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MAKING A DIFFERENCE IN MINNESOTA: ENVIRONMENT + FOOD & AGRICULTURE + COMMUNITIES + FAMILIES + YOUTH

Combining 4R Nutrient Management and Ecological Intensification to Advance Corn Production

**Jeffrey Vetsch and Dr. Jeffrey Coulter,
University of Minnesota**

z.umn.edu/corn

Research Questions

- What yield levels are possible?
- How far are current yields from these levels?
- Is standard fertilizer management capable of attaining yields at levels close to yield potential?



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Agricultural Intensification

- As farmers intensify their ag systems to increase production (yield). They need to balance profitability and environmental effects of management.



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Sustainability Questions

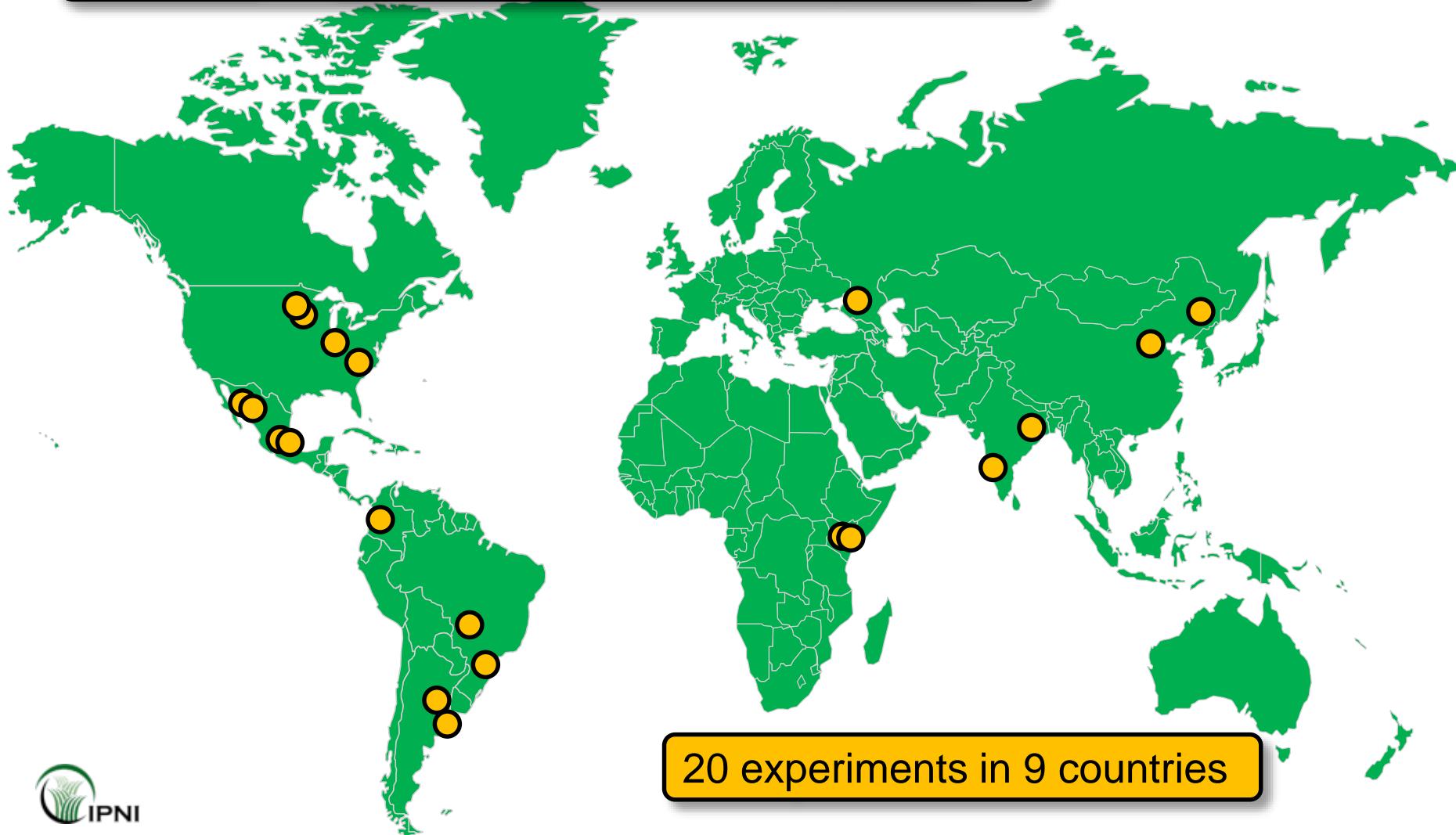
- Does intensifying management to increase yield affect profitability?
- Are there impacts to the soil resource?
- What are the environmental (water or air) effects?



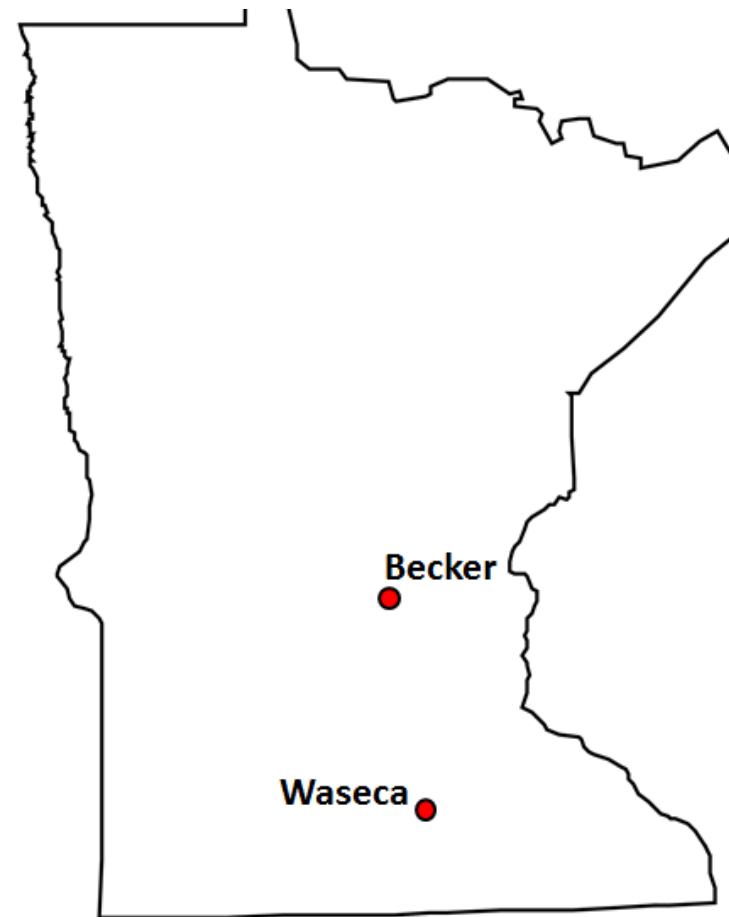
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Global network of experiments

Compare normal vs. intensive agronomics with
standard vs. advanced fertilizer management



- **Waseca (2013 – present)**
 - Nicollet clay loam
 - 4.3% SOM, 6.2 pH
 - Patterned tile drainage
 - Continuous corn
 - Same plots every year
- **Becker (2014 – present)**
 - Irrigated
 - Hubbard-Mosford loamy sand
 - 1.6% SOM, 6.6 pH
 - Continuous corn
 - New site in 2018



■ Continuous corn

- Requires top management for high yields
- Greater risk of nutrient losses

■ Irrigated sands

- High yield potential
- Greater risk of crop nutrient deficiency
- Greater risk of nutrient losses



Typical farmer practice

Ecological intensification

Normal agronomics

Intensive agronomics

Standard
fertilizer
management

Advanced
fertilizer
management

Standard
fertilizer
management

Advanced
fertilizer
management

- **Standard fertilizer management was Univ. of Minnesota guidelines for N, P, K and S.**
- **‘Systems’ treatments developed & updated:**
 - AFREC, crop advisors, industry agronomists, farmers



Agronomic treatments – Waseca

	Normal	Intensive
Corn stover harvested (%)	0	40
Hybrid maturity (CRM)	101	105
Planting rate (seeds/acre)	36,000	41,000
Fungicide at tasseling	No	Yes



Fertilizer treatments – Waseca

	Standard	Advanced
S	20 lb SO ₄ /ac	20 lb SO ₄ /ac
P	U of M guidelines	50% grain removal
K	U of M guidelines	100% grain removal
10-34-0 in furrow	4 gal/ac	4 gal/ac
Surface-banded starter (2" x 0")	---	7 gal/ac 28-0-0 + 2 gal/ac 12-0-0-26
Pre-plant N (urea)	175 lb N/ac	111 lb N/ac
V6 N (28-0-0, injected)	---	40 lb N/ac
V14 N (28-0-0, Y-DROPs)	---	40 lb N/ac
Total N	180 lb N/ac	220 lb N/ac

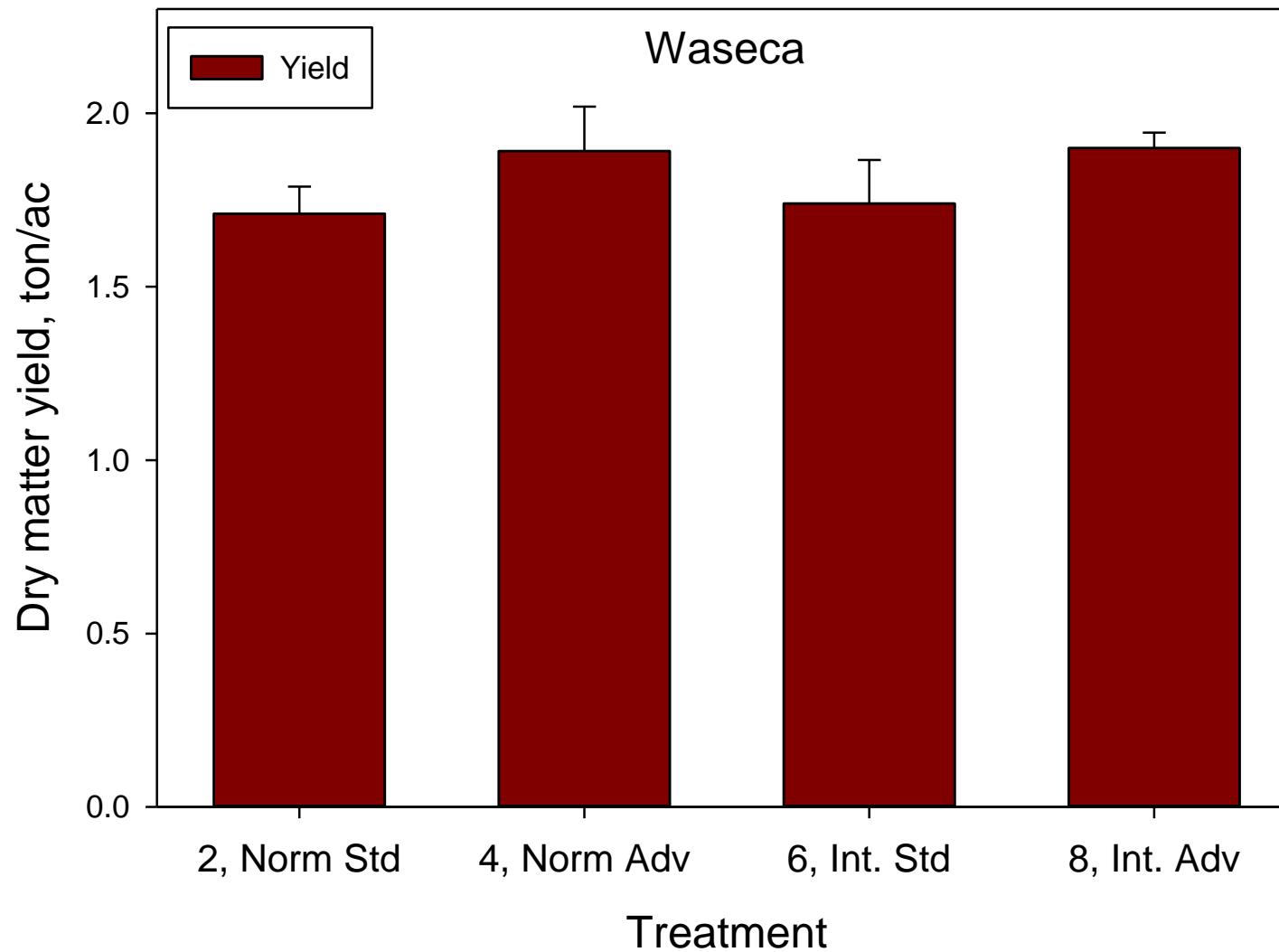


Fertilizer treatment changes 2018 – Waseca

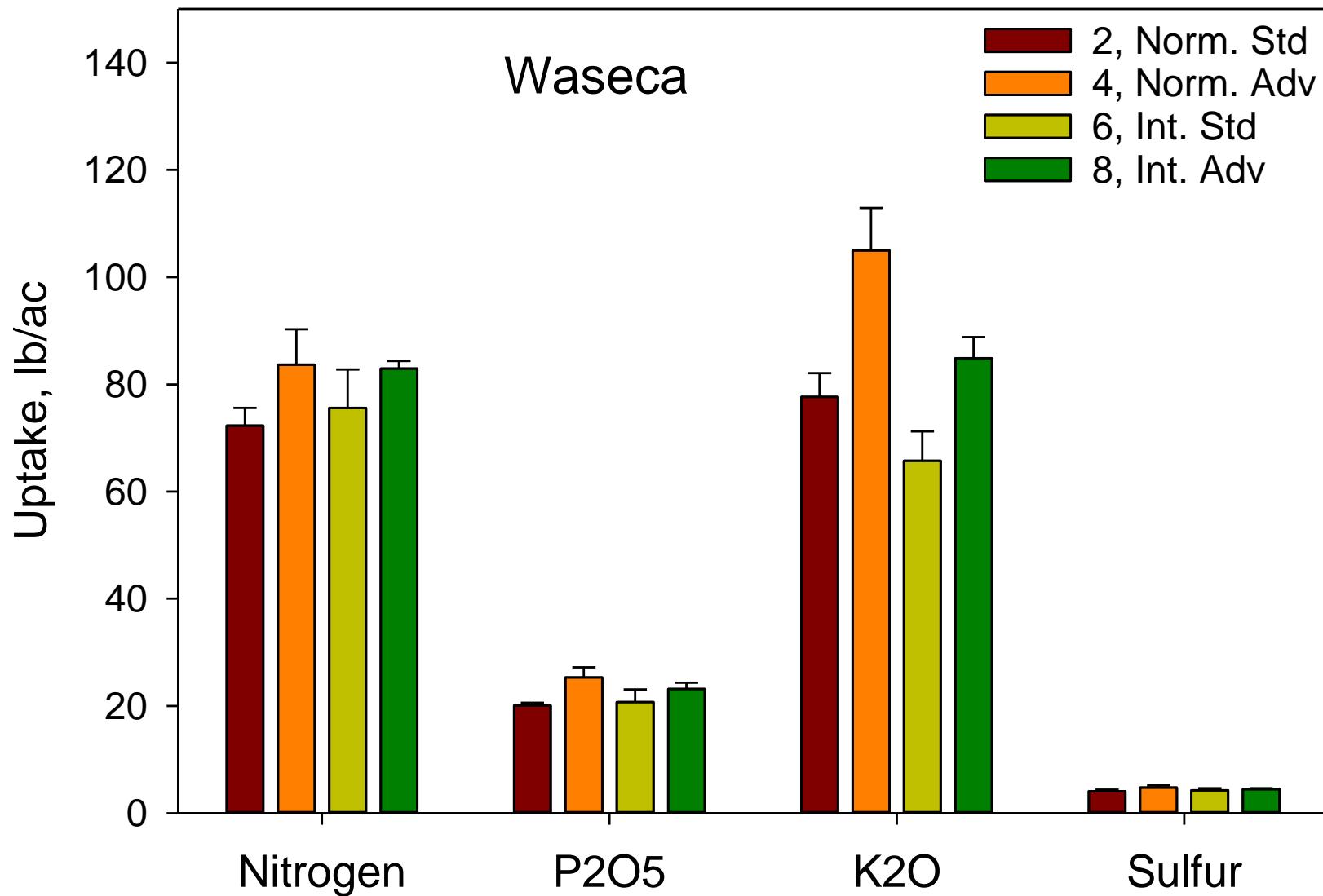
	Standard	Advanced
S	20 lb SO ₄ /ac	20 lb SO ₄ /ac
P	U of M guidelines	50% grain removal
K	U of M guidelines	100% grain removal
10-34-0 in furrow	4 gal/ac	4 gal/ac
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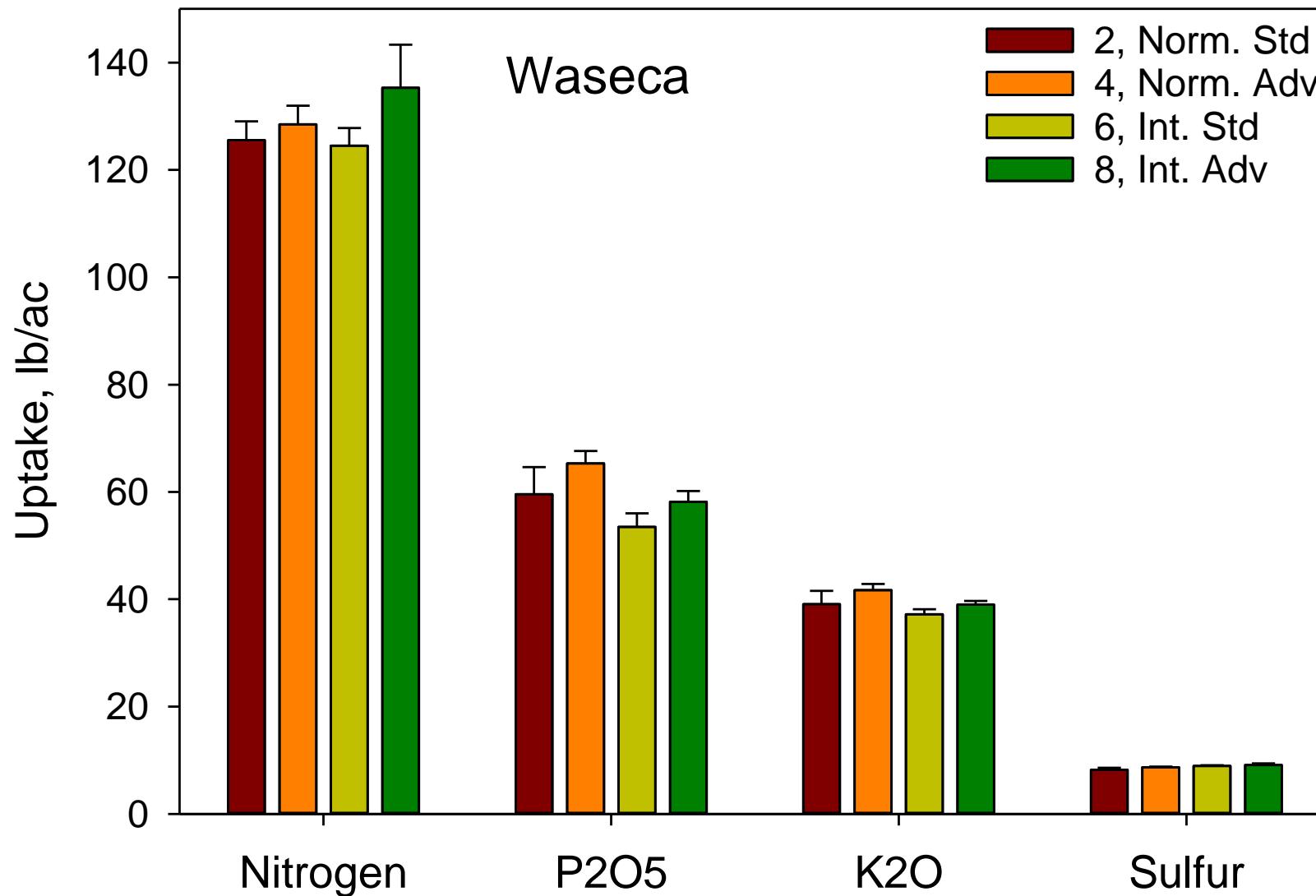
Treatment effects on dry matter yield at V10 Waseca 2018



Treatment effects on nutrient uptake at V10



Treatment effects on grain nutrient removal



- Yield gap = 16 to 64 bu/ac (average = 35 bu/ac)
- Greatest yield = advanced fertilizer mgt. + intensive agronomics
- Moderate yield = advanced fertilizer mgt. or intensive agronomics

Waseca

Agronomic management	Normal	Normal	Intensive	Intensive
Fertilizer management	Standard	Advanced	Standard	Advanced
----- year -----	----- grain yield (bu/ac) -----			
2013	193 c	215 b	210 b	233 a
2014	92 c	121 b	124 b	156 a
2015	203 c	220 b	234 a	242 a
2016	214 c	220 b	233 a	239 a
2017	209 c	230 b	228 b	238 a
2018	213 b	224 a	218 b	229 a
6-year average	187 c	205 b	208 b	223 a

- Net return increased with intensive agronomics in 2 of 6 years

Waseca

Agronomic management	Normal	Normal	Intensive	Intensive
Fertilizer management	Standard	Advanced	Standard	Advanced
Added inputs (\$/ac)	---	77 & 54	18 & 33	95 & 87
----- year -----	-- change in net return after drying + inputs (\$/ac) --			
2013	---	-8	-3	-8
2014	---	6	64	80
2015	---	-22	45	-4
2016	---	-56	6	-49
2017	---	-14	-6	-43
2018	---	-27	-54	-68
6-year average	---	-19	10	-13

Agronomic treatments – Becker (irrigated)

	Normal	Intensive
Hybrid maturity (CRM)	96	103
Planting rate (seeds/acre)	36,000	41,000

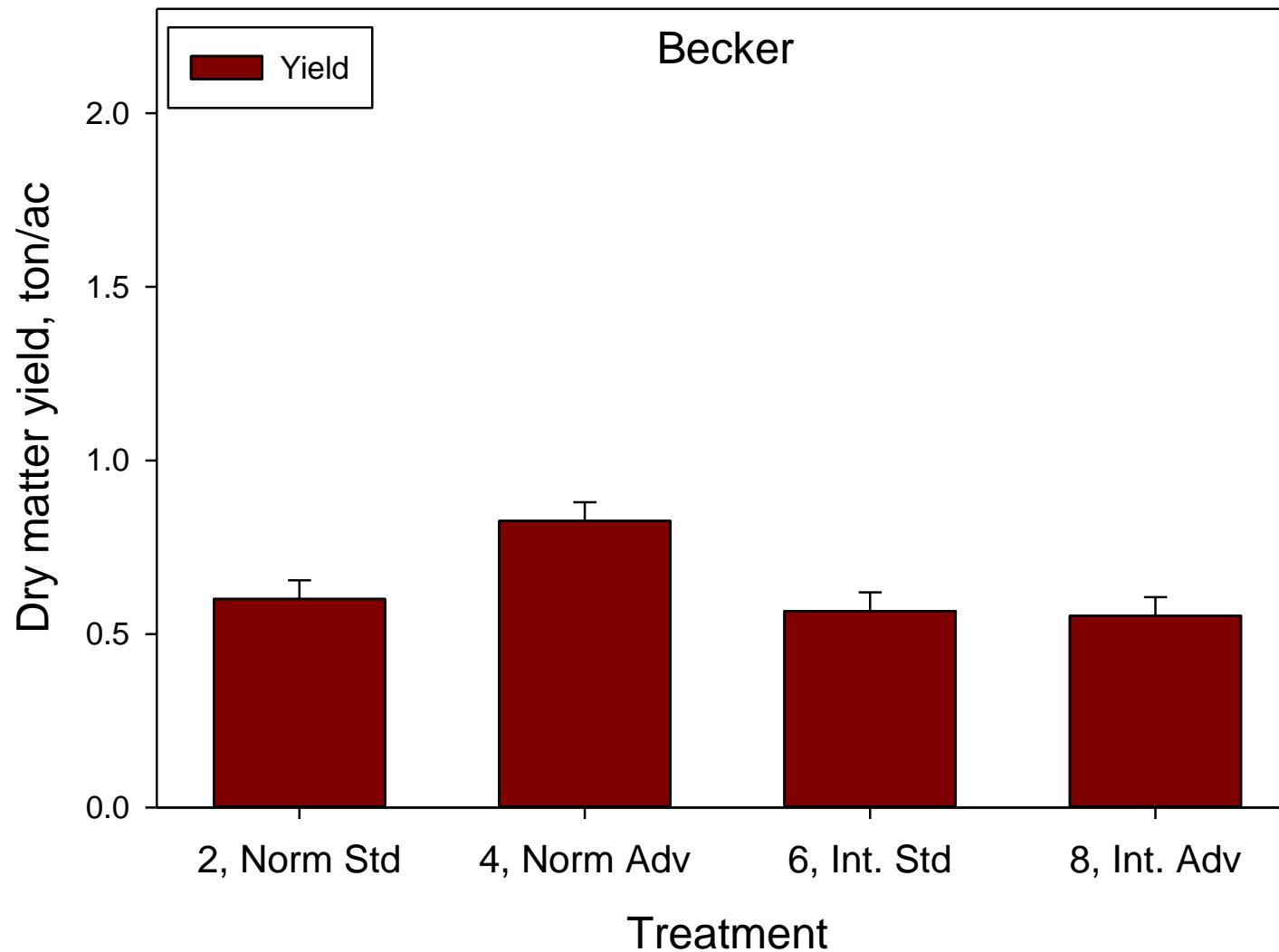


Fertilizer treatments – Becker (irrigated)

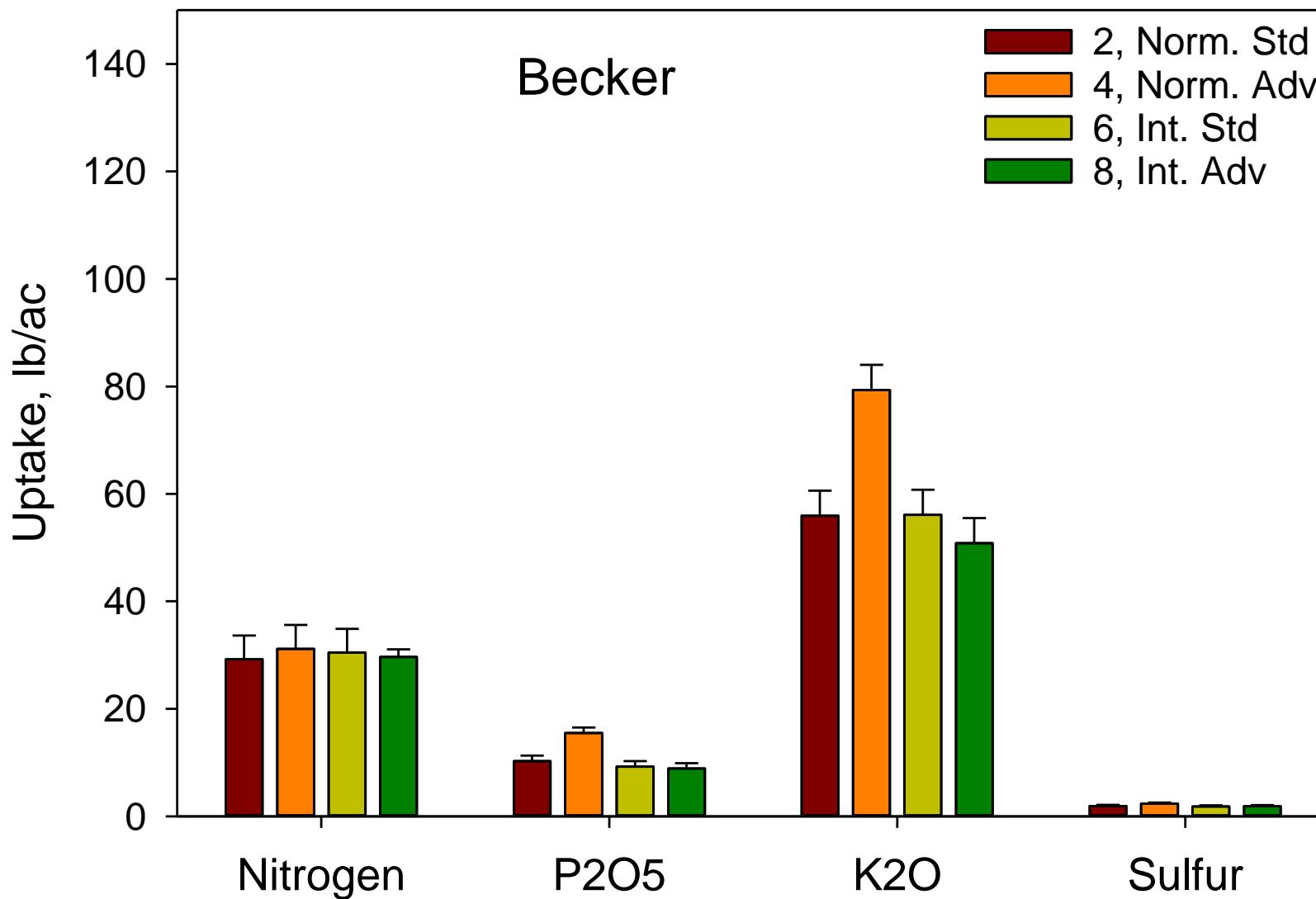
	Standard	Advanced
S	25 lb SO ₄ /ac	25 lb SO ₄ /ac
P	U of M guidelines	50% grain removal
K	U of M guidelines	100% grain removal
10-34-0 in furrow	4 gal/ac	4 gal/ac
V2 N (urea)	40 lb N/ac	40 lb N/ac
V6 N (urea)	185 lb N/ac	70 lb N/ac
V12 N (urea)	---	70 lb N/ac
VT N (urea)	---	45 lb N/ac
Total N	230 lb N/ac	230 lb N/ac



Treatment effects on dry matter yield at V10 Becker 2018



Treatment effects on nutrient uptake at V10



- Yield gap = 38 to 59 bu/ac (average = 46 bu/ac)
- Greatest yield = advanced fertilizer mgt. + intensive agronomics
- Moderate yield = advanced fertilizer mgt. or intensive agronomics

Becker (irrigated)

Agronomic management	Normal	Normal	Intensive	Intensive
Fertilizer management	Standard	Advanced	Standard	Advanced
----- year -----	----- grain yield (bu/ac) -----			
2014	159 c	192 ab	180 b	205 a
2015	163 d	183 c	197 b	222 a
2016	190 c	189 c	209 b	229 a
2017	169 c	192 b	171 c	224 a
2018	169 c	207 a	190 b	190 b
5-year average	178 c	200 b	201 b	217 a

- Greatest net return with advanced fertilizer mgt. in 3 of 5 years & advanced fertilizer mgt. + intensive agronomics in 2 of 5 years
- Net return increased with advanced fertilizer mgt. or intensive agronomics in 4 of 5 years

Becker (irrigated)

Agronomic management	Normal	Normal	Intensive	Intensive
Added inputs (\$/ac)	---	52 & 38	18	70 & 56
Fertilizer management	Standard	Advanced	Standard	Advanced
----- year -----	-- change in net return after drying + inputs (\$/ac) --			
2014	---	44	28	36
2015	---	16	84	101
2016	---	-54	31	42
2017	---	12	-6	-17
2018	---	73	19	-17
5-year average	---	19	31	29

Summary

- **Experiments established with 10-year horizon**
 - Plan to continue for 2 to 4 more years
 - Weather & crop response are dynamic over time
 - Treatment effects on soil nutrient levels expected
 - Found a significant yield gap among treatments
 - >40 bu/ac in some years
 - Current yield levels are less than potential
 - Profitability a concern



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Contact info

Jeffrey Vetsch
Researcher and Soil Scientist
Southern Research and Outreach Center
jvetsch@umn.edu
Follow on Twitter @ jvetsch2

Dr. Jeffrey Coulter
Professor and Extension Corn Agronomist
Dept. Of Agronomy and Plant Genetics
jeffcoulter@umn.edu





Thank you!



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