Quantifying Combine Auto-Adjusting Capabilities in Canola

Project Description

Canola is an essential crop in the Canadian Prairies, and canola losses are an unfortunate part of harvest that must be managed by producers. Canola losses can be categorized as environmental losses, header losses, or combine losses. Combine losses occur during harvesting and refer to grain lost (discarded with the chaff and straw) from the separation and cleaning systems; these losses were the focus of this project.

A study by PAMI in 2019 found that total combine loss is impacted by ambient conditions. The opportunity exists to control losses by adjusting combine settings; adjustments that can be made include any combination of fan speed, rotor/cylinder speed, concave clearance sieve openings, and ground speed. The challenge with manually adjusting combine settings to compensate for changing conditions is the need to check losses at regular intervals to inform that decision and then to confirm that the desired loss reduction has been achieved. The loss check process must be repeated for each combine in the field each day if an optimized set-up is to be realized.

Auto-adjusting separation and cleaning systems being introduced by the major combine manufacturers may provide a daily opportunity for producers to retain more seed by automatically adjusting settings to reduce losses throughout a harvest day.

The objectives of this project were to quantify the change in conditions during a typical harvest day and the effect on combine losses while harvesting canola and measure the performance potential of combines with auto-adjusting settings while harvesting canola.

Acknowledgements

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Methodology

Field testing for this project occurred between September 9 and October 10, 2022. PAMI visited 13 producers across Saskatchewan and Manitoba and measured canola combine losses from 22 combines, 11 were equipped with auto-adjusting capabilities and 11 required manual adjustment. Four combine manufacturers were represented during testing with a total of 14 different models.

In order to assess the impact of changing environmental conditions throughout a harvest day, losses were measured at three times for each combine: at the start of the day, then repeated midday when conditions are optimal (i.e. warm and dry), and again in the evening when conditions typically start to cooldown and humidity rises.

Figure 1. Remote controlled drop pan used to collect losses

Drop pans (**Fig 1**) were used to measure canola losses from the combines tested. The canola seed was separated from the chaff/straw and weighed. Losses were calculated using the collected sample weight, cut width, discharge width, catch area, and canola density. To capture an accurate representation of producer's losses, each combine loss test was repeated three times to calculate an average loss, and producers were asked to run at their normal operating conditions during testing. PAMI followed strict biosecurity procedures to prevent the transfer of crop contaminants.

Other information collected to gather a full picture of the test conditions included: harvest timing, ambient temperature, relative humidity (RH), weather conditions, wind conditions, harvest practices (straight-cut, swathed), grain moisture, canola variety, ground speed, grain feed rate, combine settings, combine age, and separator hours.

Results

Table 1. Observed ambient conditions and combine losses	Min	Max	Average
Combine losses measured (bu/ac)	0.1	10.6	2.1
Combine losses measured (% of producer's yield)	0.2	29	5.1
Ambient temperature(°C)	6	27	20
Ambient relative humidity (%)	20	80	37

Note: The combines were not specifically optimized for the various field conditions and harvest types. Combines were tested at the settings determined by each individual producer.

A statistical data analysis was conducted to identify whether differences observed in the combine loss data were due to the measured variables or to random variability. In order to compare the variation between combines the standard deviation across the three test times for each combine was calculated both for the environmental conditions and the calculated combine loss values. The following conclusions can be made for the data that was collected:

- The effect of relative humidity variation on combine loss variability throughout the day did not appear significant.
- The effect of temperature variation (standard deviation from three test times) did not appear to be significant.
- The number of days into testing did not appear to be significant (i.e early September vs. early October).
- Daily mean temperature did appear to have a significant effect on combine losses.

Ground speed and grain feed rate are easy-to-adjust factors impacting the loaded threshing capacity during operation which were compared to combine losses to assess whether a combine operator may be overloading the threshing area. Neither variable appeared to have a significant effect.

The average combine losses measured for auto-adjust enabled and manual adjust combines were 1.9 bu/ac (4.7% of producer's yield) and 2.1 bu/ac (5.2% of producer's yield), respectively. However, there did not appear to be a significant difference in combine losses when comparing the two types. There does appear to be a larger variability in observed variation as illustrated in **Fig 2**. While the manual adjust mean variation is slightly higher than the auto adjusting types tested, the range of potential variation is much smaller. This indicates that while auto-adjusting capabilities may be able to adjust to changing conditions as well as manual adjusting types, they cannot be blindly relied upon (i.e., a "set it and forget it" mindset should not be employed).

Conclusions

There is not a standard set of combine settings that can be attributed to specific losses. Each combine, operating in particular conditions for a specific crop must be optimized for the given environment. Auto-adjusting capabilities in new combines have the potential to effectively respond to changing environmental conditions, but they cannot just be set and forgotten. They should be calibrated regularly, and losses should be manually checked to ensure the machine is operating suitably. It is important to regularly measure losses to ensure adjustments are made to properly optimize harvest yield by reducing combine losses. While it may allow more frequent adjustment to changing conditions, auto-adjust features do not negate the requirement to measure.

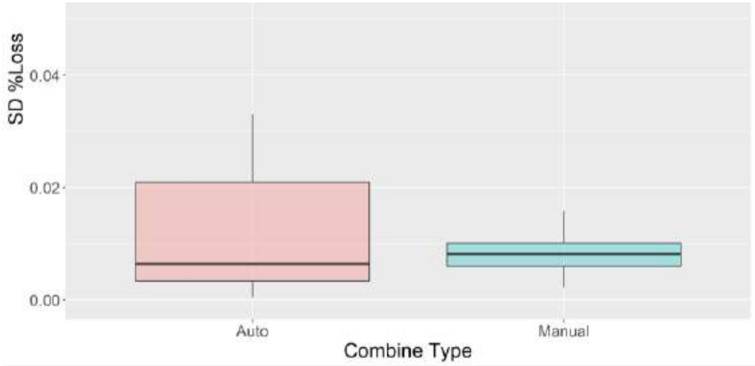

Figure 2. Box & whisker graph of std.dev. of combine loss % of yield (dark horizontal line = mean, height of the box = standard deviation, whiskers = min. and max. values