

“TO WINDROW OR NOT TO WINDROW IN 2014?”
THIS IS THE QUESTION,
“BUT IF SO, WHEN?”

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Key words

Canola, windrowing, windrow, swathe, timing, direct head, shattering, yield loss, harvesting loss, desiccation, Pod Ceal™

GRDC code

GOA 00001

Take Home Message

- Windrowing timing within an acceptable window has no impact on oil% in canola
- Windrowing timing can have a significant positive impact on yield and profitability of canola
- Yield increases up to 0.5t/ha have been seen over relatively short delays in windrowing of only 8 days
- Yield loss to shattering with later windrowing have not shown to be as bad as first thought, particularly in contrast to negative yield impacts for going too early
- Windrowing timing has a limited effect on oil potential in canola
- Direct heading is a viable option to harvest canola and in many cases could maximise profitability
- An economic benefit of over \$200/Ha can be gained from choosing the best method and timing of canola harvesting

Background

Local focus group meetings of winter 2009 highlighted an interest in validating current recommendations for ideal windrowing times in canola, particularly in the Central West of NSW. One common understanding of the impact of timing was simply that windrowing too early may only reduce oil contents and by windrowing later, yield may be lost through excessive pod shelling and shattering. Fear of the more tangible and costly loss in pod shattering had seen many paddocks being windrowed much earlier than recommended.

Grain Orana Alliance (GOA) has run multiple trials in 2009, 2010 and 2011 to examine the impact of windrowing timing on oil, yields and profitability as well as the alternate option of direct heading. One of the first trials undertaken at Coonamble in 2009 also investigated the impact on yield and oil when the crop was direct headed using pre harvest treatments with Pod Ceal™ and desiccation with Reglone™.

Methods

All trial sites were large scale replicated trials applied to commercial, farmer sown paddocks of canola. All windrowing and harvesting was carried out by commercial windrowers (25-40ft swathe) and headers (25-40ft).

This methodology was chosen as it best explores the impact on yield in full-scale contexts. Potential for pod shattering during the windrowing operation is a key influence over final yield and could not be duplicated in small scale trial work.

Pod shattering was quantitatively assessed at a number of the sites through catch trays. The methods used for this need further refinement to representative accuracy. Therefore, these details are not included in this report. It should be noted though that any yield loss through shattering is accounted for by a reduction of the final harvested yield. It is harvested yield that drives profitability regardless of shattering at any level.

Windrow timings are described as % colour change (CC), this refers to the percentage of seeds that have started to change colour in the **middle third of the main stem** of the canola plant. To determine this, 30 pods were sampled from the treatment areas, shelled out and visually assessed for colour change. This was completed three times for each replicate/plot. Once the level of CC was established the relevant treatment area was windrowed.

All windrow timings and direct headed treatments were harvested at the same time when all treatments were considered to be ripe enough to harvest. Yields of the whole treatment area were measured with mobile weigh bins with the exception of Nyngan which was weighed over a weighbridge. Grain qualities were assessed by commercial service providers using standard testing procedures.

Yields and grain qualities were assessed by ANOVA using Statistix 9 software at a 95% confidence level.

Coonamble 2009

Treatments included windrowing at three timings: 10%, 50% and 70% CC, a Reglone™ (Reg) treatment at label recommendations (2.25L/ha) which was then direct headed, Pod Ceal™ (PC) at label recommendations (1L/ha) which was also direct headed and the final treatment which was direct headed with no other treatments. Sprayed treatments were applied by ground but harvested areas did not include wheel track areas.

Dubbo 2009

Three timings were applied in this trial 10%, 50% and 70% colour change.

Warren (Site 1) 2010

Four timings of windrowing were applied at this site, 5%, 40%, 70% and 95% colour change.

Nyngan 2010

Rain prevented the first timing of windrowing to be completed on time so only two timings at 60% and 90% CC were applied at this site.

Warren (Site 2) 2010

Three timings were applied in this trial, 5%, 60% and 95%.

Nyngan 2011

Three timings were applied at 10%, 50% and 90%.

Warren 2011

This trial compared a single windrowing timing at 85% colour change to direct heading with a draper header front fitted with a finger reel and top auger.

Wongarbon 2011

This trial compared single windrow timing at 95% colour change and direct heading with a conventional "tin front" and a Draper front with a finger reel. A different header was used for the harvesting with a Draper front than was used for the other two treatments. The header used for the windrow and conventional treatments maintained the same separator settings for both treatments.

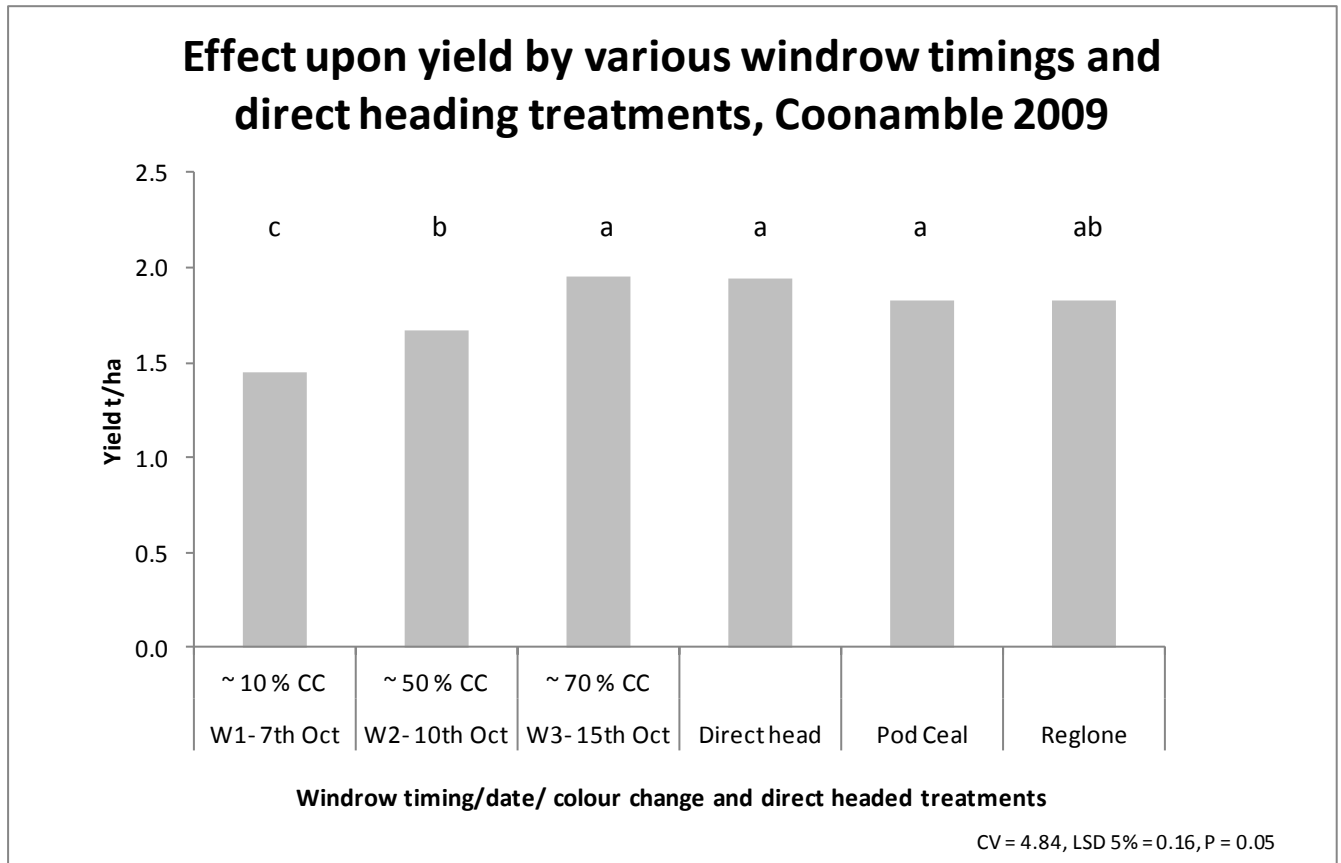
Wellington 2011

This trial compared two windrow timings of 90% CC another timing 6 days later (≈100%) and direct heading with a draper front fitted with a finger reel. The same header was used for both harvesting treatments with the same separator settings.

Results

Coonamble 2009

- W1, the earliest timing was the lowest yielding treatment of the three timings
- Each of the three windrow timings are significantly different and increased as windrowing was delayed.
- The yields between direct headed (no other treatment), Pod CealTM, desiccation with RegloneTM and W3 were not significantly different and were the highest yielding treatments.
- Desiccation with RegloneTM and W2 were not significantly different.
- There was no significant impact upon oil% for any windrow timing or direct heading treatment.

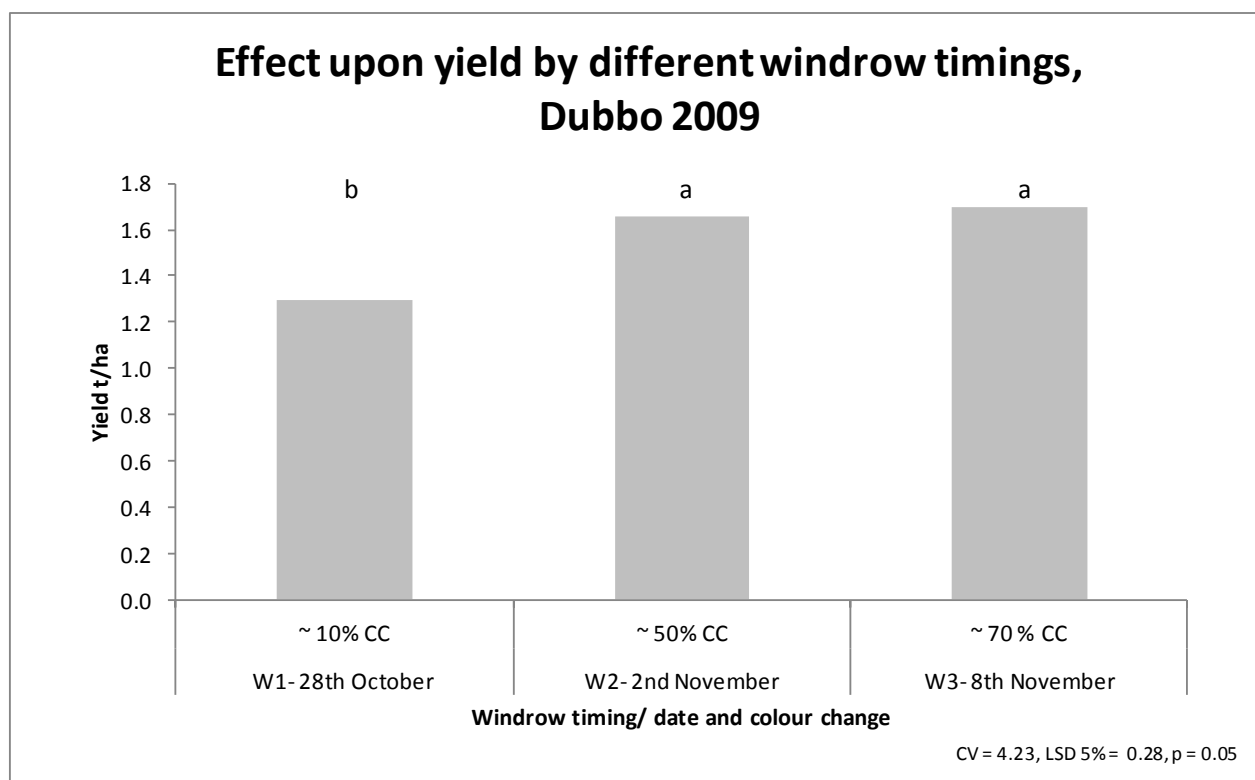


Treatments headed by the same letter denotes no significant difference

Figure 1 *Canola yield for direct harvest, PodCealTM, RegloneTM and windrow treatment timings at Coonamble*

Dubbo 2009

- W1 was the lowest yielding treatment.
- W3 was the highest yield treatment but was not significantly different to W2.
- There was no significant impact on oil% to any timing.

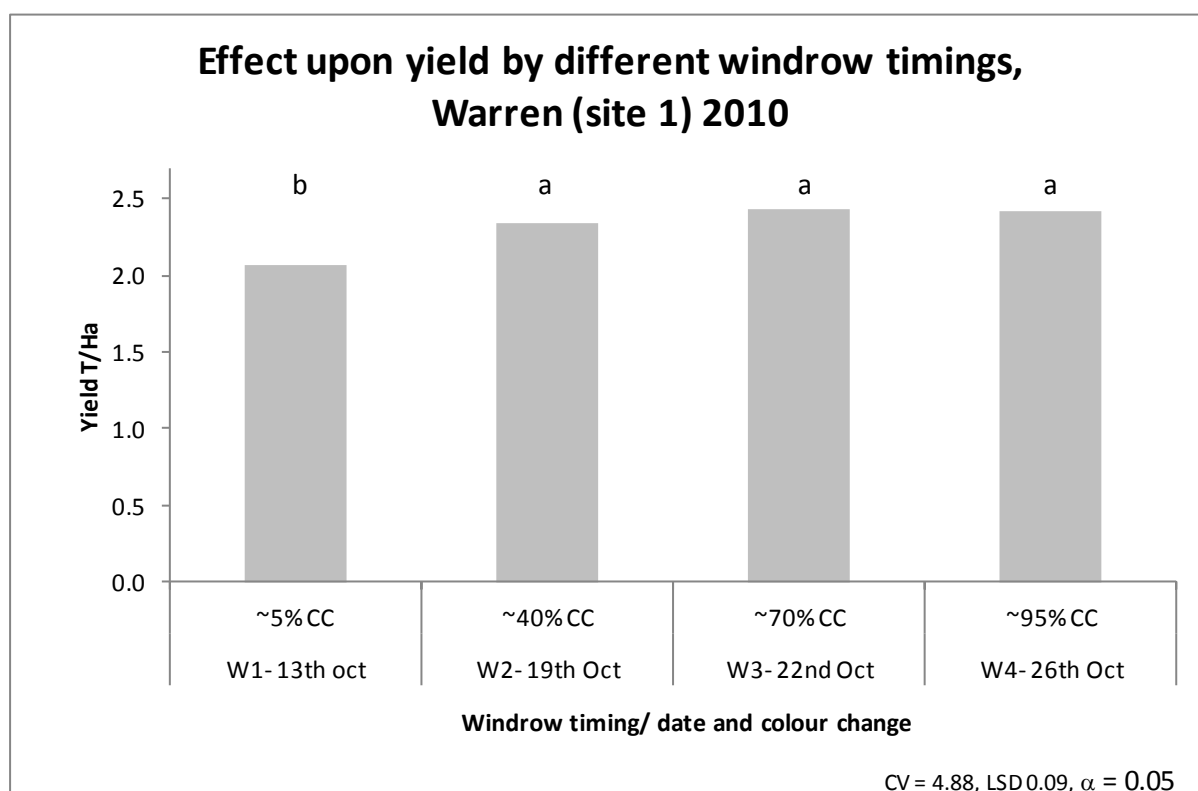


Treatments headed by the same letter denotes no significant difference

Figure 2 *Canola yield for the three windrow treatment timings at Dubbo*

Warren 2010 (Site 1)

- W1 timing was the lowest yielding treatment.
- The other three timing were not significantly different to each other but there was a trend to higher yields with delays past W1 to W3.
- Windrowing later than W3, decreased yields but only slightly and not significant.
- There was no significant impact on oil% to any treatment.



Treatments headed by the same letter denotes no significant difference

Figure 3 *Canola yield for the four windrow treatment timings at Warren 2010*

Nyngan 2010- no graph shown

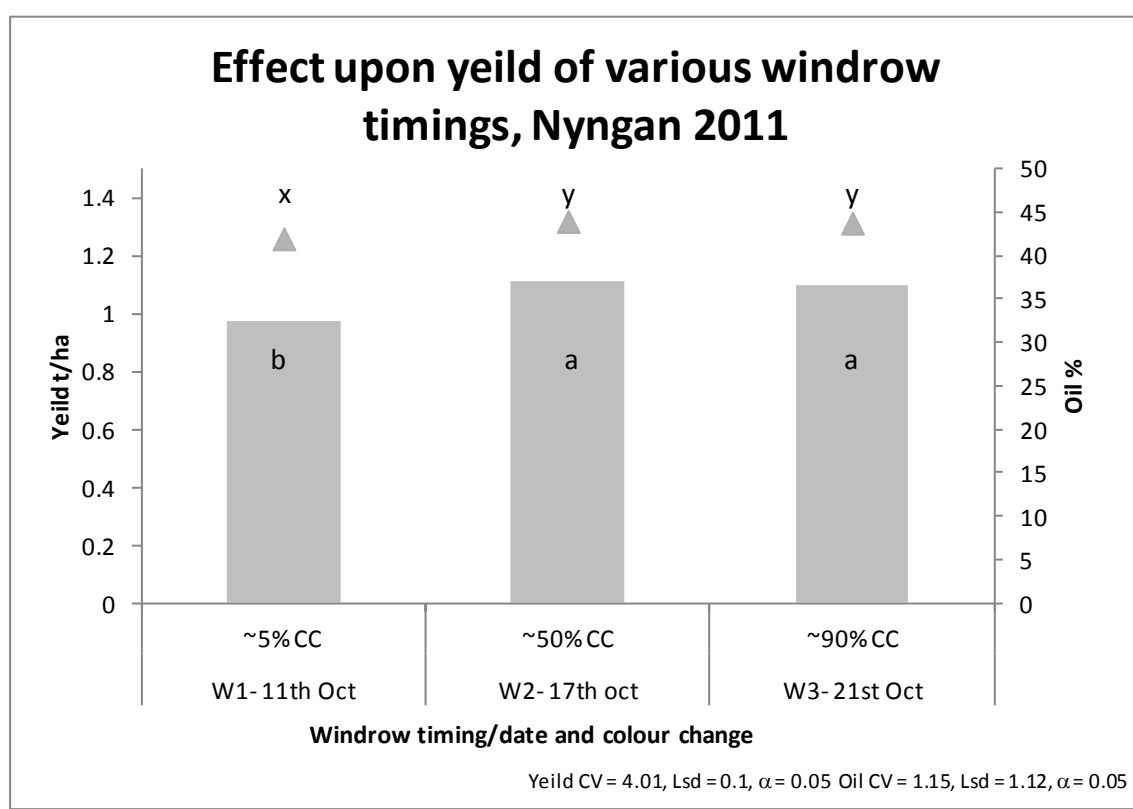
- From a delay in windrow timing from 60% to 90% there was no significant difference in yield or oil%.

Warren 2010 (Site 2) - no graph shown

- There was no significant impact on yield or oil at this site.

Nyngan 2011

- W1 was the lowest yielding treatment.
- W2 and W3 were not significantly different but yielded significantly more than W1.
- There was a significant response in oil% with W2 and W3 achieving higher oil than W1.



Treatments headed by the same letter denotes no significant difference

Figure 4 *Canola yield for the three windrow treatment timings at Nyngan 2011*

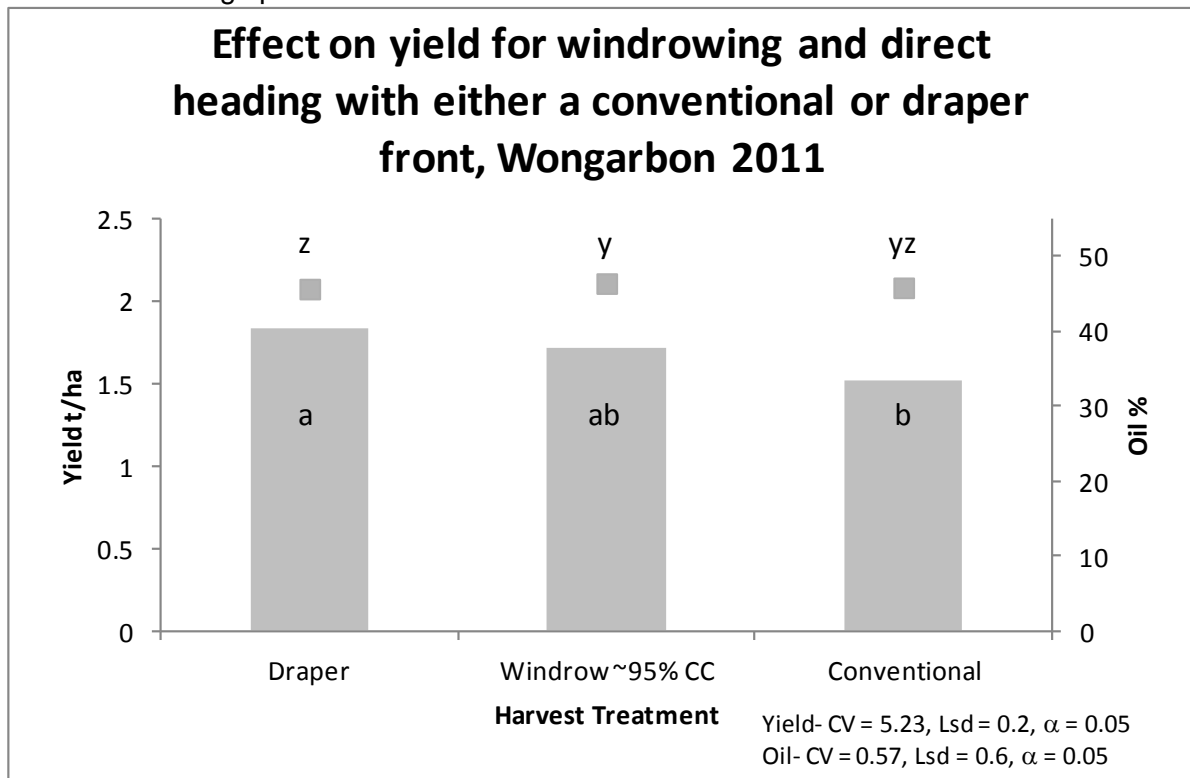
Warren 2011 (no graph)

- There was no significant difference in yield between windrowing at 85% colour change and direct heading.
- There was no impact on oil%.

Wongarbon 2011

- It should be noted that the trial area experienced a heavy wind storm (>50km/hr) between windrowing and direct heading. This shattered an amount of the standing treatments. The windrows were relatively unaffected.
- Two separate headers were used for the two direct heading treatments and it could not be guaranteed their separator configurations were the same.
- Neither style of header front was significantly different to the windrow timing of 95% for yield.

- The conventional header performed worse than the draper front however it must be noted that there were issues with the reel of the conventional front going too fast for harvesting speed.

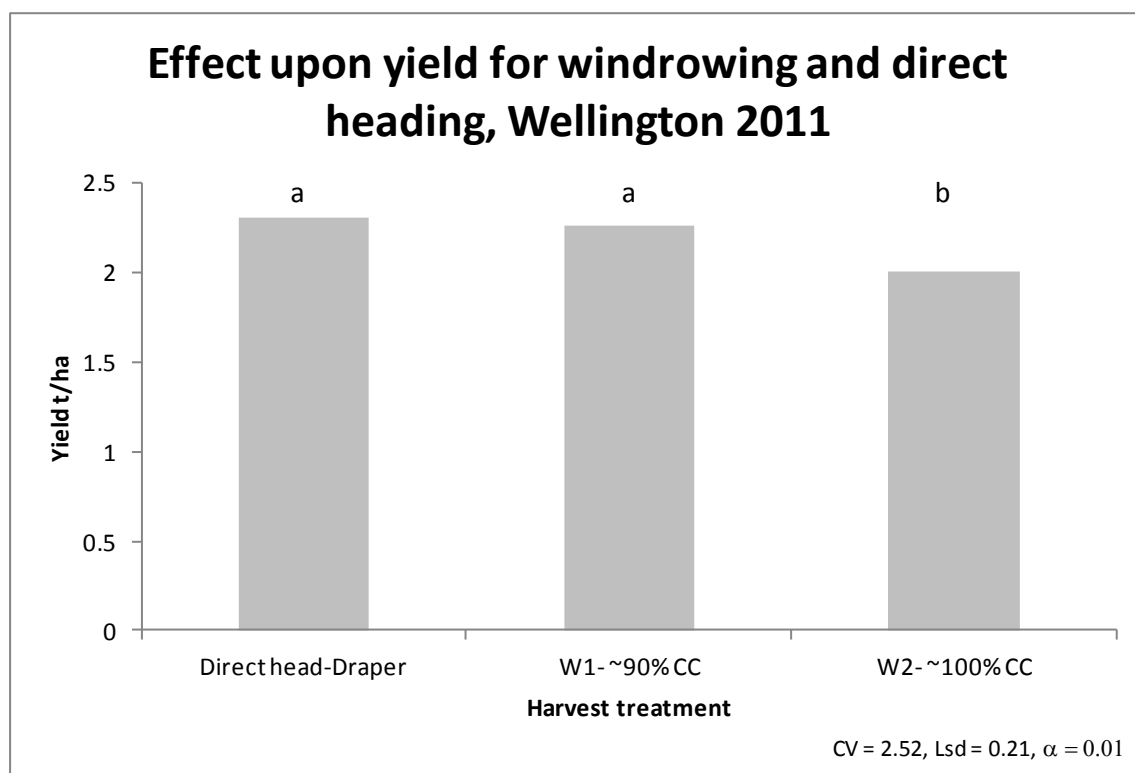


Treatments headed by the same letter denotes no significant difference

Figure 5 *Canola yield and oil% as a result of various harvest methods, Wongarbone 2011*

Wellington 2011

- Direct heading with a draper front was no different than windrowing at 90%.
- Windrowing at the later timing (+100%) yielded ~250 kg/ha lower than W1 at 90% CC or direct heading.
- There was no impact on oil% by any treatment.



Discussion

Yield

Across the three seasons and a number of sites, early windrowing around 5-10% colour change has consistently resulted in lower yields than later windrow timings. However windrowing past the currently recommended 40-60% colour change has not always resulted in further significant yield increases. It could be said that there often is a consistent trend to increase past these timings with trends to decline slightly only at 90-95% but not statistically or commercially significant levels. However increases in yield over a similar range have been sometimes quite significant. At Coonamble a ~250 kg/ha yield improvement was realised in only five days delay in windrowing from a 50% to 70% CC timing.

This is best explained by considering the process of windrowing whereby the plant's growth is ceased at time of cutting when part of the crop, including seeds, are still green and growing. Once cut, key process within the plant cease and seed will simply start to dry down regardless of their level of maturity and grain weight. This directly prevents any further growth or grain fill of green seeds, those that have not yet reached maturity, and any further yield accumulation that would have occurred otherwise.

Seed maturity, when seed will no longer increase in size, can be indicated by colour change in the seed and windrow timing is based on only a percentage of the seed within the crop having changed colour. So at the lower end of current recommended timings of 40% CC there is up to 60% of seed that is green, immature and still filling. Therefore the earlier the windrow timing the greater the proportion of seed that will not fill to its maximum potential. Therefore delaying any action that has the potential to cease grain fill will see the more seeds achieve their maximum size and hence improve yield.

Two recent small plot replicated trials run by Kathi Hertel from NSW DPI supports this theory that seed growth continues up to the point of seed physiological maturity as indicated by colour change. This worked showed that mean 1000 grain weight of the seed on the **main stem** reaches its maximum at 77% CC at the Gilgandra site and 47% CC at the Wellington on the

main stem (Hertel, 2012). When seed was sampled at earlier timings than this it had reduced size which would lead to reduced crop yields.

This potential maximisation of yield must be weighed against the risks associated with delaying windrowing or delaying to direct head. As the crop passes through the physiological mature stage and starts to dry down, the brittleness of the crop and pods increase. This exposes pods to potential shattering or splitting which would result in yield loss when the crop is either standing before or during windrowing. The ideal windrowing stage therefore should be a balance between maximising the grown yield and not losing this increase in yield through excessive pre windrowing or windrowing losses.

The question that should be asked then is how much of an issue is pod shattering, and when does this start occurring? Current recommendations and industry commentary often suggest that yield will decline through pod shattering, and the risk of this increases substantially as maturity progresses past 60% CC towards 100% CC. However this has not been demonstrated in our trial work with delayed windrow timing as detailed below;

- Warren in 2010 (site 1) demonstrated no decrease in yields between windrowing at 70% or 95% CC.
- Nyngan in 2010, delays from 60% to 90% CC showed no decrease in yields.
- Warren 2010 (site 2) showed no decrease yield by delaying from 60% to 95% CC.

In addition to this yield data, combinations of both quantitative and visual measurements of shattering at windrowing were made following each windrow timing at most sites. In summary there was no “concerning” level of seed loss observed at any trial or timing, correlating well with the yield data.

However at Wellington in 2011 due to bad weather, the first of two windrow timings were already late at 90% CC. The second timing which was well in excess of 100% CC was very late and resulted in a decrease in yield of 0.25t/ha or ~11% which was statistically significant. **It must be remembered that this second timing was potentially 7 days later than an already late timing so is an extreme example.**

In summary, yield loss as a result of delayed windrow timing assumedly through shattering has not been demonstrated except in one extreme case with very late timings and colour change in excess of 100%. The belief that significant losses occur when windrowing is delayed past 60% up to ~90% CC is not supported by this data.

When considering the comparisons above also note that if any shattering was to occur it would have been most likely to occur at the late end of the range mentioned i.e. closer to 95% CC. Yields may have actually increased later than the 60% timing before declining, therefore the point of maximum yield could be in some cases above 60% CC. This has been demonstrated at both Coonamble and Gilgandra where measured yield or grain size was maximised at 70% and 77% CC respectively.

Given that windrowing has the potential to reduce yields because it is done before all seed has matured does direct heading have potential to capture higher yields? Four trials have shown that yields from direct headed situations have generally only matched the yields of a **well timed** windrowing (~70-80% CC). However if compared to currently recommended windrow timing of 40-60% or earlier as can be seen at Coonamble in 2009, direct heading has outperformed the windrowing.

In the case of two different styles of header fronts being tested (Wongarbon trial site), the results could be best treated as inconclusive. Problems with reel speed on the conventional front and pod shatter due to weather in direct heading treatments pre harvest may have compromised the results. However despite these two negative impacts neither header front style outperformed the windrowing at 95% CC.

In considering whether to windrow or direct head canola, the Coonamble result further demonstrates an interesting point. This work has shown that windrow timing can have a significant impact on yield over very short periods. In this situation windrowing five days earlier than optimum yield has been penalised by ~250kg/ha, demonstrating a potentially small window to windrow. The question is if timing delays for a direct headed crop will realise a similar level of impact?

Trial work was undertaken by GOA in 2013 investigating the yield impacts through delayed direct heading of canola. This trial demonstrated the impact of delaying direct heading in canola to have a much smaller consequence than that in windrow timing.

There are a number of new products in the market place promoted to manage potential shattering. If successful they could address one of the key concerns growers have with direct heading of canola. One such product is Pod Ceal™ which was trialled at the Coonamble site. Pod Ceal™ aims to minimise pod shatter through a coating applied over the pod. In this trial treatment with Pod Ceal™ was not statistically different to either direct headed after desiccation with Reglone or direct headed with no other treatment. However this site in all treatments had minimal shattering problems. If the site experienced conditions supporting greater shattering the advantages of such a product could well be justified. But again, how big is the issue of shattering?

Oil levels

The potential for harvest management of canola through such things as windrow timing or direct heading has shown to have a very limited impact oil%. Very few trials have shown any significant differences in oil % due to windrow timing or direct heading within an acceptable window as discussed above. Of the trials that have resulted in significant differences in oil %, the magnitude has been small often less than 1%.

Oil accumulation in canola starts early after fertilisation but often slows substantially as the seed starts to approach the later stages of development. By the time the crop reaches maturities for windrowing, accumulation has all but ceased.

Relative performance of an individual crop in terms of oil % should not be taken as an indication of ideal windrow timing.

Assessing crop maturity- is there a better way?

Assessing crop maturity to identifying windrow timing is not well understood or consistent with either growers or advisors (Hertel, 2012). There are many conflicting perceptions of what colour change is and what part of the plant to assess as well as simply what is the ideal windrowing timing, the later hopefully clearer after reading this paper.

Currently recommended industry practice assesses crop maturity on the main stem only. However it is worth noting that pods from other parts of the plant contribute to the overall yield potential. Changes in farming practice with reduced sowing rates and established plant populations is resulting in proportionally more grain being carried on podding sites other than the main stem measured in the aforementioned research. One mathematically calculated estimate is that as little as 15% of yield may be carried on the main stem¹.

Given that seed on the secondary and tertiary branches will be less mature than that on the main stem, the maturity for the whole crop would be later than what is estimated by the main stem. That is, current assessment methods have the potential to overestimate the overall crop maturity, but the magnitude of these inaccuracies will vary with plant populations.

¹ Yield 2000kg/ha = 200g/m² /15 plants/m² = 13 g/pl. Main stem seed weight = ~30pods * ~20 seed/pod = 600 seeds * 0.003g/seed = 2gm. Main stem seed weight to whole plant 2g/13g = 0.15

Assuming the relationship between colour change in the main stem seed and seed weight detailed by Hertel was transferable to the whole plant; assessing canola maturity based on colour change over the whole plant could be a better estimate of crop maturity? This method would also have the benefit of making allowances for changing plant populations.

This method of assessment would however require further testing and calibration in the field before adoption, but the concept is worth considering.

What is it all worth?

In terms of manipulating windrowing timing to target higher yields it should be remembered that if there is no change in costs but simply a delay in time. Hence any increase in yield is 100% profit. And the improvement in profit can be substantial as demonstrated in figure 5 below with an extra \$208/ha increase by delaying windrow timing for only eight days at Coonamble.

Work by Hertel suggested that yield increases through delayed windrowing can be up to \$50/day at their peak.

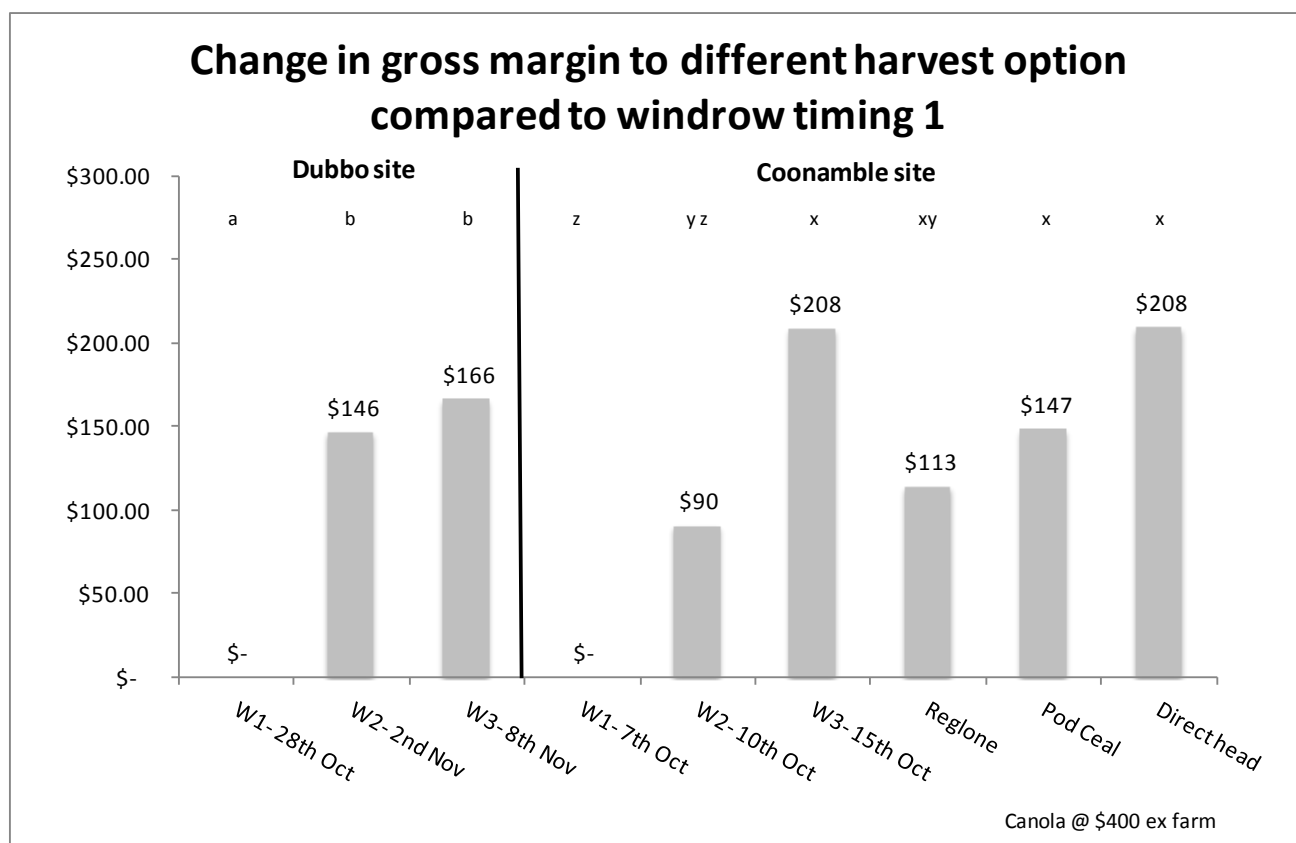
However in comparing windrowing to direct heading it can be more complicated. There are obvious savings in windrowing costs when direct heading, but the rate of harvesting windrows to direct headed crops can vary. Key considerations may include the width of the windrower swathe compared to that of the header front when direct heading but also the potential shortening of daily harvesting hours in extreme conditions when direct heading. Recently published was a Harvest Module in the Canola Technology Update 2012 which provides a lot of data and information to help compare the two harvesting options for your own circumstance.

This resource can be accessed by clicking on the following link-

http://www.australianoilseeds.com/_data/assets/pdf_file/0016/9142/MODULE_7_-_Harvest_Management_Kathi_Hertel_-_V2_Sep_2012.pdf

However many comparisons often suggest there is little difference in harvesting costs for direct headed crops and those that are windrowed with maybe slight cost advantages in direct heading. This is demonstrated in the graph below showing similar impacts on gross margins between a well-timed windrowing and direct heading.

The following graph depicts the benefits for the average of all the treatments, taking into account average yields and additional costs as well as oil penalties/bonuses from Dubbo and Coonamble in 2009.



Treatments headed by the same letter denotes no significant yield difference only ($\alpha = 0.05$)

Figure 5: Relative cost / profit difference of different harvest options to W1 at the Dubbo and Coonamble canola harvest trials

Therefore the choice on harvesting methods may depend more on other positive and negative aspects of each method rather than that of the direct economics. These aspects are covered well in the publication mentioned above. But it is clear that windrow timing can have a substantial impact on profitability of growing canola.

Conclusion

From these trials it could be concluded that windrowing timing has a limited affect on oil percentages in canola.

Windrowing earlier than the current recommended timings has always resulted in a significant reduction in yields which could seriously challenge profitability of crops in some situations.

The findings from these trials suggest that striving to meet the **upper end** of the current recommended windrow timings is important (40-60% CC) and should be targeted as a **minimum** as significant yield penalties have been demonstrated consistently if cutting earlier than these levels. However there have been trials such as at Coonamble in 2010 and at Gilgandra in 2011 (Hertel) that have clearly demonstrated that delaying past these times have shown to further improve yields. In all of GOA's trials they have shown trends in yields to have continued to increase up to 90+% CC.

One major concern with such a practice is the risk of shattering before or during windrowing when timings are delayed. These trials have demonstrated no yield penalty from delays in windrowing except in an extreme case. Therefore this fact infers that the magnitude of the shattering is small and statistically insignificant against any potential yield gains over the same period.

In the decision to delay windrowing later than 60% CC, growers and advisors should consider that each season or indeed each paddock could be different. Firstly growers and advisors should consider the crops current growing conditions. If the crop is experiencing terminal moisture stress delays beyond 60% it may not be warranted but if moisture is still available, even if limited, consider the findings of this work-

- Windrowing later than current recommendations may or may not result in increased yields, but in some cases they have
- Windrowing up to 90% colour change has not demonstrated any significant yield decline.

So if there is a potential for improved yields with delaying till later with little downside risk, why not? And remember that direct heading is an option if you cannot get the windrowing done when you need to.

Selection of varieties with greater shattering tolerance through breeding programs, changes in plant populations and farming systems as well as better machinery may mean that pod shatter may not be the issue that it was when the original recommendations of timings were founded. This may have contributed to this drift in an “ideal” timing recommendation which is now over 30 years old.

Direct heading has also shown to be a suitable management option for canola demonstrating that it often matches the performance in terms of yield of a well-timed windrowing, not so compared to ill-timed windrowing.

The choice to direct head canola therefore is better based upon the other pros and cons of such which are well detailed in the GRDC’s recently published Direct Heading Fact Sheet that can be accessed at

GRDC Direct Heading Fact Sheet

<http://www.grdc.com.au/~media/F3089AE19FFC498389DE786683461209.pdf>

What these trials do hope to demonstrate is the potential economic benefit gained by getting it right. The availability of windrowers at the correct time or the other advantages offered through windrowing should be considered.

Acknowledgements

Special thanks to:

Clyde Agriculture “Netherway” Coonamble,
Graeme Callaghan- Graeme Callaghan & associates, Dubbo
Garry Evans- “Larry’s Plains”, Dubbo
Lindsay Northcott, North-Hill harvesting, Young
Syngenta crop protection, Australia
Agspec, Australia (Pod Ceal™ Distributors)
John DeLlyall- Pioneer Hi Bred Australia
“Haddon Rig” Warren
A Walker- “Erlside” Warren
R Ledger “Erlside” Warren
The Waas family at Nyngan
The Street family- Wongarbon trial site
Mason Family, “Spicers Run” Wellington
Michael White and Co. Wellington
Julie Monroe- GOA
All windrowers, agronomists and growers that have helped out along the way.

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