Corn Grain Yield Monitor Calibration

Introduction

Many combines used for corn grain harvest today are equipped with a yield monitoring system. Accurate assessment of yield, by field and by locations within fields over multiple years, is essential for improvements in field management decisions over time. The best data are obtained when yield monitoring equipment is properly calibrated, and yield data obtained are evaluated for errors. Without calibration, yield monitor results can be as much as 50% higher or lower than reality. Yield monitor systems consist of a moisture sensor, a mass flow sensor, a Global Positioning System (GPS), and a computer logger/display. This fact sheet provides information on common yield monitor calibration procedures and equipment involved in the process.

The Yield Formula

As a combine is traveling, the yield monitor system records information on location, mass flow, and moisture content. A typical monitoring system is set to record data every second. By combining information on mass flow, logging interval, distance traveled during the logging interval, header width, grain test weight, and moisture content, as well as longitude and latitude, yield can be estimated according to this formula:

$$Yield\left(\frac{bu}{ac}\right) = (43{,}560)\left(\frac{m*t}{d*w*p}\right)\left(\frac{100-MCharvest}{100-MCmarket}\right)$$

where:

- M = mass flow rate estimated from the impact sensor (pounds per second).
- T = logging interval of the yield monitoring system (seconds).
- D = distance traveled between logged location points (feet).
- W = header cut width setting (feet).
- P = grain density or test weight (pounds per bushel).
- MCharvest = moisture content from yield monitor moisture sensor (percent).
- MCmarket = marketable moisture content (percent).
- 43,560= square feet per acre.

Equipment

- *Moisture sensor*. Grain moisture content is estimated by measuring the ability of the grain to store electric charge (capacitance) while passing through a known volume between two electrically conductive plates. Normally this sensor is mounted on the clean grain elevator.
- *Mass flow sensor*. The mass flow sensor is located at the top of the grain elevator. The grain is carried up the paddles to the top where it strikes the mass flow sensor, resulting in a reading in pounds per second.
- *Header position*. The position of the header is the start and stop signal for logging of data points. If the header position is set properly, the machine will stop logging points when the header is raised at the end of a pass in a field.
- *Lag time setting*. Lag time is the time between initiation of actual harvest (header down) and the moment in which the grain, after passing through the thresher and grain elevator, reaches the mass flow sensor.
- *GNSS or DGPS.* This is the global navigation satellite system fixed to the machine that measures speed of the combine as well as actual location.
- *Header cut width setting*. This is the standard number of rows x width that are harvested. It is used to calculate the area harvested at each time interval for which mass flow and moisture content measurements are taken.

Calibration Steps

Calibration protocols include checking of settings and equipment prior to harvest as well as in-field checks during harvest.

Pre-Harvest Checks

- *Header position*. The position sensor should be placed in the correct location according to manufacturer standards.
- *Lag time setting*. An accurate lag time needs to be entered into the in-cab display to line up the mass flow sensor readings with the logged GPS points. This can be determined by counting the seconds from when the grain enters the head until it reaches the bin on the combine. Subtract two or three seconds

because the grain hits the mass flow sensor before it hits the bin. For most machines the lag time is 10-15 seconds.

- *Header cut width setting*. This will need to be entered into the in-cab display. Most modern monitoring systems automatically adjust cut width after initial setup during times when less than a full cut-width (fewer rows) is harvested.

In-Field Tests

- *Moisture sensor.* Calibration steps as outlined by the machine manufacturer should be followed. The calibration can be checked by comparing the moisture sensor output with a grain moisture test at the local elevator or by using an oven to determine moisture content.
- *Mass flow sensor.* Perform calibrations frequently using the manufacturer's standards. Re-calibration is needed every time a different crop is harvested and when moisture contents change significantly. Perform flow sensor calibration to capture the range of flow value (low, medium and high yield levels (Figure 1).

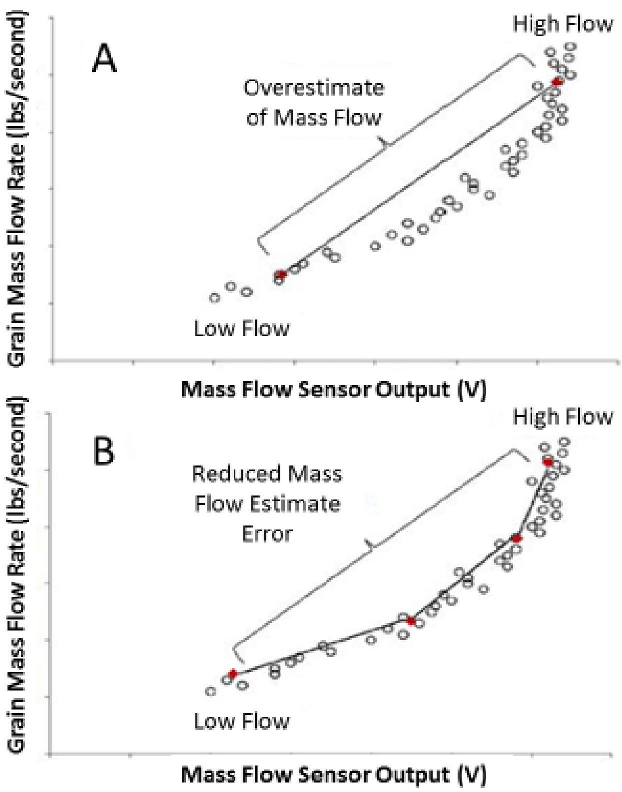

Figure 1: An inappropriately calibrated yield monitor mass flow reading (A) versus a properly calibrated yield monitor mass flow reading (B). Source: Best Management Practices for Collecting Accurate Yield Data and Avoiding Errors During Harvest. University of Nebraska Lincoln Extension Bulletin EC2004.

Best Management Practices

Use certified scale weights or a grain cart with load sensors to calibrate the yield monitor system. Grain carts outfitted with load sensors allow for frequent calibration. To avoid post-harvest data confusion, prepare a boundary shape file that contains information about all farm fields (field name, area, crop to plant or planted, fertilizer/manure applied etc.), before harvest and upload this information to the monitor. Update field and crop labels upon entering each new field to harvest.

It is recommended to operate equipment within consistent calibrated speed ranges for each crop and to ensure the header is completely lifted at the end of each pass. This allows yield maps to show proper start and end passes and will reduce the amount of time needed for post-harvest data cleaning.

General Summary

Accurate yield data are essential for making better management decisions on the farm. Without calibration yield monitors can produce inaccurate data. Check settings and frequently calibrate to ensure quality data.

References

- Best Management Practices for Collecting Accurate Yield Data and Avoiding Errors During Harvest. 2004. University of Nebraska Lincoln Extension Bulletin EC2004. http://extensionpublications.unl.edu/assets/pdf/ec2004.pdf.
- Yield Monitor Calibration Procedure. Michigan State University Extension. 2016. http://msue.anr.msu.edu/news/yield_monitor_calibration_procedure.

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For more information

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