



Agronomic Spotlight

Understanding Discolored Corn Kernels

Occasionally there will be a season when corn sporadically develops colored kernels on ears. There are several possible non-disease causes for colored kernels. The affected kernels should not influence grain grading if the embryo remains undamaged.

WHAT TO CONSIDER

From time to time, growing seasons can produce corn with ears exhibiting some colored kernels. Colored kernels can result from several internal and external causes. During grain fill, weather and temperature can affect kernel pigmentation. An example is darkened kernels that may appear as the result of diseases, such as fusarium, which can cause a starburst pattern of whitish-pink, moldy discoloration on a kernel. However, if the kernels in question lack the color and pattern of fusarium or other fungal infections, the diagnosis points toward other non-disease influences.

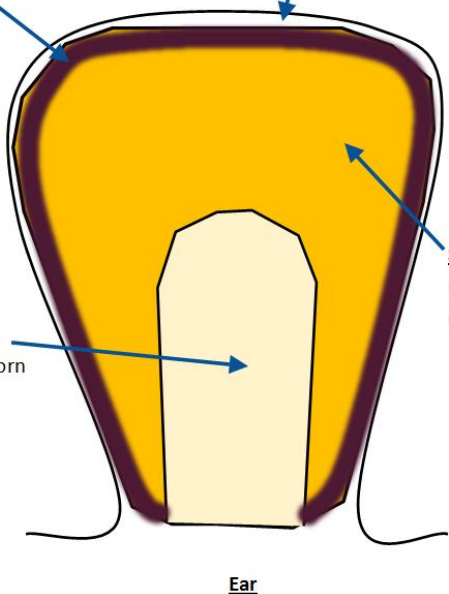
A side-split view of a corn kernel reveals four main parts: embryo (germ), endosperm, aleurone, and pericarp (Figure 1). Depending on the genetics of the corn product, the pericarp and aleurone layers can individually express purple, red, bronze, or white/clear coloration. Wheat curl mite feeding triggers red streaking within pericarps of otherwise yellow kernels. Red streaks do not necessarily signify toxins, ear molds, or grain quality issues. In white corn, purple kernel streak has been documented as triggered by cold temperatures late in the grain filling period.¹

Aleurone (one-cell thick layer can be colored red or purple)

Pericarp (usually transparent but can be colored)

Embryo (germ, develops into corn plant)

Starchy Endosperm (carbohydrates for embryo)



Ear

Figure 1. Kernel color can be controlled by genes. Pericarp color comes from the mother plant and aleurone color is from the father plant.

Late-season stink bug damage can cause dark colored kernels. Stink bugs seek developing tissues and can pierce husk leaves to inject kernels with enzymes. Enzymes help stink bugs dissolve tissue and suck up pre-digested plant fluids with their stylet mouth parts. Damage from stink bugs is more likely near field edges and in no-till fields.² Stink bug damage may be partly concentrated on the outer half of ears. Once kernels become too hard to pierce, stink bugs are expected to move on into soybean fields that have developing seeds. This fall, live stink bugs may not be found in the affected corn fields as they have likely moved to nearby soybean fields and then to overwinter into wooded and grassy cover. Late-season kernel feeding is not expected to reach economic levels, and thresholds for control are not developed for late-season corn fields. Differences in kernel appearance can be the result of gene expression similar to the non-disease lesion mimic. Corn has unique fertilization with pigmentation of aleurone layer and pericarp determined by the father and mother, respectively. Positions of particular genes can randomly "jump", and "jumped genes" become evident when they influence pigmentation.³



Figure 2. Although some ears may exhibit more colored kernels than others, overall quantity in samples or loads at the elevator tend to be diluted and less apparent.



Figure 3. The coloration of these kernels does not extend into the endosperm or affect the embryo, and discounts are not expected at the elevator.

YIELD IMPACT

Fields with colored kernels are expected to have normal yields. Midwest elevators have reported the levels of colored kernels as two percent or less this year. Kernels are considered damaged when the embryo is affected. Observations of colored kernels this season have been of kernels with colored crowns (Figure 2) and healthy

embryos. Stink bug damage that occurs early in the season can affect corn stands; however, sporadic, late-season damage is not expected to affect grain yield or quality. Cool weather that can affect pigmentation may lengthen grain fill time, and longer grain fill periods can benefit yield potential.⁴

MANAGEMENT OPTIONS

In the past, elevators have accepted this type of kernel coloration because grain is still considered good quality, and disease-free grain with colored crowns has not been discounted as damaged. An official grade by a grain inspection agency can be requested if the 'house grade' by an elevator counts colored kernels as damaged. While each elevator is different, an undamaged germ (embryo) is what matters when grading grain (Figure 3).

There are three classes of corn: yellow corn, white corn, and mixed corn. Corn classified as 'Yellow' is yellow-kerneled and contains no more than five percent of corn of other colors. A slight tinge of red is still considered yellow corn. White corn is white-kerneled with no more than two percent of corn of other colors. A slight tinge of light straw or pink color is considered white corn. Mixed corn is corn

that does not meet the above standards or white-capped yellow corn.⁵ These classifications may be important for food-grade corn; however, a kernel needs to be greater than 50% colored to be considered 'corn of other color'. In the ethanol industry, purple pericarp corn was introduced to mark loads of corn intended with an ethanol end use. These purple plants are intentionally grown within fields for visual tracking. Purple-colored pericarps are removed from kernels in ethanol processing. Field scouting for insects and disease helps manage fields and schedule harvest order. There are a number of color possibilities that are considered safe and do not affect quality or end use. Disease-free kernels with crowns that are slightly discolored are not expected to be discounted at elevators.

Sources

¹ Nielsen, R.L. 2017. Kernel red streak in corn. Corny News Network. agry.purdue.edu.

² Cullen, E. 2012. Stink bug nymphs in corn. University of Wisconsin. <http://ipcm.wisc.edu>.

³ Nannas, N.J. and Dawe, R.K. 2015. Genetic and genomic toolbox of Zea mays. Genetics. Vol. 199(3)655-669.

⁴ Nielsen, R.L. 2013. Unseasonably cool weather: good or bad for corn during grain fill?. Corny News Network. Purdue University. agry.purdue.edu.

⁵ 1996. Subpart D – United States Standards for Corn. USDA Grain Inspection, Packers, and Stockyards Administration. Federal Grain Inspection Service.