Hybrid Canola – Plant Populations 101

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Why are plant populations important?

• Maximize yield potential
• Maximize net revenue
• Weed competition
• Crop uniformity
• Shorten crop maturity
• Lodging
Plant density is more important than actual seeding rate!!!

Gone are the days of bushel and a peck!
Seed Size

2.9 TKW          5.5 TKW           7.3 TKW
(100 seeds of each)
ратив 80plants m⁻²
2.9 TKW = 4.6 kg/ha
5.5 TKW = 8.8 kg/ha
7.3 TKW = 11.7 kg/ha
How should you calculate seeding rates?

- Thousand kernel weight (grams)
- Expected emergence (%) – Usually 40-60% for canola
- Target plant population (plants m\(^{-2}\))

Seeding rate (kg/ha) = \textit{target population} \times \frac{TKW}{\text{expected seedling survival}}

Ex. Canola = \frac{80 \times 5}{50} = 8 \text{ kg/ha (7 lbs/acre)}
Canola Council of Canada recommends targeting for at least 70-140 plants m⁻² (7-14 plants ft⁻²).

Yield is generally compromised at plant stand below 50 plants m⁻² (5 plants ft⁻²).
Canola Council of Canada Recommendation
< 50 plant m\(^{-2}\)

• Where did this number come from?
  • CCC - canola manipulation trials 1999 – 2002
  • Dr. Gan -2003 study
  • Dr. Shirtliffe, 2009 meta-analysis of 35 experiments
### Canola Manipulation Trial Results (CCC 2002)

<table>
<thead>
<tr>
<th>Seeding Rate (lbs/acre)</th>
<th>Plants/m²</th>
<th>Yield (bu/ac)</th>
<th>Average Maturity (days)</th>
<th>Range Maturity (Days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Planting Date</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>20</td>
<td>30</td>
<td>103</td>
<td>84-122</td>
</tr>
<tr>
<td>3</td>
<td>50</td>
<td>35</td>
<td>99</td>
<td>82-113</td>
</tr>
<tr>
<td>5</td>
<td>80</td>
<td>37</td>
<td>98</td>
<td>82-113</td>
</tr>
<tr>
<td>Normal Planting Date</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>28</td>
<td>31</td>
<td>100</td>
<td>81-114</td>
</tr>
<tr>
<td>3</td>
<td>59</td>
<td>36</td>
<td>98</td>
<td>81-113</td>
</tr>
<tr>
<td>5</td>
<td>95</td>
<td>37</td>
<td>97</td>
<td>80-111</td>
</tr>
</tbody>
</table>
Dr. Gan and associates (1999-2001)

![Graph showing seed yield as a function of plant population for different years with regression equations and $r^2$ values.]

- **1999**: $Y = 45.2 + 1.4X - 0.009X^2$, $r^2 = 0.80$
- **2000**: $Y = 76.3 + 1.1X - 0.010X^2$, $r^2 = 0.83$
- **2001 ES**: $Y = 36.0 + 1.5X - 0.009X^2$, $r^2 = 0.99$
- **2001 LS**: $Y = 4.6 + 2.4X - 0.015X^2$, $r^2 = 0.90$
- **Mean**: $Y = 56.1 + 1.5X - 0.011X^2$, $r^2 = 0.83$
Shirtliff & Hartmann (2009)
Other factors leading up to this project:

1. **Late spring frosts** = many acres of canola affected, reseeding decisions
2. **New hybrids available** – high yields even with lower plant densities
3. **Increasing seed costs** – producers wanting to reduce seeding rates
Questions:

At low plant populations can new hybrids compensate?

At what population is yield of hybrid canola reduced?

Does it pay to re-seed?

What should we target for plant populations?
Plant Population Trial

Objective: Determine the minimum plant population required to reach maximum hybrid canola yield
5 locations (2010 – 2012)

• Scott - WARC
• Saskatoon – U of S
• Melfort - NARF
• Swift Current – Wheatland Conservation
• Indian Head – IHARF

• Total usable site years = 11
• 5440 LL variety used
5, 10, 20, 40, 80, 150, 300 seeds/m²

5 seeds/m²

150 seeds/m²
Plant Populations and Yield Potential

Canola Council of Canada
Influence of Seeding Rate on Canola Yield

Yield (bu/ac) vs. Seeding rate (seeds m\(^{-2}\))

- Points labeled d, e, and f show a significant increase in yield with increasing seeding rate.
- Points labeled c and bc indicate a moderate increase in yield.
- Points labeled a, ab show a plateau in yield, suggesting optimal seeding rate.

The graph illustrates the relationship between seeding rate and canola yield, highlighting the optimal range for maximizing yield.
90% of maximum yield achieved at 18 plants m⁻²

100% of maximum yield achieved at 28 plants m⁻²
90% of maximum yield achieved at 18 plants m$^{-2}$

100% of maximum yield achieved at 28 plants m$^{-2}$
Effect of Plant Population on Total Pods per Plant

Data from Scott in 2010
Canola Plasticity.....
Other considerations….

**Extension of Flowering Length (days) (n=7)**

- Days: 0, 2, 4, 6, 8, 10, 15, 30
- Seeding Rate: 5, 10, 20, 40, 80, 150, 300

**Extension of Maturity (days) (n=9)**

- Days: 0, 2, 4, 6, 8, 10
- Seeding Rate: 5, 10, 20, 40, 80, 150, 300
Plant Population Study Conclusions

• Maximum yield can be reached, on average, with 28 plants/m² (15-41 range) under good environmental conditions

• A **uniform** plant stand is crucial at low plant populations

• Good weed control is important with low plant populations

• When plant stands are inadequate, what are our options?
Re-Seeding Canola Trial

Objective: Determine the yield response and economic returns of re-seeding canola
Treatments

Control
• 5440 LL – 40 seeds/m² (low plant population)
• 5440 LL – 150 seeds/m² (high plant population)
• Seeded Early- to Mid-May

Re-seeded
• 5440 LL – 150 seeds/m²
• 9350 RR – 150 seeds/m²
• ACS-18 polish – 150 seeds/m²
• Seeded Early- & Mid-June
Early May (Low Population)

Early May (High Population)

Early June (Re-Seed)

Mid June (Re-seed)

Photos taken July 20, 2012 (Scott)
Low vs. Normal Early May (5440LL)

(July 27, 2011 - Scott)
Early June vs. Mid June (5440LL)

(July 27, 2011 - Scott)
Early June vs Mid June (9350 RR)

(July 27, 2011 - Scott)
Early June vs Mid June (Polish – ACS-C18)
Average Yield Response to Various Re-Seeding Dates and Cultivars

<table>
<thead>
<tr>
<th></th>
<th>Early May</th>
<th>Early June</th>
<th>Mid June</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low Pop.</td>
<td>High Pop.</td>
<td>Low Pop.</td>
</tr>
<tr>
<td></td>
<td>5440 LL</td>
<td>9350 RR</td>
<td>ACS</td>
</tr>
</tbody>
</table>

(12 site years)
Frequency of Sample Grade based on % Green Seed

- Low Pop. High Pop.
- 5440 LL
- 9350 RR
- ACS

<table>
<thead>
<tr>
<th></th>
<th>Early May</th>
<th>Early June</th>
<th>Mid June</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Pop.</td>
<td>5440 LL</td>
<td>9350 RR</td>
<td>ACS</td>
</tr>
<tr>
<td>High Pop.</td>
<td>5440 LL</td>
<td>9350 RR</td>
<td>ACS</td>
</tr>
<tr>
<td></td>
<td>5440 LL</td>
<td>9350 RR</td>
<td>ACS</td>
</tr>
</tbody>
</table>
Economic Analysis - Cost Calculations

Seeding (5 lbs/acre) or (5.6 kg/ha)

- Hybrid $12.4/lb = $62/acre
- Polish $4.75/lb = $23.75/acre
- Seeding $15.44/acre

(Seed costs obtained in spring 2013 from industry and seeding cost from Custom Rate Guide)
### In Crop Herbicide Application Costs

<table>
<thead>
<tr>
<th>Type</th>
<th>Herbicide</th>
<th>Cost</th>
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</thead>
<tbody>
<tr>
<td>LL Canola</td>
<td>Liberty</td>
<td>$10.50/acre</td>
</tr>
<tr>
<td></td>
<td>Centurion</td>
<td>$3/acre</td>
</tr>
<tr>
<td>RR Canola</td>
<td>Glyphosate</td>
<td>$2.25/acre  (0.5L)</td>
</tr>
<tr>
<td>Polish</td>
<td>Muster</td>
<td>$20/acre</td>
</tr>
<tr>
<td></td>
<td>graminicide</td>
<td>$6/acre</td>
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</table>

Spraying application cost $5/acre
# Extra Expenses Associated with Reseeding

<table>
<thead>
<tr>
<th></th>
<th>Spring Seeded</th>
<th></th>
<th>Reseeded Crops</th>
<th></th>
<th></th>
<th>ACS-18</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>5440LL Normal</td>
<td>5440LL low pp</td>
<td>5440LL</td>
<td>9350</td>
<td>ACS-18</td>
<td></td>
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<tr>
<td>seed</td>
<td>$62.00</td>
<td>$62.00</td>
<td>$23.75</td>
<td></td>
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<td>$23.75</td>
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<tr>
<td>seeding equipment</td>
<td>$15.44</td>
<td>$15.44</td>
<td>$15.44</td>
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<tr>
<td>in crop herb</td>
<td>$24.00</td>
<td>$24.00</td>
<td>$13.50</td>
<td>$2.25</td>
<td>$26.00</td>
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<tr>
<td>burn to reseed</td>
<td>$-</td>
<td>$-</td>
<td>$2.25</td>
<td>$2.25</td>
<td>$2.25</td>
<td></td>
</tr>
<tr>
<td>spray cost</td>
<td>$10.00</td>
<td>$10.00</td>
<td>$10.00</td>
<td>$10.00</td>
<td>$10.00</td>
<td></td>
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<tr>
<td><strong>TOTAL</strong></td>
<td>$34.00</td>
<td>$34.00</td>
<td>$103.19</td>
<td>$91.94</td>
<td>$77.44</td>
<td></td>
</tr>
</tbody>
</table>

Extra Costs for reseeding

- **Spring Seeded**: $69.19
- **9350**: $57.94
- **ACS-18**: $43.44
Re-seeding gain or loss compared to leaving low plant stand

<table>
<thead>
<tr>
<th>Seeding Date</th>
<th>early May</th>
<th>early June</th>
<th>Mid June</th>
</tr>
</thead>
<tbody>
<tr>
<td>INCOME</td>
<td>5440LL 5440LL</td>
<td>5440LL 9350 ACS-18</td>
<td>5440LL 9350 ACS-18</td>
</tr>
<tr>
<td>Normal low pp</td>
<td>37.9 27.6</td>
<td>37.3 32.3 20.3</td>
<td>22.7 22.2 16.7</td>
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<tr>
<td>crop value $/acre</td>
<td>$492 $359</td>
<td>$485 $419 $264</td>
<td>$295 $289 $217</td>
</tr>
<tr>
<td>Added expenses</td>
<td>$69 $58 $43</td>
<td>$69 $58 $43</td>
<td>$69 $58 $43</td>
</tr>
<tr>
<td>Difference from low pp</td>
<td>$133</td>
<td>$57 $2 ($139)</td>
<td>($134) ($128) ($186)</td>
</tr>
</tbody>
</table>

(Crop Value = $13 bu)
# With SCIC Establishment Benefit ($60/acre)

<table>
<thead>
<tr>
<th>Seeding Date</th>
<th>early May</th>
<th>early June</th>
<th>Mid June</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INCOME</strong></td>
<td>5440LL</td>
<td>5440LL</td>
<td>5440LL</td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td>low pp</td>
<td>ACS-18</td>
</tr>
<tr>
<td>yield (bu/acre)</td>
<td>37.9</td>
<td>27.6</td>
<td>37.3</td>
</tr>
<tr>
<td></td>
<td>32.3</td>
<td>20.3</td>
<td>22.7</td>
</tr>
<tr>
<td></td>
<td>22.2</td>
<td>16.7</td>
<td>16.7</td>
</tr>
<tr>
<td>crop value $/acre</td>
<td>$492</td>
<td>$359</td>
<td>$485</td>
</tr>
<tr>
<td></td>
<td>$419</td>
<td>$314</td>
<td>$295</td>
</tr>
<tr>
<td></td>
<td>$217</td>
<td>$217</td>
<td>$217</td>
</tr>
<tr>
<td>Added expenses</td>
<td>$69</td>
<td>$58</td>
<td>$43</td>
</tr>
<tr>
<td>Difference from low pp</td>
<td>$133</td>
<td>$57</td>
<td>($13) ($128) ($186)</td>
</tr>
<tr>
<td>Add SCIC reseeding Benefit</td>
<td>$117</td>
<td>$62</td>
<td>($79) ($74) ($68) ($126)</td>
</tr>
</tbody>
</table>
SCIC Re-seeding Program

Hybrid Canola

- 40+ Established
- 12 – 40 Choice
- <12 Not Established

- Other factors also considered (uniformity across field, plant vigor, frost free days, etc.)
- Will pay $60/acre
## Gain or loss where plant density in SCIC Choice Range

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<tr>
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</thead>
<tbody>
<tr>
<td>plts/m²</td>
<td>29</td>
<td>28</td>
<td>19</td>
<td>18</td>
<td>17</td>
<td>16</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>5440LL</td>
<td>$297</td>
<td>$68</td>
<td>$37</td>
<td>($129)</td>
<td>($6)</td>
<td>($156)</td>
<td>$19</td>
<td>$79</td>
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<tr>
<td>9350RR</td>
<td>$222</td>
<td>($18)</td>
<td>$4</td>
<td>($87)</td>
<td>$30</td>
<td>($133)</td>
<td>$3</td>
<td>$63</td>
</tr>
</tbody>
</table>

### Choice Range

- 50/50 chance no SCIC for reseed to pay
- 40/60 chance with SCIC for reseed to pay
Summary of Economics

• Best to target good plant populations in the first place (70-140 plants m$^{-2}$)

• What to do when “stuff” happens
  • Re-seeding to polish canola does not pay
  • Re-seeding to canola in mid June does not pay
  • Re-seeding to high yielding hybrid canola in early June when in the choice range (12-40 plants m$^{-2}$) has 50% chance of showing positive returns
  • SCIC EB ($60/acre) makes re-seeding in early June the more economical choice and helps cover risks
Things to consider

• EB with SCIC does cover extra costs to re-seed
• Re-seeding when in choice range provides also gives you production coverage (up to 80%)
• When in “choice range”, make decisions to re-seed based on:
  • Plant uniformity of field
  • Ability to control weeds
  • Soil moisture conditions and forecasts
  • Harvest management (low plant stands more variable)
Questions:

At low plant populations can new hybrids compensate?

YES by branching

At what population is yield of hybrid canola reduced?

WARC - 28 (15 to 41) vs 50 (Gan & CCC) for max yield

WARC – 18 vs 45 (Shirtliff) to achieve 90% max yield

SCIC – 12 - 40 is range of choice
Does it pay to re-seed?

Not in mid June and not to polish canola

50/50 chance without SCIC early June

SCIC EB covers additional reseeding costs

• Make decisions based on:
  • Uniformity of field
  • Ability to control weeds
  • Soil moisture conditions and forecasts
  • Harvest management (low plant stands more variable)
  • Frost free days left in growing season
What should we target for plant populations?

Good question....
We know < 41-50 plants m⁻² yields can start decreasing
Target 1.5 to 2x this rate = 60 to 100 plants/m²
CCC recommendation of 70 as a minimum ..... up to 140?
Thank You

• SaskCanola – Pat Flaten
• Site Collaborators:
  • IHARF – Indian Head – Chris Holzapfel
  • NARF – Melfort – Cecil Vera
  • U of S – Saskatoon – Steve Shirtliff
  • Wheatland Conservation – Swift Current – Bryan Nybo
• Sherrilyn Phelps, Anne Kirk, Tristan Coelho, Morley Ayars, & Eric Johnson