Oil Seed Production Issues

Hans Kandel,
North Dakota State University Extension Agronomist

Best Agronomic Practices for Sunflower & Canola

Heather Darby,
University of Vermont Extension Agronomist and Nutrient Management Specialist
Sunflower
Sunflower

*Helianthus annuus* L.

**Uses**

- **Confectionary**
  - Roasted and marketed as snack food
  - Processed to an alternative to peanut butter

- **Whole oil seeds**
  - Bird Seed

- **Oil**
  - Food grade oil
    - Varieties developed for health markets
  - Carrier
    - Paints and finishes
  - Biodiesel
  - Meal from extraction
    - 28-41% CP (varies with amount of hulls included)
Sunflower

• Confectionary varieties
  – Striped hulls
  – Larger
  – Lower oil content

• Oil varieties
  – Black
  – Smaller
  – Up to 50% oil
National Oil-Type Sunflower Yields, lbs/acre plus trend line
Sunflower following crops, Crookston, MN.
Average Crop Rooting Depth

- Sunflower
- Corn
- Wheat
- Soybean

Root depth

Feet

0 2 4 6
North Dakota and South Dakota HYBRID SUNFLOWER Performance Testing 2009
Hybrid Selection

What Traits Do Need?

• Tolerance to water stress
• Oleic content if NuSun Hybrid
• Yield potential and stability
• Seed size
• Maturity
• Standability
• Disease Tolerance

High yields are the results of having the right genetic package to meet the environmental conditions
Variation In Sunflower Hybrids

- Short and long season (early – mid season)
- Short and tall plants
- Disease packages
- Higher oil content
- Standability
- Head erectness
- Stay green gene
OILSEED SUNFLOWER

TRIUMPH

s668

2010

NuSun Short Stature

New!

Days to Maturity

96-106

Product Description

NuSun short stature hybrid with outstanding yields. Excellent response to high inputs. Unsurpassed rust tolerance. Great overall health and standability.

Agronomic Ratings

<table>
<thead>
<tr>
<th>Oil Content %</th>
<th>Height (in)</th>
<th>Self Compatability</th>
<th>NuSun Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>44-48</td>
<td>38-44</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stalk Strength</th>
<th>Root Rating</th>
<th>Flowering Uniformity</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>

Disease Tolerance

Rust, Charcoal Rot

9=Excellent, 1=Poor.

Numbers are given only as a guide. All ratings are subject to cultural practices and environmental conditions. Ratings and descriptions are based on research and field performance. Numbers should not be used as a sole basis to compare isolates or multiply yields. They represent comparisons with other Triumph isolates only.

NuSun and the NuSun logo are registered trademarks of the National Sunflower Association. DISEASEFIELD and the DISEASEFIELD logo are registered trademarks of DISEASE. ©2005 Triumph Seed.
Variety Trials – Borderview Farm

Sunflower Variety

Yield (lbs/acre)

Tons/Acre

Croplan803
Triumph
Viper
Croplan305
Croplan3080
Teton
IS6521
Defender
Hysun 521
IS6039
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 bird damage increasing as sunflower yield decreases.
Stem Curvature Classes in Sunflower
SUNFLOWER PRODUCTION PRACTICES

• Soils/Fertility
  – Nitrogen
    • Promotes plant growth
    • Promotes higher oils
    • 5 lb N per 100 lb of yield
    • eg: 1800 lb yield goal = 90 N
      2000 lb yield goal = 100 N
    • No more than 10 lb N by the seed
# Nutrient Recommendations for Sunflower

<table>
<thead>
<tr>
<th>Yield goal (Lb/acre)</th>
<th>Soil test phosphorus, ppm</th>
<th>Soil N plus fertilizer N required (Lb/acre)</th>
<th>Lb P$_2$O$_5$/acre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VL</td>
<td>L</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>0-5</td>
<td>6-10</td>
<td>11-15</td>
</tr>
<tr>
<td></td>
<td>0-3</td>
<td>4-7</td>
<td>8-11</td>
</tr>
<tr>
<td>1500</td>
<td>30</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>2000</td>
<td>40</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>2500</td>
<td>50</td>
<td>35</td>
<td>25</td>
</tr>
</tbody>
</table>
Sunflower P and other nutrient recommendations

• Will respond to P when soil test levels are medium or less.

• If a micronutrient problem is suspected, soil test and apply nutrient on a limited basis.
Sunflower Date of Planting - Carrington, ND. (4 yr. Ave).
Sunflower Observations: August 10, SW. North Dakota

April 26 Planting Date

May 10 Planting Date

May 23 Planting Date

June 7 Planting Date
SUNFLOWER PRODUCTION PRACTICES

• Planting Rates
  – Rows:
    • Oil types – 18,000 to 22,000
    • Confection types – 15,000 to 18,000
  – Solid Seeded:
    • Oil types – 24,000 to 28,000
    • Confection types – 18,000 to 22,000
## Sunflower Yield Vs. Plant Population

### 6 Locations, 12 Trials - Minnesota

<table>
<thead>
<tr>
<th>Plants/A</th>
<th>Yield, Lbs/A</th>
<th>Head Dia. Inches</th>
<th>Head Moisture</th>
</tr>
</thead>
<tbody>
<tr>
<td>7,000</td>
<td>1644</td>
<td>11</td>
<td>43</td>
</tr>
<tr>
<td>10,000</td>
<td>1987</td>
<td>10</td>
<td>34</td>
</tr>
<tr>
<td>15,000</td>
<td>2278</td>
<td>8</td>
<td>25</td>
</tr>
<tr>
<td>20,000</td>
<td>2513</td>
<td>8</td>
<td>22</td>
</tr>
<tr>
<td>25,000</td>
<td>2630</td>
<td>7</td>
<td>20</td>
</tr>
</tbody>
</table>
Non-Oilseed Population Study
2 Trials, Minnesota

<table>
<thead>
<tr>
<th>Pop.</th>
<th>Yield</th>
<th>Seeds/Head</th>
<th>Large* Seed %</th>
</tr>
</thead>
<tbody>
<tr>
<td>15,000</td>
<td>1528</td>
<td>373</td>
<td>52</td>
</tr>
<tr>
<td>20,000</td>
<td>1567</td>
<td>310</td>
<td>44</td>
</tr>
<tr>
<td>25,000</td>
<td>1705</td>
<td>281</td>
<td>33</td>
</tr>
<tr>
<td>30,000</td>
<td>1608</td>
<td>229</td>
<td>31</td>
</tr>
</tbody>
</table>
PRODUCTION PRACTICES

• Planting Rates
  – Lower populations in drier soils, higher under irrigation
  – North/South vs. East/West rows?
    • NS probably better, heads hang between rows
    • Harder for birds to feed
    • Less damage and shattering during storms
### Sunflower Row Spacing Trial 1996

<table>
<thead>
<tr>
<th>Hybrid</th>
<th>Row Spacing, inches</th>
<th>Yield, lb/a</th>
<th>Oil Content, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>DeKalb 3790</td>
<td>7.5</td>
<td>2592</td>
<td>47.5</td>
</tr>
<tr>
<td>DeKalb 3790</td>
<td>15</td>
<td>2416</td>
<td>47.4</td>
</tr>
<tr>
<td>DeKalb 3790</td>
<td>30</td>
<td>2150</td>
<td>47.6</td>
</tr>
<tr>
<td>Pioneer 6150</td>
<td>7.5</td>
<td>2547</td>
<td>43.7</td>
</tr>
<tr>
<td>Pioneer 6150</td>
<td>15</td>
<td>2754</td>
<td>44.5</td>
</tr>
<tr>
<td>Pioneer 6150</td>
<td>30</td>
<td>2231</td>
<td>44.7</td>
</tr>
</tbody>
</table>

Source: USDA-ARS, Mandan, ND
Considerations for Narrow row sunflower production

• Narrow row seeding may be susceptible to crusting because the distance between seeds is larger
• Best to consider 12 to 18 inch rows
• Full season hybrids have worked well. No need for short season hybrids (unless under late planting conditions)
Considerations for Narrow row sunflower production

• Perennial weeds need to be controlled before thinking of seeding sunflower – conventional or narrow rows.

• Weed control options (cultivation) are reduced when going with narrow rows so do not reduce rates of incorporated herbicides – use maximum rates for the soils in the field
Sunflower conventional and strip till
### Effects of tillage on oilseed sunflower yield, Carrington, 1988-97

<table>
<thead>
<tr>
<th>Tillage System</th>
<th>Sunflower seed yield (Pounds/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional</td>
<td>1377</td>
</tr>
<tr>
<td>Minimum</td>
<td>1371</td>
</tr>
<tr>
<td>No-till</td>
<td>980</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td>103</td>
</tr>
</tbody>
</table>
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
How to Improve Plant spacing
Checking Seed-placement

- **Planter Preparations**
  - Adjust seed drop
  - Check and adjust for seed depth
  - Adjust seed monitor for spacings

Repeat when changing hybrids, lots, seed sizes, etc.
Poor crop establishment

- Poor water conditions at planting
- High intensity rain causing surface crusting
- High temp causing rapid soil drying and hypocotyl damage
- Insect pest in the soil
- Inappropriate planting technique
- Poor seed quality
## Oilseed Hybrid 894

<table>
<thead>
<tr>
<th>Seeding Depth (Inches)</th>
<th>% Emergence (2 Yr Average)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 inch</td>
<td>88.0</td>
</tr>
<tr>
<td>3 inch</td>
<td>89.0</td>
</tr>
<tr>
<td>4-1/2 inch</td>
<td>82.7</td>
</tr>
</tbody>
</table>
Emerging to VE
Vegetative Stages

True leaf - 4 cm

V-12

Reproductive Stages

Less than 2 cm

More than 2 cm

Figure 4. Stages of sunflower development
(Legend on next page.)
Sunflower Downy Mildew

- Stunting, yellow leaves, distorted growth, chlorosis along main veins (systemic infection)

- Undersides of leaves may have a white, cottony growth; Topsides may have chlorosis
Downy Mildew
Sunflower beetle
PRODUCTION PRACTICES

• Reproductive Stages
  – R1 Starts with the appearance of bud
PRODUCTION PRACTICES

• Reproductive Stages
  – R2 Stage starts when the neck starts to elongate
R3 Stage immature bud elongates more than 2.0 cm above nearest leaf
R5.1

- Reproductive Stages
  - R5 Beginning of flowering
    - One of the more important stages for insect control
    - Broke down into percent of head that is flowered
1993
Interstate 3311 height
Sunwheat 101 height
Interstate 3311 light
Sunwheat 101 light

light reaching the soil (%)

plant height (cm)

days after planting

Lsd I
Interseeding in Row Crops Promising

Sweet Clover Between The Rows

Central North Dakota Farmer's Methods of Adding Organic Matter

By Vern North Dakota Investigates

Interseeding Sweet Clover Has Better Chances of Surviving Than When Seeded in a Partly Cultivated Row. Several Options to Consider

It Could Pay for Itself

Dr. R. H. Green, several weeks ago, mentioned the possibility of interseeding sweet clover in crop rows as a help toward raising alfalfa and towards improving soil condition. Several farmers have already made interseeding of this type. Interseeding was done in the fall, but it is not considered too late to make the practice at this time. Interseeding should be done as late as possible while the soil is plowed, or as early in the spring as possible to assure good growth of the crop. Sweet clover has been used with good results as a cover crop in Canada and is now being used to some extent in the United States. The main objection to the use of sweet clover as a cover crop is that it is a good source of food for wintering weeds and rodents. The crop is of more value as a cover crop than as a forage crop, but it is still much cheaper than most other cover crops. The cost of seeding is about the same as for other cover crops, but the yield of dry matter is much better. Sweet clover is a good forage crop, but it is not as good as other crop crops in terms of yield and quality of forage. It is a good practice to interseed sweet clover between the rows of crops, as it helps in conserving soil, improves soil structure, and provides a good source of food for wintering weeds and rodents.
Hairy vetch in Sunflower

• Seeding hairy vetch at the right time (V4) will provide about 1400 LB of dry matter to the system
R5.9
Figure 3. Details of the head of a sunflower and selected parts.
Sunflower bud moth
Sunflower bud moth damage
Sunflower bud moth damage
Sunflower Head Maggot Injury

• Seed sterility
• Tunneling through ovaries (seeds)
• No webbing (webbing indicates banded sunflower moth or sunflower moth)
Sunflower Head Maggot Injury
Sunflower head maggot damage
Sunflower Maggots

Related to the fruit fly

Not major problem in sunflower regions

Infests plants in early June

Overwinters as pupae in soil

Plants can have up to 30 larvae with minimal decline yield

Lodging is a result of excess nitrogen and larvae?
**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.
Influence of Weed Removal in Sunflower
## Timing of weed control

<table>
<thead>
<tr>
<th>Weeding: weeks after emergence</th>
<th>Sunflower yield in lb/a</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1527</td>
</tr>
<tr>
<td>2</td>
<td>1407</td>
</tr>
<tr>
<td>4</td>
<td>1142</td>
</tr>
<tr>
<td>6</td>
<td>1092</td>
</tr>
<tr>
<td>8</td>
<td>1021</td>
</tr>
<tr>
<td>10</td>
<td>999</td>
</tr>
</tbody>
</table>
Weed Management

Common broad leaves
Common grasses

Pre emergence control of weeds is best
  Tineweed
  Herbicides

Can’t control broad leaves post emergence
  Mechanical cultivation
  Clearfield varieties

Grasses can be controlled pre and post emergence
  Mechanical cultivation
  Grass specific herbicides (Poast
Sunflower yields as influenced by various weed populations (Nalewaja et al., 1972)

<table>
<thead>
<tr>
<th>Weed infestation</th>
<th>3-year yield average (lb/a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weed free</td>
<td>1581</td>
</tr>
<tr>
<td>Cultivated</td>
<td>1384</td>
</tr>
<tr>
<td>Weedy</td>
<td>739</td>
</tr>
<tr>
<td>Treatment</td>
<td>Harvest population</td>
</tr>
<tr>
<td>--------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td></td>
<td>plants/ acre</td>
</tr>
<tr>
<td>6 Day</td>
<td>20700</td>
</tr>
<tr>
<td>12 Day</td>
<td>20400</td>
</tr>
<tr>
<td>6 &amp; 12 Day</td>
<td>18800</td>
</tr>
<tr>
<td>Control</td>
<td>21900</td>
</tr>
<tr>
<td>Herbicide</td>
<td>22900</td>
</tr>
<tr>
<td>LSD (0.10)</td>
<td>NS</td>
</tr>
</tbody>
</table>
(New) Clearfield Sunflowers

Clearfield Sunflowers

- Naturally tolerant to BEYOND herbicide
- A post emergent program (grass & broadleaves) with residual
- Non GMO
- Apply BEYOND only to Clearfield tolerant hybrids
PRODUCTION PRACTICES

• Herbicides

• Express Sunflowers
  – Tribenuron;
  – ONLY APPLY TO EXPRESS SUN sunflower!
Express herbicide tolerant sunflower
August 13th
Application Avipel (Anthraquinone) Bird Repellent
Filter paper top at R 5.1

Filter paper right at R5.9
Slight differences in bird damage
Possibly because not enough
Active Ingredient on the seed.
R7
Defoliation

Figure 89. Sunflowers defoliated by hail.
Natural desiccation can be slow
Poor weather can cause decline of yield and quality
Bird predation may cause substantial losses
Staygreen trait causes timing uncertainty
25 Aug. Gly-2 application
## Oil Yields in Vermont?

<table>
<thead>
<tr>
<th></th>
<th>National Average</th>
<th>Vermont Average (2007)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canola:</td>
<td>74 gallons/acre</td>
<td>74 gallons/acre</td>
</tr>
<tr>
<td>Sunflower:</td>
<td>74 gallons/acre</td>
<td>74 gallons/acre</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

<table>
<thead>
<tr>
<th>Crude Protein:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canola 30 %</td>
</tr>
<tr>
<td>Sunflower 34 %</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fat:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canola 34%</td>
</tr>
<tr>
<td>Sunflower 15%</td>
</tr>
</tbody>
</table>
# 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 Mcal/lb</td>
</tr>
<tr>
<td>Purchased</td>
<td>36.3% DM</td>
<td>2.94 Mcal/lb</td>
<td>0.79 Mcal/lb</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>5.11</td>
<td>2.80</td>
</tr>
<tr>
<td>Purchased</td>
<td>39.1</td>
<td>5.25</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>
## Meal Nitrogen Release

<table>
<thead>
<tr>
<th>Amendment</th>
<th>2 week NO$_3$ (ppm)</th>
<th>4 week NO$_3$ (ppm)</th>
<th>8 week NO$_3$ (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunflower meal</td>
<td>6.75b</td>
<td>13.0c</td>
<td>10</td>
</tr>
<tr>
<td>Canola meal</td>
<td>14.75a</td>
<td>18.75ab</td>
<td>10.5</td>
</tr>
<tr>
<td>Mustard meal</td>
<td>10.0b</td>
<td>21.5a</td>
<td>10.8</td>
</tr>
<tr>
<td>Control (none)</td>
<td>6.75b</td>
<td>14.0bc</td>
<td>6.3</td>
</tr>
</tbody>
</table>
More Information:

- Crop and Soil Website
  www.uvm.edu/extension/cropsoil

Vermont Sustainable Job Funds Website
www.vsjf.org
Canola Production

Seed Sources
- Croplan Genetics
- Pioneer, Mycogen

Planted in April/May

Grain Drill

Seeding rate – 6 lbs per acre

Fertility – low requirements
Canola Production

Weed Control - preemergence
Harvest in August
Dry to 10-12% moisture
Easy to dry – heat not needed
Affect of Planting Date on Canola Yields from 1992-95 at Langdon ND.
Canola Production

• Spring Planting Time
  – Optimum is early in planting window
  – Cool season crop
  – Better yields during cool weather at flowering
  – Fewer flea beetles
  – Frost tolerant
  – Lower green seed percentage
Canola Production

• 8 - 14 plants per square foot optimum stand
• Seeding rate- 5 lb/a
• Seed size varies- 90,000/lb (Hybrids)
  • 140,000/lb (Open Pollinated)
• Plant 1/2” to 1” deep
• 6” to 12” row width
Early Growth Stages in Canola

0 – Pre-emergence
1 – Seedling-Cotyledons
Canola Production

Canola seeded to shallow for tineweeding
Reduced populations and reduced yields
# Canola Trials – Borderview Farm

<table>
<thead>
<tr>
<th>Variety</th>
<th>Yield (tons/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cropplan 601</td>
<td>1.58b</td>
</tr>
<tr>
<td>Oscar (OP)</td>
<td>1.30a</td>
</tr>
<tr>
<td>Cropplan Python</td>
<td>1.68b</td>
</tr>
</tbody>
</table>
## Oil Yields in Vermont?

<table>
<thead>
<tr>
<th></th>
<th>National Average</th>
<th>Stateline Farm Average</th>
<th>Borderview Farm Average (2007)</th>
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<tr>
<td>Sunflower:</td>
<td>74 gallons/acre</td>
<td>74 gallons/acre</td>
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</tr>
</tbody>
</table>
Oil Yields From Varieties

Oil Yield State Line Farm 2007

<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>
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