Investigation into Converting a Combine Grain-loss Signal into a Grain-loss Rate

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Technology plays a larger role on the farm than ever before throughout all aspects of farming but especially through real-time sensor data collection. However, grain loss monitoring technology for combines has generally experienced minimal advancement since being introduced into the market around 1975. Researchers at PAMI investigated the feasibility of converting a combine’s grain loss signal into a grain loss rate. Although the project results from lab and field testing of the combine loss sensors showed the ability for existing loss sensing technology to provide an actual grain loss rate is limited, the results showed promise in the correlation between the combine loss signal and actual grain loss rate and will drive further development in this area. Future technology developments will help maximize producer profit by providing the operator with more meaningful feedback and information to make economic decisions.

Technology plays a larger role on the farm than ever before throughout all aspects of farming but especially through real-time sensor data collection. Not only can this information be collected, but with today’s technology, it can be wirelessly sent to mobile devices such as phones, tablets, and computers to be analysed anywhere at any time, and used by farm managers to make better economic decisions throughout all agricultural operations. However, grain loss monitoring technology for combines has generally experienced minimal advancement since being introduced into the market around 1975. There is a need to improve the presentation of the grain loss sensor signal generated by combine harvesters from unit-less numbers or graphs to absolute grain loss in bushels/acre, dollars/acre, or other meaningful units so operators and/or farm managers can make improved economic decisions and better manage grain loss during harvest.

Researchers at the Prairie Agricultural Machinery Institute (PAMI) conducted a single year project to investigate the feasibility of converting a combine’s grain loss signal into a grain loss rate. The main objective of this project was to determine the correlation between existing harvester loss sensor output with actual grain loss by putting the harvester loss signal and the actual grain loss rate in relation. Researchers also wanted to determine: if existing technology is adequate to support a grain loss rate, optimization of the harvest loss sensor, and to decrease harvest losses across all Saskatchewan crops through improved harvest loss feedback.
The project included lab testing of the combine loss sensors as well as field tests with farmer cooperators using full-scale harvest and test equipment. Lab testing involved dropping grain kernels of varying size (peas, wheat, and canola) and frequency (simulating high and low loss scenarios) onto combine loss sensors to determine the loss signal characteristics such as amplitude, impact signal frequency (time of single seed impact to signal stabilization), and signal resolution. In knowing these characteristics, the loss signal could then be properly recorded during field testing.

Field testing was completed using PAMI’s combine test equipment to collect both actual grain loss and the loss sensor signal from a combine in three crops (peas, wheat, and canola). The loss data was collected over a range of feed rates to create loss curves, and the relationship between the grain loss curve and loss sensor signal curve was then graphically compared through the use of relationship equations. Finally, a review of other sensing technologies was completed to determine if any could be implemented to better support a grain lost rate.

The results of the project showed there was a relatively strong correlation between the loss sensor signal and actual grain loss rate in large grain crops (peas) but a relatively poor correlation in small grain crops (canola and wheat), indicating a higher resolution would be required to support a grain loss rate. The correlation was also found to be dependent on feed rate in all crop types and resulted in a non-linear relationship. This generally caused the combine loss signal to underestimate actual grain loss with increased feed rate for both loss signals recorded (raw loss sensor data and monitor data). Therefore, it can be concluded that the ability for existing loss sensing technology to provide an actual grain loss rate is limited. Though the correlation to actual loss was not consistent, for most conditions, the grain loss monitor system tested did provide a reliable indication of when actual loss was increasing or decreasing. In large grain crops, a grain loss rate could likely be determined through the use of relationship equations and
correction factors. However, in small grain crops, design improvements would need to be made to the grain loss sensor system, to accurately indicate actual grain loss rate, especially on the cleaning shoe loss sensor.

The project also included a review of other sensing technologies to determine if any could be implemented to better support a grain loss rate. A variety of technologies were investigated including accelerometers, microphones, microwave, photoelectric, and ultrasonic sensors. Some of these technologies showed promise in their ability to detect grain loss but would require further research, development, and testing to determine their full capabilities.

Overall, the results from this project are significant to the agriculture community including producers, farm managers, and manufacturers through advancing loss monitoring technologies as well as raising awareness about the importance of managing grain loss during harvest. The results also showed promise in the correlation between the combine loss signal and actual grain loss rate and will drive further development in this area. Future research and development is required to determine how the relationship equations between the loss sensor signal and actual loss rate change depending on combine make/model and/or crop type and condition. Another important area of investigation is real-time monitoring of feed rate during harvesting operations, which must be known to accurately display a grain loss rate. If such technology becomes utilized in the future, it will help maximize producer profit by providing the operator with more meaningful feedback and information to make economic decisions.