Industrial hemp: Agronomy backgrounder

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Vegreville

Growing INDUSTRIAL HEMP Seminar
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What is hemp?

- Hemp is one of the oldest fibre and food crops
- Originates from Central Asia where it was cultivated 6,500 years ago
- The Greek name of hemp, κάνναβις (kannabis), means “fragrant cane” - aroma is produced by volatile compounds (primarily terpenes)
Setting the stage - Taxonomy of hemp

- Hemp (*Cannabis sativa L.*) has two subspecies: *sativa* and *indica* that differ in content of delta-9-tetrahydrocannabinol (THC)

THC < 0.3% = Industrial hemp

THC ~ 30% = Marijuana, weed, ganja, pot, grass, Mary Jane, cannabis
Usage types

Grain type
- Short stature
- High seed yield
- Low vegetative biomass

Fibre (dual) type
- Tall or very tall plants
- Very high stem yield
- Lower seed yields
Hemp is one of the faster growing plants

Growth rate - 15 cm per day; up to 5 m
Canadian focus: hemp as a multipurpose crop

Every single part of the plant can be used
Establishing hemp as a mainstream crop for industrial applications

- Hemp fibre has great potential to be a valuable feedstock for several well established industries.

To realize potential residing within this crop InnoTech Alberta assembled a program offering solutions from “Seed to final product”

- Feedstock development
- Fibre processing
- Biocomposite research
- Market development
Hemp selection and breeding

- Germplasm evaluation
- Selection of top performers under AB conditions
- Maintenance breeding of fibre type cv. Silesia
- Initiation of new cultivars breeding for Alberta

![Graph showing straw yield (t dry/ha) for different cultivars: Crag, Alyssa, Carmen, Tygra, Silesia. Crag has the lowest yield, Silesia has the highest yield.](image)
InnoTech Alberta agronomy trials

Objective:
Optimization of cultivation practices for Alberta (at the Vegreville site)

- Seeding dates (mid May- mid June)
- Seeding densities (100 and 250/300 seed/m²)
- Fertilizers (cattle manure, mineral)
- N rates and forms (ammonia, urea)
- Harvest dates (for juvenile fibre)
- Herbicide resistance

InnoTech Alberta supported 4 y trials at Lethbridge, Vegreville and Falher

• Final report just filed with ACIDF
Hemp varieties grown in Alberta

- **Grain type varieties** dominate in cultivation and breeding
- **Demand for dual purpose varieties** is growing to address needs of emerging fibre industries
- **Mounting interest in high CBD varieties**

<table>
<thead>
<tr>
<th>Variety</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
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</thead>
<tbody>
<tr>
<td>Finola</td>
<td>5751.0</td>
<td>4525.4</td>
<td>6901.6</td>
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<tr>
<td>X59</td>
<td>2994.0</td>
<td>3217.4</td>
<td>3197.5</td>
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<tr>
<td>CFX2</td>
<td>969.0</td>
<td>828.4</td>
<td>233.5</td>
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<tr>
<td>GranMa</td>
<td>0.0</td>
<td>0.0</td>
<td>109.3</td>
</tr>
<tr>
<td>Katani</td>
<td>108.0</td>
<td>745.2</td>
<td>3490.3</td>
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<tr>
<td>Grandi</td>
<td>64.0</td>
<td>199.7</td>
<td>373.6</td>
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<tr>
<td>Picolo</td>
<td>54.0</td>
<td>3416.8</td>
<td>3777.0</td>
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<tr>
<td>Other*</td>
<td>0.0</td>
<td>4.4</td>
<td>0.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>9940.0</strong></td>
<td><strong>12937.3</strong></td>
<td><strong>18083.0</strong></td>
</tr>
</tbody>
</table>

*-* Silesia, Delores, CanMa
Variety selection

Grain yields:
- Medium-short varieties produced the highest yields
- Some fibre-type varieties (Silesia, Joey) yielded more than short grain-type

Fibre yields:
- Fibre-type varieties produced the highest yields
- Short grain-type varieties yielded 50% less
Field selection

- Hemp is very sensitive to soil structure
- Yield penalty on compacted soils
- Does not tolerate soils with poor drainage

Photo credit: O. Lalonde
Fibre and grain yields are severely compromised
Seeding

- Seed shallow - ~ 1.5cm (or into moisture)
- 20-25 kg/ha seeding rate for grain
- 40-60 kg/ha for fibre
- Warm soils – above 8°C
- High field mortality (10-70%) add 30% when calculating seeding rates
- Equipment – low fan speed for air seeders
High fan speed damages the seeds
Seeding date

- Affects more yield of crop grown for fibre, less critical for grain
- Hemp is a short day plant
  - Long days (17 h) at higher latitudes delay flowering
  - Stem elongation occurs before flowering
  - Early seeding generates taller plants and more vegetative growth
### Effects of seeding date on hemp performance (Lethbridge)

<table>
<thead>
<tr>
<th>Seeding date</th>
<th>Seed yield (kg/ha)</th>
<th>Straw yield (kg/ha)</th>
<th>Harvest Index</th>
<th>Height (cm)</th>
<th>Male plants (%)</th>
<th>Flower (DAS)</th>
<th>Maturity (DAS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early</td>
<td>1884</td>
<td>5379</td>
<td>0.28</td>
<td>181.2</td>
<td>32.6</td>
<td>47.8</td>
<td>102.3</td>
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<td>Standard</td>
<td>1828</td>
<td>4811</td>
<td>0.32</td>
<td>176.0</td>
<td>36.0</td>
<td>38.6</td>
<td>88.0</td>
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<tr>
<td>Late</td>
<td>1581</td>
<td>4277</td>
<td>0.30</td>
<td>166.6</td>
<td>37.8</td>
<td>34.7</td>
<td>78.8</td>
</tr>
</tbody>
</table>

Delayed seeding – shorter plants, while grain yield not much affected (extremes mid-June to July 16)
Fertilization

• Rule of thumb for fertility recommendations
  - a high yielding and high protein spring wheat

• Hemp is sensitive to N fertilizer placement
  – side-banded, mid-row-banded or banded in a separate operation.
Hemp response to nitrogen fertilizer

**Grain yields:**
- Maximum yields at 120 N kg/ha
- Grain yield reduction at higher yields (N toxicity ?)

**Fibre yields:**
- Maximum yields at 90 N kg/ha
- No benefits of luxury fertilizer
Differences among hemp varieties in N fertilizer response

Grain yields:
- Grain-type varieties - maximum yields at 120 N kg/ha
- Fibre type variety - maximum at 90 N kg/ha then decrease

Fibre yields:
- Grain-type varieties - weak response to increasing N rates
- Fibre type variety - maximum at 90 N kg/ha then plateau
Weed control

• Limited selection of herbicides registered for use on industrial hemp in Canada
  – Pre-seed burn-off with glyphosate
  – Grassy weeds - Assure II (Quizalofop-p-ethy) from DuPont
  – Broadleaf weeds – Bromoxynil products (in registration)

• Cultural practices
  – Hemp is very competitive – closes canopy quickly
  – Pre-seed tillage accelerates establishment – does not like hard pan
Pests and diseases

• Sclerotinia - avoid rotation with canola
• Botrytis (grey mold)

Insects – rarely a real problem
• Bertha armyworm
• European corn borer
• Cutworms
Spring frost

- Hemp is fairly resistant to spring frost

-4.7°C on May 30
Hail injuries

• Extent of damage depends on:
  – plant stage
  – usage type

• Symptoms - leaf shredding, stem bruising, kinking and/or breaking of stalks, loss of flower heads
Recovery from hail injury
CBD content in industrial hemp

It translates to:
• **12-20 kg/ha** of CBD or
• **1000 - 2000 tonnes** per year in industrial hemp grown in Canada
Hemp – a crop like no other

• Framers know how to grow staple crops in Alberta (wheat, canola, barley)
• Hemp is different - you have to know what are you growing for and adapt cultivation practices accordingly
• You need to apply for a licence