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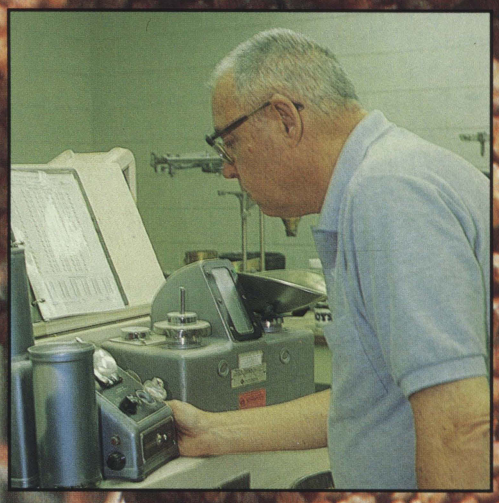
Grain Sorghum:

Grades, Standards and Types of Damage



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Grain Sorghum: Grades, Standards and Types of Damage

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This publication was developed to provide information on grain marketing standards and damage identification for growers, handlers, processors, inspectors and buyers. Clear, concise descriptions of marketing standards can be used to improve product quality and food safety. All participants in the grain sorghum industry, from producer to consumer, should be aware of their roles in ensuring a high standard of quality.

Explanation of Grading

Grading is a basic function in practically all transactions. Its purpose is to establish a common language, understood by both buyers and sellers, as a basis of judging the quality and value of the product in relation to its sales price. Effective grading establishes standards upon which price negotiations can be based.

Grading is the sorting of products into lots which are fairly uniform or homogeneous in quality. The characteristics by which the products are sorted are called grade specifications. Depending upon the commodity being graded, these specifications can include factors such as test weight, different types of damage, broken grains, and the presence of foreign material and other grains. The grade requirements for grain sorghum are shown in the next section.

Standardization is the process of establishing one set of grade specifications among all buyers and sellers of a commodity. These standards involve defining the weights and measures and indications of quality used in establishing grades. If there were no established standards, it would be risky to assume that both the buyer and the seller were using the same set of grade specifications. To avoid such problems and ensure that the grading system operates efficiently, there must be an established set of standards that are recognized and constantly followed by all traders. For example, grain producers use the bushel as a weight measure. Before that measure can be used, the definition of a bushel must be determined. Congress has given the U.S.D.A. the power to designate standards and grades for agricultural products sold in interstate commerce.

In order for the grading system to be useful or effective, one must assume that the standards and grades used actually reflect differences in quality. Unfortunately, given the broad diversity of consumers or users of grains, the preferences and needs of certain users may not always be adequately reflected in the grading system. In those cases, users often include desired quality requirements along with the grade in contract specifications. The search for equitable, uniform measures of quality to facilitate the marketing of grain has been a continuing process since the beginning of organized grain markets. Current debate, and proposals for legislation and regulation, indicate that the search will probably continue for as long as grain is bought and sold.

Definition of Sorghum

Sorghum is defined as grain that, before the removal of dockage, consists of 50 percent or more of whole kernels of sorghum (*Sorghum bicolor* L. Moench) excluding non-grain sorghum, and not more than 10 percent of other grains for which standards have been established under the United States Grain Standards Act.

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Grade Requirements for Sorghum

Grading Factors	Grades (U.S. Nos.) [1]			
	1	2	3	4
Minimum pound limits of:				
Test weight (lbs./bu.)	57.0	55.0	53.0	51.0
Maximum percent limits of:				
Damaged kernels (total) [3]	2.0	5.0	10.0	15.0
Heat (part of total)	0.2	0.5	1.0	3.0
Broken kernels and foreign materials (total) [4]	4.0	7.0	10.0	13.0
Foreign material (part of total)	1.5	2.5	3.5	4.5
Maximum count limits of:				
Other material				
Animal filth	9	9	9	9
Castor beans	1	1	1	1
Crotalaria seeds	2	2	2	2
Glass	1	1	1	1
Stones [2]	7	7	7	7
Unknown foreign substance	3	3	3	3
Cockleburs	7	7	7	7

U.S. Sample grade

Sorghum that:

(a) Does not meet the requirements for U.S. Nos. 1, 2, 3 or 4; or

(b) Has a musty, sour or commercially objectionable foreign odor (except smut odor); or

(c) Is heating, badly weathered or of distinctly low quality.

[1] Sorghum that is distinctly discolored will not grade higher than U.S. No. 3.

[2] Aggregate weight of stones also must exceed 0.2 percent of the sample weight.

[3] The maximum percent limit of damaged kernels is equal to the total percent limit of damaged kernels and heat damaged kernels minus the percent of heat damaged kernels present (i.e., for grade no. 1, if the percentage of heat damaged kernels was 0 percent, then the sample could contain up to 2 percent damaged kernels).

[4] The maximum percent limit of broken kernels is equal to the total percent limit of broken kernels and foreign materials minus the percent of foreign material present (i.e., for grade no. 1, if the percentage of foreign materials was 0 percent, then the sample could contain up to 4 percent broken kernels).

Classes of Sorghum

There are four classes for sorghum: Sorghum, Tannin sorghum, White sorghum and Mixed sorghum.

Sorghum

Sorghum that is low in tannin content because of the absence of a pigmented testa (subcoat) and that contains less than 98 percent White sorghum and not more than 3 percent Tannin sorghum. The pericarp color of this class may appear white, yellow, pink, orange, red or bronze.

Tannin Sorghum

Sorghum that is high in tannin content because of the presence of a pigmented testa (subcoat) and that contains no more than 10 percent non-Tannin sorghum. The pericarp color of this class is usually brown but also may be white, yellow, pink, orange, red or bronze.

White Sorghum

Sorghum that is low in tannin content because of the absence of pigmented testa (subcoat) and that contains no more than 2 percent sorghum of other classes. The pericarp color of this class is white or translucent and includes sorghum containing spots that, singly or in combination, cover 25 percent or less of the kernel.

Mixed Sorghum

Sorghum that does not meet the requirements for any of the classes.

Economic Importance of Grades

The objective of a grading system is to help the market operate in an efficient manner, both by facilitating merchandising activities and by identifying value in the end product (Buse and Bromley, Rhodes, Hill 1988, Hill 1990).

According to the 1986 Grain Quality Improvement Act, there are four main purposes of a grading system:

- To define uniform and acceptable descriptive terms to facilitate trade;
- To provide information to aid in determining grain storability;
- To offer end users the best possible information from which to determine end product yield and quality; and
- To create tools for the market to use in establishing quality improvement incentives.

The use of an industry-wide, uniform set of grades and standards facilitates the price discovery process by establishing a basis upon which the value of one lot of grain can be related directly to another. This reduces marketing costs and marketing margins in a number of ways, leading to larger returns for producers, merchandisers, processors, retailers and consumers. While grades and standards are intended to describe quality, they do not determine price; the market and relative levels of supply and demand determine what value (price) to place on each quality characteristic.

Two of the most important advantages of uniform grades for merchandisers are that grades allow trading to be done by description rather than physical inspection, and they allow for the grouping of somewhat homogeneous lots of grain.

The cost required for each potential buyer to physically inspect each lot of grain before a transaction could take place would be prohibitive. Given the large volumes of grain traded, the speed with which it is traded and the distance over which grain moves from production to end use, merchandising margins would have to be much larger to cover the cost of trading by physical inspection. Trading by description allows many more buyers and sellers to participate over a larger marketing region. This increases competition and improves market efficiency.

Uniform grades also allow homogeneous lots of grain to be commingled and dissimilar lots to be blended into larger homogeneous lots for more efficient merchandising. Each producer receives an appropriate price for the quality of grain he produces since it is graded before it is commingled. At the same time, the merchandiser may be able to improve the average value of the total lot if the individual heterogeneous lots are blended efficiently. This allows the merchandiser to profit from the blending.

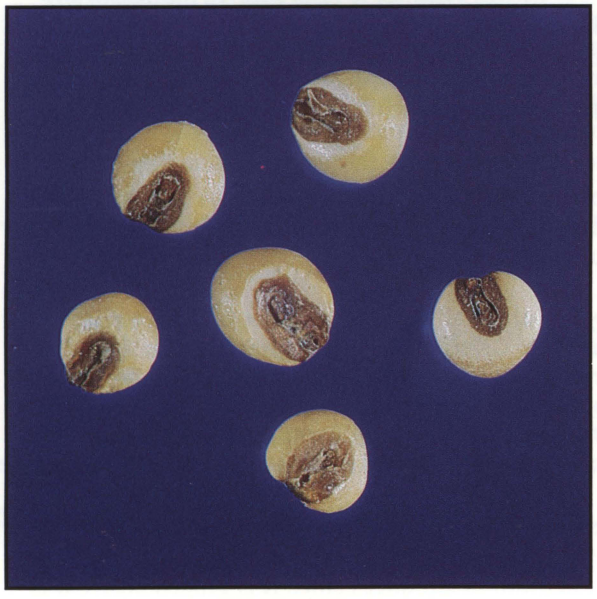
There are other economic benefits of using uniform grades. First, quality information can indicate the storability of grain and help reduce spoilage. Second, grading can help in the settlement of claims between trading partners. It is much easier to determine the market value of lost or damaged grain that has been graded and documented than for two parties to agree based only on their opinions. Third, grading can facilitate the financing of products as they move through the marketing channel. Warehouse receipts that indicate the grade of the product can be used as collateral for loans. Lending institutions are more apt to make loans on grain in storage if they have assurance of the product's quality. Finally, grades help buyers identify the specific quality of product that they wish to purchase. The premiums and discounts for the different grades will help users determine the most cost efficient quality to purchase for their needs. Those same premiums and discounts tell producers which grades are most in demand and help them identify the most profitable qualities of grain to produce.

Principal Sorghum Kernel Damage

Germ Damage (Scrape Method)

Kernels and pieces of kernels that, after scraping, contain dark colored germs.

Note: When scraping kernels of sorghum, the pericarp should be removed carefully; cutting too deeply will destroy the germ area.



Germ Damage (Bleach Method)

Kernels and pieces of kernels that, after bleaching, contain dark colored germs.

Ground and/or Weather Damage

Kernels and pieces of kernels that contain dark stains or discolorations and have a rough, cake-like appearance caused by ground and/or weather conditions.

Heat Damage

Kernels and pieces of kernels that are materially discolored and damaged by heat.

Note: It is necessary in most cases to cross section the kernels to determine if the color is creamy.

Surface Mold Damage

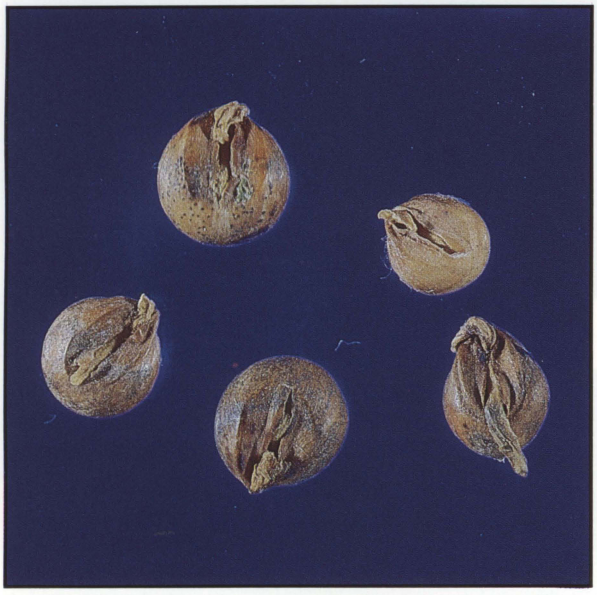
Kernels and pieces of kernels containing surface mold.

Note: Do not confuse mold with dark stains or discolorations caused by ground and/or weather conditions.

Internal Mold Damage

Kernels and pieces of kernels containing mold, usually in the germ area under the bran layer.

Note: It is difficult to detect this condition. The germ area must be examined for a slight blue discoloration. The bran layer should be lifted carefully so as not to destroy the evidence of damage.



Sprout Damage

Kernels and pieces of kernels in which the sprout definitely protrudes from the germ. In the practical application of this definition, the sprout must have split the germ covering and be 1) sticking straight up, 2) extending out of the upper portion of the germ area, or 3) extending down over the tip of the kernel.

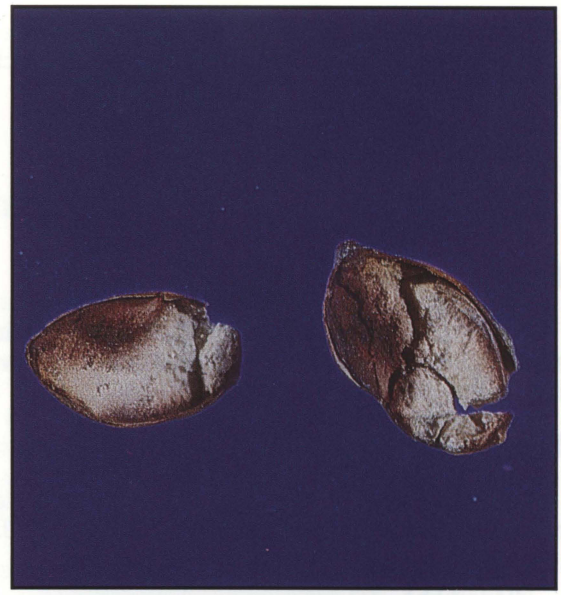
Note: Kernels with splits over the germ area but with no sprout protruding are considered sound unless otherwise damaged.

Insect Damage

Kernels and pieces of kernels that have been bored or tunneled by insects.

Purple Pigment Damage

Kernels and pieces of kernels that are materially discolored by purple pigment.



Special Grades

Smutty

Sorghum that has kernels covered with smut spores to give a smutty appearance in mass, or that contains 20 or more smut balls in 100 grams of sorghum.

Definition of Terms

Broken Kernels. All matter which passes through a 5/64-inch, triangular-hole sieve and over a 2.5/64-inch, round-hole sieve according to procedures prescribed in FGIS instructions.

Broken Kernels and Foreign Material. The combination of broken kernels and foreign material.

Damaged Kernels. Kernels, pieces of kernels and other grains that are badly damaged by ground or weather, disease, frost, heat or mold. Also kernels with germ damage, kernels bored by insects, kernels that have sprouted, or kernels damaged by any other factor.

Dockage. All matter other than sorghum that can be removed from the original sample by use of an approved device according to procedures prescribed in FGIS instructions.

Foreign Material. All matter except sorghum that passes over the number 6 riddle, and all matter other than sorghum that remains on the top of the 5/64-inch, triangular-hole sieve according to procedures prescribed in FGIS instructions.

Nongrain Sorghum. Seeds of broomcorn, Johnsongrass, Sorghum almum Parodi, sorghum-sudangrass and sweet sorghum (sorgo).

Pericarp. The outer layers of the sorghum grain that are fused to the seedcoat.

Sieves

(a) 1.98 mm (5/64 or 0.0781 inch) triangular-hole sieve. A metal sieve 0.81 mm (0.032 inches) thick with equilateral triangular perforations, the inscribed circles of which are 1.98 mm (0.0781 inches) in diameter.

(b) 0.99 mm (2.5/64 or 0.0391 inch) round-hole sieve. A metal sieve 0.81 mm (0.032 inch) thick with round holes 0.99 mm (0.0391 inches) in diameter.

Appearance Factors

Distinctly Discolored

Sorghum discolored by adverse weather conditions, giving a dusty, gray appearance to white sorghum and a slightly blackened appearance to yellow or brown sorghum, will not be graded higher than U.S. 3.

Badly Weathered

Sorghum discolored by adverse weather conditions that has deteriorated to the point that many kernels are badly discolored will be graded U.S. Sample Grade.

Sorghum Bleach Test

Caution. Any deviation from the procedures outlined below may result in improperly bleached sorghum and could be hazardous.

Safety equipment should be worn while the bleach operation is in progress. The lab area should be thoroughly cleaned once bleaching is complete.

Accidental spills should first be neutralized with vinegar before the liquid is wiped up.

Avoid mixing the potassium hydroxide (KOH)-bleach solution used in this test with chemical reagents or waste solutions associated with other tests.

When disposing of the (KOH)-bleach solution, wash the solution down the sink drain with large quantities of water.

Bleach Procedure

1. Place the representative portion of sorghum in a mixing jar.
2. Add 15 grams of KOH pellets.
3. Add 40 ml of bleach.
4. Set stirring head on jar, place jar on mixer and mix for 3 minutes.
5. Pour the contents of the mixing jar into a tea strainer and rinse with warm tap water to remove the KOH-bleach solution.
6. After rinsing, lightly tap the tea strainer against the edge of the sink to remove the excess water. Gently press the bottom of the tea strainer on a dry paper towel to remove any additional water.
7. Place the sorghum on a drier sieve and dry for 1 to 1 1/2 minutes or until the kernels are not tacky when picked up with a pair of tweezers.
8. Remove the sorghum from the drying sieve and weigh the portion. The kernels with germ damage should be readily apparent. If the germ damage is not readily apparent, it is permissible to carefully lift the bran coat from over the germ area to make this determination.

Aflatoxin

Aflatoxin is a naturally occurring mycotoxin produced by two types of mold: *Aspergillus flavus* and *Aspergillus parasiticus*. *Aspergillus flavus* is common and widespread in nature and is found in peanuts, cottonseed, corn, sorghum and other grains grown under stressful conditions such as drought. While the presence of *Aspergillus flavus* does not always indicate harmful levels of aflatoxin, it does mean that the potential for aflatoxin production is present. Sorghum is not normally as susceptible as other crops to the development of aflatoxin at harmful levels in field conditions. However, as with other crops, storing grain under conditions favorable to continued mold growth could result in more dangerous levels of contamination.

Aflatoxin, unlike most damage factors, may be concentrated in only a few kernels, and the contaminated kernels are not likely to be evenly distributed throughout the lot. Additionally, some contaminated kernels may contain many times the aflatoxin level of other contaminated kernels. Therefore, samples must be representative and sufficiently large (recommended size is 10 pounds) to compensate for the uneven distribution of the contaminant.

To learn more about aflatoxin and other mycotoxins that can be found in feed and food crops, refer to the Texas Agricultural Extension Service publication B-1279, "Mycotoxins in Feed and Food-Producing Crops," and the Council for Agricultural Science and Technology report "Mycotoxins – Economic and Health Risks."

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