Canola Soil Fertility Management

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Great Falls MT

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Question for you:
Why are there relatively few acres of canola in MT?
Objectives

I will discuss the following:

1. Nutrient considerations for canola in rotation
2. How canola needs differ from small grains
3. Soil fertility management using the right rate, source, timing and placement
Soil nutrient considerations for crop rotations that include canola

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Consideration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen (N)</td>
<td>Canola residue provides more N than wheat residue, so more important to soil test for residual soil N after canola</td>
</tr>
<tr>
<td>Phosphorus (P)</td>
<td>Canola and alfalfa are good P scavengers, deplete P for next crop</td>
</tr>
<tr>
<td>Potassium (K)</td>
<td>Canola leaves behind high K residue</td>
</tr>
<tr>
<td>Sulfur (S)</td>
<td>Canola is a good scavenger, depletes S for next crop</td>
</tr>
<tr>
<td>Other</td>
<td>Canola can reduce P, copper (Cu) and zinc (Zn) uptake by subsequent mycorrhizal crops (e.g., flax, legumes, small grains to a lesser extent)</td>
</tr>
</tbody>
</table>
Canola relative yields after other crops
Based on research at Mandan, ND, average over 4 rotations

<table>
<thead>
<tr>
<th>Residue</th>
<th>SW, Barley</th>
<th>Pea, Lentil</th>
<th>Canola</th>
<th>Sunflower, Safflower</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW, Barley</td>
<td>1.00</td>
<td>1.19</td>
<td>1.09</td>
<td>1.81</td>
</tr>
<tr>
<td>Pea, Lentil</td>
<td>1.02</td>
<td>1.00</td>
<td>1.16</td>
<td>2.04</td>
</tr>
<tr>
<td>Canola</td>
<td>0.99</td>
<td>1.00</td>
<td>1.00</td>
<td>1.67</td>
</tr>
<tr>
<td>Sunflower, Safflower</td>
<td>0.95</td>
<td>0.99</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Average</td>
<td>0.96</td>
<td>1.05</td>
<td>1.04</td>
<td>1.67</td>
</tr>
</tbody>
</table>

Adapted from Tanaka et al., 2005 and 2007, by K. McVay
Questions?

On to *deficiencies and fertilizers*
Plant symptoms – once symptoms appear, yield may already be compromised

- **Boron**
  - Image: IPNI, El Gharous
  - Image: R. Karamanos

- **Nitrogen**
  - Image: GRDC Canola Guide

- **Phosphorus**
  - Image: IPNI, El Gharous

- **Potassium**
  - Image: IPNI, Roberts

- **Sulfur**
  - Image: Gov. W. Aust., T. Potter
  - Image: R. Karamanos
Fertilizer nutrients removed by bushel of seed and total plant uptake (per bu)

Plant uptake per bu.

Removed by a bu.

Which one is canola (vs wheat)?

N is yield dependent, P, K, and S are not. Canola needs more S and K/bu but also leaves more behind.
Start with a realistic yield goal

- Use MSU’s NARC canola variety trials (http://agresearch.montana.edu/narc/varietytestingreports/variety_testing_reports_by_year.html), or successful local producers’ experience
- Having ability for in-season N application allows conservative yield estimate for pre-plant rate
- Canola requires 2.9 to 3.5 lb available N to produce a bushel of seed:
  \[(\text{soil nitrate} + \text{fertilizer}) \approx 3.25 \text{ lb/bu} \approx 6 \text{ lb/cwt}\]
Canola can access deep water (and nitrate) unless restricted by hard soil.

As yields become limited, lb avail N/bu goes up.

Economic optimal rate: ~120 – 140 lb avail N/ac for typical MT yields.

Pan et al., Crops & Soils 2017
S for canola

- Base S rate on field history, crop appearance, response to test strips, tissue & soil testing.
- S varies greatly across a field but if <20 lb S/acre (to 2 ft. depth) then likely limiting
- 18-20 lb S broadcast at seeding or 9 lb S/acre w/seed (BEWARE – very sensitive to seed placed fertilizer)
- 0.5 lb S/bu yield potential as 8-0-0-9, 21-0-0-24, or 12-0-0-26 (amm thiosulfate) as an in-season rescue through rosette (Janzen and Bettany, 1984)
Canola can only respond to N if S is not limiting; S helps most when N is sufficient.

Open pollinated variety, N and S broadcast and incorporated just prior to seeding. Malhi et al., 2007

N:S of 7:1 only helpful if both are deficient, otherwise irrelevant. (Karamanos et al., 2007)
Can soil fertility affect canola maturity?

- Starter P important for an early start
- Excess N slows maturity, especially in dry years or with delayed seeding
- Sufficient S needed before elongation stage for earlier maturity, insufficient or late S extends flowering period and reduces yield

(Janzen & Bettany, 1984, greenhouse study)
Questions?

On to *source, timing and placement*
Other N sources

- Polymer coated urea
- Legumes

- Polymer coated are safer seed-placed than urea
- PCU release is too slow in cool, dry conditions to provide enough N early on – consider blending

Malhi et al., 2003
<table>
<thead>
<tr>
<th></th>
<th>2-plus years prior</th>
<th>Prior crop</th>
<th>Fall</th>
<th>Spring, before or at seeding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfate – on soil surface or incorporated</td>
<td>😞</td>
<td>😞</td>
<td>😞</td>
<td>😊</td>
</tr>
<tr>
<td>Elemental-S incorporated</td>
<td>😊</td>
<td>😞</td>
<td>😞</td>
<td>😞</td>
</tr>
<tr>
<td>Rapid release elemental-S</td>
<td>😞</td>
<td>😞</td>
<td>😊</td>
<td>😞</td>
</tr>
</tbody>
</table>

- 😊 ideal
- 😞 not ideal but may benefit yield
- 😞 not recommended
Fertilizer needs to become ‘plant available’ but not be lost from system.

Application timing depends on source.
Application generalizations

**N:** Ideally split application, 50 to 65% of N at seeding, remainder adjusted to current production potential by 5- to 6-leaf stage.

**S:** Rescue broadcast or foliar up to early flowering, followed by rain/irrigation. Foliar after 5\(^{th}\) leaf emergence to minimize leaf burn.

**P and K:** before or at seeding
Placement: N

To minimize volatilization loss:

- side or pre-plant band >2” deep prior to packing
- early-spring broadcast with incorporation
- if seeder can’t place N deep, consider NBPT (e.g., Agrotain®)
- 28-0-0, 32-0-0 better subsurface than surface band

Dick, Nebo, Holzapfel, Tenuta, unpub data, western prairie provinces courtesy Karamanos
To avoid toxicity to root growth, avoid seed row or directly below seed row. See Crops & Soils Magazine, May-June 2017.

Wheat creates early lateral roots to avoid fertilizer band, so it's less sensitive than canola. (Pan et al., 2017)

A urea band 2” below seed canola roots.

“A” points to the end of canola roots.

0 urea below seed.

5 cm
Pan et al., 2017

(Wheat creates early lateral roots to avoid fertilizer band, so it's less sensitive than canola.)
Seed-placed guidelines

Seed row safe rates depend on source and seed bed conditions

- heavy clay soil >> coarse
- high SOM >> low SOM
- high moisture >> dry soils
- low pH >> high pH

Equipment

Use wide openers, or put fertilizer in knife and seed in fertilizer slot

Use SDSU/IPNI online safe seed-placed rate calculator

Nyborg & Henning 1969, AB and BC
• A combination of deficiency symptoms, soil testing, and tissue testing may be best approach at identifying deficiencies. This is NOT an exact science.
• Micronutrient deficiencies are exception, not rule
• Cool wet conditions cause deficiency – likely disappear when weather warms (unless get very high yields)
• Too much of some micros (e.g. B) can hurt yield more than not enough
• The main challenge is even distribution of a very small quantity – consider foliar application
Summary

- Use soil tests
- Ensure nutrients are available before stem elongation
- Adjust N in-season to reflect the growing season
- Need adequate S to ensure N response
- Low rates of seed-placed or side-banded P and S promote a healthy start
- Beware of seed-placed fertilizer toxicity
- Consider pulse crop rotation before canola
For more information and this presentation see MSU Soil Fertility Website
http://landresources.montana.edu/soilfertility/

*Soil Nutrient Management for Canola* (EB0224) – under ‘Extension publications’

*Canola: Nitrogen & Sulfur Management* and *Canola: P, K, & Micronutrient Management* – both under ‘Soil Scoop’

Canola Council of Canada *Canola Encyclopedia*
http://www.canolacouncil.org/canola-encyclopedia/

Safe seed-placed fertilizer rate calculator: SDSU and IPNI
Online Fertilizer Damage Tool
http://seed-damage-calculator.herokuapp.com/
QUESTIONS?

Image by K. Olson-Rutz