Grain Sorghum Production Management

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Northwest Research-Extension Center, Colby

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Knowledge for Life

Outline:

- Yield trends
- Sorghum Characteristics
- Planting Management
  - Row Spacing
  - Plant Population
  - Planting Date
  - Hybrid Selection
  - Tillage and Rotation Effects
  - Water use

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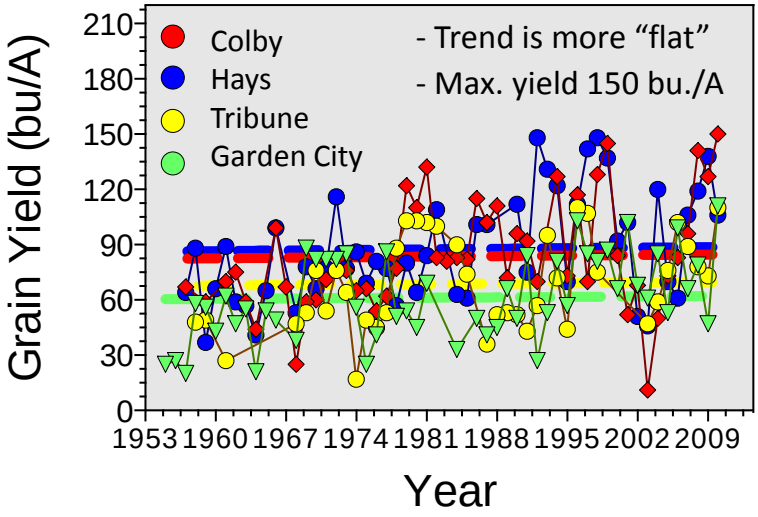
Dryland Sorghum Yields (Long-term)



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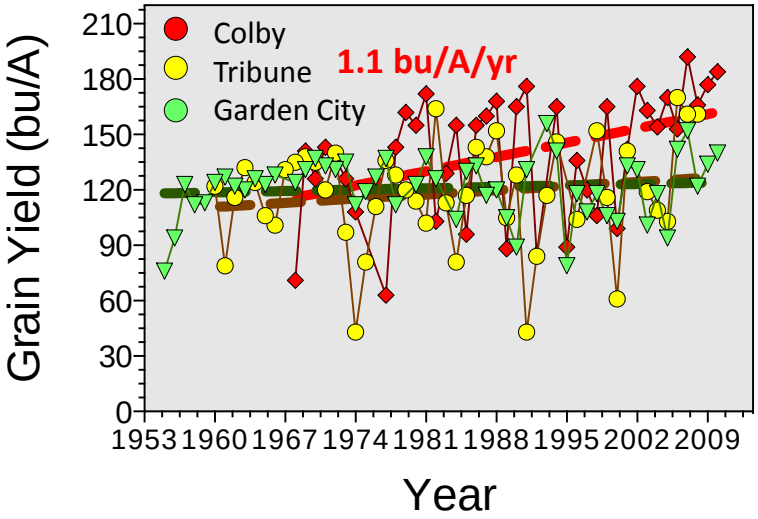
Irrigated Sorghum Yields (Long-term)



- Overall: 0.5 bu/A/yr increase
- Colby yield trend last 10-yrs

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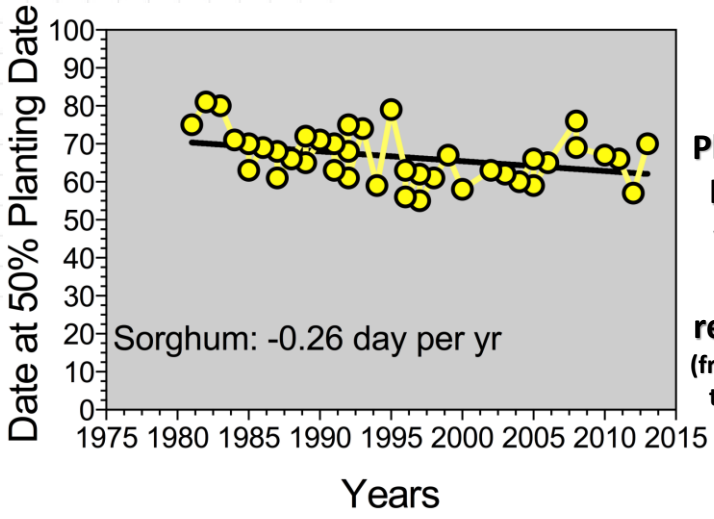
Planting Date (50%) Evolution: Sorghum in Kansas

(Sorghum – Days after March 31st)



Sorghum Planting Dates: In the last 30 yrs, planting date was reduced 8 days
(from June, 14th 1981 to May 27th 2012)

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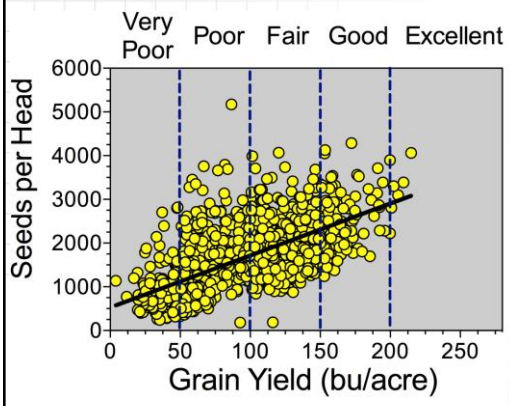
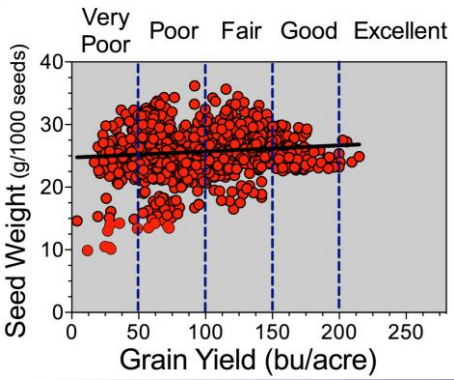
Management Practices: Understanding Sorghum Yield Components



Grain weight is slightly influencing ("flat trend") the final sorghum YIELD.

Grain number is the main YIELD component highly associated with the final sorghum YIELD.



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Sorghum and Drought

- Drought Tolerance
  - The ability to maintain growth during periods of water stress.
- Drought Avoidance
  - The ability to alter plant development or physiological processes to survive a period of water stress.

Sorghum Drought Tolerance

- 50% more stomata per in^2 of leaf than corn
- Stomata are smaller
- Extensive root system
- Small leaf:root ratio compared to other crops
- Perfect flowers
- Stay-Green Traits

Drought Avoidance

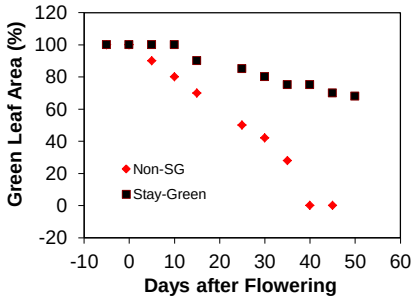
- Heavy wax layer (bloom) on leaves
- Slow/hasten maturity under stress
- Motor cells at leaf midrib to facilitate leaf curling under stress

Goal of Sorghum Production

- The primary goal of sorghum production is to minimize the damage.
  - Maximizing growing season water supply
  - Managing planting dates and maturities to minimize expected stress
  - Select hybrids that tolerate stressful conditions

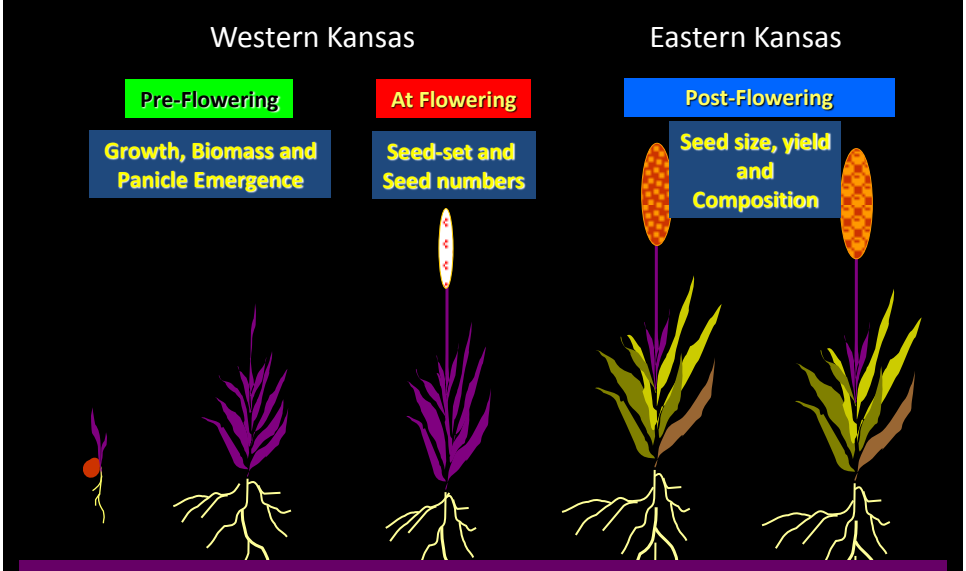
Stay-Green and Sorghum

- Delayed senescence trait
  - Results in higher SLN
  - Higher Transpiration Efficiency
  - More C & N into roots during grainfill
  - Improves yields and reduces stalk lodging in the presence of stress during grain fill.



Mahalakashimi & Bidinger Crop Sci. 42:965-974

Susceptible Stages to Drought / Heat Stress: Cereals



Reproductive stages of flowering and seed-set are most sensitive to drought and heat stress.

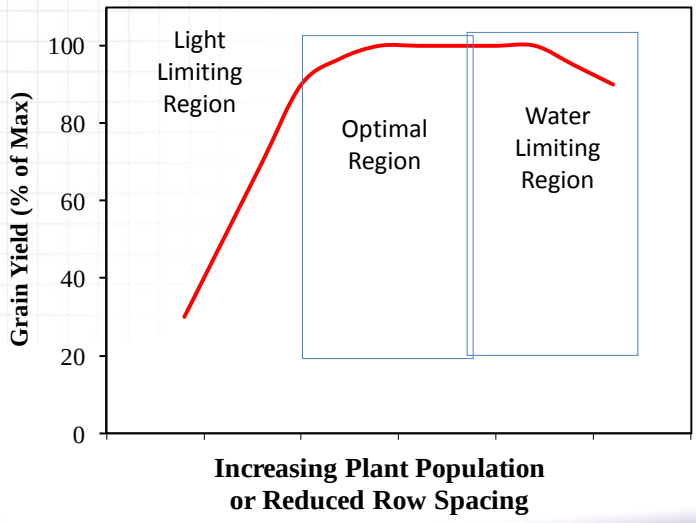
V. Prasad

Management Practices:

- Row Spacing
- Plant Population
- Planting Date
- Hybrid Selection
- Rotation effect
- Water use

Planting Geometry (Row Spacing) and Seeding Rate – Driving Factors

- What drives plant growth?
  - **Sunlight**
- What does the plant need to convert sunlight to biomass
  - **Water**
- Assuming we are doing a good job of managing other factors (fertility, pests) within the growing season we are limited by one of two things **light** or **water**.



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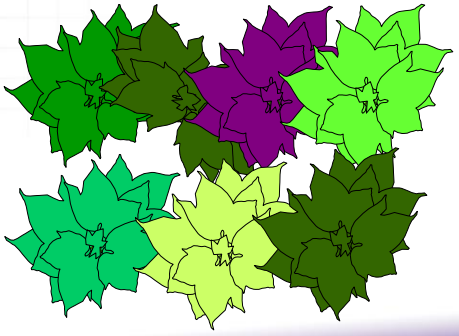
Crop Water Use

- Often thought of in a single plant frame of reference.
  - "If one plant uses 1000 g of water per day, two plants must use 2000 g of water per day."



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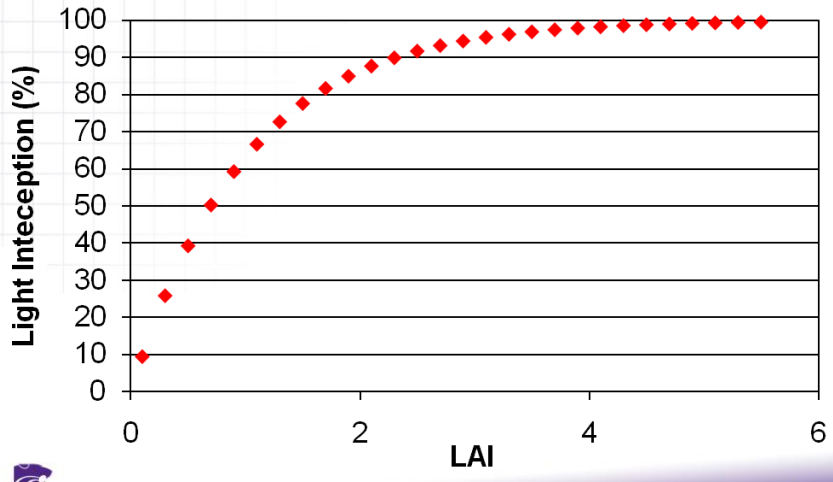
LAI and Light Interception



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Planting Geometry (Row Spacing) and Seeding Rate – Driving Factors

Water use is driven by **Light interception**

Which can be effected by **Row spacing and plant population**

Increased light interception is good if you have the water to support it

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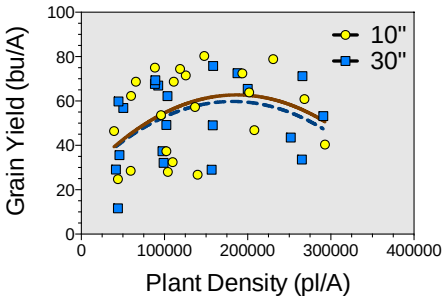
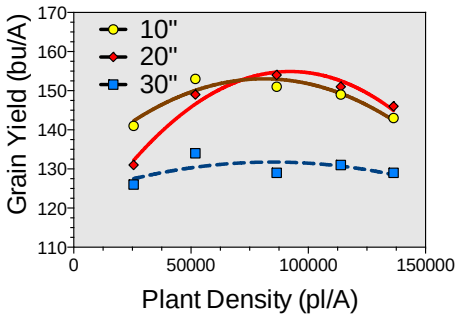
Grain Sorghum: Row Spacing x Plant Density

Narrow rows can produce greater yields at typical or greater populations in high-yield environment

Tribune & Hutchinson, 1985

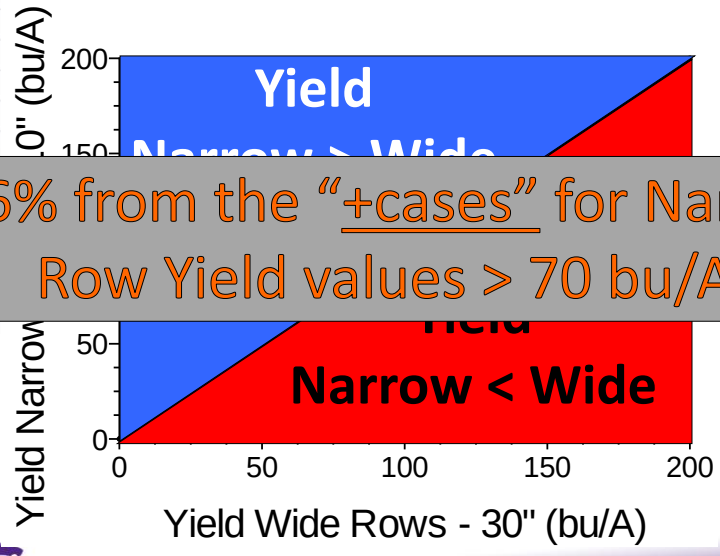


Manhattan, 2008



Under low yielding environments, the response to narrow rows under diverse population levels is similar to wide rows

Grain Sorghum Yield Response to Row Spacing



66% from the "+cases" for Narrow Row Yield values > 70 bu/A.

Planting Geometries

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Planted vs. Drilled

A.J. Foster, Southwest Area Agronomist, SWREC-Garden City
Alan Schlegel, Agronomist-in-Charge, SWREC-Tribune

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Study Setup

Study 1 : Dryland

- **Locations :** Garden City & Tribune
- **Treatments:**
  - GC- Seeding rate: drilled @ 27,000, 40,500, 54,000, 67,500, and planted @ 27,000 seeds/A; Nitrogen rate: 50, 75 , 100 lbs. N/A ; planting method : Drilled and Planted
  - Tribune - Seeding rate: drilled @ 20,000, 40,000, 60,000, 80,000, and planted @ 40,000 seeds/A; Nitrogen rate: 0, 50 , 100 lbs. N/A ; planting method : Drilled and Planted.
- **Planting date:** GC – 2 June ; Tribune -7 June
- **Variety:** DK 3707
- **Herbicide Program:** Pre-plant- Roundup, harness and Starane

Study 2: Irrigated (weed vs weed free)

- Location: Garden City
- Treatments
  - Seeding rate: 60000, 90000, 120000 lbs./A; Nitrogen Rate: 0, 100, 200 lbs./A; Weed Mgt.: half plots were managed weed free and half pigweed was allow to grow.
- Planting date: 20 June 2016
- Variety: DK 3707
- Herbicide Program: Dicamba salt DMA (8oz) + Atrazine (1pt/ac)

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Planted vs. Drilled

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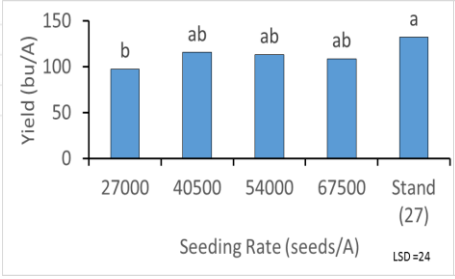
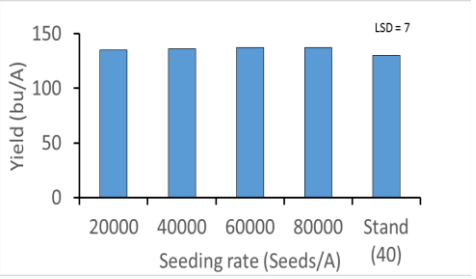
Planted vs. Drilled

Garden City



Tribune



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Weed vs Weed free

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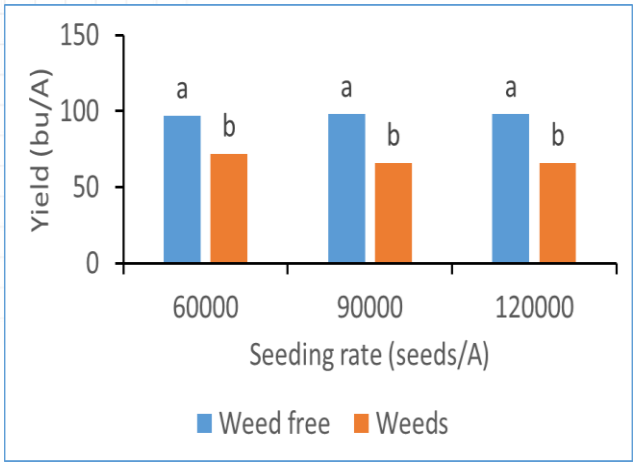
Weed vs Weed free



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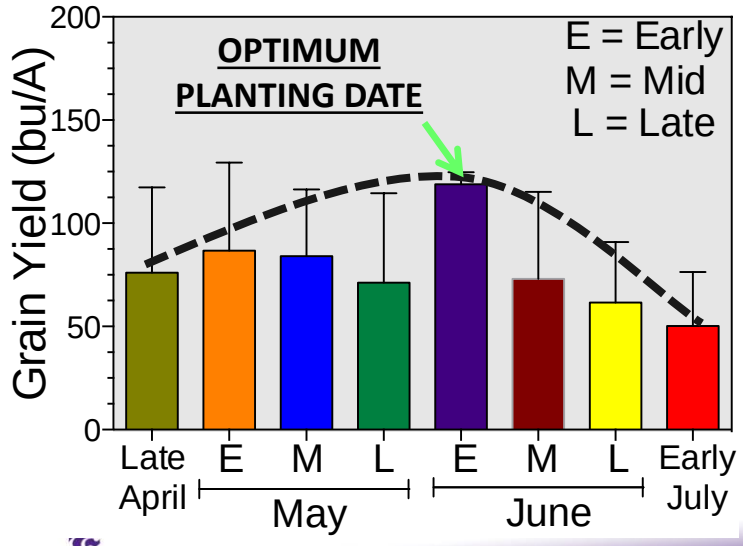
First Year Results

- Increasing sorghum population did not increase grain yield
- Field observation suggest that planting sorghum in narrow rows (<30 in.) could suppress weeds growing below the canopy.
  - This observation will be further evaluated within the irrigated weed/weed free experimental setup.

Grain Sorghum: Planting Date



This summary showed "Early June as the optimum planting date for Max. Yields.

Planting Date Revision:

Tribune/ Hutchinson/ Manhattan (Vanderlip)
Scandia 1994-1996 (Gordon)
St. John 1993-1995 (Martin & Vanderlip)
Columbus 2000/03 (Kelley)

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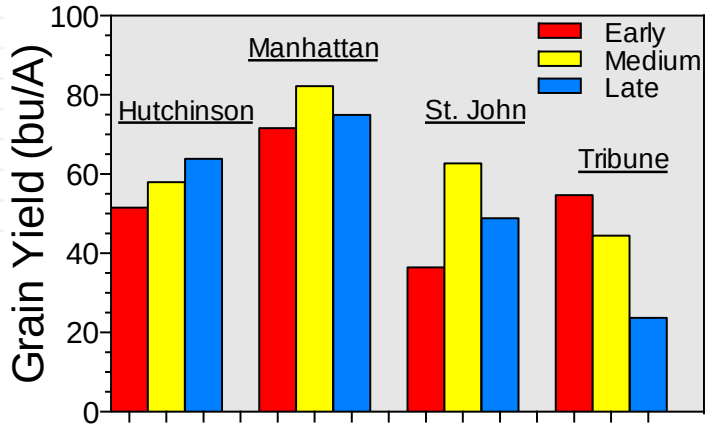
Grain Sorghum: Hybrid Selection Maturity



This summary showed the complexity of the hybrid selection. "Full (early) to medium maturity hybrids showed high yields.

Planting Date Revision:

Tribune/ Hutchinson/ Manhattan (Vanderlip)
Scandia 1994-1996 (Gordon)
St. John 1993-1995 (Martin & Vanderlip)

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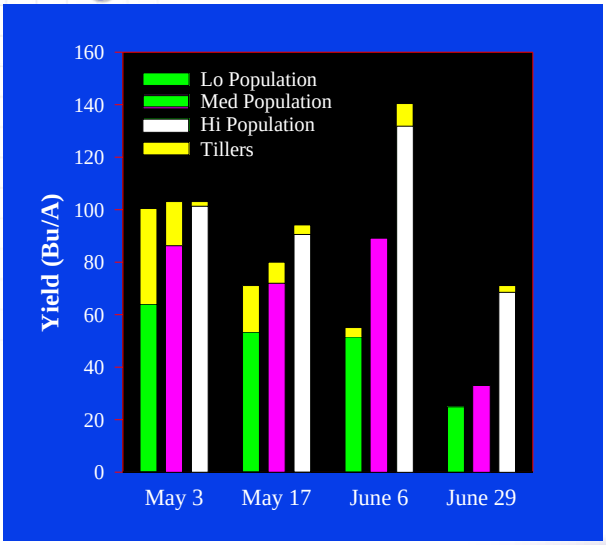
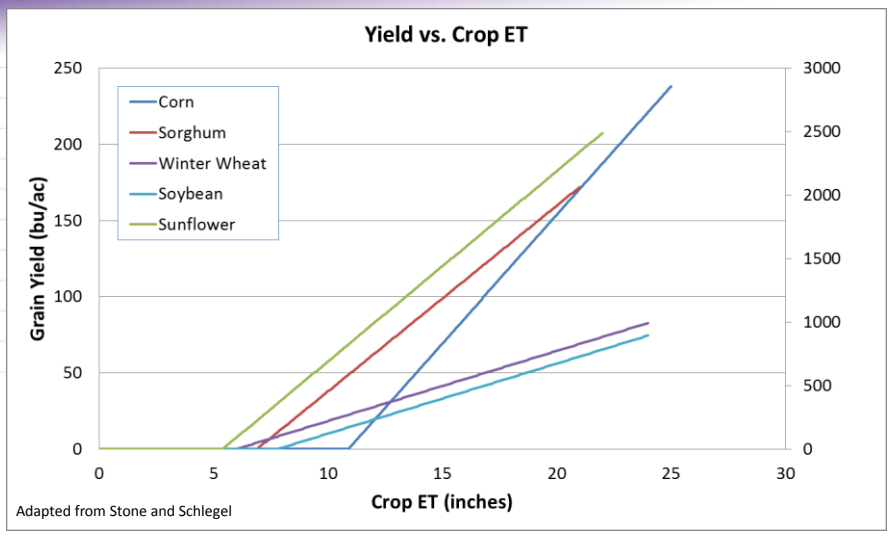
Planting Date effects on Tillering



Vanderlip, 1979

Grain Sorghum: Hybrid x Planting Date

- Plant as early as soil temperatures allow
  - Once soil temperatures reach 65° to 70° F
  - Can benefit from delayed planting into mid-June depending on year (heads and fills grain after worst of heat, catches late-summer rains)
- Plant the fullest maturity hybrid adapted to your area
  - Earlier maturing hybrids when planting is delayed into mid-June or later in W, NC KS and SC NE, late June in SC KS, July in eastern KS
  - Usually want sorghum to head
    - By early August in NW KS
    - By mid-August in SW, SC, NC, NE
    - By late August in central KS
    - By early September in SC, SE KS
- Think about next crop
  - e.g. If planting wheat immediately after sorghum…
    - Use an earlier hybrid
    - Plant earlier



Hoxie Average May, June, July, August Precip. = 11.82”
Sharon Springs Average May, June, July, August Precip. = 11.20”
Garden City Average May, June, July, August Precip. = 11.41”

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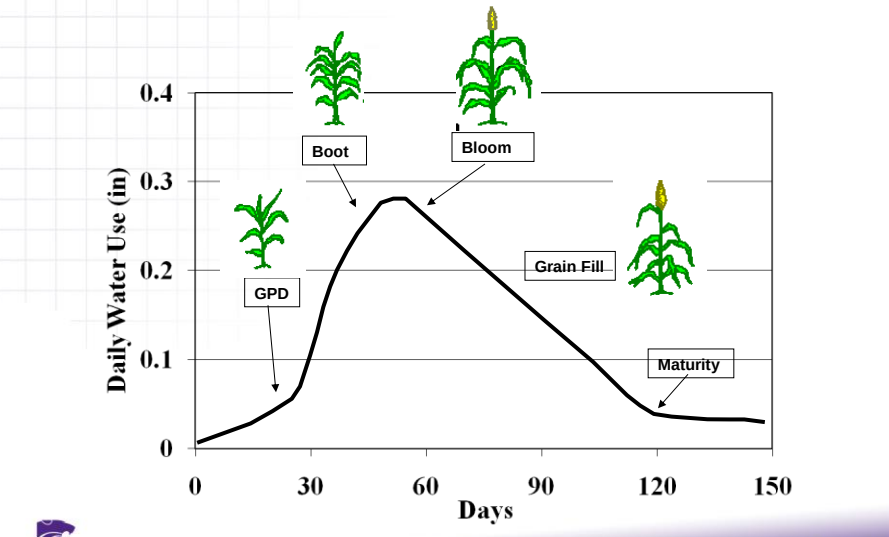

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Long-term Cropping Systems Research

Alan Schlegel
Lucas Haag
Southwest Research-Extension Center – Tribune, Kansas

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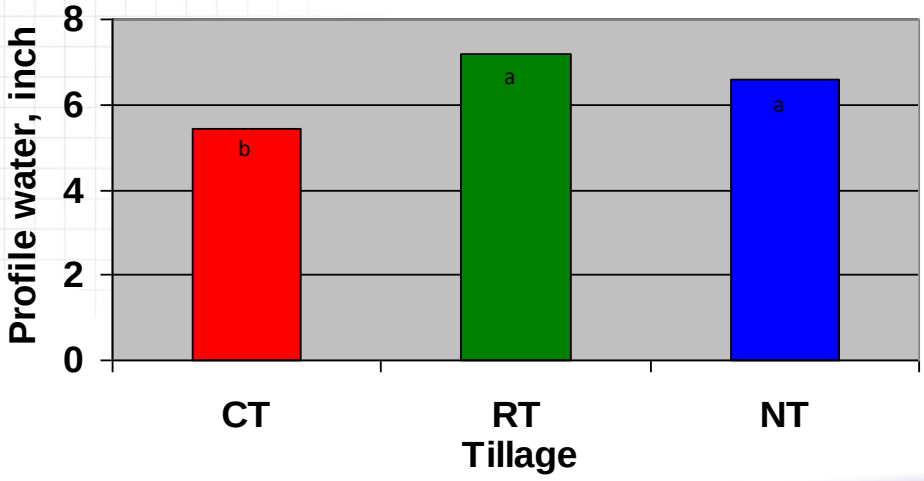
Soil Water at Sorghum Planting

WSF, Tribune, 2001-2016



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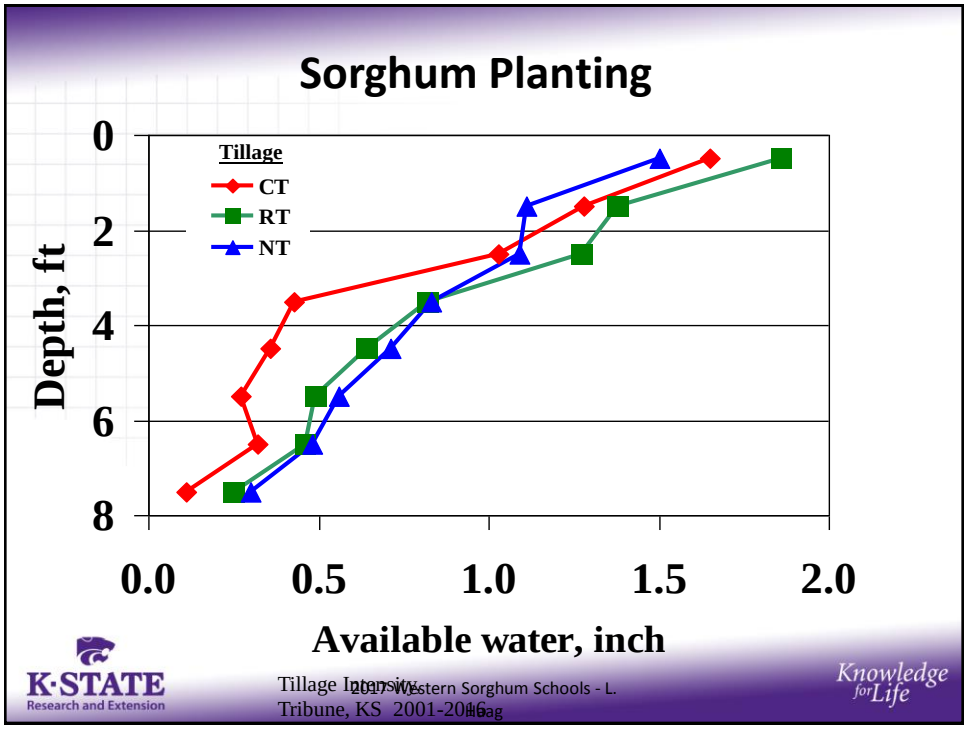
Sorghum Planting
Depth, ft
0
2
4
6
8
Tillage
CT
RT
NT
0.0
0.5
1.0
1.5
2.0
Available water, inch
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Tillage Intensity
Tribune, KS 2001-2016
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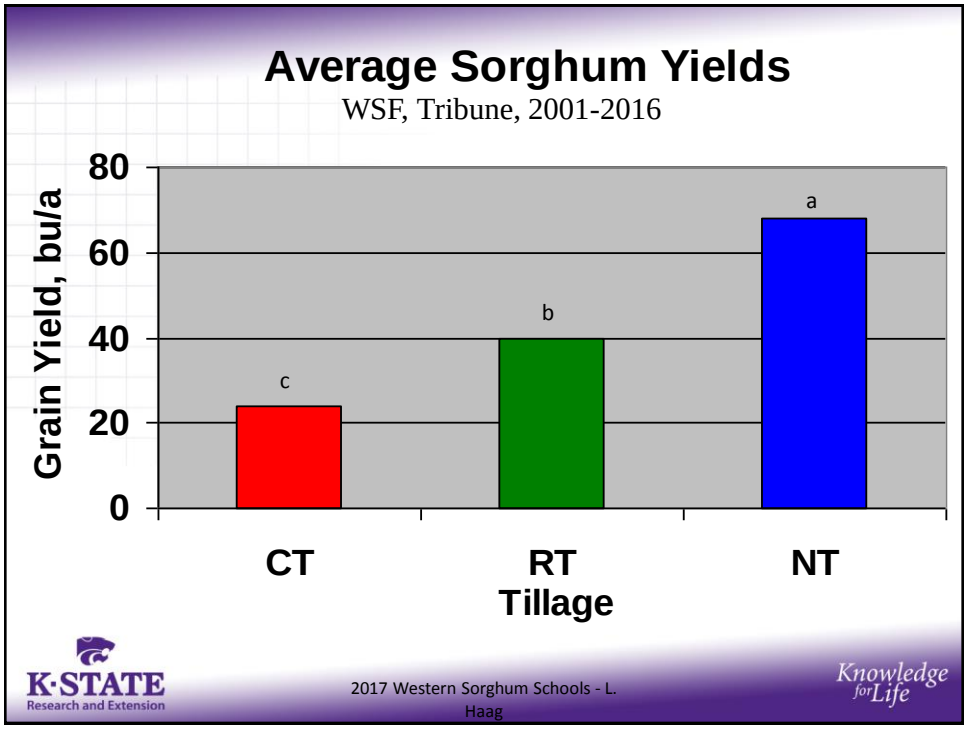
Average Sorghum Yields
WSF, Tribune, 2001-2016
Grain Yield, bu/a
80
60
40
20
0
c
b
a
CT
RT
NT
Tillage
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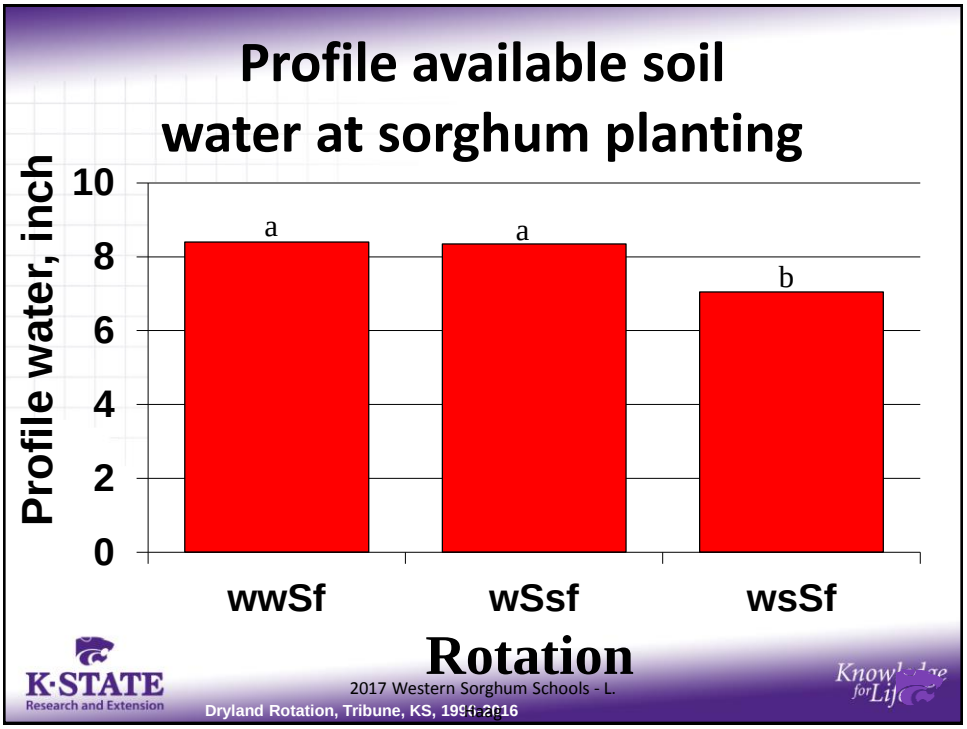
Profile available soil water at sorghum planting
Profile water, inch
10
8
6
4
2
0
a
a
b
wwSf
wSsf
wsSf
Rotation
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Dryland Rotation, Tribune, KS, 1998-2016
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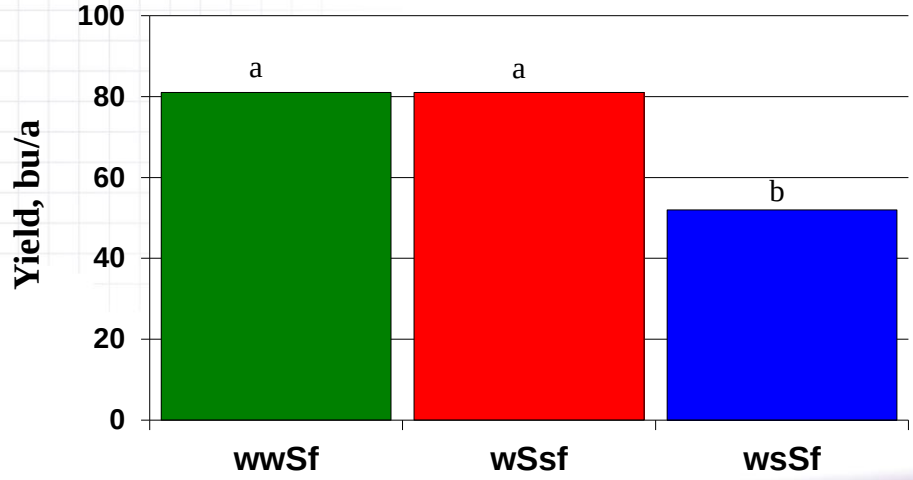
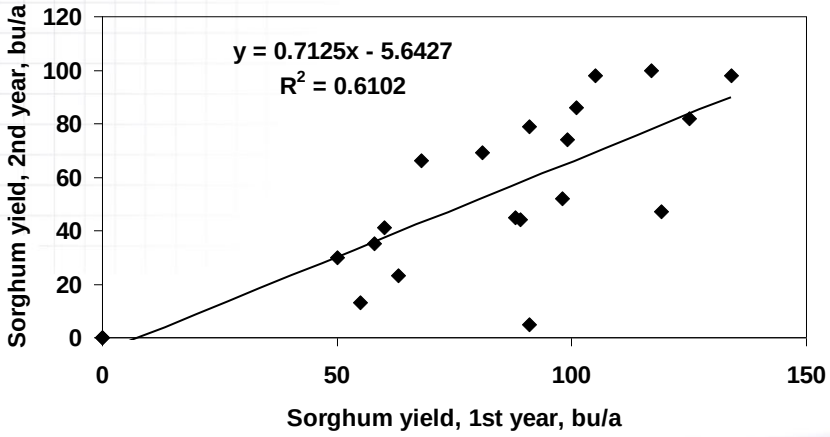
Sorghum Yield



Dryland Rotation, Tribune, KS, 1996-2016

Sorghum Yields, 1st vs 2nd year 1996-2016



OPREC Dryland Sorghum Tillage Study

Tillage	2004	2005	2006	Three-year
No-till	54.8	53.9	73.7	60.8
Strip till	44.2	46.4	51.2	44.6
Minimum till	28.0	38.3	35.6	36.7
Mean	42.3	46.2	53.5	47.4
CV %	6.4	13.6	19.0	20.1
L.S.D.	6.1	NS	24.2	9.9

Timing	2004	2005	2006	Two-year
No-till	62.5a	81.7a	80.1a	74.8a
September (fall)	47.6b	77.6a	54.1b	59.1b
March (spring)	45.5b	66.9a	56.6b	57.9b
January	42.1b			
November	37.9b			

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Dryland Strip-Till

Do the perceived benefits outweigh the known residue cost?

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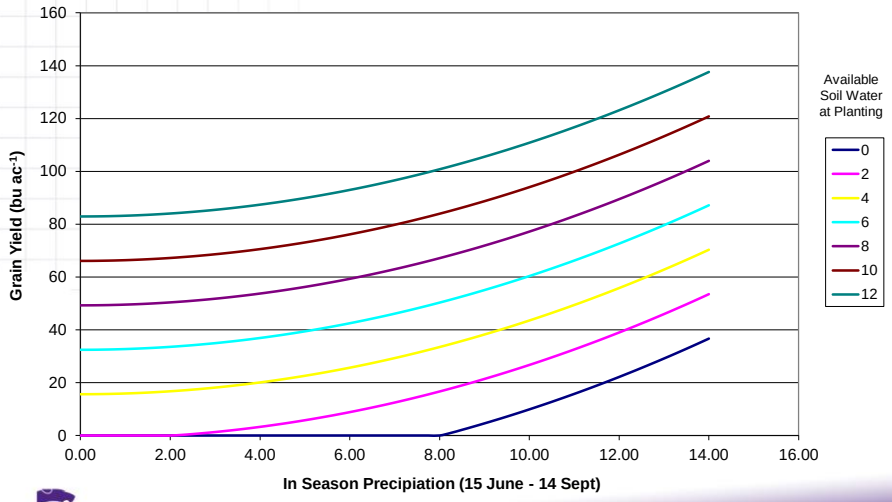
Grain Sorghum Yield associated with Water Supply Components
SWREC-Tribune 1973-2003



Adapted from Stone and Schlegel

In-Furrow Humic Acid in Grain Sorghum – Year 1

Lucas Haag, Northwest Area Agronomist, NWREC-Colby
Jeanne Falk Jones, Sunflower Dist. Agronomist
Alan Schlegel, Agronomist-in-Charge, SWREC-Tribune

Rationale

- We had received reports of in-furrow applications of humic acid reducing the occurrence of iron chlorosis

Materials and Methods

- Two Products Used
  - Raw Humic Acid (Soil Boost), 72% humic acid
  - Humic DG (The Andersons), 70% humic acid
- IDC Tolerant Hybrid, P87P06 used
- Planted in 30” rows, 45,000 seed drop
- 4 Replications per location
- 4 Locations
  - Colby, Wallace 1, Wallace2, Wallace 3

In-Furrow Rates

Product	30" Rate	Equivilent 10" Rate
	lbs/acre	
Raw Chipped Humic Acid	0	0
	10	30
	20	60
	30	90
	40	120
	70	210
Humic DG	7	21
	14	42
	21	63
	28	84
	35	105

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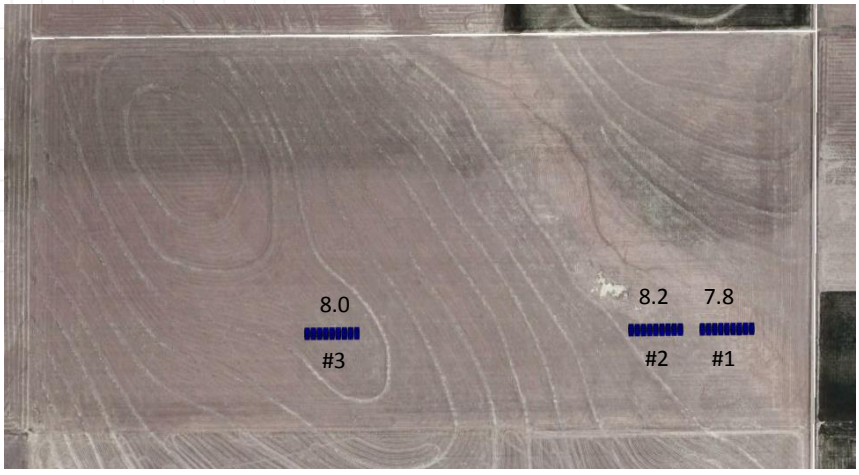
Locations - Wallace



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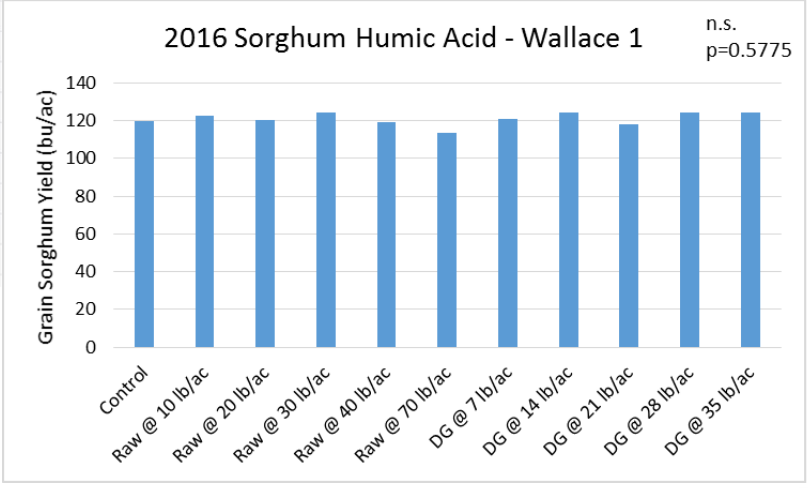
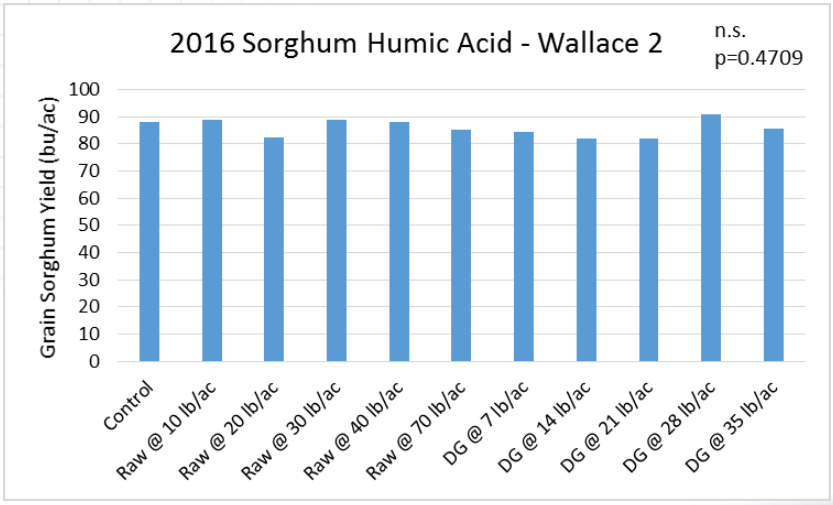
Locations - Colby

Results – Wallace 1



Results – Wallace 2



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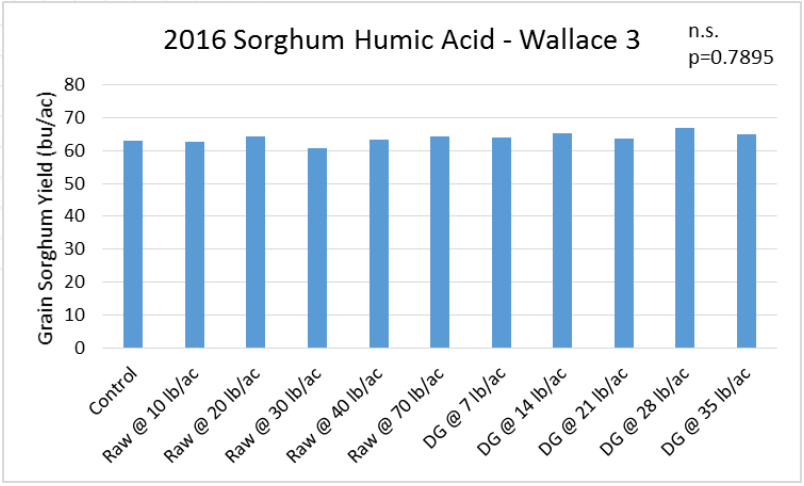
Results – Wallace 3



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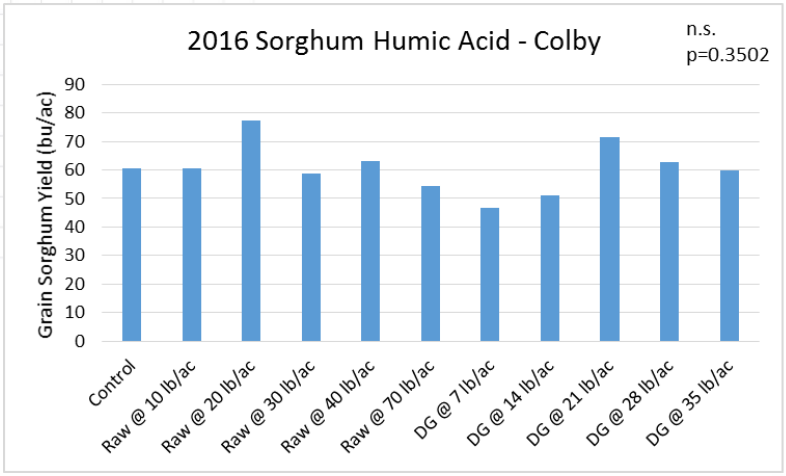
Results - Colby



Summary

- In year one of the study, across four locations, we did not see a statistical or numerical response to in-furrow applications of humic acid in grain yield or IDC score
- We are considering extending the study another year

Stanton County Clump/Conventional Sorghum, 2009. Photo by L. Haag