NUTRIENT MANAGEMENT OF OILSEED CROPS

CCA and Dealer Training
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Southern Ag Res Center, Huntley

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MSU Soil Fertility Extension
Goals

• Present influence of N rate and tillage on oilseed yields
• Present P, K and S rate recommendations
• Discuss different nutrient source options
• Present ideal fertilizer timing and placement
Questions

• How many of you have clients that have grown safflower in the last 3 years?
• Sunflower?
• Canola?
Nitrogen

• N rate is based on yield potential and soil test N
• Adjust rates for the previous crop and different areas of a field
• MT soils provide 15-20 lb nitrate-N/acre for each full percent soil organic matter (SOM) above 2%
• N rate can be reduced by about 40 lb following alfalfa and 10 to 20 lb N/acre following annual legume
• N broadcast onto small grain stubble in no-till may need additional 10 lb N/acre per 1000 lb stubble (up to 40 lb N/acre) for several years
Available-N guidelines for oilseeds (EB0161)

<table>
<thead>
<tr>
<th>Crop</th>
<th>Available N (lb N/lb seed)</th>
<th>Available N (lb N/cwt)</th>
<th>Available N (lb N/bu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunflower</td>
<td>0.045</td>
<td>4.5</td>
<td>1.06</td>
</tr>
<tr>
<td>Safflower</td>
<td>0.065</td>
<td>6.5</td>
<td>2.9</td>
</tr>
<tr>
<td>Canola</td>
<td>0.05</td>
<td>5.0</td>
<td>2.5</td>
</tr>
</tbody>
</table>

- High yielding varieties of canola tend to need less N/cwt, especially at higher N rates (Brandt et al., 2007).
Economic N for Safflower Yield at Different Water Availability

Optimal N = 12.5 (Water - 0.9)
R² = .95

Available N for max econ yield (lb/acre) vs. Available water (in.)

Huntley Fertilizer Fact 14
lb N/cwt safflower for max net revenue

available water " 
(lb N/cwt)

EB0161 has 5 lb N/cwt

What do you use?
N for safflower (Fertilizer Fact 14)

• 8 - 11 inch of water needed to produce the first lb of safflower seed. Yield increased ~2 cwt with each additional inch water

• Safflower N for max. return (optimum N levels)
  ▪ 50 lb/acre at 13 in. available water
  ▪ Increase N 12.5 lb/acre for each additional inch of water

• N levels above the optimum frequently depressed seed yields

• Variety selection exerted a greater effect on safflower seed oil content than water or N
Sunflower yield response to total available N and tillage

NT had lower residual N than MT and CT

N. Dakota Halvorson et al. 1999
Optimum available N rate from ND study: 
~7-12 lb N/cwt (sampled to 5’!)

MSU guideline: 4.5 lb N/cwt (based on 2’ sampling). 
Suggests MSU recommendation relies heavily on deep, unsampled N, OR deep N wasn’t used in ND study.

What about sunflower N removal?

1.06 lb N/bu = ~4 lb N/cwt

Conclusion: Actual sunflower available N need is likely closer to 7 lb N/cwt, but if only sample to 2’, 4.5 lb N/cwt is likely sufficient IF there is some deep nitrate. So consider soil and crop rotation (e.g. more likely sufficient N on crop fallow than recrop)
Total Available Water = soil (4.9’) water in April + rain from May-Sept

Seed Yield (lb/acre)

<table>
<thead>
<tr>
<th>Water Availability</th>
<th>MT</th>
<th>CT</th>
<th>NT</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;13.8&quot;</td>
<td>500</td>
<td>300</td>
<td>400</td>
</tr>
<tr>
<td>13.8-19.9&quot;</td>
<td>1700</td>
<td>1900</td>
<td>1600</td>
</tr>
<tr>
<td>&gt;19.6&quot;</td>
<td>1500</td>
<td>1700</td>
<td>1400</td>
</tr>
</tbody>
</table>

N. Dakota Halvorson et al., 1999

Available water, tillage and sunflower yield
Tillage and sunflower in dry and wet years

Why lower yield in wet no-till?

N. Dakota Schatz et al., 1999
• Legumes in rotation are an excellent N source
• EEFs (e.g., polymer coated, NBPT-Agrotain®, Avail®) have not shown consistent increase in yield.
• Can perhaps eliminate a spring fertilizer application
Seed-placed N

- Canola is easily damaged by seed-placed fertilizer.
- Safe seed-placed N rates depend on the soil type, soil moisture, opener width and row spacing.
- Ammonium sulfate (21-0-0-24) and urea (46-0-0) have similar safe seed-placed rates. Anhydrous ammonia (82-0-0) is not safe seed-placed (Canola Council of Canada Canola Encyclopedia).
- PCU and NBPT increase safe rates by ~2-4 fold.
EEFs increase safe seed-placed rate on canola

Swift Current, SK, Malhi et al., 2003

Less influential in wet environment
Sulfur on canola

- Canola can only respond to N if sufficient S
- If all fertilizer N is supplied with ammonium sulfate, then likely the field will receive enough S.
Sulfur

- S is critical for efficient use of N
- Canola has high demand for S early in season
- 18 lb S/acre broadcast at seeding of dryland canola = adequate
- N:S of 7:1 benefits yield if both are deficient, but ratio not important if S is sufficient
- Elemental S must be applied at least a year before oilseed crop to provide enough S. Sulfate is preferred (except in high leaching fields).
P fertilizer guidelines for canola, safflower & sunflower

<table>
<thead>
<tr>
<th>Crop</th>
<th>Olsen P soil test level (ppm)</th>
<th>P fertilizer rate (lb P$_2$O$_5$ /acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Canola</td>
<td>45</td>
<td>40</td>
</tr>
<tr>
<td>Safflower</td>
<td>50</td>
<td>40</td>
</tr>
<tr>
<td>Sunflower</td>
<td>35</td>
<td>30</td>
</tr>
</tbody>
</table>

*With P>16 ppm consider using crop removal rates:
  Canola 2.3 lb P$_2$O$_5$/cwt
  Safflower 1.25 lb P$_2$O$_5$/cwt
  Sunflower 1.14 lb P$_2$O$_5$/cwt

(EB0161)
P on Safflower

- From Canadian production manual
- Dryland soils with low soil P: 27-36 lb P$_2$O$_5$/acre with seed
- Dryland soils testing adequate in P: 13-18 lb P$_2$O$_5$/acre with seed for starter effect
- Irrigated 22-31 lb P$_2$O$_5$/acre with seed
- Max 36 lb P$_2$O$_5$/acre with seed
P and S on canola

• Canola good scavenger of P and S, so those not needed higher by higher yielding varieties – however, might deplete P and S for next crop.
# K fertilizer guidelines for canola, safflower & sunflower

<table>
<thead>
<tr>
<th>Crop</th>
<th>K soil test level (ppm)</th>
<th>K fertilizer rate (lb K$_2$O /acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>50</td>
</tr>
<tr>
<td>Canola</td>
<td>45</td>
<td>40</td>
</tr>
<tr>
<td>Safflower</td>
<td>65</td>
<td>55</td>
</tr>
<tr>
<td>Sunflower</td>
<td>55</td>
<td>50</td>
</tr>
</tbody>
</table>

With K>250 ppm consider using crop removal rates:
- Canola 1.2 K$_2$O/cwt
- Safflower 3.8 lb K$_2$O/cwt
- Sunflower 0.85 lb K$_2$O/cwt

(EB0161)
Questions?
Placement - Based largely on canola research

N – side band, pre-plant band, early spring broadcast with incorporation (tillage or > ½ inch water). Sub-surface banding increased yields by 5% over surface band (Holzapfel et al., 2007)

P – build up in prior rotation, or place in rooting zone to safe rates (no DAP for sunflower) with remainder side banded at seeding or pre-plant sub-surface band

K – broadcast in fall or winter before planting or band below and to side of seed row. Do not seed-place more than ~10 lb N+K₂O/ac.

S – seed-place, subsurface band at or before seeding, or broadcast and incorporate before seeding
Timing

- Mobile nutrients N & S: apply in early spring
- Less mobile nutrient P & K: build up in soils in prior rotation or prior to seeding, add a low rate near the seed at seeding
Timing – Canola example. Nutrients must be available BEFORE rapid growth.
Optical sensors for N mgmt. on canola

- Optical sensors, such as GreenSeeker, are a form of tissue testing for N management.
- The optimum window for using N sensor technology to recommend top-dressed N fertilizer is from approximately the 6-leaf stage (HB2.6) to the start of flowering (HB4.1; Holzapfel et al., 2009a).
- Based on SK studies, sensor-based N management resulted in a 30 lb N/acre reduction in fertilizer use with no drop in seed yield (Holzapfel et al., 2009b).
Amount and timing of split N application on canola

Lafond et al., 2008
Saskatchewan

At seeding N was subsurface mid-row or side/below seed row
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![Graph showing canola seed yield vs. N applied at seeding (% of total). The graph indicates the relationship between the percentage of N applied at seeding and canola yield. The graph has two lines: one representing Tractor impact with a peak at a certain percentage of N applied at seeding, and another representing Plant stage late-N is applied with a peak at 5-6 Leaf. The graph shows a decrease in canola seed yield as the percentage of N applied at seeding increases. The start of bolting is also marked on the x-axis.]

Lafond et al., 2008
Saskatchewan
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Lafond et al., 2008
Saskatchewan
Summary

- Deep rooting of safflower, sunflower, and canola make N needs highly dependent on deep soil N.
- Deep rooting can decrease yield of subsequent crop(s).
- Oilseeds are as, or more, sensitive than small grains to seed-placed fertilizer.
- Compared to cereals, oilseeds have lower K needs, similar P needs, and higher S needs (canola mainly).
For more information

Fertilizer Fact 14
http://landresources.montana.edu/fertilizerfacts

Soil Fertility Website
http://landresources.montana.edu/soilfertility/

We have a canola nutrient management guide in draft form that should get published this coming winter.
Questions?