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Grain Drill Metering Systems and the Need for Calibration

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A bag of soybean seed is no longer just seed, it is technology that is becoming increasingly costly. This makes it necessary to properly manage its use in order to improve profitability. It has become inefficient to simply count on the grain drill to do a pretty good job of putting down an average seeding rate.

Calibration is often overlooked as a means of improving machine performance and controlling input costs. Calibration is simply the process of verifying the rate of delivery of a crop production input such as fertilizer, herbicide, or seed. While calibration techniques are generally well known, some can be tedious and time consuming. Also, machine operators may not understand the value of such operations. As a result, the process is often neglected. We propose that calibration is more important than ever and requires more attention from farmers.

Calibration of the grain drill metering system can help eliminate uneven stands and can help control seeding costs by achieving targeted seeding rates. Also, calibration can give producers confidence in their planting operation as they move from bagged seed to bulk seed. When using bagged seed, producers could count the number of bags used in a specific field area, but it is more difficult to judge seed usage when filling from a bulk container. Also, some soybean seed is sold by count per bag and not by weight; not all bags of soybean seed weigh 50 pounds.

A Purdue University study using an alternative metering system for grain drills produced results that reinforce the value of calibrating seeding equipment. This study was initiated to address uneven soybean stands that were complicating field plot research. Uneven emergence of soybeans as seen in Figure 1 was the result of the non-uniform delivery of seed at planting.

Figure 1. Uneven soybean stand produced by an improperly calibrated grain drill.

This situation was diagnosed as a planting and seed-metering problem. The problem was identified by collecting and weighing seed from each seed tube on a grain drill (Figure 2). One result of this exercise was to document the non-uniformity among individual seed meters on a grain drill (Figure 3). Values in Figure 3 range from 86 to 156 grams (g) with an average of 125 g.

Figure 2. Seed captured during a calibration run over a known, fixed distance shown here prior to weighing.

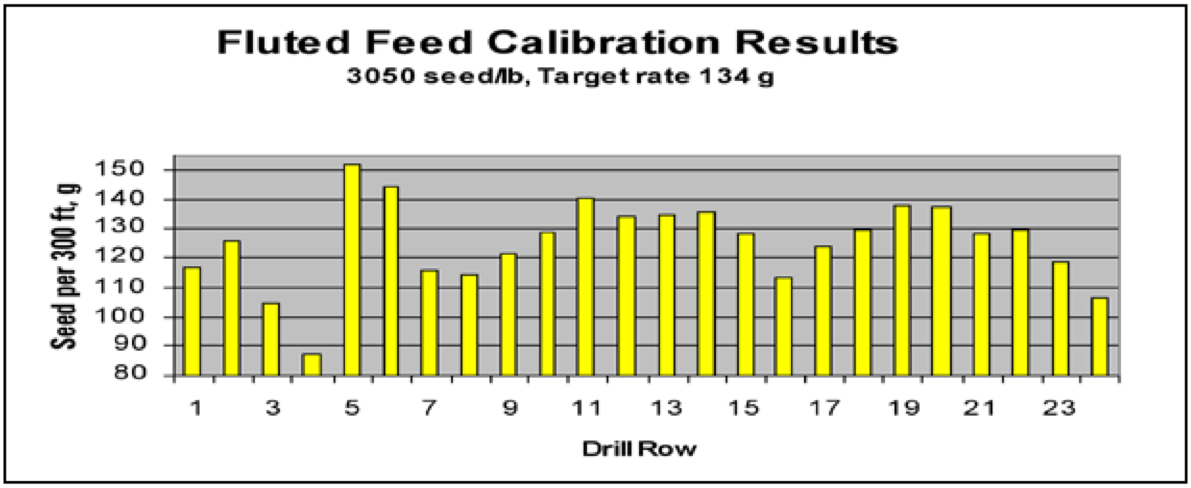

Figure 3. Measured row-to-row variation in seeding rate produced by a grain drill equipped with a standard fluted-wheel feed system.

Due to the row-to-row variation produced by a fluted-feed grain drill, Purdue researchers examined an alternative metering approach. A belt-type metering system (Figure 4) that could be fitted to a conventional grain drill was shown to reduce row-to-row variation in grain drill seed delivery during calibration (Figure 5). (Individual belt units replaced each fluted-feed mechanism on a grain drill.) Field plots confirmed that the belt-type metering system produces a significant (37 percent) reduction in plant stand variation.

The belt metering system solved the problem of non-uniformity in plant stands in research plots that led to the study. Belt metering systems have been installed on grain drills at six Purdue Agricultural Center locations for use in both field research and production of bulk soybean acreage.

While the improved uniformity of seed delivery measured during calibration did not produce a crop yield difference, more uniform metering of soybeans could still have implications for crop producers. The ability to control seed output with improved accuracy will allow for more accurate planning of seed orders and the ability to achieve targeted seeding rates without using excess seed. At $30 per 50-pound bag (or $0.60 per pound), the belt metering system provides a potential seed cost savings in situations where the variability of the fluted wheel system leads producers to increase the seeding rate to ensure that no area of a field is underplanted. Producers who are underseeding may not realize a seed-cost savings, but can benefit from more accurate estimation of seed to order.

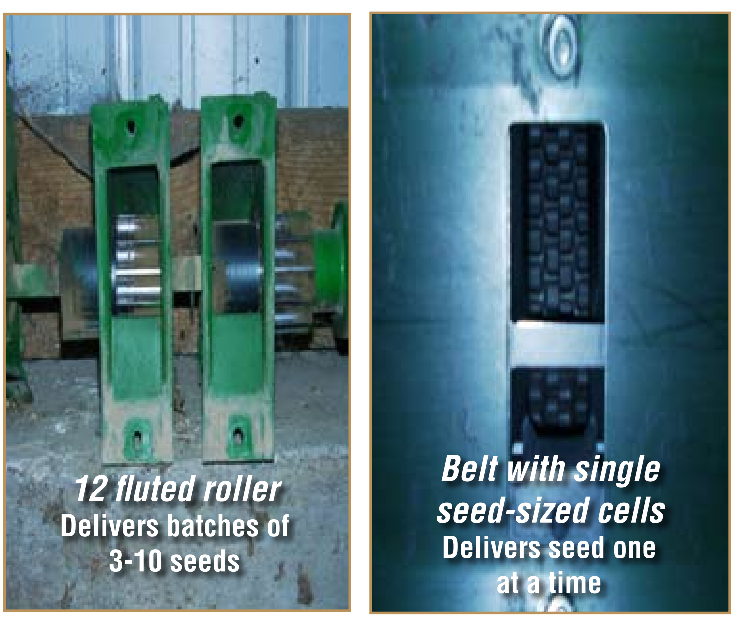

Figure 4. Illustration of the differences in construction between conventional fluted-wheel and belt-type metering systems.

Example

Recommended target population = 165,000 plants per acre (See Purdue publication AY-217-W, www.ces.purdue.edu/extmedia/AY/AY-217-W.html)

Seed used = 3,000 seeds per pound, $30 per 50-pound unit (or $0.60 per pound)

Germination = 90 percent

Expected emergence loss = 10 percent (or 90 percent survival rate)

165,000 plants per acre ÷ (0.90 × 0.90) = 203,704 seeds to be planted per acre

If a producer overplants by 30,000 seeds per acre (actual seeding rate = 233,704 seeds per acre), then by calibrating and adjusting to the desired 203,704 seeds per acre, 30,000 seeds (or 10 pounds of seed) could be saved per acre. That translates to $6 per acre. Over 500 acres, $3,000 of seed could be saved.

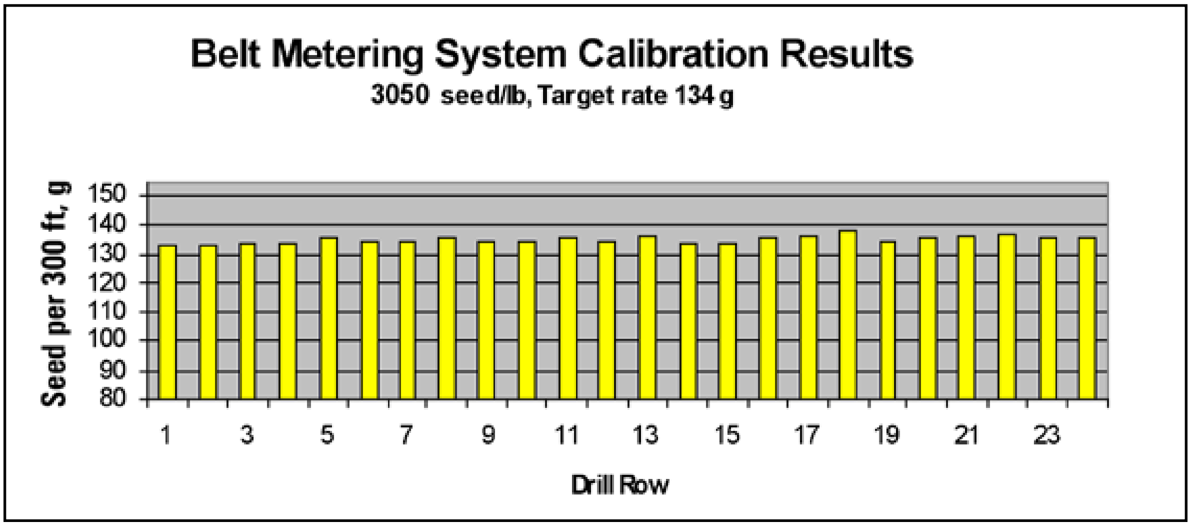

Figure 5. Measured row-to-row variation in seeding rate produced by a grain drill equipped with a belt metering system.

A more subtle impact of using a metering system that produces less row-to-row variation is in the producer's trust in the potential quality of the calibration process. It has been the experience of the authors that grain drill calibration is practiced far too infrequently. When calibration does occur, it is frequently performed on a "bulk" basis by determining average seeding rates over a known, often large, land area. Calibration performed by capturing and measuring delivered seed is most often performed on a single drill drop. Given the drop-to-drop variation measured in the fluted wheel meters in this study, calibration using a single drop could produce large errors in attempting to achieve a desired plant population in the field. A more consistent metering system could encourage more routine calibration and instill the confidence in a producer that desired rates could be achieved without intentional overseeding.

Unless the uniformity across a grain drill is known (Figures 3 & 5), then calibration through the collection of seed from one or two seed tubes could lead to misadjustment. For example, in Figure 3 if Row 4 was selected for calibration purposes and the drill adjusted to deliver the desired seeding rate, the grain drill as a whole would have been overseeding by as much as 30 percent. This translates into an extra 20.4 pounds of seed per acre. At $30 per 50-pound unit, that amounts to an excess cost of $12.24 per acre or $6,120 over 500 acres. Conversely, if Row 5 were used, then the drill would have been underseeding by about 15 percent. With soybeans, this level of underseeding should not result in a change in yield, but budgeting for inputs is more difficult and the practice will result in uneven and possibly thin stands that may lead to other agronomic problems.

Calibration Recommendations

- **Calibrate grain drills in as near to in-field conditions as can be achieved.**
  Capture seed from a grain drill that is moving along a measured path that simulates the vibrations that the drill will experience during normal operation. Such a method has been shown to produce more accurate results than so-called static calibration methods that involve a stationary grain drill in which the metering system is operated manually.
- **Always calibrate grain drills by seed population rather than pounds.**
  Seed size varies from variety to variety, from year to year, and from lot to lot within a variety. Grain drill seed metering systems that use fluted wheels are designed to deliver seed based on volume, not weight. To accurately set a grain drill for a specific lot of seed, calibration of the metering system should be done each year with each seed size that will be planted.
- **Calibrate (at least) annually.**
  Annual calibration assures that a drill remains accurate as it accumulates wear.
- **Use manufacturer's recommended settings initially.**
  The manufacturer-supplied charts for setting seeding rates generally are not the final word. The values from the charts are a good starting point when beginning the calibration process, but actual calibration results should be recorded and kept with the operator's manual for future reference.

Calibration Procedure

1. Count out at least five 100-seed lots of the soybean seed to be planted. If several varieties or lots of seed are to be used, calibrate for each. Wear the recommended personal protective equipment when handling any treated seed.
2. Weigh each batch of the seed on a gram scale — confirm the number of seeds per pound (453.6 grams). If the average weight of the five 100-seed lots is 15.12 grams, then

   453.6 grams ÷ 15.6 grams x 100 seeds = 3,000 seeds per pound
3. Load the drill so that the seed meters are covered and so that you will not run out of seed during calibration.
4. Mark off an area to run the drill — 300 feet is sufficient.
5. Attach a bag or container to each seed tube/drop.
6. Initially, adjust the drill per the manufacturer's recommendations for the desired seeding rate.
7. Calculate the desired seed delivery rate for a single tube at the initial drill settings:

   3,000 seeds per pound, or 15.12 grams per 100 seeds

   7.5-inch row spacing

   300-foot calibration distance

   The targeted seeding rate is 203,704 seeds per acre, or 67.90 pounds of seed per acre at 3,000 seeds per pound.

   (7.5 inches ÷ 12 inches x 300 feet) ÷ 43,560 square feet per acre = 0.0043 acre per seed tube

   The following equation will provide the desired weight in grams per container from each seed tube over the calibration distance:

   67.90 pounds per acre x 0.0043 acre per seed tube x 453.6 grams per pound = 132.44 grams per seed tube
8. Run the drill across the measured distance and stop. If you travel any extra distance, seed may vibrate out of the seed meters into the containers.
9. Weigh the seed from each seed tube and record those numbers. Remember to tare the scale to account for the weight of the container or bag.
10. Repeat steps 8 and 9 at least one more time and average the weights for each seed tube.
11. Compare the actual weights collected from each seed drop tube and adjust the drill to increase or decrease the seeding rate.
12. Repeat steps 8-10 to check again.

Worksheet

A worksheet for performing calculations and recording calibration data is attached.

Resources

Publications

- Christmas, E.P. *Plant Populations and Seeding Sates for Soybeans*. Purdue University Cooperative Extension Service, West Lafayette, Ind. Publication No. AY-217-W. (Can be accessed at www.ces.purdue.edu/extmedia/AY/AY-217-W.html)

Product Manufacturers

- S.I. Distributing Inc., St. Marys, Ohio. Maker of the S.I. Belt Meter.

Disclaimer

Mention of any specific trade names within this publication does not represent a product endorsement on the part of Purdue University or any of its employees.

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EXPERT REVIEWED

Worksheet for Grain Drill Metering Systems and the Need for Calibration

A. Determining necessary seeding rate:

Target plant population (or) at harvest _______ plants per acre ÷ (Germination % _____ x Emergence % _________) = ________ seeds per acre

B. Determining seeds per pound:

Average weight in grams of five 100-seed lots

[453.6 grams per pound ÷ (weight 1 ___ + weight 2 ___ + weight 3 ___ + weight 4 + weight 5 ÷ 5)] x 100 seeds = ______ seeds per pound

C. Determining targeted seed delivery rate from each drill row:

(Row spacing _____ inches x calibration distance _____ feet x seeding rate _____ pounds per acre x 453.6 grams per pound) ÷ (12 inches per foot x 43,560 square feet per acre) = ____ gram per seed tube

Record weight in grants for each seed tube (drill now) starting from the left side of the front of the drill:

Row	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Trial 1																								
Trial 2																								
Average																								

Row	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Trial 1																								
Trial 2																								
Average																								

D. Background machine and calibration information

Drill make ______________________________; Drill model ___________________________

Seed brand ______________________________; Seed size _________________ seeds per pound

Date calibration performed ______ / ______ / ______; Ground speed _________________milees per hour