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## Grain Drill Calibration Procedures for Winter Wheat

S.A. Shearer, S.G. McNeill, G.A. Watkins, and S.F. Higgins  
Department of Biosystems and Agricultural Engineering

### Introduction

Intensive wheat management requires attention to details, from planting through harvest. Perhaps most critical is stand establishment. While no-tilling wheat into corn stubble presents a range of problems in depth control and residue management, these problems do not minimize the importance of calibration.

Just as no two drills are manufactured alike, seed rarely is produced in uniform size, nor do individual metering cups deliver the same seed quantities. A few hours of attention to calibration at the start of fall planting will help producers control seed costs and achieve more desirable, uniform stands and better yields.


The following step-by-step procedure has been developed from field experiences of researchers who evaluated no-till drill performance in Kentucky. Following the procedures will help reduce stand problems associated with drill performance. Explanations are provided to help producers understand the implications of each step.

### Calibration Procedures

1. Select a desired plant stand. For example, assume the crop advisor recommends a plant stand of 375 plants/yd<sup>2</sup> (450 plants/m<sup>2</sup>). Your objective is to deliver this number of viable seeds per unit area.

2. Obtain the variety tag from one of the seed bags you will be using. Check the remaining bags to determine if they are from the same seed lot. In the event your seed supply is from multiple lots, the drill may have to be recalibrated for each lot. Each tag will exhibit a lot number, such as 86-98-G-2-8W, as shown in Figure 1.

Figure 1. Typical tag from seed bag stating variety, lot number, seed size, quality, and other information.

FOUNDATION SEED			
			287229
<small>THIS CERTIFICATION TAG IS ISSUED BY THE KENTUCKY SEED IMPROVEMENT ASSOCIATION FOR USE ON KENTUCKY FOUNDATION SEED PRODUCED IN ACCORDANCE WITH THE STANDARDS, RULES AND REGULATIONS ESTABLISHED UNDER AUTHORITY OF THE KENTUCKY SEED LAW.</small>			
<b>NOTICE TO BUYER - LIMITATION OF WARRANTY</b>			
<small>THE SEEDS CONTAINED HEREIN ARE WARRANTED TO CONFORM TO THE LABEL DESCRIPTION WITHIN RECOGNIZED TOLERANCES AS REQUIRED UNDER STATE AND FEDERAL SEED LAWS. NO WARRANTIES ARE MADE, EITHER EXPRESSED OR IMPLIED, INCLUDING MERCHANTABILITY, FITNESS FOR PURPOSE OR OTHERWISE WHICH WOULD EXTEND BEYOND SUCH DESCRIPTION IN ANY EVENT. LIABILITY FOR BREACH OF ANY WARRANTY OR CONTRACT OR FOR NEGLIGENCE WITH RESPECT TO SUCH SEEDS IS LIMITED TO THE PURCHASE PRICE OF SUCH SEEDS AS A CONDITION TO ANY LIABILITY. NOTICE MUST BE RECEIVED BY REGISTERED MAIL OF ANY CLAIM THAT THE SEED IS DEFECTIVE WITHIN 30 DAYS AFTER THE REPORT ON THE SEED SCORES APPEARS.</small>			
KIND	WHEAT	PURE SEED	99.50%
VARIETY	CLARK	CROP SEED	0.00%
LOT NO.	86-98-G-2-8W	WEED SEED	0.00%
ORIGIN	KENTUCKY	INERT MATTER	0.50%
FOUNDATION SEED PROJECT		GERMINATION	90.00%
LEXINGTON KY		HARD SEED	0.00%
		NOXIOUS WEED	NONE
		NET WT. LBS.	50
		DATE TESTED	09/98
		NO. SEED PER LB.	13765
UNAUTHORIZED PROPAGATION PROHIBITED. U.S. PROTECTED VARIETY. TO BE SOLD BY VARIETY NAME ONLY AS A CLASS OF CERTIFIED SEED			
MEMBER ASSOCIATION OF OFFICIAL SEED CERTIFYING AGENCIES			

3. Note the germination rate for the seed lot on the tag. The example tag in Figure 1 shows the germination rate is 90%. A third and less important number on this tag is the percentage of *pure seed* contained in the bag. This number is equal to 100% minus the percentage of *inert matter*; 0.50% in this case; *weed seed*, 0.00%; and *crop seed*, 0.00%.

These numbers represent maximums and generally do not vary greatly among varieties or companies. By weight, 99.50% of the contents of the seed bag is seed.

4. Adjust your desired seeding rate to accommodate the germination rate and pure seed values. To do this, divide the desired seeding rate by each of the percentages in decimal form as shown in Example 1. Thus in the example, seeding at a target rate of 419 seeds/yd<sup>2</sup> (503 seeds/m<sup>2</sup>), you should expect a stand of 375 plants/yd<sup>2</sup> (450 plants/m<sup>2</sup>).

5. Once you have a target seeding rate that takes into account the viability of the seeds and the quantity of non-seed material contained in the bag, consider what the drill will discharge. Most drill manufacturers provide charts to transform seeding rates on a weight basis (lb/ac or kg/ha) into metering cup settings. Unfortunately, the relationship between the number of seeds discharged and weight varies greatly among varieties and among lots of the same variety. Therefore, if the seed bag label does not contain information on seed density, you must determine it.

#### Example 1. Target seeding rate.

$$419 \text{ seeds/yd}^2 = \frac{375 \text{ plants/yd}^2}{(0.90) \cdot (0.995)}$$

$$503 \text{ seeds/m}^2 = \frac{450 \text{ plants/m}^2}{(0.90) \cdot (0.995)}$$

To estimate seed density, count out 1,000 seeds and weigh them to the nearest 0.1 gram. If you have a scale calibrated in ounces or pounds, the accuracy of this scale should be 0.002 ounces or 0.0002 pounds, respectively. Be careful to account for the weight of any container (tare weight) used in the weighing process. For the lot of seed with the tag shown in Figure 1, 1,000 wheat grains were determined to weigh 33.0 grams. To determine the required seeding rate in lb/ac (kg/ha), the calculations are performed as in Example 2a. An alternative approach, providing the seed count or density is provided on the tag, is shown in Example 2b. From the tag in Figure 1, the seed count per pound is 13,765. The same result is obtained using either approach.

This value, 147 lb/ac (166 kg/ha), will serve as a starting point for drill adjustment. For a John Deere 750 no-till drill, the recommended setting for wheat is between 28 and 32 (137 lb/ac and 165 lb/ac or 154 and 180 kg/ha). Since the goal is halfway between these values, start with a setting of 30.

**6.** Begin field calibration by filling a portion of the seed hopper of the drill with seed. Be certain that at least five seed cups are covered with seed. Because significant variation in delivery rates (as much as 15 percent between seed cups across the drill) may exist, using five openers reduces the chance of one or two seed cups skewing the calibration. This procedure must be repeated for each drill section with a separate metering cup adjustment. You may want to use duct tape to cover any remaining seed cups that will not be used in the calibration. *Caution: Be certain that you remove this tape after calibration and prior to planting!*

**7.** The drill should be taken to a typical field to be planted, and a 200-foot (60-meter) course should be laid out. Drop the openers to the ground as you move to the start of the course. Remove five of the flexible rubber hoses from the openers and firmly attach plastic bags to the base

**Example 2a.** Desired seeding rate based on seed count method.

$$147 \text{ lb/ac} = \left( \frac{419 \text{ seeds}}{1 \text{ yd}^2} \right) \left( \frac{1 \text{ yd}^2}{9 \text{ ft}^2} \right) \left( \frac{43,560 \text{ ft}^2}{1 \text{ ac}} \right) \left( \frac{33.0 \text{ g}}{1,000 \text{ seeds}} \right) \left( \frac{1 \text{ kg}}{1,000 \text{ g}} \right) \left( \frac{2.205 \text{ lb}}{1 \text{ kg}} \right)$$

$$166 \text{ kg/ha} = \left( \frac{503 \text{ seeds}}{1 \text{ m}^2} \right) \left( \frac{33.0 \text{ g}}{1,000 \text{ seeds}} \right) \left( \frac{1 \text{ kg}}{1,000 \text{ g}} \right) \left( \frac{10,000 \text{ m}^2}{1 \text{ ha}} \right)$$

**Example 2b.** Desired seeding rate based on seed tag data.

$$147 \text{ lb/ac} = \left( \frac{419 \text{ seeds}}{\text{yd}^2} \right) \left( \frac{1 \text{ yd}^2}{9 \text{ ft}^2} \right) \left( \frac{43,560 \text{ ft}^2}{\text{ac}} \right) \left( \frac{1 \text{ lb}}{13,765 \text{ seeds}} \right)$$

$$166 \text{ kg/ha} = \left( \frac{503 \text{ seeds}}{1 \text{ m}^2} \right) \left( \frac{1 \text{ lb}}{13,765 \text{ seeds}} \right) \left( \frac{1 \text{ kg}}{2.2046 \text{ lb}} \right) \left( \frac{10,000 \text{ m}^2}{1 \text{ ha}} \right)$$

**Example 3.** Actual seeding rate calculation for drill setting.

$$116 \text{ lb/ac} = \left( \frac{752.4 \text{ g}}{5 \text{ openers}} \right) \left( \frac{1}{200 \text{ ft}} \right) \left( \frac{1 \text{ kg}}{1,000 \text{ g}} \right) \left( \frac{2.205 \text{ lb}}{1 \text{ kg}} \right) \left( \frac{1 \text{ opener}}{7.5 \text{ in}} \right) \left( \frac{12 \text{ in}}{1 \text{ ft}} \right) \left( \frac{43,560 \text{ ft}^2}{1 \text{ ac}} \right)$$

$$132 \text{ kg/ha} = \left( \frac{752.4 \text{ g}}{5 \text{ openers}} \right) \left( \frac{1}{60 \text{ m}} \right) \left( \frac{1 \text{ kg}}{1,000^3 \text{ g}} \right) \left( \frac{1 \text{ opener}}{7.5 \text{ in}} \right) \left( \frac{1 \text{ in}}{2.54 \text{ cm}} \right) \left( \frac{100 \text{ cm}}{1 \text{ m}} \right) \left( \frac{10,000 \text{ m}^2}{1 \text{ ha}} \right)$$

of each seed drop tube using wire ties or duct tape. Be certain that the five seed tubes correspond to the seed cups that are covered with seed. You also will need to support the rubber tubes, using duct tape to assure they do not become entangled in the openers. Travel the length of the course at your typical speed. Stop at the end of the course and collect the seed from all five openers. The seed can be placed in one bag and weighed, again to the nearest 0.1 gram. (Be careful to account for the tare weight of the bag.) Next, determine the actual seed delivery rate as follows, assuming for Example 3 that 752.4 grams of seed is collected from all five openers.

**8.** In this case the seeding rate error is 21 percent lower than desired, so the metering cups must be opened about 20 percent (or to a setting of 36) and the process repeated. Continue to calibrate

and adjust the metering cup setting until you are within 5 percent of the target seeding rate. As you gain experience with a particular drill, this process will become second nature, and you will achieve acceptable performance much more quickly compared to your initial calibration attempts. Always adjust the drill by first opening the metering cups wider than necessary and then closing the metering cups to the desired setting.

**9.** A spreadsheet is available from the authors to supplement these suggested procedures. It incorporates the equations shown with seed tag data and can be used to calculate the calibration rate for each variety per seed lot based on the desired final stand and row spacing. The spreadsheet also calculates the number of seed bags needed for a given number of acres for each variety and the total seed cost (see Table 1 for example).

**Table 1.** Seeding rates for four wheat lots based on the desired plant population, row spacing, and seed tag data. Total number of bags needed and seed costs for each lot also are calculated.

Desired Stand		Row Spacing (in)	Plants per Foot of Row								
Per Square Yard	Per Square Foot										
375	41.7	7.5	26.0								
Variety per Lot	No. Seeds/lb	Seed Weight gram/1,000 Seeds	Germ %	Purity %	Seeding rate		No. Acres	No. 50 lb bags	Cost		
					Lb/Acre	Gram/200 ft of Row			Per Bag	Per Seed Lot	Per Acre
Clark	<b>13,765</b>	33.0	<b>90</b>	<b>99.50</b>	147	192	<b>134</b>	395	<b>\$6.00</b>	\$2,368	\$17.67
Foster	<b>17,089</b>	26.5	<b>97</b>	<b>99.97</b>	110	143	<b>208</b>	456	<b>\$7.50</b>	\$3,417	\$16.43
Justice	<b>16,453</b>	27.6	<b>90</b>	<b>99.00</b>	124	161	<b>47</b>	116	<b>\$6.00</b>	\$698	\$14.86
P2552	<b>9,700</b>	46.8	<b>92</b>	<b>99.84</b>	204	265	<b>111</b>	452	<b>\$13.00</b>	\$5,879	\$52.96
Total							500	1419		\$12,362	\$24.72

Notes:

- 1) Items shown in **bold** are used to compute the desired values for each variety based on seed tag and cost data.
- 2) The seeding rate for the first lot (Clark at 147 pounds per acre) matches Example 2a.

**Other Considerations**

The calibration procedure described above can be time consuming and frustrating if you wait until the planting date to make your calculations. We recommend doing most of the work well ahead of planting, in the off-season.

You may want to check the delivery from all metering cups on the drill. A rock can become lodged in the metering cup, destroying the plastic fluted

metering roll. Also, if there are large differences in the quantity of seed delivered from each cup, it may be possible to shim the metering rolls or reposition the cups slightly to achieve uniform discharge. A few hours spent with the drill in the shop may save several dollars worth of seed, help provide better stands, and enable you to achieve full yield potential.

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The calibration component of the spreadsheet shown in Table 1 was initially designed by Mike Ellis, no-till farmer/crop manager of Worth and Dee Ellis Farms in Shelby County, Kentucky. The spreadsheet was modified by the authors to allow for different row spacings and to include seed cost data.

