Optimizing forage and grain value of Kernza in polycultures

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Kernza intermediate wheatgrass
Perennial polycultures

![Graphs showing forage yield (tons ha⁻¹) vs. seeded species richness.](Boone, Two cuts)

Seeded species richness

<table>
<thead>
<tr>
<th>Forage yield (tons ha⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
</tbody>
</table>

- With wheatgrass
- No wheatgrass

**Boone, One cut**

**Boone, Three cuts**

**Picasso et al., 2008**

![Botanical illustrations.](a, b, c)

**Crews et al., 2016**
Kernza – polyculture in the mainstream landscape

- What do Kernza farmers say?
- Dual use: grain and forage
  - What is the forage nutritive value?
  - Grazing impacts on grain yield?
  - Can cattle be fed Kernza crop residue?
- Intercropping with legumes
  - Which legume species?
  - Which varieties?
  - Which management?
Farmer Perspectives on Growing Kernza

- 10 semi-structured, on-farm interviews with Kernza growers
- Summer 2017, U.S Midwest (MN, WI, IA, IL, OH)
- Ages: 30 to 80 years old
- Crops: Diversified row crops, some w/ livestock, some grass seed
- 4 Organic, 3 Conventional (except Kernza), 3 Mixed
- Farm acreage: 160 to 10,000; Kernza acreage: 1 to 38
- Kernza start date: Fall 2011 to fall 2016

Lanker et al., in review
Motivations - “I guess I was just interested in something new, looking to try something different.”

- Sense of innovation
- Personal connection to Kernza social network
- Environmental consciousness
- Interest in niche markets
- Some level of criticism of the dominant system

Management - “we don’t know much about the management.”

- Lack of agronomic management information
- Planting: diverse methods, late dates
- Harvest grain: 3 Combine, 4 swathing
- Limited inputs (some fertilizer)
- Weeds: perennials; Cutting/mowing

Lanker et al., in review
Farmers’ questions and challenges

- **Establishment (seeding, density, spacing)**
  - “nobody knows much about how to establish this.”
- **What’s a ‘good stand’**
  - ‘Should I terminate this? Is this an adequate stand?’
- **Obtaining seed on time**
  - “the seed not coming ‘til late. Just everything happened too late....”
- **Forage value**
  - “If I had cattle and I could feed it ...”
- **Weed management**
  - “pretty much squeezes everything else out.”
  - “quickly become a weedy mess.”
- **How to keep Kernza productive over years**
  - “it became sodbound”
- **Economics, processing & markets**
  - “what would the market price for it be right now?”

Lanker et al., in review
Forage value of Kernza intermediate wheatgrass in monoculture vs mixture with red clover

- Lancaster, WI, USA
- Arlington, WI, USA
- First production year
Dual-use management

Spring forage harvest  Grain/straw harvest  Fall forage harvest

Vegetation

1. Kernza monoculture
2. Kernza – red clover

Sampling: Quadrat harvest at the soil level
Forage and grain yields – 1st year, Wi

Favre et al., in review
## Forage nutritive value – 1st year, Wi

<table>
<thead>
<tr>
<th>Material</th>
<th>Season</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Spring</td>
<td>Summer</td>
<td>Fall</td>
<td></td>
</tr>
<tr>
<td><strong>NDF (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IWG monoculture</td>
<td>46 ef</td>
<td>70 ab</td>
<td>59 cd</td>
<td></td>
</tr>
<tr>
<td>IWG/clover mixture</td>
<td>-</td>
<td>64 bc</td>
<td>44 f</td>
<td></td>
</tr>
<tr>
<td><strong>ADF (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IWG monoculture</td>
<td>25 d</td>
<td>43 ab</td>
<td>34 c</td>
<td></td>
</tr>
<tr>
<td>IWG/clover mixture</td>
<td>-</td>
<td>41 b</td>
<td>28 d</td>
<td></td>
</tr>
<tr>
<td><strong>CP (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IWG monoculture</td>
<td>23 a</td>
<td>5 f</td>
<td>12 d</td>
<td></td>
</tr>
<tr>
<td>IWG/clover mixture</td>
<td>-</td>
<td>9 e</td>
<td>18 bc</td>
<td></td>
</tr>
<tr>
<td><strong>ttNDFD</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IWG monoculture</td>
<td>0.53 a</td>
<td>0.41 b</td>
<td>0.40 b</td>
<td></td>
</tr>
<tr>
<td>IWG/clover mixture</td>
<td>-</td>
<td>0.35 b</td>
<td>0.33 b</td>
<td></td>
</tr>
</tbody>
</table>

Favre et al., in review
Relative forage quality

Spring | Summer | Fall | Annual

- Lactating dairy cow
- Stocker calf
- Lactating beef cow, heifer
- Dry cow

Monoculture | Mixture

Favre et al., in review
Grazing impacts on Kernza grain yield

NCR-SARE grant – UW, UMN, TLI

- Lancaster, WI
- Morris, MN
Treatments

Vegetation (2 treatments):
   a) Kernza monoculture
   b) Kernza + legume intercrop

Grazing (4 treatments):
   a) Spring grazing
   b) Fall grazing
   c) Spring and fall grazing
   d) No grazing

Grain harvest from every plot
Grain yield vs grazing timing

Favre et al., in prep.
Lodging vs grazing timing

Favre et al., in prep.
Forage yield vs grazing timing

Favre et al., in prep.
# Beef cattle performance in a feeding trial with Kernza crop residue

<table>
<thead>
<tr>
<th></th>
<th>100% grass-alfalfa haylage</th>
<th>50% Kernza crop residue + 50% haylage</th>
<th>p-value</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cow final body weight</td>
<td>kg</td>
<td>769</td>
<td>739</td>
<td>0.05</td>
</tr>
<tr>
<td>Average daily gains</td>
<td>kg day⁻¹</td>
<td>0.92</td>
<td>0.45</td>
<td>0.02</td>
</tr>
<tr>
<td>Dry Matter intake</td>
<td>g kg BW⁻¹</td>
<td>28.7</td>
<td>21.4</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Increase in Body Condition Score</td>
<td>-</td>
<td>0.3</td>
<td>0.1</td>
<td>0.05</td>
</tr>
<tr>
<td>Calf birth weight</td>
<td>kg</td>
<td>40.8</td>
<td>39.5</td>
<td>0.55</td>
</tr>
<tr>
<td>Calf weaning weight</td>
<td>kg</td>
<td>203</td>
<td>211.2</td>
<td>0.42</td>
</tr>
</tbody>
</table>

Favre et al., in prep.
Intercropping legumes with Kernza
Experimental design

Locations: Arlington and Sturgeon Bay, WI
Seeds from Cycle 4 IWG – TLI, 11 kg ha\(^{-1}\)
5 replications

Main plot factor: Row Spacing

- 38 cm
- 57 cm

Sub-plot factor: IWG cropping system

- IWG monoculture – weedy
- IWG monoculture – weed free
- IWG monoculture + 45 kg N ha\(^{-1}\)
- IWG monoculture + 90 kg N ha\(^{-1}\)
- IWG + Alfalfa
- IWG + Red Clover
- IWG + Kura Clover
- IWG + Berseem Clover
- IWG + Soybean
Red clover
*Trifolium pratense*

Kura clover
*Trifolium ambiguum*

Alfalfa (Lucerne)
*Medicago sativa*
Zimbric et al., in prep.
Zimbric et al., in prep.
Alfalfa varieties for Kernza intercropping

Brandon Schlautman et al.

UW, Arlington, WI

Alfornex, West Salem, WI
Planting date of Kernza and legume
Kernza experimental niche crop

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Thank you!