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## EC78-190 Grain Grading

Duane Foote

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# GRAIN GRADING.



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Leo E. Lucas, Director

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# GRAIN GRADING

Duane Foote, Extension Agronomist

## Producing and Marketing High Quality Grain

Selection of approved hybrids and varieties, use of recommended cropping practices, proper seed treatment, harvesting when grain is mature, and careful threshing and handling, are all important in producing high quality grain for market.

Understanding the fundamentals of grain grading will help those who produce and handle grain. Country shippers try to pay premium prices for grain of superior quality. For high quality grain to command a premium, both buyer and seller must recognize quality—often without the benefit of knowing the actual grade.

This publication outlines why and how grain is graded. Grading of corn, sorghum, soybeans and wheat is covered. Standards for barley, oats, rye, flaxseed, triticale and mixed grain are not included.

## Why Grain Grades?

The United States Grain Standards Act was passed by Congress in 1916. The act provides in part for:

1. Establishment of official grain standards.
2. Federal licensing and supervision of the work of grain inspectors.
3. Provision for appeals from the grades assigned by licensed inspectors.

Grain standards act as commercial measures of quality and condition. They help in the efficient marketing of grain by reducing risks and promoting definite agreements between buyer and seller. Price premiums and discounts are based on grain grades. Thus, market quotations based on grade help producers and handlers market their grain more advantageously.

## Tests on Which Grain Quality Is Based

Some of the grain quality tests considered important are those for plumpness, soundness, cleanliness, dryness, purity of type and general condition.



The weight-per-bushel test usually reflects plumpness of the grain—but there are exceptions. Soundness is indicated by the absence of musty, sour or commercially objectionable foreign odors, and the quantity of damaged kernels in the grain. Cleanliness is measured by determining foreign-matter content and dockage. Dryness is determined by a moisture test. Purity of type is provided for by classes for various grains and by limitations for mixtures of other grains or of other classes of the same grain.

“Condition” is a general term and refers to whether the grain is sound or is undesirable because it is musty, sour or heating. Condition is also indicated by such special grade designations as “smutty,” “weevily,” or “treated.”

### Obtaining the Sample

The first step in grading grain is to obtain a representative sample of the lot of grain. A sample of not less than two quarts is required for assigning a grade. The sample is obtained by using a probe or other approved sampling device according to an officially designated procedure.

As the sample of grain is being obtained, it is examined for evidence of mixture, odor, insects, uneven loading, large stones and other factors which might affect grade.

### Grading Procedure

Grain samples should first be examined for any noticeable factor such as odor, pink kernels or other conditions which would designate the sample “distinctly low quality.” Such grain would be graded in the lowest grade—“Sample” grade.

After initial examination, dockage tests, weight-per-bushel tests and moisture tests are usually made. For a more detailed analysis of the grain, a representative portion of the sample is taken from either the mechanically cleaned grain or from the sample as a whole as prescribed in the Standards. A Boerner Divider is used for separating the sample into representative portions.

The following steps show the test order in grading corn, grain sorghum, soybeans and wheat.

## Corn

1. Smell the sample and examine for presence of insects, heating, stones, cinders and other obvious conditions that may affect grain quality.

2. Determine test weight per bushel. Cut the sample to 1 1/8 to 1 1/4 quarts in making test weight. Fill an airtight container with some of the leftover portion for moisture testing.

3. Determine moisture content.

4. Remove broken corn and foreign material, using the test weight portion. If a dockage tester is not available, a hand sieve, perforated with round holes 12/64 inch in diameter, may be used for determining broken corn and foreign material. Sieve vigorously—separate 1-pint portions of the 1 1/8-quart sample. Any material remaining on top of the sieve, other than corn, is added to the fine foreign material. Pieces of broken corn too large to pass through the 12/64 inch sieve function as sound unless otherwise damaged. Look for insects in the screenings.

5. Cut cleaned sample to about 250 grams and pick for damage.

6. If necessary to make color determinations, use the 250 gram portion.

## Sorghum

1. Smell the sample and examine for presence of insects, heating, stones, cinders and other conditions that may affect grain quality.

2. Determine test weight per bushel. Cut the sample to 1 1/8 to 1 1/4 quarts in making test weight. Fill an airtight container with some of the leftover portion for moisture testing.

3. Determine moisture content.

4. Determine dockage, using 1 1/8 to 1 1/4 quarts of the original sample. If a dockage tester is not available, use a hand sieve perforated with round holes 2 1/2/64 inches in diameter. Shake hand sieve vigorously with about one-fourth of the sample on the sieve at one time. Look for insects in the dockage.

5. Using the dockage-free sample determine the amount of broken kernels, foreign material and other grains. This includes all matter that will pass through a small buckwheat hand sieve when operated in the manner described in Step 4 when determining dockage. In addition, all material except sorghum that remains on the small buckwheat sieve after screening must be added.

6. Determine amount of damaged kernels and class by further analyzing 25 grams of the sieved clean grain.

### **Soybeans**

1. Smell the sample and examine it for presence of insects, heating, stones, cinders and other conditions that may affect grain quality.

2. Determine test weight per bushel. Cut the sample to 1 1/8 to 1 1/4 quarts in making test weight. Fill an airtight container with some of the leftover portion for moisture testing.

3. Determine moisture content.

4. Determine foreign material. With use of divider, cut sample to about 125 grams. Use the 8/64 inch round-hole sieve. Pick off large foreign material remaining on top of the sieve and add to the fine foreign material that went through the sieve.

5. Determine splits with about 125 grams of the sample free of foreign material. Use the 8/64 x 3/4 inch slotted sieve to facilitate separating the splits from the whole soybeans. The analysis must be completed by hand to see that no splits remain in the whole beans and that no whole beans remain in the splits separated. Kernels with 1/4 or less of the bean broken off are not considered as split.

6. Use the sieved portion (Step 5) to determine damaged kernels and color if necessary.

### **Wheat**

1. Smell the sample and examine it for presence of insects, heating stones, cinders and other conditions that may affect grain quality.

2. Determine moisture content.

3. Run the dockage test. If dockage tester is not available, approximate dockage determination can be made with hand sieves, using about 1 1/8 quarts of grain. Coarse material can be removed by working the sample over the scalper sieve, known also as the 12/64 inch round-hole corn sieve. The 1/12 inch round hole fine-seed sieve can be used for further cleaning. If wild buckwheat or other seeds of similar size and shape are present use a small buckwheat sieve. Place about one-fourth of the sample on the screen at a time and shake the sieve vigorously. Material that passes through the buckwheat sieve should be rescreened over the same sieve by placing not more than



50 grams on the upper edge of the sieve. Hold the sieve at an angle of  $10^{\circ}$  to  $20^{\circ}$  and work the material down over the sieve, using a gentle side-sieving motion to reclaim the grain. Check screenings for insects.

4. Determine test weight per bushel, using  $1 \frac{1}{8}$  to  $1 \frac{1}{4}$  quarts of the dockage-free sample.

5. Determine the amount of shrunken and broken kernels. This includes shrunken and/or broken kernels of grain and other matter that will pass through a metal sieve .032 inch thick with slotted perforations .064 inches wide by  $\frac{3}{8}$  inch long (small chess sieve). Place about 250 grams of the dockage-free wheat on the small chess sieve, held level, and shake the wheat 30 times (left to right and return) from side to side across the sieve in a steady manner with the grain moving lengthwise of the slots.

6. Analyze a 50-gram portion of the sample when free from dockage and shrunken and broken kernels for foreign material and damaged grains.

### Damaged Kernels

Damaged kernels are objectionable in grain. Soundness is a quality of considerable importance in evaluating grain for commercial use.

Damage to grain may be divided into two types—field damage and storage damage. Field damaged grain includes scab, cob-rot, smut, sprouted, ground-damaged and weather-damaged. Storage-damaged grain includes heat-damaged, weevil-damaged and moldy grain. The grade standards have a low tolerance for heat damage. Ordinarily more grain is damaged in storage than from all sources of damage in the field. This is true even though most of the damage caused in storage can be prevented with proper handling.

Extension circulars showing the various types of damage in corn, grain sorghum, soybeans and wheat are available.

### Dockage

Dockage in wheat is the foreign material which can be removed readily by appropriate cleaning devices. This includes weed seeds, stems, chaff, straw and grain other than wheat. In addition, undeveloped or shriveled kernels of wheat or small pieces of wheat kernels which cannot be recovered by proper rescreening or recleaning are considered part of the dockage. Dockage in grain



sorghum consists only of the material that will pass through an appropriate cleaning device or prescribed sieve.

If wheat contains dockage exceeding .5%, it is recorded in intervals of .5%. Dockage is assessed by reducing to the next lower whole or half percent as shown in the following examples: Dockage ranging from .5 to .9% shall be expressed as .5%; from 1 to 1.4% as 1%; from 1.5 to 1.9% as 1.5%; etc.

The Carter dockage tester is used in grain inspection offices to determine dockage. Other dockage testers are available. Results obtained with hand sieves lack accuracy and are seldom used.

### **Sample Grade and Distinctly Low-Quality Grain**

Grain standards provide a Sample grade in which is placed grain which does not meet requirements of the higher numerical grades. Not all Sample grade grain is of distinctly low quality, for grain may be Sample grade because of factors such as low test weight or excess foreign material.

The term "distinctly low quality" is incorporated in the Sample grade definition to provide for occasional lots of grain which are obviously poor quality even though it is not mentioned in the written grade requirements. Examples are grain containing large stones, pieces of glass and pieces of concrete. Rodent excreta and "pink kernels" are other examples.

### **Stones and Cinders**

Stones and cinders are objectionable in grain intended for processing or feeding. Stones and cinders removed in determining dockage in wheat and grain sorghum are regarded as dockage. Therefore, the determination for stones and cinders for these two grains is made on the dockage-free sample.

In the case of corn and soybeans the original sample is used in making the determination. When the number of stones and cinders exceeds seven in the case of wheat, the grain is graded Sample grade. With corn, grain sorghum and soybeans, the number of stones must exceed seven and the total weight of the stones and cinders must exceed .2% before the Sample grade is applied.

## **Odors in Grain**

Musty or sour grain or grain that has any objectionable foreign odor, except smut or garlic, shall be graded Sample grade. Musty or sour odors in grain are the result of mold growth or of fermentation and heating and are indexes of deterioration in grain quality that materially lowers its value to grain users.

When temperatures develop in grain as the result of excessive respiration, such grain is "heating" and is graded Sample grade. Grain which is heating usually gives off a musty odor.

## **Corn Classes**

Classes of corn are based entirely upon color, namely, Yellow Corn, White Corn and Mixed Corn. A mixture of White Corn in Yellow Corn is not so objectionable as a mixture of the same proportion of Yellow Corn in White Corn. A mixture of more than 5% kernels other than yellow in Yellow Corn, and a mixture of more than 2% kernels other than white in White Corn, causes the corn to be classified as Mixed Corn.

A slight tinge of red on otherwise yellow kernels does not affect their classification as Yellow Corn, nor does a slight tinge of light straw color or of pink on kernels that are otherwise white affect their classification as White Corn. Kernels that are deep red, blue, striped or variegated in color are considered as being neither yellow nor white and are, therefore, classified as Mixed Corn. White-capped yellow kernels are also classed as Mixed Corn.

## **Sorghum Classes**

There are four classes of sorghum based on color. The classes are Yellow, White, Brown, and Mixed. Most sorghum produced in Nebraska is of the Yellow class.

## **Soybean Classes**

Soybeans are classed as Yellow, Green, Black, Brown and Mixed. Since soybeans grown in Nebraska are all yellow, little attention is paid to class.

## Wheat Classes and Subclasses

There are seven classes of wheat: Hard Red Spring Wheat, Durum Wheat, Hard Red Winter Wheat, Soft Red Winter Wheat, White Wheat, Unclassed Wheat and Mixed Wheat. Standards provide that wheat of any class, except Mixed Wheat, may contain not more than 10% of wheat of a different class or classes either singly or combined.

The maximum limits of contrasting classes of wheat are lower in grades No. 1, 2 and 3 than for the total wheat of other classes (see Table 4). Contrasting classes in Hard Red Spring Wheat and Hard Red Winter Wheat are Durum Wheat, White Wheat, and Unclassed Wheat.

Some of the wheat classes are divided into subclasses. There are no subclasses in Hard Red Winter Wheat.

## Total Defects — Wheat

The wheat standards have the additional factor, "total defects." Total defects include *damaged kernels, foreign material, and shrunken and broken kernels*. Heat damage is included in total damage and *must not* be added with the other three factors to arrive at total defects. The summation of the three factors (damaged kernels, foreign material and shrunken and broken kernels) often gives a lower grade than any of the three factors which make up the total defects would grade the sample individually.

## Special Grades

Because the commercial value of grain is not always reflected by its numerical grade alone, official grain standards provide special grade designations. A special grade, when applicable, is supplemental to the grade assigned.

Special grade terms that denote grain of superior quality such as "Heavy" appear in the grade designation immediately following the numerical grade, as: U.S. No. 1 Heavy, Hard Winter Wheat. Special grades denoting inferior qualities are added to the grade designation following the class or subclass name as: U.S. No. 2 Dark Hard Winter Wheat, Tough; or U.S. No. 3 Yellow Corn, Weevily.



Special grade designations shall be made in addition to all other information required. For example, U.S. No. 2 Hard Winter Wheat, Smutty, or U.S. Sample Grade Yellow Corn, Weevily.

Table 1. Grade Requirements for Corn

Grade	Minimum test weight per bushel	Maximum limits of-			
		Moisture	Broken corn and foreign material	Damaged kernels	
				Total	Heat- damaged kernels
	Pounds	Percent	Percent	Percent	Percent
U.S. No. 1----	56.0	14.0	2.0	3.0	0.1
U.S. No. 2----	54.0	15.5	3.0	5.0	.2
U.S. No. 3----	52.0	17.5	4.0	7.0	.5
U.S. No. 4----	49.0	20.0	5.0	10.0	1.0
U.S. No. 5----	46.0	23.0	7.0	15.0	3.0
U.S. Sample grade	U.S. Sample grade shall be corn which does not meet the requirements for any of the grades from U.S. No. 1 to U.S. No. 5, inclusive; or which contains stones; or which is musty, or sour, or heating; or which has any commercially objectionable foreign odor; or which is otherwise of distinctly low quality.				

Table 2. Grade Requirements for Sorghum

Grade	Minimum test weight per bushel bushel	Maximum limits of-			
		Moisture	Damaged kernels		Broken kernels, foreign material, and other grains
			Total	Heat- damaged kernels	
	Pounds	Percent	Percent	Percent	Percent
U.S. No. 1----	57.0	13.0	2.0	0.2	4.0
U.S. No. 2----	55.0	14.0	5.0	0.5	8.0
U.S. No. 3 <sup>1</sup> ----	53.0	15.0	10.0	1.0	12.0
U.S. No. 4----	51.0	18.0	15.0	3.0	15.0
U.S. Sample grade	U.S. Sample grade shall be sorghum which-- (a) Does not meet the requirements for the grades U.S. Nos. 1, 2, 3, or 4. (b) Contains more than 7 stones which have an aggregate weight in excess of 0.2 percent of the sample weight or more than 2 crotalaria seeds ( <i>Crotalaria</i> spp.) per 1,000 grams of sorghum. (c) Has a musty, sour, or commercially objectionable foreign odor (except smut odor) or (d) Is badly weathered, heating, or distinctly low quality.				

<sup>1</sup>Sorghum which is distinctly discolored shall not be graded higher than U.S. No. 3

Table 3. Grade Requirements for Soybeans

Maximum limits of-							Brown, black and/or bicolored soybeans in yellow or green soybeans
Grade	Minimum test weight per bush	Moisture	Splits	Damaged kernels		Foreign material	
				Total	Heat damaged		
	Pounds	Percent	Percent	Percent	Percent	Percent	Percent
U.S. No. 1----	56.0	13.0	10.0	2.0	0.2	1.0	1.0
U.S. No. 2----	54.0	14.0	20.0	3.0	.5	2.0	2.0
U.S. No. 3 <sup>1</sup> ----	52.0	16.0	30.0	5.0	1.0	3.0	5.0
U.S. No. 4 <sup>2</sup> ----	49.0	18.0	40.0	8.0	3.0	5.0	10.0
U.S. Sample grade	U.S. Sample grade shall be soybeans which do not meet the requirements for any of the grades from U.S. No. 1 to U.S. No. 4, inclusive; or which are musty, sour, or heating; or which have any commercially objectionable foreign odor; or which contain stones; or which are otherwise of distinctly low quality.						

<sup>1</sup>Soybeans which are purple mottled or stained shall be graded not higher than U.S. No. 3.<sup>2</sup>Soybeans which are materially weathered shall be graded not higher than U.S. No. 4.



Table 4. Grade Requirements for Wheat

Grade	Minimum test weight per bushel (pounds)		Percent maximum limits of—						
	Hard Red Spring Wheat	All other classes and sub- classes	Heat- damaged kernels	Damaged kernels (total) <sup>1</sup>	Foreign material	Shrunken and broken kernels	Defects (total) <sup>2</sup>	Wheat of other classes <sup>3</sup> Con- trasting classes	Wheat of other classes (total) <sup>4</sup>
	Pounds	Pounds	Percent	Percent	Percent	Percent	Percent	Percent	Percent
U.S. No. 1----	58.0	60.0	0.2	2.0	0.5	3.0	3.0	1.0	3.0
U.S. No. 2----	57.0	58.0	0.2	4.0	1.0	5.0	5.0	2.0	5.0
U.S. No. 3----	55.0	56.0	0.5	7.0	2.0	8.0	8.0	3.0	10.0
U.S. No. 4----	53.0	54.0	1.0	10.0	3.0	12.0	12.0	10.0	10.0
U.S. No. 5----	50.0	51.0	3.0	15.0	5.0	20.0	20.0	10.0	10.0
U.S. Sample grade	U.S. sample grade shall be wheat which: (1) Does not meet the requirements for the grades U.S. Nos. 1, 2, 3, 4, or 5; or (2) Contains a quantity of smut so great that 1 or more of the grade requirements cannot be determined accurately; or (3) Contains 8 or more stones, 2 or more pieces of glass, 3 or more crotalaria seeds ( <i>Crotalaria</i> spp.), 3 or more castor beans ( <i>Ricinus communis</i> ), 4 or more particles of an unknown foreign substance(s) or a commonly recognized harmful or toxic substance(s), or 2 or more rodent pellets, bird droppings, or an equivalent quantity of other animal filth per 1,000 g of wheat; or (4) Has a musty, sour, or commercially objectionable foreign odor (except smut or garlic odor); or (5) Is heating or otherwise of distinctly low quality.								

<sup>1</sup>Includes heat-damaged kernels.<sup>2</sup>Defects (total include damaged kernels (total), foreign material, and shrunken and broken kernels. The sum of these 3 factors may not exceed the limit for defects.<sup>3</sup>Unclassed wheat of any grade may contain not more than 10% of wheat of other classes.<sup>4</sup>Includes contrasting classes.

## Writing the Grade

After the various determinations are made and checked with the grade requirements for the grain being graded, the grade is applied. The numerical grade according to the factor or factors which give it the lowest possible grade is applied. Examples of how grades are written:

U.S. No. 2 Yellow Corn

U.S. Sample Grade Mixed Corn, Musty

U.S. No. 3 Yellow Sorghum, 5% Dockage

U.S. No. 4 Yellow Soybeans, Weevily

U.S. No. 1 Hard Winter Wheat, 1.5% Dockage

U.S. No. 5 Hard Winter Wheat, Ergoty

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