Small Scale Fuel Production

Dr. Heather Darby
UVM Extension
FARMING is Mostly Dependent on Fossil Fuels
Generally NO ONE to Pass the Cost
U.S. Farm Energy Use by Source

- Electricity: 21%
- Pesticides: 6%
- Fertilizer: 28%
- Diesel: 27%
- Gasoline: 9%
- LP Gas: 5%
- Natural Gas: 4%

Source: Miranowski, 2004
The Goal

To assess the potential production and processing of oil seed crops for use as a renewable energy source on a scale that would support small groups of local farmers working together.
Identifying specific oilseed crops and varieties suitable to local conditions

Canola

Sunflower
Canola seed pods
Can Oilseed Crops Yield in Vermont?

<table>
<thead>
<tr>
<th></th>
<th>National Average</th>
<th>Vermont Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canola:</td>
<td>1374 lbs/acre</td>
<td>1500 lbs/acre</td>
</tr>
<tr>
<td>Sunflower:</td>
<td>1349 lbs/acre</td>
<td>1500 lbs/acre</td>
</tr>
</tbody>
</table>
Canola Production

Winter & Spring Seed Sources
Croplan Genetics
Pioneer and Mycogen

Spring planted in April/May
Fall planted in mid to late August

Grain Drill – $\frac{1}{2}$ to 1 inch depth
Seeding rate – 5 to 8 lbs per acre
Fertility – similar to small grains except high S needs
Canola and Soil

• Canola has traditionally been produced on lighter texture or well drained clay.
• Not highly sensitive to soil pH 5.7 to >8.
• Weak root system and does not tolerate water logged soils
Canola Production

Harvest in August
Dry to 10-12% moisture
Easy to dry – heat not needed
Winter Canola Survival

<table>
<thead>
<tr>
<th>Varieties</th>
<th>Stand Density</th>
</tr>
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<tbody>
<tr>
<td>KS4426</td>
<td>g</td>
</tr>
<tr>
<td>Sitro</td>
<td>fg</td>
</tr>
<tr>
<td>KS3132</td>
<td>efg</td>
</tr>
<tr>
<td>Kiowa</td>
<td>defg</td>
</tr>
<tr>
<td>KS4022</td>
<td>def</td>
</tr>
<tr>
<td>KS4158</td>
<td>def</td>
</tr>
<tr>
<td>Kadore</td>
<td>def</td>
</tr>
<tr>
<td>Wichita</td>
<td>de</td>
</tr>
<tr>
<td>KS3254</td>
<td>de</td>
</tr>
<tr>
<td>Kronos</td>
<td>bcd</td>
</tr>
<tr>
<td>Summer</td>
<td>bcd</td>
</tr>
<tr>
<td>Virginia</td>
<td>bcd</td>
</tr>
<tr>
<td>Visby</td>
<td>abc</td>
</tr>
<tr>
<td>KS4475</td>
<td>ab</td>
</tr>
<tr>
<td>Baldur</td>
<td>a</td>
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</tbody>
</table>
Sunflower Production

Seed Sources
- Seeds2000
- Croplan Genetics
- Mycogen
- Blue River Organics

Seed size very important (sizes 2,3,4)

Planted in May and early June

Corn planter – 30” row

Seeding rate – 30,000 to 32,000 seeds per acre

Fertility – high N requirements, low P and K requirements

Deep taproots to pull up nutrients
Sunflower and Soil

• Sunflower has traditionally been produced on heavy clay soils with good physical structure and high in nutrients.
• Not highly sensitive to soil pH 5.7 to >8.
• Drought tolerant through deep rooting
Sunflower Production

Sunflowers are long season
Harvest in late October – November
Easy to dry – forced air works best
Absorb moisture easily in storage
Sunflower Pans
SUNFLOWER PANS
Sunflower following crops, Crookston, MN.
Nitrogen Management

Sunflowers require 90 lbs/acre

Excellently scavengers of nutrients

Soil samples to a 2-3 foot depth

Too much nitrogen making stems weak
# Integrated Pest Management in Oilseeds

## Cultural
- varietal selection
- agronomic management

## Chemical
- herbicides
- insecticides
- fungicides

## Mechanical
- cultivation
- removal of pests by hand

## Biological
- introduction or conservation of predator species
Top Yield-Limiting Factors
VT Sunflower 2012

Average 2012 seed yield: 1296 lbs/acre
(oil yield ~ 68 gal/acre)
Sunflower Pest Management: Insects

- Scout regularly (different life cycle stages)
- Alter planting and/or harvesting dates to avoid vulnerable stages
- Deep fall plowing
- Crop rotation

Banded sunflower moth *Cochylis hospes*

BSM larvae burrowing

Sunflower maggot

Sunflower midge damage
Banded Sunflower Moth (BSM)

2012 BSM damage, compared to other regions.

Setting up a wing trap with pheromone lure, Newbury, VT.

2012 BSM traps

20-Aug
Sunflower Pest Management: Weeds

- Mechanical cultivation: tineweeding, row cultivator
- Herbicide (pre-plant or post-emergent)

**Tineweeding study, 2010**

<table>
<thead>
<tr>
<th>Weed control method</th>
<th>6 &amp; 12 Day</th>
<th>12 Day</th>
<th>Herbicide</th>
<th>Control</th>
<th>6 Day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
<td>ab</td>
<td>ab</td>
<td>bc</td>
<td>c</td>
</tr>
</tbody>
</table>

Weeds (DM lbs ac⁻¹)
SUNFLOWER YIELD AND LEGUME BIOMASS IN KG PER HA

PROSPER AND CARRINGTON 1992 AND 1993

LEGUMES

- CONTROL
- BLACK LENTIL
- SNAI POL
- SWEETCLOVER
- ALFALFA
- HARY VETCH
- SNAIL MEDIC
- SWEETCLOVER
- ALFALFA
- HARY VETCH
- SNAIL MEDIC
- SWEETCLOVER
- ALFALFA
- HARY VETCH

WG PER HA

- 0
- 1,000
- 2,000
- 3,000
- 4,000
- 5,000
- PLT
- V4
- V10

SUNFLOWER

LEGUME
Sunflower Pest Management: Disease

- Varietal selection
- Scout regularly
- Fungicides, seed treatments
- Deep fall plowing
- Crop rotation

Sclerotinia head rot

Sclerotinia stalk rot

Sclerotinia stalk rot (%)

Variety

Sunflower variety trial, 2011
White Mold

*Sclerotinia sclerotiorum*

400+ broadleaf hosts

Causes 3 diseases in sunflower
- sclerotinia wilt
- middle stalk rot
- sclerotinia head rot

Crop Rotation – best control
- 3 – 6 years low levels
- 8 + years for high levels

Non host crops

Contans = biocontrol agent

NDSU
Sclerotinia Wilt

- Sunflower roots come in contact with sclerotia, the sclerotia germinate and infect the roots.

- The fungus grows upward in the infected root

- The plant wilts and dies

- Adjacent plants in the row may be infected through root-to-root contact.

- 1.0 sclerotium per 1,000 cm³ of soil results in about 65 percent wilted plants.
Impact of Bird Damage on Yields, Borderview Farm

![Graph showing the relationship between Bird Damage (%) and Sunflower Yield (lbs/acre). The graph indicates a negative correlation, with higher bird damage leading to lower sunflower yields.](image-url)
Sunflower Pest Management: Birds

- Scare tactics
- Crop rotation
- Sacrificial planting
- Alter planting and/or harvesting dates
Stem Curvature Classes in Sunflower
Canola Pest Management: Insects

- Scout regularly
- Crop rotation
- Foliar insecticides
- Varietal selection

Flea beetle
*Phyllotreta cruciferae*
Canola Pest Management: Disease

- Crop rotation
- Fungicides
- Seed treatments
- Varietal selection

Blackleg, caused by fungal pathogen

Deformation on stem caused by sclerotinia
Canola Pest Management: Birds

- Scare tactics
- Crop rotation
- Sacrificial planting
- Alter planting and/or harvesting dates
<table>
<thead>
<tr>
<th>Crop</th>
<th>National Average</th>
<th>Vermont Average</th>
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</thead>
<tbody>
<tr>
<td>Canola</td>
<td>74 gallons/acre</td>
<td>74 gallons/acre (40-100 gallons/acre)</td>
</tr>
<tr>
<td>Sunflower</td>
<td>74 gallons/acre</td>
<td>74 gallons/acre (45-140 gallons/acre)</td>
</tr>
</tbody>
</table>
Oil press comparisons

Chinese Press

German Kern Kraft 40
Oil Yields From Varieties

<table>
<thead>
<tr>
<th>Variety</th>
<th>Oil %</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS6111</td>
<td>29</td>
</tr>
<tr>
<td>IS6521</td>
<td>36</td>
</tr>
<tr>
<td>Hysun 1521</td>
<td>29</td>
</tr>
<tr>
<td>IS6039</td>
<td>33</td>
</tr>
<tr>
<td>Defender</td>
<td>27</td>
</tr>
<tr>
<td>IS4049</td>
<td>37</td>
</tr>
</tbody>
</table>
## Oil Yields & Moisture

<table>
<thead>
<tr>
<th>Variety</th>
<th>Moisture (%)</th>
<th>Oil (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HySun 1521</td>
<td>12</td>
<td>24</td>
</tr>
<tr>
<td>HySun 1521</td>
<td>7</td>
<td>29</td>
</tr>
</tbody>
</table>
## Oil Yields & Press Number

<table>
<thead>
<tr>
<th>Press (#)</th>
<th>Oil (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>24</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
</tr>
</tbody>
</table>
Seed Meals

Crude Protein:
- Canola 30%
- Sunflower 34%

Fat:
- Canola 14%
- Sunflower 15%
## Dairy Feeding Trial

<table>
<thead>
<tr>
<th>Canola meal source</th>
<th>Crude protein % DM</th>
<th>Crude fat</th>
<th>Net energy lactation Mcal/lb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm grown</td>
<td>33.1</td>
<td>13.4</td>
<td>1.15</td>
</tr>
<tr>
<td>Purchased</td>
<td>36.3</td>
<td>2.94</td>
<td>0.79</td>
</tr>
</tbody>
</table>
# Dairy Feeding Trial

<table>
<thead>
<tr>
<th>Feed</th>
<th>Milk Yield (lbs)</th>
<th>Fat (%)</th>
<th>Protein (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm grown</td>
<td>40.4</td>
<td>3.11</td>
<td>2.80</td>
</tr>
<tr>
<td>Purchased</td>
<td>39.1</td>
<td>3.25</td>
<td>2.80</td>
</tr>
</tbody>
</table>
# Meal Nutrient Content

<table>
<thead>
<tr>
<th>Nutrient content</th>
<th>Sunflower</th>
<th>Canola</th>
<th>Mustard</th>
</tr>
</thead>
<tbody>
<tr>
<td>% N</td>
<td>5.60</td>
<td>4.60</td>
<td>6.00</td>
</tr>
<tr>
<td>%P</td>
<td>1.26</td>
<td>0.74</td>
<td>1.02</td>
</tr>
<tr>
<td>%K</td>
<td>1.49</td>
<td>0.68</td>
<td>1.02</td>
</tr>
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</table>
Other Meal Benefits

Biocidal properties

• Some oilseed crops have high glucosinolate values
• These glucosinolates hydrolyze into isothiocyanates
• Various mustards have high glucosinolates
• Suppress diseases and nematodes
# Weed Control with Oilseed Meals

**Table 3. Weed counts in oilseed amended plots in 2008 and 2009.**

<table>
<thead>
<tr>
<th>Amendment</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Weed count</td>
</tr>
<tr>
<td>Sunflower meal</td>
<td>33b</td>
</tr>
<tr>
<td>Canola meal</td>
<td>38b</td>
</tr>
<tr>
<td>Mustard meal</td>
<td>15a</td>
</tr>
<tr>
<td>Control (synthetic N)</td>
<td>52c</td>
</tr>
</tbody>
</table>

**Within each column, numbers followed by the same letter are not significantly different (P<0.05).**
Impact of oilseed meal amendments on soil nitrate levels at 4, and 8 weeks after planting.

<table>
<thead>
<tr>
<th>Amendment</th>
<th>4 week NO₃ (ppm)</th>
<th>8 week NO₃ (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunflower meal</td>
<td>41.2a</td>
<td>28.6b</td>
</tr>
<tr>
<td>Canola meal</td>
<td>49.7a</td>
<td>37.5a</td>
</tr>
<tr>
<td>Mustard meal</td>
<td>53.1a</td>
<td>38.5a</td>
</tr>
<tr>
<td>Control (synthetic N)</td>
<td>17.8b</td>
<td>9.38c</td>
</tr>
</tbody>
</table>

**Within each column, numbers followed by the same letter are not significantly different (P<0.05).**
Fuel Testing at NW Manufacturing

Test furnace

Clean emissions
Going Green
CONVERSION FOR USING STRAIGHT VEGGIE OIL
Making Biodiesel
Spontaneous combustion, a very real hazard!

• Oily sawdust, paper towels or rags must not pile up!
• Warm days, moving air
• Wash out rags and hang to dry
• Store in bucket of water
• Use a fire can or tight metal trash can
• Disperse in dumpster
Cost Breakdown of Oilseed Crop Production

- Hauling Cost
- Harvesting Cost
- Spraying Cost
- Cultivation Cost
- Planting Cost
- Seed Cost
- Fertilizer
- Field Prep Cost

Farm Case
Welcome

NW CROPS & SOILS PROGRAM

The mission of the UVM Extension Northwest Crops and Soils Team is to provide the best and relevant cropping information, both research-based and experiential, delivered in the most practical and understandable ways to Vermont farmers.

OUT CROPPINGS: Important crop news from the field!

Northern Corn Leaf Blight Once again, we have seen increased Northern Corn Leaf Blight in the area. Northern leaf blight is a fungal disease found in humid climates wherever corn is grown. Read the entire article.

Cereal Grain Testing Comes to the Green Mountains! UVM Extension Northwest Crops and Soils Team's Cereal Grain Laboratory is up and running! Our lab is currently accepting samples and will continue to do so through the fall. Click here to download a Cereal Grain Test Submission Form.

Northeast Hop Alliance Presents Hops 101 and 201 Courses, Saturday-Sunday, Oct. 10-11 at Fenimore Art Museum, Cooperstown, NY 13326 Click here to download a pdf flyer of the courses.

Dr. Heather Darby UVM Extension Agronomist

Evaluating the Potential of Grace Fall Seeded Grains

Dr. Heather Darby UVM Extension Agronomist

The potential for Grace Fall Seeded Grains

Visit our website with lots of interesting information and resources on Grace Fall Seeded Grains.