Section 4

Planting and Drill Calibration

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The objective when planting wheat is to establish a uniform stand of at least 25 plants per square foot with adequate fall growth for tiller development and an established root system for winter survival. Planting methods include drilling, broadcast seeding, and aerial seeding. Each has advantages and disadvantages. A planting method should be based on planting equipment, time and labor availability, seeding costs, planting date opportunity, weather, crop usage, yield goals, and stand establishment risks associated with each method. In addition, calibration of planting equipment is critical to getting the correct number of seeds in the soil. Methods for drill calibration are included at the end of this section.

As machinery moves across a field, soil compaction is a concern. Compaction causes the soil to waterlog easily, reduces air movement through the soil, puts the wheat crop under stress, and can reduce the yield. Fields should be tested for compaction by using a penetrometer or similar device when there is ample water in the soil. If soil compaction exists in the field, it should be alleviated before wheat is seeded, when the field is relatively dry. Subsoiling equipment can alleviate deep compaction while a field cultivator can alleviate shallow compaction. These tillage operations should only be conducted when the field is dry. If the field is wet, then these operations could actually worsen compaction. Some types of subsoilers leave most of the residue on the surface and other types cause considerable soil disturbance which would require additional tillage. Once the compaction is remedied and is the field is managed in a complete no-tillage system, the field usually will remain free of compaction.

Drilling

The best results in wheat stand establishment and yield are obtained by seeding with a grain drill. A drill ensures good seed-to-soil contact, promotes rapid germination, results in more uniform and optimum stands, reduces winter injury, and increases yields over broadcast seeding and aerial seeding. (For calibration of a drill, see the end of this section.)

Photo 4-1. Proper seeding techniques are critical for an excellent stand of wheat.

Drills can be used for conventional tillage, reduced tillage, and no-tillage field conditions. Conventional/full tillage provides a level, smooth seedbed for drilling and results in a more uniform planting depth. Drills with additional coulters and more down pressure on the planter units can establish a good stand of wheat in reduced tillage and no-tillage fields. Leaving crop residue on the soil surface protects the soil from erosion until the wheat crop becomes established. About half of the wheat crop in Kentucky is currently planted into no-till conditions with a drill. For fields that still receive tillage, disking is probably the most common method.

No-tillage conditions provide several advantages over tillage conditions, including reduced soil erosion, reduced equipment requirements, reduced labor costs and reduced fuel costs. No-tillage conditions also allow more timely management, such as spring applications of nitrogen (N) fertilizer. On the other hand, no-till wheat can result in variable planting depths and uneven stands, especially if equipment is not properly adjusted for no-tillage fields. In the early stages of no-tillage adoption by a producer, yields can be a reduced in a high-yield environment. However, management experience seems to eliminate most of these disadvantages. Yield comparisons from many research and on-farm trials over the last 25 years show little or no difference in yield between no-tillage and tillage. The small increase in yields of soybean and corn in a true no-tillage system for wheat, double-cropped soybean and corn is attractive to producers, also.

Photo 4-2. Wheat can be seeded into heavy corn residue with modern no-tillage drills.

Residue management varies with the previous crop. Planting into no-tillage conditions after soybeans is ideal but may not be the most economical crop rotation. Planting into corn residue requires proper management of that residue in order to get uniform seed depth and uniform emergence. Combines should have residue choppers and spreaders to distribute the corn residue evenly. In many fields, wheat seeding occurs very soon after corn harvest. Normally, stalk shredding or mowing prior to seeding is not necessary if cornstalks are moist and firmly in the soil. However, if two or three weeks will elapse between stalk shredding and wheat seeding, then shredding the corn residue can improve drill coulter penetration. A rotary mower may have a tendency to “windrow” the residue. A flail mower is a better tool and distributes the residue more evenly for a more uniform seeding depth. Drilling wheat at an angle to the corn stalk row is also helpful because a drill unit is not continually in a row of corn stalks.

Winterkill is a problem about every four or five years in Kentucky. It can be more pronounced in no-till plantings if the planting depth is ½ inch or less. To remove this increased risk, use the proper planting methods and adjustments to plant 1 to 1½ inches deep. Also, be sure to plant a winter hardy variety.

Drills should be adjusted to target 30 to 35 live seeds per square foot for conventional tillage systems and 35 to 40 live seeds per square foot for no-tillage systems.

Broadcasting

Wheat seed can be broadcast as either a planned or emergency seeding method. The wheat seed is broadcast on the soil surface with a fertilizer spreader and incorporated into the soil with light tillage (usually disk or field cultivator). Broadcasting is a fast method of seeding wheat and is an acceptable option if corn or soybean harvest is delayed or weather delays push planting dates to the end of or beyond the optimum planting period.

When broadcast seeding into corn stubble, tillage is often conducted before broadcasting. Once broadcasting occurs, then a light tillage operation incorporates the seed into the soil. When broadcasting wheat into a field of soybean stubble, generally a light tillage operation after broadcasting is necessary.

Broadcast seeding often results in uneven seed placement in the soil, which results in uneven emergence and stands. Seeds may be placed as deep as 3 to 4 inches, where many seeds will germinate but will not emerge through the soil surface. Other seeds may be placed very shallow or on the soil surface. These seeds often do not survive due to dry soil or winter damage. The uneven stands from broadcasting often result in lower yields comparing with drilling.

One method of improving stand uniformity is to broadcast seed in two passes across the field, with a half seeding rate for each pass. The second pass is made perpendicular to the first pass. While this method should improve stand uniformity, it also increases time required to seed the field.

Because plant establishment potential is reduced and seed placement is not uniform, seeding rates should be increased for broadcast seeding. Increase broadcast seeding rates by 30 percent to 35 percent over drilled seeding rates. This equates to seeding rates of 45 to 47 seeds per square foot (or approximately 2½ bushels per acre at average seed size). Soil moisture, crop residue and accuracy of seed incorporation into the soil are crucial to stand establishment.

Broadcasting wheat with fertilizer is a fast way to seed after harvest. Take precautions to ensure that the seed is uniformly blended with the fertilizer and that the fertilizer-seed mixture is uniformly applied. Seed should be mixed with fertilizer as close to the time of application as possible and applied immediately after blending. Allowing the fertilizer-seed mixture to sit after blending (longer than eight hours), particularly with triple super phosphate (0-46-0) or diammonium phosphate (18-46-0), results in seed damage (reduced germination) and, subsequently, a poor stand.

In summary, broadcast seeding is a faster method of seeding and can save time during corn or soybean harvest. The time saved may offset some of the greater costs and potential yield loss associated with broadcast wheat. Disadvantages include inconsistent seed depth and emergence, nonuniform stands, potential for reduced stands, usually lower yields, increased chances of winter injury and higher seed costs.

Aerial Seeding

Aerial seeding is a risky method for establishing wheat and is not very common. It may be considered as an option when harvest of the summer crop is delayed well into the optimum time for planting wheat. An airplane or helicopter drops a high rate of wheat seed onto the soil surface through the canopy of an established summer crop such as corn or soybean. The wheat seed is not incorporated into the soil, making successful germinate and stand establishment heavily dependent on adequate and timely rainfall. Depending on the weather during stand establishments, yields from aerial seeding can be very high or the crop can be a complete failure.

Aerial seeding normally works best when the summer crop of corn or soybean is turning yellow and leaves are dropping to the ground. This leaf drop can provide a mulch cover and improve the environment for germination. Even in the best conditions, aerial seeding will result in wheat plants with crowns at or above the soil surface, making the wheat crop extremely vulnerable to winterkill.

Historically, aerial seeding was conducting in September prior to the Hessian fly free date. This practice is not recommended, because rainfall is usually low during this period, and there is a greater risk of damage from Hessian fly, aphids, take-all and wheat spindle streak mosaic virus. Aerial seeding is not recommended for late October or November plantings, either. Normally, wheat growth from late aerial seedings will be inadequate for winter survival.

Seeding rates should be 50 to 55 seeds per square foot for aerial seeding, nearly 40 to 50 percent greater than those used for drill seeding. Expected stand establishment will be about 50 to 75 percent of the seeding rate.

In summary, aerial seeding is a high-risk venture and should only be considered for the early window of wheat seeding dates when harvest of the summer crop is delayed. Even in these cases, seeding wheat late with a drill may have better odds of surviving than aerial-seeded wheat.

Grain Drill Calibration

Several methods for calibrating drills are presented below. For any of these methods, ensure that all units are properly delivering seed before conducting any calibration. Look for any loose hoses or chains, gears, etc. that might affect seed delivery.

For all target recommendations, we are expecting a germination rate of 90 percent. For example, when 30 to 35 seeds/sq ft is recommended, we are expecting 27 to 32 plants to emerge. Seeding rates for no-tillage are slightly higher than conventional tillage, because we anticipate slightly lower emergence rates.

When calibrating a drill, make note of the standard germination of seed as marked on the seed tag. That number can be used with the desired live seeding rate to calculate how many total seeds to drop. For example, if the targeted live seeding rate is 35 live seeds per sq ft and the standard germination is 80 percent, then the total seeds needed are 38 seeds per sq ft (30 ÷ 0.8 = 38). Table 4-1 can help with calculations of standard germination and adjusted seeding rate.

Table 4-1. Adjusted seeding rate needed based on standard germination and desired live seeding rate.

Live Seeding Rate (seeds/sq ft)	Standard Germination Rate				
	95%	90%	85%	80%	75%
	Adjusted Seeding Rate (seeds/sq ft)				
25	26	28	29	31	33
30	32	33	35	38	40
35	37	39	41	44	47

Once desired seeding rate has been determined, based on field conditions and standard germination of the seed, then the following methods can be used.

Method 1. (most accurate) A five-step process for proper grain-drill calibration follows:

Step 1. Use Table 4-2 as a guide for seeding rates at various row widths when the seed germination test is 90 percent or higher. Table 4-3 gives estimates of the pounds of seed needed per acre at seeding rates of 30 and 35 seeds per square foot for a known seed size.

Step 2. Calculate the number of seeds required in 50 drill-row feet. For example, with 7-inch wide rows and on-time planting, an appropriate seeding rate would be 20 seeds per drill-row foot multiplied by 50 feet, which equals 1,000 seeds planted every 50 feet of row. Count 1,000 seeds of each variety and put them in a graduated tube, such as a rain gauge, or other clear tube or cylinder. Mark the level of the 1,000 seeds on the tube. Or, if you have scales, weigh the 1,000 seeds of each variety.

Step 3. Hook a tractor to the grain drill so that the drive wheels of the drill can be raised off the ground and the drive gears can be engaged. Jack up the drive wheel so it clears the ground and turn the wheel several revolutions to be certain all working parts are turning freely. Check all drill spouts for blockages.

Step 4. Determine the number of revolutions the drive wheel must make to travel 50 feet. Measure the distance around the drive wheel. This distance can be measured directly with a tape measure or calculated by measuring the diameter or distance across the tire and multiplying that distance by a factor of 3.2. For example, if the drive wheel measures 30 inches from tread to tread (diameter), the distance around the tire should measure 96 inches (30 x 3.2). The number of tire revolutions per 50 feet (50 x 12 inches) equals 600 inches. Divide 600 inches by 96 inches to get 6.25 revolutions of the tire per 50 feet of travel. Make a mark on the wheel so the number of revolutions can be conveniently determined when the wheel is turned.

Photo 4-3. Drill calibration takes time, but the final results are worth the effort.

Table 4-2. Recommended number of wheat seeds to plant per 50 drill-row feet.

Row Width (in)	Row Length Needed for 1 sq ft (in)	Seeds/sq ft: 30	Seeds/sq ft: 35
		Seeds/50 drill-row ft needed[a]	
4	36.0	500	600
6	24.0	750	900
7	20.6	850	1000
7.5	19.2	950	1100
8	18.0	1000	1150
10	14.4	1250	1450

a Assumes 90 percent germination rate.

Table 4-3. Number of pounds of wheat seed needed, depending on seed size and seeding rate.

Seeds/lb	Seeds/sq ft[a]: 30	Seeds/sq ft[a]: 35
	lb/acre	
10,000	131	152
12,000	109	127
14,000	93	109
16,000	82	95
18,000	73	85
20,000	65	76

a Based on 90 percent or greater germination.

Step 5. Calibrate the drill.

- Put at least a quart of seed of the variety to be calibrated over at least two drill spouts. (You get better accuracy if you use more than one drill spout.)
- Set the drill on a rate setting expected to be close to that desired, and turn the wheel the number of revolutions needed for 50 feet (as determined in step 4) while catching the seed from each spout in a separate container. Pour the seed caught into the precalibrated tube (as determined in step 2), and check the level. Repeat for each of the drill spouts.
- Change settings as needed, and repeat until you get the appropriate number of seeds (level marked on the tube). Repeat the above steps for each variety.

Option: The above procedure also can be used under actual field conditions by catching seed while the drill is traveling a distance of 50 feet. Use Table 4-4 to determine how much seed should be collected from each row unit.

Method 2. (less accurate) Put the wheat seed in the hopper of the drill to cover two or three drill spouts. Keep the seed tag for reference.

- Pull one or more hoses off of the planter units and attach bags to the bottom of the hoses using either zip ties or duct tape.
- With the drill engaged, drive the drill for 50 feet.
- Pull the bags off of the row units and weigh the seed.
- Use Table 4-4 to determine how much seed should be collected from each row unit. Use the seed tag to identify how many wheat seeds are in a pound. Each variety and possibly each seed lot of wheat will be a different seed size.
- Adjust the settings on the drill if necessary.

Method 3. (least accurate) Calculate out how many pounds of seed should be planted for each acre. For example, a target of 35 seeds per square foot is 1,524,600 seeds per acre. If the seed size is 10,000 seeds per pound, the total pounds per acre needed is 152 pounds per acre (Table 4-3).

- Put a specific amount of wheat seed into the drill hopper (either fill to a certain line inside the hopper or fill the hopper to the top).
- Plant a specified area, either one acre or one-half acre.
- Weigh out 200 pounds of seed. Put seed into the hopper until you have filled the hopper back to the specified height.
- Weigh the remaining seed to determine how many pounds were added back to the hopper.

Table 4-4. Weight of seed needed for one row unit and 50 feet of row, depending on seed size, target seeding rate and spacing between row units (assuming 90% seed germination).

30 seeds/sq ft (target seeding rate)

Seed Size (seeds/lb)	Row Width (in)					
	7	7.5	8	7	7.5	8
	Seed collected from one unit in 50 ft of row					
	ounces			grams		
10,000	1.55	1.67	1.78	44.1	47.2	50.3
12,000	1.30	1.39	1.48	36.7	39.4	42.0
14,000	1.11	1.19	1.27	31.5	33.7	36.0
16,000	0.97	1.04	1.11	27.5	29.5	31.5
18,000	0.86	0.93	0.99	24.5	26.2	28.0
20,000	0.78	0.83	0.89	22.0	23.6	25.2

35 seeds/sq ft (target seeding rate)

Seed Size (seeds/lb)	Row Width (in)					
	7	7.5	8	7	7.5	8
	Seed collected from one unit in 50 ft of row					
	ounces			grams		
10,000	1.81	1.94	2.07	51.4	55.1	58.7
12,000	1.51	1.62	1.73	42.8	45.9	49.0
14,000	1.30	1.39	1.48	36.7	39.4	42.0
16,000	1.13	1.22	1.30	32.1	34.5	36.7
18,000	1.01	1.08	1.15	28.6	30.6	32.6
20,000	0.91	0.97	1.04	25.7	27.6	29.4

40 seeds/sq ft (target seeding rate)

Seed Size (seeds/lb)	Row Width (in)					
	7	7.5	8	7	7.5	8
	Seed collected from one unit in 50 ft of row					
	ounces			grams		
10,000	2.07	2.22	2.37	58.8	63.0	67.1
12,000	1.73	1.85	1.97	49.0	52.5	55.9
14,000	1.48	1.59	1.69	42.0	45.0	48.0
16,000	1.30	1.39	1.48	36.7	39.4	42.0
18,000	1.15	1.23	1.32	32.6	35.0	37.3
20,000	1.04	1.11	1.18	29.4	31.5	33.6

Calculation to determine seeds needed:

Ounces of seed needed = [seeds per sq ft x (50 ft x row width in ft) ÷ seeds per pound) x 16 ounces per pound]/0.9

Where seeding rate is seeds per sq ft, row width is in feet, and 0.9 is 90% germination.