GUIDEBOOK FOR

# STRAIGHT CUTTING CANOLA

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# QUICK TIPS

- **Seed early,** to allow time for natural drying
- **Shatter-resistant varieties pose a lower risk for environmental losses**
  - *Varieties labeled as such vary widely in terms of high shelling loss*
- **Start off small – make sure the change fits with your operations**
- **Rigid, Draper, and Extended-Knife headers all work**
  - *Rigid loss typically higher than other two methods*
- **Fixed, Rotary Knife, and Vertical Crop Dividers all work**
  - *Dividers are a major source of harvest loss*
  - *Rotary dividers tend to have greater loss*
- **Natural drying** will work in many situations
  - *Dry, mature stalks preferable; can be obtained via natural drying or desiccation (desiccation not studied as part of this project)*
- **Potential for economic benefit to straight cutting**
- **All harvest systems resulted in similar crop quality under the conditions tested**
  - *Overall crop management and harvest timing still plays large role in crop quality, regardless of harvest system used*

# TRIAL PROTOCOL

## TRIALS

This guidebook summarizes the results from the 'Canola Direct-Cut Harvest System Development" project and includes general harvest management aspects acquired by PAMI through its years of field testing.

For the study, field sites were established in Swift Current and Indian Head, Saskatchewan, in the 2014, 2015, and 2016 crop years, and at Humboldt, Saskatchewan, in 2015 and 2016.

All tests at Indian Head and Swift Current were conducted using two canola varieties, one with documented shatter resistance (Invigor L140P) and a typical variety (Invigor L130).

**A full copy of the above report, including detailed results of the 2014, 2015, and 2016 harvest years, can be found on the PAMI website at www.pami.ca**

## LOSS COLLECTION PROCEDURE

The method used to collect environmental and header loss was unique to this project. For environmental loss, aluminum trays (**Figure 1**) were inserted into the standing crop at the time of swathing to capture dropped and shelled pods. These trays contained two screen inserts that trapped the canola seed between the two layers as seen in the cross-section view of the tray (**Figure 2**).

For header loss evaluation, the same trays were used with screens removed and placed in the adjacent crop rows in a defined pattern (**Figure 3**). An alley was first cut using the header perpendicular to seeding direction to facilitate placement of trays. The combine operator drove up to the trays with the combine and header running, stopped after passing over them, and backed up after both combine and header were finished processing the canola. The cut-over trays were then exposed, and the loss collected.

**Figure 1.** Environmental tray with screen inserts to deter rodents and prevent moisture saturation

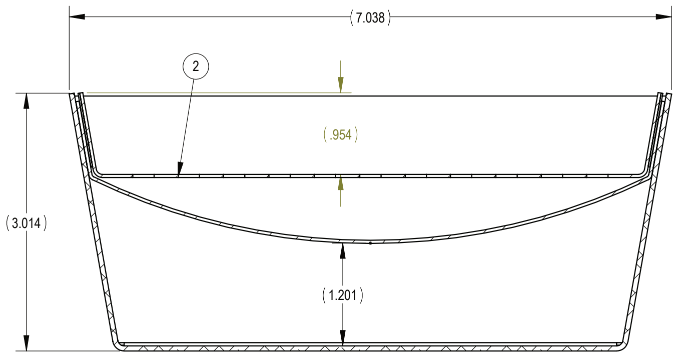



**Figure 2.** Cross-Section view of environmental loss tray, with screen inserts

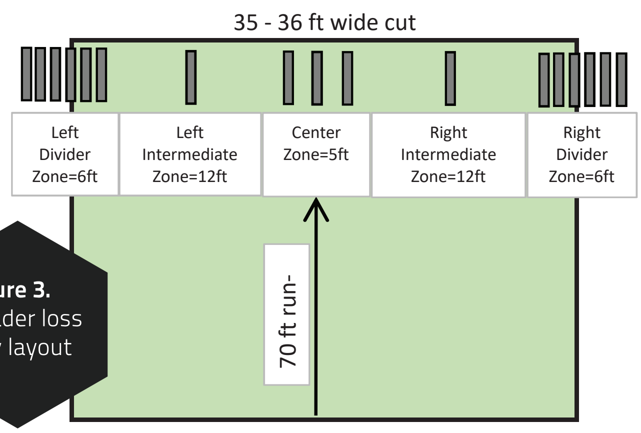



**Figure 3.** Header loss tray layout

# HEADERS / SYSTEM COMPARISONS

## STRAIGHT CUT VERSUS SWATHING

The three-year average canola yields in swathed and straight-cut treatments at the two field sites are shown in **Figure 4**. Environmental losses resulted in the swathed having a higher yield in the typical variety, while straight-cut yielded better in the shatter-resistant variety, albeit by a small margin at Indian Head.

- **Possibility for higher yields in straight cut, but swathed can yield as much/more**
  - *Largely dependent on environmental losses*
- **Thousand Kernel Weight (TKW) averaged slightly higher in straight cut**
- **Oil content can average higher in straight cut**
  - *There were instances where swathed was higher*
- **Often less engine load at same travel speed in swathed**
- Swathing can result in having slightly lower *harvest moisture*

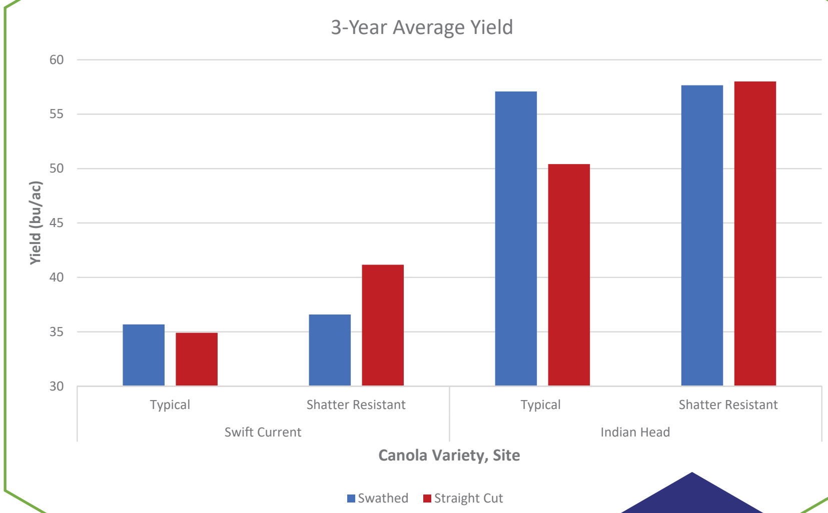



**Figure 4.** Three-Year Average Canola Yield, swathed vs. straight cut

One common assumption is that straight cutting will produce larger seeds with a higher oil content due to the seeds reaching full maturity before the plant is cut. The research conducted shows that the **straight cut treatments usually have a slightly larger seed size, but oil content isn't necessarily greater in standing canola**, as shown in **Figures 5 and 6**.

*Due to the environmental loss risk with standing canola, any gains in seed size will not necessarily guarantee higher overall harvested yield.*

The environmental conditions at Swift Current led to the 2015 and 2016 harvests producing late maturing crops. In the case of 2015, poor initial germination, combined with limited mid-season moisture, produced a wide range in maturity, contributing to a high green seed percentage in both swathed and straight cut treatments (**Figure 7**).

At Indian Head, only the swathed shatter resistant variety had a significant amount of green seeds, and even then, at an average of 0.7%.

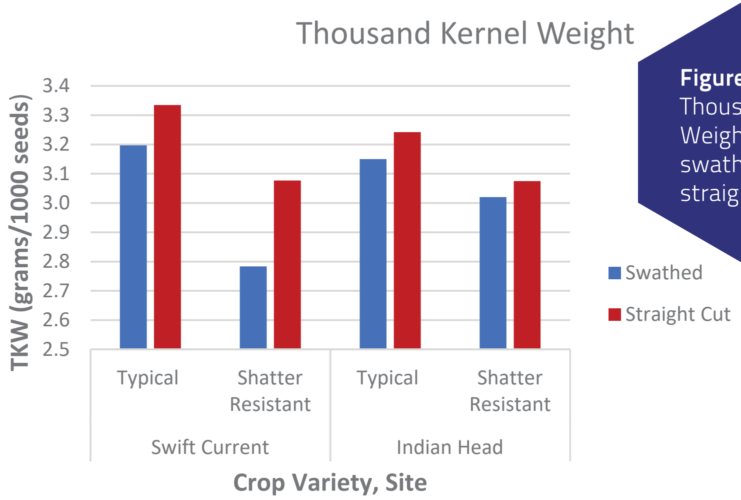



**Figure 5.** Thousand Kernel Weight (TKW), swathed vs. straight cut

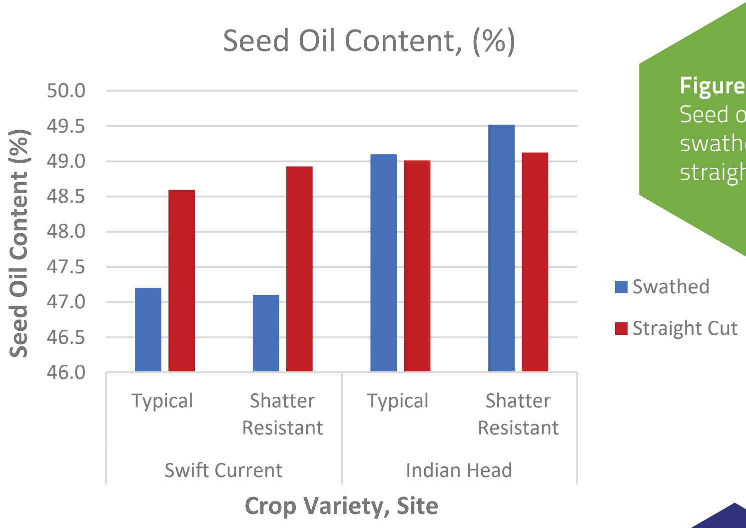



**Figure 6.** Seed oil content, swathed vs. straight cut

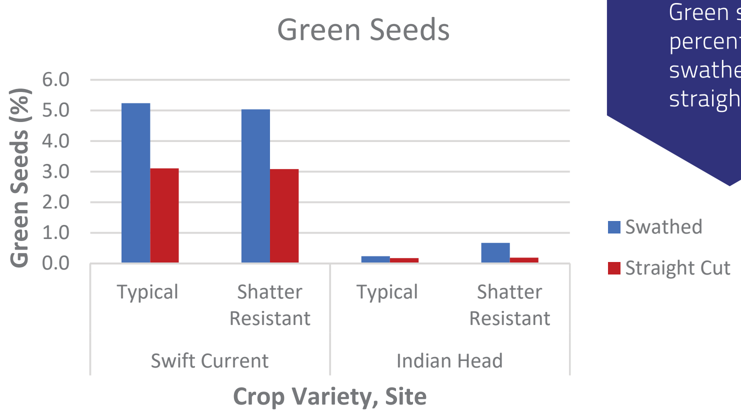



**Figure 7.** Green seed percentage, swathed vs. straight cut

**Figure 8.**
Rigid draper header

**Figure 9.**
Extended knife header with knife retracted (simulating rigid auger header)

**Figure 10.**
Extended knife header with knife extended

## STRAIGHT CUT HEADERS

***Three different header types were tested:***

- *Rigid Draper*
- *Rigid Auger*
- *Extendable Knife Auger*

***All three headers successfully harvested canola as shown in* Figures 8, 9, and 10.**

**Figure 11** highlights the loss distribution for each of the header and divider combinations used. The higher center losses in the rigid header are immediately apparent, caused by a combination of reel losses falling in front of the knife, and table auger losses being thrown in front of the knife.

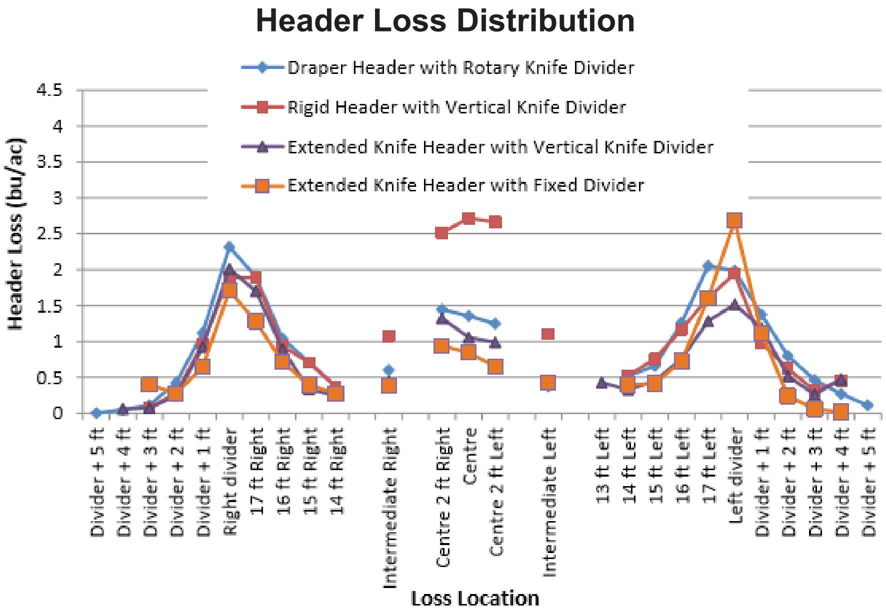



**Figure 11.** Three-year average header loss at select positions across header width.

Average yield at the Indian Head site is shown in **Figure 12**. The trend was the same in both varieties for the three straight cut headers tested.

The extendable knife header had the highest average yield in both varieties (although the swathed out-yielded all straight-cut treatments in typical variety), followed by the draper header, and, last the rigid header. This follows closely with the header loss collected.

***Disregarding any difference in losses at the dividers, the draper header average harvesting loss was slightly greater than the extended knife, with the rigid header having the greatest loss.***

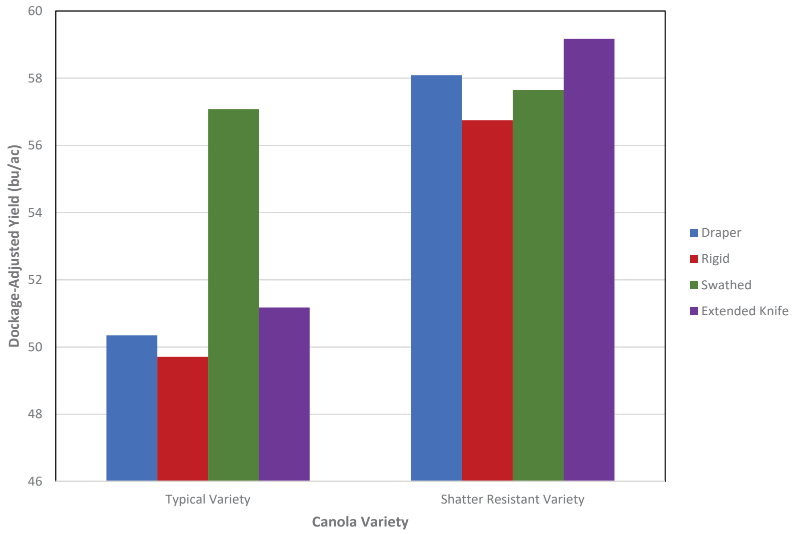



**Figure 12.** Indian Head three-year average yield per header treatment and canola variety

## DIVIDERS

***Three different divider types were tested on two different headers:***

- *Fixed*
- *Rotary Knife*
- *Vertical Knife*

***All three worked in a variety of conditions, but differing losses were found with each one as shown in* Figures 13, 14, and 15.**

Header loss at Humboldt in 2016 is depicted in **Figure 16**. The vertical knife divider averaged the lowest losses, followed by the fixed divider, with the rotary knife having the highest losses

Previous tests have found the lowest loss with the fixed divider, and conditions will dictate which divider is better suited.

The rotary knife tended to have higher losses, making it not as well suited for ripe canola, given the canola encountered in the underlying tests.

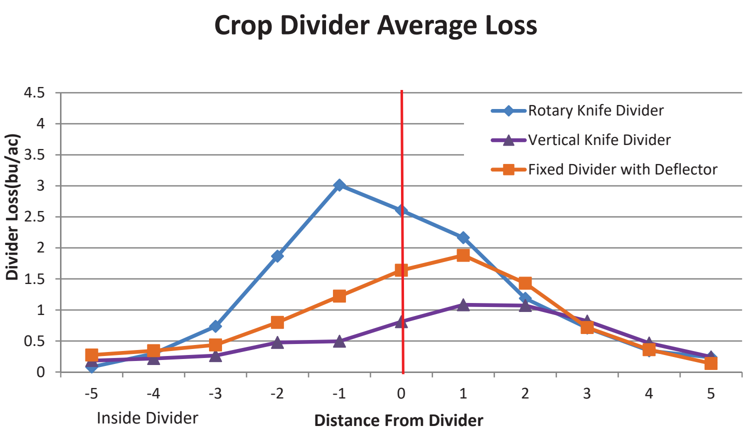



**Figure 16.** Divider losses at Humboldt, 2016.

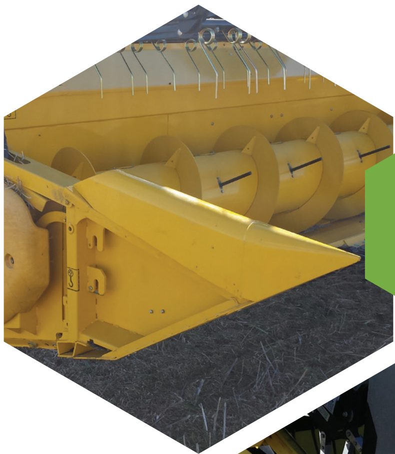


**Figure 13.** Fixed Divider


**Figure 14.** Rotary Knife Divider

**Figure 15.** Vertical Knife Divider

# HEADER SETTINGS

No scientific comparisons were conducted on most header and combine settings, but multiple conclusions on settings were drawn from the testing completed.

## REEL

Reel height can cause substantial loss if set too low.

- In well-standing crop, reel has a minimal role in feeding, especially on the auger head. Have reel fingers set so they just engage the crop, as in **Figure 17**.
- Do not use aggressive setting on reel fingers as long as crop is upright. Set fingers so that they are vertical or pointed ahead slightly when lifting out of the crop on the back side of the reel.
- Have reel as far back as possible, while still ensuring good feeding. This will minimize the shatter loss that lands ahead of the draper or table (**Figure 18**).

**Figure 17.** Optimal reel placement in standing canola

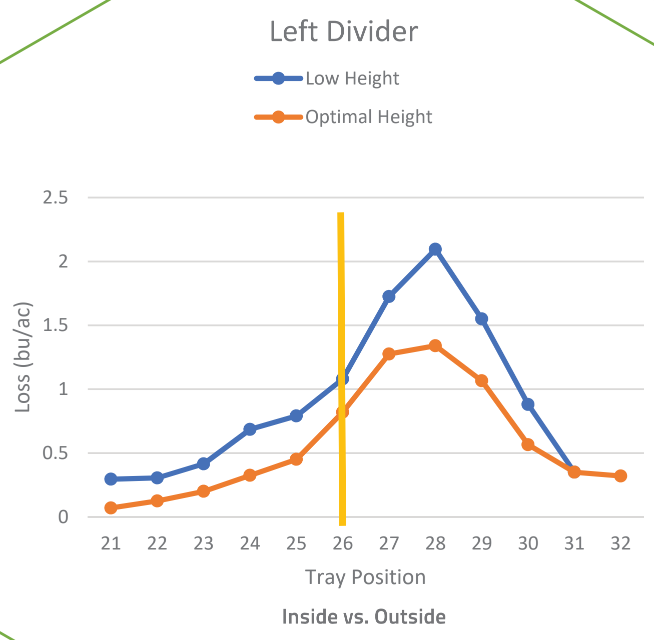



**Figure 18.** Losses at the divider at two reel heights

**Figure 19.** Draper header showing cross auger

**Figure 20.** Crop bunching between reel and auger

## DRAPER HEADER

Under higher combine capacity, and dependent on crop conditions, an aggressive cross auger setting (**Figure 19**) was necessary for even feeding.

- **Adjust speed so it matches** or slightly exceeds the drapers horizontal speed.
- If crop wants to bunch between reel and cross auger on top of the draper (**Figure 20**), more aggressive auger placement will aid in conveyance
    - position auger forward and down, so that it forces crop against the draper.
    - minor reel fore/aft adjustment can also help to get desired conveyance and crop flow

## RIGID / EXTENDED KNIFE HEADERS

Auger speed tests were conducted to evaluate any benefit of a slower table auger speed in reducing centre loss.

- From one site-year of testing, no clear benefit of slower speed (80% of factory).
    - ground speed was 3.5 mph. Alternate speed or conditions may warrant change in auger speed

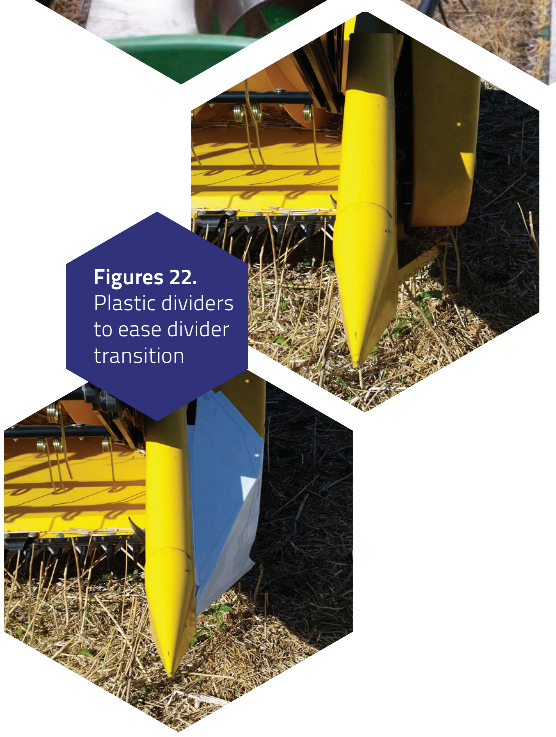
It is possible to add a removable fixed-knife extension and table to an existing rigid header to make it an extended knife header.

- This is a common product offering in Europe
- Possibly to retrofit rigid header to extendable knife, as seen in **Figure 21**.

The addition of a divider transition, such as seen in **Figure 22**, can help ease crop transition, thus reducing loss

- Wide dividers will still cause significant loss, even with a smooth transition

**Figures 21.** Custom built knife extension on rigid header



**Figures 22.** Plastic dividers to ease divider transition

# COMBINE SETTINGS

## GENERAL SETTINGS

- Reel height can cause substantial loss if set too low.
- Start with settings the same as for swathed canola and fine-tune from there
- Green straw can use up combine power and overload shoe if over-threshed
- Travel perpendicular to crop lean in a lodged field, to facilitate easier pickup in both travel directions
- Using a loss pan is recommended for any crop in order to accurately identify losses (**Figure 23**).
- Conversion tables can be found at PAMI's website to quantify losses from pans.

**Figure 23.** Loss pan for calculating combine loss

## FIELD EFFICIENCY

One easy way to lower header loss on machines with a wide drive end is to limit the contact of this end with the crop. This can be done by cutting the field in blocks, as shown in **Figure 24**.

In this method, instead of cutting the entire field in one circle, the headlands are first cut, then blocks of crop are sectioned off and cut separately. This allows the combine operator to stay in a particular area of the field, not having to go around the field in its entirety with every round. Figure 24 indicates drive direction based on the left side of the header being the wider drive end, looking from the combine cab. When combining each block, the only time the drive end comes into contact with the crop is during the initial pass to separate the two blocks, shown in red. For the rest of the cuts, the driven end is the only side coming into direct contact with the standing crop. The use of GPS navigation is beneficial when cutting with this system to ensure full-width passes, and maximum combine productivity.

Depending on operator preference, the headlands could be cut with a reverse cut on the outside round, as indicated, or with all passes in the same direction. If cutting in a clockwise motion, the divider losses on the first pass would be minimized, as the drive end would be at the outside edge of the field.

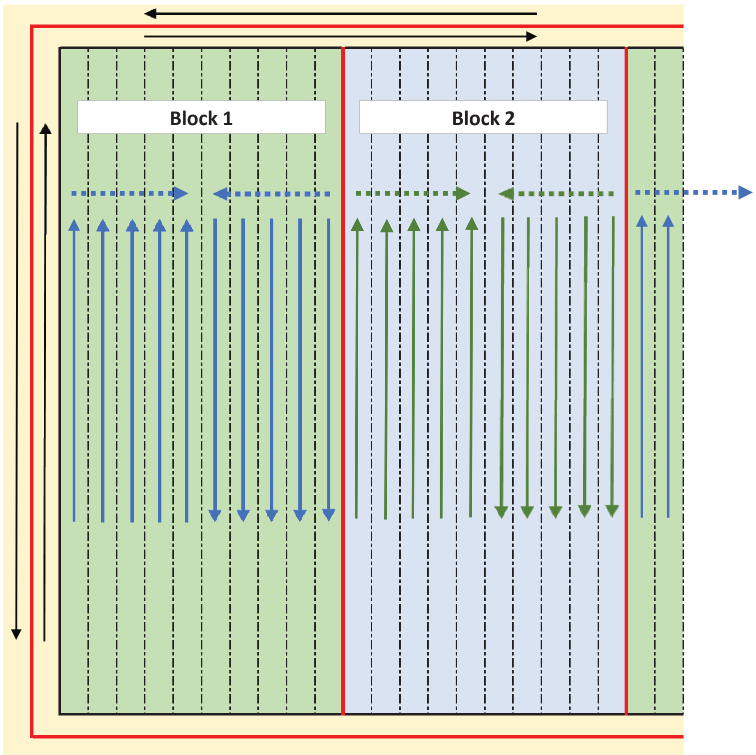



**Figure 24.** Field harvest diagram for use with asymmetrical header dividers

# VARIETY SELECTION

One of the first considerations a producer has to make when contemplating straight cutting canola is variety selection. There are many canola varieties on the market, and an ever-increasing niche of varieties marketed as shatter tolerant or shatter resistant. For the purpose of this guidebook, the term shatter resistant is used when discussing such varieties.

A combination of either inopportune growing seasons or strong winds prior to harvest caused high environmental loss in the typical canola variety at multiple site-years (**Figure 25**).

There is the possibility for low environmental shatter loss in a typical variety, but it is not guaranteed. A producer experimenting with straight cutting a small percentage of their acres could use a typical variety.

*Based on PAMI's research, it is recommended that a producer growing canola with the intention of straight cutting use a variety with documented shatter resistance.*

The typical variety also had higher average header loss than the shatter resistant variety, but by a small degree. The environmental loss played the largest role in yield differences in straight cut crop.

For more research regarding varietal traits and selection for shatter resistant canola, visit iharf.ca

| Site | Variety | 2014 | 2015 | 2016 | Average |
|---|---|---|---|---|---|
| Swift Current | Typical | 0.1 | 7.0 | 5.3 | 4.1 |
| | Shatter-Resistant | 0.2 | 2.2 | 0.2 | 0.9 |
| Indian Head | Typical | 2.7 | 2.8 | 8.3 | 4.6 |
| | Shatter-Resistant | 2.0 | 0.3 | 1.5 | 1.3 |

**Figure 25.** Header loss by site, year, and variety type in bu/ac.

*As there is no defined standard for shatter resistance yet, it is important to evaluate individual varieties to validate their resistance*

# DESICCATION

Although not a focus of this straight-cutting canola project, the Swift Current site in 2016 was desiccated due to concerns of late maturity, with mixed results.

Over all trial years, there were instances where the seeds were mature and dry, but the canola stems were still green (**Figure 26**). Canola was still successfully harvested with green stalks, but higher combine engine load and fuel consumption were observed under these conditions. Additionally, the green stalks were harder to process, as experienced at Swift Current in 2014, where the rear beater plugged and bent (**Figure 27**).

*In order to maximize combine productivity, it is beneficial to harvest at a time when stalks are mature, and the moisture content is reduced. This can be accomplished either by natural drying or desiccation.*

The method of choice will depend on crop stage, environmental conditions and harvest window, and may vary between producers, years, variety, and even individual fields

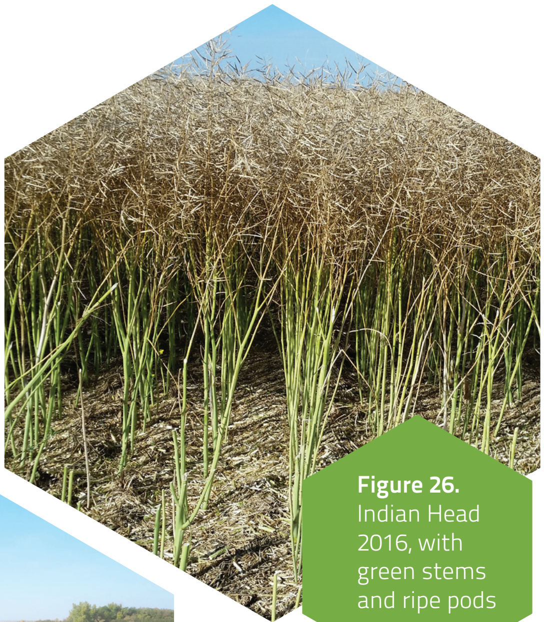


**Figure 26.** Indian Head 2016, with green stems and ripe pods

**Figure 27.** Rear beater plugged and bent due to green stalks

# ECONOMIC COMPARISON

An economic comparison between the different harvest systems and headers was conducted based on the trial results as summarized in **Figure 28**. All costs that are presumed to be identical to all harvest treatments are excluded. No difference in seed price was factored in.

Average combine, header, and swather operating costs were obtained from the **2016-2017 Custom and Rental Rate Guide**, which can be found at **http://www.publications.gov.sk.ca/details.cfm?p=76527.** Custom machine rates are used for all figures, which include labour, fuel, maintenance, and margins on these. It is important to note that average yield and attainable ground speed are based on the conditions experienced at the Indian Head site. Alternative conditions experienced may have a significantly different economic outcome. Calculations are based on the associated work rates based on ground speed, at 90% field efficiency.

| Canola Variety | Header Treatment | Average Net Yield (bu/ac) | Gross Income ($/ac) | Est. Speed at 80% Engine load (mph) | Productivity at 90% field eff. (ac/hr) | Combine Operating Cost ($/ac) | Combine Header Cost ($/ac) | Swathing Cost ($/ac) | Total Equipment Cost ($/ac) | Net Outcome (gross-harvest) ($/ac) |
|---|---|---|---|---|---|---|---|---|---|---|
| Typical | Draper | 50.3 | $ 603.60 | 3.5 | 13.7 | 31.56 | $ 3.93 | - | $ 35.48 | $ 568.12 |
| | Rigid | 49.7 | $ 596.40 | 3.5 | 13.4 | 32.46 | $ 1.46 | - | $ 33.92 | $ 562.48 |
| | Extended Knife | 51.2 | $ 614.40 | 3.5 | 13.4 | 32.46 | $ 4.04 | - | $ 36.50 | $ 577.90 |
| | Avg. St. Cut | 50.4 | $ 604.80 | 3.5 | 13.5 | 32.16 | $ 3.14 | - | $ 35.30 | $ 569.50 |
| | Swath | 57.1 | $ 685.20 | 4 | 15.6 | 27.81 | $ 0.77 | $ 9.74 | $ 38.32 | $ 646.88 |
| Shatter Resistant | Draper | 58.1 | $ 697.20 | 3.25 | 12.8 | 33.98 | $ 4.23 | - | $ 38.21 | $ 658.99 |
| | Rigid | 56.8 | $ 681.60 | 3.25 | 12.4 | 34.96 | $ 1.57 | - | $ 36.53 | $ 645.07 |
| | Extended Knife | 59.2 | $ 710.40 | 3.25 | 12.4 | 34.96 | $ 4.35 | - | $ 39.30 | $ 671.10 |
| | Avg. St. Cut | 58.0 | $ 696.40 | 3.25 | 12.5 | 34.63 | $ 3.38 | - | $ 38.02 | $ 658.38 |
| | Swath | 57.7 | $ 692.40 | 3.75 | 14.6 | 29.66 | $ 0.82 | $ 9.74 | $ 40.22 | $ 652.18 |

**Figure 28.** Economic Comparisons between Harvest Systems

Two of the three straight-cut headers had a higher profit margin than the swathed treatment in the shatter-resistant variety. **The extended knife header is calculated at $671.10** per acre, followed by the **draper at $658.99**, the **swathed at $652.18**, and lastly the **rigid header at $645.07**. The bulk of the profit variation results from average yield differences. When factoring in observed productivity potentials between different headers, total machinery cost for harvest was similar between all treatments, including the swathed canola. The added harvest operation for swathing was largely offset by an increase in productivity.

*The relevance of the economic prediction shown will be operation dependent. Labour rates are included in applicable instances, but any labour shortages may result in a higher labour opportunity cost than factored into this comparison. Additionally, the equipment costs listed represent custom rates, and each operation's realized cost per machine hour will vary. The type of machinery that an operation has on hand will largely dictate the initial machine cost per hour for each harvest system in the introductory stages of implementing straight cutting canola.*

STRAIGHT CUTTING CANOLA

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