Balanced Nutrition & Crop Production Practices for Sorghum Nutrient Partitioning & Closing Yield Gaps

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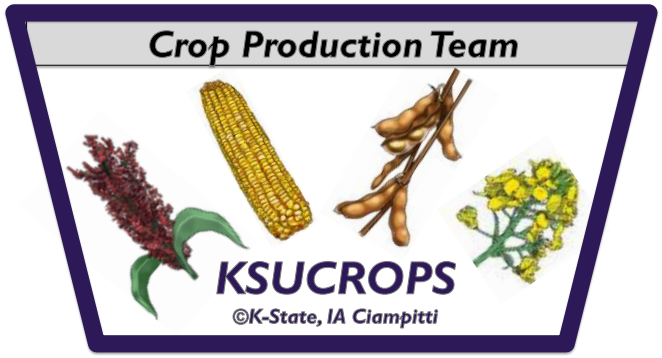
K-STATE Research and Extension



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Objectives

- Understand the effect of fertilizer applications and their interactions with diverse management practices
- Identify management factors that contribute to high sorghum yields
- Investigate nutrient uptake and partitioning under different environments and crop production practices (nutrient information is not yet available)

Materials & Methods

- **11 Treatments, 5 reps/location:**

1) (KS) Full Treatment or "Kitchen Sink" (high plant pop., 15" rows, GreenSeeker N, Insecticide/fungicide, micronutrients, starter fertilizer, plant growth regulator)
2) (PD) Plant Density (40,000 vs. 80,000)
3) (RS) Row Spacing (30" rows)
4) (Pre-N) Nitrogen (50 lbs/acre all at pre-planting)
5) (FI) Foliar Fungicide/Insecticide (Without chemicals)
6) (Micro) Foliar Micronutrients (Fe, Zn) (Without micronutrients)
7) (PGR) Plant Growth Regulator (Without PGR)
8) (NP) Fertilizer NPKS Starter (only NP starter)
9) (Cl) Chloride (Without Chloride)
10) (FP) Farmer Practice (Lower plant pop., wide rows, NP starter)
11) (KS+N) Non-limiting N = Kitchen Sink +N (Treatment #1 + 50 lbs extra N)

Treatments & Experimental Design

	Treatments										
	1 (KS)	2 (PD)	3 (RS)	4 (PD)	5 (F/I)	6 (Micros)	7 (PGR)	8 (NP)	9 (Cl)	10 (FP)	11 (KS+N)
Seeding rate	Optimum	Normal	Optimum	Optimum	Optimum	Optimum	Optimum	Optimum	Optimum	Normal	Optimum
Row Spacing	15"	15"	30"	15"	15"	15"	15"	15"	15"	30"	15"
N Program	GS	GS	GS	Standard	GS	GS	GS	GS	GS	Standard	GS
Fungicide/Insecticide	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes
Micronutrients	Fe, Zn	Fe, Zn	Fe, Zn	Fe, Zn	Fe, Zn	None	Fe, Zn	Fe, Zn	Fe, Zn	None	Fe, Zn
PGR	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes
Starter Fertilizer	NPKSZn	NPKSZn	NPKSZn	NPKSZn	NPKSZn	NPKSZn	NPKSZn	NP	NPKSZn	NP	NPKSZn
Chloride	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes
GreenSeeker + N	No	No	No	No	No	No	No	No	No	No	Yes

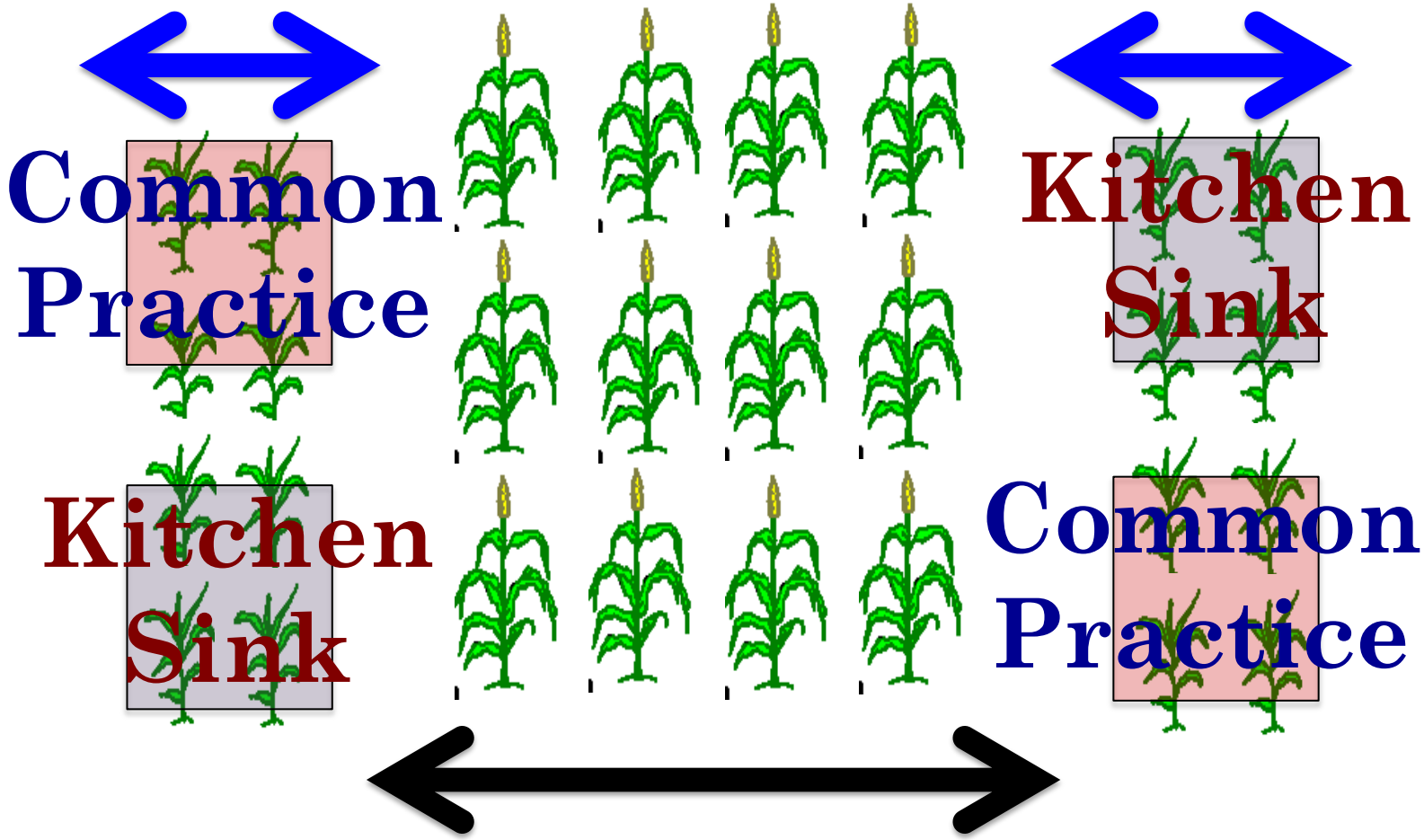
Soil Parameters	Topeka		Ottawa	
	0-6”	**6-24”**	**0-6”**	**6-24”**
pH **(units)**	6.9	6.9	6.3	6.5
Mehlich P (ppm)	67.1	40.2	12.1	4.6
K (ppm)	395	287.9	128.1	248.9
CEC (meq/100g)	17.9	19.4	20.5	28.4
OM (%)	2.86	2.26	3.15	2.71

Soil Characterization

Crop Phenology

Plant Phenology	Topeka	Ottawa
Planting Date	June 9	June 9
V-5 Growth Stage	July 7	July 7
Flowering	August 10	August 12
Harvest	September 30	October 12

Plot Layout



COMPARE **KITCHEN SINK, and other alternatives** vs. **COMMON PRACTICES in** SORGHUM

Treatments & Experimental Design

Treatment #	N	Average GreenSeeker N	Total N	P2O5	K2O	S	Cl	Fe	Zn	TOTAL N
	lbs per acre									
1	20	35	55	20	20	20	20	2	2	105
2	20	39	59	20	20	20	20	2	2	109
3	20	20	40	20	20	20	20	2	2	90
4	20	0	20	20	20	20	20	2	2	120
5	20	30	50	20	20	20	20	2	2	100
6	20	27	47	20	20	20	20	0	0	97
7	20	27	47	20	20	20	20	2	2	97
8	20	30	50	20	0	0	20	2	2	100
9	20	33	53	20	20	20	0	2	2	103
10	20	0	20	20	0	0	0	0	0	70
11	20	78	98	20	20	20	20	2	2	148

Application Rates:
Tilt (fungicide): 2-4 fl. oz. per acre
Sevin (insecticide): 1-2 quarts per acre
MCP-Agrofresh (plant growth regulator): 100 g per acre

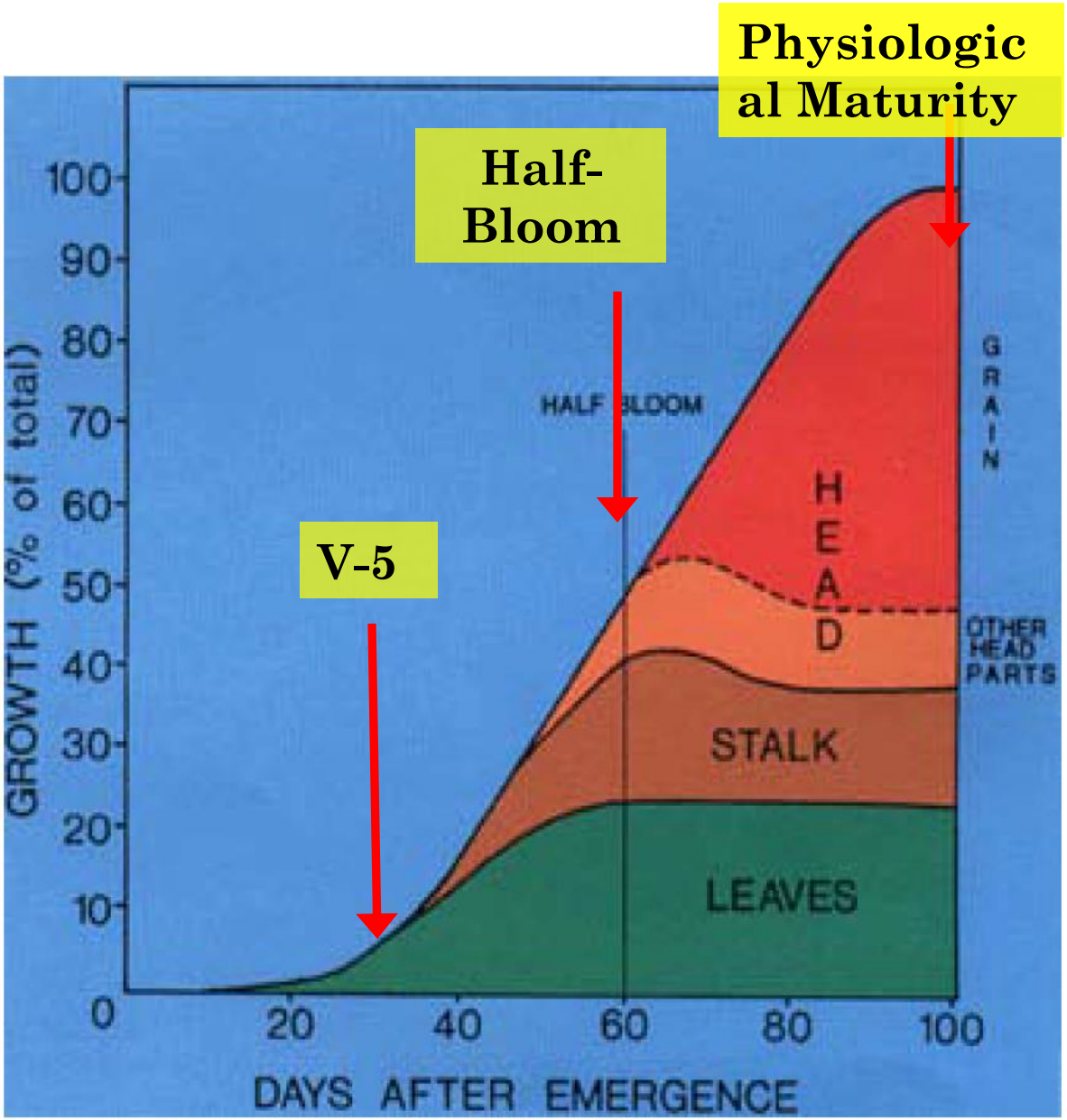
All chemicals were applied 15-20 days after flowering time

Treatment	PGR (g/plot)	Fungicide (mL/plot)	Insecticide (mL/plot)
1	1	1.4	11
2	1	1.4	11
3	1	1.4	11
4	1	1.4	11
5	1	0	0
6	1	1.4	11
7	0	1.4	11
8	1	1.4	11
9	1	1.4	11
10	0	0	0
11	1	1.4	11

Data Collection

- Plant population: stand counts
- Accurate meteorology measurements (light intensity, temperature, precipitation, humidity, wind speed)
- Soil Nutrient Analysis at pre-planting
- Leaf Area Index at 5th leaf collar, half-bloom
- Chlorophyll (SPAD) readings at 5th leaf collar, and half-bloom
- Canopy temperature at half-bloom
- Aboveground biomass, nutrient concentrations, and nutrient uptake at 5th leaf collar, half-bloom and physiological maturity (Stems, leaves, and heads)
- Grain yield (moisture, test weight, and yield components: grain number/head and seed weight)

Biomass & Nutrient Sampling



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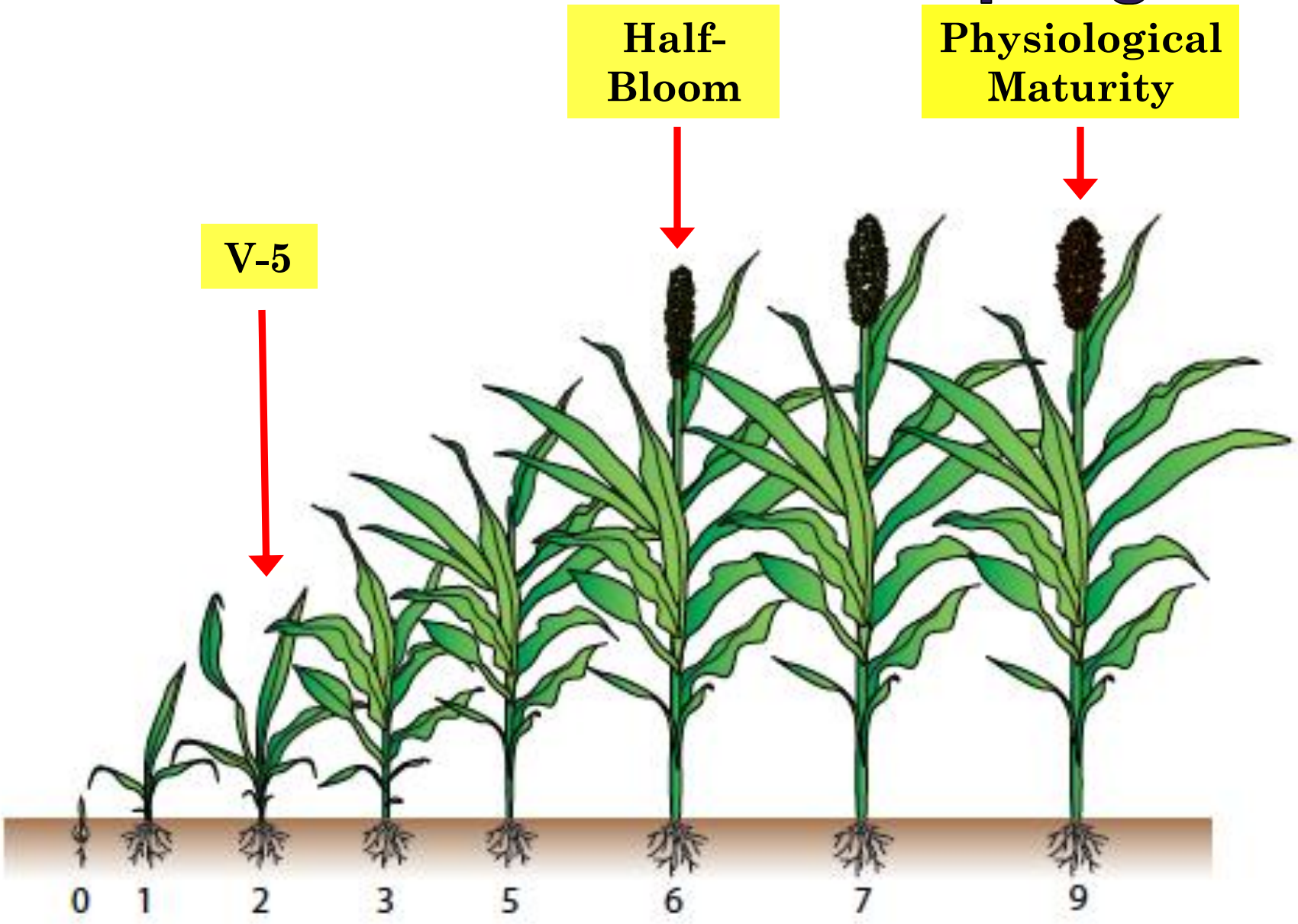
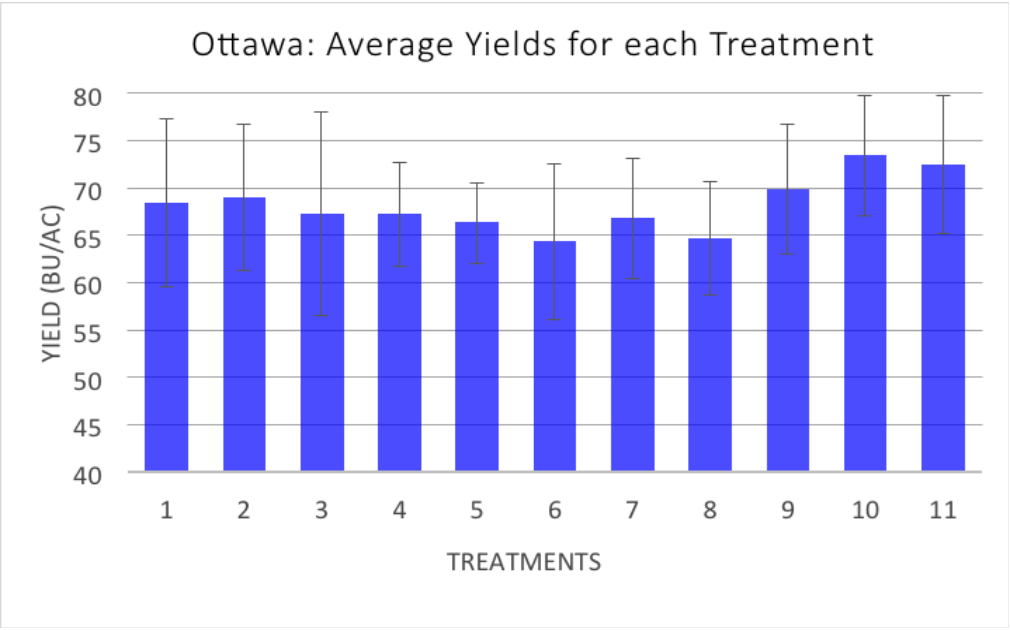


Closing Grain Sorghum Yield Gaps



#1 = Kitchen Sink (KS)

#10 = Common Practice (CP)

High Variability

Yields < 75 bu/acre

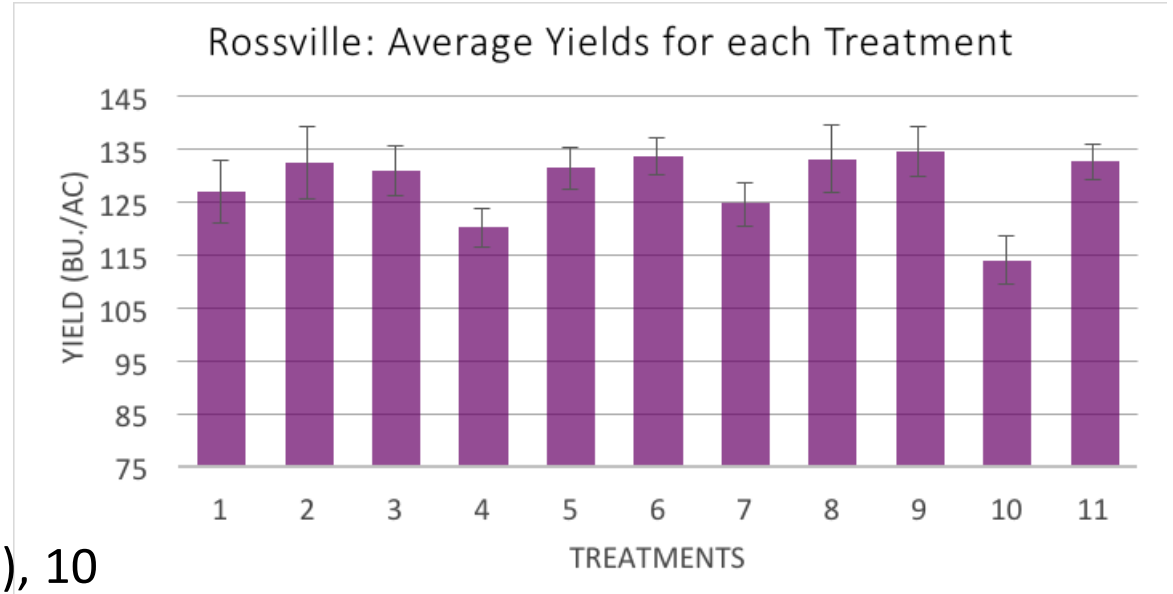
+10 bu/acre variability

#9 = Kitchen Sink (- Cl)

#10 = Common Practice

YIELD GAP

20 bushels per acre



MAX. YIELD #9, 8, 6, 5, 3, 2, 1

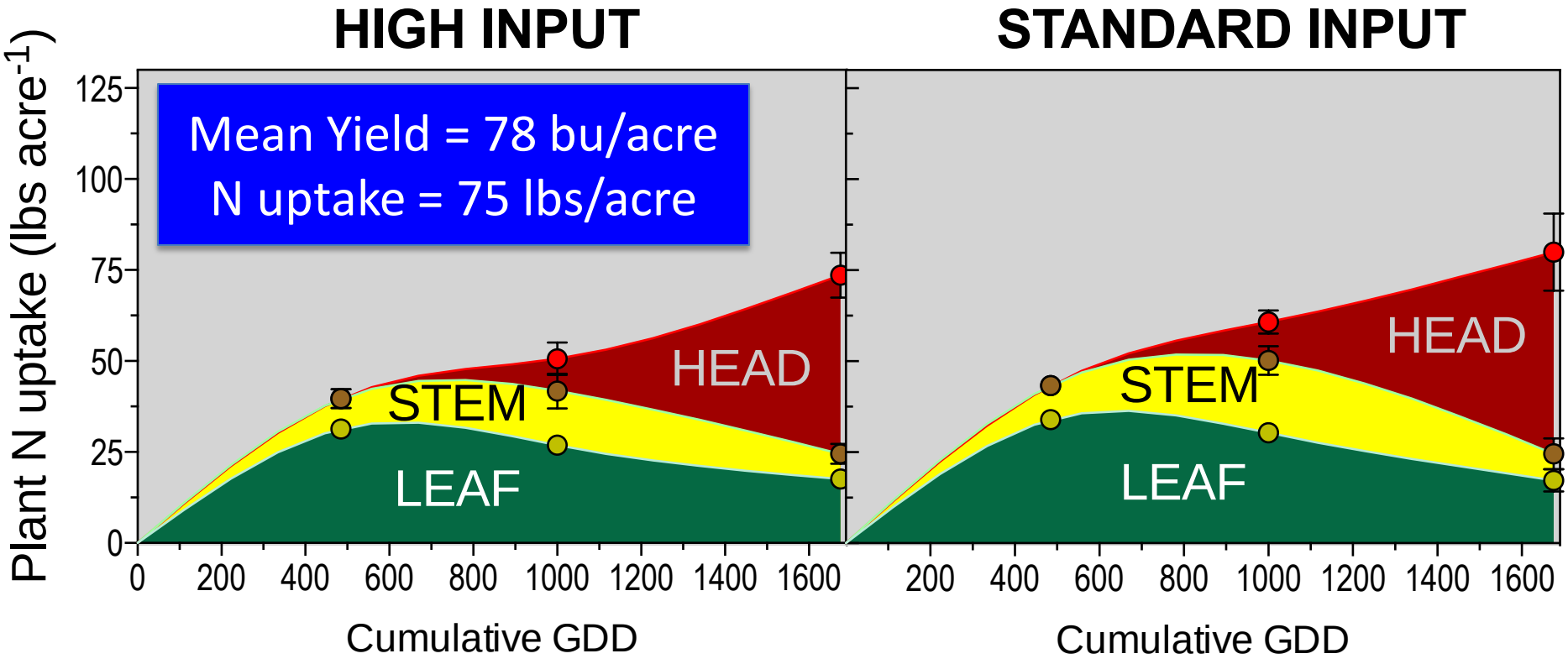
MIN. YIELD #7 (No-PGR), 4 (Pre-N), 10

Closing Grain Sorghum Yield Gaps

Site	Mean Yield	Min. Yield	Max. Yield	Coefficient of Variation
2014	- bushels per acre-			%
Scandia	109	82	139	13.7
Rossville	129	101	151	8.3
Ottawa	68	38	99	23.8
Hutchinson	79	48	100	15.9
2015				
Scandia	121	65	155	17.6
Topeka	153	130	173	5.8
Ottawa	88	67	109	9.9
Manhattan	105	75	151	13.5

Closing Grain Sorghum Yield Gaps

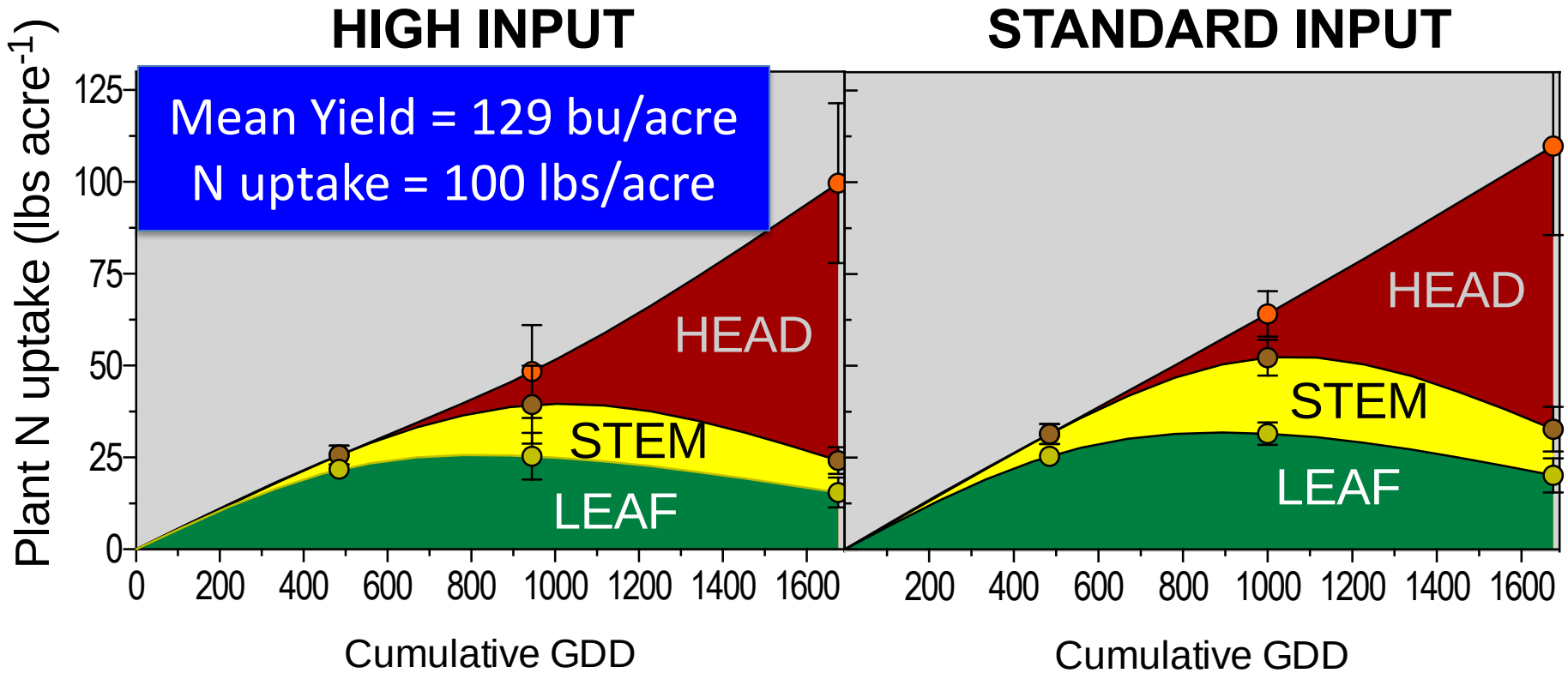
OTTAWA



Plant N uptake followed the biomass evolution with greater plant partition among all VEGETATIVE and REPRODUCTIVE fractions.

Closing Grain Sorghum Yield Gaps

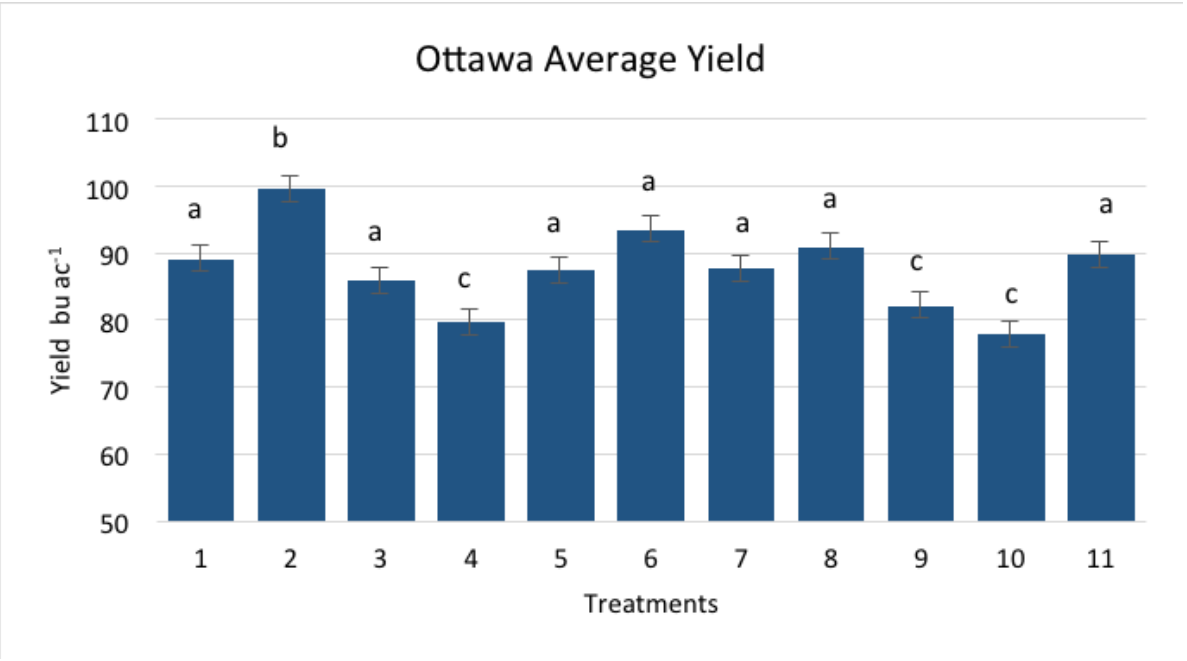
ROSSVILLE



Plant N uptake followed the biomass evolution and also mean Yield levels in each environment.

Superior yield was translated into greater N uptake.

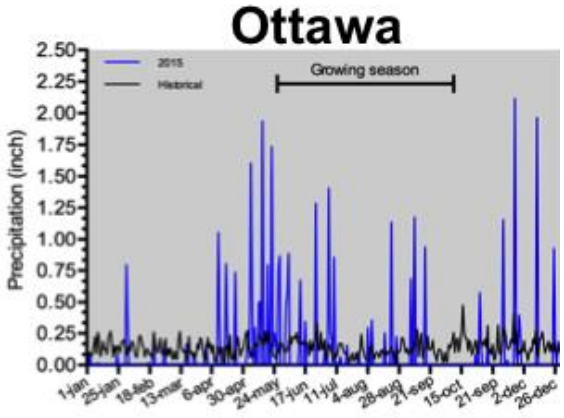
Sorghum Yield Gaps: 2015 season

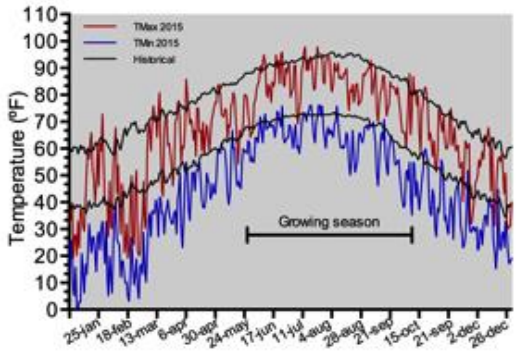


#2 = Kitchen Sink (- pop)
#10 = Standard Practice

YIELD GAP
+20 bushels per acre

MAX. YIELD #1,5, 6, 8
MIN. YIELD #4 (Pre-N), 10

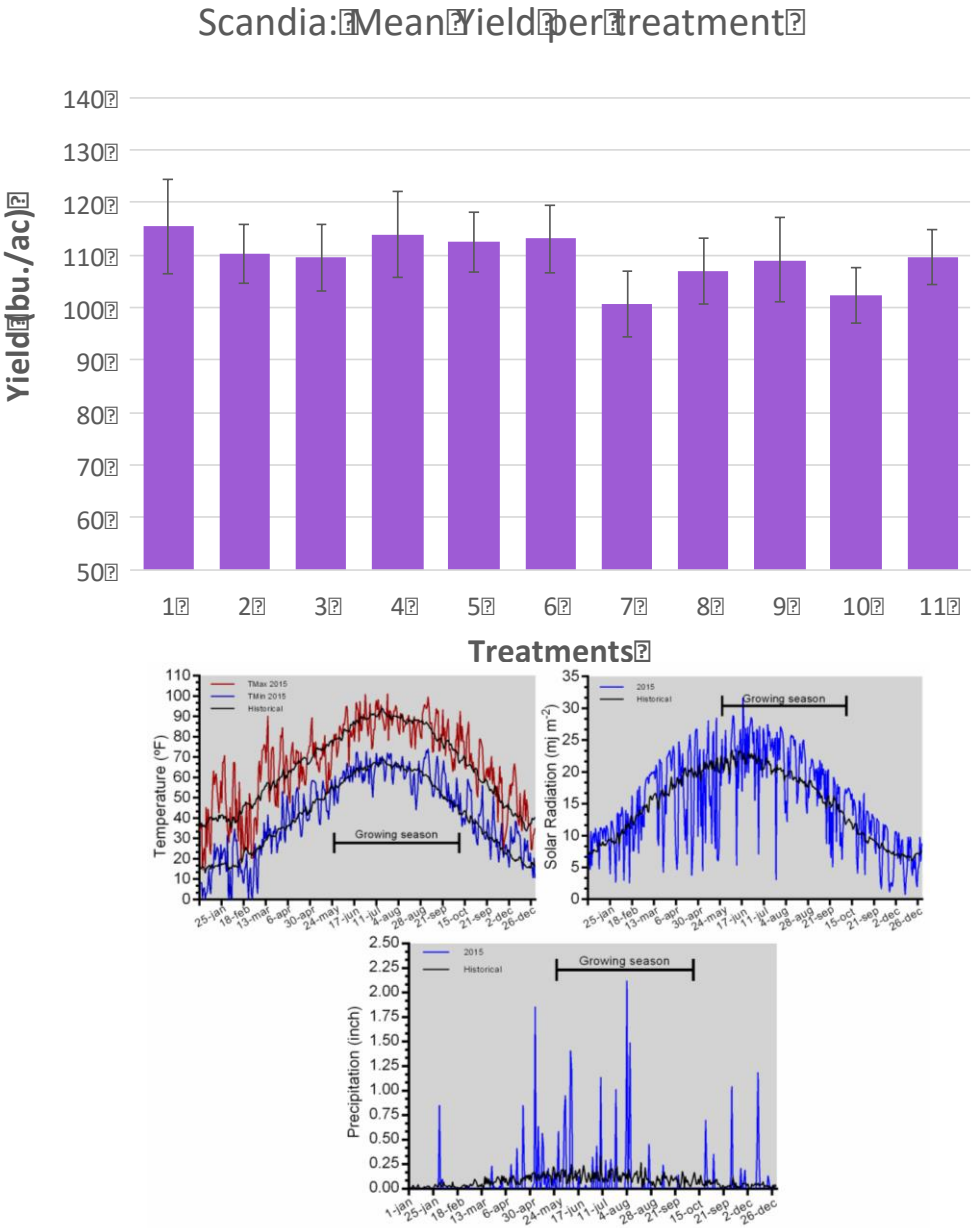




Precipitation: 10.9 inch
Irrigation: -

Total Water: 10.9 inch

Sorghum Yield Gaps: 2015 Season



#1 vs. #10

YIELD GAP

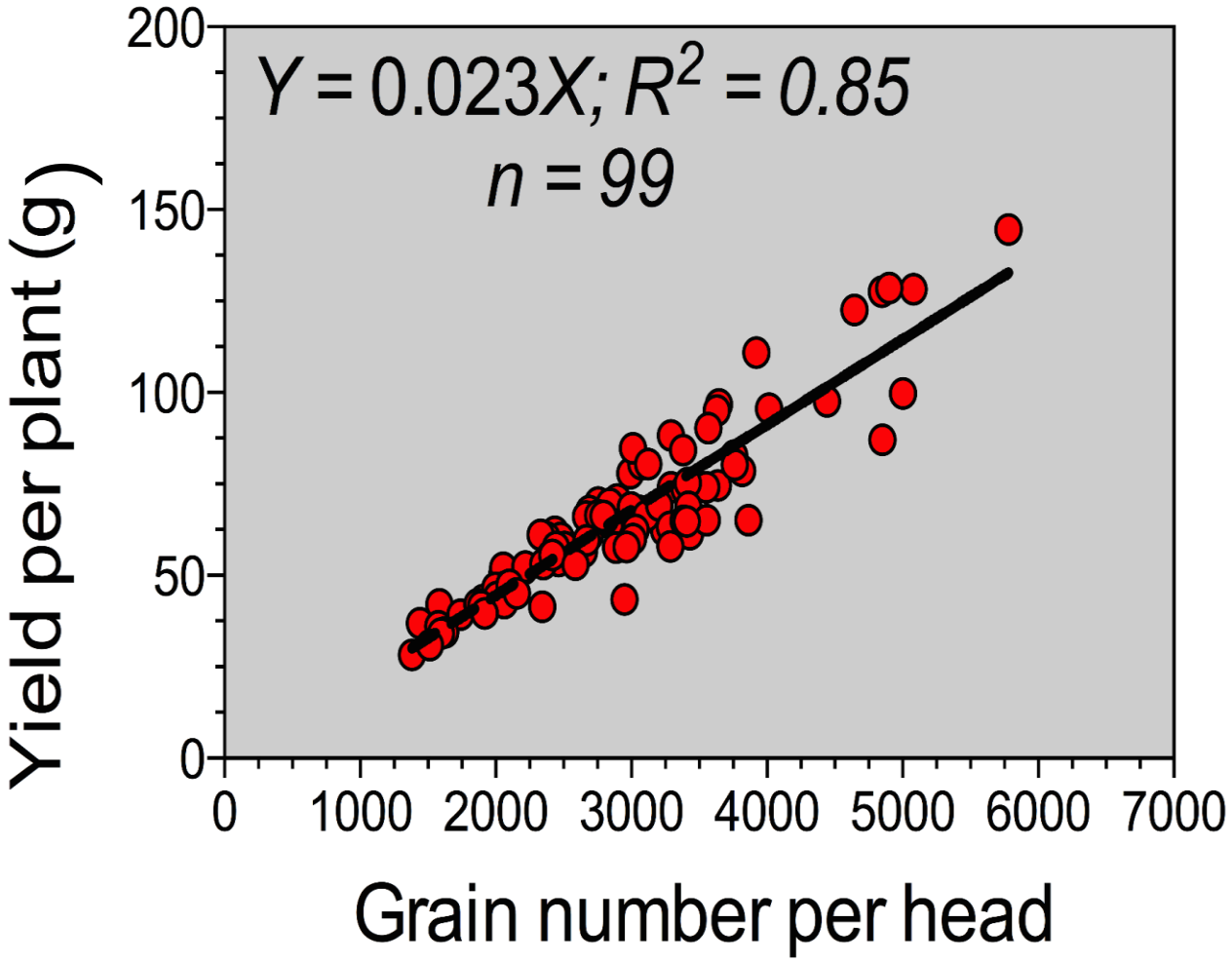
+12 bushels per acre

Under dryland conditions, Low input treatment is again out-yielded by 'Kitchen Sink' approach

Precipitation: 15 inch
Irrigation: -

Total Water: 15 inch

YIELD COMPONENTS: Grain Number Trait



Yield per plant was highly related to the final grain number per head, regardless of the treatments evaluated.

Summary

- Over both years and all sites, the standard practice (SP) treatment was generally out-yielded by the High Input (HI) approach, though it was not always statistically significant.

- During drought-stress conditions, the SP treatment yielded comparable as the HI approach.

- Under irrigation, yield variability was reduced, and more nutrients were accumulated in the grain portion at harvest time

Fluid Fertilizer Foundation

KANSAS GRAIN SORGHUM

Growers Working Together

QUESTIONS?

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