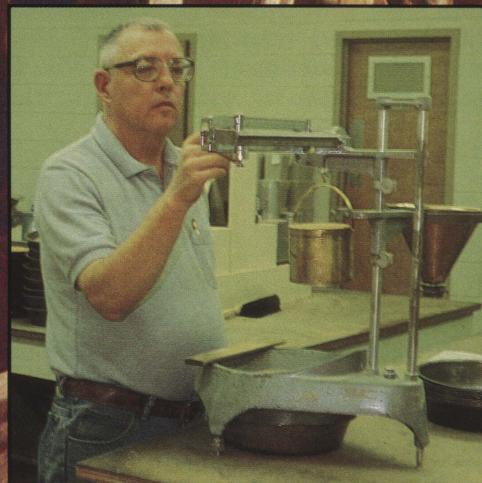


TDOC  
Z TA245.7  
B873  
NO.5091

Agricultural Extension Service  
Texas A&M University System

B-5091

# Corn: Grades, Standards and Types of Damage



## **Acknowledgments**

The authors express sincere appreciation to representatives of the Plainview Field Office of the Federal Grain Inspection Service and to Roy Roberts of the Amarillo Grain Exchange for their assistance in collecting samples illustrated in this publication and for their assistance in revising its content. Appreciation is also extended to the Texas Corn Producers Board and the Department of Agricultural Economics at Texas A&M University, whose financial support helped make this publication possible.

The photographs used are not those used by the Federal Grain Inspection Service and are intended for illustration only. Since the reproductions may not duplicate the FGIS line slides, we do not recommend that they be used for grading purposes.

# Corn: Grades, Standards and Types of Damage

Mark L. Waller, Stephen H. Amosson and Richard L. Cummins\*

This publication was developed to provide information on grain marketing standards 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 corn 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 corn 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 Corn

Corn is defined as grain that consists of 50 percent or more of whole kernels of shelled, dent corn and/or shelled, flint corn (*Zea Mays* L.) and not more than 10 percent of other grains for which standards have been established under the United States Grain Standards Act.

---

\* Associate professor and Extension economist--grain marketing and policy, professor and Extension economist--management, and Extension associate, The Texas A&M University System.

## Grade Requirements for Corn

Grade	Minimum limits of test weight per bushel (lbs.)	Maximum limits		
		Heat damaged kernels (%)	Total damaged kernels (%)	Broken kernels and foreign material (%)
U.S. No. 1	56.0	0.1	3.0	2.0
U.S. No. 2	54.0	0.2	5.0	3.0
U.S. No. 3	52.0	0.5	7.0	4.0
U.S. No. 4	49.0	1.0	10.0	5.0
U.S. No. 5	46.0	3.0	15.0	7.0

**U.S. Sample grade:**

- (a) Does not meet the requirements for the grades U.S. Nos. 1, 2, 3, 4 or 5; or
- (b) Contains eight or more stones which have an aggregate weight in excess of 0.2 percent of the sample weight, two or more pieces of glass, three or more crotalaria seeds (*Crotalaria* spp.), two or more castor beans (*Ricinus communis* L.), four or more particles of an unknown foreign substance(s) or a commonly recognized harmful or toxic substance(s), eight or more cockleburrs (*Xanthium* spp.) or similar seeds singly or in combination, or animal filth in excess of 0.2 percent in 1,000 grams; or
- (c) Has a musty, sour or commercially objectional foreign odor; or
- (d) Is heating or is otherwise of distinctly low quality.

## Classes of Corn

There are three classes of corn: Yellow corn, White corn and Mixed corn.

**Yellow corn.** Corn that is yellow kernalled and contains no more than 5 percent of corn of other colors. Yellow kernels of corn with a slight tinge of red are considered yellow corn.

**White corn.** Corn that is white kernalled and contains no more than 2 percent of corn of other colors. White kernels of corn with a slight tinge of light straw or pink color are considered white corn.

**Mixed corn.** Corn that does not meet the color requirements for either of the classes yellow corn or white corn and includes white-capped yellow corn.

## 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 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 Corn Kernel Damage



## Blue-Eye Mold Damage

A germ affected with blue-eye mold, regardless of the amount.



## Cob-Rot Damage

A distinct discoloration or rotting caused by a fungus that attacks ears of weakened plants. A kernel containing cob rot is considered damaged without opening the kernel.



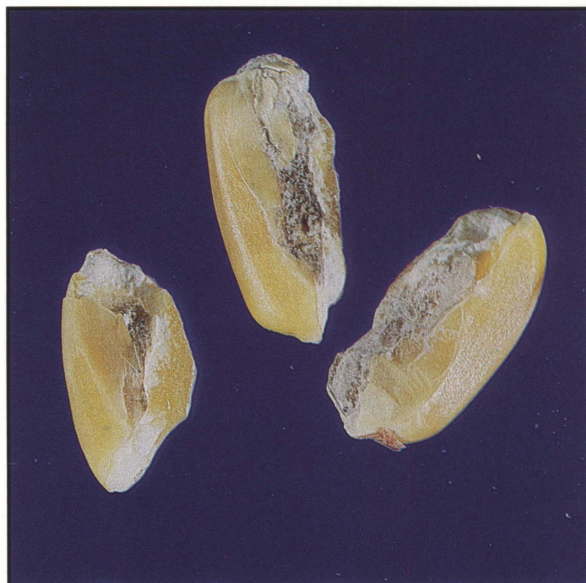
## Mold Damage

When a kernel of corn has been chipped or broken, exposing the starch, it becomes susceptible to mold. Kernels with mold on the exposed part of the kernel are considered damaged.

**Note:** Mold color can vary, e.g., black, pink, blue, etc.

**Dirt (Not Damage)**

Whole or broken kernels with dirt on the exposed part of the kernel. Do not confuse dirt with mold.



**Germ Damage**

Kernels that are slightly discolored by respiration or heat, but not heat damaged.



**Heat Damage**

Kernels that are materially discolored by excessive respiration, with the dark discoloration extending out of the germ through the sides and into the back of the kernel.





### **Dryer Damage**

Kernels with a discolored, wrinkled and blistered appearance; or that are puffed or swollen and slightly discolored and often have damaged germs; or whose seed coats are peeling off or have already peeled off; or that have a cracked or checked appearance resulting from external heat caused by artificial drying methods.



### **Heat Damage (Dryer)**

Kernels that are puffed, swollen and materially discolored by external heat caused by artificial drying methods.



### **Insect Damage**

Kernels that have been bored or tunneled by insects or weevils, indicating their presence within the kernels, and kernels with noticeable weevil-bored holes, whether or not these pests are still present in the kernels.

**Note:** Kernels that have been partially eaten by insects or rodents but that are entirely free from refuse, webbing, insects or other forms of damage are considered sound kernels.



**Surface Mold (Blight)**

Kernels with mold caused by corn leaf blight.



**Sprout**

Kernels of corn that have sprouted.



**Mold Damage (Pink Epicoccum)**

A germ affected with mold caused by a fungus, regardless of amount.



### **Purple Plumule (Not Damage)**

The outward appearance is similar to blue eye mold but the coloring is caused by genetic or varietal characteristics and is not considered damage.



## **Special Grades and Special Grade Requirements**

### **Flint Corn**

Corn that consists of 95 percent or more of flint corn.

### **Flint and Dent Corn**

Corn that consists of a mixture of flint and dent corn containing more than 5 percent but less than 95 percent of flint corn.

### **Waxy Corn**

Corn that consists of 95 percent or more waxy corn according to procedures prescribed in FGIS instructions.

### **Infested Corn**

Corn that contains live weevils or other live insects injurious to stored grain.

## Definition of Terms

**Broken Corn** – All matter that passes readily through a 12/64 round-hole sieve and over a 6/64 round-hole sieve according to procedures prescribed in FGIS instructions.

**Broken Corn and Foreign Material** – All matter that passes readily through a 12/64 round-hole sieve and all matter other than corn that remains in the sample after sieving according to procedures prescribed in FGIS instructions.

**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 factors.

**Foreign Material** – All matter that passes readily through a 6/64 round-hole sieve and all matter other than corn that remains on top of the 12/64 round-hole sieve after sieving according to procedures prescribed in FGIS instructions.

**12/64 Round-Hole Sieve** – A metal sieve 0.032 inch thick with round perforations 0.1875 (12/64) inch in diameter which are 1/4 inch from center to center. The perforations of each row shall be staggered in relation to the adjacent row.

**6/64 Round-Hole Sieve** – A metal sieve 0.032 inch thick with round perforations 0.0937 (6/64) inch in diameter which are 5/32 inch from center to center. The perforations of each row shall be staggered in relation to the adjacent row.

## 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 corn, peanuts, cottonseed, 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.

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 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."

## References

- Buse, Rueben C. and Daniel W. Bromley. *Applied Economics: Resource Allocation in Rural America*. Iowa State University Press, Ames, Iowa, 1975.
- Hill, Lowell D. *Grain Grades and Standards: Historical Issues Shaping the Future*. University of Illinois Press, Urbana, Illinois, 1990.
- Hill, Lowell D. *Grain Grades: They Lack Economic Rationale*. Choices, First Quarter 1988, pp. 24:27.
- Horne, C. Wendell, et al. *Mycotoxins in Feed and Food-Producing Crops*. B-1279, Texas Agricultural Extension Service.
- Rhodes, V. James. *The Agricultural Marketing System*. Grid Publishing, Columbus, Ohio, 1978.
- Richard, John L., et al. *Mycotoxins – Economic and Health Risks*. Council for Agricultural Science and Technology, Task Force Report No. 116, Ames, Iowa, November 1989.

For Sale Only  
\$3.00 per Copy

*Educational programs of the Texas Agricultural Extension Service are open to all citizens without regard to race, color, sex, disability, religion, age or national origin.*

---

Issued in furtherance of Cooperative Extension Work in Agriculture and Home Economics, Acts of Congress of May 8, 1914, as amended, and June 30, 1914, in cooperation with the United States Department of Agriculture. Zerle L. Carpenter, Director, Texas Agricultural Extension Service, The Texas A&M University System.