Using Agronomic Practices to Increase the per Hectare Yield of Flax Fibre

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Background

- 600,000 to 800,000 ha of oilseed flax grown annually in Western Canada
- Flax straw has high levels of cellulosic fibre
- Flax fibre-related production research relatively new to Western Canada
- Want agronomic practices that increase fibre content, straw production and seed yield cost effectively
Fibre Yield

• 2 components to Fibre Yield
  – Straw Yield-more important to farmer
    • Traditional baling after combine
      – average 1.2 to 1.5 t/ha
      – range 0 to 2.5 t/ha
    • New methods may double these “salvaged” yields
  – Fibre Content-more important to processor
    – average 13 to 18%
    – range 2 to 30%
  • Important to farmer IF straw payment were based on fiber content
# Fibre Content and Processing Cost

Example Showing how Fiber Content in Flax Straw Greatly Affects Profitability of Processing the Straw for Fiber

<table>
<thead>
<tr>
<th>Fiber Content of Straw</th>
<th>5%</th>
<th>15%</th>
<th>25%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average payment to farmers</td>
<td>$/tonne</td>
<td>&lt;8&gt;</td>
<td>&lt;8&gt;</td>
</tr>
<tr>
<td>Average total cost for baling, hauling, Stacking, unstacking from field to factory</td>
<td>$/tonne</td>
<td>&lt;42&gt;</td>
<td>&lt;42&gt;</td>
</tr>
<tr>
<td>Cost to process 1 tonne of straw</td>
<td>$/tonne</td>
<td>&lt;25&gt;</td>
<td>&lt;25&gt;</td>
</tr>
<tr>
<td><strong>Total cost of Straw + Processing</strong></td>
<td>$/tonne</td>
<td>&lt;75&gt;</td>
<td>&lt;75&gt;</td>
</tr>
<tr>
<td>Straw needed to give 1 tonne of fiber</td>
<td>tonnes</td>
<td>20</td>
<td>6.7</td>
</tr>
<tr>
<td>= Cost of 1 tonne of fiber (Straw + Processing)</td>
<td>$/tonne</td>
<td>&lt;1,500&gt;</td>
<td>&lt;500&gt;</td>
</tr>
<tr>
<td><strong>Average value of fiber fob Sask factory</strong></td>
<td>$/tonne</td>
<td>600</td>
<td>600</td>
</tr>
<tr>
<td><strong>Gross Margin (before fixed costs)</strong></td>
<td>$/tonne</td>
<td>&lt;900&gt;</td>
<td>100</td>
</tr>
</tbody>
</table>
Fibre Production

• Influenced by the interaction of several Agronomic and Non Agronomic factors
  • growing season weather
  • variety sown
  • fertility
  • seeding rate
  • seeding date
  • type of soil
  • harvest management
Geographic Location

• Results from two 2003 Saskatchewan Regional Variety Trial Locations

<table>
<thead>
<tr>
<th>Location</th>
<th>Straw Yield kg/ha</th>
<th>Fiber Content %</th>
<th>Fiber Yield kg/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watrous</td>
<td>1,013</td>
<td>16.8%</td>
<td>170</td>
</tr>
<tr>
<td>Kernan</td>
<td>349</td>
<td>11.1%</td>
<td>38</td>
</tr>
</tbody>
</table>
Agronomic Factors…. 

• Seeding Date and Fibre Yield
  – not conclusive but, in general, late seeding tends to increase fibre content and straw yield
  – BUT tends to decrease seed yield
Agronomic Factors ....

THE EFFECT OF SEEDING DATE ON FIBRE CONTENT, STRAW YIELD AND FIBRE YIELD

<table>
<thead>
<tr>
<th>Site, Year</th>
<th>Seeding Date</th>
<th>Fibre Content %</th>
<th>Straw Yield kg</th>
<th>Fibre Yield kg/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mel-01</td>
<td>Early</td>
<td>12.8</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>Late</td>
<td>14.9</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Mor-01</td>
<td>Early</td>
<td>17</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>Late</td>
<td>12.7</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>IH-01</td>
<td>Early</td>
<td>8.3</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>Late</td>
<td>10.8</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Can-03</td>
<td>Early</td>
<td>15.7</td>
<td>2,120</td>
<td>331</td>
</tr>
<tr>
<td></td>
<td>Late</td>
<td>18.2</td>
<td>2,780</td>
<td>519</td>
</tr>
<tr>
<td>IH-03</td>
<td>Early</td>
<td>13.6</td>
<td>680</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>Late</td>
<td>14.8</td>
<td>960</td>
<td>142</td>
</tr>
<tr>
<td>Red-03</td>
<td>Early</td>
<td>15.8</td>
<td>1,030</td>
<td>163</td>
</tr>
<tr>
<td></td>
<td>Late</td>
<td>17.4</td>
<td>1,550</td>
<td>214</td>
</tr>
</tbody>
</table>

Notes:
- n/a = not available
- Mel-01 = Melfort, SK 2001
- Mor-01 = Morden, MB 2001
- IH-01 = Indian Head, SK 2001
- Can-03 = Canora, SK 2003
- IH-03 = Indian Head, SK 2003
- Red-03 = Redvers, SK 2003
Agronomic Factors ....

- Possible reasons why late seeding tends to give more fiber, but less seed
  - plant “bolts” in early July when temperatures are higher, resulting in taller stems
  - blooms in late July when more heat stress and lower pollination rate (less seeds to fill)
  - fiber “filling” in late Aug when plants less stressed
  - Photo-period effects ??
Agronomic Factors

• Seeding Method
  – Goals = 1) high fiber yield/ha; 2) consistent small stem sizes, 3) fast retting
  – Seed Bed Utilization (low to high)
    • Disc < Hoes < Sweeps
  – Impact on straw yield dependent upon seeding rates (i.e., wider seed spread pattern more important with heavier seeding rates)
Agronomic Factors

- Seeding Method
  - No noticeable impact on fibre content (dry years?)
  - but generally higher straw yield, higher per ha fiber yield and more consistent stem sizes with wider seed spread pattern
  - Consistent seeding depth very important for high plant counts/m2 and for consistent stem diameters
THE EFFECT OF SEEDING METHOD ON FIBRE CONTENT, SALVAGED STRAW YIELD AND FIBRE YIELD (2003 - dry year)

<table>
<thead>
<tr>
<th>Seeding Method</th>
<th>Fibre Content %</th>
<th>Salvaged Straw Yield kg/ha</th>
<th>Salvaged Fibre Yield kg/ha</th>
<th>Stem Diam. mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweep</td>
<td>17.3</td>
<td>998</td>
<td>310</td>
<td>1.36</td>
</tr>
<tr>
<td>Hoe</td>
<td>17.2</td>
<td>864</td>
<td>276</td>
<td>1.49</td>
</tr>
</tbody>
</table>
### Agronomic Factors

- **Seeding Rate**
  - Results from 2003

<table>
<thead>
<tr>
<th>Seeding Rate (kg/ha)</th>
<th>Fibre Content (%)</th>
<th>Salvaged Straw Yield (kg/ha)</th>
<th>Fibre Yield (kg/ha)</th>
<th>Stem Diameter (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>17.2</td>
<td>1,581</td>
<td>286</td>
<td>1.50</td>
</tr>
<tr>
<td>80</td>
<td>17.3</td>
<td>1,740</td>
<td>319</td>
<td>1.32</td>
</tr>
<tr>
<td>120</td>
<td>17.2</td>
<td>1,724</td>
<td>316</td>
<td>1.24</td>
</tr>
</tbody>
</table>
….Agronomic Factors

• Interaction of Seeding Rate and Seeding Method

![Graph showing straw yield vs. seeding rate with curves for high and low seedbed utilization]
Variety Selection....

• Not all varieties have the same fibre content
  – at Canora, SK 2003
    – Linola 1084  19.2%
    – AC MacBeth  13.8%

• Not all varieties have the same straw yield
  – at Canora, SK 2003
    – Linola 1084  1142kg/ha
    – AC MacBeth  742kg/ha
....Variety Selection....

- Hence not all Varieties have the same fibre yield/ha
  - Canora 2003
    - Linola 1084  219kg/ha
    - AC MacBeth  102kg/ha
Variety Selection

• Fibre Flax Varieties
  – Fibre Contents
    • Average 20-30%
    • Range 13%-40%
  – Straw Yields
    • Average 4.2-5.6 t/ha
    • Range 1.5-10t/ha
  – Depends upon variety and year
Combined Effects of Agronomic Practices: An Example

- Canora 2003

<table>
<thead>
<tr>
<th>Variety</th>
<th>Seeding Rate kg/ha</th>
<th>Seeding Method</th>
<th>Seeding Date</th>
<th>Fiber Content %</th>
<th>Straw Yield kg/ha</th>
<th>Fiber Yield kg/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taurus</td>
<td>40</td>
<td>Hoe</td>
<td>Early</td>
<td>14.2</td>
<td>1859</td>
<td>264</td>
</tr>
<tr>
<td>Flanders</td>
<td>80</td>
<td>Sweep</td>
<td>Late</td>
<td>21.5</td>
<td>3055</td>
<td>657</td>
</tr>
</tbody>
</table>

- If fibre is worth $50-.80/kg then extra 393 kg of fibre *after processing* is $197 -314/ha
Summary....

- Agronomy has significant influence on fibre content, straw yield and fibre yield
- Most agronomic practices that increase fibre yield are not expensive to implement
…..Summary

• More agronomic research (fertilizer, seeding dates, seeding rates etc.) is needed to prepare a management regime that maximizes profits for flax as a dual purpose crop
Flax - Stop the Burning!
Start the Earning!

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