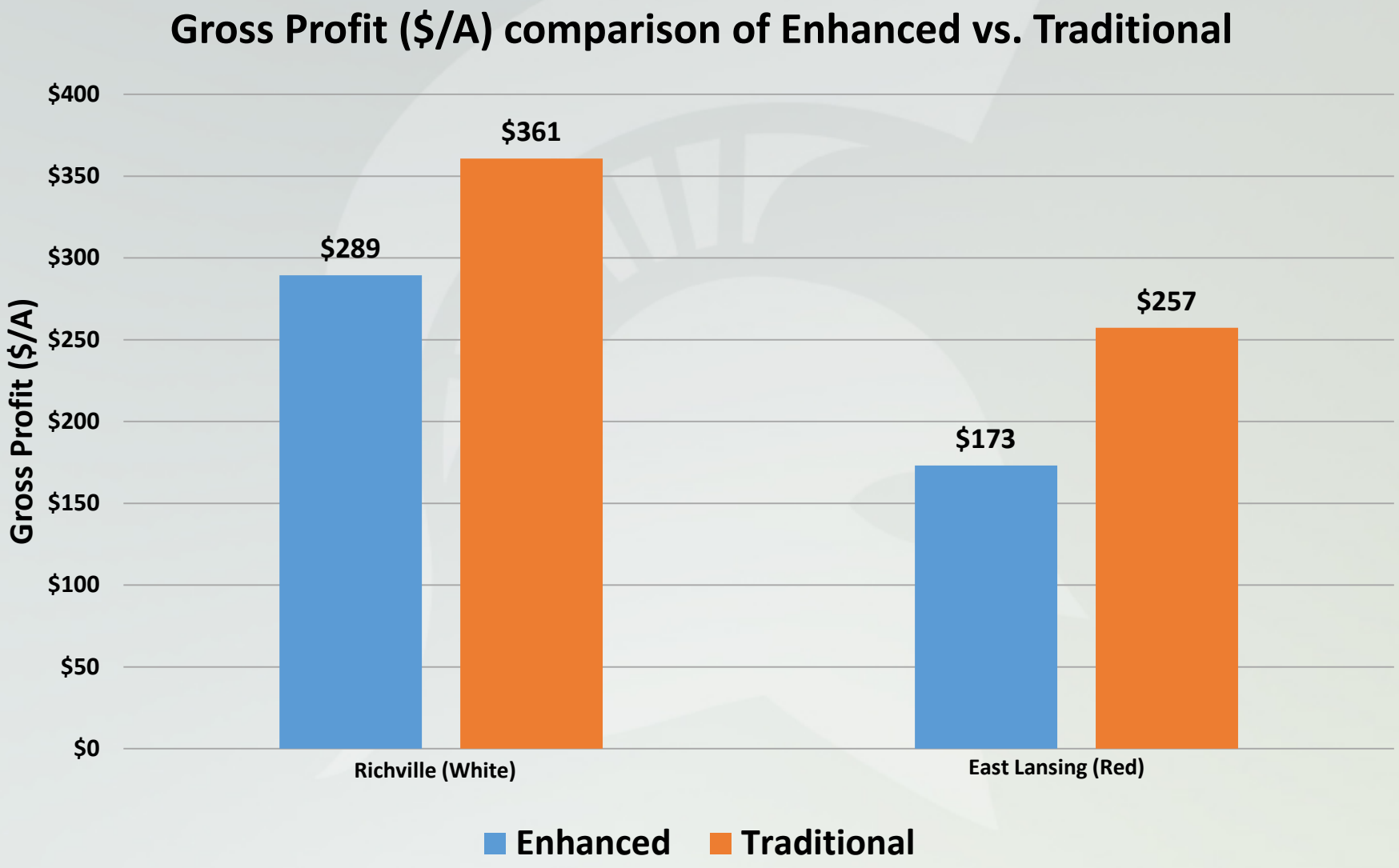
Gross Profit ($/A) Changes from Respective Enhanced or Traditional System

East Lansing (Red)			
Treatment	**Gross Profit ($/A) Change †**		**Treatment**
Enhanced (E)	**$173.04**	**$257.25**	**Traditional**
E w/o Urease Inhibitor	$28.90	-$15.90	T w/Urease Inhibitor
E w/o Nitrification Inhibitor	$21.08	$1.05	T w/Nitrification Inhibitor
E w/o Plant Growth Regulator	$15.09	-$19.73	T w/Plant Growth Regulator
E w/o Fungicide	$20.71	$14.54	T w/Fungicide
E w/o Foliar Micronutrients	$51.36	$5.50	T w/Foliar Micronutrients
E w/o Increased Nitrogen Rate	-$21.37	$7.38	T w/Increased Nitrogen Rate

† Gross profit estimates determined from $3.75 cash price of red wheat grain multiplied by grain yield, followed by a subtraction of cost of each treatment. Each treatment cost includes retail cost of inputs applied and application cost. Product, application, and grain price estimates were from local chemical dealers and grain elevators.

Grain Yield (bu/A) Comparison of Enhanced vs. Traditional




Gross Profit ($/A) comparison of Enhanced vs. Traditional
Gross Profit ($/A)
$400
$350
$300
$250
$200
$150
$100
$50
$0
$289
$361
$173
$257
Richville (White)
East Lansing (Red)
Enhanced
Traditional

Preliminary Summary

Richville, MI (White)

Enhanced System

- Removal of increased nitrogen rate showed greatest loss of yield and gross profit.
  - Additional N required when using the all inputs from this study

Traditional System

- Addition of urease inhibitor showed greatest increase of yield and gross profit.

Preliminary Summary

East Lansing, MI (Red)

Enhanced System

- Removal of increased nitrogen rate showed greatest loss of grain yield and gross profit.

Traditional System

- Addition of fungicide showed greatest increase of grain yield and gross profit.

Preliminary Summary

- No significant grain yield increase or decrease shown between enhanced and traditional systems.
  - High-input doesn't always equal high yield.
  - High N and high mgmt are NOT similar terms
- Traditional system shown to be more profitable than enhanced system.

Winter Wheat High N Management with Fall Application of Other Nutrients

- 114 N total
  - 24 N – Fall
  - 36 N – GU
  - 54 N – F5

- Fall application of remaining nutrients
  - P, K, S, B, Zn
- 6.2 pH, 30 P, 86 K soil test
  - Rec: 63 P, 53 K

High N with Autumn Application of Other Nutrients

Trt. (lbs.)	Yield (bu/A)
Check	58.0 c
114 N Only	104.5 ab
60 P	105.9 ab
60 P, 60 K	104.5 ab
60 P, 60 K, 0.5 B	108.3 a
60 P, 15 S, 1.5 Zn	101.7 ab
60 P, 60 K, 15 S, 1.5 Zn	99.8 ab
60 P, 60 K, 15 S, 1.5 Zn, 0.5 B	101.1 ab
60 P, 15 S	96.2 b
60 P, 27 S	100.6 ab
60 P, 7 S, 1.3 Zn	101.8 ab
P>F	< 0.1 (11.9 LSD)

Winter Wheat Regular N Management with Fall Application of Other Nutrients

- 94 N total
  - 24 N – Fall
  - 70 N – GU

- Fall application of remaining nutrients
  - P, K, S, B, Zn
- 6.2 pH, 30 P, 86 K soil test
  - Rec: 63 P, 53K

Regular N with Autumn Application of Other Nutrients

Trt. (lbs.)	Yield (bu/A)
Check	53.8 e
94 N Only	90.9 cd
60 P	91.9 bcd
60 P, 60 K	99.1 a
60 P, 60 K, 0.5 B	97.2 abc
60 P, 15 S, 1.5 Zn	86.7 d
60 P, 60 K, 15 S, 1.5 Zn	96.2 abc
60 P, 60 K, 15 S, 1.5 Zn, 0.5 B	98.6 ab
60 P, 15 S	94.8 abc
60 P, 27 S	92.2 abcd
P>F	< 0.1 (7.0 LSD)

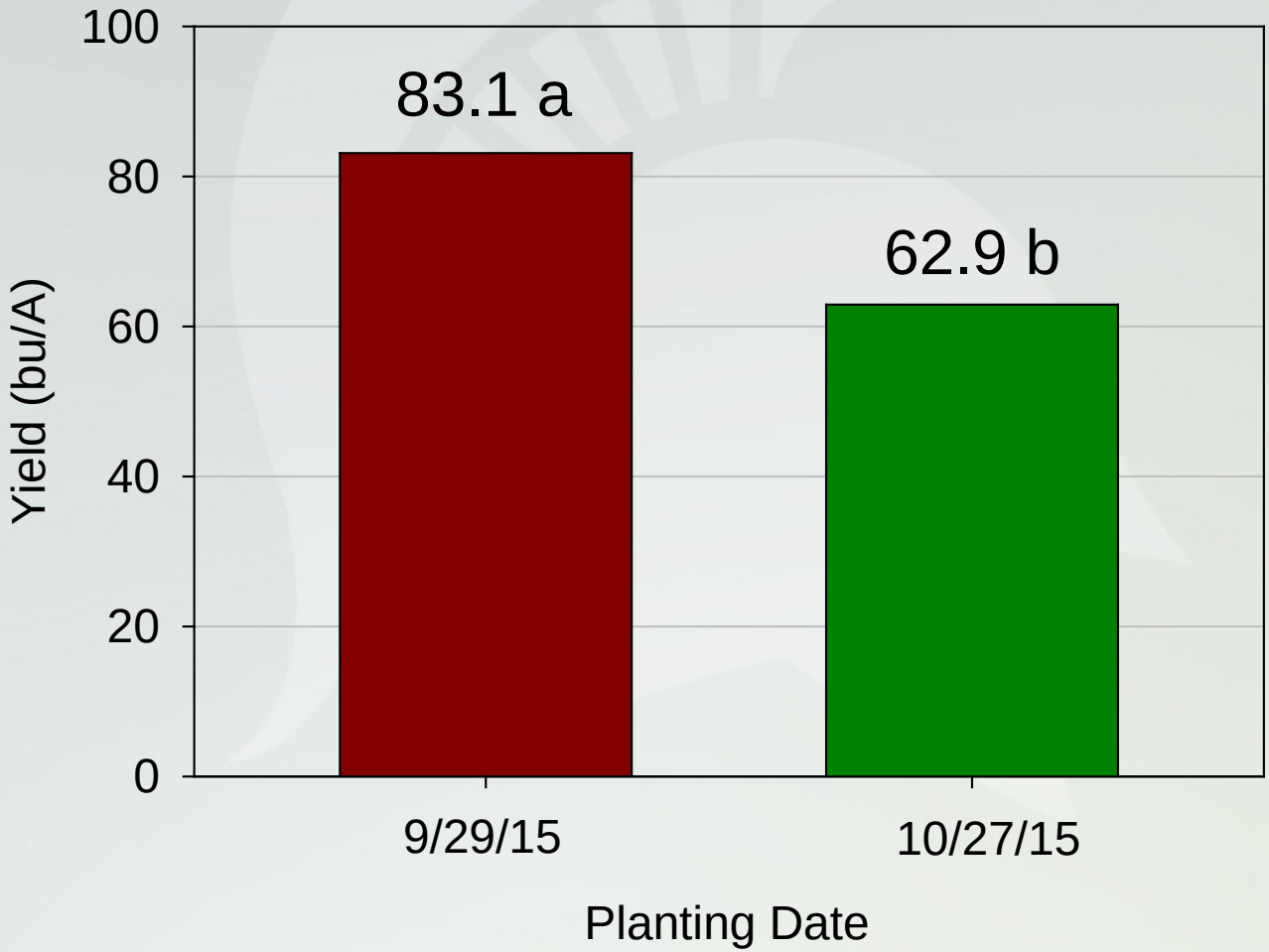
High N and Regular N with Autumn Application of Other Nutrients

- Higher rates of N
  - Often less responsive to other nutrient application
- Lower rates of N
  - More consistent response to other nutrient additions
- Both high and lower N
  - 1 -1.5 bu increase to P only
    - Low N 9 bu increase to P and K
  - 4-6 bu increase w/ P, K, and B
  - 3-4 bu decrease with P, S, and Zn

Does the need for PGR (Palisade) depend upon planting date?

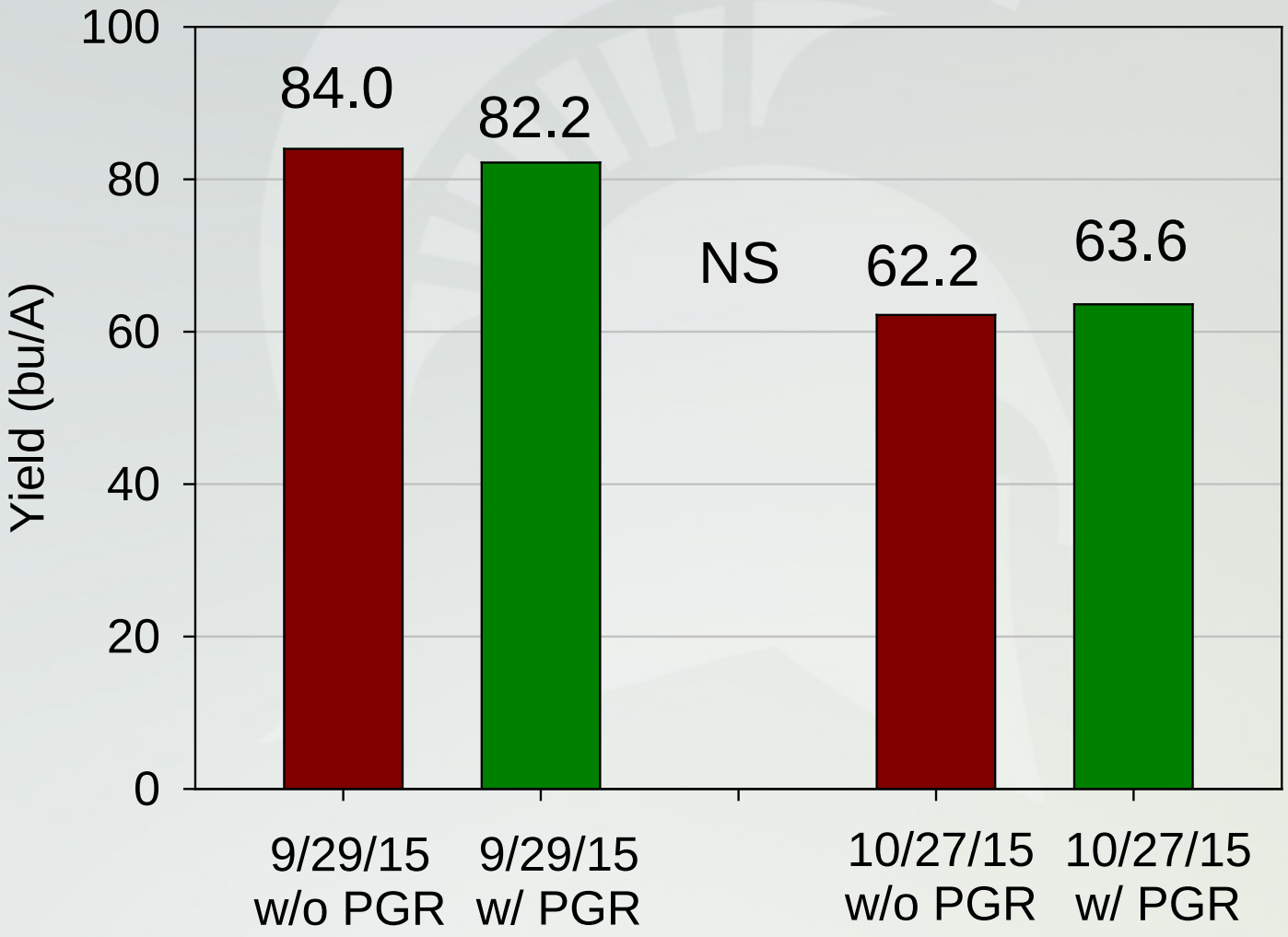
- Taken Dec. 2015
  - Left: Sept 29 PD Right: Oct 27 PD

Planting Date Continues to Pay Dividends



$P = < 0.01$

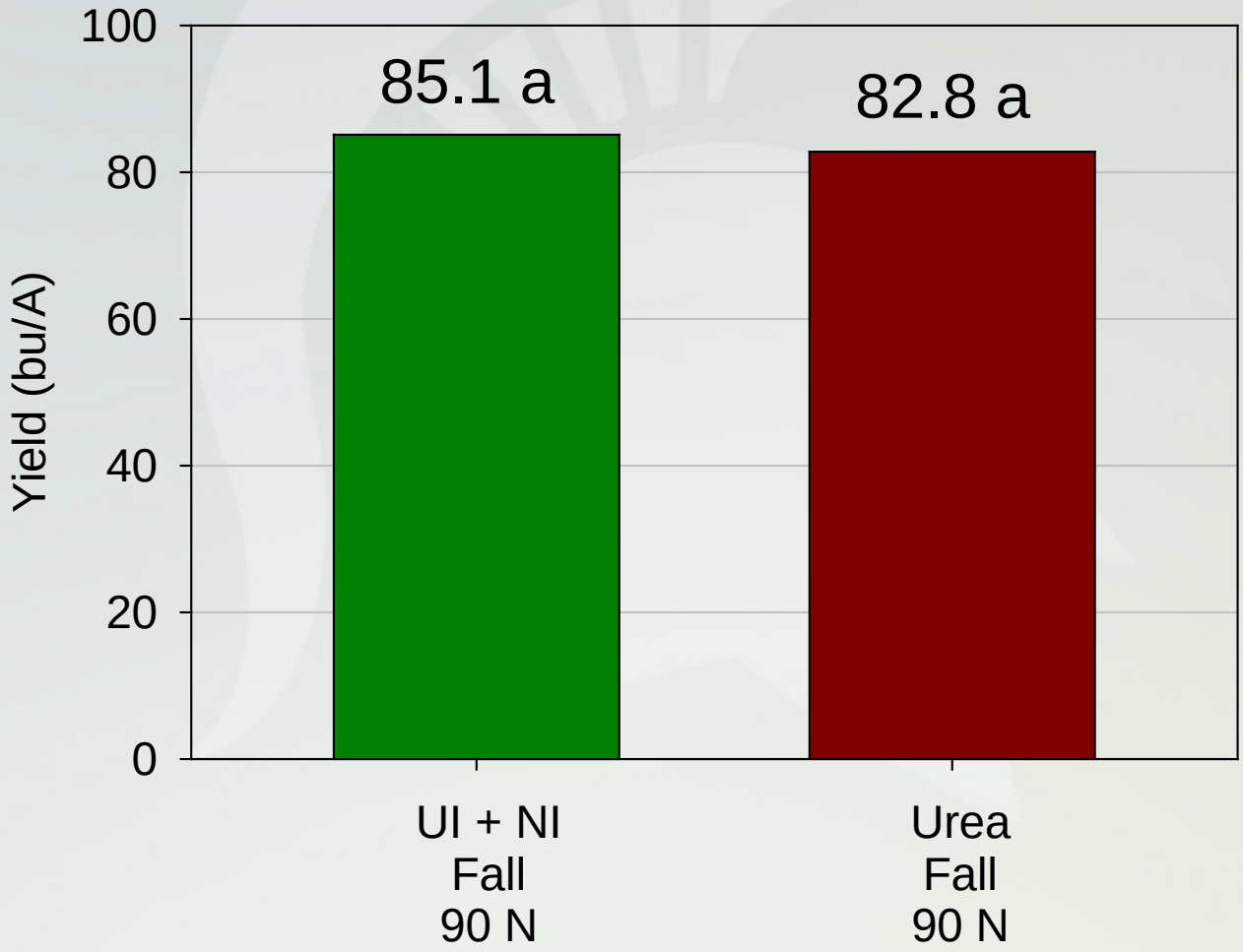
PGR and Planting Date



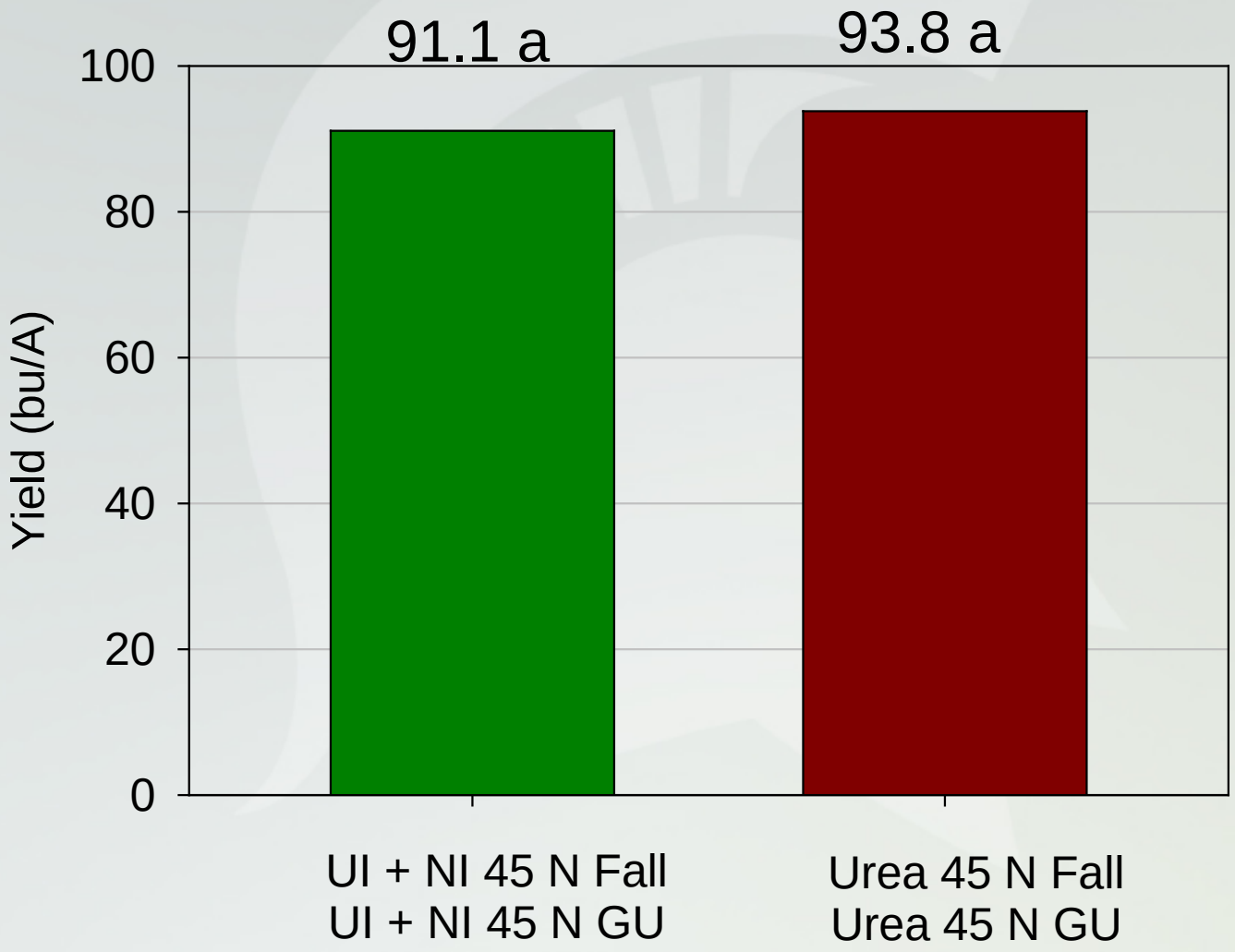
N Stabilizers – Urease and Nitrification Inhibitors: What, When, and How?

How Use?
Accuracy of N Recommendations vs. Precision of N Recommendations

Fall N Application (Nov 20)



Fall Split N Application (Nov 20, GU)



Green-Up and F 5 N Applications

Green-Up N	Yield (bu/A)
Urea	91.1 a
UI	92.4 a
UI + NI	95.6 a
P>F	0.20
Feekes 5 N	
28% UAN	90.1 a
UI	87.0 ab
UI + NI	81.7 b
P>F	0.03

Split N Applications

50% Green-Up N/ 50% F5 or F7	Yield (bu/A)
Urea/UAN (F5)	91.4 a
UI/UAN (F5)	88.9 a
UI + NI/UAN (F5)	89.0 a
Urea/UAN (F7)	91.7 a
P>F	0.53

Single N Applications

Single N Trt.	Yield (bu/A)
Urea (GU)	91.1 ab
UI (GU)	94.7 a
UI + NI (GU)	95.6 a
UAN (F5)	90.1 abc
UI (F5)	87.0 bcd
UI + NI (F5)	81.7 d
UI + NI (FALL)	85.1 cd
Urea (FALL)	82.8 cd
P>F	<0.01

Instinct Nitrification Inhibitor (NI)

Trt. (lbs.)	Yield (bu/A)
Check	52.0 c
36 N GU, 54 N F5	95.6 ab
36 N GU (NI), 54 N F5	96.6 ab
36 N GU, 54 N F5 (NI)	93.3 ab
27 N GU, 36 N F5	94.2 ab
27 N GU (NI), 36 N F5	92.7 ab
27 N GU, 36 N F5 (NI)	86.8 b
36 N GU, 54 N F5 (UI)	102.5 a
36 N GU (NI), 54 N F5 (UI)	96.3 ab
36 N GU, 54 N F5 (UI + NI)	93.8 ab
P>F	< 0.1 (10.0 LSD)

Stabilizer Summary

- Lack of soil moisture mid-May to harvest
  - No payoff to split apps nor stabilized F5 N applications
- Normal winter and early spring precipitation
  - No advantage to stabilized fall N compared to soluble spring N
  - Fall stabilized N with spring N didn't pay off (second year)
- Green-Up stabilizer results '13, '14, and '16
  - UI: 1.5-5 bu increase, UI+NI: 4.5-13 bu increase
  - Dry 2015 resulted in yield reductions

Is Starter N Required for Winter Wheat and Does this Need Vary by Planting Date?

Starter N vs. No Starter N

Planting Date	No Fall N 90 GU	25 N Fall 90 GU	25 N Fall 65 GU
29 Sept.	103.8 ab	107.5 a	98.7 abc
27 Oct.	90.9 cd	96.2 bc	85.5 d
P>F	< 0.01 (LSD=9)		

- Planting Date
  - 103 bu/A vs 91 bu/A
- Fall N = 97 bu/A vs. No Fall N = 97 bu/A
- If do apply fall N, do NOT reduce spring N

Baseline White Wheat Nutrient Management Information

White Wheat N Response Trial

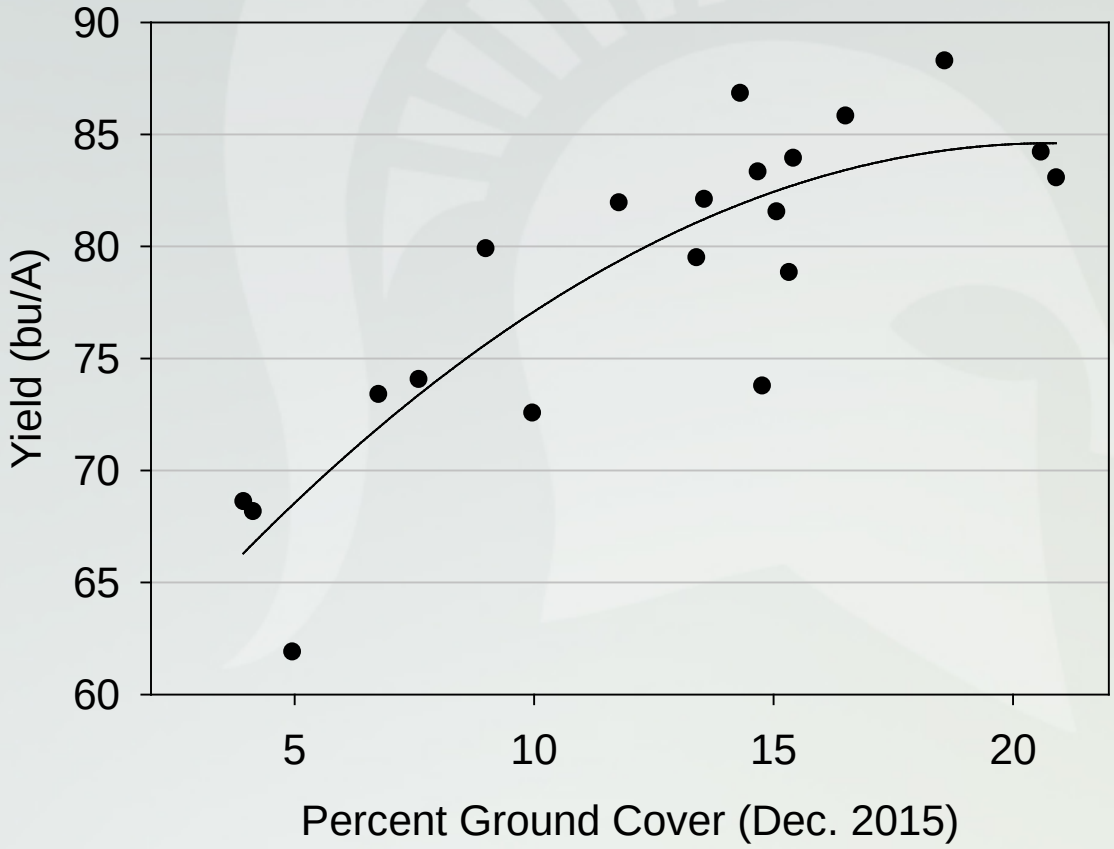
N Rate	Yield (bu/A)
Check	66.5 c
40 N GU	79.4 b
80 N GU	94.4 a
120 NGU	98.6 a
160 N GU	101.3 a
200 N GU	98.7 a
P>F	<0.01 (LSD = 7.7)

Soft Red Wheat Seeding Rate Study

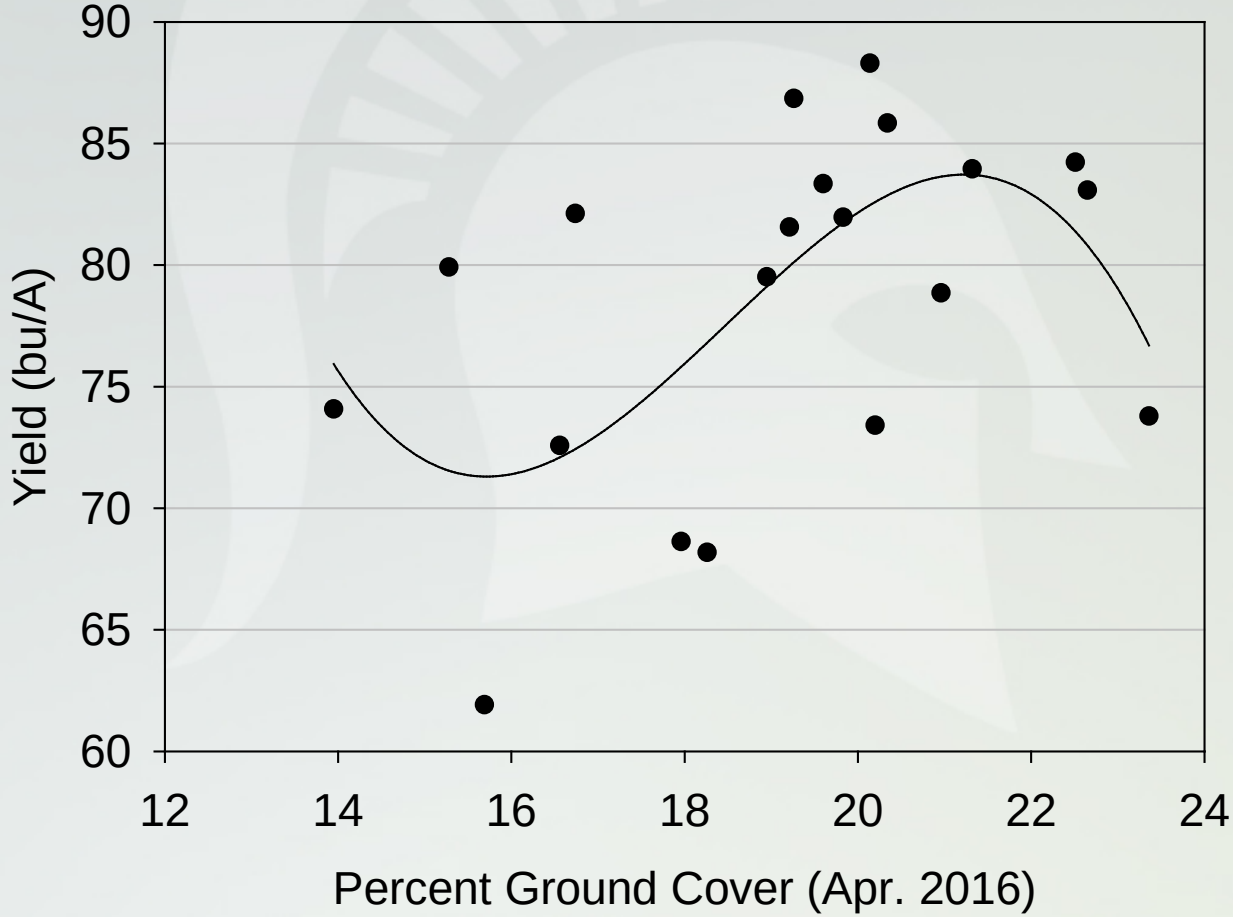
Soft Red Seeding Rate Study

Seed Rate (90 N GU)	Yield (bu/A)	Fall Canopy Cover %
250 K/A	68.0 c	4.9 d
500 K/A	77.1 b	9.6 c
1 mill/A	84.2 a	15.0 b
1.5 mill/A	80.0 ab	15.4 b
2.0 mill/A	83.7 a	17.9 a
P>F	< 0.01 (LSD 5.9)	< 0.01 (LSD 2.3)

Wheat Yield and December % Ground Coverage



Wheat Yield and April % Ground Coverage



Inoculated Wheat Seed – Yes or No?

Seed Inoculum Study

Trt	Yield (bu/A)
SabrEX Root Inoculant 90 N GU	101.2 a
No inoculant 90 N GU	102.6 a
0.5 T/A Herbrucks 66 N GU	102.3 a
P>F	0.89 NS

PlantTuff Silica Fertilizer in Wheat

PlantTuff Silica Fertilizer (6.2 pH, 30 P, 86 K)

Trt.	Yield bu./A	Trt.	Yield bu./A
Check (N Only)	85.7 a		
PT, Fall, 0.5 T	88.6 a	**PT, Spring, 0.5 T**	85.1 a
PT, Fall, 1 T	90.0 a	**PT, Spring, 1 T**	83.5 a
PT, Fall, 2 T	88.6 a	**PT, Spring, 2 T**	87.9 a
Lime, Fall, 0.5 T	85.3 a	**Lime, Spring 0.5 T**	90.4 a
Lime, Fall, 1 T	90.1 a	**Lime, Spring, 1 T**	87.7 a
Lime, Fall, 2 T	84.4 a	**Lime, Spring, 2 T**	87.7 a
P > F	0.99 (NS)		

2017 Proposed Soil Fertility Wheat Research

- Soft Red and White Winter Wheat Soil Fertility and Plant Nutrition Systems

1) (Two Projects/Locations) Red and White Winter Wheat Response to Urease Inhibitor, Nitrification Inhibitor, Plant Growth Regulator, Fungicide, Micronutrients, and High N Management

2) Seeding Rate by Variety Interactions for Profitable Wheat Production

3) Incremental Applications of B,S, and Zn in High N Management Soft Red and White Winter Wheat

4) In-furrow Starter P Fertilizer in Winter Wheat

5) Fall vs Spring Applied Nutrient Applications Including S, B, and N Extenders

6) Biostimulant Evaluation on Wheat Growth and Yield

7) Nutrient Management Strategies in White Wheat

Red and White Wheat Response To…..

- 'Jupiter' (Richville), 'Sunburst' (Lansing) [1.8 mill seeds/A]
- Omission trial treatment structure
  - 2 control treatments
    - 1 involving every input factor applied (Enhanced)
    - 1 involving none of the input factors applied (Traditional)
  - Treatment effects are then evaluated by removing a single input from **Enhanced** and comparing to **Enhanced** treatment with all inputs and conversely adding a single input to **Traditional** and comparing to **Traditional** treatment with none of the treatment factors.
  - **Factors**: urease inhibitor, nitrification inhibitor, PGR, fungicide, micronutrients, and high N (+20%) (all highly marketed products)
  - **15 total treatments at each location for white and red study**

Red and White Wheat Response To…..

Trt	Name	UI	NI	PGR	Fungicide	Micro	High N
1	Enhanced (E)	Y	Y	Y	Y	Y	Y
2	E - UI	N	Y	Y	Y	Y	Y
3	E - NI	Y	N	Y	Y	Y	Y
4	E - PGR	Y	Y	N	Y	Y	Y
5	E - Fung	Y	Y	Y	N	Y	Y
6	E - Micro	Y	Y	Y	Y	N	Y
7	E – High N	Y	Y	Y	Y	Y	N
8	Traditional (T)	N	N	N	N	N	N
9	T + UI	Y	N	N	N	N	N
10	T+ NI	N	Y	N	N	N	N
11	T + PGR	N	N	Y	N	N	N
12	T + Fung	N	N	N	Y	N	N
13	T + Micro	N	N	N	N	Y	N
14	T + High N	N	N	N	N	N	Y

Spring Stand Evaluation Or "Should I Keep My Wheat?"

- 250,000 to 2 million seeds/A (joint w/OSU)
  - Stand and tiller counts fall and spring
  - NDVI (Greenseeker) and Digital Image Analysis

2017 Research

- Questions, Concerns, Comments, Thoughts?
- ksteinke@msu.edu

SELF PROPELLED
PLOT COMBINE