Canola growth and development

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Better Crops, Better Environment ... through Science

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Two things happening

• The crop gets bigger
  – **Growth** = increase in size and weight
  – Driven by light, nutrients, water, temperature

• The crop changes what part is growing
  – **Development** = different types of tissue grow
  – Driven by temperature (usually) & daylength
Canola growth key

- DC or Z scale for cereals.
- Canola uses a different scale because it is an indeterminate flowering habit which means that flower production and grain filling are concurrent.
- Communication
  
  Especially with respect to herbicide and fertilizer application
  Situations where timing is critical
Canola Growth Scale – 6 Stage

Stage 0

Vegetative growth

Stage 1

Stage 2

Stage 3

(Adapted from NSW Canola Guide)

Stage 4

Stage 5

Stage 6
First Phase Change - Germination

- Canola seed has almost no dormancy
- Seed takes on water
- Coat splits
- Seedling root emerges – coleorhiza
- Seedling leaves taken to the surface
Germination leads to emergence

- Cotyledon leaves – previous “halves” of the seed
- Quite delicate and both frost and disease susceptible
Thermal Time & Germ./Emerg.

• Is the sum of temperatures “sensed” by the plant
• Measured as “degree-days”
• $^\circ$d = Sum of daily (Min+Max)/2 above a “base” temperature.
• **Canola seed requires around 80 $^\circ$d (base 3$^\circ$) to get from germination to emergence.**
  - It will take **10 days** of minimum 7 and maximum 15, to get from germination to emergence. $(7-3+15-3)/2 = 8$ $^\circ$d each day
  - It will take **20 days** of minimum 4 and maximum 10, to get from germination to emergence. $(4-3+10-3)/2 = 4$ $^\circ$d each day
  - triazine post-sowing/pre-emergence window
Early Development

- Cotyledons are the original “halves” of the seed (2=dicot).
- “Cabbage” stages, Leaf numbers often quoted.
- Rapid cover
  - Weed control
  - Reduce soil evaporation
  - Capture radiation

2 leaf stage

True leaves

Cotyledons (seed leaves)
Growth and Development are different

Ground cover of Dunkeld and Pinnacle at the same 4-5 leaf growth stage

Dunkeld (LAI = 0.53)  Pinnacle (LAI = 0.26)
Leaf & canopy development

- Most Australian lines are “spring” types.
- Retain enough daylength response to develop a canopy.
- Canola can produce between 9 and 30 leaves per stem.
- Temperature driven
  - 80 °d/leaf – variety specific (phyllocron)
- Earlier cv.s have fewer leaves.
Importance of timing - herbicides

- Roundup Ready® – genes for tolerance to glyphosate work fail after the 6 leaf stage of development
  - 0-2 leaf + 4-6 leaf recommended for double hit (14 d apart)
  - Min 5, Max 15 = will progress 1 leaf per 8 days
  - Min 10, Max 20 = will progress 1 leaf each 5 days
- Intervix® – also 2-6 leaf stage – weed emergence rather than crop susceptibility.
Importance of timing - grazing

- Sow early
- Winter types – 2-4 t/ha
- Support 0.2–0.3 kg/hd/d
- No health issues.
- Grazing from 5 leaf to running up <10 cm.
- Herbicide withholding periods
  - Intervix - 5 weeks
  - Select – 3 weeks
- Blackleg worse
Phase Change – veg/rep.

• Measure the season by
  – Going through a cold time (<3°C) (vernalization)
    • Most Australian lines have a VRN requirement (small ~20 days to meet)
    • Not getting a cold period holds the crop vegetative.
  – Checking on the length of day (daylength) = spring type
    • In most of our varieties critical daylength LONGER than ~11 h
      – Suppresses flowering until late July/early August from a “normal” sowing
      – If sown really early, may get DL met in autumn rather than spring.
  – Waiting until they are big enough (9-15 leaves) – thermal time (Intrinsic earliness)
    • 300 to 500 °d from emergence to flowering (variety).
Period of maximum growth

- From buds visible until flowering
- Stem rapidly grows and carries the buds upwards
- Peak N demand.
- Attention to nutrition over this period
Timing for tissue testing

- Can test for N, S, micros.
- Depend on tissue – YML or whole shoot
- Rapid decline in critical values –
- Must know the stage to interpret.
- If too early maybe roots not down to the nutrient present (S, B).

<table>
<thead>
<tr>
<th>STAGE</th>
<th>NO$_3$ (mg/kg)</th>
<th>S (%)</th>
<th>B (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-5 leaf</td>
<td>17000</td>
<td>&lt;25</td>
<td>&lt;25</td>
</tr>
<tr>
<td>5-6 leaf</td>
<td>15000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6-8 leaf</td>
<td>6700</td>
<td>0.38</td>
<td></td>
</tr>
<tr>
<td>Buds Visible</td>
<td>4000</td>
<td>0.36-0.5</td>
<td></td>
</tr>
<tr>
<td>2 Early SE</td>
<td>3300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SE</td>
<td>1300</td>
<td>0.55</td>
<td></td>
</tr>
<tr>
<td>First Fl</td>
<td>800</td>
<td>0.24-0.3</td>
<td></td>
</tr>
<tr>
<td>Petiole YML</td>
<td></td>
<td>Whole Shoot</td>
<td>YML</td>
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</tbody>
</table>
Diagnosis of N deficiency

- N is mobile
- If the crop is running out of N it will “drop” its oldest leaves
- Read this with care understanding
  - Disease
  - Drought
- Good diagnostic for N
- S deficiency will show in youngest leaves.
Timing of topdressing

- Nitrogen at Wallup 2011: high = 100, Mod = 50, Low = 10 kg N/ha
  - Before flowering important.
  - Rate was more important than timing

<table>
<thead>
<tr>
<th>Rate</th>
<th>All predrilled</th>
<th>All topdressed stem elongation</th>
<th>All topdressed early flowering</th>
<th>50:50 split; predrilled &amp; topdressed stem elongation</th>
<th>50:50 split; predrilled &amp; topdressed early flowering</th>
<th>Control (no added N)</th>
<th>LSD (5%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>2.11</td>
<td>2.30</td>
<td>1.92</td>
<td>2.10</td>
<td>2.16</td>
<td>1.36</td>
<td>0.33</td>
</tr>
<tr>
<td>Moderate</td>
<td>1.80</td>
<td>2.11</td>
<td>1.63</td>
<td>2.03</td>
<td>1.69</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>1.60</td>
<td>1.37</td>
<td>1.67*</td>
<td>1.55</td>
<td>1.32</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Similar situation for S topdress

- Data from P Hocking.

<table>
<thead>
<tr>
<th>S applied Kg/ha</th>
<th>Sowing</th>
<th>5-6 Leaf</th>
<th>Buds Visible</th>
<th>Stem Elongation</th>
<th>LSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>1.73</td>
<td>1.62</td>
<td>1.56</td>
<td>1.41</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>2.15</td>
<td>2.26</td>
<td>2.11</td>
<td>2.19</td>
<td>0.43</td>
</tr>
</tbody>
</table>
Flowering period

- Initially a slow rate
- Up to 20 new flowers per plant per day.
- Later flowers not usually big contributors to final yield.
- Duration continues as long as temperatures favourable (<32 C).
- Leaves remobilized into seed/pods.
- Very thick canopies can shade themselves.
Cabbage aphid

- Canola can tolerate quite a lot of aphid damage
- Occur in warm dry conditions.
- Often by this time the parts affected are not likely to contribute to added yield.
- BUT – make an assessment. Yield losses of 30% have been measured.
Completed Flowering

- Moisture stress and/or high temperatures terminate flower development.
- Pods still photosynthetic, oil biosynthesis very active until the crop dries.
Time between last flower & windrowing –
How long does it take to dry the washing?
Maturity

- Moisture content declines
- Oil biosynthesis slows.
- Some fatty acid alterations (temp.)
- Dries from top down.
- About 30 days after last flower is seen (temp. dependant.)
Seed maturity

- Chlorophyll significant oil contaminant.
- Green seed = bad.
- Timing of windrowing.
- 50-60% colour change.
http://anz.ipni.net

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