Adapting to a Changing Climate: Forages for Drought Prone Conditions

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Atmospheric CO2 Levels

For 650,000 years, atmospheric CO2 has never been above this line... until now.

Drought in Mid-Atlantic Region

- Records indicate (Dickerson and Dethier, 1970)
  - Moderate drought one out of five years
  - Severe drought one out of ten years
- Always seems to be a surprise
- Need to manage forage production systems for drought everyday
- Every farm needs a drought plan

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**Topic Outline**

I. Photosynthetic pathways
II. Summer annual variety testing in VA
III. Crabgrass for summer grazing
IV. Forage sorghum as silage
V. Discussion
Cool- and Warm-Season Grasses

- **Cool-Season Grasses: C3**
  - optimal growth at cooler temps (70 F)
  - more digestible and higher in CP
  - longer growing season
- **Warm-Season Grasses: C4**
  - optimal growth at higher temps (90 F)
  - less digestible and lower in CP
  - more drought tolerant
  - more efficient at using water

Growth Curves for Common Forages

Adapted from Controlled Grazing of Virginia's Pastures, Publication 418-012
Summer Annual Variety Trial

• Conducting trials since early 2000s
• Recently evaluating digestibility
• Sorghum-Sudangrass, sudangrass, forage sorghum, and pearl millet
• 75 lb N/A at seeding and 60 lb N/A after each harvest
# First Harvest-SAVT 2009

<table>
<thead>
<tr>
<th>Variety</th>
<th>Species</th>
<th>BMR</th>
<th>Yield (lb DM/A)</th>
<th>IVTD (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canex</td>
<td>FS</td>
<td>Yes</td>
<td>6848</td>
<td>74</td>
</tr>
<tr>
<td>XtraGraze</td>
<td>SS</td>
<td>Yes</td>
<td>5277</td>
<td>68</td>
</tr>
<tr>
<td>Haymaster2</td>
<td>SG</td>
<td>Yes</td>
<td>4390</td>
<td>64</td>
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<tr>
<td>SS501</td>
<td>PM</td>
<td>No</td>
<td>4820</td>
<td>54</td>
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<tr>
<td>Hayking</td>
<td>SG</td>
<td>Yes</td>
<td>4524</td>
<td>58</td>
</tr>
<tr>
<td>Promax</td>
<td>SG</td>
<td>Yes</td>
<td>3765</td>
<td>64</td>
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</tbody>
</table>

**LSD (0.10)**

<table>
<thead>
<tr>
<th>Yield (lb DM/A)</th>
<th>IVTD (%)</th>
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<tbody>
<tr>
<td>1061</td>
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</table>

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# Yield and Digestibility-2009

**Summer Annual Variety Trial 2009**

<table>
<thead>
<tr>
<th>Yield (lb DM/A)</th>
<th>IVTD (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5000</td>
<td>58</td>
</tr>
<tr>
<td>6000</td>
<td>60</td>
</tr>
<tr>
<td>7000</td>
<td>62</td>
</tr>
<tr>
<td>8000</td>
<td>64</td>
</tr>
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</table>

**In Vitro True Digestibility (%)**

![Graph showing the relationship between yield and digestibility]
Impact of BMR Trait-2009

![Bar chart showing BMR and Non-BMR In Vitro True Digestibility]

- BMR: 53 to 77%
- Non-BMR: 58 to 72%

Impact of BMR Gene-2009

![Bar chart showing In Vitro True Digestibility for different genes]

- Gene BMR-6: 66%
- Gene BMR-12: 68%
- Gene BMR-18: 70%
- Gene Non-BMR: 64%
Range of Means within Gene

<table>
<thead>
<tr>
<th>Gene</th>
<th>IVTD Range</th>
<th>Varieties</th>
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</thead>
<tbody>
<tr>
<td>Non-BMR</td>
<td>63-68</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>65-72</td>
<td>8</td>
</tr>
<tr>
<td>12</td>
<td>58-75</td>
<td>4</td>
</tr>
<tr>
<td>18</td>
<td>66-74</td>
<td>2</td>
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</table>

Yield and Digestibility-2009

Summer Annual Variety Trial 2009

![Graph showing yield and digestibility differences](image)
**Variety Performance**

- Above average yield and digestibility for both 2009 and 2010
  - Xtragraze, SS, BMR-6, Evergreen Seed
  - AS9301 or SS140, SG, BMR-6, Advanta Seed
  - AS6501, SS, BMR-6, Advanta Seed
  - 22050, SS, BMR-6, Advanta Seed

**Variety Performance**

- Above average yield and digestibility for both 2009, 2010, and 2011
  - AS9301 or SS140, SG, BMR-6, Advanta Seed
  - AS6501, SS, BMR-6, Advanta Seed
Summary and Recommendations

• BMR trait increased digestibility
• No single BMR gene appeared to be superior
• Range in digestibility was great within both BMR trait and BMR gene
• Need to consider both yield and digestibility when selecting or recommending varieties

Crabgrass

• Well adapted to mid-Atlantic region
• Annual that acts like a perennial
  – Self-reseeding
• Double cropped
  – Winter annual
• Good yield potential
• Excellent forage quality
  – Higher than bermudagrass
• No prussic acid
• Can accumulate nitrates
Red River Crabgrass

First Harvest in 2001
(60 days after seeding)

Nitrogen Rate: Total Seasonal Yield

\[ y = 3940 + 32.93x - 0.0539x^2 \]

\[ r^2 = 0.70 \quad P < 0.0001 \]

305 lb N/acre
Forage Quality

- In Vitro Digestibility
  - 75 to 90% (Teutsch et al., 2005)

- Crude Protein
  - 6 to 14% (Teutsch et al., 2005)
  - Increased with nitrogen fertilization

- Average Daily Gain (Dalrymple, 1994)
  - Poor to fair quality crabgrass: 0.6 to 1.5 lb/day
  - Medium quality crabgrass: 1.85
  - Excellent quality crabgrass: 2.35
  - Bermudagrass: 1lb/day, Crabgrass: 1.75 lb/day

Summer Annuals

- Supply forage during summer deficit periods

- Opportunities
  - fast germination and emergence
  - rapid growth
  - high productivity and quality
  - flexibility of utilization

- Challenges
  - Annual establishment cost?
  - increased risk of stand failures
  - Limited growth due to drought
Summer Annuals

• Supply forage during summer deficit periods

Profitable grazing systems will be based on well adapted perennial sods that are supplemented with annuals.

– Annual establishment cost
• increased risk of stand failures
  – Limited growth due to drought

Drought Corn/Sorghum
Materials and Methods

- Corn planted and forage sorghum alone or in a mixture in late May
  - 2, 4, 6, and 8 lb forage sorghum/A
  - BMR dwarf forage sorghum
- 100 lb N/A at seeding
- Harvested at soft stage

Summer of 2010
Summer 2010

Corn and Forage Sorghum-2010

Adjusted Yield (lb/A at 35% DM)

- Corn Alone
- Corn + 2 lb/A Forage Sorghum
- Corn + 4 lb/A Forage Sorghum
- Corn + 6 lb/A Forage Sorghum
- Corn + 8 lb/A Forage Sorghum
- Forage Sorghum Alone

2010

- Corn Alone
- Corn + 2 lb/A Forage Sorghum
- Corn + 4 lb/A Forage Sorghum
- Corn + 6 lb/A Forage Sorghum
- Corn + 8 lb/A Forage Sorghum
- Forage Sorghum Alone

Adjusted Yield (lb/A at 35% DM)
Corn and Forage Sorghum-2011

2011 Forage Sorghum Variety Trial
Adjusted Silage Yield in 2012

Plant Yield Components in 2012
Seeding Rate Averaged Over N Rate Study

Average yield for VA State Corn Silage Variety Trial, Blackstone location.
Drought Stressed Corn in 2011

N Rate Averaged Over Seeding Rate

Average yield for VA State Corn Silage Variety Trial, Blackstone location
Where does forage sorghum fit into silage production systems?

- NOT going to replace corn!!!
- Best fit on droughty soils that are marginal for corn silage production
- Geographic areas that are prone to drought?
- Delayed or late silage plantings
- Rotation with corn for Johnsongrass control