PROJECT DETAILS

- **Title**: Harvest weed seed control in early- versus late-maturing crops
- **Funders:** Alberta Canola
- **Research program:** Agriculture Funding Consortium
- **Principal investigator:** Breanne Tidemann
- **Collaborators/additional investigators:** Greg Semach, Cindy Gampe, Robert (Rob) Gulden
- **Year completed:** 2019

Final report

Background

Harvest weed seed control (HWSC) is a new paradigm of weed management developed in Australia (Walsh et al. 2013). It aims to manage weed seeds that are retained on the plant at the time of harvest that would otherwise be returned to the seedbank by the combine chaff spreaders (Walsh et al. 2013). There are numerous methods of HWSC including chaff carts, narrow windrow burning, chaff lining, bale direct systems, and physical impact implements including the integrated Harrington Seed Destructor and the Seed Terminator (Walsh et al. 2013, AHRI 2018). All of these methods are dependent on weed seed retention until crop harvest.

Key Canadian weeds have been measured and reviewed for their seed retention to identify good targets for harvest weed seed control methods (Beckie et al. 2018, Burton et al. 2016, 2017, Tidemann et al. 2017). Of particular interest has been wild oat due to the extensive herbicide resistance profile of the weed (Heap 2018), and the continued development of herbicide resistance through the Prairies. Seed retention measurements for wild oat have been quite low in our typical crops including wheat and fababean (Tidemann et al. 2017). This raises concern about producer interest in adopting HWSC when it will not target one of our major weeds. However, seed retention has been previously linked to Growing Degree Day (GDD) accumulation (Shirtliffe and Entz 2000, Tidemann et al. 2017). This suggests that if a crop matures and is harvested in fewer GDD, it is possible that an increased proportion of wild oat seed will be retained at the harvest timing and therefore available for management with HWSC methods.

Objectives and deliverables

The original objective of the project was to determine the effect of early- compared to late- maturing crops on our ability to collect and remove weed seeds using harvest weed seed control methods. The objective did not change throughout the project. Anticipated deliverables were identification of rotations that allowed for increased seed collection of wild oat, and determination of swathing and straight cutting efficacy to collect weed seeds. Additional deliverables include a scientific manuscript on the results.

Find more information on this project and many other relevant canola studies on the Canola Research Hub.
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Research design and methodology

The trial was conducted at 4 locations: Lacombe, AB, Beaverlodge, AB, Carman, MB, and Scott, SK. The treatments included an early maturing crop rotation (field peas followed by winter wheat), a "normal" crop rotation (spring wheat followed by canola), and a late maturing crop rotation (fababeans followed by flax). Each treatment had the first crop grown in 2016, the second crop grown in 2017 (2016-2017 for winter wheat) and all treatments were followed by barley in 2018. For each cropping rotation there were two harvest 'types': swathed and straight cut. The trial was arranged as a factorial RCBD with 3 crop maturity rotations x 2 harvest 'types' resulting in a total of 6 treatments. Each treatment was replicated 4 times.

The trial was direct seeded with fertility applied as recommended by soil tests at each location. Herbicide applications were limited to management of broadleaf weeds; no herbicides with efficacy on wild oats were applied aside from the pre-seed burn-offs. Desiccation was allowed in the straight cut treatments ONLY if necessary, and a minimum of one week was left between swathing and applying the desiccation treatments on the straight cut treatments to ensure there was differentials in the timing of weed kill.

Important data collection parameters included wild oat population density, wild oat biomass, wild oat density in the collected chaff, and wild oat density in the soil seedbank. Additional data included crop density, crop yield and barley quality.

Data was analyzed using Proc Mixed in SAS. Data was analyzed across sites with rotation and harvest type as fixed effects and replicate nested in location as a random effect. A pdiff statement was used to retrieve least square means as well as comparisons between appropriate treatments. These statistics and the results reported below are preliminary. The Primary Investigator went on parental leave until May at which time the data and results will be investigated and interpreted more thoroughly.

Changes to the planned methodology were required at the Scott, SK location in 2017. Severe winter kill was observed on both winter wheat treatments in all replicates at that location. As a result the early maturing crop rotation was lost at that location. The trial was continued as data could still be collected on the effects of earlier maturation in comparisons of the "normal" crop maturity and the late crop maturity treatments.

Results, discussion and conclusions

Only preliminary results are being presented at this point. Final statistical analysis will be conducted upon the return of the PI from parental leave.

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Wild oat densities were significantly affected by cropping rotation only after 3 years; harvest type did not have a significant impact. This is a change from the interim analysis where harvest type appeared to be having a bigger effect. Wild oat numbers in the barley crop grown in 2018, when analyzed across locations, were lowest in the early maturing crop rotation treatments, followed by the "normal" cropping rotation treatments and the late cropping rotation treatments having the highest wild oat density. This is in line with the initial hypothesis that early maturing crops would allow increased collection of wild oats in the chaff due to limited seed shatter at the time of harvest.

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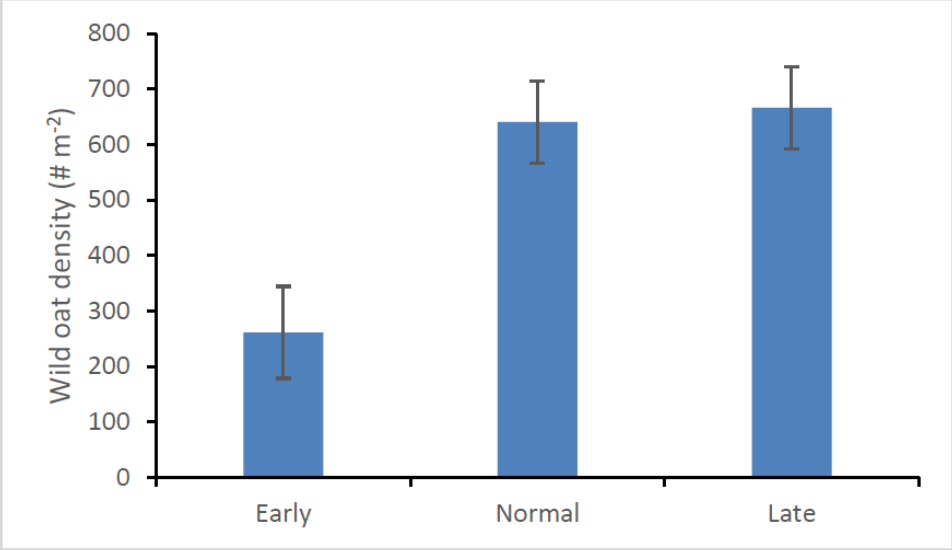

Wild oat numbers were not significantly affected by harvest method. This is interesting as in previous years the harvest method seemed to be having a larger effect than crop type. However, while not significant, across locations there were fewer wild oats counted on average in the swathed treatments. So while the difference may not be significant the absolute averages support our hypothesis that swathing would increase the number of wild oats collected, limiting populations in future years.

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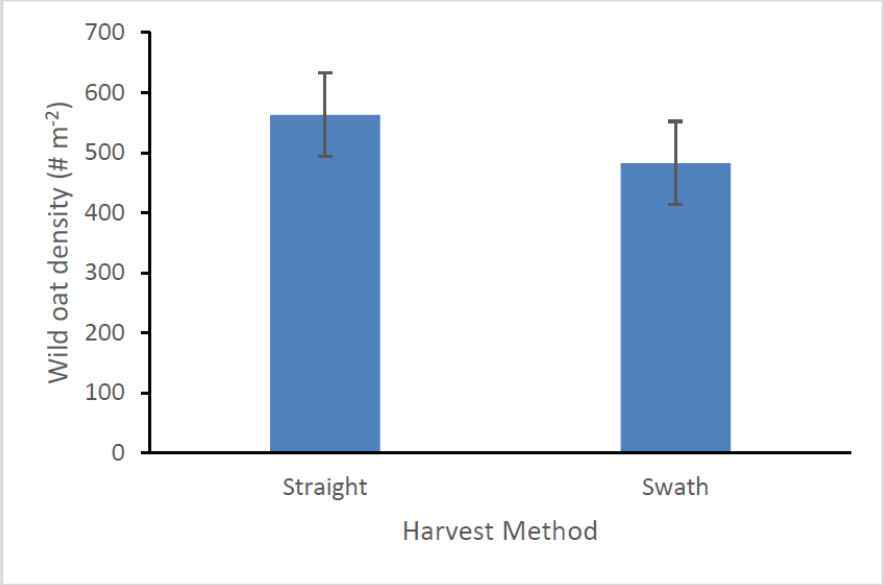
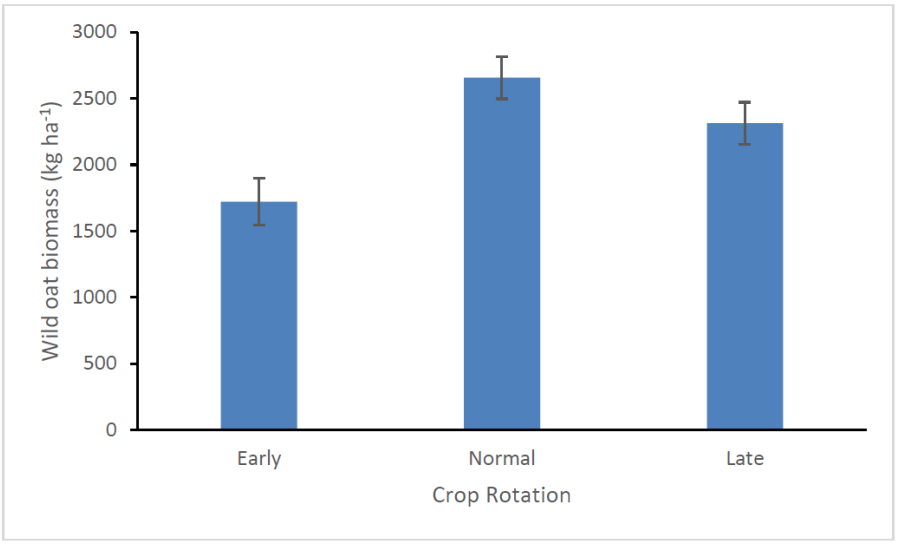


Wild oat dry weight biomass does not align as nicely with our initial populations as the density does. Both crop rotation and harvest method significantly affected the wild oat biomass when analyzed across locations. Wild oat biomass was lowest in the early maturing crop rotation, but highest in the "normal" crop rotation treatments. The reasoning for this is currently not clear. Further analysis and investigation into the data may reveal some logic behind these measurements.



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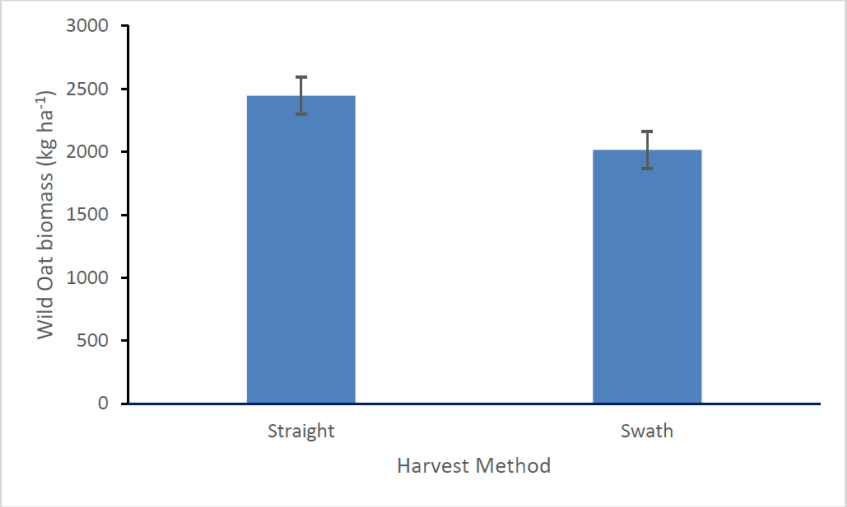
Lower wild oat biomass was observed in the swathed treatments compared to those that had been straightcut. This agrees with the initial observation and with the wild oat numbers, although those were not significant. This indicates that wild oat biomass can be decreased through use of swathing to maintain wild oat seed retention prior to harvest.



Other data such as wild oat numbers in the chaff and wild oat seedbank have not yet been analyzed. We are in the process of confirming materials and methods with our other locations to ensure that all conversion factors used to calculate final data numbers are correct (i.e. to convert the volume of the soil corers to a wild oat density per square meter).

Preliminary analysis indicates that our initial hypotheses were correct; wild oat can become a better target for harvest weed seed control methods through the use of early maturing crop rotations and incorporation of swathing. However, these two techniques did not interact on wild oat numbers or biomass. It is likely that combining the techniques, however, would provide the best opportunity to target wild oat seeds. There are some additional data parameters that we still need to analyze, including the wild oat seed bank which may alter overall conclusions. If the seedbank is higher in the early maturing crop rotation it may indicate that management options were not as effective as the density and biomass numbers are currently indicating. This is an important final piece to the information.

Overall, producers with a significant wild oat problem could potentially manipulate their cropping rotation and harvest methods to increase their ability to manage wild oat with harvest weed seed control. These results are still preliminary pending further statistical analysis and preparation of a scientific manuscript.

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Benefits to the industry

The results of the project indicate that it may be possible to increase the proportion of wild oat available for management by harvest weed seed control methods. This increases the viability of harvest weed seed control as a new weed management method for Canadian producers. This may increase interest in incorporating HWSC methods into production systems. In the long run, incorporation of HWSC methods could increase the usable effective lifetime of our herbicides, and reduce selection for new herbicide resistant biotypes. It may also limit the spread of current resistant biotypes that are geographically limited. The indication that swathing will increase wild oat management over straight cutting is against the current trend where producers are shifting to a higher proportion of straight cutting in their harvest methods. This indicates that producers will have to consider where weed control ranks on their priority list when making decisions about how they will proceed with harvest decisions in the future.

It's estimated that management of wild oat costs about $500 million per annum. This estimate can only have increased with increased herbicide resistance requiring more herbicides, more expensive herbicides, or additional management tactics to exert control over this weed. Being able to increase the proportion of wild oats retained at crop harvest means that a larger proportion of wild oats can be targeted with HWSC. This can help manage wild oat populations, potentially without needing to increase spending on herbicide options. Being able to manage wild oat may increase the adoption of HWSC by producers, meaning the impact will extend to numerous other weed species as well – HWSC targets any weed seeds retained in the crop at the time of harvest, not just wild oat.

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