Practical Corn Sampling and Hand Sieving Procedures

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This publication provides practical procedures which can be used by producers, warehouse managers, and elevator managers for sampling and grading corn. The procedures and portion sizes are based on the USDA Practical Procedures for Grain Handlers. The portions and hand sieving methods presented in this Current Report are not used by official grain inspectors licensed by the Federal Grain Inspection Service. Licensed graders must use larger portions and precision mechanical equipment that will provide the most accurate and most uniform results.

Representative Sample

Obtaining a representative grain sample is an essential part of grain inspection. Without a representative sample, the final grade will not reflect the true grade or value of the grain. In order for a sample to be considered representative, it must

1. be obtained in accordance with recommended procedures;
2. be of the prescribed size (at least 1000 grams or approximately 1 1/4 quart); and
3. be handled securely, protected from manipulation, substitution, and careless handling.

The following pages explain the proper way to do probe sampling. Some of this information was taken from Inspecting Grain-Practical Procedures for Grain Handlers, Section 1, Sampling Grain.

Probe Sampling

A large percentage of grain, as it travels from the farm to the final consumer, is at one time or another sampled with a grain probe. Probe sampling is the only approved method for obtaining samples from stationary lots. If probe sampling is performed correctly, the samples drawn will consistently be representative.

The Equipment

Before learning the sampling procedure, you should be familiar with the equipment used.

1. Hand Probe

This standard piece of equipment, sometimes referred to as a trier, is constructed of brass or aluminum. Probes come in various sizes with standard lengths of 5, 6, 8, 10, and 12 feet. The type of carrier dictates which probe length shall be used. There are two types of hand probes: compartmented probes, in which slots in the outer tube match compartments in the inner tube, and open throat probes, in which the inner tube is open. Open-throat probes tend to draw more of their sample from the top portion of the grain, while compartmented probes draw a representative sample from each layer. All official grain probes are compartmented probes with an outer tube that is 1 3/8-inches in diameter.

2. Mechanical probe

There are two types of mechanical probes which are recommended for sampling stationary lots of grain in trucks, railcars, or other open-top carriers. The gravity-fill probe function is similar to compartmented hand probes except that after the compartment is filled it rotates to an inner tube where it is forced up by air. The core probe functions by forcing the sample up into the core as the probe is pushed down and then using air to transport the sample to the output point. A third type, the in-load suction probe, which uses negative air pressure to suck the sample into the bottom of the probe, is not recommended since it tends to overestimate foreign material.

3. Sampling Canvas

Heavy canvas cloth or similar material can be used to display the sample from the compartmented probe. Another alternative is a short section of rain gutter or half section of pipe. The sampling canvas or other material should be at least 6 inches longer than the probe used to draw the sample. This size is necessary so that the grain from the entire length of each probe will not spill off the ends of the canvas. Always keep sampling canvases clean, dry, and free of holes.

4. Sampling Containers

Containers such as heavy cloth or canvas bags and metal buckets or plastic cans may be used to transport the sample to the inspection station. Sample containers should be free of all old grain, insects, and other waste material prior to use. Use air-tight containers or bags lined with a polyethylene liner to store grain in order to prevent loss of moisture and to

protect the sample from adverse environmental conditions such as rain or humid weather.

General Procedures

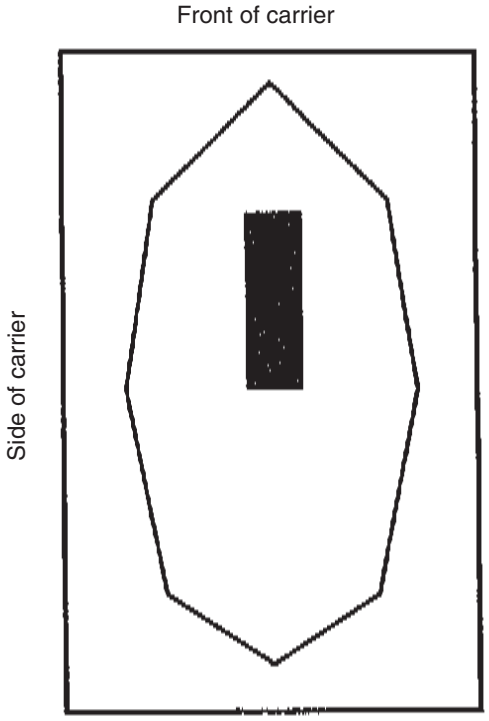
Before sampling any carrier, record on your sample ticket the carrier's identification number. Visually examine the whole lot of grain. Take a handful of grain from several locations and check it for odor. Record any unusual conditions on your sample ticket. Next, spread your canvas and check to see that the probe and canvas are clean and dry. You are now ready to start sampling.

There are several ways to insert the probe into the grain. Regardless of which technique you use, the general rules are

1. Insert the probe at a 10 degree angle from the vertical with the slots facing upward and completely closed. The 10 degree angle eases the resistance of the compacted grain against the probe while still allowing the probe to reach the bottom of the container. Keep the slots closed until the probe is inserted as far as it will go. Otherwise, a disproportionate amount of grain from the top of the load will fall into the probe compartments as it is being inserted. When sampling grain which contains sand or grit, insert the probe with the slots downward to avoid jamming it. After the probe is inserted, turn the slots upward before opening.
2. After the probe is fully inserted (with the slots facing upward), open the slots and move the probe up and down quickly in two short motions. Close the slots completely, grasp the probe by the outer tube, and withdraw it from the grain. Do not pull the probe by the wooden handle. This can result in the inner tube being pulled out of the outer tube. When this occurs, the probe must be emptied, reassembled, cleaned, and the area probed again.
3. Empty the probe onto the canvas and compare the grain from each depth of the probe for uniformity of kind, condition, and infestation. Also, compare the probe to others drawn from the same lot. If all probes and portions of probes are uniform with one another, composite them and place them in a sample bag along with a completed sample ticket. If the examination of the probes indicates that the lot of grain is made up of distinctly different parts in regard to condition, then draw a sample from each of the different parts in addition to the sample that represents the carrier as a whole.
4. When transferring the grain from the canvas to the sampling bag, take care not to allow fine material to be blown from the canvas.

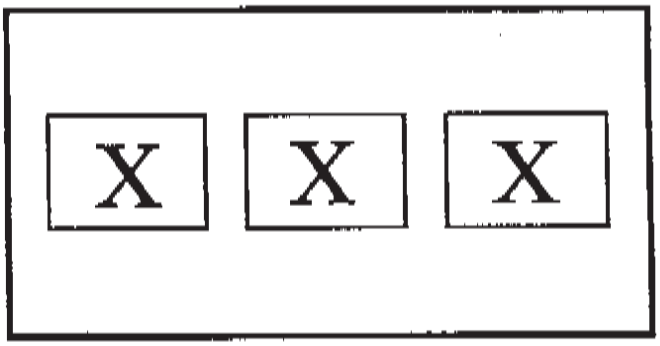
Where to Probe

Draw at least two samples from any truck or trailer that contains 600 bushels or less. Probe larger lots of grain in 3 to 5 places. Recommended probe sites, which are shown in Figure 1, are anywhere in the carrier except the corners and the center of the load (which was directly underneath the loading spout). Vary the probe sites between loads in a random manner. Elevators which routinely sample in the same location have found that bad grain seems to migrate to the areas in the load which are not sampled. Hopper-bottomed carriers should be probed in the center of each hopper (Figure 2).



* Draw at least two probe samples form any point in the shaded area.

Figure 1. Sampling Sites—Truck or Trailer.



* Draw probe samples from the points marked with an X.
Avoid prbing in the sprout-lines.

Figure 2. Sampling Sites—Hopper Bottomed Carriers.

Inspection Procedures

The process of inspecting corn begins when the sample is drawn and follows a prescribed path:

1. Obtain a representative sample of approximately 1,000 grams.
2. Examine the sample for objectionable odors, insect infestation, heating, or other harmful conditions.
3. Divide out a 250-gram portion (or the amount recommended by the moisture meter's manufacturer) and determine the moisture content.
4. Recombine the portion used for moisture and determine the test weight.

5. Divide out a 250-gram portion and determine the percentage of broken corn and foreign material (BCFM) in the sample.
6. When deemed necessary, divide out 125-gram portions to determine the percentage of damaged kernels, class, and grade (flint corn, dent corn, or waxy corn).

Step 1—Obtain a Representative Sample

Use the probing procedures described above, or a tailgate sampler or other method, to obtain a representative sample of approximately 1000 grams.

Step 2—Inspect for Objectionable Odor, Insects, and Harmful Conditions

Except for smut or garlic odors, corn which has a musty, sour, or commercially objectionable foreign odor (COFO) is "U.S. Sample grade." Use the entire sample to determine odor. Fumigant or insecticide odors are not considered COFO if they dissipate after aerating the sample for up to 4 hours. The presence of two or more live insects injurious to stored grain causes the grain to be designated "infested" but does not affect the numerical grade. Heating is a condition common to grain which is spoiling and also causes the grain to be designated "U.S. Sample grade." Be careful not to confuse heating with sound grain which is warm due to storage in bins, railcars, or other containers during hot weather. Other harmful substances which can cause the grain to be considered "U.S. Sample grade" include castor beans, crotalaria seeds, glass, stones, and unknown foreign substances such as rock salt, fertilizer, or "pink wheat."

Step 3—Determine the Moisture Content

Moisture is an essential measure of wheat storability and value and should be determined prior to removing dockage. Moisture can be determined with any device which has been tested and approved by the Oklahoma Department of Agriculture. Moisture meters should be certified once a season and maintained in adherence with the manufacturer's recommendation. Many moisture meters (such as the Montomco) require that a specific weight sample be used. The use of an inexact sample weight will result in an inaccurate measure of moisture content. Additionally, some of the newer moisture meters also display an estimate of test weight. *This test weight estimate cannot be legally used in determining grade* since it is based on a small sample size (often 100 grams or less).

Step 4—Determine the Test Weight

Test weight is a measure of the weight of grain required to fill a specific volume (pint, quart, or bushel). To determine test weight, pour the entire dockage-free sample through a funnel into a kettle until the grain overflows the kettle. Level off the kettle making three, full-length, zigzag motions with a stroker. Determine the test weight by weighing the filled kettle on either a special beam scale, an electronic scale programmed to convert gram weight to test weight, or a standard laboratory scale. If a standard scale is used, the gram weight must be converted to test weight per bushel. (Multiply the grams in a one-quart kettle by 0.0705 to obtain the test weight in pounds per bushel.)

Sieve for 20 strokes. BCFN is all material that passed through the 12/64 sieve to the bottom pan plus the foreign material which is had picked from the corn which remains on top of the 12/64 sieve.

Figure 3. Determination of Broken Corn and Foreign Material by Hand Sieving.

Step 5 (a)—Determine the Percentage of Broken Corn and Foreign Material (Hand Sieve)

USDA grade requirements for corn include the percentage of broken kernels, foreign material (BCFM), and other grains. If the percentage is 4% or above, the grain is discounted. Following is a procedure to determine the percentage BCFM and other grains.

1. Divide out a representative portion of corn (approximately 250 gram). Record the weight of sample used.
2. Assemble a 12/64 round-hole sieve on top of a bottom pan (Figure 3).
3. Sieving only about 1/4 of the sample at a time, shake the corn vigorouly. This causes the material to pass through the sieve.
4. After the complete sample has been sieved, the corn remaining on top of the 12/64 sieve should be picked to remove all material other than corn. This is hand picked foreign material.
5. Add the hand-picked foreign material is to the portion that passed through the 12/64 sieve and weigh it to determine the percentage of broken corn and foreign material in the sample. Determine the percentage of broken kernels and foreign materials by dividing the weight of the sieved BCFM by the total weight of the sample.

Step 5 (b)—Determine the percentage of Broken Corn and Foreign Material (Mechanical Dockage Tester)

1. Record the weight of sample used (approximately 1000 grams).
2. Clean the dockage tester, insert the appropriate sieve (#3 combination 12/64 and 6/64 sieve in the top carrier for a Carter Day Dockage Tester[1]), and make adjustments recommended by the manufacturer which give results comparable to FGIS standard equipment (air=1, feed=10 on a Carter Day Dockage Tester).
3. Turn on the tester and pour the sample into the hopper.
4. After the sample has cleared the last sieve, turn the tester off.
5. Remove and weigh the broken corn and foreign material (BCFM). [On a Carter Day Dockage Tester, BCFM is all material that passed through the #3 combination screen

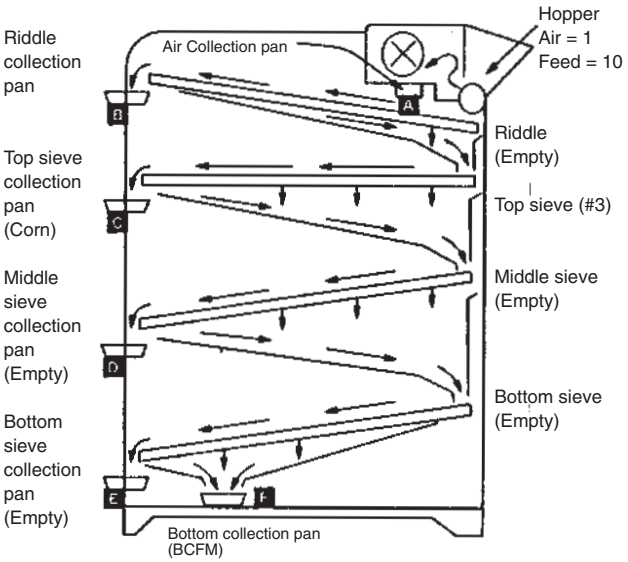


Figure 4. Set Up Procedure for Carter Day Dockage Tester Standard Set Up for Corn.

(Pan F in Figure 4), along with the handpicked foreign material which was obtained from the mechanically cleaned sample.]

Step 6 (a)—Determine Percentage of Damage

The most common types of kernel damage are blue-eye mold; cob rot; and drier, germ, frost, heat, mold, sprout, and insect damage. Blue-eyed mold should not be confused with purple plumule, which is not a type of damage. Purple plumule is generally purple in color and is always in the center of the germ. The percentage of damaged kernels is determined by handpicking a 125-gram portion.

Step 6 (b)—Determine the Class

There are three classes of corn, based on color: yellow corn, white corn, and mixed corn. There are no subclasses in corn. Class is determined by handpicking a 125-gram portion.

Step 6 (c)—Determine the Grade (Flint, Flint and Dent, or Waxy)

Flint, Flint and Dent, and Waxy are special grades for corn. Flint corn is corn which consists of 95% or more of flint corn. Flint and dent corn is corn which is a mixture of flint and dent corn and contains from 5 to 95% flint corn. Waxy corn is corn which consists of 95% or more waxy corn. These special grade designation are made by handpicking a 125-gram portion.

Summary

It is important that grain handlers concentrate in determining the correct grade. Profit margins are too small to lose money because of improper grade determination. The procedures presented in this Fact Sheet are not designed to produce official grades. The procedures should produce relatively accurate estimates of dockage, foreign material, damaged kernels, and other factors affecting grades and the value of the grain.

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Robert E. Whitson, Director of Cooperative Extension Service, Oklahoma State University, Stillwater, Oklahoma. This publication is printed and issued by Oklahoma State University as authorized by the Vice President, Dean, and Director of the Division of Agricultural Sciences and Natural Resources and has been prepared and distributed at a cost of 20 cents per copy. 0508