Grain Sorghum Production Management

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Outline:
- Yield trends
- Sorghum Characteristics
- Planting Management
  - Row Spacing
  - Plant Population
  - Planting Date
  - Hybrid Selection
  - Tillage and Rotation Effects
  - Water use
Dryland Sorghum Yields (Long-term)

- Trend is more “flat”
- Max. yield 150 bu./A

Irrigated Sorghum Yields (Long-term)

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

Management Practices:
Understanding Sorghum Yield Components

- Grain number is the main YIELD component highly associated with the final sorghum YIELD.
- Grain weight is slightly influencing (“flat trend”) the final sorghum YIELD.
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.

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Sorghum Drought Tolerance

• 50% more stomata per in² of leaf than corn
• Stomata are smaller
• Extensive root system
• Small leaf:root ratio compared to other crops
• Perfect flowers
• Stay-Green Traits

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Drought Avoidance

• Heavy wax layer (bloom) on leaves

• Slow/hasten maturity under stress

• Motor cells at leaf midrib to facilitate leaf curling under stress

Management Practices:

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

Grain Sorghum Yield Response to Row Spacing

Yield

Narrow > Wide

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

Narrow < Wide

Yield Wide Rows - 30" (bu/A)

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

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)
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
Long-term Cropping Systems Research

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

Soil Water at Sorghum Planting

WSF, Tribune, 2001-2016

Profile water, inch

CT  |  RT  |  NT
---  |  ---  |  ---
2   |  6   |  6
4   |  a   |  a
8   |  b   |  a

Tillage
Average Sorghum Yields
WSF, Tribune, 2001-2016

Grain Yield, bu/a

CT  RT  NT
Tillage

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What About Re-Cropping?

Available Soil Water at Sorghum Planting
Tribune, Kansas 1999-2008

Error bars represent LSD (0.05) within a depth
## Row crop yields as affected by rotation

**Tribune, Kansas 1998-2009**

<table>
<thead>
<tr>
<th>Crop</th>
<th>Rotation</th>
<th>Row-Crop Grain Yield</th>
<th>Subsequent Wheat Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain Sorghum</td>
<td></td>
<td>bu ac¹</td>
<td>bu ac¹</td>
</tr>
<tr>
<td></td>
<td>w-S-f</td>
<td>60.0 a⁺</td>
<td>30.4 a</td>
</tr>
<tr>
<td></td>
<td>w-c-S-f</td>
<td>35.1 b</td>
<td>26.5 a</td>
</tr>
<tr>
<td>Sunflowers</td>
<td></td>
<td>lbs ac⁻¹</td>
<td></td>
</tr>
<tr>
<td></td>
<td>w-SF-f</td>
<td>646.2 ns</td>
<td>19.9 b</td>
</tr>
<tr>
<td></td>
<td>w-c-SF-f</td>
<td>630.5 ns</td>
<td>19.4 b</td>
</tr>
<tr>
<td>Corn</td>
<td></td>
<td>bu ac⁻¹</td>
<td></td>
</tr>
<tr>
<td></td>
<td>w-C-sb-f</td>
<td>35.9 ns</td>
<td>28.6 a</td>
</tr>
<tr>
<td></td>
<td>w-C-s-f</td>
<td>35.9 ns</td>
<td>26.5 a</td>
</tr>
<tr>
<td></td>
<td>w-C-sf-f</td>
<td>32.4 ns</td>
<td>19.4 b</td>
</tr>
<tr>
<td></td>
<td>w-C-f (WP)</td>
<td>50.5 ‡</td>
<td></td>
</tr>
<tr>
<td></td>
<td>w-C-f (KDWP)</td>
<td>51.2 #</td>
<td></td>
</tr>
</tbody>
</table>

† Letters within a crop and column represent differences at LSD (0.05)
‡ WP w-C-f yields are average of like crop sequences in WP study 1998-2002
# KDWP w-C-f yields are average of an adjacent study 2001-2006

## Profile available soil water at sorghum planting

**Rotation**

- **wwSf**
- **wSsf**
- **wsSf**

<table>
<thead>
<tr>
<th>Profile water, inch</th>
<th>a</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profile water, inch</td>
<td>0</td>
<td>10</td>
</tr>
</tbody>
</table>

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Sorghum Yield

Rotation

Dryland Rotation, Tribune, KS, 1996-2016

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

y = 0.7125x - 5.6427
R² = 0.6102
OPREC Dryland Sorghum Tillage Study

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

<table>
<thead>
<tr>
<th>Timing</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>Two-year</th>
</tr>
</thead>
<tbody>
<tr>
<td>No-till</td>
<td>62.5a</td>
<td>81.7a</td>
<td>80.1a</td>
<td>74.8a</td>
</tr>
<tr>
<td>September (fall)</td>
<td>47.6b</td>
<td>77.6a</td>
<td>54.1b</td>
<td>59.1b</td>
</tr>
<tr>
<td>March (spring)</td>
<td>45.5b</td>
<td>66.9a</td>
<td>56.6b</td>
<td>57.9b</td>
</tr>
<tr>
<td>January</td>
<td>42.1b</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>November</td>
<td>37.9b</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Dryland Strip-Till
Do the perceived benefits outweigh the known residue cost?
TRIBUNE 1974-2004

\[ Y = -27.3 + 3.78X \]

\( n = 253 \quad r^2 = 0.638 \quad \text{RMSE} = 10.7 \quad P<0.0001 \)

WATER SUPPLY: ASW + PRECIP. (in.)

WHEAT GRAIN (bu/acre)

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

Grain Yield (bu/ac)

In Season Precipitation (15 June - 14 Sept)

Available Soil Water at Planting

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, Wallace 2, Wallace 3

In-Furrow Rates

<table>
<thead>
<tr>
<th>Product</th>
<th>30” Rate</th>
<th>Equivalent 10” Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Chipped Humic Acid</td>
<td></td>
<td>lbs/acre</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>210</td>
<td></td>
</tr>
<tr>
<td>Humic DG</td>
<td>7</td>
<td>21</td>
</tr>
<tr>
<td>14</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>63</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>105</td>
<td></td>
</tr>
</tbody>
</table>
**Results – Wallace 1**

2016 Sorghum Humic Acid - Wallace 1

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Grain Sorghum Yield (bu/ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>120</td>
</tr>
<tr>
<td>Raw @ 10 lb/ac</td>
<td>115</td>
</tr>
<tr>
<td>Raw @ 20 lb/ac</td>
<td>112</td>
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<tr>
<td>Raw @ 30 lb/ac</td>
<td>110</td>
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<tr>
<td>Raw @ 40 lb/ac</td>
<td>108</td>
</tr>
<tr>
<td>Raw @ 70 lb/ac</td>
<td>106</td>
</tr>
<tr>
<td>DG @ 7 lb/ac</td>
<td>104</td>
</tr>
<tr>
<td>DG @ 14 lb/ac</td>
<td>102</td>
</tr>
<tr>
<td>DG @ 21 lb/ac</td>
<td>100</td>
</tr>
<tr>
<td>DG @ 28 lb/ac</td>
<td>98</td>
</tr>
<tr>
<td>DG @ 35 lb/ac</td>
<td>96</td>
</tr>
</tbody>
</table>

n.s.  
p = 0.5775

**Results – Wallace 2**

2016 Sorghum Humic Acid - Wallace 2

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Grain Sorghum Yield (bu/ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>90</td>
</tr>
<tr>
<td>Raw @ 10 lb/ac</td>
<td>88</td>
</tr>
<tr>
<td>Raw @ 20 lb/ac</td>
<td>86</td>
</tr>
<tr>
<td>Raw @ 30 lb/ac</td>
<td>84</td>
</tr>
<tr>
<td>Raw @ 40 lb/ac</td>
<td>82</td>
</tr>
<tr>
<td>Raw @ 70 lb/ac</td>
<td>80</td>
</tr>
<tr>
<td>DG @ 7 lb/ac</td>
<td>78</td>
</tr>
<tr>
<td>DG @ 14 lb/ac</td>
<td>76</td>
</tr>
<tr>
<td>DG @ 21 lb/ac</td>
<td>74</td>
</tr>
<tr>
<td>DG @ 28 lb/ac</td>
<td>72</td>
</tr>
<tr>
<td>DG @ 35 lb/ac</td>
<td>70</td>
</tr>
</tbody>
</table>

n.s.  
p = 0.4709
Results – Wallace 3

2016 Sorghum Humic Acid - Wallace 3

- Control
- Raw @ 10 lb/ac
- Raw @ 20 lb/ac
- Raw @ 30 lb/ac
- Raw @ 40 lb/ac
- Raw @ 70 lb/ac
- DG @ 10 lb/ac
- DG @ 14 lb/ac
- DG @ 21 lb/ac
- DG @ 28 lb/ac
- DG @ 35 lb/ac

n.s. p=0.7895

Results - Colby

2016 Sorghum Humic Acid - Colby

- Control
- Raw @ 10 lb/ac
- Raw @ 30 lb/ac
- Raw @ 40 lb/ac
- Raw @ 70 lb/ac
- DG @ 7 lb/ac
- DG @ 10 lb/ac
- DG @ 21 lb/ac
- DG @ 28 lb/ac
- DG @ 35 lb/ac

n.s. p=0.3502
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

Questions?