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

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.
Borderview Farm
Alburg, VT

State Line Farm
Shaftsbury, VT
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 – ½ 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 Yields

![Graph showing seed and oil yields for various canola varieties](image-url)
Winter Canola Survival

Stand Density

Varieties

KS4426  Sitro  KS3132  Kiowa  KS4022  KS4158  Kadore  Wichita  KS3254  Kronos  Sunner  Virginia  Visby  KS4475  Baldur
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.

Sunflower Yield (pounds per acre)

- Wheat: 1700 pounds
- Pinto bean: 1600 pounds
- Potato: 1550 pounds
- Sunflower: 1450 pounds
Average Crop Rooting Depth

- Sunflower
- Corn
- Wheat
- Soybean

Root depth

Feet

0 2 4 6
Nitrogen Management

Sunflowers require 90 lbs/acre

Excellent scavengers of nutrients

Soil samples to a 2 - 3 foot depth

Too much nitrogen making stems weak
Nitrogen rates (lbs/acre)

Yield (lbs/acre)
## Integrated Pest Management in Oilseeds

<table>
<thead>
<tr>
<th>CULTURAL</th>
<th>MECHANICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>- varietal selection</td>
<td>- cultivation</td>
</tr>
<tr>
<td>- agronomic management</td>
<td>- removal of pests by hand</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>CHEMICAL</th>
<th>BIOLOGICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>- herbicides</td>
<td>- introduction or conservation of predator species</td>
</tr>
<tr>
<td>- insecticides</td>
<td></td>
</tr>
<tr>
<td>- fungicides</td>
<td></td>
</tr>
</tbody>
</table>
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.
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

SUNFLOWER
LEGUME

KG PER HA

0
1,000
2,000
3,000
4,000
5,000

CONTROL
BLACK LENTIL
SNAIL MEDIC
SWEETCLOVER
ALFALFA
HARY VETCH
CONTROL
BLACK LENTIL
SNAIL MEDIC
SWEETCLOVER
ALFALFA
HARY VETCH

PLT
V4
V10
Sunflower Pest Management: Disease

- Sclerotinia head rot
- Sclerotinia stalk rot

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

Sclerotinia stalk rot (%)
Sunflower variety trial, 2011

Variety

Sclerotinia stalk rot

Varietal selection
Scout regularly
Fungicides, seed treatments
Deep fall plowing
Crop rotation
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
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.
Sunflower Pest Management: Birds

- Scare tactics
- Crop rotation
- Sacrificial planting
- Alter planting and/or harvesting dates

% Bird Damage in Fields
Sunflower 2009-2012

Bird damage by planting date, 2012
Stem Curvature Classes in Sunflower

1. 
2. 
3. 
4. 
5. 
6. 
7.
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
### Oil Yields in Vermont?

<table>
<thead>
<tr>
<th>Crop</th>
<th>National Average</th>
<th>Vermont Average</th>
</tr>
</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

Variety: IS6111, IS6521, Hysun 1521, IS6039, Defender, IS4049

Oil %

- IS6111: 29
- IS6521: 36
- Hysun 1521: 29
- IS6039: 33
- Defender: 27
- IS4049: 37
## 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></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</th>
<th>Crude fat</th>
<th>Net energy lactation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm grown</td>
<td>33.1% DM</td>
<td>13.4 Mcal/lb</td>
<td>1.15</td>
</tr>
<tr>
<td>Purchased</td>
<td>36.3% DM</td>
<td>2.94 Mcal/lb</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>
</tbody>
</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 NO$_3$ (ppm)</th>
<th>8 week NO$_3$ (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
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 our area. Northern leaf blight is a fungal disease found in humid climates wherever corn grows. Read the entire article.

Cereal Grain Testing comes to the Green Mountains! UVM Extension Northwest Crops and Soils Team is pleased to announce that the Cereal Grain Testing Laboratory is up and running! Our lab is currently accepting samples and will continue to do so throughout the season. Click here to download a Cereal Grain Test Submission Form.

Northeast Hop Alliance Presents Hops 101 and 201 Courses, Saturday-Sunday, Oct 9-10 at the Fenimore Art Museum Cooperstown, NY 13326 Click here to download a pdf flyer of the event.