Preparing and Calibrating a No-Till or Conventional Drill

for Establishing Forage or Cover Crops

UNIVERSITY OF GEORGIA
EXTENSION

AUTHORS

Dennis W. Hancock

Professor and Extension Forage Agronomist, Department of Crop and Soil Sciences

Brian Maddy

County Extension Coordinator, Troup County

Julia Gaskin

Sustainable Agriculture Coordinator, Department of Crop and Soil Sciences

Lisa L. Baxter

Assistant Professor, Department of Crop and Soil Sciences

Deidre D. Harmon

Assistant Professor and Extension Livestock Specialist, Department of Animal Science, North Carolina State University

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Parts of a drill

There are many moving parts on a no-till or conventional drill. Each brand and model has design elements that differentiates it from other drills on the market, but most have several key features in common. These key features are identified in Figure 1. On a no-till drill, the rolling coulter travels ahead of the opener and cuts a slot through the sod, residue, and soil, and then the double-disk opener widens this slot. Conventional grain drills are used when the seedbed is already prepared and the coulter is not needed to cut through residue or the soil surface. Therefore, conventional drills do not have the coulter assembly on the front.

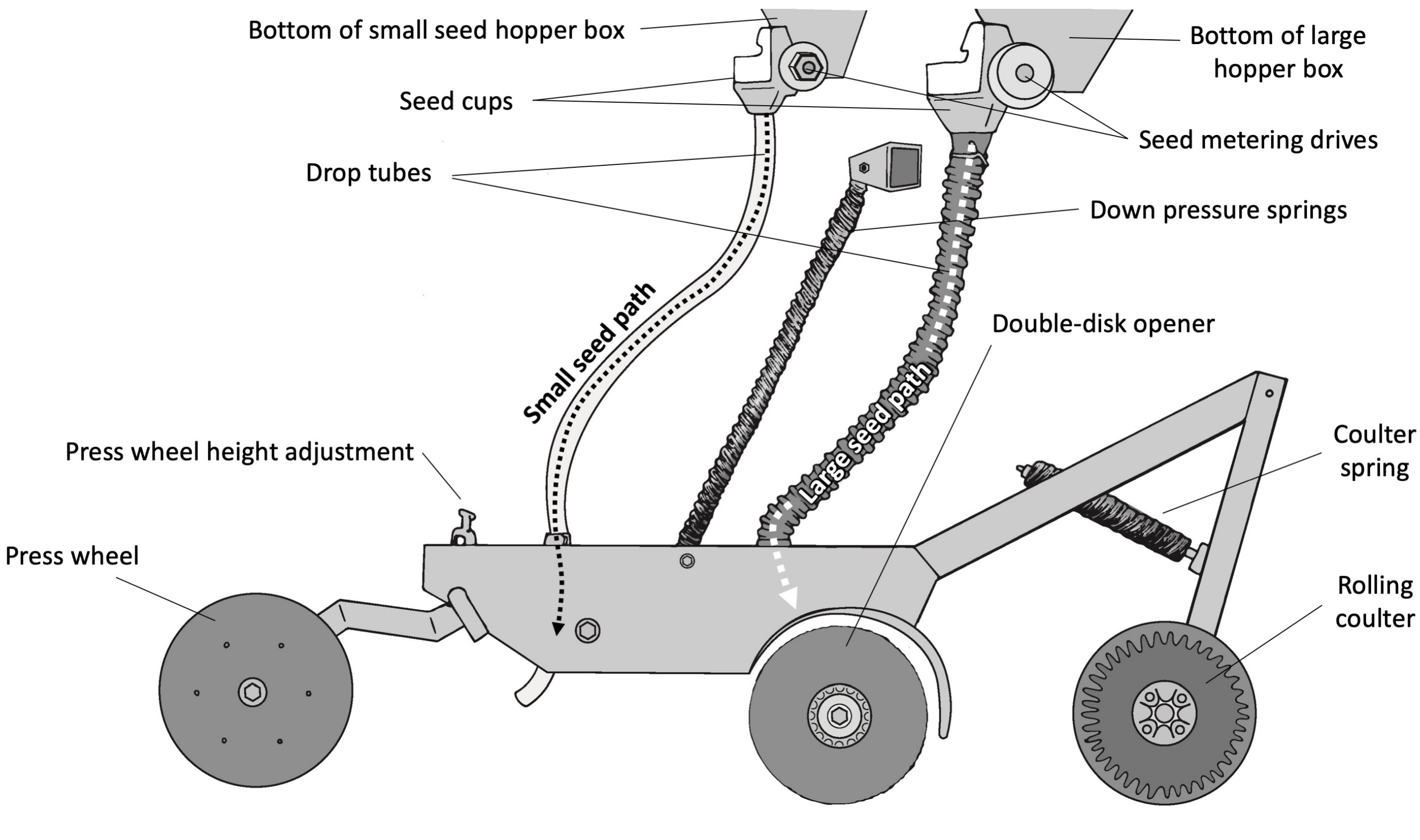


Figure 1. Schematic drawing of the typical parts on one row unit of a no-till drill. A conventional drill would have similar parts, but usually does not have the coulter assembly on the front of the drill.

Seed is held in the hopper boxes that sit on top of the drill. Some drills have multiple hopper boxes. Most drills designed for use on pastures will have large and small hopper boxes. The large hopper box would be used for planting crops that have medium to large seed sizes (e.g., cowpea, pearl millet, tall fescue), while the small hopper box would be used to plant small-seeded species (e.g., clovers, brassicas, crabgrass). Some drills may also have a "native grass box," which is a hopper box that is specially designed to handle native warm-season perennial grass species. Several of the native prairie grass species have fluffy appendages on their seed which interferes with seed flow through the bottom of the hopper. So, native grass boxes have agitators within the box that improves seed flow (Figure 2).

Figure 2. Agitators in the bottom of native grass hopper boxes ensure that the fluffy appendages on the seed of some native prairie grasses do not keep the boxes from properly metering the correct rate.

Unlike the planters that are used for row crops, seed drills do not separate and drop individual seeds. Instead, seed flowing out of the opening at the bottom of a hopper box is metered by the seed metering unit, which is opened a set distance for a given seed size and seeding rate (Figure 3). As a drive shaft turns, seed is metered out and dropped into the seed cup.

As the drill travels across the field, a ground-driven wheel connected to a driveshaft turns and seed from a hopper box above the row units is metered into the seed cup. The seed then falls down through the drop tubes. The seed is dropped between or just behind the double-disks, placing the seed within the furrow opened in the soil created by the opener. The press wheel follows behind and closes the furrow and firms the soil around the seed. The weight of the drill compresses the down pressure springs that force the press wheels against the soil surface.

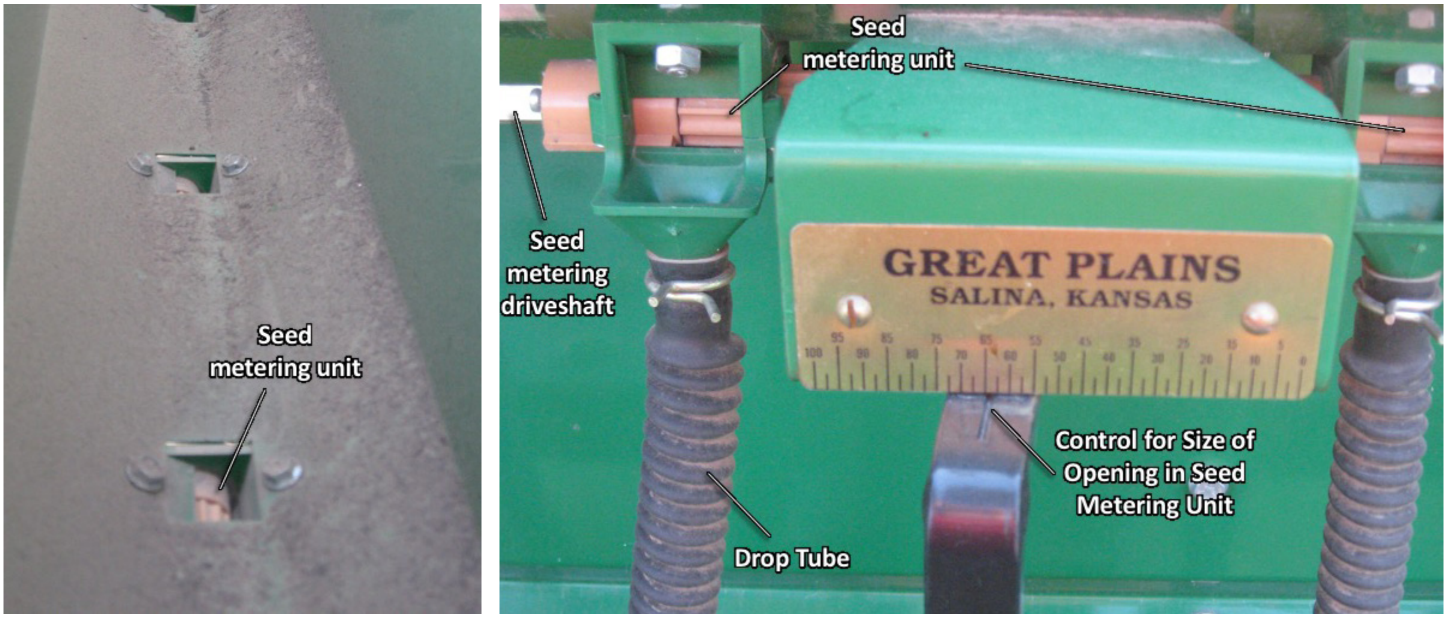


Figure 3. In the bottom of the hopper box (left), an opening allows seed to flow into the seed metering unit. When calibrating and setting a drill, consult the drill's manual to ensure that the seed metering unit is opened to the appropriate size and the driveshaft gearing is set to the appropriate settings. Usually, minor adjustments in the size of the opening at the seed metering unit will fine-tune the metering to provide the desired seeding rates.

Drills meter a volume of seed

Drills actually meter out a volume of seed rather than a precise weight or number of seeds (see inset "Counting seeds in the row"). Consequently, the weight of seed per bushel (or other measure of volume), the number of seeds per pound, the target seeding rate in pounds per acre, and the appropriate seeding depth are all key pieces of information when setting up and calibrating a drill. Table 1 provides the typical values for different forage and cover crops, but it is important to note that seed sizes can vary considerably from one seed lot to another. For this reason, it is important to calibrate, check, and adjust the drill frequently to account for changes in seed size or other planting conditions.

In the Southeastern U.S, variability in annual ryegrass seed size is a common example of why accounting for different seed sizes is crucial. There are several varieties of annual ryegrass on the market that are tetraploids, meaning that their plant cells contain four sets of chromosomes (4n) rather than the two sets of chromosomes found in the more common diploid (2n) varieties. Consequently, tetraploid varieties have seed that may be up to 150% the size of diploid varieties (Figure 4). Even though the seeding rate is the same (i.e., same pounds/acre), one will likely need to adjust the seed metering unit opening depending upon whether they are planting a diploid or tetraploid variety to ensure the appropriate seeding rate is being used.

COUNTING SEEDS IN THE ROW

Most row crops are planted with planters that singulate seed before dropping it into the furrow. For this reason, the accuracy and precision of a planter is determined by how many seeds are counted in a set distance of the row and the distance between the seed. For example, a seeding rate for corn of 33,000 planted on 30-inch centers should result in approximately 19 seeds per 10 feet of row, with 6.4 inches between seeds. Conversely, drills meter out a volume of seed which is more haphazardly distributed, so it is not as precise, and counting seeds per distance of row may result in tremendous variation. **Calibrating a drill should be done to ensure the recommended weight of seed is distributed per unit area.** Evaluating the number of seeds per distance of row is not a recommended approach to adjusting seeding rates or calibrating a drill.

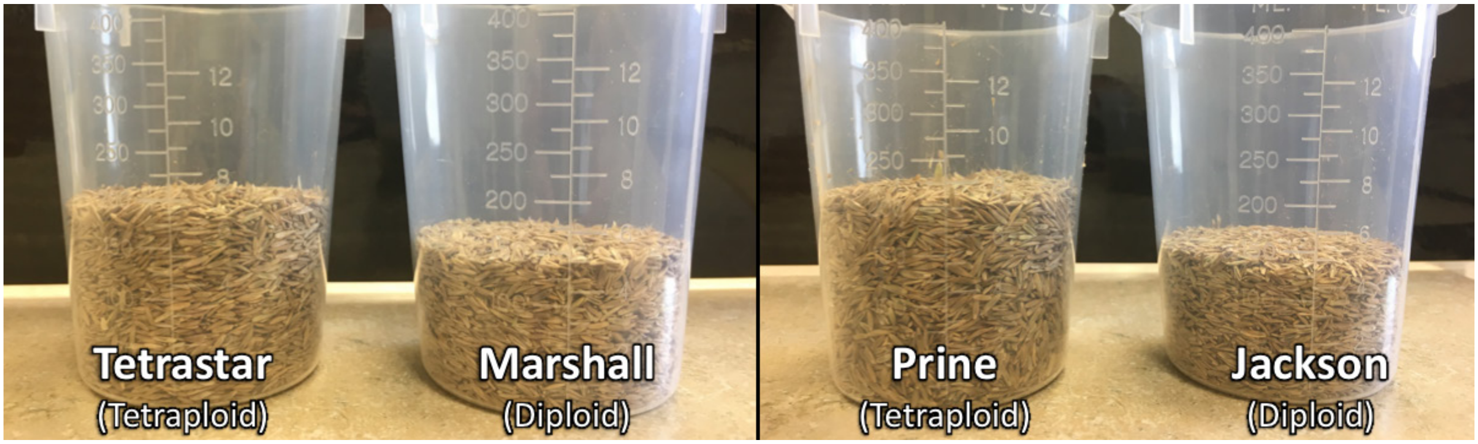


Figure 4. Varieties of annual ryegrass differ in seed size, which will likely require adjustments to conventional and no-till grain drills to maintain the same seeding rate. Each of these beakers contains 20,000 seed of their respective varieties. Note that the seed of tetraploid varieties takes up approximately 140-150% more volume as the diploid varieties. *Photo credit: Henry Jordan, UGA Statewide Variety Testing Program.*

Table 1. General seeding information for grasses and legumes used for forage and cover crops.[ˇ] These seeding rates assume the species will be planted as a monoculture. If multiple species are to be planted together, reduce the seeding rates proportionate to the number of species in the mix (i.e., if several species are to be planted together, divide the seeding rate listed here for each by the number of species in the mixture).

SEEDING RATE (DRILLED)						
CROP SPECIES	APPROXIMATE TEST WEIGHT		FORAGE CROP *(pounds/acre)*	COVER CROP *(pounds/acre)*	PLANTING DEPTH *(inches)*	SEEDLING VIGOR RATING[‡]
	(pounds/bushel)	*(number seeds/pound)*				
Grasses:						
Bahiagrass	42	273,000	10-15	nr*	¼ - ½	P
Bermudagrass, Seeded	40	2,070,000	5-10	nr	0 - ½	F
Millet, Browntop	56	140,000	10-20	14-20	½ - 1	E
Crabgrass	25	825,000	3-5	nr	¼	G
Oats	32	15,000	90-120	60-100	½ - 1	E
Orchardgrass	14	416,000	10-15	nr	¼ - ½	F
Millet, Pearl	48	82,000	12-15	10-12	½ - 1	E
Rye	56	18,000	90-120	60-100	½ - 1	E
Ryegrass, Annual (diploid)	24	190,000	20-25	10-20	¼ - ½	G
Ryegrass, Annual (tetraploid)	24	105,000**	20-25	10-20	¼ - ½	E
Forage Sorghum	56	24,000	6-8	15-20	½ - 1	G
Sorghum x Sudangrass hybrid	48	35,000**	15-20	15-20	½ - 1	E
Sudangrass	40	43,000	10-15	15-20	½ - 1	E
Tall Fescue	20	227,000	10-15	nr	¼ - ½	F
Triticale	48	15,000	90-120	60-100	½ - 1	G
Wheat	60	11,000	90-120	60-100	½ - 1	E
Legumes:						
Alfalfa	60	227,000	18-25	nr	¼ - ½	G
Arrowleaf Clover	60	400,000	5-8	nr	¼ - ½	F
Ball Clover	60	1,000,000	2-3	nr	0 - ¼	F

Table 1. Continued.

SEEDING RATE (DRILLED)						
CROP SPECIES	APPROXIMATE TEST WEIGHT *(pounds/bushel)*	*(number seeds/pound)*	FORAGE CROP *(pounds/acre)*	COVER CROP *(pounds/acre)*	PLANTING DEPTH *(inches)*	SEEDLING VIGOR RATING‡
Cowpea	60	4,000	60-90	30-90	½ - 1	E
Crimson Clover	60	150,000	15-25	15-20	¼ - ½	G
Hairy Vetch	60	16,000	20-25	5-10	½ - 1	E
Red Clover	60	272,000	8-10	nr	¼ - ½	E
Sericea Lespedeza	60	372,000	15-20	nr	¼ - ½	P
Soybean	60	2,800	60-75	40-60	½ - 1	E
Sunn Hemp	60	15,000	20-40	20-40	½ - 1	E
White Clover	60	768,000	2-3	nr	0 - ¼	F
Forbs/Other:						
Brassica (diploid)	--	160,000	3-4	5-13	0 - ¼	E
Brassica (tetraploid)	--	114,000	3-4	5-13	0 - ¼	E
Chicory	--	425,000	4-5	nr	¼ - ½	F

ˇ Adapted from University of Georgia Cooperative Extension Circular 814, "Planting Guide to Grasses and Legumes for Forage and Wildlife in Georgia," by Hancock and Lee (2017); the fifth edition of Southern Forages by Ball *et al.* (2015); and Common Grasses, Legumes and Forbs of the Eastern United States: Identification and Adaptation by Abaye (2010). Cover crop seeding rates adapted from Managing Cover Crops Profitably with data from JC Plant Materials Center and MS Plant Materials Center and review by various Southeastern experts.

‡ Ratings are P = Poor, F = Fair, G = Good, and E = Excellent.

* nr = Not recommended as a cover crop.

** These values are not listed in reference books and are highly variable in the available scientific literature.

Adjusting for pure live seed

Seed quality differs from lot to lot. Some seed lots may be relatively low in viable seed or contain more inert material or weed contamination. Seeding rates, such as those in Table 1, assume high quality seed and are usually listed on a pure live seed (PLS) basis. Thus, one should always ensure that the seeding rate being planted is corrected for differences in viable seed and purity. To adjust for these factors, calculate PLS for each seed lot by multiplying the percentage of viable seed (percent germination) by the purity of the seed (percent pure). For example, the seed lot described on the certified seed tag seen in Figure 5 indicates 80% viable seed (percent total germination) and 95% pure seed. Therefore, this bahiagrass seed lot would have 76% PLS (0.80 x 0.95 = 0.76). Thus, if the recommended seeding rate for this crop is 10 pounds/acre, one would need to apply 13 pounds/acre using this seed lot (10/76% = 13).

Several warm-season grass species naturally produce seeds that have a substantial amount of dormant seed. Dormant seed is live, viable seed and is likely to germinate, but it will not immediately germinate because of physiological constraints. Usually, the dormant seed will germinate several days to a few weeks after it is sown. The bahiagrass seed lot shown in Figure 5 has 20% dormant seed. It is not uncommon for 20- 60% of some warm-season grass species to be classified as dormant seed. When calculating PLS with seed lots containing dormant seed, the percentage that is dormant is included within the viable seed percentage (i.e., percent germination plus percent dormant seed).

Most annual species have high germination rates and usually have low levels of inert matter or weed seed. So, adjusting for PLS when establishing a cover crop or annual forage crops is usually impractical or unnecessary as long as the germination rate is 80% or greater.

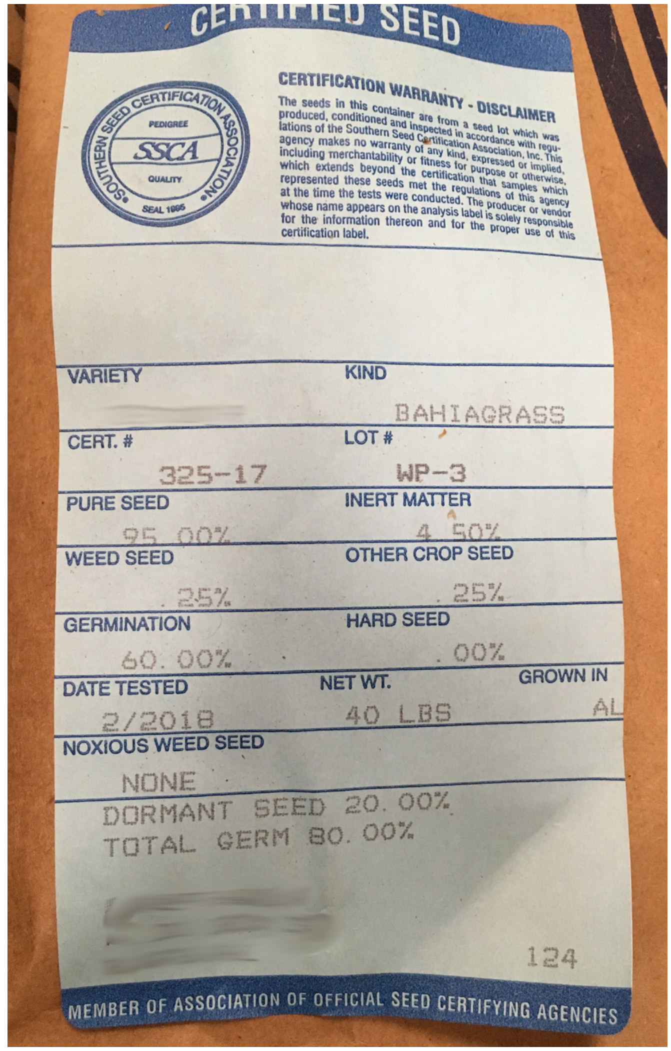


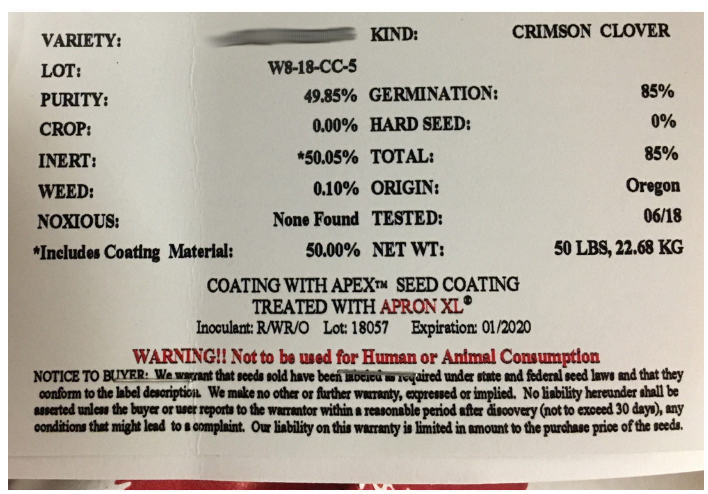
Figure 5. This bahiagrass seed lot (variety blurred intentionally) is 95% pure and has an 80% total germination, so it contains 76% PLS. Note that this seed tag is blue, indicating certified seed. Users should buy certified seed whenever possible to ensure genetic purity and the highest-quality seed product.

Adjusting for seed coats

Many seed suppliers will add a seed treatment and/or coating to the seed (Figure 6). Seed treatments often include insecticides or fungicides that guard against pest challenges to seed or seedlings but usually have no significant effect on seed weight or flow characteristics. In contrast, seed coatings involve the application of liquid binders and powdered fillers that, when combined, coat the entire seed. These coatings are designed to alter the flow rate of the seed; act as a carrier for microbial inoculants, insecticides, or fungicides; and/or enhance seed survival and seedling development. Seed coatings that carry *Rhizobia* inoculum for their specific legume species have proven effective and are a convenient alternative to inoculating legumes just prior to planting. The benefits of other seed coatings (such as those applied to grass seed) are hotly debated. Some have demonstrated marginal improvements in establishment success, occasionally even at lowered seeding rates. However, several trials conducted by unbiased third parties have observed little or no improvement in establishment success. Certified-organic growers should pay close attention, as most seed treatments and coatings are prohibited materials. Organic growers should buy raw, untreated seed and inoculate legumes just before planting.

Setting aside the questions of efficacy, seed coatings are likely to influence the rate the seed is metered by a drill and can add a considerable amount of weight or volume to the seed (usually 20-50%). Seeding rate recommendations like those in Table 1 and settings in the owner manual of a drill assume uncoated seed. Therefore, the seeding rates will need to be adjusted to account for the weight of seed coatings. The amount of weight added by the seed coating is reported on the seed tag as additional inert matter (Figure 7).

Figure 6. Alfalfa seed (top) is shown without a coating compared to a relatively light (30%) coating, and red clover seed (bottom) is shown without a coating compared to a heavier (50%) coating.



VARIETY:	[redacted]	KIND:	CRIMSON CLOVER
LOT:	W8-18-CC-5		
PURITY:	49.85%	GERMINATION:	85%
CROP:	0.00%	HARD SEED:	0%
INERT:	*50.05%	TOTAL:	85%
WEED:	0.10%	ORIGIN:	Oregon
NOXIOUS:	None Found	TESTED:	06/18
*Includes Coating Material:	50.00%	NET WT:	50 LBS, 22.68 KG

COATING WITH APEX™ SEED COATING
TREATED WITH APRON XL®
Inoculant: R/WR/O Lot: 18057 Expiration: 01/2020

WARNING!! Not to be used for Human or Animal Consumption

NOTICE TO BUYER: We warrant that seeds sold have been labeled as required under state and federal seed laws and that they conform to the label description. We make no other or further warranty, expressed or implied. No liability hereunder shall be asserted unless the buyer or user reports to the warrantor within a reasonable period after discovery (not to exceed 30 days), any conditions that might lead to a complaint. Our liability on this warranty is limited in amount to the purchase price of the seeds.

Figure 7. This seed lot of crimson clover was coated with a 50% coating that included a fungicide treatment. With 49.85% purity and 85% germination, this seed lot contains 42% PLS.

By adjusting the seeding rate for PLS, one will account for the seed coating. For example, the seed lot of crimson clover depicted in Figure 7 reports 85% viable seed (percent total germination) and 49.85% purity, which results in 42% PLS (0.85 x 0.4985 = 0.42). So if the recommended seeding rate for this crop is 15 pounds/acre, one would need to plant 36 pounds of coated seed per acre using this seed lot (15/42% = 36). Consequently, one should evaluate the cost effectiveness of coated seed.

Research is mixed as to whether or not the adjustment for coated seed to PLS is necessary. Some studies indicate similar biomass production at only 50% of the PLS rate. In other words, if 15 lbs/ac is the target PLS rate, planting 20 lbs of coated seed/acre provided similar biomass in those studies. Other studies do indicate that adjusting for PLS increases biomass. Producers have to weigh the risk of decreased biomass against increased seed cost using PLS adjustment.

Drilling seed mixtures

Establishing forage or cover crop stands consisting of mixtures of several species has become increasingly popular (although the benefits are often not apparent). From a practical standpoint, this can pose several challenges when the seed mixtures contain species that differ in seedling vigor and/or have seed of various sizes and shapes (Figure 8). When a slow-establishing species is paired with a quick-establishing species, one could expect the latter to dominate the former. In general, annual species are faster to establish than perennial species, so it is usually best to avoid planting annuals and perennials simultaneously in a forage planting. Some perennial species may be mixed with annual species for cover crop plantings. In some instances, annuals can be interseeded into perennials to increase forage quantity or quality in certain seasons. This should only be done if the perennial species is well-established.

Figure 8. Complex seed mixtures are sometimes used o establish pastures or cover crops. Carefully choosing the species used in the mix and accounting for differences in seed size and shape is crucial to ensuring the correct seeding rate results.

When planting cover crops, annual species should be used. Mixtures can provide a variety of functions. For example, a mixture of legume and grasses can improve weed suppression over a pure legume stand while still providing nitrogen for the subsequent cash crop. At the proper seeding rate, the grass can serve as a nurse crop for the legume.

Grasses and legumes are often planted simultaneously using both the large and small hopper boxes on a drill. Use the large hopper box for the largest-seeded species when planting such mixtures. For example, overseeding annual ryegrass and crimson clover into Bermudagrass in the autumn is a common practice. When doing so, it is best to use the large hopper box for the ryegrass seed and the small hopper box for the clover seed. An analogous cover crop situation would be planting oats and crimson clover with the oats in the large seed hopper box and clover in the small seed hopper box. Regardless, one should calibrate both the large and small hopper boxes independently to assure both are planting the appropriate seeding rates.

Some complex mixtures of four or more species are sometimes used, particularly in cover crop mixtures. Some of these mixtures may differ considerably in seed size and rate. The first challenge is determining what size opening the seed metering unit should be set to as a starting point for calibration. In general, it is best to start with the metering unit set to distribute the largest seed in the mixture at the rate it would be drilled and adjust from there. For example, a summer annual mix may contain sorghum-sudangrass, pearl millet, forage soybeans, and forage brassicas with a goal of planting 4, 3, 15, and 1 pound/acre, respectively. These seeds are of considerably different sizes, so one should begin the calibration with the seed metering unit opening set to distribute 15 pounds/acre of soybeans/acre. In this case, if the total weight of the seed mixture is equivalent to 23 pounds/acre at this setting, the drill setting will be set close to the appropriate setting. If not, calibration can guide the user to determine if the rate needs to be increased or decreased.

Another concern with drilling seed mixtures is that seed of differing sizes may segregate and settle out inside the hopper box as the equipment is bumped around while traversing the field. Consequently, small seeded species may settle to the bottom of the hopper box causing a disproportionate amount of large seeded species to be present in the mixture after the first few acres have been planted. To resolve this issue, periodically remix the seed within the hopper or only fill the hopper with enough seed that can be planted in 1 to 1.5 hours at a time.

Additionally, ideal planting depth varies somewhat with species. The classic example is when small grains and annual ryegrass are planted together. As shown in Table 1, the ideal planting depth for small grains is ½ to 1 inch, while the ideal planting depth of annual ryegrass is ¼- to ½- inch deep. This is further complicated by the addition of certain legumes or other small-seeded species to the mix which have an ideal planting depth of 0 to ¼ inch. Addressing this concern can be done in a number of ways. If the mixture is blended before the end user receives the seed blend, or if using a drill with only one hopper box, then it is best to select the best compromise for each species. Recognize that bigger seeds that are planted deeper can still emerge if planted shallower than is ideal, but small seeds usually fail to emerge if planted deeper than their ideal range. So, to apply these principles to the aforementioned mixture of a small grain, annual ryegrass and a small-seeded legume, it would be best to target a compromise planting depth of approximately ¼ inch. A second way that different planting depths may be accommodated is to use larger seeds in the large hopper box and smaller seeds in the small hopper box and ensure that the small hopper box is dropping seed directly in front of the press wheel instead of into the furrow. To again use the aforementioned mixture of a small grain, annual ryegrass and a small-seeded legume, the small grain could be in the large hopper box with the double-disk opener set to a ¾-inch depth and the annual ryegrass and legume could be mixed in the small hopper box with the drop tube from the small hopper box routing seed to drop directly in front of the press wheel. Some drills are designed to route the drop tube from the small hopper box in front of the press wheel, placing it on top of the ground with the press wheel only slightly pressing it into the soil. If one's drill is not designed this way, the drop tubes could be detached from their normal attachment and cable- or wire-tied to the row unit frame so that the seed drops in front of the press wheel.

Preventative maintenance

Before operating or calibrating a drill, be sure to conduct all preventative maintenance operations so that it is properly functioning. Preventative maintenance is often overlooked and can lead to stand failures, equipment malfunctions, and increased depreciation. Be sure to read and follow the equipment maintenance detailed in the operator's manual. The manual should be the first place you start when calibrating a drill and also provides important safety information.

A few key maintenance objectives include checking the tire pressure on all wheels, greasing all fittings, and oiling the drive chains. The next step is to check the function of some of the key working parts of the drill such as the seed metering units, the no-till coulters, the double-disk openers, and the press wheels. Running a drill (especially no-till drills) across rough or rocky terrain can severely damage the components and prevent proper operation. Check to make sure that the coulters on the front, the openers in the middle (where the furrow is opened), and the press wheels in the back are not chipped, bent, or wobbling. If these are damaged or chipped, it is recommended that they be replaced. The double-disk openers should be replaced if the diameter is ½ inch less than the original diameter. A good rule of thumb for disk wear is that if the disks can hold an index card where they come together, they are still operable. It is absolutely crucial that each of these parts run true with one another so that the coulter slices to open the furrow, the openers widen it further to drop the seed in it, and the press wheels close the furrow back and ensure good seed-to-soil contact. These considerations are especially important when dealing with rented or common-use drills. Unfortunately, some operators fail to pick up the drill when turning around or going around sharp turns. This can cause extreme wear and stress on the moving parts, dislocate bearings, and result in establishment failures. Repair or replace coulters, openers, or press wheels that wobble or do not travel true to one another.

Finally, maintenance of the seed box and seed tubes is of critical importance for proper seed distribution. A shop vacuum or compressed-air system can be used to clean out old seed or debris. It is also not uncommon for insects such as spiders and mud daubers to build nests in the seed tubes, which can ultimately block seed flow. After vacuuming or blowing them out, use little wads of paper to pass through the drop tube to test to make sure it is clear of obstruction. If it does not drop through easily, take off the tube and run a flexible wire through it to clean out debris.

Calibration procedures

There are many ways to calibrate a drill. The manufacturer usually provides a calibration procedure in the operator's manual. Their instructions are usually specific to the make and/or model of the drill in question. Some of the manufacturers have calibration procedures that do not require the drill to be moved, but rather the operator is given instructions on how to activate or manually crank the seed metering unit while the drill is stationary. This usually is a satisfactory calibration procedure, but the operator should consider the terrain upon which the drill is to be operated. As a drill bounces across uneven land or seed shifts due to steep terrain, the seed metering rates may be affected. If the land is bumpy or hilly, it is wise to conduct a calibration or at least confirm that seeding rates remain on target under actual operating conditions.

If one's drill does not have calibration procedures in the operator's manual or one prefers to calibrate under actual field conditions, a simplified calibration procedure is provided here.
This simple calibration procedure will guide one through calibrating virtually any drill under almost any situation.

Before beginning:

Conduct all preventative maintenance operations so that the drill is properly functioning. Gather all of the supplies that will be needed to conduct the drill's calibration and adjustment. These supplies include:

- *Seed from the seed lot being planted*
- *An accurate scale capable of weighing in grams, preferably to the nearest 0.1 g.*
- *Calculator (optional, but recommended)*
- *Wire flags or turf paint to mark a distance*
- *Measuring wheel or 200-foot tape measure*
- *Collection containers (e.g., plastic storage bags or small cups)*
- *Cable ties and/or duct tape*
- *A tool kit including adjustable pliers, screwdrivers, a knife to cut cable ties or tape, etc.*

Once these supplies have been gathered, set the seed metering units to the opening size specified in the owner's manual or the chart on the underside of the lid on the hopper box (if available). If planting a species or mixture that is not specified in the manual/chart, use the setting specified for a seed that is of similar size as a starting point. Ensure that the seed cups are free of debris and set to meter seed. If they have been opened or are not set before seed is poured into the hopper box, one's seed may flow out of the hopper box onto the ground. Fill the bottom of the hopper box that is to be calibrated so that each seed metering unit has at least 4 to 6 inches of seed covering the opening in the bottom. Engage the drill and drive forward for 100-200 feet to ensure that seed has filled the seed metering units and is being metered into the seed cups. **It is crucial to start with seed metering units already primed with seed.**

Step 1: For each of the metering units being evaluated, detach the drop tubes either from the drill's metering unit below the hopper box or as it connects to the row unit. Ensure that all metering units and drop tubes are clean and clear of obstruction. Securely attach plastic baggies or cups to catch the seed either just below the seed cup/metering unit or at the bottom of the drop tubes (Figure 9).

Figure 9. *Before beginning, assemble all the supplies that one will need. Plastic storage bags or cups can be used to catch the seed. If secured to the metering units with duct tape or cable ties, care must be taken to ensure that the drop tubes are free of obstructions by dropping a few seeds down the drop tubes to ensure that they drop through easily.*

Step 2: Determine the width between row units by consulting the owner's manual or measuring the distance between the center of one row unit to the center of the next row unit. Using this distance, determine the calibration distance from Table 2.

Step 3: Using wire flags, turf paint, or some other visible marker, measure and mark the calibration distance specified from Table 2 on the terrain that is typical of what will be planted.

Step 4: With the drill's ground-driven drive mechanism engaged and traveling at the desired operating speed, start precisely at the beginning of the calibration distance and travel to the end of the calibration distance.

Table 2. Calibration distances for corresponding widths between row units on a no-till or conventional drill.

Row spacing (inches)	Calibration distance (feet)
6	192
6.5	177
7	165
7.5	154
8	144
9	128
15	77

Step 5: At the end of the calibration distance and with the tractor and drill parked, collect the plastic bags or cups and record the weight of the seed in the collection devices (tare the scale to account for the weight of the bags/cups) using a scale that reads in grams.

Step 6: The grams of seed collected from traveling the calibration distance equals the pounds of seed being sown on a per-acre basis from that row unit. For example, if after traveling the specified distance, one collects 30 grams of seed from one unit, then that row unit is metering the equivalent of 30 pounds of seed/acre.

Step 7: Adjust the seed metering unit opening as needed and/or repeat to ensure that all row units are consistently metering a similar amount of seed (+/- 10% of the target rate).

Adjustments for proper planting depth

Forage and cover crop species differ in their recommended planting depth, so ensure that the drill is set up for the depth recommended in Table 1. Drill models will differ in their setup, but there are some planting depth adjustments that are fairly universal. On a no-till drill, one can adjust the planting depth by adjusting the cutting depth of the rolling coulter in the front of the drill. As a rule of thumb, the coulter should be cutting twice as deep as the planned seeding depth. So, if the desired planting depth is ½ inch, then the coulter should make a 1-inch slice into the soil. This is usually adjusted by a "depth control" knob or hydraulic setup. On some models, the stroke of the hydraulics that lift/lower the drill into the soil can be modified by stroke limiters or stroke blocks. These limiters/blocks are sleeves of varying sizes that go around the hydraulic cylinder and can be used to prevent the cylinder from traveling further than desired.

Those who are unfamiliar with using a no-till drill may assume that turning the "depth control" knob or limiting the stroke of the hydraulic cylinder is the only adjustment that is needed. Unfortunately, this only sets the coulter depth. There are two other adjustments that are necessary, and those are similar between no-till and conventional drill designs.

The depth of the double-disk opener is largely determined by the down pressure provided by the weight of the drill and the down pressure springs (Figure 10). Typically, there are one or two springs for each row unit that pushes the opener down. These may be placed on their lowest down pressure setting when shipped from the manufacturer. This may be sufficient down pressure, at least at the start. However, these springs may lose tension over time and may not provide enough down pressure. To create more down pressure, shorten the length of the spring's travel according to the manufacturer's instructions (usually by removing the "W" clip at the bottom of the spring and moving it to a higher hole in the rod that runs through the spring).

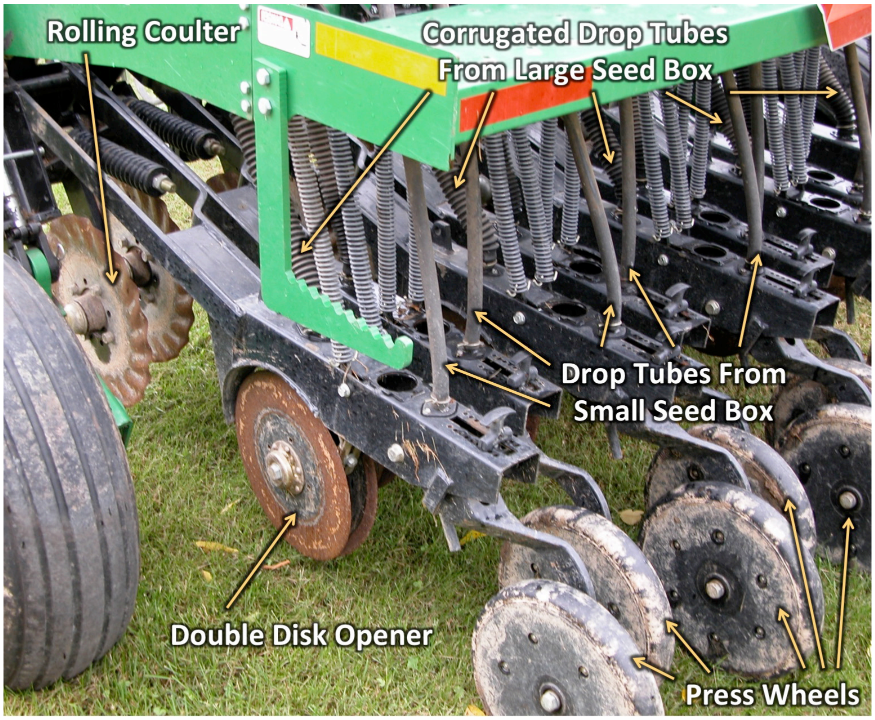


Figure 10. The labels pictured describe the parts of the drill that are important to ensuring proper seeding depth.

The final step, adjusting the press wheels correctly, is equally crucial

PRO TIP:

To more easily find the seed when initially adjusting planting depth, use a quart-sized bag full of seed that has been lightly sprayed with orange turf paint.

to planting depth control. Most press wheels have a T-handle that can be adjusted forward (toward the tractor) allowing the depth to be shallower or backward (toward the press wheel) to enable a deeper seed placement. The press wheel adjustment allows the planting depth to be fine-tuned, but it operates in conjunction with the opener's placement. The press wheels are designed to ensure that the openers are not pushed too deeply by the springs. The press wheels work in tandem with the springs to create what is called "reserve power." In other words, as the properly adjusted press wheel traverses the rough terrain of pastures and hayfields, there is enough travel in the spring that the openers are always positioned at the right depth. On some drills, depth bands can be added to the double-disk openers to ensure that the coulters penetrate to the precise depth desired.

When checking depth, carefully scrape away the soil from the middle of the furrow outwards. Measure the depth relative to the soil surface. Note that the layer of thatch or residue is not included in the planting depth. Remember that conditions often vary within the field and will change throughout the day. Regularly check seeding depth and adjust the drill accordingly.

Summary

One of the most important tasks that can help ensure successful establishment is appropriately maintaining, calibrating, and adjusting a seed drill before planting. Seed may be placed at a depth that is too deep or too shallow if the equipment is not properly prepared and set. Too much or too little seed may be planted if the equipment is not properly calibrated. These planting mistakes may result in a poor stand, greater weed competition, lower yields, and/or reductions in forage quality. Conversely, planting more seed than required can unnecessarily increase establishment costs and can sometimes result in reduced yields. As the operator has already made an investment in the seed and the time to plant a field, taking a few extra steps to ensure that investment bears fruit is well worth the time spent maintaining, calibrating, and adjusting the drill.

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